STEP 7 V10.5 SP2

02/2010
00002013

Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ **Danger**

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ **Warning**

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ **Caution**

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

Caution

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

Notice

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠ **Warning**

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Trademarks

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Table of contents

Readme 1

1.1 General notes

1.1.1 General notes

The information in this readme file supersede statements made in other documents.

Read the following notes carefully because they include important information for installation and use. Read these notes prior to installation.

Security settings

To allow the software packages to run in the TIA Portal, modifications will be made to the security settings of your system during installation:

- Port 4410 for TCP will be entered as an exception in the Windows firewall.
- The following subfolder will be shared for all users in the installation folder: Portal V10.5\Data

Installing new .Net versions or .Net service packs

- Close the TIA portal before installing a new .Net version or a new .Net service pack on your programming device/PC.
- Restart the TIA portal only after successful installation of the new .Net version or the new .Net service pack.

Error when repairing an existing installation of STEP 7 Basic V10.5

If WinCC flexible 2008 SP1 and STEP 7 Basic V10.5 are installed and you start a STEP 7 repair installation using the setup program on the DVD, an error occurs.

To repair the installation, copy the content of the STEP 7 Basic V10.5 DVD to your hard disk and restart the repair from here using the setup program.

Notes on handling

- If a project in the list of projects last used is located on a network drive that is not connected, you may experience delays when opening the "Project" menu.

- When you insert a CPU, you may need to wait for some time if the project editor is open at the same time. This generally takes longer when you insert the first CPU in a newly created project. To be able to continue working more quickly, you should close the project editor before inserting a CPU.
- The message "Application is not responding" may appear in VISTA with functions that take a long time to run (loading the CPU for example). If this occurs, wait until the function has correctly finished.
- If you have installed a Microsoft mouse with IntelliPoint, you may find that it superimposes components over the buttons of the title bar. If this is the case, uninstall the IntelliPoint software from Microsoft.
- Enabling the "Virtual Desktop" options with NVIDIA graphics cards can cause problems. In this case, disable the "nView virtual desktop manager" of your NVIDIA graphics driver.

Using the TIA Portal via a remote desktop

In principle, it is possible to use the TIA Portal via a remote desktop connection. During configuration, you should, however, avoid disconnecting the connection to the desktop client. In rare cases, this can lead to the software user interface being blocked.

If you experience this blockage, follow these steps on the desktop client.

1. Open the Windows Task-Manager and close the "rdpclip.exe" process.
2. Type in "rdpclip.exe" in the command prompt to restart the process.

Note that the current content of the clipboard will be lost. You can, however, then continue configuration as usual. To be on the safe side, you should restart the TIA Portal at the next opportunity.

Opening the TIA portal multiple times

If you are running several applications of the TIA portal and they continually become active in turn, you can briefly switch to another application or use the key combination <ALT+Tab> to solve the problem.

Note on SD cards

The SD cards have been formatted and initialized by Siemens for use with S7-1200 modules. This format must not be overwritten otherwise the card will no longer be accepted by the S7-1200 modules. Formatting with Windows tools is therefore not permitted.

Behavior in case of open force jobs

Note that active force jobs will be retained even after you have loaded a new project to the SD card. This means you should first delete all active force jobs before you remove an SD card from the CPU and before you overwrite the card in the PC with a new project.

Issues when shutting down Windows XP or when activating a screen saver

Windows XP uses the ACPI (Advanced Configuration and Power Interface) to shut down the computer or to go to standby mode. It can happen that while the system is processing a newly installed tool that the screen saver is not activated by the ACPI or that after exiting the tool that Windows XP cannot be shut down properly.

If the TIA Portal is running, the Standby function of the computer is deactivated. To put the computer into Standby, you have to first exit the TIA Portal.

The following description shows several optional settings in the "Power Options Properties" you can use to set the Standby mode of the computer with the function "Hibernate":

1. In Windows XP, open the "Power Options Properties" by pointing at "Start > Settings > Control Panel > Power Options" and select the tab "Hibernate". Select the "Enable hibernation" check box.
2. Switch to the "Advanced" tab. In the dialog field "Power buttons" click the drop-down list box under "When I close the lid of my portable computer:" and select the option "Hibernate".
3. Then click the drop-down list box under"When I press the power button on my computer:" and select the option "Shut down".
4. Click "Apply" and confirm the settings with "OK".
5. Afterwards, restart the PC.

If you experience problems shutting down the computer, make sure that the TIA Portal has closed completely.

1. In the shortcut menu, select the Task Manager from the shortcut menu on the Taskbar.
2. If you see the process "Siemens.Automation.ObjectFrame.FileStorage.Server.exe" in the "Processes" tab, wait until this process has closed.
3. Then you can shut down the computer.

FAQs on the TIA Portal

FAQs on the TIA Portal are available at http://support.automation.siemens.com.

1.1.2 Notes on the installation

Contents

Information that could not be included in the online help.

Requirements for installation of STEP 7 Basic V10.5 SP2

The following conditions have to be met in addition to the requirements listed in the installation instructions:

- The Internet download version of SP2 for STEP 7 Basic V10.5 requires STEP 7 Basic V10.5 for installation.
- The trial version of SP2 is not compatible with STEP 7 Basic V10.5. You cannot install it on a computer that already has a version of STEP 7 Basic V10.5 installed.

Installation with "start.exe /unattendedmode"

If you want to make an identical installation on several computers, you can use the setup program to save all the settings in an INI file.

1. Open the Windows command prompt with "Start > Run".
2. If you want to create an INI file, start Setup with "start.exe/recordmode". Select the settings you want to use for the installation in the dialogs. Setup closes after the licensing dialog. No installation is

performed when Setup closes. All of the settings are stored in the "SIA_Auto.ini" file that is saved in the "My Documents" folder.

3. If you want to perform an installation based on an INI file, start Setup with "start.exe/unattendedmode". The program will look for the "SIA_Auto.ini" file in "My Documents" or "InstData\Resources" folders.

   When an INI file is found, the installation is performed with the settings it contains.

   A message appears if no INI file is found.

Integrating installation with "start.exe /unattendedmode" in a batch

To start installation with "start.exe/unattendedmode" in a batch, you can change the parameters of the "SIA_Auto.ini" file as needed.

- SuppressReboot

  Rebooting is suppressed at the end of the installation process, regardless whether or not it is necessary.
- SuppressLicenseDialog

  The dialog for the license request is suppressed.
- SuppressErrorDialog

  Error messages are suppressed.
- SuppressDoneDialog

  The finish dialog at the end of Setup is suppressed.

Installation of STEP 7 Basic V10.5 under Windows XP with Turkish Regional and Language Options

Installation of STEP 7 Basic V10.5 under Windows XP may be cancelled, if the regional and language options have been set to Turkish. In this case change the regional and language options from Turkish to English or German.

1. Open the Control Panel under Windows with one of the following commands:
   - "Start > Control Panel" (Start menu under Windows XP)
   - "Start > Settings > Control Panel" (classic start menu)
2. Open the "Regional and Language Options".
3. Select the "Regional Options" tab.
4. Under "Standards and formats" select "German" or "English" in the drop-down list.
5. Click "Apply" and confirm with OK.
6. Restart your PC for the setting to become active. Now you can continue with the installation of STEP 7 Basic V10.5.
7. After installation, you can revert the regional and language settings (as described in steps 1 to 4) to Turkish.

Removing

In rare cases removal of the program can cause the computer to freeze, even when a full version of SQL Server 2005 is installed. In this occurs, disconnect the computer from the network to continue the removal process.

1.1.3 Using the sample project

Contents

Information that could not be included in the online help.

Introduction

On the installation data medium, there is a sample project that soon gets you working with projects in the TIA Portal. You can edit the sample project to suit your purposes.

Procedure

To use the sample project, follow these steps:

1. Insert the installation medium in the relevant drive.
2. Navigate to the folder "<Drive>\Documents\Examples\DEMO Project S7-1200".
3. Copy the "DEMO Project S7-1200" folder to a local drive.
4. Open the TIA Portal.
5. Select the "Open" command in the "Project" menu.

   The "Open project" dialog opens and includes the list of most recently used projects.
6. Click the "Browse" button and navigate to the "DEMO Project S7-1200" folder on the local drive.
7. Select the "DEMO Project S7-1200.ap10" file.
8. Confirm your selection with "Open".

   The sample project opens and you can edit it.

You can copy the sample project from the installation data medium again whenever you want to.

1.1.4 Displaying communications interfaces

Contents

Information that could not be included in the online help.

Introduction

Communications interfaces are displayed in the TIA Portal only if they already existed on your computer when you installed the TIA Portal. If you have installed the TIA Portal on your computer and then install a new CP (communications processor), this CP is detected by the operating system and displayed in the Windows Device Manager but it is not displayed in the project tree of the TIA Portal under "Online access".

Procedure

To display communications processors installed later in the TIA Portal, follow these steps:

1. Install/update the relevant drivers if the Windows "Hardware Update Wizard" opens after you insert the device.
2. Close the TIA Portal.
3. Select "Start > Settings> Control Panel> Set PG/PC Interface" and close the application with OK.
4. Restart the TIA Portal.

Result

The hardware now exists and can be used and the communications interface is displayed under "Online access".

1.2 Readme STEP 7

1.2.1 Notes on use

Contents

Information that could not be included in the online help.

Online operation

Simultaneous online operation of STEP 7 and STEP 7 Basic has not been approved.

Number of the time error interrupt OB

Time error interrupt OB280 is mentioned in a few topics of the online help. The correct number of the time error interrupt OB is 80.

Configuring and assigning module parameters

You will find an overview of the modules you can configure and assign with STEP 7 Basic V10.5 at http://support.automation.siemens.com.

1.2.2 Configuring devices and networks

1.2.2.1 Setting flow control for CM 1241

Contents

Information that could not be included in the online help.

Values for XON and XOFF

If flow control is enabled for the CM 1241 (RS-232) communications module and set to "XON/XOFF", you can enter identical values for the XON and XOFF characters. From a technical point of view, however, this configuration is impractical. You should therefore use different values for XON and XOFF.

1.2.2.2 Notes on Open User Communication

Unique connection ID for Open User Communication

You will have to enter a unique value for the connection ID in the connection settings of the Open User Communication in case you know the connection partner. The uniqueness of the connection ID will not be checked by the connection settings and there will be no default setting made for the connection ID when you create a new connection.

1.2.2.3 Notes on online and diagnostics

Contents

Information that could not be included in the online help.

Setting the language of the diagnostic texts

The language for the diagnostics texts is the same as the user interface language that was set when the project was created. If you want diagnostic texts to displayed in another language, go to "Language & Resources > Project languages" in the project tree of your project. Select the check box for the additional language. Then compile the devices that are relevant for diagnostics. The diagnostic texts will now be displayed in the language set for the user interface.

Displaying event texts during online access after changing the editing language

If you click "Online > Accessible devices > Update" and then set a different editing language in the project tree in "Language & Resources > Project languages" or change the user interface language in "Options > Settings", no event texts will be displayed for CPUs in "Online > Online & Diagnostics > Diagnostics buffer". Click "Online > Accessible devices > Update" again. The texts are then displayed again.

Diagnostics data from high-speed counters and pulse generators

For high-speed counters and pulse generators that have not been activated, the table with the device overview shows the diagnostics icon which means: "No diagnostics data available because the current online configuration data differs from the offline configuration data".

Opening the online and diagnostics view for inputs/outputs

You can call up the "Online & Diagnostics" function context-sensitive with a selected device in the hardware and network editor using the key combination <Ctrl+D>. You can select either an entire CPU or individual input/output modules in the device overview table and open the corresponding online and diagnostics view with the key combination <Ctrl+D>. You can also open the online and diagnostics view for the integrated inputs/outputs, if you have selected the corresponding line for an integrated input/output in the tabular device view of the CPU.

Language in the Online and Diagnostics view

If you start the online and diagnostics view from a device in the list of available nodes, there will be some rare cases when the events in the online and diagnostics view are not displayed in the language of the user interface. To display the events in the correct language, you will have to match the editing language to the language of the user interface in the respective project. Restart the TIA Portal.

Hardware detection followed by online connection

When the "Online > Hardware detection" command is performed for an unspecified CPU, the online configuration is not loaded from the CPU. If you do not load the configuration resulting from the hardware detection to the CPU, the device and network views will always show a difference between the offline and online configurations. It will appear there are different configurations in the online and diagnostic views, although the MLFBs are identical in the actual CPU and the offline CPU.

Assigning an IP address

If an IP address is assigned directly to a PLC with "Functions > Assigning an IP address" via the diagnostics and online function, this IP address will be set permanently and retained even after a restart or power failure.

1.2.2.4 Notes on cycle time

Violation of cycle monitoring time

When the cycle time exceeds the cycle monitoring time for the first time, there is an attempt to start the time error interrupt OB (OB 80). If there is no time error interrupt OB in the CPU, the CPU will switch to "RUN" mode. The CPU will switch to "STOP" mode if the cycle time exceeds the cycle monitoring time for a second time in the same cycle.

1.2.2.5 Compiling the hardware of a pulse generator

Contents

Information that could not be included in the online help.

Compiling with a disabled pulse generator

If a pulse generator is deactivated and the following error message nevertheless appears during compilation of the hardware "Pulse generator as: PTO cannot be selected. Associated high speed counter not correctly configured.", follow these steps:

1. Deactivate the high-speed counter.
2. Activate the pulse generator and set the operating mode to "PTO".
3. Deactivate the pulse generator.
4. Recompile the hardware.

1.2.3 Programming a PLC

1.2.3.1 General notes on PLC programming

Contents

Information that could not be included in the online help.

Loss of retentive data after deleting online blocks or after downloading to the device

If you delete online blocks or download an element of your project to the CPU (for example a program block, a data block or the hardware configuration), the next time the CPU changes to RUN mode, it runs cold restart. Apart from deleting the inputs, initializing the outputs and deleting the non-retentive memory, the retentive memory areas are also deleted.

All subsequent changes from STOP to RUN are warm restarts (during which the retentive memory is not deleted).

Updating the block folder in the list of available nodes

Note that the content of the block folder in the list of available nodes is only updated when you close and open the block folder. To ensure that the latest content is displayed after changing the online program, close the block folder and open it again.

Calling blocks as multi-instance

You can only call up function blocks as multiple instances if they are included in the libraries supplied with STEP 7 V10.5. You cannot call up any function blocks you have created yourself as multiple instances.

IEC check

- The "IEC check" option is disabled as default.
- You cannot link operands of the REAL data type and operands of the DWORD data type in one instruction regardless of the "IEC check" setting. You will have to perform an explicit conversion with the "CONVERT" instruction.

Global libraries

You will find information on global libraries on the product DVD in the directory "<drive>\Documents\AdditionalDocuments".

MODBUS library

The instruction "MB_SLAVE" was updated in STEP 7 V10.5 SP2.

If you have already used "MB_SLAVE" V1.0 in a project, you will have to manually replace this version with the latest version "MB_SLAVE" V1.1" after installation of SP2.

To do this, follow these steps:

1. Delete "MB_SLAVE" V1.0 from all blocks in the project.
2. Delete "MB_SLAVE" V1.0 from the project library.
3. Insert "MB_SLAVE" V1.1 in all required locations of use.
4. Compile the project.

Program status of LAD and FBD boxes

If LAD/FBD boxes do not have the ENO connected, in certain situations, the status of the box cannot be displayed, for example with

- SCALE
- NORMALIZE
- MOVE

Process image of PTO/PWM outputs

Do not use PTO/PWM outputs in the process image (for example, for accesses in the user program, for online functions or in the HMI). The update rate of the process image is much slower than the rate of the signal changes. The display in the process image does not reflect the signal flow.

Loss of symbolic constants after moving a signal board

After moving a signal board to another device, no symbolic constants are created. This affects the programming of the blocks because the required constants are not available. During compilation an alarm is generated related to the missing constants. The hardware interrupts have to be deactivated on the signal board and then reactivated so that the symbolic constants can be recreated.

Changing the mnemonic settings

To avoid error messages when compiling blocks after changing the mnemonic settings, save your project, close the project and then reopen it.

1.2.3.2 LREAL data type

1.2.3.2 Using LREAL data type

Contents

Information that could not be included in the online help.

Introduction

In some instructions you can use the LREAL (64 bit) data type in addition to the REAL (32 bit) data type to represent floating-point numbers. The LREAL data type is only available in blocks for which you have set purely symbolic addressing.

Use in instructions

The following table shows the instructions available for the LREAL data type:

Operation	Mnemonics	Description
Comparator	CMP ==	Query if the first comparison value is equal to the second comparison value.
	CMP <>	Query if the first comparison value is unequal to the second comparison value.
	CMP >=	Query if the first comparison value is greater than or equal to the second comparison value.
	CMP <=	Query if the first comparison value is less than or equal to the second comparison value.
	CMP >	Query if the first comparison value is greater than the second comparison value.
	CMP <	Query if the first comparison value is less than the second comparison value.
	-|OK|-	Query if the value of a tag is a valid floating-point number.
	-|NOT_OK|-	Query if the value of a tag is an invalid floating-point number.
Moving	MOVE	Copies the content of input IN to the output OUT when the signal state is "1" at the EN enable input.
	MOVE_BLK	Copies the contents of the memory area (source area) at the input IN to the memory area (destination area) at the output OUT. Use the COUNT parameter to specify the number of elements you want to copy to the destination area.
	UMOVE_BLK	Copies the contents of the memory area (source area) at the input IN to the memory area (destination area) at the output OUT without interruption. Use the COUNT parameter to specify the number of elements you want to copy to the destination area.
	FILL_BLK	Fills a memory area (destination area) at the output OUT with the value of input IN. The destination area is filled beginning with the address specified at the OUT output. The number of repeated copy operations is specified with the COUNT parameter.

Operation	Mnemonics	Description
	UFILL_BLK	Fills a memory area (destination area) at the output OUT with the value of input IN without interruption. The destination area is filled beginning with the address specified at the OUT output. The number of repeated copy operations is specified with the COUNT parameter.

Operation	Mnemonics	Description
Mathematic functions	ADD	Adds the value at the IN1 input to the value at the IN2 input and outputs the sum at the OUT output (OUT = IN1+IN2).
	SUB	Subtracts the value at the IN2 input from the value at the IN1 input and outputs the difference at the OUT output (OUT = IN1-IN2).
	MUL	Multiplies the value at the IN1 input by the value at the IN2 input and outputs the product at the OUT output (OUT = IN1*IN2).
	DIV	Divides the value at the IN1 input by the value at the IN2 input and outputs the quotient at the OUT output (OUT = IN1/ IN2).
	NEG	Changes the sign of the value at the IN input and outputs the result at the OUT output.
	ABS	Forms the absolute value of a number.
	SQR	Forms the square of a floating-point number.
	SQRT	Forms the square root of a floating-point number.
	LN	Forms the natural logarithm of a floating-point number.
	EXP	Forms the exponential value of a floating-point number to base e.
	SIN	Forms the sine value of a floating-point number. The floating-point number here represents an angle in a radian.
	COS	Forms the cosine value of a floating-point number. The floating-point number here represents an angle in a radian.
	TAN	Forms the tangent value of a floating-point number. The floating-point number here represents an angle in a radian.
	ASIN	Forms the arcsine value of a floating-point number whose range of definition is -1 <= input value <= 1. In this case, the result represents an angle in a radian measure.
	ACOS	Forms the arc cosine value of a floating-point number with a range of definition -1 <= input value <= 1. In this case, the result represents an angle in a radian measure.
	ATAN	Forms the arc tangent value of a floating-point number. In this case, the result represents an angle in a radian measure.

Operation	Mnemonics	Description
Converter	CONVERT	Reads the content of the IN parameter and converts it according to the specified data types.
	ROUND	Rounds the value at the IN input to the next integer and outputs the result at the OUT output.
	CEIL	Rounds the value at the IN input to the next greater integer and outputs the result at the OUT output.
	FLOOR	Rounds the value at the IN input to the next smaller integer and outputs the result at the OUT output.
	TRUNC	Selects the integer part of the floating-point number at the IN input and outputs this without decimal places to the OUT output.

1.2.3.2 LREAL

Contents

Information that could not be included in the online help.

Description

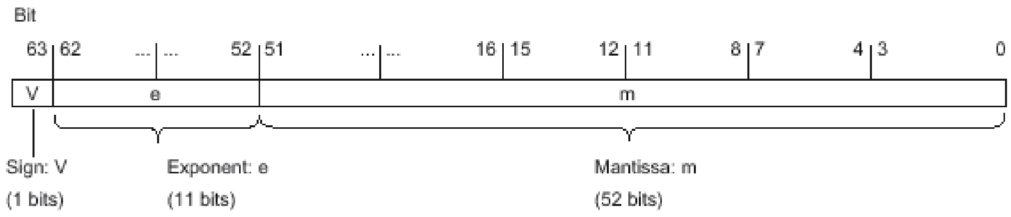
Tags of the LREAL data type have a length of 64 bits and are used to display floating-point numbers. A tag of the LREAL data type consists of the following three components:

- Sign: The sign is determined by the signal state of bit 63. The bit 63 assumes the value "0" (positive) or "1" (negative).
- 11-bit exponents to base 2: The exponent is increased by a constant (base, +1023), so that it has a range of 2047.
- 52-bit mantissa: Only the fraction part of the mantissa is shown. The integer part of the mantissa is not stored, as it is always equal to "1" within the valid value range.

The following table lists the properties of an LREAL tag:

Length (bits)	Format	Range of values	Examples of value input
64	Floating-point numbers to IEEE 754 standard	-1.7976931348623158e+308 to -2.2250738585072014e-308 ±0 +2.2250738585072014e-308 to +1.7976931348623158e+308	1.0e-5
	Floating-point numbers		1.0

The following illustration shows the structure of an LREAL tag:



See also

Using LREAL data type (Page 23)

1.2.3.3 Reset IEC timer

1.2.3.3 ---

Contents

Information that could not be included in the online help.

Introduction

In addition to the instructions described above, you have an instruction in LAD to reset IEC timers.

Symbol

<Operand>

--- (RT) ---

Parameter	Data type	Memory area	Description
<Operand>	DB	D	DB of the IEC timer reset at RLO = "1".

Description

Use the operation "Reset IEC timer" to reset IEC time to "0".

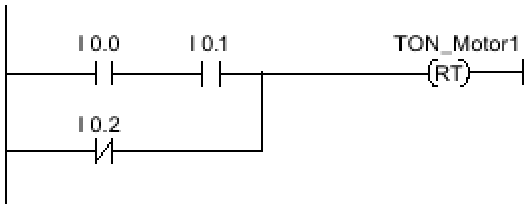
The operation is only executed if the result of logic operation (RLO) at the input of the coil is "1". If current flows to the coil (RLO is "1"), then the parameters of the IEC timer DB are set to "0". If the result of the logic operation at the input of the coil is "0" (no signal flow at the coil), then the parameters will remain unchanged.

The operation does not influence the RLO. The RLO at the input of the coil is sent immediately to the output of the coil.

Placement

The operation "Reset IEC timer" can be placed at any location in the network.

Example



The IEC timer "TON_Motor1" will be reset, if one of the following conditions is met:

- The inputs I 0.0 AND I 0.1 are "1".
- The signal state at input I 0.2 is "0".

1.2.3.3 ---

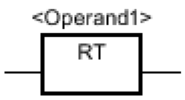
Contents

Information that could not be included in the online help.

Introduction

In addition to the instructions described above, you have an instruction in FBD to reset IEC timers.

Symbol



Parameter	Data type	Memory area	Description
<Operand>	DB	D	DB of the IEC timer reset at RLO = "1".

Description

Use the operation "Reset IEC timer" to reset IEC time to "0".

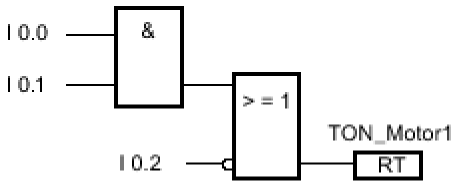
The operation is only executed if the result of logic operation (RLO) is "1" at the box input. If the box input supplies the signal status "1", then the parameters of the IEC timer DB are set to "0". If the result of logic operation is "0" at the box input, the parameters remain unchanged.

The operation does not influence the RLO. The RLO at the box input is transferred directly to the box output.

Placement

The operation "Reset IEC timer" can be placed at any location in the logic string.

Example



The IEC timer "TON_Motor1" will be reset, if one of the following conditions is met:

- The inputs I 0.0 AND I 0.1 have signal state "1".
- The signal state at input I 0.2 is "0".

1.2.3.4 Read field

1.2.3.4 Read field

Introduction

In addition to the instructions described above, you have an instruction in LAD to read individual components of a field.

Note

Insert instruction "Read field"

You insert the instruction "Read field" by dragging an empty box from the "Favorites" pane and selecting the instruction from the drop-down list of the empty box.

Symbol

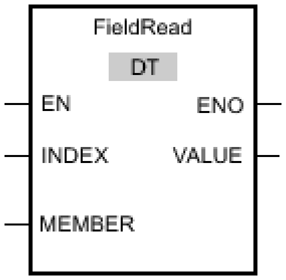


Figure1-1

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
INDEX	DINT	I, Q, M, D, L or constant	Index of field components that are read out
MEMBER	All elementary data types as components of an ARRAY tag	I, Q, M, D, L	First component of the field from which will be read
VALUE	All elementary data types	I, Q, M, D, L	Tag to which the field component is written

You can select the data type for the instruction from the "DT" drop-down list.

Description

Use the instruction "Read field" to read out a specific component from the field displayed at the MEMBER parameter and transfer its contents to the tag at the VALUE parameter. You specify the index of the field components to be read at the INDEX parameter. Enter the first component of the field which is read at the MEMBER parameter.

The data type of the field component at the MEMBER parameter and the tags at the VALUE parameter have to match the data type of the instruction "Read field".

The processing of the "Read field" instruction can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The field component indicated at the INDEX parameter is not defined in the field entered at MEMBER parameter.
- Errors such as an overflow occur during processing.

Example

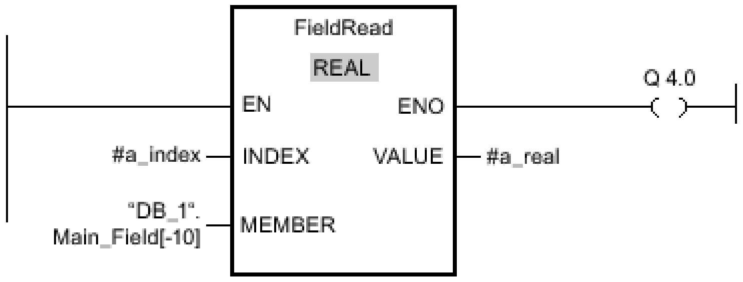


Figure1-1

Parameter	Tag	Value
INDEX	a_index	4
MEMBER	"DB_1".Main_Field[-10]	The first component of the field "Main_Field [-10..10] of REAL" in data block "DB_1"
VALUE	a_real	The component with index 4 of the field "Main_Field[-10..10] of REAL"

The field component with index 4 is read out from the field "Main_Field[-10...10] of REAL" and written to the tag "a_real". The field component to be read is specified by the value at the INDEX parameter.

1.2.3.4 Read field

Introduction

In addition to the instructions described above, you have an instruction in LAD to read individual components of a field.

Note

Insert instruction "Read field"

You insert the instruction "Read field" by dragging an empty box from the "Favorites" pane and selecting the instruction from the drop-down list of the empty box.

Symbol

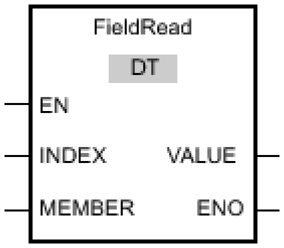


Figure1-1

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
INDEX	DINT	I, Q, M, D, L or constant	Index of field components that are read out
MEMBER	All elementary data types as components of an ARRAY tag	I, Q, M, D, L	First component of the field from which will be read
VALUE	All elementary data types	I, Q, M, D, L	Tag to which the field component is written

You can select the data type for the instruction from the "DT" drop-down list.

Description

Use the instruction "Read field" to read out a specific component from the field displayed at the MEMBER parameter and transfer its contents to the tag at the VALUE parameter. You specify the index of the field component to be read at the INDEX parameter. Enter the first component of the field which is read at the MEMBER parameter.

The data type of the field component at the MEMBER parameter and the tags at the VALUE parameter have to match the data type of the instruction "Read field".

The processing of the "Read field" instruction can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The field component indicated at the INDEX parameter is not defined in the field entered at MEMBER parameter.
- Errors such as an overflow occur during processing.

Example

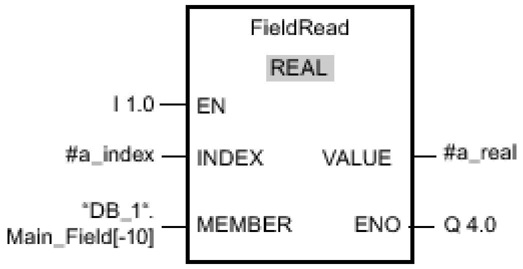


Figure1-1

Parameter	Tag	Value
INDEX	a_index	4
MEMBER	"DB_1".Main_Field[-10]	The first component of the field "Main_Field [-10..10] of REAL" in data block "DB_1"
VALUE	a_real	The component with index 4 of the field "Main_Field[-10..10] of REAL"

The field component with index 4 is read out from the field "Main_Field[-10...10] of REAL" and written to the tag "a_real". The field component to be read is specified by the value at the INDEX parameter.

1.2.3.5 Write field

1.2.3.5 Write field

Introduction

In addition to the instructions described above, you have an instruction in LAD to write individual field components of a field.

Note
Insert instruction "Write field"

You insert the instruction "Write field" by dragging an empty box from the "Favorites" pane and selecting the instruction from the drop-down list of the empty box.

Symbol

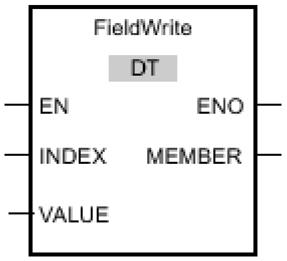


Figure1-1

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
INDEX	DINT	I, Q, M, D, L or constant	Index of field component that is written
VALUE	All elementary data types	I, Q, M, D, L or constant	Tag whose content is copied
MEMBER	All elementary data types as components of an ARRAY tag	I, Q, M, D, L	First component of the field to which you write

You can select the data type for the operation from the "DT" drop-down list.

Description

Use the instruction "Write field" to transfer the content of the tag at the VALUE parameter to a specific component of the field at the MEMBER parameter. You specify the index of the field component that is described by the value at the INDEX parameter. Enter the first component of the field to which is written at the MEMBER parameter.

The data types of the field component specified at the MEMBER parameter and the tag at the VALUE parameter have to match the data type of the instruction "Write field".

The processing of the "Write field" instruction can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The field component indicated at the INDEX parameter is not defined in the field entered at MEMBER parameter.
- Errors such as an overflow occur during processing.

Example

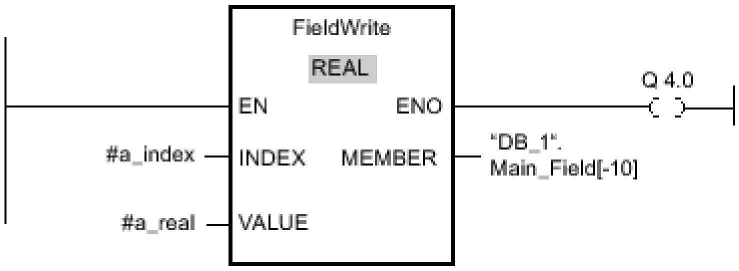


Figure1-1

Parameter	Tag	Value
INDEX	a_index	4
VALUE	a_real	10.54
MEMBER	"DB_1".Main_Field[-10]	The first component of the field "Main_Field[-10..10] of REAL" in data block "DB_1"

The value "10.54" of the tag "a_real" is written to the field component with index 4 of the field "Main_Field[-10...10] of REAL". The index of the field component to which the content of the "a_real" tag is transferred" is specified by the value at the INDEX parameter.

1.2.3.5 Write field

Introduction

In addition to the instructions described above, you have an instruction in LAD to write individual field components of a field.

Note
Insert instruction "Write field"

You insert the instruction "Write field" by dragging an empty box from the "Favorites" pane and selecting the instruction from the drop-down list of the empty box.

Symbol

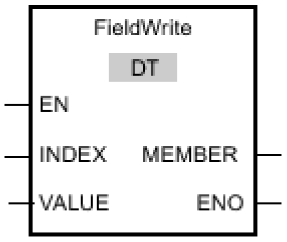


Figure1-1

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
INDEX	DINT	I, Q, M, D, L or constant	Index of field component that is written
VALUE	All elementary data types	I, Q, M, D, L or constant	Tag whose content is copied
MEMBER	All elementary data types as components of an ARRAY tag	I, Q, M, D, L	First component of the field to which you write

You can select the data type for the operation from the "DT" drop-down list.

Description

Use the instruction "Write field" to transfer the content of the tag at the VALUE parameter to a specific component of the field at the MEMBER parameter. You specify the index of the field component that is described by the value at the INDEX parameter. Enter the first component of the field to which is written at the MEMBER parameter.

The data types of the field component specified at the MEMBER parameter and the tag at the VALUE parameter have to match the data type of the instruction "Write field".

The processing of the "Write field" instruction can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The field component indicated at the INDEX parameter is not defined in the field entered at MEMBER parameter.
- Errors such as an overflow occur during processing.

Example

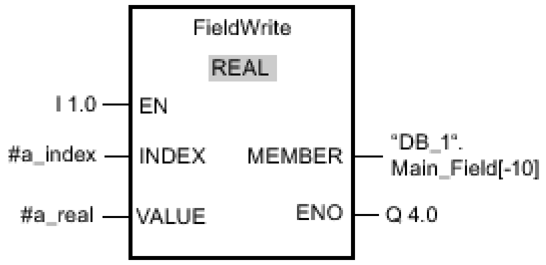


Figure1-1

Parameter	Tag	Value
INDEX	a_index	4
VALUE	a_real	10.54
MEMBER	"DB_1".Main_Field[-10]	The first component of the field "Main_Field [-10..10] of REAL" in data block "DB_1"

The value "10.54" of the tag "a_real" is written to the field component with index 4 of the field "Main_Field[-10...10] of REAL". The index of the field component to which the content of the "a_real" tag is transferred" is specified by the value at the INDEX parameter.

1.2.3.6 Comparing blocks

1.2.3.6 Know-how protected blocks

Contents

Information that could not be included in the online help.

Special considerations when comparing know-how protected blocks

If you download a know-how-protected block to a device, no restore information is loaded along with it. This means you can no longer open or read the user program of a know-how protected block that was loaded to a device. You cannot alter this behavior by using the correct password.

Because the user program can no longer be read, detailed comparison is not possible with know-how protected blocks.

Notice

You can neither read nor edit know-how protected blocks that you load from a device to your project. We recommend that you create backup copies of the offline version of the relevant block before you load a know-how protected block from a device to your project.

1.2.3.7 Testing the user program

1.2.3.7 Testing with the watch table

Contents

Information that could not be included in the online help.

Multiple access to the same CPU

Access to a CPU from a PG/PC is permitted only when a TIA portal is open. Multiple access to the same CPU is not permitted and can lead to errors.

Modify with trigger

When modifying with a trigger, for example when permanently modifying a tag, an existing control job is aborted if the CPU memory is currently being reset (MRES). The control job is also terminated even if you answer "no" to the prompt asking whether to stop modifying with trigger in the watch table dialog.

Rounding floating-point numbers

In the watch table, floating-point numbers are stored as binary numbers in IEEE format. Since some floating-point numbers (real, long real) that can be displayed in the user interface cannot be mapped exactly to the IEEE format, it is possible that floating-point numbers will be rounded.

If a floating-point number has been rounded for this reason and it is then copied to another input cell in the watch table, the rounding may result in a slight deviation.

Loading data blocks during an active control job

Notice

Loading changed data blocks during an active control job can result in unforeseen operating states. The control job continues to control the specified address, although the address allocation may have changed in the data block. Complete active control jobs before loading data blocks.

1.2.3.8 Using technological objects

1.2.3.8 Using PID Compact

Contents

Information that could not be included in the online help.

Restarting the "PID_Compact" technological object after restarting the CPU

After turning on the power and restarting the CPU, the "PID_Compact" technological object changes to automatic mode if this was the last mode of the technological object.

The automatic change to automatic mode can be disabled. To do this, set the "sb_RunModeByStartup" variable in the instance DB to the value FALSE.

Using an analog manipulated variable output of the "PID_Compact" technological object

If you use the manipulated variable outputs "Output" or "Output_PER", any times of the "PWM limits" that may have changed must be corrected to the value 0.0. You set the "PWM limits" in the "Advanced settings > PWM limits" configuration window.

Incomplete parameters for the "PID_Compact" instruction

If the parameters for the "PID_Compact" instruction are incomplete (three red question marks), this is not indicated as an error during compilation.

Prior to compilation and before downloading to the device, make sure that the parameters for the "PID_Compact" instruction are complete and have correct values.

1.2.3.8 Using Motion Control

1.2.3.8 General notes on motion control

Contents

Information that could not be included in the online help.

Reaction times of the control panel

The reaction time of the control panel depends on the communication load of the CPU. Close all other online windows of the Portal in order to keep the reaction time low.

Starting motion commands following error acknowledgment via "MC_Reset"

If an axis error occurs which has to be acknowledged with the motion control instruction "MC_Reset", please proceed as follows:

1. Remove the cause of the problem.
2. Acknowledge the error using the motion control instruction "MC_Reset".
3. Check the following signal statuses before starting a new motion command:
   - Output parameter "Done" = TRUE
   - Tag for the technology object "Axis".StatusBits.Error" = FALSE

Active homing with auto reverse after reaching hardware limit switch

The auto reverse after reaching hardware limit switch functions if the following configuration condition is met: "Approach velocity" > "Reduced velocity".

1.2.3.8 Limits of the pulse generators

Contents

Information that could not be included in the online help.

Limits of the pulse generators (PTO)

The following limits apply when you use the pulse generators of the CPU 1211C, CPU 1212C and CPU 1214C in connection with an "Axis" technological object:

- Minimum frequency 2 Hz
- Maximum frequency 100 kHz (when using 20 kHz signal board)
- Minimum frequency change (acceleration/deceleration) 0.28 Hz/s
- Maximum frequency change (acceleration/deceleration) 9500 MHz/s

1.2.3.8 Hardware limit switch and reference point switch

Contents

Information that could not be included in the online help.

Delay time hardware limit switch and reference point switch

The digital inputs are set to a 6.4 ms filter time by default.

Unwanted delays may occur if you use them as hardware limit switches.

Unwanted delays and inaccuracies may occur if you use them as reference point limit switches. Depending on the approach velocity and the level of the reference point switch, the reference point may not be detected.

If this occurs, reduce the filter time for the corresponding digital inputs in the device configuration of the digital inputs.

1.2.3.8 Axis configuration in runtime

Contents

Information that could not be included in the online help.

Changing the axis configuration during the runtime of the user program

The selection of the axis configuration data can be changed by the user program during runtime. The following can be accessed in the configuration data of the axis in the user program through the tags of the technological object:

- Configuration of the hardware/software limit switch
  - "Axis".Config.PositionLimits_HW.Active

    Enabling of the hardware limit switch (TRUE = enabled)
  - "Axis".Config.PositionLimits_SW.Active

    Enabling of the software limit switch (TRUE = enabled)
  - "Axis".Config.PositionLimits_SW.MinPosition

    Position of the low software limit switch
  - "Axis".Config.PositionLimits_SW.MaxPosition

    Position of the high software limit switch

  Change takes effect after the axis is stopped and a new movement job is started.
- Configuration of dynamic values
  - "Axis".Config.DynamicDefaults.Acceleration

    Acceleration of the axis
  - "Axis".Config.DynamicDefaults.Deceleration

    Delay of the axis

    "Axis".Config.DynamicDefaults.EmergencyDeceleration
    Emergency stop delay of the axis

  Change takes effect when a new movement job is started.

1.2.3.8 Calling motion control instructions

Contents

Information that could not be included in the online help.

Calling motion control instructions

A motion control instruction may not be interrupted by the same motion control instruction in a higher priority class if they are using the same instance block.

Avoid such interruption by taking the following measures:

- Prevent simultaneous execution of motion control instructions with the same instance block in the user program (by using conditional block call, for example).
- Use different instance data blocks in different priority classes.

1.2.3.8 List of ErrorIDs and ErrorInfos

Contents

Information that could not be included in the online help.

List of ErrorIDs/ErrorInfos

The following tables list the ErrorIDs and ErrorInfos that can be displayed in the motion control statements. This list replaces the section "List of ErrorIDs and ErrorInfos".

Operational fault with stop of the axis

ErrorID	ErrorInfo	Description	Remedy
16#8000		**Drive error, "Drive ready" failure**	
	16#0001	-	Acknowledge the error with the "MC_Reset" statement; Providing the drive signal
16#8001		**Lower software limit switch was triggered**	
	16#000E	The axis has reached the limit switch	Acknowledge the error with the "MC_Reset" statement; set a motion command to move the axis in positive direction out of the range of the SW limit switch
	16#000F	The axis has reached the limit switch (emergency stop)	
	16#0010	The axis has overshot the limit switch (emergency stop)	
16#8002		**Upper software limit switch was triggered**	
	16#000E	The axis has reached the limit switch	Acknowledge the error with the "MC_Reset" statement; set a motion command to move the axis in negative direction out of the range of the SW limit switch
	16#000F	The axis has reached the limit switch (emergency stop)	
	16#0010	The axis has overshot the limit switch (emergency stop)	
16#8003		**Lower hardware limit switch was triggered**	
	16#000E	The axis has reached the limit switch	Acknowledge the error with the "MC_Reset" statement; set a motion command to move the axis in positive direction out of the range of the HW limit switch
16#8004		**Upper hardware limit switch was triggered**	

ErrorID	ErrorInfo	Description	Remedy
	16#000E	The axis has reached the limit switch	Acknowledge the error with the "MC_Reset" statement; set a motion command to move the axis in negative direction out of the range of the HW limit switch
16#8005		PTO and HSC are already in use by a different axis	
	16#0001	-	Correct the configuration of the PTO und HSC and download it to the controller

Operational fault without stop of the axis

ErrorID	ErrorInfo	Description	Remedy
16#8200		Axis is not enabled	
	16#0001	-	Enable the axis; restart the command
16#8201		Axis has already been enabled by another statement " MC_Power "	
	16#0001	-	Enable the axis with only one "MC_Power" statement
16#8202		The maximum number of simultaneously active Motion Control commands was exceeded (max. 256 commands for all Motion Control technological objects)	
	16#0001	-	Reduce the number of simultaneously active commands; restart the command
16#8203		Axis is currently operated in "Manual control" (control panel)	
	16#0001	-	Exit "Manual control"; restart the command
16#8204		Axis is not homed	
	16#0001	-	Home the axis by means of the "MC_Home" statement; restart the command
16#8205		The axis is currently controlled by the user program (the error is only displayed in the control panel)	
	16#0001	-	Lock axis with the "MC_Power" instruction and select "Manual control" again in the control panel
16#8206		Technological object is not yet enabled	
	16#0001	-	Enable the axis with the "MC_Power" statement or in the axis control panel.
16#8207		Command rejected	
	16#0016	Active homing running; Passive homing cannot be started.	Wait for active homing to complete or cancel active homing with a movement command such as "MC_Halt". Passive homing can then be started.

Block parameter error

ErrorID	ErrorInfo	Description	Remedy
16#8400		**Incorrect value at the "Position" parameter of the Motion Control statement**	
	16#0002	Value with invalid number format	Correct the "position" value; restart the command
	16#0005	The value is outside the number range (greater than 1e^{12})	
	16#0006	The value is outside the number range (less than -1e^{12})	
16#8401		**Incorrect value at the " Distance " parameter of the motion control statement**	
	16#0002	Value with invalid number format	Correct "Distance" value; restart the command
	16#0005	The value is outside the number range (greater than 1e^{12})	
	16#0006	The value is outside the number range (less than -1e^{12})	
16#8402		**Incorrect value at the " Velocity " parameter of the motion control statement**	
	16#0002	Value with invalid number format	Correct "Velocity" value; restart the command
	16#0008	The maximum velocity is exceeded	
	16#0009	The velocity is less than the start / stop velocity	
16#8403		**Incorrect value at the " Direction " parameter of the motion control statement**	
	16#0011	Invalid selection value	Correct the selection value; restart the command
16#8404		**Incorrect value at the " Mode " parameter of the Motion Control statement " MC_Home "**	
	16#0011	Invalid selection value	Correct the selection value; restart the command
	16#0015	Active/passive homing is not configured	Correct the configuration and download it to the controller; restart the command
	16#0017	Axis reversal is activated at the HW limit switch, despite the fact that the hardware limit switches are disabled	Enable the hardware limit switch with the tag "Axis".Config.PositionLimits_HW.Active = TRUE or correct the configuration and download it to the controller; restart the command
16#8405		**Incorrect value at the " StopMode " parameter of the Motion Control statement " MC_Power "**	
	16#0011	Invalid selection value	Correct the selection value; restart the command
16#8406		**Simultaneous jogging backwards and forwards not allowed**	
	16#0001	-	Prevent the simultaneous signal state TRUE for the "JogForward" and "JogBackward" parameters; restart the command.
16#8407		**Changing the axis at the "MC_Power" statement only allowed with locked axis.**	
	16#0001	-	Lock active axis; the axis can be changed and enabled again with Status = FALSE and Busy = FALSE.

Configuration error

ErrorID	ErrorInfo	Description	Remedy
16#8600		**Invalid configuration of the pulse generator (PTO)**	
	16#000B	Invalid address	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
16#8601		**Invalid configuration of the high-speed counter (HSC)**	
	16#000B	Invalid address	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
16#8602		**Invalid configuration of the "Drive enable" output**	
	16#000D	Invalid address	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
16#8603		**Invalid configuration of the "Drive ready" input**	
	16#000D	Invalid address	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
16#8604		**Invalid "Pulses per motor revolution" value**	
	16#000A	The value is less than or equal to zero	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
16#8605		**Invalid "Distance per motor revolution" value**	
	16#0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#000A	The value is less than or equal to zero	
16#8606		**Invalid "Start / stop velocity" value**	
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0003	Value exceeds the hardware limit	
	16#0004	Value is less than the hardware limit	
	16#0007	The start/stop velocity is greater than the maximum velocity	
16#8607		**Invalid "maximum velocity" value**	
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0003	Value exceeds the hardware limit	
	16#0004	Value is less than the hardware limit	
16#8608		**Invalid "Acceleration" value**	

ErrorID	ErrorInfo	Description	Remedy
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0003	Value exceeds the hardware limit	
	16#0004	Value is less than the hardware limit	
16#8609		Invalid "Deceleration" value	
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0003	Value exceeds the hardware limit	
	16#0004	Value is less than the hardware limit	
16#860A		Invalid "Emergency stop deceleration" value	
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0003	Value exceeds the hardware limit	
	16#0004	Value is less than the hardware limit	
16#860B		Invalid position value for the lower SW limit switch	
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0005	The value is outside the number range (greater than $1e^{12}$)	
	16#0006	The value is outside the number range (less than $-1e^{12}$)	
	16#0007	The position value of the lower SW limit switch is greater than that of the upper SW limit switch	
16#860C		Invalid position value for the upper SW limit switch	
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0005	The value is outside the number range (greater than $1e^{12}$)	
	16#0006	The value is outside the number range (less than $-1e^{12}$)	
16#860D		Invalid address of the lower HW limit switch	
	16#000C	Invalid address of the falling edge	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#000D	Invalid address of the rising edge	
16#860E		Invalid address of the upper HW limit switch	
	16#000C	Invalid address of the falling edge	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#000D	Invalid address of the rising edge	
16#860F		Invalid "reference point shift" value	

ErrorID	ErrorInfo	Description	Remedy
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0005	The value is outside the number range (greater than 1e^{12})	
	16#0006	The value is outside the number range (less than -1e^{12})	
16#8610		**Invalid "startup velocity" value**	
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0008	The maximum velocity is exceeded	
	16#0009	The velocity is less than the start/stop velocity	
16#8611		**Invalid "approach velocity" value**	
	16#0002	Value with invalid number format	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#0008	The maximum velocity is exceeded	
	16#0009	The velocity is less than the start/stop velocity	
16#8612		**Invalid address of the reference point switch**	
	16#000C	Invalid address of the falling edge	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	16#000D	Invalid address of the rising edge	
16#8613		**Reversal is enabled at the hardware limit switch for active homing, although the hardware limit switches are not configured**	
	16#0001	-	Correct the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement

Internal error

ErrorID	ErrorInfo	Description	Remedy
16#8FFF		**Internal error**	
	16#F0**	-	Restart the CPU by means of POWER OFF and POWER ON

1.2.3.9 Communications instructions

1.2.3.9 Notes on communications instructions

Contents

Information that could not be included in the online help.

Communication connection via ISO-on-TCP

Use only ASCII characters in the TSAP extension for passive communication partners when configuring a connection via ISO-on-TCP with the "S7-1200" controller.

Sending and receiving data

- If you are using symbolic values at the DATA parameter of the instructions "TRCV_C", "TSEND_C", "TRCV" or "TSEND", then the LEN parameter must have the value "0".
- When sending data (rising edge at the REQ parameter) with the TSEND_C instruction, the CONT parameter must have the value TRUE in order to make or keep a connection.
- When receiving data (falling edge at the EN_R parameter) with the TRCV_C instruction, the CONT parameter must have the value TRUE in order to make or keep a connection.

TSEND_C

The values of the STATUS parameter described in the online help have the following meanings:

STATUS	Description
8086	The ID parameter is outside the permitted range.
8088	The value at the LEN parameter does not match the receive area set at the DATA parameter.
80A1	• Connection or port already being used by user. • Communications error: – The specified connection has not yet been established. – The specified connection is being terminated. Transfer over this connection is not possible. – The interface is being re-initialized.
80A3	• Attempt being made to re-establish an existing connection. • Attempt being made to terminate a non-existent connection.
80B3	Inconsistent parameter assignment: Group error for error codes W#16#80A0 to W#16#80A2, W#16#80A4, W#16#80B4 to W#16#80B9
80C3	• All connection resources are being used. • A block with this ID is already being processed in a different priority group. • Internal lack of resources.

STATUS	Description
80C4	Temporary communications error: • The connection cannot be established at this time. • The interface is receiving new parameters or the connection is being established. • The configured connection is being removed from a TDISCON instruction.

In addition to the values described in the online help, the status parameter can also have the following value:

STATUS	Description
80A0	Group error for error codes W#16#80A1 and W#16#80A2
80A2	Local or distributed port is being used by system.
80A4	IP address of the distributed endpoint of the connection is invalid, in other words, it matches the IP address of the local partner.
80B5	Error in "active_est" parameter.
80B6	Parameter assignment error in the "connection_type" parameter of the data block for connection description
80B7	Error in one of the following parameters of the data block for connection description: block_length, local_tsap_id_len, rem_subnet_id_len, rem_staddr_len, rem_tsap_id_len, next_staddr_len

TRCV_C

The values of the STATUS parameter described in the online help have the following meanings:

STATUS	Description
8085	• LEN parameter is higher than the highest permitted value. • The value at the LEN or DATA parameter was changed after the first call.
8086	The ID parameter is outside the permitted range.
8088	The value at the LEN parameter does not match the receive area set at the DATA parameter.
80A1	• Connection or port already being used by user. • Communications error: – The specified connection has not yet been established. – The specified connection is being terminated. Transfer over this connection is not possible. – The interface is being re-initialized.

In addition to the values described in the online help, the status parameter can also have the following value:

STATUS	Description
80A0	Group error for error codes W#16#80A1 and W#16#80A2
80A2	Local or distributed port is being used by system.
80A3	• Attempt being made to re-establish an existing connection. • Attempt being made to terminate a non-existent connection.
80A4	IP address of the distributed endpoint of the connection is invalid, in other words, it matches the IP address of the local partner.
80A7	Communications error: You executed TDISCON before TCON had completed.
80B3	Inconsistent parameter assignment: Group error for error codes W#16#80A0 to W#16#80A2, W#16#80A4, W#16#80B4 to W#16#80B9
80B4	IP address of the distributed endpoint of the connection is invalid, in other words, it matches the IP address of the local partner.
80B5	Error in "active_est" parameter.
80B6	Parameter assignment error in the "connection_type" parameter of the data block for connection description
80B7	Error in one of the following parameters of the data block for connection description: block_length, local_tsap_id_len, rem_subnet_id_len, rem_staddr_len, rem_tsap_id_len, next_staddr_len
80C3	• All connection resources are being used. • A block with this ID is already being processed in a different priority group. • Internal lack of resources.
80C4	Temporary communications error: • The connection cannot be established at this time. • The interface is receiving new parameters or the connection is being established. • The configured connection is being removed from a TDISCON instruction.
8722	Error in "CONNECT" parameter: Invalid source area (area not declared in data block).
873A	Error in "CONNECT" parameter: Access to connection description is not possible (no access to data block).
877F	Error in "CONNECT" parameter: Internal error

"CONDITIONS" data type

The permitted value ranges for the following parameters of the "CONDITIONS" data type are:

Parameter	Range of values	Description
MAXLEN	0 to 1024	Maximum number of characters in a message. The end of a message is recognized when the maximum length of a message is exceeded.
N	1 to 1024	Offset of the length field in the message. This value specifies the position of the character at which the length field begins.

These value ranges also apply to the corresponding hardware settings for specifying the end of message.

1.3 Readme WinCC

1.3.1 Installation

Contents

Information that could not be included in the online help.

Parallel installation of STEP 7 V10.5 (incl. WinCC V10.5) and other SIMATIC HMI products

Parallel installation of STEP 7 V10.5 (incl. WinCC V10.5) has been released with

- WinCC flexible 2008; WinCC flexible 2008 SP1
- WinCC V6.2 as of SP3 (please read the information in FAQ 30576253 if you want to install WinCC V6.2 SP3 after STEP 7 V10.5).
- WinCC V7

Parallel installation of STEP 7 V10.5 (incl. WinCC V10.5) is not permitted with

- WinCC flexible 2004 and WinCC flexible 2004 SP1
- WinCC flexible 2005 and WinCC flexible 2005 SP1
- WinCC flexible 2007
- All versions of WinCC prior to WinCC V6.2 SP2

Configured system time for installation

To successfully perform the installation of Microsoft SQL Express, the system time of the installation computer needs to be set to the current time of day.

Missing fonts after installing and uninstalling WinCC flexible

After installing or uninstalling WinCC flexible, it is possible that some fonts are no longer available. This happens in the following situations:

- If you have installed WinCC flexible 2008 after STEP 7 V10.5.

- If you have uninstalled WinCC flexible 2008 or WinCC flexible 2008 SP1 after STEP 7 V10.5.

The fonts are nevertheless still on the computer and only need to be made known to Windows again. Follow these steps:

1. Open Windows Explorer.
2. Enter "%WINDIR%\Fonts" in the address bar.
   The folder with the fonts opens.
3. Select "File > Install New Font..."
4. In the "Folders" box, select the folder in which Windows stores the fonts. You will see the folder in the address bar in the Windows Explorer.
5. Select the following fonts in the "List of fonts" box.

   Siemens Sans Global

   Siemens Sans Global Bold

   Siemens Sans Global Bold Italic

   Siemens Sans Global Italic
6. Confirm your selection with "OK".

Note

In Windows Vista, you require administrator privileges to install fonts.

1.3.2 Notes on use

Contents

Information that could not be included in the online help.

Compiling and loading

The project is not continually compiled in the background during configuration in WinCC V10.5.

If internal errors or warnings occur during compiling, compile the complete project using the command "Compile > Software (rebuild all)" in the shortcut menu of the HMI device.

Before you start productive operation with your project, compile the project completely using the command "Compile > Software (rebuild all)" in the shortcut menu of the HMI device.

If you are using HMI tags that are connected to the control tags in your project, compile all modified blocks with the command "Compile > Software" in the shortcut menu before you compile the HMI device.

Copying HMI devices with HMI connections

If you copy an HMI device with HMI connections to a PLC, the HMI connection in the new HMI device will not automatically be connected to an existing PLC with the same name. This statements applies to copying within a project as well as copying across projects.

To access the PLC tag via HMI tag in the new HMI device, you will have to complete the HMI configuration immediately after the copying step. Proceed as follows:

1. Open the "Devices & Networks" editor.
2. Connect the new HMI device with the desired network.
3. Open the connection table.
4. Select the HMI connection of the new HMI device.
5. Select the desired PLC under "Partner."

If you compile the new HMI device or connect additional PLC tags in between copying the HMI device and completing the connection, there may be some instances in which you create an additional HMI connection to the same PLC. This is especially true if you connect HMI tags with DB array elements.

1.3.3 Migration

Contents

You can continue to use projects from WinCC flexible 2008 in WinCC V10.5. "Basic Panels" type HMI devices can be migrated.

You cannot migrate projects from WinCC flexible 2008 SP1 directly to WinCC V10.5. If you wish to continue using such projects in WinCC V10.5, you must first migrate them to WinCC flexible 2008.

Changing the names of alarm classes

In contrast to WinCC flexible, the names of the predefined alarm classes are not dependent on the user interface language currently in use. During migration, the names of the alarm classes are assigned as follows:

WinCC flexible	WinCC
Error	Alarms
System	System
Warnings	Events

The names of the alarm classes can be changed as necessary after migration.

Project languages in WinCC V10.5

WinCC V10.5 does not support all project languages that were available in WinCC flexible, such as Arabic. If you receive an empty project as the result of your migration, you may want to check the set editing language. Do not set the project languages that are not supported as editing language in the source project. Proceed as follows:

1. Open the project with WinCC flexible.
2. Change the editing language to English, for example.
3. Save the project.
4. Restart the migration.

See also

Object support during migration (Page 1018)
→ Object support during migration (13279660683/14023607307.htm)

1.3.4 Engineering System

1.3.4.1 Screens and Screen Objects

Contents

Information that could not be included in the online help.

Text format of output fields in alarm text

It is not possible to underline tags and text list entries.

Copying display objects between two projects or two devices

In Project_1 configure an alarm window in the Global Screen, for example. You copy the alarm window and paste it in the Global Screen in Project_2.

The enabled alarm classes are partly not enabled in the alarm window after pasting.

This behavior applies to the following display objects:

- Alarm window
- Alarm indicator
- Alarm view

Representation of the cross-references in the Inspector window

The Inspector window displays objects used by a screen object in the "About > Cross-reference" tab.

A screen is open and an object selected. You are using an HMI tag at the object as process tag.

The object and the linked HMI tag are displayed in the cross-references. All locations of use of the object and the HMI tags are listed.

If the HMI tag is interconnected with a PLC tag or a DB tag, then the locations of use of the interconnected PLC tag or DB tag will be displayed.

Event names in case of alarms in the "Info" tab of the Inspector window

In some alarms of the Inspector window the event names in the "Info" tab will deviate from the names in the "Properties" tab.

Name in the "Properties" tab of the Inspector window	Name in the "Info" tab of the Inspector window
Cleared	ClearScreen
Loaded	GenerateScreen
Enable	Activate
Change	Change
When dialog is opened	ONMODALBEGIN
When dialog is closed	ONMODALEND
User change	PASSWORD
Screen change	SCREEN
Disable	Deactivate
Press	Press
Outgoing	Going
Incoming	Coming
Limit "high limit error" violated	AboveUpperLimit
Limit "low limit error" violated	BelowLowerLimit
Click	Click
Loop-in alarm	LoopInAlarm
Release	Release
Alarm buffer overflow	OVERFLOW
Acknowledge	Acknowledgement
Runtime stop	Shutdown
Press key	KeyDown
Release key	KeyUp
Switch ON	SwitchOn
Switch OFF	SwitchOff
Value change	Change value

Global and local assignment of function keys

In the "Global screen" editor, the function key F1 is assigned with a function and a graphic.

The option "Use global assignment" is disabled in the template "Temp_1" for the function key F1. The function key is not assigned.

The screen "Screen_1" is based on the template "Temp_1". The option "Use local template" is enabled.

The function list of function key F1 is empty in screen "Screen_1", but the graphic of the global screen is visible.

Proceed as follows to change this behavior:

1. Enable the function key F1 in the screen "Screen_1".
2. Disable the option "Use local template" in the Inspector window under "Properties > General".
3. If the graphic is still visible, click under "Graphic" in the list.
4. Select "<None>".

1.3.4.2 Tags

Contents

Information that could not be included in the online help.

Tag names

HMI tag names may not start with the character @.

Display of deleted array elements at location of use of HMI tags

The locations of use of HMI tags, such as the process value of IO fields, are usually indicated by the tag name. If the element of an array tag is used, then the tag name will be extended by the index of the array element indicated in brackets.

If a used tag is no longer included in the project, then the tag name will still be displayed at the location of use. The field will be displayed with a red background to indicate the missing tag. If a used array element or the array tag is no longer present, then only the index of the array element will be displayed in brackets. The tag name will not be displayed. The field is highlighted in red. You can no longer identify the name of the associated array tag based on the location of use in this instance.

If you do not know which array tag was linked to this location of use, then it may be necessary to link the array element once again.

If a tag or array tag was created based on a reference, then the selected reference will be closed automatically.

If an HMI tag is connected with an array element of a PLC tag and the PLC tag does no longer exist in the project, then the same behavior will take place in the "HMI tags" editor.

Array tags as list entry of multiplex tags

You can use the array tags of the Char data type just like the tags of the String data type.

The use of an array tag of the Char data type as list entry of a multiplex tag in the "HMI tags" editor is not supported.

1.3.4.3 Alarm system and alarm displays

Contents

Information that could not be included in the online help.

Displaying special characters in alarm texts

When configuring alarm texts, a fixed character set is used in the Engineering System. This character set allows you to use numerous special characters in alarm texts.

Language-dependent fonts are used in runtime to display the texts, for example MS PGothic, SimSun. The fonts used in runtime do not support all special characters. As a result, some special characters are not displayed in runtime.

Use of multiplex tags in output boxes with alarm texts

In the engineering system, it is also possible to use multiplex tags in the output boxes of alarm texts. During runtime, this leads to an incorrect display of the alarm, because the use of multiplex tags is not supported by the basic panels.

1.3.4.4 System functions

Contents

Information that could not be included in the online help.

1.3.4.5 Recipes

Contents

Information that could not be included in the online help.

1.3.4.6 User administration

Contents

Information that could not be included in the online help.

Exporting and importing user data

You cannot import or export user data.

1.3.4.7 Connections

Contents

Information that could not be included in the online help.

Use of the "DTL" data type for area pointers

Use the "DTL" data type for configuration of area pointers "Date/time" and "Date/time PLC". The "DTL" data type supports time stamp information in the nanosecond range. Because Basic Panels support time stamp information only down to the millisecond range, you will encounter the following restrictions when using the area pointers:

- Area pointer "Date/time"
  For transmission of time information from a Basic Panel to the PLC, the smallest unit of time is 1 millisecond. The value range from microseconds to nanoseconds of the "DTL" data type will be filled with zeros.
- Area pointer "Date/time PLC"
  For transmission of time information from a PLC to a Basic Panel, the area from microseconds to nanoseconds will be ignored. The time information will be processed on the panel down to milliseconds.

Limited number of possible HMI connections

An error message will be displayed during compilation of a device indicating that the configuration of the HMI connection in the "Devices & Networks" editor is invalid. The reason may be that the maximum number of possible connections of the HMI device or PLC may be exceeded.

Check the maximum number of possible connections. Consult the device manuals of the devices you are using.

1.3.4.8 Compiling and loading

Contents

Information that could not be included in the online help.

Incorrect installation of ProSave

If you receive an error message during installation of ProSave when loading data to a target device or maintenance of an HMI device, then you cannot remedy this error using the repair function of setup. Remove ProSave via the Control Panel. Then start setup and install the "ProSave" component again.

Checking the address parameters

During compilation of an HMI device in the project tree with the command "Compile > Software" in the shortcut menu, the address parameters of the HMI device, such as the IP address, will not be checked. If you want to ensure that the address parameters are checked as well, you will have to compile the HMI device in the "Devices & Networks" editor of the toolbar.

Error message when downloading data to the PLC

A panel and a PLC are connected and communicating with other.

If a tag is accessed while downloading data from the panel to the PLC, an error message is displayed on the panel.

1.3.5 Runtime

1.3.5.1 Notes on operation in Runtime

Contents

Information that could not be included in the online help.

Caution
Ethernet communication

In Ethernet-based communication, the end user is responsible for the security of his data network. The proper functioning of the device cannot be guaranteed in all circumstances; targeted attacks, for example, can lead to overload of the device.

Special characters in the user view

Special characters, such as / " § $ % & ' ?, are not permitted when entering a name or the password in the user view.

Language behavior - Layout of screen keyboard

The layout of the screen keyboard is not switched when the runtime language changes.

Tag values overwrite the maximum length

You enter a character string in a string tag via an I/O field. If the character string exceeds the number of configured tags, the character string will be shortened to the configured length.

1.3.6 HMI devices

1.3.6.1 General notes

Contents

Information that could not be included in the online help.

Simulation of the Basic Panels

Use an output field in an alarm text to output an external tag. The content of the output field will always be displayed with "0" during simulation.

Simulation with real PLC connection

The access point used by the simulation is independent from the settings of the Engineering System and can only be altered in the Control Panel with the "Setting PG/PC Interface" tool. If the PLC connection is terminated right after the start of the simulation with message 140001, you should check the access point used by the simulation with "Setting PG/PC Interface".

1. Double-click "Setting PG/PC Interface" in the Control Panel. A dialog opens.
2. Select" "S7ONLINE" in the "Access point of application" field as standard for HMI.
3. Select the interface in the "Interface Parameter Assignment Used" area.
4. Exit the dialog "Setting PG/PC Interface" with OK

Loading of projects without recipe data records

You are using recipes in a project. You transfer the project to a Basic Panel without recipe data records.

You may encounter inconsistencies if you have altered the structure of the recipe in the Engineering System and the device already held recipe data records.

Check the consistency of the data records in this case. The device will not issue a note for all structural changes.

Installation 2

2.1 System requirements for installation

2.1.1 Notes on the system requirements

System requirements for individual products

The system requirements may differ depending on the products you want to install. You should therefore check the individual system requirements of your products.

If you want to install several products, make sure that your system meets the demands of the product with the highest requirements.

Displaying PDF files

To be able to read the supplied PDF files, you require a PDF reader that is compatible with PDF 1.7 (ISO32000-1:2008 PDF).

2.1.2 System requirements STEP 7

2.1.2.1 Software and hardware requirements STEP 7

System requirements for installation

The following table shows the minimum software and hardware requirements for installation of the "SIMATIC STEP 7 Basic" software package:

Hardware/Software	Requirements
Processor type	Pentium 4, 1.7 GHz or similar
RAM	Windows XP: 1 GB Windows Vista: 2 GB

Hardware/Software	Requirements
Free hard disk space	2 GB
Operating systems *	• Windows XP (Home SP3, Professional SP3) • Windows Vista (Home Premium SP1, Business SP1, Ultimate SP1)
Graphics card	32 MB RAM 32-bit color depth
Screen resolution	1024 x 768
Network	10Mbit/s Ethernet or faster
Optical drive	DVD-ROM

* For more detailed information on operating systems, refer to the help on Microsoft Windows or the Microsoft homepage.

2.2 Licenses

Availability of licenses

The licenses for the products of the TIA Portal are supplied on the installation data medium and installed automatically by the Automation License Manager (ALM) during the installation process. This means you do not receive a separate installation medium with licenses and you cannot transfer the licenses to other computers. If you uninstall the TIA Portal, the corresponding licenses are also uninstalled automatically.

Automation License Manager (ALM)

The Automation License Manager is used to manage licenses. It is supplied on the installation data medium and is installed automatically during the installation process. If you uninstall the TIA Portal, the Automation License Manager remains installed on your system.

2.3 Starting installation

Introduction

Software packages are installed automatically by the setup program. The setup program starts once the installation medium has been inserted in the drive.

Note

The first time you install the TIA Portal in Windows Vista, a user group called "TIA-Engineer" is created. The currently logged in user who installs the TIA Portal is automatically added to the new user group.

Requirement

- Hardware and software of the programming device or PC meet the system requirements.
- The software package has not yet been installed on your computer.
- All open programs are closed.

Procedure

To install the software packages, follow these steps:

1. Insert the installation medium in the relevant drive.

   The setup program starts automatically unless you have disabled Autostart on the programming device or PC.
2. If the setup program does not start up automatically, start it manually by double-clicking the "Start.exe" file.

   The dialog for selecting the setup language opens.
3. Select the language you want for the dialogs of the setup program and click "Next".

   The dialog for selecting the product language opens.
4. Select the languages for the product user interface.
5. If you want to read the product notes, click the "Yes, I would like to read the Product Information" button.

   The help file with the product notes opens.
6. After you have read the product notes, close the help file again.
7. Click the "Next" button.

   The dialog for selecting the product configuration opens.
8. Select the directory in which you want to install the selected products. Please note that the length of the installation path does not exceed 89 characters.
9. Click the "Next" button.

   The next dialog displays an overview of the installation setting and the license agreements.
10. Check the selected installation settings. If you want to make any changes, click the "Back" button until you reach the point in the dialog where you want to make changes.
11. Read and accept all the license conditions.
12. Click the "Install" button.

    Installation is started.

Note

If the installation is successful, a message to this effect is displayed on the screen. If errors occurred during installation, an error message is displayed informing you of the type of error or errors.

13. It may be necessary to restart the computer. If this is the case, select the "Yes, restart my computer now." option button.
14. Click the "Finish" or "Restart" button.

Result

The TIA Portal along with the products and licenses you have ordered and the Automation License Manager have been installed on your computer.

See also

System requirements for installation (Page 63)
Starting to uninstall (Page 66)

2.4 Starting to uninstall

Introduction

Software packages are uninstalled automatically by the setup program. The Setup program is included in the installation package and there is no need to install it separately. Once started, the Setup program guides you step-by-step through the entire uninstall procedure.

Procedure

To uninstall the software packages, follow these steps:

1. Open the Control Panel with "Start > Settings > Control Panel".
2. Double click on "Add or Remove Programs" in the control panel.

   The "Add or Remove Programs" dialog opens.
3. Select the software package to be removed in the dialog "Add or Remove Programs", and click "Remove".

   The dialog for selecting the setup language opens.
4. Select the language you want for the dialogs of the setup program and click "Next".

   The dialog for selecting the products you want to uninstall opens.
5. Select the products you want to uninstall.
6. Click the "Next" button.
7. Check the list with the products to be uninstalled. If you want to make any changes, click the "Back" button.
8. Click the "Uninstall" button.

Uninstallation is started.

9. It may be necessary to restart the computer. If this is the case, select the "Yes, restart my computer now." option button.
10. Click the "Finish" or "Restart" button.

Note

The Automation License Manager will not be uninstalled automatically when you uninstall the software packages, because it is used for the administration of several license keys for products supplied by Siemens AG.

First steps 3

3.1 Basic functions of the Totally Integrated Automation Portal

3.1.1 Overview

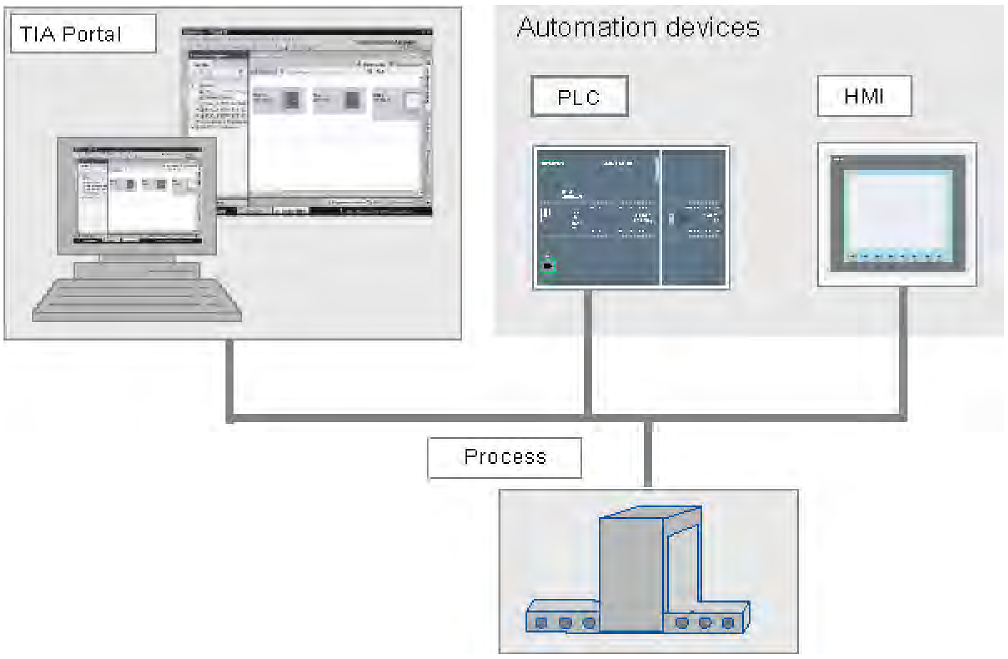
3.1.1.1 Basic functions of the Totally Integrated Automation Portal

Introduction

The Totally Integrated Automation Portal (TIA portal) integrates the SIMATIC Totally Integrated Automation (TIA) products in a software application with which you can increase your productivity and efficiency. All TIA products work together smoothly and transparently within the the TIA portal and support you in all areas in creating an automation solution.

A typical automation solution encompasses the following:

- The PLC controls the machine with the help of a user program.
- You use the HMI device to operate and monitor the process.



Tasks

The TIA portal supports you in configuring your automation solution. The most important configuration steps are:

- Creating the project
- Configuring the hardware
- Networking the devices
- Programming the PLC
- Configuring the visualization
- Loading the configuration data
- Using the online and diagnostic functions

New engineering concept

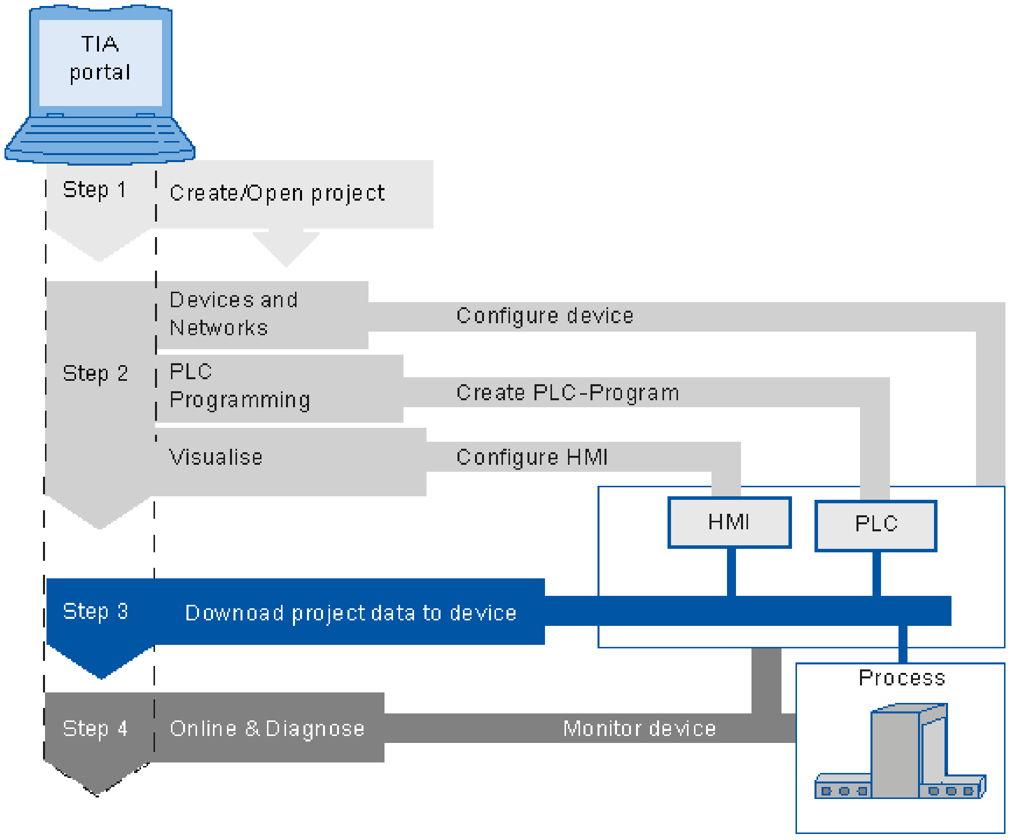
You can use the TIA to configure both the PLC and the visualization in a uniform engineering. The listed tasks not only use a common user interface but are are also optimally coordinated together. The TIA portal offers the following advantages:

- Common data
- Easy handling of programs, configuration data and visualization data
- Easy editing using drag-and-drop operation
- Easy loading of data to the devices
- Easy operation
- Graphic supported configured and diagnostics

3.1.1.2 Basic procedure

Procedural sequence

There are many ways to solve an automation task. The following figures shows how the TIA portal supports you during these work steps.



Basic procedure

1. Opening/creating a project

   First you must either create a new project or open an existing project. The sequence of the further steps is not fixed. You can continue with any task.

2. Alternatively:

   – Configuring a device

   – Creating a PLC program

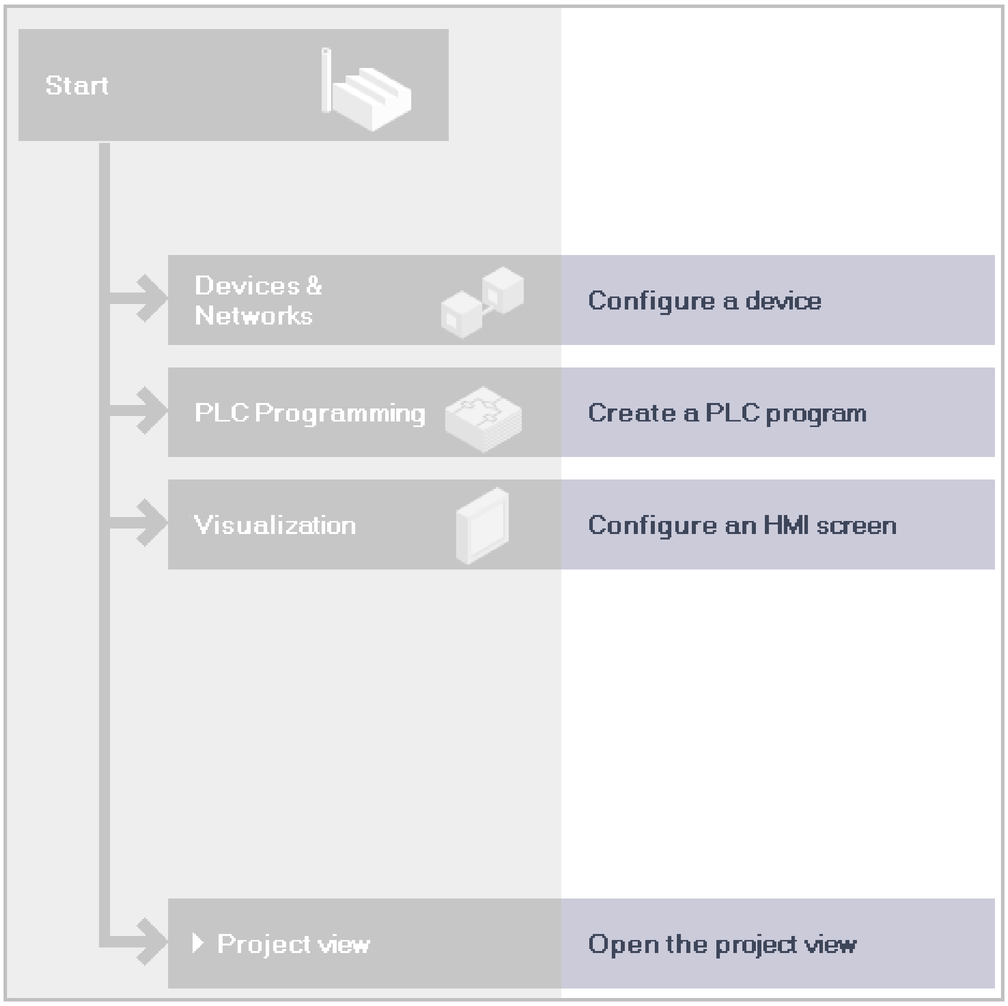
   – Configuring an HMI screen

3. Loading project data to the devices

4. Monitoring devices online

Typical procedure in the Portal view

The typical procedure in the TIA portal is displayed if you select "First Steps" in the Portal view after the creation of a new project.



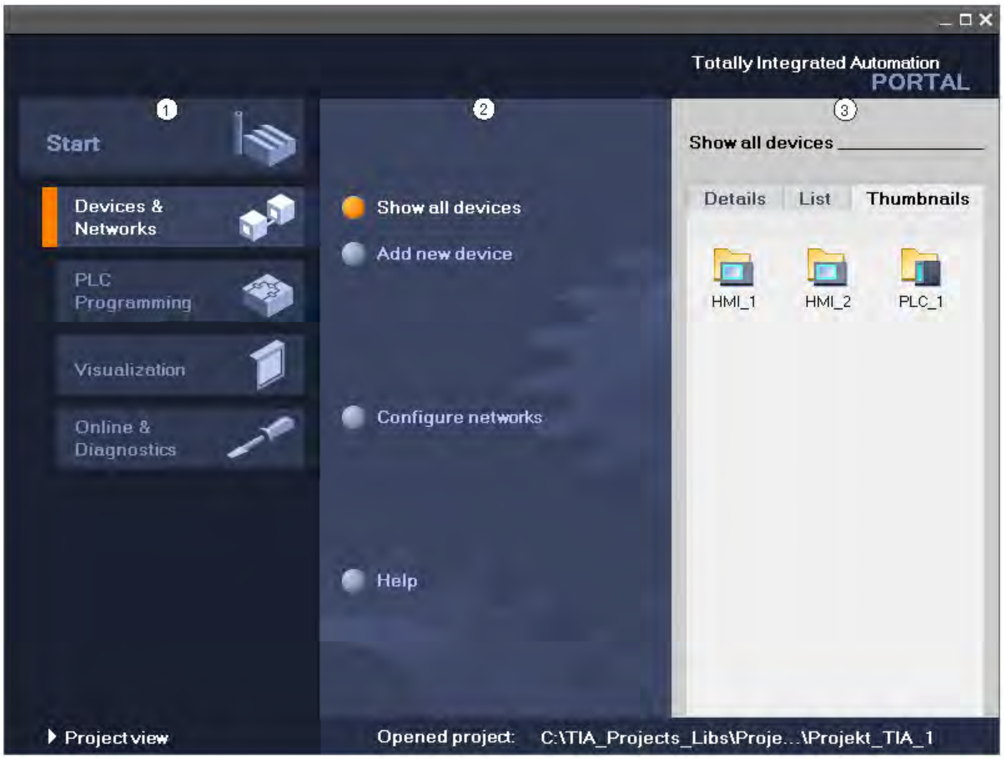
3.1.1.3 Working with various views

The Totally Integrated Automation Portal provides to different views for increasing your productivity: the portal view and the project view.

While the Portal view guides you through the key tasks, the Project view provides you with an object-oriented view of the elements in the project. You simply click to switch between Portal view and Project view.

Function-oriented display in the Portal view

The goal of the portal view is to provide a simple navigation in the tasks and data of the project. This means the functions of the application can be reached via individual portals for the most important tasks. The following illustration is an example of a portal for the configuration of devices and their networking:



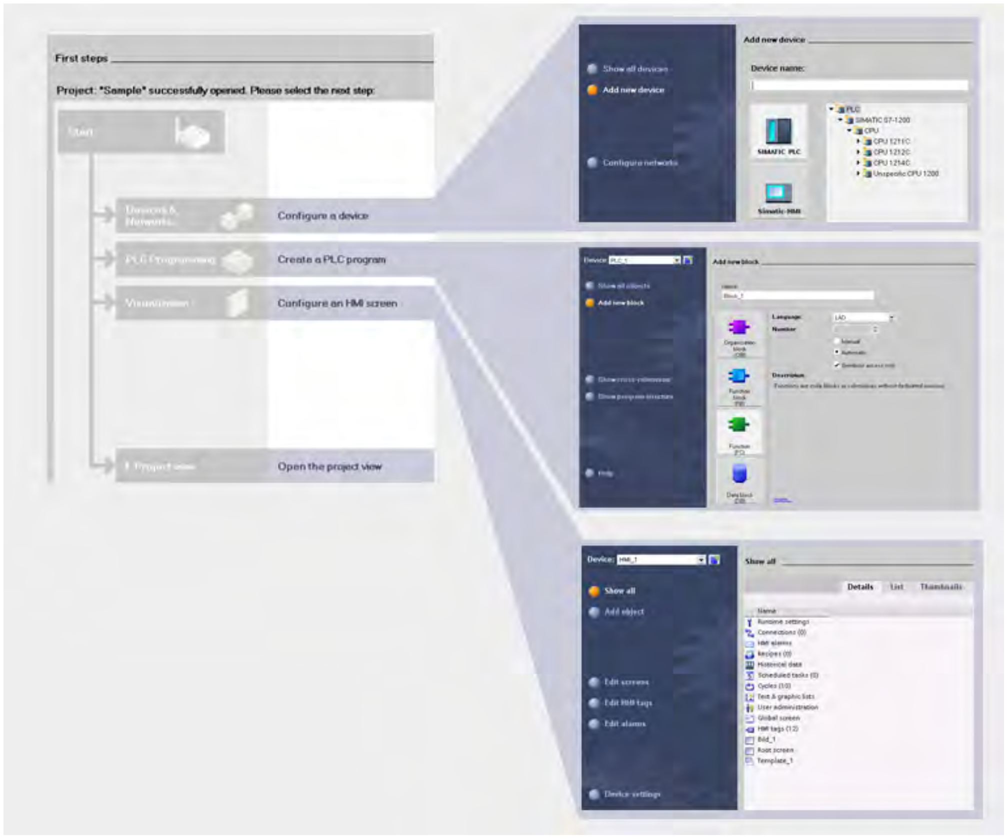
①	Portal selection
②	Actions
③	Project data

Description of the portals

Portal	Description
Start	You use the Start portal to set up the project for your application. Here, you can create new projects, open existing ones and navigate to the most important tasks of the project.
Devices & networks	In the "Devices & Networks" portal you define and configure the devices and their communication relationships in the project. You configure, for example, the PLC and HMI devices and define the network connections between the devices. You also create the logical links by means of which the devices can use tags in common.
PLC programming	You use the PLC Programming portal to create the control program for each device in the project.
Visualization	In the Visualization portal you create the screens for the HMI devices in your project.
Online & Diagnostics	In the "Online & Diagnostics" portal you can display the accessible devices and their online status.

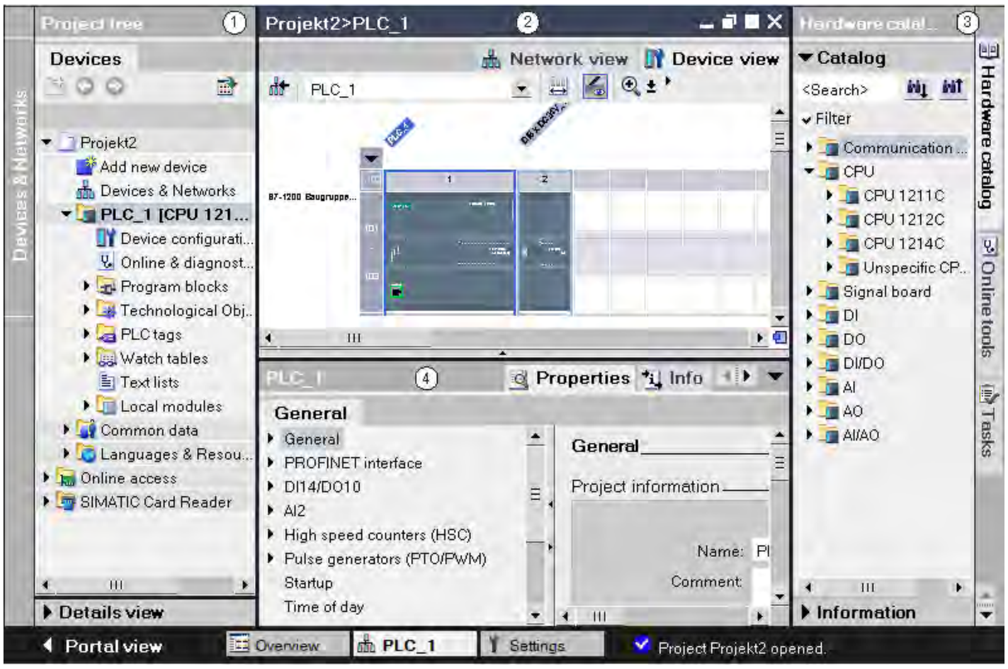
Quick access to the first steps

The "First steps" overview is displayed in the Start portal to allow you to quickly select a portal for a particular task. Clicking the specific links here takes you to the required portal.



Access to all elements of the project in the Project view

The Project view is a data-based view of the project and shows all elements of a project in a structured format. This provides you with quick access to all project data.



①	Project tree
②	Work area
③	Task cards
④	Inspector window

Project tree

The project tree gives you access to all devices and project data. You can perform, for example, the following tasks in the project tree:

- Adding new devices
- Editing existing devices
- Requesting properties
- Open editors to process project data

Work area

You open the editors in the work area that you can use to process the project data.

Task cards

Depending on the edited or selected object, there are task cards available in the editors that allow you perform additional actions. These actions include:

- Selecting objects from a library or from the hardware catalog
- Searching for and replacing objects in the project

- Dragging predefined objects to the work area

Inspector window

Additional information on an object selected or on actions executed are displayed in the inspector window.

See also

Project tree (Page 119)
Work area (Page 122)
Inspector window (Page 123)
Task cards (Page 125)

3.1.1.4 Accessing Help

Elements of the Help system

A comprehensive Help system is available for solving your tasks. It describes basic concepts, instructions and functions. While working with the program, you receive in addition the following support:

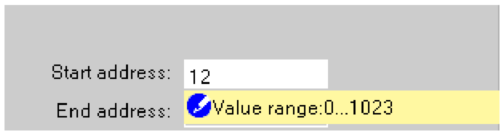
- Roll-out for correct inputs in dialog boxes
- Tooltip with information about user interface elements, for example text boxes, buttons and symbols. Some of the tooltips are supplemented by cascades containing additional information.
- Help on the current context, on menu commands for example when you click on the keys <F1> or <Shift+F1>.

Roll-outs

Certain text boxes offer information that rolls out and helps you to enter valid parameters and values. The roll-out informs you about permissible value ranges and data types of the text boxes.

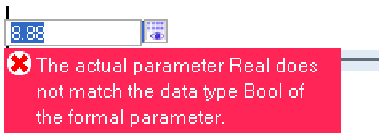
The following figure shows examples of a roll-out:

Roll-out example: Valid value



Value range:0...1023

Roll-out example: Error message if value is invalid

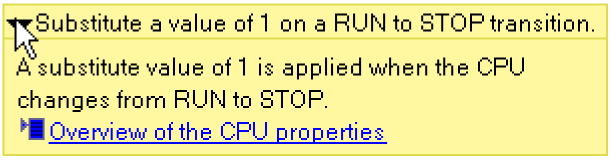


The actual parameter Real does not match the data type Bool of the formal parameter.

Tool tips

Interface elements offer you a tooltip for easier identification.

Tooltips that have an arrow symbol on the left contain additional information in tooltip cascades. If additional information is contained in the Help, a link appears to the corresponding Help topic in the cascade. The following figure shows a tooltip with opened cascade:


Substitute a value of 1 on a RUN to STOP transition.
A substitute value of 1 is applied when the CPU changes from RUN to STOP.
Overview of the CPU properties

Help

The Help describes concepts, instructions and functions. It also contains reference information and examples.

The Help opens up in its own window on the right side of the screen.

You can display a navigation field in the Help. You have access to the following functions there:

- Table of contents
- Search in the index
- Full text search of the entire Help
- Favorites

Additional information on working with Help is available in the Chapter "Using the Help system (Page 139) ".

Identification of the topics in the Help

The help topics are identified by different symbols depending on the type of information they contain.

Symbol	Information type	Explanation
➡	Operating instructions	Describes the steps to follow in order to carry out a particular task.
⏩	Example	Contains a concrete example to explain the task.
▤	Factual information	Contains background information that you need to know to carry out a task.
▨	Reference	Contains detailed reference information, for example descriptions of program blocks.

3.1.2 Creating a project

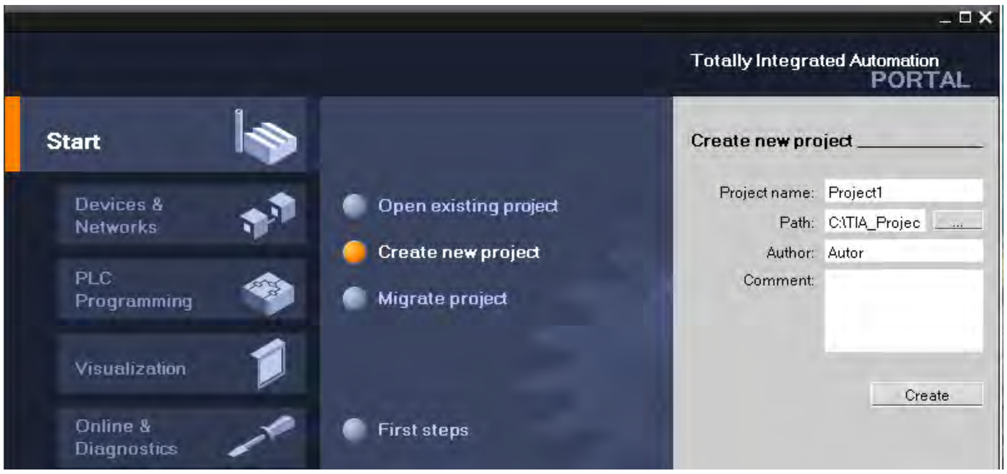
Introduction

To begin, create a new project. Data and programs that occur during the creation of an automation task are stored in ordered manner in the project. For this example, open the Totally Integrated Automation Portal in the Portal view. The Start portal contains commands for creating a new project and for opening an existing project.

Procedure

To create a project, follow these steps:

1. Select the "Create new project" command.



Project name: Project1
Path: C:\TIA_Projec
Author: Autor
Comment:

2. Enter a name for the project (for example, "Project1" or "First steps").
3. Click "Create".

Result

The project is created.

The buttons for selecting the various, task-oriented portals are enabled in the Portal view.

Tip

After creating or opening a project, you can use the "First steps" command to execute tasks for creating an automation application.

Next steps

After the project has been created, carry out the following task:

- Configure the hardware, either by online PLC recognition or by manual configuration
- Create a program to control the application

You can define the order of these steps. If you configure the hardware first, you can subsequently assign the configured PLC to the program. If you create the program blocks first, these blocks will be assigned to an automatically created, unspecified PLC.

3.1.3 Configuring hardware and networks

3.1.3.1 Introduction to the hardware configuration

To set up an automation system, you will need to configure, parameterize and interlink the individual hardware elements. Both PLC and HMI devices can be inserted in the project in the same context and in the same manner.

Hardware configuration in Portal view and Project view

You can add a new device in either Portal view or in Project view.

You add a PLC device (CPU) or an HMI device in the "Devices & Networks" portal.

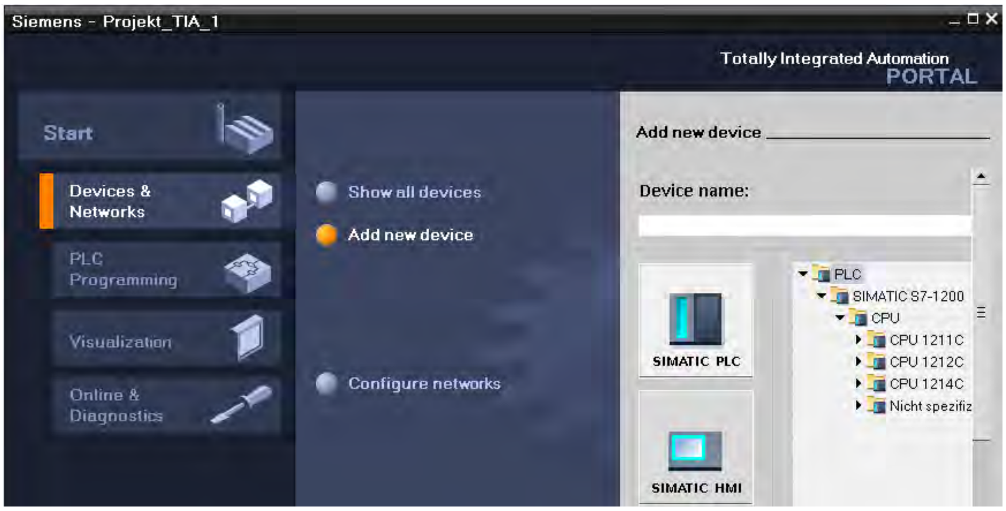
If you want to insert additional modules or network the devices, you will require the Project view.

3.1.3.2 Adding devices in the Portal view

Adding a SIMATIC PLC in the Portal view

To add a SIMATIC PLC, follow these steps:

1. Select "Devices & Networks" in the Portal view.
2. Select the "Add new device" command.
3. Click the "SIMATIC PLC" button. The list of the SIMATIC PLCs opens.
4. Select a SIMATIC S7-1200 and click "Add".



Adding an HMI device in Portal view

To add an HMI device, follow these steps:

1. Select the "Add new device" command.
2. Click the "SIMATIC HMI" button. The list of the SIMATIC HMI panels opens.
3. Select an HMI panel and click "Add".

What do I do next?

You configure the PLC and the HMI device.

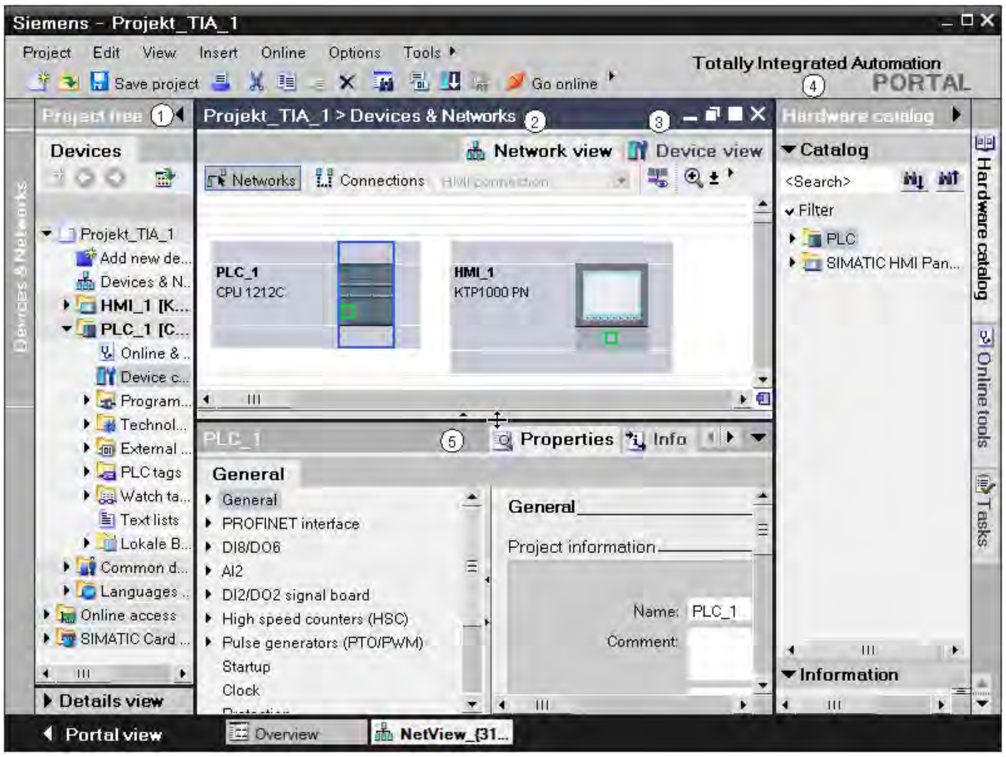
Double-click one of the devices displayed in the project to navigate to the hardware and network editor of the Project view.

3.1.3.3 Devices and networks in Project view

Hardware configuration in the Project view

The hardware and network editor is available in the Project view. This editor is an integrated development environment for configuring, parameterizing and networking devices and modules, offering you maximum support in carrying out the automation task.

Double-click "Devices and Networks" in the project tree to open the hardware and network editor.



①	Project tree
②	Network view
③	Device view
④	Hardware catalog
⑤	Inspector window

Network view and Device view

The hardware and network editor consists of a Device view and a Network view. You can switch between these two components at any time depending on whether you want to produce and edit individual devices or entire networks.

Hardware catalog

Drag the devices and modules you need for your automation system from the hardware catalog into the network or device view.

Inspector window

The Inspector window contains information on the object currently marked under "Properties". Here you can change the settings for the object marked.

3.1.3.4 Adding devices in the Project view

Inserting a device in the Project view

There are various ways of adding a CPU or an HMI device to the hardware configuration in the Project view, for example:

- Command "Add new device" in the project tree
- Double-click the device in the hardware catalog
- Drag-and-drop from the hardware catalog in the Network view
- Command "Insert > Device" from menu bar in Network view

A suitable rack is created along with the new CPU. The selected device is inserted at the first permitted slot of the rack.

Regardless of the method selected, the added device is visible in the project tree and the Network view of the hardware and network editor.

What do I do next?

You configure the PLC by plugging additional modules into the rack.

You define the device settings of the HMI panel.

3.1.3.5 Plugging additional modules into racks

Introduction

After you have added a CPU to your configuration, equip the device with additional modules. You have various options for adding these modules, for example:

- Double-click a module in the hardware catalog
- Drag a module from the hardware catalog to a free slot

The device view contains an illustration of the device selected within a rack. The graphic illustration of the rack in the software corresponds to the real structure, which means that you can see the same number of slots as exist in the real structure.
Tip

To enter the device view from the Network view, double-click on a device or station in the Network view.

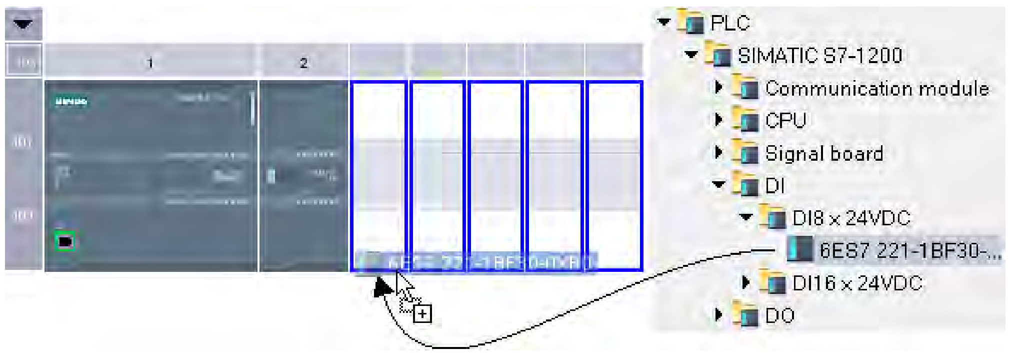
Requirement

- You are in the device view.
- The hardware catalog is open.

Adding modules from the hardware catalog

How to insert a module from the hardware catalog into a rack is illustrated based on the example of a signal module. To do so, follow these steps:

1. Go to the required module board in the hardware catalog.
2. Select the module you want.
3. Drag the signal module to a free slot in the rack.



You have now inserted the digital signal module in a slot in the rack. Repeat these steps with the other modules.

3.1.3.6 Editing properties and parameters

After you have assigned hardware components on your rack, you can edit their default properties, for example, parameters or addresses, in the Network or Device view.

Requirement

You are in the device view.

Note

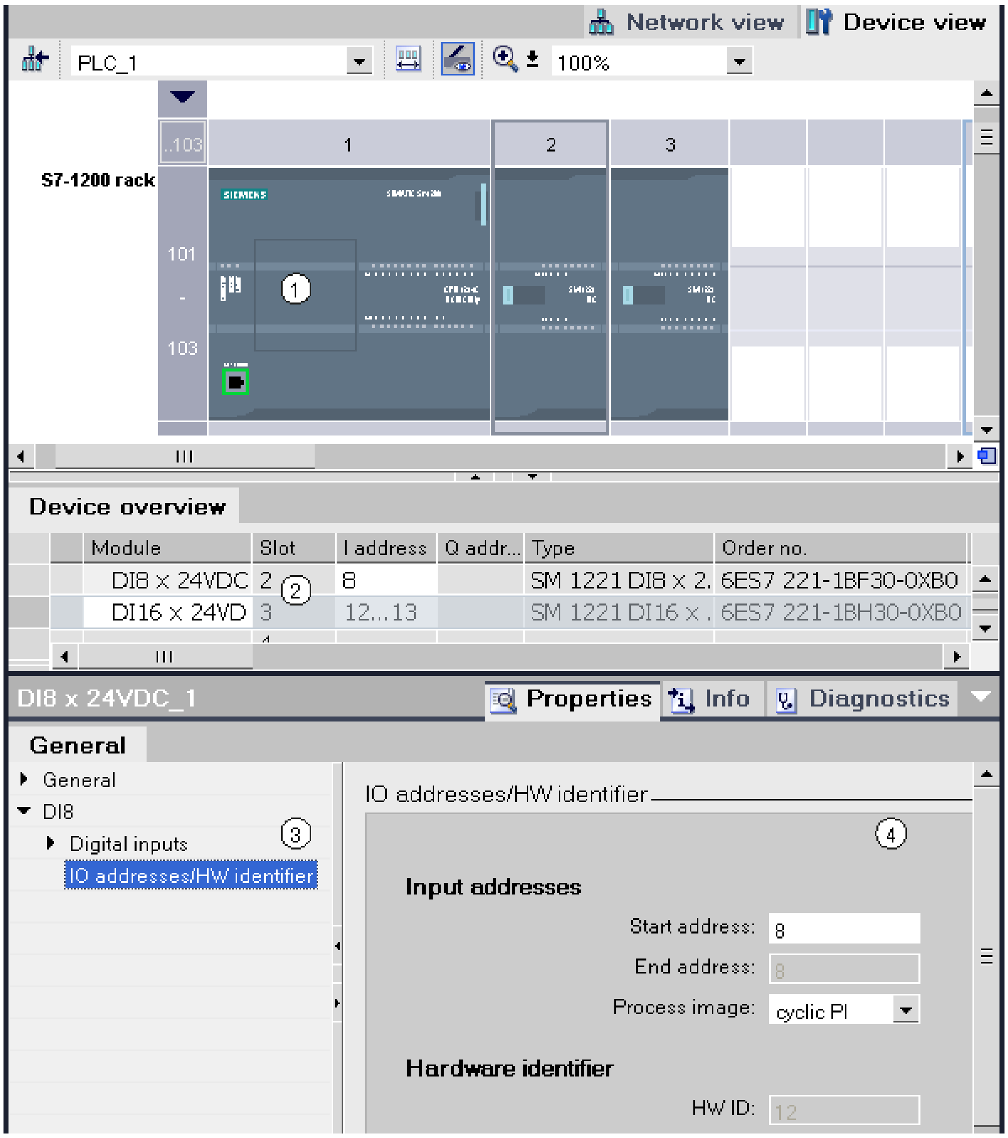
You can also edit properties and parameters in the Network view. In Network view you only have access to the network-related hardware components and the station.

Procedure

To change the properties and parameters of the hardware components, follow these steps:

1. In the Graphic view, select the module, rack or interface you want to edit.
2. Edit the settings for the selected object:
   - Use the Table view, for example, to edit addresses and names.
   - In the Inspector window additional setting possibilities are available in "Properties".

Example of changing settings



	Module	Slot	I address	Q addr...	Type	Order no.
	DI8 x 24VDC	2	8		SM 1221 DI8 x 2.	6ES7 221-1BF30-0XB0
	DI16 x 24VD	3	12...13		SM 1221 DI16 x .	6ES7 221-1BH30-0XB0

Input addresses

Start address: 8

End address: 8

Process image: cyclic PI

Hardware identifier

HW ID: 12

① Selection of interface

② Editing option for addresses in the device overview

③ Selection options in the inspector window

④ Editing option for addresses in the inspector window

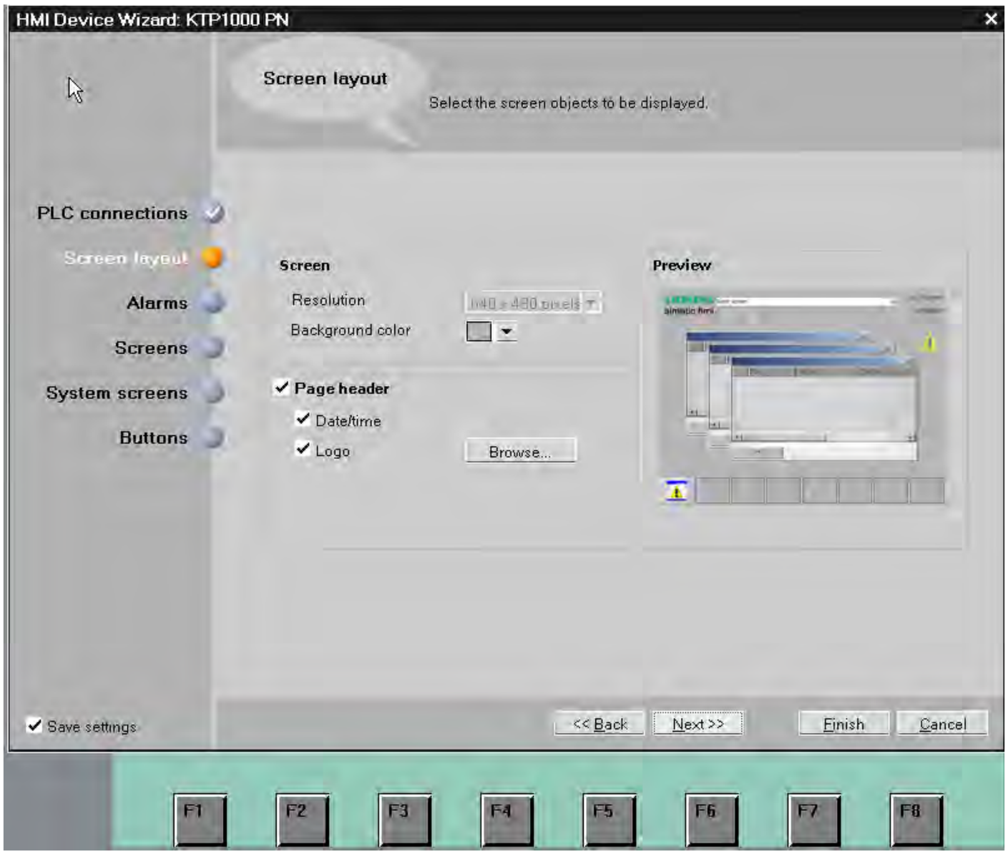
3.1.3.7 Modifying settings for HMI devices

Settings for HMI devices

The HMI device wizard opens after you have inserted an HMI device. You can define the properties immediately here, for example:

- Figures
- Alarms
- User administration
- Language and font

The following figure shows an example of the HMI device wizard.


HMI Device Wizard: KTP1000 PN

Screen layout

Select the screen objects to be displayed.

Screen
Resolution: 640 x 480 pixels
Background color

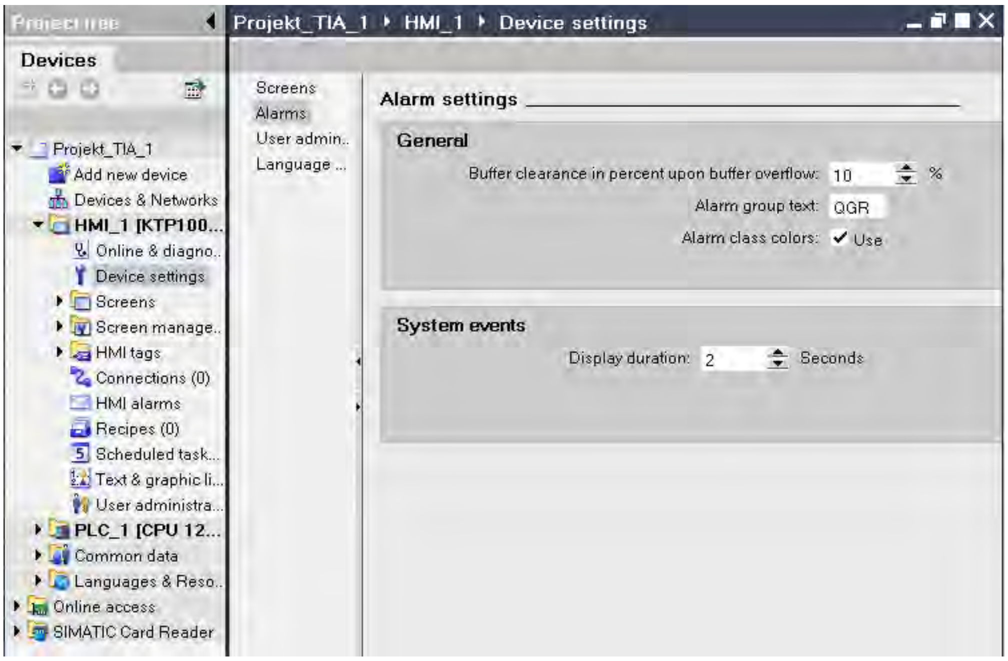
✓ Page header
✓ Date/time
✓ Logo

✓ Save settings

Changing the device settings for runtime

To query and change the device settings in Project view, follow these steps:

1. Open the project tree and go to the HMI device.
2. Click "Device settings".



Alarm settings

General

Buffer clearance in percent upon buffer overflow: 10 %

Alarm group text: QGR

Alarm class colors: ✓ Use

System events

Display duration: 2 Seconds

1. You change other properties, such as for screens and HMI tags, in the Inspector window or the respective editor (see Chapter Configuring screens and screen objects (Page 99)).

3.1.3.8 Networking devices

Options

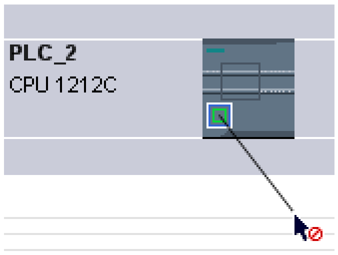
In the work area of the graphic Network view you can comfortably network the interfaces of the communication-capable components. The tabular Network view provides an ordered view of all relevant information.

Connecting two target devices to a new subnet

To connect an interface with another device via a subnet that does not yet exist, follow these steps:

1. Position the mouse pointer over the interface for a component capable of communication requiring networking.
2. Click with the left mouse button and hold the button down.
3. Move the mouse pointer.

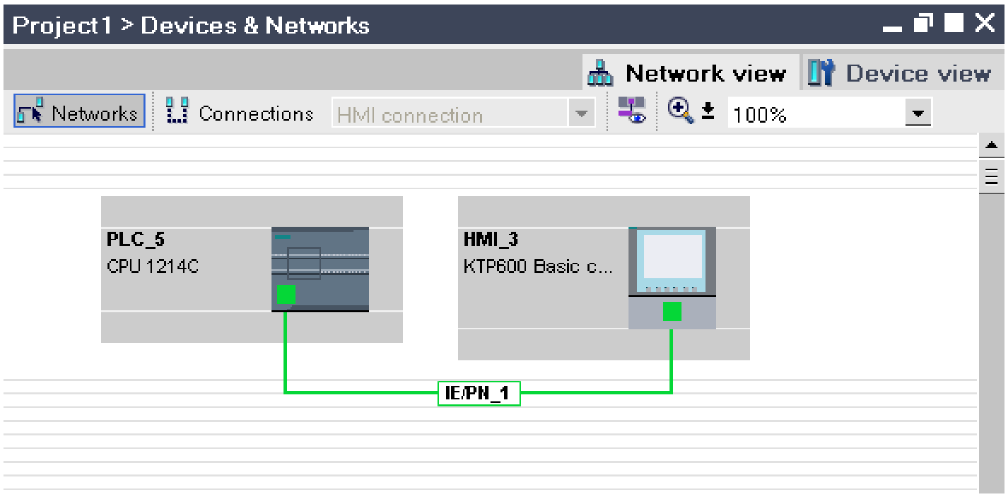
   The pointer now uses the networking symbol to indicate "Networking" mode. At the same time, the mouse pointer shows the lock symbol that will only disappear when the pointer is on a valid target.



4. Now move the pointer onto the interface of the target device. You can either keep the mouse button pressed or release it.
5. Now release the left mouse button or press it again (depending on previous action).

A new subnet is created. The interfaces are now connected via the new subnet. Consistent address parameters are set automatically for the interface.

The following figure shows the two networked devices:



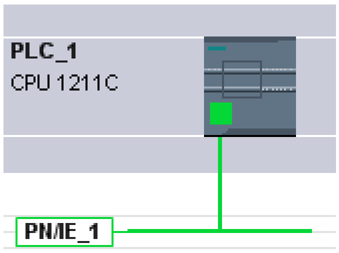
Creating a subnet

To create a subnet and to connect it to an interface, follow these steps:

1. Select the interface of a CPU.
2. Select the "Create subnet" command in the shortcut menu of the interface.

The selected interface is connected to a new subnet of the appropriate subnet type. Consistent address parameters are set automatically for the interface.

The following schematic shows an interface with outgoing line connecting to a subnet:



3.1.4 Programming the PLC

3.1.4.1 Programming environment in the TIA portal.

This section provides an overview of the TIA portal's programming environment:

- Programming languages
- Program editor
- Symbolic programming
- Libraries

Programming languages

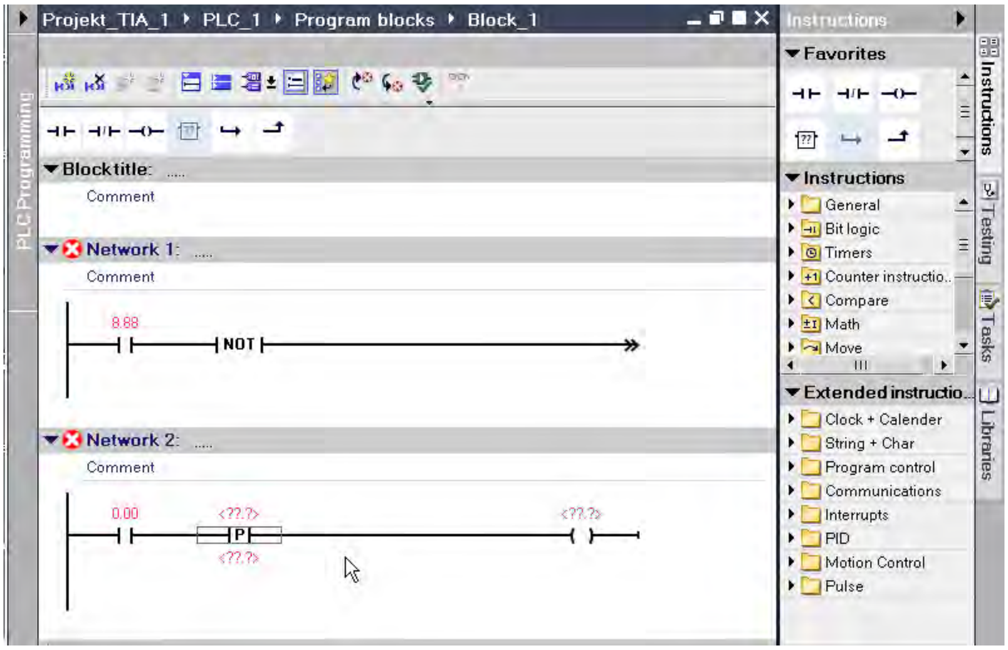
The TIA portal supports you in the programming of code blocks in the following programming languages:

- Ladder Logic (LAD)
- Function Block Diagram (FBD)

Program editor

The program editor is the integrated development environment for programming functions, function blocks, and organization blocks. If offers comprehensive support for programming and troubleshooting.

Using LAD as an example, the following figure shows the components of the program editor:



Symbolic programming

To make the program layout clearer and to simplify trouble-shooting, it is advisable to use symbolic names for the operands and tags in the programming.

You specify the symbolic names:

- Define symbolic names for global tags in the PLC tag table.
- In the block interface, specify symbolic names for local tags in logic blocks or in global data blocks.

Support during programming

When programming you can start out working with symbolic operands and then assign the absolute addresses later. The program can still be saved, even though the assignment is incomplete.

An operand to which no absolute address has yet been assigned is highlighted by a red wavy underline.

Libraries

You can store objects you want to use more than once in libraries. It is possible to reuse the stored objects throughout a project or across projects. This means you can, for example, create block templates for use in different projects and adapt them to the particular requirements of your automation task.

Libraries can accommodate a large number of objects. These include, for example:

- Functions (FCs)
- Function blocks (FBs)
- Data blocks (DBs)
- Devices
- PLC data types
- Watch tables
- Process pictures
- Faceplates

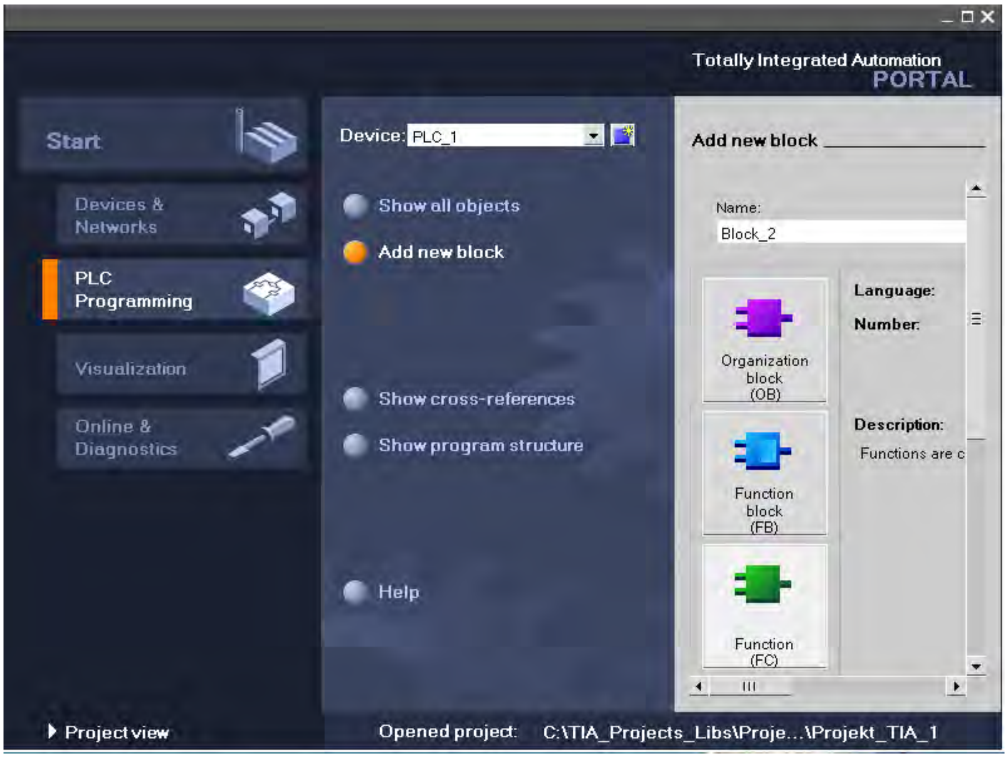
3.1.4.2 Adding blocks

To create the program for your automation solution, you have to add the blocks in the project and program them. You can add new devices in either Portal view or in Project view. The program editor and the task cards in the Project view support you in the programming.

Adding blocks in Portal view

To add a block in Portal view, follow these steps:

1. Select "PLC programming > Add new block".



2. Click on one of the buttons to create the block type you want.
3. Select the programming language for code blocks.
4. If necessary, change the block properties.
5. Click "Create".

Result

The block is created and opened in the program editor.

Adding blocks in Portal view

To add a block in Portal view, follow these steps:

1. Go to the required device in the project tree.
2. Double-click "Add new block" under "Program blocks".

   The same selection dialog as in Portal view opens.
3. Execute steps 2. to 5. as in the Portal view.

Additional steps

You program a code block.

3.1.4.3 Programming a code block

This section shows you how to program a function block in the programming language LAD in the program editor.

Requirement

The function block is created and opened in the program editor.

Procedure

To program a function block, follow these steps in any order:

- Programming instructions
- Declaring the block interface
- Declaring PLC tags and using these in the program

These actions are explained below on the basis of examples.

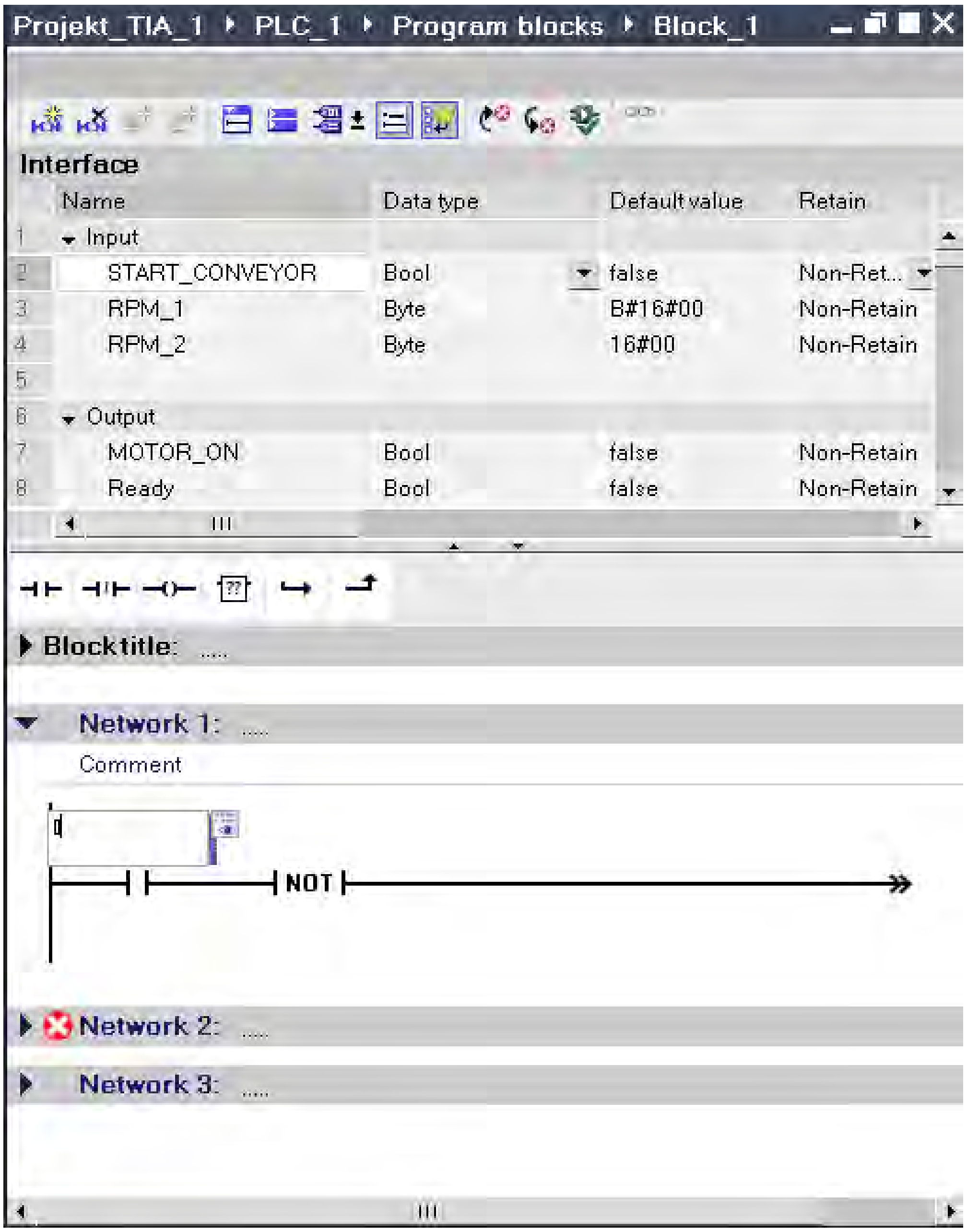
Programming instructions

You have the following options for inserting LAD elements in a block:

- Per drag-and-drop operation from the "Instructions" task card
- With the help of an empty box to which you subsequently assign a LAD instruction. You can find the empty box under "General", in the "Instructions" task card. To assign an instruction, click the yellow triangle in the upper right corner and select the instruction from the drop-down list box.

Declaring the block interface

The block interface is shown as a table in the upper part of the program editor.


Projekt_TIA_1 ▸ PLC_1 ▸ Program blocks ▸ Block_1

Interface

	Name	Data type	Default value	Retain
1	Input			
2	START_CONVEYOR	Bool	false	Non-Ret...
3	RPM_1	Byte	B#16#00	Non-Retain
4	RPM_2	Byte	16#00	Non-Retain
5				
6	Output			
7	MOTOR_ON	Bool	false	Non-Retain
8	Ready	Bool	false	Non-Retain

To declare a tag in the block interface, follow these steps:

1. Select the section (Input, Output, ...).
2. Enter the tag name in the "Name" column.
3. In the "Data type" column, select a data type from the list.
4. If required, enter a default value.

Result

The tag is created. A syntax check is performed after each entry, and any errors found are displayed in red.

3.1.4.4 Declaring PLC tags

Using PLC tags and local tags in the program

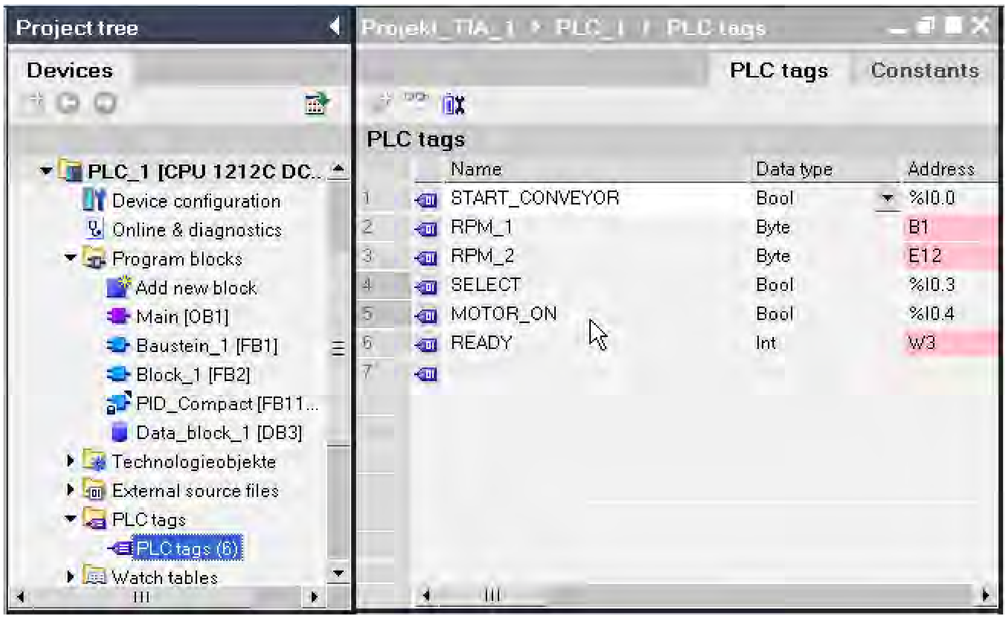
You can define tags with different scopes for your program:

- PLC tags are valid for the entire CPU and can be used by all blocks of a CPU. PLC tags are defined in the PLC tag table.
- Local tags apply only to the block in which they are defined.

Opening the PLC tag table

To open the PLC tag table in a CPU, proceed as follows:

1. Open the "PLC tags" folder under the CPU in the project tree.
2. Double-click the PLC tag table in the folder.
3. In the top right corner select the "PLC tags" tab or the "Constants" tab.

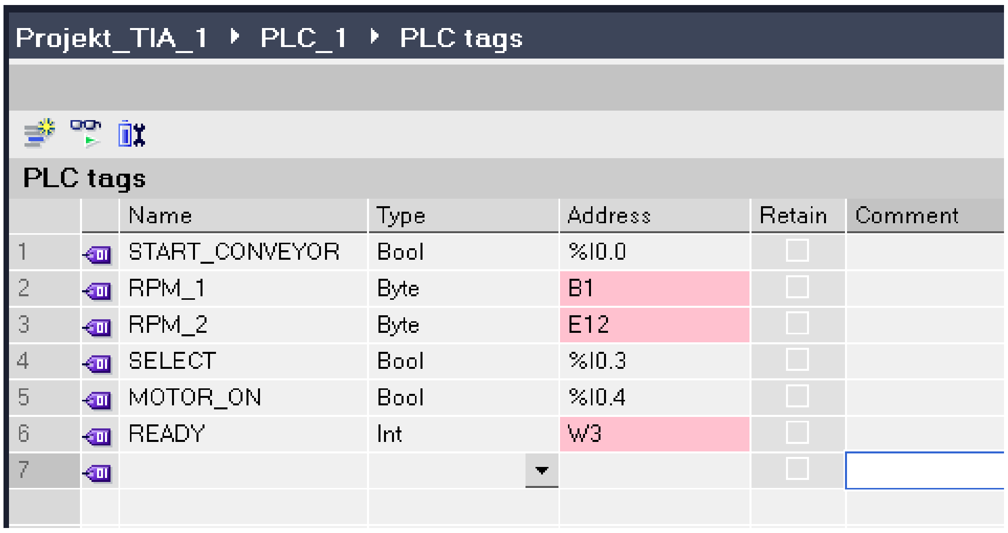


PLC tags

	Name	Data type	Address
1	START_CONVEYOR	Bool	%I0.0
2	RPM_1	Byte	B1
3	RPM_2	Byte	E12
4	SELECT	Bool	%I0.3
5	MOTOR_ON	Bool	%I0.4
6	READY	Int	W3
7			

Structure of the PLC tag table

The figure below shows an example of the structure of the PLC tag table.



	Name	Type	Address	Retain	Comment
1	START_CONVEYOR	Bool	%I0.0	☐	
2	RPM_1	Byte	B1	☐	
3	RPM_2	Byte	E12	☐	
4	SELECT	Bool	%I0.3	☐	
5	MOTOR_ON	Bool	%I0.4	☐	
6	READY	Int	W3	☐	
7				☐	

You can click the symbol in the first column to drag a tag into a network and use it there as an operand.

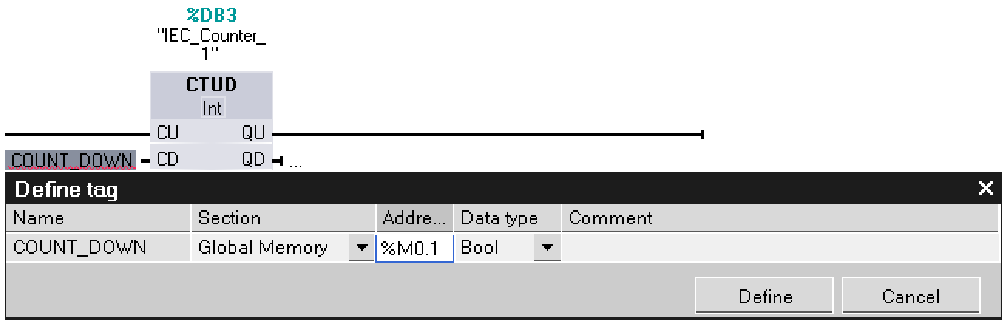
Declaring PLC tags

Operands that are not declared as PLC tag will be displayed in red in the program editor. You can declare PLC tags in the following way:

- Directly in the program

  Select an operand and click "Define tag" in the shortcut menu. The "Define tag" dialog box is opened. This dialog displays a declaration table in which the name of the operand is already entered.

  In the "Section" column, select the type you want and enter address, data type and comment in the other columns.



Name	Section	Addre...	Data type	Comment
COUNT_DOWN	Global Memory	%M0.1	Bool	

- In the PLC tag table

  Open the PLC tag table you want to use. Enter the name for each PLC tag and select the data type.

3.1.5 Configuring technology functions

3.1.5.1 Introduction to the technology functions

Integrated technology functions of the devices, such as technological object "Axis" or PID controller, can be configured using their own editors.

Technological objects

You can create and configure the technological objects directly in the project tree.

The following section will show you how to edit a motion control function.

3.1.5.2 Basic approach to motion tasks

Requirement

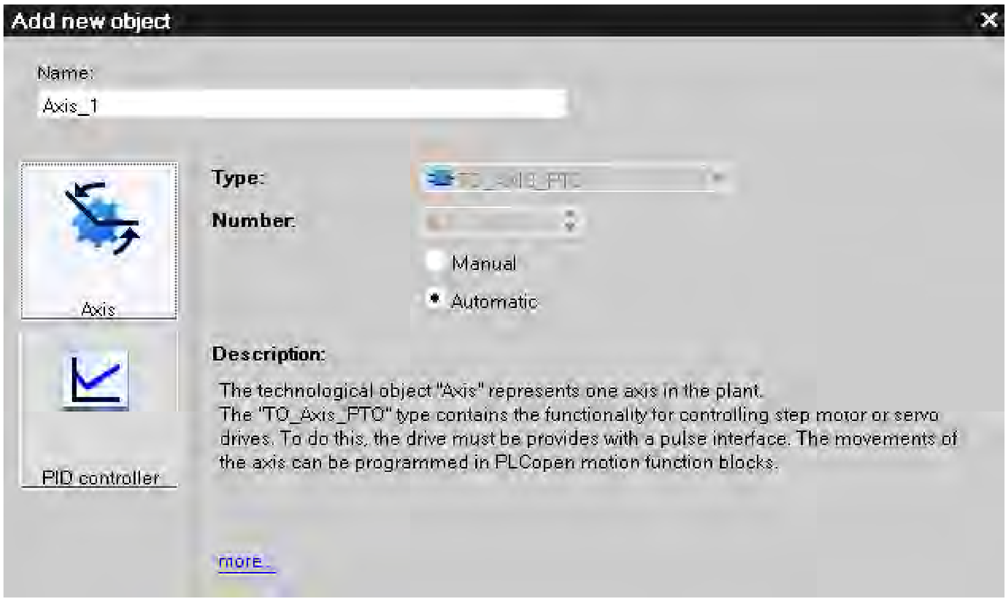
A project with a CPU 12xx was created.

Procedure

To use a technological object "Axis", follow these steps:

1. Add technological object "Axis"

   Click <PLC> "Technological objects > Add new object" in the project tree.



Add new object

Name: Axis_1

Type: TO_Axis_PTO

Number: [illegible]

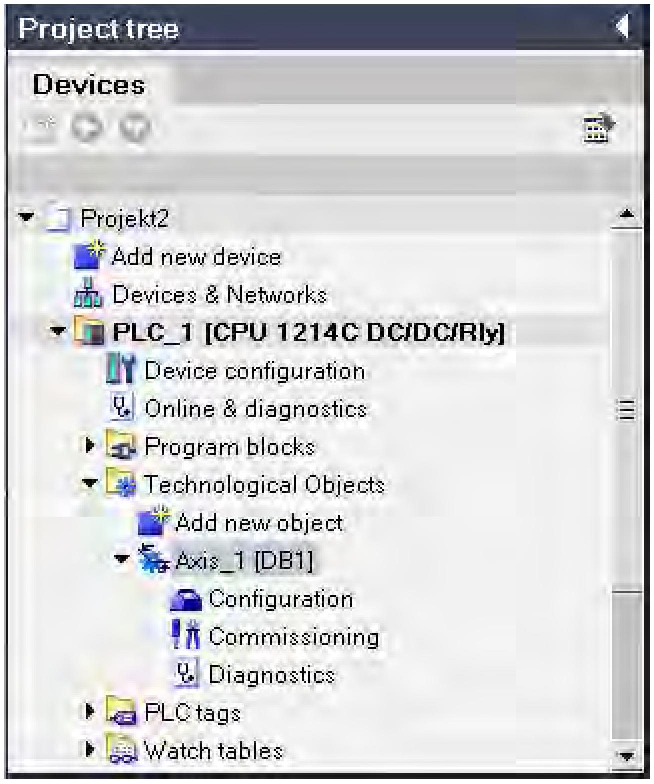
( ) Manual
(●) Automatic

Description:

The technological object "Axis" represents one axis in the plant.
The "TO_Axis_PTO" type contains the functionality for controlling step motor or servo drives. To do this, the drive must be provides with a pulse interface. The movements of the axis can be programmed in PLCopen motion function blocks.

2. Select the object type and the required properties, then click "OK".

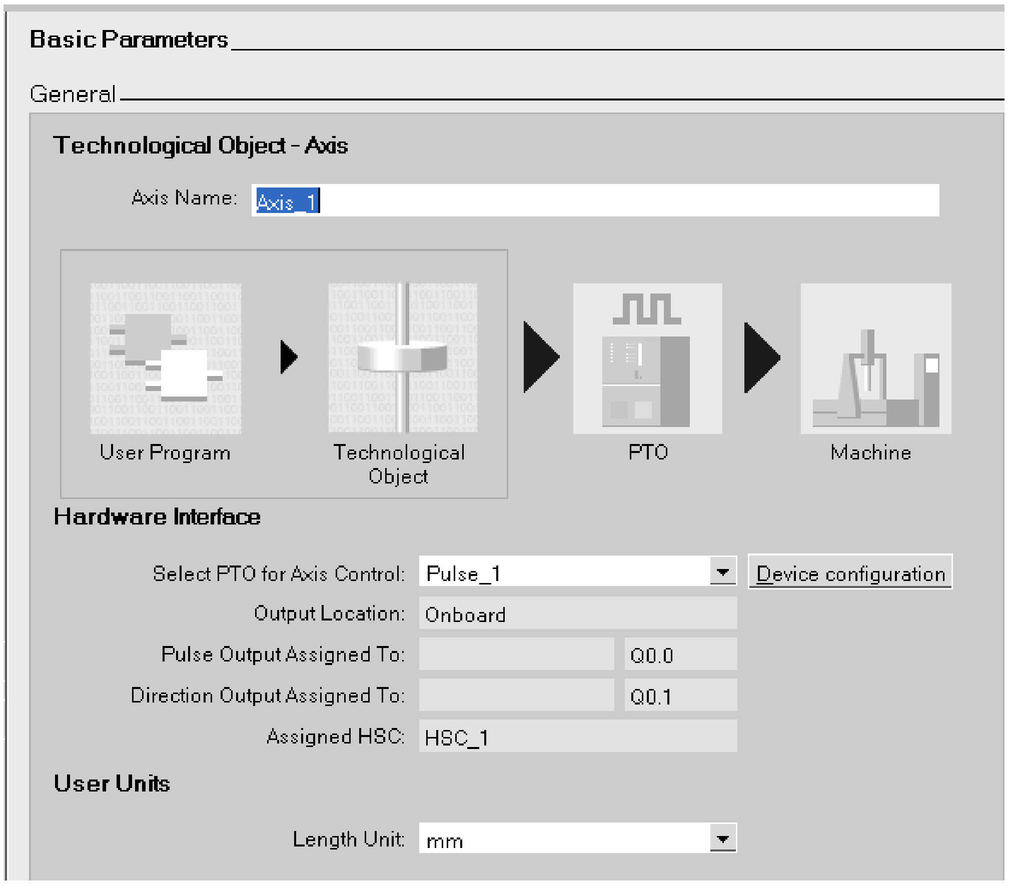
   The new technology object will be created and saved in the project tree in the folder "Technology objects".



3. Configuring the axis parameters

   Open the group of the required technology object in the project tree.

   Double-click on the object "Configuration".



Basic Parameters

General

Technological Object - Axis

Axis Name: Axis_1

Hardware Interface

Select PTO for Axis Control:	Pulse_1	Device configuration
Output Location:	Onboard	
Pulse Output Assigned To:		Q0.0
Direction Output Assigned To:		Q0.1
Assigned HSC:	HSC_1	

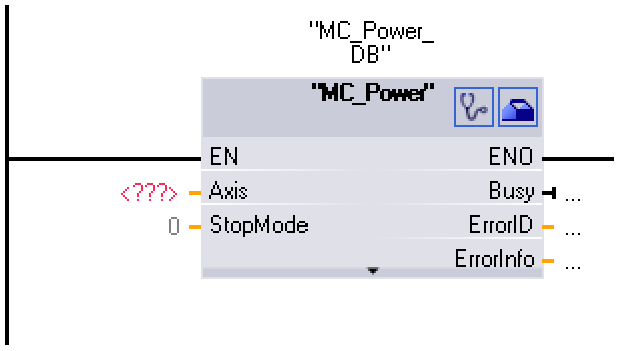
User Units

Length Unit: mm

4. Creating a user program

   The available blocks are listed in the task card "Extended instructions, Motion Control" and can be inserted in block OB1 of the user program.

   Example: Motion Control instruction "MC_Power"



5. Load project in CPU
6. Function test of the axis with the axis control panel
7. Testing axis control with "Diagnostics"

3.1.6 Configuring visualization

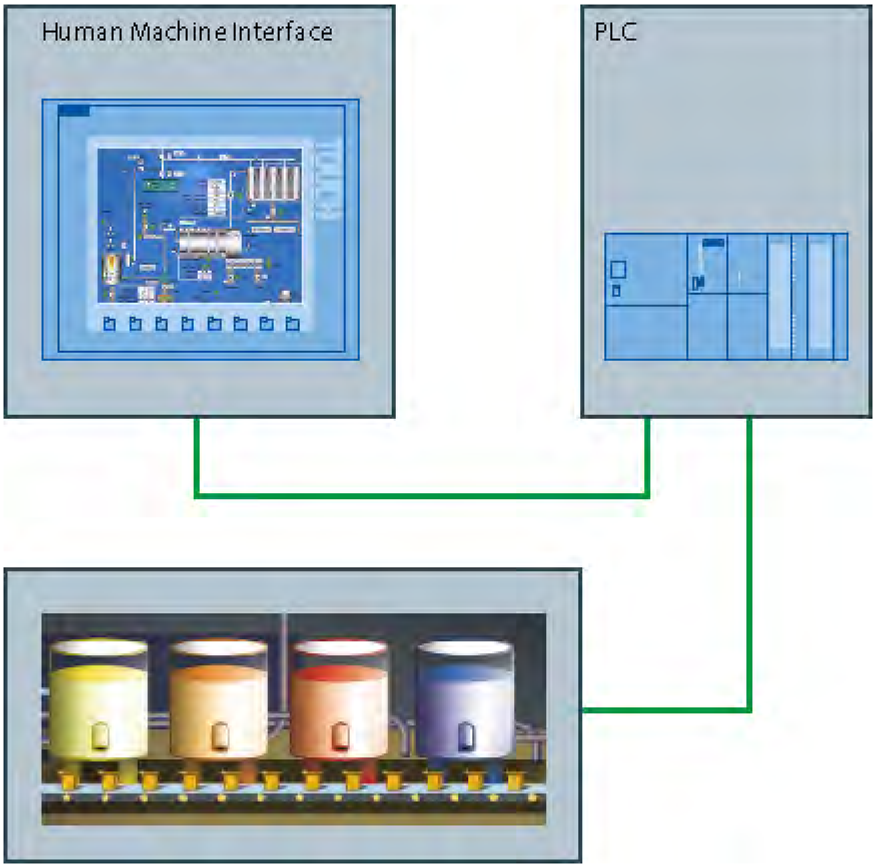
3.1.6.1 Visualization in the TIA portal

This section provides an overview of the visualization options of the TIA portal.

HMI - Human Machine Interface

An HMI system represents the interface between the operator and the process. The PLC has the actual control over the process. There is therefore an interface between the operator and the HMI panel and an interface between the HMI panel and the PLC.

The human machine interface offers transparency during operation and monitoring.



For operating and monitoring machines and plants the TIA portal offers the following options:

- Display processes
- Operate processes
- Output alarms
- Archive process values and alarms
- Document process values and alarms
- Administer process parameters and machine parameters

Editors

In the core area of the visualization there is a special editor for each configuration task.

- Figures
- HMI tags
- HMI alarms
- Recipes
- Schedulers
- Text and graphics lists
- User administration

3.1.6.2 Configuring screens and screen objects

You can use the TIA portal to create screens for operating and monitoring machines and plants. Predefined objects are available to help you create these screens; you can use these objects to simulate your plant, display processes and define process values.

HMI screens

A screen can consist of static and dynamic elements.

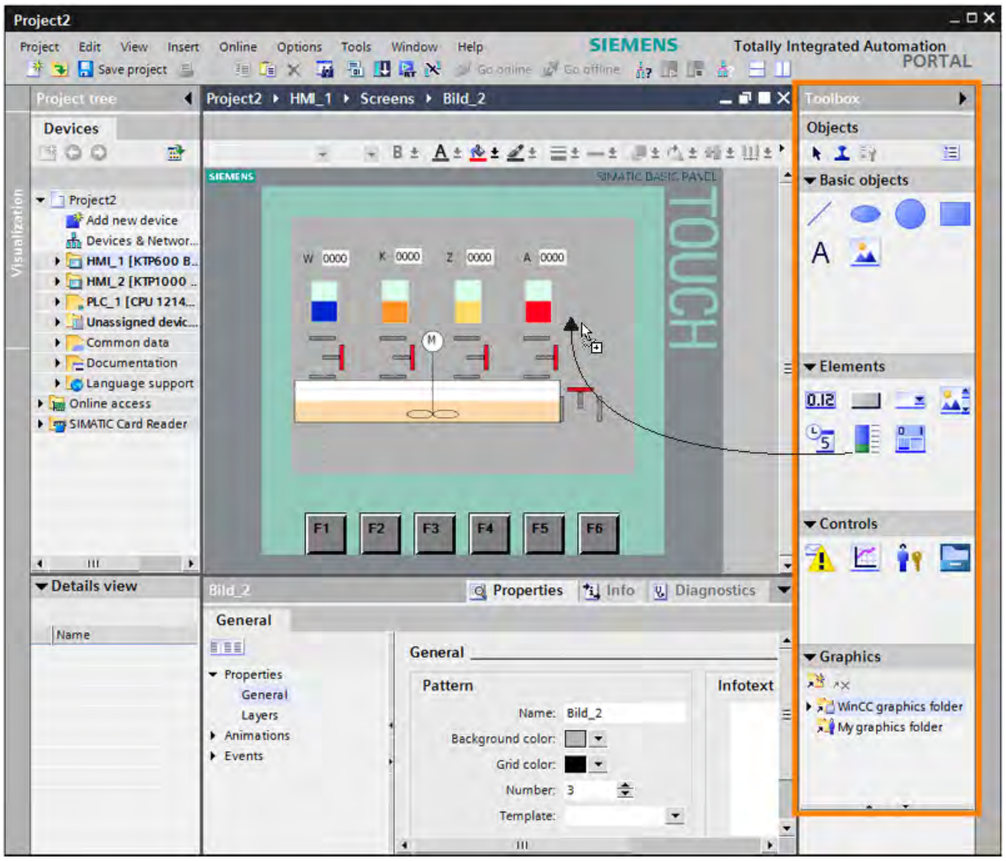
- Static elements such as text or graphic objects do not change their status in runtime. The tank labels shown in this example of a mixing unit are such static elements.
- Dynamic elements change their status depending on the process. You visualize current process values as follows:
  - From the memory of the PLC
  - From the memory of the HMI device in the form of alphanumeric displays, trends and bars.
  - Input fields on the HMI device are also considered dynamic objects. The fill level values of the tanks in our example of a mixing plant are dynamic objects.

Process values and operator inputs are exchanged between the controller and the HMI device via tags.

Configuring screen objects in the TIA portal

The functions of the HMI device determine project visualization in WinCC and the functional scope of the screen objects.

Simply drag the screen objects from the task card "Tools" into the screen. You make specific settings for the selected screen object in the Inspector window "Properties".



3.1.6.3 Configuring HMI tags

You use the "HMI tag" editor to configure internal and external tags.

External tags

External tags allow communication (exchange of data) between the components of an automation process, such as between the HMI device and the PLC.

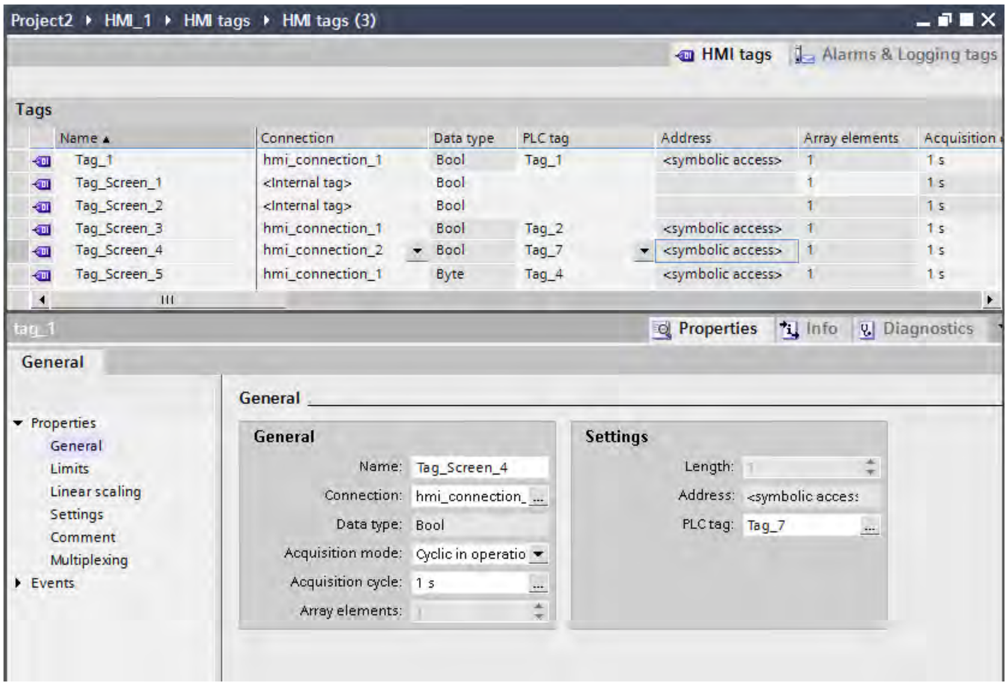
An external tag is the image of a defined memory location in the PLC. You have read and write access to this memory location from both the HMI device and from the PLC.

Internal tags

Internal tags have no connection to the PLC. Internal tags are stored in the memory of the HMI device. Therefore, only this HMI device has read and write access to the internal tags. You can create internal tags to perform local calculations, for example.

HMI Tags editor

All HMI tags for the visualization project are created in the "HMI Tags" editor. Depending on the category, you change the properties of a tag in the Property view. You also have the option of changing the properties directly in the Table view. The Table view can be adjusted to your requirements.



Name ▴	Connection	Data type	PLC tag	Address	Array elements	Acquisition
Tag_1	hmi_connection_1	Bool	Tag_1	<symbolic access>	1	1 s
Tag_Screen_1	<Internal tag>	Bool			1	1 s
Tag_Screen_2	<Internal tag>	Bool			1	1 s
Tag_Screen_3	hmi_connection_1	Bool	Tag_2	<symbolic access>	1	1 s
Tag_Screen_4	hmi_connection_2	Bool	Tag_7	<symbolic access>	1	1 s
Tag_Screen_5	hmi_connection_1	Byte	Tag_4	<symbolic access>	1	1 s

General

Name:	Tag_Screen_4
Connection:	hmi_connection_
Data type:	Bool
Acquisition mode:	Cyclic in operatio
Acquisition cycle:	1 s
Array elements:	1

Settings

Length:	1
Address:	<symbolic acces:
PLC tag:	Tag_7

3.1.6.4 TIA: Configuring PLC tags in the HMI screen

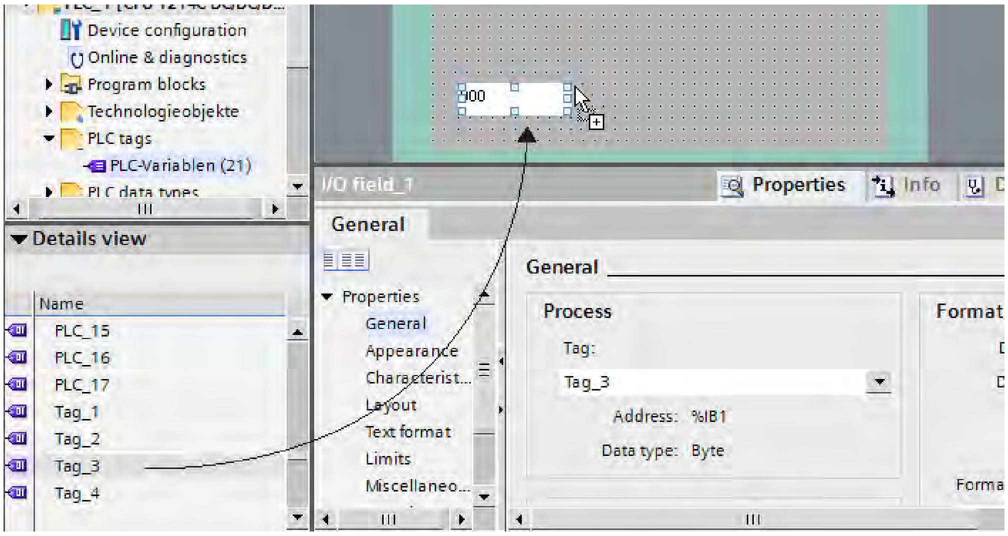
Configuring PLC tags

If you want to configure already configured PLC tags in an HMI screen, follow these steps:

1. Open an HMI screen.
2. In the project tree, select the "PLC Tags" editor.

   All external tags are show under "Detail view"
3. Drag the external tag per drag-and-drop operation to the HMI screen.

   An IO field with linked PLC tag is created in the HMI screen.



3.1.6.5 Configuring recipes

Recipes are a collection of production data that belongs together, such as mixing ratios. A mixing ratio can be transferred from the panel to the PLC in one work step, for example, to change the production types.

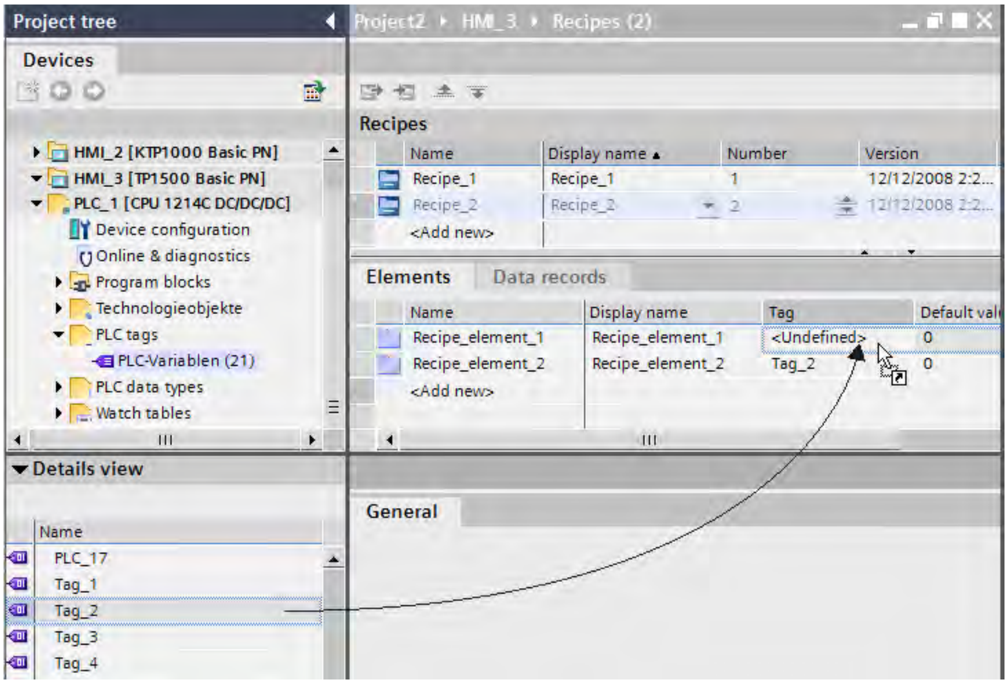
A recipe consists of several elements: One tag is assigned to each element. The data records of a recipe are the various mixing ratios of the individual recipe elements.

Assigning external tags to a recipe element.

1. Open the "Recipes" editor.
2. In the project tree, select the "PLC Tags" editor.

   All external tags are show under "Detail view"
3. Drag the external tag per drag-and-drop operation to the area "..."

   The recipe element is now linked to the external tag.



Name	Display name	Number	Version
Recipe_1	Recipe_1	1	12/12/2008 2:2...
Recipe_2	Recipe_2	2	12/12/2008 2:2...
<Add new>			

Name	Display name	Tag	Default val
Recipe_element_1	Recipe_element_1	<Undefined>	0
Recipe_element_2	Recipe_element_2	Tag_2	0
<Add new>			

3.1.7 Loading project data to the devices

Scope of the loaded project data

The project data loaded on the devices is divided into hardware and software project data:

- Hardware project data results from configuring the hardware, networks, and connections.
- Software project data involves the blocks of the user program.

Depending on the device, the following options are available:

- Hardware configuration
- Software
- Software (all blocks)
- All - common load process for hardware and software project data.

Loading options

You can load individual objects, folders or complete devices depending on the scope of the installation. The following options are available for loading:

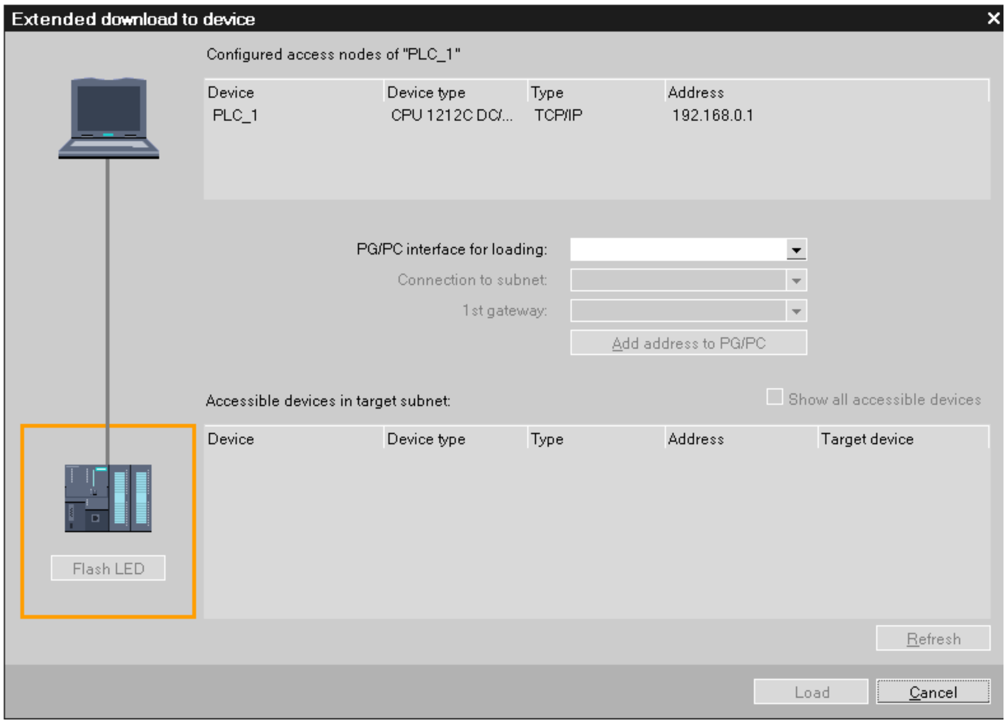
- Loading the project data in the project tree
- You can drag project data to load it to an accessible device.
- You can drag project data per drag-and-drop operation to load it to a memory card.

Requirement

The project data is consistent.

The project is compiled - for the selected devices or objects. If not, the project data is compiled automatically before it is loaded.

Example: You can drag project data to load it to an accessible device.



Configured access nodes of "PLC_1"

Device	Device type	Type	Address
PLC_1	CPU 1212C DC/...	TCP/IP	192.168.0.1

PG/PC interface for loading:
Connection to subnet:
1st gateway:

Accessible devices in target subnet:

Device	Device type	Type	Address	Target device

Result

The project data is loaded to the selected device. You can then carry out the test and diagnostics functions on the device.

3.1.8 Using online functions

3.1.8.1 Overview of online functions

Online mode

In online mode, there is an online connection between your programming device/PC and one or more devices. An online connection between the programming device/PC and device is required for loading programs and configuration data to the device as well as for activities such as the following:

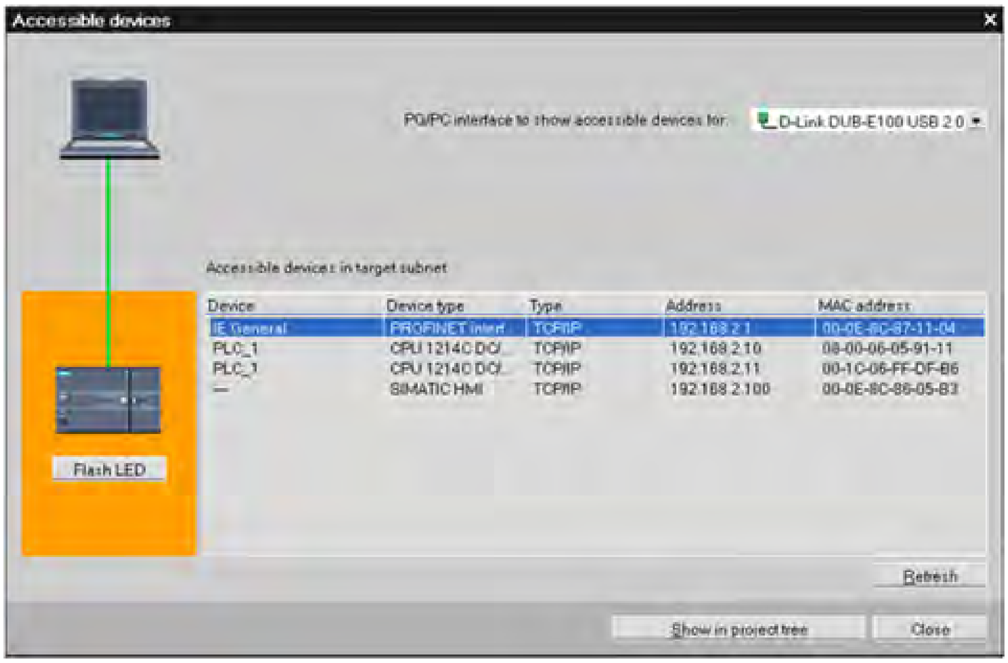
- Testing user programs
- Displaying and changing the operating mode of the CPU
- Displaying and setting the date and time-of-day of the CPU
- Displaying module information
- Comparing online and offline blocks
- Diagnosing hardware

Displaying accessible devices

Accessible devices are all devices connected to an interface of the programming device / PC and that are turned on.

To display accessible devices, follow these steps:

1. Select "Online & Diagnostics" in the Portal view.
2. Click on "Accessible devices".



PG/PC interface to show accessible devices for: D-Link DUB-E100 USB 2.0

Accessible devices in target subnet

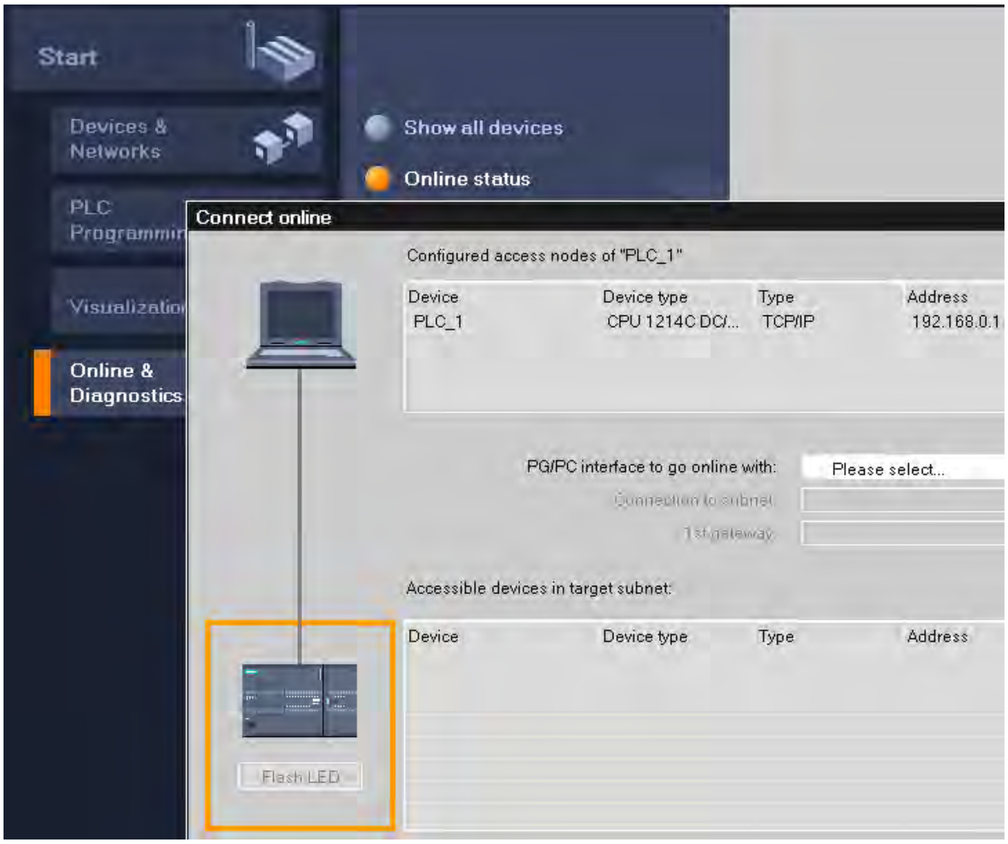
Device	Device type	Type	Address	MAC address
IE General	PROFINET interf	TCP/IP	192.168.2.1	00-0E-8C-87-11-04
PLC_1	CPU 1214C DC/...	TCP/IP	192.168.2.10	08-00-06-05-91-11
PLC_1	CPU 1214C DC/...	TCP/IP	192.168.2.11	00-1C-06-FF-DF-B6
---	SIMATIC HMI	TCP/IP	192.168.2.100	00-0E-8C-86-05-B3

The dialog "Accessible devices" lists all devices and their addresses in a table. You can select the PG/PC interface for the online connection and have the LED flash on a selected device.

Going online

An online connection to a device can be established both in the Portal view and

in the Project view. The following figure shows how you start the online mode from the "Online & Diagnostics" portal view. To do this, click "Online Status".



Configured access nodes of "PLC_1"

Device	Device type	Type	Address
PLC_1	CPU 1214C DC/...	TCP/IP	192.168.0.1

PG/PC interface to go online with: Please select...
Connection to subnet:
1st gateway:

Accessible devices in target subnet:

Device	Device type	Type	Address

Displaying diagnostics information

You can then use the Online and Diagnostics view or the "Online tools" task card to access the data on the device. The current online status of a device is displayed symbolically in the various views. For information on the meaning of the individual status symbols, refer to the relevant tooltip.

See also

Diagnostic functions for hardware and networks (Page 108)

3.1.8.2 Testing the user program

You have the option of testing the running of your user program on the device. You can then monitor signal states and values of tags and can assign values to tags to simulate certain situations in the running of the program.

Requirement

- An online connection to the device is established.
- The project data including an executable program are loaded to the device.

Test options

The following test options are available to you:

- Testing with program status

  The program status allows you to monitor the running of the program. You can display the values of operands and the results of logic operations of the networks so that you can recognize and fix logical errors in your program.

- Testing with the watch table

  With the watch table, you can monitor, modify or force the current values of individual tags in the user program or on a CPU. You can assign values to individual tags for testing and run the program in a variety of different situations. You can also assign fixed values to the I/O outputs of a CPU in STOP mode, for example to check the wiring.

Example: Displays in program status

The display of the program status is updated cyclically. It begins at the selected network. The following figure shows an example of the program status display for LAD:

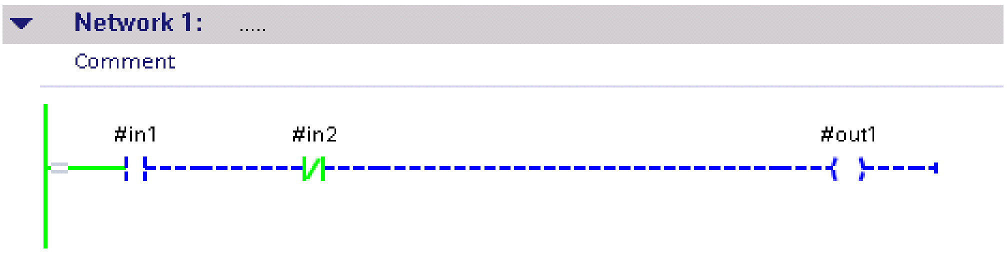
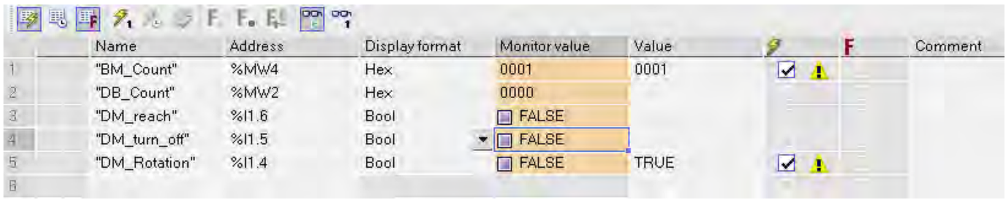


Figure3-1 You can recognize the status of individual operations and lines of a network quickly based on the color and type of lines and symbols.

Example: Testing with the watch table

A watch table contains the tags you defined for the entire CPU. A "Watch tables" folder is automatically generated for each CPU created in the project. You create a new watch table in this folder by selecting the "Add new watch table" command.

The following figure shows the layout of the watch table in basic mode with the ("Control") and ("Force") columns:



	Name	Address	Display format	Monitor value	Value		F	Comment
1	"BM_Count"	%MW4	Hex	0001	0001	✓ ⚠		
2	"DB_Count"	%MW2	Hex	0000				
3	"DM_reach"	%I1.6	Bool	▢ FALSE				
4	"DM_turn_off"	%I1.5	Bool	▢ FALSE				
5	"DM_Rotation"	%I1.4	Bool	▢ FALSE	TRUE	✓ ⚠		
6								

You can use the symbol ("Monitor immediately") to start the monitoring immediately and then control and force the tags.

3.1.8.3 Diagnostic functions for hardware and networks

Diagnostic functions for hardware and networks

The following views and work areas are available for the diagnostics of the hardware and the networks:

- The Online and Diagnostics view provides you with comprehensive information, also in graphics form, about the status of a device and can transfer commands to the device, set the time-of-day for example.
- For modules with their own operating mode, the "Online tools" task card allows you to query and transfer current diagnostics information and commands to the module, change operating mode for example.
- In the "Diagnostics > Device Info" area of the Inspector window you will obtain an overview of the defective devices that are connected online.

Symbolic display of the status and diagnostics information

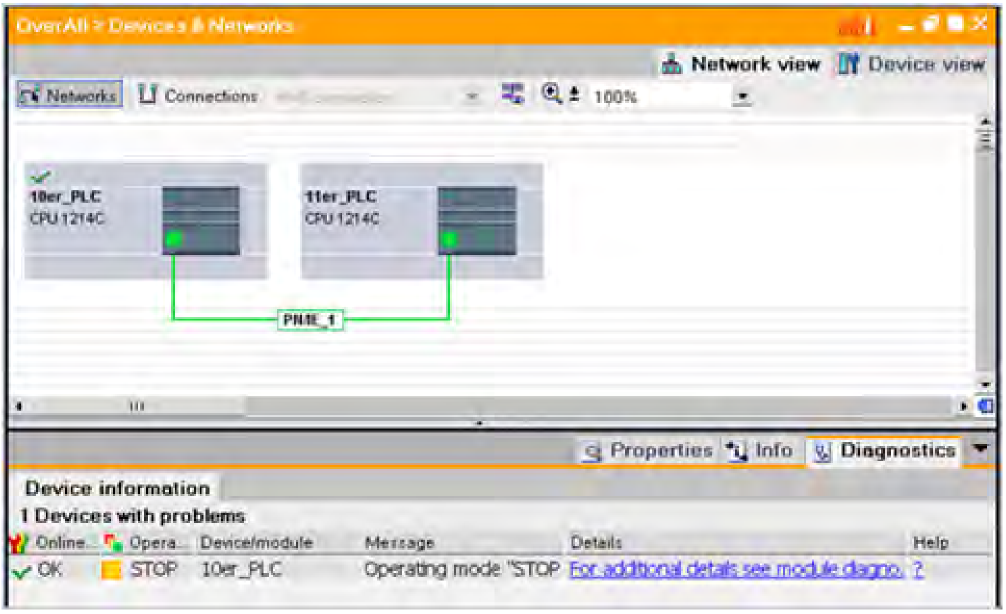
When establishing the online connection with a device, the status and, if necessary, the operating mode of the associated modules are also determined and displayed.

The display is performed in these views:

- In the Device view, diagnostics symbols are displayed in most of the hardware components. For modules with their own operating mode, the operating state symbol is also displayed.
- In the Network view a diagnostic symbol is shown for each device, showing the collective status of all associated hardware components.
- The diagnostics icon is shown in the network overview and device overview for each hardware component.
- In the project tree, the diagnostics symbol is displayed behind the hardware components for centralized IO devices. For modules with their own operating mode the operating state symbol is also displayed in the top right corner of the module symbol.
- In the Online and Diagnostics view, the online status is displayed in the "Status" area of the "Online access" group.

Example

The following figure shows the devices in online mode in the Network view.



1 Devices with problems

Online...	Opera...	Device/module	Message	Details	Help
✓ OK	🟧 STOP	10er_PLC	Operating mode "STOP	For additional details see module diagno.	?

Introduction to the TIA Portal 4

4.1 User interface and operation

4.1.1 Special features specific to the operating system

4.1.1.1 Influence of user rights

Restrictions when user rights are limited

The software provides several functions that require direct access to the hardware of the programming device / PC and therefore also to the installed operating system. To make full use of the range of functions, the software must cooperate closely with the operating system. To ensure problem-free interaction, you should therefore be logged on to the operating system with adequate user rights. Ideally, you should log on as administrator with the full set of rights.

In particular, you may not be able to use functions requiring an online connection or those that change the settings of interface cards if you work with limited user rights.

Recognizing restricted functions

You can recognize functions requiring special rights as follows:

- A shield icon is displayed beside the function.

  The function can be used but is regulated by the user account control.

- A box is grayed out and cannot be accessed.

  You require administrator privileges to access the box. In some operating system environments, you can obtain administrator privileges by entering an administrator password.

Note

A box being grayed out does not necessarily mean a lack of rights. You should also check the additional information in the tooltip cascades to find out the conditions for editing the box.

4.1.1.2 Expanding user rights

Counteracting restrictions due to user rights

Certain functions may not be available if you are not logged on to the operating system with adequate rights. You can counteract these restrictions in the following ways:

- Enabling of extended rights using Windows user account control
- Obtaining administrator privileges
  - Logging on to the operating system with administrator privileges
  - Obtaining administrator privileges temporarily

Obtaining extended rights using the Windows user account control

To be able to use a function indicated by the shield icon of the Windows user account control, follow these steps:

1. Click on the box or button with the shield icon.

   The security prompt of the Windows user account control opens.
2. Follow the instructions of the Windows user account control and, when prompted enter an administrator password, if possible.

The function can now be used once without restrictions.

Logging on to the operating system with administrator privileges

To be able to use a function that is disabled due to lack of user rights, follow these steps:

1. Close the software.
2. Log off from the operating system.
3. Log on to the operating system with administrator privileges.
4. Restart the software.

Obtaining administrator privileges temporarily

To obtain administrator privileges temporarily, follow these steps:

1. Click the "Change settings" button. You will find this button in dialogs that allow the temporary assignment of administrator privileges.

   An operating system dialog box for entering an administrator password opens.
2. Enter an administrator password.

The settings can be temporarily changed. When you call the dialog again, the procedure must be repeated.

Note

This function is not supported by all operating systems. If no "Change settings" button is present or the button is grayed out, you will need to log on to the operating system with administrator privileges instead.

4.1.2 Starting, setting and exiting the TIA Portal

4.1.2.1 Starting and exiting the TIA Portal

Starting the TIA Portal

Follow the steps below to start the TIA Portal:

1. In Windows, select "Start > Programs > Siemens Automation > Totally Integrated Automation Portal V10."

Exiting the TIA Portal

Follow the steps below to exit the TIA Portal:

1. In the "Project" menu, select the "Exit" command.

   If the project contains any changes that have not been saved, you will be asked if you wish to save them.

   – Select "Yes" to save the changes in the current project and close the TIA Portal.

   – Select "No" to close the TIA Portal without saving the most recent changes in the project.

   – Select "Cancel" to cancel the closing procedure. The TIA Portal will remain open if you select this option.

See also

Setting the start view (Page 113)
Start settings (Page 114)
Storage locations (Page 115)

4.1.2.2 Setting the start view

You can determine the view that will be displayed when the project opens. You can select one of the following options:

- "Most recent view"

  The program will be opened in the view that was displayed when you last closed it.

- Portal view (Page 116)

  The program is always opened in portal view.

- Project view (Page 118)

  The program is always opened in project view.

Requirement

The project view is open.

Procedure

To determine the start view follow the steps below:

1. In the "Options" menu, select the "Settings" command.

   The "Settings" window appears in the work area.
2. Select the "General" group.
3. In the "Start view" area, select the start view you require.

   The change will come into effect the next time the program is started.

See also

Starting and exiting the TIA Portal (Page 113)
Start settings (Page 114)
Storage locations (Page 115)

4.1.2.3 Start settings

You can select the following options via the start settings:

- Start most recent project

  Activate this option to load the most recently opened project once the program has started.
- Show list of recently used projects

  Use this option to determine how many existing projects are displayed in the project list on the portal screen.
- Load most recent window settings

  Activate this option to load the most recently saved window settings when the program starts.

Requirement

The project view is open.

Procedure

To determine the start settings, follow these steps:

1. In the "Options" menu, select the "Settings" command.

   The "Settings" window appears in the work area.
2. Select the "General" group.
3. Select the required options in the "Start settings" area.

The change will come into effect the next time the program is started.

See also

Starting and exiting the TIA Portal (Page 113)
Setting the start view (Page 113)
Storage locations (Page 115)

4.1.2.4 Storage locations

You have the option of determining the locations in the program where new projects and libraries are saved. This enables you to avoid manual selection of save locations when creating projects and libraries.

Requirement

The project view is open.

Procedure

To determine the save settings, follow these steps:

1. In the "Options" menu, select the "Settings" command.

   The "Settings" window appears in the work area.
2. Select the "General" group.
3. In the "Storage locations" area, select either "Recently used storage location" or "Default storage location".
4. If you have selected "Default storage location", enter the save locations for new projects and libraries.

   If you specify a location that is not available, the standard save location settings will be used.
5. To apply a save location that is not yet available, click "Browse".
6. The "Find folder" dialog opens.
7. Navigate to the directory you require and click "Create new folder".
8. Enter a name for the new folder.

   The change will come into effect the next time a project or library is created.

See also

Starting and exiting the TIA Portal (Page 113)
Setting the start view (Page 113)
Start settings (Page 114)

4.1.3 Layout of the user interface

4.1.3.1 Views

Views

Two different views are available for your automation project:

- The portal view (Page 116) is a task-oriented view of the project tasks.
- The project view (Page 118) is a view of the components of the project, as well as the relevant work areas and editors.

You can change over between the two views using a link.

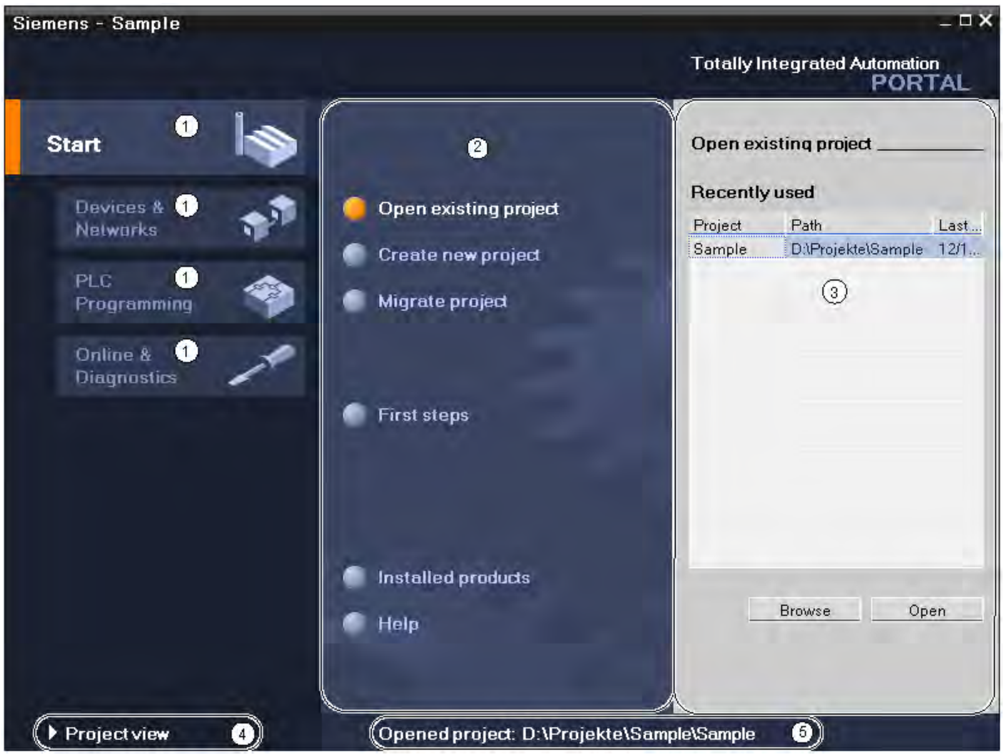
4.1.3.2 Portal view

Purpose of the portal view

The portal view provides you with a task-oriented view of the tools. Here, you can quickly decide what you want to do and call up the tool for the task in hand. If necessary, the view changes automatically to the project view (Page 118) for the selected task.

Layout of the portal view

The following figure shows an example of the components in the portal view:



Project	Path	Last ...
Sample	D:\Projekte\Sample	12/1...

①	Portals for different tasks
②	Actions for the selected portal
③	Selection panel for the selected action
④	Change to the project view
⑤	Display of the project that is currently open

Portals

The portals provide the basic functions for the individual task areas. The portals that are provided in the portal view depends on the products that have been installed.

Actions for the selected portal

Here, you will find the actions available to you in the portal you have selected. You can call up the help function in every portal on a context-sensitive basis.

Selection panel for the selected action

The selection panel is available in all portals. The content of the panel adapts to your current selection.

Change to the project view

You can use the "Project view" link to change to the project view.

Display of the project that is currently open

Here, you can obtain information about which project is currently open.

See also

Project tree (Page 119)
Work area (Page 122)
Inspector window (Page 123)
Task cards (Page 125)
Details view (Page 127)

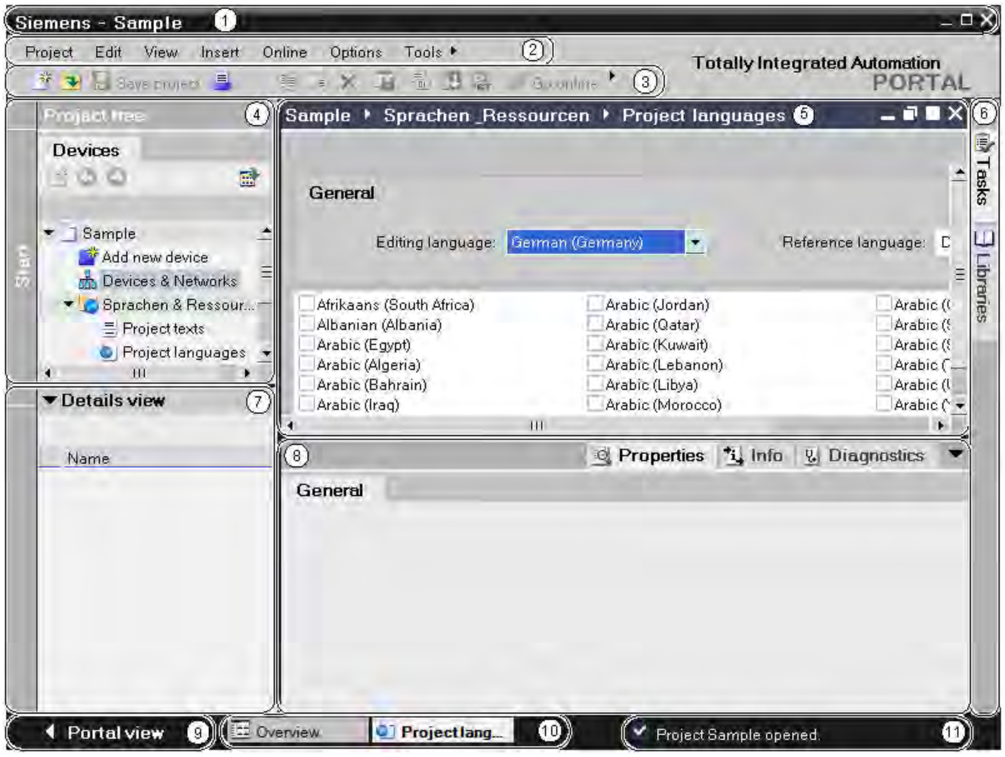
4.1.3.3 Project view

Purpose of the project view

The project view is a structured view of all components of the project.

Layout of the project view

The following figure shows an example of the components of the project view:



①	Title bar
②	Menu bar
③	Toolbar

④	Project tree (Page 119)
⑤	Work area (Page 122)
⑥	Task cards (Page 125)
⑦	Details view (Page 127)
⑧	Inspector window (Page 123)
⑨	Change to the Portal view (Page 116)
⑩	Editor bar
⑪	Status bar

Title bar

The name of the project is displayed in the title bar.

Menu bar

The menu bar contains all the commands that you require for your work.

Toolbar

The toolbar provides you with buttons for commands you will use frequently. This gives you faster access to these commands.

Changing to the portal view

You can use the "Portal view" link to change to the portal view.

Editor bar

The Editor bar displays the open editors. If you have opened a lot of editors, they are shown grouped together. You can use the Editor bar to change quickly between the open elements.

Status bar

You can find the most recently generated alarm on the status bar.

4.1.3.4 Project tree

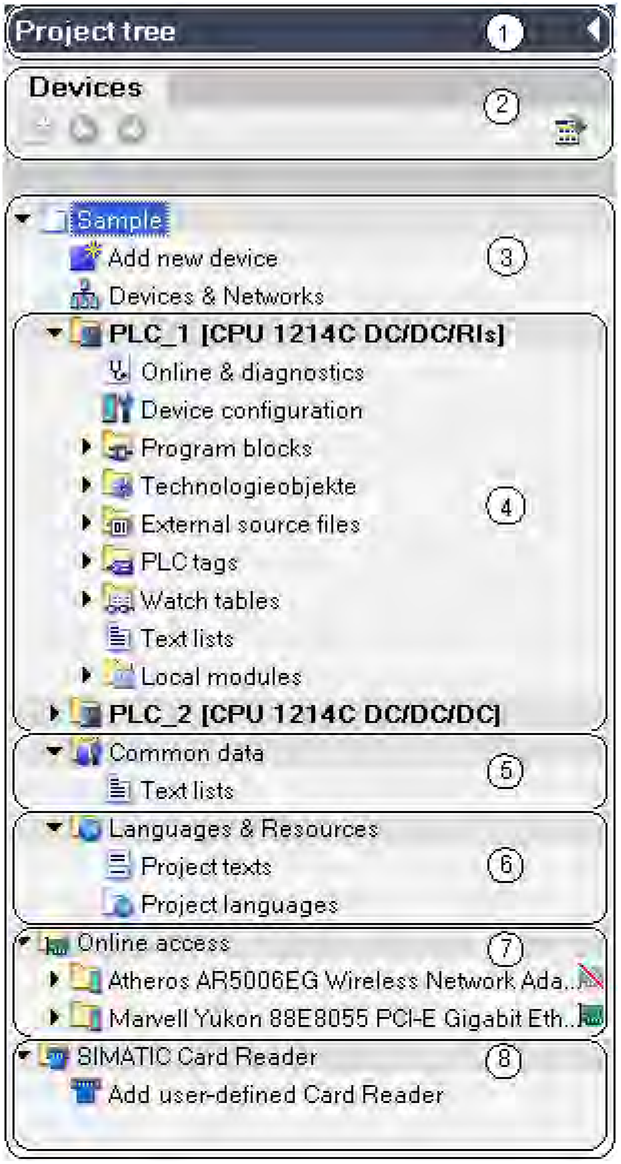
Function of the project tree

Using the project tree features gives you access to all components and project data. You can perform the following tasks in the project tree:

- Add new components
- Edit existing components
- Scan and modify the properties of existing components

Layout of project tree

The following figure shows an example of the project tree components:



①	Title bar
②	Toolbar
③	Project
④	Devices
⑤	Common data
⑥	Languages & resources
⑦	Online access

⑧ SIMATIC Card Reader

Title bar

The title bar of the project tree has a button to collapse the project tree. Once it has collapsed, the button will be positioned at the left-hand margin. It changes from an arrow pointing left to one that is pointing right, and can now be used to reopen the project tree.

Toolbar

You can do the following tasks in the toolbar of the project tree:

- Create a new user folder; for example, in order to group blocks in the "Program blocks" folder.
- Navigate forward to the source of a link and back to the link itself.

  There are two buttons for links in the project tree. You can use these to navigate from the link to the source and back.
- Show an overview of the selected object in the work area.

  When the overview is displayed, the lower-level objects and actions of the elements in the project tree are hidden. To show them again, minimize the overview.

Project

You will find all the objects and actions related to the project in the "Project" folder, e.g.:

- Devices
- Languages & resources
- Online access

Device

There is a separate folder for each device in the project, which has an internal project name. Objects and actions belonging to the device are arranged inside this folder.

Common data

This folder contains data that you can use across more than one device, such as common message classes, scripts and text lists.

Languages & resources

You can determine the project languages and texts in this folder.

Online access

This folder contains all the interfaces of the programming device / PC, even if they are not used for communication with a module.

SIMATIC Card Reader

This folder is used to manage all card readers connected to the programming device / PC.

See also

Portal view (Page 116)
Project view (Page 118)
Work area (Page 122)
Inspector window (Page 123)
Task cards (Page 125)
Details view (Page 127)

4.1.3.5 Work area

Function of the work area

The objects that you can open for editing purposes are displayed in the work area. These objects include, for example:

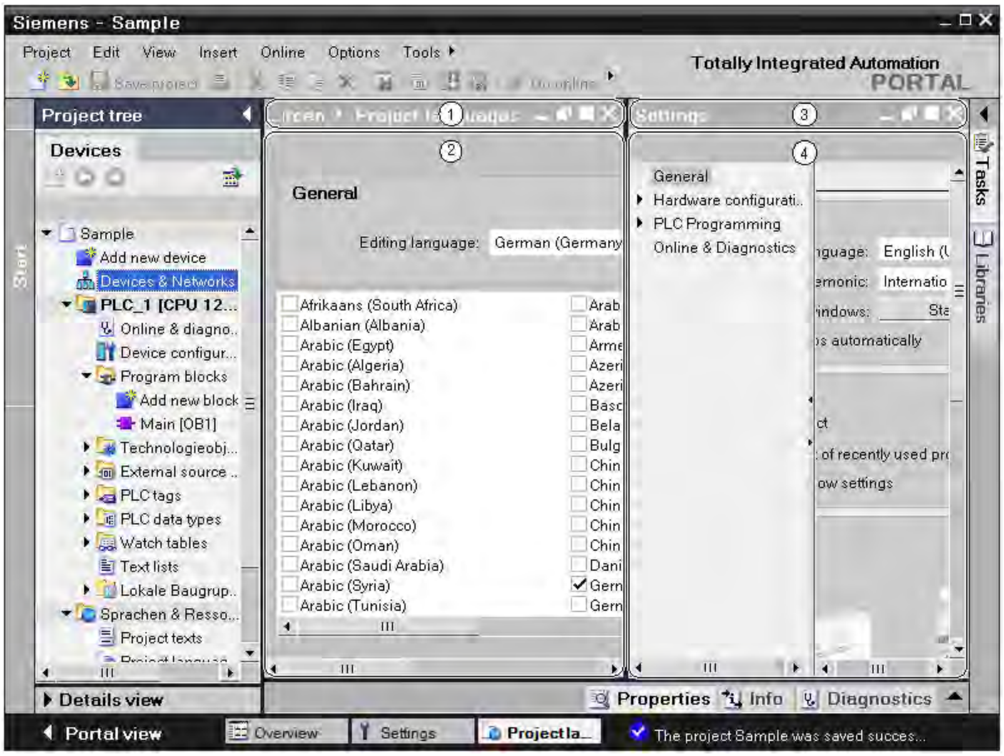
- Editors and views
- Tables

You can open several objects. However, normally it is only possible to see one of these at a time in the work area. All other objects are displayed as tabs in the Editor bar. If, for the purpose of certain tasks, you would like to view two objects at the same time, you can split the work area either horizontally or vertically. If no objects are open, the work area will be empty.

See also: Adapting the work area (Page 129)

Layout of the work area

The following figure shows an example of a vertically split work area:



① Title bar of left-hand editor

② Work area of left-hand editor

③ Title bar of right-hand editor

④ Work area of right-hand editor

See also

Project tree (Page 119)
Portal view (Page 116)
Project view (Page 118)
Inspector window (Page 123)
Task cards (Page 125)
Details view (Page 127)

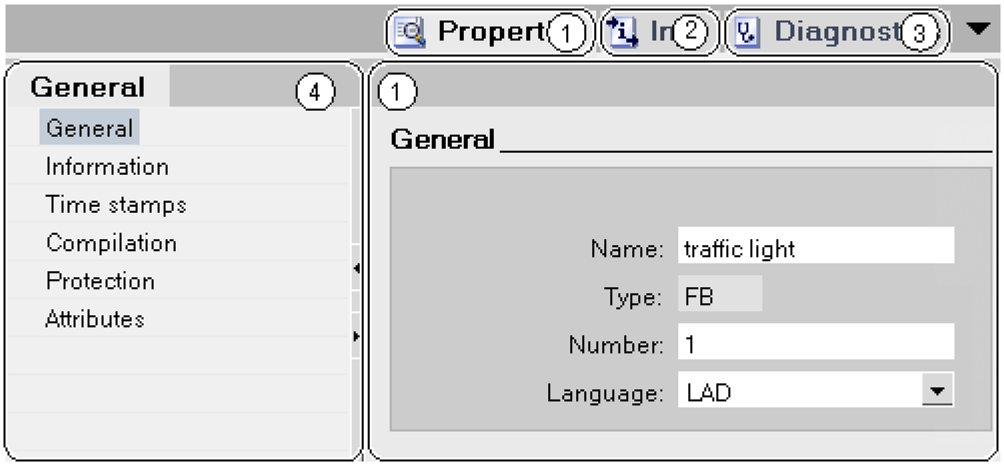
4.1.3.6 Inspector window

Function of the Inspector window

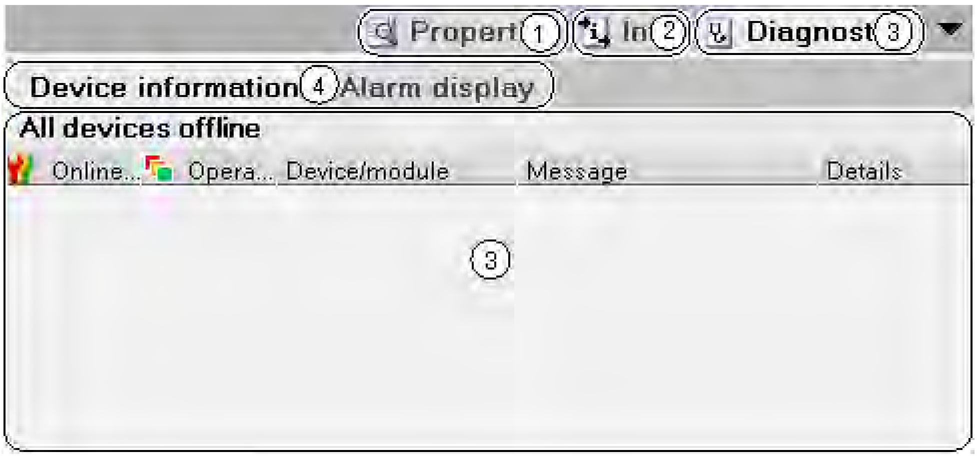
Additional information on an object selected or on actions executed are displayed in the inspector window.

Layout of the Inspector window

The following figures show the components of the Inspector window:



Name: traffic light
Type: FB
Number: 1
Language: LAD



①	"Properties" tab
②	"Info" tab
③	"Diagnostics" tab
④	Navigation within the tabs: • Area navigation within the "Properties" tab • Lower-level tabs in the "Info" and "Diagnostics" tabs

"Properties" tab

This tab displays the properties of the object selected. You can change editable properties here.

"Info" tab

This tab displays additional information on the object selected, as well as alarms on the actions executed (such as compiling).

"Diagnostics" tab

This tab provides information on system diagnostics events and configured alarm events.

Navigation within the tabs

You can use area navigation and the lower-level tabs to display the information you require within the tabs.

See also

Project tree (Page 119)
Work area (Page 122)
Portal view (Page 116)
Project view (Page 118)
Task cards (Page 125)
Details view (Page 127)

4.1.3.7 Task cards

Function of task cards

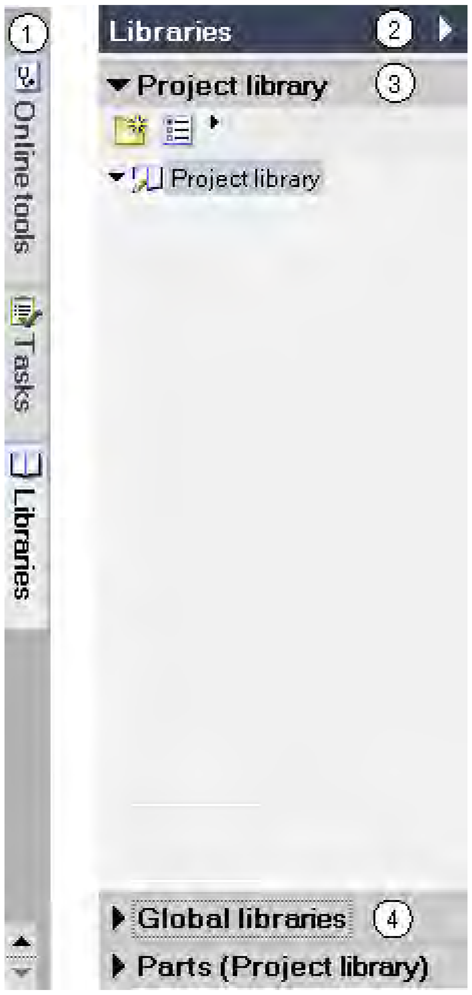
Depending on the edited or selected object, task cards that allow you perform additional actions are available. These actions include:

- Selecting objects from a library or from the hardware catalog
- Searching for and replacing objects in the project
- Dragging predefined objects to the work area

The task cards available can be found in a bar on the right-hand side of the screen. You can collapse and reopen them at any time. Which task cards are available depends on the products installed. More complex task cards are divided into panes that you can also collapse and reopen.

Layout of task cards

The following figure shows an example of the bar with the task cards:



①	Task cards closed
②	"Library" task card open
③	"Project library" pane open
④	Pane closed

See also

Project tree (Page 119)
Work area (Page 122)
Inspector window (Page 123)
Portal view (Page 116)
Project view (Page 118)
Details view (Page 127)

4.1.3.8 Details view

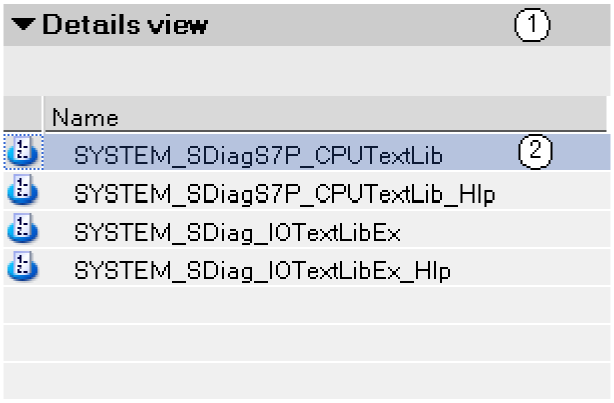
Purpose of the details view

Certain content of the selected object is shown in the details view. This might include text lists or tags.

The content of folders is not shown, however. To display the content of folders, use the project tree or the overview window.

Layout of the details view

The following figure shows an example of the details view:



SYSTEM_SDiagS7P_CPUTextLib
SYSTEM_SDiagS7P_CPUTextLib_Hlp
SYSTEM_SDiag_IOTextLibEx
SYSTEM_SDiag_IOTextLibEx_Hlp

①	Title bar
②	Content of the selected object

Title bar

The arrow for closing the details view is located in the title bar of the details view. After it has closed, the direction in which the arrow is pointing changes from left to right. It can now be used to reopen the details view.

Objects

The displayed content varies depending on the selected object. You can move the content of objects from the details view to the required location using drag-and-drop.

See also

Project tree (Page 119)
Work area (Page 122)
Inspector window (Page 123)
Task cards (Page 125)
Portal view (Page 116)
Project view (Page 118)
Overview window (Page 128)

4.1.3.9 Overview window

Functions of the overview window

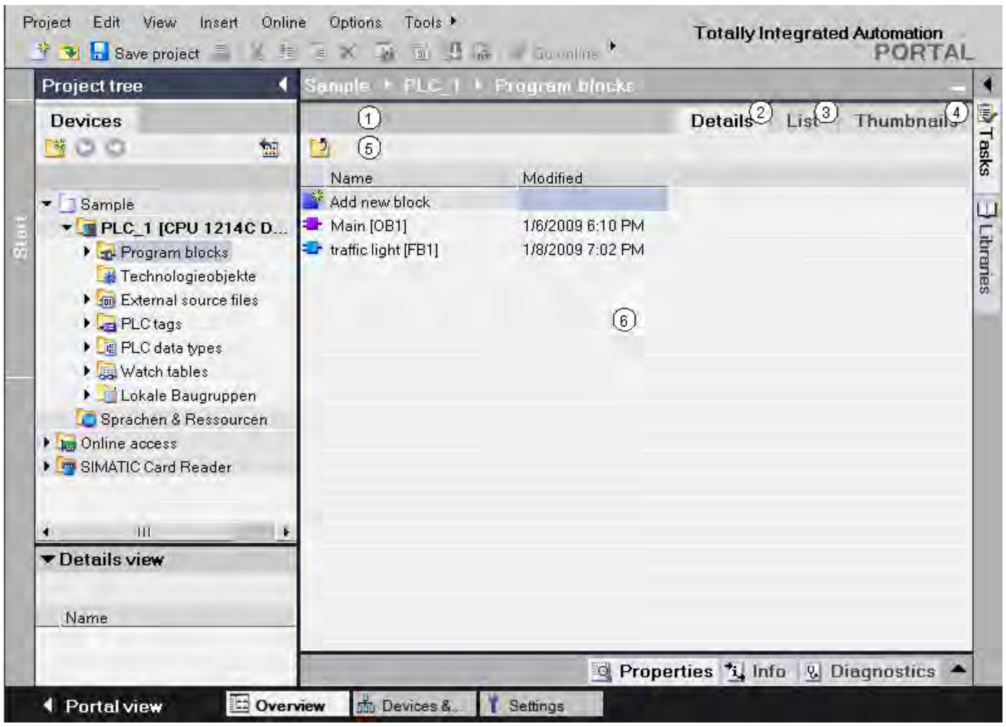
The overview window supplements the project tree. The overview window shows the content of the folder currently selected in the project tree.

In addition, you can perform the following actions in the overview window:

- Open objects
- Display and edit the properties of objects in the Inspector window
- Rename objects
- Call object-specific actions from the shortcut menu

Layout of the overview window

The following figure shows the components of the overview window:



①	Overview window
②	Switch to the Details view
③	Switch to the List view
④	Switch to the Icon view
⑤	Move to higher level
⑥	Display of folder content

Display form of the overview window

The content of the overview window can be displayed as follows:

- Details view

  The objects are displayed in a list with additional information, such as the date of the last change.
- List view

  The objects are displayed in a simple list.
- Icon view

  The objects are displayed as icons.

See also

Project tree (Page 119)

4.1.4 Adapting the user interface

4.1.4.1 Selecting the language

You have the option of changing the language of the user interface.

Procedure

To change the user interface language, follow these steps:

1. In the "Options" menu, select the "Settings" command.
2. Select the "General" group in the area navigation.
3. In "General settings", select the required language from the "User interface language" drop-down list.

   The user interface language setting is changed. In future, the program will open in this user interface language.

See also

Adapting the work area (Page 129)

4.1.4.2 Adapting the work area

You have the option of adapting the work area to meet your requirements. The following functions are available for this purpose:

- Maximizing the work area

  You can close the task cards, project tree and inspector window with a single click. This increases the size of the work area.
- Minimizing elements in the work area

You can minimize the elements that are open in the work area, such as editors or tables. However, an element remains open even if it has been minimized, and can quickly be maximized again using the Editor bar.

- Splitting the work area vertically or horizontally

  If you want to display two elements in the work area at the same time, you can split the work area either vertically or horizontally.
- Detaching elements from the work area

  You can also detach elements completely from the work area and open them in a new window.
- Restoring the work area

  If you have maximized the work area or detached elements, you can undo these actions with a single click.

Maximizing the work area

To maximize the work area, follow these steps:

1. Open an element such as an editor or a table.

   The element appears in the work area.
2. Click the "Maximize" button in the title bar of the element.

   The task cards, project tree and inspector window collapse, and the work area is shown with its maximum dimensions.

Minimizing the work area

To minimize the work area again, follow these steps:

1. Click the "Restore down" button in the title bar of the displayed element.

   The task cards, project tree and inspector window reopen.

Minimizing elements in the work area

To minimize elements in the work area, follow these steps:

1. Click the "Minimize" button in the title bar of the element.

   The element is minimized, but can still be accessed via the Editor bar.

To minimize all elements at the same time, follow these steps:

1. In the "Window" menu, select the "Minimize all" command.

Maximizing elements in the work area

To maximize elements in the work area again, follow these steps:

1. Click the required element in the Editor bar.

   The element is maximized and appears in the work area.

Splitting the work area vertically or horizontally

To split the work area vertically or horizontally, follow these steps:

1. In the "Window" menu, select the "Split editor space vertically" or "Split editor space horizontally" command.

   The element you have clicked and the next element in the Editor bar will be displayed either next to one another or one above the other.

Note

If there are fewer than two elements in the work area, the "Split editor space vertically" and "Split editor space horizontally" functions will not be available.

Detaching elements from the work area

To detach elements from the work area, follow these steps:

1. Click the "Detach" button in the title bar of the element.

   The element will be released from the work area and displayed in its own window. You can now place the window wherever you wish. If you have minimized the window, you can restore it via the Editor bar.

Docking elements in the work area

To dock elements in the work area again, follow these steps:

1. Click the "Embed" button in the title bar of the element.

   The element will appear in the work area again.

Switching between the elements in the work area

You can switch between the elements in the work area at any time. To switch to the previous or next editor, follow these steps:

1. In the "Window" menu, select the "Next editor" or "Previous editor" command.

   The next or previous editor will be displayed.

See also

Work area (Page 122)
Selecting the language (Page 129)

4.1.4.3 Adapting tables

You can optimize the width of the table column to be able to read all the text in the rows.

Optimizing column width

To adapt the width of a column to the content, follow these steps:

1. In the table header, move the mouse pointer to the right-hand separation line of the column whose width you want to adjust.

   The mouse pointer will change to a vertical line, with an arrow pointing left and an arrow pointing right.

2. Double-click the separation line.

Note
Note the following:

– In the case of columns that are too narrow, the entire content of the individual cells will appear as a tooltip when the mouse pointer is briefly hovered over the relevant field.

– The column widths and visible columns will be saved with project-specific settings when the project is closed. This means that all the settings will remain valid, even if you open the project on a different computer.

4.1.5 Keyboard shortcuts

4.1.5.1 Keyboard shortcuts for project editing

Editing a project

Function	Key combination	Menu command
Create a new project	<Ctrl+N>	Project > New
Open a project	<Ctrl+O>	Project > Open
Close a project	<Ctrl+W>	Project > Close
Save a project	<Ctrl+S>	Project > Save
Save a project under a different name	<Ctrl+Shift+S>	Project > Save as
Print project	<Ctrl+P>	Project > Print
Compile a project	<Ctrl+B>	Edit > Compile

Editing objects within a project

Function	Key combination	Menu command
Rename a project	<F2>	Edit > Rename
Highlight all objects in an area	<Ctrl+A>	Edit > Select all
Copy an object	<Ctrl+C>	Edit > Copy
Cut an object	<Ctrl+X>	Edit > Cut
Paste an object	<Ctrl+V>	Edit > Paste
Delete an object	<Del>	Edit > Delete
Find or replace object	<Ctrl+F>	Edit > Find and replace

Calling up the help function

Function	Key combination	Menu command
Call up the help function	<F1> or <Shift+F1>	Help > Show help

4.1.5.2 Keyboard shortcuts for windows

Opening and closing windows

Function	Key combination	Menu command
Open/close project tree	<Ctrl+1>	View > Project tree
Opening/closing the detailed view	<Ctrl+4>	View > Details view
Opening/closing the overview	<Ctrl+2>	View > Overview
Opening/closing a task card	<Ctrl+3>	View > Task card
Open/close inspector window	<Ctrl+5>	View > Inspector window
Close all editors	<Ctrl+Shift+F4>	Window > Close all
Open the shortcut menu	<Shift+F10>	-

4.1.5.3 Keyboard shortcuts in the project tree

Keyboard shortcuts in the project tree

Function	Key combination
Jump to the start of the project tree	<Home> or <Page Up>
Jump to the end of the project tree	<End> or <Page Down>
Open folder	<Arrow Right>
Close folder	<Arrow Left>

4.1.5.4 Keyboard shortcuts in tables

General keyboard shortcuts in tables

Function	Key combination
Place a cell in edit mode	<F2> or <Return>
Open drop-down list box in a cell	<Return>

Navigate in tables

Function	Key combination
Go to the next cell	<Arrow keys>
Go to the next editable cell on the right	<Tab>
Go to the next editable cell on the left	<Shift+Tab>
Move a screen upwards	<PgUp>
Move a screen downwards	<PgDn>
Go to the first cell in the row	<Home>
Go to the last cell in the row	<End>
Go to the first cell in the table	<Ctrl+Home>
Go to the last cell in the table	<Ctrl+End>
Go to the top cell in the column	<Ctrl+up arrow>
Go to the bottom cell in the column	<Ctrl+down arrow>

Highlighting areas in tables

Function	Key combination
Highlight a column	<Ctrl+space bar>
Highlight a row	<Shift+space bar>
Highlight all cells	<Ctrl+A>
Highlight to expand a cell	<Shift+arrow keys>
Extend highlighting to the first visible cell	<Shift+PgUp>
Extend highlighting to the last visible cell	<Shift+PgDn>
Extend highlighting to the first row	<Ctrl+Shift+up arrow>
Extend highlighting to the last row	<Ctrl+Shift+down arrow>

Function	Key combination
Extend highlighting to the first cell in the row	<Ctrl+Shift+left arrow>
Extend highlighting to the last cell in the row	<Ctrl+Shift+right arrow>

4.1.5.5 Keyboard shortcuts for text editing

Editing text

Function	Key combination
Switch to insert or overwrite mode	<Insert>
Exit edit mode	<Esc>
Delete	<Del>
Delete characters	<Backspace>

4.1.5.6 Screen keyboard

Introduction

When working with the TIA portal, you also have the Microsoft on-screen keyboard available.

Displaying the on-screen keyboard

To display the on-screen keyboard, follow these steps:

1. In the "View" menu, select the "Screen keyboard" command.

Exiting the on-screen keyboard

To exit the on-screen keyboard, follow these steps:

1. In the "File" menu of the on-screen keyboard, select the "Exit" command.

4.2 Help on the information system

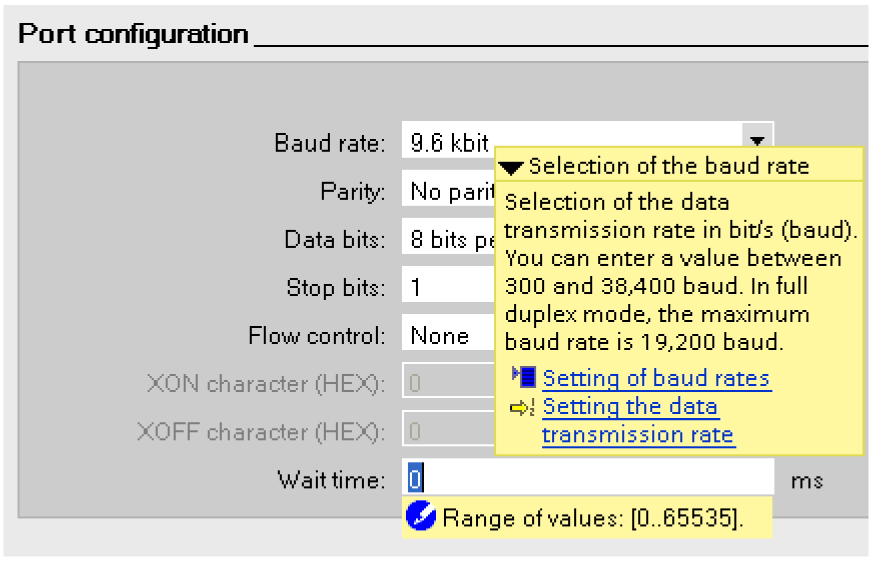
4.2.1 General remarks on the information system

Quick answers to your questions

A comprehensive Help system is available for solving your tasks. It describes basic concepts, instructions and functions. While working with the program, you also receive the following support:

- Roll-out for correct inputs in dialog boxes
- Tooltips for information on elements of the user interface, for example text boxes, buttons and icons. Some of the tooltips are supplemented by cascades containing more precise information.
- Help on the current context, on menu commands for example when you click on the keys <F1> or <Shift+F1>.

The following figure shows an example of a cascading tooltip (top) and a roll-out (bottom):


Port configuration

Baud rate: 9.6 kbit
Parity: No parit
Data bits: 8 bits pe
Stop bits: 1
Flow control: None
XON character (HEX): 0
XOFF character (HEX): 0
Wait time: 0 ms

Selection of the baud rate
Selection of the data transmission rate in bit/s (baud). You can enter a value between 300 and 38,400 baud. In full duplex mode, the maximum baud rate is 19,200 baud.
Setting of baud rates
Setting the data transmission rate

Range of values: [0..65535].

Help

The Help system describes concepts, instructions and functions. It also contains reference information and examples.

The Help system opens up in its own window on the right side of the screen.

You can display a navigation field in the Help system. You have access to the following functions there:

- Table of contents
- Search in the index
- Full text search of the entire Help

- Favorites

You will find further information on working with Help in the Chapter "Using the Help system (Page 139) ".

Identification of the topics in the Help system

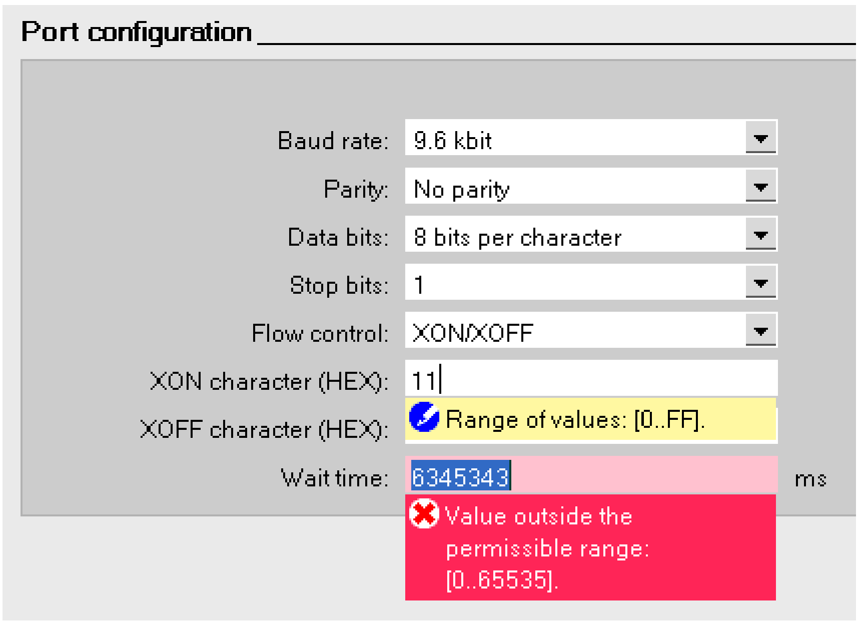
The help topics are identified by different symbols depending on the type of information they contain.

Symbol	Information type	Explanation
➡	Operating instructions	Describes the steps to follow in order to carry out a particular task.
⏩	Example	Contains a concrete example to explain the task.
▤	Factual information	Contains background information that you need to know to carry out a task.
↗	Reference	Contains comprehensive reference information to refer back to.

Roll-out

Certain text boxes offer information that rolls out and helps you to enter valid parameters and values. The roll-out informs you about permissible value ranges and data types of the text boxes.

The following figure shows a roll-out (yellow) and a roll-out error message (red), which indicates an invalid value:



Port configuration

Baud rate:	9.6 kbit
Parity:	No parity
Data bits:	8 bits per character
Stop bits:	1
Flow control:	XON/XOFF
XON character (HEX):	11
XOFF character (HEX):	
Wait time:	6345343 ms

Range of values: [0..FF].

Value outside the permissible range: [0..65535].

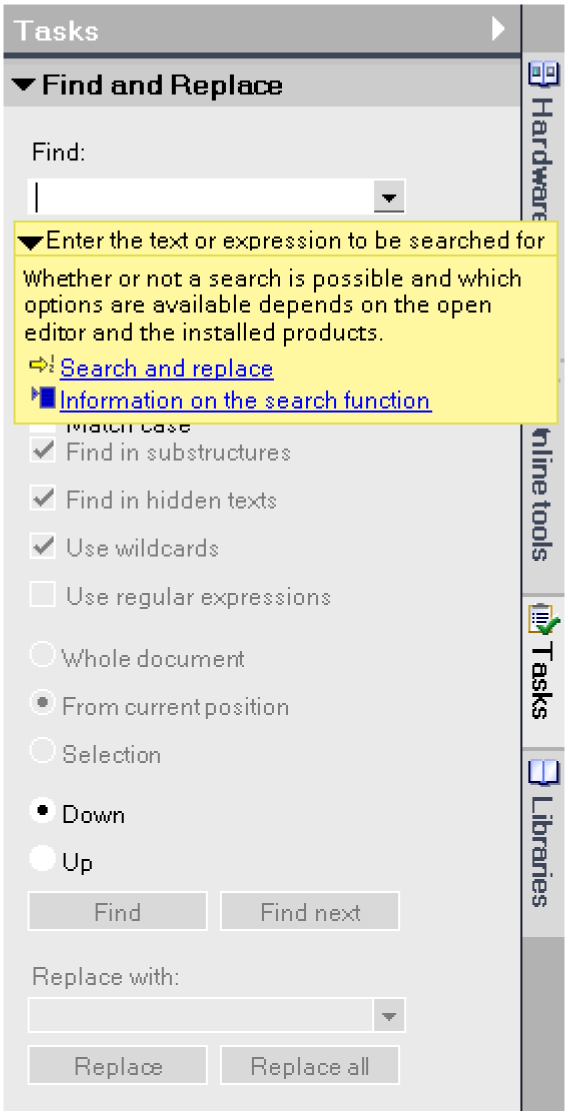
Tooltip

Interface elements offer you a tooltip for easier identification.

Tooltips, which have an arrow icon on the left, contain additional information in tooltip cascades. If you position the mouse pointer briefly over the tooltip or click the arrow icon, this information is displayed. The automatic display of tooltip cascades can be disabled.

If additional information is contained in the Help system, a link appears to the corresponding Help topic in the cascade. If you click on the link, the corresponding topic opens in Help.

The following figure shows a tooltip with opened cascade:


Enter the text or expression to be searched for

Whether or not a search is possible and which options are available depends on the open editor and the installed products.

Search and replace

Information on the search function

See also

Using the Help (Page 139)
Disabling the display of tooltip cascades (Page 141)
Safety Guidelines (Page 142)

4.2.2 Using the Help

Opening the Help system

You can open the Help system in the following ways:

1. In the "Help" menu, select the command "Show help" or press <F1> to display the corresponding help for the respective context.

or

1. Click on the link in a tooltip cascade to go directly to an additional point in the Help system.

Navigation via the toolbar

Click the "Show/hide table of contents" button on the left of the toolbar to show/hide the navigation area with the table of contents, search functions, index and favorites.

Use the "Forward" and "Back" buttons to display previous Help topics again.

Click on the "Display start page" button to return to the start page of the Help system.

Navigation via the menu

The Help system has its own menu containing the menu items "Examples", "See also", "History" and "Extra".

- Examples

  If available, examples are provided on the topic currently opened.
- See also

  If they exist, you will also find additional help topics here whose content is related to the current topic. Select a topic from the list to obtain additional information.
- History

  Select a topic that you have recently looked at in order to return to it.
- Extra

  Select the "Glossary" command to call up the glossary. The glossary contains explanations on important terms in alphabetical order.

Finding help topics based on the index

1. Click the "Show/hide table of contents" button in the help toolbar.

   The table of contents is displayed and the "Index", "Search" and "Favorites" tabs are visible.
2. Open the "Index" tab.
3. Enter the search term in the input box or select the search term from the list of key words.
4. Click "Display".

Full-text search

1. Click the "Show/hide table of contents" button in the help toolbar.

   The table of contents is displayed and the "Index", "Search" and "Favorites" tabs are visible.

2. Open the "Search" tab.
3. Type in your search term in the text box.
4. Refine your search if necessary using additional criteria:
   - Select "Search previous results" to start an additional search operation of your last search results only.
   - Select "Search for similar words" to find words that differ only slightly to your search term.
   - Select "Search titles only" to obtain exclusively results that contain your search term in the title. The contents of the Help topics are not taken into consideration during the search.
5. Click on the arrow icon on the right of the search field to use logic operations. The following logic operations are available:
   - Combine two or more search terms using the "AND" operator to find only Help topics that contain all the words searched for in the text.
   - Combine two or more search terms using the "OR" operator to find only Help topics that contain one or more of the search terms in the text.
   - Combine two or more search terms using the "NEAR" operator to find only Help topics that contain directly associated terms (eight words).
   - Precede a word with the "NOT" operator to exclude Help topics from the search that contain this word.
6. Click on "List topics" to start the search.

   The results are now listed with title, position and grade. The "Position" column contains the chapter in which the Help topic found is located. Sorting according to grade takes place in accordance with the position of the Help topics found in the table of contents and in accordance with the hits in the Help topics.

Using favorites

You can save individual help topics as favorites. This saves you searching for the help topic a second time.

To save a help topic as a favorite, follow these steps:

1. Open the help topic or the chapter you want to save as a favorite.
2. Click the "Show/hide table of contents" button in the help toolbar.

   The table of contents is displayed and the "Index", "Search" and "Favorites" tabs are visible.
3. Open the "Favorites" tab.
4. Click "Add".

   The help topic or chapter is saved as a favorite and is available the next time you open the help system.

To open a help topic saved as a favorite, follow these steps:

1. Click the "Show/hide table of contents" button in the help toolbar.

   The table of contents is displayed and the "Index", "Search" and "Favorites" tabs are visible.
2. Open the "Favorites" tab.
3. Select the topic you want to open from the list.

4. Click the "Display" button.

To remove a help topic from the favorites list, follow these steps:

1. Click the "Show/hide table of contents" button in the help toolbar.

   The table of contents is displayed and the "Index", "Search" and "Favorites" tabs are visible.
2. Open the "Favorites" tab.
3. Select the topic you want to remove from the list.
4. Click the "Remove" button.

Printing information

You can either print all the contents of the Help system or individual topics only. To mark the topics you would like to print, follow these steps:

1. Click the "Print" button. The table of contents opens in a separate window.
2. In "Print help topics", tick the folders and Help topics you would like printed.
3. Click on the "Print" button to print the selected information.

   The "Print" dialog opens.
4. Select the printer on which you want print the help topics.
5. Click "Settings" if you want to make additional printer settings.
6. Confirm your entries with "Print".

   The help topics are printed out on the selected printer.

See also

Safety Guidelines (Page 142)
Disabling the display of tooltip cascades (Page 141)

4.2.3 Disabling the display of tooltip cascades

You can suppress the automatic display of tooltip cascades. Manual display remains possible.

Procedure

To disable the automatic display of tooltip cascades, follow these steps:

1. In the "Options" menu, select the "Settings" command.
2. Select the "General" group in the area navigation.
3. Disable the "Show cascading tooltips automatically" check box in the "General settings".

If you want to display a tooltip cascade manually, click on the arrow icon within the tooltip.

See also

General remarks on the information system (Page 136)
Using the Help (Page 139)

4.2.4 Safety Guidelines

Safety guidelines

This Help manual contains you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

Danger

indicates that death or severe personal injury will result if proper precautions are not taken.

Warning

indicates that death or severe personal injury may result if proper precautions are not taken.

Caution

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

Caution

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

Notice

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by qualified personnel. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠ **Warning**

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

5 Editing projects

5.1 The basics of projects

Introduction

Projects are used to organize the storage of data and programs resulting from the creation of an automation solution. The data that makes up a project includes the following:

- Configuration data on the hardware structure and parameter assignment data for modules
- Project engineering data for communication over networks
- Project engineering data for the devices

Project hierarchy

Data is stored in a project in the form of objects. Within the project, the objects are arranged in a tree structure (project hierarchy).

The project hierarchy is based on the devices and stations along with the configuration data and programs belonging to them.

Common data of the project and online access, for example, are also displayed in the project tree.

See also

Creating a new project (Page 145)
Opening projects (Page 146)
Saving projects (Page 146)
Deleting projects (Page 147)

5.2 Creating a new project

Procedure

To create a new project, follow these steps:

1. Select the "New" command in the "Project" menu.

   The "Create a new project" dialog opens.

2. Enter your project name and path or accept the proposed settings.
3. Click the "Create" button.

Result

The new project is created and displayed in the project tree.

See also

The basics of projects (Page 145)
Opening projects (Page 146)
Saving projects (Page 146)
Deleting projects (Page 147)

5.3 Opening projects

Procedure

To open an existing project, follow these steps:

1. Select the "Open" command in the "Project" menu.

   The "Open project" dialog opens and includes the list of most recently used projects.
2. Select a project from the list and click "Open".
3. If the project you require is not included in the list, click the "Browse" button. Navigate to the required project folder and open the project file. The file extension is ".ap10".

Result

The project opens in the project view.

See also

The basics of projects (Page 145)
Creating a new project (Page 145)
Saving projects (Page 146)
Deleting projects (Page 147)

5.4 Saving projects

You can save the project at any time either under the same or a different name. You can even save a project when it still contains elements with errors.

Saving a project

To save a project, follow these steps:

1. Select the "Save" command in the "Project" menu.

   All changes to the project are saved under the current project name.

Project Save as

To save a project under another name, follow these steps:

1. Select the "Save as" command in the "Project" menu.

   The "Save current project as" dialog opens.
2. Select the project folder in the "Save in" box.
3. Enter the new project name in the "File name" box.
4. Confirm your entry with "Save".

   The project is saved under the new name and opened.

See also

The basics of projects (Page 145)
Creating a new project (Page 145)
Opening projects (Page 146)
Deleting projects (Page 147)

5.5 Closing projects

Procedure

To close a project, follow these steps:

1. Select the "Close" command in the "Project" menu.

   If you have made changes to the project since the last time you saved it, a message is displayed.
2. Decide whether or not you want to save the changes.

5.6 Deleting projects

Notice

When you delete a project, the entire project data is removed from the storage medium.

Requirement

The project you want to delete is not open.

Procedure

Follow the steps below to delete an existing project:

1. Select the "Delete project" command in the "Project" menu.

The "Delete project" dialog opens and includes the list of most recently used projects.

2. Select a project from the list and click the "Delete" button.

   If the project you require is not included in the list, click the "Browse" button. Navigate to the required project folder and open the project file. The file extension is ".ap10".

Result

The entire project folder is deleted from the file system.

See also

The basics of projects (Page 145)
Creating a new project (Page 145)
Opening projects (Page 146)
Saving projects (Page 146)

5.7 Comparing project data

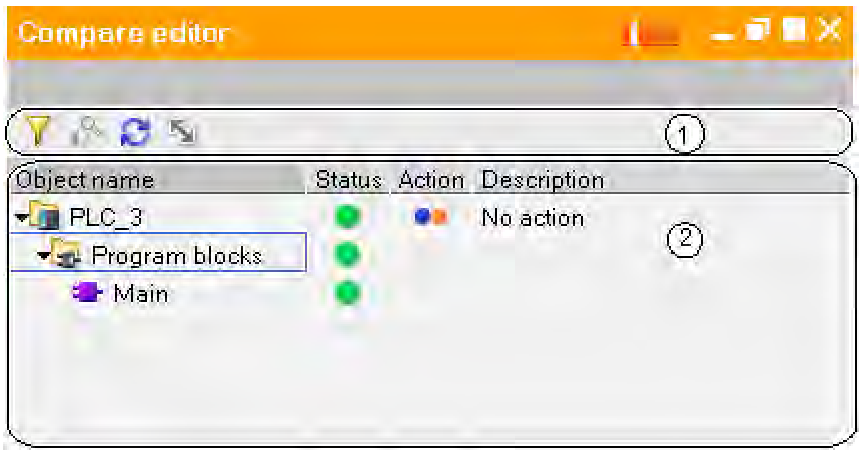
5.7.1 Overview of the comparison editor

Function

The comparison editor allows you to make an online-offline comparison of your project data. This allows you to display discrepancies and to react to them. Which project data you can compare, depends on the installed products.

Components of the comparison editor

The comparison editor is made up of the following components:



Object name	Status	Action	Description
PLC_3	●	●●	No action
Program blocks	●		
Main	●		

① Comparison editor toolbar

② Tabular comparison overview

Comparison editor toolbar

With the toolbar, you can access the following comparison editor functions:

- Filter for comparison results

  Using the filter, you can display or hide the objects that are identical online and offline.
- Start detailed comparison

  You can start a detailed comparison of the objects that differ online and offline. This function is, however, not available for every object.
- Update comparison results

  After you have modified objects, you can update the view of the comparison editor with this function.
- Synchronize comparison actions

  You can synchronize objects that differ online and offline with specific, customized comparison actions. The selected comparison action has an effect on all objects. After synchronization, the objects are identical online and offline.

Tabular comparison overview

The following table shows the meaning of the columns of the comparison overview:

Column	Meaning
Object name	Name of the objects or folder, for which the online-offline comparison is being conducted.
Status	Status of the online-offline comparison, indicated by means of symbols
Action	Action for object synchronization
Description	Description of the selected action

Symbols of the comparison overview

The status of the comparison is indicated by means of symbols. The following table shows the relevant symbols and their meaning:

Symbol	Column	Meaning
❗	Status	Folder contains objects whose online and offline versions differ
🟩	Status	Online and offline versions of the object are identical
●	Status	Online and offline versions of the object are different
◐	Status	Object only exists offline
◑	Status	Object only exists online

Symbol	Column	Meaning
●●	Action	No action
●◗	Action	Load object on the device
◖●	Action	Upload the object from the device to the programming device / PC

The status information is also shown in the project tree.

See also

Comparing online-offline (Page 150)
Using the filter for comparison results (Page 151)
Updating comparison results (Page 152)
Specifying actions (Page 152)
Synchronizing comparison actions (Page 153)

5.7.2 Comparing online-offline

Requirement

The project tree is open.

Procedure

To obtain an overview of the comparison status of the project data, follow these steps:

1. Select a device in the project tree.
2. Select the "Compare offline/online" command in the shortcut menu.

   If you have not yet established an online connection, the "Connect online" dialog opens. If the online connection has already been defined, the comparison editor opens.

Result

All objects that exist online and offline are displayed. You can see the status of the objects based on the icons. You can now define the actions you require for the objects.

See also

Overview of the comparison editor (Page 148)
Using the filter for comparison results (Page 151)
Updating comparison results (Page 152)
Specifying actions (Page 152)
Synchronizing comparison actions (Page 153)

5.7.3 Using the filter for comparison results

To make the comparison easier to view, you can show and hide objects whose online and offline versions are identical.

Requirement

The comparison editor is open.

Showing identical objects

To show identical objects again, follow these steps:

1. Click the "Filter for comparison results" button in the toolbar.

   All elements are displayed again.

Hiding identical objects

To hide identical objects, follow these steps:

1. Click the "Filter for comparison results" button in the toolbar.

   Only the elements that differ online and offline are displayed.

See also

Comparing online-offline (Page 150)
Overview of the comparison editor (Page 148)
Updating comparison results (Page 152)
Specifying actions (Page 152)
Synchronizing comparison actions (Page 153)

5.7.4 Running a detailed comparison

You can display a detailed comparison of the objects whose versions differ online and offline.

Note

This function is not available for every object.

Requirement

The comparison editor is open.

Procedure

To display a detailed comparison of an object, follow these steps:

1. Select the object in the comparison editor.

2. Click the "Start detailed comparison" button in the toolbar.

   If a detailed comparison is possible for the selected object, the object is opened in the online and offline version and the differences are highlighted.

5.7.5 Updating comparison results

As soon as you change an object, the comparison results are no longer valid and must be updated.

Requirement

The comparison editor is open.

Procedure

To update the comparison results, follow these steps:

1. Click the "Update comparison results" button in the toolbar.

   The comparison results are updated.

See also

Overview of the comparison editor (Page 148)
Comparing online-offline (Page 150)
Using the filter for comparison results (Page 151)
Specifying actions (Page 152)
Synchronizing comparison actions (Page 153)

5.7.6 Specifying actions

If you have performed a comparison, you can specify the actions to be performed for non-identical objects in the comparison editor. You cannot select any actions for identical objects.

Requirement

The comparison editor is open.

Procedure

To select an action for a non-identical object, follow these steps:

1. Right-click the icon in the "Action" column in the row of the object for which you want to select the action.
2. Select the action you require in the shortcut menu of the object.

See also

Overview of the comparison editor (Page 148)
Comparing online-offline (Page 150)

Using the filter for comparison results (Page 151)
Updating comparison results (Page 152)
Synchronizing comparison actions (Page 153)

5.7.7 Synchronizing comparison actions

When you synchronize, the actions you specified for objects that are not identical are executed.

See also: Specifying actions (Page 152)

Requirement

- The comparison editor is open.
- The desired actions have been selected.

Procedure

To synchronize the comparison actions, follow these steps:

1. Click the "Synchronize online and offline" button in the toolbar.

Result

The actions you specified for the objects are performed.

See also

Overview of the comparison editor (Page 148)
Comparing online-offline (Page 150)
Using the filter for comparison results (Page 151)
Updating comparison results (Page 152)

5.8 Compiling project data

5.8.1 General information on compiling project data

Compiling project data

During compilation, project data is converted so that it can be read by the device. Hardware configuration data and program data can be compiled separately or together. You can compile the project data for one or more target systems at the same time.

The following project data must be compiled prior to loading:

- Hardware project data, for example configuration data of the devices or networks and connections
- Software project data, for example, program blocks or process pictures

Scope of the compilation

When you compile project data, you have the following options depending on the device involved:

- All
- Hardware configuration
- Software
- Software (rebuild all blocks)

See also

Compiling project data (Page 154)

5.8.2 Compiling project data

The following section describes the general procedure for compiling project data in the project tree. You will find details of how certain objects are compiled and any special points to note in the help on programming and configuring your specific hardware.

Procedure

To compile project data, follow these steps:

1. In the project tree, right-click on the device for which you want to compile the project data.
2. Select the option you require in "Compile" shortcut menu.

Note

Note that the options available to you depend on the selected device.

Result

The project data is compiled. You can check whether or not the compilation was successful in the Inspector window with "Info > Compile".

See also

General information on compiling project data (Page 153)

5.9 Loading project data on the device

5.9.1 General information on loading

Loaded project data

The project data loaded on the devices is divided into hardware and software project data:

- Hardware project data results from configuring the hardware, networks, and connections. The first time you load, the entire hardware project data is loaded. When you load again later, only changes to the configuration are loaded.
- Software project data involves the blocks of the user program. The first time you load, the entire software project data is loaded. When you load again later, you can decide whether to load the entire software or only the software changes.

You can load individual objects, folders or complete devices depending on the scope of the installation. The following options are available for loading:

- Loading the project data in the project tree
- Loading project data to an accessible device

  You can drag-and-drop project data to load it to an accessible device.
- Loading project data to a memory card

  You can drag-and-drop project data to load it to a memory card.

Scope of the loaded project data

When you load the project data to the devices of the project, you have the following options depending on the device:

- All
- Hardware configuration
- Software
- Software (all blocks)

Which options are available depends on the object you want to load.

See also

Downloading project data from the project tree to the device (Page 155)

5.9.2 Downloading project data from the project tree to the device

The following section describes the general procedure for downloading project data to a device in the project tree. You will find details of how certain objects are loaded and any special points to note in the help on programming and configuring your specific hardware.

Requirement

- The project data is consistent.
- Each device is accessible via an online access.

Procedure

To load the project data to the selected devices, follow these steps:

1. Select one or more devices systems in the project tree.
2. Right-click on a selected element.

   The shortcut menu opens.
3. Select the option you require in the shortcut menu of the "Download to device" menu.

   Note

   Note that the options available to you depend on the selected device.

   If you had not previously established an online connection, the "Extended download to device" dialog is opened. If you have already defined an online connection, the "Load preview" dialog opens. Continue then with step 6.
4. Select the interface for your programming device / PC from the "PG/PC interface for loading" drop-down list box in the "Extended download to device" dialog. If there is a subnet, select also your subnet from the "Connection to subnet" drop-down list.
5. Select your device in the "Accessible devices in target subnet" table and confirm your selection with "Load".

   When necessary, the project data is compiled. The "Load preview" dialog opens. This dialog displays messages and proposes actions necessary for loading.
6. Check the messages and, where necessary, enable the actions in the "Action" column.

   Notice

   Performing the proposed actions during operation of the plant can cause serious damage to property or injury to persons if there are functional disturbances or program errors!

   Make sure that no dangerous situations can arise before you start the actions!

   As soon as loading becomes possible, the "Load" button is enabled.
7. Click the "Load" button.
8. The load is performed. The "Load results" dialog then opens. In this dialog, you can check whether or not the load was successful and take any further action that may be necessary.
9. Click the "Finish" button.

Result

The selected project data was loaded to the devices.

See also

General information on loading (Page 155)

5.9.3 Loading project data to an accessible device

The following section describes the general procedure for downloading project data to an accessible device in the project tree. You will find details of how certain objects are loaded and any special points to note in the help on programming and configuring your specific hardware.

Requirement

The accessible devices are displayed.

See also: Displaying accessible devices (Page 1533)

Procedure

To load project data to an accessible device, follow these steps:

1. In the project tree, drag the folder containing your device to the accessible device.

   The "Load preview" dialog opens. This dialog displays messages and proposes actions necessary for loading.
2. Check the messages and, where necessary, enable the actions in the "Action" column.

   Notice

   Performing the proposed actions during operation of the plant can cause serious damage to property or injury to persons if there are functional disturbances or program errors!

   Make sure that no dangerous situations can arise before you start the actions!
3. As soon as loading becomes possible, the "Load" button is enabled.
4. Click the "Load" button.

   The load is performed. The "Load results" dialog then opens. In this dialog, you can check whether or not the load was successful and take any further action that may be necessary.
5. Click the "Finish" button.

5.10 Printing project contents

5.10.1 Documentation settings

Introduction

Once you have created a project, you can print out the entire project data clearly. A well-structured printout is helpful when editing the project or performing service work. The printout can also be used for customer presentations.

Documentation settings

The documentation settings are used to create and manage plant documentation in printed form. You can prepare your project in the form of standardized circuit diagrams and print it in a uniform layout. You can either print the entire project or a compact overview of the project. The printout is always created based on the current project engineering.

You can also design the appearance of the printed pages according to your own requirements, for example with your company logo or company layout. The cover page of the printout in particular provides many editing options.

There are design templates available to allow to design the subsequent printout. These include templates complying with the ISO standard for technical documentation.

See also

Printing project data (Page 159)

5.10.2 Creating a print preview

Creating a print preview

You can create a preview of the printout. Just as when you actually print, you can select print templates and templates for cover pages. The settings are retained for later printing.

Procedure

To create a print preview and to set the scope of the later printout, follow these steps:

1. Select the "Print preview" command in the "Project" menu.

   The "Print preview" dialog opens.
2. Select the frame layout you want to use for the printout.
   - Select the print template in the "Frame" drop-down list.
   - Disable the "Exclude cover page" check box to specify a cover page for the printout. Select the template for the cover page from the "Cover page" drop-down list.
3. Select the "Compact" check box to print a shortened version of the project data. If you do not select this option, the full project data will be printed.

4. Confirm with "Preview"

   A print preview is created in the working view.

See also

Printing project data (Page 159)

5.10.3 Printing project data

Requirement

At least one printer is configured.

Printing project data

To print the data of the current project, follow these steps:

1. Select the "Print" command in the "Project" menu.

   The "Print" dialog opens.
2. Select the printer in the "Name" box.
3. Click "Advanced" if you want to specify additional printer settings.
4. Select the frame layout you want to use for the printout.
   – Select the print template in the "Frame" drop-down list.
   – Disable the "Exclude cover page" check box to specify a cover page for the printout. Select the template for the cover page from the "Cover page" drop-down list.
5. Select the "Compact" check box to print a shortened version of the project data. If you do not select this option, the full project data will be printed.
6. Confirm your entries with "Print".

   The project data is printed out on the selected printer.

See also

Documentation settings (Page 158)

5.11 Migrating projects

5.11.1 Migrating projects

Migration of existing projects

You can migrate objects or entire projects from previous automation solutions to the TIA portal. Each time you migrate, a new project is created for the migrated data with which you can then work.

All the migrations that go to make up a project are displayed clearly in a table. In the table, you have access to a log file that is created automatically for each migration.

The project parts you can migrate and the requirements that must be met depend on the initial product that was used used and the currently installed products. For more information on the migration options for your products, you can, for example, refer to the Service & Support Internet pages and the documentation of your software products.

See also

Displaying the project history (Page 160)
Displaying the log file of a migration (Page 161)

5.11.2 Displaying the project history

You can display an overview table of all the previous migrations.

The table shows the following:

- The product and the product version with which a project was created
- The product and the product version into which the migration was integrated
- A migration log for each migration
- The time of each migration

Procedure

To display the previous migrations in an overview table, follow these steps:

1. Select the open project in the project tree.
2. Select "Properties" in the shortcut menu of the project.

   The "Properties" dialog of the project opens.
3. Select "Project history" in the area navigation.

   The overview table is displayed.

See also

Displaying the log file of a migration (Page 161)

5.11.3 Displaying the log file of a migration

A log file in XML format is created for each migration. You can display the log file in the Microsoft Internet Explorer.

The log file contains the following information:

- Migrated objects
- Modifications to the objects caused by the migration
- Errors that occurred during migration

Procedure

To display the log file of a migration, follow these steps:

1. Select the open project in the project tree.
2. Select "Properties" in the shortcut menu of the project.

   The "Properties" dialog of the project opens.
3. Select "Project history" in the area navigation.

   The overview table is displayed.
4. Click on the link to the log file in the "Log file" column.

   The log file is displayed in the Microsoft Internet Explorer.

5.12 Finding and replacing in projects

5.12.1 Information on the search function

Find and replace

You can search for texts in the editors. The search function finds all texts containing the search key in the currently opened editor. The results are selected in sequence in the opened editor.

You also have the following options:

- Narrowing down the search with additional options
- Replacing found texts

The additional options and the type of texts for which you can search depend on the installed products and the currently open editor.

See also

Search and replace (Page 162)

5.12.2 Search and replace

Using Find

The "Find and replace" function enables you to search for or replace texts in an editor.

Additional options for searching

You can narrow down your search by selecting one of the following additional options:

- Whole words only

  Only whole words are found. Words that contain the search key as part of the word are ignored.
- Match case

  Upper- and lowercase letters are taken into account in the search.
- Find in substructures

  The search also includes texts contained in a parent object.
- Find in hidden texts

  Texts that are assigned to another text but that are currently hidden are also included in the search.
- Use wildcards

  Enter an asterisk as the wildcard for any number of characters. Example: You want to search for all words starting with "Device". Type in "Device*" in the search key box.

  Enter a question mark as the wildcard, however, if you only want to leave out a single character.
- Use regular expressions (for searching in scripts only)

  A regular expression is a character string used to describe sets of values and for filtering. This allows you to create complex search patterns.

The additional options available depend on the installed products and the editor opened.

Start search

Follow these steps to start the "Find and replace" function:

1. Select the "Find and replace" command in the "Edit" menu or select the "Find and replace" pane in the "Tasks" task card.

   The "Find and replace" pane opens.
2. Enter a term in the "Find" drop-down list.

   As an alternative, you can select the most recent search key from the drop-down list.
3. Select the options desired for the search.
4. Using the option buttons, select the starting point for the search and the search direction.
   - Select "Whole document" if you want to search through the entire editor regardless of the current selection,
   - Select "From current position" if you want to start the search at the current selection.
   - Select "Selection" if you only want to search within the current selection.
   - Select "Down" to search through the editor from top to bottom or from left to right.

– Select "Up" to search through the editor from bottom to top or from right to left.

5. Click "Find".

   The first hit is marked in the editor.

6. Click "Find next" to display the next hit.

   The next hit is marked in the editor. Repeat this process until you reach the last hit.

Replacing the search key

You have the option of replacing hits individually or automatically replacing all the found texts, if the respective editor supports this function. Follow these steps to replace terms:

1. Enter a term in the "Find" drop-down list.

   As an alternative, you can select the most recent search key from the drop-down list.

2. Select the options desired for the search.
3. Click the "Find" button to start a search for the specified search key.

   The first hit is displayed in the editor.

4. In the "Replace" drop-down list, enter the text you wish to use to replace the search key.

   As an alternative, you can select the most recently text specified from the drop-down list.

5. Click the "Replace" button to replace the selected hit with the specified text.

   The found text is replaced and the next hit is marked in the editor.

   Repeat this process until you have replaced all the hits as wanted. To skip to the next hit without replacing the marked word, click the "Find" button instead of "Replace".

6. Click "Replace all" to automatically replace all hits at once.

See also

Information on the search function (Page 161)

5.13 Working with memory cards

5.13.1 Basics about memory cards

Introduction

Memory cards are plug-in cards that can be used for a variety of purposes. There are several different types of memory cards available. With devices of the S7-1200 series, you can only use SD cards from Siemens. The SD card is accessed either using an SD card reader connected to the programming device or directly via the device.

Before you insert a memory card in the CPU or remove a card from it, make sure that you turn the CPU off. The CPU restarts automatically when it is powered up again.

Using memory cards

Before you can use a memory card, you first need to specify the card type. Depending on the card type you select, you can use the card for various tasks. You can choose from the following card types:

- Program

  If it is used as a program card, you can load the user program on the memory card. In this case, the internal load memory of the device is replaced by the memory card and the internal load memory is erased. The user program is then fully executable from the memory card. If the memory card with the user program is removed, there is no longer a program available.

- Transfer

  If it is used as a transfer card, you can transfer the user program from the memory card to the internal load memory of the CPU. You can then remove the memory card again.

See also

Adding a user-defined card reader (Page 164)
Accessing memory cards (Page 165)
Selecting the card type of a memory card (Page 165)
Displaying properties of memory cards (Page 166)

5.13.2 Adding a user-defined card reader

Introduction

If your card reader is not detected automatically, you can add it manually.

Requirement

The project view is open.

Procedure

To add a card reader, follow these steps:

1. Open the project tree.
2. Select "SIMATIC Card Reader > Add user-defined Card Reader" in the "Project" menu.

   The "Add user-defined Card Reader" dialog opens.
3. In the drop-down list box, select the path for the card reader.
4. Confirm your entries with "OK".

See also

Basics about memory cards (Page 163)
Accessing memory cards (Page 165)
Selecting the card type of a memory card (Page 165)
Displaying properties of memory cards (Page 166)

5.13.3 Accessing memory cards

Requirement

- A memory card is inserted in the card reader.
- The project view is open.

Procedure

To access memory cards, follow these steps:

1. Open the project tree.
2. Select "SIMATIC Card Reader > Show SIMATIC Card Reader" in the "Project" menu.

   The "SIMATIC Card Reader" folder opens in the project tree.
3. Open the "SIMATIC Card Reader" folder.

   You can now access the memory card.

See also

Basics about memory cards (Page 163)
Adding a user-defined card reader (Page 164)
Selecting the card type of a memory card (Page 165)
Displaying properties of memory cards (Page 166)

5.13.4 Selecting the card type of a memory card

Requirement

- A memory card is inserted in the card reader.
- The project view is open.

Procedure

To select the card type of a memory card, follow these steps:

1. Right-click on the memory card for which you want to select the card type.
2. Select the "Properties" command in the shortcut menu.

   The "Memory Card <name of the memory card>" dialog opens.
3. In the "Card type" drop-down list, select the required card type.

See also

Basics about memory cards (Page 163)
Adding a user-defined card reader (Page 164)
Accessing memory cards (Page 165)
Displaying properties of memory cards (Page 166)

5.13.5 Displaying properties of memory cards

Overview of the properties

The following table shows which properties of the current memory card you can display:

Property	Description
Name	Name of the memory card
Write protection	Shows if the memory card is read-only.
File system	File system of the memory card
Memory capacity	Available memory on the memory card
Used space in bytes	Card memory in use in bytes
Free space in bytes	Free memory of the memory card in bytes
Serial number	The serial number of the memory card is displayed if the memory card supports this function.
Card type	Display and selection of the card type

Requirement

- A memory card is inserted in the card reader.
- The project view is open.

Procedure

To display the properties of a memory card, follow these steps:

1. Right-click on the memory card for which you want to display the properties.
2. Select the "Properties" command in the shortcut menu.

   The "Memory Card <name of the memory card>" dialog opens. The properties are displayed in this dialog.

See also

Basics about memory cards (Page 163)
Adding a user-defined card reader (Page 164)
Accessing memory cards (Page 165)
Selecting the card type of a memory card (Page 165)

5.14 Working with text lists

5.14.1 Text lists

Introduction

You can manage texts to be referenced in alarms centrally. All the texts are stored in text lists. Each text list has a unique name with which you can call up its content. A range of values is assigned to each text in a text list. If a value from a range of values occurs, the corresponding text is called up.

All the texts can be translated to all project languages. Here, you have two options available:

- You can enter the translation of the texts in a list.
- You can export all texts to an Excel or CSV file and enter the translation in a spreadsheet program. The translations can then be imported again.

Each device in the project has its own text lists. For this reason, they are arranged under the devices in the project tree.

User-defined and system-defined text lists

There are two types of text lists:

- User-defined text lists

  You can create user-defined text lists yourself and fill them with texts; in other words, you can specify value ranges and the corresponding texts yourself. The name of user-defined text lists begins with "USER" or a user-selected name.

- System-defined text lists

  System-defined text lists are created by the system. These always involve texts relating to modules. They are automatically created as soon as you insert a module in your project. With system alarms, the name of the text list begins with "SYSTEM". The name of the text list and the ranges of values it contains cannot be modified. You can only edit texts assigned to individual value ranges.

User-defined text lists	System-defined text lists
A user-defined text list can only be assigned to one device.	System-defined text lists can be assigned both to a device as well as to the entire project.
You can create new text lists and delete existing text lists.	You cannot create new text lists or delete text lists.
You can add and delete value ranges in the text lists.	You cannot add or delete value ranges in the text lists.
You can specify both the value ranges as well as the associated texts.	You can only edit the text associated with one value range.

Device-specific and cross-device text lists

Device-specific text lists relate to only one device in the project and are therefore only valid for this device. For this reason, they are arranged under a device in the project tree. Device-specific text lists can be used-defined or created by the system.

If system-defined text lists are generally valid for several devices or not intended uniquely for one device, these are grouped together in the project tree under "Common data". These text lists are available for all devices. Cross-device text lists are always created by the system and are used solely for system diagnostics alarms. For this reason, you cannot store any user-defined text lists under "Common data".

See also

Project text basics (Page 170)
Creating user-defined text lists (Page 168)
Editing user-defined text lists (Page 169)
Editing system-defined text lists (Page 169)

5.14.2 Creating user-defined text lists

Creating text lists

You can create user-defined text lists for individual devices.

Requirement

- You are in the project view
- A project is open
- The project includes a least one device

Procedure

To create user-defined text lists, follow these steps:

1. Click on the arrow to the left of a device in the project tree.

   The elements arranged below the device are displayed.
2. Double-click on "Text lists".

   All the text lists assigned to the device are displayed in the work area listed in a table.
3. Double-click on the first free row in the table.

   A new user-defined text list is created.
4. Enter a name for your new text list in the "Name" column.
5. From the drop-down list in the "Selection" column, select whether you want to specify the value ranges in decimal, binary or in bits.
6. Enter a comment in the "Comment" column.

   A new user-defined text list has been created and you can now enter the value ranges and texts.

See also

Editing user-defined text lists (Page 169)

5.14.3 Editing user-defined text lists

Editing user-defined text lists

You can enter value ranges and the corresponding texts in user-defined text lists. User-defined text lists are always located below a device in the project tree.

Requirement

- You are in the project view
- A project is open
- The project includes a least one device

Adding to user-defined text lists with value ranges and texts

To add to user-defined text lists with value ranges and texts, follow these steps:

1. Click on the arrow to the left of a device in the project tree or the "Common data" element.

   The elements arranged below are displayed.
2. Double-click on "Text lists".

   All the text lists assigned to the device are displayed in the work area listed in a table.
3. Select a text list in the table.

   An additional table is opened in the work area below the text lists in which you can enter the value range and texts.
4. Enter the value ranges you require in the "Range from" and " Range to" columns. The entry must be made in the numeric format selected for the text list.
5. Enter a text for each value range in the "Entry" column.

See also

Editing system-defined text lists (Page 169)
Translating texts directly (Page 173)

5.14.4 Editing system-defined text lists

Editing system-defined text lists

In system-defined text lists, you can only modify the individual texts assigned to a value range.

System-defined text lists are located in the project tree either below a device or under "Common data".

Requirement

- You are in the project view
- A project is open
- The project includes a least one device

Modifying texts in system-defined text lists

To add to or edit texts in system-defined text lists that are assigned to a value range, follow these steps:

1. Click on the arrow to the left of a device in the project tree or the "Common data" element.

   The elements arranged below are displayed.
2. Double-click on "Text lists".

   All the text lists assigned to the device or used in common are displayed in the work area listed in a table.
3. Select a text list in the table.

   A further table is opened in the work area below the text lists. Here, you can add to or edit the texts assigned to a value range.
4. Enter a text for each value range in the "Entry" column.

See also

Editing user-defined text lists (Page 169)
Translating texts directly (Page 173)

5.15 Working with multi-language projects

5.15.1 Project text basics

Texts in different languages in the project

Texts that are output on display devices during processing are typically entered in the language in which the automation solution is programmed. Comments and the names of objects are also entered in this language.

If operators do not understand this language, they require a translation of all operator-relevant texts into a language they understand. You can therefore translate all the texts into any language. In this way, you can ensure that anyone who is subsequently confronted with the texts sees the texts in his/her language of choice.

Editing language and project languages

Every project has an editing language. When you enter texts, these are always created in the editing language.

Project languages are all languages in which a project will later be used. Based on the editing language, all the texts can be translated to the various project languages.

Text types that can be managed in more than one language

You can, for example, manage the following types of text in more than one language:

- Titles and comments
  - Block titles and block comments
  - Network titles and network comments
  - Statement comments from STL programs
  - Comments in tables
- Display texts
  - Alarm texts
  - Operator-relevant texts
  - Text lists

Translating texts

There are two ways of translating texts.

- Translating texts directly

  You can enter the translations for the individual project languages directly in the "Project texts" table.
- Translating texts using reference texts

  For smaller amounts of text, you can change the editor language. All the text cells are filled again with the default values and can be filled in the current language.

Note
Using Asian project languages

A language is only available as a runtime language if it has been installed in the operating system. If you want to create a project with Asian fonts, you need to enable the support for the respective language in the operating system. See the documentation for the operating system for details about the procedure.

See also

Text lists (Page 167)
Select project languages (Page 172)
Translating texts directly (Page 173)
Selecting the language (Page 129)
Setting the editing language (Page 172)
Translating texts using reference texts (Page 173)

5.15.2 Select project languages

Select project languages

All the texts can be displayed in the same language that you selected for your software user interface. This means that all texts must exist in the corresponding language. You can select the available languages yourself.

Requirement

- You are in the project view
- A project is open

Procedure

To select the project languages, follow these steps:

1. Click on the arrow to the left of "Languages & resources" in the project tree.

   The elements below this are displayed.
2. Double-click on "Project languages".

   In the work area, you will see a list of languages that you can select.
3. Select the required languages.

All texts can be displayed in the enabled languages.

5.15.3 Setting the editing language

Setting the editing language

All the texts in the project are created in the editing language. If you change the editing language, all future text input will be stored in the new editing language.

Requirement

- You are in the project view
- A project is open

Procedure

To change the editing language, follow these steps:

1. Click on the arrow to the left of "Languages & resources" in the project tree.

   The low-level elements are displayed.
2. Double-click on "Project languages".

   The possible settings for the project languages are displayed in the work area.
3. Select the editing language in "General > Editing language".

5.15.4 Translating texts directly

Translating texts

If you use more than one language in your project, you can enter translations of individual texts directly in the selected project languages. As soon as you change the language of the software user interface, the translated texts are available in the selected language.

Requirement

- You are in the project view
- A project is open
- You have selected at least one further project language.

Procedure

To translate individual texts, follow these steps:

1. Click on the arrow to the left of "Languages & resources" in the project tree.

   The elements below this are displayed.
2. Double-click on "Project texts".

   A list with the texts in the project is displayed in the work area. There is a separate column for each project language.
   - To group identical texts and to translate them all at once, click the "Switch on/off grouping" button in the toolbar.
   - To hide texts that do not have a translation, click the "Filter for empty texts on/off" button in the toolbar.
3. Enter the translation in the relevant column.

Note

If there is no translation for a text in a particular language, the English text is displayed.

5.15.5 Translating texts using reference texts

Introduction

After changing the editing language, all texts are shown in input boxes in the new editing language. If there is not yet a translation available for this language, the input boxes are empty or filled with default values.

If you enter text again in an input field, this is saved in the current editing language. Following this, the texts exist in two project languages for this input field, in the previous editing language and in the current editing language. This makes it possible to create texts in several project languages.

You can display existing translations for an input box in other project languages. These serve as a comparison for text input in the current editing language and they are known as the reference language.

Note

The "Show reference texts" function depends on the installed products and the open editor.

Requirement

There is at least one translation into a different project language for an input field.

Procedure

To display the translation of an input cell in a reference language, follow these steps:

1. In the "Tasks" task card, select the "Languages & resources" pane.
2. Select a reference language from the "Reference language" drop-down list.

Result

The reference language is preset. If you click in a text block, translations that already exist in other project languages are shown in the "Tasks > Reference text" task card.

5.16 Working with libraries

5.16.1 Library basics

Introduction

You can store objects you want to use more than once in libraries. It is possible to reuse the stored objects throughout a project or across projects. This means you can, for example, create block templates for use in different projects and adapt them to the particular requirements of your automation task.

Library types

Depending on the task, you can use one of the following library types:

- Project library

  Each project has its own library. Here, you store the objects you want to use more than once in the project. This project library is always opened, saved, and closed together with the current project.
- Global libraries

You can also create other libraries in addition to the project library. Here, you store the objects you want to use in more than one project. You can create, change, save, and transfer these global libraries independent of projects.

In the global libraries area, you will also find libraries that ship with the software. These include off-the-peg functions and function blocks that you can use within your project. You cannot modify the supplied libraries.

Library objects

Libraries can accommodate a large number of objects. These include, for example:

- Functions (FCs)
- Function blocks (FBs)
- Data blocks (DBs)
- Devices
- PLC data types
- Watch tables
- Process screens
- Faceplates

Use types

You can use the library objects as either a copy template or an instance. You use copy templates to create true copies. If you make changes to the template later, these changes will not be made to the copies that are in use. However, if you create instances, the change will be applied to each point of use.

Note

The use as an instance is not available for every object, however.

See also

Project library basics (Page 178)
Global library basics (Page 182)

5.16.2 "Libraries" task card

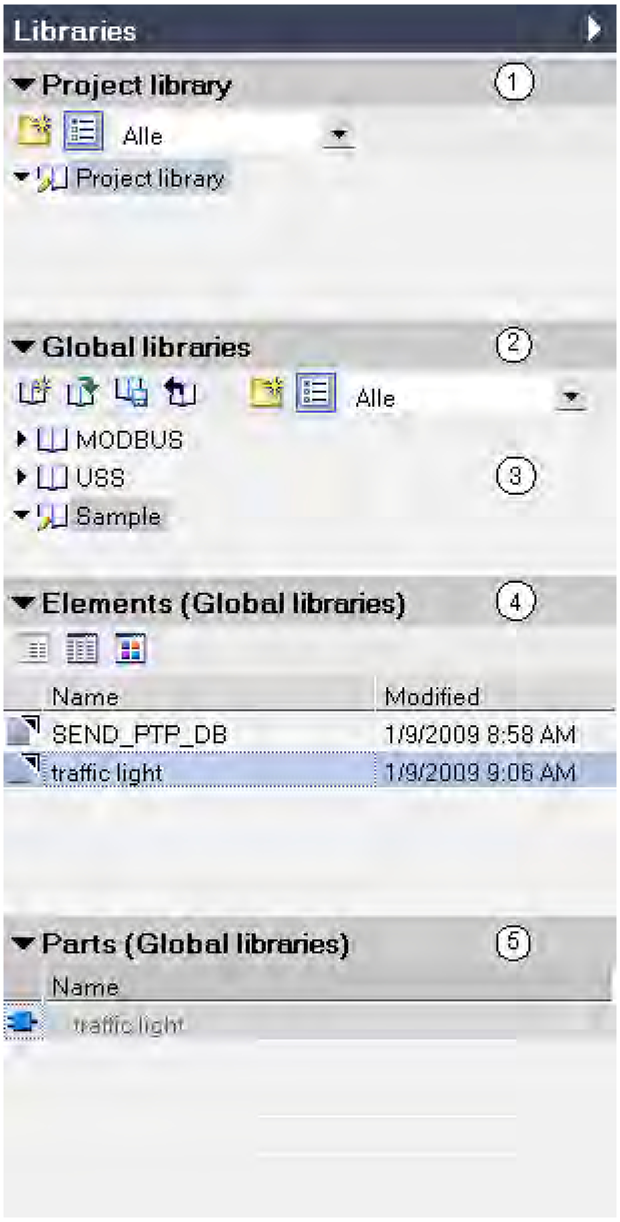
Function of the "Libraries" task card

The "Libraries" task card enables you to work efficiently with the project library and the global libraries.

You can show or hide the task card as needed.

Structure of the "Libraries" task card

The "Libraries" task card consists of the following components:



Name	Modified
SEND_PTP_DB	1/9/2009 8:58 AM
traffic light	1/9/2009 9:06 AM

①	"Project library" pane
②	"Global libraries" pane
③	Supplied global libraries
④	"Elements" pane
⑤	"Parts" pane

"Project library" pane

In this pane, you can store the objects that you want to use more than once in the project.

"Global libraries" pane

In this pane, you can store the objects you want to use more than once in various projects.

Supplied global libraries

The "Global libraries" pane also lists libraries that ship with the system. These libraries provide you with ready-made functions and function blocks. You can use these supplied global libraries but cannot modify them.

"Elements" pane

In this pane, you can display the elements of a library.

"Parts" pane

In this pane, you can display the contents of the library elements.

5.16.3 Using the elements and parts view

Introduction

When you open the "Libraries" task card the first time, the "Project library" and "Global libraries" panes are opened and the "Parts" pane is closed. You need to open the "Elements" pane explicitly.

The elements view shows the elements of the selected library. You can select one of the following views:

- Details
- List
- Overview

The parts view shows the contents of the selected library element.

Requirement

The "Libraries" task card is displayed.

Procedure

To use the elements and parts view, follow these steps:

1. Click "Open or close element view" in the "Project library" or "Global libraries" pane.

5.16.4 Working with the project library

5.16.4.1 Project library basics

Function

In the project library, you can store the elements that you want to use more than once in the project. The project library is generated and saved automatically with the project.

See also

Library basics (Page 174)

5.16.4.2 Creating folders in the project library

You can structure the elements of the project library individually to suit your purposes using folders and subfolders.

Requirement

The "Libraries" task card is displayed.

Procedure

To create a new folder in the project library, follow these steps:

1. Right-click on the project library or an existing folder.
2. Select "Add folder" from the shortcut menu.

   A new folder is created.
3. Enter a name for the new folder.

5.16.4.3 Adding elements to the project library

Prerequisites

The "Libraries" task card is displayed.

Procedure

To add a new element to the project library, follow these steps:

1. Select the element you want to add to the project library.
2. Drag the selected element onto the book icon of the project library in the "Project library" palette in the "Libraries" task card. Release the left mouse button when a small plus symbol appears below the mouse pointer.

5.16.4.4 Using elements of the project library

Requirement

The "Libraries" task card is displayed.

Procedure

To use an element from the project library in your project, follow these steps:

1. Open the project library so that you can see the elements of the library.
2. Drag the element from the "Project library" pane to the location where you want to use it. If you are not permitted to insert it at this location, the mouse pointer changes to a circle with a slash.

   If there is already an element with the same name at this location, the "Paste" dialog opens. In this dialog, you can decide whether to replace the existing element or to insert the element from the project library with a different name.

   Note

   The "Paste" dialog is not displayed for all elements. The elements for which the dialog is available depends on the installed products.

Or:

1. Open the element view.
2. Drag the element from the "Elements" pane to the location where you want to use it. If you are not permitted to insert it at this location, the mouse pointer changes to a circle with a slash.

   If there is already an element with the same name at this location, the "Paste" dialog opens. In this dialog, you can decide whether to replace the existing element or to insert the element from the project library with a different name.

   Note

   The "Paste" dialog is not displayed for all elements. The elements for which the dialog is available depends on the installed products.

5.16.4.5 Editing elements of a project library

You can use the following editing commands on library elements:

- Copy
- Cut
- Paste
- Moving within the library

- Rename
- Delete

Each of these commands can always be executed via the keyboard (Page 132) , menu, and shortcut menu.

Requirement

The "Libraries" task card is displayed.

Copying elements

To copy a library element, follow these steps:

1. Right-click on the library element you want to copy.
2. Select the "Copy" command in the shortcut menu.

Cutting elements

To cut a library element, follow these steps:

1. Right-click on the library element you want to cut.
2. Select the "Cut" command in the shortcut menu.

Pasting elements

To paste a library element, follow these steps:

1. Copy or cut a library element.
2. Right-click on the library where you want to paste the element.
3. Select the "Paste" command in the shortcut menu.

Moving elements

To move a library element within a library, follow these steps:

1. Select the library element you want to move.
2. Drag the library element to the library where you want to insert the element.

Note

When you move an element from a library to another library, the element is copied and not moved.

Renaming elements

To rename a library element, follow these steps:

1. Right-click on the element you want to rename.

2. Select the "Rename" command in the shortcut menu.
3. Enter the new name.

Deleting elements

To delete a library element, follow these steps:

1. Right-click on the library element you want to delete.
2. Select the "Delete" command in the shortcut menu.

5.16.4.6 Removing elements from the project library

Prerequisites

The "Libraries" task card is displayed.

Procedure

To remove an element from the project library, follow these steps:

1. Maximize the project library in the "Project library" palette so that you can see the elements of the library.
2. Right-click on the element you want to remove.
3. Select the "Delete" command in the context menu.

Or:

1. Open the element view.
2. Right-click on the element you want to remove in the "Elements" palette.
3. Select the "Delete" command in the context menu.

5.16.4.7 Filtering the view

To make viewing of extensive libraries more straightforward, you can use filter options to limit the display.

Requirement

The "Libraries" task card is displayed.

Procedure

To filter the view, follow these steps:

1. Open either the "Project library" pane or "Global libraries" pane.
2. In the drop-down list, select the object type for which you want to display the library elements.

Result

Only the library elements that are available for the object type are displayed. You can set the filter to "All" at any time to revert to an unfiltered view.

5.16.5 Working with global libraries

5.16.5.1 Global library basics

Function

You can store elements in global libraries that you want to use in other projects. You must create global libraries explicitly.

Shared work with global libraries

You can use global libraries together with other users. This requires, however, that all users who want to access to the global library open the library as read-only.

See also

Library basics (Page 174)

5.16.5.2 Creating a new global library

Requirement

The "Libraries" task card is displayed.

Procedure

To create a new global library, follow these steps:

1. Click "Create new global library" in the toolbar of the "Global libraries" pane or select the menu command "Options > Global libraries > Create new library".

   The "Create new global library" dialog box opens.
2. Specify the name and the storage location for the new global library.
3. Confirm your entries with "Create".

Result

The new global library is generated and inserted into the "Global libraries" pane. A folder with the name of the global library is created in the file system at the storage location of the global library. This actual library file is given the file name extension ".al10".

5.16.5.3 Opening a global library

Requirement

The "Libraries" task card is displayed.

Procedure

To open a global library, follow these steps:

1. Click "Open global library" in the toolbar of the "Global libraries" pane or select the menu command "Options > Global libraries > Open library".

   The "Open global library" dialog box opens.
2. Select the global library you want to open. Library files are identified by the file name extension ".al10".
3. You can also open the library so that it is write-protected. To do this, enable the "Open as read-only" option in the "Open global library" dialog.

   Note

   Note the following:

   – You cannot enter any additional elements in the global library if you open the library as read-only.

   – All users have to open the library as read-only if multiple users want to access the library. This is a requirement for shared access to the library.

   ---
4. Click "Open".

   The selected global library is opened and inserted into the "Global libraries" pane.

5.16.5.4 Saving a global library

You can save changes made to global libraries not supplied by Siemens at any time. You can save a global library under another name using the "Save as" command.

Requirement

- The "Libraries" task card is displayed.
- The global library is not write protected.

Saving changes

To save a global library, follow these steps:

1. Right-click on the global library you want to save.
2. Select the "Save library" command in the shortcut menu.

Saving a global library under another name

To save a global library under another name, follow these steps:

1. Right-click on the global library you want to rename.

2. Select the "Save library as" command in the shortcut menu.

   The "Save global library as" dialog opens.
3. Select the storage location and enter the file name.
4. Confirm your entries with "Save".

5.16.5.5 Closing a global library

Global libraries are independent of projects. This means that they are not closed together with your project. You must therefore close global libraries explicitly.

Requirement

The "Libraries" task card is displayed.

Procedure

To close a global library, follow these steps:

1. Right-click on the global library you want to close.
2. Select the "Close library" command in the shortcut menu.
3. If you make changes to the global library, a dialog box opens where you can choose whether you want to save the changes to the global library. Click "Yes" or "No", depending on whether or not you would like to save your changes.

   The global library is closed.

5.16.5.6 Deleting a global library

A global library is deleted in the Windows Explorer.

Requirement

The global library has been closed by all users.

Procedure

To delete a global library, follow these steps:

1. Open Windows Explorer.
2. Right-click on the library directory.
3. Select the "Delete" command in the shortcut menu.
4. Confirm the safety prompt with "Yes".

5.16.5.7 Creating folders in the global libraries

You can organize the elements of your custom global libraries to suit your purposes using folders and subfolders.

Requirement

- The "Libraries" task card is displayed.
- The global library is not write protected.

Procedure

To create a new folder in the global library, follow these steps:

1. Right-click on the global library or an existing folder.
2. Select "Add folder" from the shortcut menu.

   A new folder is created.
3. Enter a name for the new folder.

5.16.5.8 Adding elements to a global library

Prerequisites

- The "Libraries" task card is displayed.
- The global library is not write protected.

Procedure

To add a new element to a global library, follow these steps:

1. Select the element you want to add to the library.
2. Drag the element selected in the "Global libraries" palette in the "Libraries" task card to the book icon of the library to which you want to add the element. Release the left mouse button when a small plus symbol appears below the mouse pointer.

5.16.5.9 Using elements of a global library

Requirement

The "Libraries" task card is displayed.

Procedure

To use an element from a global library in your project, follow these steps:

1. Maximize the global library so that you can see the elements of the library.

2. Drag the element from the "Global libraries" pane to the location where you want to use it, for example to the project tree. If you are not permitted to insert it at this location, the mouse pointer changes to a circle with a slash.

   If there is already an element with the same name at this location, the "Paste" dialog opens. In this dialog, you can decide whether to replace the existing element or to insert the element from the project library with a duplicate identification (Name_Number).

Note

The "Paste" dialog is not displayed for all elements. The elements for which the dialog is available depends on the installed products.

Or:

1. Open the element view.
2. Drag the element either from the "Elements" pane or the "Parts" pane to the location where you want to use it, for example to the project tree. If you are not permitted to insert it at this location, the mouse pointer changes to a circle with a slash.

   If there is already an element with the same name at this location, the "Paste" dialog opens. In this dialog, you can decide whether to replace the existing element or to insert the element from the project library with a duplicate identification (Name_Number).

Note

The "Paste" dialog is not displayed for all elements. The elements for which the dialog is available depends on the installed products.

5.16.5.10 Editing elements of a global library

You can use the following editing commands on library elements:

- Copy
- Cut
- Paste
- Moving within the library
- Rename
- Delete

Each of these commands can always be executed via the keyboard (Page 132) , menu, and shortcut menu.

Requirement

- The "Libraries" task card is displayed.

- The global library is not write protected.

Copying elements

To copy a library element, follow these steps:

1. Right-click on the library element you want to copy.
2. Select the "Copy" command in the shortcut menu.

Cutting elements

To cut a library element, follow these steps:

1. Right-click on the library element you want to cut.
2. Select the "Cut" command in the shortcut menu.

Pasting elements

To paste a library element, follow these steps:

1. Copy or cut a library element.
2. Right-click on the library where you want to paste the element.
3. Select the "Paste" command in the shortcut menu.

Moving elements

To move a library element within a library, follow these steps:

1. Select the library element you want to move.
2. Drag the library element to the library where you want to insert the element.

Note

When you move an element from a library to another library, the element is copied and not moved.

Renaming elements

To rename a library element, follow these steps:

1. Right-click on the element you want to rename.
2. Select the "Rename" command in the shortcut menu.
3. Enter the new name.

Deleting elements

To delete a library element, follow these steps:

1. Right-click on the library element you want to delete.

2. Select the "Delete" command in the shortcut menu.

5.16.5.1 Removing elements from a global library
1

Prerequisites

- The "Libraries" task card is displayed.
- The global library is not write protected.

Procedure

To remove an element from a global library, follow these steps:

1. Maximize the global library in the "Global libraries" palette so that you can see the elements of the library.
2. Right-click on the element you want to remove.
3. Select the "Delete" command in the context menu.

Or:

1. Open the element view.
2. Right-click on the element you want to remove in the "Elements" palette.
3. Select the "Delete" command in the context menu.

5.16.5.1 Using a supplied global library
2

Depending on the products you install, various global libraries ship with the system.

Requirement

The "Libraries" task card is displayed.

Procedure

To use an element from a supplied global library in your project, follow these steps:

1. Open the relevant library so that you can see the elements of the library.
2. Drag the element from the "Global libraries" pane to the location where you want to use it, for example to the project tree. If you are not permitted to insert it at this location, the mouse pointer changes to a circle with a slash.

Or:

1. Open the element view.

2. Drag the element from the "Parts" pane to the location where you want to use it, for example to the project tree. If you are not permitted to insert it at this location, the mouse pointer changes to a circle with a slash.

5.16.5.1 Filtering the view 3

To make viewing of extensive libraries more straightforward, you can use filter options to limit the display.

Requirement

The "Libraries" task card is displayed.

Procedure

To filter the view, follow these steps:

1. Open either the "Project library" pane or "Global libraries" pane.
2. In the drop-down list, select the object type for which you want to display the library elements.

Result

Only the library elements that are available for the object type are displayed. You can set the filter to "All" at any time to revert to an unfiltered view.

5.17 Protecting project data

5.17.1 Protection concept for project data

Introduction

You can protect your project data from unauthorized access. These include, for example:

- Restrictions when accessing devices
- Copy and display protection of blocks

5.18 Using cross-references

5.18.1 Using cross-references

Introduction to cross-references

The cross-reference list provides an overview of the use of objects within the project. You can see which objects are interdependent and where the individual objects are located. Cross-references are therefore part of the project documentation.

You can also jump directly to the point of use of an object.

Which objects you can display and localize in the cross-reference list depends on the installed products.

Configuring devices and networks 6

6.1 Hardware and network editor

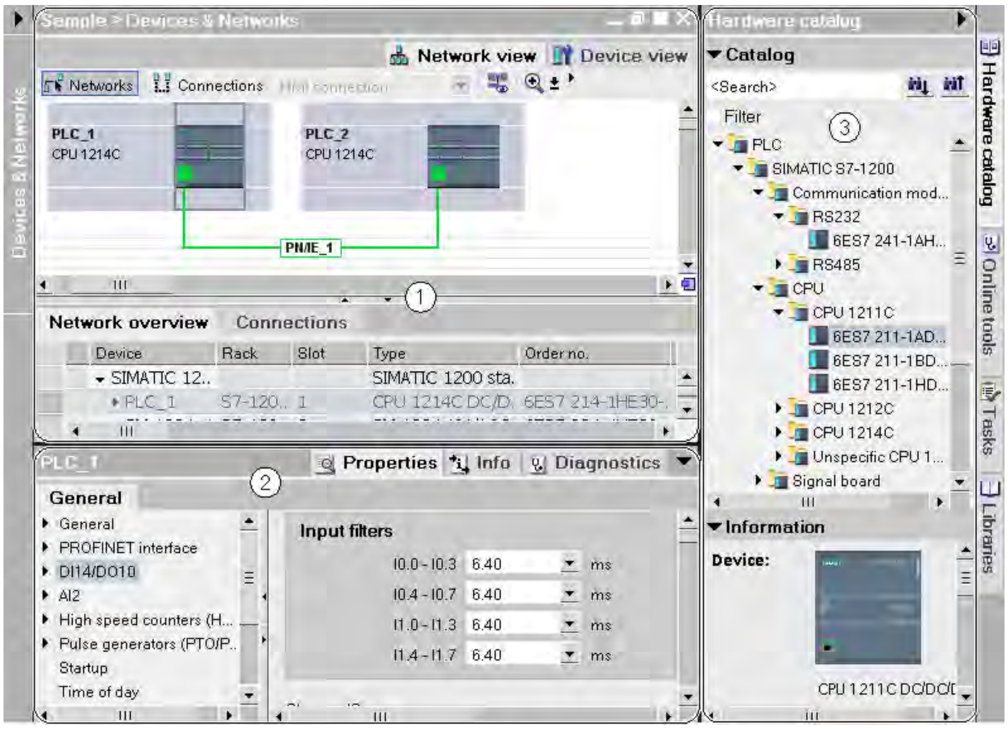
6.1.1 Overview of hardware and network editor

Function of the hardware and network editor

The hardware and network editor is the integrated development environment for configuring, networking and assigning parameters to devices and modules. It offers maximum assistance in the realization of the automation project.

Structure of the hardware and network editor

The hardware and network editor consists of the following components:



① Device view (Page 194) and/or network view (Page 192)

② Inspector window (Page 197)

③ Hardware catalog (Page 198)

The hardware and network editor consists of a device view and a network view. You can switch between these two components at any time depending on whether you want to produce and edit individual devices and modules or entire networks and device configurations.

The inspector window contains information on the object currently marked. Here you can change the settings for the object marked.

Drag the devices and modules you need for your automation system from the hardware catalog into the network or device view.

6.1.2 Network view

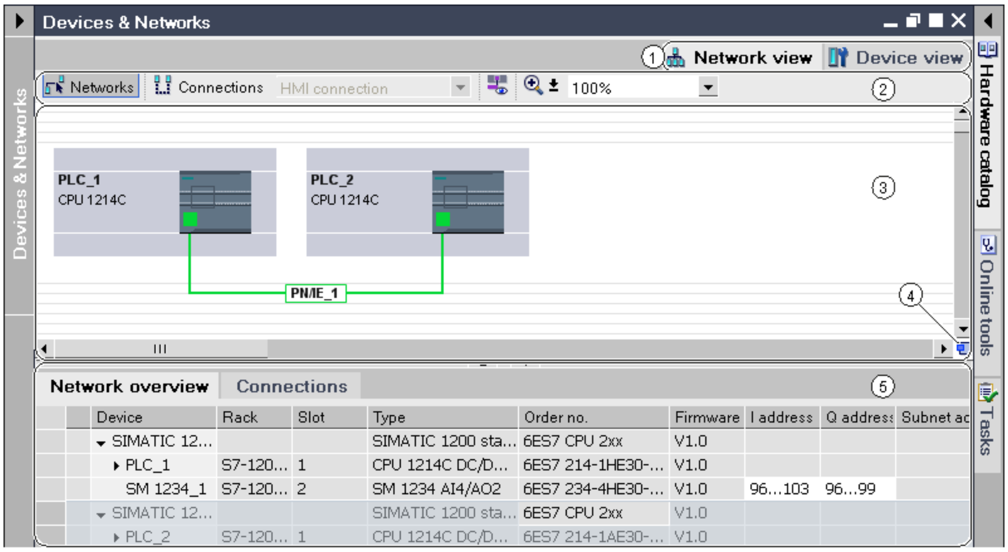
Introduction

The network view is the network editor's work area. You undertake the following tasks here:

- Configuring and assigning device parameters
- Networking devices with one another

Structure

The following diagram shows the components of the network view:



Device	Rack	Slot	Type	Order no.	Firmware	I address	Q address	Subnet ac
SIMATIC 12...			SIMATIC 1200 sta...	6ES7 CPU 2xx	V1.0			
PLC_1	S7-120...	1	CPU 1214C DC/D...	6ES7 214-1HE30-...	V1.0			
SM 1234_1	S7-120...	2	SM 1234 AI4/AO2	6ES7 234-4HE30-...	V1.0	96...103	96...99	
SIMATIC 12...			SIMATIC 1200 sta...	6ES7 CPU 2xx	V1.0			
PLC_2	S7-120...	1	CPU 1214C DC/D...	6ES7 214-1AE30-...	V1.0			

①	Selection network view/device view
②	Toolbar of network view
③	Graphic area of network view
④	Overview navigation
⑤	Table area of network view

You can use your mouse to change the spacing between the graphic and table areas of the network view. To do this, click on the upper edge of the table view and expand or contract this by moving the mouse with the mouse button held down. You can use the two small arrow keys to minimize, maximize or select the latest table structure of the table view with just one click.

Toolbar

Use the toolbar to select from networking or connection of devices (Page 220) :

- Networks
- Connections and connection type

Use the symbol "Show addresses" to display the interface addresses in the graphic area of network view.

Symbol	Meaning
🖧	Display addresses

Use the zoom function to change the display in the graphic area.

Graphic area

The graphic area of the network view displays any network-related devices, networks, connections and relations. In this area, you add devices from the hardware catalog (Page

210) , connect them with each other via their interfaces and configure the communication settings.

Overview navigation

Click in the overview navigation to obtain an overview of the created objects in the graphic area. By holding down the mouse button, you can quickly navigate to the desired objects and display them in the graphic area.

Table area

The table area of the network view includes various tables for the devices, connections and communication settings present:

- Network overview
- Connections

See also

Layout of the user interface (Page 116)
Adapting the user interface (Page 129)
Determination of online status and display using symbols (Page 280)

6.1.3 Device view

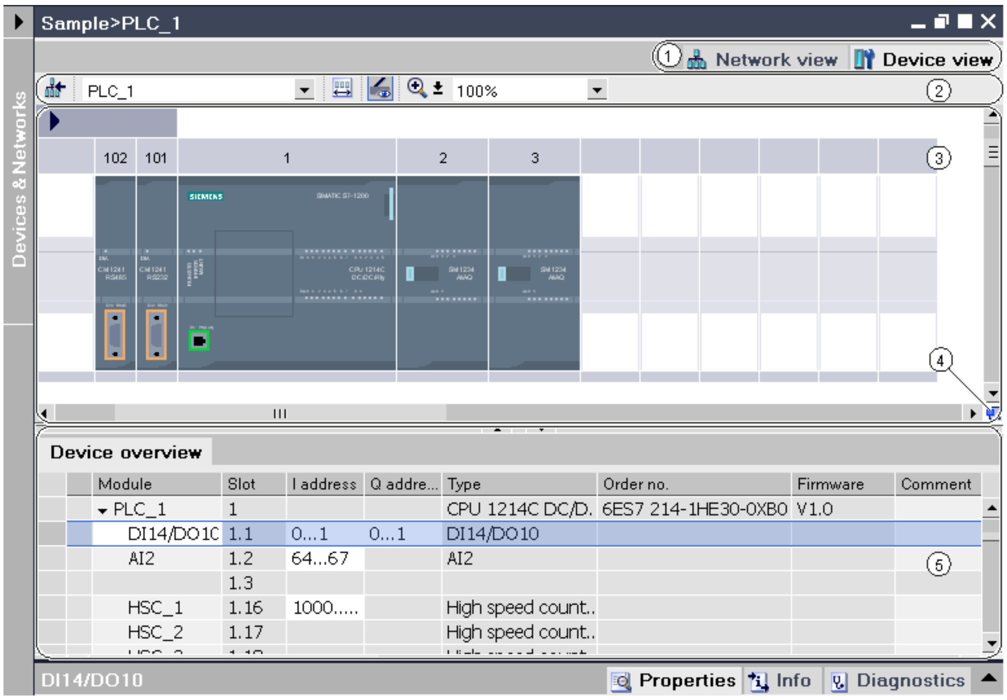
Introduction

The device view is the hardware editor's work area. You undertake the following tasks here:

- Configuring and assigning device parameters
- Configuring and assigning module parameters

Structure

The following diagram shows the components of the device view:



Module	Slot	I address	Q addre...	Type	Order no.	Firmware	Comment
▾ PLC_1	1			CPU 1214C DC/D.	6ES7 214-1HE30-0XB0	V1.0	
DI14/DO1C	1.1	0...1	0...1	DI14/DO10			
AI2	1.2	64...67		AI2			
	1.3						
HSC_1	1.16	1000.....		High speed count..			
HSC_2	1.17			High speed count..			

①	Selection network view/device view
②	Toolbar of device view
③	Graphic area of the network view
④	Overview navigation
⑤	Table area of network view

You can use your mouse to change the spacing between the graphic and table areas of the network view. To do this, click on the upper edge of the table view and expand or contract this by moving the mouse with the mouse button held down. You can use the two small arrow keys to minimize, maximize or select the latest table structure of the table view with just one click.

Toolbar

Use the device view to toggle between the different devices by selecting the respective device from the drop-down list.

There are additional symbols to display a variety of information:

Symbol	Meaning
🖧	Change to network view (Page 192)
▤	Clipboard for unassigned modules (Page 209)
✎	Show module titles (Page 206)

Use the zoom function to change the display in the graphic area.

Graphic area

The graphic area of the device view displays devices and associated modules that are assigned to each other via one or more racks. Here you have the option to install additional hardware objects from the hardware catalog into the slots on the racks (Page 211) .

Overview navigation

Click in the overview navigation to obtain an overview of the created objects in the graphic area. By holding down the mouse button, you can quickly navigate to the desired objects and display them in the graphic area.

Table area

The table area of the device view gives you an overview of the modules used and the most important technical and organizational data (Page 207) .

See also

Layout of the user interface (Page 116)
Adapting the user interface (Page 129)
Determination of online status and display using symbols (Page 280)

6.1.4 Printing hardware and network configurations

Printout of hardware and network configurations

You can print out the following elements of the hardware and network views as part of the project documentation:

- Graphic network view
- Network overview table
- Graphic device view
- The device overview table
- The parameters of the object currently selected in the editor

Scope of printout

When you start printing, the editor that is currently open is always printed. By default, the graphic representation as well as the table associated with the editor are always printed. You can adapt the scope of the printout. Refer to the section "Changing the print options (Page 197) " for instructions on how to do this.

Parameters of selected objects are printed out along with the current value settings in text form. If a module is selected, the parameters of related modules are also printed. For example, if you have selected a CPU, the parameters of an inserted signal board, if present, are printed as well.

Form of printout

Graphics are always printed in the currently selected zoom setting. If a graphic or a table does not fit the selected paper format, the printout is split up over multiple sheets.

See also

Changing the print options (Page 197)
Documentation settings (Page 158)
Creating a print preview (Page 158)
Printing project data (Page 159)

6.1.5 Changing the print options

Changing the scope of the printout

When printing from the device or network view, you can specify whether both graphics and tables are to be printed or just one or the other. Both are printed by default.

Procedure

To change the scope of the printout, follow these steps:

1. In the "Options" menu, select the "Settings" command.
2. Open the "Hardware configuration" group in the area navigation.
3. Select or clear the "Active graphic view" check box, depending on whether you want to print the graphics of the network and device views as well.
4. Select or clear the "Active table" check box, depending on whether you want to print the device and network overview tables as well.

See also

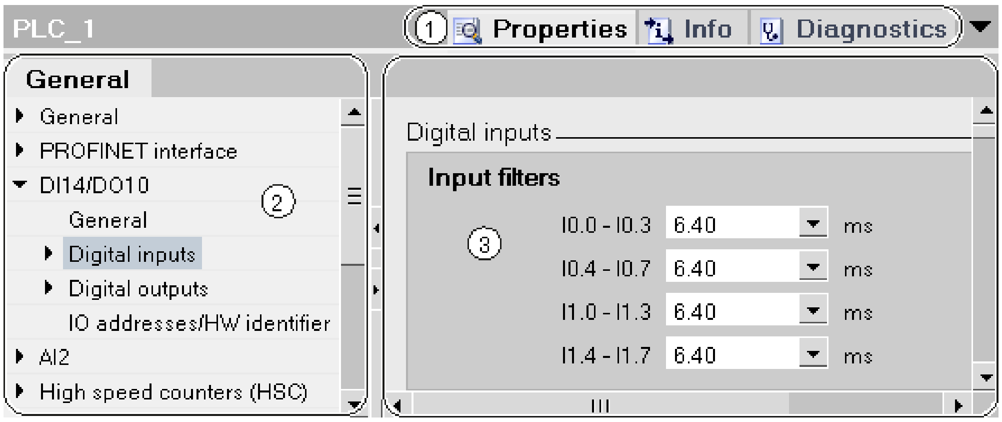
Printing hardware and network configurations (Page 196)

6.1.6 Inspector window

The properties and parameters shown for the object selected can be edited in the inspector window.

Structure

The inspector window consists of the following components:



① Switch between various information and work areas

② Navigation between various pieces of information and parameters

③ Display showing the selected information and parameters

Function

The information and parameters in the inspector window are split into different types of information:

- Properties
- Info
- Diagnostics

To display the corresponding information and parameters, click in the area you want. The "Properties" area is the most important one for configuring an automation system. This area is displayed by default.

The left pane of the inspector window is used for area navigation. Information and parameters are arranged there in groups. If you click on the arrow symbol to the left of the group name, you can expand the group if sub-groups are available. If you select a group or sub-group, the corresponding information and parameters are displayed in the right pane of the inspector window and can be edited there too.

See also

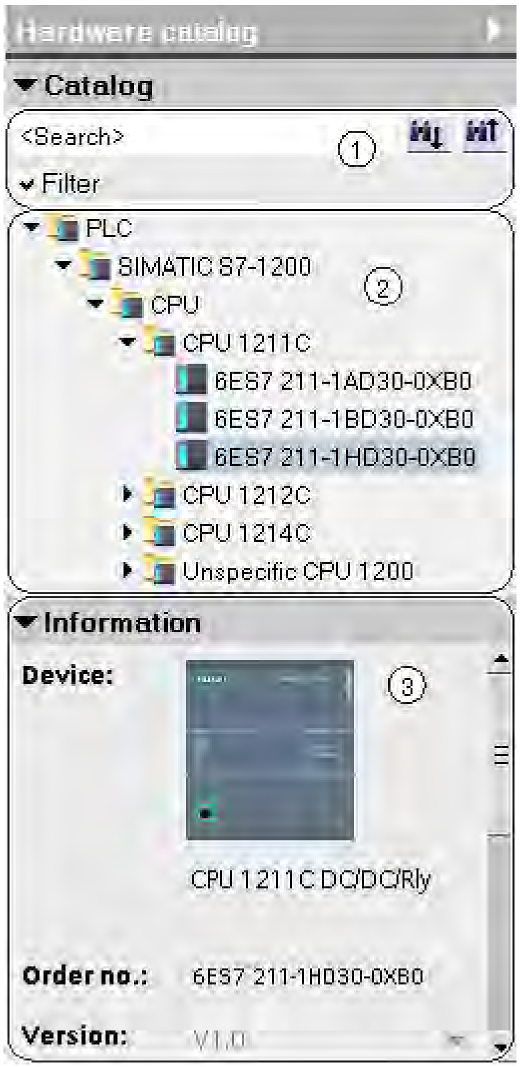
Editing properties and parameters (Page 218)
Overview of hardware and network editor (Page 191)

6.1.7 Hardware catalog

The "Hardware catalog" task card gives you easy access to a wide range of hardware components.

Structure

The "Hardware catalog" task card consists of the following panes:



① "Catalog" pane, search and filter function

② "Catalog" palette, component selection

③ "Information" pane

Function

- The "Catalog" pane and search and filter functions make it easy to search for particular hardware components. If you activate the filter function, only objects that you can position in the current context are displayed. Objects that can be used in the current context include, for example, interconnectable objects in the network view or only modules compatible with the device in the device view.
- The "Catalog" pane contains the various hardware components in a tree structure. You can move the devices or modules you want from the catalog to the graphic work area of the device or network view.
- The "Information" pane contains detailed information on the object selected from the catalog:
  - Schematic representation
  - Name

  - Version number
  - Order number
  - Brief description

See also

Browsing the hardware catalog (Page 204)
Overview of hardware and network editor (Page 191)
Information on hardware components (Page 200)

6.1.8 Information on hardware components

In the hardware catalog, you can display information on selected hardware components in the "Information" pane. You can also display further information on the selected hardware components using the shortcut menu.

Access to further information

If you select a hardware object in the hardware catalog and open the shortcut menu, you not only have the "Copy" function available but also three options for accessing information on Service & Support:

- Product support
- FAQs
- Manuals

The required information is displayed in the work area of the hardware and network editor.

Note

You can only access Service & Support when you are connected to the Internet and the function is enabled. By default, the function is disabled. To enable the function, refer to the instructions in the section "Enabling product support (Page 201) ".

Information regarding product support

Here, you have access to general information on hardware and software components. The order number of the selected hardware object is entered automatically in the search mask. You can, however, also search for other hardware and software components.

FAQs

Here, you have access to "Frequently Asked Questions" (FAQs). You can view various entries on hardware and software questions. Using a detailed search mask, you can filter the required topics.

Manuals

Here, you have access to the manuals of the various hardware components. This is particularly useful if the configuration, addressing or parameter assignment you are planning requires more detailed knowledge of the hardware you are using.

See also

Hardware catalog (Page 198)
Enabling product support (Page 201)

6.1.9 Enabling product support

Enabling Service & Support function

For each device in the hardware catalog, you have the option of displaying additional information that is stored in the Service & Support area of the Siemens website. By default, the function is disabled. Instructions for enabling the function are given below.

Requirement

The software must have access to the Internet.

Procedure

To enable the Service & Support function, follow these steps:

1. In the "Options" menu, select the "Settings" command.
2. Open the "Hardware configuration" group in the area navigation.
3. Select the "Via Internet" check box.

Result

You can now access product support, FAQs, and manuals from the hardware catalog via the shortcut menu for the module.

See also

Information on hardware components (Page 200)

6.1.10 Keyboard action in the hardware and network editor

You can execute some of the functions of the network and device view directly with a combination of keyboard and mouse in the hardware and network editor. The keyboard operation in tables (Page 132) corresponds to standard behavior. Here you find the keyboard operation for the graphic work area of the network and device view.

General keyboard operation

Function	Key combination	Comment
Zoom in on view in frame	<Ctrl+Space> + mouse button pressed	No object selection
Move view	<Space> + mouse button pressed	Mouse may not be positioned above an object
Cancel current operation	<Esc>	-
Separate connection	<Esc> or double-click	When making a connection

Selected objects

Function	Key combination	Comment
Select object	Mouse click	-
Move object	<Ctrl+X>, then <Ctrl+V>	Copy selected object to move and then paste in new position
Copy object	<Ctrl+C>	Copy selected object to clipboard
Paste object	<Ctrl+V>	Paste object from clipboard to selection
Delete selected object	<Del>	-
Select several objects 1	<Shift> + click	Select objects individually
Select several objects 2	<Ctrl> + click	Selected objects can also be deselected
Move selection	Mouse button pressed	Move to permitted slot
Copy selection	<Ctrl> + mouse button pressed	Move to permitted slot

6.2 Configuring devices

6.2.1 Basics

6.2.1.1 Introduction to configuring hardware

To set up an automation system, you will need to configure, assign parameters and interlink the individual hardware components. The work needed for this is undertaken in the device and network views.

Configuring

"Configuring" is understood to mean arranging, setting and networking devices and modules within the device or network view. Racks are represented symbolically. Just like "real" racks, they allow you to plug in a defined number of modules.

An address is automatically assigned to each module. You can change the module addresses if the CPU permits free assignment of addresses.

When the automation system is started, the CPU compares the setpoint configuration produced by the software with the system's actual configuration. Possible errors can be detected and reported straight away.

Assigning parameters

"Assigning parameters" is understood to mean setting the properties of the components used. Hardware components and settings for the exchange of data are assigned:

- Properties of modules with selectable parameters
- Settings for data exchange between components

The parameters are loaded into the CPU and transferred to the corresponding modules when the CPU starts up. Modules can be replaced with ease since the parameters set are automatically loaded into the new module during startup.

Need to configure hardware

You need to configure hardware if you want to set up, expand or change an automation project. To do this, add more hardware components to your structure, link these with existing components and adapt the hardware properties to the tasks.

The properties of the automation systems and modules are preset such that in many cases they do not have to be parameterized again. Parameter assignment is however needed in the following cases:

- You want to change the default parameter settings of a module.
- You want to use special functions.
- You want to configure communication connections.

See also

Changing properties of the modules (Page 248)

6.2.1.2 General slot rules

Introduction

Specific slot rules apply to each automation system and module.

If you select a module from the hardware catalog in the device view, all possible slots for the module selected are marked in the rack. You can only drag modules to marked slots.

If you insert, move or swap a module, the slot rules are also applied.

Consistency

Some slot rules depend on how the environment is configured. This means that you can sometimes plug modules into the rack although this would result in inconsistencies at the current time. If you change the configuration, e.g. by selecting different modules or module parameter settings, you can however make the configuration consistent again.

In cases where inserting a module results in an inconsistency that can be corrected, this will be permitted. A consistency check is run when transferring the configuration. Inconsistencies are displayed as alarms in the inspector window under "Info". You can revise your configuration on the basis of the results of the consistency check and make it consistent.

General rules for arranging modules

As a rule of thumb, the following applies to modules in racks:

- Can only be inserted in certain slots
- Inertion depends on other modules, CPUs or settings
- Limitation of the number of times used in a rack

6.2.1.3 Browsing the hardware catalog

Introduction

To select the hardware components you want for a hardware configuration, use the "Hardware catalog" task card. Use the hardware catalog to select the interconnectable hardware components in the network view and to select the modules you want in the device view.

Context filter

There is a filter function in the hardware catalog. If the filter function is deactivated, all the objects available in the catalog are always displayed for you in the hardware catalog.

To only display the objects that you can use in the current context, activate the "Filter" check box.

If you have activated the filter, only the following objects are displayed:

- Only networkable objects are displayed in the network view.
- All modules that are part of the context of the current device are displayed in the device view.

If you switch between network and device view, the view of the filter objects is adapted to the current context.

Search options

You can use the search function to search for specific entries in the hardware catalog. Note the following rules when entering a search term:

- No distinction is made between upper and lower case text.
- Spaces and/or tabs or hyphens are entered as displayed in the hardware catalog.

- The search function considers parts of a search term.

Note

Note the difference between spaces and hyphens in order numbers.

You start the search from an object highlighted in the hardware catalog and either search upwards or downwards.

Symbol	Meaning
↓	Downwards search
↑	Upwards search

Browsing the hardware catalog

If you want to browse the hardware catalog, proceed as follows:

1. Click in the entry field of the search function
2. Enter a search term. The search includes the following elements:
   - Name of a device or module
   - Order number
   - Info text
3. Click on either the "Downwards search" or "Upwards search" buttons.

Note

To ensure the right search direction, note which point you have marked in the hardware catalog. To browse the entire catalog, click on the topmost object of the hardware catalog and start the search once you have entered the search term by clicking "Downwards search".

The first match with the search term found is displayed as the result. For more search results, again click on the "Downwards search" or "Upwards search" button.

See also

Hardware catalog (Page 198)
Information on hardware components (Page 200)

6.2.1.4 Working with racks

Introduction

To assign modules to a device, you need a rack, e.g. a mounting rail. Secure the modules on the rack and connect these via the backplane bus with the CPU, a power supply or other modules.

Creating a rack

If you insert a device in the network view, a station and a rack suitable for the device selected are created automatically. The rack and slots available are displayed in the device view. The number of slots available again depends on the type of device used.

Rack structure

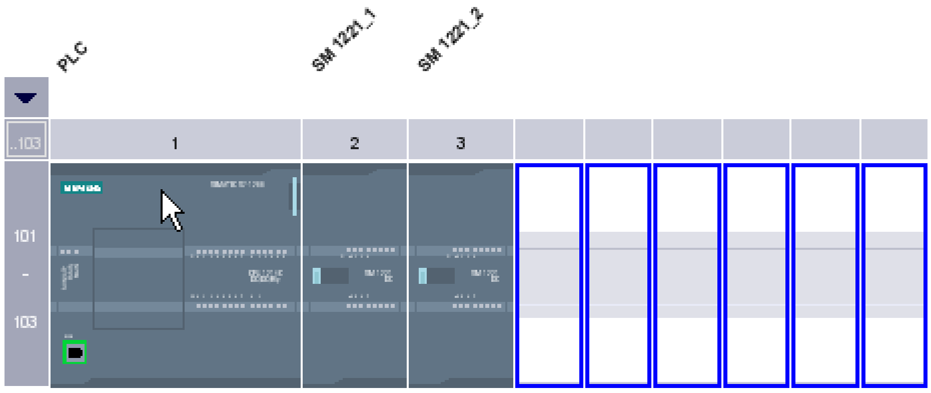
A rack always contains the device that has been inserted in the network view. The device is permanently assigned a slot which will depend on the type of device in question. There are additional slots on the right of the device and, if necessary, on left of the device; slot numbers are located above slots in which devices are plugged.

A corresponding short description is displayed above the plugged devices and modules. You show or hide this short description via the toolbar under "View" with the command "Display module titles" or the corresponding symbol in the toolbar of the device view (Page 194) .

Symbol	Meaning
✎	Show module titles

When modules are selected in the hardware catalog, all the slots permitted for these modules are marked. This allows you to see immediately the slot into which the selected module can be inserted.

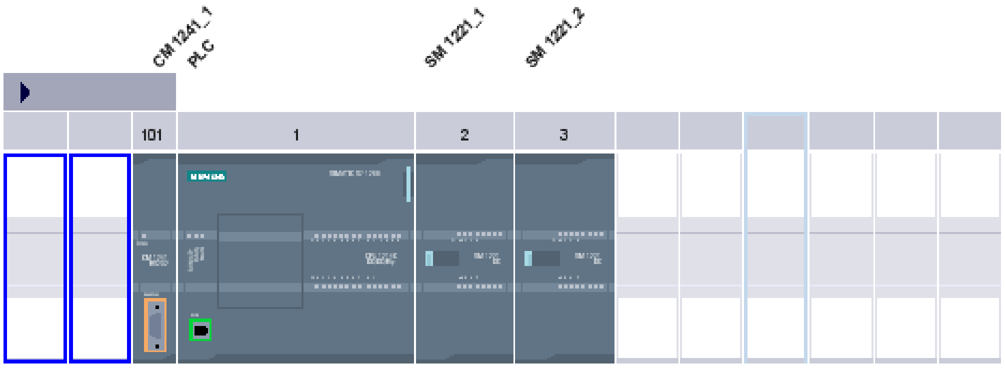
In the following screenshot, a signal module has been selected in the hardware catalog for a partly filled rack:



Since slots 101-103 are reserved for communications modules, only the other free slots are shown as available slots.

You can expand and collapse the front group of slots using an arrow symbol above the expandable slot. When the group of slots is collapsed, the first and last of the group's slot numbers are displayed.

The following figure shows the expanded slot group:



Groups of slots into which modules have already been plugged cannot be collapsed.

Multiple selection of modules and slots

There are various ways of selecting several modules or slots:

- By pressing <Shift> or <Ctrl>, you can select several modules or slots at the same time.
- Click outside the rack and then hold the mouse button and drag the frame to include the modules or slots you want to select.

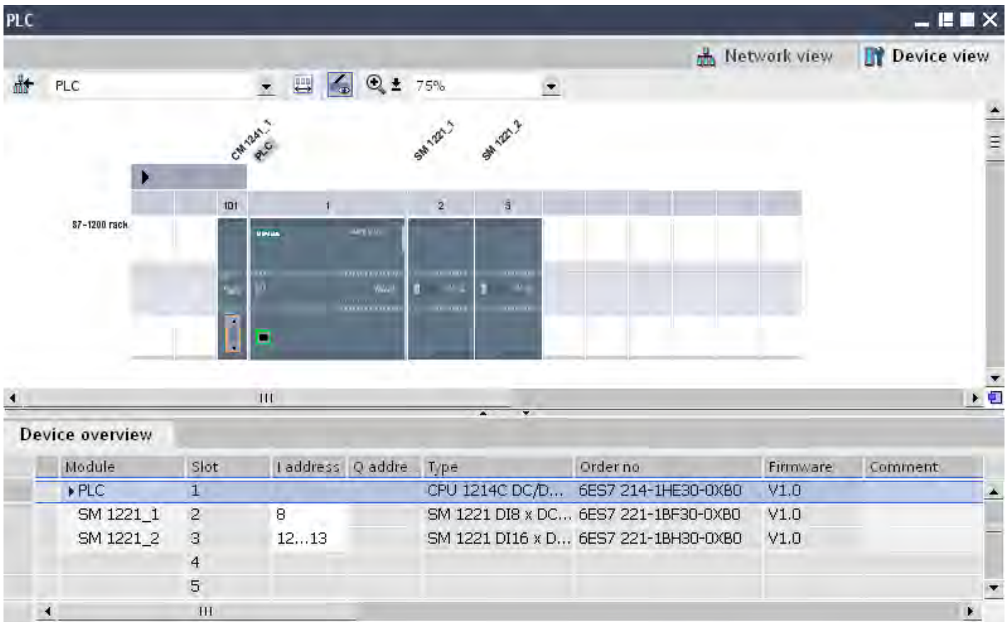
6.2.1.5 Objects in the device overview

You can see the device overview in the bottom part of the device view. The device overview is a table showing you the key information about the modules inserted in the rack.

Structure and content of device overview

In the device overview, you are shown the assignment of racks in tabular form. Each line in the table contains the information for assigning a slot.

The following screenshot shows the device view with the configuration of a SIMATIC S7-1200 CPU.



Device overview

Module	Slot	I address	Q addre	Type	Order no	Firmware	Comment
PLC	1			CPU 1214C DC/D...	6ES7 214-1HE30-0XB0	V1.0	
SM 1221_1	2	8		SM 1221 DI8 x DC...	6ES7 221-1BF30-0XB0	V1.0	
SM 1221_2	3	12...13		SM 1221 DI16 x D...	6ES7 221-1BH30-0XB0	V1.0	
	4						
	5						

In the upper part, you can see the graphic view showing how the rack is occupied by various modules in slots 1 to 3 as well as 101. In the lower part you can see a tabular representation of the rack in the device overview.

Each line in the device overview represents one slot. The key information for each slot is displayed in the various columns:

Column	Meaning
Module	Name of module, can be edited in any way
Slot	Slot number
I address	Input address area, can be edited in any way
Q address	Output address area, can be edited in any way
Type	Catalog name of module
Order no.	Module order number
Firmware	Firmware version of module
Comments	Optional comments

See also

Device view (Page 194)

6.2.1.6 Area of unplugged modules

In some cases, the modules for a hardware configuration are not assigned a slot for short periods. Such unplugged modules are moved to the "area of unplugged modules", a special area in the device view.

Adding modules to the storage area

The modules, which e.g. are to be assigned to a device using a copy action but for which the corresponding rack does not have a free compatible slot, are moved automatically into the area of unplugged modules.

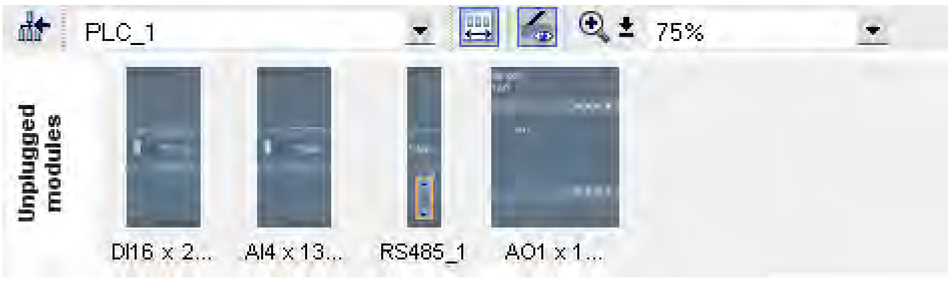
Modules are added to the area of unplugged modules under the following conditions:

- In the network view, a module is moved to a device but the rack does not have a compatible free slot.
- In the device view, a module is moved from the rack, the hardware catalog, or the project tree straight into the storage area.

Using the area of unplugged modules

Use the corresponding button to open the area of unplugged modules.

You will find the "area of unplugged modules" in the device view.



You open the area of unplugged modules with the respective symbol in the toolbar of the device view (Page 194) .

Symbol	Meaning
▤	Open area of unplugged modules

Note

To free up slots, move modules from your configuration into the storage area and plug the modules you want from the storage area into the freed up slots.

You can use this approach to temporarily move modules that have already been parameterized out of the configuration without deleting them.

Treatment of modules in the storage area

The following rules apply to modules in the storage area:

- The modules appear in the project tree under the corresponding device in the "Local modules" folder.
- The modules retain all settings and parameters previously provided.
- The modules are not taken into account when downloading to a target system so a consistency check is not undertaken for modules in the area of unplugged modules.

6.2.2 Configuring individual devices

6.2.2.1 Adding a device to the hardware configuration

Introduction

There are various ways of adding a CPU from the hardware configuration in the network view:

- Command "Add new device" in the project tree
- Double-click device in hardware catalog
- Drag-and-drop from the hardware catalog in network view
- Command "Add > Device" from menu bar in network view
- Shortcut menu of a device in the hardware catalog for copying and pasting

A suitable rack is created along with the new device. The selected device is inserted at the first permitted slot of the rack.

Regardless of the method selected, the added device is visible in the project tree and the network view of the hardware and network editor.

Adding device using the project tree

To use the project tree to add a device to the hardware configuration, follow these steps:

1. Click on the command "Add new device" in the project tree.

   The "Add new device" dialog box is opened.
2. Display the required device in the tree structure:
   - Go to required device in the tree structure.
   - Enter a device name in the entry field.
3. Select the required device from the tree.

   More information about the device presently selected is displayed on the right-side of the dialog box.
4. If necessary, set the firmware version using the drop-down list in the dialog box.
5. Select the "Open device view" check box if you want to change to the device view immediately after adding the device.

There you can immediately continue with device configuration and equipping the rack.

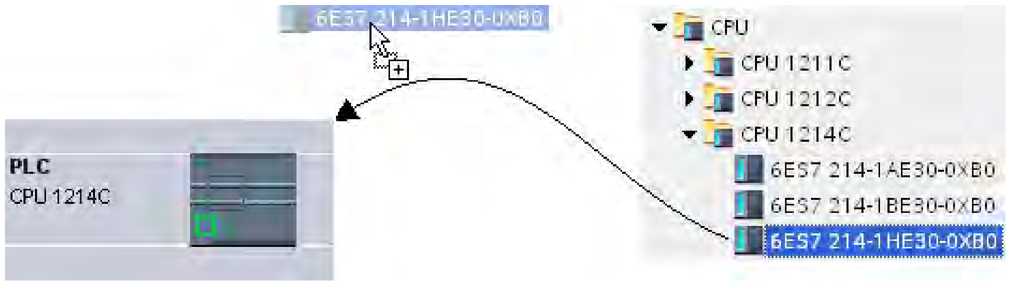
6. Click on "OK" to add the device selected.

   The dialog box closes.

Adding device from the hardware catalog

To add a device to the hardware configuration using the hardware catalog, follow these steps:

1. Open the network view.
2. Open the hardware catalog.
3. Go to the required CPU in the hardware catalog.
4. Click on the chosen CPU to select it.
5. If necessary, set the firmware version using the drop-down list in the hardware catalog.
6. Drag the CPU to the network view.



You have now placed the CPU in the network view. A "PLC" station has been created. Double-click on the device or station frame to open the device view and view the new rack and inserted CPU. In the next steps, you can configure the device in the device view and equip the rack with modules.

See also

Network view (Page 192)
Creating an unspecified CPU (Page 298)
Information on hardware components (Page 200)

6.2.2.2 Inserting a module into a rack

Introduction

Once you have added devices from the hardware catalog to your configuration in network view, you can add modules to the devices.

There are various ways of adding a module to a rack in the device view:

- If there is an available valid slot, double-click a module in the hardware catalog.
- Use drag-and-drop to move the module from the hardware catalog to an available valid slot in the graphic or table area.

- Select "Copy" in the shortcut menu for a module in the hardware catalog, and then select "Paste" in the shortcut menu on an available valid slot in the graphic or table area.

To access the device view from the network view, double-click a device or station in the network view or select the Device view tab. The device view contains an illustration of the device selected within a rack. The graphic illustration of the rack in the software corresponds to the real structure, i.e. you can see the same number of slots as exist in the real structure.

Note

You can also move a module to a rack in the network view. The filter function for the hardware catalog must be deactivated in this instance. The module is automatically plugged into a free and permitted slot. If there are no slots available, the module will be moved to the area of unplugged modules (Page 209) .

Equipping a rack

Arrange the modules on a rack according to the applicable slot rules.

After a module has been inserted in the rack, the address areas are checked automatically so that addresses are not assigned twice. After it has been inserted, each module then has one valid address range.

Requirement

- You are in the device view.
- The hardware catalog is open.

Adding module from the hardware catalog

How to insert a module from the hardware catalog into a rack is illustrated based on the example of a signal module. To do so, follow these steps:

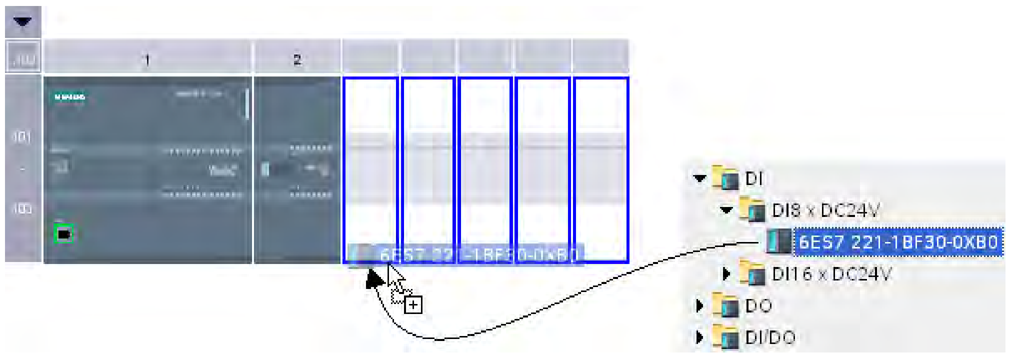
1. Go to the required module board in the hardware catalog.

   Note

   If you activate the filter function of the hardware catalog, only those modules which match the selected device type will be displayed.

   ---

2. Select the chosen module.
3. If necessary, set the firmware version using the drop-down list in the hardware catalog.
4. Drag the signal module to a free slot in the rack.

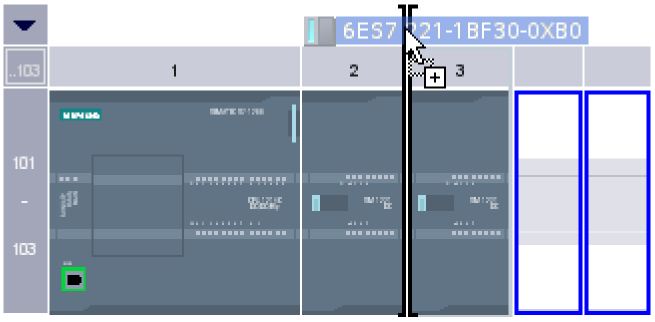


You have now inserted the digital signal module in a slot in the rack. Repeat these steps with the other modules.

The names of the modules are displayed above the inserted modules. You can activate or deactivate module labeling in the menu bar with "View > Show module labels".

Inserting module

You can also drag modules and insert them between modules that have already been inserted. To do this, drag a module above and between the two existing modules while holding down the mouse button.



A mouse pointer appears. When you release the mouse button, all modules plugged to the right of the pointer are moved one slot to the right. Any redundant modules are moved to the area of unplugged modules. The new module is plugged at the point of the freed up slot.

See also

Device view (Page 194)
Area of unplugged modules (Page 209)
Information on hardware components (Page 200)

6.2.2.3 Deleting a hardware component

You can delete hardware components in the device or network view. Deleted hardware components are removed from the system and assigned addresses made available again.

Rules

- Modules inserted in the rack and placed in the area of unplugged modules can be deleted.
- CPUs and racks with a CPU inserted cannot be deleted individually, but only in the network view or project tree together with all plugged hardware components (deleting the entire station).

Procedure

Proceed as follows to delete a hardware component:

1. Select the hardware components you want to delete.
   - Device view: Select the racks or modules in racks or in the area of unplugged modules.
   - Network view: Select the stations or the relevant hardware component from the network view.
2. Select "Delete" from the shortcut menu or press <Del>.

   If the "Delete" menu item is unavailable, your selection contains at least one component that cannot be deleted.

The selected hardware components are deleted.

Note

Deleting hardware components may result in inconsistencies in the project, e.g. infringement of slot rules. Inconsistencies are reported during the consistency check. Correct the inconsistencies by taking appropriate action, for example, make sure that slot rules are kept to.

See also

Keyboard action in the hardware and network editor (Page 201)

6.2.2.4 Copying a hardware component

You can copy hardware components in the device or network view. Copied hardware components are stored on a clipboard and can be pasted at another point from this clipboard. Copied stations are pasted as new stations in the network view. Copied devices and modules can be pasted into existing racks in the network and device view.

Rules

- Modules inserted in the rack and in the area of unplugged modules can be copied.
- You can only copy devices and modules to free and valid slots in keeping with the slot rules.
- CPUs and racks with a CPU inserted cannot be copied individually, but only as complete units along with all inserted hardware components.

Procedure

Proceed as follows to copy a hardware component:

1. Select the hardware components you want to copy.
   - Device view: Select the module in a rack or in the area of unplugged modules.
   - Network view: Select the station or the relevant hardware component from the network view.
   - Project tree: Select the station or module.
2. Select "Copy" from the shortcut menu or press <Ctrl+C>.

   If the "Copy" menu item is unavailable, your selection contains at least one component that cannot be copied.
3. Select the location at which the content of the clipboard is to be pasted.
   - Device view: Select a free slot in the rack or area of unplugged modules.
   - Network view: Select a station where you want to insert devices or modules or move the mouse pointer to a free location in the network view to paste a copied station or a hardware component relevant to the network view.
4. Select "Paste" from the shortcut menu or press <Ctrl+V>.

   If the "Paste" menu item is unavailable, the clipboard is empty or contains at least one component that cannot be pasted at this point.

The selected object is pasted at the chosen point.

Once you have selected a station where you want to insert a module in the network view, the module is inserted in the first free and valid slot. If no free, valid slots are available, the object is inserted in the area of unplugged modules.

Note

You can also copy a module from one device to another:

To do so, copy a module in the hardware and network editor, select a different device in the network view or the drop down list of the device view, and insert the module.

You can insert the copied object directly in a slot or place it in the area of unplugged modules in the device view. If you add the copied object in the network view of a station, it will be inserted in the first available slot.

If there is no slot available for the object, it is automatically placed in the area of unplugged modules (Page 209) .

Note

You can use <Ctrl> and drag-and-drop to directly copy a selected hardware component.

See also

Keyboard action in the hardware and network editor (Page 201)

6.2.2.5 Moving a hardware component

You can move hardware components in the device or network view.

Rules

- You can move devices and modules from the rack and the area of unplugged modules as long as you keep to the slot rules.
- CPUs cannot be moved.

Procedure

Proceed as follows to move a hardware component:

1. Select the hardware component you want to move.
   - Device view: Select the module in a rack or put it in the area of unplugged modules.
   - Network view: Select the hardware component of relevance to the network view.
2. Select "Cut" from the shortcut menu or press <Ctrl+X>.

   If the "Cut" menu item is unavailable, your selection contains at least one component that cannot be cut.
3. Select the location to which the cut object is to be moved.
   - Device view: Select a free slot in the rack or area of unplugged modules.
   - Network view: Select a station where you want to insert devices or modules.
4. Select "Paste" from the shortcut menu or press <Ctrl+V>.

   If the "Paste" menu item is unavailable, the clipboard is empty or contains at least one component that cannot be pasted at this point.

The selected hardware component is moved to the target. If the hardware component being moved is a networked object, it is disconnected from the network.

Note

You can use drag-and-drop to directly move a selected hardware component.

See also

Keyboard action in the hardware and network editor (Page 201)

6.2.2.6 Replacing a hardware component

You can replace hardware components with others. This, for example, allows you to replace unspecified CPUs (Page 298) with available CPUs from the hardware catalog.

Rules

You can only replace hardware components if they support module replacement and if the two components are compatible.

Procedure

To replace one module with another, follow these steps:

1. Select the module you want to replace.
2. Open the shortcut menu:
   - If the "Change device type" entry is enabled, the module can be replaced.
   - If the "Change device type" entry is disabled, the module cannot be replaced.
3. Click on "Change device type" in the shortcut menu. The "Change device type" dialog opens.
4. Under "New device" in the tree structure, select the module with which you want to replace your current module.
5. Click "OK".

The existing module is replaced by the new one.

As an alternative, you can take a module by dragging it from the hardware catalog to the module you are replacing. If the module can be replaced by the selected module, this is indicated by the mouse pointer symbol.

6.2.2.7 Inserting a signal board in a CPU

Introduction

Using signal boards allows you to increase the number of the CPU's own inputs and outputs. Just like all other hardware components, you will find signal boards in the hardware catalog. However, you do not insert signal boards in the rack like other modules but directly in a slot of the CPU itself.

Note the following points when using a signal board:

- Each CPU can have only one signal board inserted in it.
- A signal board can only be inserted when the slot in the CPU is free.

There are various ways of inserting a signal board in a CPU:

- Double click on a signal board in the hardware catalog when there is a free slot in the CPU
- Drag from the hardware catalog to a free slot in the CPU
- Shortcut menu of a signal board in the hardware catalog for copying and pasting

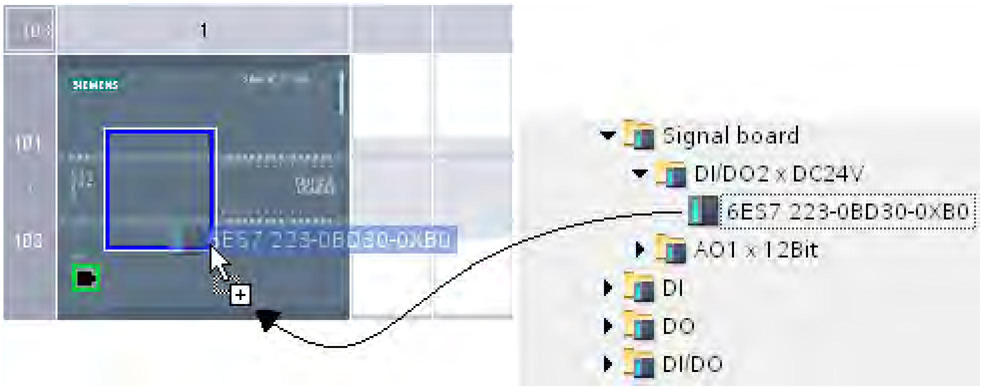
Requirement

- The hardware catalog is open.
- The CPU has a free slot for the signal board.

Inserting a signal board in a CPU

To insert a signal board in a CPU, follow these steps:

1. Go to the required signal board in the hardware catalog.
2. Select the signal board you want to use.
3. Drag the signal board to the free slot in the CPU.



You have now inserted a signal board in the slot of the CPU.

If you are in the network view, you can also drag a signal board to a device. If the CPU has a an empty slot for a signal board, the signal board is inserted automatically into this slot.

6.2.2.8 Editing properties and parameters

Once you have inserted hardware components in your rack, you can edit their default properties, for example parameters or addresses in the network or device view.

Requirement

You are in the device view.

Note

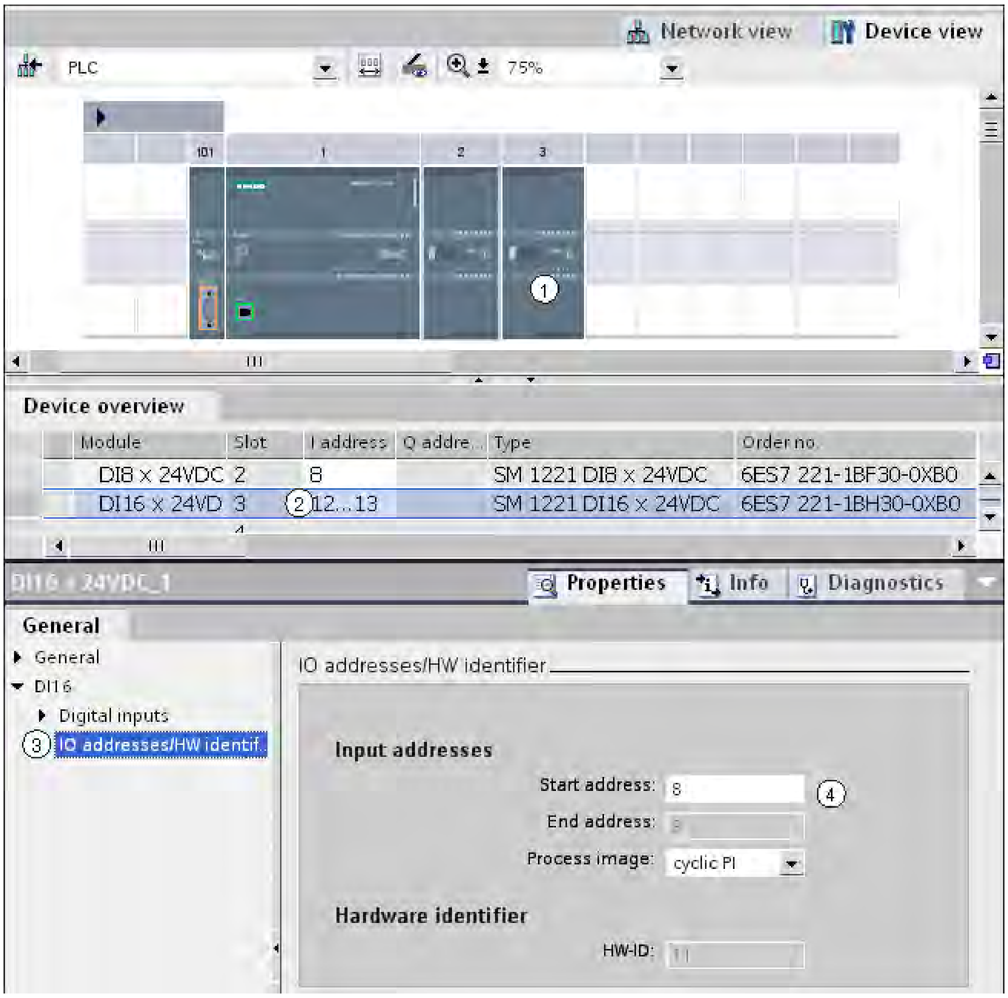
You can also edit properties and parameters in the network view. In the graphic network view, you have access to the network-related hardware components and the station. You can access modules and hardware components not displayed in the graphic network view using the table network view.

Procedure

To change the properties and parameters of the hardware components, follow these steps:

1. In the graphic view, select the CPU, module, rack or interface you want to edit.
2. Edit the settings for the selected object:
   - Use the table view to edit addresses and names, for example.
   - In the Inspector window additional setting possibilities are available in "Properties".

Example of changing settings



Device overview

Module	Slot	I address	Q addre...	Type	Order no.
DI8 x 24VDC	2	8		SM 1221 DI8 x 24VDC	6ES7 221-1BF30-0XB0
DI16 x 24VD	3	② 12...13		SM 1221 DI16 x 24VDC	6ES7 221-1BH30-0XB0

IO addresses/HW identifier

Input addresses

Start address: 8
End address: 9
Process image: cyclic PI

Hardware identifier

HW-ID: 11

① Selection of a module
② Editing option for addresses in the device overview
③ Selection options in the inspector window
④ Editing option for addresses in the inspector window

See also

Inspector window (Page 197)

6.3 Networking devices

6.3.1 Communication and networks

Communication between devices

The basis of all types of communication is always a previously configured network. The network configuration lays the foundation for communication, in other words:

- All the devices in a network have a unique address;
- The devices process communication with consistent transmission properties.

Network configuration

The following steps are necessary when configuring networks:

- Connect devices to subnet
- Specify the properties/parameters for each subnet
- Specify the device properties for every networked module
- Download configuration data to the devices to supply interfaces with the settings resulting from the network configuration
- Document the network configuration

For Open User Communication, creating and configuring a subnet is supported by the connection parameter assignment.

Relation between network configuration and project

Within a project, subnets and their properties are managed. Properties result mainly from adjustable network parameters and the quantity and communication properties of the connected devices.

The devices to be networked must be in the same project.

Subnet name and subnet ID

Within the project, subnets are clearly identified by a subnet name and ID. The subnet ID is saved in all components along with interconnectable interfaces. Components can then be clearly assigned to a subnet even after uploading into a project.

Networking options

In the project, you can create and network devices with components capable of communication. The following basic options are available for networking the devices:

- You link the interfaces of the components capable of communication with one another. A new subnet is created suitable for the type of interface.
- You connect the interface of the devices capable of communication with a new or existing subnet.
- You create an Open User Communication connection. When you assign parameters to the connection for Open User Communication, a subnet is created automatically between the communications partners.

Due to the different tasks of the devices or the span of the plant, you may need to use several subnets. These subnets are managed in a project.

6.3.2 Networking devices in the network view

Options

In the graphic network view, you have an overview of the subnets of the entire system in the project. You can use the tabular network overview for additional support.

Depending on the starting situation, there are various ways of undertaking configuration to network the interface for a component capable of communication. Possible starting situations are:

- A suitable subnet is not yet available.
- The subnet with which you want to connect the component already exists.

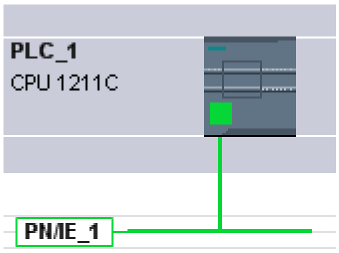
Procedure - creating a single subnet

To create a subnet and to connect it to an interface, follow these steps:

1. Select the interface of a CPU.
2. Select the "Create subnet" command in the shortcut menu of the interface.

The selected interface is connected to a new subnet. Consistent address parameters are set automatically for the interface.

The following schematic shows an interface with outgoing line connecting to a subnet:



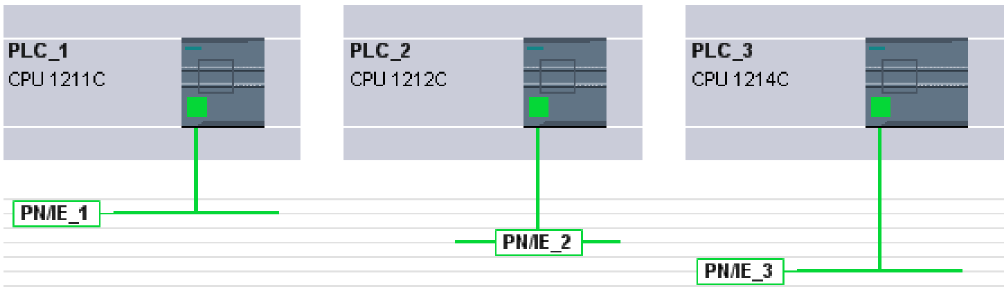
Procedure - creating several subnets at one time

To create several subnets at one time, follow these steps:

1. Select several interfaces by clicking on them while pressing the <Ctrl> button.
2. Select the "Create subnet" command in the shortcut menu of the interface.

Each selected interface is connected to a new subnet. Consistent address parameters are set automatically for the interface.

The following figure shows multiple subnets created by selecting multiple interfaces:

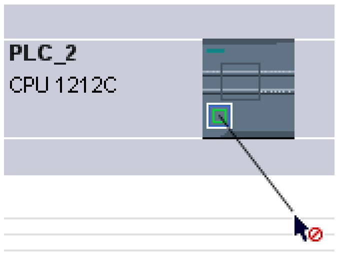


Procedure - connecting two target devices to a new subnet

To connect an interface with another device via a subnet that does not yet exist, follow these steps:

1. Position the mouse pointer over the interface for a component capable of communication requiring networking.
2. Click with the left mouse button and hold the button down.
3. Move the mouse pointer.

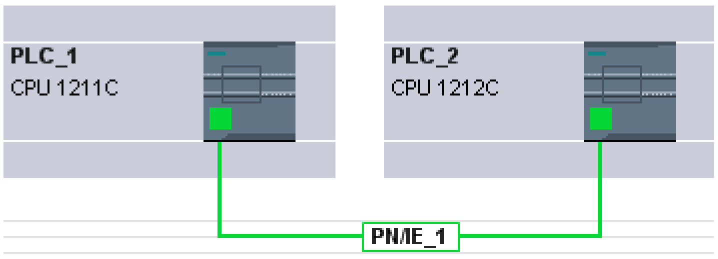
   The pointer now uses the networking symbol to indicate "Networking" mode. At the same time, the mouse pointer shows the lock symbol that will only disappear when the pointer is on a valid target.



4. Now move the pointer onto the interface of the target device. You can either keep the mouse button pressed or release it.
5. Now release the left mouse button or press it again (depending on previous action).

A new subnet is created. The interfaces are now connected via the new subnet. Consistent address parameters are set automatically for the interface.

The following schematic shows two networked devices:

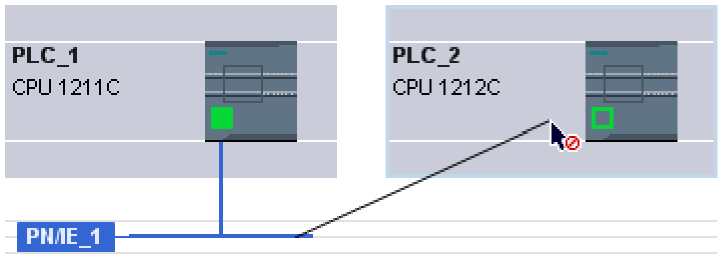


Procedure - connecting two devices to an existing subnet

To connect an interface to an existing subnet, follow these steps:

1. Position the mouse pointer on the interface of a communications-compliant component you want to network or on the existing subnet.
2. Click with the left mouse button and hold the button down.
3. Move the mouse pointer.

   The pointer now uses the networking symbol to indicate "Networking" mode. At the same time, the mouse pointer shows the lock symbol that will only disappear once the pointer is moved to a valid target.
4. Now move the mouse pointer to the existing subnet or to the interface to be networked. You can either keep the mouse button pressed or release it.



5. Now release the left mouse button or press it again (depending on previous action).

Result:

The interface and selected subnet are now connected. Consistent address parameters are set automatically for the interface.

Procedure - selecting an existing subnet from a list

To link an interface with a subnet that has already been created, proceed as follows:

1. Select the interface of a CPU.
2. Select the "Assign to new subnet" command in the shortcut menu of the interface.

   A list box containing the available subnets appears.
3. Select a subnet from the list.

The interface and selected subnet are now connected. Consistent address parameters are set automatically for the interface.

6.3.3 Tabular network overview

Meaning

The tabular network overview adds the following functions to the graphic network view:

- You obtain detailed information on the structure and parameter settings of the devices.

- Using the "Subnet" column, you can connect components capable of communication with created subnets.

Basic functions for tables

The network overview supports the following basic functions for editing a table:

- Displaying and hiding table columns

  Note: The columns of relevance to configuration cannot be hidden.
- Optimizing column width
- Sorting table
- Displaying the meaning of a column, line or field using tool tips.

6.3.4 Networking devices in the device view

Networking in the device view

In the device view, you can check and set all the parameters of the components belonging to a device and the interfaces in detail. Here you can also assign the interfaces to the subnets created in the project.

Requirement

- The subnet with which you want to connect an interface has already been created.
- If the subnet has not yet been created, change to the network view and make the settings required for networking.

Procedure - connecting to an existing subnet

To connect an interface to an existing subnet, follow these steps:

1. Select the entire communications-compliant component or the interface to be networked.
   The properties of the selected interface or component are displayed in the Inspector window.
2. Select the "Ethernet Addresses" parameter group for the selected interface in the Inspector window.
3. Select the subnet to be connected from the "Interface connected with" drop-down list.

The interface and selected subnet are now connected. Consistent address parameters are set automatically for the interface.

Procedure - creating a new subnet

To create a subnet and to connect it to the interface, follow these steps in the device view:

1. Select the entire communications-compliant component or the interface to be networked.
   The properties of the selected interface or component are displayed in the Inspector window.
2. Select the "Ethernet Addresses" parameter group for the selected interface in the Inspector window.
3. In "Interface connected with", click the "Add new subnet" button.

The interface is connected to a new subnet of the appropriate subnet type. Consistent address parameters are set automatically for the interface.

6.3.5 Checking or changing network parameters and interface parameters

Introduction

Communication between networked devices requires the following parameters to be configured:

- Network parameters

  Network parameters identify the network within the system configuration, for example, using a name.
- Interface parameters

  Interface parameters define specific properties of a component capable of communication. Addresses and transmission characteristics are set automatically and are consistent with the network parameters.

Note

Network parameters and interface parameters are usually set during networking such that communication can take place for numerous applications without the parameters having to be changed.

Procedure - checking or changing network parameters

Proceed as follows to check or change network parameters:

1. Enter the network view.
2. Select the subnet from the network view.

   You can see the network parameters in the "Properties" tab in the inspector window.
3. If necessary, check or modify the network parameters in the relevant group of parameters.

Procedure - checking or changing interface parameters

You can check and modify interface parameters in the network and device view.

Proceed as follows to check or change interface parameters:

1. Enter the network view or device view.
2. Select the interface.

   You can see the interface parameters in the "Properties" tab in the inspector window.
3. If necessary, check or modify the interface parameters in the relevant group of parameters.

6.3.6 Changing networkings

Introduction

You can cancel an interface's network connection or assign it to another subnet of the same subnet type.

Consequences

Depending on the version, a distinction should be made between:

- Canceling a network connection for an interface

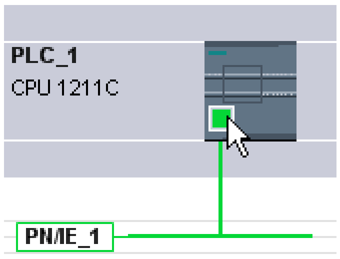
  The configured parameters for the interface remain unchanged.
- Assigning a network connection to another subnet

  If the addresses in the assigned subnet are not unique, in other words, they already exist, they will be changed automatically to make them unique.

Procedure - disconnecting from a network

Proceed as follows to cancel the network connection for an interface:

1. Select the networked interface.



2. Select the "Disconnect from subnet" command in the shortcut menu for the interface.

The network connection is deleted, the interface addresses are, however, not changed.

Configured connections are retained; however these connections are marked red in the connection table because they are not networked. Specified connections remain specified.

See also

Networking devices in the network view (Page 221)

6.3.7 Copying, cutting or deleting subnets

Introduction

You can copy subnets as individual objects or copy them along with networked devices or other networks.

For example, you can create complex configurations to be used more than once in different variants within the project with no additional effort.

Effects on the copied subnet

Properties that have to be assigned explicitly within a project are re-assigned appropriately when the copied objects are copied.

For subnets, this means: The subnet ID and name are re-assigned to the copied subnet.

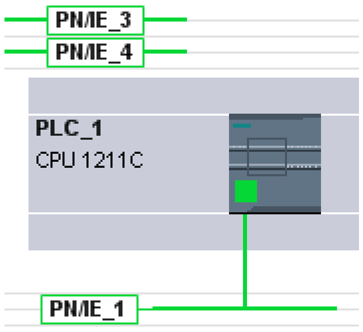
The configured properties are adopted in the copied subnet.

Procedure - copying a subnet

Proceed as follows to copy one or more subnets:

1. Select one or more subnets.
2. In the shortcut menu, select the "Copy" command.
3. Select the "Paste" command in the shortcut menu.

The copied subnets are shown as "orphaned" subnets in the top part of the network view.



Procedure - copying a subnet with connected devices

To copy one or more subnets with networked devices, follow these steps:

1. Select one or more subnets with the connected devices, for example by drawing a lasso around them.
2. In the shortcut menu, select the "Copy" command.
3. Select the "Paste" command in the shortcut menu.

Complete copies of the subnets and connected devices are created.

Configured connections are adopted and remain within the copied devices. Connections to devices that have not been copied are interrupted and become unspecified.

6.3.8 Configuring Industrial Ethernet

Rules for the network configuration

The Ethernet interfaces have a default IP address that you change.

IP address

The IP parameters are visible if the module capable of communication supports the TCP/IP protocol. This is usually the case for all Ethernet modules.

The IP address consists of 4 decimal figures in the range of 0 to 255. The decimal figures are separated from one another by a dot.

Example: 140.80.0.2

The IP address consists of

- The address of the (sub) net
- The address of the node (generally also called host or network node)

Subnet mask

The subnet mask splits these two addresses. It determines which part of the IP address addresses the network and which part of the IP address addresses the node.

The set bits of the subnet mask determine the network part of the IP address.

Example:

Subnet mask: 255.255.0.0 = 11111111.11111111.00000000.00000000

In the example given for the above IP address, the subnet mask shown here has the following meaning:

The first 2 bytes of the IP address identify the subnet - i.e. 140.80. The last two bytes address the node, thus 0.2.

It is generally true that:

- The network address results from AND linking the IP address and subnet mask.
- The node address results from AND NOT linking the IP address and subnet mask.

Relation between IP address and default subnet mask

An agreement exists relating to the assignment of IP address ranges and so-called "Default subnet masks". The first decimal number (from the left) in the IP address determines the structure of the default subnet mask. It determines the number of "1" values (binary) as follows:

IP address (decimal)	IP address (binary)	Address class	Default subnet mask
0 to 126	0xxxxxxx.xxxxxxxx....	A	255.0.0.0
128 to 191	10xxxxxx.xxxxxxxx...	B	255.255.0.0
192 to 223	110xxxxx.xxxxxxxx...	C	255.255.255.0

Note

Range of values for the first decimal point

A value of between 224 and 255 is also possible for the first decimal number of the IP address (address class D etc). This is, however, not recommended because there is no address check for these values.

Masking other subnets

You can use the subnet mask to add further structures and form "private" subnets for a subnet that is assigned one of the address classes A, B or C. This is done by setting other lower points of the subnet mask to "1". For each bit set to "1", the number of "private" networks doubles and the number of nodes they contain is halved. Externally, the network functions like an individual network as it did previously.

Example:

You have a subnet of address class B (e.g. IP address 129.80.xxx.xxx) and change the default subnet mask as follows:

Masks	Decimal	Binary
Default subnet mask	255.255.0.0	11111111.11111111.00000000.00000000
Subnet mask	255.255.128.0	11111111.11111111.10000000.00000000

Result:

All nodes with addresses between 129.80.001.xxx and 129.80.127.xxx are on one subnet, all nodes with addresses between 129.80.128.xxx and 129.80.255.xxx are on another subnet.

Router

The job of the routers is to connect the subnets. If an IP datagram is to be sent to another network, it first has to be conveyed to a router. To make this possible, in this case you have to enter the address of the router for each node in the subnet.

The IP address of a node in the subnet and the address of the router may only differ at the points at which there is a "0" in the subnet mask.

6.3.9 Open User Communication

6.3.9.1 Basics of Open User Communication

Introduction

Open User Communication is the name of a program-controlled communications technique for communication via the integrated PN/IE interface of the CPU. Various connection types are available for this communications technique.

The main feature of Open User Communication is its high degree of flexibility in terms of the data structures transferred. This allows open data exchange with any communicating devices providing they support the connection types available here. Since this communication is controlled solely by instructions in the user program, event-driven connection establishment and termination is possible. Connections can also be modified by the user program during runtime.

For S7-1200 CPUs with an integrated PN/IE interface, the TCP and ISO-on-TCP connection types are available for Open User Communication. The communications partners can be two SIMATIC PLCs or a SIMATIC PLC and a suitable third-party device.

Instructions for Open User Communication

To create the connections, you have various instructions available after opening the program editor in the "Instructions > Extended instructions > Communication" task card:

- Compact instructions for sending or receiving data with the integrated functions for establishing and terminating the connection:
  - TSEND_C (Page 958) (connection establishment/termination, sending)
  - TRCV_C (Page 961) (connection establishment/termination, receiving)
- Individual instructions for sending and receiving data or for establishing or terminating connections:
  - TCON (Page 965) (connection establishment)
  - TDISCON (Page 968) (connection termination)
  - TSEND (Page 970) (send)
  - TRCV (Page 972) (receive)

Connection establishment

For Open User Communication, instructions for establishing and terminating the connection must exist for both communications partners. One communications partner sends its data using TSEND or TSEND_C while the other communications partner receives the data using TRCV or TRCV_C.

One of the communications partners starts the connection establishment as the active partner. The other communications partner reacts by starting its connection establishment as the passive partner. If both communication partners have triggered their connection establishment then the operating system can completely establish the communication connection.

Connection parameter assignment

You can assign parameters to establish the connection using a connection description DB with the TCON_Param structure as follows:

- Manually create, assign parameters, and write directly to the instruction.
- Supported by connection parameter assignment.

Connection parameter assignment supports the establishment of the connection and should, therefore, be given preference over the other methods.

You specify the following in the connection parameter assignment:

- Connection partner
- Connection type
- Connection ID
- Connection description DB
- Address details according to selected connection type

In addition, you specify here which communication partner activates the connection establishment and which partner establishes a connection passively in response to a request from its communications partner.

See also

Principle of operation of connection-oriented protocols (Page 299)

6.3.9.2 Overview of connection parameter assignment

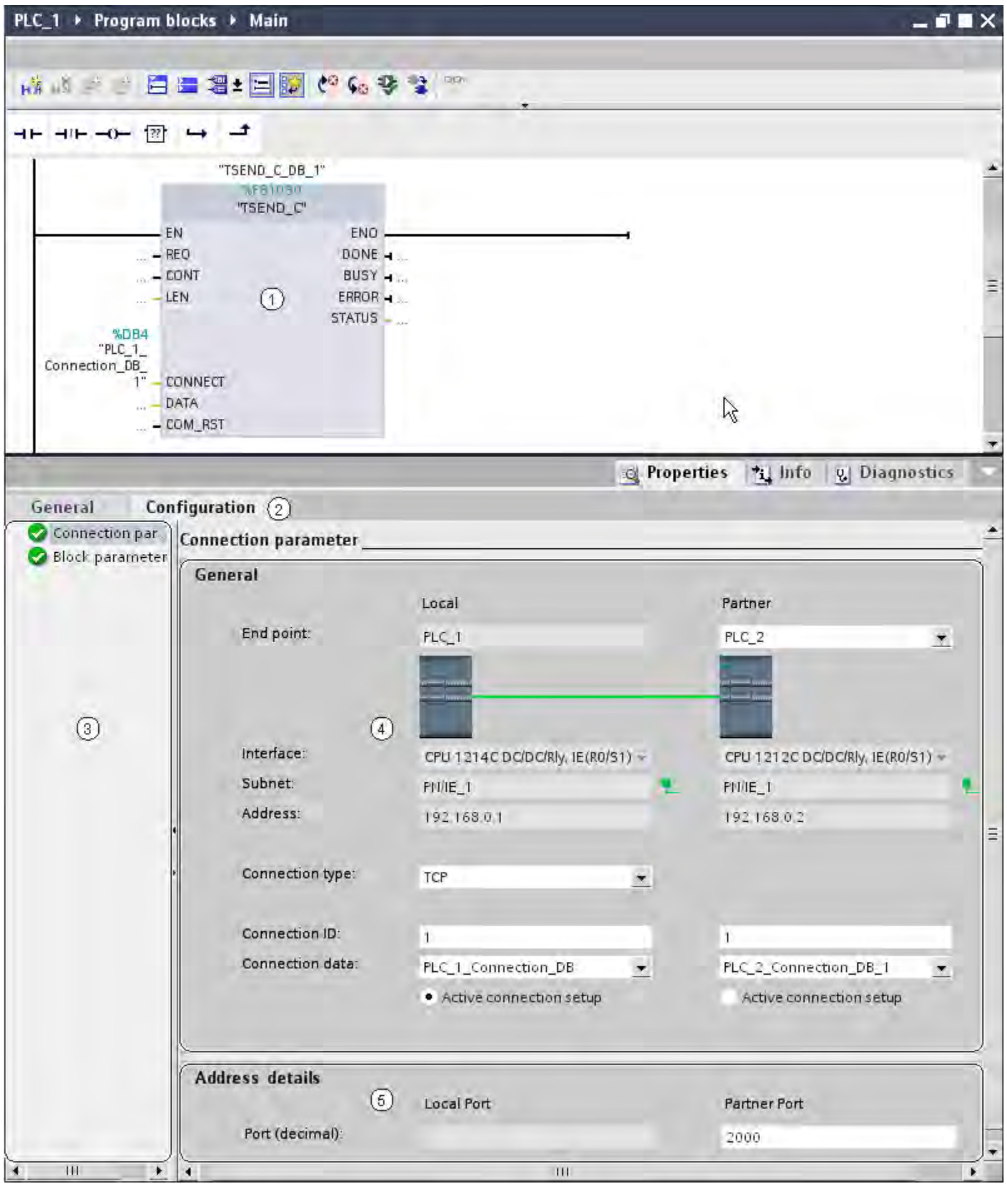
Introduction

You will find the connection parameter assignment in the Inspector window of the program editor if you want to program Open User Communication with the TSEND_C, TRCV_C or TCON expanded instructions.

Connection parameter assignment supports the flexible functionality of communications programming: The parameters entered in the connection parameter assignment are stored in an automatically created instance DB with a fixed structure of the type TCON_Param. You can modify the connection parameters in this connection description DB.

Structure of the connection parameter assignment

The connection parameter assignment is made up of the following components:



Connection parameter

General

	Local	Partner
End point:	PLC_1	PLC_2
Interface:	CPU 1214C DC/DC/Rly, IE(R0/S1)	CPU 1212C DC/DC/Rly, IE(R0/S1)
Subnet:	PN/IE_1	PN/IE_1
Address:	192.168.0.1	192.168.0.2
Connection type:	TCP	
Connection ID:	1	1
Connection data:	PLC_1_Connection_DB	PLC_2_Connection_DB_1
	● Active connection setup	○ Active connection setup

Address details

	Local Port	Partner Port
Port (decimal):		2000

① Expanded instruction for Open User Communication (TCON, TSEND_C or TRCV_C)

② "Configuration" tab in the "Properties" tab

③ Area navigation of the "Configuration" tab

④ General properties of the connection parameters

⑤ Address details in the connection parameters

"Configuration" tab

Enter the desired connection parameters in the "Configuration" tab. The area navigation of the "Configuration" tab includes the "Connection parameters" group. This group contains the connection parameter assignment. Here, you can enter the parameters for the connections and the address details with system support. Here, you also initialize the CONNECT (TCON, TSEND_C, TRCV_C) and ID (TCON, TSEND, TRCV) parameters of the selected communication instructions.

When all the required parameters are assigned, a check mark is set in front of the "Connection parameters" group in the area navigation.

Notice

The connection parameter assignment does not check that connection IDs and port numbers (TCP) or TSAPs (ISO-on-TCP) are unique. When you configure Open User Communication, you should, therefore, make sure that the parameter settings are unique within a device.

See also

Parameters of communication connections (Page 301)

6.3.9.3 Description of the connection parameters

Overview

The following table shows the general connection parameters:

Parameter	Description
Endpoint	The names of the local endpoint and the partner endpoint are shown. The local endpoint is the CPU for which TCON, TSEND_C or TRCV_C is programmed. The local endpoint is, therefore, always known. The partner endpoint is selected from the drop-down list. The drop-down list shows all available possible connection partners including unspecified connection partners for devices whose data is unknown in the project. As long as no connection partner is set, all other parameters in the mask are disabled.
Interface	The interface of the local endpoint is displayed. The partner interface is displayed only after a specified partner endpoint.
Subnet	The subnet of the local endpoint is displayed. The partner subnet is displayed only after the partner endpoint has been selected. If the selected partner endpoint is not connected to the local end point over a subnet, the networking of both connection partners is created automatically. The partner endpoint must be specified for this purpose. A connection between partners in different subnets is only possible with IP routing. The routing settings can be edited in the relevant interface properties.
Address	The IP address of the local endpoint is displayed. The IP address of the partner is displayed only after the partner endpoint has been selected. If you have selected an unspecified connection partner, the input box is empty and has a red background. In this case, you will need to specify a valid IP address.

Parameter	Description
Connection type	Select the connection type you want to use from the "Connection type" drop-down list: • TCP • ISO-on-TCP The parameters for the required connection data change depending on the selected connection type.
Connection ID	Enter the connection ID in the input box. When you create a new connection, the default value 1 is assigned. You can change the connection ID in the input boxes or enter it directly in TCON. Ensure that the connection ID assigned is unique within the device.
Connection data	The names of the connection description DBs for the connection description structured according to TCON_Param are displayed in the drop-down lists. When you create the connection, one data block each is generated for the specified connection partner and automatically filled with the values from the connection parameter assignment. For the local connection partner, the name of the selected data block is entered automatically in the block parameter CONNECT of the selected TSEND_C, TRCV_C, or TCON instruction. For the second connection partner, the connection description DB generated by the first connection partner can also be used directly at the CONNECT input of the TSEND_C, TRCV_C or TCON instructions. With this procedure, you can use the existing connection description DB after selecting the first connection partner or create a new connection description DB. From the drop-down list, you can also reference another valid data block. If a DB is referenced using the CONNECT input parameter of the TSEND_C, TRCV_C or TCON expanded instruction and this does not correspond to the structure of a TCON_Param, the drop-down list is shown with no content on a red background.
Active connection establishment	Enable the "Active connection establishment" check box to specify the active partner for Open User Communication.
Port (TCP only)	Address component for a TCP connection. The default after creating a new TCP connection is 2000. You can change the port numbers. The port numbers must be unique on the device!
TSAP (ISO-on-TCP only)	Address component for an ISO-on-TCP connection. The default after creating a new ISO-on-TCP connection is E0.01.49.53.4F.6F.6E.54.43.50.2D.31. You can enter the TSAP-ID with an extension or as an ASCII TSAP. The TSAPs must be unique on the device!

See also

Parameters of communication connections (Page 301)
Assignment of port numbers (Page 303)
TSAP structure (Page 305)
Examples of TSAP assignment (Page 307)
Ability to read back connection description parameters (Page 304)
Creating and assigning parameters to connections (Page 235)

6.3.9.4 Starting connection parameter assignment

The connection parameter assignment for Open User Communication is enabled as soon as a TCON, TSEND_C or TRCV_C instruction for communication is selected in a program block.

Requirement

- Your project must contain at least one S7-CPU.
- The program editor is open.
- A network is available.

Procedure

To insert the expanded instructions for Open User Communication, follow these steps:

1. Open the task card, pane and folder "Instructions > Extended instructions > Communication".
2. Drag one of the following instructions to a network:
   - TSEND_C
   - TRCV_C
   - TCON (in the "Others" subfolder)

   The "Call options" dialog is opened.
3. Edit the properties of the instance DB in the "Call properties" dialog. You have the following options:
   - Change the default name.
   - Select the "Manual" check box to assign your own number.
4. Click "OK" to complete your entry.

Result

A connection description DB structured according to TCON_Param is created as an instance DB belonging to the inserted instruction.

With TSEND_C, TRCV_C or TCON selected, you will see the "Configuration" tab under "Properties" in the Inspector window. The "Connection parameters" group in area navigation contains the connection parameter assignment that you can now make.

See also

Inserting FBD elements using the "Instructions" task card (Page 484)
Inserting LAD elements using the "Instructions" task card (Page 452)
Creating and assigning parameters to connections (Page 235)

6.3.9.5 Creating and assigning parameters to connections

In the connection parameter assignment for Open User Communication, you can create and make the parameter settings for connections of the type TCP or ISO-on-TCP.

Requirement

A CPU exists with a TCON, TSEND_C or TRCV_C expanded instruction.

Procedure

To create a connection for Open User Communication, follow these steps:

1. Select a TCON, TSEND_C or TRCV_C block of Open User Communication in the program editor.
2. Open the "Properties > Configuration" tab in the inspector window.
3. Select the "Connection parameters" group. Until you select a connection partner, only the empty drop-down list for the partner endpoint is enabled. All other input options are disabled.

   The connection parameters already known are displayed:
   - Name of the local endpoint
   - Interface of the local endpoint
   - IP address of the local endpoint
   - Connection ID with default of 1
   - Unique name of the data block for the connection data
   - Local endpoint as active connection partner
4. In the drop-down list box of the partner endpoint, select a connection partner. You can select an unspecified device or a CPU in the project as the communications partner. Certain connection parameters are then entered automatically.

   An existing partner is automatically networked with the local endpoint and a data block structured for the connection data according to TCON_Param is created for the partner CPU. The following parameters are set:
   - Interface of the partner endpoint
   - Name of the local subnet and the partner subnet
   - IP address of the partner endpoint
   - ISO-on-TCP connection type
   - Connection ID with default of 1
   - Unique name of the data block for the connection data
   - TSAP-ID E0.01.54.43.50.2D.31

   With an unspecified partner, the following parameters are set:
   - TCP connection type
   - Port number 2000
5. Select the connection type you want from the relevant drop-down list. You can choose between the following:
   - TCP
   - ISO-on-TCP

The address details are switched over between port numbers (TCP) and TSAP (ISO-on-TCP) depending on the connection type.

6. Enter the connection IDs in the relevant input boxes of the connection partner. No connection ID can be assigned to an unspecified partner.
7. You can select a different connection description DB in the relevant "Connection data" drop-down list or change the name of the connection description DB to create a new data block:
   – You can also see the selected data block at the interconnection of the CONNECT input parameter of the selected TCON, TSEND_C or TRCV_C instruction.
   – If you have already specified a connection description DB for the connection partner using the CONNECT parameter of the TCON, TSEND_C or TRCV_C instruction, you can either use this DB or create a new DB.
   – If you edit the name of the displayed data block in the drop-down list, a new data block with the changed name but with the same structure and content is generated and used for the connection.
   – Changed names of a data block must be unique in the context of the communications partner.
   – A connection description DB must have the TCON_Param structure.
   – A data block cannot be selected for an unspecified partner.
8. Set the behavior for connection establishment using the "Active connection establishment" check boxes. You can decide which communications partner establishes the connection actively.
9. You can edit the input boxes in the address details. Depending on the selected protocol, you can edit the ports (for TCP) or the TSAPs (for ISO-on-TCP).

Changed values are checked immediately for input errors by the connection parameter assignment and entered in the data block for the connection description.

Note

Open User Communication between two communications partners can only work when the program section for the partner endpoint has been downloaded to the hardware. To achieve fully functional communication, make sure that you load not only the connection description of the local CPU on the device but also that of the partner CPU as well.

See also

Description of the connection parameters (Page 233)
Starting connection parameter assignment (Page 235)
TSAP structure (Page 305)
Assignment of port numbers (Page 303)
Parameters of communication connections (Page 301)

6.3.9.6 Deleting connections

Introduction

The data of a created connection for Open User Communication is stored in a connection description DB. You can delete the connection by deleting the data block containing the connection description.

Requirement

You have created an Open User Communication connection.

Procedure

To delete a connection, follow these steps:

1. Select a communications partner for Open User Communication in the project tree.
2. Open the "Program blocks" folder below the selected communications partner.
3. Select the "Delete" command from the shortcut menu of the data block with the connection parameter assignment.

Note

If you are not certain which block to delete, open the expanded instruction TCON, TSEND_C or TRCV_C. You will find the name of the data block as the CONNECT input parameter or in the connection parameter assignment as the "Connection data" parameter.

If you only delete the instance DBs of the expanded instructions TCON, TSEND_C or TRCV_C, the assigned connections are not deleted as well.

Note

If the connection DB is used by other blocks of the expanded instructions, then the corresponding calls, their instance DBs, and the combination blocks TSEND_C and TRCV_C are also deleted from the block folder, provided they are not used elsewhere.

This action prevents the program from being inconsistent.

Result

You have deleted the connection.

Note

Insert an expanded instruction TCON, TSEND_C or TRCV_C again to reference an existing connection description with the TCON_Param structure via the "Connection data" parameter.

6.3.10 HMI connections

6.3.10.1 Introduction to configuring connections

Definition

A connection defines a logical assignment of two communication partners in order to undertake communication services. A connection defines the following:

- Communication partner involved
- Type of connection (e.g., HMI connection)
- Special properties (e.g., whether a connection is established permanently or whether it is established and terminated dynamically in the user program, and whether status messages are to be sent)
- Connection path

What you need to know about connection configuration

During connection configuration, a local connection name is assigned for an HMI connection as a unique local identification.

In the network view, a "Connections" tab is displayed in addition to the "Network overview" tab. This tab contains the connection table. A line in this connection table represents a configured connection, e.g., between an HMI device and PLC, along with its properties.

See also

Configuring a connection (Page 1405)
Automatic creation of a connection (Page 1408)

6.3.10.2 What you need to know about using connection resources

Introduction

Each connection requires connection resources for the end point and/or transition point on the devices involved. The number of connection resources is device-specific.

If all the connection resources of a communication partner are assigned, no new connections can be established. This situation is apparent when a newly created connection in the connection table has a red background. The configuration is then inconsistent and cannot be compiled.

HMI connections

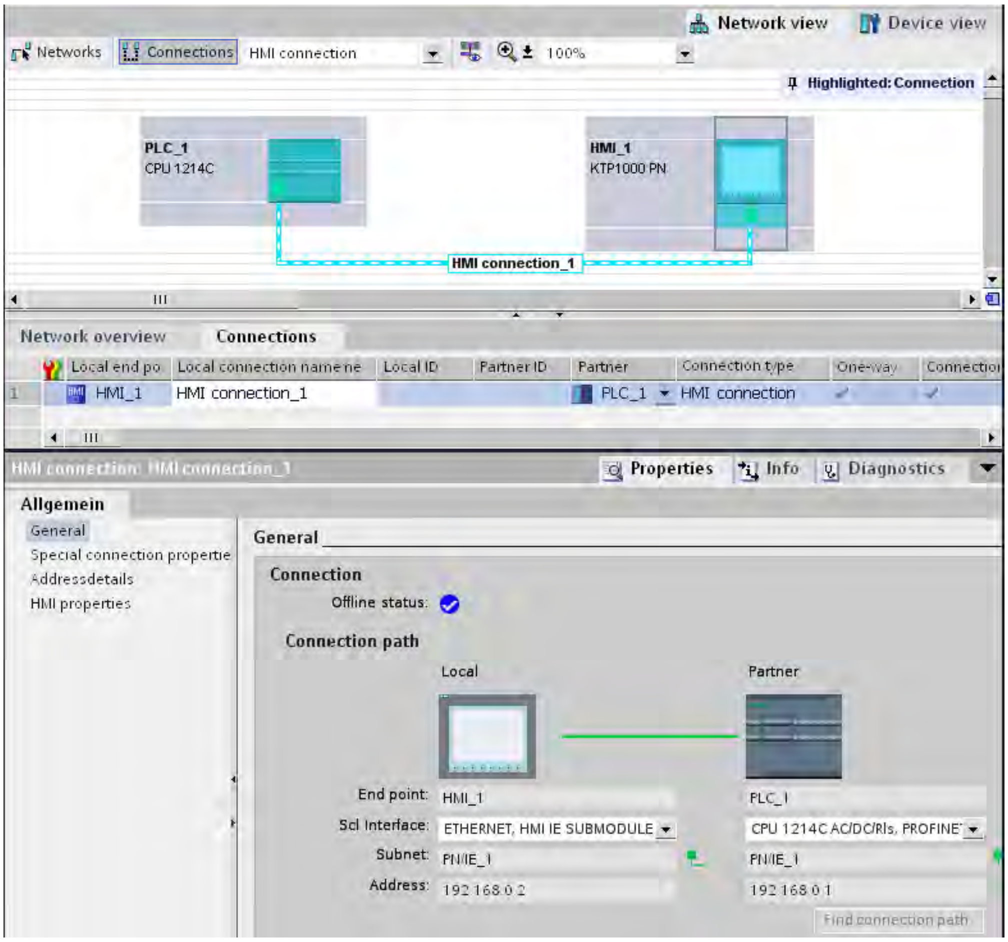
For HMI connections via the **integrated** PN interface, one connection resource for the endpoint per HMI connection is occupied for the HMI device.

One connection resource is also required for the connection partner (PLC).

6.3.10.3 Views containing information about the configured connections

The views described below will provide you with comprehensive access to all the information and functions regarding configuring and checking communication connections.

- Connection display in the network view
- Connection table
- "Properties" tab for a connection in the inspector window



	Local end po	Local connection name	Local ID	Partner ID	Partner	Connection type	One-way	Connectio
1	HMI_1	HMI connection_1			PLC_1	HMI connection	✓	✓

Offline status: ✓

	Local	Partner
End point:	HMI_1	PLC_1
Scl Interface:	ETHERNET, HMI IE SUBMODULE	CPU 1214C AC/DC/Rls, PROFINE
Subnet:	PN/IE_1	PN/IE_1
Address:	192.168.0.2	192.168.0.1

Benefits

The information shown in these views are always up-to-date in terms of the current user actions. This means:

- The connection table displays all connections created.
- If you have selected a connection in the connection table:
  – You will graphically see the connection path in the network view.
  – The "Properties" tab in the Inspector window displays the parameters of this connection.

The connection table

The connection table offers the following functions:

- List of all connections in the project
- Selection of a connection and display of connections associated with it in the network view
- Changing of connection partners
- Display showing status information

"Properties" tab for a connection in the inspector window

The properties dialog has the following meaning:

- Display for connection parameters
- Display of connection path
- Subsequent specification of connections using the "Find connection path" button

6.3.10.4 Creating a new connection

Creating a connection - alternatives

You have the following options for creating a connection in the network view:

- Graphic connection configuration
- Interactive connection configuration

You'll find the individual steps for this in the following chapters.

Requirement and result

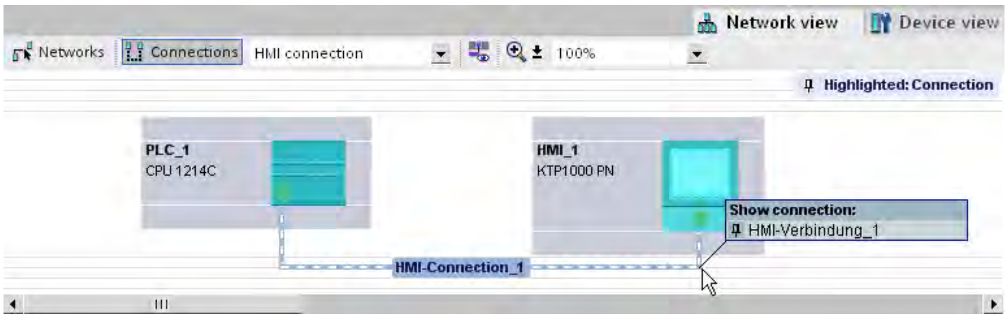
You have created the devices with CPUs and HMI devices between which you want to configure connections in the network view.

Specifying a connection

If both partners for the connection type selected are networked on the same network, use the graphic or interactive selection of both communication partners to create a fully specified connection.

This connection is entered automatically into the connection table of the HMI device. A local connection name is assigned for this connection.

The following schematic shows a configured connection with a networked device:



6.3.10.5 Creating a new connection graphically

Graphically configuring connections

When using the graphic connection configuration, if necessary the system asks you to define the connection path. Select the devices to be connected in the current configuration.

Automatically determining connection path

To create a connection graphically, follow these steps:

1. Click the "Connections" button.

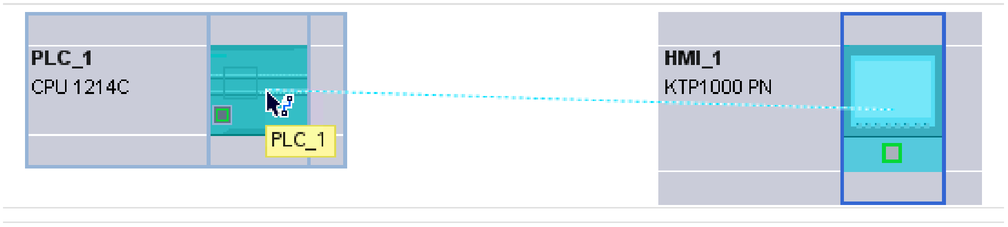
   Connections

   The connection mode for the connection type you have selected is then activated.

   You will see this from the following:

   The devices that can be used for the connection type selected in your project are color-highlighted in the network view.

2. Hold down the mouse button and drag the mouse pointer from the device from which the connection will originate to the device at which the connection ends.



3. Release the mouse button over the destination device to create the connection between the two devices.

Result

- A specified connection is created.
- The connection path is highlighted.
- The connection is entered in the connection table.

6.3.10.6 Interactively creating a new connection

Interactively configuring connections

Define the local device and its connection partners.

Procedure

Proceed as follows to interactively create a connection:

1. Select the "Create new connection" command in the shortcut menu of a connection partner for which you want to create a connection.

   The "Create new connection" dialog is opened.
2. Select the partner endpoint.

   In the right pane of the dialog, a possible connection path fitting the selected endpoint is displayed, if available. Incomplete paths, for example, for a non-specified CPU, are marked by an exclamation mark on a red background.
3. To close the dialog, click "OK".
   To accept the configured connection and to configure additional connections to other endpoints, click "Apply".

6.3.10.7 Working in the network view

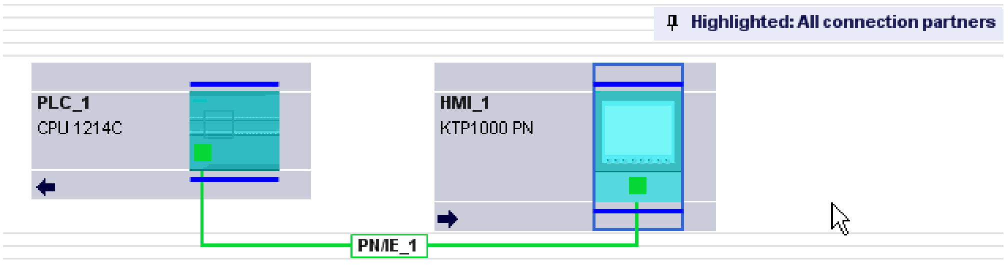
Highlighting connection path and partner in the network view

To display the connection partners for all or certain connection types in the network view, proceed as follows:

1. Click the "Connections" button.

2. Select the "Highlight connection partners" command in the shortcut menu for the HMI device whose connection partners you want to display in the network view.
3. Select "All connection partners" in the following menu.

   The local device and the CPUs of the target devices are selected. The local connection partner shows an arrow pointing right and the remote connection partners show an arrow pointing left.
4. To open a list with information on the target devices, click the arrow of the local device. This additional function is useful in complex network configurations in which some devices are not visible.



Note

You can display one of the connection partners which cannot be seen in the current display range of the network view. Click on the communication partner in the list that appears. Result: The display is moved such that the connection partner becomes visible.

See also

Creating a new connection graphically (Page 242)

6.3.10.8 Working with the connection table

Basic functions for tables

The connection table supports the following basic functions for editing a table:

- Changing column width
- Displaying the meaning of a column, line or field using tool tips.

Changing column width

To adjust the width of a column to the content so that all texts in the lines are legible, follow these steps:

1. Position the cursor in the header of the connection table to the right of the column that you want to optimize until the cursor changes its shape to two parallel lines (as if you wanted to change the width of the column by dragging it with the cursor).
2. Double click on this point.

For columns that are too narrow, the complete content of specific fields is shown when you pause with the cursor on the respective field.

Using cursor keys to move within the connection table

You can use the UP and DOWN cursor keys to select a connection from the connection table; the selected connection is marked and is shown highlighted in the network view.

Changing properties of connection

You can directly edit the parameters displayed in the connection table in some cases. To change the name of a connection, you do not have to navigate to the Inspector window.

Changing connection partners

You can change the connection partner of a connection as follows:

1. Select the connection.
2. Select the new connection partner from the open drop-down list in the "Partner" column.

6.3.10.9 Deleting connections

You can delete configured connections via the network view or the connection table.

In the network view you can delete a highlighted connection. In the connection table you can delete one or more connections.

Procedure in the connection table

To delete a highlighted connection, proceed as follows:

1. In the connection table select the connection that you want to delete.
2. Open the shortcut menu with a right mouse click.
3. Select the "Delete" command.

   The selected connection will be completely deleted.
4. Load the relevant device.

6.3.10.1 Copying connections
0

Introduction

Connections are not copied singly but always in context along with the project or the device.

You can copy:

- Entire projects
- One or more devices within a project or from one project to another

Copying a project

When you copy a project all configured connections will also be copied. No settings whatsoever are required for the copied connections because the connections remain consistent.

Copying devices

If you copy devices for which connections have been configured (HMI devices), the connections are copied as well. To complete the connection path, you must still finalize the networking.

An S7-1200 is merely a server for HMI connections and has no connection configuration itself. For this reason, when an S7-1200 CPU is copied, no connections are copied along with it.

6.3.10.1 Inconsistent connections - connections without assignment
1

With an inconsistent connection the structure of the connection data is destroyed or the connection is not functional in the project context.

Inconsistent connections cannot be compiled and loaded - operation is not possible with such a connection.

In the connection table inconsistent connections are marked in red.

Possible causes for inconsistent connections

- Deletion or change of the hardware configuration.
- Missing interface network links in the project, which are necessary for a connection.
- Connection resources are exceeded
- Errors when backing up data due to insufficient memory
- Connections to an unspecified connection partner without partner address information.

Detailed information regarding the reasons for the inconsistency can be found in the "Compile" tab following compilation (Edit > Compile).

Remedies

If the connection cannot be repaired by opening the connection properties, changing them or undoing them in the configuration, then it may be necessary to delete the connection and re-create it.

6.3.10.1 HMI connection general settings
2

General connection parameters

General connection parameters are displayed in the "General" parameter group under the properties of the connection; these connection parameters identify the local connection end point.

Here, you can also assign the connection path and specify all aspects of the connection partner.

Special connection properties

Display of the connection properties (cannot be changed):

- Active connection establishment

  The connection establishment always starts from the HMI device. This option is selected by default if the address of the partner is specified.
- One-way

  One-way means that the connection partner functions as a server on this connection and cannot send or receive actively.
- Sending operating mode messages

  Not relevant for HMI devices.

Address details

Displaying address details of the HMI connection. With an unspecified partner, the values for the rack and slot can be changed. All other values are obtained from the current configuration and cannot be changed.

Miscellaneous

Display of the access points for the online connection between HMI device and connection partner.

6.4 Configuring operation

6.4.1 Selecting a CPU

Introduction

Select a CPU from the hardware catalog and place it, together with a rack, in the network view. On this device drag the desired modules from the hardware catalog; they are arranged automatically on the rack.

Selecting the components in the hardware catalog

Each hardware component is displayed as a folder in the hardware catalog. When you open this folder you will see the different versions of the selected hardware component with its respective order numbers.

There will be an example of how to set up a CPU with a rack in network view.

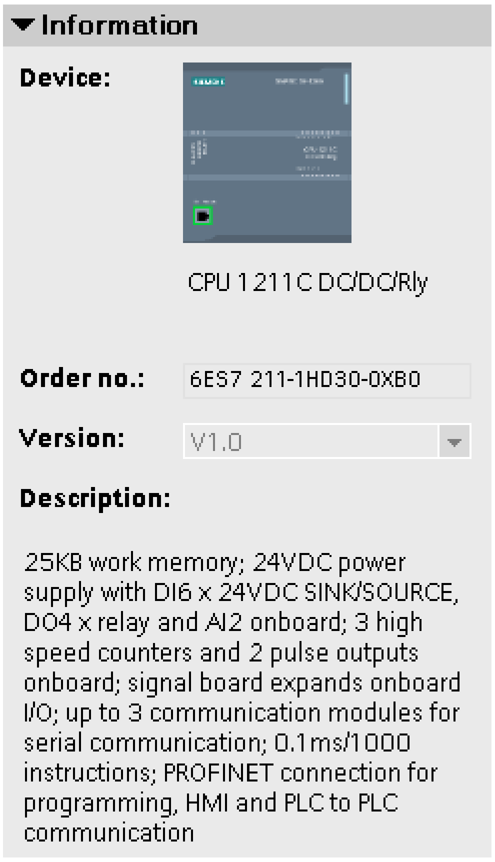
Requirement

- The hardware catalog is open.
- You must be in the network view.

Procedure

To select a CPU from the hardware catalog, proceed as follows:

1. In the hardware catalog navigate to the folder with the desired CPUs.
2. Open the folder with the desired CPU type; you will see all order numbers for the selected CPU type.
3. Click on a CPU order number to get information about the selected CPU under "Information" pane.



Device:

CPU 1211C DC/DC/Rly

Order no.: 6ES7 211-1HD30-0XB0

Version: V1.0

Description:

25KB work memory; 24VDC power supply with DI6 x 24VDC SINK/SOURCE, DO4 x relay and AI2 onboard; 3 high speed counters and 2 pulse outputs onboard; signal board expands onboard I/O; up to 3 communication modules for serial communication; 0.1ms/1000 instructions; PROFINET connection for programming, HMI and PLC to PLC communication

4. Set up the CPU and a rack. You have the following options:
   - Use drag-and-drop to drag the CPU from the hardware catalog into network view.
   - Use Copy & Paste to copy the CPU to the network view.
   - Double-click the CPU entry in the hardware catalog.

See also

Browsing the hardware catalog (Page 204)
Adding a device to the hardware configuration (Page 210)
Inserting a module into a rack (Page 211)
Working with racks (Page 206)
Creating an unspecified CPU (Page 298)
Information on hardware components (Page 200)

6.4.2 Changing properties of the modules

Default settings

When they leave the factory, all hardware components with parameters have default settings suitable for standard applications. These default values allow the hardware components to be used immediately without making any additional settings.

You can, however, modify the behavior and the properties of the hardware components to suit the requirements and circumstances of your application. Hardware components with settable parameters include, for example, communications modules and several analog and digital modules.

Setting and loading parameters

When you have selected a hardware component in the device or network view, you can set the properties in the Inspector window. When you save a device configuration with its parameters, data is generated that needs to be loaded on the CPU. This data is transferred to the relevant modules during startup.

Properties of the CPUs

The properties of the CPUs have special significance for system behavior. For example for a CPU you can set:

- Interfaces
- Inputs and outputs
- High-speed counters
- Pulse generators
- Startup behavior
- Time-of-day
- Protection level
- Bit memory for system and clock
- Cycle time
- Communications load

The entry possibilities specify what is adjustable and in which value ranges. Fields that cannot be edited are disabled or are not shown in the properties window.

Requirement

You have already arranged the hardware components for which you want to change properties on a rack.

Procedure

To change the properties and parameters of the hardware components, follow these steps:

1. In the device or network view, select the hardware component or interface that you want to edit.
2. Edit the settings for the selected object:
   - For example in the device view you can edit addresses and names.
   - In the Inspector window additional setting possibilities are available.

You do not need to confirm your entries, the changed values will be applied immediately.

See also

Editing properties and parameters (Page 218)
Introduction to loading a configuration (Page 276)

6.4.3 CPU properties

6.4.3.1 Overview of the CPU properties

Overview

The following table provides you with an overview of the CPU properties:

Group	Properties	Description
General	Project information	General information to describe the inserted CPU. Apart from the slot number, you can change all the settings
	Catalog information	Read-only information from the hardware catalog for this CPU.
PROFINET interface	General	Name and comment for this PROFINET interface. The name is limited to 128 characters.
	Ethernet addresses	Selects whether the Ethernet interface is networked. If subnets have already been created in project, they can be selected in the drop-down list. If not, you can create a new subnet with the "Add new subnet" button. Information on the IP address, subnet mask, and IP router usage in the subnet is available in the IP protocol. If an IP router is used, the information about the IP address of the IP router is necessary.
	Extended	Name of and comment on the port of the Ethernet interface
	Time-of-day synchronization	Settings for time-of-day synchronization in the NTP time format. The NTP (network time protocol) is a general mechanism for synchronizing system clocks in local and global area networks. In NTP mode, the interface of the CPU sends time queries (in client mode) at regular intervals to NTP servers on the subnet (LAN) and the addresses must be set in the parameters here. Based on the replies from the server, the most reliable and most accurate time is calculated and synchronized. The advantage of this mode is that it allows the time to be synchronized across subnets. The accuracy depends on the quality of the NTP server being used.

Group	Properties	Description
DI#/DO#	General	Name of and comment on the integrated digital inputs of the CPU.
	Digital inputs	Input delays can be set for digital inputs. The input delays can be set in groups (in each case for 4 inputs). The detection of a rising and a falling edge can be enabled for each digital input. A name and a hardware interrupt can be assigned to this event. Depending on the CPU, pulse catches can be activated at various inputs. When the pulse catch is activated, even pulse edges that are shorter than the cycle time of the program are detected.
	Digital outputs	The reaction to a mode change from RUN to STOP can be set for all digital outputs: The state can either be frozen (corresponds to retain last value) or you set a substitute value ("0" or "1")
	I/O/Diagnostic addresses	The address space of the input and output addresses is specified as is the process image. The hardware ID of the device is displayed.
AI#	General	Name of and comment on the integrated analog inputs of the CPU.
	Analog inputs	During noise reduction, the specified integration time suppresses interference frequencies at the specified frequency (in Hz). The channel address, measurement type, voltage range, smoothing, and overflow diagnostics must be specified in the "Channel #" group. The measurement type and voltage range are set permanently to voltage, 0 to 10 V. Smoothing analog values provides a stable analog signal for further processing. Smoothing analog values can be useful with slow measured value changes, for example in temperature measurement. The measured values are smoothed with digital filtering. Smoothing is achieved by the module forming mean values from a specified number of converted (digitalized) analog values. The selected level (slight, medium, strong) decides the number of analog signals used to create the mean value. If overflow diagnostics is enabled, a diagnostics event is generated if an overflow occurs.
	I/O/Diagnostic addresses	The address space of the input addresses is specified as is the process image. The hardware ID of the device is displayed.
High-speed counter (HSC)	High-speed counter (HSC)#	High-speed counters are typically used to drive counting mechanisms. For description and parameter assignment, see: Configuring high-speed counters (Page 264)

Group	Properties	Description
Pulse generators (PTO/PWM)	PTO#/PWM#	A pulse generator is activated and can be initialized with project information. For the parameter assignment of an activated pulse generator, specify the usage as PWM (Pulse Width Modulation) or as PTO (Pulse Train Output). Specify the output source, time base, pulse width format, cycle time, and initial pulse width for PWM. A pulse output is specified as the hardware output. The PWM output is controlled by the CTRL_PWM instruction, see CTRL_PWM (Page 1014) . Specify the output source for PTO. A pulse output and a direction output are specified as the hardware outputs. A PTO is operated together with a high-speed counter in the "motion axis" count mode and controlled by the Motion Control technology object, see Configuration - General (Page 627) . The hardware ID is displayed in the I/O/Diagnostic addresses and, if the PWM function is selected, the address space of the output addresses and the process image can be selected.
Startup	Startup type	Setting the start up behavior after cycling power. See: Principles of the STARTUP mode (Page 313)
Time-of-day	Local time and daylight-saving time	Setting of the time zone in which the CPU is operated and setting of the daylight-saving/standard time changeover.
Protection	Protection and password for read/ write access	Setting options for the level of protection (Page 275)
System and clock memory bits	System memory bits and clock memory bits	You use system memory bits for the following scans: • Is the current cycle the first since cycling power? • Have there been any diagnostics state changes compared with the previous cycle? • Scan for "1" (high) • Scan for "0" (low) Clock memory bits change their values at specified periodic intervals. See: Using clock memory (Page 274)
Cycle time	Maximum cycle time and minimum cycle time.	See: Cycle time and maximum cycle time (Page 253)
Communications load	Maximum allocation of the cycle for communication (as a percentage)	See: Cycle loading by communications (Page 254)

Group	Properties	Description
I/O addresses overview	-	Tabular representation of all addresses used by the CPU for integrated inputs/outputs as well as for the inserted modules. Addresses that are not used by any module are represented as gaps. The view can be filtered according to: • Input addresses • Output addresses • Address gaps

See also

Specifying input and output addresses (Page 257)
Configuring high-speed counters (Page 264)
Setting options for the level of protection (Page 275)
Cycle time and maximum cycle time (Page 253)
Cycle loading by communications (Page 254)
Assigning parameters to hardware interrupt OBs (Page 417)
Principles of the STARTUP mode (Page 313)
Access to the I/O addresses (Page 322)
Using clock memory (Page 274)
Addressing modules (Page 256)
Special features during startup (Page 315)

6.4.3.2 Cycle time and maximum cycle time

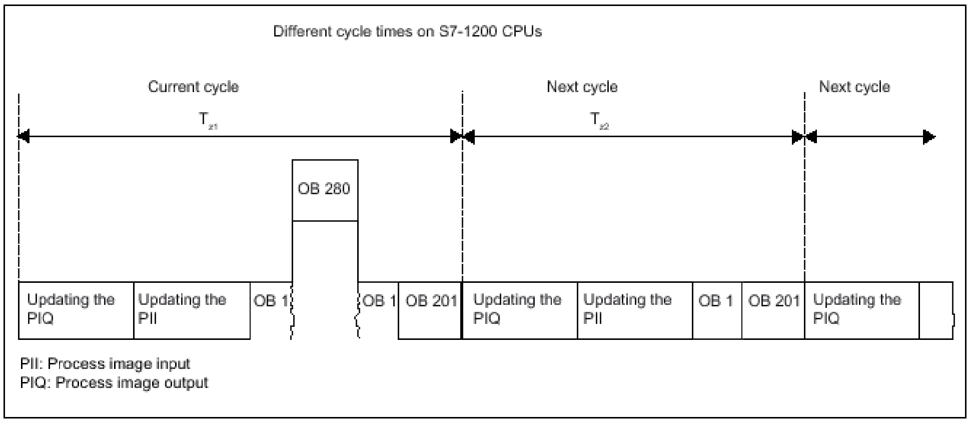
Function

The cycle time is the time that the operating system requires to execute the cyclic program and all the program sections that interrupt this cycle. The program execution can be interrupted by:

- Time errors and 2xMaxCycleTime errors
- System activities, e.g., process image updating

The cycle time (Tcyc) is therefore not the same for every cycle.

The following schematic shows an example of different cycle times (TZ1 ≠ TZ2) for S7-1200 CPUs:



In the current cycle, the cyclic OB used here (e.g., OB 1) is interrupted by a time error (e.g., OB 280) Following the cyclic OB, the next cycle OB 201 is processed.

Maximum cycle time

The operating system monitors the execution time of the cyclic program for a configurable upper limit known as the maximum cycle time. You can restart this time monitoring at any point in your program by calling the RE_TRIGR instruction.

If the cyclic program exceeds the maximum cycle time, the operating system attempts to start the time error OB (for example OB 280). If this does not exist, the CPU changes to "STOP" mode.

In addition to monitoring the execution time for the maximum cycle time, adherence to a minimum cycle time is guaranteed. To do this, the operating system delays the start of the new cycle until the minimum cycle time has been reached. During this waiting time, new events and operating system services are processed.

If the maximum cycle time is exceeded a second time, for example while the time error OB is being processed (2xMaxCycleTime error), the CPU changes to STOP mode.

6.4.3.3 Cycle loading by communications

Function

The cycle time of the CPU can be extended due to communications processes. These communications processes include for example:

- Transferring data to another CPU
- Loading of blocks initiated by a programming device

You can control the duration of these communications processes to some extent using the CPU parameter "Cycle load due to communication".

In addition to communications processes, test functions also extend the cycle time. The "Cycle load due to communication" parameter has very little influence on the duration of these functions.

How the parameter works

You use the "Cycle load due to communication" parameter to enter the percentage of the overall CPU processing capacity that can be available for communications processes. This CPU processing capacity is now available at all times for communication. When not required for communication, this processing capacity is available to the rest of the processing.

Effect on the actual cycle time

The "Cycle load due to communication" parameter can be used to extend the cycle time of the cyclic organization block (e.g., OB 1) by a factor calculated according to the following formula:

$$\frac{100}{100 - \text{"Cycle load due to communication"}}$$

The formula does not take into account the effect of asynchronous events such as hardware interrupts or cyclic interrupts on the cycle time.

If the cycle time is extended due to communication processes, more asynchronous events may occur within the cycle time of the cyclic organization block. This extends the cycle still further. The extension depends on how many events occur and how long it takes to process them.
Example 1 – no additional asynchronous events:

If the "Cycle load due to communication" parameter is set to 50%, this can cause the cycle time of the cyclic organization block to increase by up to a factor of 2.
Example 2 – additional asynchronous events:

For a pure cycle time of 500 ms, a communication load of 50% can result in an actual cycle time of up to 1000 ms, provided that the CPU always has enough communications jobs to process. If, parallel to this, a cyclic interrupt with 20 ms processing time is executed every 100 ms, this cyclic interrupt would extend the cycle by a total of 5*20 ms = 100 ms without communication load. That is, the actual cycle time would be 600 ms. Because a cyclic interrupt also interrupts communications, it affects the cycle time by adding 10 * 20 ms at 50 % communication load. That is, in this case, the actual cycle time amounts to 1200 ms instead of 1000 ms.

Note

Observe the following:

- Check the effects of changing the value of the "Cycle load due to communication" parameter while the system is running.
- The communications load must always be taken into account when setting the minimum cycle time; otherwise, time errors will occur.

Recommendations

- Increase this value only if the CPU is used primarily for communication purposes and the user program is not time critical.

- In all other situations you should only reduce this value.

6.4.4 Addressing modules

6.4.4.1 Addressing modules

Introduction

In the device view you see the addresses or address ranges of the modules in the I-address and Q-address columns. There are other addresses as well, which are explained below.

I/O address

I/O addresses are required to read inputs and/or set outputs in the user program.

Input and output addresses are assigned automatically when inserting modules in the rack. The address of the first channel is the start address of a module. The addresses of the other channels are derived from this start address. The address end is derived from the module-specific address length.

Device address (e.g., Ethernet address)

Device addresses are addresses of programmable modules (Industrial Ethernet addresses). They are required to address the different stations of a subnet, e.g. to load a user program into a CPU.

Hardware ID for identification of modules or functional units of modules

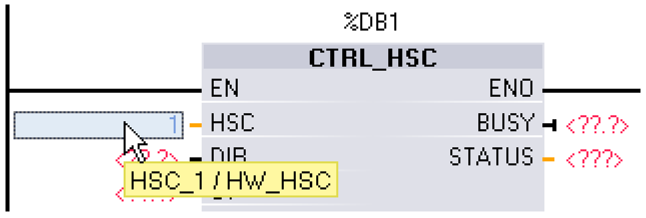
In addition to the I addresses and Q addresses, a hardware identifier is also assigned automatically and is used to identify the module. Functional units of a module, for example an integrated counter, also receive a hardware identifier.

The hardware identifier consists of a whole number and is output by the system along with diagnostics alarms to allow the faulty module or functional unit to be localized.

You also use the hardware identifier for a number of instructions to identify the relevant module on which the instruction will be used.

The hardware ID cannot be changed.

Example: Identifying a high-speed counter



The hardware ID is assigned automatically when components are inserted in the device or network view and in the constants table of the PLC tags. A name is also assigned automatically for the hardware ID. These entries in the constants table of the PLC tags cannot be changed either.

See also

Specifying input and output addresses (Page 257)
Assigning addresses to a location in the program (Page 257)
Introduction to loading a configuration (Page 276)

6.4.4.2 Specifying input and output addresses

Default input and output addresses are set automatically. You can, however, change the address assignment later.

All addresses of modules are located in the process image area. The process image is automatically updated cyclically.

Requirement

You are in the device view.

Procedure

To change the preset address range proceed as follows:

1. In the device view, click on the module for which you want to set the start address.
2. Go to "I/O diagnostics addresses" in "Properties" in the Inspector window.
3. Under "Start address" enter the required start address.
4. Press <Return> or click on any object to accept a modified value.

If you have entered an invalid address, a message indicating the next available address is displayed.

Note

You can also change the addresses directly in the device overview.

See also

Editing properties and parameters (Page 218)

6.4.4.3 Assigning addresses to a location in the program

You can assign addresses or symbols from the I/O channels of the modules directly to the locations in the program.

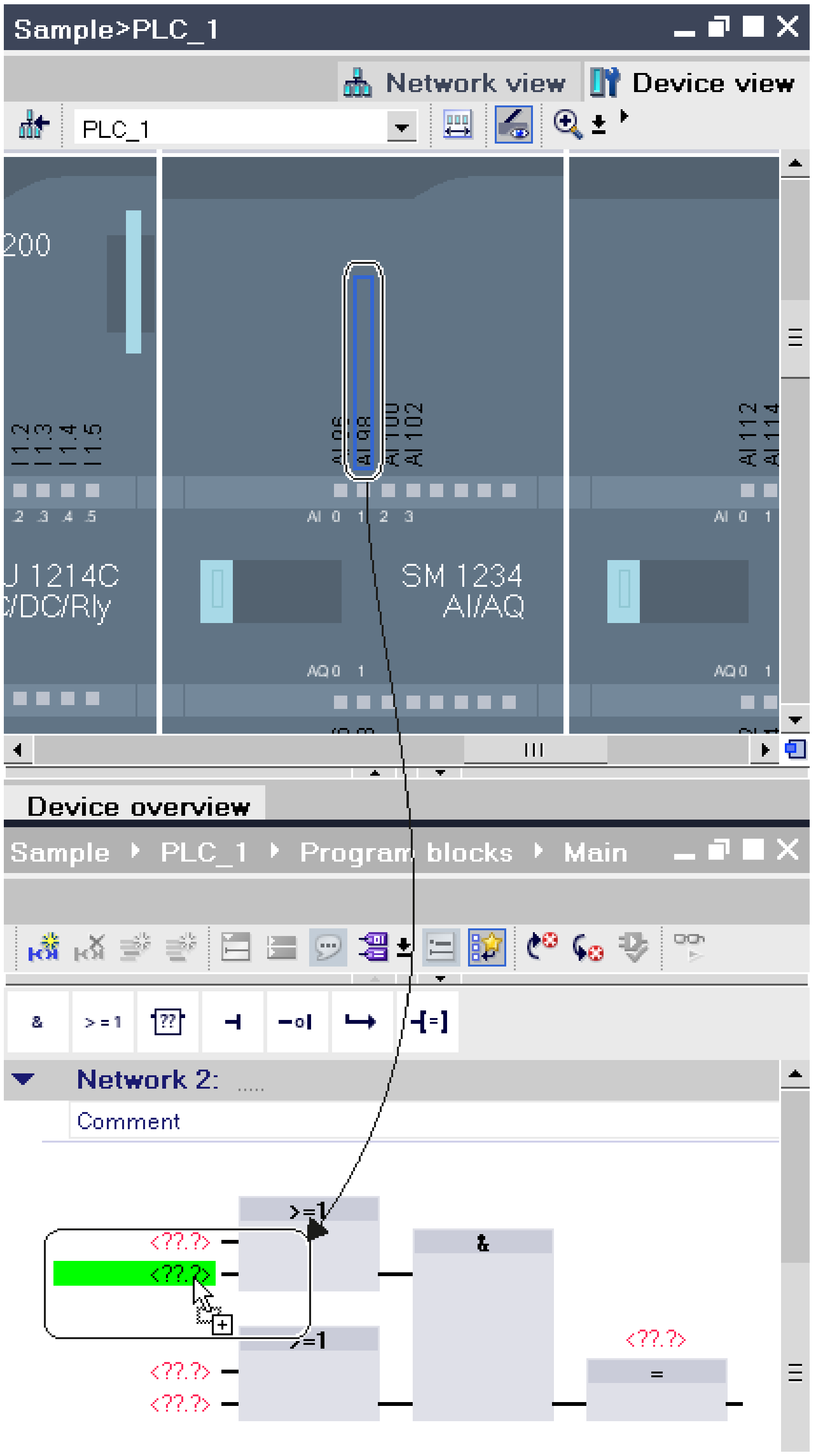
Requirement

The device view of the hardware and network editor as well as the instruction window of the program editor must be opened and arranged one below the other.

Procedure

To assign addresses or symbols of modules and locations in the program, proceed as follows:

1. In the device view, navigate to the module with the desired I/O channel.
2. Use the zoom function to specify a magnification of at least 200%: At a magnification level of 200% and higher, the labels of the individual address channels are displayed and can be edited.
3. In the program, navigate to the block with the matching location.
4. Keep the mouse button pressed and drag the desired address or the icon to the appropriate location of the block or the I/O channel of the module.



The address or the symbol of the module is assigned to the location in the program or the address or the symbol in the program is assigned to an I/O channel of the module.

6.4.5 Time-of-day functions

6.4.5.1 Basic principles of time of day functions

All S7-1200 CPUs are equipped with an internal clock. The backup supports the display of the correct time for up to 10 hours if the power supply is interrupted.

Time-of-day format

The clock always shows the time of day with a resolution of 1 millisecond and the date including the day of the week. The time adjustment for daylight-saving time is also taken into account.

6.4.5.2 Setting and reading the time of day

Setting the time of day as a system function

You can set and start the time of day and date of the CPU clock with the following system functions:

- "SFC 0 SET_CLK"
- "SFC 100 SET_CLKS", if it exists on the CPU

Note

To avoid time-of-day display differences in HMI systems, set the CPU to standard time or use central time-of-day synchronization.

Reading the time of day as a system function

You read the current date and time of day of the CPU with system function "SFC 1 READ_CLK" or via a menu command from the programming device.

Manual setting

You can also read and set the time of day manually in the online and diagnostics view under "Functions > Set time of day".

6.4.5.3 Parameterizing the clock

Clock parameters

The clock parameters allow you to make the following settings:

- Enable time-of-day synchronization using an NTP server

Select this check box if you want the internal clock to be synchronized using the NTP synchronization mode.

- Network time server

  The IP addresses of up to four NTP servers need to be configured.
- Update interval

  The update interval defines the interval between time queries.

6.4.6 High-speed counters

6.4.6.1 General information on high-speed counters

Introduction

High-speed counters are typically used to drive counting mechanisms in which a shaft turning at a constant speed is equipped with an incremental step encoder. The incremental step encoder ensures a certain number of count values per rotation and a reset pulse once per rotation. The clock memory bit(s) and the reset pulse of the incremental step encoder supply the inputs for the high-speed counter.

The various S7-1200 CPUs have differing numbers of high-speed counters available:

S7-1200 CPU	Number of HSCs	HSC designation
CPU 1211C	3 (with digital signal board 4)*	HSC1…3 (and HSC5)*
CPU 1212C	4 (with digital signal board 5)*	HSC1…4 (and HSC5)*
CPU 1214C	6	HSC1…6

* with DI2/DO2 signal board

How it works

The first of several default values is loaded on the high-speed counter. The required outputs are enabled for the time during which the current value of the counter is lower than the default value. The counter is set up so that an interrupt occurs if the current value of the counter is equal to the default value or when the counter is reset.

If the current value is equal to the default value and an interrupt event results, a new default value is loaded and the next signal state is set for the outputs. If an interrupt event occurs because the counter is reset, the first default value and the first signal states of the outputs are set and the cycle repeated.

Since the interrupts occur much less frequently than the high-speed counter counts, a precise control of the fast operations can be implemented with only a slight influence on the overall cycle of the automation system. Since you can assign specific interrupt programs to interrupts, each new default can be loaded in a separate interrupt program allowing simple control of the state.

Note

You can also process all interrupt events in a single interrupt program.

Description of the various counters

All counters work in the same way in the same counter mode, however, some high-speed counters do not support all count modes. There are four basic counter modes:

- Single-phase counter with internal direction control
- Single-phase counter with external direction control
- 2-phase counter with 2 clock inputs
- A/B counter

Each high-speed counter can be used with or without a reset input. If the reset input is activated, this resets the current value. The current value remains reset until the reset input is deactivated.

See also

Configuring high-speed counters (Page 264)
Interdependency of the counter mode and counter inputs (Page 262)

6.4.6.2 Interdependency of the counter mode and counter inputs

General information on counter mode and counter inputs

You can assign not only the counter modes and counter inputs to the high-speed counters but also functions such as clock pulse generator, direction control, and reset. The following rules apply:

- An input cannot be used for two different functions.
- If an input is not required by the current counter mode of the defined high-speed counter, it can be used other purposes.

If, for example, you set HSC1 to counter mode 1, in which inputs I0.0 and I0.3 are required, you can use I0.1 for edge interrupts or for HSC2.

If, for example, you set HSC1 and HSC5, inputs I0.0 (HSC1) and I1.0 (HSC5) are always used with the counting and frequency counter modes. As a result, these two inputs are not available for any other functions when counters are operated.

You have additional inputs available if you use a digital signal board.

Overview of the interdependency of counter mode and counter inputs

Counter mode	Description	Inputs		
	HSC1	I0.0 (CPU) I4.0 (signal board)	I0.1 (CPU) I4.1 (signal board)	I0.3 (CPU) I4.3 (signal board)
	HSC2	I0.2 (CPU) I4.2 (signal board)	I0.3 (CPU) I4.3 (signal board)	I0.1 (CPU) I4.1 (signal board)
	HSC3*	I0.4 (CPU)	I0.5 (CPU)	I0.7 (CPU)
	HSC4 (CPU 1212/14C only)	I0.6 (CPU)	I0.7 (CPU)	I0.5 (CPU)
	HSC5 (CPU 1214C only)**	I1.0 (CPU) I4.0 (signal board)	I1.1 (CPU) I4.1 (signal board)	I1.2 (CPU) I4.3 (signal board)
	HSC6 (CPU 1214C only)**	I1.3 (CPU)	I1.4 (CPU)	I1.5 (CPU)
Counting / frequency	Single-phase counter with internal direction control	Clock pulse generator		
Counting		Clock pulse generator		Resetting
Counting / frequency	Single-phase counter with external direction control	Clock pulse generator	Direction	
Counting		Clock pulse generator	Direction	Resetting
Counting / frequency	2-phase counter with 2 clock inputs	Clock pulse generator forwards	Clock pulse generator backwards	
Counting		Clock pulse generator forwards	Clock pulse generator backwards	Resetting
Counting / frequency	A/B counter	Clock pulse generator A	Clock pulse generator B	
Counting		Clock pulse generator A	Clock pulse generator B	Resetting
Motion axis	Pulse generators PWM/PTO	HSC1 and HSC2 support the motion axis count mode for the PTO1 and PTO2 pulse generators: • For PTO1, HSC1 evaluates the Q0.0 outputs for the number of pulses. • For PTO2, HSC2 evaluates the Q0.2 outputs for the number of pulses. Q0.1 is used as the output for the motion direction.		

* HSC3 can only be used for CPU 1211 without a reset input

** HSC5 can be also be used for CPU 1211/12 if a DI2/DO2 signal board is used

See also

General information on high-speed counters (Page 261)

Configuring high-speed counters (Page 264)

6.4.6.3 Configuring high-speed counters

Requirement

An S7-1200 CPU has been inserted in the hardware configuration.

Procedure

To configure a high-speed counter, follow these steps:

1. Select an S7-1200 CPU in the device or network view.
2. Click on the required high-speed counter under "Properties > High-speed counter" in the Inspector window:
   - CPU 1211C: HSC1 to HSC3 (also HSC5 with a DI2/DO2 signal board)
   - CPU 1212C: HSC1 to HSC4 (also HSC5 with a DI2/DO2 signal board)
   - CPU 1214C: HSC1 to HSC6
3. Enable the high-speed counter in the "General" parameter group using the relevant check box.

   Note

   If you use a CPU 1211C or CPU 1212C with a DI2/DO2 signal board, you can also enable the high-speed counter HSC5.

   Note

   If you activate the pulse generators and operate them as PTO1 or PTO2, they use the associated high-speed counter HSC1 or HSC2 with "Motion axis" counting mode to evaluate the hardware outputs. If you configure high-speed counter HSC1 or HSC2 for other counting tasks, these cannot be used by pulse generator PTO1 or PTO2, respectively.

   If required, you can enter a name and a comment for the high-speed counter here.
4. Define the functionality of the high-speed counter in the "Function" parameter group:
   - Count mode: Select what you want to be counted from the drop-down list.
   - Operating phase: Select the count algorithm from the drop-down list.
   - Input source: Select the on-board CPU inputs or the inputs of an optional digital signal board as the input source for the count pulses from the drop-down list.
   - Count direction is specified by: If you have selected a single-phase operating phase, open the drop-down list and select whether the count direction is set internally by an SFB parameter of the user program or externally via a digital input.

   - Initial count direction: If the user program is set as the internal direction control for the count direction, you can select the count direction at the start of counting from the drop-down list.
   - Frequency meter period: If frequency is set as the count mode, you can select the duration of the frequency meter periods in the drop-down list.
5. Specify the initial values and reset condition of the high-speed counter in the "Reset to initial values" parameter group:
   - Initial counter value: Enter a start value for the high-speed counter.
   - Initial reference value: Enter a maximum value for the high-speed counter.

   Here, you can also specify whether the high-speed counter will use a reset input and the set the corresponding signal level for the reset input from the drop-down list.
6. Configure the reaction of the high-speed counter to certain events in the "Event configuration" parameter group. The following events can trigger an interrupt:
   - The counter value matches the reference value.
   - An external reset event was generated.
   - A change of direction was triggered.

   Enable an interrupt reaction using the check box, enter a name and select a hardware interrupt for the interrupt from the drop-down list.
7. Assign the start address for the high-speed counter in the "I/O/Diagnostic addresses" parameter group.

Note

In the "Hardware inputs" parameter group, you can only see which hardware inputs and values are being used for the clock, direction determination, reset pulse, and maximum count speed.

Result

You have now adapted the parameters of the high-speed counter to the requirements of your project.

See also

CTRL_HSC: Control high-speed counters in FBD (Page 835)
General information on high-speed counters (Page 261)
Interdependency of the counter mode and counter inputs (Page 262)

6.4.7 Point-to-point communication

6.4.7.1 Overview of point-to-point communication

PtP communication is communication via a serial interface that uses standardized UART data transmission (Universal Asynchronous Receiver/Transmitter). The S7-1200 uses communications modules with an RS-232 or RS-485 interface to establish PtP communication.

Functions of point-to-point communication

Point-to-point communication (PtP) allows numerous applications:

- Direct transmission of information to an external device, for example a printer or a barcode reader
- Reception of information from external devices such as barcode readers, RFID readers, cameras and third-party optical systems as well as many other devices.
- Exchange of information with third-party devices, for example GPS devices, radio modems and many others

The Freeport protocol

The S7-1200 supports the Freeport protocol for character-based serial communication. Using Freeport communication, the data transmission protocol can be configured entirely by the user program.

Siemens provides libraries with Freeport communication functions that you can use in your user program:

- USS Drive protocol
- Modbus RTU Master protocol
- Modbus RTU Slave protocol

See also

Configuring a communications port (Page 267)

6.4.7.2 Using RS-232 and RS-485 communications modules

Communications modules with RS-232 and RS-485 interfaces

In an S7-1200 CPU, you can use two different communications modules:

- RS-232 communications module
- RS-485 communications module

The communications modules can be connected to the S7-1200 CPU via the I/O channel on the left. You can plug in up to three different modules.

Properties of the communications modules

The communications modules have the following features:

- Support of the Freeport protocol
- Configuration by the user program with the aid of expanded instructions and library functions

6.4.7.3 Configuring a communications port

Configuring a communications port

After you have inserted a communications module with an RS-232 or RS-485 interface, you then set the interface parameters. You set the parameters for the interface either in the properties of the interface or you control the interface parameters from the user program using the PORT_CFG instruction. The following description relates to the graphic configuration.

Note

If you change the port setting from the user program, the settings of the graphic configuration are overwritten.

You should also keep in mind that the settings made by the user program are not retained if there is a power down.

Requirement

- A communications module is already plugged in.
- You are in the device view.

Procedure

To configure the communications port, proceed as follows:

1. Select the interface in the graphic representation in the device view.

   The properties of the interface are displayed in the Inspector window.
2. Select the "Port configuration" group in the area navigation of the Inspector window.

   The settings of the port are displayed.
3. Select the transmission speed of the cable from the "Baud rate" drop-down list. With user-programmed communication, remember the influence of the transmission speed on the changeover time.
4. From the "Parity" drop-down list, select the type of detection of bad information words.
5. Using the "Data bits" drop-down list, decide whether a character consists of eight or seven bits.
6. From the "Stop bit" drop-down list, select how many bits will identify the end of a transmitted word.
7. From the "Flow control" drop-down list, select the method for ensuring a trouble-free data stream between sender and receiver. This parameter can only be set for the RS-232 interface.

   – Enter a HEX value in the "XON character" box that will cause the transmission of the message to be continued when it is detected. This parameter can only be set for software-controlled data flow control.
   – Enter a HEX value in the "XOFF character" box that will cause the transmission of the message to be suspended for the set wait time. This parameter can only be set for software-controlled data flow control.
8. In the "Wait time" box, enter a wait time in ms that must be kept to after the end of the message before the next transmission can start.

Note
Note

You can configure the interface in the network view as well. To do so, you must first select the communication module in the tabular network view and then select the interface in the Inspector window. Then you can continue as described above.

See also

Setting data flow control (Page 268)

6.4.7.4 Setting data flow control

Data flow control

Data flow control is a method that ensures a balanced send and receive behavior. In the ideal situation, the intelligent control does not allow data to be lost. It ensures that a device does not send more information than the receiving partner can process.

There are two methods of data flow control:

- Hardware-controlled data flow control
- Software-controlled data flow control

With both methods, the DSR signals of the communications partners must be active at the beginning of transmission. If the DSR signals are inactive, the transmission is not started.

The RS-232 communications module can handle both methods. The RS-485 communications module does not support data flow control.

Hardware-controlled data flow control

Hardware-controlled data flow control uses the request to send (RTS) and clear to send (CTS) signals. With the RS-232 communications module, the RTS signal is transmitted via the output by pin 7. The CTS signal is received via pin 8.

If hardware-controlled data flow control is enabled, the RTS signal is then always set to activated when data is sent. At the same time, the CTS signal is monitored to check whether the receiving device can accept data. If the CTS signal is active, the module can transfer data until the CTS signal becomes inactive. If the CTS signal is inactive, the data transfer must be suspended for the set wait time. If the CTS signal is still inactive after the set wait time, the data transfer is aborted and an error is signaled back to the user program.

Data flow control using hardware handshaking

If data flow control is controlled by hardware handshaking, the sending device sets the RTS signal to active as default. A device such as a modem can then transfer data at any time. It does not wait for the CTS signal of the receiver. The sending device itself monitors it own transmission by sending only a limited number of frames (characters), for example to prevent overflow of the receive buffer. If there is nevertheless an overflow, the transferring device must hold back the message and signal an error back to the user program.

Software-controlled data flow control

Software-controlled data flow control uses certain characters within the messages and these control the transfer. These characters are ASCII characters selected for XON and XOFF.

XOFF indicates when a transmission must be suspended. XON indicates when a transmission can be continued.

If the sending device receives the XOFF character, it must suspend sending for the selected wait time. If the XON character is sent after the selected wait time, the transfer is continued. If no XON character is received after the wait time, an error is signaled back to the user program.

Software data flow control requires full duplex communication because the receiving partner needs to send the XON character during the ongoing transfer.

See also

Configuring a communications port (Page 267)

6.4.7.5 Configuration of message transfer

User-programmed communication

You can control the data traffic between a communications module and a device connected externally via the serial interface using your own mechanisms. If you want to do this, you will need to define a communications protocol yourself. In user-programmed communication, ASCII and binary protocols are supported for message transfer.

Within the communications protocol, you will need to specify the criteria by which the start and end of a transferred message can be recognized in the data stream.

User-programmed communication can only be activated in RUN mode. If there is a change to STOP mode, the user-programmed communication is stopped.

Specifying the communications protocol

You can specify the communications protocol as follows:

- With the user program

  - The behavior when sending data is controlled by the SEND_CFG instruction.
  - The behavior when receiving data is controlled by the RCV_CFG instruction.
- Using parameter settings set graphically in the Inspector window

---

Note

If you change the communications protocol from the user program, the settings of the graphic configuration are overwritten.

You should keep in mind that the settings made by the user program are not retained if there is a power down.

See also

User-programmed communication with RS-232 devices (Page 270)
Making the settings for sending (Page 272)
Specifying the start of the message (Page 272)
Specifying the end of the message (Page 273)

6.4.7.6 User-programmed communication with RS-232 devices

RS-232/PPI multi-master cable and user-programmed communication with RS-232 devices

Using the RS-232/PPI multi-master cable and user-programmed communication, you can connect a wide variety of RS-232-compliant devices to the communications modules of the S7-1200. The cable must, however, be set to the "PPI/user-programmed communication" mode.

Settings on the cable

The switches on the cable must be set as follows:

- Switch 5 must be set to 0
- Switch 6 sets either the local mode (DCE) or the remote mode (DTE):
  - Switch set to 0 for the local mode
  - Switch set to 1 for the remote mode

Changing over between send and receive mode

The RS-232/PPI multi-master cable is in send mode when data is sent from the RS-232 interface to the RS-485 interface. The cable is in receive mode when it is idle or when data is sent from the RS-485 interface to the RS-232 interface. The cable changes from receive to send mode immediately when it detects characters on the RS-232 send line.

Supported baud rates

The RS-232/PPI multi-master cable supports baud rates between 1200 baud and 115.2 kbaud. The RS-232/PPI multi-master cable can be set to the required baud rate using the DIP switch on the PC/PPI cable.

The following table shows the switch settings for the various baud rates:

Baud rate	Switchover time	Settings (1 = up)
115200	0.15 ms	110
57600	0.3 ms	111
38400	0.5 ms	000
19200	1.0 ms	001
9600	2.0 ms	010
4800	4.0 ms	011
2400	7.0 ms	100
1200	14.0 ms	101

The cable returns to receive mode when the RS-232 send line is idle for a certain time that is defined as the changeover time of the cable. The set baud rate influences the changeover time as shown in the table.

Influence of the changeover time

When working with an RS-232/PPI multi-master cable in a system in which user-programmed communication is used, the program must take into account the changeover time for the following reasons:

- The communications module reacts to messages sent by the RS-232 device.

  Once the communications module has received a request from the RS-232 device, it must delay the reaction message for a period that is equal to or longer than the changeover time of the cable.

- The RS-232 device reacts to messages sent by the communications module.

  Once the communications module has received a reaction message from the RS-232 device, it must delay the next request message for a period that is equal to or longer than the changeover time of the cable.

In both situations, the RS-232-PPI multi-master cable has enough time to change from send to receive mode so that the data can be sent from the RS-485 interface to the RS-232 interface.

See also

Configuration of message transfer (Page 269)
Making the settings for sending (Page 272)
Specifying the start of the message (Page 272)
Specifying the end of the message (Page 273)

6.4.7.7 Making the settings for sending

Sending messages

You can program pauses between individual messages.

The following table shows which pauses can be set:

Parameter	Definition
RTS ON delay	You can set the time that must elapse after the send request RTS (request to send) before the actual data transfer starts.
RTS OFF delay	You can set the time that must elapse after the complete transfer before RTS signal is deactivated.
Send pause at the start of the message	You can specify that a pause is sent at the start of every message transfer when the RTS ON delay has elapsed. The pause is specified in bit times.
Send Idle Line after a pause	You can make a setting so that following a selected pause at the start of the message, the "Idle Line" signal is output to signal that the line is not in use. To enable the parameter, "Send pause at message start" must be set. The duration of the "Idle Line" signal is specified in bit times.

See also

Specifying the start of the message (Page 272)
Specifying the end of the message (Page 273)
User-programmed communication with RS-232 devices (Page 270)

6.4.7.8 Specifying the start of the message

Recognizing the start of the message

To signal to the receiver when the transfer of a message is completed and when the next message transfer starts, criteria must be specified in the transmission protocol to identify the end and start of a message.

If a criterion is met that indicates the start of a message, the receiver starts searching the data stream for criteria that mean the end of the message.

There are two different methods for identifying the start of a message:

- Starting with any character:

  Any character can defined the start of a message. This is the default method.
- Starting with a specific condition:

  The start of a message is identified based on selected conditions.

Conditions for detecting the start of a message

The following table shows the various options for defining the start of a message:

Parameter	Definition
Recognize start of message by line break	The receiver recognizes a line break when the received data stream is interrupted for longer than one character. If this is the case, the start of the message is identified by the line break.
Recognize start of message by idle line	The start of a message is recognized when the send transmission line is in the idle state for a certain time (specified in bit times) followed by an event such as reception of a character.
Recognize start of message with individual characters	The start of a message is recognized when a certain character occurs. You can enter the character as a HEX value.
Recognize start of message by a character string	The start of a message is detected when one of the specified character sequences arrives in the data stream. You can specify up to four character sequences each with up to five characters.

The individual conditions can be logically linked in any way.

See also

Making the settings for sending (Page 272)
User-programmed communication with RS-232 devices (Page 270)

6.4.7.9 Specifying the end of the message

Recognizing the end of the message

To signal to the receiver when the transfer of a message is completed and when the next message transfer starts, criteria must be specified in the transmission protocol to identify the end and start of a message.

In total, there are six different methods of recognizing the end of a message and these can all be logically linked in any way. The following table shows the various possible setting options:

Parameter	Definition
Recognize end of message by message timeout	The end of a message is recognized automatically when a selected maximum duration for a message is exceeded. Values from 0 to 65535 ms can be set.
Recognize end of message by reply timeout	The end of a message is recognized when there is no reply within a set time after transferring data. Values from 0 to 65535 ms can be set.

Parameter	Definition
Recognize end of message by timeout between characters	The end of a message is detected when the time between two characters specified in bit times is exceeded. Values from 0 to 2500 bit times can be set. The S7-1200 CPU only accepts a maximum time of eight seconds even if the value that is set results in a duration of more than eight seconds.
Recognize end of message by maximum length	The end of a message is recognized when the maximum length of a message is exceeded. Values from 1 to 4132 characters can be set.
Read message length from message	The message itself contains information about the length of the message. The end of a message is reached when the value taken from the message is reached. Which characters are used for the evaluation of the message length is specified with the following parameters: • Offset of the length field in the message The value decides the position of the character in the message that will be used to indicate the message length. Values from 0 to 4131 characters can be set. • Size of the length field This value specifies how many characters starting at the first evaluation position will be used to indicate the message length. Values of 0, 1, 2 and 4 characters can be set. • The data following the length field (does not belong to the message length) The value specifies the number of bytes after the length field that must be ignored in the evaluation of the message length. Values from 0 to 255 characters can be set.
Recognize message length by a character string	The end of a message is detected when the specified character sequence arrives in the data stream. You can define up to five characters in the character string.

See also

Making the settings for sending (Page 272)
User-programmed communication with RS-232 devices (Page 270)

6.4.8 Using clock memory

Clock memory

A clock memory is a bit memory that changes its binary status periodically in the pulse-no-pulse ratio of 1:1.

You decide which memory byte of the CPU will become the clock memory byte when assigning the clock memory parameters.

Benefits

You can use clock memory, for example, to activate flashing indicator lamps or to initiate periodically recurring operations such as recording of actual values.

Available frequencies

Each bit of the clock bit memory byte is assigned a frequency. The following table shows the assignment:

Bit of the clock memory byte	7	6	5	4	3	2	1	0
Period (s)	2,0	1,6	1,0	0,8	0,5	0,4	0,2	0,1
Frequency (Hz)	0,5	0,625	1	1,25	2	2,5	5	10

Note

Clock memory runs asynchronously to the CPU cycle, i.e. the status of the clock memory can change several times during a long cycle.

The selected memory byte cannot be used for intermediate storage of data.

6.4.9 Setting options for the level of protection

Protection level

In the following sections, you will learn how to use the various protection levels of the CPU.

Effects of the protection level setting

You can choose between the following protection levels:

- No protection: corresponds to the default behavior. You cannot enter a password. Read and write access is always permitted.
- Write protection: Read only access is possible. You cannot change any data on the CPU and cannot load any blocks or a configuration. Diagnostics data and PLC tags that you have marked as relevant for HMI are excluded from the write protection.
- Read/write protection: No write or read access is possible in the "Accessible devices" area or in the project for devices that are switched online. Only the CPU type and the identification data can be displayed in the project tree under "Accessible devices". Online information or blocks cannot be displayed under "Accessible devices" or in the project for devices switched online unless you enter a password.

  The following objects are excluded from read/write protection:

  – PLC tags that are marked as HMI-relevant

- Monitorable properties of HMI objects
- Diagnostics data (read-protected only)

Behavior of a password-protected CPU during operation

Before an online function is executed, the necessary permission is checked and, if necessary, the user is prompted to enter a password.

Example: The module was assigned a protection level and you want to execute the "Modify tags" function. This requires write access; therefore, the assigned password must be entered to execute the function.

The functions protected by a password can only be executed by one programming device/PC at any one time. Another programming device/PC cannot log on with a password.

Note

You can use functions for process control, monitoring, and communications without restrictions. Thus, for example, the "Set time of day/date" function should not be locked with a password.

Some functions are still protected due to their use as online data. RUN/STOP in the "Online Tools" task card or "Set time of day" in the diagnostics and online editor is therefore write-protected.

6.4.10 Loading a configuration

6.4.10.1 Introduction to loading a configuration

Loading a configuration on a device

After you have inserted a new device in the project and configured it or if you have modified an existing hardware configuration, the next step is to load the current configuration on the device. This makes sure that the same configuration is always set on the programming device/PC as well as on the physical module.

The first time you load, the entire hardware project data is loaded. When you load again later, only changes to the configuration are loaded.

You have the following options when loading the hardware configuration:

- Loading in the device or network view
- Loading in the project tree
- Loading on an accessible device

See also

Special features during startup (Page 315)

6.4.10.2 Loading the hardware configuration on a device

Within the project tree, you can load the hardware configuration of a device on the relevant device.

Warning
Load only in STOP mode

After loading, you may experience unexpected behaviors on the machine or in the process if the parameter settings are incorrect. The CPU must be set to STOP mode for the load operation to rule out possible damage to equipment or personal injury.

Loading multiple blocks on a device in the project tree

To load the hardware configuration on the relevant device, follow these steps:

1. Select the "Load to device > Hardware configuration" command in the shortcut menu of the device.
   - If you have not previously established an online connection, the "Extended loading" dialog is opened.
   - If you have already defined an online connection, the "Load preview" dialog opens. Continue then with step 4.
2. Select the interface for your PG/PC from the "Programming device/PC interface for loading process" drop-down list box in the "Extended loading" dialog.
3. Select your device in the "Accessible devices in the target subnet" table and confirm your selection with "OK".

   The "Load preview" dialog opens.
4. Click "Load".

   The hardware configuration is loaded and the "Load results" dialog opens. This dialog shows you the status and the actions after loading.
5. Close the "Load results" dialog with "OK".

Result

The configured hardware configurations on the programming device/PC and on the device are now identical.

The messages under "Info > General" in the inspector window report whether the loading process was successful.

See also

Special features during startup (Page 315)

6.5 Diagnosing hardware

6.5.1 Overview of hardware diagnostics

6.5.1.1 Principal methods of hardware diagnostics

Principal methods of hardware diagnostics

Hardware diagnostics can be performed as follows:

- Using the online and diagnostics view
- Using the "Online Tools" task card
- Using the "Diagnostics > Device Info" area of the Inspector window
- Using diagnostics symbols, for example, in the device view and the project tree

Structure of the online and diagnostics view

The online and diagnostics view consists of two windows alongside each other:

- The left window shows a tree structure with folders and - when you open the folder - groups.
- The right window contains detailed information on the selected folder or selected group.

The "Online access" group and the "Diagnostics" and "Functions" folders are located here:

- "Online access" group: Displays whether or not there is currently an online connection with the associated target. In addition, you can establish or disconnect the online connection.
- "Diagnostics": Contains several diagnostics groups for the selected module
- "Functions": Contains several groups, in which you can make settings for the selected module or issue commands to the module

Function and structure of the "Online Tools" task card

For modules with their own operating mode (such as CPUs), the "Online tools" task card allows you to read current diagnostics information and commands to the module.

If you selected a module without its own operating mode or if you selected several modules before activation of the "Online Tools" task card, the task card relates to the relevant CPU.

The "Online Tools" task card consists of the following panes:

- CPU control panel
- Cycle time
- Memory

Note

A pane is filled with content only if the module controls the associated functions and an online connection exists.

If there is no online connection to the respective module, the display "No online connection" appears in blue.

Structure or the "Diagnostics" tab of the Inspector window

The "Diagnostics" tab of the Inspector window itself consists of one tab:

- Device information

  This tab relates to all CPUs of the project to which the online connection is established. Alarms are reported here if one or more CPUs are defective or are not in the RUN mode.

See also

Task cards (Page 125)
Inspector window (Page 123)

6.5.1.2 Determination of which of the devices that are connected online are defective

Overview of the defective devices

In the "Diagnostics > Device Info" area of the Inspector window you will obtain an overview of the defective devices that are connected online.

The "Diagnostics> Device Info" area of the Inspector window consists of the following elements:

- Header line with the number of defective devices
- Table with detailed information on each defective device

If you originate the establishment of an online connection to a device which is not reachable or reports one or more faults or is not in RUN mode, it will rank as defective.

Structure of the table with detailed information on the defective devices

The table consists of the following columns:

- Online status: Contains the online status as a diagnostic symbol and in words
- Operating mode: Contains the operating mode as a symbol and in words
- Device / module: Name of the affected device or the affected module
- Message: explains the preceding column
- Details: The link opens the online and diagnostics view for the device, and places it in the foreground.
- Help: The link supplies further information on the defect that has occurred.

See also

Inspector window (Page 123)
Determination of online status and display using symbols (Page 280)

6.5.1.3 Determination of online status and display using symbols

Determination of online status and display using symbols

When establishing the online connection with a device, the status and, if necessary, the operating mode of the associated module are also identified and displayed.

The display is performed in these views:

- Device view

  With the exception of the signal board on the CPU, the diagnostics icon is displayed here in every hardware component. For modules with their own operating mode, the operating state icon is also displayed.

- Device overview

  The diagnostics icon is shown here for each hardware component.

- Network view

  Here a diagnostic symbol is shown for each device, showing the collective status of all associated hardware components.

- Network overview

  The diagnostics icon is shown here for each hardware component.

- Project tree

  Here the diagnostic symbol is shown behind the hardware components. For modules with their own operating mode, the operating state icon is also displayed in the top right corner of the module icon.

- Online and diagnostics view

  The online status is displayed in the "Status" area of the "Online access" group. Here, you can also establish and terminate the online connection.

Note

The "Online access" group exists only with CPUs. However, if you have called the online and diagnostics view with the "Show / update accessible devices" function, it will not be displayed.

- Detail view in the project tree

  This step requires that you have selected "Local modules" in the project tree.

Diagnostics symbols for modules and devices

The following table shows the available symbols and their respective meaning:

Symbol	Meaning
	The connection with a CPU is currently being established.
	The CPU is not reachable at the set address.

Symbol	Meaning
🖧	The configured CPU and the CPU actually present are of incompatible types.
✓	No fault
🔧	Maintenance required
🔧	Maintenance request
🔧	Error
▯☒	The module or the device cannot be reached from the CPU (valid for modules and devices below a CPU).
▯!	Diagnostics data are not available because the current online configuration data differ from the offline configuration data.
◢	The configured module or device and the module or device actually present are incompatible (valid for modules or devices under a CPU).
?	The connection is established, but the state of the module has not yet been determined.
?	The configured module does not support display of the diagnostics status

Icons for the comparison status

The diagnostics icons can be combined with additional smaller icons that indicate the result of the online/offline comparison. The following table shows the available symbols and their meaning.

Symbol	Meaning
❗	Folder contains objects whose online and offline versions differ (only in the project tree)
◐	Online and offline versions of the object are different
◑	Object only exists online
◐	Object only exists offline

Combined diagnostics and comparison icons

The following table shows examples of combined icons and their meaning.

Symbol	Meaning
❗✓	No fault. Folder contains objects whose online and offline versions differ (only in the project tree)

Symbol	Meaning
☒	The module or the device cannot be reached from the CPU (valid for modules and devices below a CPU). Object only exists offline

Operating mode symbols for CPUs and CPs

The following table shows the available symbols and their respective operating states.

Symbol	Operating mode
🟩	RUN
🟨	STOP
🟨🟩	STARTUP
⏸	HOLD
❎	DEFECTIVE
❓	Unknown operating mode
?	The configured module does not support display of the operating mode

6.5.1.4 Start online and diagnostics view

Requirement

The project with the module to be diagnosed is open.

Note

This requirement does not apply if you call the online and diagnostics view from the project tree after you have identified the accessible devices.

Procedure

To start the online and diagnostics view of a module, follow these steps:

1. In the project tree, open the respective device folder.
2. Double click on the "Online & Diagnostics" function.

Note

The "Online & Diagnostics" function is always available if the module in the project tree has sub-entries, for example in PLCs.

Or:

1. In the project tree, select the respective device folder.
2. Select the "Online & Diagnostics" command in the shortcut menu or the "Online" main menu.

Or:

1. Open the device view in the device configuration.
2. Select the module to be diagnosed.
3. Select the "Online & Diagnostics" command in the shortcut menu or the "Online" main menu.

Or:

1. Open the network view in the device configuration.
2. Select the station with the module to be diagnosed.
3. Select the "Online & Diagnostics" command in the shortcut menu or the "Online" main menu.

Or:

1. In the project tree, open the "Online access" folder.
2. Open the folder for the interface with which you want to establish the online connection.
3. Double click on "Show/Update accessible devices".
4. Select the module to be diagnosed.
5. Select the "Online & Diagnostics" command from the shortcut menu or the "Online" main menu.

Or:

1. In the project tree, open the "Local modules" folder.
2. Select the respective device or the module that is to be diagnosed.
3. Select the "Online & Diagnostics" command in the shortcut menu or the main menu.

Result

The online and diagnostics view of the module to be diagnosed will be started. If an online connection to the associated CPU had previously been created, the header bar of the Online and Diagnostics view will now have an orange background.

Note

If no online connection exists when the online and diagnostics view is started, no online information is displayed and the display fields remain empty.

6.5.1.5 Activation of the "Online Tools" task card

Activation of the "Online Tools" task card

You can activate this task card as follows:

1. Start the online and diagnostics view.
2. Click on the "Online Tools" task card.

Or:

1. Start the device view.
2. Click on the "Online Tools" task card.

Or:

1. Start the network view.
2. Click on the "Online Tools" task card.

6.5.2 Showing non-editable and current values of configurable module properties

6.5.2.1 Showing general properties and system-relevant information for a module

Where do I find the information I need?

The general properties and system-relevant information for a module can be found in the "General" group in the "Diagnostics" folder in the online and diagnostics view of the module to be diagnosed.

Structure of the "General" group

The "General" group consists of the following areas:

- Module
- Module information
- Manufacturer information

"Module" area

This area shows the following data for the module:

- Short designation, for example, CPU 1214C DC/DC/DC
- Order number
- Hardware
- Firmware
- Racks
- Slot

"Module information" area

This area shows the following module specifications that you specified during the hardware configuration:

- Module name

"Manufacturer information" area

This area shows the following data for the module:

- Manufacturer

Note

With the exception of Siemens AG, the manufacturer's code is shown as a decimal number. The associated manufacturer names can be found in the Manufacturer ID table in PROFIBUS International (see "www.profibus.com").

- Serial number
- Profile: Profile ID as hexadecimal number

Note

You will find the corresponding profile name in the profile ID table for PROFIBUS International (see "www.profibus.com").

- Profile details: Profile-specific type as hexadecimal number

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Note

You will find the corresponding profile-specific type name in the profile-specific type table for PROFIBUS International (see "www.profibus.com").

6.5.2.2 Display configured cycle times

Where do I find the information I need?

The required information can be found in the following places:

- In the "Cycle time" group in the "Diagnostics" folder of the online and diagnostics view of the module to be diagnosed (this is where all the assigned cycle times are displayed).
- In the "Online Tools" task card of the "Cycle time" pane (only the maximum cycle time of the configured cycle times is shown here).

Structure of the "Cycle time" group in the "Diagnostics" folder of the online and diagnostics view

The "Cycle time" group consists of the following areas:

- Cycle time diagram (graphic display of the measured cycle times)
- Cycle time configured (display of the configured cycle times as absolute values)
- Cycle times measured (display of the measured cycle times as absolute values)

Parameterized cycle times

The following configured times are displayed:

- Minimum cycle time
- Maximum cycle time

Structure of the "Cycle time" pane of the "Online Tools" task card

The "Cycle time" pane provides information regarding the configured maximum cycle time and the measured cycle times.

Maximum cycle time

The value at the end of the time diagram represents the maximum cycle time.

6.5.3 Showing the current values of dynamic modules properties

6.5.3.1 Display measured cycle times

Where do I find the information I need?

The measured cycle times can be found at each of the following places:

- In the "Cycle time" group in the "Diagnostics" folder in the online and diagnostics view of the module to be diagnosed.
- In the "Cycle time" pane of the "Online Tools" task card

Structure of the "Cycle time" group in the "Diagnostics" folder of the online and diagnostics view

The "Cycle time" group consists of the following areas:

- Cycle time diagram (graphic display of the measured cycle times)
- Cycle time configured (display of the configured cycle times as absolute values)
- Cycle times measured (display of the measured cycle times as absolute values)

Measured cycle times

The following times are displayed:

- Shortest cycle time: Duration of the shortest cycle since the last transition from STOP to RUN

  This is shown in the graphic display by the black arrow.
- Current / last cycle time: Duration of the last cycle

This is shown in the graphic display by the green arrow.

If the duration of the last cycle comes close to the maximum cycle time this indicates the possibility that this may be exceeded and the module may switch to the STOP operating mode. If for instance you are monitoring the tags in your program, this will increase the cycle time.

- Longest cycle time: Duration of the longest cycle since the last transition from STOP to RUN.

  This is shown in the graphic display by the blue arrow.

Note
Graphic display

The time axis is limited by the parameterized limit values for the cycle time.

Arrows and bars shown in red denote times that lie outside the parameterized limit values.

Structure of the "Cycle time" pane of the "Online Tools" task card

The "Cycle time" pane provides information regarding the configured maximum cycle time and the measured cycle times.

Measured times

The following measured times are shown:

- Shortest cycle time since the last activation of the "Online Tools" task card shown in gray.
- Current/last cycle time shown in green.
- Longest cycle time since the last activation of the "Online Tools" task card shown in blue.

6.5.3.2 Showing the current status of the LEDs of a CPU

Where do I find the information I need?

The current status of the LEDs of a CPU can be found in the display area of the "CPU control panel" pane of the "Online tools" task card.

Display area of the "CPU control panel" pane of the "Online Tools" task card

This area contains the following displays:

- Station name and CPU type (short designation)
- RUN / STOP (corresponds to the "RUN / STOP" LED of the CPU)
- ERROR (corresponds to the "ERROR" LED on the CPU)
- MAINT (corresponds to the "MAINT" LED on the CPU)

6.5.3.3 Showing fill levels of all types of memory on a CPU

Where do I find the information I need?

The fill levels of all types of memory on a CPU can be found on the following two pages:

- In the display area of the "Memory" group in the "Diagnostics" folder in the online and diagnostics view of the module to be diagnosed.
- In the "Memory" pane display area of the "Online Tools" task card

Display area of the "Memory" group in the "Diagnostics" folder of the online and diagnostics view

This area contains the current memory utilization of the respective module and details of the individual memory areas.

The memory utilization is shown both as a bar diagram and as a numerical value (percentage).

The following memory utilizations are shown:

- Load memory

  If no memory card is inserted, the internal load memory is displayed.

  If a memory card is inserted, the operating system only uses the inserted load memory as the load memory. This is displayed here.
- Work memory
- Retentive memory

Display area of the "Memory" pane of the "Online Tools" task card

This area contains the current memory utilization of the module. The available memory is shown both as a bar diagram and as a numerical value (percentage). The numerical value is rounded to an integer value.

Note

If a memory area is utilized to less than 1%, the available portion of this memory area is shown as "99%".

The following memory utilizations are shown:

- Load memory

  If no memory card is inserted, the internal load memory is displayed.

  If a memory card is inserted, the operating system only uses the inserted load memory as the load memory. This is displayed here.
- Work memory
- Retentive memory

See also

Load memory (Page 317)
Work memory (Page 317)
Retentive memory areas (Page 319)

6.5.4 Checking a module for defects

6.5.4.1 Determining the diagnostic status of a module

Where is the diagnostic status of a module displayed?

The diagnostic status of a module is displayed in the "Diagnostic status" group in the "Diagnostics" folder in the online and diagnostics view of the module to be diagnosed.

"Diagnostic status" group

The following status information is displayed in the "Diagnostic status" group:

- Status of the module as viewed by the CPU, for example:
  - Module available and OK.
  - Module defective.

    If the module experiences a fault and you have enabled the diagnostic interrupt during configuration, the "Module defective" status is displayed.
  - Module configured, but not available.
- Detected differences between the configured and the inserted module. Provided it can be ascertained, the order number will be displayed for the set and actual type.

Scope of the displayed information

The scope of the displayed information depends on the selected module.

6.5.4.2 Reading out the diagnostics buffer of a CPU

Where do you read out the diagnostics buffer of a CPU?

You read out the diagnostics buffer of a CPU in the "Diagnostics buffer" group in the "Diagnostics" folder in the online and diagnostics view.

Structure of the "Diagnostics buffer" group

The "Diagnostics buffer" group consists of the "Events" tab.

Diagnostics buffer

The diagnostics buffer is used as a log file for the diagnostics events that occurred on the CPU and the modules assigned to it. These are entered in the order of their occurrence, with the latest event shown at the top.

"Events" tab

The "Events" tab consists of the following elements:

- "Time including CPU/local time difference" check box
- Events list
- Details of the event
- "Freeze view/Cancel freeze", "Help on event", "Open block", "Save as..." buttons.

"Time including CPU/local time difference" check box

If you have not activated the check box, the diagnostics buffer entries are shown with the module time.

If you have activated the check box, the diagnostics buffer entries are shown with the time given by the following formula:

Displayed time = module time + time zone offset on your programming device / PC

This requires the module time to be identical to UTC.

You should use this setting if you wish to see the times of the diagnostics buffer entries for the module expressed in the local time of your programming device / PC.

Selecting or clearing the check box immediately changes the times displayed for the diagnostics buffer entries.

Note

If you use the "WR_SYS_T" instruction in your program or if you set the real-time clock of the CPU using an HMI device instead of using UTC, we recommend that you clear the "Real-time incl. CPU/local time difference" check box. In this case, the module time is the sole time of concern.

Events list

The following information is listed for each diagnostic event:

- Sequential number of the entry

  The first entry contains the latest event.
- Date and time of the diagnostic event

  If no date and time are shown, the module has no integral clock.
- Short name of the event and, if applicable, the reaction of the CPU

Note

If an individual parameter of a text cannot be determined, the character string "###" is shown in its place.

If no display text is yet available for new modules or new events, the numbers of the events and the individual parameters are stated as hexadecimal values.

Details of the event

If you select a line in the list you will obtain a detailed description of the respective event:

- Event ID and designation of the event
- Addition information related to the event, such as the address of the command that caused the event, and the operating mode transition that was caused by the diagnostic event
- Incoming or outgoing event

"Freeze view" or "Cancel view"

The "Freeze view" or "Cancel freeze" button is only enabled when there is an online connection to the CPU.

The default setting is "Freeze view".

The following happens if you click the "Freeze view" button:

- The current display of the diagnostics buffer entries is frozen.
- The labeling of the button changes to "Cancel freeze".

If an error has occurred in your system, diagnostic events can occur very quickly in succession. This produces a high update rate on the display. Freezing the display allows you to calmly examine the situation in more detail.

If the display is frozen and you click the "Cancel freeze" button, the following happens:

- The display of the diagnostics buffer entries is updated again.
- The labeling of the button changes to "Freeze view".

Note

If you freeze the diagnostics buffer display, the CPU continues to enter events in the diagnostics buffer.

"Help on event" button

If you click on this button, the selected event is explained in more detail and any remedies given.

Note

If the selected event is not a CPU event, the "Help on event" button is unavailable.

"Open block" button

The "Open block" button can be selected only if there is a pointer to the relative address of a block in the diagnostic event. This is the address of the command that caused the event.

The "Open block" function opens the referenced block in the offline view at the programming instruction that causes the error. This allows you to check and, if necessary, change the source code of the block at the specified place and then download it again to the CPU.

"Save as ..." button

If you click this button, the content of the diagnostics buffer is saved in a text file. "Diagnose.txt" is proposed as the file name. You can however change this name.

See also

Basic information on the diagnostics buffer (Page 296)

6.5.4.3 Performing module-specific diagnostics of non-CPU modules

Where are the module-specific diagnostics of non-CPU modules displayed?

The module-specific diagnostics of non-CPU modules are displayed in the "Standard diagnostics" group in the online and diagnostics view.

"Standard diagnostics" group

The following diagnostics information for non-CPU modules is displayed in the "Standard diagnostics" group:

- Internal and external defects which relate to the overall module
- Associated diagnostics events

Examples of such diagnostic information are:

- Entire backup supply failed
- Module defective

Note

Diagnostic interrupts

A diagnostics interrupt can be reported to the CPU only if the module is diagnostics interrupt-capable and the diagnostics interrupt has been enabled.

The display of the diagnostics interrupt is a snapshot. Sporadic defects in a module can be recognized diagnostics buffer of the respective CPU.

6.5.5 Changing the properties of a module or the programming device / PC

6.5.5.1 Changing the mode of a CPU

Requirement

There is an online connection to the CPU whose mode you want to change.

Procedure

To change the mode of the CPU, follow these steps:

1. Enable the "Online tools" task card of the CPU.
2. Click the "RUN" button in the "CPU control panel" pane if you want to change the CPU to RUN mode or the "STOP" button if you want to change the CPU to STOP mode.

Note

The only button active is the one that can be selected in the current operating mode of the CPU.

---

3. Answer the prompt for confirmation with "OK".

Result

The CPU is changed to the required mode.

6.5.5.2 Performing a memory reset

Requirement

- There is an online connection to the CPU on which the memory reset is to be performed.
- The CPU is in STOP mode.

Note

If the CPU is still in RUN mode and you start the memory reset, you can place it in STOP mode after acknowledging a confirmation prompt.

Procedure

To perform a memory reset on a CPU, follow these steps:

1. Enable the "Online Tools" task card of the CPU.
2. Click the "MRES" button in the "CPU control panel" pane.
3. Acknowledge the confirmation prompt with "OK".

Result

The CPU is switched to STOP mode, if necessary, and the memory reset is performed on the CPU.

See also

Basics of a memory reset (Page 316)

6.5.5.3 Determining and setting the time of day on a CPU

Where do I find the functions I need?

You determine and change the time of day on a CPU in the "Set time of day" group in the "Functions" folder of the online and diagnostics view. This requires an online connection.

Structure of the "Set time of day" group

The "Set time of day" group consists of the following areas:

- Programming device / PC time

  Here the time zone setting, the current date and the current time setting of your programming device / PC are displayed.
- Module time

  Here the date and time values currently read from the module (for example the CPU), are converted to local time and date and displayed.

  If the "Take from PG/PC" check box is selected, when you click the "Apply" button, the date and the PG/PC time converted to UTC are transferred to the module.

  If the "Take from PG/PC" check box is not selected, you can assign the date and time for the integrated clock of the module. After clicking the "Apply" button, the date and the time recalculated to UTC time are transferred to the module.

6.5.5.4 Configuring Ethernet devices

Overview

You can assign an IP address and IP parameters to a module for the first time.

The IP address thus established can then be used to reach the module, for instance to load configuration data or to perform diagnostics.

Requirement

- The Ethernet LAN connection must already be established.
- The Ethernet interface of your programming device or PC must be located in the same IP range as the module to be configured.
- The module must be in the same subnet as the programming device or PC.

Procedure

To configure the module as an Ethernet device, follow these steps:

1. Open the online and diagnostics view of the module.
2. Select the "Assign IP address" group from the "Functions" folder.
3. Enter the MAC address if you know it.
4. Enter the IP address.
5. Enter the subnet mask.
6. If a router is to be used, select the "Use router" check box and enter its IP address.
7. Click "Assign IP address".

Result

The IP configuration is assigned to the module.

6.5.5.5 Resetting a CPU to the factory settings

Requirement

- There is no memory card inserted in the CPU.
- There is an online connection to the CPU that you want to reset to the factory settings.
- The CPU is in STOP mode.

Note

If the CPU is still in RUN mode and you start the reset operation, you can place it in STOP mode after acknowledging a confirmation prompt.

Procedure

To reset a CPU to the factory settings, follow these steps:

1. Open the online and diagnostics view of the CPU.
2. Select the "Reset to factory settings" group from the "Functions" folder.
3. Select the "Retain IP address" check box if you want to retain the IP address or the "Delete IP address" if you want to delete the IP address.
4. Click the "Reset" button.
5. Acknowledge the confirmation prompt with "OK".

Result

The module is switched to STOP mode, if necessary, and the factory settings are then reset. This means:

- The work memory and the internal load memory and all operand areas are deleted.
- All parameters are reset to their defaults.
- The diagnostics buffer is cleared.
- The time of day is reset.
- The IP address is retained or deleted depending on the setting you make.

6.5.6 Diagnostics in STOP mode

6.5.6.1 Basic information on the diagnostics buffer

Function

The operating system of the CPU enters the errors detected by the CPU and the diagnostics-capable modules into the diagnostics buffer in the order in which they occurred. This includes the following events:

- Every mode change of the CPU (POWER UP, change to STOP mode, change to RUN mode)
- Every hardware and diagnostic error interrupt

The top entry contains the most recent event. The entries in the diagnostics buffer are stored permanently. They are retained even if the power supply fails and can only be deleted by resetting the CPU to factory settings.

A diagnostics buffer entry contains the following elements:

- Time stamp
- Error ID
- Additional information specific to the error ID

Advantages of the diagnostics buffer

The diagnostics buffer offers the following advantages:

- After the CPU has changed to STOP mode, you can evaluate the last events prior to the STOP so that you can locate and identify the cause of the STOP.
- You can detect and eliminate the causes of errors more quickly and thus increase the availability of the system.
- You can evaluate and optimize the dynamic system response.

Organization of the diagnostics buffer

The diagnostics buffer is a ring buffer. The maximum number of entries for the S7-1200 CPUs is 50. When the diagnostics buffer is full and a further entry needs to be made, all existing entries are shifted by one position (which means that the oldest entry is deleted) and the new entry is made at the top position that is now free (FIFO principle: first in, first out).
Evaluation of the diagnostics buffer

The contents of the diagnostics buffer can be accessed as follows:

- Using the online and diagnostics view

The evaluation of events occurring prior to the error event (e.g., transition to STOP mode) allows you to obtain a picture of the possible causes or to zero in more closely or specify in more detail the possible causes (depending on the error type).

Read the detailed information about the events carefully and use the "Help on event" button to obtain additional information and possible causes of individual entries.

Note

To make the best use of the time stamp information on the diagnostics buffer entries in time-critical systems, it is advisable to check and correct the date and time of day on the CPU occasionally.

Alternatively, it is possible to perform a time-of-day synchronization using an NTP time server.

See also

Resetting a CPU to the factory settings (Page 295)
Determining the cause of a STOP of a CPU (Page 297)
Determining and setting the time of day on a CPU (Page 294)
Parameterizing the clock (Page 260)

6.5.6.2 Determining the cause of a STOP of a CPU

Requirement

The CPU you want to analyze is in STOP mode.

Procedure

To find out the reason why a CPU changed to STOP, follow these steps:

1. Open the online and diagnostics view of the CPU.
2. Select the "Diagnostics buffer" group from the "Diagnostics" folder.
3. Evaluate the events occurring prior to the transition to STOP mode. Use this to obtain a picture of the possible causes or to zero in on or specify in more detail the possible causes (depending on the error type).

   Read the detailed information about the events carefully and use the "Help on event" button to obtain additional information and possible causes of individual entries.

Result

You were able to zero in on or determine in more detail the cause of the CPU STOP.

Note

If the analysis does not enable you to overcome the problem, contact Customer Support. In this case, use the "Save as" button to back up the content of the diagnostics data to a text file and submit it to Customer Support.

See also

Reading out the diagnostics buffer of a CPU (Page 289)

6.6 References

6.6.1 Creating an unspecified CPU

Introduction

If you have not yet selected a CPU but have already started programming or want to use an existing program, you have the option of using an unspecified CPU.

Creating an unspecified CPU

To create an unspecified CPU, follow these steps:

1. Go to the portal view.
2. Click "Start > Getting started"
3. Click "Create a PLC program"

An unspecified CPU is created.

Or

1. Go to the portal view.
2. Now, click one of the following options:
   - "Devices & networks > Add new device"
   - "PLC programming" > "Device" button
3. Select the unspecified CPU from the tree structure of the "Add new device" dialog.
4. Click OK.

An unspecified CPU is created.

Further options for creating unspecified CPUs

In the project view, you can create unspecified CPUs as well as specified CPUs:

- Using the "Create new device" button in the project navigator
- In the "Hardware catalog" task card

You can also use these methods to create multiple unspecified CPUs.

Specifying unspecified CPUs

You have two options for specifying unspecified CPUs:

- Use drag-and-drop to assign an existing CPU from the hardware catalog to an unspecified CPU by means of module replacement (Page 217) .
- Select an unspecified CPU, and then click "Online > Hardware detection" in the menu bar and assign a CPU identified online. For this purpose, you assign an IP address using the "Add address for PG/PC" button.

See also

Selecting a CPU (Page 247)
Adding a device to the hardware configuration (Page 210)

6.6.2 Open User Communication

6.6.2.1 Principle of operation of connection-oriented protocols

Introduction

Connection-oriented protocols establish a logical connection to the communication partner before data transmission is started. After the data transmission is complete, they then terminate the connection, if necessary. In particular, connection-oriented protocols are used for data transmission when reliable, guaranteed delivery is of importance. Several logical connections can exist over one physical line.

Open User Communication supports the following connection types:

- TCP
- ISO-on-TCP

For communication partners that do not support an ISO-on-TCP connection, a TCP connection should be used. For these types of communication partners, such as third-party devices or PCs, enter "unspecified" for the partner end point during connection parameter assignment.

Characteristics of TCP

During data transmission via a TCP connection, no information about the length or about the start and end of a message is transmitted. This does not pose a problem during sending because the sender knows the amount of data to be transmitted. However, the receiver has no means of recognizing where one message in the data stream ends and the next one begins. It is therefore recommended that the number bytes to be received (parameter LEN, instruction TRCV/TRCV_C) be assigned the same value as the number of bytes to be sent (parameter LEN, instruction TSEND/TSEND_C).

If the length of the sent data and the length of the expected data do not match, the following will occur:

- Length of data to be received (parameter LEN, instruction TRCV/TRCV_C) greater than length of data to be sent (parameter LEN, instruction TSEND/TSEND_C):

  TRCV/TRCV_C copies the received data to the specified receive area (parameter DATA) only after the assigned length is reached. When the assigned length is reached, data of the subsequent job are already being received. As a result, the receive area contains data from two different send jobs. If you do not know the exact length of the first message, you are unable to recognize the end of the first message and the start of the second message.

- Length of data to be received (parameter LEN, instruction TRCV/TRCV_C) less than length of data to be sent (parameter LEN, instruction TSEND/TSEND_C):

  TRCV/TRCV_C copies the number of bytes you specified in the LEN parameter to the receive data area (parameter DATA). Then, it sets the NDR status parameter to TRUE (job completed successfully) and assigns RCVD_LEN (amount of data actually received) the value of LEN. With each subsequent call, you receive a further block of the sent data.

Characteristics of ISO-on-TCP

During data transmission via an ISO-on-TCP connection, information regarding the length and the end of a message is also supplied.

If the length of the sent data and the length of the expected data do not match, the following will occur:

- Length of data to be received (parameter LEN, instruction TRCV/TRCV_C) greater than length of data to be sent (parameter LEN, instruction TSEND/TSEND_C):

  TRCV/TRCV_C copies all the sent data to the receive data area (parameter DATA). Then, it sets the NDR status parameter to TRUE (job completed successfully) and assigns RCVD_LEN (amount of data actually received) the length of the data sent.

- Length of data to be received (parameter LEN, instruction TRCV/TRCV_C) less than length of data to be sent (parameter LEN, instruction TSEND/TSEND_C):

TRCV/TRCV_C does not copy any data to the receive data area (parameter DATA), but instead supplies the following error information: ERROR=1, STATUS=W#16#8088 (destination buffer too small).

See also

Basics of Open User Communication (Page 230)
TSEND_C (Page 958)
TRCV_C (Page 961)
TSEND (Page 970)
TRCV (Page 972)

6.6.2.2 Parameters of communication connections

Data block for connection description

A connection description DB with a structure according to TCON_Param is used to assign the communication connection parameters for TCP and ISO-on-TCP. The fixed data structure of the TCON_Param contains all the parameters that are needed to establish the connection. The connection description DB is automatically created for a new connection by the connection parameter assignment for Open User Communication when the TSEND_C, TRCV_C, or TCON instruction is used.

The CONNECT connection parameter of the instance DBs for TSEND_C, TRCV_C, or TCON contains a reference to the utilized data block.

Structure of the connection description according to TCON_Param

Byte	Parameter	Data type	Initial value	Description
0 … 1	block_length	UINT	64	Length: 64 bytes (fixed)
2 … 3	id	CONN_OUC	1	Reference to this connection (range of values: 1 to 4095). You specify the value of this parameter for the TSEND_C, TRCV_C, or TCON instruction under ID.
4	connection_type	USINT	17	Connection type: • 17: TCP • 18: ISO-on-TCP
5	active_est	BOOL	TRUE	ID for the manner in which the connection is established: • FALSE: Passive connection establishment • TRUE: Active connection establishment
6	local_device_id	USINT	2	ID for the local PN/IE interface.

Byte	Parameter	Data type	Initial value	Description
7	local_tsap_id_len	USINT	0	Length of parameter local_tsap_id used, in bytes; possible values: • 0 or 2, if connection type = 17 (TCP) Only the value 0 is permissible for the active side. • 2 to 16, if connection type = 18 (ISO-on-TCP)
8	rem_subnet_id_len	USINT	0	This parameter is not used.
9	rem_staddr_len	USINT	4	Length of address of partner end point, in bytes: • 0: unspecified, i.e., parameter rem_staddr is irrelevant. • 4: Valid IP address in parameter rem_staddr
10	rem_tsap_id_len	USINT	2	Length of parameter rem_tsap_id used, in bytes; possible values: • 0 or 2, if connection type = 17 (TCP) Only the value 0 is permissible for the passive side. • 2 to 16, if connection type = 18 (ISO-on-TCP)
11	next_staddr_len	USINT	0	This parameter is not used.
12 … 27	local_tsap_id	ARRAY [1..16] of BYTE	-	Local address component of connection: • 17 (TCP): local port no. (possible values: 1 to 49151; recommended values: 2000...5000); local_tsap_id[1] = high byte of port no. in hexadecimal notation; local_tsap_id[2] = low byte of port no. in hexadecimal notation; local_tsap_id[3-16] = irrelevant • 18 (ISO-on-TCP): local TSAP-ID: local_tsap_id[1] = B#16#E0; local_tsap_id[2] = rack and slot of local end points (bits 0 to 4: slot number, bits 5 to 7: rack number); local_tsap_id[3-16] = TSAP extension, optional Note: Make sure that every value of local_tsap_id is unique within the CPU.
28 … 33	rem_subnet_id	ARRAY [1..6] of USINT	-	This parameter is not used.

34 … 39	rem_staddr	ARRAY [1..6] of USINT	-	IP address of the partner end point, e.g. for 192.168.002.003:
				rem_staddr[1] = 192
				rem_staddr[2] = 168
				rem_staddr[3] = 002
				rem_staddr[4] = 003
				rem_staddr[5-6]= irrelevant

Byte	Parameter	Data type	Initial value	Description
40 … 55	rem_tsap_id	ARRAY [1..16] of BYTE	-	Partner address component of connection • 17 (TCP): partner port no. (possible values: 1 to 49151; recommended values: 2000...5000); rem_tsap_id[1] = high byte of the port no. in hexadecimal notation; rem_tsap_id[2] = low byte of the port no. in hexadecimal notation; rem_tsap_id[3-16] = irrelevant • 18 (ISO-on-TCP): partner TSAP-ID: rem_tsap_id[1] = B#16#E0; rem_tsap_id[2] = rack and slot of partner end point (bits 0 to 4: slot number, bits 5 to 7: rack number); rem_tsap_id[3-16] = TSAP extension, optional
56 … 61	next_staddr	ARRAY [1..6] of BYTE	-	This parameter is not used.
62 … 63	spare	WORD	W#16#0000	Reserved.

See also

Principle of operation of connection-oriented protocols (Page 299)
Description of the connection parameters (Page 233)
Ability to read back connection description parameters (Page 304)
Basic principles for programming of data blocks (Page 510)
Overview of connection parameter assignment (Page 231)

6.6.2.3 Assignment of port numbers

Introduction

When an Open User Communication is created, the value 2000 is automatically assigned as the port number.

Permissible values for port numbers are 1 to 49151. You can assign any port number within this range. However, because some ports may already be used depending on the system, port numbers within the range from 2000 to 5000 are recommended.

Overview of port numbers

The following table summarizes the system reactions to various port numbers.

Port no.	Description	System reaction
2000 … 5000	Recommended range	No warning, no error message on entry Port number is permitted and accepted
1 … 1999, 5001 … 49151	Can be used, but is outside the recommended range	Warning message on entry Port number is permitted and accepted
20, 21, 25, 80, 102, 135, 161, 34962 … 34964	Can be used conditionally*	
53, 80, 102, 135, 161, 162, 443, 520, 9001, 34962 … 34964	Can be used conditionally**	

* These ports are used by TSEND_C and TRCV_C with the TCP connection type.

** These ports are blocked depending on the function scope of the utilized S7-1200 CPU. The documentation of the respective CPUs provides the assignment of these ports.

See also

Description of the connection parameters (Page 233)
Creating and assigning parameters to connections (Page 235)

6.6.2.4 Ability to read back connection description parameters

Changing parameter values in the connection description

The connection description for exactly one connection of the Open User Communication is entered from the connection parameter assignment in the connection description DB.

You can change the parameter values of the connection description DB outside of the connection parameter assignment in the user program. The structure of the connection description cannot be changed.

Connection description DBs containing values you changed subsequently can be read back from the connection parameter assignment. Under "Properties > Configuration > Connection parameters", the Inspector window displays only the connection parameters stored in the connection description DB.

The connection parameter assignment does not support nested entries of connection descriptions in DB types that can only be found via offset referencing (e.g., Global-DB).

Ability to read back individual connection parameters

For the "Address" parameter of the communication partner, its IP address from the "rem_staddr" parameter of the connection description is displayed.

The following values can also be reloaded from the connection description:

- Connection type
- Local connection ID:

- Connection establishment (active/passive)
- Local TSAP (ISO-on-TCP only)
- Partner TSAP (ISO-on-TCP only)
- Local port (TCP only)
- Partner port (TCP only)

The values of the connection ID parameters of the communication partner, the connection data, as well as the connection establishment, are not included in the connection description in the local connection description DB. Consequently, these parameters cannot be displayed when the connection parameter assignment is reopened. The connection establishment of the partner results from the local connection establishment and is therefore also displayed.

A new communication partner can be selected at any time in the "Partners" drop-down list box.

When a CPU recognized in the project is selected as a specified communication partner, the entry options for the connection ID and the connection data are shown again.

See also

Parameters of communication connections (Page 301)
Description of the connection parameters (Page 233)

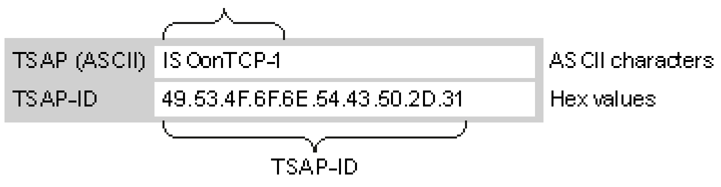
6.6.2.5 TSAP structure

Introduction

For an ISO-on-TCP connection, Transport Service Access Points (TSAPs) must be assigned for both communication partners. TSAP IDs are assigned automatically after an ISO-on-TCP connection is created. To ensure the uniqueness of TSAP IDs within a device, you can change the preassigned TSAPs in the connection parameter assignment.

Structure of TSAPs

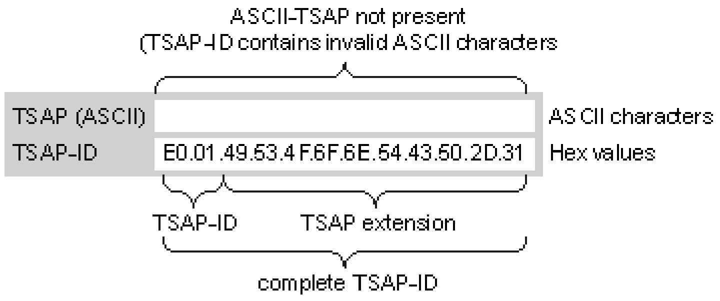
You must comply with certain rules when assigning TSAPs. A TSAP must contain a certain number of bytes, which are able to be displayed and entered as hexadecimal values (TSAP-ID) or as ASCII characters (ASCII-TSAP):



Entries or changes of the TSAP-ID or the ASCII-TSAP in the corresponding entry fields always take effect in the other display format as well.

If a TSAP contains no valid ASCII characters, the TSAP is displayed only as TSAP-ID and not as ASCII-TSAP. This is the case after a connection is created. The first two hex characters as

TSAP-ID identify the communication type and the rack/slot. Because these characters are not valid ASCII characters for a CPU, the ASCII-TSAP is not displayed in this case.



In addition to the rules for length and structure of TSAPs, you must also ensure the uniqueness of the TSAP-ID. The assigned TSAPs are not automatically unique.

Length and content of TSAPs

A TSAP is structured as follows:

- TSAP-ID with TSAP extension

  Length = 2 to 16 bytes

  x_tsap_id[0] = 0xE0 (Open User Communication)

  x_tsap_id[1] (bits 0 to 4) = slot number of CPU

  x_tsap_id[1] (bits 5 to 7) = rack number of CPU

  x_tsap_id[2...15] = any characters (TSAP extension, optional)

  (x = loc (local) or x = rem (partner))
- TSAP-ID as ASCII-TSAP

  Length = 3 to 16 bytes

  x_tsap_id[0 to 2] = 3 ASCII characters (0x20 to 0x7E)

  x_tsap_id[3...15] = any characters (optional)

  (x = loc (local) or x = rem (partner))

The following table shows the schematic structure of a TSAP-ID:

TSAP-ID	tsap_id_len	tsap_id[0]	tsap_id[1]	tsap_id[2..15]	tsap_id[3..15]
...with extension	2...16 bytes	0xE0	0x01 (0x00)*	Extension (optional)	Extension (optional)
...as ASCII-TSAP	3...16 bytes	0x20...0x7E	0x20...0x7E	0x20...0x7	Any (optional)

*A recognized CPU is normally inserted on rack 0 in slot 1. For this reason, hex value 01 is valid for the second place of the TSAP-ID with extension. If the connection partner is an unspecified CPU, e.g., a third-party device, the hex value 00 is also permissible for the slot address.

Note

For unspecified communication partners, the local TSAP-ID and the partner TSAP-ID can have a length of 0 to 16 bytes, in which all hex values from 00 to FF are permitted.

ASCII code table for entry of ASCII TSAPs

For entry of an ASCII-TSAP in the connection parameter assignment, only hexadecimal values from 20 to 7E are permitted:

Code	..0	..1	..2	..3	..4	..5	..6	..7	..8	..9	..A	..B	..C	..D	..E	..F
2..		!	"	#	$	%	&	’	(	)	*	+	,	-	.	/
3..	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4..	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5..	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6..	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7..	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	

See also

Examples of TSAP assignment (Page 307)
Description of the connection parameters (Page 233)
Creating and assigning parameters to connections (Page 235)

6.6.2.6 Examples of TSAP assignment

The following examples illustrate various aspects of editing TSAPs:

- Example 1: Creating a new connection for PLC-PLC communication
- Example 2: Entry of a local ASCII-TSAP
- Example 3: Entry of a TSAP extension in the TSAP-ID
- Example 4: Incorrect editing of the TSAP-ID
- Example 5: Entry of an ASCII-TSAP via the "TSAP-ID" entry field

Example 1: Creating a new connection for PLC-PLC communication

Once you have created a new connection with two PLCs for the Open User Communication, the TSAP extension "ISOonTCP-1" is assigned automatically.

This TSAP extension produces the TSAP-ID E0.01.49.53.4F.6F.6E.54.43.50.2D.31, which is entered automatically in the connection description DB and in the entry fields of the local and the partner TSAP. The entry fields of the ASCII-TSAPs remain empty:

	Local TSAP	Partner TSAP
TSAP (ASCII)		
TSAP-ID	E0.01.49.53.4F.6F.6E.54.43.50.2D.31	E0.01.49.53.4F.6F.6E.54.43.50.2D.31

You can change the values in the entry fields of the TSAP-ID and the ASCII-TSAP at any time.

The entry field of the TSAP-ID shows the complete TSAP stored in the data block of the connection description. The TSAP-ID with TSAP extension, which is limited to 16 characters, is not displayed in the "TSAP (ASCII)" entry field because the character E0 does not represent a valid character for the ASCII-TSAP.

If the displayed TSAP-ID is a valid ASCII-TSAP, it is displayed in the "TSAP (ASCII)" entry field.

Changes in the entry fields for TSAP-ID and ASCII-TSAP affect the other field.

Example 2: Entry of a local ASCII-TSAP

If you have created a new connection and assigned an ASCII value for the local TSAP in the "TSAP (ASCII)" entry field, e.g., "ISOonTCP-1", the resulting TSAP-ID is created automatically.

When you exit the "TSAP (ASCII)" entry field, the number of ASCII characters is checked automatically for compliance with the limit (3 to 16 characters) and the resulting TSAP-ID is entered into the corresponding entry field:

	Local TSAP	Partner TSAP
TSAP (ASCII)	ISOonTCP-1	
TSAP-ID	49.53.4F.6F.6E.54.43.50.2D.31	E0.01.49.53.4F.6F.6E.54.43.50.2D.31

Example 3: Entry of a TSAP extension in the TSAP-ID

If, following creation of a connection and entry of an ASCII-TSAP (see examples 1 and 2) in the entry field of the local TSAP-ID, you add the prefix "E0.01" to the TSAP value, the ASCII-TSAP will no longer be displayed when the entry field is exited.

	Local TSAP	Partner TSAP
TSAP (ASCII)		
TSAP-ID	E0.01.49.53.4F.6F.6E.54.43.50.2D.31	E0.01.49.53.4F.6F.6E.54.43.50.2D.31

Once you have exited the entry field of the TSAP-ID, a check is performed automatically to determine whether the first character of the TSAP-ID is a valid ASCII character. Since the character "E0" now present in the TSAP-ID is not a valid character for the ASCII-TSAP, the "TSAP (ASCII)" entry field no longer displays an ASCII-TSAP.

If a valid ASCII character is used, the check for compliance with the length specification of 2 to 16 characters follows.

Example 4: Incorrect editing of the TSAP-ID

If you remove the hex value "E0" from a TSAP-ID beginning with "E0.01", the TSAP-ID now begins with "01" and therefore no longer complies with the rules and is invalid:

	Local TSAP	Partner TSAP
TSAP (ASCII)		
TSAP-ID	01.49.53.4F.6F.6E.54.43.50.2D.31	E0.01.49.53.4F.6F.6E.54.43.50.2D.31

After the entry field is exited, a message is output because the TSAP-ID is neither a valid ASCII-TSAP (this would have to have a hex value in the range from 20 to 7E as the first value) or a valid TSAP-ID (this would have to have the identifier "E0" as the first value).

Example 5: Entry of an ASCII-TSAP via the "TSAP-ID" entry field

If you remove the value "01" in addition to the value "E0" from the incorrect TSAP-ID in example 4, the TSAP-ID begins with the hex value 49. This value is within the permissible range for ASCII-TSAPs:

	Local TSAP	Partner TSAP
TSAP (ASCII)		
TSAP-ID	49.53.4F.6F.6E.54.43.50.2D.31	E0.01.49.53.4F.6F.6E.54.43.50.2D.31

When you exit the entry field, the TSAP-ID is recognized as a valid ASCII-TSAP and the resulting ASCII-TSAP "ISOonTCP-1" is written to the "TSAP (ASCII)" entry field.

See also

TSAP structure (Page 305)
Description of the connection parameters (Page 233)

7 Programming a PLC

7.1 Functional description of S7-1200 CPUs

7.1.1 Operating modes

7.1.1.1 Principles of the operating modes of S7-CPUs

Introduction

Operating modes describe the behavior of the CPU. The following operating modes are possible:

- STARTUP
- RUN
- STOP

In these operating modes, the CPU can communicate via the PN/IE interface, for example.

Other operating modes

If the CPU is not ready for operation, it is in one of following two operating modes:

- Deenergized, i.e. the supply voltage is switched off.
- Defective, which means an internal error has occurred.

  If the "Defective" status is caused by a firmware error, this state is indicated by the status LEDs of the CPU (refer to the description of the CPU). To find out the cause, follow these steps:

  – Turn the power supply switch off and on again.

  – Read out the diagnostics buffer when the CPU starts up and send the data for analysis to Customer Support.

  If the CPU does not start up, replace it.

See also

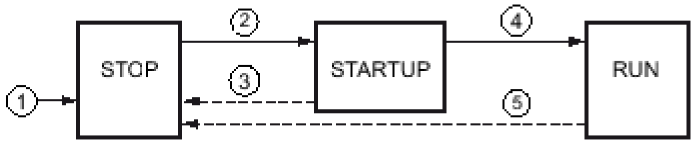
"STARTUP" operating mode (Page 313)

STOP mode (Page 316)
RUN mode (Page 316)

7.1.1.2 Operating mode transitions

Overview

The following figure shows the operating modes and the operating mode transitions of S7-1200 CPUs:



The following table shows the conditions under which the operating modes will change:

No.	Operating mode transition	Conditions
①	STOP	After you turn on the power supply, the CPU is in "STOP" mode. It then determines the required type of startup and changes to the next operating mode.
②	STOP → STARTUP	If the hardware configuration and the program blocks are consistent, the CPU changes to "STARTUP" mode in the following situations: • The CPU is set to "RUN" from the programming device. • After automatic triggering of a STARTUP operating mode by "POWER-ON".
③	STARTUP → STOP	The CPU returns to the "STOP" mode in the following situations: • An error is detected during startup. • The CPU is set to "STOP" from the programming device. • A STOP command is executed in the STARTUP OB.
④	STARTUP → RUN	If the STARTUP is successful, the CPU switches to "RUN".
⑤	RUN → STOP	The CPU returns to the "STOP" mode in the following situations: • An error is detected that prevents continued processing. • The CPU is set to "STOP" from the programming device. • A STOP command is executed in the user program.

7.1.1.3 "STARTUP" operating mode

7.1.1.3 Principles of the STARTUP mode

Function

After turning on the CPU, it executes a startup program before starting to execute the cyclic user program.

By suitably programming startup OBs, you can specify certain initialization variables for your cyclic program in the startup program. There is no rule in terms of the number of startup OBs. That is, you can set up one or several startup OBs in your program, or none at all.

Parameter settings for startup characteristics

You can specify whether the CPU remains in STOP mode or whether a warm restart is run. Over and above this, you can set the response during startup (RUN or previous mode) in the "Startup" group of the CPU properties.

Special characteristics

Note the following points regarding the "STARTUP" mode:

- The startup OBs are executed. All startup OBs you have programmed are executed, regardless of the selected startup mode.
- No time-based or interrupt-based program execution can be performed.
- The outputs on the modules are disabled.
- The process image is not updated; direct I/O access to inputs is possible.

See also

Editing properties and parameters (Page 218)
Principles of the operating modes of S7-CPUs (Page 311)
Organization blocks for startup (Page 338)
Warm restart (Page 313)

7.1.1.3 Warm restart

Function

During a warm restart, all non-retentive bit memory is deleted and non-retentive DB contents are reset to the initial values from load memory. Retentive bit memory and DB contents are retained.

Program execution begins at the call of the first startup OB.

Triggering a warm restart

You can trigger a "Warm restart" using a corresponding menu command on your programming device in the following situations:

- The CPU must be in "STOP" mode.
- After a memory reset
- After loading a consistent program and a consistent hardware configuration with the CPU in "STOP" mode.

"POWER ON" triggers a "warm restart" if you have set the following parameters for the startup response:

- Startup type "warm restart - RUN" (regardless of the CPU operating mode prior to POWER OFF).
- "Warm restart - mode prior to POWER OFF" (depending on the CPU operating mode prior to POWER OFF. The CPU must have been in RUN mode prior to this.)

See also

Retentive memory areas (Page 319)

7.1.1.3 Startup activities

Overview

The following table shows which activities the CPU performs at STARTUP:

Activities in execution sequence	At warm restart
Clear non-retentive bit memories	Yes
Clear all bit memories	No
Clear the process image output	Yes
Processing startup OBs	Yes
Update the process image input	Yes
Enable outputs after changing to "RUN" mode	Yes

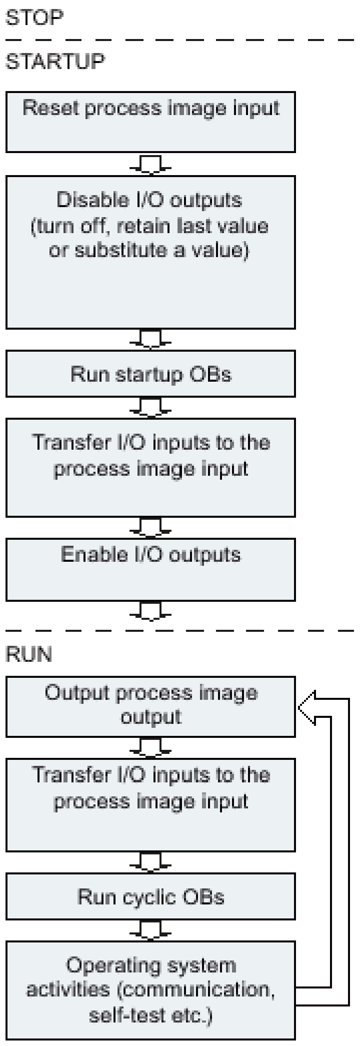
Sequence

The following figure shows the activities of the CPU in "STOP", "STARTUP", and "RUN" modes.

You can use the following measures to specify the state of the I/O outputs in the first cycle of the user program:

- Use assignable output modules to be able to output substitute values or to retain the last value.
- Set default values for outputs in startup OBs.

During the startup, all interrupt events are entered in a queue so that they can be processed later during RUN mode. In RUN mode, hardware interrupts can be processed at any time.


STOP
STARTUP
Reset process image input
Disable I/O outputs (turn off, retain last value or substitute a value)
Run startup OBs
Transfer I/O inputs to the process image input
Enable I/O outputs
RUN
Output process image output
Transfer I/O inputs to the process image input
Run cyclic OBs
Operating system activities (communication, self-test etc.)

7.1.1.3 Special features during startup

Response when expected and actual configurations do not match

The expected configuration is represented by the engineering configuration loaded on the CPU. The actual configuration is the actual configuration of the automation system.

If the expected configuration and actual configuration differ, the CPU nevertheless initially changes to RUN.

Canceling a STARTUP

If errors occur during startup, the startup is canceled and the CPU remains in "STOP" mode.

Under the following conditions, a startup will not be performed or will be canceled:

- If there is no valid SIMATIC SD card inserted.

- If no hardware configuration has been loaded.

See also

Overview of the CPU properties (Page 250)

7.1.1.4 RUN mode

Function

In "RUN" mode the cyclic, time-driven, and interrupt-driven program sections execute:

- The process image output is read out.
- The user program is executed.
- The process image input table is read.

Active data exchange between S7-1200 CPUs by means of Open User Communication is only possible in "RUN" mode.

See also

Principles of the operating modes of S7-CPUs (Page 311)
Open User Communication (Page 230)

7.1.1.5 STOP mode

Function

In "STOP" mode, the user program is not executed. All outputs are disabled or react according to the parameter settings: They provide a substitute value as set in the parameters or retain the last value output and bring the controlled process to a safe status.

The CPU checks the following points:

- Hardware, for example whether are all modules are available
- Whether the default settings for the CPU are applicable or parameter sets are present
- Whether the general conditions for the programmed startup behavior are correct

See also

Principles of the operating modes of S7-CPUs (Page 311)

7.1.1.6 Basics of a memory reset

Function

A memory reset on the CPU is possible only in STOP mode.

When memory is reset, the CPU is changed to an "initial status". This means:

- Work memory is cleared (retentive and non retentive data).
- The load memory (code and data blocks) is then copied to work memory. As a result, the DBs no longer have current values but their initial values.
- An existing online connection between your programming device/PC and the CPU is terminated.
- The diagnostics buffer, the time, the IP address, the hardware configuration and active force jobs are retained.

Note

If you replace the memory card when the CPU is turned off, the CPU runs a memory reset when you turn on the power again.

7.1.2 Memory areas

7.1.2.1 Load memory

Function

Each CPU has an internal load memory. The size of this internal load memory depends on the CPU used.

This internal load memory can be replaced by using external memory cards. If there is no memory card inserted, the CPU uses the internal load memory; if a memory card is inserted, the CPU uses the memory card as load memory.

The size of the usable external load memory cannot, however, be greater than the internal load memory even if the inserted SD card has more free space.

See also

Working with memory cards (Page 163)

7.1.2.2 Work memory

Function

Work memory is a non-retentive memory area for storing elements of the user program that are relevant for program execution. The user program is executed exclusively in work memory and system memory.

7.1.2.3 System memory

7.1.2.3 System memory areas

Function

System memory contains the memory elements that each CPU makes available to the user program, such as the process image and bit memory.

By using appropriate operations in your user program, you address the data directly in the relevant operand area.

The following table shows the operand areas of the system memory:

Operand area	Description	Access via units of the following size:	S7 notation
Process image output	The CPU writes the values from the process image output table to the output modules at the start of the cycle.	Output (bit)	Q
		Output byte	QB
		Output word	QW
		Output double word	QD
Process image input	The CPU reads the inputs from the input modules and saves the values to the process image input table at the start of the cycle.	Input (bit)	I
		Input byte	IB
		Input word	IW
		Input double word	ID
Bit memory	This area provides storage for intermediate results calculated in the program.	Bit memory (bit)	M
		Memory byte	MB
		Memory word	MW
		Memory double word	MD
Data block	Data blocks store information for the program. They can either be defined so that all code blocks can access them (global DBs) or assigned to a specific FB or SFB (instance DB). Requirement: The block attribute "Symbolic access only" is not enabled.	Data bit	DBX
		Data byte	DBB
		Data word	DBW
		Data double word	DBD

Operand area	Description	Access via units of the following size:	S7 notation
Local data	This area contains the temporary data of a block while the block is being processed. Requirement: The block attribute "Symbolic access only" is not enabled. Recommendation: Only access local data (temp) symbolically.	Local data bit	L
		Local data byte	LB
		Local data word	LW
		Local data double word	LD
I/O input area	The I/O input and output areas permit direct access to central and distributed input and output modules.	I/O input bit	<tag>:P
		I/O input byte	
		I/O input word	
		I/O input double word	
I/O output area		I/O output bit	
		I/O output byte	
		I/O output word	
		I/O output double word	

See also

Diagnostics buffer (Page 321)
Basic principles of process images (Page 320)
Basic principles for programming of data blocks (Page 510)
Declaring local tags in the block interface (Page 435)
Layout of the block interface (Page 432)
Access to the I/O addresses (Page 322)

7.1.2.3 Retentive memory areas

Retentive memory areas

Data loss after power failure can be avoided by marking certain data as retentive. This data is stored in a retentive memory area. A retentive memory area is an area that retains its content following a warm restart, in other words, after cycling the power when the CPU changes from STOP to RUN.

The values of retentive data are deleted during a cold restart.

The following data can be assigned retentivity:

- Bit memory: The precise width of the memory can be defined for bit memory in the PLC tag table or in the assignment list.

- Tags of a function block (FB): In the interface of an FB, you can define individual tags as being retentive if you have enabled symbolic tag addressing. Retentivity settings can only be defined in the assigned instance data block if symbolic addressing is not activated for the FB.
- Tags of a global data block: Depending on the settings for symbolic addressing you can define retentivity either for individual or for all tags of a global data block.
  "Symbolic access only" attribute of the DB is enabled: Retentivity can be set for each individual tag.
  "Symbolic access only" attribute of the DB is disabled: The retentivity setting applies to all tags of the DB; either all tags are retentive or no tag is retentive.

See also

Setting the retentivity of PLC tags (Page 401)
Setting the retentivity of local tags (Page 440)
Setting retentivity in global data blocks (Page 517)
Warm restart (Page 313)

7.1.2.3 process image input/output

7.1.2.3 Basic principles of process images

Function

When the user program addresses the input (I) and output (O) operand areas, it does not query or change the signal states on the digital signal modules. Instead, it accesses a memory area in the system memory of the CPU. This memory area is referred to as the process image.

Advantages of the process image

Compared with direct access to input and output modules, the main advantage of accessing the process image is that the CPU has a consistent image of the process signals for the duration of one program cycle. If a signal state on an input module changes during program execution, the signal state in the process image is retained until the process image is updated again in the next cycle. The process of repeatedly scanning an input signal within a user program ensures that consistent input information is always available.

Access to the process image also requires far less time than direct access to the signal modules since the process image is located in the internal memory of the CPU.

7.1.2.3 Updating the process images

Sequence

The operating system updates the process images at cyclic intervals unless defined otherwise in your configuration. The process image input/output is updated in the following order:

1. The internal tasks of the operating system are performed.

2. The process image output (PIQ) table is written to the outputs of the module.
3. The status of inputs is read to the process image input (PII) table.

   Input bits which do not have corresponding hardware inputs are set to 0 unless they are forced.
4. The user program is executed with all the blocks that are called in it.

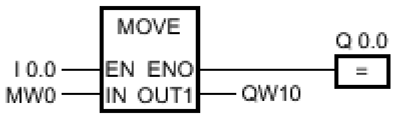
The operating system automatically controls the writing of the process image output to the outputs of the modules and the reading of the process image input.

Special characteristics

You have the option of accessing inputs or outputs directly using direct I/O access.

- If an instruction accesses an output directly and the output address is located in the process image output, the process image of the relevant output is updated.
- If an instruction accesses an output directly and the output address is **not** located in the process image output, the process image of the relevant output is **not** updated.

Example of normal I/O access by way of the process image



Update QW10 in the I/O output area with the value from MW0.

I/O access error during process image updating

If an error occurs while updating the process image (I/O access error), the CPU reacts with the default system reaction "STOP".

See also

Troubleshooting options (Page 507)
Start address of a module (Page 322)
Access to the I/O addresses (Page 322)
Startup activities (Page 314)

7.1.2.3 Diagnostics buffer

Function

The diagnostics buffer is part of the system memory of the CPU. It contains the errors detected by the CPU or modules with diagnostics capability. It includes the following events:

- Every mode change of the CPU (for example, POWER UP, change to STOP mode, change to RUN mode)
- Every diagnostics interrupt

The diagnostics buffer of the S7-1200-CPU has a capacity of 50 entries of which the last (most recent) 10 entries are retained following power cycling.

Those entries can only be cleared by restoring the CPU to factory defaults.

You can read the content of the diagnostics buffer with the help of the Online and Diagnostics view.

See also

Basic information on the diagnostics buffer (Page 296)

7.1.3 I/O data area

7.1.3.1 Start address of a module

Definition

The start address is the lowest byte address of a module. It represents the start address of the user data area in the module and is used in many cases to represent the entire module.

Configuring module start addresses

The addresses used in the user program and the module start addresses are coordinated when the modules are configured.

In the module properties ("I/O addresses" group), you can change the start addresses that were assigned automatically after the modules were inserted.

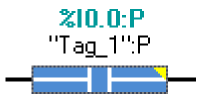
You can also make a setting that decides whether or not the addresses are located in the process image.

7.1.3.2 Access to the I/O addresses

I/O addresses

If you insert a module in the device view, its user data is located in the process image of the S7-1200-CPU (default). The CPU handles the data exchange between the module and the process image area automatically during the update of the process images.

Append the suffix ":P" to the I/O address if you want the program to access user data directly instead of using the process image.



This could be necessary, for example, during execution of a time time-sensitive program which also has to control the outputs within the same cycle.

7.1.4 Basics of program execution

7.1.4.1 Events and OBs

Events and OBs

The operating system of S7-1200-CPUs is based on events. There are two types of events:

- Events which can start an OB
- Events which cannot start an OB

An event which can start an OB triggers the following reaction:

- It calls the OB you possibly assigned to this event. The event is entered in a queue according to its priority if it is currently not possible to call this OB.
- The default system reaction is triggered if you did not assign an OB to this event.

An event which cannot start an OB triggers the default system reaction for the associated event class.

The user program cycle is therefore based on events, the assignment of OBs to those events, and on the code which is either contained in the OB, or called in the OB.

The following table provides an overview of the events which can start an OB, including the associated event classes and OBs. The table is sorted based on OB priority. Priority class 1 is the lowest.

Event class	OB no.	Number of OBs	Start event	OB priority	Priority group
Cyclic program	1, >= 200	>= 1	Starting or end of the last cyclic OB	1	1
Startup	100, >= 200	>=0	STOP to RUN transition	1	
Time-delay interrupt	>= 200	Max. 4	Delay time expired	3	2
Cyclic interrupt	>= 200		Constant bus cycle time expired	4	
Hardware interrupt	>= 200	Max. 50 (more can be used with DETACH and ATTACH)	• Rising edge (max. 16) • Falling edge (max. 16)	5	
			• HSC: Count value = reference value (max. 6) • HSC: Count direction changed (max. 6) • HSC: External reset (max. 6)	6	
Diagnostic error interrupt	82	0 or 1	Module has detected an error	9	

Event class	OB no.	Number of OBs	Start event	OB priority	Priority group
Time error	80	0 or 1	Maximum cycle time exceeded	26	3
			• Called OB is still being executed • Queue overflow • Interrupt loss due to high interrupt load		

The following table describes events which do not trigger an OB start, including the corresponding reaction of the operating system. The table is sorted based on event priority.

Event class	Event	Event priority	System reaction
Insertion/removal	Insertion/removal of a module	21	STOP
Access error	I/O access error during process image update	22	Ignore
Programming error	Programming error in a block for which you use system reactions provided by the operating system (note: the error handling routine in the block program is executed if you activated local error handling).	23	STOP
I/O access error	I/O access error in a block for which you use system reactions provided by the operating system (note: the error handling routine in the block program is executed if you activated local error handling).	24	STOP
Maximum cycle time exceeded twice	Maximum cycle time exceeded twice	27	STOP

Assignment between OBs and events

With the exception of the cyclic program and startup program and event can only be assigned to one OB. However, in certain event classes such as hardware interrupts one and the same OB can be assigned to several events.

The assignment between OBs and events is defined in the hardware configuration. Defined assignments can be changed at runtime by means of ATTACH and DETACH instructions.

OB priority and runtime behavior

S7-1200 CPUs support priority classes 1 (lowest) to 27 (highest) that are split up into 3 priority groups. An OB is assigned the priority of its start event.

Events of a priority group override any OB of a lower priority group. This means:

- Any event of priority group 2 interrupts cyclic program execution.
- An OB of priority group 2 cannot be interrupted by any other event of priority group 2. This rule also applies to events of a priority higher than that of the currently active OB.

Any further event of priority group 2 generated while an OB of priority group 2 is being executed is added to a queue in accordance with its priority. The queues are processed at a later time based on the order of their priority (starting at the highest priority). Start events within a queue are processed in chronological order.

- A time error interrupts any other OB.

OB start information

Certain OBs have start information, while others do not. This is explained in greater detail in the description of the relevant OB.

See also

Event-based program execution (Page 325)
Principles of local error handling (Page 508)
ATTACH (Page 992)
DETACH (Page 993)
Basics of organization blocks (Page 337)
Troubleshooting options (Page 507)

7.1.4.2 Event-based program execution

OB priority and runtime behavior

S7-1200-CPUs support the priority classes 1 (lowest) to 27 (highest). An OB is assigned the priority of its start event.

Interrupt OBs can only be interrupted by time error interrupts. This rule also applies to events of a priority higher than that of the currently active OB. That is, only one interrupt OB can be active, with exception of the time error interrupt OB.

Any further event of generated while an interrupt OB is being executed is added to a queue in accordance with its priority. Start events within a queue are processed later based on the chronological order of their occurrence.

Program execution on the CPU

Program execution on the CPU is handled at three different levels:

- The level of cyclic organization blocks (e.g. OB 1)
- The level of organization blocks called due to events such as hardware interrupts (interrupt OBs)
- The level of time error interrupt organization blocks (time error interrupt OB)

Cyclic OBs are interrupted by interrupt OBs.

Interrupt OBs can only be interrupted by time error interrupt OBs.

The following figure shows the basic sequence:

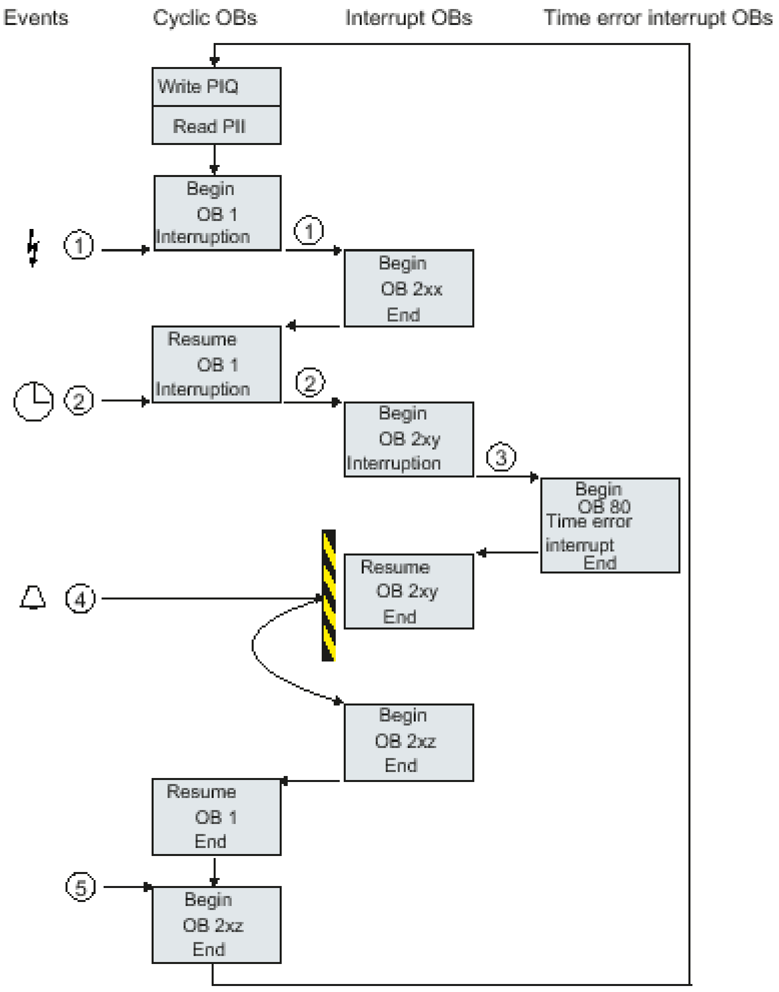


Figure7-1 Program sequence

Description of program execution

① and ②	An event (e.g. a hardware interrupt) calls its associated OB. A called OB is executed without interruption, including all of its nested blocks. Execution of the cyclic OB is resumed on completion of interrupt processing, provided the queue does not contain any events which trigger an OB start.
③	An interrupt OB can only be interrupted by a time error interrupt OB (OB 80).
④	An new alarm-triggering event occurs during interrupt processing. This new event is added to a queue. The queued events successively call their corresponding OBs only after execution of the current interrupt OBs was completed and according to the following rules: • Events are processed in the order of their priority (starting at the highest priority) • Events of the same priority are processed in chronological order
⑤	The cyclic OBs are processed one after the other.

Notes on queues

- Every priority class (OBs of the same priority to be called) is assigned a separate queue. The size of those queues is set by default.
- Any new event leading to the overflow of a queue is discarded and therefore lost. A "time error interrupt event" is generated simultaneously. Information identifying the OB that caused the error is included in the start information of the time error interrupt OB (OB 80). A corresponding reaction such as an alarm trigger can be programmed in the time error interrupt OB.

See also

Basics of organization blocks (Page 337)

7.1.4.3 Example of a hardware interrupt event

The function principle of event-oriented program execution in the S7-1200-CPU is described based on the example of a hardware interrupt-triggering module.

Process events and their priority

Process events are triggered by the I/O (e.g. at a digital input) and initiate a call of the assigned OB in the S7-1200 CPU. OBs assigned to a hardware interrupt event are so-called hardware interrupt OBs.

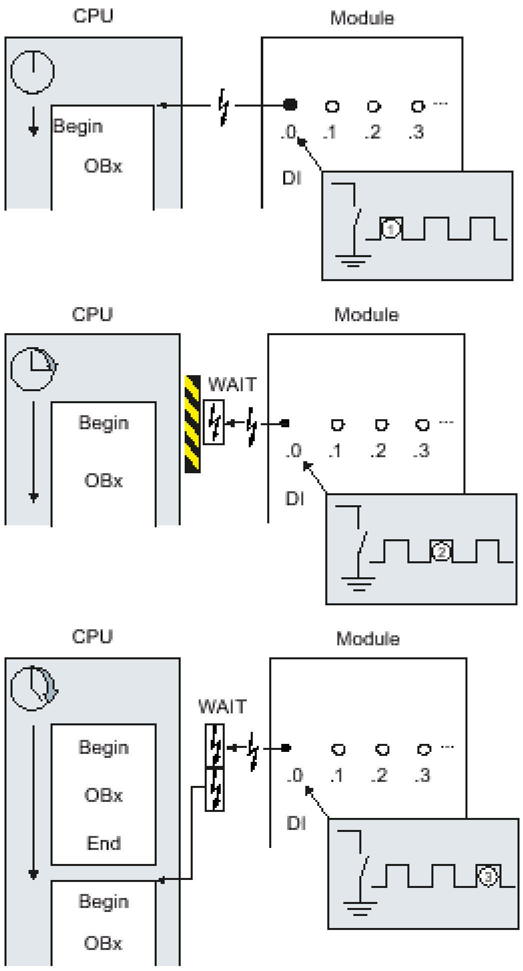
Examples of process events and their priority:

- Process events "rising edge" or "falling edge" at an interrupt-triggering module: The hardware interrupt OB started by such an event is always assigned priority 5.
- Process events from a high-speed counter
  - Count value corresponds to the reference value
  - Change count direction
  - External reset of the high-speed counter

  The hardware interrupt OB started by this event is always assigned priority 6.

The OBs are executed in ascending order of their priority.

The following figure shows the sequence of hardware interrupt execution.



Hardware interrupt execution

① A hardware interrupt-triggering event such as a rising edge at the input calls the OB to which it is assigned.

② If a new event occurs that triggers a hardware interrupt while the OB is executing, this event is entered in a queue.

③ The new event that triggers a hardware interrupt starts the hardware interrupt OB assigned to the event.

Assigning the interrupt-triggering event

The interrupt-triggering event is assigned to an OB in the input properties of the device view.

- An interrupt-triggering event can only be assigned to a single OB.
- OBs, however, can be assigned to several interrupt-triggering events.
  That is, you could assign both the rising and the falling edge event to the same interrupt OB in order to trigger the same reaction to any transition of the input signal.

- The started OB can interrupt a cycle OB at every instruction. Consistent data access is secured up to dword size.
- You can parameterize module-specific interrupt-triggering events such as a rising and the falling edge at the input.
- Assign the interrupt-triggering event and the OB to be started in the configuration of the interrupt-triggering module. However, within the started hardware interrupt OB you can override this assignment using the DETACH instruction, or assign the same event to a different OB using the ATTACH instruction. This functionality allows a flexible reaction to external process signals.

See also

Organization blocks for hardware interrupts (Page 343)
Assigning parameters to hardware interrupt OBs (Page 417)
ATTACH (Page 992)
DETACH (Page 993)

7.1.4.4 Symbolic and numerical names of instructions

Symbolic and numerical names

Advanced instructions and instructions from the global libraries call functions (FC), function blocks (FB), system functions (SFC) and system function blocks (SFB) that are identified internally by numbers.

This rule is also valid for default data structures (UDT) which are used in advanced instructions.

The following tables show the assignments to advanced instructions and instructions from global libraries for AS1200-CPUs, sorted by their symbolic or numerical name.

Table7-1 Sorted by symbolic name

Symbolic name	Numerical name
ATH	SFC198
ATTACH	SFC192
CAN_DINT	SFC33
CONDITIONS	UDT1001
CTRL_PWM	SFB122
DETACH	SFC193
DIS_AIRT	SFC41
EN_AIRT	SFC42
HTA	SFC199
MB_COMM_LOAD	FC1080
MB_MASTER	FB1081

Symbolic name	Numerical name
MB_PORT	FBT1083
MB_SLAVE	FB1082
○MC_Halt	FB1100
MC_Home	FB1101
MC_MoveAbsolute	FB1102
MC_MoveJog	FB1103
MC_MoveRelative	FB1104
MC_MoveVelocity	FB1105
MC_Power	FB1107
MC_Reset	FB1108
PID_Compact	FB1130
PORT_CFG	SFB110
RCV_CFG	SFB112
RCV_PTP	SFB114
RCV_RST	SFB117
RD_LOC_T	SFC154
RD_SYS_T	SFC151
RE_TRIGR	SFC43
S_CONV (DI_STRG)	SFC216
S_CONV (I_STRG)	SFC215
S_CONV (R_STRG)	SFC218
S_CONV (SI_STRG)	SFC214
S_CONV (STRG_DI)	SFC206
S_CONV (STRG_I)	SFC205
S_CONV (STRG_R)	SFC208
S_CONV (STRG_SI)	SFC204
S_CONV (STRG_UDI)	SFC202
S_CONV (STRG_UI)	SFC201
S_CONV (STRG_USI)	SFC200
S_CONV (UDI_STRG)	SFC212
S_CONV (UI_STRG)	SFC211
S_CONV (USI_STRG)	SFC210
SEND_CFG	SFB111

Symbolic name	Numerical name
SEND_PTP	SFB113
SGN_GET	SFB115
SGN_SET	SFB116
SRT_DINT	SFC32
STP	SFC46
T_ADD	SFC159
T_DIFF	SFC158
T_SUB	SFC157
TCON	SFB102
TDISCON	SFB103
TO_AXIS_1	FBT1
TO_AXIS_PTO	FBT2
TRCV	SFB101
TRCV_C	FB1031
TSEND	SFB100
TSEND_C	FB1030
USS_COMM_LOAD	FC1070
USS_DRIVE	FB1071
USS_RPM	FB1072
USS_WPM	FB1073
WR_SYS_T	SFC156

Table7-2 Sorted by numerical name

Numerical name	Symbolic name
FB1030	TSEND_C
FB1031	TRCV_C
FB1071	USS_DRIVE
FB1072	USS_RPM
FB1073	USS_WPM
FB1081	MB_MASTER
FB1082	MB_SLAVE
FB1100	○MC_Halt
FB1101	MC_Home

Numerical name	Symbolic name
FB1102	MC_MoveAbsolute
FB1103	MC_MoveJog
FB1104	MC_MoveRelative
FB1105	MC_MoveVelocity
FB1107	MC_Power
FB1108	MC_Reset
FB1130	PID_Compact
FBT1	TO_AXIS_1
FBT2	TO_AXIS_PTO
FBT1083	MB_PORT
FC1070	USS_COMM_LOAD
FC1080	MB_COMM_LOAD
SFB100	TSEND
SFB101	TRCV
SFB102	TCON
SFB103	TDISCON
SFB110	PORT_CFG
SFB111	SEND_CFG
SFB112	RCV_CFG
SFB113	SEND_PTP
SFB114	RCV_PTP
SFB115	SGN_GET
SFB116	SGN_SET
SFB117	RCV_RST
SFB122	CTRL_PWM
SFC32	SRT_DINT
SFC33	CAN_DINT
SFC41	DIS_AIRT
SFC42	EN_AIRT
SFC43	RE_TRIGR
SFC46	STP
SFC151	RD_SYS_T
SFC154	RD_LOC_T

Numerical name	Symbolic name
SFC156	WR_SYS_T
SFC157	T_SUB
SFC158	T_DIFF
SFC159	T_ADD
SFC192	ATTACH
SFC193	DETACH
SFC198	ATH
SFC199	HTA
SFC200	S_CONV (STRG_USI)
SFC201	S_CONV (STRG_UI)
SFC202	S_CONV (STRG_UDI)
SFC204	S_CONV (STRG_SI)
SFC205	S_CONV (STRG_I)
SFC206	S_CONV (STRG_DI)
SFC208	S_CONV (STRG_R)
SFC210	S_CONV (USI_STRG)
SFC211	S_CONV (UI_STRG)
SFC212	S_CONV (UDI_STRG)
SFC214	S_CONV (SI_STRG)
SFC215	S_CONV (I_STRG)
SFC216	S_CONV (DI_STRG)
SFC218	S_CONV (R_STRG)
UDT1001	CONDITIONS

Note

The list shows any sublevel blocks which are called in an instruction enclosed in parenthesis, depending on the data type transferred (instruction S_CONV). Note that the list only contains instructions which are implemented as blocks. Instructions with internal calls of macro or machine commands do not have block numbers.

7.2 Creating a user program

7.2.1 Programming basics

7.2.1.1 Operating system and user program

7.2.1.1 Operating system

Function

Every CPU comes with an integrated operating system that organizes all CPU functions and sequences not associated with a specific control task.

The tasks of the operating system, for example, include the following:

- Handling Warm restart (Page 313)
- Updating the process image of the inputs and outputs
- Calling the user program
- Detecting interrupts and calling interrupt OBs
- Detecting and handling errors
- Managing memory areas

The operating system is a component of the CPU and is already installed there upon delivery.

See also

User program (Page 334)

7.2.1.1 User program

Function

The user program contains all functions that are necessary for processing your specific automation task.

The tasks of the user program include:

- Checking the requirements for a (warm) restart using startup OBs, for example, limit switch in correct position or safety relay active.
- Processing process data, e.g. linking binary signals, reading in and evaluating analog values, defining binary signals for output, and outputting analog values
- Reaction to interrupts, for example, diagnostic error interrupt if the limit value of an analog expansion module is overshot.

- Error handling in normal program execution

You write the user program and load it into the CPU.

See also

Operating system (Page 334)

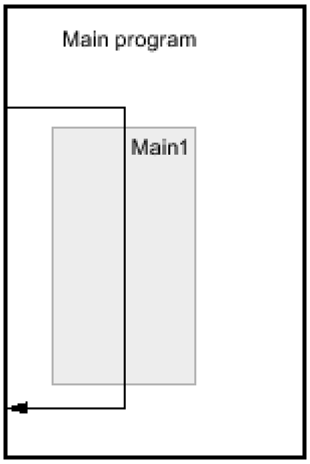
7.2.1.2 Blocks in the user program

7.2.1.2 Linear and structured programming

Linear programming

Solutions for small automation tasks can be programmed linearly in a program cycle OB. This is only recommended for simple programs.

The following figure shows a linear program schematically: In this case the "Main1" program cycle OB contains the complete user program.



Structured programming

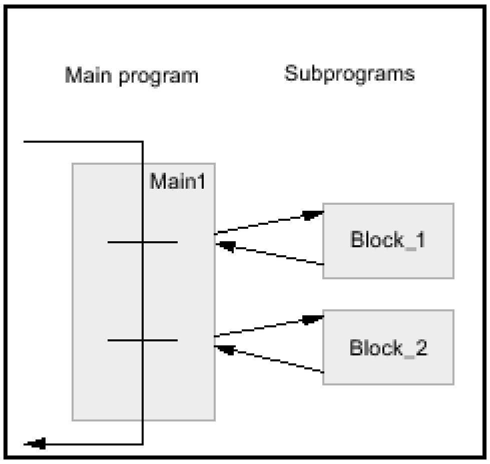
Complex automation tasks can be more easily handled and managed by dividing them into smaller sub-tasks that correspond to the technological functions of the process or that can be reused. These sub-tasks are represented in the user program by corresponding program sections, known as blocks. Each block is then an independent section of the user program.

Structuring the program offers the following advantages:

- Extensive programs are easier to understand.
- Individual program sections can be standardized.
- Program organization is simplified.
- Changes to the program can be made more easily.

- Debugging is simplified since separate sections can be tested.
- Commissioning is simplified.

The following figure shows a structured program schematically: The "Main1" program cycle OB calls subprograms one after the other that execute defined subtasks.



7.2.1.2 Block types

7.2.1.2 Overview of the block types

Block types

Different BLOCK types are available to perform tasks within an automation system. The following table shows the available block types:

Block type	Brief description
Organization blocks (Page 337) (OB)	Organization blocks define the structure of the user program.
Functions (Page 346) (FC)	Functions contain program routines for recurring tasks. They have no "memory".
Function blocks (Page 346) (FB)	Function blocks are code blocks that store their values permanently in instance data blocks, so that they remain available even after the block has been executed.
Instance data blocks (Page 347)	Instance data blocks are assigned to a function block when it is is called for the purpose of storing program data.
Global data blocks (Page 347)	Global data blocks are data areas for storing data that can be used by any blocks.

7.2.1.2 Organization blocks

7.2.1.2 Basics of organization blocks

Definition

Organization blocks (OBs) form the interface between the operating system and the user program. They are called by the operating system and control the following operations:

- Startup behavior of the automation system
- Cyclic program execution
- Interrupt-driven program execution
- Error handling

You can program the organization blocks and at the same time determine the behavior of the CPU.

Use of organization blocks

Various options are available for using organization blocks in your program:

- Startup OB, program cycle OB, time error interrupt OB and diagnostics OB:

  It is easy to insert and program these organization blocks in your project. You do not have to assign parameters or call these organization blocks.
- Hardware interrupt OBs and cyclic interrupt OBs:

  After these organization blocks have been inserted into your program, you need to make parameter settings for them. Hardware interrupt OBs can also be attached to an event at run time using the ATTACH instruction or detached again using DETACH.
- Time-delay interrupt OB:

  You can insert and program the time delay interrupt OB in your project. You must call it using the SRT_DINT instruction. No parameter assignment is necessary.

Start information of organization blocks

At the start of many organization blocks the operating system outputs information that can be evaluated in the user program. The descriptions of the organization blocks contain information on whether information is output and on which information is output.

See also

Basics of program execution (Page 323)
Organization blocks for startup (Page 338)
Organization blocks for cyclic program execution (Page 338)
Organization blocks for interrupt-driven program execution (Page 340)
Organization block for time error (Page 345)

7.2.1.2 Organization blocks for startup

Description

You can determine the boundary conditions for the startup behavior of your CPU, for example the initialization values for "RUN". To do this, write a startup program. The startup program consists of one or more startup OBs (OB numbers 100 or >= 200).

The startup program is executed once during the transition from "STOP" mode to "RUN" mode. Current values from the process image of the inputs are not available for startup program, nor can these values be set.

After the complete execution of the startup OBs, the process image of the inputs is read in and the cyclic program is started.

There is no time limit for executing the startup program. Therefore the maximum cycle time is not active. Time-driven or interrupt-driven organization blocks cannot be used.

Start information

A startup OB has the following start information:

Tag	Data type	Description
LostRetentive	BOOL	= 1, if retentive data storage areas have been lost
LostRTC	BOOL	= 1, if realtime clock has been lost

See also

"STARTUP" operating mode (Page 313)
Basics of organization blocks (Page 337)
Events and OBs (Page 323)

7.2.1.2 Organization blocks for cyclic program execution

Introduction

For the program execution to start, at least one program cycle OB must be present in the project. The operating system calls this program cycle OB once in each cycle and thereby starts the execution of the user program. You can use multiple OBs (OB numbers >= 200).

The program cycle OBs have the priority class 1. This corresponds to the lowest priority of all OBs. The cyclic program can be interrupted by events of any other event class.

Programming cyclic program execution

You program cyclic program execution by writing your user program in the cycle OBs and the blocks that they call.

The first cyclic program execution begins as soon as the startup program has ended without errors. The cycle restarts after the end of each cyclic program execution.

Sequence of cyclic program execution

One cycle of the program execution encompasses the following steps:

1. The operating system starts the maximum cycle time.
2. The operating system writes the values from the process image output to the output modules.
3. The operating system reads out the state of the inputs of the input modules and updates the process image input.
4. The operating system processes the user program and executes the operations contained in the program.
5. At the end of a cycle, the operating system executes any tasks that are pending, for example, loading and deleting blocks, or calling other cycle OBs.
6. Finally, the CPU returns to the start of the cycle and restarts the watchdog.

See also: process image input/output (Page 320)

Options for interrupting

Cyclic program execution can be interrupted by the following events:

- An interrupt
- A STOP command, triggered by
  - Operation of the programming device
  - "STP" instruction
- Supply voltage failure
- Occurrence of a device fault or program error

Start information

Cycle OBs have no start information.

See also

Basics of organization blocks (Page 337)
Events and OBs (Page 323)

7.2.1.2 Organization blocks for interrupt-driven program execution

7.2.1.2 Information regarding interrupt-driven program execution

Function

The processing of the cyclic organization blocks can be interrupted by start events of other organization blocks. These interrupting organization blocks can, for example, be interrupt OBs or the time error interrupt OB.

Interrupt OBs are called in the following two cases:

- Parts of the user program should be executed periodically.
- The user program should react to external signals from the process.

In the event of an interrupt, the operating system will ensure that the corresponding interrupt OB is called. You program how the automation system will react to the interrupt in the interrupt OB.

Interrupt OBs can only be interrupted by interrupt OBs with a higher priority and not by interrupt OBs with the same or lower priority.

Interrupt types and applications

The following table shows the interrupt types and examples of the use of interrupt OBs:

Interrupt type	Interrupt OBs	Number of OBs	Application examples
Time delay interrupt (Page 340)	> = 200	< = 4	Controlling a fan, which should run for 20 s after a motor is switched off, and then be switched off.
Cyclic interrupt (Page 342)	> = 200		Scanning a signal level for a closed-loop control system.
Hardware interrupt (Page 343)	> = 200	< = 50	Reporting that the maximum level of a tank has been reached.

Interrupt OBs have no start information.

7.2.1.2 Organization blocks for the time-delay interrupt

Description

A time-delay interrupt OB is started after a configurable time delay of the operating system. The delay time starts after the SRT_DINT instruction is called.

You can use up to four time-delay interrupt OBs or cyclic OBs (OB numbers >= 200) in your program. If, for example, you are already using two cyclic interrupt OBs, you can insert a maximum of two further time-delay interrupt OBs in your program.

You can use the CAN_DINT instruction to prevent the execution of a time-delay interrupt that has not yet started.

Function of time-delay interrupt OBs

The operating system starts the corresponding OB after the delay time, which you have transferred with an OB number and an identifier to the SRT_DINT instruction.

To use a time-delay interrupt OB, you must execute the following tasks:

- You must call the instruction SRT_DINT.
- You must download the time-delay interrupt OB to the CPU as part of your program.

The delay time is measured with a precision of 1 ms. A delay time can immediately start again after it expires.

Time delay interrupt OBs are executed only when the CPU is in the "RUN" mode. A warm restart clears all start events of time-delay interrupt OBs.

The operating system calls the time-delay interrupt OB if one of the following events occurs:

- If the operating system attempts to start an OB that is not loaded and you specified its number when calling the SRT_DINT instruction.
- If the next start event for a time-delay interrupt occurs before the time delay OB has completely executed.

You can disable and re-enable time-delay interrupts using the DIS_AIRT and EN_AIRT instructions.

Note

If you disable an interrupt with DIS_AIRT after executing SRT_DINT, this interrupt executes only after it has been enabled with EN_AIRT. The delay time is extended accordingly.

Start information

Time delay interrupt OBs have no start information.

See also

SRT_DINT (Page 994)
CAN_DINT (Page 995)
Basics of organization blocks (Page 337)
Events and OBs (Page 323)

7.2.1.2 Organization blocks for cyclic interrupts

Description

Cyclic interrupt OBs serve to start program in periodic time intervals independently of the cyclic program execution. The start times of a cyclic interrupt OB are specified using the time base and the phase offset.

The time base defines the intervals at which the cyclic interrupt OB is started and is a whole multiple of the basic clock cycle of 1 ms. The phase offset is the time by which the start time is offset compared with the basic clock cycle. If several cyclic interrupt OBs are being used, you can use this offset to prevent a simultaneous start time if the time bases of the cyclic interrupt OBs have common multiples.

You can specify a time period between 1 ms and 60000 ms.

You can use up to four cyclic interrupt OBs or time-delay OBs (OB numbers >= 200) in your program. If, for example, you are already using two time-delay interrupt OBs, you can insert a maximum of two further cyclic interrupt OBs in your program.

Note

The execution time of each cyclic interrupt OB must be noticeably smaller than its time base. If a cyclic interrupt OB has not been completely executed but execution is again pending because the cycle clock has expired, the time error interrupt OB is started. The cyclic interrupt that caused the error is executed later or discarded.

Example of the use of phase offset

You have inserted two cyclic interrupt OBs in your program:

- Cyclic interrupt OB1
- Cyclic interrupt OB2

For cyclic interrupt OB1, you have set a time base of 20 ms and for cyclic interrupt OB2 a time base of 100 ms. After the expiry of the time base of 100 ms, the cyclic interrupt OB1 reaches the start time for the fifth time, cyclic interrupt OB2 for the first time. To nevertheless execute the cyclic interrupt OBs offset, enter a phase offset for one of the two cyclic interrupt OBs.

Start information

Cyclic interrupt OBs have no start information.

See also

Basics of organization blocks (Page 337)
Assigning parameters to cyclic interrupt OBs (Page 418)
Events and OBs (Page 323)

7.2.1.2 Organization blocks for hardware interrupts

Description

You can use hardware interrupt OBs to react to specific events. You can assign an event that triggers an alarm to precisely one hardware interrupt OB. A hardware interrupt OB in contrast can be assigned to several events.

Hardware interrupts can be triggered by high-speed counters and input channels. For each high-speed counter and input channel that should trigger a hardware interrupt, the following properties need to be configured:

- The process event that should trigger the hardware interrupt (for example, the change of a count direction of a high-speed counter)
- The number of the hardware interrupt OB which is assigned to this process event

You can use up to 50 hardware interrupt OBs (OB numbers >= 200) that are independent of each other in your program.

Function of a hardware interrupt OB

After triggering a hardware interrupt, the operating system identifies the channel of the input or the high-speed counter and determines the assigned hardware interrupt OB.

If no other interrupt OB is active, the determined hardware interrupt OB is called. If a different interrupt OB is already being executed, the hardware interrupt is placed in the queue of its priority class. The hardware interrupt is acknowledged after the completion of the assigned hardware interrupt OB.

If another event that triggers a hardware interrupt occurs on the same module during the time between identification and acknowledgement of a hardware interrupt, the following applies:

- If the event occurs on the channel that previously triggered the hardware interrupt, then no additional hardware interrupt is triggered. Another hardware interrupt can only be triggered if the current hardware interrupt is acknowledged.
- If the event occurs on a different channel, a hardware interrupt is triggered.

Hardware interrupt OBs are called only in the CPU's "RUN" mode.

Start information

Hardware interrupt OBs have no start information.

See also

Basics of organization blocks (Page 337)
Assigning parameters to hardware interrupt OBs (Page 417)
Events and OBs (Page 323)

7.2.1.2 Organization block for diagnostic error interrupts

Description

You can enable the diagnostic error interrupt for diagnostics-capable modules so that the module detects changes in the I/O status. As a result, the module triggers a diagnostic error interrupt in the following cases:

- A fault is present (incoming event)
- A fault is no longer present (outgoing event)

If no other interrupt OB is active, the diagnostic error interrupt OB is called. If another interrupt OB is already being executed, the diagnostic error interrupt is placed in the queue of its priority group.

You can use only one diagnostic error interrupt OB in your program.

Start information

The diagnostic error interrupt OB has the following start information:

Tag	Data type	Description
IO_state	WORD	Contains the I/O status of the diagnostics-capable module.
laddr	HW_ANY	HW-ID
Channel	UINT	Channel number
multi_error	BOOL	= 1, if there is more than one error

IO_state tag

The following table shows the possible I/O states that the IO_state tag can contain:

IO_state	Description
Bit 0	Configuration correct: = 1, if the configuration is correct = 0, if the configuration is no longer correct
Bit 4	Error: = 1, if an error is present, e.g., a wire break = 0, if the error is no longer present
Bit 5	Configuration not correct: = 1, if the configuration is not correct = 0, if the configuration is correct again

IO_state	Description
Bit 6	I/O cannot be accessed: = 1, if an I/O access error has occurred In this case, laddr contains the hardware identifier of the I/O with the access error. = 0, if the I/O can be accessed again

See also

Basics of organization blocks (Page 337)
Events and OBs (Page 323)

7.2.1.2 Organization block for time error

Description

The operating system calls the time error interrupt OB if one of the following events occurs:

- The cyclic program exceeds the maximum cycle time.
- The called OB is currently being executed (possible for time-delay interrupt OBs and cyclic interrupt OBs).
- An overflow has occurred in an interrupt OB queue.
- An interrupt was lost due to the excessive interrupt load.

If you have not programmed a time error interrupt OB, the appropriate system reactions are executed.

See also: Events and OBs (Page 323)

The twice repeated violation of the maximum cycle time is a serious error and does not result in the calling of an OB. Instead, the CPU goes to STOP. You can avoid the second violation by restarting the cycle monitoring of the CPU with the RE_TRIGR instruction.

You can use only one time error interrupt OB in your program.

Start information

The time error interrupt OB has the following start information:

Tag	Data type	Description
fault_id	BYTE	0x01: Maximum cycle time exceeded 0x02: Called OB is still being executed 0x07: Queue overflow 0x09: Interrupt loss due to excessive interrupt load
csg_OBnr	OB_ANY	Number of the OB being executed at the time of the error
csg_prio	UINT	Priority of the OB being executed at the time of the error

See also

Basics of organization blocks (Page 337)

7.2.1.2 Functions

Definition

Functions (FCs) are code blocks without memory. After the function has been executed, the data in the temporary tags is therefore lost. Functions can use global data blocks to store data permanently.

Application

A function contains a program that is executed when the function is called by another code block. Functions can be used, for example, for the following purposes:

- To return function values to the calling block, e.g. for mathematical functions
- To execute technological functions, e.g. individual controls using bit logic operations

A function can also be called several times at different points in a program. As a result, they simplify programming of frequently recurring complex functions.

See also

Creating functions and function blocks (Page 407)

7.2.1.2 Function blocks

Definition

Function blocks are code blocks that store their values permanently in instance data blocks, so that they remain available even after the block has been executed. They save their input, output and in/out parameters permanently in the instance data blocks. Consequently, the parameters are still available after the block execution. Therefore they are also referred to as blocks "with memory".

Application

Function blocks contain subroutines that are always executed when a function block is called by another code block. A function block can also be called several times at different points in a program. As a result, they simplify programming of frequently recurring complex functions.

Instances of function blocks

A call of a function block is referred to as an instance.

Each instance of a function block is assigned an instance data block, which contains the data that the function block uses.

Note

To avoid errors when working with function blocks, refer to the section "Parameter transfer at block call (Page 353) "

See also

Call of a function by another function (Page 355)
Creating functions and function blocks (Page 407)
Multi-instances (Page 351)
Instance data blocks (Page 347)

7.2.1.2 Instance data blocks

Definition

The call of a function block is referred to as an instance. An instance data block is assigned to every function block call that transfers parameters. This instance data block serves as a data memory. The actual parameters and the static data of the function block are stored in it.

The maximum size of instance data blocks varies depending on the CPU. The tags declared in the function block determine the structure of the instance data block.

See also: Call function blocks as single or multi-instances (Page 351)

See also

Creating data blocks (Page 0)
Insert block calls in LAD (Page 0)
Inserting block calls in FBD (Page 0)

7.2.1.2 Global data blocks

Definition

Data blocks, in contrast to code blocks, contain no instructions, but serve only to store user data. Data blocks thus contain variable data to be used by the user program. Global data blocks store data that can be used by all other blocks.

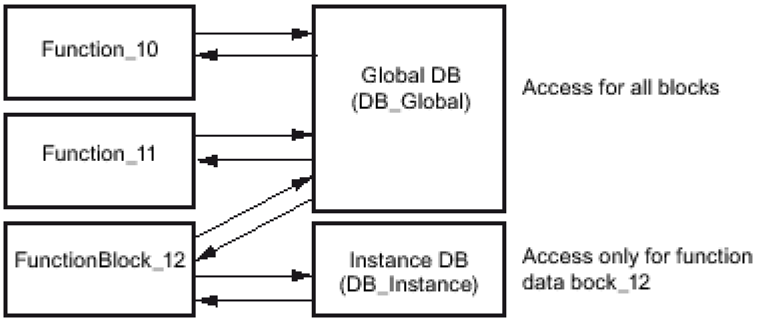
The maximum size of data blocks varies depending on the CPU. You can define the structure of global data blocks anyway you please.

Global data blocks in the user program

If a code block is called it can open a memory area in the form of a data block. The data contained in a data block is not deleted when the data block is closed or the execution of the corresponding code block comes to an end.

Every function block, function, or organization block can read the data from a global data block or can itself write data to a global data block. This data remains in the data block even after the data block is exited. A global data block and an instance data block can be open at the same time.

The following figure shows the different accesses to data blocks:



See also

Creating data blocks (Page 0)

7.2.1.3 Block calls

7.2.1.3 Principles of block calls

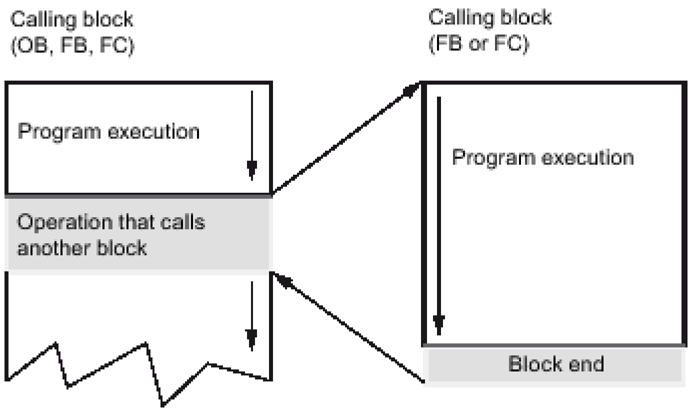
Function of block calls

For your blocks to be executed in the user program, they need to be called from another block.

When one block calls another block, the operations of the called block are executed. Only when execution of the called block has been completed does execution of the calling block resume. The execution is continued with the operation that follows on the block call.

When a block is called, you must assign values to the parameters in the block interface. By providing input parameters you specify the data with which the block is executed. By providing the output parameters you specify where the execution results are saved.

The following figure shows the sequence of a block call within a user program:



See also

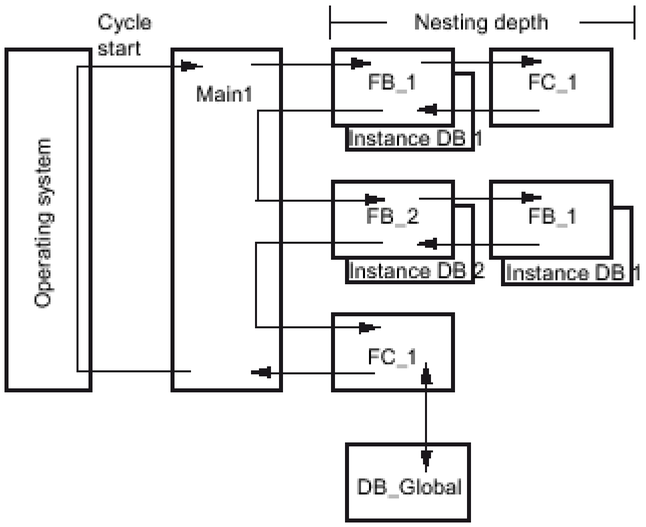
Call hierarchy (Page 349)
Basics of single instances and multi-instances (Page 350)
Parameter transfer at block call (Page 353)

7.2.1.3 Call hierarchy

Definition

The order and nesting of block calls is referred to as the call hierarchy. The permissible nesting depth depends on the CPU.

The following figure shows an example of the order and nesting of block calls within an execution cycle:



See also

Basics of single instances and multi-instances (Page 350)
Principles of block calls (Page 348)

7.2.1.3 Call function blocks as single or multi-instances

7.2.1.3 Basics of single instances and multi-instances

Use of single instances and multi-instances

Function blocks (FBs) store their data in instance data blocks. When you program the call of a function block, assign an instance data block to the function block. The values of the block parameters and the static local data are stored in the assigned instance data block

You can assign instance data blocks as follows:

- Calling as a single instance:

  One instance data block for each instance of a function block
- Calling as a multi-instance:
  - One instance data block for several instances of a function block
  - One instance data block for several instances of different function blocks

See also

Principles of block calls (Page 348)
Accessing the data of a multi-instance (Page 0)
Multi-instances (Page 351)
Single instances (Page 350)
Call hierarchy (Page 349)

7.2.1.3 Single instances

Definition

The call of a function block, which is assigned its own instance data block, is called a single instance data block.

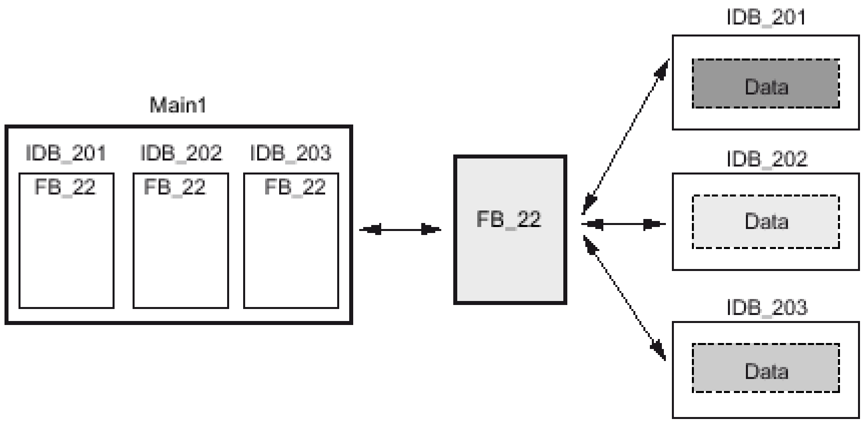
By assigning the instance data block, you specify which data are to be processed. You can assign a different instance data block for each call, thus increasing reusability of the block.

Example of a single instance

You can control several motors using one function block. For this purpose, you assign a different instance data block for each function block call for motor control.

The different data for the various motors, such as speed, ramp-up time, total operating time, are saved in the different instance data blocks. A different motor will be controlled, depending on the instance data block assigned.

The following figure shows the control of three motors using one function block and three different data blocks:



See also

Basics of single instances and multi-instances (Page 350)
Multi-instances (Page 351)
Accessing the data of a multi-instance (Page 0)

7.2.1.3 Multi-instances

If the performance data of your S7-CPU limits the number of available instance data blocks, you can use multi-instances.

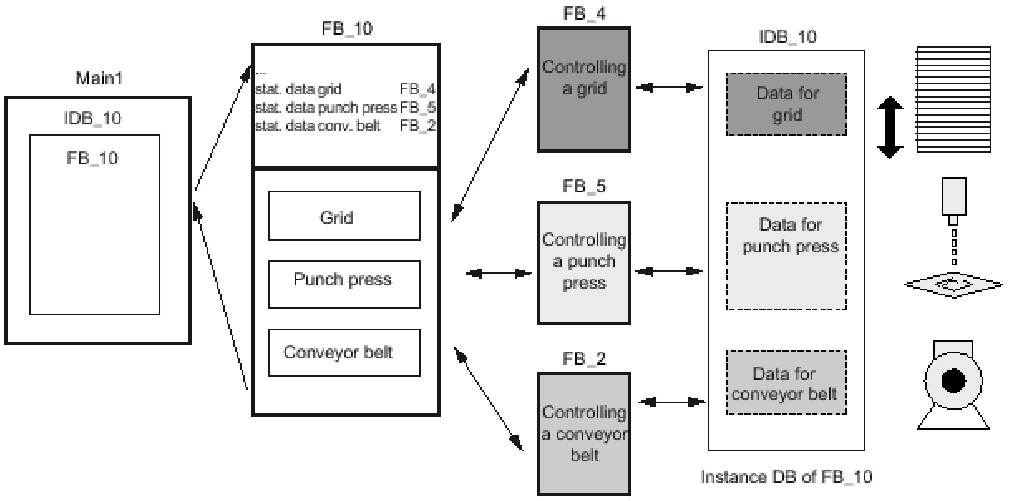
Definition

Multi-instances enable a called function block to store its data in the instance data block of the calling function block.

This allows you to concentrate the instance data in one instance data block and thus make better use of the number of instance data blocks available.

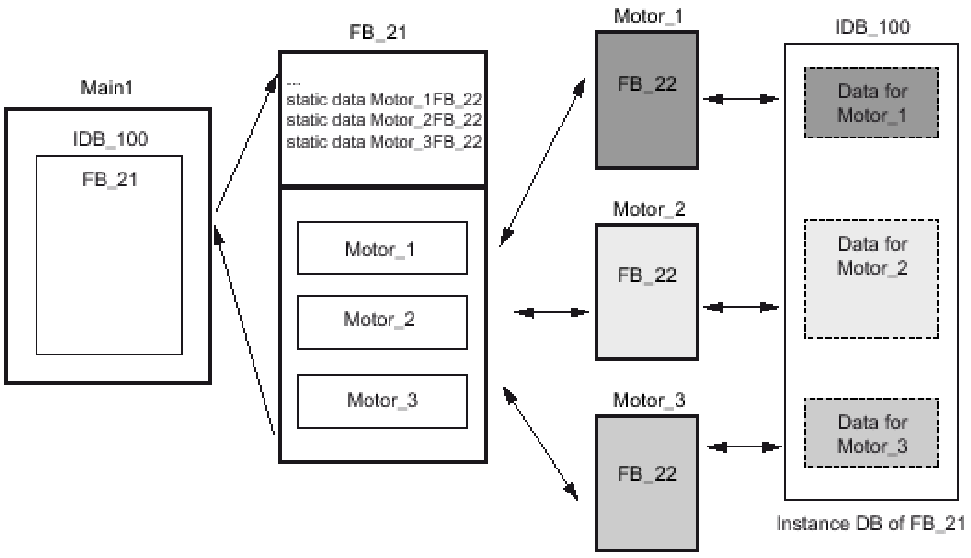
One instance data block for the instances of different function blocks

The following figure shows how multiple different function blocks store their data in a calling block. FB 10 consecutively calls FB 4, FB 5, and FB 2. The called blocks store their data in DB 10, the data block of the calling block.



One instance data block for multi-instances of a function block

The following figure shows how a function block that is called in multi-instances stores the data for all the instances in one instance data block.



The function block FB 21 calls three instances of FB 22. The instances are "Motor_1", "Motor_2", and "Motor_3". Each call uses different instance data. However, all instance data are located in a single instance data block, DB 100.

Notice

Do not use multi-instance data blocks if online changes can be expected while the CPU is running. A bumpless reloading can only be ensured if you use instance data blocks.

See also

Instance data blocks (Page 347)
Basics of single instances and multi-instances (Page 350)
Single instances (Page 350)
Accessing the data of a multi-instance (Page 0)

7.2.1.3 Parameter transfer at block call

7.2.1.3 Parameter transfer

Principle of parameter transfer

When you call functions or function blocks, data exchange takes place between the calling and the called block. The interface of the called block contains parameters used for executing the block. These parameters are referred to as formal parameters. They are merely placeholders for the parameters that are transferred to the block when it is called. The parameters transferred to the block when it is called are referred to as actual parameters.

Warning

When programming the called block, ensure that a parameter declared as an output parameter is also written to. Otherwise the values output are random!

7.2.1.3 Parameter assignment of functions

Assignment of function parameters

Functions (FCs) have no data memory in which values of block parameters can be saved. Therefore, when a function is called, all formal parameters must be assigned actual parameters.

Unassigned output parameters

If an output parameter of a function was not assigned a value, the value that was returned to the called block can be random.

Unassigned in/out parameters

For the in/out parameters of a function, the output values cannot be random, since here the old output value or the input value will be retained if the parameter is not written. Nevertheless, the above information should be noted, to ensure that the old values are not processed inadvertently.

Recommendations

Note the following rules when assigning parameters:

- Make sure that the output parameters are always written - independent of all possible program paths within the block. Pay special attention here to the call statements.
- Note that the set and reset commands are dependent on the result of logic operation. If the value of an output parameters is determined with these commands and RLO = 0, a value will not be generated.

7.2.1.3 Parameter assignment of function blocks

Assignment of function block parameters

The parameter values for function blocks (FBs) are saved in the instance data block.

Unassigned input, output, and in/out parameters

If the input, output, or in/out parameters of a function block were not assigned with values, the values stored in the instance data block will be used.

Contrary to functions (FCs), no random values can be used. However, there is the danger that the old values will inadvertently continue to be processed. Therefore we recommend that all block parameters be assigned.

In some cases, you must assign parameters.

The following table shows which parameters of a function block must be assigned actual parameters:

Parameter	Elementary data type	Complex data type	Parameter type
Input	optional	optional	required
Output	optional	optional	required
InOut	optional	required	required

Assigning initial values to formal parameters

You can assign initial values to the formal parameters in the function block interface. These values are transferred to the associated instance data block.

If you do not assign actual parameters to the formal parameters in the call instruction, the values currently stored in the instance data block will be used.

The following table shows which tags can be assigned an initial value:

Tags	Elementary data type	Complex data type	Parameter type
Input	optional	optional	not possible

Tags	Elementary data type	Complex data type	Parameter type
Output	optional	optional	not possible
InOut	optional	not possible	not possible
Static	optional	optional	not possible
Temporary	not possible	not possible	not possible

7.2.1.3 Permitted data types for parameter transfer

7.2.1.3 Rules

Rules for parameter transfer between blocks

Either a tag or a constant can be specified as an actual parameter. However certain restrictions apply. For example, output and in/out parameters cannot be assigned a constant value, because the purpose of an output and an in/out is to accept a variable value, for example, the result of a calculation.

Rules for supplying block parameters with values

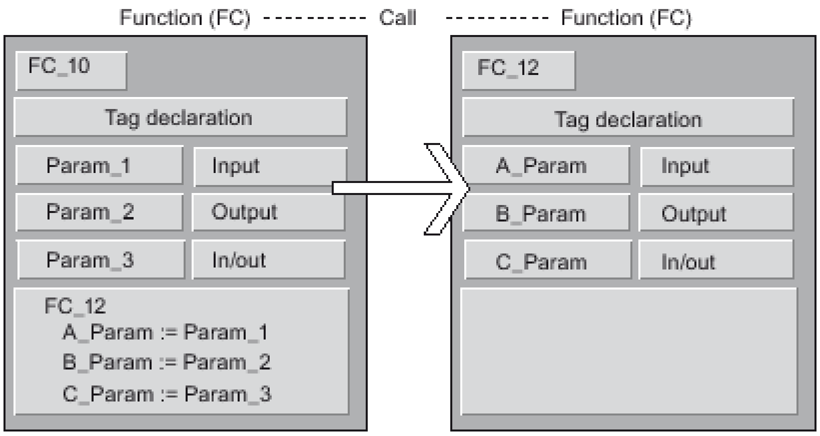
The following table shows data types that you can assign to block parameters:

Declaration type	PLC tag	Tag in the block interface	Constant
Input	Elementary data types Complex data types	Elementary data types Complex data types	Elementary data types
Output	Elementary data types Complex data types	Elementary data types Complex data types	-
InOut	Elementary data types Complex data types	Elementary data types Complex data types	-

7.2.1.3 Call of a function by another function

Permissible data types for the call of a function by another function

You can assign the formal parameters of the calling function to the formal parameters of the called function. The following figure shows the formal parameters of function FC 10 that are assigned as actual parameters to the formal parameters of function FC 12:



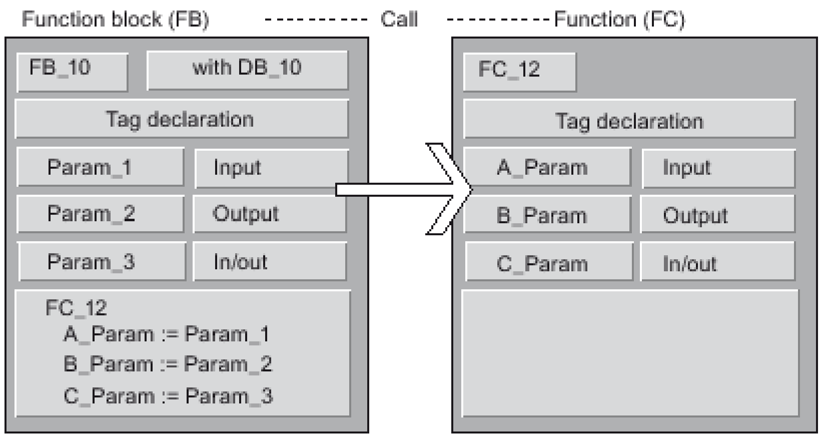
The assignment of formal parameters of a function to the formal parameters of another function is restricted. The following table shows the permissible data types when a function calls another function:

FC → FC	Input	InOut	Output
Input	Elementary data types Complex data types	-	-
InOut	Elementary data types Complex data types	Elementary data types Complex data types	Elementary data types Complex data types
Output	-	-	Elementary data types Complex data types

7.2.1.3 Call of a function by a function block

Permissible data types for the call of a function by a function block

You can assign the formal parameters of the calling function block to the formal parameters of the called function. The following figure shows the formal parameters of function block FB 10 that are assigned as actual parameters to the formal parameters of function FC 12:



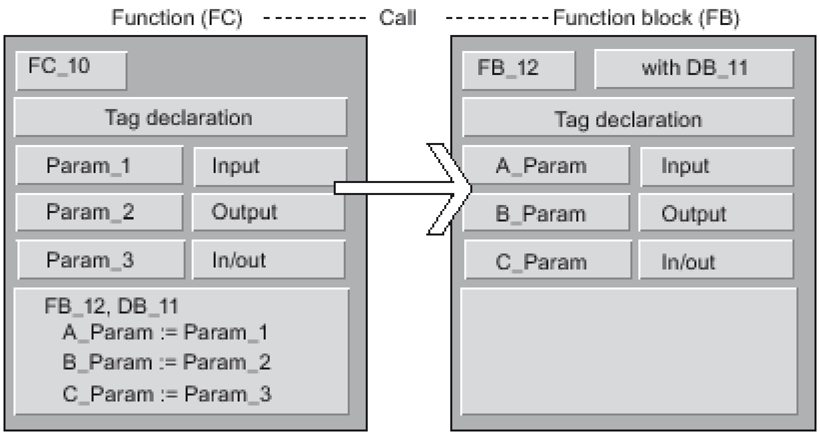
The assignment of the formal parameters of a function block to the formal parameters of a function is restricted. For example, you cannot assign parameters with parameter type as actual parameters. The following table shows the permissible data types when a function block calls a function:

FB → FC	Input	InOut	Output
Input	Elementary data types Complex data types	-	-
InOut	Elementary data types Complex data types	Elementary data types Complex data types	Elementary data types Complex data types
Output	-	-	Elementary data types Complex data types

7.2.1.3 Calling a function block by a function

Permissible data types for the call of a function block by a function

You can assign the formal parameters of the calling function to the formal parameters of the called function block. The following figure shows the formal parameters of function FC 10 that are assigned as actual parameters to the formal parameters of function block FB 12:



The assignment of formal parameters of a function to the formal parameters of a function block is restricted. For example, you cannot assign parameters with complex data type as actual parameters.

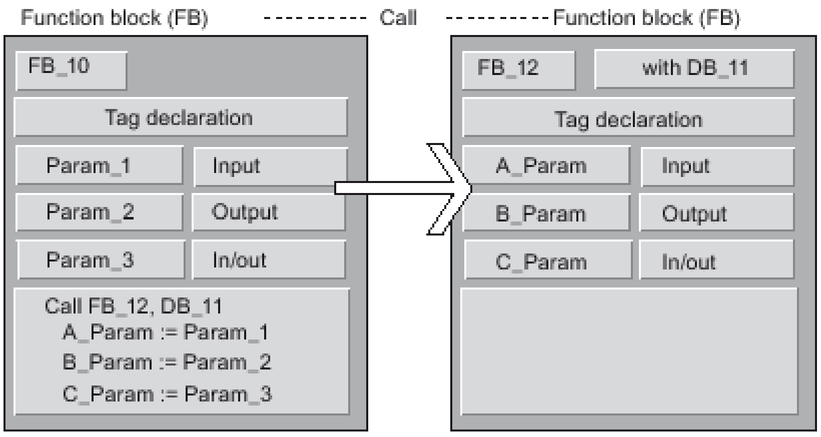
The following table shows the permissible data types when a function calls a function block:

FC → FB	Input	InOut	Output
Input	Elementary data types Complex data types	-	-
InOut	Elementary data types Complex data types	Elementary data types Complex data types	Elementary data types Complex data types
Output	-	-	Elementary data types Complex data types

7.2.1.3 Calling a function block by another function block

Permissible data types for the call of a function block by another function block

You can assign the formal parameters of the calling function block to the formal parameters of the called function block. The following figure shows the formal parameters of function block FB 10 that are assigned as actual parameters to the formal parameters of function block FB 12:



The assignment of formal parameters of a function block to the formal parameters of another function block is restricted. For example, you cannot assign input or output parameters with complex data type as actual parameters to the input or output parameters of a called function block.

The following table shows the permissible data types when a function block calls another function block:

FB → FB	Input	InOut	Output
Input	Elementary data types Complex data types	-	-
InOut	Elementary data types Complex data types	Elementary data types Complex data types	Elementary data types Complex data types
Output	-	-	Elementary data types Complex data types

7.2.1.4 EN/ENO mechanism

7.2.1.4 Basics of the EN/ENO mechanism

Description

Some operations can create runtime errors that would require a program abort. To prevent such program aborts, the affected operations have one enable input (EN) and one enable output (ENO). With this EN/ENO mechanism you can query and react to runtime errors in blocks or operations. A CPU internal status word serves for the transfer of the execution results. If the operation is completed without error, the enable out ENO is set. If an error has occurred, the values of the EN and ENO differ.

- ENO <> EN (error in the box)

  A runtime error has occurred.
- ENO = EN (error in the box = 0)

  No runtime error has occurred.

Use

The EN/ENO mechanism is used for the following operations:

- Math operations
- Transfer and conversion operations
- Shift and rotate operations
- Word logic instructions

The EN/ENO mechanism is not used for the following operations:

- Bit logic operations
- Comparators
- Counters
- Timers
- Program control

These operations cannot create runtime errors that would require a program abort. Therefore, the EN/ENO mechanism is not needed in this case.

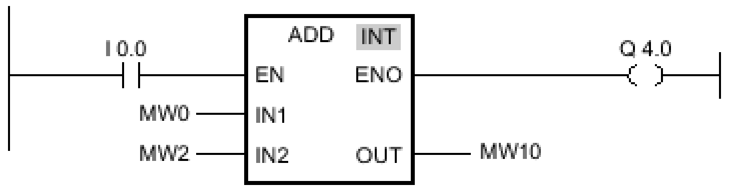
See also

Example of the use of the EN/ENO mechanism (Page 360)

7.2.1.4 Example of the use of the EN/ENO mechanism

Description

The following figure shows an ADD instruction with EN and ENO protective circuit:



After the normally open contact, the RLO contains the previous result of logic operation:

- If the RLO is "0" the addition is not executed. EN and ENO both lead to the signal state "0".
- If the RLO is "1", EN is also "1" and the addition is executed. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

ADD: Add (Page 717)

7.2.1.5 Symbolic programming

7.2.1.5 Symbolic programming

Symbolic programming

When programming you work with operands and tags such as inputs, outputs and bit memories. The CPU identifies these operands based on a numerical, absolute address. This absolute address consists of an operand ID and an address (such as Q 4.0, I 1.1, M 2.0).

However, to make the program layout clearer and to simplify trouble-shooting, you should use symbolic names for the operands and tags in the programming.

You specify the symbolic names:

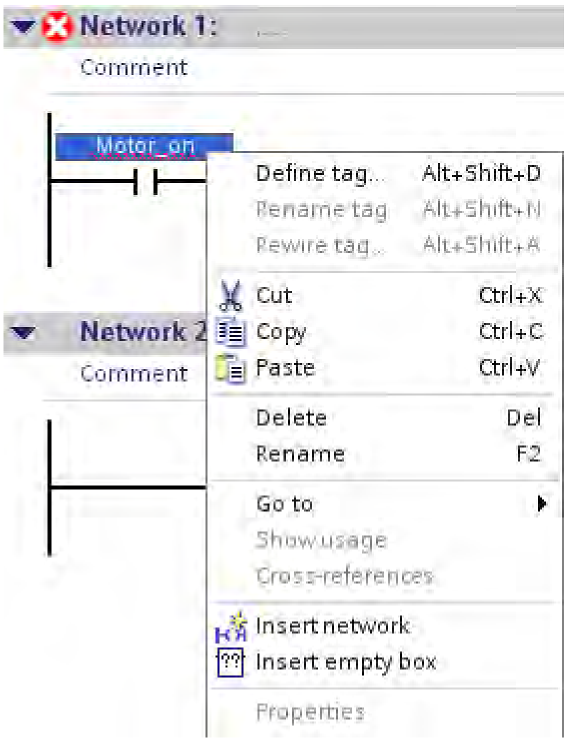
- Define symbolic names for global tags in the PLC tag table.
- In the block interface, specify symbolic names for local tags in code blocks or in global data blocks.

You can, for example, assign the symbolic name "Motor_on" to an input signal I 1.0.

Support during programming

When programming you can start out working with symbolic operands and then assign the absolute addresses later. The program can still be saved, even though the assignment is incomplete.

An operand to which no absolute address has yet been assigned is highlighted by a red wavy underline. To assign an absolute address, select the operands and click "Define tag" in the shortcut menu.



See also

PLC tags and local tags (Page 365)
Displaying symbolic and absolute addresses (Page 362)
Symbolic addressing of blocks only (Page 363)
Activating symbolic addressing for new blocks only (Page 364)

7.2.1.5 Displaying symbolic and absolute addresses

You have the following options for displaying operands in the program editor:

- Symbolic representation

  The symbolic operands are displayed in the program. The corresponding absolute addresses are shown in tooltips if you hold the mouse pointer over the operand.

- Absolute representation

  The absolute addresses are displayed in the program. The corresponding symbolic operands are displayed in tooltips.

- Symbolic and absolute representation

  Symbolic operands and absolute addresses are displayed in program.

Requirement

The program editor is open.

Procedure

To change the representation of the operands, follow these steps:

1. Click the "Absolute operands on/off" button in the program editor toolbar.

   Each time you click the button, the representation and the symbol on the button change.

Or:

1. Click the small arrow next to the "Absolute operands on/off" button in the program editor toolbar.

   A drop-down list is displayed.
2. Select the required representation from the drop-down list.

   The symbol on the button changes.

See also

Symbolic programming (Page 361)
PLC tags and local tags (Page 365)

7.2.1.5 Symbolic addressing of blocks only

7.2.1.5 Symbolic addressing of blocks only

Symbolic declaration and addressing of tags

Tags within a block can be declared in two different ways:

- Symbolic declaration

  The declaration contains only one symbolic name, no fixed addressing within the block. The absolute address of the tag is transmitted dynamically during compilation and not displayed in the block interface. The tags are saved in the available memory area in such a way as make optimal use of this area's capacity. You can address symbolically declared tags only in symbolic form. For example, you access the "Fill Level" tag in the "Data" DB as follows:

  "Data".Fill Level
- Symbolic and absolute declaration

  The declaration contains only one symbolic name and a fixed absolute address within the block. The address is display, for example, in the "Offset" column of the block interface.

  You can address these tags in a symbolic or absolute manner. For example, you access the "Fill Level" tag in the "Data" DB as follows:

  "Data".Fill Level or *%DB1.DBX0.0*

Advantages of purely symbolic declaration

The purely symbolic declaration of tags offers the following advantages:

- The data are structured and aligned in a way that is optimal for the CPU used. This allows you to increase the performance of the CPU.

- You can define specific individual tags as retentive. In the case of absolute declaration, the retentivity settings apply for all the block's tags.

Symbolically addressed blocks and non-symbolically addressed blocks in one program

Within one program you can randomly combine the two types of blocks.

See also

Activating symbolic addressing for new blocks only (Page 364)
Symbolic programming (Page 361)
Retentive memory areas (Page 319)

7.2.1.5 Activating symbolic addressing for new blocks only

Introduction

You can set the symbolic access of the tags centrally for all code blocks and global data blocks that are newly created in the program. All newly created blocks are then created with this default. This setting has no effect on instance data blocks, as they take over the access from higher-level code blocks. This setting also has no effect on existing or migrated blocks.

Through the setting of the symbolic access, a block's tags can be declared purely symbolically, without information on an absolute address. Furthermore, the symbolic access allows you to set the retentive behavior of the individual tags in the block.

Procedure

To set the symbolic access for all new blocks in the program, proceed as follows:

1. Select the "Settings" command in the "Options" menu.

   The "Settings" window is displayed in the work area.
2. In the area navigation, select the "PLC Programming" group.
3. Select the "Symbolic access only" check box in the "Default settings for new blocks" group.

Result

The symbolic access is activated for all new blocks in the program. The retentive behavior can be set specifically for the individual tags of a block.

See also

Symbolic addressing of blocks only (Page 363)
Symbolic programming (Page 361)
Retentive memory areas (Page 319)

7.2.1.6 Use of tags

7.2.1.6 Using tags within the program

Definition

A tag defines a data value that is used in the program and whose content varies. A tag consists of an operand (such as M 3.1) and a data type (such as BOOL) and is identified with a symbol (such as BELT_ON).

Use of tags within the program

The use of tags makes your program more flexible. For example, you can assign different values to tags that you have declared in the block interface for each block call. As a result, you can reuse a block you have already programmed for various purposes.

See also

PLC tags and local tags (Page 365)
Reserved key words (Page 366)

7.2.1.6 PLC tags and local tags

PLC tags and local tags

You can define tags with different scopes for your program:

- PLC tags that apply in all areas of the CPU
- Local tags apply only to the block in which they are defined.

The following table shows the difference between PLC tags and local tags:

	PLC tags	Local tags
Scope	• Are valid throughout the entire CPU. • Can be used by all blocks on the CPU. • Have the same meaning in all blocks. • The name is unique within the CPU.	• Are known only in the block in which they were defined. • The same tag name can be used in other blocks for different purposes.
Permissible characters	• Letters, numbers, special characters • Quotation marks are not permitted.	• Letters, numbers, special characters • If special characters are used, tags must be enclosed in quotation marks.

	PLC tags	Local tags
Use	You can define PLC tags for: • I/O signals (I, IB, IW, ID, Q, QB, QW, QD) • Bit memory (M, MB, MW, MD)	You can define local tags for: • Block parameters (input, output and in/out parameters), • Static data of a block • Temporary local data of a block
Location of definition	PLC tag table	Block interface
Representation	PLC tags are shown in quotes. Example: "Anna".	Local tags from the block interface are represented with the prefix #. Example: #Berta.

See also

Symbolic programming (Page 361)
Using tags within the program (Page 365)
Reserved key words (Page 366)
Displaying symbolic and absolute addresses (Page 362)

7.2.1.6 Reserved key words

SIMATIC recognizes a range of key words whose definitions are fixed and which have a certain meaning in the program. You should not use these keywords as names for tags.

If it is necessary to use a key word as the name of a tag, you must first declare it in the PLC tag table or in the block interface. It cannot be entered directly in the program.

Table of reserved key words

The following table shows all the reserved key words.

Keywords German mnemonics	Keywords English mnemonics	Description
A	Q	Output, bit
AB	QB	Output, byte
AD	QD	Output, double word
ANY	ANY	Designation for ANY data type
AR1	AR1	Address Register 1
AR2	AR2	Address Register 2
ARRAY	ARRAY	Introduces the specification of an array and is followed by the index list between "[" and "]"

Keywords German mnemonics	Keywords English mnemonics	Description
AUTHOR	AUTHOR	Name of the author, company name, department name, or other name (max. 8 characters, no spaces)
AW	QW	Output, word
AX	QX	Output, bit
B	B	Byte
BEGIN	BEGIN	Introduces the instruction part for code blocks or initialization part for a data block
BIE	BR	Binary result
BOOL	BOOL	Elementary data type for binary data
BY	BY	Increment of the FOR loop
BYTE	BYTE	Elementary data type
CALL	CALL	Call
CASE	CASE	Introduction to the case instruction
CHAR	CHAR	Elementary data type
CODE_VERSION1	CODE_VERSION1	Label, whether an FB is multi-instance capable or not. If you want to declare multi-instances, the FB must not have this characteristic.
CONST	CONST	Start of the constant declaration
CONTINUE	CONTINUE	Instruction to exit a loop in SCL
DATA_BLOCK	DATA_BLOCK	Introduces the data block
DATE	DATE	Elementary data type for date
DATE_AND_TIME	DATE_AND_TIME	Complex data type for date and time
DB	DB	Data block, bit
DBB	DBB	Data byte
DBD	DBD	Data double word
DBLG	DBLG	Data block length
DBNO	DBNO	Data block number
DBW	DBW	Data word
DBX	DBX	Data bit

Keywords German mnemonics	Keywords English mnemonics	Description
DI	DI	Data block, opened with "DB OPEN"
DIB	DIB	Data byte
DID	DID	Data double word
DILG	DILG	Instance data block length
DINO	DINO	Instance data block number
DINT	DINT	Elementary data type for whole numbers (integers) double precision
DIW	DIW	Data word
DIX	DIX	Data bit
DO	DO	Introduction of the instruction part in FOR and WHILE instruction
DT	DT	Elementary data type for date and time
DWORD	DWORD	Elementary data type for double word
E	I	Input, (via process image), bit
EB	IB	Input, (via process image), byte
ED	ID	Input, (via process image), double word
ELSE	ELSE	Alternative branch in IF and CASE instruction
ELSIF	ELSIF	Alternative condition of the IF instruction
EN	EN	System operand of the EN/ENO mechanism
ENO	ENO	System operand of the EN/ENO mechanism
END_CASE	END_CASE	End of the CASE instruction
END_DATA_BLOCK	END_DATA_BLOCK	Ends the data block
END_FOR	END_FOR	End of the FOR instruction
END_FUNCTION	END_FUNCTION	Ends the function
END_FUNCTION_BLOCK	END_FUNCTION_BLOCK	Ends the function block
END_IF	END_IF	End of the IF instruction
END_ORGANIZATION_BLOCK	END_ORGANIZATION_BLOCK	Ends the organization block

Keywords German mnemonics	Keywords English mnemonics	Description
END_REPEAT	END_REPEAT	End of the REPEAT instruction
END_STRUCT	END_STRUCT	Ends the specification of a structure
END_SYSTEM_FUNCTION	END_SYSTEM_FUNCTION	Ends the system function
END_SYSTEM_FUNCTION_BLOCK	END_SYSTEM_FUNCTION_BLOCK	Ends the system function block
END_TYPE	END_TYPE	Ends the UDT
END_VAR	END_VAR	Ends a declaration block
END_WHILE	END_WHILE	End of the WHILE instruction
EW	IW	Input, (via process image), word
EXIT	EXIT	Instruction to exit a loop in SCL
FALSE	FALSE	Predefined Boolean constant: Logical condition false, value equal to 0
FAMILY	FAMILY	Block family name: for example, closed-loop controller (max. 8 characters, no spaces)
FB	FB	Function block
FC	FC	Function
FOR	FOR	Introduction of the FOR instruction
FUNCTION	FUNCTION	Introduces the function
FUNCTION_BLOCK	FUNCTION_BLOCK	Introduces the function block
GOTO	GOTO	Introduction of the GOTO instruction
IF	IF	Introduction of the IF instruction
INT	INT	Elementary data type for whole numbers (integers) single precision
KNOW_HOW_PROTECT	KNOW_HOW_PROTECT	Block protection; a block compiled with this option permits no view of the instruction part.
L	L	Local data bit
LB	LB	Local data byte
LD	LD	Local data double word
LW	LW	Local data word
M	M	Bit memory, bit

Keywords German mnemonics	Keywords English mnemonics	Description
MB	MB	Bit memory, byte
MD	MD	Bit memory, double word
MOD	MOD	Modulo operator
MW	MW	Bit memory, word
NAME	NAME	Block name (max. 8 characters)
NETWORK	NETWORK	Network
NOT	NOT	Logic inversion
OB	OB	Organization block
OF	OF	Introduction of the data type specification / Introduction of the instruction part of the CASE instruction
OR	OR	Or logical operation logical expressions
ORGANIZATION_ BLOCK	ORGANIZATION_ BLOCK	Introduces the organization block
OS	OS	Save overflow
OV	OV	Overflow
PA	PQ	Output (direct output), bit
PAB	PQB	Output (direct output), byte
PAD	PQD	Output (direct output), double word
PAW	PQW	Output (direct output), word
PE	PI	Input (direct input), bit
PEB	PIB	Input (direct input), byte
PED	PID	Input (direct input), double word
PEW	PIW	Input (direct input), word
POINTER	POINTER	Pointer data type, only permitted in parameter declaration in the parameter block
READ_ONLY	READ_ONLY	Write protection for data blocks; their data can be read, but not changed.
REAL	REAL	Elementary data type
REPEAT	REPEAT	Introduction of the REPEAT instruction

Keywords German mnemonics	Keywords English mnemonics	Description
RET_VAL	RET_VAL	Return value
RETURN	RETURN	RETURN instruction in SCL
S5T	S5T	Syntax for S5 data type
S5TIME	S5TIME	Elementary data type for time information, special S5 format
S7_	S7_	Keywords for system attributes (basic package)
SDB	SDB	System data block
SFB	SFB	System function block
SFC	SFC	System function
STANDARD	STANDARD	
STRING	STRING	Data type for character string
STRUCT	STRUCT	Introduces the specification of a structure and is followed by a list of components
STW	STW	Status word
SYSTEM_FUNCTION	SYSTEM_FUNCTION	System function
SYSTEM_FUNCTION_BLOCK	SYSTEM_FUNCTION_BLOCK	System function block
T	T	Time element (timer)
THEN	THEN	Introduction of the instruction part of an IF instruction
TIME	TIME	Elementary data type for time information
TIME_OF_DAY	TIME_OF_DAY	Elementary data type for time of day
TITLE	TITLE	Optional block title or network title
TO	TO	Definition of the full-scale value of a FOR instruction
TOD	TOD	Elementary data type for time of day
TRUE	TRUE	Predefined Boolean constant: Logical condition true, value not equal to 0
TYPE	TYPE	Introduces UDT
UDT	UDT	Global or PLC data type
UNLINKED	UNLINKED	Marking 'non runtime-related'

Keywords German mnemonics	Keywords English mnemonics	Description
UNTIL	UNTIL	End of the instruction part of a REPEAT instruction
UO	AO	Interrogation after (Q1=1) AND (Q0=1)
VAR	VAR	Introduces a declaration block
VAR_IN_OUT	VAR_IN_OUT	Introduces a declaration block
VAR_INPUT	VAR_INPUT	Introduces a declaration block
VAR_OUTPUT	VAR_OUTPUT	Introduces a declaration block
VAR_TEMP	VAR_TEMP	Introduces a declaration block
VERSION	VERSION	Version number of the block
VOID	VOID	No return value on function call
WHILE	WHILE	Introduction of a WHILE instruction
WORD	WORD	Elementary data type for word
XOR	XOR	Logic operation
C	C	Counter
$_<any character>	$_	Alignment symbol

See also

Using tags within the program (Page 365)
PLC tags and local tags (Page 365)

7.2.1.7 Use of constants

7.2.1.7 Basics of constants

Introduction of constants

Constants are tags assigned with a fixed value These serve to make static values available under a name in the program. Constants can be read by various program elements during the execution of the program but cannot be overwritten. A change of the constant value during the program's execution can lead to syntax or runtime errors.

Declaration of constants

Constants are declared in the "Constants" tab of the PLC tag table. To declare a constant you have to enter a symbolic name, a data type and a fixed value. The input format and the value range of the constant depend on the data type of the constant.

See also

Data types (Page 373)
Structure of the PLC tag table (Page 394)

7.2.1.8 Data types

7.2.1.8 Introduction to data types and parameter types

Data types

All data used in a user program must be identified by a data type. The following data types are available:

- Elementary data types
- Complex data types, formed by linking elementary data types.
- Parameter types, with which you can define parameters to be transferred to functions or function blocks.
- System data types that are made available by the system and have a predefined, non-editable structure.
- Hardware data types that are supplied by the CPU.

Size of the data objects

The operations work with data objects of specific size. Bit instructions work for example with bits, transfer operations with bytes, words and double words.

A bit is a binary digit "0" or "1". A byte is made up of 8 bits, a word of 16 bits, and a double word of 32 bits.

Mathematical operations work with data types that have the width of bytes, words, or double words. Numbers in various formats (for example, integers or floating-point numbers) can be coded using the various bit locations.

7.2.1.8 Elementary data types

7.2.1.8 Overview of the elementary data types

Overview of the elementary data types

You use the data type to specify the length and the admissible ranges and representation types for the values of a tag or constant.

The following table shows the basic properties of elementary data types:

Data type	Length (bits)	Standard format	Value range	Example of value input
BOOL (Page 375)	1	Boolean	TRUE/FALSE	TRUE
BYTE (Page 375)	8	Hexadecimal number	16#0 to16#FF	16#F0
WORD (Page 375)	16	Hexadecimal number	16#0 to 16#FFFF	16#F0F0
DWORD (Page 376)	32	Hexadecimal number	16#0000_0000 to 16#FFFF_FFFF	16#F0F0_F0F0
SINT (Page 376)	8	Signed integers	-128 to 127	(+)120
USINT (Page 377)	8	Unsigned integers	0 to 255	50
INT (Page 378)	16	Signed integer	-32768 to 32767	(+)1
UINT (Page 378)	16	Unsigned integers	0 to 65535	300
DINT (Page 379)	32	Signed integers	- 2 147 483 648 to + 2 147 483 647	(+)2131754992
UDINT (Page 380)	32	Unsigned integers	0 to 4294967295	4042322160
REAL (Page 380)	32	Floating-point numbers	-3.402823e+38 to -1.175 495e-38 ±0 +1.175 495e-38 to +3.402823e +38	1.234567e+13
TIME (Page 381)	32	Time period with sign:	T# -24d20h31m23s648ms to T#+24d20h31m23s647ms	T#10d20h30m20s630ms
CHAR (Page 381)	8	ASCII characters	ASCII character set	'I'

7.2.1.8 BOOL

Description

A tag of the BOOL data type can contain one of the following bit values:

- TRUE
- FALSE

The following table shows the properties of a BOOL tag:

Length (bits)	Format	Value range	Examples of value input
1	Boolean	FALSE or TRUE	TRUE
	Binary numbers	0 or 1	1
	Octal numbers	8#0 or 8#1	8#1
	Hexadecimal numbers	16#0 or 16#1	16#1

7.2.1.8 BYTE

Description

A tag of the BYTE data type is a bit sequence of 8 bits.

The following table shows the properties of a BYTE tag:

Length (bits)	Format	Value range	Examples of value input
8	Unsigned integers	0 to 255	15
	Binary numbers	2#0 to 2#11111111	2#00001111
	Octal numbers	8#0 to 8#377	8#17
	Hexadecimal numbers	B#16#0 to B#16#FF	B#16#F, 16#F

7.2.1.8 WORD

Description

A tag of the WORD data type is a bit sequence of 16 bits.

The following table shows the properties of a WORD tag:

Length (bits)	Format	Value range	Examples of value input
16	Unsigned integers	0 to 65535	61680
	Binary numbers	2#0 to 2#1111111111111111	2#1111000011110000
	Octal numbers	8#0 to 8#177777	8#170360
	Hexadecimal numbers	W#16#0 to W#16#FFFF 16#0 to 16#FFFF	W#16#F0F0, 16#F0F0
	2x8 bit signed decimal numbers	B#(0,0) to B#(255,255)	B#(240,240)

7.2.1.8 DWORD

Description

A tag of the DWORD data type is a bit sequence of 32 bits.

The following table shows the properties of a DWORD tag:

Length (bits)	Format	Value range	Examples of value input
32	Unsigned integers	0 to 4294967295	15793935
	Binary numbers	2#0 to 2#11111111111111111111111 111111111	2#111100001111111100001111
	Octal numbers	8#0 to 8#37777777777	8#74177417
	Hexadecimal numbers	DW#16#0000_0000 to DW#16#FFFF_FFFF, 16#0000_0000 to 16#FFFF_FFFF	DW#16#F0FF0F, 16#F0FF0F
	4x8 bit unsigned decimal numbers	B#(0,0,0,0) to B# (255,255,255,255)	B#(240,255,240,255)

7.2.1.8 SINT

Description

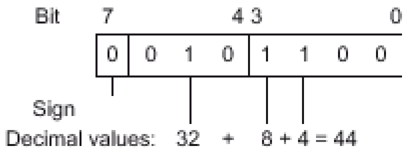
A tag of the SINT (short INT) data type has a length of 8 bits and can consists of two components, one sign and one numerical value. The signal stats of the bits 0 to 6 stand for the value of the number. The signal state of bit 7 represents the sign. The sign assume "0" for positive or "1" for negative.

A tag of the SINT data type occupies one byte in the memory.

The following table shows the properties of a SINT tag:

Length (bits)	Format	Value range	Examples of value input
8	Signed integers	-128 to 127	+50
	Binary numbers	2#0 to 0111111	2#01010000
	Octal numbers	8#0 to 8#177	8#120
	Hexadecimal numbers	16#0 to 16#7F	16#50

The following figure shows the integer +44 as a binary number:



7.2.1.8 USINT

Description

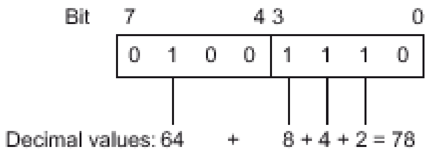
A tag of the USINT data type (unsigned short INT) has a length of 8 bits and can contain unsigned numerical values.

A tag of the USINT data type occupies one byte in the memory.

The following table shows the properties of a USINT tag:

Length (bits)	Format	Value range	Examples of value input
8	Unsigned integers	0 to 255	78
	Binary numbers	2#0 to 2#11111111	2#01001110
	Octal numbers	8#0 to 8#377	8#116
	Hexadecimal numbers	16#0 to 16#FF	16#4E

The following figure shows the integer 78 as a binary number:



7.2.1.8 INT

Description

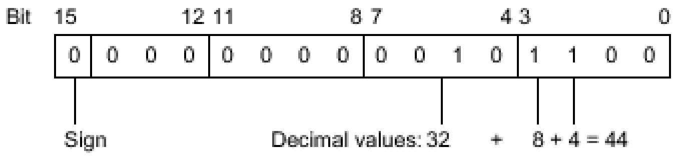
A tag of the INT data type has a length of 16 bits and consists of two components: one sign and one numerical value. The signal stats of the bits 0 to 14 stand for the value of the number. The signal state of bit 15 represents the sign. The sign assume the value "0" (positive) or "1" (negative).

A tag of the INT data type occupies two bytes in the memory.

The following table shows the properties of an INT tag:

Length (bits)	Format	Value range	Examples of value input
16	Signed integers	- 32768 to 32767	+44
	Binary numbers (only positive)	2#0 to 2#0111111111111111	2#0000000000101100
	Octal numbers (only positive)	8#0 to 8#77777	8#54
	Hexadecimal numbers (only positive)	16#0 to 16#7FFF	16#2C

The following figure shows the integer +44 as a binary number:



7.2.1.8 UINT

Description

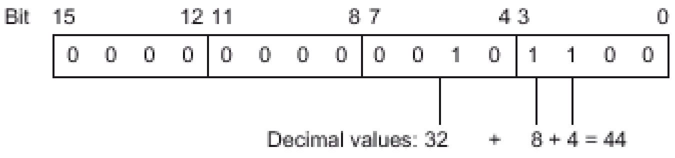
A tag of the UINT data type (unsigned INT) has a length of 16 bits and can contain unsigned numerical values.

A tag of the UINT data type occupies two bytes in the memory.

The following table shows the properties of a UINT tag:

Length (bits)	Format	Value range	Examples of value input
16	Unsigned integers	0 to 65535	65295
	Binary numbers	2#0 to 2#1111111111111111	2#1111111100001111
	Octal numbers	8#0 to 8#177777	8#177417
	Hexadecimal numbers	16#0 to 16#FFFF	16# FF0F

The following figure shows the integer 44 as a binary number:



7.2.1.8 DINT

Description

A tag of the DINT data type has a length of 32 bits and consists of two components: one sign and one numerical value. The signal stats of the bits 0 to 30 stand for the value of the number. The signal state of bit 31 represents the sign. The sign assume the value "0" (positive) or "1" (negative).

A tag of the DINT data type occupies four bytes in the memory.

The following table shows the properties of a DINT tag:

Length (bits)	Format	Value range	Examples of value input
32	Signed integers	- 2 147 483 648 to + 2 147 483 647	2131754992
	Binary numbers	2#0 to 2#01111111111111111111111111111111	2#01111111000011111111111110000
	Octal numbers	8#0 to 8#17777777777	8#17703777760
	Hexadecimal numbers	16#0000_0000 to 16#7FFFF_FFFF	16#7F0FFFF0

7.2.1.8 UDINT

Description

A tag of the UDINT data type (unsigned double INT) has a length of 32 bits and can contain unsigned numerical values.

A tag of the UDINT data type occupies four bytes in the memory.

The following table shows the properties of a UDINT tag:

Length (bits)	Format	Value range	Examples of value input
32	Unsigned integers	0 to 4294967295	4042322160
	Binary numbers	2#0 to 2#1111111111111111111 1111111111111	2#1111000011110000111 1000011110000
	Octal numbers	8#0 to 8# 37777777777	8#36074170360
	Hexadecimal numbers	16#0000_0000 to 16# FFFF_FFFF	16#F0F0F0F0

7.2.1.8 REAL

Description

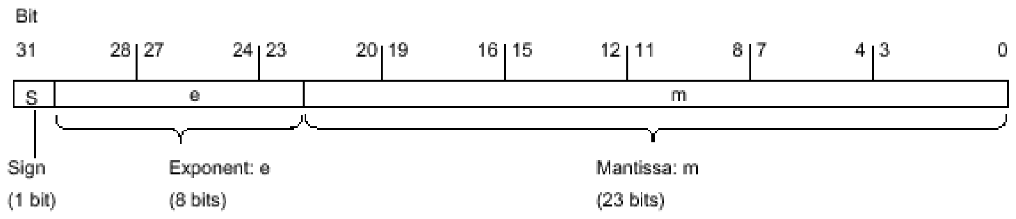
Tags of the REAL data type have a length of 32 bits and are used to display floating-point numbers. A tag of the REAL data type consists of the following three components:

- Sign: The sign is determined by the signal state of bit 31. The bit 31 assume the value "0" (positive) or "1" (negative).
- 8-bit exponents to basis 2: The exponent is increased by one constant (basis, +127), so that it has a range of 255.
- 23-bit mantissa: Only the broken part of the mantissa is shown. The integer part of the mantissa is not stored, as it is always equal to "1" within the valid value range.

The following table shows the properties of a REAL tag:

Length (bits)	Format	Value range	Examples of value input
32	Floating-point numbers to IEEE 754 standard	-3.402823e+38 to -1.175 495e-38 ±0	1.0e-5
	Floating-point numbers	+1.175 495e-38 to +3.402823e+38	1.0

The following figure shows the structure of a REAL tag:



7.2.1.8 TIME

Description

A tag of the TIME data type occupies 32 bits in the memory. The duration contains information for days (d), hours (h), minutes (m), seconds (s) and milliseconds (ms).

The following table shows the properties of a TIME tag:

Length (bits)	Format	Value range	Examples of value input
32	Time period with sign:	T# -24d20h31m23s648ms to T#+24d20h31m23s647ms	T#10d20h30m20s630ms, TIME#10d20h30m20s630 ms, 10d20h30m20s630ms;

It is not necessary to specify all time units. So for instance T#5h10s is valid. If only one unit is specified, the absolute value of days, hours, and minutes must not exceed the high or low limits. When more than one unit of time is specified, the value of the unit must not exceed 23 hours 59 minutes 59 seconds 999 milliseconds.

7.2.1.8 CHAR

Description

A tag of the CHAR data type has a length of 8 bits and occupies one byte in the memory.

The CHAR data type stores a single character in ASCII format.

The following table shows the value range of the CHAR data type:

Length (bits)	Format	Value range	Examples of value input
8	ASCII characters	ASCII character set	’Q’

7.2.1.8 Complex data types

7.2.1.8 Overview of the complex data types

Introduction

Complex data types define data groups that are composed of other data types.

You cannot use any constants as actual parameters for complex data types. Neither can you transfer any absolute addresses as actual parameters to complex data types.

The following table provides an overview of the complex data types:

Data type	Description
DTL (Page 382)	The DTL data type represents a point in time defined by the date and time.
STRING (Page 383)	The STRING data type represents a character string comprising a maximum of 254 characters.
ARRAY	The ARRAY data type represents a field that consists of a fixed number of components of the same data type.
STRUCT (Page 386)	The STRUCT data type represents a structure that consists of a fixed number of components. The various structural components can have different data types.

7.2.1.8 DTL

Description

A tag of the DTL data type has a length of 12 bytes and saves information on date and time in a predefined structure.

The following table shows the properties of a DTL tag:

Length (bytes)	Format	Value range	Example of value input
12	Clock and calendar (Year-Month tag:Hour:Minute:Second.Nanoseconds)	Min.: DTL#1970-01-01-00:00:00.0 Max.: DTL#2554-12-31-23:59:59.999 999 999	DTL#2008-12-16-20:30:20.250

The structure of a DTL tag consists of several components each of which can contain a different data type and range of values. The data type of a specified value must match the data type of the corresponding components.

The following table shows the structure components of a DTL tag and its properties:

Byte	Component	Data type	Value range
0	Year	UINT	1970 to 2554
1			
2	Month	USINT	0 to 12
3	Day	USINT	1 to 31
4	Day of week	USINT	1(Sunday) to 7(Saturday) The weekday is not considered in the value entry.
5	Hour	USINT	0 to 23
6	Minute	USINT	0 to 59
7	Second	USINT	0 to 59
8	Nanoseconds	UDINT	0 to 999 999 999
9			
10			
11			

7.2.1.8 STRING

Description

A tag from the STRING data type saves several characters in a character string that consists of maximum 254 characters. The maximum length of the character string for each tag can be specified by the keyword STRING in square brackets (for example, STRING[4]). If the information on maximum length is omitted, the standard length of 254 characters is set for the respective tag.

In the memory, a tag of STRING data type occupies two bytes more than the specified maximum length(s).

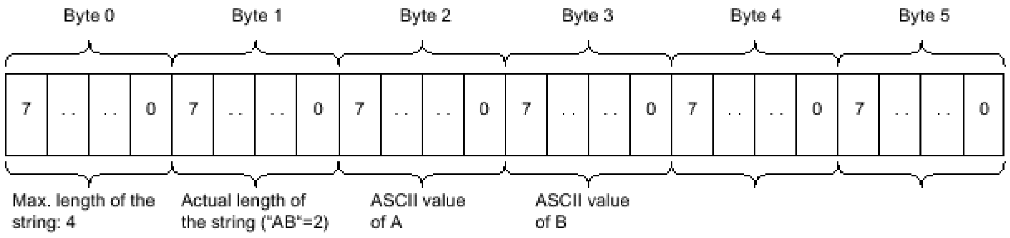
Tags of the STRING data type can be assigned characters. The characters are specified in single quotation marks. If the actual length of a specified character string is shorter than the declared maximum length, the remaining character spaces remain empty. Only occupied character spaces are considered in the value processing.

The following table shows the properties of a STRING tag:

Length (bytes)	Format	Value range	Example of value input
n + 2	ASCII character string	0 to 254 characters	'Name'

Example

The example below shows the byte sequence if the STRING[4] data type is specified with output value 'AB':



7.2.1.8 ARRAY

7.2.1.8 Format of ARRAY

Description

The ARRAY data type represents a field that consists of a fixed number of components of the same data type. Components of all elementary data types can be combined in an ARRAY tag.

The information on the ranges of the ARRAY components is shown in square brackets after the keyword ARRAY. The low limit value must be smaller than or equal to the high limit value of a range. An ARRAY can contain a dimension.

The following table shows the properties of an ARRAY tag:

Length	Format	Value range
Number of elements * length of the data type	ARRAY [low limit value...high limit value] of <data type>	[- 32 768.. +32 767] of <data type>

Example

The following example shows how tags of the ARRAY data type can be declared:

Name	Data type	Comment
Measured value	ARRAY[1..20] of REAL	One-dimensional ARRAY tag with 20 components
Time-of-day	ARRAY[-5..5] of INT	One-dimensional ARRAY tag with 11 components

See also

Declaring tags of ARRAY data type (Page 437)
Example of a one-dimensional ARRAY (Page 385)

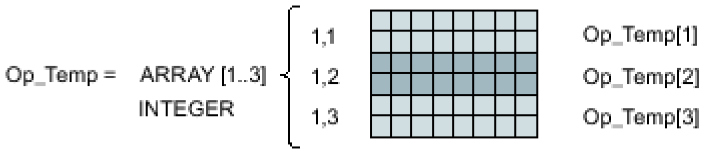
7.2.1.8 Example of a one-dimensional ARRAY

Declaration of a one-dimensional ARRAY tag

The following table shows the declaration of a one-dimensional ARRAY tag:

Name	Data type	Comment
Op_Temp	ARRAY[1..3] of INT	One-dimensional ARRAY tag with 3 components.

The following figure shows the structure of the declared ARRAY tag:



Access to ARRAY components

The individual array components are accessed via an index.. The index of the first ARRAY component is [1], of the second [2], and of the third [3]. To access the value of the second ARRAY component, the specification "OP_Temp[2]" is required in the program in this case.

The tag "Op_Temp" could also be declared as ARRAY[-1..1] of INT. The index of the first ARRAY components would then be [-1], of the second [0], and of the third [1].

See also

Format of ARRAY (Page 384)
Declaring tags of ARRAY data type (Page 437)

7.2.1.8 STRUCT

Description

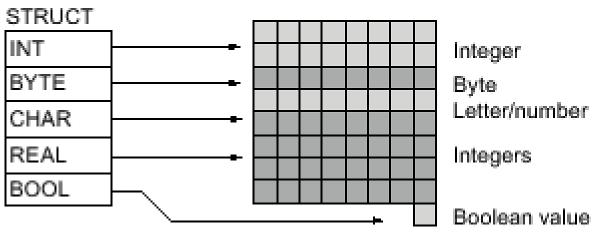
A tag of the STRUCT data type saves values in a structure that consists of a fixed number of components. The various structural components can have different data types. It is not possible to nest structures in a STRUCT tag.

A STRUCT tag always starts with one byte with even address and occupies the memory up to the next word limit.

The following table shows the properties of a STRUCT tag:

Length	Format	Value range	Example of value input
A STRUCT tag starts with one byte with even address and occupies the memory up to the next word limit.	STRUCT	The value ranges of the used data types apply.	The value input rules of the used data types apply.

The following figure shows an example of the structure of a STRUCT tag:



See also

Declaring tags of STRUCT data type (Page 438)

7.2.1.8 Parameter types

7.2.1.8 Overview of parameter types

Introduction

In addition to the elementary and complex data types, you can also define parameter types for formal parameters that are transferred between blocks.

The following table provides an overview of parameter types:

Parameter	Size (bytes)	Description
VARIANT (Page 387)	0	A parameter of the VARIANT type is a pointer that can point to tags of various data or parameter types. The VARIANT parameter type can recognize structures and point to these.
VOID	-	Saves no values. The VOID data type is used if a function requires no return value.

7.2.1.8 VARIANT

Description

A parameter of the VARIANT type is a pointer that can point to tags of various data or parameter types. The VARIANT parameter type can recognize structures and point to these. With the parameter type VARIANT you can also point to individual components of a STRUCT tag. A VARIANT parameter type tag does not occupy any space in the memory.

The following table shows the properties of the VARIANT parameter type:

Representation	Format	Length (bytes)	Example of value input
Symbolic	Operand	0	MyTag
	NameDataBlock.NameOperand.Component		MyDB.StructTag.FirstComponent
Absolute	Operand		%MW10
	DataBlockNumber.Operand Type Length		P#DB10.DBX10.0 INT 12

7.2.1.8 VOID

Description

The VOID data type saves no values. It is used if a function requires no return value.

7.2.1.8 System data types

7.2.1.8 System data types

Description

The system data types (SDT) are made available by the system and have a predefined structure. The structure of a system data type consists of a fixed number of components that can have various data types. It is not possible to change the structure of a system data type.

The system data types can only be used for specific instructions. The following table shows the available system data types and their purpose:

System data type	Structure length in bytes	Description
IEC_TIMER	16	Structure of a clock This data type is used for the "TP", "TOF", "TON" and "TONR" instructions, for example.
IEC_SCOUNTER	3	Structure of a counter, the count of which is the SINT data type This data type is used for the CTU", "CTD" and "CTUD" instructions, for example.
IEC_USCOUNTER	3	Structure of a counter, the count of which is the USINT data type This data type is used for the CTU", "CTD" and "CTUD" instructions, for example.
IEC_COUNTER	6	Structure of a counter, the count of which is the INT data type This data type is used for the CTU", "CTD" and "CTUD" instructions, for example.
IEC_UCOUNTER	6	Structure of a counter, the count of which is the UINT data type This data type is used for the CTU", "CTD" and "CTUD" instructions, for example.
IEC_DCOUNTER	12	Structure of a counter, the count of which is the DINT data type This data type is used for the CTU", "CTD" and "CTUD" instructions, for example.

System data type	Structure length in bytes	Description
IEC_UDCOUNTER	12	Structure of a counter, the count of which is the UDINT data type This data type is used for the CTU", "CTD" and "CTUD" instructions, for example.
ERROR_STRUCT	28	Structure of error information for a programming or I/O access error This data type is used for the "GET_ERROR" instruction, for example.
CONDITIONS	52	Defined data structure, that define the conditions for the start and end of data reception. This data type is used for the "RCV_GFG" instruction, for example.
TCON_Param	64	Specifies the structure of a data block which stores descriptions of connections for open communication via Industrial Ethernet (PROFINET).
VOID	-	The VOID data type saves no values. This data type is used if no return values are required for an output. The VOID data type, for example, can be specified at the STATUS output if no error information is required.

7.2.1.8 Hardware data types

7.2.1.8 Hardware data types

Description

The hardware data types are made available by the CPU. The number of available hardware data types depends on the CPU.

Constants of a specific hardware data type are stored based on the modules set in the hardware configuration. When an instruction for controlling or activating a configured module is inserted in the user program, the available constants can be used for the parameters.

The following table shows the available hardware data types and their purpose:

Data type	Basic data type	Description
HW_ANY	WORD	Identification of any HW component, such as a module
HW_IO	HW_ANY	Identification of an I/O component
HW_SUBMODULE	HW_IO	Identification of a central HW component
HW_INTERFACE	HW_SUBMODULE	Identification of an interface component
HW_HSC	HW_SUBMODULE	Identification of a fast counter This data type is used for the "CTRL_HSC" instruction, for example.
HW_PWM	HW_SUBMODULE	Identification of pulse width modulation This data type is used for the "CTRL_PWM" instruction, for example.
HW_PTO	HW_SUBMODULE	Identification of a pulse sensor This data type is used for motion control
AOM_IDENT	DWORD	Identification of an object in the runtime system of the AS.
EVENT_ANY	AOM_IDENT	Used to identify any event
EVENT_ATT	EVENT_ANY	Used to identify an event that can be dynamically assigned to an OB. This data type is used for the "ATTACH" and "DETACH" instructions, for example.
EVENT_HWINT	EVENT_ATT	Used to identify a hardware interrupt event.
OB_ANY	INT	Used to identify any OB.
OB_DELAY	OB_ANY	Used to identify an OB called when a time-delay interrupt occurs. This data type is used, for example, for the "SRT_DINT" and "CAN_DINT" instructions.
OB_CYCLIC	OB_ANY	Used to identify an OB called when a cyclic interrupt occurs.

Data type	Basic data type	Description
OB_ATT	OB_ANY	Used to identify an OB that can be dynamically assigned to an event. This data type is used for the "ATTACH" and "DETACH" instructions, for example.
OB_PCYCLE	OB_ANY	Used to identify an OB that can be assigned to an event of the "Cyclic program" event class.
OB_HWINT	OB_ATT	Used to identify an OB called when a hardware interrupt occurs.
OB_DIAG	OB_ANY	Used to identify an OB called when a diagnostic error interrupt occurs.
OB_TIMEERROR	OB_ANY	Used to identify an OB called when a time error occurs.
OB_STARTUP	OB_ANY	Used to identify an OB called when a startup event occurs.
PORT	UINT	Used to identify a communication port This data type is used for point-to-point communication.
CONN_ANY	WORD	Used to identify any connection
CONN_OUC	CONN_ANY	Used to identify a connection for open communication via Industrial Ethernet (PROFINET)

7.2.1.8 Data type conversion

7.2.1.8 Overview of data type conversion

Introduction

If you link several operands in an instruction, you must make sure that the data types are compatible. This applies also for assignments or for supplying block parameters. If the operands are not the same data type, a conversion has to be carried out.

There are two options for the conversion:

- Implicit conversion

  The conversion take place automatically when the instruction is executed.

- Explicit conversion

  You use an explicit conversion instruction before the actual instruction is executed.

Implicit conversion

An implicit conversion is executed automatically if the data types of the operands are compatible. This compatibility test can be carried out according to criteria that are more or less strict:

- With IEC check (default setting):

  Strict compatibility rules are applied: Operands that are linked in an instruction have to be of the same data type.

- Without IEC check

  The compatibility test is carried out according to rules that are less strict. Operands that are linked in an instruction do not necessarily have to be of the same data type. However, the data types have to have the same data width.

  When IEC check is disabled you can, for example, link an operand of the INT data type with an operand of the WORD data type.

Note

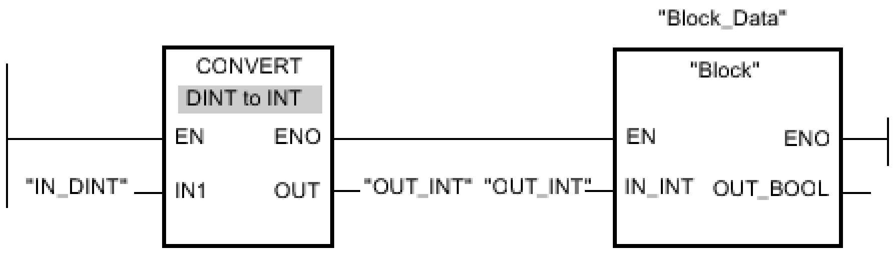
The conversion from REAL to TIME or TIME to REAL is an exception. This conversion is implicitly not possible.

Explicit conversion

If the operands are not compatible and an implicit conversion is therefore not possible, you can use an explicit conversion instruction. You can find the conversion instructions in the "Instructions" task card in the sections "Math", "String + Char" and "Convert".

The advantage with explicit conversion is that any violation of the range can be checked at the ENO output.

The following figure shows an example in which an explicit data type conversion must be carried out:



The "Block" function block expects a tag of the INT data type at the "IN_INT" input parameter. The value in the "IN_DINT" tag therefore first must be converted from DINT to INT. It can then be transferred with the INT data type to "Block".

During conversion from DINT to INT the low-value bits of DINT are used and interpreted as INT. However, a currently existing sign can get lost in the process.

See also

Setting IEC test (Page 393)

7.2.1.8 Setting IEC test

When an instruction is executed, the data types are checked for compatibility to the employed operands. This compatibility test can be carried out according to criteria that are more or less strict. If "IEC Check" is activated, stricter criteria are applied.

You can set the IEC check centrally for all new blocks of the project or for specific blocks.

Setting IEC check for new blocks

To set the IEC check for all new blocks in the project, proceed as follows:

1. Select the "Settings" command in the "Options" menu.

   The "Settings" window is displayed in the work area.
2. Select the "PLC programming > General" group in the area navigation.
3. Select or clear the "IEC Check" check box in the "Default settings for new blocks" group.

   The IEC check is enabled or disabled for all new blocks in the program.

Setting IEC check for a block

To set the IEC check for a block, proceed as follows:

1. Open the block.
2. Open the "Properties" tab in the inspector window.
3. Click the "Attributes" group in area navigation.
4. Select or clear the "IEC Check" check box.

   The IEC check is enabled or disabled for this block. The setting is not saved, however, until the project is saved.

See also

Overview of data type conversion (Page 391)

7.2.1.9 Procedure for block programming

7.2.1.9 Basic procedure

Overview

After you have created the concept for the automation solution, the next step is to implement it. We recommend the following procedure:

Declaring PLC tags
↓
Creating blocks (Page 406)
↓
Declaring local tags (Page 432)
↓
Creating program code (Page 443)
↓
Save (Page 146)
↓
Compile (Page 527)
↓
Load (Page 528)
↓
Test (Page 565)

7.2.2 Declaring PLC tags

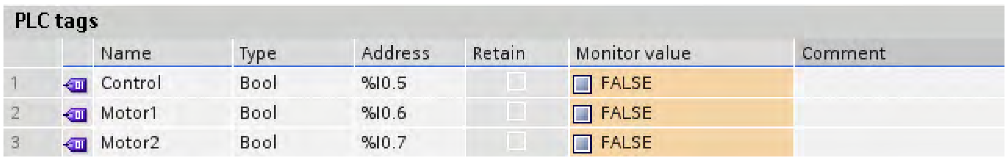
7.2.2.1 Structure of the PLC tag table

Definition

The PLC tag table contains the definition of the tags and constants that are valid throughout the CPU. A PLC tag table is created automatically for each CPU used in the project. The PLC tag table contains a tab for tags and a tab for constants.

Structure of the "PLC tags" tab

In the "PLC tags" tab you declare the global tags that you require in the program. The following figure shows the tab structure:



PLC tags

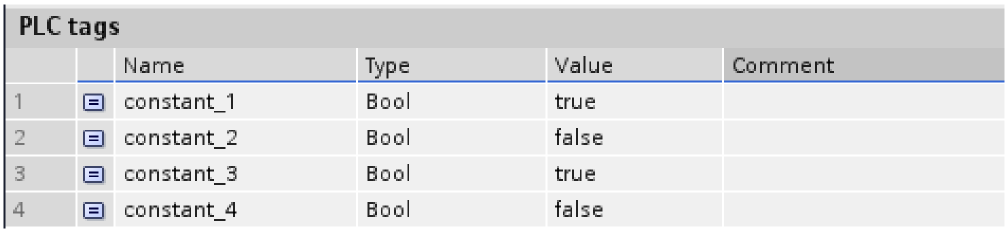
		Name	Type	Address	Retain	Monitor value	Comment
1		Control	Bool	%I0.5	☐	FALSE	
2		Motor1	Bool	%I0.6	☐	FALSE	
3		Motor2	Bool	%I0.7	☐	FALSE	

The following table shows the meaning of the individual columns:

Column	Description
◀	Symbol you can click in order to move a tag into a network via a drag-and-drop operation for use as an operand.
Name	Unique name throughout the CPU that you specify for the tag.
Data type	Data type that you specify for the tag
Address	Tag address.
Retain	Marks the tag as retentive. The values of retentive tags are retained even after the power supply is switched off.
Monitor value	Current data value in the CPU. This column only appears if an online connection is available and you select the "Monitor" button.
Comment	Comments to document the tags.

Structure of the "Constants" tab

The constants required by the system are shown in the "Constants" tab. The following figure shows the tab structure:


PLC tags

		Name	Type	Value	Comment
1	▤	constant_1	Bool	true	
2	▤	constant_2	Bool	false	
3	▤	constant_3	Bool	true	
4	▤	constant_4	Bool	false	

The following table shows the meaning of the individual columns:

Column	Description
▤	Symbol for the constants
Name	CPU-wide unique name for the constants.
Data type	Data type of the constants
Value	Value of the constants,
Comment	Comments to document the tags.

See also

Data types (Page 373)
Hardware data types (Page 389)
Opening the PLC tag table (Page 396)
Declaring tags in the PLC tag table (Page 398)

PLC tags and local tags (Page 365)
Basics of constants (Page 372)
Symbolic programming (Page 361)
Keyboard shortcuts in tables (Page 134)

7.2.2.2 Opening the PLC tag table

Procedure

To open the PLC tag table in a CPU, proceed as follows:

1. Open the "PLC tags" folder under the CPU in the project tree.
2. Double-click the PLC tag table in the folder.
3. In the top right corner select the "PLC tags" tab or the "Constants" tab.

Result

The PLC tag table associated with the CPU opens. You can declare the required tags and constants.

7.2.2.3 Declaring PLC tags

7.2.2.3 Rules for PLC tags

7.2.2.3 Permissible addresses and data types of PLC tags

Mnemonics used

The addresses that you enter in the PLC tag table are automatically adapted to the set mnemonics.

Permissible addresses and data types for tags

The following table shows the permissible addresses and data types:

English mnemonics	German mnemonics	Explanation:	Data type:	Address area:
I	E	Input bit	BOOL	0.0..1023.7
IB	EB	Input byte	BYTE, CHAR, SINT, USINT	0..1023
IW	EW	Input word	WORD, INT, UINT	0..1022

English mnemonics	German mnemonics	Explanation:	Data type:	Address area:
ID	ED	Input double word	DWORD, DINT, UDINT, REAL, TIME	0..1020
Q	A	Output bit	BOOL	0.0..1023.7
QB	AB	Output byte	BYTE, CHAR, SINT, USINT	0..1023
QW	AW	Output word	WORD, INT, UINT	0..1022
QD	AD	Output double word	DWORD, DINT, UDINT, REAL, TIME	0..1020
M	M	Memory bit	BOOL	0.0..8191.7
MB	MB	Memory byte	BYTE, CHAR, SINT, USINT	0..8191
MW	MW	Memory word	WORD, INT, UINT	0..8190
MD	MD	Memory double word	DWORD, DINT, UDINT, REAL, TIME	0..8188

See also

Setting the mnemonics (Page 443)

7.2.2.3 Incomplete and ambiguous entries in the PLC tag table

Incomplete definitions

You can save even incompletely defined tags or constants. For example, you can first specify just the name and later add the data type information. You can therefore interrupt your work on the PLC tag table at any time and save the interim information.

However you cannot compile blocks that contain these tags or constants until their definition is complete.

Ambiguous definitions

The names of the PLC tags must be unique throughout the CPU. You cannot use a name that has already been assigned to an object within the CPU – for example, a block or another PLC tag – for a new PLC tag. If you enter an already assigned name another time, a sequential number is automatically appended to the second name entered. For example, if you enter the name "Motor" a second time, the second entry will be changed to "Motor_1".

The addresses must also be unique throughout the CPU. If you enter an address that is already assigned to another tag, the address will be highlighted at both places in yellow and an error message will be issued.

7.2.2.3 Declaring PLC tags

7.2.2.3 Declaring tags in the PLC tag table

Requirement

The "PLC tags" tab of the PLC tag table is open.

Procedure

To define PLC tags, proceed as follows:

1. Enter a tag name in the "Name" column.
2. Click the arrow key in the "Data type" column and select the desired data type.

   An address corresponding to the data type is automatically appended.
3. If necessary, modify the address of the tag in the "Address" column.
4. If you want, enter comments in the "Comment" column.
5. Repeat steps 1 to 4 for all the tags you require.

   See also: Permissible addresses and data types of PLC tags (Page 396)

Syntax check

A syntax check is performed after each entry, and any errors found are displayed in red. You do not have to correct these errors immediately - you can continue editing and make any corrections later. However, you will not be able to compile the program if the tag declaration contains syntax errors.

See also

Incomplete and ambiguous entries in the PLC tag table (Page 397)
Structure of the PLC tag table (Page 394)
Editing the PLC tag table (Page 405)
Inserting table rows (Page 0)
Sorting rows in the PLC tag table (Page 405)
Keyboard shortcuts in tables (Page 134)

7.2.2.3 Declaring PLC tags in the program editor

Requirement

- The program editor is open.
- One or more operands are used in the program.

Procedure

To declare operands as global PLC tags, proceed as follows:

1. Select one or more operands.
2. Select the "Define tag" command in the shortcut menu.

   The "Define tag" dialog box opens. This dialog box displays a declaration table in which the name of the operand is already entered.
3. Click the arrow key in the "Section" column and select one of the following entries:
   - Global Memory
   - Global Input
   - Global Output
4. In the other columns, enter the address, data type, and comments.

   See also: Permissible addresses and data types of PLC tags (Page 396)
5. Click the "Define" button to complete your entry.

Result

The tag declaration is written to the PLC tag table and is valid for all blocks in the CPU.

See also

Incomplete and ambiguous entries in the PLC tag table (Page 397)
Keyboard shortcuts in tables (Page 134)
Automatically filling in cells in the PLC tag table (Page 404)

7.2.2.3 Changing addresses of PLC tags

You can change the address of a PLC tag in the PLC tag table or directly in the program editor. The changes take immediate effect throughout the entire program.

Procedure

To change the address of a PLC tag, proceed as follows:

1. Double-click on the PLC tag table in the project tree.

   The PLC tag table opens.
2. Open the "Tag" tab.
3. Change the entry in the "Address" column.

Or

1. Select one or more tags at their point of use in the program.
2. Select the "Rewire tag" command in the shortcut menu.

   The "Rewire tag" dialog box opens.
3. Change the entry in the "Address" column.
4. Click the "Change" button to complete your entry.

Result

The address of the tag is changed automatically at all points of use in the program.

See also

Permissible addresses and data types of PLC tags (Page 396)

7.2.2.3 Changing the name of PLC tags

You can change the name of a PLC tag in the PLC tag table or directly in the program editor. The changes take immediate effect throughout the entire program.

Procedure

To change the name of PLC tag, follow these steps:

1. Double-click on the PLC tag table in the project tree.

   The PLC tag table opens.
2. Open the "Tag" tab.
3. Change the entry in the "Name" column.

Or

1. Select one or more tags at their point of use in the program.
2. Select the "Rename tag" command in the shortcut menu.

   The "Rename tag" dialog box opens.
3. Change the entry in the "Name" column.
4. Click the "Change" button to complete your entry.

Result

The name of the tag is changed automatically at all points of use in the program.

See also

Permissible addresses and data types of PLC tags (Page 396)

7.2.2.3 Setting the retentivity of PLC tags

7.2.2.3 Retentive behavior of PLC tags

Retentive memory areas for bit memories

To prevent data loss in the event of power failure, you can define a retentive memory area for bit memories. A retentive memory area is an area whose content is retained after the switching off of the supply voltage and after switching on upon a transition from "STOP" to "RUN". You can specify the exact width of the retentive memory area in the PLC tag table.

The values of retentive memory area are saved to the backup memory on the CPU. These values are retained in the event of a hot restart.

See also

Setting the retentive behavior of PLC tags (Page 401)

7.2.2.3 Setting the retentive behavior of PLC tags

Introduction

In the PLC tag table you can specify the width of the retentive memory area for bit memories. All tags that are addressed in this memory area are then designated as retentive. You can recognize the retentivity setting of a tag by the check mark set in the "Retain" column of the PLC tag table.

Requirement

The "PLC tags" tab of the PLC tag table is open.

Procedure

To define the width of the retentive memory area for bit memories, proceed as follows:

1. On the toolbar, click the "Retain" button.

   The "Retain memory" dialog box opens.
2. Specify the width of the retentive memory area by entering the last byte of the area, counting from 0, in the text box. When specifying not the addresses of existing tags that are declared as bit memories.
3. Click the "OK" button.

Result

The width if the retentive memory area is defined. In the "Retain" column of the tag table a check mark is automatically set for all tags that are located within the retentive memory area.

See also

Retentive behavior of PLC tags (Page 401)

7.2.2.3 Editing the properties of PLC tags

7.2.2.3 Properties of PLC tags

Overview

The following table gives an overview of the properties of PLC tags:

Group	Property	Description
General	Tag name	A unique name within the table.
	Address	Tag address.
	Comment	Comment on the tag,
	Data type	Data type of the tags.
Time stamp	Created on	Time when the tag was created (cannot be changed).
	Changed on	Time when the tag was last changed (cannot be changed).
Usage	Visible in HMI	Default setting for the operand selection in HMI.
	Read only for HMI	Write protection in HMI
	User defined sort criterion	Identifier for sorting the tags in external tables.
Values	Initial value	Value of the tag if a current value is not stored in a data block. This value must be compatible with the declared data type.
	Low limit	Value that the tag may not be less than.
	High limit	Value that the tag may not exceed.

See also

Editing the properties of PLC tags (Page 402)

7.2.2.3 Editing the properties of PLC tags

Editing general properties in the PLC tag table

To edit the general properties of one or more tags, proceed as follows:

1. Double-click the PLC tag table of the CPU in the project tree.

   The PLC tag table opens.

2. Change the entries in the "Name", "Address", or "Comment" columns.

Editing detailed properties in the properties window

To edit the detailed properties of an individual tag, proceed as follows:

1. Select a tag in the network.
2. Select the "Properties" command in the shortcut menu.

   The properties dialog opens. This dialog displays the detailed properties of the tag.
3. Change the entries in the properties window.

See also

Properties of PLC tags (Page 402)

7.2.2.4 Monitoring of PLC tags

7.2.2.4 Monitoring of PLC tags

You can monitor the current data values of the tags on the CPU directly in the PLC tag table.

Requirement

An online connection is available.

Procedure

To monitor the data values, proceed as follows:

1. Start monitoring by clicking the "Monitor all" button.

   The additional "Monitor value" column is displayed in the table. This shows the current data values.
2. End the monitoring by clicking the "Monitor all" button again.

See also

Structure of the PLC tag table (Page 394)

7.2.2.5 Editing the PLC tag table

7.2.2.5 Copying entries in the PLC tag table

You can copy PLC tags within a table.

Procedure

To copy a tag, proceed as follows:

1. Select the tags you want to copy.

You can also select several tags by clicking on them one after the other while holding down the <Ctrl> key or by pressing and holding down <Shift> and clicking on the first and last tag.

2. Select "Copy" in the shortcut menu.
3. Position the insertion pointer at the location where you want to insert the tags.
4. Select "Paste" in the shortcut menu.

Or

1. Select the tag.
2. Hold down the left mouse button.
3. At the same time, press <Ctrl>.
4. Drag the tag to the destination.

Result

- The tag is copied to the destination.
- If there is a name conflict, a number is automatically appended to the tag name. For example, "Tag" would become "Tag_1".
- All other properties of the tag remain unchanged.

See also

Keyboard shortcuts in tables (Page 134)
Adapting tables (Page 131)

7.2.2.5 Deleting entries in the PLC tag table

Procedure

To delete a tag, proceed as follows:

1. Select the row with the tag to be deleted. You can also select several rows by clicking on them one after the other while holding down the <Ctrl> key or by pressing and holding down <Shift> and clicking on the first and last row.
2. Select the "Delete" command in the shortcut menu.

See also

Adapting tables (Page 131)
Keyboard shortcuts in tables (Page 134)

7.2.2.5 Automatically filling in cells in the PLC tag table

You can load the contents of one or several table cells into the cells below and thus automatically fill in up to 100 successive cells.

If you automatically fill in cells in the "Name" column, a consecutive number will be appended to each name. For example, "Motor" will become "Motor_1".

If you fill the cells in the column "address" automatically, the addresses will be increased depending on the indicated data type.

Procedure

To automatically fill in successive cells, proceed as follows:

1. Select the cells to be loaded.
2. Click the "Fill" symbol in the bottom right corner of the cell.

   The mouse pointer is transformed into a crosshair.
3. Keep the mouse button pressed and drag the mouse pointer downwards over the cells that you want to fill in automatically.
4. Release the mouse button.

See also

Adapting tables (Page 131)
Keyboard shortcuts in tables (Page 134)

7.2.2.5 Inserting table rows

Procedure

To insert row above the position of the mouse pointer, proceed as follows:

1. Position the mouse pointer in the row above which you want to insert a new row.
2. Click the "Insert row" button on the toolbar of the table.

   A new row is inserted above the selected row.

See also

Keyboard shortcuts in tables (Page 134)
Adapting tables (Page 131)

7.2.2.5 Sorting rows in the PLC tag table

You can sort the rows in the table alphanumerically by name, data type, or address.

Procedure

To sort the table rows, proceed as follows:

1. Select the column by which you want to sort.
2. Click the column header.

   The column will be sorted in order of increasing values.

   An up arrow shows the sort sequence.
3. In order to change the sort sequence, click the arrow.

The column will be sorted in order of decreasing values.

A down arrow shows the sort sequence.

4. To restore the original sequence, click a third time on the column header.

See also

Keyboard shortcuts in tables (Page 134)
Adapting tables (Page 131)

7.2.3 Creating and managing blocks

7.2.3.1 Creating blocks

7.2.3.1 Block folder

Function

You can find a "Program blocks" folder in the project tree, in which you can create and manage the following blocks:

- Organization blocks (OB) (Page 406)
- Function blocks (FB) (Page 407)
- Functions (FC) (Page 407)
- Data blocks (DB) (Page 0)

A program cycle OB is automatically generated for each device and inserted in the "Program blocks" folder.

7.2.3.1 Creating organization blocks

Requirement

The "Program blocks" folder opens in the project tree.

Procedure

To create an organization block, proceed as follows:

1. Double-click the "Add new block" command.

   The "Add new block" dialog box opens.
2. Click the "Organization block (OB)" button.
3. Select an organization block.

4. Select the "Manual" option button if you want to assign the number of the organization block.
5. In the "Language" drop-down list, select the programming language for the new organization block.
6. If you insert a cyclic interrupt OB, you can enter the cycle time in the "Scan time" text box.
7. To add additional properties for the new organization block, click the arrow beside "Further information" in the lower part of the dialog box.

   An area with further input fields is displayed.
8. Enter all the properties you require.
9. Confirm your entries with "OK".

Result

The new organization block is created. You can find the organization block in the project tree in the "Program blocks" folder.

Note

You can select the "Add new and open" check box at the bottom of the dialog box. As a result, the organization block will be opened immediately after it is created.

See also

Organization blocks (OB) (Page 337)
Assigning parameters to hardware interrupt OBs (Page 417)
Assigning parameters to cyclic interrupt OBs (Page 418)

7.2.3.1 Creating functions and function blocks

Requirement

The "Program blocks" folder opens in the project tree.

Procedure

To create a function (FC) or a function block (FB), proceed as follows:

1. Double-click the "Add new block" command.

   The "Add new block" dialog box opens.
2. Click the "function block (FB)" or "function (FC)" button.
3. Enter a name for the block.
4. In the "Language" drop-down list, select the programming language for the new block.
5. Select the "Manual" option button if you want to assign the number of the block.
6. If you choose to use manual assignment, enter the block number in the input field.

7. To add additional properties for the new block, click the arrow beside "Further information" in the lower part of the dialog box.

   An area with further input fields is displayed.
8. Enter all the properties you require.
9. Confirm your entries with "OK".

Result

The new block is created. You can find the block in the project tree in the "Program blocks" folder.

Note

You can select the "Add new and open" check box at the bottom of the dialog box. As a result, the block will be opened immediately after it is created.

See also

Function blocks (FB) (Page 346)
Functions (FCs) (Page 346)

7.2.3.1 Creating data blocks

Prerequisites

The "Program blocks" folder opens in the project tree.

Procedure

To create a data block, proceed as follows:

1. Double-click the "Add new block" command.

   The "Add new block" dialog box opens.
2. Click the "Data block (DB)" button.
3. Enter a name for the data block.
4. Select the type of the data block. You have the following options available to you:
   - To create a global data block, select the list entry "Global DB".
   - To create an instance data block, select the function block to which you want to assign the instance data block from the list.
5. Select the "Manual" option button if you want to assign the number of the block.
6. If you choose to use manual assignment, enter the block number in the input field.
7. To add additional properties for the data new block, click the arrow beside "Further information" in the lower part of the dialog box.

An area with further input fields is displayed.

8. Enter all the properties you require.
9. Confirm your entry with "OK".

Result

The new data block is created. You can find the data block in the project tree in the "Program blocks" folder.

Note

You can select the "Add new and open" check box at the bottom of the dialog box. As a result, the block will be opened immediately after it is created.

See also

Instance data blocks (Page 347)
Programming data blocks (Page 510)
Global data blocks (DB) (Page 347)

7.2.3.1 Using blocks from libraries

You can save blocks in the project library or in a global library, so that you can use them more than once within a user program.

Requirement

- The "Libraries" task card is displayed.
- No write protection is set for global libraries.

Adding blocks to the project library or to a global library

To add new blocks to the project library or to a global library, proceed as follows:

1. Select the block that you want to add to the library.
2. Use a drag-and-drop operation to move the selected block to the book symbol of the library in the library pane in the "Libraries" task card. Don't release the left mouse button until a small plus sign appears underneath the mouse pointer.

Using blocks of the project library or a global library

To use a block from the project library or a global library in your project, proceed as follows:

1. Maximize the project library or the global library, so that you can see the elements of the library.
2. Use a drag-and-drop operation to move the block to the CPU block folder. If the selected insertion points is not allowed, the mouse pointer will appear as a circle with a slash.

See also

Working with libraries (Page 177)
Opening a global library (Page 183)

7.2.3.1 Copying and pasting blocks

7.2.3.1 Principles of copying and inserting blocks

Function

You can also create new blocks by copying existing blocks and pasting the copy. Observe the following principles when using this method:

- You can copy organization blocks (OBs), functions (FCs), function blocks (FBs), and global data blocks (DBs) without restriction.
- You can copy instance data blocks only for the same function block, since the assignment to the function block cannot be changed afterwards. However, the assignment is canceled if you copy the instance data block to a different CPU. If a function block with the same number exists there, the instance data block will be assigned to this function block. If you copy the instance data block together with the function block into the other CPU, the instance data block is assigned to the copy of the function block.

Copying data

With paste, all the block data is copied and forwarded to the copy. This data includes:

- Block interface tags
- All networks
- Comments in all existing compilations
- Interrupts defined in the block
- The entire program code of the copied block including the call instructions contained in the block.

  However, called blocks and their associated instance data blocks are not copied.

Avoiding name conflicts during pasting

When pasting copied blocks with identical names to already existing blocks, the following mechanisms are used to avoid name conflicts:

- Pasting the copied block into the same CPU:

  The copy of the block gets a name that is extended by a number. For example, if block "A" is copied, a possible name for the copy is "A_1". Consecutive numbering is not used, but rather the smallest free number. The copy of block "A" can also get the name "A_25", if no lower number is available.
- Pasting the copied block into another CPU:

  A dialog box opens in which you can select whether the block with the same name will be replaced or the copied block will be pasted with a duplicate designation (Name_Number).

Note

Number conflicts may occur, if the pasted block has the same block number as an existing block. The block number is not automatically changed during pasting. This double number may have an effect on block calls. When you copy blocks you should therefore check the block number carefully and correct duplicate block numbers manually or using the block properties.

See also

Copying blocks (Page 411)
Inserting blocks (Page 411)

7.2.3.1 Copying blocks

Requirement

The "Program blocks" folder is opened in the project tree.

Procedure

To copy a block, follow these steps:

1. Right-click the block that you want to copy.
2. Select "Copy" in the shortcut menu.

Result

A copy of the block is now on the clipboard and can be pasted either into the same CPU or into another one.

See also

Principles of copying and inserting blocks (Page 410)

7.2.3.1 Inserting blocks

Requirement

You have copied a block.

Procedure

To paste a copied block and its data into a CPU, proceed as follows:

1. In the project tree, open the folder structure for the CPU into which you want to paste the copied block.
2. Right-click on the "Program blocks" folder.
3. Select "Paste" in the shortcut menu.

- If you are pasting the block into the same CPU as the original block, "_<consecutive number>" will be appended to the name of the copy.
- If you are pasting the block into a different CPU where a block of the same name already exists, the "Paste" dialog box opens. Select the required option and confirm with "OK".

See also

Principles of copying and inserting blocks (Page 410)

7.2.3.1 Entering a block title

The block title is the title of the block. It is not the same thing as the block name, which was assigned when the block was created. The length of the block title is restricted to one row. You can enter the block title for open and closed blocks.

Requirement

A code block is available.

Enter block title for open block

To insert the block title in an open block, proceed as follows:

1. Click "....." in the title bar of the block in program editor.

   The "....." text passage is selected.
2. Enter the block title.

Enter block title for closed blocks

To insert the block title in a closed block, follow these steps:

1. Right-click the block in the project tree.
2. Select the "Properties" command in the shortcut menu.

   The "Properties" dialog box opens.
3. Select the entry "Information" in the area navigation.
4. Enter the block title in the "Title" input field.
5. Confirm your entry with "OK".

7.2.3.1 Entering a block comment

You can use the block comment to document the entire code block. For example, you can indicate the purpose of the block or draw attention to special characteristics. You can enter the block comment for open and closed blocks.

Requirement

A code block is available.

Enter block comment for open blocks

To insert a block comment in an open block, proceed as follows:

1. Click the small arrow in front of the block title.

   The right arrow becomes a down arrow, and the comment area is displayed.
2. Click "Comment" in the comment area.

   The "Comment" text passage is selected.
3. Enter the block comment.

Enter block comments for closed blocks

To insert the block comment in a closed block, follow these steps:

1. Right-click the block in the project tree.
2. Select the "Properties" command in the shortcut menu.

   The "Properties" dialog box opens.
3. Select the entry "Information" in the area navigation.
4. Enter the block comment in the "Comment" input field.
5. Confirm your entry with "OK".

7.2.3.2 Specifying block properties and parameters

7.2.3.2 Basics of block properties and parameters

Block properties

Each block has certain properties, which you can display and edit. These properties are used to:

- Identify the block
- Display the memory requirements and the compilation status of the block
- Display the time stamp
- Display the reference information
- Specify the access protection

Block parameters

Organization blocks have block parameters with which you can assign parameters for specific types of behavior, for example the assignment of an event to an organization block.

See also

Display and edit block properties (Page 415)

Setting the mnemonics (Page 443)

7.2.3.2 Block properties

7.2.3.2 Overview of block properties

Overview

The following table shows the block properties:

Group	Property	Description
General	Name	Unique block name within the station
	Constant name	Name of the constant pasted for the OB in the PLC tag table
	Type	Block type (cannot be changed)
	Number	Block number
	Event class	Event class of an OB (cannot be changed)
	Language	Programming language of the block
Information	Title	Block title
	Comment	Block comment
	Version	Version number of the block
	Author	Name of the author, company name, department name, or other names
	Family	Block family name
	User-defined ID	ID created by the user
Time stamp	Block/data type	Times of creation and time of change of the block (cannot be changed)
	Interface	Time of creation of the block interface (cannot be changed)
	Code/data	Time of change of code/data (cannot be changed)
Compilation	Status	Details of the last compilation run (cannot be changed)
	Lengths	Details of the block lengths (cannot be changed)
Protection	Protection	Know-how protection of the block (cannot be changed)

Group	Property	Description
Attributes	Symbolic access only	Specifies if the tags in the interface of this block are declared purely symbolically without the declaration of an absolute address. You specify this setting as default for the creation of new blocks in the project. You cannot change this setting in existing blocks. See also: General settings for the PLC programming (Page 0)
	IEC Check	The compatibility of the operands in comparison operations and arithmetic operations are tested according to IEC 61131. You have to explicitly convert non-compatible operands. See also: Data type conversion
	Handle errors within block	Error handling inside the block with the GetError or GetErrorID instruction (cannot be changed). See also: Handling program execution errors (Page 507)
	Data block write-protected in the device	Indicates whether the data block is read-only in the target system, and cannot be overwritten while the program is running (for data blocks only)
	Only store in load memory	On activation the data block is stored only in the load memory, occupies no space in the work memory, and is not linked into the program. The "Instructions" task card in the "Move" section offers options for the transfer of data blocks to the work memory. (only for data blocks)
Triggers	Triggers	Assigns the organization block to event by means of which it can be started. (only hardware interrupt OB) See also: Assigning parameters to hardware interrupt OBs (Page 417)
Cyclic interrupt	Cyclic interrupt	Settings for the cyclic interrupt OB See also: Assigning parameters to cyclic interrupt OBs (Page 418)

See also

Display and edit block properties (Page 415)
Symbolic addressing of blocks only (Page 363)
Protecting blocks (Page 536)

7.2.3.2 Display and edit block properties

The properties that can be displayed and edited vary according to the selected block. Properties that can only be displayed are write-protected.

Displaying and editing properties of a closed block

To display and edit the properties of a closed block, proceed as follows:

1. Open the "Program blocks" folder in the project tree.
2. Right-click the block whose properties you want to display or edit.
3. Select the "Properties" command in the shortcut menu.

   The properties dialog box of the block opens.
4. In the area navigation, click a group whose properties you want to display or edit.
5. Change the relevant property.
6. Confirm your entries with "OK".

Displaying and editing properties of an open block

To display or edit the properties of an open block, proceed as follows:

1. In the "View" menu, select the "Inspector window" check box.

   The Inspector window opens.
2. Click the "Properties" tab.
3. Click the title of the block.

   The properties of the block are shown in the "Properties" tab of the Inspector window.
4. In the area navigation, click a group whose properties you want to display or edit.
5. Change the relevant property.

Result

The specific properties of the block will be changed. The changes are not saved until the project is saved.

See also

Overview of block properties (Page 414)

7.2.3.2 Block parameters of organization blocks

7.2.3.2 Basics of block parameters

Introduction

Several organization blocks (OBs) have properties with which you can control their behavior or their assignment to specific events. You can influence these properties by assigning parameters.

Overview

You can assign parameters to the properties for the following organization blocks:

- Hardware interrupt OBs

- Cyclic interrupt OBs

See also

Assigning parameters to hardware interrupt OBs (Page 417)
Assigning parameters to cyclic interrupt OBs (Page 418)

7.2.3.2 Assigning parameters to hardware interrupt OBs

Introduction

You must select the corresponding event and assign the following parameters for every input channel and high-speed counter that should trigger a hardware interrupt:

- Event name
- Number of the hardware interrupt OB that is assigned to this process event

The parameters of the hardware interrupt are assigned in the properties of the corresponding device. You can assign parameters for up to 50 hardware interrupt OBs.

You can create the hardware interrupt OB to be assigned parameters either before or during activation of an event.

Procedure

To assign parameters for the hardware interrupt OB, follow these steps:

1. Double-click the "Devices & Networks" command in the project tree.

   The hardware and network editor opens in the network view.
2. Change to the device view.
3. If the Inspector window closed in the device view, select the "Inspector window" check box in the "View" menu.

   The Inspector window opens.
4. Click the "Properties" tab.
5. In the device view, select the module for which you want to a assign a hardware interrupt.
6. Select the corresponding event.
7. Enter an event name.
8. Select an existing hardware interrupt OB from the "Hardware interrupt" drop-down list.

   Note

   If you have not previously created any hardware interrupt OB, you can click "Add new block" in the drop-down list.

   See also: Creating organization blocks (Page 406)
9. If you want to assign further hardware interrupts, repeat steps 5 to 8.

See also

Basics of block parameters (Page 416)
Organization blocks for hardware interrupts (Page 343)
Events and OBs (Page 323)
CTRL_HSC: Control high-speed counters in FBD (Page 835)

7.2.3.2 Assigning parameters to cyclic interrupt OBs

Introduction

You can use cyclic interrupt OBs to start programs at regular time intervals. To do so you must enter a scan time and a phase shift for each cyclic interrupt OB used.

You can use up to four cyclic interrupt OBs or time-delay OBs (OB numbers >= 200) in your program. If, for example, you are already using two time-delay interrupt OBs, you can insert a maximum of two further cyclic interrupt OBs in your program.

Note

If you assign multiple cyclic OBs, make sure that you assign a different cycle time or phase offset to each cyclic interrupt OB to avoid them executing at the same time or having to queue. When you create a cyclic interrupt OB, the cycle time 100 and the phase offset 0 are entered as the start values.

Procedure

To enter a scan time and a phase shift for a cyclic interrupt OB, proceed as follows:

1. Open the "Program blocks" folder in the project tree.
2. Right-click on an existing cyclic interrupt OB.
3. Select the "Properties" command in the shortcut menu.

   The "<Name of the cyclic interrupt OB>" dialog box opens.
4. Click the "Cyclic interrupt" group in the area navigation.

   The text boxes for the scan time and the phase shift are displayed.
5. Enter the scan time and the phase shift.
6. Confirm your entries with "OK".

See also

Creating organization blocks (Page 406)
Basics of block parameters (Page 416)
Organization blocks for cyclic interrupts (Page 342)

7.2.3.3 Managing blocks

7.2.3.3 Saving blocks

Blocks are always saved together with the project. Faulty blocks can also be saved. This allows the error to be resolved at a convenient time.

Procedure

See also: Saving projects (Page 146)

7.2.3.3 Closing blocks

Procedure

To close a block, follow these steps:

1. Click the "Close" button in the title bar of the program editor.

Notice

Note that the block will not be saved on closing.

7.2.3.3 Renaming blocks

Requirement

The "Program blocks" folder is opened in the project tree.

Procedure

To change the name of a block, follow these steps:

1. Right-click the block that you want to rename.
2. Select the "Rename" command in the shortcut menu.

   The block name in the project tree changes to an input field.
3. Input the new name for the block.
4. Confirm your entry with the Enter key.

Result

The name of the block is now changed at all points of use in the program.

7.2.3.3 Deleting blocks offline

Requirement

The "Program blocks" folder opens in the project tree.

Procedure

To delete a block that exists offline, proceed as follows:

1. In the project tree in the "Program blocks" folder, right-click on the block that you want to delete.
2. Select the "Delete" command in the shortcut menu.
3. Confirm the safety prompt with "Yes".

   The block is deleted offline from the project.

Note

If you are deleting organization blocks, note that events may be assigned to these blocks. If you delete such organization block the program cannot respond to parameterized events.

See also

Downloading blocks (Page 528)

7.2.3.3 Deleting blocks online

Requirement

The "Program blocks" folder of an accessible node is open.

Procedure

To delete a block that exists online, proceed as follows:

1. In the accessible node in the "Program blocks" folder, right-click on the block that you want to delete.
2. Select the "Delete" command in the shortcut menu.
3. Confirm the safety prompt with "Yes".

   The block is deleted in the device.

7.2.4 Programming blocks

7.2.4.1 Program editor

7.2.4.1 Overview of the program editor

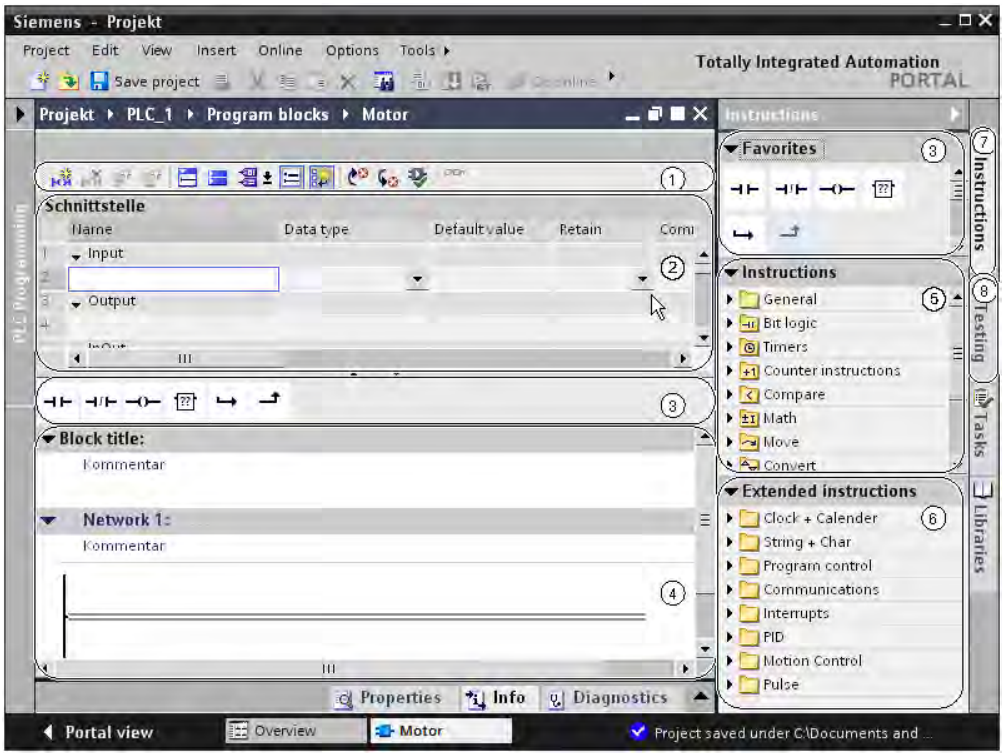
Function of the program editor

The program editor is the integrated development environment for programming functions, function blocks, and organization blocks. If offers comprehensive support for programming and troubleshooting.

The appearance and functionality of the program editor can vary depending on the programming language used.

Structure of the program editor

Using LAD as an example, the following figure shows the components of the program editor:



① Toolbar (Page 422)

② Block interface (Page 423)

③ "Favorites" pane in the "Instructions" task card (Page 424) and Favorites in the program editor (Page 424)

④ Instruction window (Page 427)

⑤ "Instructions" pane in the "Instructions" task card (Page 424)

⑥ "Extended Instructions" pane in the "Instructions" task card (Page 424)

⑦ "Instructions" task card (Page 424)

⑧ "Testing" task card (Page 426)

7.2.4.1 Function bar

Function

The toolbar allows you access the principal functions of the program editor, such as:

- Insert, delete, open, and close networks
- Show and hide absolute operands
- Show and hide network comments
- Showing and hiding favorites
- Skip to syntax errors

- Updating block calls
- Show and hide program status

7.2.4.1 Block interface

Function

The block interface allows local tags to be created and managed.

See also: Declaring the block interface (Page 432) .

Representation

The block interface is shown as table. The number of columns depends on the block type. The following table shows the meaning of the individual columns:

Column	Description
Name	Name of the tags. You can declare the tags in various sections of the block interface. See also: Layout of the block interface (Page 432)
Data type	Data type of the tags.
Default value	Value with which you pre-assign the tag in the interface of the code block. Specification of the default value is optional. If you do not specify any value the predefined value for the indicated data type will be used. For example, the value "false" is predefined for BOOL. The default value is accepted as initial value in the corresponding instance data block. You can replace these values with instance-specific initial values in the instance data block. The column is only available in the interface of function blocks.
Retain	Marks the tag as retentive. The values of retentive tags are retained even after the power supply is switched off. This column is only visible if the block is marked as "symbolic access only". See also: Symbolic addressing of blocks only (Page 363) The column is only available in the interface of function blocks.
Comment	Comments to document the tags.

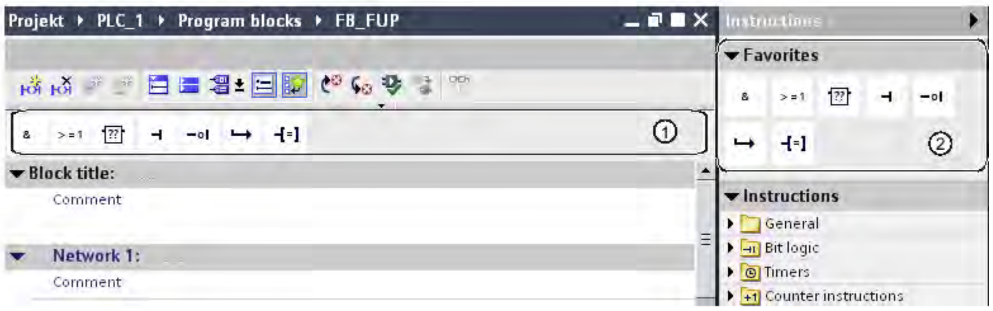
7.2.4.1 Favorites

Function

The favorites provide quick access to the instructions that you use frequently.

The program editor displays the favorites that you created in the "Instructions" task card. This allows you to access these favorites even when you either have another task card in the foreground or you have closed all task cards. You can show and hide the favorites using the program editor toolbar.

The following figure shows the favorites in the "Favorites" pane of the "Instructions" task card and in the program editor:



① Favorites in the program editor

② Favorites in the "Favorites" pane of the "Instructions" task card

See also

Adding elements to Favorites (Page 0)

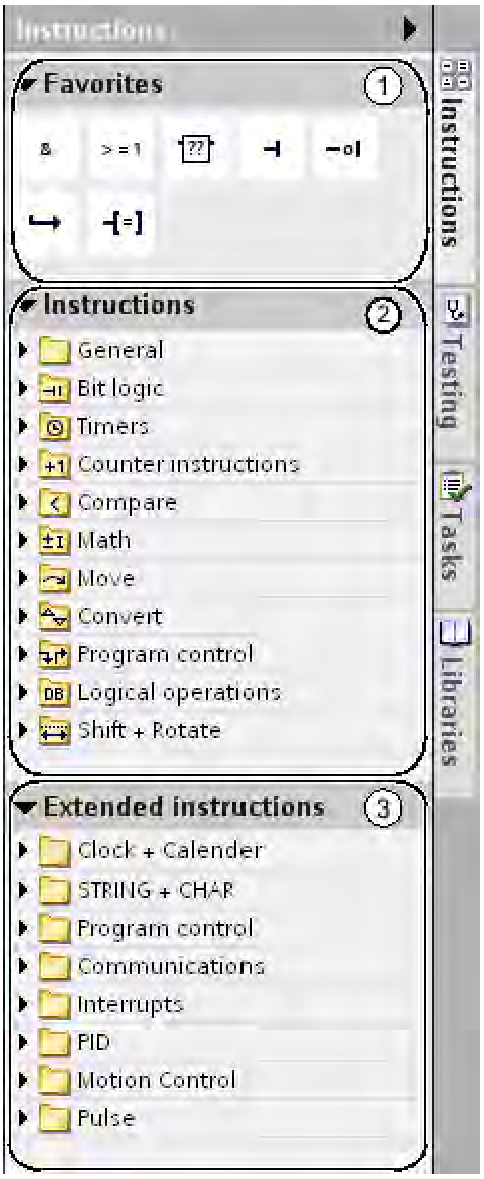
7.2.4.1 "Instructions" task card

Function

The "Instructions" task card offers you easy access to all operations that you can use when creating your program.

Layout of the "Instructions" task card

The "Instructions" task card consists of the following components:



①	"Favorites" pane
②	"Instructions" pane
③	"Extended instructions" pane

See also

Inserting LAD elements using the "Instructions" task card (Page 452)
Inserting FBD elements using the "Instructions" task card (Page 484)

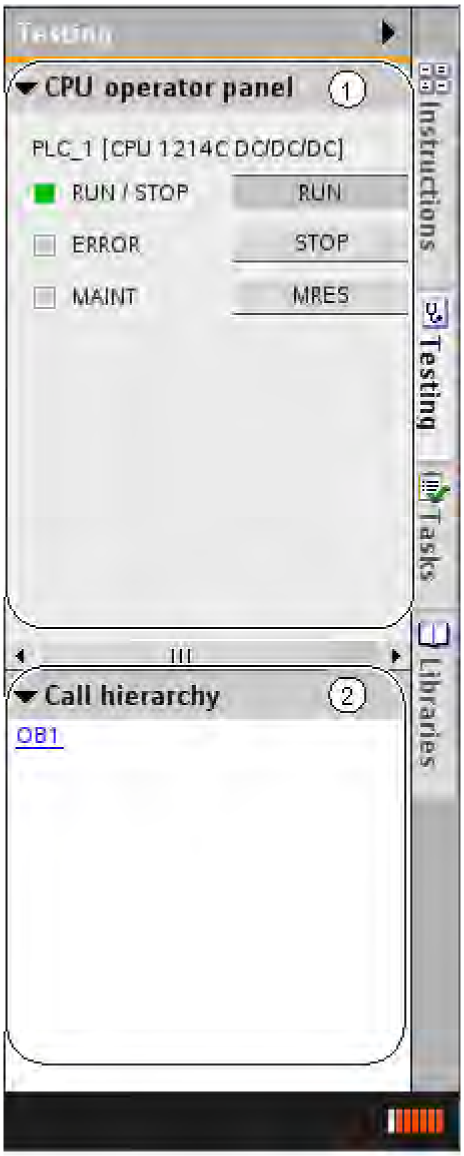
7.2.4.1 "Testing" task card

Function of the testing task card

In the testing task card, you can make settings for troubleshooting using the program status. The functions of the "Test" task card are only available in online mode.

Layout of the testing task card

The testing task card consists of the following components:



① CPU control panel

② Call hierarchy

CPU control panel

In the CPU control panel you can switch the CPU operating mode.

See also: Changing the mode of a CPU (Page 293)

Call hierarchy

In this pane you can trace the call hierarchy of the blocks. You only see the call hierarchy during the monitoring of the blocks.

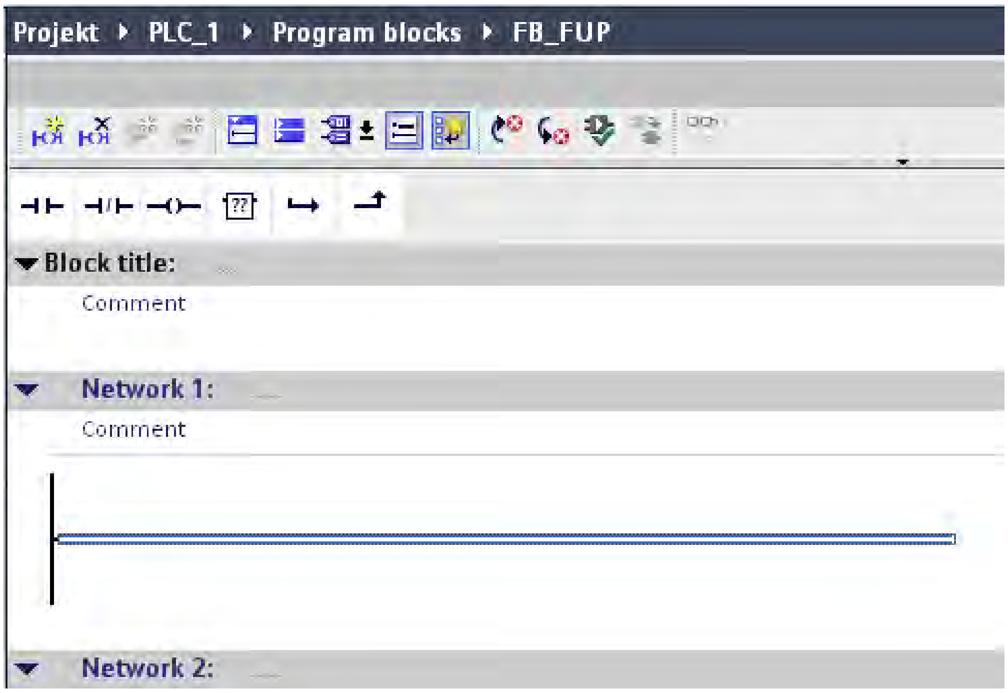
7.2.4.1 Instruction window

Function

The instruction window is the work area of the program editor. You can perform the following tasks here:

- Creating and managing networks
- Entering titles and comments for blocks and networks
- Entering program code

The following figure shows the instruction window of the program editor:



See also

Creating program code (Page 443)

7.2.4.1 Enlarge the working area of the instruction window

Introduction

When all components of the application are shown, the area of the instruction window is relatively small. If the program code is large, you may find you have to rearrange the work area constantly. To avoid this problem, you can hide or minimize the display of the following components of the application and of the program editor:

- Project tree
- Task cards
- Block interface
- Favorites
- Comments
- Networks

Hiding and showing the project tree

The project tree allows you to access all areas of the project. It is therefore displayed after a project has been opened. You can hide the project tree while you are creating a program to gain more area for the instruction window.

To show and hide the project tree, proceed as follows:

1. Select the "Project tree" check box in the "View" menu, or click "Collapse" on the project tree title bar.

Opening and closing task cards

The task cards are located at the right-hand edge of the application window.

To open or close the task cards, proceed as follows:

1. Select the "Task card" check box in the "View" menu, or click "Collapse" or "Expand" on the task cards title bar.

Hiding and showing the block interface

After a block has been opened, the block interface is shown in the upper area of the program editor. During programming you can show and hide it as required.

To show and hide the block interface, proceed as follows:

1. In the lower part of the interface within the window splitter, click on the Up arrow or Down arrow.

Showing and hiding favorites

To hide or show the favorites in the program editor, proceed as follows:

1. Click the "Show favorites also in the editor" button in the program editor toolbar.

Showing and hiding comments

Within a block you can enter a comment for the block or for each network. These two types of comments are shown and hidden differently.

To show or hide a block comment, proceed as follows:

1. Click the the triangle at the start of the line with the block title.

To show or hide network comments, proceed as follows:

1. Click "Network comments on/off" on the program editor toolbar.

Opening and closing networks

You can open or close the networks in your program either individually or collectively.

To open or close networks, follow these steps:

1. If you want to open a network, click the right arrow in front of the network title. If you want to close a network, click the down arrow in front of the network title.

To open and close networks, proceed as follows:

1. Click "Open all networks" or "Close all networks" in the program editor toolbar.

7.2.4.1 Using the keyboard in the program editor

Navigate in the network

Function	Selected object	Keyboard shortcut
Navigate between objects in the network.	Object in the network	Arrow keys

Edit instructions (LAD/FBD)

Function	Selected object	Keyboard shortcut
Delete an operation.	Operation	<Del>

Enter operands (LAD/FBD)

Function	Selected object	Keyboard shortcut
Enable the input field for the first operand of the operation.	Operation	<Enter> Or <Any letter> <Return> opens an empty input field; with any other letter, this letter will be entered in the input field.

Function	Selected object	Keyboard shortcut
Enable input field for the operand.	Operand	<F2>
Delete value of the operand.		<Del>
Define tag		<Alt+Shift+D>
Entering operands	Input field for operands	<Any letters/numbers>
Confirm entry of the operand.		<Enter>
Open operand selection.		<Ctrl+I>
Discard current change.		<Esc> The input field is deactivated and the previous content restored.

See also

Keyboard shortcuts for project editing (Page 132)
Keyboard shortcuts in the project tree (Page 133)
Keyboard shortcuts for windows (Page 133)
Keyboard shortcuts in tables (Page 134)
Keyboard shortcuts for text editing (Page 135)

7.2.4.1 General settings for the PLC programming

7.2.4.1 Overview of the general settings

Overview

The following table shows the general settings that you can make:

Group	Setting	Description
View	With comments	Comments are shown
Print	With interface	Block interface is printed out alongside
	With comments	Comments are printed out alongside
	Zoom factor	Scaling of networks for print-out
Compilation	Delete actual parameters on interface update	Actual parameters are deleted if the associated formal parameters were deleted in the called block, and you run the "Update block call" function.

Group	Setting	Description
Default settings for new blocks	IEC Check	The compatibility of the operands in comparison operations and arithmetic operations will be tested. You have to explicitly convert non-compatible operands.
	Symbolic access only	Tags in the interface of this block are declared purely symbolically without the declaration of an absolute address and therefore can be addressed only symbolically.
Additional settings	Display operand selection	The operand selection is displayed
	Mnemonics	German and international representation of the instructions

See also

Changing the settings (Page 0)
Inserting operands into LAD instructions (Page 0)
Inserting operands into FBD instructions (Page 495)
Permissible addresses and data types of PLC tags (Page 396)

7.2.4.1 Changing the settings

Procedure

To change the settings, proceed as follows:

1. Select the "Settings" command in the "Options" menu.

   The "Settings" window is displayed in the work area.
2. In the area navigation, select the "PLC programming" group.
3. Change the settings.

Result

The change will be loaded directly, there is no need to save it explicitly.

7.2.4.2 Programming code blocks

7.2.4.2 Declaring the block interface

7.2.4.2 Layout of the block interface

Definition

See also: Block interface (Page 423)

The interface contains the declarations of local tags that are used solely within the block. The tags are subdivided into two groups:

- Block parameters that form the block interface when it is called in the program.
- Local data that are used for storage of intermediate results.

The block interface is shown as a table in the upper part of the program editor.

Block parameters

The following table shows the types of block parameters:

Type	Section	Function	Available in
Input parameters	Input	Parameters whose values are read by the block.	Functions, function blocks and some types of organization blocks
Output parameters	Output	Parameters whose values are written by the block.	Functions and function blocks
InOut parameters	InOut	Parameters whose values are read by the block when it is called, and whose values are written again by the block after execution.	Functions and function blocks

Local data

The following table shows the types of local data:

Type	Section	Function	Available in
Temporary local data	Temp	Tags that are used to store temporary intermediate results. Temporary local data are retained for only one cycle.	Functions, function blocks and organization blocks

Type	Section	Function	Available in
Static local data	Static	Tags that are used for storage of static intermediate results in the instance data block. Static data is retained until overwritten, which may be after several cycles.	Function blocks

7.2.4.2 Purpose of local tag declaration

Purpose of tag declaration

You use tag declaration to define the names and data types of tags that you want to use in the block.

In the function blocks you can assign default values for the block parameters and static local data.

Effect of tag declaration

Tag declaration has the following effects:

- Tag declaration for a function block reserves memory space in the instance DB.
- Tag declaration for a code block determines the call interface of the function block in the program.
- Tag declaration for a function block determines the data structure of each instance DB that is assigned to the FB.

See also

PLC tags and local tags (Page 365)
Block interface (Page 423)

7.2.4.2 Rules for local tags

7.2.4.2 Valid data types in the code block interfaces

Valid data types for the interface of organization blocks

The following rules apply to the interface of an organization block:

- The TEMP and INPUT sections can contain elementary and complex data types as well as the VARIANT data type. Other parameter types are not permissible.
- An organization block does not have input, output, or in/out parameters, since it is not called by other blocks.
- An organization block has no static tags, since it has no instance DBs.

The following table shows the valid data types for the interface of an organization block:

Section	Elementary data types	Complex data types	VARIANT parameter type
Temp	♦	♦	♦
Input	♦	♦	♦

♦: valid assignment

-: invalid assignment

Valid data types for the interface of function blocks

The following rules apply to the interface of a function block:

- Elementary and complex data types, as well as the VARIANT parameter type, are permissible when declaring the input parameters.
- No parameter types are permissible when declaring the output parameters.
- Only VARIANT is permitted as a parameter type when declaring in/out parameters.
- Only the VARIANT parameter type is permitted for the declaration of temporary tags. All other parameter types are invalid.

The following table shows the valid data types for the interface of a function block:

Section	Elementary data types	Complex data types	VARIANT parameter type
Input	♦	♦	♦
Output	♦	♦	-
InOut	♦	♦(3)	♦
Static	♦	♦	-
Temp	♦	♦	♦

♦: valid assignment

-: invalid assignment

(3) STRING can be defined only in default length of 254 characters.

Valid data types for the interface of a function

The following rules apply to the interface of a function:

- A function has no static tags, since it does not have an instance DB.
- Only the VARIANT parameter type is permitted in the Input, Output, and InOut sections. All other parameter types are prohibited.

- The TEMP section can contain elementary and complex data types as well as the VARIANT data type. Other parameter types are not permissible.

The following table shows the valid data types for the interface of a function:

Section	Elementary data types	Complex data types	VARIANT parameter type
Input	♦	♦(2)	♦
Output	♦	♦(2)	♦
InOut	♦	♦(2)	♦
Temp	♦	♦	♦

♦: valid assignment

-: invalid assignment

(2) STRING can be defined only in default length of 254 characters.

7.2.4.2 Declaring local tags

7.2.4.2 Declaring local tags in the block interface

Requirement

The block is open.

Procedure

To declare a tag of the elementary data type, follow these steps:

1. Select the appropriate section in the interface:
   - Input
   - Output
   - InOut
   - Static
   - Temp

   See also: Layout of the block interface (Page 432)

   Enter a tag name in the "Name" column.
2. Click the arrow key in the "Data type" column and select the desired data type.

   The default initial value for this data type will be entered in the "Default value" column.
3. If necessary, change the default value.

Result

The tag is created.

Syntax check

A syntax check is performed after each entry, and any errors found are displayed in red. You do not have to correct these errors immediately - you can continue editing and make any corrections later. However, you will not be able to compile the program if the tag declaration contains syntax errors.

Note

If you change the interface of a block, you then also have to change all the locations in the program where this block is called.

The call locations are updated automatically if you select the "Program blocks" folder in project tree and compile it.

See also

Inserting a table row in the interface (Page 0)
Adding table rows at the end (Page 0)
Keyboard shortcuts in tables (Page 134)
Editing the block interface (Page 0)
Basic information on initial values (Page 515)

7.2.4.2 Declaring local tags directly in the program editor

Requirement

One or more operands are used in the program.

Procedure

To declare an operand as a local tag, follow these steps:

1. Select one or more operands.
2. Select the "Define tag" command in the shortcut menu.

   The "Define tag" dialog box opens. This dialog box displays a declaration table in which the name of the selected operand is already entered.
3. Position the cursor in the "Section" column.

   An arrow button is displayed.
4. Click the arrow button.
5. To declare a local tag, select one of the following sections:

- Local In
- Local Out
- Local InOut
- Local Static
- Local Temp

6. In the other columns, enter data type and comments.
7. Click the "Define" button to complete your entry.

Result

The declaration is written directly into the block interface and is valid within the entire block.

Note

If you change the interface of a block, you then also have to change all the locations in the program where this block is called.

The call locations are updated automatically if you select the "Program blocks" folder in project tree and compile it.

7.2.4.2 Declaring tags of ARRAY data type

Requirement

The block is open.

Procedure

To declare a tag of the ARRAY data type, follow these steps:

1. Enter a tag name in the "Name" column in the interface.
2. In the "Data type" column, click the arrow key and select the data type "Array [o .. hi] of type".
3. Then enter the desired dimensions in the same column, showing high limit and low limit and the data type. (for example, ARRAY [1..10] of Bool). A space must be inserted between the closing square bracket and the keyword "of" and also between "of" and the data type information for the ARRAY elements.

Note

You cannot define specific default values for ARRAY elements. You can, however, assign them a start value in the instance data block.

See also

Format of ARRAY (Page 384)
Example of a one-dimensional ARRAY (Page 385)

7.2.4.2 Declaring tags of STRUCT data type

Requirement

The block interface is open.

Procedure

To declare a tag of the STRUCT data type, follow these steps:

1. Enter a tag name in the "Name" column.
2. In the "Data type" column, click the arrow key and select the "Struct" entry.

   Two empty rows are inserted after the new tag.
3. Insert the first structure element in the first empty row.

   An additional empty row is inserted after the element.
4. Select a data type for the structure element.
5. Optionally, enter a default value for the structure element.
6. Repeat the step 3 to 5 for all additional structure elements.

   It is not necessary to end the structure explicitly. The structure ends with the last element that is entered.
7. To insert a new tag after the structure, leave a blank row after the end of the structure and then start the new tag in the second empty row.

See also

STRUCT (Page 386)

7.2.4.2 Changing the names of local tags

You can change the name of a local tag at the following locations:

- in the block interface
- directly in the program editor

Procedure

To change the name of a local tag, follow these steps:

1. Select the tag in the block interface.
2. Change the entry in the "Name" column.

Or

1. Select the tag at its point of use in the program.
2. Select the "Rename tag" command in the shortcut menu.

   The "Rename tag" dialog box opens.
3. Change the entry in the "Name" column.

Result

The name of the tag is changed automatically at all points of use in the program.

7.2.4.2 Changing the data types of local tags

You can change the data type of a local tag in the block interface.

Procedure

To change the data type of a tag, follow these steps:

1. Select the tag in the block interface.
2. Click the arrow button in the "Data type" column.

   A selection of the permissible data types is displayed. The selection depends on the block type and section.

   See also: Valid data types in the code block interfaces (Page 433)
3. Select one of the displayed data types.
4. If required, change the default value of the tag.

Result

The data type is changed.

7.2.4.2 Defining the default values of local tags

You can define a default value for each tag in the interface of a function block. These default values are used as initial values during the creation of the instance data block. You can then replace these values with instance-specific initial values in the instance data block.

In the block interface you cannot assign any default values for tags of ARRAY data type.

Requirement

A tag name is entered in a row of the interface.

Procedure

To change the default value of a tag, follow these steps:

1. Click the "Default value" column in the block interface.
2. Enter a default value that is appropriate for the indicated data type.

Note

If you do not enter a default value, the standard value for the indicated data type will be used. For example, the default value for the BOOL data type is "False".

See also

Basic information on initial values (Page 515)

7.2.4.2 Setting the retentivity of local tags

7.2.4.2 Retentive behavior and symbolic addressing of code blocks

Symbolic access of blocks

You have the option of defining blocks as "Symbolic access only". If the setting is set to "symbolic access only", the tags of a block can be declared purely symbolically without the specification of an absolute address.

Retentive behavior of local tags.

The option of setting the retentivity depends on the set addressability of the block.

- In blocks that can only be accessed symbolically, you can define individual tags as retentive.
- In blocks that can be accessed otherwise, you cannot make retentivity settings for the individual tags in the block interface. You can only defined the assigned instance data block as retentive. All tags contained in the block are then considered as retentive.

The following table provides an overview of the possible settings:

Block type	Block property "Symbolic access only" enabled	Block property "Symbolic access only" disabled
FB	The retentivity can be set for individual tags.	The retentivity cannot be set.
Instance DB	The retentivity setting is made by the higher-level code block.	The retentivity can be set for the entire instance DB.

See also

Symbolic addressing of blocks only (Page 363)

7.2.4.2 Setting the retentive behavior of local tags in a function block

Introduction

If symbolic access is enabled, you can set the retentive behavior of each individual tag in one function block. The "Retentivity" column of the block interface provides a drop-down list with the following selection options for this:

- Retain

  The tag is defined as retentive. This setting is accepted by the assigned instance data block and cannot be changed in this block.
- Non-retain

  The tag is defined as non-retentive. This setting is accepted by the assigned instance data block and cannot be changed in this block.

If you make no setting, the tags are defined as non-retentive.

Requirement

- The symbolic access of the tags in enabled in the opened function block.
- Tags are declared in the block interface

Procedure

To set the retentive behavior of a local tag, follow these steps:

1. In the "Retain" column, select the cell of a tag for which you want to set the retentive behavior.
2. Click the arrow on the right border of the cell.

   The drop-down list with the entries "Retain" and "Non-retain" opens.
3. Select the required setting from the drop-down list.

7.2.4.2 Editing the properties of local tags

7.2.4.2 Editing the properties of local tags

You can find a description of the properties of local tag on the following page:

Layout of the block interface (Page 432)

Editing properties in the block interface

To edit the properties of one or more tags, follow these steps:

1. Open the block interface.
2. Change the entries in the "Name", "Comments" and other columns.

Renaming tags directly in the program editor

To rename one or more tags, follow these steps:

1. Select one or more tags in the program.
2. Select the "Rename tag" command in the shortcut menu.

   The "Rename tag" dialog box opens. This dialog box displays a declaration table with the selected tags.
3. Change the entries in the "Name" column.
4. Confirm the input by clicking the "Change" button.

7.2.4.2 Editing the block interface

7.2.4.2 Deleting entries in the PLC tag table

Procedure

To delete a tag, proceed as follows:

1. Select the row with the tag to be deleted. You can also select several rows by clicking on them one after the other while holding down the <Ctrl> key or by pressing and holding down <Shift> and clicking on the first and last row.
2. Select the "Delete" command in the shortcut menu.

See also

Adapting tables (Page 131)
Keyboard shortcuts in tables (Page 134)

7.2.4.2 Inserting table rows

Procedure

To insert row above the position of the mouse pointer, proceed as follows:

1. Position the mouse pointer in the row above which you want to insert a new row.
2. Click the "Insert row" button on the toolbar of the table.

   A new row is inserted above the selected row.

See also

Keyboard shortcuts in tables (Page 134)
Adapting tables (Page 131)

7.2.4.2 Adding table rows at the end

Procedure

To add a new row at the end of the table or at the end of a complex data type, follow these steps:

1. Click the "Add row" button on the table toolbar.

   A new empty row will be added at the end of the table or at the end of a complex data type.

See also

Keyboard shortcuts in tables (Page 134)
Adapting tables (Page 131)

7.2.4.2 Creating program code

7.2.4.2 Setting the mnemonics

You can program blocks using German or international mnemonics. If you open the TIA portal for the first the international mnemonics is set as default. You can change the mnemonics at any time.

Procedure

To set the mnemonics, follow these steps:

1. Select the "Settings" command in the "Options" menu.

   The "Settings" window is displayed in the work area.
2. Select the "General" group in the area navigation.
3. In the "General settings" group, select the mnemonics that you want to use.

   The mnemonics is changed in all blocks.

7.2.4.2 Creating LAD programs

7.2.4.2 Basic information on LAD

7.2.4.2 LAD programming language

Overview of the Ladder Logic (LAD) programming language

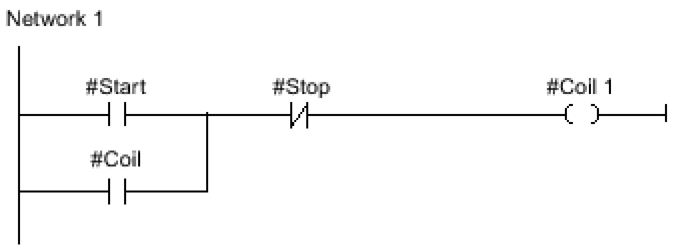
LAD is a graphical programming language. The representation is based on circuit diagrams.

The program is mapped in one or more networks. On both the left and right edge the network contains one power rail from which the rungs go out. The binary signals are arranged in the form of contacts on the rungs. The serial arrangement of the elements on a branch creates a series connection, the arrangement on simultaneous branches creates a parallel connection. Complex functions are represented by boxes.

A rung is closed by a coil in which the result of logic operation is written.

Example of networks in LAD

The following figures shows a LAD network with normally open contacts, normally closed contacts and a coil:



7.2.4.2 Overview of the LAD elements

LAD elements

A LAD program consists of separate elements that you can arrange in series or parallel on the power rail of a network. Most program elements must be supplied with tags. For timer and counter operations, a data block must also be created to store the formal parameters.

There is at least one rung from the power rail. The programming of the network start at the left edge of the rung. You can extend a power rail with several rungs and branches.

For example, the following figure shows elements of a LAD network:

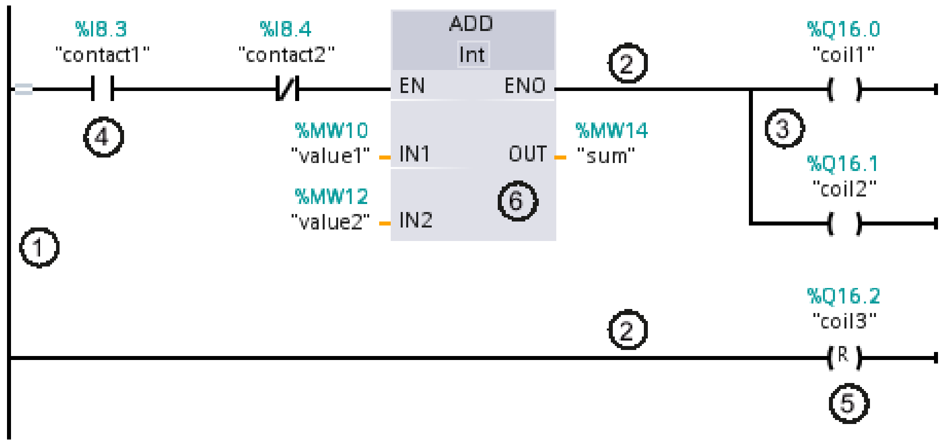


Figure7-2

1) Power rail

2) Rung

3) Branch

4) Contact

5) Coil

6) Box

Power rail

Each LAD network consists of a power rail that contains at least one rung. A network can be extended by adding additional rungs. You can use branches to program parallel connections in the specific rungs.

Contacts

You can use contacts to create or interrupt a current-carrying connection between two elements. In such cases the elements can be the LAD program elements or the edges of the power rail. The current is relayed from left to right. You can use contacts to query the signal state or the value of an operand and control it depending on the result of the current flow.

The following types of contact are available to you in a LAD program:

- Normally open contacts:
  Normally open contacts forward the current if the signal state of a specified binary operand is "1".
- Normally closed contacts:
  Normally open contacts forward the current if the signal state of a specified binary operand is "0".
- Contact with additional function:
  Contacts with additional function forward the current if a specific condition is met. With these contacts you can also execute an additional function, such as an RLO edge detection and a comparison.

Coils

You can use coils to control binary operands. Coils can set or reset a binary operand depending on the signal state of the result of logic operation.

The following types of coils are available to you in a LAD program:

- Standard coils:
  Standard coils set a binary operand if current flows in the coil. The "Relay coil, output" operation is an example of a standard coil.
- Coils with additional function:
  These coils have additional functions besides the evaluation of the result of logic operation. Coils for RLO edge detection and program control are examples of coils with additional function. In the case of coils for program control, a jump destination is specified instead of an operand.

Boxes

Boxes are LAD elements with complex functions. The empty box is an exception. You can use the empty box as a placeholder in which you can select the required operation.

The following types of boxes are available to you in a LAD program:

- Boxes without EN/ENO mechanism:
  A box is executed depending on the signal state at the box inputs. The error status of the processing cannot be queried.
- Boxes with EN/ENO mechanism:
  A box is only executed if the enabling input "EN" carries the signal state "1". If the box is processed correctly, the "ENO" enable output has signal state "1". If an error occurs during the processing, the "ENO" output is reset.

Calls of code block are also shown in the network as boxes with EN/ENO mechanism.

See also

Rules for the use of LAD elements (Page 451)

7.2.4.2 Settings for LAD

7.2.4.2 Overview of the settings for LAD

Overview

The following table shows the settings that you can make:

Group	Setting	Description
Font	Size	Font size in program editor
View	Layout	Compact or wide Changes the vertical spacing between operands and other objects (such as operand and contact). The change becomes visible once the block is reopened.
	With absolute information	Additional display of the absolute addresses
Operand field	Maximum width	Maximum number of characters that can be entered horizontally in the operand field
	Maximum height	Maximum number of characters that can be entered vertically in the operand field

7.2.4.2 Changing the settings

Procedure

To change the settings, proceed as follows:

1. Select the "Settings" command in the "Options" menu.

   The "Settings" window is displayed in the work area.
2. In the area navigation, select the "PLC programming" group.
3. Change the settings.

Result

The change will be loaded directly, there is no need to save it explicitly.

7.2.4.2 Working with networks

7.2.4.2 Using networks

Function

The user program is created in the block within networks. For a code block to be programmed, it must contain at least one network. To achieve a better overview of the user program, you can also subdivide your program into several networks.

See also

Inserting networks (Page 0)
Selecting networks (Page 0)
Copying and inserting networks (Page 0)
Deleting networks (Page 0)
Expanding and collapsing networks (Page 0)

7.2.4.2 Inserting networks

Requirement

A block is open.

Procedure

To insert a new network, follow these steps:

1. Select the network after which you want to insert a new network.
2. Select the "Insert network" command in the shortcut menu.

Note

If you insert an element into the last (and still empty) network of the block in an LAD or FBD program, a new empty network is automatically inserted below it.

Result

A new empty network is inserted into the block.

See also

Using networks (Page 0)

7.2.4.2 Selecting networks

Requirement

A network is available.

Selecting a network

To select a network, follow these steps:

1. Click the title bar of the network that you want to select.

Selecting several networks

To select several networks, follow these steps:

1. Press and hold down the <Ctrl> key.
2. Click all the networks that you want to select.

To select several successive networks, follow these steps:

1. Press and hold down the <Shift> key.
2. Click the first network that you want to select.
3. Click the last network that you want to select.

   The first and last networks and all those in between are selected.

See also

Using networks (Page 0)

7.2.4.2 Copying and inserting networks

Copied networks can be pasted within the block or in another block. If the network is pasted into a block written in a different programming language, the programming language of the network is retained.

Prerequisite

A network is available.

Procedure

To copy and paste a network, follow these steps:

1. Select the network or networks to be copied.
2. Select "Copy" in the shortcut menu.
3. Select the network after which you want to paste the copied network.
4. Select "Paste" in the shortcut menu.

Note

You can also copy networks from one block to another.

See also

Using networks (Page 0)

7.2.4.2 Deleting networks

Requirement

A network is available.

Procedure

To delete a network, follow these steps:

1. Select the network that you want to delete.
2. Select the "Delete" command in the shortcut menu.

See also

Using networks (Page 0)

7.2.4.2 Expanding and collapsing networks

Requirement

A network is available.

Opening and closing a network

1. Select the network that you want to open or close.
2. Select "Expand" or "Collapse" in the shortcut menu.

Opening and closing all networks

1. Click "Open all networks" or "Close all networks" in the toolbar.

See also

Using networks (Page 0)

7.2.4.2 Entering the network title

The network title is the header of a network. The length of the network title is unrestricted, but it cannot occupy more than one line.

Requirement

A network is available.

Procedure

To enter a network title, follow these steps:

1. Double-click "....." in the title bar of the network.

   The "....." text passage is selected.
2. Enter the network title.

7.2.4.2 Entering network comments in LAD networks

You can use network comments to document individual networks. For example, you can indicate the function of the network or draw attention to special characteristics.

Requirement

A network is available.

Procedure

To enter a network comment, follow these steps:

1. Click the small arrow in front of the network title.

   The right arrow becomes a down arrow.
2. If the comment area is not visible, click "Network comments on/off" in the toolbar.

   The comment area is displayed.
3. Click "Comment" in the comment area.

The "Comment" text passage is selected.

4. Enter the network comment.

7.2.4.2 Inserting LAD elements

7.2.4.2 Rules for the use of LAD elements

Rules

Note the following rules when inserting LAD elements:

- Every LAD network must terminate with a coil or a box. However, the following LAD elements must not be used to terminate a network:
  - Comparator boxes
  - Coils for positive or negative RLO edge detection
- The starting point of the branch for a box connection must always be the left power rail. Logic operations or other boxes can be present in the branch before the box.
- Coils are automatically placed on the right edge of the network, where they are used to terminate a branch. Coils for positive or negative RLO edge detection are an exception. These can be positioned neither at the far left nor the far right of the branch. Nor are they permissible in additional branches.
- Only contacts can be inserted into simultaneous branches with preceding logic operations. The contact for negating the result of logic operation (-|NOT|-) is an exception here. The contact for negating the result of logic operation, as well as coils and boxes, can be used in simultaneous branches if they originate directly from the power rail.
- Operations for positive or negative RLO edge detection may not be arranged directly at the left edge of the power rail.
- Jump operations can be positioned only at the end, RET can also be positioned at the start.
- Enable input "EN" and enable output "ENO" can be connected to boxes, but this is not mandatory.
- Constants (e.g. TRUE or FALSE) cannot be assigned to normally open or normally closed contacts. Instead, use the operands of the BOOL data type.

For information on where you can insert LAD elements on the power rail, refer to the LAD reference help.

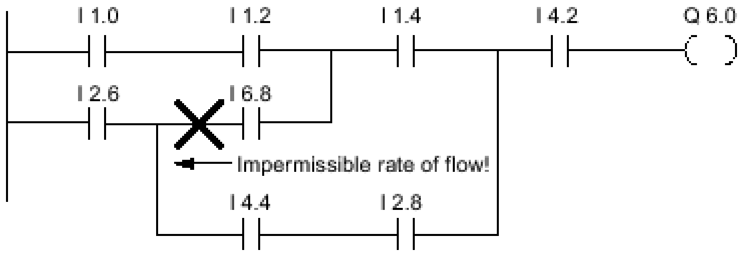
See also

EN/ENO mechanism (Page 359)
Prohibited interconnections in LAD (Page 452)
Overview of the LAD elements (Page 444)

7.2.4.2 Prohibited interconnections in LAD

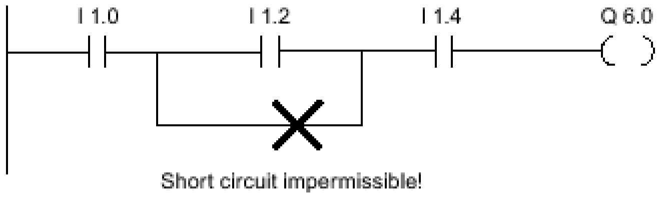
Power flow from right to left

No branches can be programmed that could result in a power flow in the reverse direction.



Short-circuit

No branches may be programmed that would cause a short-circuit.



Logic operations

The following rules apply to logic operations:

- Only Boolean inputs can be combined with preceding logic operations.
- Only the first Boolean output can be combined with a further logic operation.
- Only one complete logical path can exist per network. Paths that are not connected can be linked.

See also

Rules for the use of LAD elements (Page 451)

7.2.4.2 Inserting LAD elements using the "Instructions" task card

Requirement

A network is available.

Procedure

To insert a LAD element into a network using the "Instructions" task card, follow these steps:

1. Open the "Instructions" task card.
2. Navigate to the LAD element that you want to insert.
3. Use a drag-and-drop operation to move the element to the desired place in the network.

If the element is a function block (FB) within the system, the data of the function block must be stored in a data block. The "Call options" dialog box is therefore opened, in which you can create the corresponding data block.

Or

1. Select the point in the network at which you want to insert the element.
2. Open the "Instructions" task card.
3. Double-click on the element you want to insert.

   If the element is a function block (FB) within the system, the data of the function block must be stored in a data block. The "Call options" dialog box is therefore opened, in which you can create the corresponding data block.

Result

The selected LAD element is inserted with placeholders for the parameters.

See also

Inserting LAD elements using an empty box (Page 453)
Inserting LAD elements using favorites (Page 0)

7.2.4.2 Inserting LAD elements using an empty box

Requirement

A network is available.

Procedure

To insert an LAD element into a network using an empty box, follow these steps:

1. Open the "Instructions" task card.
2. Navigate to "General > Empty box".
3. Use a drag-and-drop operation to move the "Empty box" element to the desired place in the network.
4. Hover the cursor over the yellow triangle in the top right corner of the empty box.

   A drop-down list is displayed.
5. Select the desired LAD element from the drop-down list.

Result

The empty box is changed to the respective LAD element. Placeholders are inserted for the parameters.

See also

Inserting LAD elements using the "Instructions" task card (Page 452)
Inserting LAD elements using favorites (Page 0)

7.2.4.2 Selecting the data type of a LAD element

7.2.4.2 Selecting a data type

Introduction

Some operations can be executed with several different data types. If one of these operations is used in the program, a valid data type must be specified for the operation at the specific point in the program. Data types for the inputs and outputs must be explicitly selected for some operations.

Note

The valid data type (BOOL) for the tags on the enable input ENO and the enable output ENO is predefined by the system and cannot be changed.

The valid data types for an operation are listed in the drop-down list of the operation. You specify the data type of the operation by selecting an entry from the drop-down list. If the data type of a indicated tag deviates from the data type of the operation, the tag name is displayed in red.

7.2.4.2 Specifying the data type of an operation

Introduction

Some operations can be executed with several different data types. If such operations have to be inserted in the program a data type has to be specified at a specific point in the program for their execution.

Specifying the data type by means of the drop-down list

To specify the data type of an operation by means of the drop-down list, follow these steps:

1. Insert the operation by drag-and-drop operation at the required point in the program.

   The operation will be inserted at the required point in the program. The entry "???" (undefined) is displayed in the drop-down list.
2. Click the yellow triangle in the upper corner of the drop-down list.

   The drop-down list opens displaying the data types that are valid for the operation.
3. Select a data type from the drop-down list.

   The selected data type is displayed.
4. If the operation has two drop-down list, select the data type for the inputs of the operation in the left drop-down list and the data type for the outputs of the operation in the right drop-down list.

Specifying data type by assigning tags

To specify the data type of an operation by assigning tags, follow these steps:

1. Insert the operation by drag-and-drop operation at the required point in the program.

   The operation will be inserted at the required point in the program. The entry "???" (undefined) is displayed in the drop-down list.
2. At an input or output, specify a valid tag the data type of which is to be accepted as data type of the operation.

   The selected data type is displayed in the drop-down list.
3. If data types have to be specified for the inputs and outputs of the operation, enter a valid tag at an input and a valid tag at an output. The tag specified at the input determines the data type of the inputs and the tag specified at the output determines the data type of the outputs of the operation.

7.2.4.2 Using favorites in LAD

7.2.4.2 Adding elements to Favorites

Requirement

A block is open.

Procedure

To add elements to Favorites, follow these steps:

1. Open the "Instructions" task card.
2. Maximize the "Instructions" pane.
3. Navigate in the "Instructions" pane to the element that you want to add to the favorites.
4. Drag the element to the "Favorites" pane or to the Favorites area in the program editor.

See also

Inserting FBD elements using favorites (Page 0)

7.2.4.2 Inserting LAD elements using favorites

Requirement

- A network is available.
- Favorites are available.

Procedure

To insert an element into a network using favorites, follow these steps:

1. If the Favorites are not displayed in the program editor, click the "Show favorites also in the editor" button in the program editor toolbar.

   The Favorites are displayed under the block interface.
2. Drag the desired element from Favorites to the network.

Or

1. Select the point in the network at which you want to insert the element.
2. In the Favorites, click on the element you want to insert.

See also

Adding elements to Favorites (Page 0)
Inserting FBD elements using the "Instructions" task card (Page 484)
Inserting FBD elements using an empty box (Page 485)

7.2.4.2 Removing elements from Favorites

Prerequisites

A code block is open.

Procedure

To remove elements from Favorites, follow these steps:

1. Either open the "Favorites" pane in the "Instructions" task card or click the "Show favorites also in the editor" button in the program editor in the toolbar to show the favorites.
2. Right-click the element that you want to remove.
3. Select the "Remove instruction" command in the shortcut menu.

7.2.4.2 Insert block calls in LAD

7.2.4.2 Inserting block calls using drag & drop

You can insert calls for existing functions (FC) and function blocks (FB) using a drag-and-drop operation from the project tree. If you call function blocks from other function blocks, you can call these either as single instance or as multi-instance.

Requirement

- A network is available.
- The block that is to be called is available.

Inserting a call of a function (FC)

To insert a call of a function (FC) into a network using a drag-and-drop operation, follow these steps:

1. Drag the function from the project tree into the network.

Inserting a call of a function block (FB) as a single instance

You can call a function block as a single instance. In this case, the called function block stores its data in a data block of its own.

See also: Single instances (Page 350)

To insert the call for a function block (FB) into a network as a single instance using a drag-and-drop operation, follow these steps:

1. Drag the function block from the project tree into the network.

   The "Call options" dialog opens.
2. Click the "Single instance" button.
3. Enter a name for the data block that is to be assigned to the function block.
4. Confirm your entries with "OK".

Inserting a call of a function block (FB) as a multi-instance

You can call a function block as a multi-instance. In this case, the called function block stores its data in the instance data block of the calling function block.

See also: Multi-instances (Page 351)

To insert the call for a function block (FB) into a network as a multi-instance using a drag-and-drop operation, follow these steps:

1. Drag the function block from the project tree into the network.

   The "Call options" dialog opens.
2. Click the "Multi instance" button.
3. In the "Name in the interface" text block, enter the name of the tag with which the called function block will be entered as a static tag in the interface of the calling block.
4. Confirm your entries with "OK".

Result

The function or the function block is inserted with its parameters. You can then assign the parameters.

See also: Parameter transfer at block call (Page 353)

Note

If when calling a function block you specify an instance data block that does not exist, it will be created. If you have called a function block as a multi-instance, this will be entered as a static tag in the interface.

7.2.4.2 Calling functions and function blocks from supplied global libraries

In your user program, you can call pre-programmed functions and function blocks that are contained in the supplied global libraries.

Requirement

The "Libraries" task card is displayed.

Calling a function from a supplied global library

To call a function (FC) from a supplied global library, follow these steps:

1. Maximize the "Global libraries" pane.
2. Maximize the library in which the desired element is located.
3. Drag the function to the network.

Or:

1. Maximize the "Global libraries" pane.
2. Maximize the library in which the desired element is located.
3. Open the element view.
4. Drag the function from the "Elements" pane to the network.

Calling a function block from a supplied global library

To call a function block (FB) from a supplied global library, follow these steps:

1. Maximize the "Global libraries" pane.
2. Maximize the library in which the desired element is located.
3. Use a drag-and-drop operation to move the function block into the network.

   The "Call options" dialog opens.
4. Select either single or multi-instance and enter a name for the data block.
5. Confirm your selection with "OK".

Or:

1. Maximize the "Global libraries" pane.
2. Maximize the library in which the desired element is located.
3. Open the element view.

4. Drag the function block from the "Elements" pane to the network.

   The "Call options" dialog opens.
5. Select either single or multi-instance and enter a name for the data block.
6. Confirm your selection with "OK".

See also

Parameter transfer at block call (Page 353)

7.2.4.2 Update block calls

If interface parameters of a called block are changed, the block call can no longer be executed correctly. You can avoid such inconsistent block calls by updating the block calls.

You have two options to update the block calls:

- Explicit updating in the program editor.

  The block calls in the open block will be updated.
- Implicit update during compilation.

  All block calls in the program as well as the used PLC data types will be updated.

Update blocks in the program editor

To update a block call within a block, follow these steps:

1. Open the block in the program editor
2. Click "Update inconsistent block calls" in the toolbar.

Or:

1. Open the block in the program editor.
2. Right-click on the instruction with the block call.
3. Select the "Update block call" command in the shortcut menu.

   The "Interface update" dialog opens. This dialog shows the differences between the block interface in use and the changed interface of the called block.
4. If you want to update the block call, click "OK". To cancel the update, click "Cancel".

Update block calls during compilation

Proceed as follows to update all block calls and uses of PLC data types during compilation implicitly:

1. Open the project tree.
2. Select the "Program blocks" folder.
3. Select the "Compile > Software (rebuild all blocks)" command in the shortcut menu.

7.2.4.2 Correcting the call type

Call type

There are two ways of calling function blocks:

- As a single instance
- As a multi-instance

See also: Call function blocks as single or multi-instances (Page 351)

You can modify a defined call type at any time.

Requirement

A network contains a block call.

Procedure

To change the call type of a function block, follow these steps:

1. Select the block call.
2. Select the "Change call type" command in the shortcut menu.

   The "Call options" dialog opens.
3. Click the "Single instance" or "Multi instance" button.
   - If you select the "Single instance" call type, enter a name for the data block that will be assigned to the function block.
   - If you select "Multi instance" as the call type, enter the name of the tag in the "Name in the interface" text box, with which the called function block will be entered as a static tag in the interface of the calling block.
4. Confirm your entries with "OK".

7.2.4.2 Changing LAD elements

7.2.4.2 Replacing LAD elements

You can easily exchange LAD elements with other LAD elements of the same type. This has the advantage that the parameters are retained and need not be entered again. For example, you can exchange normally open contacts and normally closed contacts, RS FlipFlop and SR FlipFlop, or timers.

Requirement

A network with at least one LAD element is present.

Procedure

To replace an LAD element with another LAD element, follow these steps:

1. Select the LAD element that you want to replace.
2. Hover the cursor over the yellow triangle in the top right corner of the LAD element.

   A drop-down list is displayed.
3. From the drop-down list, select the LAD element that you want to use to replace the existing LAD element.

7.2.4.2 Editing LAD elements

You can edit LAD elements using the following edit commands:

- Copy
- Cut
- Paste
- Delete

Each command can always be executed via the keyboard, menu, and shortcut menu.

Requirement

An LAD element is available.

Copying

To copy a LAD element, follow these steps:

1. Right-click the LAD element that you want to copy.
2. Select "Copy" in the shortcut menu.

Cutting

To cut a LAD element, follow these steps:

1. Right-click the LAD element that you want to cut.
2. Select "Cut" in the shortcut menu.

Inserting

To paste a LAD element, follow these steps:

1. Copy a LAD element or cut a LAD element.
2. Right-click the point in the network where you want to paste the element.
3. Select "Paste" in the shortcut menu.

Deleting

To delete a LAD element, follow these steps:

1. Right-click the LAD element that you want to delete.
2. Select the "Delete" command in the shortcut menu.

7.2.4.2 Inserting additional inputs and outputs

Introduction

You can expand the LAD elements with additional inputs that execute commutative arithmetic operations. Such elements are, for example, the instructions "Add" (ADD) and "Multiply" (MUL). The number of inserted inputs is not limited.

You can insert additional outputs only for the LAD element "Transmit value" (MOVE).

Requirement

An LAD element is available that permits the insertion of additional inputs and outputs.

Inserting an additional input

To add an additional input to the box of a LAD element, follow these steps:

1. Right-click on an existing input of the LAD element.
2. Select "Insert input" in the shortcut menu.

   An additional input is added to the box of the LAD element.

Inserting an additional output

To add an additional output to the box of a LAD element, follow these steps:

1. Right-click on an existing output of the LAD element.
2. Select "Insert output" from the shortcut menu.

   An additional output is added to the box of the LAD element.

See also

Inserting LAD elements (Page 452)

7.2.4.2 Removing inputs and outputs

Introduction

For LAD elements that you have extended with additional inputs, you can subsequently remove these inputs. If you have added outputs to the LAD element "Copy value" (MOVE), you can also remove these outputs.

Requirement

An LAD element is available to which you have added additional inputs and outputs.

Remove input

To remove an input, follow these steps:

1. Select the input that you want to remove.
2. Select the "Delete" command in the shortcut menu.

   The input of the LAD element is removed.

Remove output

To remove an output of the LAD element "Copy value", follow these steps:

1. Select the output that you want to remove.
2. Select the "Delete" command in the shortcut menu.

   The output of the LAD element "Copy value" is removed.

7.2.4.2 Inserting operands into LAD instructions

7.2.4.2 Inserting operands

When a LAD element is inserted, the string of question marks "???" and "..." are inserted as placeholders for the parameters. The "???" string displayed in red indicates parameters that must be connected. The "..." string displayed in black indicates parameters that may be connected.

Note

Hover the mouse cursor over the placeholder to display the expected data type.

Requirement

An LAD element is available.

Procedure

To connect the parameters of a LAD element, follow these steps:

1. Double-click the placeholder of the parameter.

   An entry field opens, and the placeholder is selected.
2. Enter the appropriate parameter.

Note

If you enter the absolute address of a parameter that has already been defined, this absolute address will be changed to the symbolic name of the parameter as soon as the input is confirmed. If you have not yet defined the parameter, a new tag with this absolute address and the default name "Tag_1" will be entered in the PLC tag table. When you confirm your input, the absolute address will be replaced with the symbolic name "Tag_1".

3. Confirm the parameter with the Enter key.
4. If you have not yet defined the parameter, you can define it directly in the program editor using the shortcut menu.

   See also: Declaring PLC tags in the program editor (Page 398)

Alternatively, using the operand selection:

1. Double-click the placeholder of the parameter.
2. To open the operand selection, click the symbol beside the text box.
3. Enter the initial letter of the parameter.

   A list of all the defined parameters starting with this letter is displayed.
4. Select the relevant parameter from the list and confirm your selection with the Enter key.

See also: Using the operand selection (Page 0)

Or drag from it the PLC tag table:

1. In the project tree, select the "PLC tags" folder or open the PLC tag table.
2. If you have opened the PLC tag table, drag the symbol from the first column of the desired tag to the appropriate place in your program. If you have not opened the PLC tag table yet, open the detail view now. Drag the desired tag from the detail view to the appropriate place in your program.

Or drag from it the block interface:

1. Open the block interface.
2. Drag the required operand from the block interface to the instruction window.

Result

- If the syntax is error-free, the displayed parameter is black. The editor then jumps to the next placeholder.
- If there is an error in the syntax, the cursor stays in the entry field and a corresponding error message is displayed in the status line. If you press the Enter key again, the entry field is closed and the faulty entry is displayed in red italics.

See also

Symbolic programming (Page 361)

7.2.4.2 Using the operand selection

The operand selection is a drop-down list that displays all available operands for a selected instruction. It contains all global and local tags of the suitable data type.

Requirement

The operand selection is enabled.

See also: General settings for the PLC programming (Page 0)

Procedure

To select an operand from the operand selection, follow these steps:

1. Select an instruction.
2. Press the <Return> key.

   The input field for the operand opens. The icon for operand selection appears next to the input field.
3. Click on the icon for operand selection.

   The operand selection opens. This contains local and global tags, data blocks and multi-instances.
4. If necessary, filter the list:
   - Enter one or several letters to show only the operands that start with these initial letters.
   - Enter # in the first location to show only local operands from the block interface.
   - Enter " in the first position to show global operands from the PLC tag table and the existing data blocks.
5. Select an operand.

   If the selected operand is a structured tag, a data block or a multi-instance, a period is inserted automatically after the higher-level element. The lower-level elements of the first operand are then displayed in the list.
6. Select the lower-level element.

Note

Even if operand selection is disabled in the general settings, you can display an operand selection list when necessary. You can do this with the <Ctrl+I> keyboard shortcut.

See also

Inserting and editing operands (Page 495)
Accessing ARRAYs (Page 0)
Accessing the data of STRUCT (Page 0)
Accessing the data of a multi-instance (Page 0)

7.2.4.2 Accessing ARRAYs

Accessing data in an ARRAY

You access the data in an ARRAY using the index of the specific element in the ARRAY. An index consists of any integer values (-32768 to 32767) enclosed in square brackets, for example Motor.Waerme_1x3[2].

Using ARRAYs as block parameters

You can transfer ARRAYs as parameters. If a block has an input parameter of ARRAY type, you must transfer as actual parameter an ARRAY with identical structure. You can also transfer individual elements of an ARRAY as actual parameter if the element corresponds to the data type of the formal parameter.

7.2.4.2 Accessing the data of STRUCT

Accessing the data in structures

You access individual elements in a structure using "StructureName.ElementName".

Example of accessing a structure

You access the "Temperature" element in the "Stack_1" structure as follows:

"Stack_1.Temperature"

Using structures as block parameters

You can transfer structures as parameters. If a block has an input parameter of the STRUCT type, you must transfer as actual parameter a STRUCT with identical structure. You can also transfer individual elements of an STRUCT as actual parameter if the element corresponds to the data type of the formal parameter.

7.2.4.2 Accessing the data of a multi-instance

Access to multi-instance data

You can access the data of a multi-instance block within the multi-instance block and from the caller block.

- Within the multi-instance block you address the data from the block interface, the same as for all other data.

  For example, the "On" input parameter of the multi-instance block is accessed using "#On".
- You access the data of the multi-instance block from the calling block using "Multi-instanceName.TagName".

  For example, the "On" input parameter of the multi-instance block "Multi" is accessed using "Multi.On".

7.2.4.2 Accessing I/O with LAD

Basics

The process image of the CPU is updated once in a cycle. In time-critical applications, however, it can be that the current state of a digital input or output has to be read or transferred more often than once per cycle. For this purpose you can use a suffix for I/O access ID on the operand to directly access the I/O.

Immediate read

If you want to read the input directly from the I/O, use the peripheral input memory area (PI) instead of the process image of the inputs (I). The I/O memory area can be read as a bit, byte, word, or double word.

To read a signal directly from an input, you can add the suffix for I/O access ":P", e.g. "Switch:P", to the operand.

Immediate write

To perform an immediate write to an output, use the peripheral output (PQ) memory area instead of the process images of the outputs (Q). The peripheral output memory area can be written as a bit, byte, word, or double word.

To transfer a signal directly to peripheral output, you can add the suffix for I/O access ":P" to an operand, for example "Motor1:P".

Warning

Note that the immediate writing to the I/O can lead to hazardous states, for example when writing multiple times to an output in one program cycle.

See also

I/O data area (Page 322)
process image input/output (Page 320)

7.2.4.2 Wiring hidden parameters

Introduction

Depending on the CPU used, you can use complex instructions in your program that are dispatched with the TIA portal. These instructions can contain parameters that are declared as hidden.

If an instruction contains hidden parameters, the instruction box has a small arrow on the lower edge. You can recognize hidden parameters by their white font.

You can show and wire the hidden parameters at any time.

Showing or hiding hidden parameters

To show or hide hidden parameters, follow these steps:

1. Click on the small down arrow at the lower edge of the instruction box to show hidden parameters.
2. Click on the small up arrow at the lower edge of the instruction box to hide hidden parameters.

Wiring hidden parameters

To wire parameters, follow these steps:

1. Wire the hidden parameters like normally visible parameters.

   The hidden parameter is transformed into a visible parameter.

See also

Inserting operands into FBD instructions (Page 495)

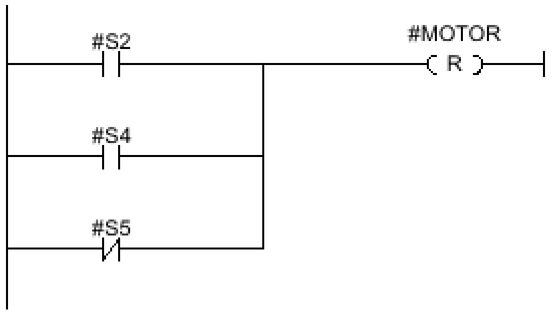
7.2.4.2 Branches in LAD

7.2.4.2 Basic information on branches in LAD

Definition

You use branches to program parallel circuits with the Ladder Logic (LAD) programming language. Branches are inserted in the main rung. You can insert several contacts into the branch and thus achieve a parallel circuit of series connections. This allows you to program complex ladder logic.

The figure below shows an example of the use of branches:



MOTOR carries signal 1, if one of the following conditions is fulfilled:

- Signal 1 is pending on S2 or S4
- Signal 0 is pending on S5.

See also

Rules for branches in LAD (Page 469)

7.2.4.2 Rules for branches in LAD

Rules

The following rules apply to simultaneous branches:

- Simultaneous branches are opened downwards or are connected directly to the power rail. They are terminated upwards.
- Simultaneous branches are opened after the selected LAD element.
- Simultaneous branches are terminated after the selected LAD element.
- To delete a simultaneous branch, you must delete all LAD elements of this branch. When the last LAD element is removed from the branch, the rest of the branch is also removed.

See also

Basic information on branches in LAD (Page 468)
Inserting branches into the LAD network (Page 469)
Deleting branches in LAD networks (Page 470)
Closing branches in the LAD network (Page 469)

7.2.4.2 Inserting branches into the LAD network

You can create several branches in a network.

Requirement

- A network is available.
- The network contains elements.

Procedure

To insert a new branch in a network, follow these steps:

1. Open the "Instructions" task card.
2. Navigate in the "Instructions" pane to "General > Open branches".
3. Use a drag-and-drop operation to move the element to the desired place in the network.

   If you want to connect the new branch directly to the power rail, drag the element to the power rail.

See also

Closing branches in the LAD network (Page 469)
Rules for branches in LAD (Page 469)

7.2.4.2 Closing branches in the LAD network

Branches must be closed again at suitable places. When a branch is closed, any necessary empty elements are added. If necessary, branches will be arranged so that they do not cross each other.

Requirement

A branch is available.

Procedure

To close an open branch, follow these steps:

1. Select the open branch.
2. Press and hold down the left mouse button.

   A dashed line will appear as soon as the cursor is moved.
3. Drag the dashed line to a suitable place on the network. Permissible connections are indicated by green lines.
4. Release the left mouse button.

See also

Inserting branches into the LAD network (Page 469)
Deleting branches in LAD networks (Page 470)
Rules for branches in LAD (Page 469)

7.2.4.2 Deleting branches in LAD networks

Requirement

A closed branch is available.

Procedure

To disconnect a closed branch, follow these steps:

1. Select the connection line that links the branch to the main branch.
2. Select the "Delete" command in the shortcut menu.

See also

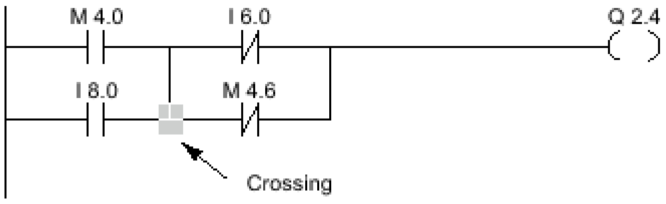
Closing branches in the LAD network (Page 469)
Rules for branches in LAD (Page 469)

7.2.4.2 Crossings in LAD

7.2.4.2 Introduction

Definition

A crossing is a place in a LAD network where one branch is closed and at the same time another branch is opened.



Q 2.4 contains signal 1, if the following two conditions are fulfilled:

- M4.0 or I8.0 carries signal 1
- I6.0 or M4.6 carries signal 0.

See also

Inserting crossings (Page 471)
Rearranging crossings (Page 472)
Deleting crossings (Page 472)

7.2.4.2 Inserting crossings

You can insert crossings in a LAD network by creating connections between the main branch and an additional branch or between different branches.

Requirement

A branch is available.

Procedure

1. Open the "Instructions" task card.
2. Navigate in the "Instructions" pane to "General > Open branch".
3. Use a drag-and-drop operation to move the element and after the new branch.
4. Insert any element into the open branch.
5. Click the arrow of the open branch after the inserted element.
6. Hold down the left mouse button and drag the dashed connecting line to the main branch.
7. Release the left mouse button.

See also

Introduction (Page 471)
Inserting branches into the LAD network (Page 469)

7.2.4.2 Rearranging crossings

Requirement

A crossing is available.

Rearranging a crossing

To rearrange a connection, follow these steps:

1. Select the connection line that defines the crossings in the respective branches.
2. Select the "Delete" command in the shortcut menu.
3. Open the "Instructions" task card.
4. Navigate in the "Instructions" pane to "General > Open branch".
5. Use a drag-and-drop operation to move the element to the place in the network where you want to insert the new crossing.
6. Insert any element into the open branch.
7. Click the arrow of the open branch after the inserted element.
8. Hold down the left mouse button and drag the dashed connecting line to the main branch.
9. Release the left mouse button.

See also

Introduction (Page 471)

7.2.4.2 Deleting crossings

Requirement

A crossing is available.

Procedure

To delete a crossing, follow these steps:

1. Select the connection line that defines the crossings in the respective branches.
2. Select the "Delete" command in the shortcut menu.

See also

Introduction (Page 471)

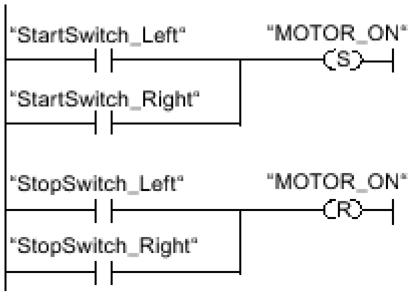
7.2.4.2 Rungs in LAD

7.2.4.2 Introduction

Using rungs

The program is mapped in one or more networks. On both the left and right edge, a network contains one power rail from which one or more rungs go out. The binary signals are arranged in the form of contacts on the rungs. The serial arrangement of the elements on a branch creates a series connection, the arrangement on simultaneous branches creates a parallel connection. A rung is closed by a coil in which the result of logic operation is written.

The figure below shows an example of the use of several rungs within a network:



Rules

Remember the following rules when using several rungs:

- Connections are not permitted between rungs.
- Only one jump instruction is permissible per network. The positioning rules for jump instructions remain valid.

Running rungs

Rungs and networks are executed from top to bottom and from left to right. This means that the first instruction in the first rung of the first network is processed first. All instructions of this rung are then processed. After this come all other rungs of the first network. The next network is processed only after all rungs have first been run.

Differences between branches and rungs

The difference between branches and rungs is that the rungs are independent branches that can also stand in a different network. Branches, on the other hand, permit the programming of a parallel connection.

See also

Insert rung (Page 474)
Deleting a rung (Page 474)

7.2.4.2 Insert rung

Requirement

- A block is open.
- A network is available.

Procedure

To insert a new rung in a network, proceed as follows:

1. Insert any coil on the left power rail.

   A new rung will be inserted and the coil positioned at the end of the rung.
2. Insert additional instructions in the new rung.

See also

Introduction (Page 473)
Deleting a rung (Page 474)

7.2.4.2 Deleting a rung

Requirement

A rung is available.

Procedure

To delete a rung, proceed as follows:

1. Hold down the left mouse button and draw a frame around the rung. At the same time, make sure that you select all instructions. Alternatively, you can hold down the <Shift> key and select the first the last instruction of the rung.
2. Right-click on one of the instructions in the rung.
3. Select the "Delete" command in the shortcut menu.

See also

Introduction (Page 473)
Insert rung (Page 474)

7.2.4.2 Using free-form comments

7.2.4.2 Basic information on using free-form comments in LAD

Introduction

Free-form comments allow you to add comments to the source code for graphic programming languages similar to line comments for textual languages.

Free-form comments can be used for the following elements:

- Boxes
- Coils

7.2.4.2 Inserting free-form comments

Procedure

To insert free-form comments, proceed as follows:

1. Right-click on the object for which you want to insert a free-form comment.
2. Select the "Insert comment" command in the shortcut menu.

   A comment box with a standard comment opens. The comment box is connected by an arrow to the corresponding object.

7.2.4.2 Editing free comments

Introduction

Free-form comments can be edited as follows:

- Changing the comment text
- Changing the positioning or size of the comment box
- Attaching a comment to another element
- Showing and hiding free-form comments

Changing the comment text

To change the text of free-form comments, proceed as follows:

1. Double-click in the comment box.
2. Enter the desired text.

Changing the positioning of the comment box

To change the positioning of the comment box, follow the steps below:

1. Left-click the comment box and keep the mouse button pressed.
2. Drag the comment box to the desired location.

Changing the size of the comment box

To change the size of the comment box, follow the steps below:

1. Click the edge of the comment box.
2. Drag the comment box on the move handle in the lower right corner to the desired size.

Attaching a comment to another element

To attach a free-form comment to another element, proceed as follows:

1. Left-click the point of the arrow that links the comment box with the instruction and keep the mouse button pressed.
2. Drag the arrow to the element to which you want to attach the comment. Possible insertion points are marked with a green square.
3. Release the mouse button.

Showing and hiding free-form comments

To show or hide a free-form comments, proceed as follows:

1. Click "Show / hide free comments" in the toolbar.

7.2.4.2 Deleting free-form comments

Procedure

To delete a free-form comment, proceed as follows:

1. Right-click on the free-form comment that you want to delete.
2. Select the "Delete" command in the shortcut menu.

7.2.4.2 Creating FBD programs

7.2.4.2 Basic information on FBD

7.2.4.2 FBD programming language

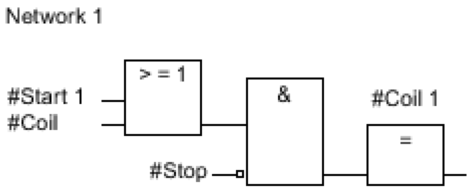
Overview of the Function Block Diagram (FBD) programming language

FBD is a graphical programming language. The representation is based on electronic circuit systems.

The program is mapped in one or more networks. A network contains one or more logic operation paths. The binary signals are linked by boxes. The representation of the logic is based on the graphical logic symbols used in Boolean algebra.

Example of networks in FBD

The following figure shows an FBD network with AND and OR boxes and an assignment:



See also

Working with networks (Page 0)

7.2.4.2 Overview of the FBD elements

FBD elements

An FBD program consists of separate elements that are linked by means of a binary signal flow. Most program elements must be supplied with tags. For timer and counter operations, a data block must also be created to store the formal parameters.

A FBD network is programmed from left to right.

For example, the following figure shows elements of an FBD network:

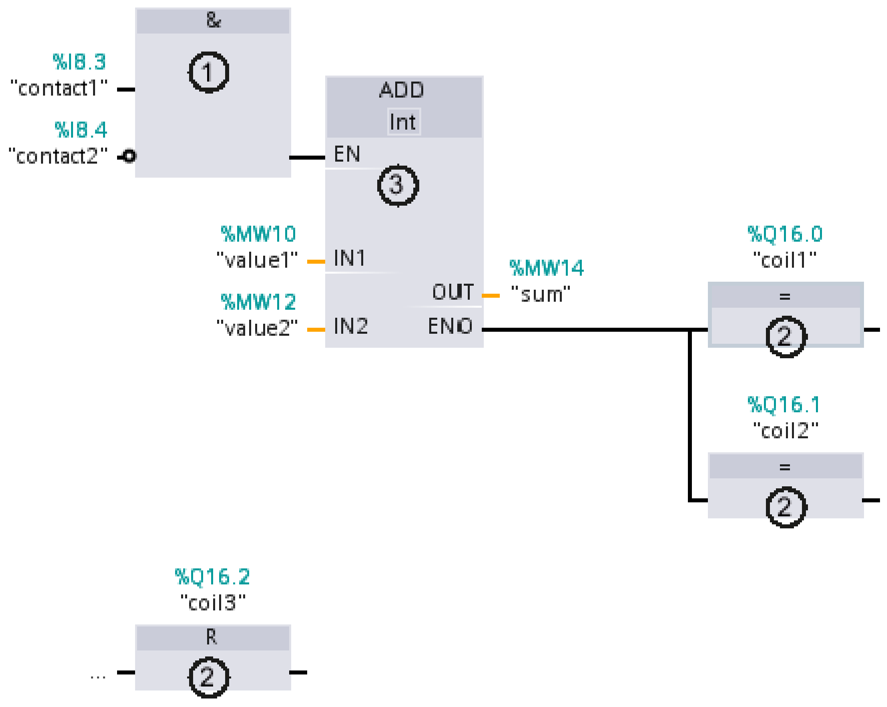


Figure7-2

1) Binary function

2) Standard box

3) Complex box

Binary functions

You can use binary functions to query binary operands and to combine their signal states. The following operations are examples of binary functions: "AND operation", "OR operation" and "EXCLUSIVE operation".

Standard boxes:

You can use standard boxes to control binary operands, perform RLO edge detection or execute jump functions in the program. Standard boxes generally have only one single input.

Complex boxes

Complex boxes represent program elements with complex functions. The empty box is an exception. You can use the empty box as a placeholder in which you can select the required operation.

The following types of boxes are available to you in an FBD program:

- Complex boxes without EN/ENO mechanism:
  A box is executed independent of the signal state at the box inputs. The error status of the processing cannot be queried.

- Boxes with EN/ENO mechanism:
  A box is only executed if the enabling input "EN" carries the signal state "1". If the box is processed correctly, the "ENO" enable output has signal state "1". If an error occurs during processing, the "ENO" output is reset.
  If the EN enable input is not interconnected, the box is always executed.

Calls of code block are also shown in the network as complex boxes with EN/ENO mechanism.

7.2.4.2 Settings for FBD

7.2.4.2 Overview of the settings for LAD

Overview

The following table shows the settings that you can make:

Group	Setting	Description
Font	Size	Font size in program editor
View	Layout	Compact or wide Changes the vertical spacing between operands and other objects (such as operand and contact). The change becomes visible once the block is reopened.
	With absolute information	Additional display of the absolute addresses
Operand field	Maximum width	Maximum number of characters that can be entered horizontally in the operand field
	Maximum height	Maximum number of characters that can be entered vertically in the operand field

7.2.4.2 Changing the settings

Procedure

To change the settings, proceed as follows:

1. Select the "Settings" command in the "Options" menu.

   The "Settings" window is displayed in the work area.
2. In the area navigation, select the "PLC programming" group.

3. Change the settings.

Result

The change will be loaded directly, there is no need to save it explicitly.

7.2.4.2 Working with networks

7.2.4.2 Using networks

Function

The user program is created in the block within networks. For a code block to be programmed, it must contain at least one network. To achieve a better overview of the user program, you can also subdivide your program into several networks.

See also

Inserting networks (Page 0)
Selecting networks (Page 0)
Copying and inserting networks (Page 0)
Deleting networks (Page 0)
Expanding and collapsing networks (Page 0)

7.2.4.2 Inserting networks

Requirement

A block is open.

Procedure

To insert a new network, follow these steps:

1. Select the network after which you want to insert a new network.
2. Select the "Insert network" command in the shortcut menu.

Note

If you insert an element into the last (and still empty) network of the block in an LAD or FBD program, a new empty network is automatically inserted below it.

Result

A new empty network is inserted into the block.

See also

Using networks (Page 0)

7.2.4.2 Selecting networks

Requirement

A network is available.

Selecting a network

To select a network, follow these steps:

1. Click the title bar of the network that you want to select.

Selecting several networks

To select several networks, follow these steps:

1. Press and hold down the <Ctrl> key.
2. Click all the networks that you want to select.

To select several successive networks, follow these steps:

1. Press and hold down the <Shift> key.
2. Click the first network that you want to select.
3. Click the last network that you want to select.

   The first and last networks and all those in between are selected.

See also

Using networks (Page 0)

7.2.4.2 Copying and inserting networks

Copied networks can be pasted within the block or in another block. If the network is pasted into a block written in a different programming language, the programming language of the network is retained.

Prerequisite

A network is available.

Procedure

To copy and paste a network, follow these steps:

1. Select the network or networks to be copied.
2. Select "Copy" in the shortcut menu.
3. Select the network after which you want to paste the copied network.
4. Select "Paste" in the shortcut menu.

Note

You can also copy networks from one block to another.

See also

Using networks (Page 0)

7.2.4.2 Deleting networks

Requirement

A network is available.

Procedure

To delete a network, follow these steps:

1. Select the network that you want to delete.
2. Select the "Delete" command in the shortcut menu.

See also

Using networks (Page 0)

7.2.4.2 Expanding and collapsing networks

Requirement

A network is available.

Opening and closing a network

1. Select the network that you want to open or close.
2. Select "Expand" or "Collapse" in the shortcut menu.

Opening and closing all networks

1. Click "Open all networks" or "Close all networks" in the toolbar.

See also

Using networks (Page 0)

7.2.4.2 Entering the network title

The network title is the header of a network. The length of the network title is unrestricted, but it cannot occupy more than one line.

Requirement

A network is available.

Procedure

To enter a network title, follow these steps:

1. Double-click "....." in the title bar of the network.

   The "....." text passage is selected.
2. Enter the network title.

7.2.4.2 Entering network comments in LAD networks

You can use network comments to document individual networks. For example, you can indicate the function of the network or draw attention to special characteristics.

Requirement

A network is available.

Procedure

To enter a network comment, follow these steps:

1. Click the small arrow in front of the network title.

   The right arrow becomes a down arrow.
2. If the comment area is not visible, click "Network comments on/off" in the toolbar.

   The comment area is displayed.
3. Click "Comment" in the comment area.

   The "Comment" text passage is selected.
4. Enter the network comment.

7.2.4.2 Inserting FBD elements

7.2.4.2 Rules for the use of FBD elements

Rules

Note the following rules when inserting FBD elements:

- An FBD network can consist of several elements. All elements of a logic path must be linked to each other in accordance with IEC 61131-3.
- Standard boxes (flip flops, counters, timers, math operations, etc.) can be added as output to boxes with binary logic operations (for example AND, OR). Comparison boxes are excluded from this rule.
- Only Boolean inputs can be combined with preceding logic operations.
- Only the bottom Boolean output can be combined with an additional logic operation.
- Jump operations can be positioned only at the end, RET can also be positioned at the start.
- Enable input "EN" and enable output "ENO" can be connected to boxes, but this is not mandatory.
- Constants (e.g. TRUE or FALSE) cannot be assigned to binary logic operations. Instead of this, use tags of the BOOL data type.

For information on where you can paste FBD elements in the network, refer to the FBD reference help.

7.2.4.2 Inserting FBD elements using the "Instructions" task card

Requirement

A network is available.

Procedure

To insert FBD elements into a network using the "Instructions" task card, proceed as follows:

1. Open the "Instructions" task card.
2. Navigate to the FBD element that you want to insert.
3. Use a drag-and-drop operation to move the element to the desired place in the network.

   If the element is a function block (FB) within the system, the data of the function block must be stored in an instance data block. In this case the "Call options" dialog box is opened, in which you can create the corresponding data block.

Or

1. Select the point in the network at which you want to insert the element.
2. Open the "Instructions" task card.
3. Double-click on the element you want to insert.

If the element is a function block (FB) within the system, the data of the function block must be stored in an instance data block. In this case the "Call options" dialog box is opened, in which you can create the corresponding instance data block.

Result

The selected FBD element is inserted with dummy entries for the parameters.

See also

Inserting FBD elements using an empty box (Page 485)
Inserting FBD elements using favorites (Page 0)

7.2.4.2 Inserting FBD elements using an empty box

Requirement

A network is available.

Procedure

To insert FBD elements into a network using an empty box, follow these steps:

1. Open the "Instructions" task card.
2. Navigate to "General > Empty box".
3. Use a drag-and-drop operation to move the "Empty box" element to the desired place in the network.
4. Hover the cursor over the yellow triangle in the top right corner of the empty box.

   A drop-down list is displayed.
5. Select the desired FBD element from the drop-down list.

Result

The empty box is changed to the respective FBD element. Placeholders are inserted for the parameters.

See also

Inserting FBD elements using the "Instructions" task card (Page 484)
Inserting FBD elements using favorites (Page 0)

7.2.4.2 Selecting the data type of an FBD element

7.2.4.2 Selecting a data type

Introduction

Some operations can be executed with several different data types. If one of these operations is used in the program, a valid data type must be specified for the operation at the specific point in the program. Data types for the inputs and outputs must be explicitly selected for some operations.

Note

The valid data type (BOOL) for the tags on the enable input ENO and the enable output ENO is predefined by the system and cannot be changed.

The valid data types for an operation are listed in the drop-down list of the operation. You specify the data type of the operation by selecting an entry from the drop-down list. If the data type of a indicated tag deviates from the data type of the operation, the tag name is displayed in red.

7.2.4.2 Specifying the data type of an operation

Introduction

Some operations can be executed with several different data types. If such operations have to be inserted in the program a data type has to be specified at a specific point in the program for their execution.

Specifying the data type by means of the drop-down list

To specify the data type of an operation by means of the drop-down list, follow these steps:

1. Insert the operation by drag-and-drop operation at the required point in the program.

   The operation will be inserted at the required point in the program. The entry "???" (undefined) is displayed in the drop-down list.
2. Click the yellow triangle in the upper corner of the drop-down list.

   The drop-down list opens displaying the data types that are valid for the operation.
3. Select a data type from the drop-down list.

   The selected data type is displayed.
4. If the operation has two drop-down list, select the data type for the inputs of the operation in the left drop-down list and the data type for the outputs of the operation in the right drop-down list.

Specifying data type by assigning tags

To specify the data type of an operation by assigning tags, follow these steps:

1. Insert the operation by drag-and-drop operation at the required point in the program.

   The operation will be inserted at the required point in the program. The entry "???" (undefined) is displayed in the drop-down list.
2. At an input or output, specify a valid tag the data type of which is to be accepted as data type of the operation.

   The selected data type is displayed in the drop-down list.
3. If data types have to be specified for the inputs and outputs of the operation, enter a valid tag at an input and a valid tag at an output. The tag specified at the input determines the data type of the inputs and the tag specified at the output determines the data type of the outputs of the operation.

7.2.4.2 Using favorites

7.2.4.2 Adding elements to Favorites

Requirement

A block is open.

Procedure

To add elements to Favorites, follow these steps:

1. Open the "Instructions" task card.
2. Maximize the "Instructions" pane.
3. Navigate in the "Instructions" pane to the element that you want to add to the favorites.
4. Drag the element to the "Favorites" pane or to the Favorites area in the program editor.

See also

Inserting FBD elements using favorites (Page 0)

7.2.4.2 Inserting LAD elements using favorites

Requirement

- A network is available.
- Favorites are available.

Procedure

To insert an element into a network using favorites, follow these steps:

1. If the Favorites are not displayed in the program editor, click the "Show favorites also in the editor" button in the program editor toolbar.

   The Favorites are displayed under the block interface.
2. Drag the desired element from Favorites to the network.

Or

1. Select the point in the network at which you want to insert the element.
2. In the Favorites, click on the element you want to insert.

See also

Adding elements to Favorites (Page 0)
Inserting FBD elements using the "Instructions" task card (Page 484)
Inserting FBD elements using an empty box (Page 485)

7.2.4.2 Removing elements from Favorites

Prerequisites

A code block is open.

Procedure

To remove elements from Favorites, follow these steps:

1. Either open the "Favorites" pane in the "Instructions" task card or click the "Show favorites also in the editor" button in the program editor in the toolbar to show the favorites.
2. Right-click the element that you want to remove.
3. Select the "Remove instruction" command in the shortcut menu.

7.2.4.2 Inserting block calls in FBD

7.2.4.2 Inserting block calls using drag & drop

You can insert calls for existing functions (FC) and function blocks (FB) using a drag-and-drop operation from the project tree. If you call function blocks from other function blocks, you can call these either as single instance or as multi-instance.

Requirement

- A network is available.
- The block that is to be called is available.

Inserting a call of a function (FC)

To insert a call of a function (FC) into a network using a drag-and-drop operation, follow these steps:

1. Drag the function from the project tree into the network.

Inserting a call of a function block (FB) as a single instance

You can call a function block as a single instance. In this case, the called function block stores its data in a data block of its own.

See also: Single instances (Page 350)

To insert the call for a function block (FB) into a network as a single instance using a drag-and-drop operation, follow these steps:

1. Drag the function block from the project tree into the network.

   The "Call options" dialog opens.
2. Click the "Single instance" button.
3. Enter a name for the data block that is to be assigned to the function block.
4. Confirm your entries with "OK".

Inserting a call of a function block (FB) as a multi-instance

You can call a function block as a multi-instance. In this case, the called function block stores its data in the instance data block of the calling function block.

See also: Multi-instances (Page 351)

To insert the call for a function block (FB) into a network as a multi-instance using a drag-and-drop operation, follow these steps:

1. Drag the function block from the project tree into the network.

   The "Call options" dialog opens.
2. Click the "Multi instance" button.
3. In the "Name in the interface" text block, enter the name of the tag with which the called function block will be entered as a static tag in the interface of the calling block.
4. Confirm your entries with "OK".

Result

The function or the function block is inserted with its parameters. You can then assign the parameters.

See also: Parameter transfer at block call (Page 353)

Note

If when calling a function block you specify an instance data block that does not exist, it will be created. If you have called a function block as a multi-instance, this will be entered as a static tag in the interface.

7.2.4.2 Calling functions and function blocks from supplied global libraries

In your user program, you can call pre-programmed functions and function blocks that are contained in the supplied global libraries.

Requirement

The "Libraries" task card is displayed.

Calling a function from a supplied global library

To call a function (FC) from a supplied global library, follow these steps:

1. Maximize the "Global libraries" pane.
2. Maximize the library in which the desired element is located.
3. Drag the function to the network.

Or:

1. Maximize the "Global libraries" pane.
2. Maximize the library in which the desired element is located.
3. Open the element view.
4. Drag the function from the "Elements" pane to the network.

Calling a function block from a supplied global library

To call a function block (FB) from a supplied global library, follow these steps:

1. Maximize the "Global libraries" pane.
2. Maximize the library in which the desired element is located.
3. Use a drag-and-drop operation to move the function block into the network.

   The "Call options" dialog opens.
4. Select either single or multi-instance and enter a name for the data block.
5. Confirm your selection with "OK".

Or:

1. Maximize the "Global libraries" pane.
2. Maximize the library in which the desired element is located.
3. Open the element view.

4. Drag the function block from the "Elements" pane to the network.

   The "Call options" dialog opens.
5. Select either single or multi-instance and enter a name for the data block.
6. Confirm your selection with "OK".

See also

Parameter transfer at block call (Page 353)

7.2.4.2 Update block calls

If interface parameters of a called block are changed, the block call can no longer be executed correctly. You can avoid such inconsistent block calls by updating the block calls.

You have two options to update the block calls:

- Explicit updating in the program editor.

  The block calls in the open block will be updated.
- Implicit update during compilation.

  All block calls in the program as well as the used PLC data types will be updated.

Update blocks in the program editor

To update a block call within a block, follow these steps:

1. Open the block in the program editor
2. Click "Update inconsistent block calls" in the toolbar.

Or:

1. Open the block in the program editor.
2. Right-click on the instruction with the block call.
3. Select the "Update block call" command in the shortcut menu.

   The "Interface update" dialog opens. This dialog shows the differences between the block interface in use and the changed interface of the called block.
4. If you want to update the block call, click "OK". To cancel the update, click "Cancel".

Update block calls during compilation

Proceed as follows to update all block calls and uses of PLC data types during compilation implicitly:

1. Open the project tree.
2. Select the "Program blocks" folder.
3. Select the "Compile > Software (rebuild all blocks)" command in the shortcut menu.

7.2.4.2 Correcting the call type

Call type

There are two ways of calling function blocks:

- As a single instance
- As a multi-instance

See also: Call function blocks as single or multi-instances (Page 351)

You can modify a defined call type at any time.

Requirement

A network contains a block call.

Procedure

To change the call type of a function block, follow these steps:

1. Select the block call.
2. Select the "Change call type" command in the shortcut menu.

   The "Call options" dialog opens.
3. Click the "Single instance" or "Multi instance" button.
   - If you select the "Single instance" call type, enter a name for the data block that will be assigned to the function block.
   - If you select "Multi instance" as the call type, enter the name of the tag in the "Name in the interface" text box, with which the called function block will be entered as a static tag in the interface of the calling block.
4. Confirm your entries with "OK".

7.2.4.2 Changing FBD elements

7.2.4.2 Inserting FBD elements

You can easily exchange FBD elements with other FBD elements of the same type. This has the advantage that the parameters are retained and need not be entered again. For example, you can exchange OR and AND, RS-FlipFlop and SR-FlipFlop, comparison functions or jump instructions.

Requirement

A network with at least one FBD element is present.

Procedure

To replace an FBD element with another FBD element, follow these steps:

1. Select the FBD element that you want to replace.

   If elements compatible to the selected FBD element are available, a yellow triangle appears in the upper right-hand corner of the element.
2. Move the cursor over the yellow triangle of the FBD element.

   A drop-down list is displayed.
3. From the drop-down list, select the FBD element that you want to use to replace the existing FBD element.

7.2.4.2 Editing FBD elements

You can edit FBD elements using the following edit commands:

- Copy
- Cut
- Paste
- Delete

Each command can always be executed via the keyboard, menu, and shortcut menu.

Copying

To copy an FBD element, proceed as follows:

1. Right-click the FBD element that you want to copy.
2. Select "Copy" in the shortcut menu.

Cutting

To cut an FBD element, proceed as follows:

1. Right-click the FBD element that you want to cut.
2. Select "Cut" in the shortcut menu.

Inserting

To paste an FBD element, proceed as follows:

1. Copy an FBD element or cut an FBD element.
2. Right-click the point in the network where you want to paste the element.
3. Select "Paste" in the shortcut menu.

Deleting

To delete an FBD element, proceed as follows:

1. Right-click the FBD element that you want to delete.
2. Select the "Delete" command in the shortcut menu.

7.2.4.2 Pasting additional inputs and outputs

Introduction

You can expand the FBD elements with additional inputs that execute arithmetic or binary operations. Such elements are, for example, the instructions "Add" (ADD), "Multiply" (MUL), AND or OR.

You can insert additional outputs only for the FBD element "Transmit value" (MOVE).

Requirement

An FBD element is available that permits the insertion of additional inputs and outputs.

Inserting an additional input

To add an additional input to the box of an FBD element, proceed as follows:

1. Right-click on an existing input of the FBD element.
2. Select "Insert input" in the shortcut menu.

   An additional input is added to the box of the FBD element.

Inserting an additional output

To add an additional output to the box of an FBD element, proceed as follows:

1. Right-click on an existing output of the FBD element.
2. Select "Insert output" from the shortcut menu.

   An additional output is added to the box of the FBD element.

See also

Inserting FBD elements (Page 484)

7.2.4.2 Removing inputs and outputs

Introduction

For FBD elements that you have extended with additional inputs, you can subsequently remove these inputs. If you have added outputs to the FBD element "Transfer value" (MOVE), you can also remove these outputs.

Requirement

An FBD element is available, which you have expanded with additional inputs or outputs.

Remove input

To remove an input, follow these steps:

1. Select the input that you want to remove.
2. Select the "Delete" command in the shortcut menu.

   The input of the FBD element is removed.

Remove output

To remove an output of the FBD element "Transfer value", follow these steps:

1. Select the output that you want to remove.
2. Select the "Delete" command in the shortcut menu.

   The output of the FBD element "Transfer value" is removed.

7.2.4.2 Inserting operands into FBD instructions

7.2.4.2 Inserting and editing operands

When an FBD element is inserted, the character strings "???", "??.?" and "..." are inserted as placeholders for the parameters. The "???" and "??.?" strings displayed in red indicate parameters that must be connected. The "..." string displayed in black indicates parameters that may be connected. "??.?" stands for Boolean placeholders.

Note

To display the available data types in a tooltip, move the cursor over the placeholder.

Requirement

An FBD element is present.

Procedure

To connect the parameters of an FBD element, proceed as follows:

1. Click the placeholder of the parameter.

   An input field is opened.
2. Enter the corresponding parameters, for example a PLC tag, a local tag or a constant.

Note

If you enter the absolute address of a parameter that has already been defined, this absolute address will be changed to the symbolic name of the parameter as soon as the input is confirmed. If you have not yet defined the parameter, a new tag with this absolute address and the default name "Tag_1" will be entered in the PLC tag table. When you confirm your input, the absolute address will be replaced with the symbolic name "Tag_1".

3. Confirm the parameter with the Enter key.
4. If you have not yet defined the parameter, you can define it directly in the program editor using the shortcut menu.

   See also: "Declaring PLC tags in the program editor (Page 398) ".

Alternatively, using the operand selection:

1. Click the placeholder of the parameter.
2. Press <Ctrl + I> to open the operand selection.
3. Enter the initial letter of the parameter.

   A list is displayed of all defined parameters that start with this letter and have a compatible data type. To further restrict the selection, you can enter additional letters.
4. Select the relevant parameter from the list and confirm your selection with the Enter key.

See also: Using the operand selection (Page 0)

Or drag from it the PLC tag table:

1. In the project tree, select the "PLC tags" folder and open the PLC tag table.
2. If you have opened the PLC tag table, drag the desired tag to the corresponding location in your program. If you have not opened the PLC tag table yet, open the detail view now. Drag the desired tag from the detail view to the appropriate place in your program.

Or drag from it the block interface:

1. Open the block interface.
2. Drag the desired operand from the block interface to the corresponding location in your program.

Result

- If the syntax is error-free, the displayed parameter is black.
- If there is an error in the syntax, the cursor stays in the input field and a corresponding error message is displayed in the inspector window in the "Info > Syntax" register.

See also

Symbolic programming (Page 361)

7.2.4.2 Using the operand selection

The operand selection is a drop-down list that displays all available operands for a selected instruction. It contains all global and local tags of the suitable data type.

Requirement

The operand selection is enabled.

See also: General settings for the PLC programming (Page 0)

Procedure

To select an operand from the operand selection, follow these steps:

1. Select an instruction.
2. Press the <Return> key.

   The input field for the operand opens. The icon for operand selection appears next to the input field.
3. Click on the icon for operand selection.

   The operand selection opens. This contains local and global tags, data blocks and multi-instances.
4. If necessary, filter the list:
   - Enter one or several letters to show only the operands that start with these initial letters.
   - Enter # in the first location to show only local operands from the block interface.
   - Enter " in the first position to show global operands from the PLC tag table and the existing data blocks.
5. Select an operand.

   If the selected operand is a structured tag, a data block or a multi-instance, a period is inserted automatically after the higher-level element. The lower-level elements of the first operand are then displayed in the list.
6. Select the lower-level element.

Note

Even if operand selection is disabled in the general settings, you can display an operand selection list when necessary. You can do this with the <Ctrl+I> keyboard shortcut.

See also

Inserting and editing operands (Page 495)
Accessing ARRAYs (Page 0)
Accessing the data of STRUCT (Page 0)
Accessing the data of a multi-instance (Page 0)

7.2.4.2 Accessing ARRAYs

Accessing data in an ARRAY

You access the data in an ARRAY using the index of the specific element in the ARRAY. An index consists of any integer values (-32768 to 32767) enclosed in square brackets, for example Motor.Waerme_1x3[2].

Using ARRAYs as block parameters

You can transfer ARRAYs as parameters. If a block has an input parameter of ARRAY type, you must transfer as actual parameter an ARRAY with identical structure. You can also transfer individual elements of an ARRAY as actual parameter if the element corresponds to the data type of the formal parameter.

7.2.4.2 Accessing the data of STRUCT

Accessing the data in structures

You access individual elements in a structure using "StructureName.ElementName".

Example of accessing a structure

You access the "Temperature" element in the "Stack_1" structure as follows:

"Stack_1.Temperature"

Using structures as block parameters

You can transfer structures as parameters. If a block has an input parameter of the STRUCT type, you must transfer as actual parameter a STRUCT with identical structure. You can also transfer individual elements of an STRUCT as actual parameter if the element corresponds to the data type of the formal parameter.

7.2.4.2 Accessing the data of a multi-instance

Access to multi-instance data

You can access the data of a multi-instance block within the multi-instance block and from the caller block.

- Within the multi-instance block you address the data from the block interface, the same as for all other data.

  For example, the "On" input parameter of the multi-instance block is accessed using "#On".
- You access the data of the multi-instance block from the calling block using "Multi-instanceName.TagName".

  For example, the "On" input parameter of the multi-instance block "Multi" is accessed using "Multi.On".

7.2.4.2 Accessing I/O with LAD

Basics

The process image of the CPU is updated once in a cycle. In time-critical applications, however, it can be that the current state of a digital input or output has to be read or transferred more often than once per cycle. For this purpose you can use a suffix for I/O access ID on the operand to directly access the I/O.

Immediate read

If you want to read the input directly from the I/O, use the peripheral input memory area (PI) instead of the process image of the inputs (I). The I/O memory area can be read as a bit, byte, word, or double word.

To read a signal directly from an input, you can add the suffix for I/O access ":P", e.g. "Switch:P", to the operand.

Immediate write

To perform an immediate write to an output, use the peripheral output (PQ) memory area instead of the process images of the outputs (Q). The peripheral output memory area can be written as a bit, byte, word, or double word.

To transfer a signal directly to peripheral output, you can add the suffix for I/O access ":P" to an operand, for example "Motor1:P".

Warning

Note that the immediate writing to the I/O can lead to hazardous states, for example when writing multiple times to an output in one program cycle.

See also

I/O data area (Page 322)
process image input/output (Page 320)

7.2.4.2 Wiring hidden parameters

Introduction

Depending on the CPU used, you can use complex instructions in your program that are dispatched with the TIA portal. These instructions can contain parameters that are declared as hidden.

If an instruction contains hidden parameters, the instruction box has a small arrow on the lower edge. You can recognize hidden parameters by their white font.

You can show and wire the hidden parameters at any time.

Showing or hiding hidden parameters

To show or hide hidden parameters, follow these steps:

1. Click on the small down arrow at the lower edge of the instruction box to show hidden parameters.

2. Click on the small up arrow at the lower edge of the instruction box to hide hidden parameters.

Wiring hidden parameters

To wire parameters, follow these steps:

1. Wire the hidden parameters like normally visible parameters.

   The hidden parameter is transformed into a visible parameter.

See also

Inserting operands into FBD instructions (Page 495)

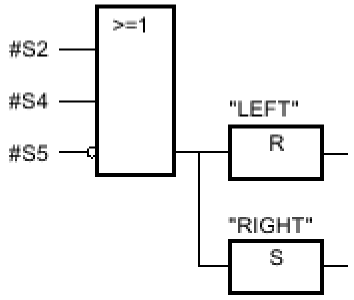
7.2.4.2 Branches in FBD

7.2.4.2 Basic information on branches in FBD

Definition

You can use the Function Block Diagram (FBD) programming language to program parallel branches. This is done using branches that are inserted between the boxes. You can insert additional boxes within the branch and in this way build up complex function block diagrams.

The figure below shows an example of the use of branches:



See also

Rules for branches in FBD (Page 500)
Inserting branches in FBD networks (Page 501)
Deleting branches in FBD networks (Page 501)

7.2.4.2 Rules for branches in FBD

Rules

The following rules apply to the use of branches in FBD:

- Branches are opened downward.

- Branches can be inserted only between FBD elements.
- To delete a branch, you must delete all FBD elements, including the branch itself.
- If you delete the connection between two branches, the FBD elements of the branches are moved to separate logic paths.

See also

Basic information on branches in FBD (Page 500)
Inserting branches in FBD networks (Page 501)
Deleting branches in FBD networks (Page 501)

7.2.4.2 Inserting branches in FBD networks

Requirement

A network is available.

Procedure

To insert a new branch in a network, follow these steps:

1. Open the "Instructions" task card.
2. Navigate in the "Instructions" pane to "General > Branch".
3. Use a drag-and-drop operation to move the element to the desired place in the network.

See also

Rules for branches in FBD (Page 500)
Basic information on branches in FBD (Page 500)
Deleting branches in FBD networks (Page 501)

7.2.4.2 Deleting branches in FBD networks

Requirement

A branch is available.

Procedure

To delete a branch, follow these steps:

1. Select the connection line that links the branch to the main branch.
2. Select the "Delete" command in the shortcut menu.

Result

The branch is now deleted. Boxes connected to the deleted branch are placed freely within the network.

See also

Rules for branches in FBD (Page 500)
Basic information on branches in FBD (Page 500)
Inserting branches in FBD networks (Page 501)

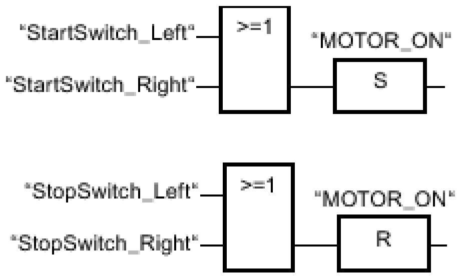
7.2.4.2 Logic paths in FBD

7.2.4.2 Introduction

Use of logic paths

The program is mapped in one or more networks. The networks can contain one or more logic paths on which the binary signals are arranged in the form of boxes.

The following figure shows an example of the use of several logic paths within a network:



Rules

Remember the following rules when using logic paths:

- Connections are not permitted between logic paths.
- Only one jump instruction is permissible per network. The positioning rules for jump instructions remain valid.

Executing logic paths

Logic paths are executed from top to bottom and from left to right. This means that the first instruction in the first logic path of the first network is executed first. All instructions of this logic path are then executed. After this come all other logic paths of the first network. The next network is executed only after all logic paths have first been executed.

When jumps are used the regular execution of the logic paths is circumvented and the instruction is executed at the jump destination.

Differences between branches and logic paths

The difference between branches and logic paths is that the logic paths are independent branches that can also stand in a different network. Branches, on the other hand, permit the programming of a parallel connection.

See also

Inserting a logic path (Page 503)
Deleting a logic operation path (Page 503)

7.2.4.2 Inserting a logic path

Requirement

- A block is open.
- A network is available.

Procedure

To insert a new logic path in a network, proceed as follows:

1. Insert any instruction in a network in such a way that it has no connection to existing instructions.

   A new logic path is inserted.
2. Insert an assignment at the end of the new logic path.
3. Insert additional instructions in the new logic path.

See also

Introduction (Page 502)
Deleting a logic operation path (Page 503)

7.2.4.2 Deleting a logic operation path

Requirement

A logic path is available.

Procedure

To delete a logic path, proceed as follows:

1. Hold down the left mouse button and draw a frame around the logic path. At the same time, make sure that you select all instructions of the logic path. Alternatively, you can hold down the <Shift> key and select the first the last instruction of the logic path.
2. Right-click on one of the instructions in the logic path.
3. Select the "Delete" command in the shortcut menu.

See also

Introduction (Page 502)
Inserting a logic path (Page 503)

7.2.4.2 Using free-form comments

7.2.4.2 Basic information on using free comments in FBD

Introduction

Free-form comments allow you to add comments to the source code for graphic programming languages similar to line comments for textual languages.

Free-form comments can be used for all non-binary boxes.

7.2.4.2 Inserting free-form comments

Procedure

To insert free-form comments, proceed as follows:

1. Right-click on the object for which you want to insert a free-form comment.
2. Select the "Insert comment" command in the shortcut menu.

   A comment box with a standard comment opens. The comment box is connected by an arrow to the corresponding object.

7.2.4.2 Editing free comments

Introduction

Free-form comments can be edited as follows:

- Changing the comment text
- Changing the positioning or size of the comment box
- Attaching a comment to another element
- Showing and hiding free-form comments

Changing the comment text

To change the text of free-form comments, proceed as follows:

1. Double-click in the comment box.
2. Enter the desired text.

Changing the positioning of the comment box

To change the positioning of the comment box, follow the steps below:

1. Left-click the comment box and keep the mouse button pressed.
2. Drag the comment box to the desired location.

Changing the size of the comment box

To change the size of the comment box, follow the steps below:

1. Click the edge of the comment box.
2. Drag the comment box on the move handle in the lower right corner to the desired size.

Attaching a comment to another element

To attach a free-form comment to another element, proceed as follows:

1. Left-click the point of the arrow that links the comment box with the instruction and keep the mouse button pressed.
2. Drag the arrow to the element to which you want to attach the comment. Possible insertion points are marked with a green square.
3. Release the mouse button.

Showing and hiding free-form comments

To show or hide a free-form comments, proceed as follows:

1. Click "Show / hide free comments" in the toolbar.

7.2.4.2 Deleting free-form comments

Procedure

To delete a free-form comment, proceed as follows:

1. Right-click on the free-form comment that you want to delete.
2. Select the "Delete" command in the shortcut menu.

7.2.4.2 Finding syntax errors in the program

Syntax errors in the user program are highlighted by red underlining. This allows you to see erroneous entries at a glance. You can also jump from error to error within a block. In addition, syntax errors are listed in the "Info" tab of the inspector window together with an error message.

Procedure

To find syntax errors in the program, follow these steps:

1. Select the block title.
2. Click "Go to next error" in the toolbar.

   The first error in the block is marked.

You can use "Go to next error" and "Go to previous error" in the toolbar to find and correct all errors in the block.

Or:

1. Open the error list in the inspector window with "Info > Syntax".

   All syntax errors are listed in the table with a short description of the error.
2. If there are any errors, click on the blue question mark next to the error text to obtain information on eliminating the problem.
3. Double-click the error you want to correct.

   The corresponding error is highlighted.

7.2.4.2 Changing the programming language

7.2.4.2 Rules for changing the programming language

Rules

Observe the following rules if you want to change the programming language for a block:

- You can only change between the graphic programming languages LAD and FBD.
- If the language of individual networks of the block cannot be changed, these networks will be displayed in their original language.
- You can only change the programming language of entire blocks. The programming language cannot be changed for individual networks.
- However, you can create networks within a block using another programming language and then copy them into the desired block.

See also

Changing the programming language (Page 506)

7.2.4.2 Changing the programming language

Procedure

To change the programming language, proceed as follows:

1. Right-click the block in the project tree.
2. Select the "Properties" command in the shortcut menu.

   The "Properties" dialog box opens.
3. Select the "General" entry in the area navigation.
4. Select the new programming language in the "Language" drop-down list.
5. Confirm your selection with "OK".

See also

Rules for changing the programming language (Page 506)

7.2.4.2 Handling program execution errors

7.2.4.2 Troubleshooting options

Introduction

You can use the error handling settings to specify how the system should respond to any programming or IO area access errors that occur. The following options are available:

- You use the system reactions already provided by the operating system.
- You use separate local error handling.

Using system reactions

The operating system uses the following system reactions for error handling:

- STOP
- Ignore

Using local error handling

Local error handling refers to an error handling within a block. Local error handling has the following advantages:

- The error information is stored in the system memory, which you can query and evaluate.
- You can use the error information to program a response in the block to the error that has occurred.
- Programmed error evaluation and error reactions do not interrupt the program cycle.
- The system performance is not unnecessarily burdened by the local error handling. If no errors occur, programmed error analyses and reactions are not executed.

Local error handling applies only to blocks for which it has been set explicitly. If local error handling is set for a block, the system reaction is ignored during the execution of this block.

See also

Basics of program execution (Page 323)
Events and OBs (Page 323)
Local error handling (Page 508)
GetError (Page 954)
GetErrorID (Page 957)

7.2.4.2 System reactions

Use

During the execution of the user program, programming and IO area access errors can occur to which there must be a reaction. The operating system provides two system reactions for this: "Ignore" and "STOP".

The system reaction is always used for handing programming errors provided you do not use local error handling. If you set local error handling for a block, this has priority over the system reaction.

7.2.4.2 Local error handling

7.2.4.2 Principles of local error handling

Introduction

Local error handling makes it possible to query the occurrence of errors within a block and evaluate the associated error information. You can set local error handling for organization blocks (OBs), function blocks (FBs), and functions (FCs). If local error handling is enabled, the system reaction is ignored.

Local error handling applies only to blocks for which it has been set explicitly. The local error handling setting is not assumed by a calling block, nor is it transferred to called blocks. For higher-level blocks and lower-level blocks, the system settings still apply provided error handling has not been programmed for these blocks.

General procedure for local error handling

When errors occur while a block is being executed with local error handling, a predefined response is initiated based on the following error types:

- Write errors: These errors are ignored, and program execution simply continues.
- Read errors: Program execution continues with the substitute value "0".
- Execution errors: Execution of the instruction is aborted. Program execution resumes with the next instruction.

Information about the first error that occurs is stored in the system memory. This information can be queried and output with an instruction (GET_ERROR or GET_ERRORID). Error information is output in a format that can undergo additional processing. You can use additional instructions to analyze error information and program a reaction to the error based.

When information about the first error is queried, the error memory space in the system memory is enabled. Then, when additional errors occur, information about the next error is output.

Instructions for local error handling

You can use the following instructions for local error handling:

- GET_ERROR (Page 954)
- GET_ERRORID (Page 957)

The instructions GET_ERROR and GET_ERRORID differ in the amount of error information that is output with each one.

7.2.4.2 Error output priorities

Overview of the priorities

In local error handling, information about the first error that occurred is displayed. If multiple errors occur at the same time while an instruction is being executed, these errors are displayed according to their priority. The following table shows the priority of different types of errors.

Priority	Error type
1	Error in the program code
2	Missing reference
3	Invalid range
4	DB does not exist
5	Operands are not compatible
6	Width of specified area is not sufficient
7	Timers or counters do not exist
8	No write access to a DB
9	I/O error
10	Instruction does not exist
11	Block does not exist
12	Invalid nesting depth

The highest priority is 1 and the lowest priority is 12.

See also

GetError (Page 954)
GetErrorID (Page 957)

7.2.4.2 Enabling local error handling for a block

Introduction

Local error handling is enabled for a block if you insert one of the following instructions in a network.

- GET_ERROR (Page 954)
- GET_ERRORID (Page 957)

If local error handling is enabled for a block, the system reactions for this block are ignored.

Prerequisites

- The block is open.
- The "Instructions" task card is open.

Procedure

To enable local error handling for a block, proceed as follows:

1. Navigate to the "Extended Instructions" pane of the "Instructions" task card.
2. Open the "Program Control" folder.
3. Drag the GET_ERROR or GET_ERRORID instruction to the desired network.

Result

Local error handling is enabled for the open block. In the Inspector window under "Properties > Attributes", the "Handle errors within block" check box is selected. This setting cannot be edited in the Inspector window. The local error handling can be disabled by deleting the inserted instructions to the local error handling.

7.2.4.3 Programming data blocks

7.2.4.3 Basic principles for programming of data blocks

A data block (DB) is used to save the values that are written during execution of the program.

In contrast to the code block, the data block contains only tag declarations. It contains no networks or instructions. The tag declarations define the structure of the data block.

Types of data blocks

There are two types of data blocks:

- Global data blocks

  The global data block is not assigned to a code block. You can access the values of a global data block from any code block. A global data block contains only static tags.

  You enter the tags that the global data block should contain in the declaration table.

- Instance data blocks

  The instance data block is a block that is assigned directly to a function block (FB). The structure of an instance data block is determined by the interface declaration of the function block. It contains exactly those block parameters and static tags that are declared there.

  However, you can define instance-specific values in instance data blocks, e.g. initial values for the declared tags.

Retentivity of data values

To prevent data loss in the event of power failure, you can store the data values in a retentive memory area.

Monitoring data values online

If an online connection is available, you can display the current data values in data blocks.

See also

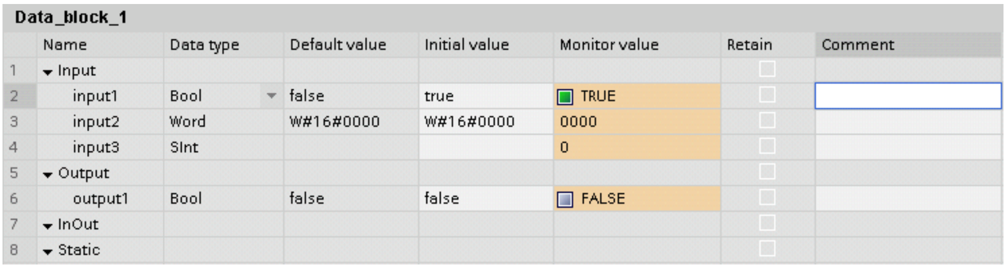
Creating data blocks (Page 0)

7.2.4.3 Structure of the declaration table for data blocks

Structure of the declaration table for data blocks

The form of the declaration table depends on various settings, for example, the symbolic access of the block.

The figure below shows the structure of the declaration table with a symbolic access data block in online view as an example.



Data_block_1

	Name	Data type	Default value	Initial value	Monitor value	Retain	Comment
1	▼ Input					☐	
2	input1	Bool	false	true	🟩 TRUE	☐	
3	input2	Word	W#16#0000	W#16#0000	0000	☐	
4	input3	SInt			0	☐	
5	▼ Output					☐	
6	output1	Bool	false	false	☐ FALSE	☐	
7	▼ InOut					☐	
8	▼ Static					☐	

Meaning of the columns

The following table shows the meaning of the individual columns:

Column	Description
Name	Name of the tags.
Data type	Data type of the tags.
Offset	Relative address of the tags. This column is only visible in data blocks that cannot be symbolically addressed.
Default value	Value with which the tag in the interface of a higher-level code block is pre-assigned. The "Default value" column is hidden per default. To show it, click "Expanded mode". The values contained in this column can only be changed in the higher-level code block. The values are only displayed in the data block.

Column	Description
Initial value	Value that the tag should assume at startup. The default values defined in a code block are used as initial values during the creation of the data block. You can then replace these values with instance-specific initial values in the data block. Specification of an initial value is optional. If you do not specify any value, the tag assumes the default value at startup. If a default is not defined either, the default value valid for the data type is used. For example, the value "FALSE" is specified as standard for BOOL.
Monitor value	Current data value in the CPU. This column only appears if an online connection is available and you select the "Monitor" button.
Retain	Marks the tag as retentive. The values of retentive tags are retained even after the power supply is switched off.
Comment	Comments to document the tags.

See also

Creating data blocks (Page 0)
Creating a data structure for global data blocks (Page 513)
Defining initial values (Page 516)
Setting the retentivity of data values
Basic information on initial values (Page 515)

7.2.4.3 Creating data blocks

Prerequisites

The "Program blocks" folder opens in the project tree.

Procedure

To create a data block, proceed as follows:

1. Double-click the "Add new block" command.

   The "Add new block" dialog box opens.
2. Click the "Data block (DB)" button.
3. Enter a name for the data block.
4. Select the type of the data block. You have the following options available to you:
   - To create a global data block, select the list entry "Global DB".
   - To create an instance data block, select the function block to which you want to assign the instance data block from the list.
5. Select the "Manual" option button if you want to assign the number of the block.

6. If you choose to use manual assignment, enter the block number in the input field.
7. To add additional properties for the data new block, click the arrow beside "Further information" in the lower part of the dialog box.

   An area with further input fields is displayed.
8. Enter all the properties you require.
9. Confirm your entry with "OK".

Result

The new data block is created. You can find the data block in the project tree in the "Program blocks" folder.

Note

You can select the "Add new and open" check box at the bottom of the dialog box. As a result, the block will be opened immediately after it is created.

See also

Instance data blocks (Page 347)
Programming data blocks (Page 510)
Global data blocks (DB) (Page 347)

7.2.4.3 Creating a data structure for global data blocks

7.2.4.3 Declaring tags with elementary data type

Requirement

A global data block is open.

Procedure

To declare a tag of the elementary data type, proceed as follows:

1. Enter a tag name in the "Name" column.
2. Click the arrow key in the "Data type" column and select the desired data type.

   See also: Declaring tags of STRUCT data type (Page 514)

   See also: Declaring tags of the ARRAY data type (Page 514)
3. Repeat steps 1 and 2 for all tags that are to be declared.

See also

Display and edit block properties (Page 415)

Keyboard shortcuts in tables (Page 134)
Editing the declaration table for data blocks (Page 0)
Defining initial values (Page 516)
Setting the retentivity of data values
Monitoring data values online (Page 519)

7.2.4.3 Declaring tags of the ARRAY data type

Requirement

A data block is open.

Procedure

To declare a tag of the ARRAY data type, follow these steps:

1. Enter a tag name in the "Name" column.
2. In the "Data type" column, click the arrow key and select the data type "Array [o .. hi] of type".
3. Then enter the dimensions in the same column, showing high limit and low limit and the data type (for example, ARRAY [1..10] of Bool). A space must be inserted between the closing square bracket and the keyword "of" and also between "of" and the data type information for the ARRAY elements.

Entering initial values of ARRAY elements

To initialize the individual elements of an ARRAY, follow these steps:

1. Click the "Expanded mode" button.

   The ARRAY opens and the individual ARRAY elements are shown in separate rows.
2. Enter the required value in the "Initial value" column.
3. To close the ARRAY again, click the "Expanded mode" button.

See also

Defining initial values (Page 516)
Setting the retentivity of data values
Monitoring data values online (Page 519)
Editing the declaration table for data blocks (Page 0)

7.2.4.3 Declaring tags of STRUCT data type

Requirement

A data block is open.

Procedure

To declare a tag of the STRUCT data type, proceed as follows:

1. Enter a tag name in the "Name" column.
2. In the "Data type" column, click the arrow key and select the "Struct" entry.

   Two empty rows are inserted after the new tag.
3. Insert the first structure element in the first empty row.

   An additional empty row is inserted after the element.
4. Repeat step 3 for all additional structure elements.

   It is not necessary to end the structure explicitly. The structure ends with the last element that is entered.
5. To insert a new tag after the structure, leave a blank row after the end of the structure and then start the new tag in the second empty row.

Entering initial values of STRUCT elements

To initialize the individual elements of a structure, proceed as follows:

1. Click the "Expanded mode" button.

   The structure opens and the individual STRUCT elements are shown in separate rows.
2. Enter the required value in the "Initial value" column.
3. To close the ARRAY again, click the "Expanded mode" button.

See also

Defining initial values (Page 516)
Setting the retentivity of data values
Monitoring data values online (Page 519)
Editing the declaration table for data blocks (Page 0)
STRUCT (Page 386)

7.2.4.3 Defining initial values

7.2.4.3 Basic information on initial values

Definition

The initial value of a tag is a value defined by you that the tag will assume after a startup.

The retentive tags have a special status. After a "warm restart" they retain their values and are not reset to the initial value.

Default values and instance-specific initial values

- The structure of the data blocks can be derived from higher-level elements. An instance data block is based, for example, on the interface of a higher-level code block.

In this case you can define a default value for each tag in the higher-level element. The default values defined in the code block are used as initial values during the creation of the data block. You can then replace these values with instance-specific initial values in the data block.

Specification of an initial value is optional. If you do not specify any value, the tag assumes the default value at startup. If a default is not defined either, the default value valid for the data type is used. For example, the value "FALSE" is specified as standard for BOOL.

See also

Defining initial values (Page 516)
Structure of the declaration table for data blocks (Page 511)
Declaring local tags in the block interface (Page 435)

7.2.4.3 Defining initial values

Requirement

A data block is opened and contains declared tags.

Procedure

To determine the initial values for the tags, follow these steps:

1. Click the "Expanded mode" button to show all elements of structured data types.
2. Enter the desired initial values in the "Initial value" column. The value must match the data type of the tag and should not exceed the range of the data type.

Note

The "Default value" column contains the default values that were defined for the tags in the interface of a higher-level code block.

Result

The instance-specific initial values are defined. The tag takes the defined value at startup, provided it was not declared as retentive.

See also

Basic information on initial values (Page 515)

7.2.4.3 Setting the retentivity of data values

7.2.4.3 Setting retentivity in global data blocks

7.2.4.3 Retentive behavior and symbolic addressing in global data blocks

Symbolic access

By setting symbolic access, you can specify how tags of a global data block are declared, symbolic only or both symbolic and absolute. If symbolic access is enabled, you can declare tags only by entering a symbolic name. In this case the tags are automatically addressed, making optimum use of the available memory capacity. If symbolic access is not enabled, the tag also gets a fixed absolute address. The memory area is allocated depending on the address of the declared tags.

Retentive behavior

If symbolic access is enabled you can specify the retentive behavior of individual tags in a global data block. If a tag is defined as retentive it is automatically stored in the retentive memory area of the global data block.

If symbolic access is disabled in a global data block, you cannot specify the retentive behavior of individual tags. In this case the retentivity settings are valid for all tags of the global data block.

See also

Symbolic addressing of blocks only (Page 363)
Retentive memory areas (Page 319)

7.2.4.3 Setting retentive behavior in global data block

Introduction

Depending on the setting for symbolic access, the retentivity behavior in a global data block can be set either for individual or for all tags. To specify the retentive behavior, the following settings of the global data block must be considered:

- The symbolic access of the tags is enabled:

  The retentive behavior can be specified for the individual tags. For tags with structured data types, retentivity settings are transferred for all tag elements.
- The symbolic access of tags is disabled:

  The retentivity settings are valid for all tags of the global data block.

Requirement

A global data block is open.

Procedure

To set the retentive behavior of the tags in a global data block, follow these steps:

1. In the "Retain" column, select the cell of tags for which you want to set a retentive behavior.
2. Select the check box in the "Retain" column.

Result

- If symbolic access is enabled, the selected tag is defined as retentive.
- If symbolic access is disabled, all tags of the global data block are defined as retentive.

See also

Retentive behavior and symbolic addressing in global data blocks (Page 517)
Symbolic addressing of blocks only (Page 363)
Retentive memory areas (Page 319)

7.2.4.3 Setting retentivity in instance data blocks

7.2.4.3 Retentive behavior in instance data blocks

Retentive behavior of local tags in an instance data block

Depending on the settings for symbolic access in the higher-level function block, the retentivity in an instance data block can be set either for all or for some of the tags. To specify the retentive behavior in an instance data block, the following settings of the function data block must be considered:

- **Symbolic access is enabled in the higher-level function block:**

  The instance data block assumes the retentivity settings of all tags from the higher-level function block. This property is displayed in the structure of the instance data block and cannot be edited.
- **Symbolic access is disabled in the higher-level function block:**

  The retentivity settings can be edited and are valid for all tags of the instance data block.

The setting for symbolic access of the higher-level function block is displayed as write-protected under the "Attribute" group in the property view of the instance data block and cannot be changed. In the instance data block, you can recognize the tags defined as retentive by the check mark set in the "Retain" column.

See also

Setting retentive behavior in an instance data block (Page 519)
Retentive behavior and symbolic addressing of code blocks (Page 440)

Setting the retentive behavior of local tags in a function block (Page 441)
Retentive memory areas (Page 319)

7.2.4.3 Setting retentive behavior in an instance data block

Introduction

In an instance data block, the editability of the retentivity behavior depends on the settings for symbolic access in the higher-level function block. In this case the retentive behavior cannot be set individually for each tag. The retentivity settings always affect all tags that are contained in an instance data block.

See also: Retentive behavior in instance data blocks (Page 518)

Requirement

- An instance data block is opened.

Procedure

To set the retentive behavior of the tags in an instance block, follow these steps:

1. Select a tag.
2. Select the check box in the "Retain" column of the tags.

Result

All tags are defined as retentive.

7.2.4.3 Monitoring data values online

7.2.4.3 Monitoring data values in data blocks online

You can monitor the current data values of the tags in the CPU directly in the declaration table.

Requirement

- An online connection is available.
- The data block has been loaded to the CPU.

Procedure

To monitor the data values, proceed as follows:

1. Start monitoring by clicking the "Monitor all" button.

   The additional "Monitor value" column is displayed in the table. This shows the current data values.

   See also: Structure of the declaration table for data blocks (Page 511)

2. End the monitoring by clicking the "Monitor all" button again.

7.2.4.3 Editing the declaration table for data blocks

7.2.4.3 Deleting tags in data blocks

Requirement

A global data block is open.

Procedure

To delete a tag, follow these steps:

1. Select the row that contains the tag you want to delete.
2. Select the "Delete" command in the shortcut menu.

Note

Only global data blocks permit tags to be deleted. You cannot directly change the structure of instance data blocks, because the structures of these blocks are defined by the function block.

The type of the data block is entered in the block properties.

See also: Display and edit block properties (Page 415)

See also

Keyboard shortcuts in tables (Page 134)
Adapting tables (Page 131)

7.2.4.3 Inserting table rows

Procedure

To insert row above the position of the mouse pointer, proceed as follows:

1. Position the mouse pointer in the row above which you want to insert a new row.
2. Click the "Insert row" button on the toolbar of the table.

   A new row is inserted above the selected row.

See also

Keyboard shortcuts in tables (Page 134)
Adapting tables (Page 131)

7.2.4.3 Adding table rows at the end

Procedure

To add a new row at the end of the table or at the end of a complex data type, follow these steps:

1. Click the "Add row" button on the table toolbar.

   A new empty row will be added at the end of the table or at the end of a complex data type.

See also

Keyboard shortcuts in tables (Page 134)
Adapting tables (Page 131)

7.2.5 Comparing blocks

7.2.5.1 Basics of block comparison

Function

Block comparison allows you to compare a block in the programming device with a block in the CPU. There are two ways of displaying the differences:

- Comparison editor (Page 148)

  Only the time stamp of the blocks is compared in the comparison editor. This comparison gives you an overview of the differences of all blocks. You can read the respective status from the symbols.
- Detailed comparison (Page 522)

  The offline and online versions of a block are opened side-by-side and the differences are highlighted.

You can perform a block comparison for the following blocks:

- Code blocks

  With code blocks, you can run a comparison with the comparison editor and make a detailed comparison.
- Data blocks

  Data blocks can only be compared using the time stamp in the comparison editor.

Objects to be compared

For the comparison of code blocks, both the block interfaces and the individual networks are compared. In addition, any different tag names are also determined. All comments and other block attributes are excluded from the comparison.

Procedure for the detailed comparison of code blocks

When networks are compared, first inserted or deleted networks are detected. Then the other networks are compared. Instructions are the same if the operator and operand are the same. In each case the first difference per operation is displayed. However, several differences per network can be displayed.

If the block interface changes, the respective time stamp of the block interface of the online and offline version of the code block changes. This change means a change in the time stamp of the program code. For the comparison of block interfaces, the time stamps of the program code of the online and offline versions of the code block are therefore compared first. If these time stamps are the same, it is assumed that the interfaces are the same. If these time stamps are different, the next step is to compare the data types of the interfaces, section by section. Multi-instances and PLC data types are included in the comparison. If the data types in the sections are the same, the initial values of the tags are compared. All differences are displayed.

7.2.5.2 Detailed comparison

7.2.5.2 Start detail comparison

Requirement

- The comparison editor is open.
- There is a block available with different online and offline versions.

See also: Overview of the comparison editor (Page 148)

Procedure

To perform a detailed comparison for a block, follow these steps:

1. In the comparison editor, right-click on the block for which you want to perform a detailed comparison.
2. Select the "Start detailed comparison"" command in the shortcut menu.

Result

One instance of the program editor is opened for the online version of the block and another instance for the offline version of the block, and the two instances are arranged side-by-side. The differences in the two variants are highlighted in color.

See also: Representation of the detailed comparison (Page 523)

7.2.5.2 Representation of the detailed comparison

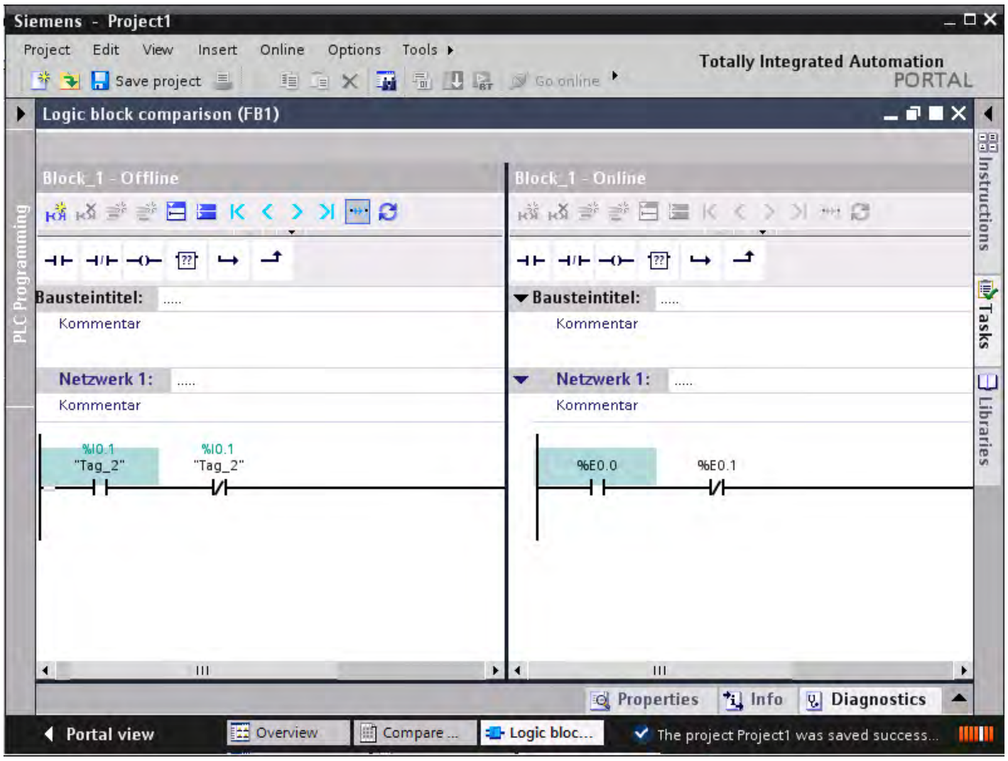
Identification of the differences

The detailed comparison allows you to identify the exact places where the online and offline versions of a block differ. The following color coding allows you to find these places as quickly as possible:

- The lines where there are differences are highlighted in gray.
- Differing operands and operations are highlighted in green.
- If the number of networks differs, pseudo-networks are added to allow the display of identical networks to be synchronized. These pseudo-networks are highlighted in grey and contain the text "No corresponding network found" in the title bar of the network. Pseudo-networks cannot be edited.
- If the sequence of the networks is incorrect, pseudo networks will be inserted at the corresponding locations. These pseudo networks are highlighted in gray and contain the text "The networks are not synchronized" in the title bar of the network. The pseudo network also features a "Go to network <No>" link, which you can use to navigate to the corresponding network.

Example

The following figure shows an example of the detailed comparison for the LAD programming language:



Reducing the number of differences displayed

For the sake of clarity, not all the differences are highlighted but rather the first difference of an operation in each case. For example, if all the inputs in a box with multiple inputs are different in the offline and online versions of the block, only the first input is highlighted as a difference. You can resolve this difference and update the comparison list. The next input will then be highlighted as a difference.

The number of differences highlighted within a network therefore depends on the number of existing operations.

7.2.5.2 Navigating in the detailed comparison

Requirement

You have run a detailed comparison.

Navigate to the differences

To navigate to a difference between the two blocks, follow these steps:

1. Open the list of results for the detailed comparison under "Info > Comparison result" in the Inspector window.
2. Double-click a difference.

   The difference is selected in both editors.

Or:

1. Click one of the following navigation buttons on the toolbar:
   - Position on first difference

     Navigates to the first difference in the block, and displays the difference in both editors.
   - Position on previous difference

     Navigates to the previous difference starting from the current position, and displays the difference in both editors.
   - Position on next difference

     Navigates to the next difference starting from the current position, and displays the difference in both editors.
   - Position on last difference

     Navigates to the last difference in the block, and displays the difference in both editors.

Switching off/on the synchronization of the vertical scrolling between the editors

The scrolling for both editors is synchronized to ensure that the corresponding networks are visible parallel to each other during vertical scrolling. You can switch this mode off and on. To do this, follow these steps:

1. To switch off synchronized scrolling, click the "Synchronize scrolling between editors" button in the toolbar.
2. To switch on synchronized scrolling again, click the "Synchronize scrolling between editors" button one more time in the toolbar.

7.2.5.2 Changing networks during the detailed comparison

Changing the offline block

You can change the offline block at any time.

Changing the online block

You cannot change the online block.

7.2.5.2 Updating the comparison results

As soon as you change an object, the comparison results are no longer valid and must be updated.

Requirement

You have run a detailed comparison.

Procedure

To update the comparison results, proceed as follows:

1. Click "Update the comparison result" in the toolbar.

7.2.6 Compiling blocks

7.2.6.1 Basic information on compiling blocks

Introduction

A user program must first be compiled before the CPU can execute it. You need to recompile your program each time you make a change.

The following procedures take place during compilation:

- The user program is checked for syntax errors.
- All the block calls within the compiled blocks are checked. If changes have been made to the interfaces of called blocks, the block calls are updated.
- Finally, the user program is compiled into a code that can be read by the CPU.

Compilation methods

You can start compilation in the following windows or editors:

- Compiling blocks in the project tree

Used to compile individual blocks or for the simultaneous compilation of all blocks in the "Program blocks" folder.

- Compiling blocks in the program editor

  This is intended for compilation of a single open block.

- Compiling blocks in the call or dependency structure

  Used to compile individual blocks.

  See also: Call structure (Page 546) , Dependency structure (Page 552)

Compilation options

If you are compiling blocks in project tree, you have further options:

- Software

  Only the changed blocks are compiled.

- Software (rebuild all blocks)

  All blocks are compiled. This is recommended for the first compilation and after major revisions.

See also

Compiling project data (Page 154)

7.2.6.2 Compiling blocks in the project navigation

You can compile one block, multiple blocks or all of the blocks in the project tree.

Requirement

The project tree is open.

Compiling multiple blocks in the project tree

To compile multiple blocks in the project tree, follow these steps:

1. Open the "Program blocks" folder in project tree.
2. Select the blocks you want to compile.
3. You can select one of two different options for the compilation:
   - If you want to compile only the changes since the last compilation, select the "Compile > Software" command in the shortcut menu.
   - If you want to compile all blocks completely, select the "Compile > Software (rebuild all blocks)" command in the shortcut menu.

Compiling all blocks in the project tree

To compile all blocks in the "Program blocks" folder in project tree, follow these steps:

1. Select the "Program blocks" folder in the project tree.
2. You can select one of two different options for the compilation:

  – If you want to compile only the changes since the last compilation, select the "Compile > Software" command in the shortcut menu.
  – If you want to compile all blocks completely, select the "Compile > Software (rebuild all blocks)" command in the shortcut menu.

Result

The code for the blocks is generated.

If the blocks to be compiled call blocks whose interface has changed, the block calls are updated.

- If you have selected one or more blocks for compilation, the block calls will be updated within the selected blocks.
- If you have selected the folder "Program blocks" for compilation, all block calls in the program as well as the used PLC data types will be updated.

The message under "Info > Compilation" in the Inspector window reports whether the compilation was successful.

See also: Correcting compilation errors (Page 528)

See also

Finding syntax errors in the program (Page 505)

7.2.6.3 Compiling blocks in the program editor

Requirement

The block to be compiled is open.

Procedure

To compile a block in the program editor, follow these steps:

1. Right-click the white area underneath a network in the instruction window of the program editor.
2. Select the "Compile" command in the shortcut menu.

Result

The code for the block is generated. If the block to be compiled has block calls in which the interface has changed, the block calls are updated.

The message under "Info > Compilation" in the inspector window reports whether the compilation was successful.

See also: Correcting compilation errors (Page 528)

7.2.6.4 Correcting compilation errors

In the Inspector window in "Info > Compile", you can see whether any compilation was successful or whether errors were detected in the program. If errors occur, you will need to correct them and then start the compilation again.

Procedure

To correct errors following compilation, proceed as follows:

1. Open the error list in the Inspector window with "Info > Compile".
2. Click on the blue question mark next to the error text to obtain information on eliminating the problem.
3. Double-click the error you want to correct.

   The corresponding error is highlighted.
4. Correct the error.
5. Restart compilation.

7.2.7 Downloading blocks

7.2.7.1 Introduction to loading of blocks

Downloading blocks to device

So that the CPU can execute the user program, the program must first be compiled and then downloaded to the device. The following options are available for downloading:

- Downloading blocks to the program editor

  This is intended for downloading a single open block.
- Downloading blocks to the project tree

  This is intended for simultaneous downloading of several or all blocks in the block folder.
- Downloading blocks to an accessible device

  You can download blocks to an accessible device by dragging them.

Note

Observe the following:

- If you download a know-how-protected block to a device, no restore information is installed along with it. This means that you cannot reopen a know-how-protected block if you upload it from the device.
- To avoid inconsistencies between calling and called blocks, all affected blocks are complied and downloaded each time global changes, such as changes in the block interface, are made.

Uploading blocks from device

You can upload blocks from an accessible device to your project. This is necessary, for example, if you want to edit blocks that only exist in the device. All existing blocks (organization blocks, function blocks, functions, data blocks) and the global tags are then uploaded to the project.

Uploading blocks from or downloading blocks to a memory card

Memory cards are plug-in cards used, for example, to expand the memory of a device. Only Siemens SD cards can be used for devices of the S7-1200 series.

To use a memory card as replacement of the load memory, you must download the user program or individual blocks to a memory card. You can just as well upload blocks from a memory card back into the project.

Note

Note the following when uploading to or downloading from a memory card:

- If the CPU contains no previous program and you insert an empty memory card in the CPU the program will be loaded from the PG/PC to the memory card and not to the CPU.
- If you insert an empty memory card prior to the startup of the CPU, the program that is on the CPU will be transferred automatically to the memory card. The program on the CPU will then be deleted.
- If you insert a memory card with a program in the CPU prior to the startup of the CPU and the CPU already contains a program, the program on the memory card will be executed and not the program on the CPU. The program on the CPU will be deleted.

See also

Uploading blocks from or downloading blocks to a memory card (Page 534)
Loading blocks from an accessible device (Page 534)

7.2.7.2 Downloading blocks to device

7.2.7.2 Loading blocks in device in the program editor

Requirement

The block to be downloaded is open.

Procedure

To download a block from the program editor to the device, follow these steps:

1. Right-click the white area underneath a network in the instruction window of the program editor.

2. Select the "Download to device" command in the shortcut menu.

   If you have not already established an online connection, the "Extended download to device" dialog opens.

   If you have already specified an online connection, the "Download preview" dialog opens. Continue then with step 5.

   Note

   You can also open the "Extended download to device" dialog with the "Online" menu.

   ---

3. Select the interface for your PG/PC from the "PG/PC interface for downloading" drop-down list in the "Extended download to device" dialog. If a subnet is available, also select a subnet from the "Connection to subnet" drop-down list.
4. Select your device in the "Accessible devices in target subnet" table and confirm your selection with "Load".

   When necessary, the project data is compiled. The "Download preview" dialog opens. This dialog displays messages and proposes actions necessary for uploading.
5. Check the messages and, where necessary, enable the actions in the "Action" column.

   Notice

   Performing the proposed actions during operation of the plant can cause serious damage to property or injury to persons if there are functional disturbances or program errors!

   Make sure that no dangerous situations can arise before you start the actions!

   As soon as downloading becomes possible, the "Download" button is enabled.
6. Click "Download".
7. The block is downloaded and the "Download results" dialog opens. This dialog shows you the status and the actions after downloading.
8. If you want to start the modules again directly after downloading, select the "Start all" check box.
9. To close the "Download results" dialog box, click "Finish".

Result

The code for the blocks is downloaded to the device. If the changes affect additional blocks, these will be compiled and also downloaded to the device. Blocks that exist only online in the device are deleted. Inconsistencies between the blocks in the user program are avoided by downloading all affected blocks and deleting the unneeded blocks in the device.

The messages under "Info > General" in the Inspector window report whether the downloading process was successful.

7.2.7.2 Loading blocks into the device in the project tree

In the project tree you can download one block, multiple blocks or all blocks to a device.

Downloading multiple blocks in the project tree to the device

To download one block or multiple blocks to the device from the project tree, follow these steps:

1. Open the "Program blocks" folder in project tree.
2. Select the blocks you want to download.
3. Select the "Download to device" command in the shortcut menu.
4. If you only want to download the changes since the last download, select the "Software" option. If you want to download all blocks in their entirety, select the "Software (all blocks)" option.
   - If you have not already established an online connection, the "Extended download to device" dialog opens.
   - If you have already specified an online connection, the "Download preview" dialog opens. Continue then with step 7.

   Note

   You can also open the "Extended download to device" dialog with the "Online" menu.
5. Select the interface for your PG/PC from the "PG/PC interface for downloading" drop-down list in the "Extended download to device" dialog. If a subnet is available, also select your subnet from the "Connection to subnet" drop-down list.
6. Select your device in the "Accessible devices in target subnet" table and confirm your selection with "Load".

   When necessary, the project data is compiled. The "Download preview" dialog opens. This dialog displays messages and proposes actions necessary for the downloading.
7. Check the messages and, where necessary, enable the actions in the "Action" column.

   Notice

   Performing the proposed actions during operation of the plant can cause serious property damage and personal injury if there are malfunctions or program errors!

   Make sure that no dangerous situations can arise before you start the actions!

   As soon as downloading becomes possible, the "Download" button is enabled.
8. Click "Download".

   The block is downloaded and the "Download results" dialog opens. This dialog shows you the status and the actions after downloading.
9. If you want to start the modules again directly after downloading, select the "Start all" check box.
10. To close the "Download results" dialog box, click "Finish".

Downloading all blocks in the project tree to the device

To download all blocks in the "Program blocks" folder to the device from the project tree, follow these steps:

1. Select the "Program blocks" folder in the project tree.
2. Select the "Download to device" submenu in the shortcut menu.
3. If you only want to download the changes since the last download, select the "Software" option. If you want to download all blocks in their entirety, select the "Software (all blocks)" option.
   - If you have not already established an online connection, the "Extended download to device" dialog opens.
   - If you have already specified an online connection, the "Download preview" dialog opens. Continue then with step 6.

   Note

   You can also open the "Extended download to device" dialog with the "Online" menu.

   ---
4. Select the interface for your PG/PC from the "PG/PC interface for downloading" drop-down list in the "Extended download to device" dialog. If a subnet is available, also select your subnet from the "Connection to subnet" drop-down list.
5. Select your device in the "Accessible devices in target subnet" table and confirm your selection with "Load".

   When necessary, the project data is compiled. The "Download preview" dialog opens. This dialog displays messages and proposes actions necessary for the downloading.
6. Check the messages and, where necessary, enable the actions in the "Action" column.

   Notice

   Performing the proposed actions during operation of the plant can cause serious property damage and personal injury if there are malfunctions or program errors!

   Make sure that no dangerous situations can arise before you start the actions!

   As soon as downloading becomes possible, the "Download" button is enabled.
7. Click "Download".

   The block is downloaded and the "Download results" dialog opens. This dialog shows you the status and the actions after downloading.
8. If you want to start the modules again directly after downloading, select the "Start all" check box.
9. To close the "Download results" dialog box, click "Finish".

Result

The code for the blocks is downloaded to the device. If the changes affect additional blocks, these will be compiled and also downloaded to the device. Blocks that exist only online in the device are deleted. Inconsistencies between the blocks in the user program are avoided by downloading all affected blocks and deleting the unneeded blocks in the device.

The messages under "Info > General" in the inspector window report whether the downloading process was successful.

7.2.7.2 Loading blocks to an accessible device

Requirement

The accessible devices are displayed.

See also: Displaying accessible devices (Page 1533)

Procedure

To download blocks to an accessible device, follow these steps:

1. Open the "Program blocks" folder of the PLC in the project tree.
2. Select the blocks you want to download to the accessible devices.
3. In the project tree, drag the blocks to the "Program blocks" folder of the accessible device.

   The "Download preview" dialog opens. This dialog displays messages and proposes actions necessary for downloading.
4. Check the messages and, where necessary, enable the actions in the "Action" column.

   Notice

   Performing the proposed actions during operation of the plant can cause serious damage to property or injury to persons if there are functional disturbances or program errors!

   Make sure that no dangerous situations can arise before you start the actions!
5. As soon as downloading becomes possible, the "Download" button is enabled.
6. Click the "Download" button.

   The download is performed. The "Download results" dialog then opens. In this dialog, you can check whether or not the download was successful and take any further action that may be necessary.
7. If you want to start the modules again directly after downloading, select the "Start all" check box.
8. Click "Finish".

Result

The block is downloaded to an accessible node. If the changes affect additional blocks, these will also be downloaded to the accessible node. Blocks that exist only online in the device are deleted. Inconsistencies between the blocks in the user program are avoided by downloading all affected blocks and deleting the unneeded blocks in the device.

The messages under "Info > General" in the Inspector window report whether the downloading process was successful.

7.2.7.3 Uploading blocks from device

7.2.7.3 Loading blocks from an accessible device

Requirement

- The accessible devices are displayed.

  See also: Displaying accessible devices (Page 1533)
- The PLC folder in the project contains no data.

Procedure

To upload blocks from an accessible device to your project, follow these steps:

1. In the project tree, drag the "Program blocks" folder of the accessible device to the "Program blocks" folder of the PLC in the project.

   The "Upload preview" dialog box opens. This dialog displays messages and proposes actions necessary for uploading. If the PLC folder in the project already contains data, a message informs you that these data will be replaced.
2. Check the messages and, where necessary, enable the actions in the "Action" column.
3. As soon as uploading becomes possible, the "Upload from device" button is enabled.
4. Click the "Upload from device" button.

7.2.7.4 Uploading blocks from or downloading blocks to a memory card

7.2.7.4 Loading blocks to a memory card

Requirement

- The memory card is not marked as program card.
- The "Program blocks" folder of the memory card is open.

See also: Accessing memory cards (Page 165)

Procedure

To download blocks to a memory card, follow these steps:

1. Open the "Program blocks" folder of the PLC in the project tree.
2. Select the blocks you want to download to the memory card.
3. Drag the blocks in project tree to the "Program blocks" folder of the memory card.

   The "Download preview" dialog opens. This dialog displays messages and proposes actions necessary for uploading.

4. Check the messages and, where necessary, enable the actions in the "Action" column.
5. As soon as downloading becomes possible, the "Download" button is enabled.
6. Click the "Download" button.

   The download is performed. The "Download results" dialog then opens. In this dialog, you can check whether or not the download was successful and take any further action that may be necessary.
7. Click "Finish".

Result

The block is downloaded to the memory card If the changes affect additional blocks, these will also be downloaded to the memory card. Blocks that exist only on the memory card are deleted. Inconsistencies between the blocks in the user program are avoided by downloading all affected blocks and the deleting of the non-required blocks on the memory card.

The messages under "Info > General" in the Inspector window report whether the downloading process was successful.

7.2.7.4 Loading blocks from a memory card

Requirement

The "Program blocks" folder of the memory card is open.

See also: Accessing memory cards (Page 165)

Procedure

To upload blocks from a memory card to your project, follow these steps:

1. Select the blocks you want to upload in the "Program blocks" folder of the memory card in project tree.
2. Drag the blocks to the "Program blocks" folder of the PLC.

   The "Upload preview" dialog box opens. This dialog displays messages and proposes actions necessary for uploading.
3. Check the messages and, where necessary, enable the actions in the "Action" column.
4. As soon as uploading becomes possible, the "Upload from device" button is enabled.
5. Click the "Upload from device" button.

7.2.8 Protecting blocks

7.2.8.1 Protecting blocks

Introduction

You can protect one or more blocks of the types OB, FB, FC and DB from unauthorized access using a password.

If a block is know-how protected, only the following data is readable:

- Interface parameters Input, Output, InOut, Return
- Block title
- Block comment
- Block properties
- Program structure
- Global tags in the cross-references without information on the point of use

The following actions can still be performed with a know-how protected block:

- Copying and deleting
- Calling in a program
- Checking and where necessary updating when compiling

The code of the block, on the other hand, is protected from unauthorized reading and modification.

Note

Observe the following:

- If you download a know-how-protected block to a device, no restore information is loaded along with it. This means that you cannot open a know-how-protected block again even with the correct password if you upload it from the device. A block comparison between the offline and online version of the block remains possible with the correct password.
- If you forget the password, you will no longer be able to access the block.

Possible actions

The following actions are possible depending on the protection status of a block:

- If no know-how protection exists, you can set up know-how protection.
- If know-how protection already exists, you can either cancel the know-how protection or change the password.

See also

Setting up know-how protection (Page 537)

7.2.8.2 Setting up know-how protection

Setting up know-how protection

You can use a password to apply know-how protection to blocks to protect them from unauthorized access.

Setting up know-how protection

To set up know-how protection, proceed as follows:

1. Select the blocks you want to protect.
2. Select the command "Know-how protection > Enable know-how protection" in the "Edit" menu.

   The "Enable know-how protection" dialog box opens.
3. Enter a password in the "Enter password" box.
4. Enter the same password in the "Confirm password" box.
5. Confirm your entries with "OK".

Changing a password

To change the password, proceed as follows:

1. Select the know-how protected block for which you want to change the password.
2. Select the "Know-how protection > Change password" command in the "Edit" menu.

   The "Change password" dialog box opens.
3. Enter the old password in the "Enter old password" box.
4. Enter the new password in the "Enter new password" box.
5. Enter the same new password in the "Confirm new password" box.
6. Confirm your entries with "OK".

Disabling know-how protection

To disable know-how protection, proceed as follows:

1. Select the block for which you want to disable know-how protection.
2. Select the command "Know-how protection > Disable know-how protection" in the "Edit" menu.

   The "Disable know-how protection" dialog box opens.
3. Enter the password.
4. Confirm your entries with "OK".

7.3 Displaying program information

7.3.1 Overview of available program information

Program information

The program information of a user program contains the view specified in the following table.

View	Application
Assignment list (Page 539)	Provides an overview of the address bits for the I, Q, and M memory areas already allocated within the user program. Also indicates if an address has been allocated by access from an S7 program or if the address has been assigned to a SIMATIC S7 module.
Call structure (Page 546)	Shows the call structure of the blocks within the user program and provides an overview of the blocks used and their relationships.
Dependency structure (Page 552)	Shows the list of blocks used in the user program. A block is shown at the first level and blocks that call or use this block are indented below it. In contrast to the call structure, instance blocks are listed separately.
Resources (Page 557)	Shows the hardware resources of the CPU for objects (OB, FC, FB, DB, PLC tags and user-defined data types), for CPU memory areas and for the existing I/O modules.

Displaying several views simultaneously

You can generate and display several views for one or more user programs to facilitate testing and changing your user program.

Displaying multiple views, for example, enables you to:

- Display all program information for a user program next to one another
- Compare different user programs

7.3.2 Displaying an assignment list

7.3.2.1 Introduction to the assignment list

Program information in the assignment list

The assignment list shows if an address has been allocated by access from an S7 program or if the address has been assigned to a SIMATIC S7 module. It is therefore an important basis for locating errors or changes in the user program.

The assignment list provides you with an overview of the bits in the bytes of the memory areas listed below:

- Input (I)
- Output (O)
- Bit memory (M)
- I/O (P)

Display of the assignment list

The assignment list of inputs, outputs, and bit memories is displayed in several separate work windows.

Filters

You can filter the display within the assignment list. You can use predefined filters or create your own.

Displaying cross-reference information

You have the option of displaying cross-reference information for selected addresses in the assignment list.

You can display the cross references to selected addresses or to individual selected bits in the Inspector window by selecting the command "Display usage" from the shortcut menu. The command "Tools > Cross References" allows you to also open the cross-reference list for the selected object.

Displaying the PLC tag table

You can open the PLC tag table from the assignment list and edit the properties of the tags used.

To do this select an address of the assignment list and select the "Open editor" command in the shortcut menu.

Enabling the display of retentivity

You can enable and disable the display of the retentive state of bit memories by selecting the "Display/hide retentivity" toolbar button.

See also

Symbols in the assignment list (Page 540)
Layout of the assignment list (Page 540)

7.3.2.2 Layout of the assignment list

Layout of the assignment list

The assignment list is displayed in several work windows separated by:

- Inputs and outputs
- Bit memories
- I/O

Each line in the assignment list is dedicated to a byte of the memory area, in which the corresponding eight bits from 7 to 0 are labeled according to their access. In conclusion, a "bar" indicates if access is made by a byte (B), word (W) or double word (D).

Displaying inputs, outputs, and bit memories

The list displays all input/output bytes and bit memory bytes used and their assignment in the S7 user program.

You can find an explanation of the symbols in the assignment list here. (Page 540)

See also

Introduction to the assignment list (Page 539)

7.3.2.3 Symbols in the assignment list

Meaning of the symbols in the assignment list

The following table shows the meaning of the symbols in the assignment list:

Symbol	Meaning
◆	Indicates the address assignment in the selected state.
◆	Indicates the address assignment in the non-selected state.
◇	Indicates that a pointer start address and a tag address access the same address range and that they are selected.
◇	Indicates that a pointer start address and a tag address access the same address range and that they are not selected.

Symbol	Meaning
●	Indicates the pointer assignment in the selected state.
○	Indicates the pointer assignment in the non-selected state.
▮	Indicates that the byte is in use with byte access and the corresponding tag is selected. The shortcut menu allows you to display cross-reference information for the selected variables as well as the PLC tag table.
▯	Indicates that the byte is in use with byte access and the corresponding tag is not selected.
▮▮	Indicates that the byte is in use with word access and the corresponding tag is selected. The shortcut menu allows you to display cross-reference information for the selected variables as well as the PLC tag table.
▯▯	Indicates that the byte is in use with word access and the corresponding tag is not selected.
▮▮▮▮	Indicates that the byte is in use with double word access and the corresponding tag is selected. The shortcut menu allows you to display cross-reference information for the selected variables as well as the PLC tag table.
▯▯▯▯	Indicates that the byte is in use with double word access and the corresponding tag is not selected.
Background color: gray	Indicates that a byte is in use with byte, word or double word access and that the address is also in use by the hardware. The gray background color indicates overlapping memory access.
Background color: yellow	Indicates that the address is not in use by the hardware.

See also

Layout of the assignment list (Page 540)
Introduction to the assignment list (Page 539)

7.3.2.4 Displaying an assignment list

Requirement

A project has been created with programmed blocks.

Procedure

Proceed as follows to display the assignment list:

1. Select the block folder or one or more of the blocks contained therein.
2. Select the "Assignment list" command in the "Tools" menu.

Result

The assignment list for the selected program is displayed.

View options in the assignment list

Refer to view respective view options that are set to display the desired information in the assignment list.

See also

Setting the view options for the assignment list (Page 542)
Layout of the assignment list (Page 540)

7.3.2.5 Setting the view options for the assignment list

Introduction

The following view options are available for the assignment list:

- Used addresses:

  When this check box is activated, the addresses, I/Os and pointers used in the program are displayed.
- Free hardware addresses:

  When this check box is activated, only the free hardware addresses are displayed.

Requirement

- A project has been created with programmed blocks.
- The assignment list is open.

Procedure

Proceed as follows to set the view options for the assignment list:

1. Click on the arrow of the

   symbol ("View options") in the task bar.

   The view options for the call structure opens. Check marks are set in front of the activated view options.
2. If you want to activate or deactivate a view option, click on the respective check box and set or remove the check mark.

Result

The view options are set and the desired information is displayed in the assignment list.

7.3.2.6 Filter options in the assignment list

Filter settings

You can define your own filter settings for the assignment list. The following options are available for defining filters:

- Display all addresses of the address areas specified
- Show single, defined addresses from the selected address area, for example, "IB 0" and "IB 200".
- Show complete area from the selected address area, for example, "IB 0" to "IB 256".

The following table provides an overview of all available options:

Selection in the	Selection	Symbol	Meaning
Address area	All addresses (I, Q, M) can be enabled either separately or as in the default setting.	Check box is activated	The assignment list only displays the enabled address areas (I, Q, M).
Filter area	Show assignment for all addresses	*	Displays the assignment of all addresses of the enabled address areas (I, Q, M).
	Show assignment for selected addresses, for example, for the inputs "IB 0" and "IB 256"	0;256 Separate individual addresses and areas by a semicolon.	Assignments of selected addresses for the activated address areas (I) are shown.
	Show assignment for selected areas, for example, for the inputs "IB 0 to IB 100" and "IB 200 to IB 256".	0-100;200-256 Contiguous areas should be connected by a hyphen.	Assignments of selected areas for the activated address areas (I) are shown.

7.3.2.7 Defining filters for assignment list

Requirement

- A project has been created with programmed blocks.
- The assignment list is open.

Defining filter

Proceed as follows to define a filter for the assignment list:

1. Click on the

   symbol ("Filter") in the task bar.

   The "Filter" dialog opens.

2. Click on the

symbol ("Create new filter") in the task bar.

A new filter is created with the name "Filter_1". The check boxes for all addresses (inputs, outputs, bit memories) are set by default for the filter.

3. If you want to change the name of the filter, click on the drop-down list in the task bar and enter a new title.
4. Deactivate the check boxes of addresses that are not to be affected by the filter.
5. Enter one of the following options in the filter area of the activated address:
   – Show all addresses used = "*"
   – Show single, defined addresses, for examle, IB 0" and IB 25 = "0;25". Individual addresses and address areas are separated by a semicolon.
   – Show complete address areas, for example, IB 0 to IB 256 = "0-256". Complete address areas should be connected by a hyphen.
6. Confirm your entries with "OK".

   The newly defined filter is shown in the task bar of the assignment list under the specified name.

Delete filter

Proceed as follows to delete a filter:

1. Click on the

   symbol ("Filter") in the task bar.

   The "Filter" dialog opens.
2. In the drop-down list of the task bar, select the filter you want to delete.
3. Click on the

   symbol ("Delete selected filter") in the task bar.

   The selected filter is deleted.

See also

Filter options in the assignment list (Page 543)
Displaying an assignment list (Page 541)
Introduction to the assignment list (Page 539)

7.3.2.8 Filtering an assignment list

Requirement

- A project has been created with programmed blocks.
- The assignment list is open.

Procedure

1. Click on the arrow on the drop-down list.

   The available filter are displayed.
2. Select the desired filter.

Result

The assignment list is filtered according to the settings of the selected filter.

Note

The filter settings are saved when the project is closed.

7.3.2.9 Defining retentive memory areas for bit memories

Introduction

In the assignment list you can define the width of the retentive memory area for bit memories. The content of tags which are addressed in retentive memory is retained after power off and at the STOP to RUN transition after power on.

The display of retentive bit memories can be enabled and disabled in the assignment list. If their display is enabled, retentive bit memories are identified by an icon in the "Address" column.

Requirement

The assignment list is open.

Procedure

Proceed as follows to define the width of the retentive memory area for bit memories:

1. Click "Retentivity" in the toolbar.

   The "Retentive memory areas" dialog opens.
2. Starting at the count of 0, define the width of the retentive memory area by entering the last byte of this area in the input field. Watch out for any addresses of tags already assigned to the retentive area.
3. Load the block to the target system. Select the "Program blocks" folder in the Project tree and select the "Download to device" submenu in the shortcut menu.

Result

The width of the retentive memory area is defined. If enabled in the assignment list, an icon will indicate the retentive state of all tags in the "Address" column.

7.3.2.10 Enabling the display of retentive bit memories

Introduction

In the assignment list you can enable and disable the display of retentive bit memories. The retentive bit memories are identified by means of an icon in the "Address" column if the display of retentivity is enabled.

Requirement

The assignment list is open.

Procedure

Proceed as follows to enable and disable the display of retentive bit memories:

1. Click "Display/hide retentivity" in the toolbar.

Result

The retentive tags are identified by means of an icon in the "Address" column of the bit memory area if the display of retentivity is enabled. The icons in the "Address" column are hidden if the display of retentivity is disabled.

7.3.3 Displaying the call structure

7.3.3.1 Introduction to the call structure

Call structure

The call structure describes the call hierarchy of the block within an S7 program.

It provides an overview of:

- The blocks used
- Jumps to the places of use of the blocks
- Relationships between blocks
- Local data requirements of the blocks
- Status of the blocks

Information in the call structure

Displaying the call stucture provides you with a list of the blocks used in the user program. The first level of the call structure is highlighted in color and shows the blocks that are not called by any other block in the program. Organization blocks are always shown on the first level of the call structure. Functions, function blocks and data blocks are only shown on the first level if they are not called by an organization block. When a block calls other blocks or functions, they are listed indented under the calling block. System functions and blocks are shown in the call structure only if they are called by a block.

View options

The following view options are available for the call structure:

- Display conflicts only:

  When this check box is activated, only the conflicts within the call structure are displayed.
- Group several calls:

  When this check box is activated, several block calls are grouped together. The number of block calls is displayed in the "Number of calls" column. The links to the various call locations are offered in a drop-down list in the "Details" column.

Displaying the block calls

You can display the block calls in a block by clicking on the arrow in front of the block title. To display the call information of all blocks, click on the

symbol ("Expand all") in the toolbar.

You can hide the total overview by clicking on the

symbol ("Collapse all").

Displaying cross-reference information

You can display the cross-reference information for a block in the Inspector window by right-clicking on the respective block and selecting the "Display Usage" command from the shortcut menu.

Displaying blocks in the program editor

You can open the program editor and edit blocks there from the call structure.

To do this select the required block in the call structure and select the "Open" command in the shortcut menu.

Displaying deleted blocks

The lines for deleted blocks are marked with the

icon.

7.3.3.2 Layout of the call structure

Layout of the call structure

The view of the call structure consists of the following columns:

Column	Content/meaning
Call structure	Shows an overview of the blocks called Several block calls are grouped and the "Number of calls" column is displayed if the "Group calls" check box is set.
Call type (!)	Shows the type of call, for example recursive block call.
Address	Shows the absolute address of the block. With a function block, the absolute address of the corresponding instance data block is also shown.
Details	Shows the network or interface of the calling block. All information are offered as a link in this column. With this link, you can jump to the location of the block call in the program editor. When the "Group several calls" view option is activated, the calls are grouped and offered as links in a drop-down list.
Local data (in the path)	Indicates the local data requirement of the full path. Blocks which can only be addressed symbolically have higher local data requirements because the information for the symbolic addressing is stored with them.
Local data (for blocks)	Show the local data requirements of the block. Blocks which can only be addressed symbolically have higher local data requirements because the information for the symbolic addressing is stored with them.

See also

Symbols in the call structure (Page 548)
Introducing the consistency check in the call structure (Page 551)

7.3.3.3 Symbols in the call structure

Meaning of the symbols in the call structure

The following table shows the meaning of the symbols in the call structure:

Symbol	Meaning
🟪	Indicates an organization block (OB).

Symbol	Meaning
🟦	Indicates a function block (FB).
🟩	Indicates a function (FC).
🛢	Indicates a data block (DB).
🛢	Indicates that the block is declared as a multiinstance.
⧉	The object has an interface dependency to an object connected to the left.
🟥	Indicates that the block needs to be compiled again.
▯	Indicates that the data block needs to be compiled again.
\	Indicates that the object is not available.
⧉	Indicates that the interface causes a time stamp conflict.
🕒	Indicates that the variable causes a time stamp conflict.
▨	Indicates that the block is not called directly or indirectly from an OB.
🔒	Indicates that an object is marked with know-how protection. An object with this property cannot be edited.
▶	Indicates that the block is normally called recursively.
⧉	Indicates that a tag declaration in the interface has a recursive dependency: • Scenario 1: FB1 calls FB2 and then FB2 calls FB1. The instance data blocks of these FBs have a recursion in the interface. • Scenario 2: A multi-instance FB uses the instance DB of its parent FB as a global DB.

7.3.3.4 Displaying the call structure

Requirement

A project has been created with blocks.

Procedure

Proceed as follows to display the call structure:

1. Select the block folder or one or more of the blocks contained therein.
2. Select the "Call structure" command in the "Tools" menu.

Result

The call structure for the selected object is displayed.

See also

Setting the view options for the call structure (Page 550)

7.3.3.5 Setting the view options for the call structure

Introduction

The following view options are available for the call structure:

- Display conflicts only:

  Only the blocks causing conflicts within the call structure are displayed if this check box is activated.

  The following blocks cause conflicts:

  – Blocks executing any calls with older or newer code time stamps.

  – Blocks calling a block with modified interface.

  – Blocks using a tag with modified address and/or data type.

  – Block called neither directly, nor indirectly by an OB.

  – Blocks calling a block which no longer exists.

- Group several calls:

  When this check box is enabled, several block calls and data block accesses are grouped together. The number of block calls is shown in the "Number" column. The links to the various call locations are offered in a drop-down list in the "Details" column.

Requirement

- A project has been created with programmed blocks.
- The call structure is open.

Procedure

Proceed as follows to set the view options for the call structure:

1. Click on the arrow of the

   symbol ("View options") in the task bar.

   The view options for the call structure opens. Check marks are set in front of the activated view options.

2. If you want to activate or deactivate a view option, click on the respective check box and set or remove the check mark.

Result

The view options are set and the required information is displayed in the call structure.

7.3.3.6 Introducing the consistency check in the call structure

Consistency check

Changing the time stamp of a block during or after the program is generated can lead to time stamp conflicts, which in turn cause inconsistencies among the blocks that are calling and being called.

Using the consistency check

The "Consistency check" function is used to visualize inconsistencies when time stamp conflicts occur. Whe the consistency check is performed, the inconsistent blocks are shown in the call structure and marked with the correspoinding symbols.

- Most time stamp and interface conflicts can be rectified by recompiling the blocks.
- If compilation fails to clear up inconsistencies you can use the link in the "Details" column to go to the source of the problem in the program editor and manually eliminate any inconsistencies.
- The blocks marked in red must be recompiled.

See also

Symbols in the call structure (Page 548)

7.3.3.7 Checking block consistency in the call structure

Requirement

- A project has been created with programmed blocks.
- The call structure is open.

Procedure

Proceed as follows to check the block consistency:

1. Click on the

   symbol ("Consistency check") in the task bar.

   The block consistency is checked. Blocks found to be inconsistent are marked accordingly by a symbol.
2. If a block is inconsistent, click on the arrow in front of the block title in the call structure.

The inconsistent blocks are displayed. The exact problem locations are listed as links in the "Details" column.

3. Click on the respective link in the "Details" column to jump to the location in the block requiring correction.
4. Check and correct the inconsistencies in the blocks.
5. Recompile the blocks by selecting the required blocks and clicking on the command "Compile" in the shortcut menu.
6. Download the corrected blocks to the target system by clicking the command "Download to device" in the shortcut menu.

Result

The block consistency is checked. The inconsistencies in the blocks are corrected. The corrected blocks are loaded to the target system.

See also

Symbols in the call structure (Page 548)

7.3.4 Displaying the dependency structure

7.3.4.1 Introduction to the dependency structure

Introduction

The dependency structure shows the dependencies each block has to other blocks in the program.

Information in the dependency structure

Displaying the dependency structure provides you with a list of the blocks used in the user program. A block is shown at the far left and blocks that call or use this block are indented below it.

The dependency structure also shows the status of the individual blocks using symbols.

Objects causing a time stamp conflict and perhaps leading to an inconsistency in the program are marked with various symbols.

The dependency structure is an extension of the cross-reference list for objects.

View options

The following view options are available for the dependency structure:

- Display conflicts only:

  When this check box is activated, only the conflicts within the dependency structure are displayed.
- Group several calls:

When this check box is activated, several block calls are grouped together. The number of block calls is shown numerically in the "dependency structure" column. The links to the various call locations are offered in a drop-down list in the "Details" column.

Displaying the dependency structure

Clicking on the arrow in front of the block title displays the blocks that call or use this block. To display the dependency structure for all blocks, click on the

symbol ("Expand all") in the task bar.

You can hide the total overview by clicking on the

symbol ("Collapse all").

Displaying cross-reference information

You can display the cross-reference information for a block in the Inspector window by right-clicking on the respective block and selecting the "Display Usage" command from the shortcut menu.

Displaying blocks in the program editor

You can open the program editor and edit blocks there from the dependency structure. To do this select the required block in the dependency structure and select the "Open" command in the shortcut menu.

Displaying deleted blocks

The lines for deleted blocks are marked with the

icon.

7.3.4.2 Layout of the dependency structure

Layout of the dependency structure

The view of the dependency structure consists of the following columns:

Column	Content/meaning
Dependency structure	It indicates the dependencies between each block and the other blocks in the program.
Call type (!)	Shows the type of call, for example recursive block call.
Address	Shows the absolute address of the block.

Column	Content/meaning
Number of calls	Indicates the number of multiple calls of blocks.
Details	Shows the network or interface of the called block. All information are offered as a link in this column. With this link, you can jump to the location of the block call in the program editor. When the "Group several calls" view option is activated, the calls are grouped and offered as links in a drop-down list.

See also

Symbols in the dependency structure (Page 554)

7.3.4.3 Symbols in the dependency structure

Meaning of the symbols in the dependency structure

The following table shows the meaning of the symbols in the dependency structure:

Symbol	Meaning
🟪	Indicates an organization block (OB).
🟦	Indicates a function block (FB).
🟩	Indicates a function (FC).
🛢	Indicates a data block (DB).
🛢	Indicates that the block is declared as a multiinstance.
⊡	The object has an interface dependency to an object connected to the left.
▭	Indicates that the block needs to be compiled again.
▯	Indicates that the data block needs to be compiled again.
╲	Indicates that the object is not available.
⊐	Indicates that the interface causes a time stamp conflict.
🕒	Indicates that there is an inconsistency with this object.
🔒	Indicates that an object is marked with know-how protection. An object with this property cannot be edited.

Symbol	Meaning
⇥	Indicates that a tag declaration in the interface has a recursive dependency: • Scenario 1: FB1 calls FB2 and then FB2 calls FB1. The instance data blocks of these FBs have a recursion in the interface. • Scenario 2: A multi-instance FB uses the instance DB of its parent FB as a global DB.

7.3.4.4 Displaying the dependency structure

Requirement

A project has been created with programmed blocks.

Procedure

Proceed as follows to display the dependency structure:

1. Select the block folder or one or more of the blocks contained therein.
2. Select the "Dependency structure" command in the "Tools" menu.

Result

The dependency structure for the selected program is displayed.

See also

Setting the view options for the dependency structure (Page 555)

7.3.4.5 Setting the view options for the dependency structure

Introduction

The following view options are available for the dependency structure:

- Display conflicts only:

  When this check box is activated, only the conflicts within the dependency structure are displayed.

  The following blocks cause conflicts:

  – Blocks executing any calls with older or newer code time stamps.

  – Blocks called by a block with modified interface.

  – Blocks using a tag with modified address and/or data type.

  – Block called neither directly, nor indirectly by an OB.

- Group several calls:

When this check box is activated, several block calls are grouped together. The number of block calls is shown in the relevant column. The links to the various call locations are offered in a drop-down list in the "Details" column.

Requirement

- A project has been created with programmed blocks.
- The dependency structure is open.

Procedure

Proceed as follows to set the view options for the dependency structure:

1. Click on the arrow of the

   symbol ("View options") in the task bar.

   The view options for the call structure opens. Check marks are set in front of the activated view options.
2. If you want to activate or deactivate a view option, click on the respective check box and set or remove the check mark.

Result

The view options are set and the required information is displayed in the call structure.

7.3.4.6 Introducing the consistency check in the dependency structure

Consistency check

Changing the time stamp of a block during or after the program is generated can lead to time stamp conflicts, which in turn cause inconsistencies among the blocks that are calling and being called.

Using the consistency check

The "Consistency check" function is used to visualize inconsistencies. Whe the consistency check is performed, the inconsistent blocks are shown in the dependency structure and marked with the correspoinding symbols.

- Most time stamp and interface conflicts can be rectified by recompiling the blocks.
- If compilation fails to clear up inconsistencies you can use the link in the "Details" column to go to the source of the problem in the program editor and manually eliminate any inconsistencies.
- The blocks marked in red must be recompiled.

See also

Layout of the dependency structure (Page 553)
Symbols in the dependency structure (Page 554)

7.3.4.7 Checking block consistency in the dependency structure

Requirement

- A project has been created with programmed blocks.
- The dependency structure is open.

Procedure

Proceed as follows to check the block consistency:

1. Click on the

   symbol ("Consistency check") in the task bar.

   The block consistency is checked. Blocks found to be inconsistent are marked accordingly by a symbol.
2. If a block is inconsistent, click on the arrow in front of the block title in the call structure.

   The inconsistent blocks are displayed. The exact problem locations are listed as links in the "Details" column.
3. Check and correct the inconsistencies in the blocks.
4. Recompile the blocks by selecting the required blocks and clicking on the command "Compile" in the shortcut menu.
5. Download the corrected blocks to the target system by clicking the command "Download to device" in the shortcut menu.

Result

The block consistency is checked. The inconsistencies in the blocks are corrected. The corrected blocks are loaded to the target system.

See also

Symbols in the dependency structure (Page 554)

7.3.5 Displaying CPU resources

7.3.5.1 Introducing resources

Introduction

The "Resources" tab indicates the hardware resources of the configured CPU for:

- the used programming objects,
- the assignment of memory areas within the CPU and
- the assigned inputs and outputs of the existing input and output modules.

Information provided in the "Resources" tab

The resources tab provides an overview of the hardware resources used on your CPU for:

- the programming objects used in the CPU (e.g. OB, FC, FB, DB, PLC tags, and user-defined data types),
- the memory areas available on the CPU (work memory, load memory, retentive memory), their maximum size and utilization by the programming objects stated above,
- the I/O of modules which can be configured for the CPU (I/O modules, digital input modules, digital output modules, analog input modules, and analog output modules), including the I/O already in use.

Display of the maximum available load memory

The maximum size of available load memory can be selected from a drop-down list box in the "Total" row of the "Load memory" column.

Display of the maximum available work memory

The maximum size of available work memory can be selected from a drop-down list box in the "Total" row of the "Work memory" column.

Display of the maximum available retentive memory

The maximum size of available retentive memory can be selected from a drop-down list box in the "Total" row of the "Retentive memory" column.

Note

Retentive memory data

All bit memories and data blocks specified as retentive will be integrated in the calculation of the retentive data.

Updating the display in the "Resources" tab

Click the "Update view" toolbar button to update the display of objects.

Benefits of the display in the "Resources" tab

The "Resources" tab of the program information dialog provides a detailed list of all objects and of the corresponding memory area used.

The tab also indicates shortage of resources and helps to avoid such states.

Blocks which are not compiled can be identified as their size is indicated by a question mark.

See also

Layout of the "Resources" tab (Page 559)
Displaying resources (Page 560)
Selecting the maximum load memory available (Page 560)

7.3.5.2 Layout of the "Resources" tab

Layout of the "Resources" tab in the program information

The view of the "Resources" tab consists of the following columns:

Column	Content/meaning
Objects	The "Details" area provides an overview of the programming objects available in the CPU, including their memory assignments.
Load memory	Displays the maximum load memory resources of the CPU as a percentage and as absolute value. The values displayed under "Total" provide information on the maximum memory available in the load memory. The values displayed under "Used" provide information on the memory actually used in the load memory.
Work memory	Displays the maximum work memory resources of the CPU as a percentage and as absolute value. The values displayed under "Total" provide information on the maximum memory available in the load memory. The values displayed under "Used" provide information on the memory actually used in the load memory.
Retentive memory	Displays the maximum resources for retentive memory in the CPU as a percentage and as absolute value. The values displayed under "Total" provide information on the maximum memory available in the load memory. The values displayed under "Used" provide information on the memory actually used in the load memory.
I/O	Displays the I/Os which are available on the CPU, including their module-specific availability in the next columns. The values displayed at "Configured" provide information about the maximum number of I/O available. The values displayed under "Used" provide information on the memory actually used in the load memory.

DI / DQ / AI / AQ	Displays the number of configured and used inputs/outputs:
	DI = Digital inputs
	DQ = Digital outputs
	AI = Analog inputs
	AQ = Analog outputs
	The values displayed at "Configured" provide information about the maximum number of I/O available.
	The values displayed under "Used" provide information on the actually used inputs and outputs.

See also

Displaying resources (Page 560)
Selecting the maximum load memory available (Page 560)
Introducing resources (Page 557)

7.3.5.3 Displaying resources

Requirement

A project with programmed blocks has been created.

Procedure

Proceed as follows to display the resources of the respective CPU memory areas:

1. Select the block folder or one or several of the blocks contained therein.
2. Select the "Resources" command in the "Tools" menu.

Result

The memory resources of the CPU are displayed.

7.3.5.4 Selecting the maximum load memory available

Requirement

A project with programmed blocks has been created.

Procedure

Proceed as follows to display the available maximum of load memory resources:

1. Open the drop-down list in the "Total" field of the "Load memory" column by clicking the icon.
2. Select a corresponding value for the CPU used by clicking it in the drop-down list box.

Result

The "Total" field displays the selected maximum memory resources.

7.4 Displaying cross-references

7.4.1 General information about cross references

Introduction

The cross-reference list provides an overview of the use of operands and tags within the user program.

Uses of cross-references

The cross-reference list offers you the following advantages:

- When creating and changing a program, you retain an overview of the operands, tags and block calls you have used.
- From the cross-references, you can jump directly to the point of use of operands and tags.
- During a program test or when troubleshooting, you are informed of the following:
  - which operand is processed by which command in which block,
  - which tag is used in which picture,
  - which block is called by which other block.
- As part of the project documentation, the cross-references provide a comprehensive overview of all operands, memory areas, blocks, tags and pictures used.
- You can display the point of use of objects, for example to modify or delete them.
- You can display the points of use of deleted objects and adapt them when necessary.

See also

Structure of the cross-reference list (Page 561)
Displaying the cross-reference list (Page 563)
Displaying cross-references in the Inspector window (Page 564)

7.4.2 Structure of the cross-reference list

Views of the cross-reference list

There are two views of the cross-reference list. The difference between the two views is in the objects displayed in the first column:

- Used by:

  Display of the referenced objects. Here, you can see where the object is used.
- Used:

  Display of the referencing objects. Here, you can see the users of the object.

The assigned tool tips provide additional information about each object.

Structure of the cross-reference list

The cross-reference list has the following structure:

Column	Content/meaning
Object	Name of the object that uses the lower-level objects or that is being used by the lower-level objects.
Quantity	Quantity of uses
Location	Each location of use, for example, network
Property	Special properties of referenced objects, for example, the tag names in multi-instance declarations.
as	Shows additional information about the object, e.g., that an instance DB is used as template or as multiple instance.
Access	Type of access, whether access to the operand is read access (R) and/ or write access (W).
Address	Address of the operand
Type	Information on the type and language used to create the object
Path	Path of object in project tree

Depending on the installed products, additional columns or different columns are displayed for the cross-references.

Settings in the cross-reference list

You can make the following settings using the buttons in the toolbar of the cross-reference list:

- Update cross-reference list

  Updates the current cross-reference list.
- Making settings for the cross-reference list

  Here, you select check boxes to specify whether all used, all unused, all defined or all undefined objects will be displayed. If the "Undefined objects" option is enabled, references to previously deleted objects are also displayed.
- Collapse entries

  Reduces the entries in the current cross-reference list by closing the lower-level objects.
- Expand entries

  Expands the entries in the current cross-reference list by opening the low-level objects.

Sorting in the cross-reference list

You can sort the entries in the "Object" column, including other product-specific columns, in ascending or descending order. To do this, click on the relevant column title.

See also

General information about cross references (Page 561)
Displaying the cross-reference list (Page 563)

7.4.3 Displaying the cross-reference list

Prerequisites

You have created a project.

Introduction

There are several ways of displaying cross-references depending on whether you are in the Portal view or in the Project view and which object you have selected in the project tree.

In the Portal view, you can only display cross-references for the entire CPU; in the Project view, you can display cross-references for the following objects:

- "PLC" folder
- "Blocks" folder
- Individual blocks
- "PLC tags" folder
- "Tags and connections" folder
- Individual tags

Displaying cross-references

Proceed as follows to display cross-references:

1. Select the required action in the Portal view, for example "Program PLC" and the "Show cross-references" command or select one of the objects listed above in the Project view and select the "Cross-references" command in the "Tools" menu.
2. Click the "Used by" button to display where the objects shown in the cross-reference list are used.
3. Click the "Used" button to view the users of the objects displayed in the cross-reference list.
4. You can perform the following actions using the buttons in the toolbar:
   - Update cross-reference list
   - Making settings for the cross-reference list
   - Collapse entries
   - Expand entries
5. You can sort the entries in the "Object" and "Address" columns in ascending or descending order by clicking on the relevant column title.
6. To go to the point of use of the object, click on the displayed link.

See also

General information about cross references (Page 561)
Structure of the cross-reference list (Page 561)

7.4.4 Displaying cross-references in the Inspector window

Introduction

The Inspector window displays cross-reference information about an object you have selected in the "About > Cross-reference" tab. This tab displays the instances where a selected object is being used and the other objects using it.

The Inspector window also includes blocks which are only available online in the cross-references.

Structure

The Inspector window displays the cross-reference information in tabular format. Each column contains specific and detailed information on the selected object and its application. The table below shows the additional information listed in the "About > Cross-reference" tab:

Column	Meaning
Object	Name of the object that uses the lower-level objects or that is being used by the lower-level objects.
Quantity	Quantity of uses
Location	Each location of use, for example, network
Property	Special properties of referenced objects, for example, the tag name in multi-instance declarations
as	Shows additional information about the object, e.g., that an instance DB is used as template or as multiple instance.
Access	Access mode Shows whether the operand is accessed by a read (R) and/or write (W) operation.
Address	Address of the operand
Type	Information about the type and language used to create the object
Path	Path of object in project tree

Depending on the installed products, additional columns or different columns are displayed for the cross-references.

7.5 Testing the user program

7.5.1 Basics of testing the user program

Function

You have the option of testing the running of your user program on the device. You can then monitor signal states and values of tags and can assign values to tags to simulate certain situations in the running of the program.

Requirement

There must be an executable program loaded on the device.

Test options

The following test options are available:

- Testing with program status

  The program status allows you to monitor the running of the program. You can display the values of operands and the results of logic operations (RLO) of the networks, allowing you to recognize and fix logical errors in your program.

- Testing with the watch table

  With the watch table, you can monitor, modify or force the current values of individual tags in the user program or on a CPU. You can assign values to individual tags for testing and run the program in a variety of different situations. You can also assign fixed values to the I/O outputs of a CPU in STOP mode, for example to check the wiring.

See also

Introduction to testing with program status (Page 565)
Introduction to testing with the watch table (Page 570)

7.5.2 Testing with program status

7.5.2.1 Introduction to testing with program status

Function

If you display the program status, you can monitor the execution of the program. You can enable the status starting at a specific location in the program and you then obtain an overview of the values of the individual operands and the results of logic operations. This allows you to check whether or not the components of the automation system are being correctly controlled.

Warning

Testing while the plant is operating can cause serious damage to property or injury to persons if there are functional disturbances or program errors.

Make sure that no dangerous situations can arise before you conduct a test.

7.5.2.2 Testing the program

7.5.2.2 Switching test with program status on/off

Requirement

- The identical block exists in the device.
- The block is open.

Switching the program status on or off

To switch the program status for a block on or off, follow these steps:

1. Click the "Monitoring on/off" button in the toolbar.

Enabling program status starting at a specific point in a network

To start the program status at a specific point, follow these steps:

1. Click the "Monitoring on/off" button in the toolbar.
2. Right-click on the tag you want program status to start from.
3. Select "Start monitoring here" in the shortcut menu.

Note

The resources for testing with program status are limited. If there are not enough resources for the current test, earlier tests will be terminated.

Result

If you enable the display of the program status, an online connection is established and the program status is displayed. When you enable the display of the program status, you will be asked if you want to interrupt the online connection.

See also

Displays in program status (Page 568)

7.5.2.2 Editing blocks during the program test

If you edit blocks while the test with program status is still running, online monitoring will be interrupted and you will be able to edit the block offline. If the block is not available offline in the project, you will first have to load it from the device to the project. After editing the block, you will also have to compile and load it again.

Requirement

The test with program status is enabled.

Procedure

To edit blocks while the test with program status is still running, follow these steps:

1. Edit the block as necessary.

   The test with program status is interrupted and the block is switched offline assuming it exists offline.
2. If the block does not exist offline, load it to the project from the device.
3. Compile the block.

   See also: Compiling blocks (Page 527)
4. Download the block to the device.

   See also: Downloading blocks (Page 528)

Result

The block now contains your modifications both online and offline. The online connection is re-established and testing with program status continues.

7.5.2.2 Modifying tags in the program status

While testing with the program status, you have the option of modifying tags to the following values once and immediately:

- Modify to 1

  Modifies tags of the "Bool" data type to the value "True".
- Modify to 0

Modifies tags of the "Bool" data type to the value "False"

- Modify value

  You can enter a modify value for tags that do not belong to the "Bool" data type.

Note that you cannot modify I/O inputs.

Procedure

To modify tags during testing with the program status, proceed as follows:

1. Right-click on the tag you want to modify.
2. Select one of the following commands in the shortcut menu:
   - "Modify > Modify to 1"
   - "Modify > Modify to 0"
   - "Modify > Modify value"
3. If you select "Modify value", the "Modify" dialog opens. Enter the value you require in the "Modify value" box and confirm with "OK".

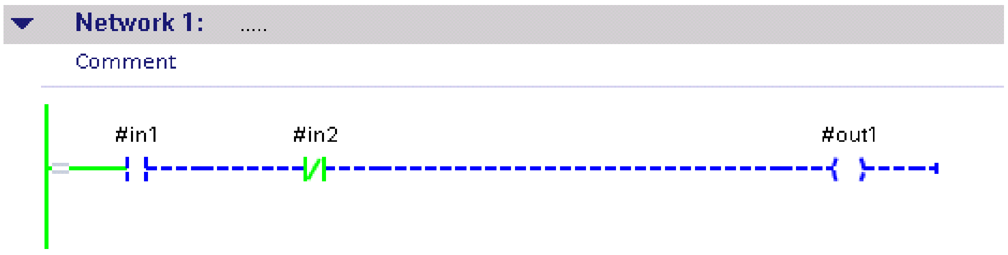
7.5.2.3 Displays in program status

7.5.2.3 Program status display for LAD programs

Displays in program status

The display of the program status is updated cyclically. It begins at the selected network.

The following figure shows an example of the program status display for LAD:



Representation of the program status

You can recognize the status of individual operations and lines of a network quickly based on the color and type of lines and symbols. The following table shows the relationship between representation and status:

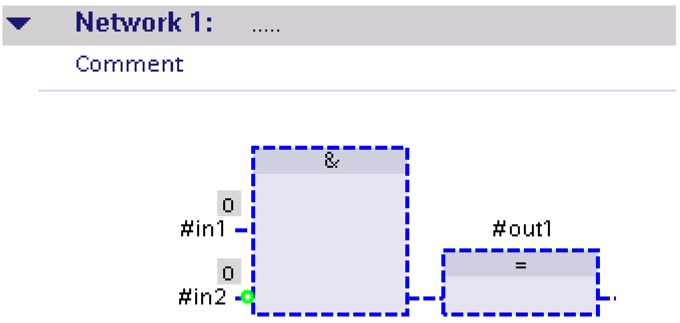
Representation	Status
Green solid	Satisfied
Blue dashed	Not satisfied
Gray solid	Unknown or not executed
Black	Not interconnected
Parameter in a frame with a saturation of 100 %	Value is current
Parameter in a frame with a saturation of 50 %	Value originates from an earlier cycle. The point in the program was not executed in the current cycle.

7.5.2.3 Program status display for FBD programs

Displays in program status

The display of the program status is updated cyclically. It begins at the selected network.

The following figure shows an example of the program status display for FBD:



Representation of the program status

You can recognize the status of individual operations and lines of a network quickly based on the color and type of lines and symbols. The following table shows the relationship between representation and status:

Representation	Status
Green solid	Satisfied
Blue dashed	Not satisfied
Gray solid	Unknown or not executed
Black	Not interconnected
Parameter in a frame with a saturation of 100 %	Value is current

Representation	Status
Parameter in a frame with a saturation of 50 %	Value originates from an earlier cycle. The point in the program was not executed in the current cycle.

The values of the operands are displayed above the relevant operand name in a gray box.

7.5.3 Testing with the watch table

7.5.3.1 Introduction to testing with the watch table

Overview

The following functions are available for testing with the watch table:

- Monitoring tags
  This displays the current values of the individual tags of a user program or a CPU on the programming device or PC.
- Modifying tags
  You can use this function to assign specific values to the individual tags of a user program or CPU. Modifying is also possible with Test with program status (Page 565) .
- "Enable peripheral outputs" and "Modify now"
  These two functions enable you to assign specific values to individual peripheral outputs of a CPU in STOP mode. You can also use them to check your wiring.
- Forcing tags
  Use this function to assign a specific value to individual tags of a user program or CPU.

Monitoring and modifying tags

The following tags can be monitored and modified:

- Inputs, outputs, and bit memories
- Contents of data blocks
- I/O

Possible applications

The advantage of the watch table is that a variety of test environments can be stored. This enables you to reproduce tests during commissioning or for service and maintenance purposes.

See also

Creating and editing watch tables (Page 571)
Basic procedure for testing with the watch table (Page 573)

7.5.3.2 Creating and editing watch tables

7.5.3.2 Creating a watch table

Introduction

If you want to monitor and modify tags, you enter them in a watch table. Once you have created a watch table, you can save it, duplicate it, and print it and use it again and again to monitor, modify, and force tags.

Requirements

A project is open.

Procedure

To create a watch table, follow these steps:

1. Click "Project view" in the status bar.

   The project view is displayed.
2. In the project tree, double-click the CPU for which you want to create a watch table.
3. Double-click the "Watch Tables" folder and then the "Add watch table" command.

   A new watch table is added.
4. In the "Name" column or in the "Address" column, enter the name or the absolute address for the tags that you want to monitor or modify.
5. You can select a display format from the drop-down list in the "Display format" column if you want to change this default setting.
6. Now decide whether you want to monitor, modify, or force the entered tags and, if applicable, enter the desired values for modifying or forcing.

See also

Adapting tables (Page 131)

7.5.3.2 Opening a watch table

Requirements

A watch table has been created.

Procedure

To open a watch table, follow these steps:

1. Open the "Watch tables" folder below the CPU.
2. Double-click on the relevant watch table in the folder.

Result

The selected watch table opens.

7.5.3.2 Copying and pasting a watch table

Prerequisite

A watch table has been created.

Procedure

To copy a watch table, follow these steps:

1. Right-click the watch table that you want to copy.
2. In the context menu, select "Copy".
3. In the project tree, open the folder structure for the CPU in which you want to paste the copied watch table.
4. Right-click the "Watch Tables" folder.
5. In the context menu, select "Paste".
6. Alternatively, you can select the entire contents of the watch table and drag-and-drop it onto another watch table.

Result

A copy of the watch table is pasted in the "Watch Tables" folder of the CPU.

7.5.3.2 Saving a watch table

Prerequisite

A watch table has been created.

Procedure

To save a watch table, follow these steps:

1. If you wish to change the preset name of the table, select the "Rename" command in the context menu and enter a new name for the table.
2. In the "Project" menu, select "Save". Note that this save operation will save the entire project.

Result

The contents of the watch table and the project are saved.

Note

You can reuse saved watch tables to monitor, modify and force tags when retesting your program.

7.5.3.3 Basic procedure for testing with the watch table

Overview

Follow the steps below to use the monitor, modify and force tag functions in the watch table:

Creating and editing watch tables (Page 571)
↓
Entering tags in the watch table (Page 582)
↓
Monitoring tags in the watch table (Page 582)
↓
Modifying tags in the watch table (Page 591)
↓
Forcing tags in the watch table (Page 594)

You will find more detailed information on the individual steps in the sections listed above.

7.5.3.4 Form of the watch table

Introduction

A watch table contains the tags you defined for the entire CPU. A "Watch tables" folder is automatically generated for each CPU created in the project. You create a new watch table in this folder by selecting the "Add watch table" command.

Layout of the watch table

The columns displayed in the watch table depend on the mode you are working in: basic mode or expanded mode.

The following additional columns are shown in expanded mode:

- Monitor with trigger
- Modify with trigger

are shown.The names of the columns can also be changed dynamically based on the action.

Meaning of the columns

The following table shows the meaning of the individual columns in basic mode and expanded mode:

Mode	Column	Meaning
Basic mode		Identifier column
	Name	Name of the inserted tag
	Address	Address of the inserted tag
	Display format	Selected display format
	Monitoring value	Values of the tags, depending on the selected display format.
	Modify value	Value with which the tag is modified.
	Force value	Value with which the tag is forced.
	Value	Value with which the tag is modified and forced.
	("Modify")	Select the tag to be modified by clicking the corresponding check box.
	F ("Force")	Select the tag to be forced by activating the corresponding check box.
	Comment	Comment for documentation of the tags
The following additional columns are shown in expanded mode:	Monitor with trigger	Display of selected monitoring mode
	Modify with trigger	Display of selected modify mode

7.5.3.5 Basic mode and advanced mode

Difference between basic mode and expanded mode

Depending on the mode specified, the watch table displays different columns and column headings that can be used to perform different actions.

You will find a detailed list of the columns in Layout of the watch table (Page 573) .

Switching between basic mode and expanded mode

You have the following options of toggling between the basic and expanded mode:

- Click the icon
  ("Display/hide all expanded mode columns"). Click this icon again to return to the basic mode.

Or:

- Activate the check box for the "Expanded mode" command in the "Online" menu. Deactivate this check box to return to the basic mode.

Functionality in expanded mode

The following functionality is only possible in expanded mode:

- Monitor with trigger
- Modify with trigger
- Enable peripheral outputs

7.5.3.6 Icons in the watch table

Meaning of the icons in the watch table

The following table shows the meaning of the icons in the watch table:

Icon	Meaning
	Modifies the addresses of all selected tags immediately and once. This command is executed once and as quickly as possible without reference to a defined trigger point in the user program.
	Modifies the addresses of all selected tags with reference to a defined trigger point in the user program.
	Disables the command output disable of the peripheral outputs. You can then modify the peripheral outputs when the CPU is in STOP mode.
	Displays all columns of expanded mode. If you click this icon again, the columns of expanded mode will be hidden.
	Displays all force columns. If you click this icon again, the force columns will be hidden.
	Displays all modify columns. If you click this icon again, the modify columns will be hidden.
	Starts forcing for all addresses of the selected tags. If forcing is already running, the previous action is replaced without interruption.
	Stops forcing of addresses in the active watch table.
	Displays all addresses that are being forced in the CPU in the active watch table.
	Starts monitoring of the visible tags in the active watch table. The default setting for the monitoring mode in basic mode is "permanent". In expanded mode, you can set defined trigger points for the monitoring of tags.
	Starts monitoring of the visible tags in the active watch table. This command is executed immediately and the tags are monitored once.

Icon	Meaning
F	Displays the check box for the selection of tags to be forced.
⚡	Displays the check box for the selection of tags to be modified.
🟩	Indicates that the value of the selected tag has been modified to "1".
⬜	Indicates that the value of the selected tag has been modified to "0".
=	Indicates that the address is being used multiple times.
☒	Indicates that the substitute value is being used. Substitute values are values that are output to the process in case of signal output module faults or are used instead of a process value in the user program in case of signal input module faults. The substitute values can be assigned by the user (e.g., retain old value).
🔒	Indicates that the address is blocked because it is already being modified.
F⊘	Indicates that the address cannot be forced.
⚡⊘	Indicates that the address cannot be modified.
⊘	Indicates that the address cannot be monitored.
F	Indicates that the address is being forced.
F	Indicates that the address is being forced in part.
✖	Indicates that a syntax error occurred.
⚠	Indicates that the address is selected but is not yet being modified or forced at the moment.

7.5.3.7 Entering tags in the watch table

7.5.3.7 Basics for entering tags in the watch table

Recommended procedure

Select the tags whose values you want to modify or monitor and enter them in the watch table.

When entering tags, work from the outside to the inside. This means that you start by entering the tags for the inputs in the watch table. Then, you enter the tags that are affected by the inputs or that affect the outputs. Finally, you enter the tags for the outputs.

Example of filling out a watch table

- If, for example, you want to monitor input bit "1.0", memory word "5" and output byte "0", enter the following values in the "Address" column:

  I 1.0

  MW 5

  QB 0

Or:

- Enter the corresponding symbolic name in the "Name" column.
- As an option, you can select the display format you require from the drop-down list in the "Display format" column, if you do not want to use the default setting.
- Now decide whether you want to monitor, modify, or force the entered tags.

Syntax check

When you enter the tags in the watch table, the syntax of each cell is checked when you exit the cell. Incorrect entries are marked in red.

Note

When you place the mouse pointer in a cell marked in red, brief information is displayed with additional notes on the error.

See also

Permitted addresses for the watch table (Page 577)
Permissible modify values for the watch table (Page 578)

7.5.3.7 Permitted addresses for the watch table

Entry of operands in the watch table

The following table shows the operands that are permitted for the watch table:

Permitted operand	Data type	Example (International mnemonics)
Input/output/bit memory	BOOL	I1.0, Q1.7, M10.1 I0.0:P; Q0.0:P

Permitted operand	Data type	Example (International mnemonics)
Input/output/bit memory	BYTE	IB1/QB10/MB100 IB1:P; QB1:P
Input/output/bit memory	WORD	IW1; QW10; MW100 IW2:P; QW3:P
Input/output/bit memory	DWORD	ID4; QD10; MD100 ID2:P; QD1:P
Data block	BOOL	DB1.DBX1.0
Data block	BYTE	DB1.DBB1
Data block	WORD	DB1.DBW1
Data block	DWORD	DB1.DBD1

Note

You cannot enter "DB0..." because it is used by the system!

See also

Basics for entering tags in the watch table (Page 576)

7.5.3.7 Permissible modify values for the watch table

Entry of modify values in the watch table

The following table shows the operands that are permitted for the entry of force values in the watch table:

Table7-3 Bit operands

Possible bit operands	Example for permitted modify values
I1.0	True
M1.7	False
Q1.0	0
Q1.1:P	1
DB1.DBX1.1	2#0
M1.6	2#1

Table7-4 Byte operands

Possible byte operands	Example for permitted modify values
IB1	2#00110011
MB12	B#16#1F
QB10	1F
QB11:P	'a'
DB1.DBB1	10

Table7-5 Word operands

Possible word operands	Example for permitted modify values
IW1	2#0011001100110011
MW12	W#16#ABCD
MW14	ABCD
QW10	B#(12, 34)
QW12:P	12345
DB1.DBW1	'ab'
MW16	S5t#12s340ms
MW18	C#123
MW9	D#2006-12-31

Table7-6 Double word operands

Possible double word operands	Example for permitted modify values
ID1	2#00110011001100110011001100110011
MD0	1.23e4
MD4	01 Feb
QD10	Dw#16#abcdef10
QD12:P	ABCDEF10
DB1.DBD2	b#(12,34,56,78)
MD8	L#-12
MD12	L#12
MD16	123456789
MD20	123456789
MD24	T#12s345ms
MD28	Tod#1:2:34.567
MD32	P#e0.0

7.5.3.7 Permissible force values for the watch table

Entry of force values in the watch table

The following table shows the operands that are permitted for the entry of force values in the watch table:

Table7-7 Bit operands

Possible bit operands	Example for permitted force values
I1.0:P	True
I1.1:P	False
Q1.0P	0
Q1.1:P	1
I2.0:P	2#0
I2.1:P	2#1

Table7-8 Byte operands

Possible byte operands	Example for permitted force values
IB1:P	2#00110011
IB2:P	B#16#1F
QB14:P	1F
QB10:P	'a'
IB3:P	10

Table7-9 Word operands

Possible word operands	Example for permitted force values
IW0:P	2#0011001100110011
IW2:P	W#16#ABCD
QW10:P	ABCD
QW12:P	B#(12, 34)
IW4:P	'ab'
IW6:P	12345
IW8:P	S5t#12s340ms
IW10:P	C#123
IW12:P	D#2006-12-31

Table7-10 Double word operands

Possible double word operands	Example for permitted force values
ID0:P	2#00110011001100110011001100110011
ID4:P	1.23e4
QD10:P	1.2
QD14:P	Dw#16#abcdef10
ID8:P	ABCDEF10
ID12:P	b#(12,34,56,78)
ID16:P	L#-12
ID20:P	L#12
ID24:P	123456789
ID28:P	123456789
ID32:P	T#12s345ms
ID36:P	Tod#1:2:34.567
ID40:P	P#e0.0

7.5.3.7 Introducing the display formats

Display formats in the watch table

The display format you select specifies the representation of a tag value. Select a display format for each tag from the drop-down list in the "Display formats" column of the watch table. The drop-down list only offers the display formats which are valid for the data type of the selected tag.

The following table shows an example of the display formats you can select in the watch table for a corresponding tag type:

Data type	Display formats
BOOL (Page 375)	e.g.: Bool, Hex, BCD, Octal, Bin, Dec, Dec+/-
BYTE (Page 375)	e.g.: Hex, BCD, Octal, Bin, Dec, Dec+/-, Character
WORD (Page 375)	e.g.: Hex, BCD, Octal, Bin, Dec, Dec+/-, Dec_Sequence, Character, SIMATIC_Timer, Date
DWORD (Page 376)	e.g.: Hex, BCD, Octal, Bin, Dec, Dec+/-, Dec_Sequence, Character, Floating-point number, Time of day, Timer, Pointer

For more information, refer to the description of data types (Page 373) .

7.5.3.7 Selecting the display format for tags

Procedure

To select the display format of the tags in the watch table, follow these steps:

1. Enter the desired tag in the watch table.
2. Click the desired cell in the "Display format" column, and open the drop-down list.

   The permissible display formats are shown.
3. Select a display format from the drop-down list.

7.5.3.8 Monitoring tags in the watch table

7.5.3.8 Introduction to monitoring tags

Introduction

The watch table allows you to monitor the tags of the configured input and output modules in the CPU, depending on the monitoring and modify mode (Page 582) selected. To monitor the tags, an online connection to the CPU must exist.

Options for monitoring tags

The following options are available for monitoring tags:

- Monitor all
  This command starts the monitoring of the visible tags in the active watch table:
  - In basic mode, the monitoring mode is set to "permanent" by default.
  - In expanded mode, monitoring depends on the monitoring mode defined at the time. If the monitoring mode is changed while in expanded mode and then a switch is made to basic mode, the monitoring mode setting will also be applied in basic mode.
- Monitor now
  This command starts the monitoring of the visible tags in the active watch table. The tags are monitored immediately and once only.

7.5.3.8 Setting the monitoring and modify mode

Introduction

By selecting the monitoring and modify mode, you specify the trigger point and the duration of the tag monitoring in the watch table.

Possible monitoring and modify modes (duration of monitoring or modifying)

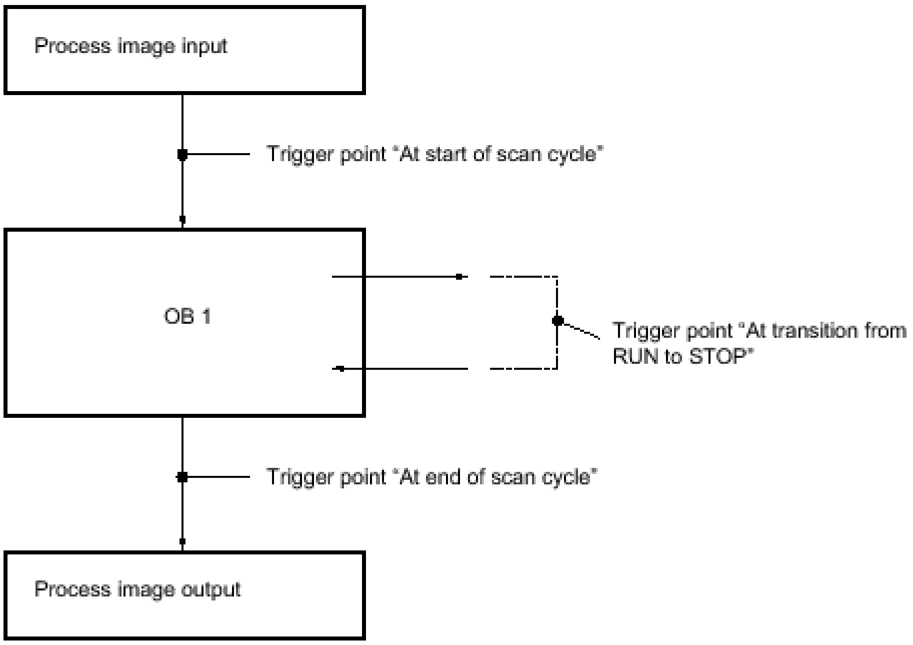
The following monitoring and modify modes are available:

- Permanent
  - In this mode, the inputs can be monitored at the start of the scan cycle and the outputs at the end.
- Once only, at start of scan cycle
- Once only, at end of scan cycle
- Permanently, at start of scan cycle
- Permanently, at end of scan cycle
- Only once, at transition from RUN to STOP
- Permanently, at transitions from RUN to STOP

Selecting the trigger point

The trigger points "Beginning of scan cycle", "End of scan cycle", and "Switch to stop" specify the time at which the tags are to be read from the CPU or updated in the CPU.

The following diagram illustrates the position of these trigger points:


Process image input
Trigger point "At start of scan cycle"
OB 1
Trigger point "At transition from RUN to STOP"
Trigger point "At end of scan cycle"
Process image output

Position of the trigger points

From the position of the trigger points, it follows that:

- Modifying of inputs is only appropriate at the beginning of the scan cycle (corresponding to the beginning of the user program OB 1), because otherwise the process image input is updated again after modifying and is thus overwritten.

- Modifying of outputs is only appropriate at the end of the scan cycle (corresponding to the end of the user program OB 1), because otherwise the process image output can be overwritten by the user program.
- The modified value is displayed in the "Monitoring value" column, provided that monitoring is active and the modified value is not overwritten by the user program.

Monitoring of tags

When tags are being modified, the following applies to the trigger points:

- If you have specified the modify mode as "once only", you will receive a message if the selected tags cannot be modified.
- In "permanent" modify mode, you do not receive a message.

Note regarding the "Modify now" command

You can modify the values of selected tags immediately using the "Online > Modify now" command. This command is executed once only and as quickly as possible without reference to a defined position (trigger point) in the user program. This function is used mainly for modifying when the CPU is in STOP mode.

7.5.3.8 "Monitor all" command for tags

Introduction

The "Monitor all" command allows you to start monitoring the visible tags in the active watch table. The default setting for the monitoring mode in basic mode of the watch table is "permanent". In expanded mode, you can specify defined trigger points for the monitoring of tags. In this case, the tags are monitored with reference to the specified trigger points.

Requirements

- A watch table has been created.
- An online connection to the CPU exists.

Procedure

To execute the "Monitor all" command, follow these steps:

1. Enter the tags to be monitored and the corresponding addresses in the watch table.
2. Switch to expanded mode by clicking

   the

   icon in the toolbar ("Show/hide advanced settings columns").
3. If you want to change the default monitoring mode for a tag, click the appropriate cell in the "Monitor with trigger" column and select the desired monitoring mode from the drop-down list.
4. Click the

icon in the toolbar ("Monitor all").

Result

The tags of the active watch table are monitored using the monitoring mode selected.

See also

Icons in the watch table (Page 575)
Entering tags in the watch table (Page 582)
Basic mode and advanced mode (Page 574)

7.5.3.8 "Monitor now" command for tags

Introduction

The "Monitor once and now" command starts the monitoring of tags immediately without reference to defined trigger points. The tag values are read out once only and displayed in the watch table.

Requirements

- A watch table has been created.
- An online connection to the CPU exists.

Procedure

To execute the "Monitor once and now" command, follow these steps:

1. Enter the tags to be monitored and the corresponding addresses in the watch table.
2. Click the
   icon in the toolbar ("Monitor once and now").

Result

The tags of the active watch table are monitored immediately and once only.

See also

Icons in the watch table (Page 575)
Entering tags in the watch table (Page 582)
Basic mode and advanced mode (Page 574)

7.5.3.9 Modifying tags in the watch table

7.5.3.9 Introduction to modifying tags

Introduction

The watch table allows you to modify the tags of the configured input and output modules in the CPU, depending on the monitoring and modify mode (Page 582) selected. To monitor the tags, an online connection to the CPU must exist.

Note
When modifying, note the following:

Modifying can **not** be undone.

Options for modifying tags

The following options are available for modifying tags:

- Modify to "0"

  This command modifies the selected address to the modify value "0".
- Modify to "1"

  This command modifies the selected address to the modify value "1".
- Modify once only and immediately

  This command modifies all selected addresses in the active watch table "once only and immediately".
- Modify with trigger

  This command modifies all selected addresses in the active watch table using the monitoring and modify mode (Page 582) selected.

  The "Modify with trigger" function is only available in expanded mode. You will not receive a message indicating whether or not the selected addresses were actually modified with the specified value. You should use the "Modify once only and immediately" function if you require such a confirmation.
- Enable peripheral outputs

  This command disables the command output disable.

  This function can only be executed in expanded mode and when the CPU is in STOP.

⚠ Danger
Danger when modifying:

Serious personal injury and material damage can result from changes in the tags or addresses during plant operation in the event of malfunctions or program errors!
Make certain that dangerous conditions cannot occur before you execute the "Modify" function.

7.5.3.9 Modify tags to "0"

Introduction

You can assign one-time values to tags independent of the monitoring and modify mode and modify them. The modify command is executed as fast as possible, similar to a "Trigger now" command, without reference to a defined position in the user program.

⚠ Danger
Danger when modifying:

Serious personal injury and material damage can result from changes in the tags or addresses during plant operation in the event of malfunctions or program errors!
Make certain that dangerous conditions cannot occur before you execute the "Modify" function.

Prerequisite

- A watch table has been created.
- An online connection to the CPU exists.

Procedure

To modify tags to "0", follow these steps:

1. Enter the desired address in the watch table.
2. Select the "Online > Modify > Modify to 0" command in order to modify the selected address with the specified value.

Result

The selected address is modified to "0".

Note
When modifying, note the following:

Modifying can **not** be undone!

7.5.3.9 Modify tags to "1"

Introduction

You can assign one-time values to tags independent of the monitoring and modify mode and modify them. The modify command is executed as fast as possible, similar to a "Trigger now" command, without reference to a defined position in the user program.

⚠ Danger
Danger when modifying:

Serious personal injury and material damage can result from changes in the tags or addresses during plant operation in the event of malfunctions or program errors!
Make certain that dangerous conditions cannot occur before you execute the "Modify" function.

Prerequisite

- A watch table has been created.
- An online connection to the CPU exists.

Procedure

To modify tags to "1", follow these steps:

1. Enter the desired address in the watch table.
2. Select the "Online > Modify > Modify to 1" command in order to modify the selected address with the specified value.

Result

The selected address is modified to "1".

Note
When modifying, note the following:

Modifying can **not** be undone!

7.5.3.9 "Modify now" command for tags

Introduction

You can assign one-time values to tags independent of the monitoring and modify mode and modify them immediately. The modify command is executed as fast as possible, similar to a "Trigger now" command, without reference to a defined position in the user program.

Danger
Danger when modifying:

Serious personal injury and material damage can result from changes in the tags or addresses during plant operation in the event of malfunctions or program errors!
Make certain that dangerous conditions cannot occur before you execute the "Modify" function.

Requirements

- A watch table has been created.
- An online connection to the CPU exists.

Procedure

To modify tags immediately, follow these steps:

1. Enter the desired addresses and modify values in the watch table.
2. Select the addresses to be modified by selecting the check boxes for modifying in the column after the "Modify value".
   A yellow triangle appears behind the selected check box, indicating that the address is now selected for modifying but has not yet been modified.
3. Select the "Online > Modify > Modify once and now" command in order to immediately modify the selected address once only with the specified value.

Result

The selected addresses are modified immediately and once only.

Note
When modifying, note the following:

Modifying can **not** be undone!

7.5.3.9 "Modify with trigger" command for tags

Introduction

You can assign values to addresses dependent on the defined monitoring and modify mode and modify them. The modify command is executed as specified in the monitoring and modify mode, with reference to the defined trigger position in the user program.

Danger
Danger when modifying:

Serious personal injury and material damage can result from changes in the tags or addresses during plant operation in the event of malfunctions or program errors!
Make certain that dangerous conditions cannot occur before you execute the "Modify" function.

Requirements

- A watch table has been created.
- An online connection to the CPU exists.
- The watch table has to be in expanded mode.

Procedure

To modify tags "with trigger", follow these steps:

1. Enter the desired addresses and modify values in the watch table.
2. Select the addresses to be modified by selecting the check boxes for modifying in the column after the "Modify value".
   A yellow triangle appears behind the selected check box, indicating that the address is now selected for modifying but has not yet been modified.
3. Switch to expanded mode using the

   icon ("Show/hide all columns of expanded mode" in the toolbar or the "Online > Expanded mode" command.

   The "Monitor with trigger" and "Modify with trigger" columns are displayed.
4. In the "Modify with trigger" column, select the desired modify mode from the drop-down list box. The following options are available:
   - Permanent
   - Permanently, at start of scan cycle
   - Once only, at start of scan cycle
   - Permanently, at end of scan cycle
   - Once only, at end of scan cycle
   - Permanently, at transition to STOP
   - Once only, at transition to STOP
5. Start modifying using the "Online > Modify > Modify with trigger" command.
6. Confirm the prompt with "Yes" if you want to start modifying with trigger.

Result

The selected tags are modified using the selected monitoring and modify mode. The yellow triangle is no longer displayed.

Note
When modifying, note the following:

Modifying can **not** be undone!

7.5.3.9 Enable I/O outputs

Introduction

The "Enable peripheral outputs" function deactivates the command output disable of the peripheral outputs. You can then modify the peripheral outputs when the CPU is in STOP mode. This function is available in the watch table in "Expanded mode" only.

⚠ **Danger**
Danger when modifying:

Serious personal injury and material damage can result from changes in the tags or addresses during plant operation in the event of malfunctions or program errors!
Make certain that dangerous conditions cannot occur before you execute the "Modify" function.

Requirements

- A watch table has been created.
- An online connection to the CPU exists.
- The CPU is in STOP mode before you can enable the peripheral outputs.
- The watch table has to be in expanded mode.

Note

The function "Enable Peripheral Outputs" is possible only in STOP mode. The function is exited by an operating state change of the CPU and by the termination of the online connection.

Procedure

To enable the peripheral outputs in STOP mode, follow these steps:

1. Enter the desired addresses and modify values in the watch table.
2. Select the addresses to be modified by selecting the check boxes for modifying in the column after the "Modify value".

A yellow triangle appears behind the selected check box, indicating that the address is now selected for modifying but has not yet been modified.

3. Switch to expanded mode using the

   icon ("Show/hide all columns of expanded mode") in the toolbar or the "Online > Expanded mode" command.

   The "Monitor with trigger" and "Modify with trigger" columns are displayed.
4. Change the relevant CPU to STOP using the operator panel.
5. Right-click to open the shortcut menu and select "Enable peripheral outputs".
6. Confirm the prompt with "Yes" if you want to unlock the command output disable for the peripheral outputs.
7. Modify the peripheral outputs using the "Online > Modify > Modify once and now" command.

Result

The peripheral outputs are modified with the selected modify values. The yellow triangle is no longer displayed.

Enabling the peripheral outputs

The "Enable peripheral outputs" function remains active until:

- The "Enable peripheral outputs" command is deactivated again via the shortcut menu or via the "Online > Modify > Enable peripheral outputs" command.
- The CPU is no longer in STOP mode.
- The online connection is terminated.

Note
When modifying, note the following:

Modifying can **not** be undone!

7.5.3.10 Forcing tags in the watch table

7.5.3.10 Introduction to forcing tags

Introduction

You can use the watch table to assign permanent values to individual tags of the user program. This action is referred to as forcing.

To use the forcing function, you must have an online connection to the CPU and the utilized CPU must support this functionality.

Possible applications

You can force default tag values which you activate in the user program to test the programmed functions. Forcing is possible in basic mode and in expanded mode (Page 574) .

Caution when forcing tags

Before forcing, you must review the safety precautions (Page 594) for this procedure.

Danger
Prevent personal injury and material damage!

Note that an incorrect action when executing the "Force" function can:

- Endanger the life or health of personnel
- Cause damage to machinery or the entire plant

Options for forcing tags

The following options are available for forcing tags:

- Force to "0"

  This command forces the selected address to the force value "0".
- Force to "1"

  This command forces the selected address to the force value "1".
- Force all

  This command starts forcing of the selected addresses in the active watch table.
- Stop forcing

  This command stops forcing of all addresses in the active watch table.
- Show force values

  This command shows all addresses forced in the CPU in the active watch table.

Constraints when forcing tags

Observe the following restrictions when forcing values:

- Forcing is always dependent on the operand scope of the CPU used.
- A CPU of the S7-1200 product line can only force I/Os, that is: "Tag_1":P or "QW0:P" or "IW0:P". Note that "Tag_1":P must not be the symbolic name of a bit memory.

Unique aspects when forcing tags

Note that forcing of tags will overwrite values in the CPU and will continue even after the online connection to the CPU is terminated.

- **Stop forcing**

Terminating the online connection is not sufficient to stop the forcing operation! To stop forcing, you must select the "Online > Force > Stop forcing" command. Only then will the tags visible in the active watch table no longer be forced.

- Show all forced values

  To stop forcing tags, the tags must be inserted in the active watch table. If tags that are contained in another watch table are already being forced, these tags must be inserted at the end of the active watch table using the "Online > Force > Show forced values" command. These tags must be visible in the active watch table before their forcing can be stopped using the "Online > Force > Stop forcing" command.

- Stop forcing of individual tags

  The "Online > Force > Stop forcing" command always applies to all tags displayed in the active watch table. To stop forcing of individual tags, you must clear the check mark for these tags in the active watch table and restart forcing using the "Online > Force > Force all" command.

7.5.3.10 Safety precautions when forcing tags

Safety precautions when forcing tags

Because the forcing function allows you to intervene permanently in the process, observance of the following notices is essential:

Danger
Prevent personal injury and material damage!

Note that an incorrect action when executing the "Force" function can:

- Endanger the life or health of personnel
- Cause damage to machinery or the entire plant

Caution
Prevent personal injury and material damage

- Before you start the "Force" function, you should ensure that no one else is currently executing this function on the same CPU.
- Forcing can only be stopped by clicking the icon ("Stop forcing") or using the "Online > Force > Stop forcing" command. Closing the active watch table does **not** stop the forcing!
- Forcing can **not** be undone!
- Review the differences between " modifying tags" (Page 586) and "forcing tags" (Page 592) .
- If a CPU does not support the "Force" function, the relevant icons cannot be selected.
- If the peripheral outputs are enabled by selecting the "Online > Modify > Enable peripheral outputs" command and selecting the check box, all forced output modules will output their forced value.

7.5.3.10 Force tags to "0"

Introduction

You can use the force function to assign permanent values to individual tags of a user program.

Caution when forcing tags

Before forcing, you must review the safety precautions when forcing tags (Page 594) .

Danger
Prevent personal injury and material damage!

Note that an incorrect action when executing the "Force" function can:

- Endanger the life or health of personnel
- Cause damage to machinery or the entire plant

Requirements

- A watch table has been created.
- An online connection to the CPU exists.
- The utilized CPU supports the force function.

Procedure

To force tags to "0", follow these steps:

1. Enter the desired address in the watch table.
2. Select the "Online > Force> Force to 0" command in order to force the selected address with the specified value.
3. Confirm the next dialog with "Yes".

Result

The selected address is forced to "0". The yellow triangle is no longer displayed. A red "F" is displayed in the first column indicating that the tag is being forced.

Stop forcing

To stop forcing, follow these steps:

1. Select the "Online > Force > Stop forcing" command.
2. Confirm the next dialog with "Yes".

Result

Forcing of the selected values is stopped. The red "F" in the first column is no longer displayed. The yellow triangle reappears behind the check box again to indicate that the address is selected for forcing but is not being forced at the moment.

Note
When forcing, note the following:

- Forcing can **not** be undone!
- Terminating the online connection does not stop the forcing!
- To stop forcing, the forced address must be visible in the active watch table. If necessary, use the "Online > Force > Show force values" command to display all forced addresses in the active watch table.

7.5.3.10 Force tags to "1"

Introduction

You can use the force function to assign permanent values to individual tags of a user program.

Caution when forcing tags

Before forcing, you must review the safety precautions when forcing tags (Page 594) .

Danger
Prevent personal injury and material damage!

Note that an incorrect action when executing the "Force" function can:

- Endanger the life or health of personnel
- Cause damage to machinery or the entire plant

Requirement

- A watch table has been created.
- An online connection to the CPU exists.
- The utilized CPU supports the force function.

Procedure

To force tags to "1", follow these steps:

1. Enter the desired address in the watch table.
2. Select the "Online > Force> Force to 1" command in order to force the selected address with the specified value.
3. Confirm the next dialog with "Yes".

Result

The selected address is forced to "1". The yellow triangle is no longer displayed. A red "F" indicating that the tag is being forced is displayed in the first column.

Stop forcing

To stop forcing, follow these steps:

1. Select the "Online > Force > Stop forcing" command.
2. Confirm the next dialog with "Yes".

Result

Forcing of the selected values is stopped. The red "F" in the first column is no longer displayed. The yellow triangle reappears behind the check box again to indicate that the address is selected for forcing but is not being forced at the moment.

Note

When forcing, note the following:

- Forcing can **not** be undone!
- Terminating the online connection does not stop the forcing!
- To stop forcing, the forced address must be visible in the active watch table. If necessary, use the "Online > Force > Show force values" command to display all forced addresses in the active watch table.

7.5.3.10 "Force all" command for tags

Introduction

You can use the force function to assign permanent values to individual tags of a user program.

If forcing is already active, this forcing operation is replaced without interruption by the "Online > Force > Force all" command. Any forced addresses that are not selected will no longer be forced.

Caution when forcing tags

Before forcing, you must review the safety precautions when forcing tags (Page 594) .

⚠

Danger

Prevent personal injury and material damage!

Note that an incorrect action when executing the "Force" function can:

- Endanger the life or health of personnel
- Cause damage to machinery or the entire plant

Requirements

- A watch table has been created.
- An online connection to the CPU exists.
- The utilized CPU supports the force function.

Procedure

To force tags with the "Online > Force all" command, follow these steps:

1. Open a watch table and click the

   icon ("Show/hide all force columns") in order to display the force columns.
2. Enter the desired addresses and force values in the watch table.

3. Select the addresses to be forced by selecting the check boxes for forcing in the column after the "Force value".
   A yellow triangle appears behind the selected check box, indicating that the address is selected for forcing but is not being forced at the moment.
4. Select the "Online > Force> Force all" command in order to force the selected addresses with the specified values.
5. Confirm the next dialog with "Yes".

Result

The selected addresses are forced to the specified values. The yellow triangle is no longer displayed. A red "F" is displayed in the first column indicating that the tag is being forced.

Stop forcing

To stop forcing, follow these steps:

1. Select the "Online > Force > Stop forcing" command.
2. Confirm the next dialog with "Yes".

Result

Forcing of the selected addresses is stopped. The red "F" in the first column is no longer displayed. The yellow triangle reappears behind the check box again to indicate that the address is selected for forcing but is not being forced at the moment.

Note
When forcing, note the following:

- Forcing can **not** be undone!
- Terminating the online connection does **not** stop the forcing!
- To stop forcing, the forced address must be visible in the active watch table. If necessary, use the "Online > Force > Show force values" command to display all forced addresses in the active watch table.

7.5.3.10 Show force values

Introduction

You can use the force function to assign permanent values to individual tags of a user program.

You can define these tags in one or more watch tables. The "Show force values" command is available to ensure that all tags forced in the CPU can be displayed in one watch table. This command is only available if tags are being forced in more than one watch table. If tags are being forced in only one watch table, this command is not active.

Caution when forcing tags

Before forcing, you must review the safety precautions when forcing tags (Page 594) .

Danger
Prevent personal injury and material damage!

Note that an incorrect action when executing the "Force" function can:

- Endanger the life or health of personnel
- Cause damage to machinery or the entire plant

Requirements

- A watch table is defined in which tags are forced.
- An online connection to the CPU exists.
- The utilized CPU supports the force function.

Procedure

To show all tags forced in the CPU in a watch table, follow these steps:

1. Open an existing watch table in which tags are being forced.
2. Click the

   icon ("Show/hide all force columns") in order to display the force columns.
3. Select the "Online > Force > Show force values" command to display all tags forced in the CPU in the current watch table.

Result

All tags forced in the CPU are displayed in the open watch table. Tags that were defined in other watch tables are inserted at the bottom of the current watch table. A red "F" is displayed in the first column indicating that the tag is being forced.

Stop forcing

To stop forcing, follow these steps:

1. Select the "Online > Force > Stop forcing" command.
2. Confirm the "Stop forcing" dialog with "Yes".

Result

Forcing of the selected values is stopped. The red "F" in the first column is no longer displayed. The yellow triangle reappears again behind the check box for forcing to indicate that the address is selected for forcing but is not being forced at the moment.

Note
When forcing, note the following:

- Forcing can **not** be undone!
- Terminating the online connection does **not** stop the forcing!
- To stop forcing, the forced address must be visible in the active watch table. If necessary, use the "Online > Force > Show force values" command to display all forced addresses in the active watch table.

7.5.3.10 Stop forcing

Introduction

Note the following before you stop forcing tags:

- Forcing can **not** be undone!
- Terminating the online connection does not stop the forcing!
- To stop forcing, the forced address must be visible in the active watch table. If necessary, use the "Online > Force > Show force values" command to display all forced addresses in the active watch table, if you want to stop forcing all tags simultaneously.

Caution when forcing tags

Before forcing, you must review the safety precautions when forcing tags (Page 594) .

Danger
Prevent personal injury and material damage!

Note that an incorrect action when executing the "Force" function can:

- Endanger the life or health of personnel
- Cause damage to machinery or the entire plant

Requirements

- A watch table is created in which tags are being forced.
- An online connection to the CPU exists.
- The utilized CPU supports the force function.

Procedure

To stop forcing tags, follow these steps:

1. Open a watch table and click the icon ("Show/hide all force columns") in order to display the force columns.
2. Use the "Online > Force > Show force values" command to show all addresses forced in the CPU.
3. Select the "Online > Force > Stop forcing" command in order to stop forcing the displayed addresses.
4. Confirm the "Stop forcing" dialog with "Yes".

Result

Forcing of the selected values is stopped. The red "F" in the first column is no longer displayed. The yellow triangle reappears behind the check box again to indicate that the address is selected for forcing but is not being forced at the moment.

7.6 Programming examples

7.6.1 LAD programming examples

7.6.1.1 Overview of programming examples

Practical applications

The "Programming examples" chapter uses practical applications to reinforce your understanding of individual LAD instructions. The following automation tasks will be used for this purpose:

- Controlling a conveyor belt using bit logic instructions (Page 603)
- Detecting the direction of a conveyor belt using bit logic instructions (Page 605)
- Detecting the fill level of a storage area using counter and comparison instructions (Page 606)
- Calculating an equation using mathematic functions (Page 609)
- Controlling room temperature using timer and bit logic instructions (Page 610)

Instructions used

Mnemonics	Instruction	Description
---| |--- (Page 667)	Bit logic instruction	Normally open contact
---|/|--- (Page 668)	Bit logic instruction	Normally closed contact
---| NOT |--- (Page 670)	Bit logic instruction	Invert result of logic operation
---( )--- (Page 670)	Bit logic instruction	Output coil
---(R)--- (Page 672)	Bit logic instruction	Reset output
---(S)--- (Page 673)	Bit logic instruction	Set output
---| P |--- (Page 679)	Bit logic instruction	Query positive signal edge of an operand
CTUD (Page 697)	Counter	Count up and down
CMP >= (Page 706)	Comparator	Query if the first comparison value is greater than or equal to the second comparison value.
CMP < (Page 711)	Comparator	Query if the first comparison value is less than the second comparison value.
ADD (Page 717)	Mathematic functions	Add
MUL (Page 720)	Mathematic functions	Multiply
DIV (Page 722)	Mathematic functions	Divide
TP (Page 687)	Timer instructions	Generate pulse

7.6.1.2 Example of controlling a conveyor belt

Controlling a conveyor belt

The following figure shows a conveyor belt that can be activated electrically. There are two push-button switches at the beginning of the belt: S1 for Start and S2 for Stop. There are also two push-button switches at the end of the belt: S3 for Start and S4 for Stop. It is possible to start or stop the belt from either end.

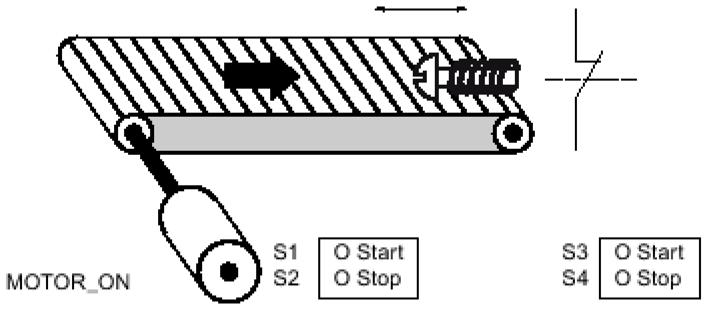


Figure7-2

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
StartSwitch_Left	Bool	Start switch on the left side of the conveyor belt
StopSwitch_Left	Bool	Stop switch on the left side of the conveyor belt
StartSwitch_Right	Bool	Start switch on the right side of the conveyor belt
StopSwitch_Right	Bool	Stop switch on the right side of the conveyor belt
MOTOR_ON	Bool	Turn on the conveyor belt motor

The following networks show the LAD programming for solving this task:

Network 1: The conveyor belt motor is switched on when Start switch "S1" or "S3" is pressed.

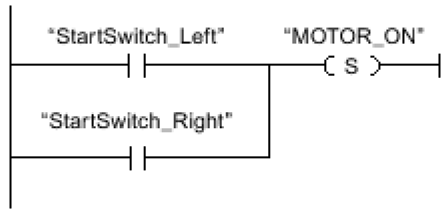


Figure7-2

Network 2: The conveyor belt motor is switched off when Stop switch "S2" or "S4" is pressed.

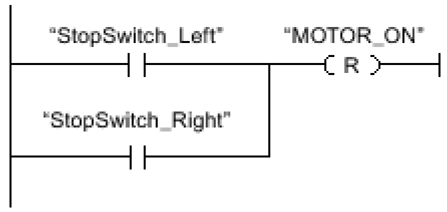


Figure7-2

See also

---(R)---: Reset output (Page 672)
---(S)---: Set output (Page 673)
---| |---: Normally open contact (Page 667)

7.6.1.3 Example of detecting the direction of a conveyor belt

Detecting the direction of a conveyor belt

The following figure shows a conveyor belt that is equipped with two photoelectric barriers (PEB1 and PEB2). These are designed to detect the direction in which a package is moving on the belt.

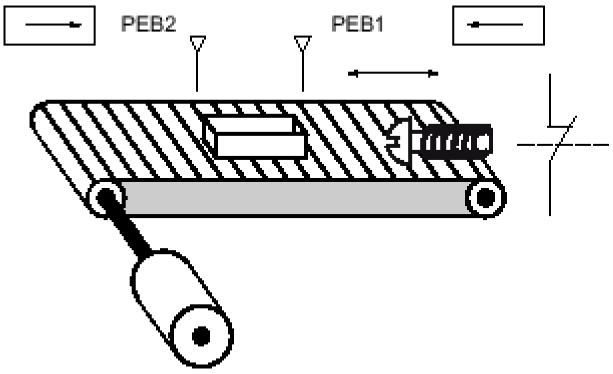


Figure7-2

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
PEB1	Bool	Photoelectric barrier 1
PEB2	Bool	Photoelectric barrier 2
RIGHT	Bool	Display during movement to right
LEFT	Bool	Display during movement to left
CM1	Bool	Edge bit memory 1
CM2	Bool	Edge bit memory 2

The following networks show the LAD programming for solving this task:

Network 1: If the signal changes from "0" to "1" (positive edge) at "PEB1" and, at the same time, the signal state at "PEB2" is "0", then the package on the belt is moving to the left.

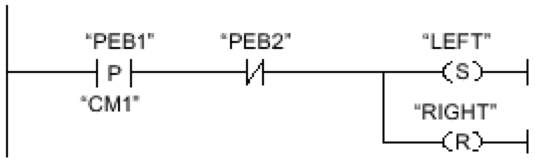


Figure7-2

Network 2: If the signal changes from "0" to "1" (positive edge) at "PEB2" and, at the same time, the signal state at "PEB1" is "0", then the package on the belt is moving to the right.

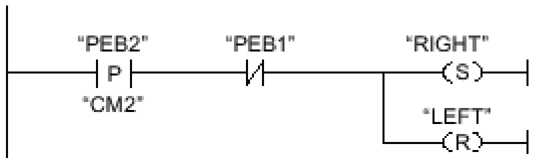


Figure7-2

See also

---(R)---: Reset output (Page 672)
---(S)---: Set output (Page 673)
--|P|--: Scan positive signal edge at operand (Page 679)
---| / |---: Normally closed contact (Page 668)

7.6.1.4 Example of detecting the fill level of a storage area

Detecting the fill level of a storage area

The following figure shows a system with two conveyor belts and a temporary storage area between them. Conveyor belt 1 delivers packages to the storage area. A photoelectric barrier at the end of conveyor belt 1 near the storage area detects how many packages are delivered to the storage area. Conveyor belt 2 transports packages from the temporary storage area to a loading dock onto which the packages are loaded for delivery to customers by truck. A photoelectric barrier at the storage area exit detects how many packages leave the storage area to go to the loading dock. A display panel with five lamps indicates the utilization of the temporary storage area.

When a conveyor belt is restarted, the current count value is set to the number of packages available in the storage area.

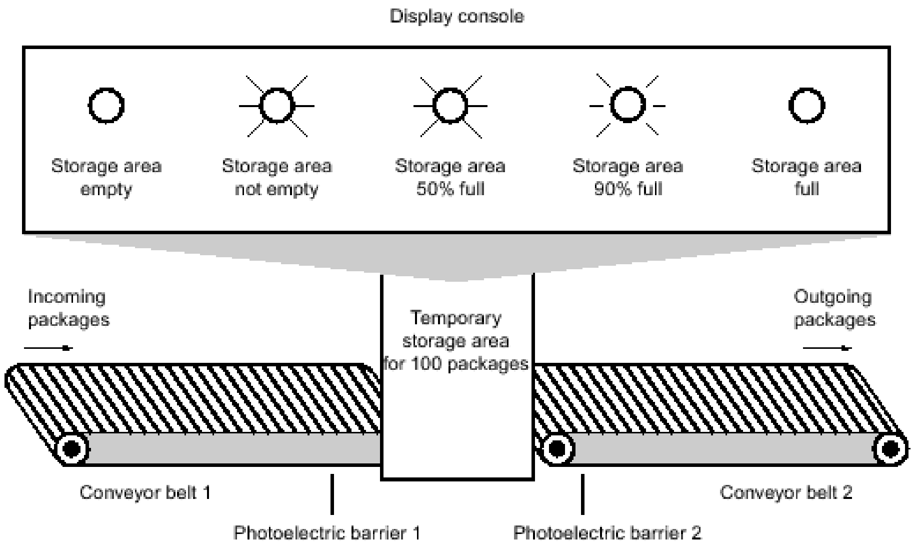


Figure7-2

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
PEB1	BOOL	Photoelectric barrier 1
PEB2	BOOL	Photoelectric barrier 2
RESET	BOOL	Reset counter
LOAD	BOOL	Set counter to value of "PV" parameter
STOCK	UINT	Stock at restart
PACKAGECOUNT	UINT	Number of packages in the storage area (current count value)
STOCK_PACKAGE	BOOL	Is set if the current count value is greater than or equal to the value of the tag "STOCK".
STOR_EMPTY	BOOL	Display lamp: Storage area empty
STOR_NOT_EMPTY	BOOL	Display lamp: Storage area not empty
STOR_50%_FULL	BOOL	Display lamp: Storage area 50% full
STOR_90%_FULL	BOOL	Display lamp: Storage area 90% full
STOR_FULL	BOOL	Display lamp: Storage area full

Name	Data type	Comment
VOLUME_50	UINT	Comparison value: 50 packages
VOLUME_90	UINT	Comparison value: 90 packages
VOLUME_100	UINT	Comparison value: 100 packages

The following networks show the LAD programming for activating the lamps:

Network 1: When a package is delivered to the storage area, the signal state at "PEB1" switches from "0" to "1" (positive edge). On a positive edge at "PEB1", the "Up" counter is enabled, and the current count value of "PACKAGECOUNT" is increased by one.

When a package is delivered from the storage area to the loading dock, the signal state at "PEB2" switches from "0" to "1" (positive edge). On a positive edge at "PEB2", the "Down" counter is enabled, and the current count value of "PACKAGECOUNT" is decreased by one.

If there are no packages in the storage area ("PACKAGECOUNT" = "0"), the "STOR_EMPTY" tag is set to signal state "1", and the "Storage area empty" lamp is switched on.

The current count value can be reset to "0" if the "RESET" tag is set to signal state "1".

If the "LOAD" tag is set to signal state "1", the current count value is set to the value of the "STOCK" tag. If the current count value is greater than or equal to the value of the "STOCK" tag , the "STOCK_PACKAGE" tag supplies the signal state "1".

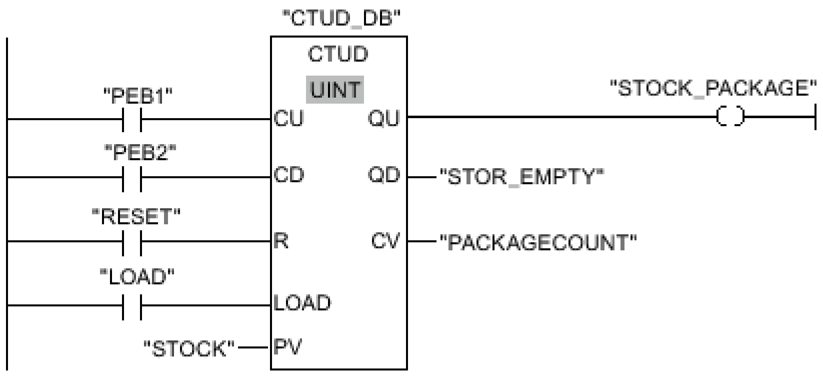


Figure7-2

Network 2: As long as there are packages in the storage area the "STOR_NOT_EMPTY" tag is set to signal state "1", and the "Storage area not empty" lamp is switched on.

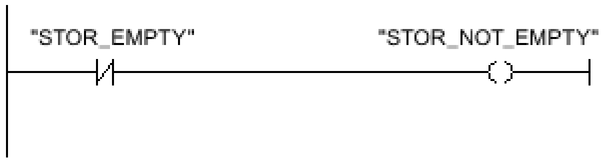


Figure7-2

Network 3: If the number of packages in the storage area is greater than or equal to 50, the "Storage area 50% full" lamp switches on.

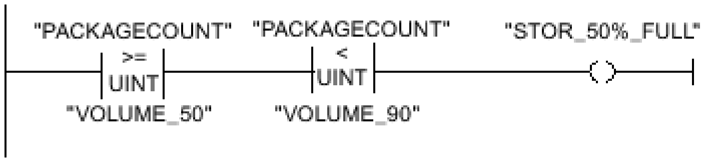
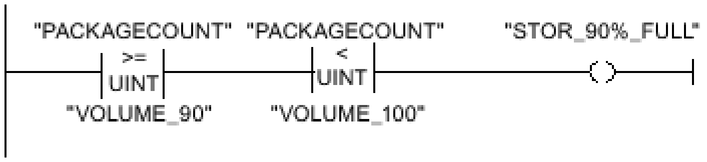
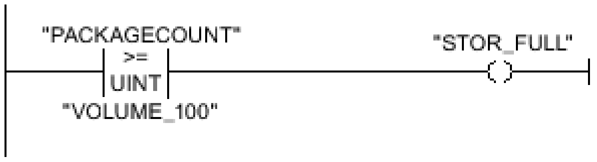


Figure7-2

Network 4: If the number of packages in the storage area is greater than or equal to 90, the "Storage area 90% full" lamp switches on.



Network 5: If the number of packages in the storage area reaches 100, the "Storage area full" lamp switches on.



See also

---( )---: Output coil (Page 670)
CTUD: Count up and down (IEC) (Page 697)
CMP >=: Greater than or equal to (Page 706)
---| |---: Normally open contact (Page 667)
---| / |---: Normally closed contact (Page 668)

7.6.1.5 Example of calculating an equation

Calculating an equation

The sample program shows you how to use three mathematic functions to produce the same result as the following equation:

RESULT = ((A + B) x 15) / E

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
A	INT	First value for addition

Name	Data type	Comment
B	INT	Second value for addition
C	INT	First intermediate result
15	INT	Multiplier
D	INT	Second intermediate result
E	INT	Divisor
RESULT	INT	End result

The following network shows the LAD programming for calculating the equation:

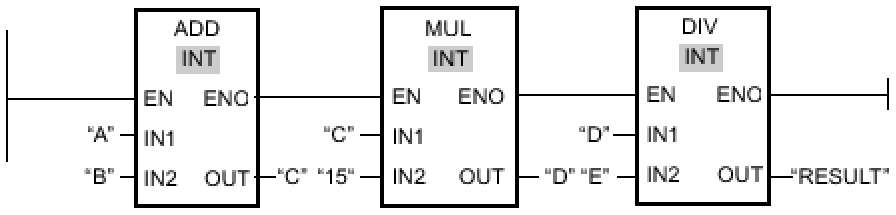


Figure7-2

The value of operand "A" is added to the value of operand "B". The sum is stored in operand "C". The value of operand "C" is multiplied by "15". The multiplication result is stored in operand "D". The value stored in operand "D" is then divided by the value of operand "E". The end result is stored in the "RESULT" operand.

See also

ADD: Add (Page 717)
MUL: Multiply (Page 720)
DIV: Divide (Page 722)

7.6.1.6 Example of controlling room temperature

Controlling room temperature

In a cold room, the temperature must be maintained below zero degrees Celsius. Temperature fluctuations are monitored by means of a sensor. If the temperature rises above zero degrees Celsius, the cooling system switches on for a predetermined time. The "Cooling system On" lamp is lit during this time.

The cooling system and the lamp are turned off if one of the following conditions is fulfilled:

- The sensor reports a temperature fall below zero degrees Celsius.
- The preset cooling time has elapsed.
- The pushbutton switch "Stop" has been pressed.

If the preset cooling time has expired, and the temperature in the cold room is still too high, the cooling system can be restarted by means of the pushbutton switch "Reset".

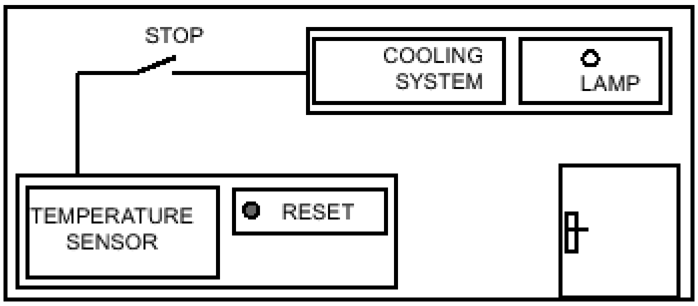


Figure7-2

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
Sensor	BOOL	Temperature sensor signal
Reset	BOOL	Restart
Stop	BOOL	The cooling system is switched off.
MaxCoolTime	TIME	Predetermined cooling time This tag is defined in the "DB_Cool" data block.
CurrCoolTime	TIME	Currently elapsed cooling time This tag is defined in the "DB_Cool" data block.
CoolSystem	BOOL	The cooling system is switched on.
Lamp	BOOL	The "Cooling system On" lamp is switched on.

The following network shows the LAD programming for controlling room temperature:

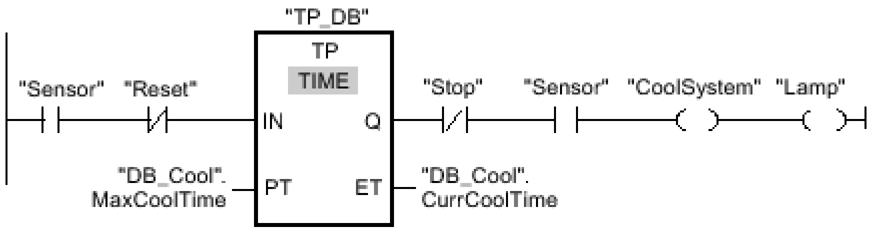


Figure7-2

When the temperature in the cold room rises above zero degrees Celsius, the signal state at the "Sensor" operand switches from "0" to "1" (positive edge). On a positive edge at input "IN" of the timer function, the predetermined cooling time is started, and the cooling system and lamp are switched on. If the temperature in the cold room falls below zero degrees Celsius, the signal state of the sensor switches back to "0". This switches the cooling system and lamp off.

If the sensor does not signal a temperature drop, the cooling system and lamp are switched off after the predetermined cooling time has elapsed, at the latest. In this case, the cooling process can be restarted by pressing the "Reset" push-button switch. Pressing and releasing the push-button switch generates a new positive edge at input "IN", which restarts the cooling system.

The cooling system and the display lamps can be turned off with the pushbutton switch "Stop" at any time.

See also

---( )---: Output coil (Page 670)
---| |---: Normally open contact (Page 667)
---| / |---: Normally closed contact (Page 668)
--|NOT|--: Invert result of logic operation (Page 670)
TON: On delay (IEC) (Page 688)

7.6.2 FBD programming examples

7.6.2.1 Overview of programming examples

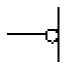
Practical applications

The "Programming examples" chapter uses practical applications to reinforce your understanding of individual FBD instructions. The following automation tasks will be used for this purpose:

- Controlling a conveyor belt using bit logic instructions (Page 613)
- Detecting the direction of a conveyor belt using bit logic instructions (Page 614)
- Detecting the fill level of a storage area using counter and comparison instructions (Page 616)
- Calculating an equation using mathematic functions (Page 620)
- Controlling room temperature using timer and bit logic instructions (Page 621)

Instructions used

Mnemonics	Instruction	Description
& (Page 799)	Bit logic instruction	AND logic operation
>=1 (Page 801)	Bit logic instruction	OR logic operation
= (Page 806)	Bit logic instruction	Assignment

Mnemonics	Instruction	Description
	Bit logic instruction	Negate binary input
R (Page 808)	Bit logic instruction	Reset output
S (Page 809)	Bit logic instruction	Set output
P (Page 815)	Bit logic instruction	Query positive signal edge of an operand
CTUD (Page 832)	Counter	Count up and down
CMP >= (Page 840)	Comparator	Query if the first comparison value is greater than or equal to the second comparison value.
CMP < (Page 845)	Comparator	Query if the first comparison value is less than the second comparison value.
ADD (Page 851)	Mathematic functions	Add
MUL (Page 854)	Mathematic functions	Multiply
DIV (Page 856)	Mathematic functions	Divide
TP (Page 822)	Timer instructions	Generate pulse

See also

Negate binary value (Page 805)

7.6.2.2 Example of controlling a conveyor belt

Controlling a conveyor belt

The following figure shows a conveyor belt that can be activated electrically. There are two push-button switches at the beginning of the belt: S1 for Start and S2 for Stop. There are also two push-button switches at the end of the belt: S3 for Start and S4 for Stop. It is possible to start or stop the belt from either end.

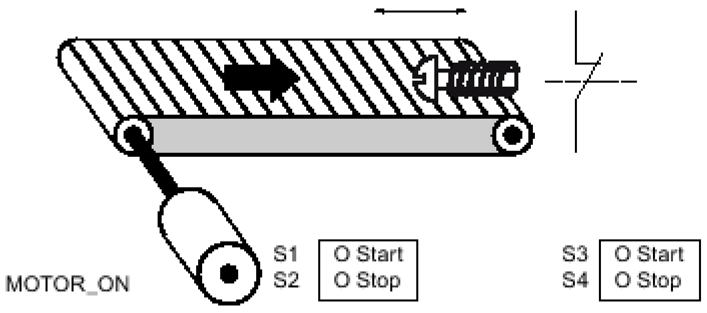


Figure7-2

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
StartSwitch_Left	Bool	Start switch on the left side of the conveyor belt
StopSwitch_Left	Bool	Stop switch on the left side of the conveyor belt
StartSwitch_Right	Bool	Start switch on the right side of the conveyor belt
StopSwitch_Right	Bool	Stop switch on the right side of the conveyor belt
MOTOR_ON	Bool	Turn on the conveyor belt motor

The following networks show the FBD programming for accomplishing this task:

Network 1: The conveyor belt motor is switched on when Start switch "S1" or "S3" is pressed.

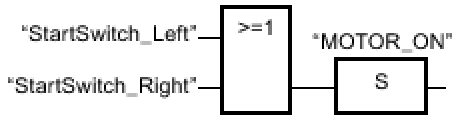


Figure7-2

Network 2: The conveyor belt motor is switched off when Stop switch "S2" or "S4" is pressed.

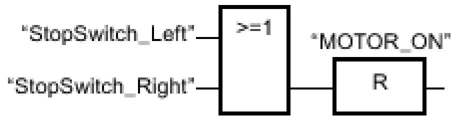


Figure7-2

See also

R: Reset output (Page 808)
S: Set output (Page 809)
OR logic operation (Page 801)

7.6.2.3 Example of detecting the direction of a conveyor belt

Detecting the direction of a conveyor belt

The following figure shows a conveyor belt that is equipped with two photoelectric barriers (PEB1 and PEB2). These are designed to detect the direction in which a package is moving on the belt.

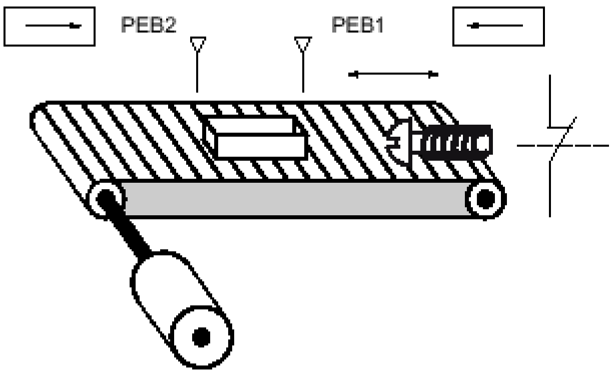


Figure7-2

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
PEB1	Bool	Photoelectric barrier 1
PEB2	Bool	Photoelectric barrier 2
RIGHT	Bool	Display during movement to right
LEFT	Bool	Display during movement to left
CM1	Bool	Edge bit memory 1
CM2	Bool	Edge bit memory 2

The following networks show the FBD programming for solving this task:

Network 1: If the signal changes from "0" to "1" (positive edge) at "PEB1" and, at the same time, the signal state at "PEB2" is "0", then the package on the belt is moving to the left.

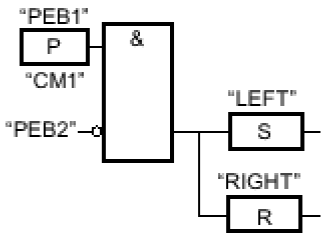


Figure7-2

Network 2: If the signal state changes from "0" to "1" (positive edge) at "PEB2" and, at the same time, the signal state at "PEB1" is "0", then the package on the belt is moving to the right.

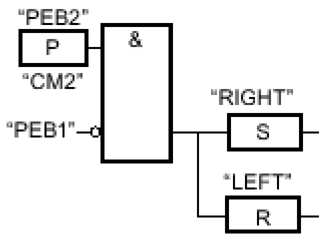


Figure7-2

See also

R: Reset output (Page 808)
S: Set output (Page 809)
P: Scan positive signal edge at operand (Page 815)
Negate binary value (Page 805)
AND logic operation (Page 799)

7.6.2.4 Example of detecting the fill level of a storage area

Detecting the fill level of a storage area

The following figure shows a system with two conveyor belts and a temporary storage area between them. Conveyor belt 1 delivers packages to the storage area. A photoelectric barrier at the end of conveyor belt 1 near the storage area detects how many packages are delivered to the storage area. Conveyor belt 2 transports packages from the temporary storage area to a loading dock onto which the packages are loaded for delivery to customers by truck. A photoelectric barrier at the storage area exit detects how many packages leave the storage area to go to the loading dock. A display panel with five lamps indicates the utilization of the temporary storage area.

When a conveyor belt is restarted, the current count value is set to the number of packages available in the storage area.

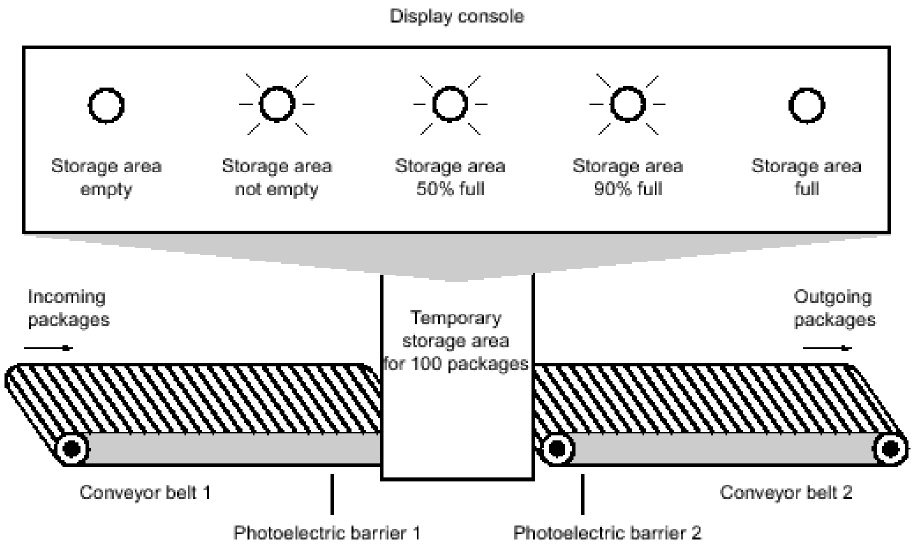


Figure7-2

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
PEB1	BOOL	Photoelectric barrier 1
PEB2	BOOL	Photoelectric barrier 2
RESET	BOOL	Reset counter
LOAD	BOOL	Set counter to value of "CV" parameter
STOCK	UINT	Stock at restart
PACKAGECOUNT	UINT	Number of packages in the storage area (current count value)
STOCK_PACKAGE	BOOL	Is set if the current count value is greater than or equal to the value of the tag "STOCK".
STOR_EMPTY	BOOL	Display lamp: Storage area empty
STOR_NOT_EMPTY	BOOL	Display lamp: Storage area not empty
STOR_50%_FULL	BOOL	Display lamp: Storage area 50 % full
STOR_90%_FULL	BOOL	Display lamp: Storage area 90% full
STOR_FULL	BOOL	Display lamp: Storage area full

Name	Data type	Comment
VOLUME_50	UINT	Comparison value: 50 packages
VOLUME_90	UINT	Comparison value: 90 packages
VOLUME_100	UINT	Comparison value: 100 packages

The following networks show the FBD programming for activating the lamps:

Network 1: When a package is delivered to the storage area, the signal state at "PEB1" switches from "0" to "1" (positive edge). On a positive edge at "PEB1", the "Up" counter is enabled, and the current count value of "PACKAGECOUNT" is increased by one.

When a package is delivered from the storage area to the loading dock, the signal state at "PEB2" switches from "0" to "1" (positive edge). On a positive edge at "PEB2", the "Down" counter is enabled, and the current count value of "PACKAGECOUNT" is decreased by one.

If there are no packages in the storage area ("PACKAGECOUNT" = "0"), the "STOR_EMPTY" tag is set to signal state "1", and the "Storage area empty" lamp is switched on.

The current count value can be reset to "0" if the "RESET" tag is set to signal state "1".

If the "LOAD" tag is set to signal state "1", the current count value is set to the value of the "STOCK" tag. If the current count value is greater than or equal to the value of the "STOCK" tag , the "STOCK_PACKAGE" tag supplies the signal state "1".

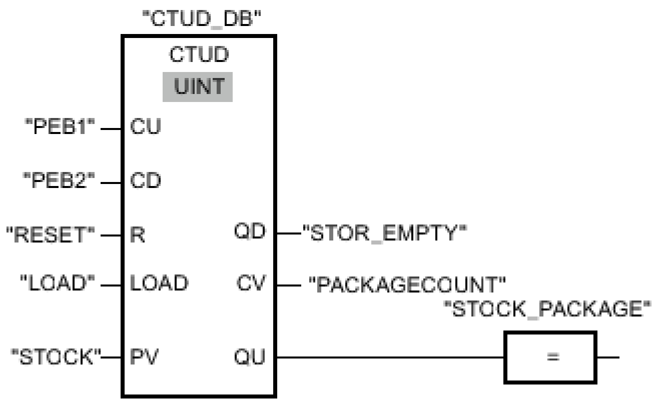


Figure7-2

Network 2: As long as there are packages in the storage area the "STOR_NOT_EMPTY" tag is set to signal state "1", and the "Storage area not empty" lamp is switched on.

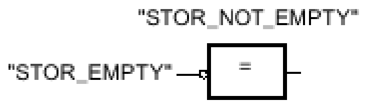


Figure7-2

Network 3: If the number of packages in the storage area is greater than or equal to 50, the "Storage area 50 % full" lamp switches on.

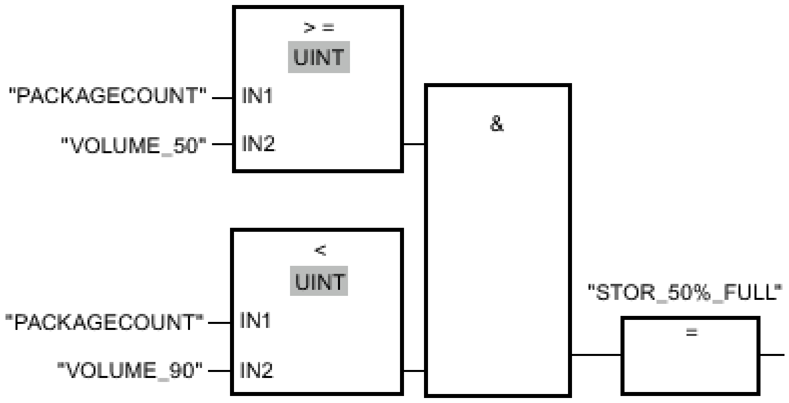


Figure7-2

Network 4: If the number of packages in the storage area is greater than or equal to 90, the "Storage area 90% full" lamp switches on.

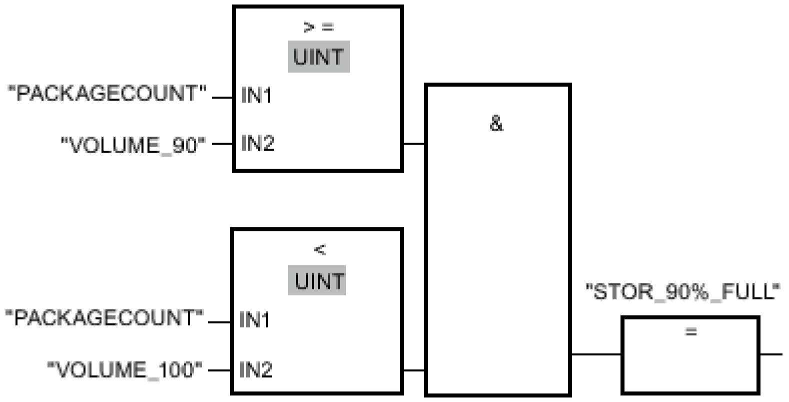
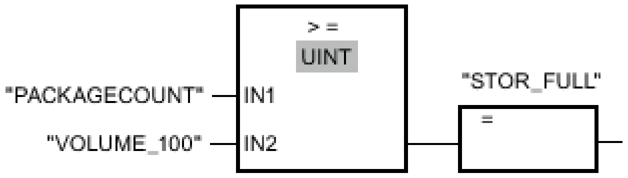


Figure7-2

Network 5: If the number of packages in the storage area reaches 100, the "Storage area full" lamp switches on.



See also

=: Assignment (Page 806)
CTUD: Count up and down (IEC) (Page 832)
CMP >=: Greater than or equal to (Page 840)
Negate binary value (Page 805)
OR logic operation (Page 801)

7.6.2.5 Example of calculating an equation

Calculating an equation

The sample program shows you how to use three mathematic functions to produce the same result as the following equation:

RESULT = ((A + B) x 15) / E

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
A	INT	First value for addition
B	INT	Second value for addition
C	INT	First intermediate result
15	INT	Multiplier
D	INT	Second intermediate result
E	INT	Divisor
RESULT	INT	End result

The following network shows the FBD programming for calculating the equation:

Network 1: The value of operand "A" is added to the value of operand "B". The sum is stored in operand "C". The value of operand "C" is multiplied by "15". The multiplication result is stored in operand "D". The value stored in operand "D" is then divided by the value of operand "E". The end result is stored in the "RESULT" operand.

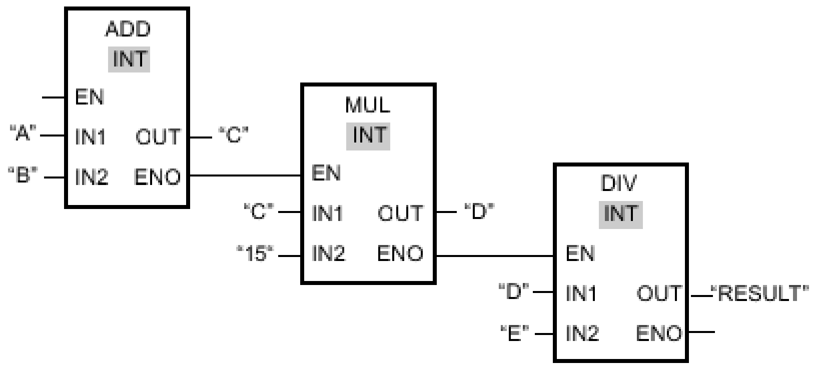


Figure7-2

See also

ADD: Add (Page 851)
MUL: Multiply (Page 854)
DIV: Divide (Page 856)

7.6.2.6 Example of controlling room temperature

Controlling room temperature

In a cold room, the temperature must be maintained below zero degrees Celsius. Temperature fluctuations are monitored by means of a sensor. If the temperature rises above zero degrees Celsius, the cooling system switches on for a predetermined time. The "Cooling system On" lamp is lit during this time.

The cooling system and the lamp are turned off if one of the following conditions is fulfilled:

- The sensor reports a temperature fall below zero degrees Celsius.
- The preset cooling time has elapsed.
- The pushbutton switch "Stop" has been pressed.

If the preset cooling time has expired, and the temperature in the cold room is still too high, the cooling system can be restarted by means of the pushbutton switch "Reset".

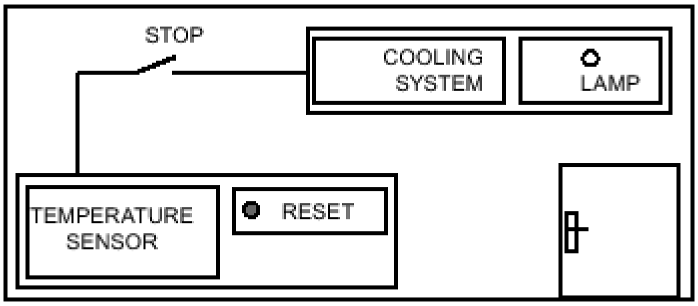


Figure7-2

Implementation

The following table shows the definition of the tags used:

Name	Data type	Comment
Sensor	BOOL	Temperature sensor signal
Reset	BOOL	Restart
Stop	BOOL	The cooling system is switched off.
MaxCoolTime	TIME	Predetermined cooling time This tag is defined in the "DB_Cool" data block.
CurrCoolTime	TIME	Currently elapsed cooling time This tag is defined in the "DB_Cool" data block.
CoolSystem	BOOL	The cooling system is switched on.

Name	Data type	Comment
Lamp	BOOL	The "Cooling system On" lamp is switched on.

The following network shows the FBD programming for controlling room temperature:

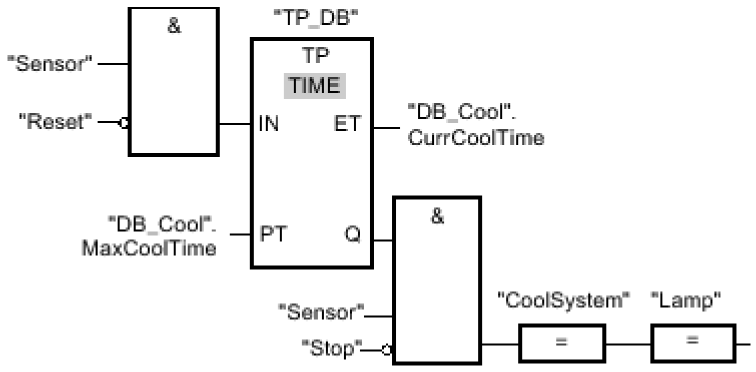


Figure7-2

When the temperature in the cold room rises above zero degrees Celsius, the signal state at the "Sensor" operand switches from "0" to "1" (positive edge). On a positive edge at input "IN" of the timer function, the predetermined cooling time is started, and the cooling system and lamp are switched on. If the temperature in the cold room falls below zero degrees Celsius, the signal state of the sensor switches back to "0". This switches the cooling system and lamp off.

If the sensor does not signal a temperature drop, the cooling system and lamp are switched off after the predetermined cooling time has elapsed, at the latest. In this case, the cooling process can be restarted by pressing the "Reset" push-button switch. Pressing and releasing the push-button switch generates a new positive edge at input "IN", which restarts the cooling system.

The cooling system and the display lamps can be turned off with the pushbutton switch "Stop" at any time.

See also

TONR: Retentive on delay (IEC) (Page 827)
=: Assignment (Page 806)
Negate binary value (Page 805)
AND logic operation (Page 799)
OR logic operation (Page 801)
TON: On delay (IEC) (Page 824)

7.7 Using technology objects

7.7.1 Using Motion Control

7.7.1.1 Motion Control guideline

The "Axis" technological object creates an image of an axis in the controller and is suitable for controlling stepper motors and servo drives with pulse interface. The "Axis" technological object is controlled by means of Motion Control statements. The following commands (statements) can be called in the user program:

- MC_Power: Enable/disable axes
- MC_Reset: Acknowledge error
- MC_Home: Home axes, set reference point
- MC_Halt: Stop axes
- MC_MoveAbsolute: Position axes absolute
- MC_MoveRelative: Position axes relative
- MC_MoveVelocity: Move axes with speed preset
- MC_MoveJog: Move axes in jogging mode

Requirements

To use the "Axis" technological object, you must create a project with a CPU S7-1200.

Procedure

To use a technological object "Axis", follow these steps:

1. Add technological object Axis (Page 626)
2. Configuring the technological object (Page 626)
3. Download to CPU (Page 644)
4. Function test of the axis in the commissioning window (Page 645)
5. Creating a user program (Page 634)
6. Diagnostics of the axis control (Page 648)

See also

MC_Power: Enable, disable axis (Page 1001)
MC_Reset: Acknowledge error (Page 1003)
MC_Home: Home axes, set home position (Page 1004)
MC_Halt: Halt axis (Page 1006)
MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveRelative: Relative positioning of axes (Page 1009)

MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
MC_MoveJog: Move axes in jog mode (Page 1012)

7.7.1.2 Axes - Basics

7.7.1.2 Difference between Axis and Drive

The term "Axis" denotes the technical image of the drive by the "Axis" technological object. The "Axis" technological object interfaces the user program with the drive. The technological object receives the Motion Control commands from the user program, executes them and monitors their runtime. The Motion Control commands are initiated in the user program by means of Motion Control statements.

The term "Drive" denotes the electromechanical unit of a stepper motor plus power section or a servo drive plus converter with pulse interface. The drive is controlled by the "Axis" technological object via a pulse generator of the CPU S7-1200.

See also

MC_Power: Enable, disable axis (Page 1001)
MC_Reset: Acknowledge error (Page 1003)
MC_Home: Home axes, set home position (Page 1004)
MC_Halt: Halt axis (Page 1006)
MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveRelative: Relative positioning of axes (Page 1009)
MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
MC_MoveJog: Move axes in jog mode (Page 1012)

7.7.1.2 Homing

The position entries and displays for position-controlled axes refer to the axis coordinate system. The axis coordinate system must be synchronized with the real, physical position of the axis (homing).

Note

Please note the following:

- The homed state of the axis can be lost under the following conditions.
  - CPU memory reset
  - POWER OFF -> POWER ON
  - CPU restart
  - Reset of the axis enable at the Motion Control statement "MC_Power" (the axis is blocked in this state)
- With the exception of the Motion Control statement "MC_MoveAbsolute", all motion commands can be executed in a non-homed state.

Axis homing is initiated by the Motion Control statement "MC_Home". During homing, the reference point coordinate is set at a defined mechanical position of the axis.

Homing modes

- Active homing

  In active homing mode, the Motion Control statement "MC_Home" performs the required reference point approach. All other active motions are cancelled.
- Passive homing

  In passive homing mode, the Motion Control statement "MC_Home" does **not** execute a reference point approach. Other active motions are not cancelled. Approaching the reference point switch must be executed by the user via Motion Control statements or by mechanical movement.
- Direct homing absolute

  The axis position is set irrespective of the reference cam position. Other active motions are not cancelled. The value of the "Position" parameter in the "MC_Home" statement is activated immediately as a reference point and position value of the axis. The axis must be at a standstill in order to allow the precise assignment of the reference point to a mechanical position.
- Direct homing relative

  The axis position is set irrespective of the reference cam position. Other active motions are not cancelled. Rule for the reference point and axis position:

  New axis position = current axis position + value of the "Position" parameter.

  The value for the reference point and axis position is activated immediately. The axis must be at a standstill in order to allow the precise assignment of the reference point to a mechanical position.

See also

MC_Home: Home axes, set home position (Page 1004)
Configuration - Homing (Page 632)

7.7.1.3 Add technological object Axis

To add an "Axis" technological object in the project navigator, follow these steps:

Requirements

A project with a CPU S7-1200 has been created.

Procedure

1. Open the CPU folder in the project navigator.
2. Open the technological objects folder.
3. Double-click the "Add new object" object.
   The "Add new object" dialog box opens.
4. Type in an individual name for the technological object in the "Name" input field.
5. Click "Axis".
   The required "TO_AXIS_PTO" type is already selected.
6. Select the "Manual" option if you want to change the proposed data block number.
7. Click "Further information" if you want to supplement user information for the technological object.
8. Click "OK" to add the technological object. Click "Cancel" to discard your entries.

Result

The new technological object is created and saved to the "Technological objects" folder in the project navigator.

Note

You can select the "Add and open new block" check box at the bottom of the dialog box. This opens the configuration of the technological object after adding has been completed.

7.7.1.4 Configuring

7.7.1.4 Configuring the technological object

You configure the properties of the Motion Control technological object in the configuration window. To open the configuration window of the technological object, follow these steps:

1. Open the group of the selected technological object in the project navigator.
2. Double-click the "Configuration" object.

Icons of the configuration window

Icons in the area navigation of the configuration show additional information about the completeness of the configuration:

✓	**The configuration contains default values and is complete.** The configuration only contains default values. With those default values you can use the technological object without further changes.
✓	**The configuration contains user-defined values and is complete** All values in the input fields of the configuration are valid and at least one default value was modified.
✗	**Incomplete or incorrect configuration** At least one input field or a drop-down list box contains no value or an invalid value. The corresponding field, or the drop-down list box, is displayed on a red background. Click the roll-out error message to indicate the cause of error.

See also

Configuration - General (Page 627)
Configuration - Drive signals (Page 629)
Configuration - Mechanics (Page 629)
Configuration - Position monitoring (Page 630)
Configuration - General dynamic response (Page 631)
Configuration - Dynamic emergency stop (Page 631)
Configuration - Homing (Page 632)

7.7.1.4 Basic parameters

7.7.1.4 Configuration - General

Configure the fundamental properties of the "Axis" technological object in the "General" configuration window.

Axis name

Define the name of the axis and technological object in this field. The "Axis" technological object is listed in the project navigator under this name.

Hardware interface

The technological object generates the pulses for the stepper motor control via PTO (Pulse Train Output). The pulses are output to the power section of the stepper motor via permanently assigned digital outputs.

On CPUs with integrated relay outputs, the pulse signal cannot be output because the relays do not support the switching frequencies of the signals. To enable the use of PTO on such CPUs, you must implement a signal board with digital outputs.

Note

The PTO internally requires the functionality of a high-speed counter (HSC). The user cannot use the respective high-speed counter in any other way.

The first PTO is interconnected with the first high-speed counter; the second PTO is interconnected with the second high-speed counter.

To configure the selected PTO, proceed as follows:

1. Select "Pulse_1" or "Pulse_2" from the "PTO selection drive control" drop-down list box.
2. Click on "Device configuration".
3. In the area navigator, open the "Pulse generators" group.
4. In the area navigator, click the selected PTO.
   The configuration of the PTO is displayed.
5. Select the "Enable this pulse generator" check box.
6. Select the "PTO" entry in the "Pulse generator as" drop-down list box.
7. Go to the "Output source" drop-down list box and select either an integrated output of the CPU, or the output of signal board.

   If the corresponding high-speed counter is not in use by any other application, the PTO fields in the "General" axis configuration are not output on a red background. If this is not the case, correct the configuration based on the error messages.

User-defined unit

Select the measuring system for axis positioning from the drop-down list box.

Notice

If you change the measuring system at a later time, the values might not be converted correctly in all configuration windows. In this case, check the configuration of all axis parameters.

See also

Configuring the technological object (Page 626)
Configuration - Drive signals (Page 629)
Configuration - Mechanics (Page 629)
Configuration - Position monitoring (Page 630)
Configuration - General dynamic response (Page 631)
Configuration - Dynamic emergency stop (Page 631)
Configuration - Homing (Page 632)

7.7.1.4 Advanced parameters

7.7.1.4 Configuration - Drive signals

Configure the enable signal and the "Ready" feedback signal of the drive in the "Drive signals" configuration window. You don't have to set up the parameters if the drive does not provide any such interfaces.

See also

Configuring the technological object (Page 626)
Configuration - General (Page 627)
Configuration - Mechanics (Page 629)
Configuration - Position monitoring (Page 630)
Configuration - General dynamic response (Page 631)
Configuration - Dynamic emergency stop (Page 631)
Configuration - Homing (Page 632)

7.7.1.4 Configuration - Mechanics

Configure the mechanical properties of the drive in the "Mechanics" configuration window.

Pulses per motor revolution

Configure the pulses required for one revolution of the stepper motor in this field.

Distance per motor revolution

In this field, configure the distance per motor revolution covered by the mechanical system of your unit.

Inverting the sense of direction

Set the "Invert sense of direction" check box if the direction of the mechanical drive system is reciprocal to the sense of direction of the stepper motor.

See also

Configuring the technological object (Page 626)
Configuration - General (Page 627)
Configuration - Drive signals (Page 629)
Configuration - Position monitoring (Page 630)
Configuration - General dynamic response (Page 631)
Configuration - Dynamic emergency stop (Page 631)
Configuration - Homing (Page 632)

7.7.1.4 Configuration - Position monitoring

Configure the software and hardware limit switches of the axis in the "Position monitoring" configuration window.

Activate hardware limit switches

The check box activates the upper and lower hardware limit switches. After the axis has approached or passed the hardware limit switch, it is ramped down to a standstill by means of emergency stop deceleration. Braking with an emergency stop deceleration during an active homing procedure (Page 632) can be replaced with an axis reversal on the hardware limit switch.

Activate software limit switches

This check box activates the upper and lower software limit switches. An active motion is stopped after the axis has reached a position of the software limit switch. The technological object reports a fault. The axis can be returned to its working range after the fault has been acknowledged.

Notice

The activate software limit switches setting only affects a homed axis.

Lower / upper HW limit switch input

Select the digital input for the lower or upper hardware limit switch from the drop-down list box. The input must support alarm functionality. The integrated CPU inputs and the inputs of a signal board can be selected as inputs for the HW limit switches.

Signal level selection

Select the triggering signal level ("Lower level" / "Upper level") of the hardware limit switch. At "Lower level", the input signal is FALSE after the axis has reached or passed the hardware limit switch. At "Upper level", the input signal is TRUE after the axis has reached or passed the hardware limit switch.

Lower / upper SW limit switch input

Specify the position of the corresponding software limits switch in these fields.

See also

Configuring the technological object (Page 626)
Configuration - General (Page 627)
Configuration - Drive signals (Page 629)
Configuration - Mechanics (Page 629)
Configuration - General dynamic response (Page 631)
Configuration - Dynamic emergency stop (Page 631)
Configuration - Homing (Page 632)

7.7.1.4 Dynamic response

7.7.1.4 Configuration - General dynamic response

In the "General dynamic response" configuration window, set up the maximum velocity, the start/stop velocity, and the maximum acceleration/deceleration of the axis.

Unit for velocity limit

Select the physical unit for the velocity limits from the drop-down list box.

Velocity

Define the maximum and start/stop velocity of the axis in those fields.

Acceleration/deceleration

Set the acceleration value in the "Ramp-up time" or "Acceleration" fields. Set the deceleration value in the "Ramp-down time" or "Deceleration" fields.

Note

All changes to velocity limits have an effect on the acceleration/deceleration values of the axis. The ramp-up and ramp-down times are retained.

See also

Configuring the technological object (Page 626)
Configuration - General (Page 627)
Configuration - Drive signals (Page 629)
Configuration - Mechanics (Page 629)
Configuration - Position monitoring (Page 630)
Configuration - Dynamic emergency stop (Page 631)
Configuration - Homing (Page 632)

7.7.1.4 Configuration - Dynamic emergency stop

Configure the maximum emergency stop deceleration of the axis in the "Dynamic emergency stop" configuration window. In the event of an error, the axis is brought to a standstill at this deceleration rate.

Velocity

The velocity values configured in the "General dynamic response" configuration window power once again displayed in this information area.

Deceleration

Set the deceleration limit for emergency stop in the "Emergency stop ramp-down time" or "Emergency stop deceleration" fields.

See also

Configuring the technological object (Page 626)
Configuration - General (Page 627)
Configuration - Drive signals (Page 629)
Configuration - Mechanics (Page 629)
Configuration - Position monitoring (Page 630)
Configuration - General dynamic response (Page 631)
Configuration - Homing (Page 632)

7.7.1.4 Configuration - Homing

Configure the parameters for active and passive homing in the "Homing" configuration window. The homing mode of the active reference point approach is set up by means of the statement "MC_Home" Mode = 3; passive homing is set up with Mode = 2.

Reference cam input (active and passive homing)

Select the digital input for the reference point switch from the drop-down list box. The input must support alarm functionality. The integrated CPU inputs and the inputs of a signal board can be selected for the reference point switch.

Allow reversal at the hardware limit switch (active homing only)

Activate the check box to use the hardware limit switch as a reversing cam for the reference point approach. After the axis has reached the hardware limit switch during active homing, it is ramped down at the set deceleration rate and then reversed. The reference point switch is then sensed in reverse direction. If this function is not active and the axis reaches the hardware limit switch during active homing, the reference point approach is canceled with an error and the axis is stopped by means of emergency stop deceleration ramp.

Approach direction (active homing only)

Here, you specify the approach direction for sensing the reference point switch.

Reference cam (active and passive homing)

Select either the left or the right side of the reference point switch as homing position.

Note

Depending on the start position of the axis, the reference point approach can differ from the sequence displayed in the diagram in the configuration window.

Startup velocity (active homing only)

In this field, specify the velocity at which the reference point switch is sensed during the reference point approach.

Approach velocity (active homing only)

In this field, specify the velocity at which the axis approaches the reference point switch for homing.

Reference point shift (active homing only)

In the case of a different position of the reference point switch and reference point position, in this field enter the respective reference point shift. The axis approaches the homing position at approach velocity.

The absolute reference point coordinate is specified at the "Position" parameter in the "MC_Home" statement.

See also

Configuring the technological object (Page 626)
Configuration - General (Page 627)
Configuration - Drive signals (Page 629)
Configuration - Mechanics (Page 629)
Configuration - Position monitoring (Page 630)
Configuration - General dynamic response (Page 631)
Configuration - Dynamic emergency stop (Page 631)
Homing (Page 624)
MC_Home: Home axes, set home position (Page 1004)

7.7.1.5 Programming

7.7.1.5 Overview of the Motion Control statements

The Motion Control statements represent the interface between the user program and the "Axis" technological object. The Motion Control statements are used to transfer commands to the technological object for their processing and monitoring.

The status of the technological object and error events can be read from the output parameters of the Motion Control statements and from the "diagnostics" in the project navigator. The following Motion Control statements are available:

- MC_Power: Enable, disable axis (Page 1001)
- MC_Reset: Acknowledge error (Page 1003)
- MC_Home: Home axes, set home position (Page 1004)
- MC_Halt: Halt axis (Page 1006)
- MC_MoveAbsolute: Absolute positioning of axes (Page 1007)

- MC_MoveRelative: Relative positioning of axes (Page 1009)
- MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
- MC_MoveJog: Move axes in jog mode (Page 1012)

7.7.1.5 Creating a user program

In the section below you learn how to create a user program with the basic configuration for controlling your axis. The Motion Control statements to be inserted are used to control all motions of your axis.

Requirements

- A technological object was created and configured without errors.

Before creating and testing the user program, it is advisable to test the axis and drive functions using the control panel (Page 645) .

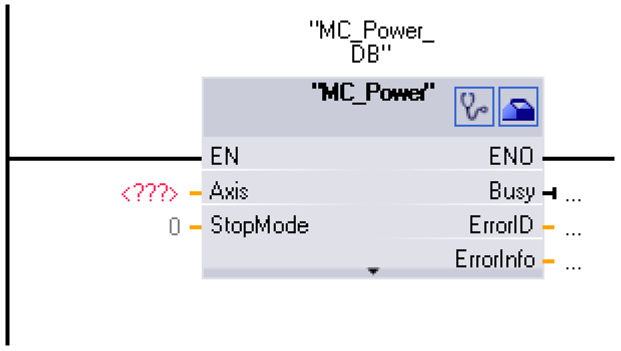
Procedure

1. In the project navigator, double click your program block (the program block must be called in the cyclic program).

   The block is opened in the programming editor and all available statements are displayed.
2. Open the advanced statements and the "Motion Control" folder.
3. Drag-and-drop the "MC_Power" statement to the selected network of the block.

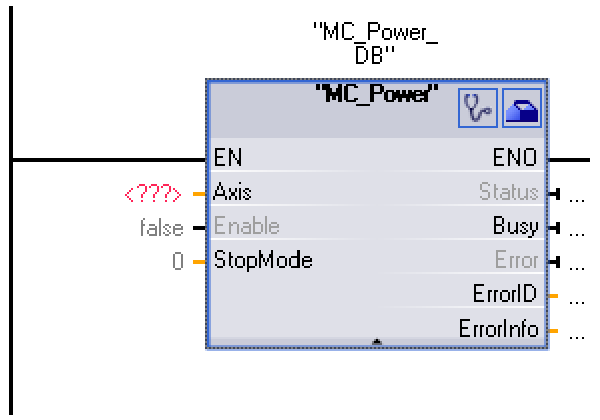
   The dialog box for defining the instance DB opens.
4. Click "Single instance" and select whether to define the number of the instance DB automatically or manually.
5. Click "OK".

   The Motion Control statement "MC_Power" is inserted into the network.



The programming editor provides the following control options:

Click the stethoscope icon if you want to open the diagnostics dialog for the technological object. Click the toolbox icon to open the configuration window of the technological object. Click the arrow down icon to view additional parameters of the Motion Control statement.



All parameters marked with "<???>" must be configured. Parameters displayed in black font are required for a practical use of the Motion Control statement. Grayed parameters are optional.

6. Double click <???> and select the "Axis" technological object from the address list.
7. Insert the Motion Control statements "MC_Reset", "MC_Home", "MC_Halt", "MC_MoveAbsolute", "MC_MoveRelative", "MC_MoveVelocity" and "MC_MoveJog" into further networks in accordance with steps 3 to 6.

Result

You have created the basic configuration for axis control in the user program. In a further section of the user program you control the parameter values of the Motion Control statements. For additional information about the parameters, refer to the description of the Motion Control statement.

See also

MC_Power: Enable, disable axis (Page 1001)
MC_Reset: Acknowledge error (Page 1003)
MC_Home: Home axes, set home position (Page 1004)
MC_Halt: Halt axis (Page 1006)
MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveRelative: Relative positioning of axes (Page 1009)
MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
MC_MoveJog: Move axes in jog mode (Page 1012)
Commissioning (Page 645)

7.7.1.5 Monitoring active commands

Monitor the command status of the Motion Control statement by means of the Busy, Done, InVelocity and CommandAborted output parameters.

While the Motion Control command is active: output parameter Busy has the value TRUE, and after the command was completed Busy has the value FALSE. The Done, InVelocity and CommandAborted output parameters indicate the status at least for the duration of one cycle. These status messages are displayed in retentive mode as long as input parameter Execute is set to TRUE.

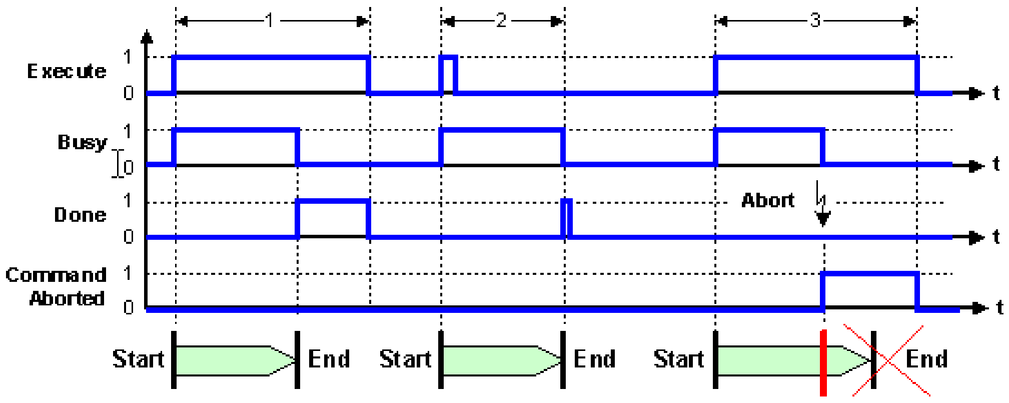
Motion Control statements with output parameter Done

The commands of the following Motion Control statements have a defined conclusion:

- MC_Reset
- MC_Home
- MC_Halt
- MC_MoveAbsolute
- MC_MoveRelative

Output parameter Done returns the value TRUE to signal successful completion of the command.

The section below shows the behavior of the command status based on three example phases:



Phase 1

- The command is started with a positive edge at input parameter Execute = TRUE .
- Output parameter displays Busy = TRUE. during command execution
- Output parameter Busy changes to FALSE and output parameter Done changes to TRUE after command execution has been completed.
- If Execute = FALSE , output parameter Done changes to FALSE.

Phase 2

- The command is started with a positive edge at input parameter Execute .
- Output parameter displays Busy = TRUE. during command execution
- Output parameter Busy changes to FALSE. and output parameter Done changes to TRUE after command execution has been completed.

Phase 3

- The command is started with a positive edge at input parameter Execute = TRUE .
- Output parameter displays Busy = TRUE. during command execution
- Command execution is canceled by another command.
- Output parameter CommandAborted changes from FASLE to TRUE after command execution was canceled.

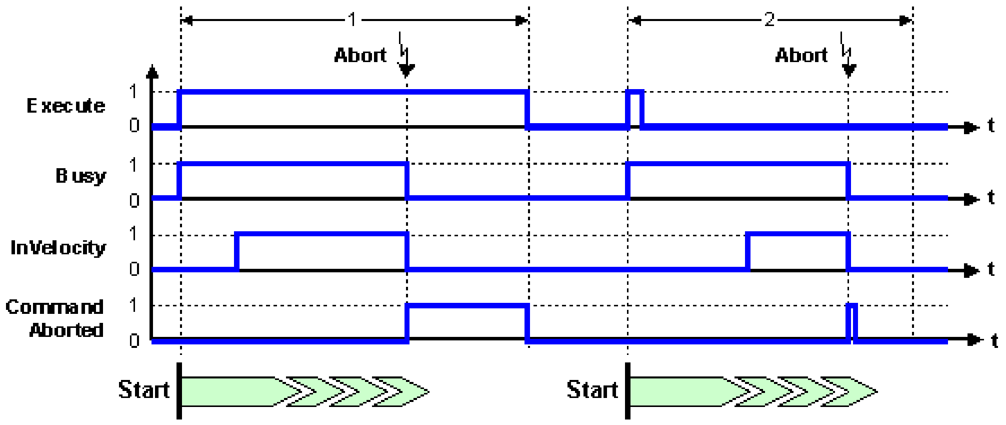
- Output parameter Busy changes to FALSE. after command execution has been completed.
- If Execute = FALSE , output parameter CommandAborted changes to FALSE.

Motion Control statements with output parameter Done

The commands of the following Motion Control statements do not have a defined conclusion:

- MC_MoveVelocity
- MC_MoveJog

The Motion Control statements listed indicate at output parameter InVelocity that the selected operating state was reached the first time. The section below shows the behavior of the command status in two example phases, based on the Motion Control statement "MC_MoveVelocity":



Phase 1

- The command is started with a positive edge at input parameter Execute = TRUE .
- Output parameter displays Busy = TRUE. during command execution
- The InVelocity output parameter is set to TRUE as soon as the target velocity is reached.
- The command is canceled by another command:
  - Output parameter Busy changes to FALSE.
  - Output parameter InVelocity changes to FALSE.
  - Output parameter CommandAborted returns the value TRUE to indicate that the command was canceled.
- If Execute = FALSE , output parameter CommandAborted changes to FALSE.

Phase 2

- The command is started with a positive edge at input parameter Execute = TRUE .
- Output parameter displays Busy = TRUE. during command execution
- The InVelocity output parameter is set to TRUE as soon as the target velocity is reached.
- The command is canceled by another command:
  - Output parameter Busy changes to FALSE.

– Output parameter InVelocity changes to FALSE.
– Output parameter CommandAborted returns the value TRUE during one execution cycle to indicate that the command was canceled.

7.7.1.5 Behavior of the Motion Control commands after POWER OFF and restart

The technological object is initialized after each POWER OFF (POWER OFF -> POWER ON) and restart (RUN-STOP -> STOP-RUN).

The axis must be re-enabled with the Motion Control statement "MC_Power".

If homing is required, the axis must be re-referenced with the Motion Control statement "MC_Home".

Active commands will not be initialized before a POWER OFF or restart.

7.7.1.5 Error displays of the Motion Control statements

The Motion Control statements indicate all errors of the technological object at output parameters Error, ErrorID und, ErroInfo.

Error display at output parameters Error, ErrorID and ErrorInfo

Output parameter Error = TRUE indicates that the Motion Control statement was unable to execute the command. The cause of error is indicated by the value at output parameter ErrorID . More information about the cause of error is returned by the value at output parameter ErrorInfo. We distinguish between the following error classes for error indication:

- Operational fault without stop of the axis

  Operational faults are faults that occur during the term of the Motion Control statement. Operational faults without axis stop are indicated only at the triggering Motion Control statement. The Motion Control statement can be restarted after the error has been remedied without error acknowledgement.

- Operational fault with stop of the axis

  Operational faults are faults that occur during the term of the Motion Control statement. Operational faults with axis stop are indicated at the triggering Motion Control statement and at the "MC_Power" statement. The axis is stopped at the configured emergency stop deceleration rate. The technological object can only accept new motion commands after the error has been acknowledged by means of "MC_Reset" statement.

- Configuration error of the Motion Control statement

  Configuration errors are incorrect entries on the input parameters of the Motion Control statement that has caused the error. The error is indicated only at the triggering Motion Control statement. The Motion Control statement can be restarted after the error has been remedied without error acknowledgement.

- Configuration error

  There is a configuration error if the axis parameter has been incorrectly configured. The error is indicated at the triggering Motion Control statement and at the "MC_Power" statement. The following options are available for troubleshooting:

- Download the technological object once again to the controller.
- Correct the configuration error online.

  Acknowledge the error by means of the "MC_Reset" statement.

  Enable the axis again with the "MC_Power" statement.

- Internal error

  The error is indicated at the triggering Motion Control statement and at the "MC_Power" statement. If necessary, the error can be reset by restarting the controller.

See also

List of ErrorIDs and ErrorInfos (Page 639)

7.7.1.5 List of ErrorIDs and ErrorInfos

List of ErrorIDs / ErrorInfos

The following tables list the ErrorIDs and ErrorInfos that can be displayed on the Motion Control statements.

Operational fault with stop of the axis

ErrorID	ErrorInfo	Description	Remedy
8000		Drive error, "Drive ready" failure	
	0001	-	Providing the drive signal
8001		Lower software limit switch was triggered	
	000E	The axis has reached the limit switch	Acknowledge the error with the "MC_Reset" statement; set a motion command to move the axis in positive direction out of the range of the SW limit switch
	0010	The axis has passed the limit switch	
8002		Upper software limit switch was triggered	
	000E	The axis has reached the limit switch	Acknowledge the error with the "MC_Reset" statement; set a motion command to move the axis in negative direction out of the range of the SW limit switch
	0010	The axis has passed the limit switch	
8003		Lower hardware limit switch was triggered	
	000E	The axis has reached the limit switch	Acknowledge the error with the "MC_Reset" statement; set a motion command to move the axis in positive direction out of the range of the HW limit switch
8004		Upper hardware limit switch was triggered	

ErrorID	ErrorInfo	Description	Remedy
	000E	The axis has reached the limit switch	Acknowledge the error with the "MC_Reset" statement; set a motion command to move the axis in negative direction out of the range of the HW limit switch
8005		**PTO and HSC are already in use by a different axis**	
	0001	-	Revise the configuration of the PTO and HSC and download it to the controller

Operational fault without stop of the axis

ErrorID	ErrorInfo	Description	Remedy
8200		**Axis is not enabled**	
	0001	-	Enable the axis; restart the command
8201		**Axis has already been enabled by another statement " MC_Power "**	
	0001	-	Enable the axis with only one "MC_Power" statement
8202		**The maximum number of simultaneously active Motion Control commands was exceeded (max. 256 commands for all Motion Control technological objects)**	
	0001	-	Reduce the number of simultaneously active commands; restart the command
8203		**Axis is currently operated in "Manual control" (control panel)**	
	0001	-	Exit "Manual control"; restart the command
8204		**Axis is not homed**	
	0001	-	Home the axis by means of the "MC_Home" statement; restart the command
8205		**The axis is currently controlled by the user program (the error is only displayed in the control panel)**	
	0001	-	

Block parameter error

ErrorID	ErrorInfo	Description	Remedy
8400		**Incorrect value at the "Position" parameter of the Motion Control statement**	
	0005	The value is outside the number range (greater than $1e^{12}$)	Correct the "position" value; restart the command
	0006	The value is outside the number range (less than $-1e^{12}$)	Correct the "position" value; restart the command
8401		**Incorrect value at the "Distance" parameter of the Motion Control statement**	

ErrorID	ErrorInfo	Description	Remedy
	0005	The value is outside the number range (greater than 1e^{12})	Correct the "distance" value; restart the command
	0006	The value is outside the number range (less than -1e^{12})	Correct the "distance" value; restart the command
8402		**Incorrect value at the "Velocity" parameter of the Motion Control statement**	
	0008	The velocity is less than the start / stop velocity	Correct the "velocity" value; restart the command
	0009	The maximum velocity is exceeded	Correct the "velocity" value; restart the command
8403		**Incorrect value at the "Direction" parameter of the Motion Control statement**	
	000F	Invalid selection value	Correct the selection value; restart the command
8404		**Incorrect value at the " Mode " parameter of the Motion Control statement " MC_Home "**	
	000F	Invalid selection value	Correct the selection value; restart the command
8405		**Incorrect value at the " StopMode " parameter of the Motion Control statement " MC_Power "**	
	000F	Invalid selection value	Correct the selection value; restart the command

Configuration error

ErrorID	ErrorInfo	Description	Remedy
8600		**Invalid configuration of the pulse generator (PTO)**	
	000D	Invalid address	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
8601		**Invalid configuration of the high-speed counter (HSC)**	
	000D	Invalid address	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
8602		**Invalid configuration of the "Drive enable" output**	
	000D	Invalid address	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
8603		**Invalid configuration of the "Drive ready" input**	
	000D	Invalid address	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
8604		**Invalid "Pulses per motor revolution" value**	
	000A	The value is less than or equal to zero	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
8605		**Invalid "Distance per motor revolution" value**	

ErrorID	ErrorInfo	Description	Remedy
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	000A	The value is less than or equal to zero	
8606		**Invalid "Start / stop velocity" value**	
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0003	Value exceeds the hardware limit	
	0004	Value is less than the hardware limit	
8607		**Invalid "maximum velocity" value**	
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0003	Value exceeds the hardware limit	
	0004	Value is less than the hardware limit	
8608		**Invalid "Acceleration" value**	
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0003	Value exceeds the hardware limit	
	0004	Value is less than the hardware limit	
8609		**Invalid "Deceleration" value**	
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0003	Value exceeds the hardware limit	
	0004	Value is less than the hardware limit	
860A		**Invalid "Emergency stop deceleration" value**	
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0003	Value exceeds the hardware limit	
	0004	Value is less than the hardware limit	
860B		**Invalid position value for the lower SW limit switch**	
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0005	The value is outside the number range (greater than $1e^{12}$)	
	0006	The value is outside the number range (less than $-1e^{12}$)	
	0007	The position value of the lower SW limit switch is greater than that of the upper SW limit switch	
860C		**Invalid position value for the upper SW limit switch**	

ErrorID	ErrorInfo	Description	Remedy
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0005	The value is outside the number range (greater than 1e^{12})	
	0006	The value is outside the number range (less than -1e^{12})	
860D		**Invalid address of the lower HW limit switch**	
	000B	Invalid address of the falling edge	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	000C	Invalid address of the rising edge	
860E		**Invalid address of the upper HW limit switch**	
	000B	Invalid address of the falling edge	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	000C	Invalid address of the rising edge	
860F		**Invalid "reference point shift" value**	
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0005	The value is outside the number range (greater than 1e^{12})	
	0006	The value is outside the number range (less than -1e^{12})	
8610		**Invalid "startup velocity" value**	
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0008	The velocity is less than the start / stop velocity	
	0009	The maximum velocity is exceeded	
8611		**Invalid "approach velocity" value**	
	0002	Value with invalid number format	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	0008	The velocity is less than the start / stop velocity	
	0009	The maximum velocity is exceeded	
8612		**Invalid address of the reference point switch**	
	000B	Invalid address of the falling edge	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement
	000C	Invalid address of the rising edge	
8613		**Axis reversal is activated at the HW limit switch, despite the fact that the hardware limit switches are disabled**	
	0001	-	Revise the configuration and download it to the controller; re-enable the axis by calling the "MC_Power" statement

Internal error

ErrorID	ErrorInfo	Description	Remedy
8FFF		Internal error	
	F001	-	Restart the CPU by means of POWER OFF and POWER ON
	F002	-	
	F003	-	
	F004	-	
	F005	-	
	F006	-	
	F007	-	
	F008	-	

See also

Error displays of the Motion Control statements (Page 638)

7.7.1.6 Download to CPU

A new or modified configuration of the technological object must be downloaded to the CPU for the online mode. The following menu and shortcut menu commands are available for the download:

- Menu command Online > Download to device

  Downloads the configuration of the technological object, the compiled hardware data and the remaining software project data to the device.

- Menu command Online > Advanced download to device

  Sets up an online connection to the selected device and downloads the compiled hardware and software project data, including the configuration of a technological object to the device.

The CPU object was selected in the project navigator.

- Download to Device > All shortcut menu command

  Downloads the configuration of the technological object, the compiled hardware data and the remaining software project data to the device.

- Download to Device > Software shortcut menu command

  Downloads the modified configuration of the technological object and the modified blocks to a device. Only the modified objects are transferred to the device.

- Download to Device > Software (all blocks) shortcut menu command

  Downloads all blocks and the technological objects, including the objects which were not changed to the device.

The "Program blocks" object was selected in the project navigator.

- Download to Device > Software shortcut menu command

  Downloads the modified configuration of the technological object and the modified blocks to a device. Only the modified objects are transferred to the device.

- Download to Device > Software (all blocks) shortcut menu command

  Downloads all blocks and the technological objects, including the objects which were not changed, to the device.

7.7.1.7 Commissioning

Use the control panel to test the axis and drive functions or to move the axis in manual mode. The control panel can only be used if an online connection to the CPU is set up.

"Manual control" button

Click "Manual control" to move the axis in manual control mode. Start by clearing the axis enable at the Motion Control statement "MC_Power" in the user program. In "Manual control" mode, the control panel assumes control priority for the axis and drive functions. The user program has no influence on the axis functions.

Warning

The Manual control is active for one axis only. A second axis could be moved in Automatic control, but this would bring about a dangerous situation.

In this case, set the second axis out of operation.

"Auto mode" button

Click "Auto mode" to end the "Manual control" mode. Control priority is transferred again to the controller.

Re-enable the axis with a FALSE -> TRUE edge at input parameter "Enable" of the Motion Control statement "MC_Power" and initiate axis homing by means of Motion Control statement "MC_Home".

"Enable" button

Click "Enable" to move the axis in manual control mode.

"Lock" button

Click "Lock" to temporarily lock the axis in manual control mode.

"Command" area

Operation in the "Command" area is only possible if the axis is enabled. You can select one of the following command inputs:

- Jog

  This command is equivalent to the Motion Control command "MC_MoveJog" in the user program.
- Positioning

  This command is equivalent to the Motion Control commands "MC_MoveAbsolute" and "MC_MoveRelative" in the user program. The axis must be homed for absolute positioning.
- Homing

  This command is equivalent to the Motion Control command "MC_Home" in the user program.

Depending on your selection, the screen displays different fields for setpoint input and different buttons for starting the command.

"Axis status" area

If "Manual control" mode is active, the displays in the "Axis status" area output the current state of the axis and drive. The current position and velocity of the axis is displayed at "Actual values".

Click "Acknowledge" to acknowledge all cleared errors.

Last error

In "Manual control" mode, the "Last error" field indicates the most recent error and the corresponding additional error information. Having eliminated the cause of error, click "Acknowledge" to clear the error entry.

7.7.1.8 Diagnostics

7.7.1.8 Status and error bits

Use the "Status and error bits" diagnostics function to monitor the vital status and fault messages of the axis. The display of diagnostics functions is available in online mode in the "Manual control" mode and in "Auto mode". The status error messages have the following meaning:

Status of the axis

Status	Description
Enabled	The axis is enabled and ready to accept Motion Control commands.
Homed	The axis is homed and is capable of executing positioning commands such as those of the "MC_MoveAbsolute" statement. The axis does not have to be homed for relative homing. The status is FALSE during active homing with the "MC_Home" statement.

Status	Description
Error	An error occurred at the axis technological object. Depending on the type of error, either the axis is stopped, or the command is rejected. More information about the error is available in auto mode at the ErrorID and ErrorInfo parameters of the Motion Control statements. In manual mode, the "Last error" field of the control panel displays more information about the cause of error.
Control panel active	The "Manual control" mode was enabled in the control panel. The control panel takes control priority over the axis technological object. The user program has no influence over the technological object.

Drive status

Status	Description
Drive ready	The drive is ready.
Error	The drive has reported an error after failure of its ready signal.

Status of the axis motion

Status	Description
Standstill	The axis is at a standstill.
Acceleration	The axis accelerates.
Constant velocity	The axis travels at a constant velocity.
Deceleration	The axis decelerates (slows down).

Status of the motion mode

Status	Description
Positioning	The axis is executing a positioning command (e.g. by means of the "MC_MoveAbsolute" or "MC_MoveRelative" statement).
Motion with speed preset	The axis is executing a command of the following Motion Control statement: • MC_MoveVelocity • MC_MoveJog • MC_Halt
Homing	The axis is executing a homing command (e.g. by means of "MC_Home" statement).

Error bits

Error	Description
SW limit switch has reached the negative end position	The negative end position of the SW limit switch was reached; the axis is stopped.
SW limit switch has exceeded the negative end position	The negative end position of the SW limit switch was exceeded; the axis is stopped.
SW limit switch has reached the positive end position	The positive end position of the SW limit switch was reached; the axis is stopped.
SW limit switch has exceeded the positive end position	The positive end position of the SW limit switch was exceeded; the axis is stopped.
HW limit switch at negative end position	The negative end position of the HW limit switch was reached or exceeded; the axis is stopped with emergency stop deceleration.
HW limit switch at positive end position	The positive end position of the HW limit switch was reached or exceeded; the axis is stopped with emergency stop deceleration.
PTO and HSC are already in use	The axis cannot access the assigned pulse generator and high-speed counter. The axis is stopped and locked.
Configuration error	The technological object is unable to execute the command due to a configuration error. The axis is stopped and locked
Internal error	An internal error has occurred. The axis is stopped and locked.

7.7.1.8 Motion status

Use the diagnostics function "Motion status" to monitor the motion commands of the axis. The display of diagnostics functions is available in online mode in the "Manual control" mode and in "Auto mode". The displayed fields have the following meaning:

Motion status

Status	Description
Target position	The "Target position" indicates the current target position of positioning command (e.g. by means of the "MC_MoveAbsolute" or "MC_MoveRelative" statement). The target position is only displayed if the axis is homed and a positioning command is active.
Current position	The "Current position" field indicates the current axis position. The field only indicates the current position of a homed axis.
Current velocity	The "Current velocity" field indicates the actual axis velocity.

Dynamic limits

Dynamic limit	Description
Velocity	The "Velocity" field indicates the configured maximum velocity of the axis.
Acceleration	The "Acceleration" field indicates the configured maximum acceleration of the axis.
Deceleration	The "Deceleration" field indicates the configured maximum deceleration of the axis.

7.7.2 Using PID Compact

7.7.2.1 Guidelines for "PID Compact"

The "PID_Compact" technology object makes available a PID controller with optimizing self tuning for automatic and manual mode.

Within a control loop the PID controller continuously acquires the measured actual value of the controlled variable and compares it with the desired setpoint. From the resulting system deviation the PID controller calculates a controller output that adapts the controlled variable to the setpoint as rapidly and stably as possible. At the PID controller the calculated value of the controller output consists of three components:

- Proportional component

  The value of the controller output calculated by the proportional component is proportional to the system deviation.

- Integral component

  The value of the controller output calculated by the integral component increases with the duration of the controller output and finally results in the controller output being compensated.

- Derivative component

  The derivative component of the PID controller increases as the rate of change of the system deviation increases. The controlled variable is adapted as fast as possible to the setpoint. When the rate of change of the system deviation decreases, the derivative component decreases as well.

The technology object calculates the proportional. integral and derivative component of the PID controller by itself during the "Self tuning during initial start". The parameters can be optimized further by means of a "Self-tuning in the operating point".

Requirement

To use the "PID Compact" technology object, a project has to be created with a CPU S7-1200.

Procedure

To use a "PID Compact" technology object, follow these steps:

1. Adding a "PID Compact" technology object (Page 650)
2. Calling the "PID_Compact" instruction in the user program (Page 656)
3. Configuring the technology object (Page 651)
4. Download to CPU (Page 657)
5. Commissioning (Page 659)
6. Saving the optimized PID parameters (Page 666)

7.7.2.2 Adding a "PID Compact" technology object

You have the following options for creating the "PID Compact" technology object within the project:

Adding a "PID Compact" technology object in the project navigator

When a technology object is added, an instance DB is created for the "PID_Compact" instruction. The configuration of the technology object is stored in this instance DB. To add a "PID Compact" technology object in the project navigator, follow these steps:

Requirement

A project with a CPU S7-1200 has been created.

Procedure

1. Open the CPU folder in the project tree.
2. Open the "Technology objects" folder.
3. Double-click the "Add new object" object.
   The "Add new object" dialog box opens.
4. Enter an individual name for the technology object in the "Name" input field.
5. Click the "PID controller" button.
6. Select the "Manual" option if you want to change the suggested data block number of the instance DB.
7. Click "Further information" if you want to add own information to the technology object.
8. Click "OK" if you want to add the technology object. Click "Cancel" if you want to reject your entries.

Result

The new technology object has been created and stored in the project tree in the "Technology objects" folder.

Note

You can select the "Add and open new block" check box at the bottom of the dialog box. This opens the configuration of the technology object after adding has been completed.

Adding the technology object by inserting the "PID_Compact" instruction in the program editor.

An instance DB is created when the "PID_Compact" instruction is added in the program editor. The instance DB corresponds to the "PID Compact" technology object. The configuration of the technology object is stored in this instance DB. To add the "PID Compact" technology object in the program editor, follow these steps:

Requirement

A project with a CPU S7-1200 has been created.

Procedure

1. Open the cyclic interrupt OB in which you want to insert the "PID_Compact" instruction.
   In order to ensure a constant scan time of the controller, the "PID_Compact" instruction has to be called in a cyclic interrupt OB.
2. In the "Instructions" window open the "Extended instructions" group and the "PID" folder.
3. Select the "PID_Compact" instruction and drag it to your block.
   The "Call options" dialog box opens.
4. Enter an individual name for the technology object in the "Name" input field.
5. Select "Manual" if you want to change the suggested data block number of the instance DB.
6. Click "OK" if you want to add the instance DB or the technology object.

Result

The "PID_Compact" instruction is inserted and the new technology object is created. The object is stored in the project navigation in the "Technology objects" folder.

See also

Programming (Page 656)

7.7.2.3 Configuring

7.7.2.3 Configuring the technology object

The properties of the "PID Compact" technology object can be configured in the configuration window and in the inspector window.

- In the configuration window: For all the configuration properties
- In the inspector window: For the configuration properties required during operation

Configuration in the configuration window

To open the configuration window of the technology object, follow these steps:

1. Open the group of the desired technology object in the project tree.
2. Double-click the "Configuration" object.

Configuration in the inspector window

To open the inspector window of the "PID Compact" technology object, follow these steps:

1. Open the "Program blocks" folder in the project tree.
2. Double-click the block (cyclic interrupt OB) in which the "PID Compact" instruction is called.
   The block is opened in the work area.
3. Click the "PID_Compact" instruction.
4. In the inspector window, select the "Properties" and "Configuration" tabs consecutively.

Icons of the configuration window

Icons in the area navigation of the configuration and in the inspector window show additional details about the completeness of the configuration:

✓	The configuration contains default values and is complete. The configuration contains exclusively default values. With these default values the use of the technology object is possible without further changes.
✓	The configuration contains values defined by the user and is complete All the input fields of the configuration contain valid values, and at least one default value has been changed.
✗	The configuration is incomplete or faulty At least one input field or a drop-down list box contains no value or an invalid value. The corresponding field or the drop-down list box has a red background. When clicked the roll-out error message indicates the cause of the error.

See also

Basic parameters (Page 652)
Actual value scaling (Page 653)
Input monitoring (Page 654)
PWM limitations (Page 655)
Manipulated value limits (Page 655)
PID parameters (Page 656)

7.7.2.3 Basic parameters

Configure the basic properties of the "PID Compact" technology object in the "Default settings" in the inspector window or in the configuration window.

Type of control system

Select the desired unit for the type of control system by means of the "Type of control system" preselection.

Select the "Inversion of the control direction" check box if an increase in the manipulated value is to effect a decrease of the actual value (for example, sinking water level owing to an increase of the valve position or declining temperature owing to an increase in the cooling performance).

Input / output supply

In this section valid values are assigned to the input and output parameters for the setpoint, actual value and manipulated variable of the "PID_Compact" instruction. The input and output parameters can only be configured in the inspector window.

- Setpoint

  In the drop-down list box, select whether the value at the function block or the value of the instance DB is to be used.

- Actual value

  In the drop-down list box, select whether the input parameter "Input" or "Input_PER" is to be used.

  – Use "Input" if you want to use an actual value from the user program. In the drop-down list box, also select whether the value at the function block or the value of the instance DB is to be used.

  – Use "Input_PER" if you want to use the actual value of an analog input.

    In the field below this specify the parameter suitable for the actual value.

- Manipulated variable

  In the drop-down list box, select the to-be-configured, manipulated variable of the "PID_Compact" instruction. The following options are available:

  – Output

    Uses a variable of the user program as the manipulated variable output.

  – Output_PER

    Uses an analog output as the manipulated variable output.

  – Output_PWM

    Uses a digital switching output and controls it by means of a pulse width modulation. The manipulated variable is formed by means of variable turn-on and turn-off times.

  In the field below this specify the parameter suitable for the manipulated variable output.

See also

Configuring the technology object (Page 651)
Actual value scaling (Page 653)
Input monitoring (Page 654)
PWM limitations (Page 655)
Manipulated value limits (Page 655)
PID parameters (Page 656)

7.7.2.3 Actual value scaling

In the "Actual value scaling" configuration window, configure the scaling of your actual value and specify the absolute actual value limits.

Scaling

Specify the scaling of your actual value by means of a lower and an upper pair of values.

Each pair of values consists of the analog value of the analog input and the physical value of the respective scaling point. Depending on the configuration of the default setting, a process value of the user program can also be used instead of the analog value of the analog input.

Upper and lower limit

Specify the absolute upper and lower limit of the actual value. As soon as these limits are exceeded or undershot during operation, the regulatory control switches off and the manipulated variable is set to 0%.

"Default setting" button

Click the "Default setting" button if you want to load the default setting value for the scaling and the upper and lower limits and want to replace the existing values.

See also

Configuring the technology object (Page 651)
Basic parameters (Page 652)
Input monitoring (Page 654)
PWM limitations (Page 655)
Manipulated value limits (Page 655)
PID parameters (Page 656)

7.7.2.3 Advanced parameters

7.7.2.3 Input monitoring

In the "Input monitoring" configuration window, configure a lower and an upper warning limit for the actual value. If one of the warning limits is exceeded or undershot during operation, a warning is displayed at the "PID_Compact" instruction:

- At the "InputWarning_H" output parameter if the upper warning limit was exceeded
- At the "InputWarning_L" output parameter if the lower warning limit was undershot

See also

Configuring the technology object (Page 651)
Basic parameters (Page 652)
Actual value scaling (Page 653)
PWM limitations (Page 655)
Manipulated value limits (Page 655)
PID parameters (Page 656)

7.7.2.3 PWM limitations

In the "PWM limitations" configuration window configure the minimum permissible ON and OFF switching times of the pulse width modulation. Extend the minimum ON and OFF times if you want to reduce the number of switching cycles.

The configuration of the PWM limitations affects the manipulated variable output "Output_PWM". The manipulated variable is switched via a pulse width modulation to the "Output_PWM" switching output. The ON and OFF switching times of the pulse width modulation are a multiple of the call cycle of the "PID_Compact" instruction.

Note

The switching output for the pulse width modulation is controlled by the "PID_Compact" instruction. The pulse generators integrated in the CPU are not used.

See also

Configuring the technology object (Page 651)
Basic parameters (Page 652)
Actual value scaling (Page 653)
Input monitoring (Page 654)
Manipulated value limits (Page 655)
PID parameters (Page 656)

7.7.2.3 Manipulated value limits

In the "Manipulated value limits" configuration window configure the absolute limits of your manipulated variable. Absolute manipulated variable limits are not exceeded or undershot either in manual mode or in automatic mode. If a manipulated variable outside the limits is specified in manual mode, the effective value is limited in the CPU to the configured limits.

Note

If the "Output_PWM" manipulated variable output is used, only positive manipulated variables can be controlled.

See also

Configuring the technology object (Page 651)
Basic parameters (Page 652)
Actual value scaling (Page 653)
Input monitoring (Page 654)
PWM limitations (Page 655)
PID parameters (Page 656)

7.7.2.3 PID parameters

In the "PID parameters" configuration window, configure the parameters of the PID controller. Use the configuration if you want to manually specify the PID parameters of the technology object. To do so, select the "Use manual PID parameters" check box and enter the desired PID parameters.

Depending on the initial situation, the following values are displayed at the call:

- After the technology object has been added

  After the technology object has been added, the default values of the technology object are displayed.
- After the "Load PID parameters into project" icon has been clicked

  After the icon has been clicked in the commissioning window, the PID parameters currently acting in the CPU are loaded into the project and displayed in the configuration.

See also

Configuring the technology object (Page 651)
Basic parameters (Page 652)
Actual value scaling (Page 653)
Input monitoring (Page 654)
PWM limitations (Page 655)
Manipulated value limits (Page 655)

7.7.2.4 Programming

7.7.2.4 Calling the "PID_Compact" instruction in the user program

Requirement

The sampling time of the "PID Compact" controller is determined by the interval between the calls. To comply strictly with the sampling time, the "PID_Compact" instruction has to be called in a cyclic interrupt organization block. Add the desired cyclic interrupt OB to the project. Configure the value of the desired sampling time as a "time frame" of the cyclic interrupt OB.

Procedure

Proceed as follows to call the "PID_Compact" instruction in the user program:

1. Open the "Program blocks" folder in the project tree.
2. Double-click the required watchdog interrupt OB.
   The block is opened in the work area.
3. In the "Instructions" window open the "Extended instructions" group and the "PID" folder.
4. Select the "PID_Compact" instruction and drag it to your cyclic interrupt OB.
   The "Call options" dialog box opens.
5. Depending on the initial situation, carry out the following actions:

- Technology object "PID Compact" was already added:
  Click "Cancel" to close the "Call options" dialog.
  On the work area, double-click in the input field for the instance DB.
  Select the technology object from the list.
- Technology object "PID Compact" was not yet added:
  The "Call options" dialog opens.
  In the "Name" input field, type in an individual name for the technology object.
  Select "manual" if you want to change the proposed data block number of the instance DB (the technology object and instance DB are identical at technology object "PID Compact").
  To add the instance DB or the technology object, confirm your entries with "OK".

Result

The "PID_Compact" instruction is inserted and the new technology object is created. The object is created in the project tree in the "Technology objects" folder.

See also

PID_Compact: PID controller with self tuning (Page 997)
Download to CPU (Page 657)
Read/write access to the variable of the technology objects (Page 658)

7.7.2.4 Download to CPU

A new or modified configuration of the technology object must be downloaded to the CPU for the online mode. The following menu and shortcut menu commands are available for the download:

- Menu command Online > Download to device

  Downloads the configuration of the technology object, the compiled hardware data and the remaining software project data to the device.
- Menu command Online > Advanced download to device

  Sets up an online connection to the selected device and downloads the compiled hardware and software project data, including the configuration of a technology object to the device.

The CPU object was selected in the project navigator

- Download to Device > All shortcut menu command

  Downloads the configuration of the technology object, the compiled hardware data and the remaining software project data to the device.
- Download to Device > Software shortcut menu command

  Downloads the modified configuration of the technology object and the modified blocks to a device. Only the modified objects are transferred to the device
- Download to Device > Software (all blocks) shortcut menu command

  Downloads all blocks and the technology objects, including the objects which were not changed to the device

The "Program blocks" object was selected in the project navigator

- Download to Device > Software shortcut menu command

  Downloads the modified configuration of the technology object and the modified blocks to a device. Only the modified objects are transferred to the device
- Download to Device > Software (all blocks) shortcut menu command

  Downloads all blocks and the technology objects, including the objects which were not changed to the device

See also

Calling the "PID_Compact" instruction in the user program (Page 656)

7.7.2.4 Read/write access to the variable of the technology objects

You can access the essential configuration data, the operating mode of the PID controller, as well as additional status displays of the technology object using the variables of the instance DB (corresponds to the "PID Compact" technology object).

The following table lists the available variables and describes their effect and meaning:

Variable	Data type	Description	
sRet.i_Mode	INT	The operating mode is changed edge-controlled.	
		0	Select "Inactive" mode (stops the controller)
		1	Select "Self tuning during initial start" mode
		2	Select "Self tuning in the operating point" mode
		3	Select "Automatic mode" mode
		4	Select "Manual" mode
sPid_Cmpt.r_Sp_Hlm	REAL	Absolute setpoint upper limit (default setting is the configured absolute actual value upper limit)	
sPid_Cmpt.r_Sp_Llm	REAL	Absolute setpoint lower limit (default setting is the configured absolute actual value lower limit)	
sPid_Cmpt.r_Pv_Norm_IN_1	REAL	Lower analog value of the "Input_PER" analog input	
sPid_Cmpt.r_Pv_Norm_IN_2	REAL	Upper analog value of the "Input_PER" analog input	
sPid_Cmpt.r_Pv_Norm_OUT_1	REAL	Physical value of the lower scaling point	
sPid_Cmpt.r_Pv_Norm_OUT_2	REAL	Physical value of the upper scaling point	
sPid_Cmpt.r_Lmn_Hlm	REAL	Upper manipulated variable limit for the "Output" output parameter	
sPid_Cmpt.r_Lmn_Llm	REAL	Lower manipulated variable limit for the "Output" output parameter	
sPid_Cmpt.r_Lmn_Pwm_PPTm	REAL	Minimum ON time of the pulse width modulation in seconds	
sPid_Cmpt.r_Lmn_Pwm_PBTm	REAL	Minimum OFF time of the pulse width modulation in seconds	

Variable	Data type	Description	
sPid_Cmpt.b_InvCtrl	BOOL	FALSE	Do not invert control direction
		TRUE	Invert control direction
sPid_Cmpt.b_Input_PER_On	BOOL	FALSE	"Input_PER" input parameter not activated
		TRUE	"Input_PER" input parameter activated
sPid_Cmpt.b_LoadBackUp	BOOL	Activate the back-up parameter set. If an optimization has failed, you can reactivate the previous PID parameters by setting this bit.	
sPid_Calc.d_CycCountEnd	DINT	Estimated maximum number of processing cycles that the "PID_Compact" instruction executes until the current self tuning has been completed.	
sPid_Calc.d_CycCounter	DINT	Current number of processing cycles that the "PID_Compact" instruction has executed since starting the self tuning.	

Note

Edit the variables listed in this table in the "Inactive" mode to avoid malfunction of the PID controller. The "Inactive" mode is forced by setting the value "0" at the "si_Mode" variable.

7.7.2.5 Commissioning

7.7.2.5 Commissioning

The commissioning window helps you commission the PID controller. You can monitor the values for the setpoint, actual value and manipulated variable along the time axis in the trend view. The following functions are supported in the commissioning window:

- Optimizing the controller using "Self tuning during initial start"
- Optimizing the controller using "Self tuning in the operating point"

  Use "Self tuning in the operating point" if you want to carry out fine adjustment of the controller optimization.
- Monitoring the current closed-loop control in the trend view
- Testing the process by specifying a manual manipulated variable

The commissioning window can only be used if an online connection to the CPU has been established.

Basic handling

- Select the desired updating cycle in the "Updating cycle" drop-down list box.

  All the values displayed in the commissioning window are updated in the selected updating cycle.
- Click the "Measuring on" icon if you want to use the commissioning functions.

  Recording of the values is started. The current values for the setpoint, actual value and manipulated variable are entered in the trend view. Operation of the commissioning window is enabled.
- Click the "Measuring off" icon if you want to end the commissioning functions.

  The values recorded in the trend view can continue to be analyzed.

When the commissioning window is closed, the recording in the trend view is terminated and the recorded values are deleted.

See also

"Self tuning during initial start" mode (Page 660)
"Self tuning in the operating point" mode (Page 661)
Using the trend view (Page 662)
"Manual" mode (Page 665)
Saving the optimized PID parameters (Page 666)

7.7.2.5 "Self tuning during initial start" mode

The following section describes how to carry out "Self tuning during initial start" in the commissioning window of the "PID Compact" technology object.

Requirement

- The "PID_Compact" instruction is called in a cyclic interrupt OB.
- An online connection to the CPU is established and the CPU is in "RUN" mode.
- The functions of the commissioning window have been enabled via the "Measuring on" icon.
- The "Manual manipulated variable" check box is not selected.
- The setpoint and the actual value lie within the configured limits (see "Input monitoring" configuration).
- The distance between the setpoint and the actual value > 50% (referenced to the configured limits of the "Input monitoring").

Procedure

To carry out "Self tuning during initial start", follow these steps:

1. Select the "Self tuning during initial start" option in the "Optimization" section of the commissioning window.
2. Click the "Start self tuning" icon.

   Self tuning starts. The "Status" field displays the current steps and any errors that may have occurred. The progress bar indicates the progress of the current step.

Note

Click the "Stop controller" icon when the progress bar has reached 100% and blocking of the self tuning function has to be assumed. Check the configuration of the technology object and, if necessary, restart self tuning.

Result

If self tuning was executed without errors, the PID parameters have been optimized. The PID controller changes to automatic mode and uses the optimized parameters. The optimized PID parameters are retained during power ON and a restart of the CPU.

See also

Commissioning (Page 659)
"Self tuning in the operating point" mode (Page 661)
Using the trend view (Page 662)
"Manual" mode (Page 665)
Saving the optimized PID parameters (Page 666)

7.7.2.5 "Self tuning in the operating point" mode

The following section describes how to carry out "Self tuning in the operating point" in the commissioning window of the "PID Compact" technology object.

Requirement

- The "PID_Compact" instruction is called in a cyclic interrupt OB.
- An online connection to the CPU is established and the CPU is in "RUN" mode.
- The functions of the commissioning window have been enabled via the "Measuring on" icon.
- The "Manual manipulated variable" check box is not selected.
- The setpoint and the actual value lie within the configured limits (see "Input monitoring" configuration).
- The distance between the setpoint and the actual value < 50% (referenced to the limits of the "Input monitoring").

  If the distance is greater than 50%, "Self tuning during initial start" is carried out. "Self tuning in the operating point" is carried out automatically after that.

Procedure

To carry out the "Self tuning in the operating point", follow these steps:

1. Select the "Self tuning in the operating point" option in the "Optimization" section of the commissioning window.
2. Click the "Start self tuning" icon.

   Self tuning starts. The "Status" field displays the current steps and any errors that may have occurred. The progress bar indicates the progress of the current step.

Note

Click the "Stop controller" icon when the progress bar has reached 100% and blocking of the self tuning function has to be assumed. Check the configuration of the technology object and, if necessary, restart self tuning.

Result

If self tuning was executed without errors, the PID parameters have been optimized. The PID controller changes to automatic mode and uses the optimized parameters. The optimized PID parameters are retained during power ON and a restart of the CPU.

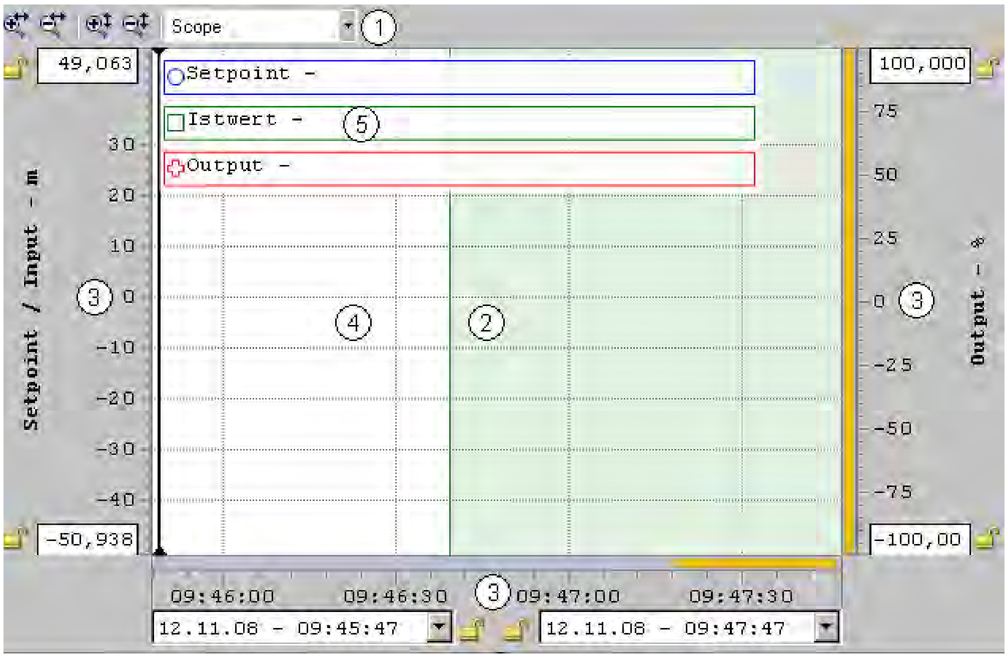
See also

Commissioning (Page 659)
"Self tuning during initial start" mode (Page 660)
Using the trend view (Page 662)
"Manual" mode (Page 665)
Saving the optimized PID parameters (Page 666)

7.7.2.5 Using the trend view

The trend view is used for graphic illustration of the setpoint, actual value and manipulated variable. The values of the trend view are updated in the selected updating cycle. Start the recording of the trend values by clicking "Measurement on" and stop it by clicking "Measurement off".

Elements of the trend view



①	Selection of the display mode
②	Trend view
③	Area for moving and scaling the axes
④	Ruler
⑤	Legend with the trend values at the ruler

Selection of the display mode

The following display modes can be selected for displaying the trend recording:

- Strip (continuous display)

  New trend values are entered at the right-hand trend view. Previous trend values are scrolled to the left. The time axis cannot be moved.

- Scope (jumping area display)

  New trend values are entered within the trend view from left to right. When the right-hand margin of the trend view is reached, the monitoring area is moved one view width to the right. The time axis can be moved within the limits of the monitoring area.

- Sweep (rotating display)

  New trend values are displayed in the trend view in accordance with a rotating display. The trend values are entered from left to right. The trend values of the last rotating display are overwritten at the writing position. The time axis cannot be moved.

- Static (static area display)

  Writing of the trends is interrupted. Recording of the new trend values is carried out in the background. The time axis can be moved across the entire previous recording period.

The ratio of the visible area to the recorded area is shown in the ratio display:

The width of the ratio display represents the complete duration of the recording. The yellow section of the display represents that part of the recording that is visible in the trend view. The grayed section of the display represents that part of the recording that is **not** visible in the trend view.

In the "Static" display mode, you can move the visible range of the ratio display along the axis by dragging it with the mouse.

Trend view

The trends for the setpoint, actual value and manipulated variable are displayed in the trend view. In addition to different colors, the trends are identified by symbols (refer to legend).

Moving and scaling the axes

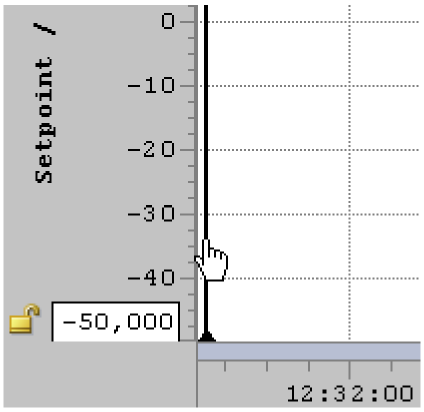
The axes for the setpoint and actual value, for the manipulated variable and the time axis can be moved and scaled individually. The right and left mouse buttons are assigned alternating functions. You can use the following icons and mouse actions:

↕	Moving the setpoint / actual value axes, or the manipulated variable axis up or down. The axis cannot be moved if the upper or the lower scaling value is blocked.
↔	Moving the time axis to the right or left. The axis cannot be moved if the left or right scaling value is blocked.
⊕↕ ⊖↕	Stretch and compress the setpoint , actual value axes, or the manipulated variable axis. ● The scaling of the axes is stretched or compressed symmetrically if none of the scaling values is blocked. ● Blocked scaling values are retained when you stretch or compress an axis.
⊕↔ ⊖↔	Stretching and compressing the time axis ● The scaling of the axis is stretched or compressed symmetrically if none of the scaling values is blocked. ● Blocked scaling values are retained when you stretch or compress an axis.
▲	Stretching and compressing the setpoint / actual value axes, or the manipulated variable axis. The lower scaling value is not changed as a result of stretching or compressing.
▼	Stretch and compress the setpoint / actual value or the manipulated variable axis. The upper scaling value is not changed during stretching or compressing.
◀	Stretching and compressing the time axis. The right scaling value is not changed as a result of stretching or compressing.
▶	Stretching and compressing the time axis. The left scaling value is not changed as a result of stretching or compressing.
🔓 50,000	Enter a scaling value.
🔒 50,000	The current scaling value can be blocked using the padlock icon. Only one value of a respective axis can be blocked.
	Double-clicking in the trend view optimizes the scaling and position of the setpoint, actual value and manipulated variable in the trend view.
	Double-clicking in the axis area restores the default position and scaling of the axis.

Working with rulers

Use one or several rulers to analyze discrete values of the trend profile.

The ruler parking position is located at the left edge of the trend area. A second parking position is located at the top edge of the trend area. However, the values of those rulers cannot be displayed.



Move the mouse to the left edge of the trend area and watch out for the transition of the mouse pointer. Drag a vertical ruler onto the measuring trend that you want to analyze.

The trend values are output left-aligned on the ruler. The time of the ruler position is displayed at the base of the ruler.

The trend values of the active ruler are displayed in the legend. If several rulers are dragged to the trend area, the respectively last ruler is active. The active ruler is indicated by the correspondingly colored
▼
symbol.

You can reactivate an inactive ruler by clicking it.

Use the shortcut ALT+Click to remove rulers which are no longer required.

See also

Commissioning (Page 659)
"Self tuning during initial start" mode (Page 660)
"Self tuning in the operating point" mode (Page 661)
"Manual" mode (Page 665)
Saving the optimized PID parameters (Page 666)

7.7.2.5 "Manual" mode

The following section describes how you can use the "Manual" operating mode in the commissioning window of the "PID Compact" technology object.

Requirement

- The "PID_Compact" instruction is called in a cyclic interrupt OB.
- An online connection to the CPU has been established and the CPU is in the "RUN" mode.
- The functions of the commissioning window have been enabled via the "Measuring on" icon.

Procedure

Use "Manual mode" in the commissioning window if you want to test the process by specifying a manual manipulated variable. To specify a manual manipulated variable, follow these steps:

1. In the "Current values" area, select the "Manual manipulated variable" check box.

   The connection between controller output and manipulated variable output is disconnected. The PID controller continues to run in automatic mode.

   The last current manipulated variable of the closed-loop control remains active as the manual manipulated variable at the manipulated variable outputs.
2. Enter the desired manipulated variable in the "Output" field as a % value.
3. Click the control icon

   .

Result

The manipulated variable is written to the CPU and is active immediately.

Note

Since the PID controller continues to monitor the actual value, any resultant violation of actual value limits is displayed in the "Status" field and the PID controller is deactivated.

Clear the "Manual manipulated variable" check box if the manipulated variable is to be specified again by the PID controller.

See also

Commissioning (Page 659)
"Self tuning during initial start" mode (Page 660)
"Self tuning in the operating point" mode (Page 661)
Using the trend view (Page 662)
Saving the optimized PID parameters (Page 666)

7.7.2.5 Saving the optimized PID parameters

The PID controller is optimized in the CPU. If you want to use the PID parameters that were optimized in the CPU again when the project data are reloaded to the CPU, save the PID parameters in the project. Follow these steps:

Requirement

- An online connection to the CPU is established and the CPU is in "RUN" mode.
- The functions of the commissioning window have been enabled by means of the "Measuring on" button.

Procedure

1. Click the "Load PID parameters into project" icon in the commissioning window.

Result

The currently active PID parameters are stored in the project data.

See also

Commissioning (Page 659)
"Self tuning during initial start" mode (Page 660)
"Self tuning in the operating point" mode (Page 661)
Using the trend view (Page 662)
"Manual" mode (Page 665)

7.8 References

7.8.1 Instructions

7.8.1.1 LAD

7.8.1.1 Bit logic

7.8.1.1 ---| |---: Normally open contact

Symbol

<Operand>

---| |---

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, L, D (Page 318)	Operand whose signal state is queried.

Description

The activation of the normally open contact depends on the signal state of the associated operand. If the operand has signal state "1," the normally open contact is closed. Power flows from the left power rail through the normally open contact into the right power rail and the signal state at the output of the operation is set to "1".

If the operand has signal state "0," the normally open contact is not activated. The power flow to the right power rail is interrupted and the signal state at the output of the operation is reset to "0".

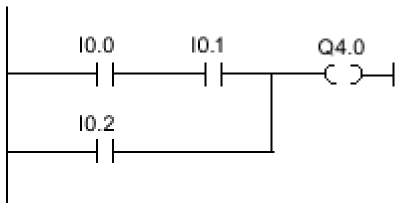
Two or more normally open contacts are linked bit-by-bit by AND when connected in series. With a serial connection, power flows when all contacts are closed.

The normally open contacts are linked by OR when connected in parallel. With a parallel connection, power flows when one contact is closed.

Placement

The "Normally open contact" operation can be placed at any position in the network.

Example



Output Q 4.0 is set when one of the following conditions is fulfilled:

- Inputs I 0.0 AND I 0.1 have signal state "1".
- The signal state at input I 0.2 is "1".

See also

Inserting operands into LAD instructions (Page 0)
Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Example of controlling a conveyor belt (Page 603)
Example of detecting the fill level of a storage area (Page 606)
Example of controlling room temperature (Page 610)

7.8.1.1 ---| / |---: Normally closed contact

Symbol

<Operand>

—| / |—

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, L, D (Page 318)	Operand whose signal state is queried.

Description

The activation of the normally closed contact depends on the signal state of the associated operand. When the operand has signal state "1," the contact "opens" and the power flow to the right power rail is interrupted. The output of the operation in this case has signal state "0".

If the operand has signal state "0," the normally closed contact is "closed". Power flows through the normally closed contact into the right power rail and the output of the operation is set to signal state "1".

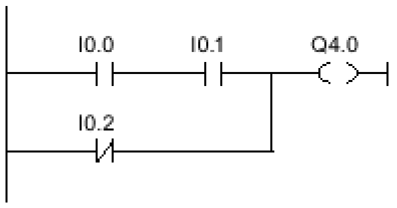
Two or more normally closed contacts are linked bit-by-bit by AND when connected in series. With a serial connection, power flows when all contacts are closed.

The normally closed contacts are linked by OR when connected in parallel. With a parallel connection, power flows when one contact is closed.

Placement

The operation can be placed at any position in the network.

Example



Output Q 4.0 is set when one of the following conditions is fulfilled:

- Inputs I 0.0 and I 0.1 have signal state "1".
- The signal state at input I 0.2 is "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Example of detecting the direction of a conveyor belt (Page 605)
Example of detecting the fill level of a storage area (Page 606)
Example of controlling room temperature (Page 610)

7.8.1.1 --|NOT|--: Invert result of logic operation

Symbol

---| NOT |---

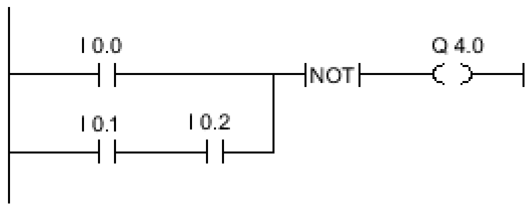
Description

You can use the "Invert result of logic operation" operation to invert the signal state of the result of logic operation (RLO). When the signal state is "1" at the input of the operation, the output of the operation provides the signal state "0". When the signal state is "0" at the input of the operation, the output of the operation provides the signal state "1".

Placement

The "Invert result of logic operation" operation can be placed at any position in the network.

Example



Output Q 4.0 is reset when one of the following conditions is fulfilled:

- Input I 0.0 has signal state "1".
- The signal state at inputs I 0.1 AND I 0.2 is "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Example of controlling room temperature (Page 610)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 ---

Symbol

<Operand>

--- ( ) ---

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, L, D (Page 318)	Operand which is set with RLO = "1".

Description

You can use the "Output coil" operation to set the bit of a specified operand. When the result of logic operation (RLO) at the input of the coil is "1," the specified operand is set to signal state "1". When the signal state is "0" at the input of the coil, the bit of the specified operand is reset to "0".

The operation does not influence the RLO. The RLO at the input of the coil is sent immediately to the output.

Placement

The "Output coil" operation can be placed at any position in the network. Using branches, several coils can be placed within each other.

Example

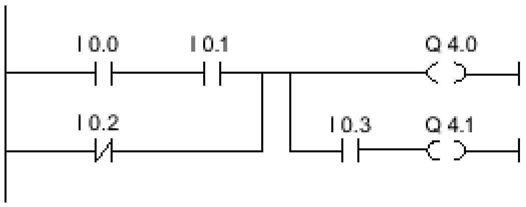


Figure7-2

Output Q 4.0 is set when one of the following conditions is fulfilled:

- Inputs I 0.0 AND I 0.1 have signal state "1".
- The signal state at input I 0.2 is "0".

Output Q 4.1 is set when one of the following conditions is fulfilled:

- Inputs I 0.0 AND I 0.1 as well as the input I 0.3 have signal state "1".
- The signal state at the input I 0.2 "0" AND at the input I 0.3 is "1".

See also

Inserting LAD elements (Page 452)
Inserting operands into LAD instructions (Page 0)
Example of detecting the fill level of a storage area (Page 606)
Example of controlling room temperature (Page 610)
Changing LAD elements (Page 460)

7.8.1.1 --

Symbol

<Operand>

--- (/) ---

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	Operand which is set with RLO = "0".

Description

The "Negated coil" operation inverts the result of logic operation (RLO) and assigns it to the specified operand. When the RLO at the input of the coil is "1", the operand is reset. When the RLO at the input of the coil is "0", the operand is set to signal state "1".

The operation does not influence the RLO. The RLO at the input of the coil is sent immediately to the output of the coil.

Placement

The "Negated coil" operation can be placed at any position in the network.

Example

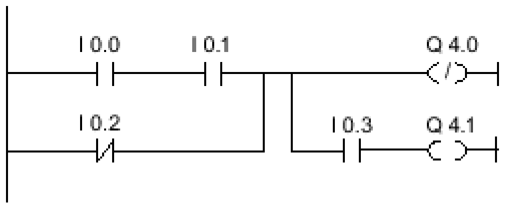


Figure7-2

Output Q 4.0 is reset when one of the following conditions is fulfilled:

- Inputs I 0.0 AND I 0.1 have signal state "1".
- The signal state at input I 0.2 is "1".

See also

Inserting LAD elements (Page 452)
Inserting operands into LAD instructions (Page 0)
Changing LAD elements (Page 460)

7.8.1.1 ---

Symbol

<Operand>

--- (R) ---

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, L, D (Page 318)	Operand which is reset with RLO = "1".

Description

You can use the "Reset output" operation to set the signal state of a specified operand to "0".

The operation is only executed if the result of logic operation (RLO) at the input of the coil is "1". If power flows to the coil (RLO is "1"), the specified operand is set to "0". If the result of logic operation at the input of the coil is "0" (no signal flow to the coil), the signal state of the specified operand remains unchanged.

The operation does not influence the RLO. The RLO at the input of the coil is sent immediately to the output of the coil.

Placement

The "Reset output" operation can be placed at any position in the network.

Example

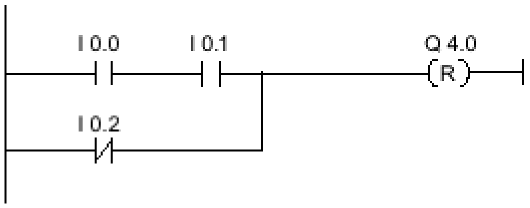


Figure7-2

Output Q 4.0 is reset when one of the following conditions is fulfilled:

- The inputs I 0.0 AND I 0.1 "1"
- The signal state at input I 0.2 is "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Example of controlling a conveyor belt (Page 603)
Example of detecting the direction of a conveyor belt (Page 605)

7.8.1.1 ---

Symbol

<Operand>

--- (S) ---

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, L, D (Page 318)	Operand which is set with RLO = "1".

Description

You can use the "Set output" operation to set the signal state of a specified operand to "1".

The operation is only executed if the result of logic operation at the input of the coil is "1". If power flows to the coil (RLO is "1"), the specified operand is set to "1". If the result of logic operation at the input of the coil is "0" (no signal flow to the coil), the signal state of the specified operand remains unchanged.

The operation does not influence the RLO. The RLO at the input of the coil is sent immediately to the output.

Placement

The "Set output" operation can be placed at any position in the network.

Example

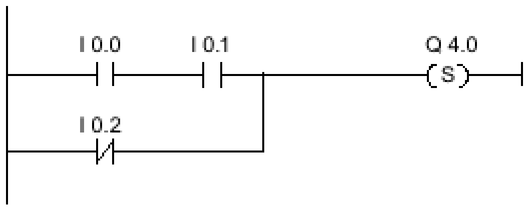


Figure7-2

Output Q 4.0 is set when one of the following conditions is fulfilled:

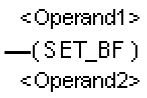
- Inputs I 0.0 AND I 0.1 have signal state "1".
- The signal state at input I 0.2 is "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Example of controlling a conveyor belt (Page 603)
Example of detecting the direction of a conveyor belt (Page 605)

7.8.1.1 SET_BF: Set bit field

Symbol



Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, D, L (Page 318)	Pointer to the first bit to be set
<Operand2>	UINT	Constant	Number of bits to be set

Description

You can use the "Set bit field" operation to set several bits beginning with a certain address. The number of bits to be set determine the value of <Operand2>. The address of the first bit to be set is defined by <Operand1>. If the value of <Operand2> is greater than the number of bits in a selected byte, the bits of the next byte are set. The bits remain set until they are explicitly reset, for example, by another operation.

The operation is only executed if the signal state is "1" at the enable input. If the signal state is "0" at the input, the operation is not executed.

Placement

The "Set bit field" operation can be assigned only to the right end of the network.

Example

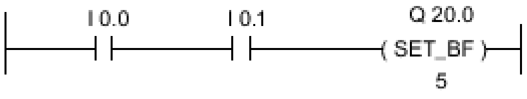


Figure7-2

If inputs I 0.0 AND I 0.1 have signal state "1", outputs Q 20.0, Q 20.1, Q 20.2, Q 20.3 and Q 20.4 are set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 RESET_BF: Reset bit array

Symbol

```
  <Operand1>
—( RESET_BF )
  <Operand2>
```

Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, D, L (Page 318)	Pointer to the first bit to be reset
<Operand2>	UINT	Constant	Number of bits to be reset

Description

You can use the "Reset bit field" operation to reset several bits beginning with a certain address. The number of bits to be reset determine the value of <Operand2>. The address of the first bit to be reset is defined by <Operand1>. If the value of <Operand2> is greater than the number of bits in a selected byte, the bits of the next byte are reset. The bits remain reset until they are explicitly set, for example, by another operation.

The operation is only executed if the signal state is "1" at the enable input. If the signal state is "0" at the input, the operation is not affected.

Placement

The "Reset bit field" operation can be assigned only to the right end of the network.

Example

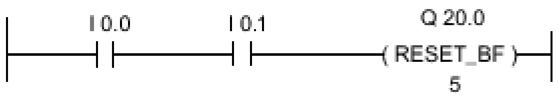


Figure7-2

If inputs I 0.0 AND I 0.1 have signal state "1", outputs Q 20.0, Q 20.1, Q 20.2, Q 20.3 and Q 20.4 are reset.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 SR: Set reset flip-flop

Symbol

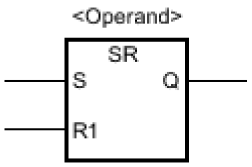


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, L, D (Page 318)	Operand that is specified.
S	BOOL	I, Q, M, L, D	Set enable
R1	BOOL	I, Q, M, L, D	Reset enable
Q	BOOL	I, Q, M, L, D	Signal state of the specified operand

Description

You can use the "Set reset set flip-flop" operation to set or reset the bit of the specified operand based on the signal state of the inputs S and R1. If the signal state at input S is "1" and is "0" at input R1, the specified operand is set to "1". If the signal state at input S is "0" and is "1" at input R1, the specified operand is reset to "0".

Input R1 takes priority over input S. If the signal state is "1" at the two inputs S and R1, the signal state of the specified operand is reset to "0".

The operation is not executed if the signal state at the two inputs R1 and S is "0". The signal state of the operand then remains unchanged.

The current signal state of the operand is transferred to output Q and can be queried there.

Placement

The "Set reset flip-flop" operation can be assigned to the right side of the network.

Example

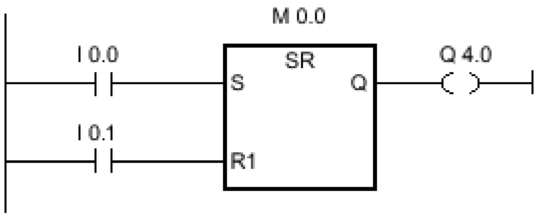


Figure7-2

Bit memory M 0.0 and output Q 4.0 are set when the following conditions are fulfilled:

- Input I 0.0 has signal state "1".
- Input I 0.1 has signal state "0".

The bit memory M 0.0 and output Q 4.0 are reset when one of the following conditions is fulfilled:

- Input I 0.0 has signal state "0" and input I 0.1 has signal state "1".
- Both inputs I 0.0 and I 0.1 have signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 RS: Reset set flip-flop

Symbol

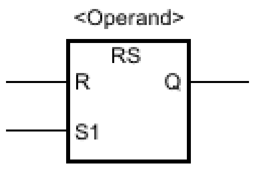


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, L, D (Page 318)	Operand that is specified.
R	BOOL	I, Q, M, L, D	Reset enable
S1	BOOL	I, Q, M, L, D	Set enable
Q	BOOL	I, Q, M, L, D	Signal state of the specified operand

Description

You can use the "Reset set flip-flop" operation to set or reset the bit of the specified operand based on the signal state of the inputs R and S1. If the signal state at input R is "1" and is "0" at input S1, the specified operand is reset to "0". If the signal state at input R is "0" and is "1" at input S1, the specified operand is set to "1".

Input S1 takes priority over input R. If the signal state is "1" at the two inputs R and S1, the signal state of the specified operand is set to "1".

The operation is not executed if the signal state at the two inputs R and S1 is "0". The signal state of the operand then remains unchanged.

The current signal state of the operand is transferred to output Q and can be queried there.

Placement

The "Reset set flip-flop" operation can be assigned to the right side of the network.

Example

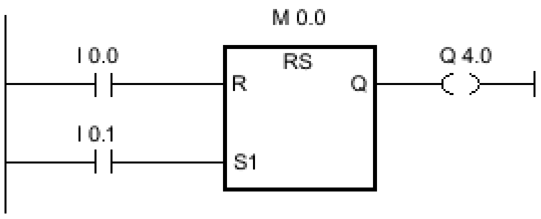


Figure7-2

Bit memory M 0.0 and output Q 4.0 are set when the following conditions are fulfilled:

- Input I 0.0 has signal state "0" and input I 0.1 has signal state "1".
- Both inputs I 0.0 and I 0.1 have signal state "1".

Bit memory M 0.0 and output Q 4.0 are reset when the following conditions are fulfilled:

- Input I 0.0 has signal state "1".
- Input I 0.1 has signal state "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 --|P|--: Scan positive signal edge at operand

Symbol

<Operand1>

--|P|--

<Operand2>

Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, L, D (Page 318)	Signal to be queried
<Operand2>	BOOL	I, Q, M, L, D	Edge memory bit in which the signal state of the previous query is saved.

Description

You can use the "Scan positive signal edge at operand" operation to determine if there is a "0" to "1" change in the signal state of a specified operand (<operand1>). The operation compares the current signal state of <operand1> to the signal state of the previous query saved in <operand2>. If the operation detects a change in the result of logic operation from "0" to "1", there is a positive, rising edge.

If a rising edge is detected, the output of the operation has signal state "1". In all other cases, the signal state at the output of the operation is "0".

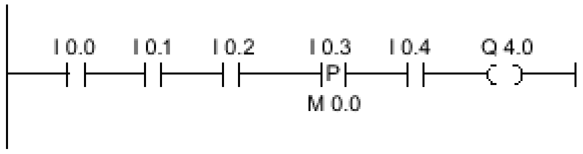
Note

The address of the edge memory bit must not be used more than once in the program, otherwise the memory bit would be overwritten. This would influence edge evaluation and the result would no longer be unequivocal.

Placement

The "Scan positive signal edge at operand" operation can be placed at any position in the network.

Example



Output Q 4.0 is set when the following conditions are fulfilled:

- Inputs I 0.0 AND I 0.1 AND I 0.2 have signal state "1".
- There is a rising edge at input I 0.3.
- The signal state at input I 0.4 is "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Example of detecting the direction of a conveyor belt (Page 605)

7.8.1.1 --|N|--: Scan negative signal edge at operand

Symbol

<Operand1>

--|N|--

<Operand2>

Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, L, D (Page 318)	Signal to be queried
<Operand2>	BOOL	I, Q, M, L, D	Edge memory bit in which the signal state of the previous query is saved.

Description

You can use the "Scan negative signal edge at operand" operation to query a change in the signal state from "1" to "0" of a specified operand (<operand1>). The operation compares the current signal state of <operand1> to the signal state of the previous query saved in <operand2>. If the operation detects a change in the result of logic operation from "1" to "0", there is a negative, falling edge.

If a falling edge is detected, the output of the operation has signal state "1".

If there is no falling edge, the signal state to the right power rail is reset to "0".

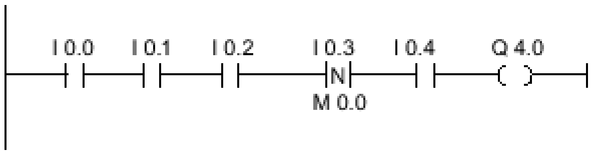
Note

The address of the edge memory bit must not be used more than once in the program, otherwise the memory bit would be overwritten. This would influence edge evaluation and the result would no longer be unequivocal.

Placement

The "Scan negative signal edge at operand" operation can be placed at any position in the network.

Example



Output Q 4.0 is set when the following conditions are fulfilled:

- Inputs I 0.0 AND I 0.1 AND I 0.2 have signal state "1".
- There is a falling edge at input I 0.3.
- The signal state at input I 0.4 is "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 --

Symbol

```
<Operand1>
 —( P )—
<Operand2>
```

Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, D, L (Page 318)	Operand which is set by a positive edge.
<Operand2>	BOOL	I, Q, M, D	Edge memory bit

Description

You can use the "Set operand on positive signal edge" operation to set a specified operand when there is a "0" to "1" change in the power flow. The operation compares the current result of logic operation (RLO) to the result of operation from the previous query, which is saved in the edge bit memory. When the operation detects a change in the power flow from "0" to "1", there is a positive, rising edge.

When there is a positive edge, <operand1> is set to signal state "1" for one program cycle. In all other cases, the operand has signal state "0".

Note

The address of the edge memory bit must not be used more than once in the program, otherwise the memory bit would be overwritten. This would influence edge evaluation and the result would no longer be unequivocal.

The operation does not influence the RLO. The RLO at the input of the coil is sent immediately to the output of the coil.

Placement

The "Set operand on positive signal edge" operation can be assigned either within the network or to the right side of the network. Using branches, several coils can be placed within each other.

Example

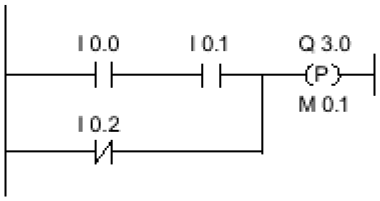


Figure7-2

Output Q 3.0 is set for one program cycle, when the signal state at the input of the coil switches from "0" to "1" (positive edge). In all other cases, output Q 3.0 has signal state "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 --

Symbol

```
<Operand1>
 — ( N )—
<Operand2>
```

Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, D, L (Page 318)	Operand which is set by a negative edge.
<Operand2>	BOOL	I, Q, M, D	Edge memory bit

Description

You can use the "Set operand on negative signal edge" operation to set a specified operand when there is a "1" to "0" change in the power flow. The operation compares the current result of logic operation (RLO) to the result of operation from the previous query, which is saved in the edge bit memory. When the operation detects a change in the power flow from "1" to "0", there is a negative, falling edge.

When a negative edge is detected, <operand1> is set to signal state "1" for one program cycle. In all other cases, the operand has signal state "0".

Note

The address of the edge memory bit must not be used more than once in the program, otherwise the memory bit would be overwritten. This would influence edge evaluation and the result would no longer be unequivocal.

The operation does not influence the RLO. The RLO at the input of the coil is sent immediately to the output of the coil.

Placement

The "Set operand on negative signal edge" operation can be assigned either within the network or to the right side of the network. Using branches, several coils can be placed within each other.

Example

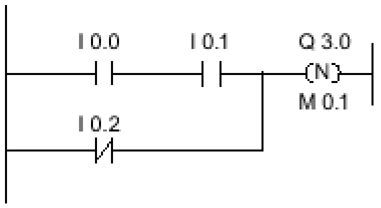


Figure7-2

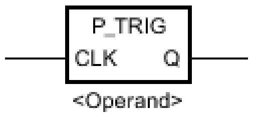
Output Q 3.0 is set for one program cycle, when the signal state at the input of the coil switches from "1" to "0" (positive edge). In all other cases, output Q 3.0 has signal state "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 P_TRIG: Set output on positive signal edge

Symbol



Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, L, D (Page 318)	Edge memory bit in which the RLO of the last query is saved.

Parameter	Data type	Memory area	Description
CLK	BOOL		Current RLO
Q	BOOL		Result of edge evaluation

Description

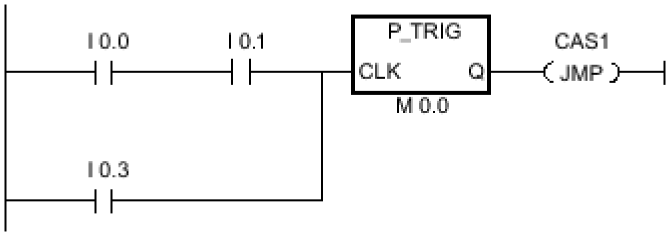
You can use the "Set output on positive signal edge" operation to query a change in the signal state of the result of logic operation from "0" to "1". The operation compares the current signal state of the result of logic operation (RLO) to the signal state from the previous query, which is saved in the edge bit memory. If the operation detects a change in the RLO from "0" to "1", there is a positive, rising edge.

If a rising edge is detected, the output of the operation has signal state "1". In all other cases, the signal state at the output of the operation is "0".

Placement

The "Set output on positive signal edge" operation can be assigned within the network.

Example



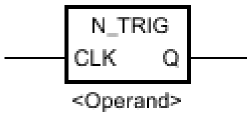
The RLO from the complete bit logic operation is saved in edge bit memory M 0.0. If there is a change in the signal state of the RLO from "1" to "0", the program jumps to jump label CAS1.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 N_TRIG: Set output on negative signal edge

Symbol



Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, L, D (Page 318)	Edge memory bit in which the RLO of the last query is saved.
CLK	BOOL		Current RLO
Q	BOOL		Result of edge evaluation

Description

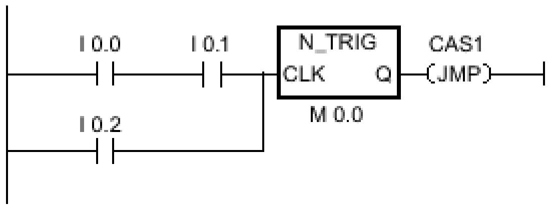
You can use the "Set output on negative signal edge" operation to detect a "1" to "0" change in the signal state of the result of logic operation (RLO). The operation compares the current signal state of the result of logic operation to the signal state of the previous query saved in the edge memory bit. If the operation detects a change in the RLO from "1" to "0", there is a negative, falling edge.

If a falling edge is detected, the output of the operation has signal state "1". In all other cases, the signal state at the output of the operation is "0".

Placement

The "Set output on negative signal edge" operation can be assigned within the network.

Example



The RLO of the preceding bit logic operation is saved in the edge memory bit M 0.0. If a "1" to "0" signal change is detected at the RLO, the program jumps to jump label CAS1.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0   )

7.8.1.1 Timers

7.8.1.1 TP: Pulse generation

Symbol

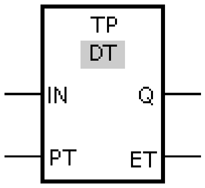


Figure7-2

Parameter	Data type	Memory area	Description
IN	BOOL	I, Q, M, D, L (Page 318)	Start input
PT	TIME	I, Q, M, D, L or constant	Duration of the pulse. PT must be positive.
Q	BOOL	I, Q, M, D, L	Pulse output
ET	TIME	I, Q, M, D, L	Elapsed time

Description

You can use the "Generate pulse" operation to set the Q output for a pre-programmed period of time. The operation is started when the result of logic operation (RLO) at the IN input changes from "0" to "1". When the operation is started, the time programmed for PT starts running. Output Q is set for the period of time, PT, regardless of the subsequent course of the input signal. Even when a new positive edge is detected, the signal state at the Q output is not affected as long as PT is running.

It is possible to query how long the current timer function has been running at output ET. This time starts at T#0s and ends when the value set for the PT timer is reached. The value at the ET output can be queried as long as the PT timer is running and the input IN has signal state "1".

'When inserting the "Generate pulse" operation, an instance data block is created in which the operation data is saved.

Placement

The "Generate pulse" operation requires a preceding logic operation for the edge evaluation. It can placed within or at the end of the network.

Pulse diagram

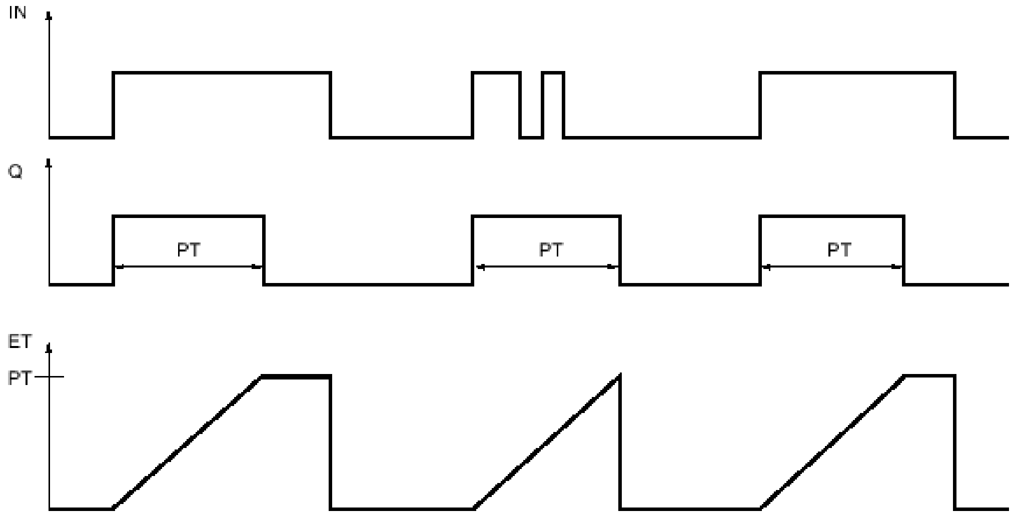


Figure7-2

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 TON: On delay

Symbol

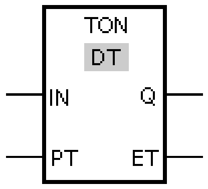


Figure7-2

Parameter	Data type	Memory area	Description
IN	BOOL	I, Q, M, D, L (Page 318)	Start input
PT	TIME	I, Q, M, D, L or constant	Time by which the rising edge is delayed at the IN input.
Q	BOOL	I, Q, M, D, L	Output, which is delayed by the time PT.

Parameter	Data type	Memory area	Description
ET	TIME	I, Q, M, D, L	Elapsed time

Description

You can use the "On delay" operation to delay a rising edge by the time set at PT. The "On delay" operation is executed when the result of logic operation (RLO) changes from "0" to "1" at input IN (rising edge). When the operation is started, the time set for PT starts running. When the PT time expires, output Q has signal state "1". Output Q remains set as long as the start input is still "1". If there is a signal change at the start input from "1" to "0", output Q is reset. The timer function is started again when a new positive edge is detected at the start input.

The ET output supplies the time that has elapsed since the last rising edge at the IN input. This time starts at T#0s and ends when the value set for the PT timer is reached. The elapsed time can be queried at output ET as long as input IN has signal state "1".

'When inserting the "On delay" operation, an instance data block is created in which the operation data is saved.

Placement

The "On delay" operation requires a preceding logic operation for the edge evaluation. It can placed within or at the end of the network.

Pulse diagram

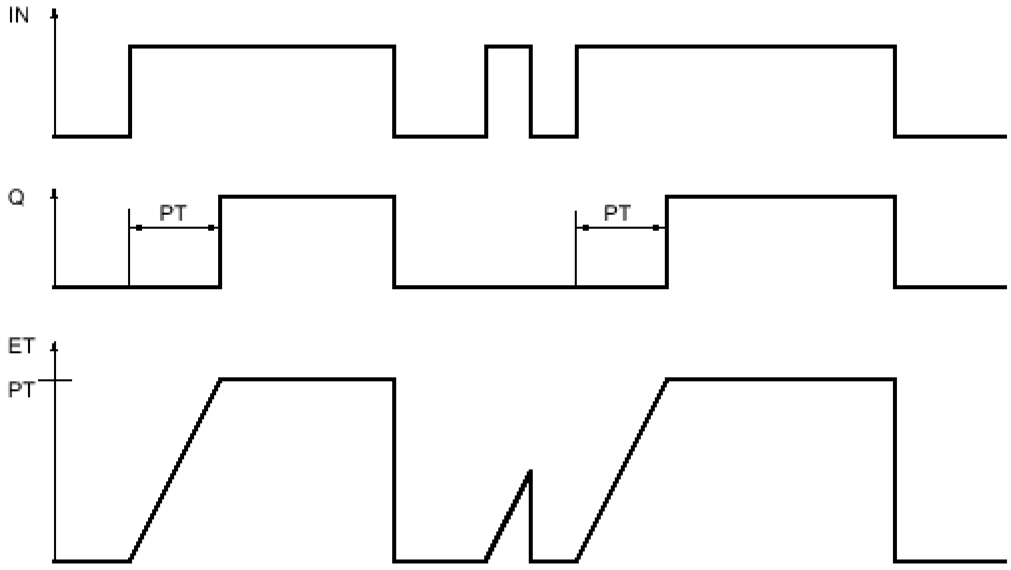


Figure7-2

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)
Example of controlling room temperature (Page 610)

7.8.1.1 TOF: Off delay

Symbol

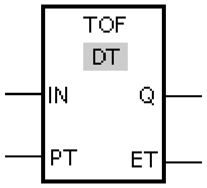


Figure7-2

Parameter	Data type	Memory area	Description
IN	BOOL	I, Q, M, D, L (Page 318)	Start input
PT	TIME	I, Q, M, D, L or constant	Time by which the falling edge is delayed at the IN input. PT must be positive.
Q	BOOL	I, Q, M, D, L	Output, which is delayed by the time PT.
ET	TIME	I, Q, M, D, L	Elapsed time

Description

You can use the "Off delay" operation to delay a falling edge by the time set at PT. The Q output is set when the result of logic operation (RLO) at input IN changes from "0" to "1". When the signal state at the IN input switches back to "0", the time set at PT starts. Output Q remains set as long the time set at PT is running. The Q output is reset when the PT time expires. If the signal state at the IN input changes to "1" before the time set at PT time expires, the timer is reset. The signal state at the Q output will continue to be "1".

It is possible to query how long the current timer function has been running at output ET. This time starts at T#0s and ends when the value set for the PT timer is reached. When the time set at PT expires, output ET remains set to the current value until input IN changes back to "1". If the IN input switches to "1" before the PT time has expired, the ET output is reset to the value T#0.

'When inserting the "OFF delay" operation, an instance data block is created in which the operation data is saved.

Placement

The "Off delay" operation requires a preceding logic operation for the edge evaluation. It can placed within or at the end of the network.

Pulse diagram

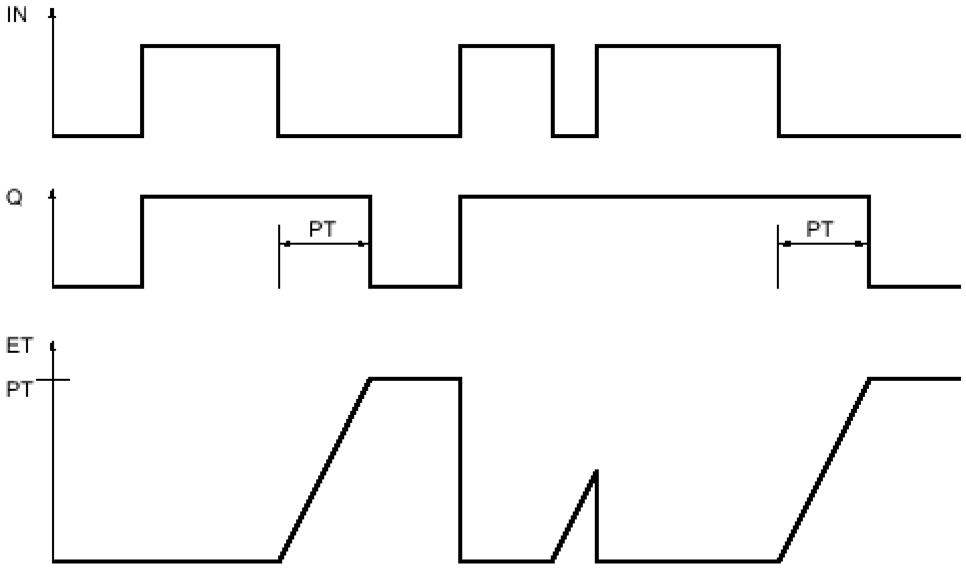


Figure7-2

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 TONR: Time accumulator

Symbol

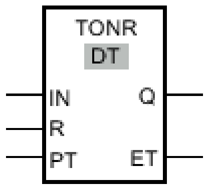


Figure7-2

Parameter	Data type	Memory area	Description
IN	BOOL	I, Q, M, D, L (Page 318)	Start input
R	BOOL	I, Q, M, D, L	Reset input
PT	TIME	I, Q, M, D, L or constant	Maximum duration of time recording

Parameter	Data type	Memory area	Description
Q	BOOL	I, Q, M, D, L	Output that is set when the PT time expires.
ET	TIME	I, Q, M, D, L	Accumulated time

Description

You can use the "Time accumulator" operation to accumulate time values within a period set with the PT parameter. When input IN changes to signal state "1", the operation is executed and the time set at PT starts. While the time set at PT is running, the time values are accumulated that are recorded at signal state "1" at input IN. The accumulated time is written to output ET and can be queried there. When the PT time expires, output Q has signal state "1".

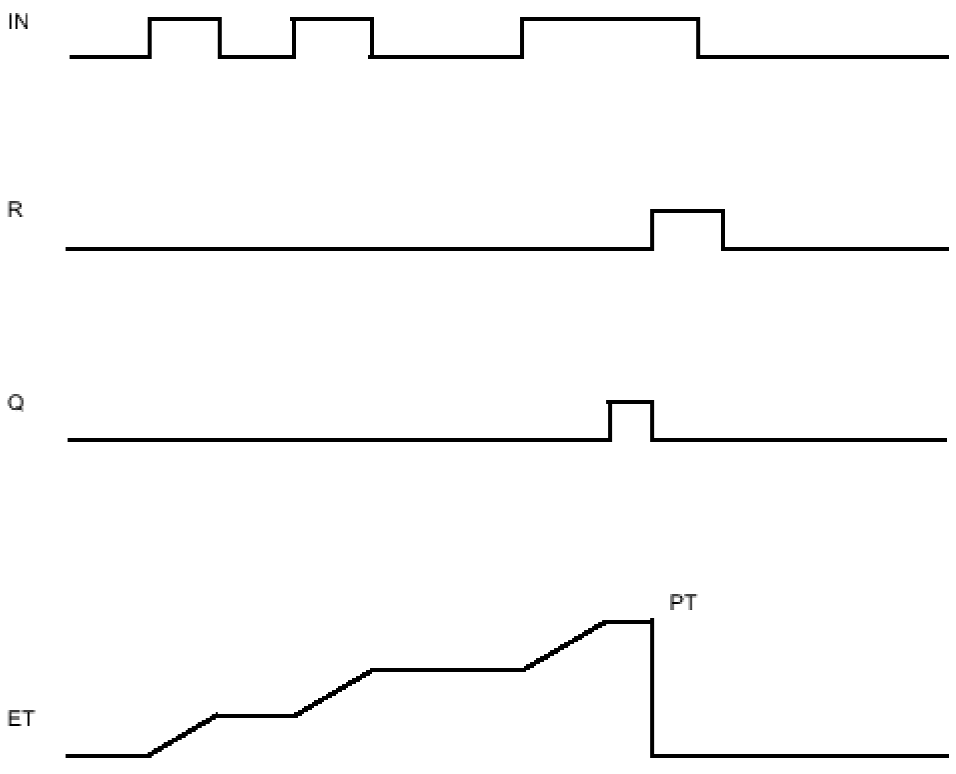
Input R resets the outputs ET and Q regardless of the signal state at the start input.

'When inserting the "Time accumulator" operation, an instance data block is created in which the operation data is saved.

Placement

The "Time accumulator" operation requires a preceding logic operation. It can placed within or at the end of the network.

Pulse diagram



See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 Counters

7.8.1.1 CTU: Count up

Symbol

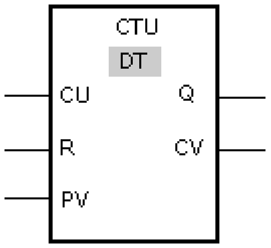


Figure7-2

Parameter English	Data type	Memory area	Description
CU	BOOL	I, Q, M, D, L (Page 318)	Count input
R	BOOL	I, Q, M, D, L	Reset input
PV	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, D, L or constant	Preset count
Q	BOOL	I, Q, M, D, L	Counter status
CV	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, D, L	Actual count value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Count up" operation to increment the value at the CV output. If the signal state at the CU input changes from "0" to "1" (positive edge), the operation is executed and the current count value at the CV output is incremented by one. The first time the operation is executed, the current count at the CV output is set to zero. The count is incremented each time a positive edge is detected, until it reaches the high limit for the specified data type at the CV output. When the high limit is reached, the signal state at the CU input no longer has an effect on the operation.

The counter status can be queried at the Q output. The signal state at output Q is determined by the PV parameter. If the current count value is greater than or equal to the value of the PV parameter, the Q output is set to signal state "1". In all other cases, the signal state at the Q output is "0".

The value at the CV output is reset to zero when the signal state at R input changes to "1". As long as there is the signal state "1" at R input, the signal state at input CU has no effect on the operation.

'When inserting the "Count up" operation, an instance data block is created in which the operation data is saved.

Placement

The "Count up" operation requires a preceding logic operation for the edge evaluation. It can placed within or at the end of the network.

Example

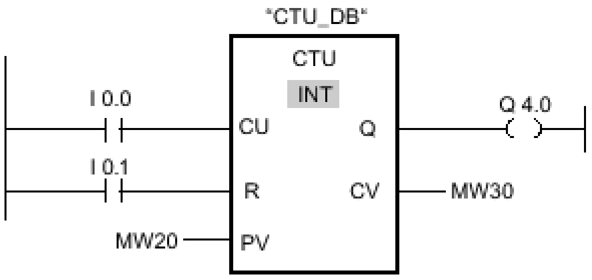


Figure7-2

When the signal state at the input I 0.0 changes from "0" to "1", the "Count up" operation is executed and the current count at the MW30 output is increased by one. With each further positive edge, the count value is incremented until the high limit value of the specified data type (32 767) is reached.

The value at the MW20 parameter is applied as the limit for determining the output Q 4.0. Output Q 4.0 has signal state "1" as long as the current count is greater than or equal to the value at the MW20 parameter. In all other cases, output Q 4.0 has signal state "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 CTD: Count down

Symbol

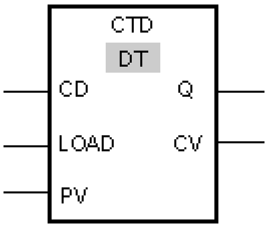


Figure7-2

Parameter English	Data type	Memory area	Description
CD	BOOL	I, Q, M, D, L (Page 318)	Count input
LOAD	BOOL	I, Q, M, D, L	Load input
PV	SINT, UINT, DINT, USINT, UINT, UDINT	I, Q, M, D, L or constant	Preset count
Q	BOOL	I, Q, M, D, L	Counter status
CV	SINT, UINT, DINT, USINT, UINT, UDINT	I, Q, M, D, L	Actual count value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Count down" operation to decrement the value at the CV output. If the signal state at the CD input changes from "0" to "1" (positive edge), the operation is executed and the current count value at the CV output is decremented by one. The first time the operation is executed, the current count at the CV output is set to zero. Each time a positive edge is detected, the count value is further decremented until it reaches the low limit value of the specified data type. When the low limit value is reached, the signal state at the CD input has no further effect on the operation.

The counter status can be queried at the Q output. If the current count value is less than or equal to zero, output Q is set to signal state "1". In all other cases, the signal state at the Q output is "0".

The value at the CV output is set to the value of the PV parameter when the signal state at LOAD input changes to "1". As long as there is the signal state "1" at the LOAD input, the signal state at the CD input has no effect on the operation.

'When inserting the "Count down" operation, an instance data block is created in which the operation data is saved.

Placement

The "Count down" operation requires a preceding logic operation for the edge evaluation. It can placed within or at the end of the network.

Example

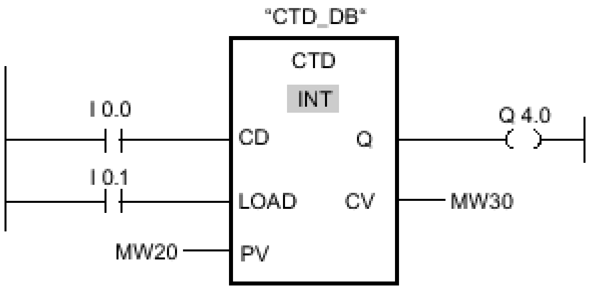


Figure7-2

When the signal state at the input I 0.0 changes from "0" to "1", the "Count down" operation is executed and the value at the MW30 output is decreased by one. With each further positive edge, the count value is decremented until the low limit value of the specified data type (-32 768) is reached.

Output Q 4.0 has signal state "1" as long as the current count value is less than or equal to zero. In all other cases, output Q 4.0 has signal state "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 CTUD: Count up and down

Symbol

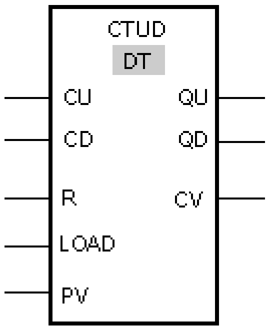


Figure7-2

Parameter English	Data type	Memory area	Description
CU	BOOL	I, Q, M, D, L (Page 318)	Count up input
CD	BOOL	I, Q, M, D, L	Count down input
R	BOOL	I, Q, M, D, L	Reset input
LOAD	BOOL	I, Q, M, D, L	Load input
PV	SINT, UINT, DINT, USINT, UINT, UDINT	I, Q, M, D, L or constant	Preset count
QU	BOOL	I, Q, M, D, L	Status of the incremental counter
QD	BOOL	I, Q, M, D, L	Status of the decremental counter
CV	SINT, UINT, DINT, USINT, UINT, UDINT	I, Q, M, D, L	Actual count value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Count up and down" operation to increment and decrement the count value at the CV output. If the signal state at CU input changes from "0" to "1" (positive edge), the current count value is incremented by one and stored in the CV output. If the signal state at CD input changes from "0" to "1" (positive edge), the count value at the CV output is decremented by one. If there is a positive edge at the CU and CD inputs in one program cycle, the current count value at the CV output remains unchanged.

The count value can be incremented until it reaches the high limit value of the data type specified at the CV output. When the high limit value is reached, the count value is no longer incremented on a positive edge. When the low limit value of the specified data type is reached, the count value is not decremented any further.

When the signal state at the LOAD input changes to "1", the count value at the CV output is set to the value of the PV parameter. As long as there is the signal state "1" at the LOAD input, the signal state at the CU and CD inputs has no effect on the operation.

The count value is set to zero when the signal state at input R changes to "1". As long as the signal state at the R input is "1", changes of signal state at inputs CU and CD and LOAD have no effect on the "Count up and down" operation.

The incremental counter status can be queried at QU output. If the current count value is greater than or equal to the value of the PV parameter, QU output has signal state "1". In all other cases, the signal state at the QU output is "0".

The decremental counter status can be queried at QD output. If the current count value is less than or equal to zero, output QD has signal state "1". In all other cases, the signal state at the QD output is "0".

'When inserting the "Count up and down" operation, an instance data block is created in which the operation data is saved.

Placement

The "Count up and down" operation requires a preceding logic operation for the edge evaluation. It can placed within or at the end of the network.

Example

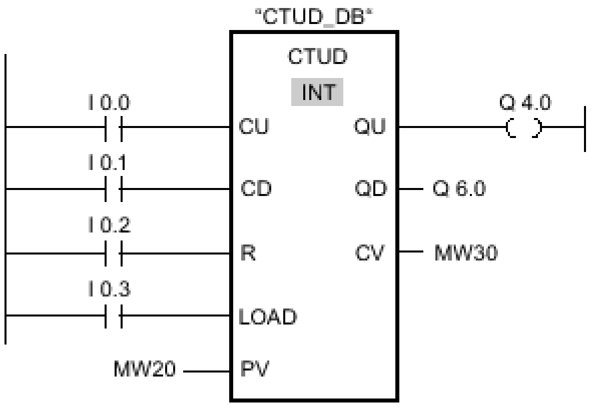


Figure7-2

If the signal state at input I 0.0 or at input I 0.1 changes from "0" to "1" (positive edge), the "Count up and down" operation is executed. When there is a positive edge at the input I 0.0, the current count is increased by one and stored at the output MW30. When there is a positive edge at the input I 0.1, the current count is decreased by one and stored at the output MW30. When there is a positive edge at CU input the count value is incremented until it reaches the high limit of 32 767. When there is a positive edge at input I 0.1, the count value is decremented until it reaches the low limit value of -32 768.

Output Q 4.0 has signal state "1" as long as the current count is greater than or equal to the value at the MW20 input. In all other cases, output Q 4.0 has signal state "0".

Output Q 6.0 has signal state "1" as long as the current count value is less than or equal to zero. In all other cases, output Q 6.0 has signal state "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)
Example of detecting the fill level of a storage area (Page 606)

7.8.1.1 High-speed counters

7.8.1.1 CTRL_HSC: Control high-speed counters in LAD

Symbol

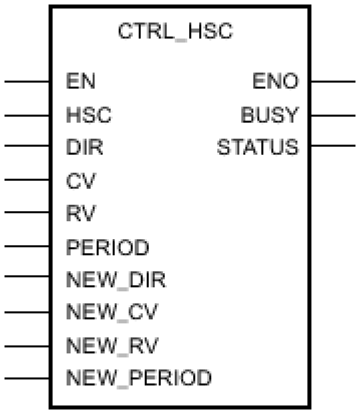


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
HSC	HW_HSC	L, D or constant	Hardware address of the high-speed counter (HW-ID)
DIR	BOOL	I, Q, M, L, D	Enables the new count direction (see NEW_DIR)
CV	BOOL	I, Q, M, L, D	Enables the new count value (see NEW_CV)
RV	BOOL	I, Q, M, L, D	Enables the new reference value (see NEW_RV)
PERIOD	BOOL	I, Q, M, L, D	Enables the new period of a frequency measurement (see NEW_PERIOD)
NEW_DIR	INT	I, Q, M, L, D	Count direction loaded when DIR = TRUE.
NEW_CV	DINT	I, Q, M, L, D	Count value loaded when CV = TRUE.

Parameter	Data type	Memory area	Description
NEW_RV	DINT	I, Q, M, L, D	Reference value loaded when CV = TRUE.
NEW_PERIOD	INT	I, Q, M, L, D	Period of the frequency measurement loaded when PERIOD = TRUE.
BUSY	BOOL	I, Q, M, L, D	Processing status
STATUS	WORD	I, Q, M, L, D	Status of the operation

Description

With the "Control high-speed counters" operation, you can make parameter settings and control the high-speed counters supported by the CPU by loading new values into the counter. Error-free execution of the operation is possible only when the high-speed counter you want to control is enabled in the hardware configuration. You can only insert and execute one "Control high-speed counters" operation per high-speed counter in the program. You enter the hardware identifier of the high-speed counter (HW-ID), whose values you want to assign at the HSC input.

Only tags of the data type "HW_HSC" can be specified at the HSC input. The hardware data type "HW_HSC" has a length of one WORD.

You can load the following parameter values into a high-speed counter using the "Control high-speed counters" operation:

- Count direction (NEW_DIR): The count direction defines whether a high-speed counter counts up or down. The count direction is defined by the following values at the NEW_DIR input: 1 = up, -1 = down.
  A change to the count direction with the "Control high-speed counters" operation is possible only when direction control is set in the parameters by the program.
  The count direction specified at the NEW_DIR input is loaded into a high-speed counter when the bit at the DIR input is set.
- Count value (NEW_CV): The count value is the initial value at which a high-speed counter starts counting. The count value can be in a range from - 2147483648 to 2147483647.
  The count value specified at the NEW_CV input is loaded into a high-speed counter when the bit at the CV input is set.
- Reference value (NEW_RV): The reference value is the highest value that a high-speed counter can reach. The reference value can be in a range from - 2147483648 to 2147483647.
  The reference value specified at the NEW_RV input is loaded into a high-speed counter when the bit at the RV input is set.
- Period of the frequency measurement (NEW_PERIOD): The period of the frequency measurement is specified by the following values at the NEW_PERIOD input: 10 = 0.01s, 100 = 0.1s, 1000 = 1s.
  The period can be updated when the "Frequency measurement" function is set in the parameters of the specified high-speed counter.
  The period specified at the NEW_PERIOD input is loaded into a high-speed counter if the bit at the PERIOD input is set.

The "Control high-speed counters" operation is only executed if the signal state at the EN input is "1". As long as the operation is executing, the bit at the BUSY output is set. Once the operation has executed completely, the bit at the BUSY output is reset.

The ENO enable output is set only when the EN input has signal state "1" and no errors occurred during execution of the operation.

'When inserting the "Control high-speed counters" operation, an instance data block is created in which the operation data is saved.

Parameter STATUS

At the STATUS output, you can query whether errors occurred during execution of the "Control high-speed counters" operation. The following table shows the meaning of the values output at the STATUS output:

Error code (hexadecimal)	Description
0	No error
80A1	Hardware identifier of the high-speed counter invalid
80B1	Count direction (NEW_DIR) invalid
80B2	Count value (NEW_CV) invalid
80B3	Reference value (NEW_RV) invalid
80B4	Period of the frequency measurement (NEW_PERIOD) invalid
80C0	Multiple access to the high-speed counter

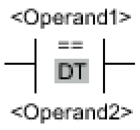
See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Configuring high-speed counters (Page 264)
Assigning parameters to hardware interrupt OBs (Page 417)

7.8.1.1 Compare

7.8.1.1 CMP ==: Equal to

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Equal" operation to determine if a first comparison value is equal to a second comparison value. Both values to be compared must be of the same data type.

If the comparison is true, the result of logic operation of the instruction is "1". The RLO is linked to the RLO of the entire current path as follows:

- By AND, when the comparison operation is connected in series.
- By OR, when the comparison operation is connected in parallel.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'AA'	'AA'	1
'Hello World'	'HelloWorld'	0
'AA'	'aa'	0

Placement

The "Equal" operation can be assigned at the left-hand edge or within the network.

Example

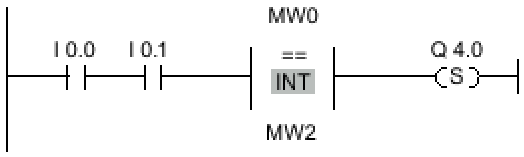


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

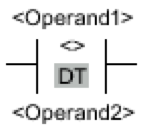
- Inputs I 0.0 AND I 0.1 have signal state "1".
- The condition of the comparison operation is fulfilled (MW0 = MW2).

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 CMP <>: Not equal to

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Not equal" operation to determine if a first comparison value is not equal to a second comparison value. Both values to be compared must be of the same data type.

If the comparison is true, the RLO is "1". The RLO is linked to the RLO of the entire current path as follows:

- By AND, when the comparison operation is connected in series.
- By OR, when the comparison operation is connected in parallel.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'AA'	'aa'	1
'Hello World'	'HelloWorld'	1
'AA'	'AA'	0

Placement

The "Not equal" operation can be assigned at the left-hand edge or within the network.

Example

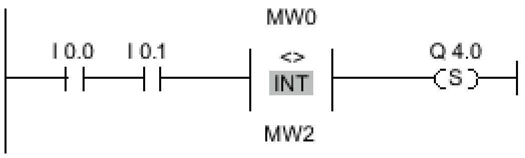


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

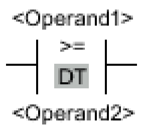
- Inputs I 0.0 AND I 0.1 have signal state "1".
- The condition of the comparison operation is fulfilled (MW0 <> MW2).

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 CMP >=: Greater than or equal to

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Greater or equal" operation to determine if a first comparison value is greater than or equal to a second comparison value. Both values to be compared must be of the same data type.

If the comparison is true, the RLO is "1". The RLO is linked to the RLO of the entire current path as follows:

- By AND, when the comparison operation is connected in series.
- By OR, when the comparison operation is connected in parallel.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the longer string is considered greater.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'BB'	'AA'	1
'AAA'	'AA'	1
'Hello World'	'Hello World'	1
'Hello World'	'HelloWorld'	0
'AA'	'aa'	0

<Operand1>	<Operand2>	RLO of operation
'AAA'	'a'	0

In comparing time values the RLO is "1" if the point of time at <Operand1> is greater (more recent) than or equal to the point of time at <Operand2>.

Placement

The "Greater or equal" operation can be assigned at the left-hand edge or within the network.

Example

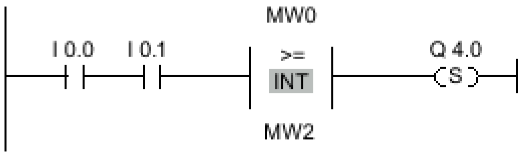


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

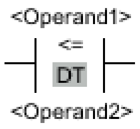
- Inputs I 0.0 AND I 0.1 have signal state "1".
- The condition of the comparison operation is fulfilled (MW0 >= MW2).

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)
Example of detecting the fill level of a storage area (Page 606)

7.8.1.1 CMP <=: Less than or equal to

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare

Parameter	Data type	Memory area	Description
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Less or equal" operation to determine if a first comparison value is less than or equal to a second comparison value. Both values to be compared must be of the same data type.

If the comparison is true, the RLO is "1". The RLO is linked to the RLO of the entire current path as follows:

- By AND, when the comparison operation is connected in series.
- By OR, when the comparison operation is connected in parallel.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the shorter string is considered smaller.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'AA'	'aa'	1
'AAA'	'a'	1
'Hello World'	'Hello World'	1
'HelloWorld'	'Hello World'	0
'BB'	'AA'	0
'AAA'	'AA'	0

In comparing time values the RLO is "1" if the point of time at <Operand1> is smaller (less recent) than or equal to the point of time at <Operand2>.

Placement

The "Less or equal" operation can be assigned at the left-hand edge or within the network.

Example

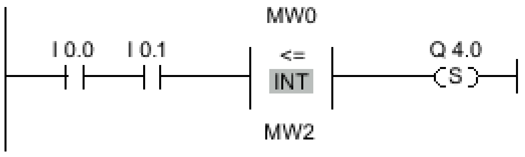


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

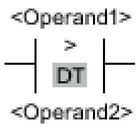
- Inputs I 0.0 AND I 0.1 have signal state "1".
- The condition of the comparison operation is fulfilled (MW0 <= MW2).

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 CMP >: Greater than

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Greater than" operation to determine if a first comparison value is greater than a second comparison value. Both values to be compared must be of the same data type.

If the comparison is true, the RLO is "1". The RLO is linked to the RLO of the entire current path as follows:

- By AND, when the comparison operation is connected in series.
- By OR, when the comparison operation is connected in parallel.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the longer string is considered greater.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'BB'	'AA'	1
'AAA'	'AA'	1
'AA'	'aa'	0
'AAA'	'a'	0

In comparing time values, the RLO is "1" if the point of time at <Operand1> is greater (more recent) than the point of time at <Operand2>.

Placement

The "Greater" operation can be assigned at the left-hand edge or within the network.

Example

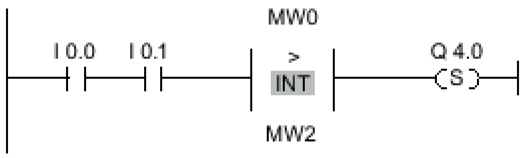


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

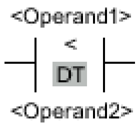
- Inputs I 0.0 AND I 0.1 have signal state "1".
- The condition of the comparison operation is fulfilled (MW0 > MW2).

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 CMP <: Less than

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Less than" operation to determine if a first comparison value is less than a second comparison value. Both values to be compared must be of the same data type.

If the comparison is true, the RLO is "1". The RLO is linked to the RLO of the entire current path as follows:

- By AND, when the comparison operation is connected in series.
- By OR, when the comparison operation is connected in parallel.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the shorter string is considered smaller.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'AA'	'aa'	1
'AAA'	'a'	1
'BB'	'AA'	0
'AAA'	'AA'	0

In comparing time values, the RLO is "1" if the point of time at <Operand1> is smaller (less recent) than the point of time at <Operand2>.

Placement

The "Smaller" operation can be assigned at the left-hand edge or within the network.

Example

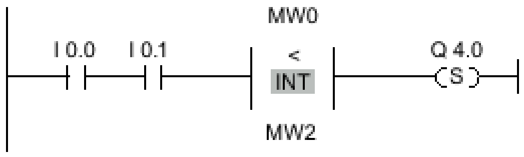


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

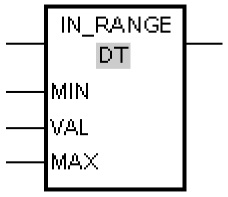
- Inputs I 0.0 AND I 0.1 have signal state "1".
- The condition of the comparison operation is fulfilled (MW0 < MW2).

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 IN_RANGE: Value within range

Symbol



Parameter	Data type	Memory area	Description
Box input	BOOL	I, Q, M, L, D (Page 318)	Result of the previous logic operation
Box output	BOOL	I, Q, M, L, D	Result of the comparison
MIN	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Low limit of the value range

Parameter	Data type	Memory area	Description
VAL	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Comparison value
MAX	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	High limit of the value range

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Value within range" operation to determine of the value at the VAL input is within a specific value range. You specify the limits of the value range with the MIN and MAX parameters. When the query is processed, the "Value within range" operation compares the value at the VAL input to the values of the MIN and MAX parameters and sends the result to the box output. If the value at the VAL input satisfies the comparison MIN <= VALUE <= MAX, the box output has signal state "1". If the comparison is not fulfilled, the signal state is "0" at the box output.

If the signal state at the box input is "0", the "Value within range" operation is not executed.

The comparison function can only execute if the values to be compared are of the same data type and the box output is interconnected.

Placement

The "Value within range" operation can be assigned at the left-hand edge or within the network.

Example

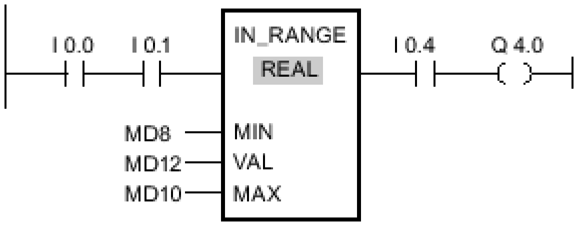


Figure7-2

Output Q 4.0 is set when all of the following conditions are fulfilled:

- The signal state at inputs I 0.0 AND I 0.1 is "1".
- The value at the MD12 input is within the value range, which is specified by the current values at the inputs MD8 and MD10 (MIN <= VAL <= MAX).
- Input I 0.4 has signal state "1".

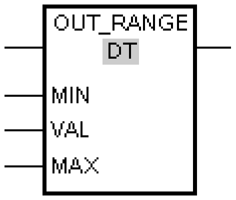
See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)

Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)
GetError (Page 954)

7.8.1.1 OUT_RANGE: Value outside range

Symbol



Parameter	Data type	Memory area	Description
Box input	BOOL	I, Q, M, L, D (Page 318)	Result of the previous logic operation
Box output	BOOL	I, Q, M, L, D	Result of the comparison
MIN	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Low limit of the value range
VAL	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Comparison value
MAX	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	High limit of the value range

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Value outside range" operation to query whether or nor the value at the VAL input is outside a specific range. You specify the limits of the value range with the MIN and MAX parameters. When the query is processed, the "Value outside range" operation compares the value at the VAL input to the values of the MIN and MAX parameters and sends the result to the box output. If the value at the VAL input satisfies the comparison MIN > VAL or VAL > MAX, the box output has signal state "1". If the comparison is not fulfilled, the signal state is "0" at the box output.

If the signal state at the box input is "0", the "Value outside range" operation is not executed.

The comparison function can only execute if the values to be compared are of the same data type and the box output is interconnected.

Placement

The "Value outside range" operation can be assigned at the left-hand edge or within the network.

Example

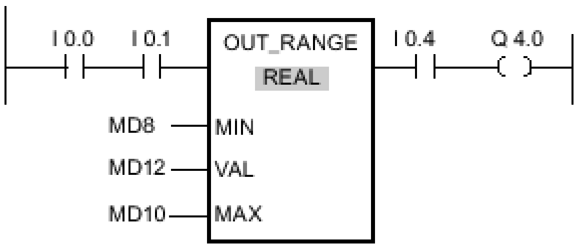


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

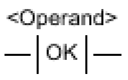
- The signal state at inputs I 0.0 and I 0.1 is "1".
- The value at input MD12 is outside the range of values set by the values of inputs MD8 and MD10 (MIN > VAL or VAL > MAX).
- Input I 0.4 has signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)
GetError (Page 954)

7.8.1.1 ----I OK I----: Check validity

Symbol



Parameter	Data type	Memory area	Description
<Operand>	REAL	I, Q, M, L, D (Page 318) or constant	Value to be checked.

Description

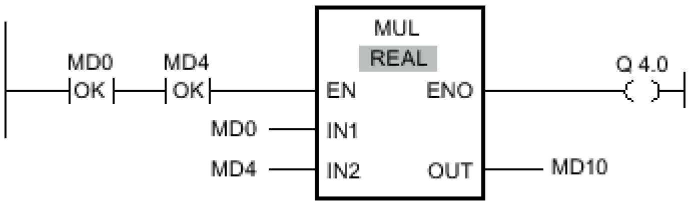
You can use the "Check validity" operation to check if the value of a tag (<operand>) is a valid floating-point number. The query is started in each program cycle when the signal state at the input of the operation is "1". When the tag value at the point in time of the query is a valid floating-point number, the output to the right power rail has signal state "1". In all other cases, the signal state at the output of the "Check validity" operation is "0".

You can use the "Check validity" operation together with the EN mechanism. If you connect the OK box to an EN enable input, the enable input is set only when the result of the validity query of the value is positive. You can use this function to ensure that an operation is enabled only when the value of the specified tag is a valid floating-point number.

Placement

The "Check validity" operation can be assigned at the left-hand edge or within the network.

Example



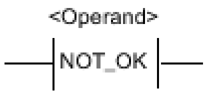
When MD0 AND MD4 show valid floating-point numbers, the "Multiply" (MUL) operation is activated and the ENO output is set. When the "Multiply" (MUL) operation is executed, the value at input MD0 is multiplied by the value of MD4. The product of the multiplication is stored at output MD10. If no errors occur during execution of the operation, outputs ENO and Q 4.0 are set to signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 ----I NOT_OK I----: Check invalidity

Symbol



Parameter	Data type	Memory area	Description
<Operand>	REAL	I, Q, M, L, D (Page 318) or constant	Value to be checked.

Description

You can use the "Check invalidity" operation to check if the value of a tag (<operand>) is an invalid floating-point number. The query is started in each program cycle when the signal state at the input of the operation is "1". When the tag value at the point in time of the query is an invalid floating-point number and the signal state to the left power rail is "1", the output to the right power rail has signal state "1". In all other cases, the signal state at the output of the "Check invalidity" operation is "0".

Placement

The "Check invalidity" operation can be assigned at the left-hand edge or within the network.

Example

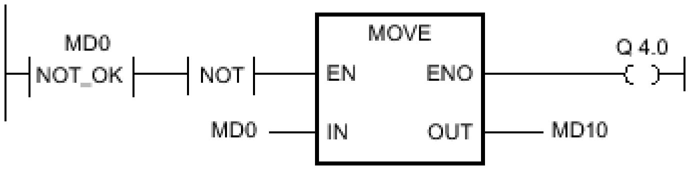


Figure7-2

When the value at the MD0 input is an invalid floating-point number, the "Move value" operation (MOVE) is not executed. Output Q 4.0 is reset to signal state "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 Math

7.8.1.1 ADD: Add

Symbol

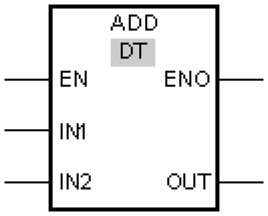


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	First value for addition
IN2	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Second value for addition
OUT	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D	Result of addition

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Add" operation to add the value at the IN1 input to the value at the IN2 input and query the sum at the OUT output (OUT =IN1+IN2).

The operation is only executed if the signal state at the enable input EN is "1". If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result of the operation is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

The "Add" operation can be placed at any position in the network.

Example

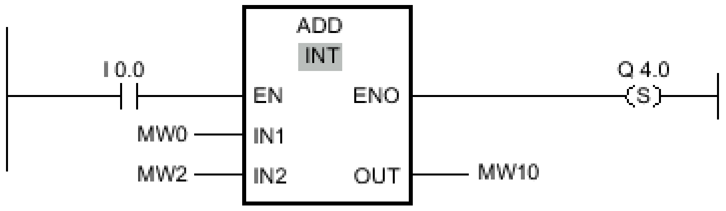


Figure7-2

If the input I 0.0 has signal state "1", the "Add" operation is executed. The value at the MW0 input is added to the value at the MW2 input. The result of the addition is stored at the MW10 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)
Inserting additional inputs and outputs (Page 462)
Example of calculating an equation (Page 609)

7.8.1.1 SUB: Subtract

Symbol

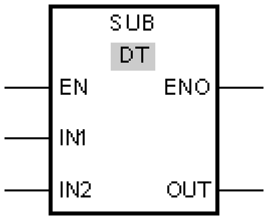


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	First value for subtraction
IN2	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Value to be subtracted.
OUT	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D	Result of subtraction

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Subtract" operation to subtract the value at input IN2 from the value at input IN1 and query the difference at the OUT output (OUT =IN1-IN2).

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result of the operation is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

The "Subtract" operation can be placed at any position in the network.

Example

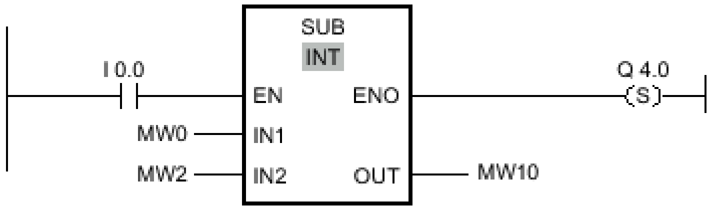


Figure7-2

If input I 0.0 has signal state "1", the "Subtract" operation is executed. The value at the MW2 input is subtracted from the value at the MW0 input. The result of the subtraction is stored at the MW10 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 MUL: Multiply

Symbol

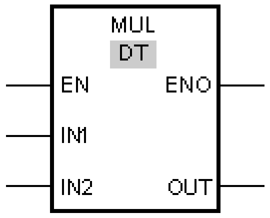


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output

Parameter	Data type	Memory area	Description
IN1	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	First value for multiplication
IN2	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Second value for multiplication
OUT	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D	Result of multiplication

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Multiply" operation to multiply the value at the IN1 input to the value at the IN2 input and query the product at the OUT output (OUT =IN1*IN2).

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

The "Multiply" operation can be placed at any position in the network.

Example

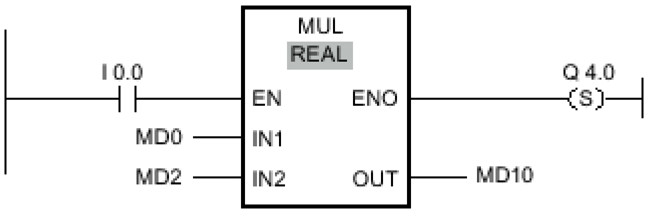


Figure7-2

If the input I 0.0 has signal state "1", the "Multiply" operation is executed. The value at input MD0 is multiplied by the value at input MD2. The product of the multiplication is stored in output MD10. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)

Inserting operands into LAD instructions (Page 0)
Inserting additional inputs and outputs (Page 462)
Selecting the data type of a LAD element (Page 0)
Example of calculating an equation (Page 609)

7.8.1.1 DIV: Divide

Symbol

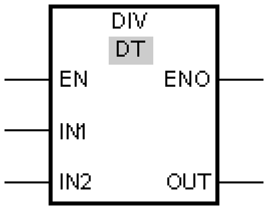


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Dividend
IN2	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Divisor
OUT	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D	Result of division

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Divide" operation to divide the value at the IN1 input by the value at the IN2 input and query the quotient at the OUT output (OUT =IN1/IN2).

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result of the operation is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

The "Divide" operation can be placed at any position in the network.

Example

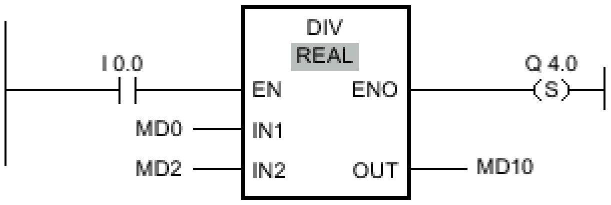


Figure7-2

If the input I 0.0 has signal state "1", the "Divide" operation is executed. The value at input MD0 is divided by the value at input MD2. The result of the division is stored at the MD10 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)
Example of calculating an equation (Page 609)

7.8.1.1 MOD: Return remainder of division

Symbol

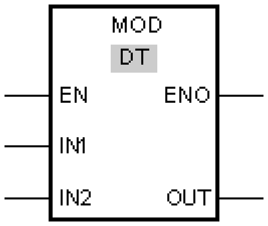


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, L, D or constant	Dividend
IN2	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, L, D or constant	Divisor

Parameter	Data type	Memory area	Description
OUT	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, L, D	Remainder of division

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Return remainder of division" operation to divide the value at the IN1 input by the value at the IN2 input and query the remainder at the OUT output.

The operation is only executed if the signal state at the EN input is "1". If no errors occur during execution of the operation, the ENO output also has signal state "1".

The operation is not executed if the signal state at the EN input is "0". In this case, the ENO output is reset.

Placement

The "Return remainder of division" operation can be placed at any position in the network.

Example

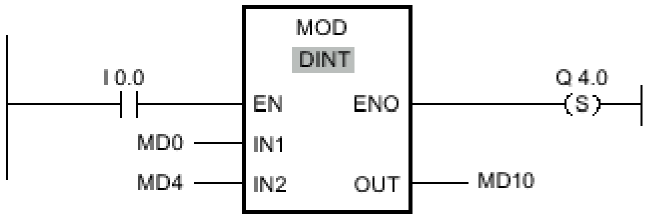


Figure7-2

If the input I 0.0 has signal state "0", the "Return remainder of division" operation is performed. The value at the MD0 input is divided by the value at the MD4 input. The remainder of the division is provided at output MD10. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 NEG: Create twos complement

Symbol

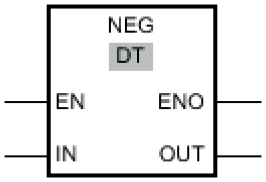


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	SINT, INT, DINT, REAL	I, Q, M, L, D or constant	Input value
OUT	SINT, INT, DINT, REAL	I, Q, M, L, D	Twos complement of the input value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Create twos complement" operation to change the sign of the value at the IN input and query the result at the OUT output. If there is a positive value at the IN input, for example, the negative equivalent of this value is sent to the OUT output.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result of the operation is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

The "Create twos complement" operation can be placed at any position in the network.

Example

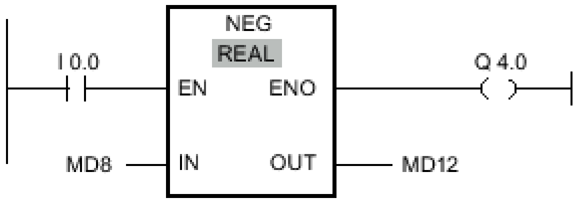


Figure7-2

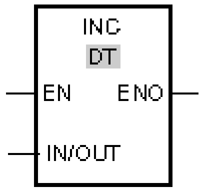
If input I 0.0 has signal state "1", the "Create twos complement" operation is performed. The sign of the value at input MD8 is changed and the result is provided at output MD12. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 INC: Increment

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN/OUT	SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, D, L	Value to be incremented.

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Increment" operation to change the tag at the IN/OUT output to the next higher value and query the result. The "Increment" operation can only be started when the signal state at the EN enable input is "1". If no overflow error occurs during the execution, the ENO output also has signal state "1".

If the signal state is "0" at the enable input EN, the operation is not executed. In this case, the ENO enable output is reset.

Placement

The "Increment" operation can be placed at any position in the network.

Example

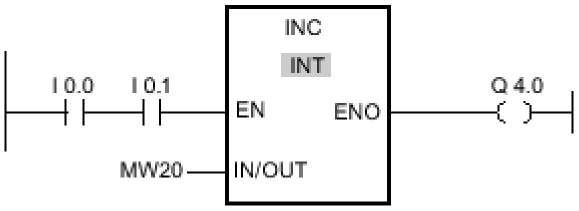


Figure7-2

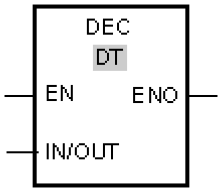
If the inputs I 0.0 AND I 0.1 have signal state "1", the value at the MW20 output is incremented by one and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 DEC: Decrement

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN/OUT	SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, D, L	Value to be decremented.

You can select the data type for the operation from the "DT" drop-down list.

Description

With the "Decrement" operation, you can change the value of the tag at the output IN/OUT output to the next lower value and query the result. Execution of the "Decrement" operation is started when the signal state at the EN enable input is "1". If no underflow error occurs during the execution, the ENO output also has signal state "1".

If the signal state is "0" at the enable input EN, the operation is not executed. In this case, the ENO enable output is reset.

Placement

The "Decrement" operation can be placed at any position in the network.

Example

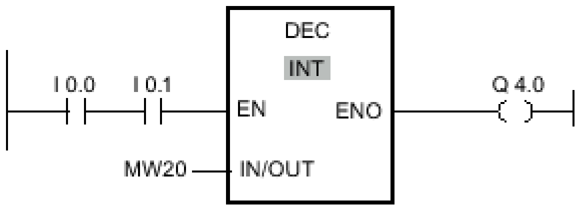


Figure7-2

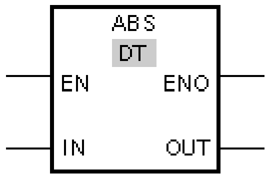
If the inputs I 0.0 AND I 0.1 have signal state "1", the value at the MW20 output is decremented by one and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 ABS: Form absolute value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output

Parameter	Data type	Memory area	Description
IN	SINT, INT, DINT, REAL	I, Q, M, L, D or constant	Input value
OUT	SINT, INT, DINT, REAL	I, Q, M, L, D	Absolute value of the input value

Description

You can use the "Form absolute value" operation to calculate the absolute value of the value specified at input IN. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value of a specified REAL tag is not a valid floating-point number.

Placement

The "Form absolute value" operation can be placed at any position in the network.

Example

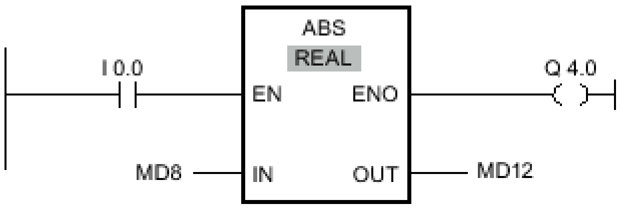


Figure7-2

IN	MD8 = - 6, 234
OUT	MD12 = 6, 234

If input I 0.0 has signal state "1", the "Form absolute value" operation is executed. The operation calculates the absolute amount of the value at the MD8 input and sends the result to the MD12 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 MIN: Determine minimum

Symbol

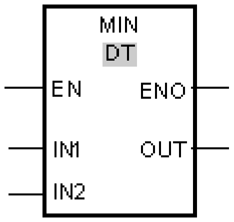


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	First input value
IN2	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Second input value
OUT	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

The "Get minimum" operation compares the value at the IN1 input to the value at the IN2 input and writes the lower value to the OUT output. The operation can only be executed if the tags set for all parameters are of the same data type.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO enable output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The specified tags are not of the same data type.
- An input tag of the REAL data type has an invalid value.

Placement

The "Get minimum" operation can be placed at any position in the network.

Example

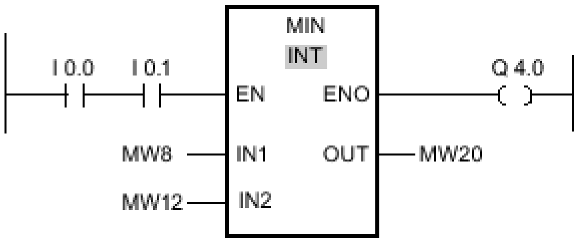


Figure7-2

IN1	MW8 = 12 666
IN2	MW12 = 14 444
OUT	MW20 = 12 666

If the inputs I 0.0 AND I 0.1 have signal state "1", the "Get minimum" operation is executed. The operation compares the value at the MW8 input to the value at the MW12 input and selects the lower value (MW8). This value is copied to the MW20 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 MAX: Determine maximum

Symbol

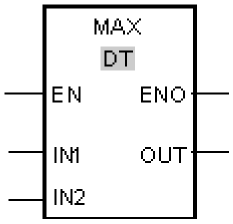


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output

Parameter	Data type	Memory area	Description
IN1	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	First input value
IN2	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Second input value
OUT	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

The "Get maximum" operation compares the value at the IN1 input to the value at the IN2 input and writes the higher value to the OUT output. The operation can only be executed if the tags set for all parameters are of the same data type.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO enable output also has signal state "1".

The enable output has signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The specified tags are not of the same data type.
- An input tag of the REAL data type has an invalid value.

Placement

The "Get maximum" operation can be placed at any position in the network.

Example

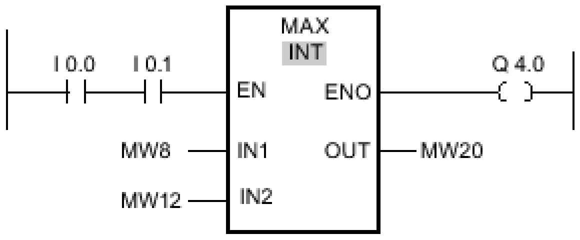


Figure7-2

IN1	MW8 = 12 666
IN2	MW12 = 14 444
OUT	MW20 = 14 444

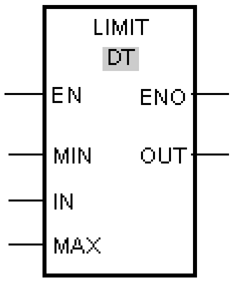
If the inputs I 0.0 AND I 0.1 have signal state "1", the "Get maximum" operation is executed. The operation compares the value at the MW8 input to the value at the MW12 input and selects the higher value (MW12). This value is copied to the MW20 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 LIMIT: Set limit value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
MIN	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Low limit
IN	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Input value
MAX	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	High limit
OUT	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Set limit value" operation to limit the value at input IN to the values at the inputs MIN and MAX. If the value at input IN satisfies the condition MIN < IN < MAX, it is copied to output OUT. If the condition is not fulfilled and the input value is below the low limit, the output is set to the value of the MIN input. If the high limit is exceeded, output OUT is set to the value of the MAX input.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO enable output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The specified tags are not of the same data type.
- An input tag has an invalid value.
- The value at the MIN input is greater than the value at the MAX input.

Placement

The "Set limit value" operation can be placed at any position in the network.

Example

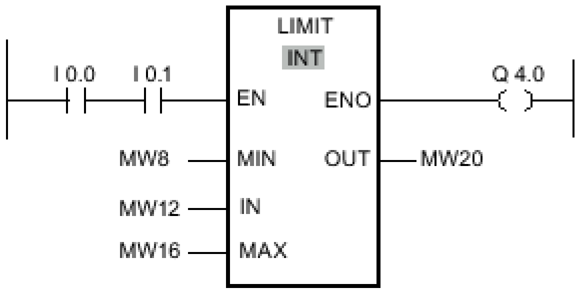


Figure7-2

MIN	MW8 = 12 000
IN	MW12 = 8 000
MAX	MW16 = 16 000
OUT	MW20 = 12 000

If the inputs I 0.0 AND I 0.1 have signal state "1", the "Set limit value" operation is executed. The value at the MW12 input is compared to the values at the inputs MW8 and MW16. Since the value at the MW12 input is less than the low limit, the MW8 input is copied to the MW20 output. If no errors occur during execution of the operation, output Q 4.0 is set.

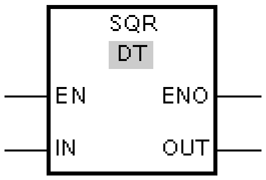
See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)

Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 SQR: Form square

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Input value
OUT	REAL	I, Q, M, L, D	Square of the input value

Description

You can use the "Form square" operation to square the value at the IN input and query the result at the OUT output.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form square" operation can be placed at any position in the network.

Example

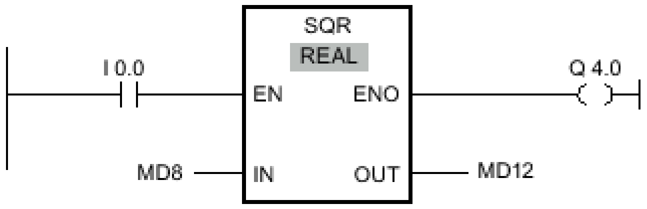


Figure7-2

IN	MD8 = 5
OUT	MD12 = 25

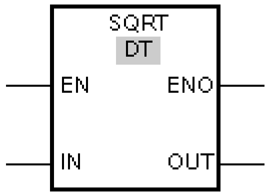
If input I 0.0 has signal state "1", the "Form square" operation is performed. The operation calculates the square of the value at the MD8 input and sends the result to the MD12 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 SQRT: Form square root

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Input value
OUT	REAL	I, Q, M, L, D	Square root of the input value

Description

You can use the "Form square root" operation to find the square root of the value at the IN input and query the result at the OUT output. The operation has a positive result if the input value is greater than zero. If input values are less than zero, the OUT output returns an invalid floating-point number. If the value at input IN is "-0", the result is also "-0".

The operation is only executed if the signal state is "1" at the enable input. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.
- The value at IN input is negative.

Placement

The "Form square root" operation can be placed at any position in the network.

Example

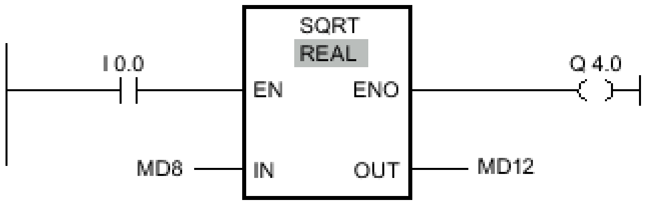


Figure7-2

IN	MD8 = 25
OUT	MD12 = 5

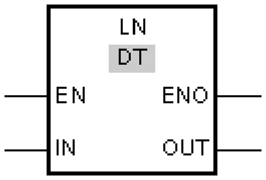
If the input I 0.0 has signal state "1", the "Form square root" operation is executed. The operation calculates the square root of the value at the MD8 input and sends the result to the MD12 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 LN: Form natural logarithm

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Input value:
OUT	REAL	I, Q, M, L, D	Result of the operation

Description

You can use the "Form natural logarithm" operation to calculate the natural logarithm of the value at input IN to base e (e=2.718282e+00). The result is provided at the OUT output and can be queried there. The operation has a positive result if the input value is greater than zero. If input values are less than zero, the OUT output returns an invalid floating-point number.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.
- The value at IN input is negative.

Placement

The "Form natural logarithm" operation can be placed at any position in the network.

Example

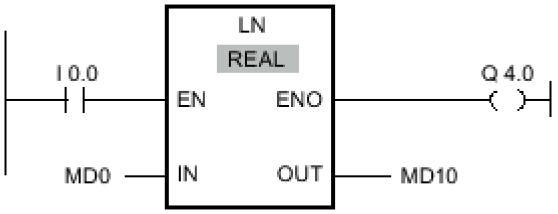


Figure7-2

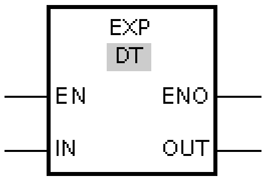
If input I 0.0 has signal state "1", the "Form natural logarithm" operation is executed. The operation forms the natural logarithm of the value at the MD0 input and sends the result to the MD10 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 EXP: Form exponential value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Input value
OUT	REAL	I, Q, M, L, D	Output value

Description

You can use the "Form exponential value" operation to calculate the exponent from the base e (e = 2.718282e+00) and the value set at input IN. The result is provided at the OUT output and can be queried there (OUT = e^{IN}).

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form exponential value" operation can be placed at any position in the network.

Example

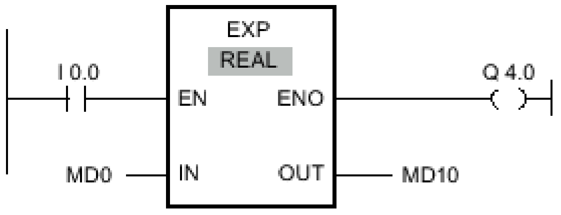


Figure7-2

If input I 0.0 has signal state "1", the "Form exponential value" operation is performed. The operation forms the power to base e with the value at input MD0 and sends the result to output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0   )
Selecting the data type of a LAD element (Page 0   )

7.8.1.1 SIN: Form sine value

Symbol

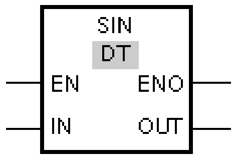


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Size of angle in the radian measure
OUT	REAL	I, Q, M, L, D	Sine of the specified angle

Description

You can use the "Form sine value" operation to form the sine of the angle specified in the radian measure at the IN input. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form sine value" operation can be placed at any position in the network.

Example

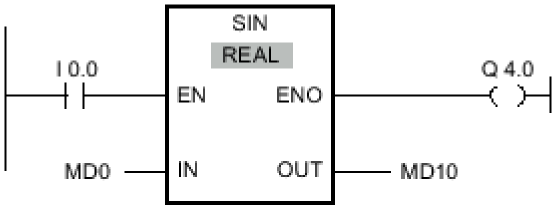


Figure7-2

IN	MD0 = +1.570796e+00 (π/2)
OUT	MD10 = 1

If input I 0.0 has signal state "1", the "Form sine value" operation is performed. The operation calculates the sine of the angle specified at the MD0 input and sends the result to the MD10 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 COS: Form cosine value

Symbol

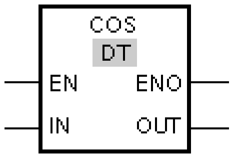


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Size of angle in the radian measure
OUT	REAL	I, Q, M, L, D	Cosine of the specified angle

Description

You can use the "Form cosine value" operation to calculate the cosine of an angle. The size of the angle is specified in the radian measure at input IN. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form cosine value" operation can be placed at any position in the network.

Example

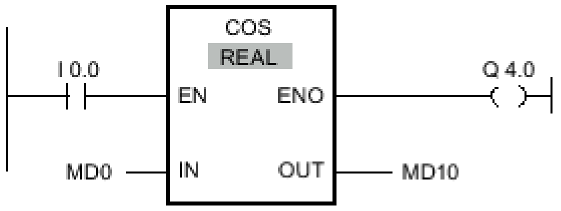


Figure7-2

IN	MD0 = +1.570796e+00 (π/2)
OUT	MD10 = 0

If input I 0.0 has signal state "1", the "Form cosine value" operation is performed. The operation calculates the cosine of the angle specified at the MD0 input and sends the result to the MD10 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)

Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 TAN: Form tangent value

Symbol

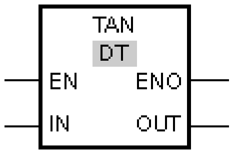


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Size of angle in the radian measure
OUT	REAL	I, Q, M, L, D	Tangent of the specified angle

Description

You can use the "Form tangent value" operation to calculate the tangent of an angle. The size of the angle is specified in the radian measure at input IN. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form tangent value" operation can be placed at any position in the network.

Example

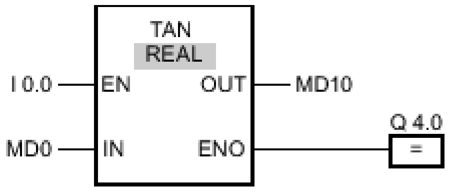


Figure7-2

IN	MD0 = +3.141593e++00 (π)
OUT	MD10 = 0

If input I 0.0 has signal state "1", the "Form tangent value" operation is performed. The operation calculates the tangent of the angle specified at the MD0 input and sends the result to the MD10 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 ASIN: Form arcsine value

Symbol

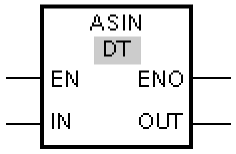


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Sine value
OUT	REAL	I, Q, M, L, D	Size of angle in the radian measure

Description

You can use the "Form arcsine value" operation to calculate the size of the angle from the sine value specified at the IN input, which corresponds to this value. Only valid floating-point numbers within the range -1 to +1 can be specified at the IN input. The calculated angle size is given in the radian measure at the OUT output and can range in value from -π/2 to +π/2.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.
- The value at input IN is outside the permitted range (-1 to +1).

Placement

The "Form arcsine value" operation can be placed at any position in the network.

Example

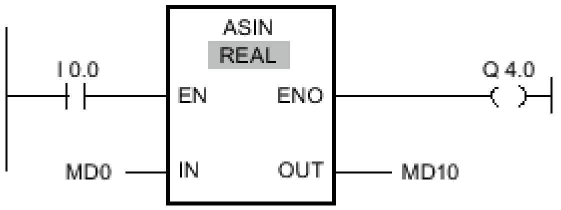


Figure7-2

IN	MD0 = 1
OUT	MD10 = +1.570796e+00 (π/2)

If input I 0.0 has signal state "1", the "Form arcsine value" operation is performed. The operation calculates the size of the angle corresponding to the sine value at input MD0. The result of the operation is stored at output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 ACOS: Form arccosine value

Symbol

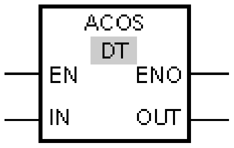


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Cosine value
OUT	REAL	I, Q, M, L, D	Size of angle in the radian measure

Description

You can use the "Form arccosine value" operation to calculate the size of the angle from the cosine value specified at the IN input, which corresponds to this value. Only valid floating-point numbers within the range -1 to +1 can be specified at the IN input. The calculated angle size is given in the radian measure at the OUT output and can range in value from 0 to +π.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.
- The value at input IN is outside the permitted range (-1 to +1).

Placement

The "Form arccosine value" operation can be placed at any position in the network.

Example

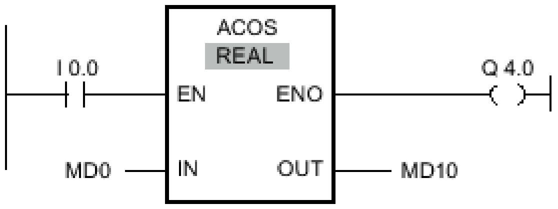


Figure7-2

IN	MD0 = 0
OUT	MD10 = +1.570796e+00 (π/2)

If input I 0.0 has the signal state "1", the "Form arccosine value" operation is performed. The operation calculates the size of the angle corresponding to the cosine value at input MD0. The result of the operation is stored at output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 ATAN: Form arctangent value

Symbol

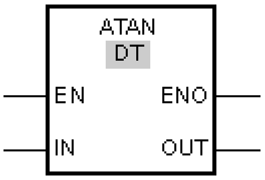


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Tangent value
OUT	REAL	I, Q, M, L, D	Size of angle in the radian measure

Description

You can use the "Form arctangent value" operation to calculate the size of the angle from the tangent value specified at the IN input, which corresponds to this value. Only valid floating-point numbers may be specified at the IN input. The calculated angle size is given in the radian measure at the OUT output and can range in value from -π/2 to +π/2.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form arctangent value" operation can be placed at any position in the network.

Example

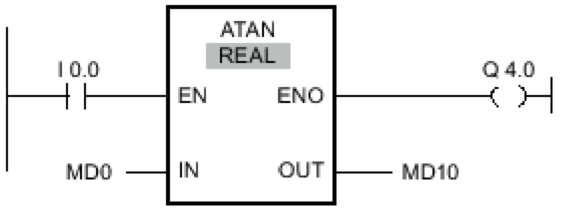


Figure7-2

IN	MD0 = 1
OUT	MD10 =+0.785398e++00 (π/4)

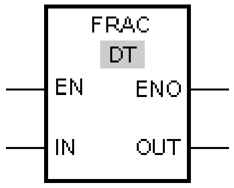
If input I 0.0 has signal state "1", the "Form arctangent value" operation is performed. The operation calculates the size of the angle corresponding to the tangent value at input MD0. The result of the operation is stored at output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 FRAC: Return fraction

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Value, whose decimal places are to be determined.
OUT	REAL	I, Q, M, L, D	Decimal places of the value at the IN input

Description

You can use the "Return fraction" operation to find the decimal places of the value at the IN input. The result of the query is stored at the OUT output and can be queried there. If the value at input IN is, for example, 123.4567, output OUT returns the value 0.4567. The operation is started when there is a "1" at the EN input. In this case, the enable output ENO also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors occur during processing of the operation, for example there is no valid floating-point number at the input.

Placement

The "Return fraction" operation can be placed at any position in the network.

Example

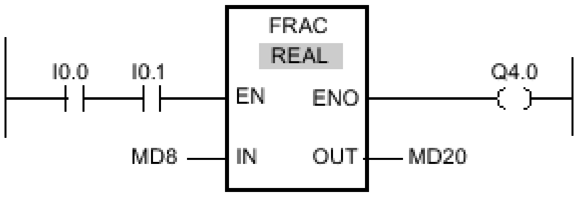


Figure7-2

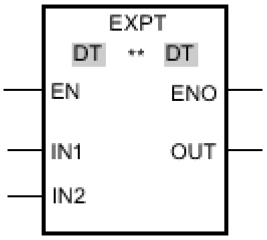
If the inputs I 0.0 AND I 0.1 have signal state "1", the "Return fraction" operation is started. The decimal places from the value at the MD8 input are copied to the MD20 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 EXPT: Exponentiate

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	REAL	I, Q, M, L, D or constant	Base value
IN2	REAL, INT, UINT, USINT, SINT, DINT, UDINT	I, Q, M, L, D or constant	Value with which the base value is exponentiated
OUT	REAL	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Exponentiate" operation to raise the value at the IN1 input by a power specified with the value at the IN2 input. The result of the operation is provided at the OUT output and can be queried there (OUT = $IN1^{IN2}$).

The IN1 input can only be assigned valid floating-point numbers. Integers are also allowed for setting the IN2 input.

The "Exponentiate" operation can only be executed when the signal state at the EN enable input is "1". In this case, the ENO enable output has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors occur during processing of the operation, for example there is an overflow.

Placement

The "Exponentiate" operation can be placed at any position in the network.

Example

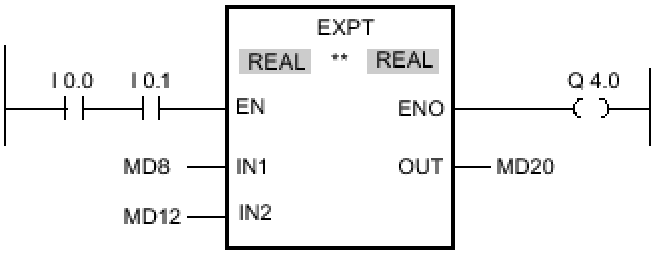


Figure7-2

If the inputs I 0.0 AND I 0.1 have signal state "1", the "Exponentiate" operation is executed. The value at the MD8 input is raised to the power specified by the value at the MD12 input. The result is stored at the MD20 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 Move

7.8.1.1 MOVE: Move value

Symbol

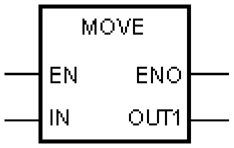


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	All elementary data types, DTL, STRUCT, ARRAY	I, Q, M, D, L or constant	Source value
OUT1	All elementary data types, DTL, STRUCT, ARRAY	I, Q, M, D, L	Destination address

Description

You can use the "Move value" operation to transfer the content of the operand at the IN input to the operand at the OUT1 output. The transfer is always made in the direction of the ascending address.

If IEC test is enabled the tags at IN input and OUT1 output must be of the same data type. If the IEC test is not enabled, the operand width at the IN input and the OUT1 output of the operation must be the same.

Copying entire arrays is possible only when the array components of the tags at input IN and at output OUT1 are of the same data type.

For the "Move value" operation, you can insert additional outputs. In this case, the content of the operand at the IN input is transferred to all available outputs.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the EN input is "0", the enable output ENO is reset to "0".

The "Move block" (MOVE_BLK) and "Move block uninterruptible" (UMOVE_BLK) operations can also be used to copy tags of the ARRAY data type. You can copy tags of the STRING data type with the operation S_CONV.

Placement

The "Move value" operation can be placed at any position in the network.

Example

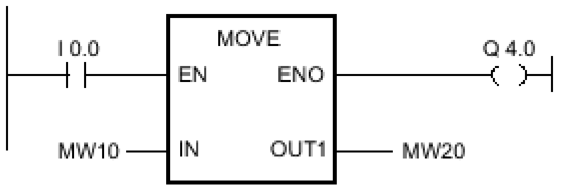


Figure7-2

IN	MW10 = 0011 1111 1010 1111
OUT1	MW20 = 0011 1111 1010 1111

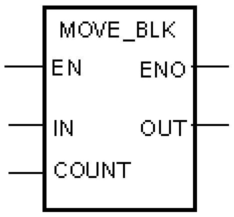
If input I 0.0 has signal state "1", the "Move value" operation is executed. The operation copies the contents of the input operand (MW10) to the output operand (MW20) and sets the output Q 4.0 to the signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting additional inputs and outputs (Page 462)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 MOVE_BLK: Move block

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	ARRAY	D, L	The first element of the source area to be copied.
COUNT	UINT	I, Q, M, D, L or constant	Number of elements to be copied from the source area to the destination area.
OUT	ARRAY	D, L	The first element of the destination area to which the content of the source area is copied.

Description

You can use the "Move block" operation to copy the content of a memory area (source area) to another memory area (destination area). The number of elements to be copied to the destination area is specified with the COUNT parameter. The width of the elements to be copied is defined by the width of the element at input IN. The copy operation takes place in the direction of ascending addresses.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- More data is copied than is available in the memory area at output OUT.

Placement

The "Move block" operation can be placed at any position in the network.

Example

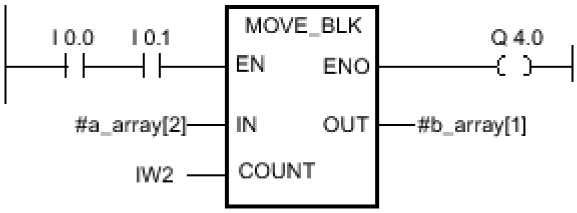


Figure7-2

IN	The tag "a_array" is an ARRAY data type and consists of 5 elements of the INT data type.
COUNT	IW2 = 3
OUT	The tag "b_array" is an ARRAY data type and consists of 6 elements of the INT data type.

If the inputs I 0.0 AND I 0.1 have signal state "1", the "Move block" operation is executed. The operation selects three INT elements from the "a_array" tag (a_array[2..4]) and copies the content to the output tag "b_array" (b_array[1..3]). If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting additional inputs and outputs (Page 462)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 UMOVE_BLK: Move block uninterruptible

Symbol

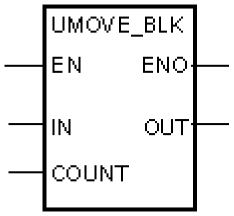


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input

Parameter	Data type	Memory area	Description
ENO	BOOL	I, Q, M, D, L	Enable output
IN	ARRAY	D, L	The first element of the source area to be copied.
COUNT	UINT	I, Q, M, D, L or constant	Number of elements to be copied from the source area to the destination area.
OUT	ARRAY	D, L	The first element of the destination area to which the content of the source area is copied.

Description

You can use the "Move block uninterruptible" operation to copy the content of a memory area (source area) to another memory area (destination area) without interruption. The number of elements to be copied to the destination area is specified with the COUNT parameter. The width of the elements to be copied is defined by the width of the element at input IN.

The content of the source area is copied to the destination area in the direction of the ascending address. The copy operation cannot be interrupted by other operating system activities. This is why the alarm reaction times of the CPU increase during the execution of the "Move block uninterruptible" operation.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- More data is copied than is made available at output OUT.

Placement

The "Move block uninterruptible" operation can be placed at any position in the network.

Example

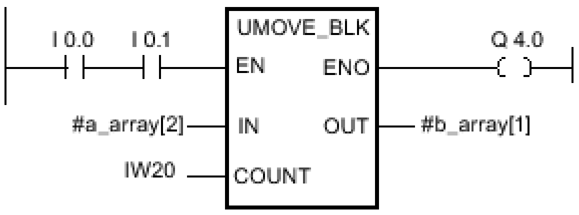


Figure7-2

IN	The tag "a_array" is an ARRAY data type and consists of 5 elements of the INT data type.
COUNT	IW20 = 3
OUT	The tag "b_array" is an ARRAY data type and consists of 6 elements of the INT data type.

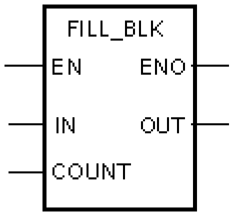
If the inputs I 0.0 AND I 0.1 have signal state "1", the "Move block" operation is executed. The operation selects three INT elements from the "a_array" tag (a_array[2..4]) and copies the content to the output tag "b_array" (b_array[1..3]). The copy operation cannot be interrupted by other operating system activities. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Inserting additional inputs and outputs (Page 462)

7.8.1.1 FILL_BLK: Fill block

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	ARRAY	D, L or constant	Element used to fill the destination area.
COUNT	UINT	I, Q, M, D, L or constant	Number of repeated copy operations
OUT	ARRAY	D, L	Address in destination area where filling begins.

Description

You can use the "Fill block" operation to fill a memory area (destination area) with the value of the IN input. The destination area is filled beginning with the address specified at the OUT output. The number of repeated copy operations is specified with the COUNT parameter. When the operation is executed, the value at input IN is selected and copied to the destination area as often as specified by the value of the COUNT parameter.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- More data is copied than is available in the memory area at output OUT.

Placement

The "Fill block" operation can be placed at any position in the network.

Example

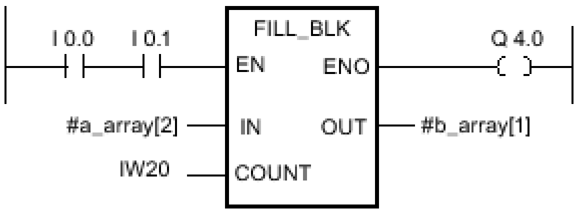


Figure7-2

IN	The tag "a_array" is an ARRAY data type and consists of 4 elements of the WORD data type (ARRAY[1..4] of WORD).
COUNT	IW20=3
OUT	The tag "b_array" is an ARRAY data type and consists of 5 elements of the WORD data type (ARRAY[1..5] of WORD).

If the inputs I 0.0 AND I 0.1 have signal state "1", the "Fill block" operation is executed. The operation copies the second element (a_array[2]) of the "a_array" tag three times to the output tag "b_array" (b_array[1..3]). If no errors occur during execution of the operation, outputs ENO and Q 4.0 are set to signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Inserting additional inputs and outputs (Page 462)

7.8.1.1 UFILL_BLK: Fill block uninterruptible

Symbol

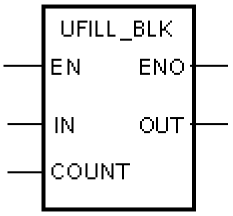


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	ARRAY	D, L or constant	Element used to fill the destination area.
COUNT	UINT	I, Q, M, D, L or constant	Number of repeated copy operations
OUT	ARRAY	D, L	Address in destination area where filling begins.

Description

You can use the "Fill block uninterruptible" operation to fill a memory area (destination area) with the value of the IN input without interruption. The destination area is filled beginning with the address specified at the OUT output. The number of repeated copy operations is specified with the COUNT parameter. When the operation is executed, the value at input IN is selected and copied to the destination area as often as specified by the value of the COUNT parameter.

The copy operation cannot be interrupted by other operating system activities. This is why the alarm reaction times of the CPU increase during the execution of the "Fill block uninterruptible" operation.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- More data is copied than is available in the memory area at output OUT.

Placement

The "Fill block uninterruptible" operation can be placed at any position in the network.

Example

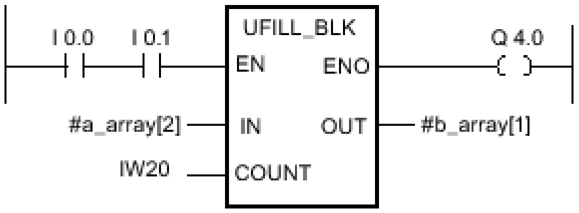


Figure7-2

IN	The tag "a_array" is an ARRAY data type and consists of 4 elements of the WORD data type (ARRAY[1..4] of WORD).
COUNT	IW20=3
OUT	The tag "b_array" is an ARRAY data type and consists of 5 elements of the WORD data type (ARRAY[1..5] of WORD).

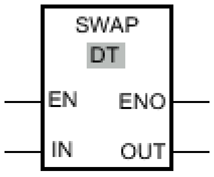
If the inputs I 0.0 AND I 0.1 have signal state "1", the "Fill block" operation is executed. The operation copies the second element (a_array[2]) of the "a_array" tag three times to the output tag "b_array" (b_array[1..3]). The copy operation cannot be interrupted by other operating system activities. If no errors occur during execution of the operation, outputs ENO and Q 4.0 are set to signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Inserting additional inputs and outputs (Page 462)

7.8.1.1 SWAP: Swap

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output

Parameter	Data type	Memory area	Description
IN	WORD, DWORD	I, Q, M, L, D or constant	Operand whose bytes are swapped.
OUT	WORD, DWORD	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Swap" operation to change the order of the bytes within the tag at the IN input and query the result at the OUT output.

The following figure shows how the bytes of a DWORD data type tag are swapped using the "Swap" operation:

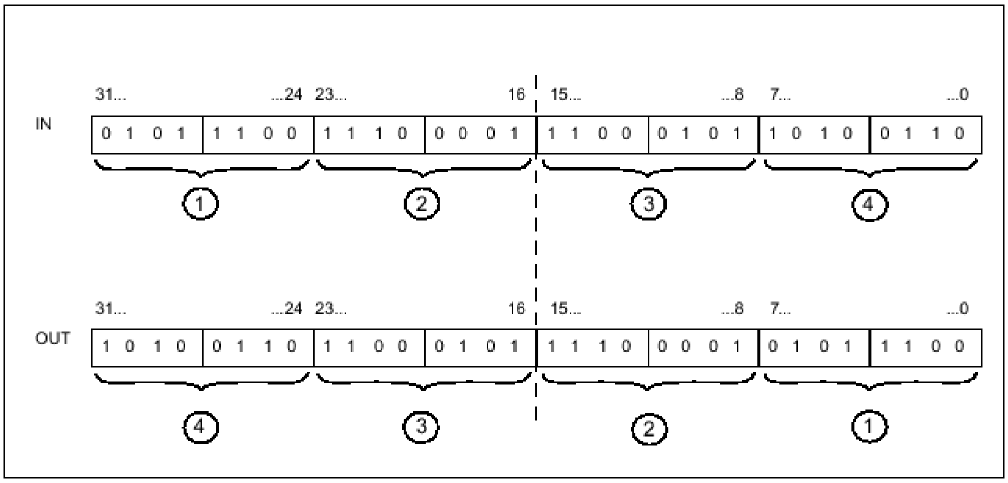


Figure7-2

The "Swap" operation is only executed if the signal state at the EN enable input is "1". In this case, the ENO enable output has signal state "1".

The ENO enable output is reset when the EN enable input has signal state "0" or errors occur during execution of the operation.

Placement

The "Swap" operation can be placed at any position in the network.

Example

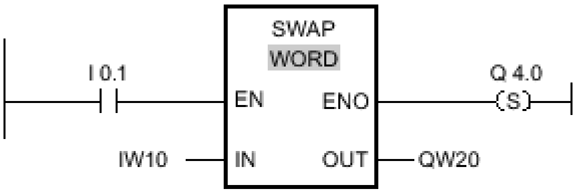


Figure7-2

IN	IW10 = 0000 1111 0101 0101
OUT	QW20 = 0101 0101 0000 1111

If the input I 0.1 has signal state "1", the "Swap" operation is executed. The arrangement of the bytes is changed and stored in the QW20 tag. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

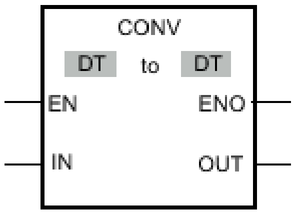
See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)
Inserting additional inputs and outputs (Page 462)

7.8.1.1 Convert

7.8.1.1 CONVERT: Convert value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	BYTE, WORD, DWORD, SINT, INT, DINT, USINT, UINT, UDINT, BCD16, BCD32, REAL	I, Q, M, D, L or constant	Value to be converted.
OUT	BYTE, WORD, DWORD, SINT, INT, DINT, USINT, UINT, UDINT, BCD16, BCD32, REAL	I, Q, M, D, L	Result of the conversion

You can select the data type for the operation from the "DT" drop-down list.

Description

The "Convert" operation reads the content of the IN parameter and converts it according to the specified data types.

The "Convert" operation can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors such as an overflow occur during processing.

Placement

The "Convert" operation can be placed at any position in the network.

Example

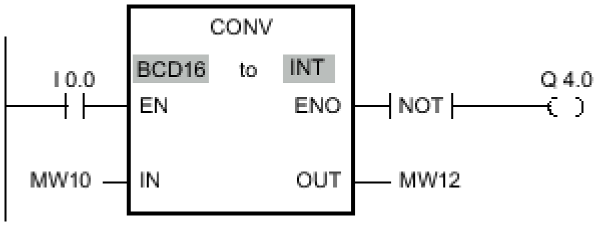


Figure7-2

If input I 0.0 = 1, the content of MW10 is read as a three-digit BCD-coded number and converted to an integer (16 bits). The result is stored in MW12. Output Q 4.0 is "1" if the conversion is not executed (ENO = EN = 0).

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 ROUND: Round to double integer

Symbol

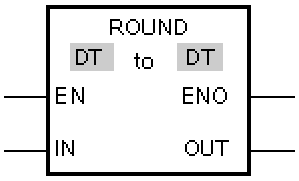


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Input value to be rounded.
OUT	INT, USINT, UINT, SINT, UDINT, DINT, REAL	I, Q, M, L, D	Output value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Round numerical value" operation to round the value at the IN input to the nearest integer. The operation interprets the value at input IN as a floating-point number and converts this to the nearest double integer. If the input value is exactly between an even and odd number, the even number is selected. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors such as an overflow occur during processing.

Placement

The "Round numerical value" operation can be placed at any position in the network.

Example

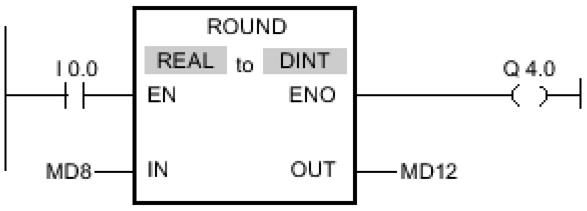


Figure7-2

IN	MD8 = 0.50000000
OUT	MD12 = 0

If input I 0.0 has signal state "1", the "Round numerical value" operation is executed. The floating-point number at input MD8 is rounded to the nearest even double integer and sent to the OUT output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Changing LAD elements (Page 460)
Inserting LAD elements (Page 452)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 CEIL: Generate next higher integer from floating-point number

Symbol

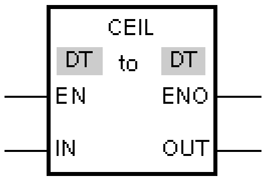


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Input value
OUT	INT, USINT, UINT, SINT, UDINT, DINT, REAL	I, Q, M, L, D	Output value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Generate next higher integer from floating-point number" operation to round the value at the IN input to the next higher integer. The operation interprets the value at the IN input as a floating-point number and converts this to the next higher integer. The result of the operation is provided at the OUT output and can be queried there. The output value can be greater than or equal to the input value.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".

- Errors such as an overflow occur during processing.

Placement

The "Generate next higher integer from floating-point number" operation can be placed at any position in the network.

Example

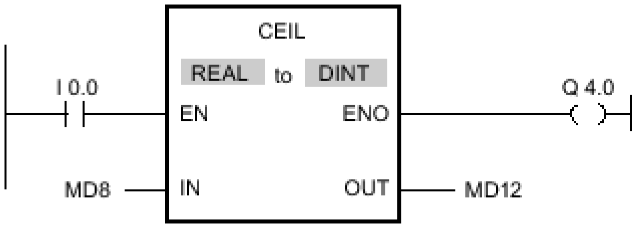


Figure7-2

IN	MD8 = 0.50000000
OUT	MD12 = 1

If input I 0.0 has signal state "1", the "Generate next higher integer from floating-point number" operation is executed. The floating-point number at input MD8 is rounded to the next higher integer and sent to the MD12 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Changing LAD elements (Page 460)
Inserting LAD elements (Page 452)
Selecting the data type of a LAD element (Page 0)
Inserting operands into LAD instructions (Page 0)

7.8.1.1 FLOOR: Generate next lower integer from floating-point number

Symbol

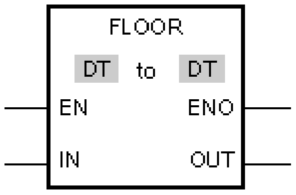


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Input value
OUT	INT, USINT, UINT, SINT, UDINT, DINT, REAL	I, Q, M, L, D	Output value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Generate next lower integer from floating-point number" operation to round the value at the IN input to the next lower integer. The operation interprets the value at input IN as a floating-point number and converts this to the next higher integer. The result of the operation is provided at the OUT output and can be queried there. The output value can be less than or equal to the input value.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors such as an overflow occur during processing.

Placement

The "Generate next lower integer from floating-point number" operation can be placed at any position in the network.

Example

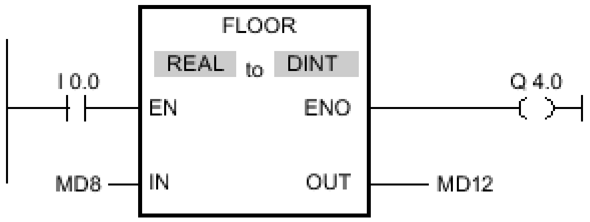


Figure7-2

IN	MD8 = 0.50000000
OUT	MD12 = 0

If input I 0.0 has signal state "1", the "Generate next lower integer from floating-point number" operation is executed. The floating-point number at input MD8 is rounded to the next lower integer and sent to the MD12 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 TRUNC: Truncate to integer

Symbol

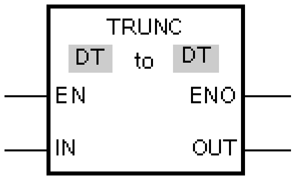


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Input value
OUT	INT, USINT, UINT, SINT, UDINT, DINT, REAL	I, Q, M, L, D	Integer part of the input value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Truncate numerical value" operation to form an integer without rounding the value at the IN input. The value at input IN is interpreted as a floating-point number. The operation selects only the integer part of the floating-point number and sends this to the OUT output without decimal places.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors such as an overflow occur during processing.

Placement

The "Truncate numerical value" operation can be placed at any position in the network.

Example

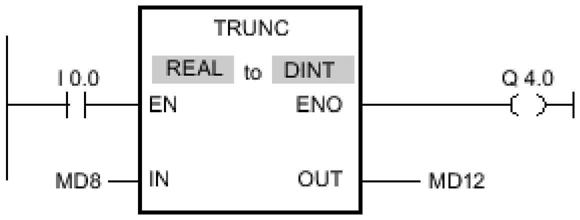


Figure7-2

IN	MD8 = 0.50000000
OUT	MD12 = 0

If the input I 0.0 has signal state "1", the "Truncate numerical value" operation is executed. The integer part of the floating-point number at input MD8 is converted to an integer and sent to the MD12 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 SCALE_X: Scale

Symbol

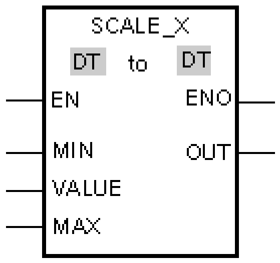


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input

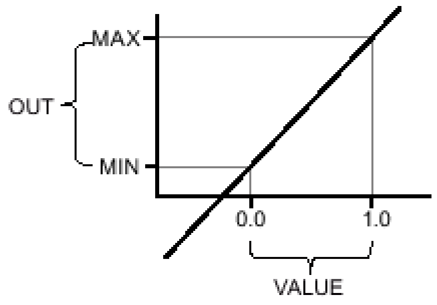
Parameter	Data type	Memory area	Description
ENO	BOOL	I, Q, M, D, L	Enable output
VALUE	REAL	I, Q, M, D, L or constant	Value to be scaled.
MIN	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	Low limit of the value range
MAX	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	High limit of the value range
OUT	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L	Result of scaling

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Scale" operation to scale the value at the VALUE input by mapping it to a specified value range. When the "Scale" operation is executed, the floating-point value at the VALUE input is scaled to the value range, which is defined by the MIN and MAX parameters. The result of the scaling is an integer, which is stored at the OUT output.

The following figure shows an example of how values can be scaled:



The "Scale" operation is only executed if the signal state is "1" at the enable input EN. In this case, the enable output ENO also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".

- The value at the MIN input is greater than or equal to the value at the MAX input.
- The value of a specified REAL tag is outside the range of the normalized numbers according to IEEE-754.
- An overflow occurs.
- The value at input VALUE is NaN (result of an invalid arithmetic operation).

Placement

The "Scale" operation can be placed at any position in the network.

Example

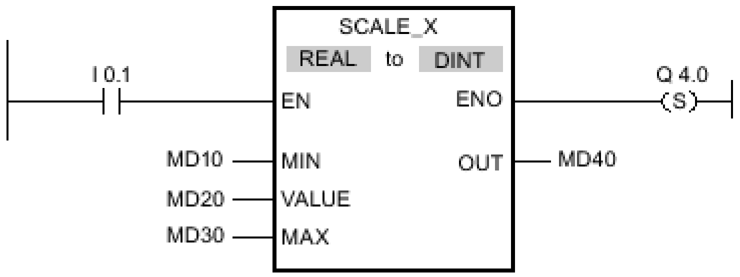


Figure7-2

VALUE	MD20 = 0.5
MIN	MD10 = 10
MAX	MD30 = 30
OUT	MD40 = 20

If input I 0.1 has signal state "1", the "Scale" operation is executed. The value at input MD20 is scaled to the range of values defined by the values at inputs MD10 and MD30. The result is stored at output MD40. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 NORM_X: Standardize

Symbol

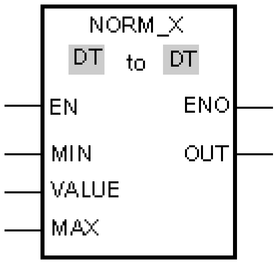


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
VALUE	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	Value to be normalized.
MIN	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	Low limit of the value range
MAX	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	High limit of the value range
OUT	REAL	I, Q, M, D, L	Result of the normalization

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Normalize" operation to normalize the value of the tag at the VALUE input by mapping it to a linear scale. You can use the MIN and MAX parameters to define the limits of a value range that is applied to the scale. The result at the OUT output is calculated and stored as a floating-point number depending on the location of the normalized value in this value range. If the value to be normalized is equal to the value at the MIN input, the OUT output returns the value "0.0". If the value to be normalized is equal to the value at the MAX input, the OUT output has the value "1.0".

The following figure shows an example of how values can be normalized:

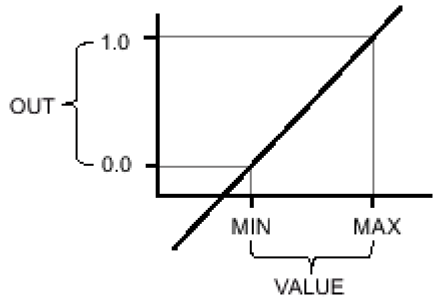


Figure7-2

The "Normalize" operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO enable output has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at the MIN input is greater than or equal to the value at the MAX input.
- The value of a specified REAL tag is outside the range of the normalized numbers according to IEEE-754.
- An overflow occurs.
- The value at input VALUE is NaN (result of an invalid arithmetic operation).

Placement

The "Normalize" operation can be placed at any position in the network.

Example

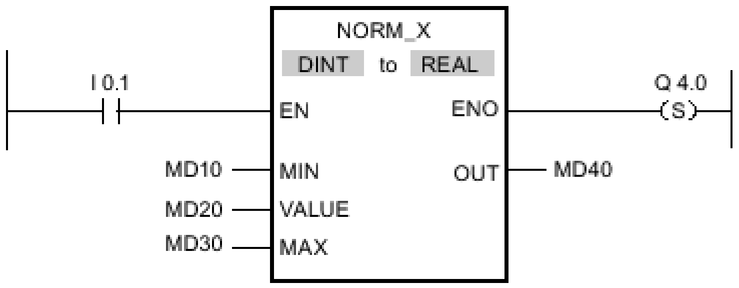


Figure7-2

VALUE	MD20 = 20
MIN	MD10 = 10
MAX	MD30 = 30
OUT	MD40 = 0.5

If input I 0.1 has signal state "1", the "Normalize" operation is executed. The value at input MD20 is assigned to value range defined by the values at inputs MD10 and MD30. The tag value at the input MD20 is normalized corresponding to the defined value range. The result is stored as a floating-point number in output MD40. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 Program control

7.8.1.1 ---

Symbol

<jump label>

--- (JMP)

Description

You can use the "Jump in block if 1 (conditionally)" operation to interrupt the linear execution of the program and resume it in another network. The target network must be identified by a jump label. The name of this jump label is specified for execution of the operation. The specified jump label is located above the operation.

The specified jump label must be in the same block in which the operation is executed. The name you specify can only occur once in the block.

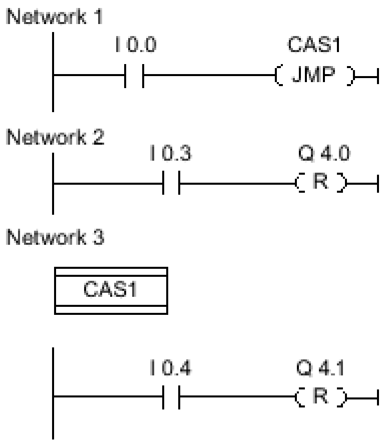
If the result of logic operation (RLO) at the input of the operation is "1", the jump to the network identified by the jump label is executed. The jump direction can be towards higher or lower network numbers.

If the condition at the input of the operation is not fulfilled (RLO = 0), execution of the program continues in the next network.

Placement

The "Jump in block if 1 (conditionally)" operation can only be placed at the right-side edge of the network.

Example



If input I 0.0 has signal state "1", the "Jump in block if 1 (conditionally)" operation is executed. The linear execution of the program is interrupted and continues in Network 3, which is identified by the jump label CAS1. If input I 0.4 has signal state "1", output Q 4.1 is reset.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)

7.8.1.1 ---

Symbol

<jump label>

--- (JMPN)

Description

You can use the "Jump in block if 0 (conditionally)" operation to interrupt the linear execution of the program and resume it in another network, when the result of logic operation at the input of the operation is "0". The target network must be identified by a jump label. The name of this jump label is specified for execution of the operation. The specified jump label is located above the operation.

The specified jump label must be in the same block in which the operation is executed. The name you specify can only occur once in the block.

If the result of logic operation (RLO) at the input of the operation is "0", the jump to the network identified by the jump label is executed. The jump direction can be towards higher or lower network numbers.

If the result of the logic operation at the input of the operation is "1", execution of the program continues in the next network.

Placement

The "Jump in block if 0 (conditionally)" operation requires a preceding logic operation and can only be placed at the right side of the network.

Example

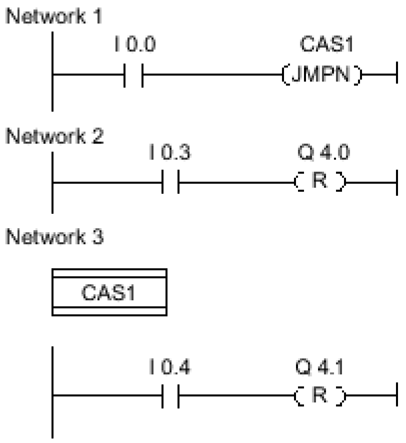


Figure7-2

If input I 0.0 has signal state "0", the "Jump in block if 0 (conditionally)" operation is executed. The linear execution of the program is interrupted and continues in Network 3, which is identified by the jump label CAS1. If input I 0.4 has signal state "1", output Q 4.1 is reset.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)

7.8.1.1 LABEL: Jump label

Symbol

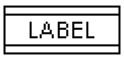


Figure7-2

Description

You can use "Jump label" to specify a destination network, in which the program execution should resume after a jump. The name of the jump label can consist of letters, numbers or underscores.

The jump label and the operation in which the jump label is specified must be located in the same block. The name of a jump label can only be assigned once in a block.

Each jump label can jump to several locations.

Example

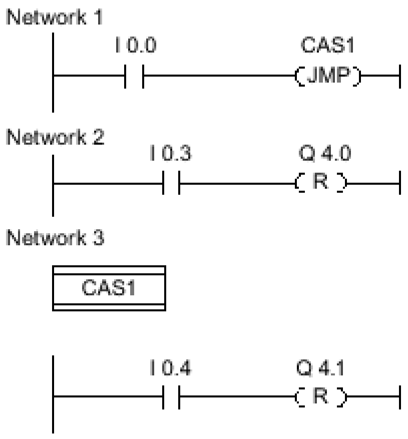


Figure7-2

If input I 0.0 has signal state "1", the "Jump in block if 1 (conditionally)" operation is executed. The linear execution of the program is interrupted and continues in Network 3, which is identified by the jump label CAS1. If input I 0.4 has signal state "1", output Q 4.1 is reset.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)

7.8.1.1 --

Symbol

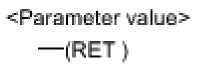


Figure7-2

Parameter values	Data type	Memory area	Description
TRUE	-	-	The status of the call function is set to "1".
FALSE	-	-	The status of the call function is set to "0".
<Operand>	BOOL	I, Q, M, L, D (Page 318)	The status of the call function is set to the signal state of the specified operand.

Description

You can use the "Return" operation to stop the execution of a block. The operation is then only executed if the signal state at the left connector is "1". If this condition is fulfilled, program execution is terminated in the currently called block and continued after the call function in the calling block (for example in the calling OB). The status of the call function is determined by the parameter of the "Return" operation. This can assume the following values:

- TRUE: Output ENO of the call function is set to "1".
- FALSE: Output ENO of the call function is reset to "0".
- <Operand>: Output ENO of the call function is determined by the signal state of the specified operand.

If an organization block is terminated by the "Return" operation, the CPU continues in the system program.

If the signal state at the input of the "Return" operation is "0", the operation is not executed. In this case, program execution continues in the next network of the called block.

Placement

The "Return" operation can be assigned to the left or right side of the network.

Example

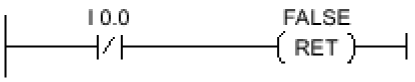


Figure7-2

If the input I 0.0 has signal state "0", the "Return" operation is executed. Program execution in the called block is terminated and continues in the calling block. Output ENO of the call function is reset to signal state "0".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)

7.8.1.1 Logical operations

7.8.1.1 AND: AND logic operation

Symbol

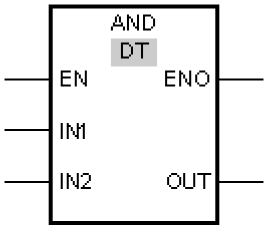


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	BYTE, WORD, DWORD	I, Q, M, L, D or constant	First value for logic operation
IN2	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Second value for logic operation
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "AND logic operation" to link the value at the IN1 input to the value at the IN2 input bit-by-bit by AND logic and query the result at the OUT output.

When the operation is executed, bit 0 of the value at the IN1 input is linked by AND to bit 0 of the value at the IN2 input. The result is stored in bit 0 of the OUT output. The same logic operation is executed for all other bits of the specified values.

The result bit has signal state "1" only when both of the bits in the logic operation also have signal state "1". If one of the two bits of the logic operation has signal state "0", the corresponding result bit is reset.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "AND logic operation" can be placed at any position in the network.

Example

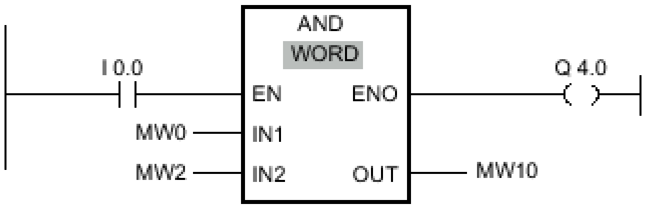


Figure7-2

IN1	MW0 = 01010101 01010101
IN2	MW2 = 00000000 00001111
OUT	MW10= 00000000 00000101

If input I 0.0 has signal state "1", the "AND logic operation" is executed. The value at the MW0 input is linked by AND logic to the value at the MW2 input. The result is mapped bit-for-bit and sent to the MW10 output. Output ENO and output Q 4.0 are set to signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 OR: OR logic operation

Symbol

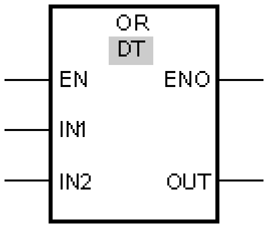


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input

Parameter	Data type	Memory area	Description
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	BYTE, WORD, DWORD	I, Q, M, L, D or constant	First value for logic operation
IN2	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Second value for logic operation
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "OR logic operation" to link the value at the IN1 input to the value at the IN2 input bit-by-bit by OR logic and query the result at the OUT output.

When the operation is executed, bit 0 of the value at the IN1 input is linked by OR to bit 0 of the value at the IN2 input. The result is stored in bit 0 of the OUT output. The same logic operation is executed for all bits of the specified tags.

The result bit has signal state "1" when at least one of the two bits in the logic operation has signal state "1". If both of the bits of the logic operation have signal state "0", the corresponding result bit is reset.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "OR logic operation" can be placed at any position in the network.

Example

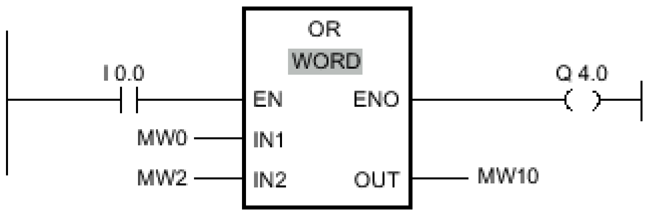


Figure7-2

IN1	MW0 = 01010101 01010101
IN2	MW2 = 00000000 00001111
OUT	MW10= 01010101 01011111

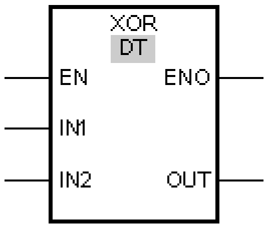
If input I 0.0 has signal state "1", the "OR logic operation" is executed. The value at the MW0 input is linked by OR logic to the value at the MW2 input. The result is mapped bit-for-bit and sent to the MW8 output. Output ENO and output Q 4.0 are set to signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 XOR: EXCLUSIVE OR logic operation

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	BYTE, WORD, DWORD	I, Q, M, L, D or constant	First value for logic operation
IN2	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Second value for logic operation
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "EXCLUSIVE OR logic operation" to link the value at the IN1 input to the value at the IN2 input bit-by-bit by EXCLUSIVE OR logic and query the result at the OUT output.

When the operation is executed, bit 0 of the value at the IN1 input is linked by EXCLUSIVE OR to bit 0 of the value at the IN2 input. The result is stored in bit 0 of the OUT output. The same logic operation is executed for all other bits of the specified value.

The result bit has signal state "1" when one of the two bits in the logic operation has signal state "1". If both of the bits of the logic operation have signal state "1" or "0", the corresponding result bit is reset.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "EXCLUSIVE OR logic operation" can be placed at any position in the network.

Example

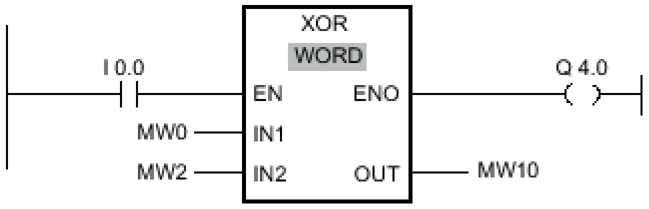


Figure7-2

IN1	MW0 = 01010101 01010101
IN2	MW2 = 00000000 00001111
OUT	MW10= 01010101 01011010

If input I 0.0 has signal state "1", the "EXCLUSIVE OR logic operation" is executed. The value at the MW0 input is linked by EXCLUSIVE OR logic to the value at the MW2 input. The result is mapped bit-for-bit and sent to the MW8 output. Output ENO and output Q 4.0 are set to signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 INV: Create ones complement

Symbol

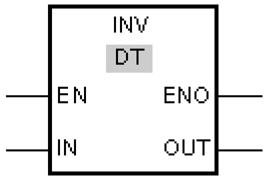


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	BYTE, WORD, DWORD, USINT, UINT, UDINT, SINT, INT, DINT	I, Q, M, D, L or constant	Input value
OUT	BYTE, WORD, DWORD, USINT, UINT, UDINT, SINT, INT, DINT	I, Q, M, D, L	Ones complement of the value at input IN

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Create ones complement" operation to invert the signal status of the bits at the IN input. When the operation is executed, the value at the IN input is linked by EXCLUSIVE OR to a hexadecimal mask (W#16#FFFF for 16-bit numbers or DW#16#FFFF FFFF for 32-bit number). This inverts the signal state of the individual bits that are then stored in the OUT output.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Create ones complement" operation can be placed at any position in the network.

Example

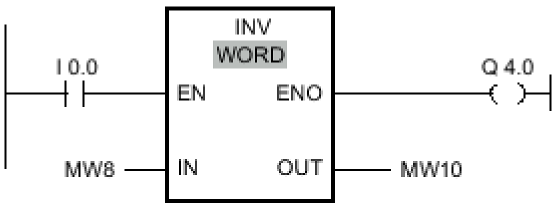


Figure7-2

IN	MW8 = W#16#000F
OUT	MW10 = W#16#FFF0

If input I 0.0 has signal state "1", the "Create ones complement" operation is executed. The operation inverts the signal state of the individual bits at the MW8 input and writes the result to the MW10 output. Output ENO and output Q 4.0 are set to signal state "1".

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 DECO: Decode

Symbol

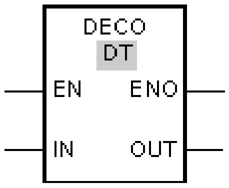


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L.	Enable output
IN	UINT	I, Q, M, D, L or constant	Input value
OUT	BYTE, WORD, DWORD	I, Q, M, D, L	Output value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Decode" operation to set a bit in the output value specified by the input value.

The "Decode" operation reads the value at the IN input and sets the bit in the output value, whose bit position corresponds to the value read. The other bits in the output value are filled with zeroes. When the value at the IN input is greater than 31, a modulo 32 operation is executed.

The "Decode" operation can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Decode" operation can be placed at any position in the network.

Example

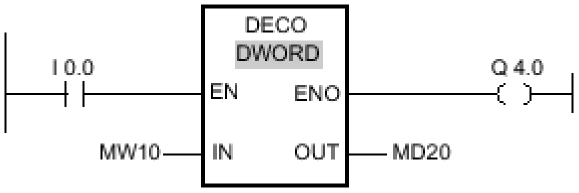


Figure7-2

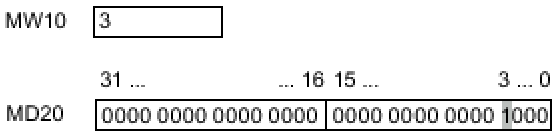


Figure7-2

If the input I 0.0 has signal state "1", the "Decode" operation is executed. The operation reads bit number "3" from the value at the MW10 input and set the third bit to the value at the MD20 output.

If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 ENCO: Encode

Symbol

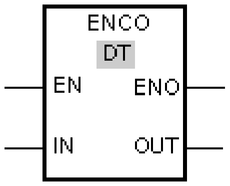


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L.	Enable output
IN	BYTE, WORD, DWORD	I, Q, M, D, L or constant	Input value
OUT	INT	I, Q, M, D, L	Output value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can used the "Encode" operation to read the bit number of the least significant set bit in the input value and send it to the OUT output.

The "Encode" operation selects the least significant bit of the value at input IN and writes this bit number to the tag at the OUT output.

The "Encode" operation can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Encode" operation can be placed at any position in the network.

Example

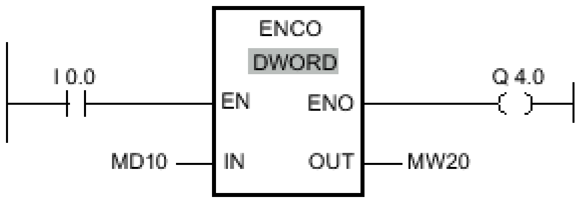


Figure7-2

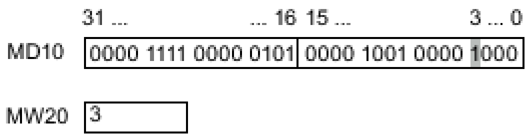


Figure7-2

If the input I 0.0 has signal state "1", the "Encode" operation is executed. The operation selects the least significant bit set at the MD10 input and writes bit position 3 to the tag at the MW20 output.

If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 SEL: Select

Symbol

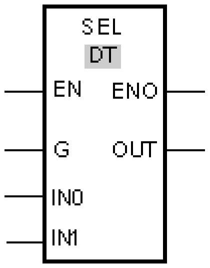


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
G	BOOL	I, Q, M, D, L	Selection switch
IN0	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT, REAL, TIME, CHAR	I, Q, M, D, L or constant	First input value
IN1	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT, REAL, TIME, CHAR	I, Q, M, D, L or constant	Second input value
OUT	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT, REAL, TIME, CHAR	I, Q, M, D, L	Value of the selected input

You can select the data type for the operation from the "DT" drop-down list.

Description

The "Select" operation selects one of the inputs IN0 or IN1 depending on a switch (parameter G) and copies its content to the OUT output. If parameter G has signal state "0", the value at input IN0 is copied. When the G parameter has the signal status "1", the value at the IN1 input is copied to the OUT output.

The operation is only executed if the signal state is "1" at the enable input EN. If no error occurs during execution, the ENO output also has signal state "1".

The ENO enable output is reset when the EN enable input has signal state "0" or errors occur during execution of the operation.

Placement

The "Select" operation can be placed at any position in the network.

Example

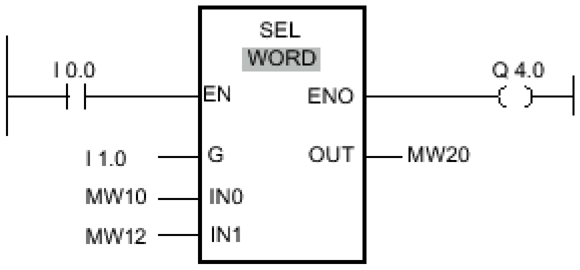


Figure7-2

G	I 1.0 = 1
IN0	MW10 = W#16#0000
IN1	MW12 = W#16#FFFF
OUT	MW20 = W#16#FFFF

If the input I 0.0 has signal state "1", the "Select" operation is executed. Based on the signal status at the input I 1.0, the value at the MW12 input is selected and copied to the MW20 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 MUX: Multiplex

Symbol

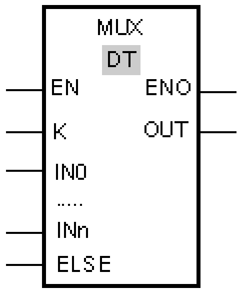


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
K	UINT	I, Q, M, D, L	Specifies the input whose content is to be copied.
IN0	BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, SINT, USINT, REAL, CHAR, TIME	I, Q, M, D, L or constant	First available input
INn	BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, SINT, USINT, REAL, CHAR, TIME	I, Q, M, D, L or constant	Available input
ELSE	BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, SINT, USINT, REAL, CHAR, TIME	I, Q, M, D, L or constant	Specifies the value to be copied with K > n.
OUT	BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, SINT, USINT, REAL, CHAR, TIME	I, Q, M, D, L	Output to which the value is to be copied.

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Multiplex" operation to copy the content of a selected input to the OUT output. The number of selectable inputs of the MUX box can be expanded. The inputs are automatically numbered in the box. Numbering starts at IN0 and is incremented continuously with each new input. You can use the K parameter to determine the input whose content should be copied to the OUT output. If the value of the K parameter is greater than the number of available inputs, the content of the ELSE parameter is copied to the OUT output and the enable output ENO is assigned signal state "0".

The "Multiplex" operation can only be executed, when the tags at all inputs and at the OUT output are from the same data type. The K parameter is an exception, since only integers can be specified for it.

The operation is only executed if the signal state is "1" at the enable input EN. If no error occurs during execution, the ENO output also has signal state "1".

The enable output ENO is reset if one of the following conditions applies:

- The enable input EN has signal state "0".

- The value of the K parameter is greater than the number of available inputs.
- Errors occurred during processing of the operation.

Placement

The "Multiplex" operation can be placed at any position in the network.

Example

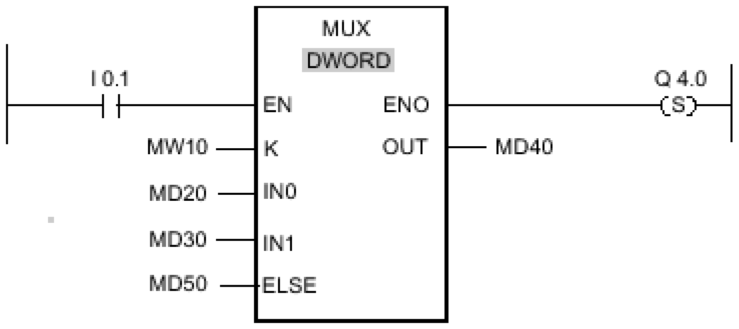


Figure7-2

K	MW10 = 1
IN0	MD20 = DW#16#00000000
IN1	MD30 = DW#16#FFFFFFFF
ELSE	MD50 = DW#16#FFFF0000
OUT	MD40 = DW#16#FFFFFFFF

If the input I 0.1 has signal state "1", the "Multiplex" operation is executed. Based on the value at the MW10 input, the value at the MD30 input is copied and assigned to the tag at the MD40 output. If no error occurs during execution of the operation, the outputs ENO and Q 4.0 are set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 Shift + rotate

7.8.1.1 SHR: Shift right

Symbol

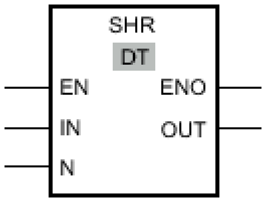


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	BYTE, WORD, DWORD, USINT, UINT, UDINT, SINT, INT, DINT	I, Q, M, L, D or constant	Value to be shifted.
N	UINT	I, Q, M, L, D or constant	Number of bit positions by which the value is shifted.
OUT	BYTE, WORD, DWORD, USINT, UINT, UDINT, SINT, INT, DINT	I, Q, M, L, D	Result of the shift operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Shift right" operation to shift the content of the tag at the IN input bit-by-bit to the right and query the result at the OUT output. You can use the N parameter to specify the number of bit positions by which the specified value should be shifted.

When the N parameter has the value "0", the value at the IN input is copied to the tag at the OUT output.

When the value at the N parameter is greater than the number of bit positions, the tag value at IN input is moved by the available number of bit positions to the right.

The freed bit positions in the left area of the tag are filled by zeroes when values without signs are shifted. If the specified value has a sign, the free bit positions are filled with the signal state of the sign bit.

The following figure show how the content of a integer data type tag is shifted four bit positions to the right:

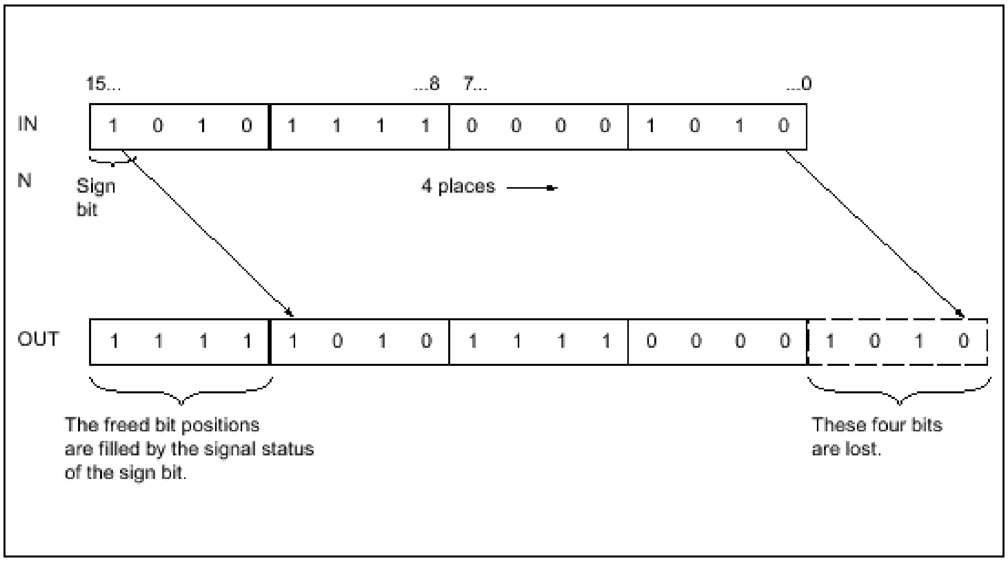


Figure7-2

The "Shift right" operation is only executed if the signal state is "1" at the enable input EN. In this case, the enable output ENO also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The **Shift right** operation can be placed anywhere in the network.

Example

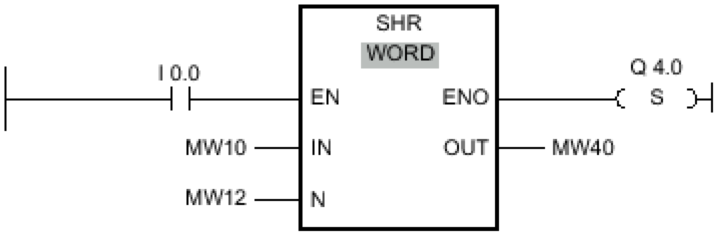


Figure7-2

IN	MW10 = 0011 1111 1010 1111
N	MW12 = 3
OUT	MW40 = 0000 0111 1111 010 1

If input I 0.0 has signal state "1", the "Shift right" operation is executed. The content of the MW10 tag is shifted three bit positions to the right. The result is stored at the MW40 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 SHL: Shift left

Symbol

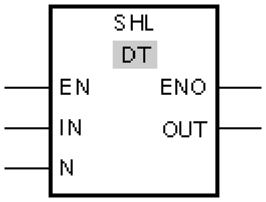


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, L, D or constant	Value to be shifted.
N	UINT	I, Q, M, L, D or constant	Number of bit positions by which the value is shifted.
OUT	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, L, D	Result of the shift operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Shift left" operation to shift the content of the tag at the IN input bit-by-bit to the left and query the result at the OUT output. You can use the N parameter to specify the number of bit positions by which the specified value should be shifted.

When the N parameter has the value "0", the value at the IN input is copied to the tag at the OUT output.

When the value at the N parameter is greater than the number of bit positions, the tag value at IN input is moved by the available number of bit positions to the left.

The bit positions in the right part of the tag freed by shifting are filled with zeros.

The following figure show how the content of a WORD data type tag is shifted six bit positions to the left:

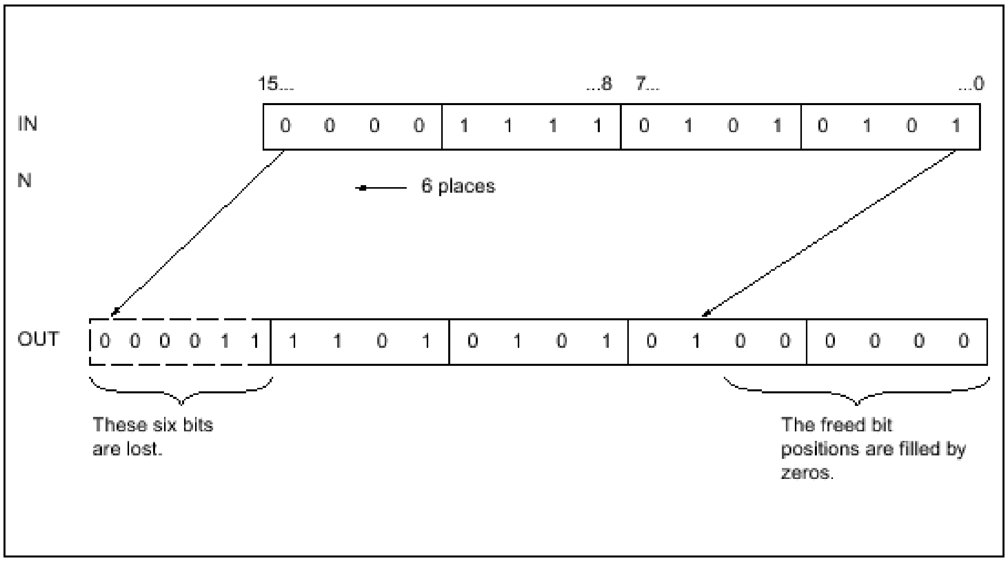


Figure7-2

The "Shift left" operation is only executed if the signal state is "1" at the enable input EN. In this case, the enable output ENO also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Shift left" operation can be placed anywhere in the network.

Example

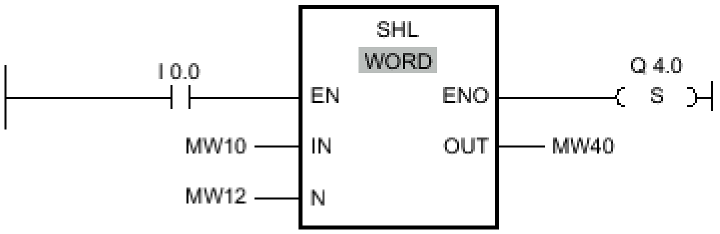


Figure7-2

IN	MW10 = 0011 1111 1010 1111

N	MW12 = 4
OUT	MW40 = 1111 1010 1111 0000

If input I 0.0 has signal state "1", the "Shift left" operation is executed. The content of the MW10 tag is shifted four bit positions to the left. The result is stored at the MW40 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 ROR: Rotate right

Symbol

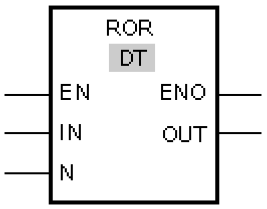


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Value to be rotated.
N	UINT	I, Q, M, L, D or constant	Number of bit positions by which the value is rotated.
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Rotate right" operation to rotate the content of the tag at the IN input bit-by-bit to the right and query the result at the OUT output. The N parameter specifies the number of bit positions by which the specified value will be rotated. The bit positions freed by rotating are filled with the bit positions that are pushed out.

When the N parameter has the value "0", the value at the IN input is copied to the tag at the OUT output.

When the value at the N parameter is greater than the number of bit positions, the tag value at IN input is rotated by the available number of bit positions.

The following figure show how the content of a DWORD data type tag is rotated three bit positions to the right:

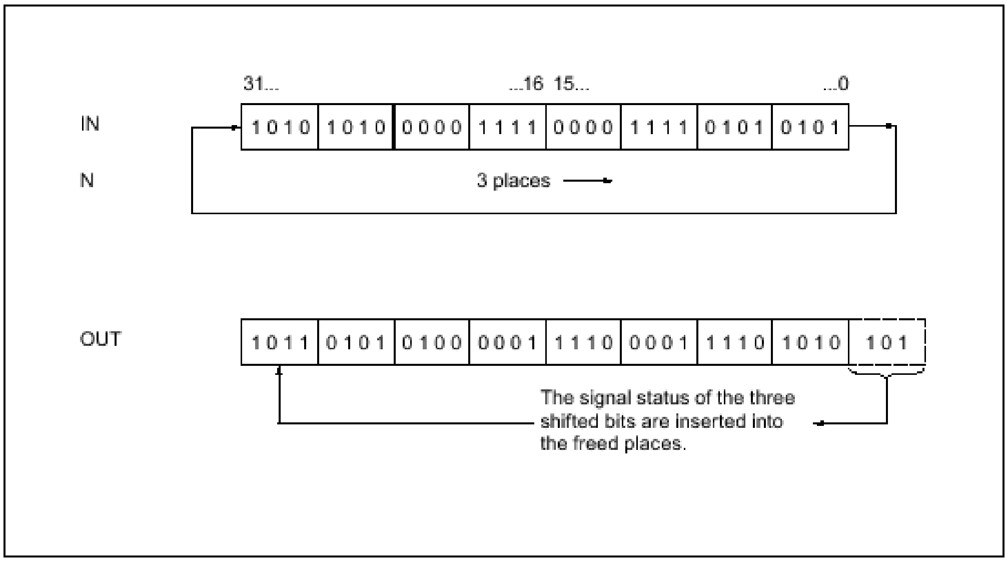


Figure7-2

The "Rotate right" operation is only executed if the signal state is "1" at the enable output ENO. In this case, the enable output ENO also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Rotate right" operation can be placed anywhere in the network.

Example

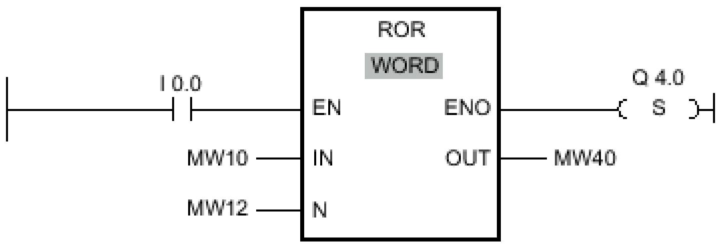


Figure7-2

IN	MW10 = 0000 1111 1001 0101
N	MW12 = 5
OUT	MW40 = 1010 1000 0111 1100

If input I 0.0 has signal state "1", the "Rotate right" operation is executed. The content of the MW10 tag is rotated five bit positions to the right. The result is stored at the MW40 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.1 ROL: Rotate left

Symbol

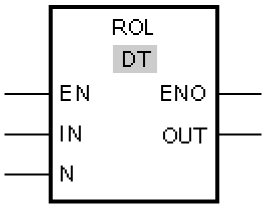


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Value to be rotated.
N	UINT	I, Q, M, L, D or constant	Number of bit positions by which the value is rotated.
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Rotate left" operation to rotate the content of the tag at the IN input bit-by-bit to the left and query the result at the OUT output. The N parameter specifies the number of bit positions by which the specified value will be rotated. The bit positions freed by rotating are filled with the bit positions that are pushed out.

When the N parameter has the value "0", the value at the IN input is copied to the tag at the OUT output.

When the value at the N parameter is greater than the number of bit positions, the tag value at IN input is rotated by the available number of bit positions.

The following figure show how the content of a DWORD data type tag is rotated three bit positions to the left:

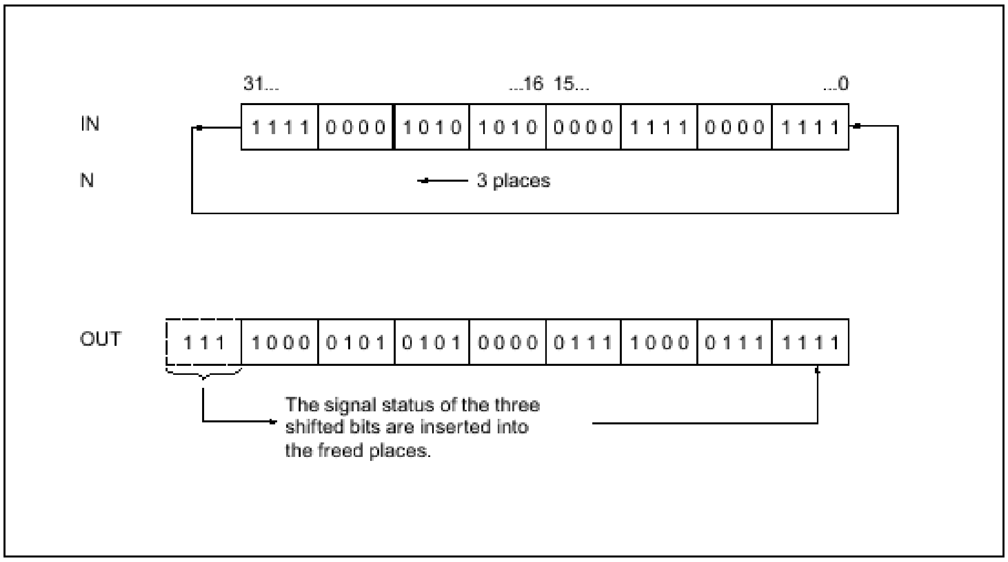


Figure7-2

The "Rotate left" operation is only executed if the signal state is "1" at the enable output ENO. In this case, the enable output ENO also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Rotate left" operation can be placed anywhere in the network.

Example

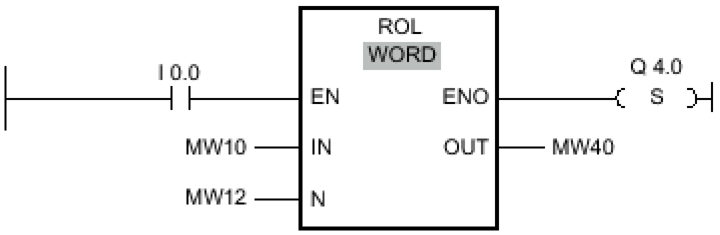


Figure7-2

IN	MW10 = 1010 1000 1111 0110
OUT	MW12 = 5
N	MW40 = 0001 1110 1101 010 1

If input I 0.0 has signal state "1", the "Rotate left" operation is executed. The content of the MW10 tag is rotated five bit positions to the left. The result is stored at the MW40 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting LAD elements (Page 452)
Changing LAD elements (Page 460)
Inserting operands into LAD instructions (Page 0)
Selecting the data type of a LAD element (Page 0)

7.8.1.2 FBD

7.8.1.2 Bit logic

7.8.1.2 AND logic operation

Symbol

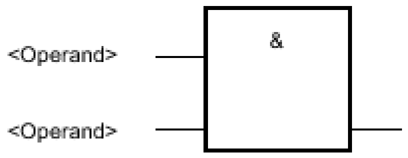


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	The operand indicates the bit whose signal state will be queried.

Description

You can use the "AND" logic operation to query the signal states of two or more specified operands and evaluate them according to the AND truth table.

If the signal state of all the operands is "1", then the conditions are fulfilled and the operation returns the result "1". If the signal state of one of the operands is "0", then the conditions are not fulfilled and the operation generates the result "0".

If the "AND" logic operation is the first operation in a logic string, it saves the result of its signal state query in the RLO bit.

Each "AND" logic operation that is not the first operation in the logic string, logically combines the result of its signal state query with the value saved in the RLO bit. This logical combination is performed according to the AND truth table.

Example

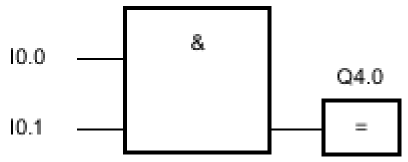


Figure7-2

Output Q 4.0 is set when the signal state is "1" at input I 0.0 AND I 0.1.

See also

AND truth table (Page 800)
Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Example of detecting the direction of a conveyor belt (Page 614)
Example of controlling room temperature (Page 621)

7.8.1.2 AND truth table

Results of the logic operation

Signal state I1.0	Signal state I1.1	Result of the logic operation
1	1	1
0	1	0
1	0	0
0	0	0

See also

AND logic operation (Page 799)

7.8.1.2 OR logic operation

Symbol

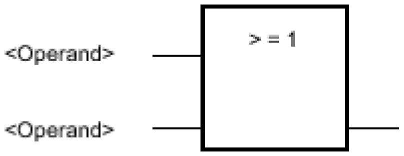


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	The operand indicates the bit whose signal state will be queried.

Description

You can use the "OR" logic operation to query the signal states of two or more specified operands and evaluate them according to the OR truth table.

If the signal state of one of the operands is "1", then the conditions are fulfilled and the operation returns the result "1". If the signal state of all the operands is "0", then the conditions are not fulfilled and the operation generates the result "0".

If the "OR" logic operation is the first operation in a logic string, it saves the result of its signal state query in the RLO bit.

Each "OR" logic operation that is not the first operation in the logic string logically combines the result of its signal state query with the value saved in the RLO bit. This logical combination is performed according to the OR truth table.

Example

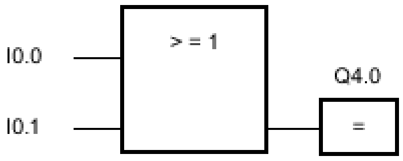


Figure7-2

Output Q 4.0 is set when the signal state is "1" at input I 0.0 OR at input I 0.1.

See also

OR truth table (Page 802)
Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Example of controlling a conveyor belt (Page 613)
Example of detecting the fill level of a storage area (Page 616)

Example of controlling room temperature (Page 621)

7.8.1.2 OR truth table

Results of the logic operation

Signal state I1.0	Signal state I1.1	Result of the logic operation
1	0	1
0	1	1
1	1	1
0	0	0

See also

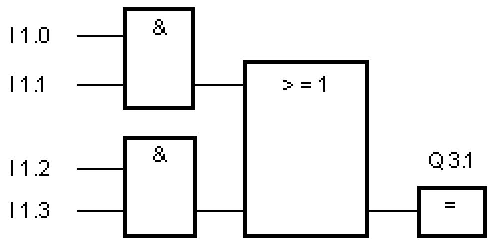
OR logic operation (Page 801)

7.8.1.2 AND-before-OR logic operation and OR-before-AND logic operation

Description

With an "AND-before-OR" logic operation, you can query the result of a signal state query according to the OR truth table. With an AND-before-OR logic operation, the signal state is 1 when at least one AND logic operation is fulfilled.

Example



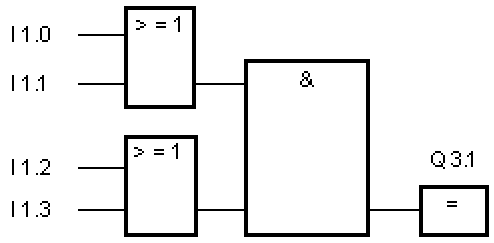
Output Q 3.1 is set when at least one AND logic operation is fulfilled.

Output Q 3.1 is reset when no AND logic operation is fulfilled.

Description

With an "OR-before-AND" logic operation, you can query the result of a signal state query according to the AND truth table. With an OR logic operation, the signal state is 1 when all OR logic operations are fulfilled.

Example



Output Q 3.1 is set when both OR logic operations are fulfilled.

Output Q 3.1 is reset when one or both OR logic operations are not fulfilled.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 X: EXCLUSIVE OR logic operation

Symbol

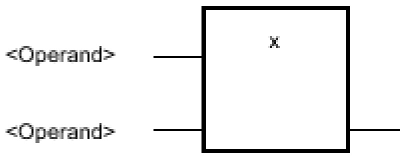


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	The operand indicates the bit whose signal state will be queried.

Description

You can use the "EXCLUSIVE OR" operation to query the result of a signal state query according to the the EXCLUSIVE OR truth table.

With an "EXCLUSIVE OR" operation, the signal state is "1" when the signal state of one of the two specified operands is "1". When XOR elements are used to query more than two operands, the common result is "1" if an odd number of the queried operands returns the result "1".

Example

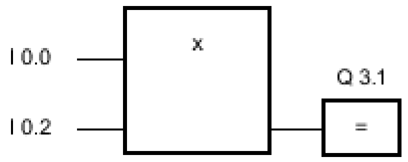


Figure7-2

Output Q 3.1 is set when the signal state is "1" either at input I 0.0 OR at input I 0.2 EXCLUSIVELY.

See also

EXCLUSIVE OR truth table (Page 804)
Inserting FBD elements (Page 484)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 EXCLUSIVE OR truth table

Results of the logic operation

Signal state I1.0	Signal state I1.1	Result of the logic operation
1	0	1
0	1	1
1	1	0
0	0	0

See also

Changing FBD elements (Page 492)

7.8.1.2 Insert binary input

Symbol

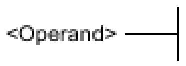


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	The operand indicates the bit whose signal state will be queried.

Description

You can use the "Insert binary input" operation to add a further binary input to an AND, OR, or XOR box after the marker.

Example

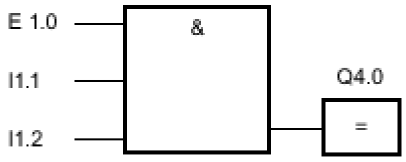


Figure7-2

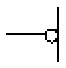
Output Q 4.0 is set when the inputs I 1.0 AND I 1.1 AND I 1.2 have signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 Negate binary value

Symbol



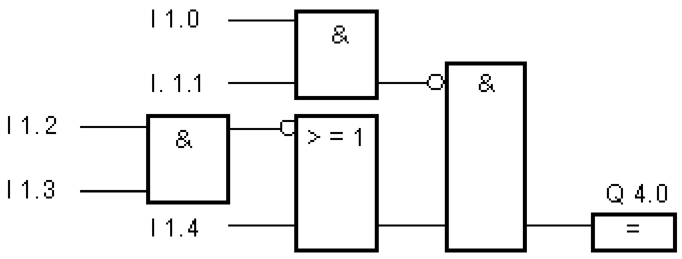
Description

You can use the "Negate binary value" operation to invert the result of logic operation of an operation.

If the result of logic operation is negated, remember the following rules:

- If the result of logic operation at the first input of an AND or OR box is negated, there is no nesting.
- If the result of logic operation is negated but not at the first input of an OR box, the entire binary logic operation before the input is included in the OR logic operation.
- If the result of logic operation is negated but not at the first input of a AND box, the entire binary logic operation before the input is included in the AND logic operation.

Example



Output Q 4.0 is set when the following conditions are fulfilled:

- Inputs I 1.0 AND I 1.1 have signal state "0".
- Inputs I 1.2 AND I 1.3 have signal state "0" OR input I 1.4 has signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Example of detecting the direction of a conveyor belt (Page 614)
Example of detecting the fill level of a storage area (Page 616)
Example of controlling room temperature (Page 621)

7.8.1.2 =: Assignment

Symbol

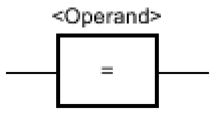


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	Operand which is set with RLO = "1".

Description

You can use the "Assignment" operation to set the bit of a specified operand. If the result of logic operation (RLO) at the box input has signal state "1", the specified operand is set to signal state "1". If the signal state at the box input is "0", the bit of the specified operand is reset to "0".

The operation does not influence the RLO. The RLO at the box input is transferred directly to the box output.

Placement

The "Assignment" operation can be placed at any position in the logic string.

Example

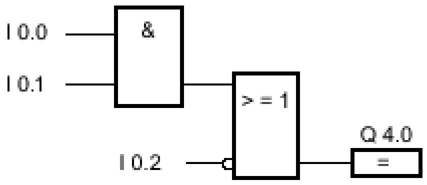


Figure7-2

Output Q 4.0 is set when one of the following conditions is fulfilled:

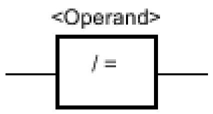
- Inputs I 0.0 AND I 0.1 have signal state "1".
- The signal state at input I 0.2 is "0".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Example of detecting the fill level of a storage area (Page 616)
Example of controlling room temperature (Page 621)

7.8.1.2 /=: Negate assignment

Symbol



Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	Operand which is set with RLO = "0".

Description

The "Negate assignment" operation inverts the result of logic operation (RLO) and assigns this to the operand above the box. If the RLO at the input of the box is "1", the binary operand is reset. If the RLO at the input of the box is "0", the binary operand is set to signal state "1".

The operation does not influence the RLO. The RLO at the box input is transferred directly to the box output.

Placement

The "Negate assignment" operation can be placed at any position in the logic string.

Example

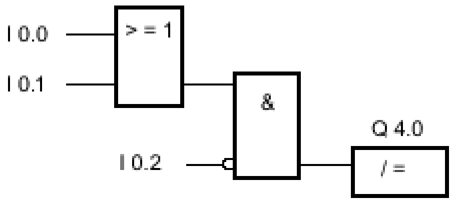


Figure7-2

Output Q 4.0 is reset when the following conditions are fulfilled:

- Inputs I 0.0 OR I 0.1 have signal state "1".
- The signal state at input I 0.2 is "0".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 R: Reset output

Symbol

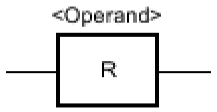


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	Operand that is reset when RLO = "0".

Description

You can use the "Reset output" operation to reset the signal state of a specified operand to "0".

The operation is only executed if the result of logic operation (RLO) is "1" at the box input. If the box input has signal state "1", the specified operand is reset to "0". If there is a result of logic operation of "0" at the box input, the signal state of the specified operand remains unchanged.

The operation does not influence the RLO. The RLO at the box input is transferred directly to the box output.

Placement

The "Reset output" operation can be placed at any position in the logic string.

Example

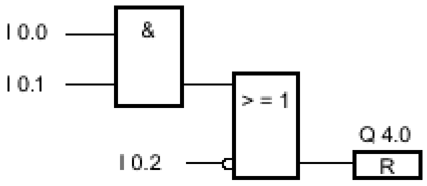


Figure7-2

Output Q 4.0 is reset when one of the following conditions is fulfilled:

- Inputs I 0.0 and I 0.1 have signal state "1".
- The signal state at input I 0.2 is "0".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Example of controlling a conveyor belt (Page 613)
Example of detecting the direction of a conveyor belt (Page 614)

7.8.1.2 S: Set output

Symbol

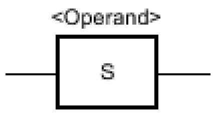


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	Operand which is set with RLO = "1".

Description

You can use the "Set output" operation to set the signal state of a specified operand to "1".

The operation is only executed if the result of logic operation (RLO) is "1" at the box input. If the box input has signal state "1", the specified operand is set to "1". If there is a result of logic operation of "0" at the box input, the signal state of the specified operand remains unchanged.

The operation does not influence the RLO. The RLO at the box input is transferred directly to the box output.

Placement

The "Set output" operation can be placed at any position in the logic string.

Example

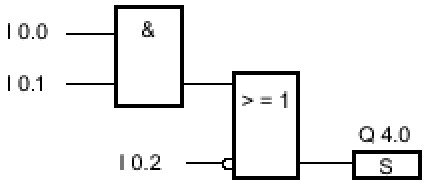


Figure7-2

Output Q 4.0 is set when one of the following conditions is fulfilled:

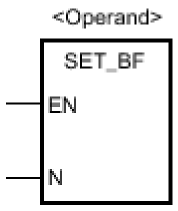
- Inputs I 0.0 AND I 0.1 have signal state "1".
- The signal state at input I 0.2 is "0".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Example of controlling a conveyor belt (Page 613)
Example of detecting the direction of a conveyor belt (Page 614)

7.8.1.2 SET_BF: Set bit field

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Result of the previous logic operation
<Operand>	BOOL	I, Q, M, D, L	Pointer to the first bit to be set
N	UINT	Constant	Number of bits to be set

Description

You can use the "Set bit field" operation to set several bits starting at a specified address. You specify the number of bits to be set with the value of the N parameter. The address of the first bit to be set is specified by the (<Operand>) operand. If the value of the N parameter is greater than the number of bits in a selected byte, the bits of the next byte are set. The bits remain set until they are explicitly reset, for example, by another operation.

The operation is only executed if the signal state at the EN input is "1". If the signal state is "0" at the input EN, the operation is not executed.

Placement

The "Set bit field" operation can be assigned only to the end of the logic string.

Example

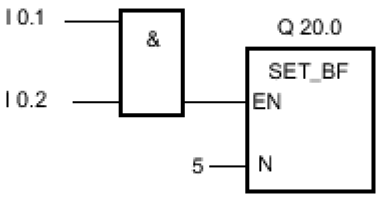


Figure7-2

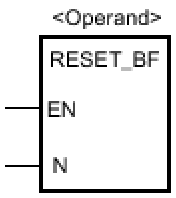
If inputs I 0.1 AND I 0.2 have signal state "1", outputs Q 20.0, Q 20.1, Q 20.2, Q 20.3 and Q 20.4 are set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 RESET_BF: Reset bit field

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Result of the previous logic operation

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L	Pointer to the first bit to be reset
N	UINT	Constant	Number of bits to be reset

Description

You can use the "Reset bit field" operation to reset several bits starting at a specified address. You specify the number of bits to be reset with the value of the N parameter. The address of the first bit to be reset is specified by the (<Operand>) operand. If the value of the N parameter is greater than the number of bits in a selected byte, the bits of the next byte are reset. The bits remain reset until they are explicitly set, for example, by another operation.

The operation is only executed if the signal state at the EN input is "1". If the signal state is "0" at the input EN, the operation is not executed.

Placement

The "Reset bit field" operation can be assigned only to the end of the logic string.

Example

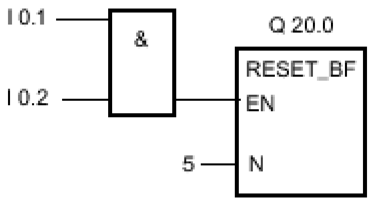


Figure7-2

If inputs I 0.0 AND I 0.1 have signal state "1", outputs Q 20.0, Q 20.1, Q 20.2, Q 20.3 and Q 20.4 are reset.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 SR: Set reset flip-flop

Symbol

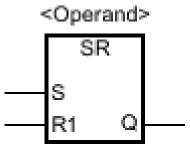


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	Operand that is specified.
S	BOOL	I, Q, M, D, L	Enabled set
R1	BOOL	I, Q, M, D, L	Enabled reset
Q	BOOL	I, Q, M, D, L	Signal state of the specified operand

Description

You can use the "Set reset flip-flop" operation to set or reset the bit of the specified operand based on the signal state of the inputs S and R1. If the signal state at input S is "1" and is "0" at input R1, the specified operand is set to "1". If the signal state at input S is "0" and is "1" at input R1, the specified operand is reset to "0".

Input R1 takes priority over input S. If the signal state is "1" at the two inputs S and R1, the signal state of the specified operand is reset to "0".

The operation is not executed if the signal state at the two inputs R and S1 is "0". The signal state of the operand then remains unchanged.

The current signal state of the operand is transferred to output Q and can be queried there.

Placement

The "Set reset flip-flop" operation can be placed within or at the end of the logic string.

Example

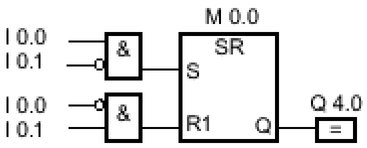


Figure7-2

Bit memory M 0.0 and output Q 4.0 are set when the following conditions are fulfilled:

- Input I 0.0 has signal state "1".
- Input I 0.1 has signal state "0".

Bit memory M 0.0 and output Q 4.0 are reset when the following conditions are fulfilled:

- Input I 0.0 has signal state "0".
- Input I 0.1 has signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 RS: Reset set flip-flop

Symbol

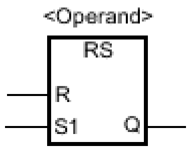


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	Operand that is specified.
R	BOOL	I, Q, M, D, L	Enabled reset
S1	BOOL	I, Q, M, D, L	Enabled set
Q	BOOL	I, Q, M, D, L	Signal state of the specified operand

Description

You can use the "Reset set flip-flop" operation to set or reset the bit of the specified operand based on the signal state of the inputs R and S1. If the signal state at input R is "1" and is "0" at input S1, the specified operand is reset to "0". If the signal state at input R is "0" and is "1" at input S1, the specified operand is set to "1".

Input S1 takes priority over input R. If the signal state is "1" at the two inputs R and S1, the signal state of the specified operand is set to "1".

The operation is not executed if the signal state at the two inputs R and S1 is "0". The signal state of the operand then remains unchanged.

The current signal state of the operand is transferred to output Q and can be queried there.

Placement

The "Reset set flip-flop" operation can be placed within or at the end of the logic string.

Example

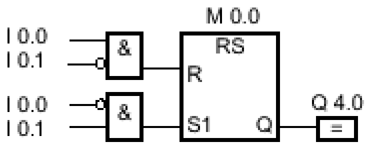


Figure7-2

Bit memory M 0.0 and output Q 4.0 are reset when the following conditions are fulfilled:

- Input I 0.0 has signal state "1".
- Input I 0.1 has signal state "0".

Bit memory M 0.0 and output Q 4.0 are set when the following conditions are fulfilled:

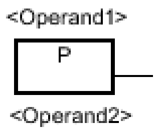
- Input I 0.0 has signal state "0".
- Input I 0.1 has signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 P: Scan positive signal edge at operand

Symbol



Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, D, L (Page 318)	Signal to be queried
<Operand2>	BOOL	I, Q, M, D	Edge memory bit in which the signal state of the previous query is saved.

Description

You can use the "Scan positive signal edge at operand" operation to determine if there is a "0" to "1" change in the signal state of a specified operand (<operand1>). The operation compares the current signal state of <operand1> to the signal state of the previous query saved in <operand2>. If the operation detects a change in the result of logic operation from "0" to "1", there is a positive, rising edge.

If a rising edge is detected, the output of the operation has signal state "1". In all other cases, the signal state at the output of the operation is "0".

Note

The address of the edge memory bit must not be used more than once in the program, otherwise the memory bit would be overwritten. This would influence edge evaluation and the result would no longer be unequivocal.

Placement

The "Scan positive signal edge at operand" operation can be placed at any position in the logic string.

Example

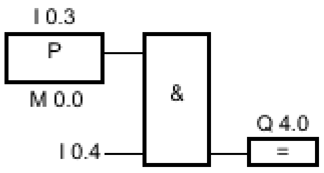


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

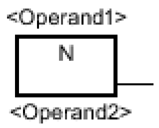
- There is a rising edge at input I 0.3.
- The signal state at input I 0.4 is "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Example of detecting the direction of a conveyor belt (Page 614)

7.8.1.2 N: Scan negative signal edge at operand

Symbol



Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, D, L (Page 318)	Signal to be queried
<Operand2>	BOOL	I, Q, M, D	Edge memory bit in which the signal state of the previous query is saved.

Description

You can use the "Scan negative signal edge at operand" operation to query a change in the signal state from "1" to "0" of a specified operand (<operand1>). The operation compares the current signal state of <operand1> to the signal state of the previous query saved in <operand2>. If the operation detects a change in the result of logic operation from "1" to "0", there is a negative, falling edge.

If a falling edge is detected, the output of the operation has signal state "1".

If no falling edge is detected, the output of the operation has signal state "0".

Note

The address of the edge memory bit must not be used more than once in the program, otherwise the memory bit would be overwritten. This would influence edge evaluation and the result would no longer be unequivocal.

Placement

The "Scan negative signal edge at operand" operation can be placed at any position in the logic string.

Example

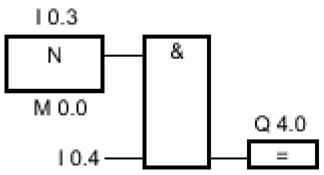


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

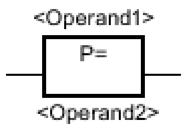
- There is a falling edge at input I 0.3.
- The signal state at input I 0.4 is "1".

See also

Inserting FBD elements (Page 484)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 P=: Set operand on positive signal edge

Symbol



Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, D, L (Page 318)	Operand which is set by a positive edge.
<Operand2>	BOOL	I, Q, M, D	Edge memory bit

Description

You can use the "Set operand on positive signal edge" operation to detect a change in the result of logic operation (RLO) from "0" to "1". When processing the query, the operation compares the current RLO with the RLO of the previous query saved in the edge memory bit. If the operation detects a change in the RLO from "0" to "1", there is a rising, positive edge.

If a positive edge is detected, <operand1> is set to signal state "1" for one program cycle. In all other cases, the operand has signal state "0".

Note

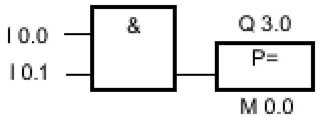
The address of the edge memory bit must not be used more than once in the program, otherwise the memory bit would be overwritten. This would influence edge evaluation and the result would no longer be unequivocal.

The operation does not influence the RLO. The RLO at the input of the box is transferred directly to the output of the box.

Placement

The "Set operand on positive signal edge" operation can be placed either within or at the end of the logic string.

Example



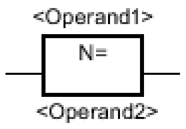
Output Q 3.0 is set for one program cycle if the signal state at the box input changes from "0" to "1" (positive edge). In all other cases, output Q 3.0 has signal state "0".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 N=: Set operand on negative signal edge

Symbol



Parameter	Data type	Memory area	Description
<Operand1>	BOOL	I, Q, M, D, L (Page 318)	Operand which is set by a negative edge.
<Operand2>	BOOL	I, Q, M, D, L	Edge memory bit

Description

You can use the "Set operand on negative signal edge" operation to detect a change in the result of logic operation (RLO) from "1" to "0". When processing the query, the operation compares the current RLO with the RLO of the previous query saved in the edge memory bit. If the operation detects a change in the RLO from "1" to "0", there is a falling, negative edge.

If a negative edge is detected, <operand1> is set to signal state "1" for one program cycle. In all other cases, the operand has signal state "0".

Note

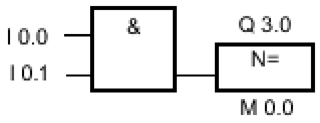
The address of the edge memory bit must not be used more than once in the program, otherwise the memory bit would be overwritten. This would influence edge evaluation and the result would no longer be unequivocal.

The operation does not influence the RLO. The RLO at the input of the box is transferred directly to the output of the box.

Placement

The "Set operand on negative signal edge" operation can be placed either within or at the end of the logic string.

Example



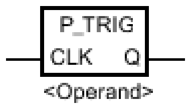
Output Q 3.0 is set for one program cycle if the signal state at the box input changes from "1" to "0" (negative edge). In all other cases, output Q 3.0 has signal state "0".

See also

Inserting FBD elements (Page 484)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 P_TRIG: Set output on positive signal edge

Symbol



Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	Edge memory bit in which the RLO of the last query is saved.
CLK	BOOL	I, Q, M, D, L	Current RLO.
Q	BOOL	I, Q, M, D, L	Result of edge evaluation

Description

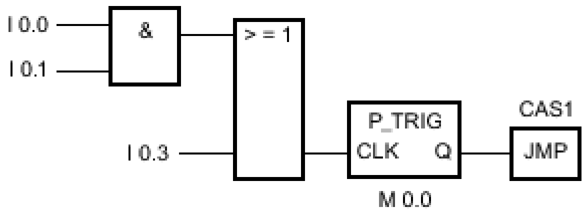
You can use the "Set output on positive signal edge" operation to query a change in the signal state of the result of logic operation from "0" to "1". The operation compares the current signal state of the result of logic operation to the signal state of the previous query saved in the edge memory bit. If the operation detects a change in the RLO from "0" to "1", there is a positive, rising edge.

If a rising edge is detected, the output of the operation has signal state "1". In all other cases, the signal state at the output of the operation is "0".

Placement

The "Set output on positive signal edge" operation can be placed either within or at the end of the logic string.

Example



The RLO of the preceding bit logic operation is saved in the edge memory bit M 0.0. If a "0" to "1" signal change is detected at the RLO, the program jumps to label CAS1.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 N_TRIG: Set output on negative signal edge

Symbol

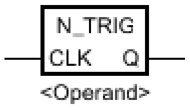


Figure7-2

Parameter	Data type	Memory area	Description
<Operand>	BOOL	I, Q, M, D, L (Page 318)	Edge memory bit in which the RLO of the last query is saved.
CLK	BOOL	I, Q, M, D, L	Current RLO
Q	BOOL	I, Q, M, D, L	Result of edge evaluation

Description

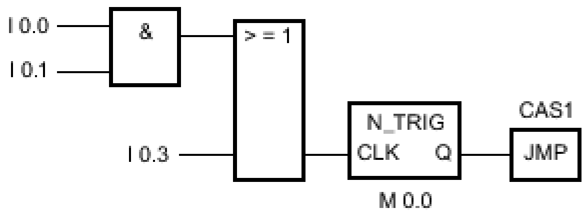
You can use the "Set output on negative signal edge" operation to detect a "1" to "0" change in the signal state of the result of logic operation (RLO). The operation compares the current signal state of the result of logic operation to the signal state of the previous query saved in the edge memory bit. If the operation detects a change in the RLO from "1" to "0", there is a negative, falling edge.

If a falling edge is detected, the output of the operation has signal state "1". In all other cases, the signal state at the output of the operation is "0".

Placement

The "Set output on negative signal edge" operation can be placed either within or at the end of the logic string.

Example



The RLO of the preceding bit logic operation is saved in the edge memory bit M 0.0. If a "1" to "0" signal change is detected at the RLO, the program jumps to jump label CAS1.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 Timers

7.8.1.2 TP: Pulse timer

Symbol

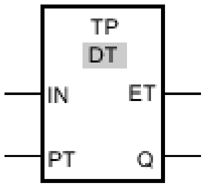


Figure7-2

Parameter	Data type	Memory area	Description
IN	BOOL	I, Q, M, D, L (Page 318)	Start input

Parameter	Data type	Memory area	Description
PT	TIME	I, Q, M, D, L or constant	Duration of the pulse. PT must be positive.
ET	TIME	I, Q, M, D, L	Elapsed time
Q	BOOL	I, Q, M, D, L	Pulse output

Description

You can use the "Generate pulse" operation to set the Q output for a pre-programmed period of time. The operation is started when the result of logic operation (RLO) at the IN input changes from "0" to "1". When the operation is started, the time programmed for PT starts running. Output Q is set for the period of time, PT, regardless of the subsequent course of the input signal. Even when a new positive edge is detected, the signal state at output Q is not affected as long as the PT timer is running.

It is possible to query how long the current timer function has been running at output ET. This time starts at T#0s and ends when the value set for the PT timer is reached. The value at the ET output can be queried as long as the PT timer is running and the input IN has signal state "1".

'When inserting the "Generate pulse" operation, an instance data block is created in which the operation data is saved.

Placement

The "Generate pulse" operation requires a preceding logic operation for the edge evaluation. It can be located within or at the end of the logic string.

Pulse diagram

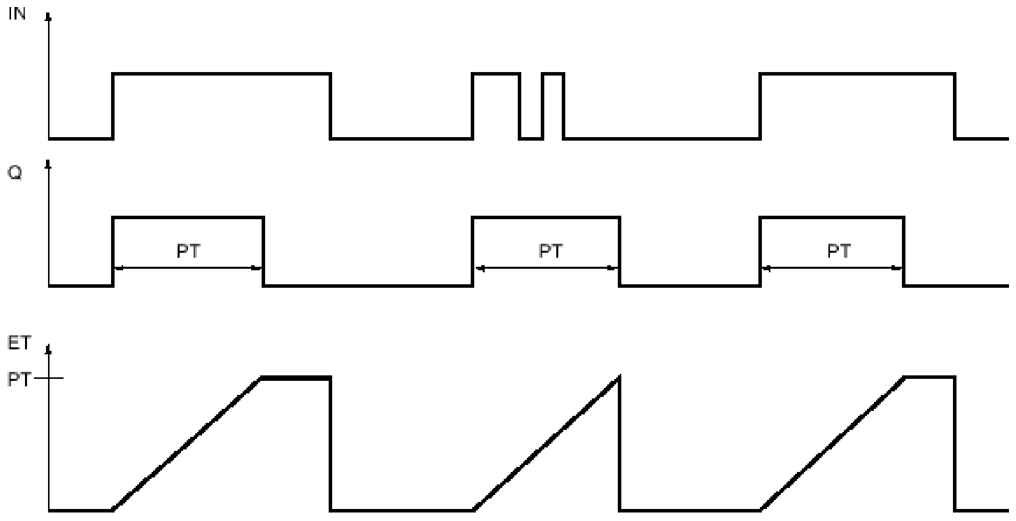


Figure7-2

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 TON: On delay

Symbol

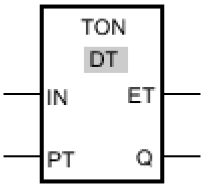


Figure7-2

Parameter	Data type	Memory area	Description
IN	BOOL	I, Q, M, D, L (Page 318)	Start input
PT	TIME	I, Q, M, D, L or constant	Time by which the rising edge is delayed at the IN input.
ET	TIME	I, Q, M, D, L	Elapsed time
Q	BOOL	I, Q, M, D, L	Output, which is delayed by the time PT.

Description

You can use the "On delay" operation to delay a rising edge by the time set at PT. The "On delay" operation is executed when the result of logic operation (RLO) changes from "0" to "1" at input IN (rising edge). When the operation is started, the time set for PT starts running. When the PT time expires, output Q has signal state "1". Output Q remains set as long as the start input is still "1". If there is a signal change at the start input from "1" to "0", output Q is reset. The timer function is started again when a new positive edge is detected at the start input.

The ET output supplies the time that has elapsed since the last rising edge at the IN input. This time starts at T#0s and ends when the value set for the PT timer is reached. The elapsed time can be queried at output ET as long as input IN has signal state "1". If input IN changes to "0", output ET is reset to the value T#0.

'When inserting the "On delay" operation, an instance data block is created in which the operation data is saved.

Placement

The "On delay" operation requires a preceding logic operation for the edge evaluation. It can be located within or at the end of the logic string.

Pulse diagram

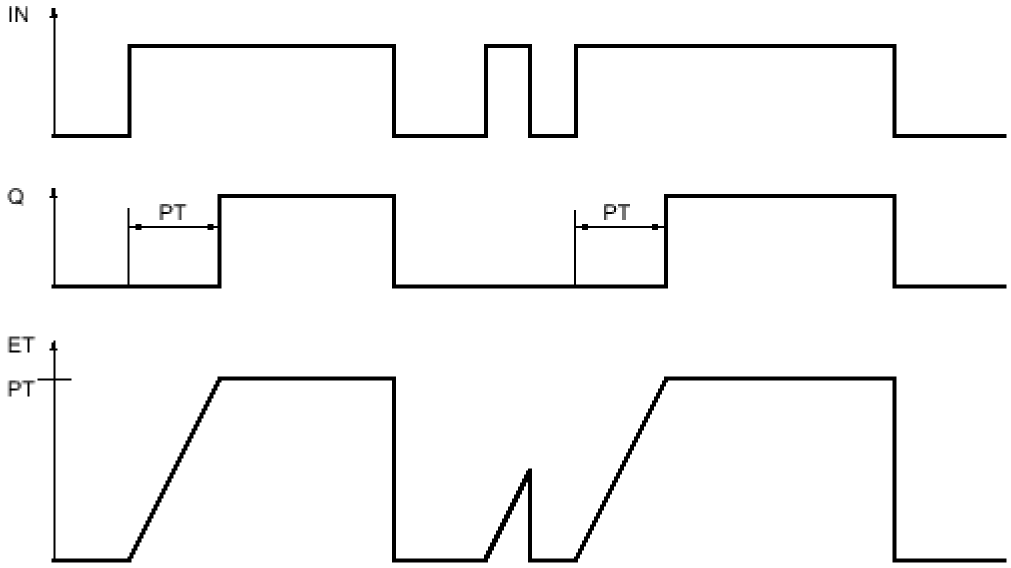


Figure7-2

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Example of controlling room temperature (Page 621)

7.8.1.2 TOF: Off delay

Symbol

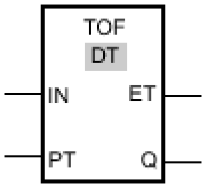


Figure7-2

Parameter	Data type	Memory area	Description
IN	BOOL	I, Q, M, D, L (Page 318)	Start input
PT	TIME	I, Q, M, D, L or constant	Time by which the falling edge is delayed at the IN input. PT must be positive.
ET	TIME	I, Q, M, D, L	Elapsed time
Q	BOOL	I, Q, M, D, L	Output, which is delayed by the time PT.

Description

You can use the "Off delay" operation to delay a falling edge by the time set at PT. The Q output is set when the result of logic operation (RLO) at input IN changes from "0" to "1". When the signal state at the IN input switches back to "0", the time set at PT starts. Output Q remains set as long the time set at PT is running. The Q output is reset when the PT time expires. If the signal state at IN input changes to "1" before the time set at PT expires, the timer is reset. The signal state at the Q output will continue to be "1".

It is possible to query how long the current timer function has been running at output ET. This time starts at T#0s and ends when the value set for the PT timer is reached. When the time set at PT expires, output ET remains set to the current value until input IN changes back to "1".

'When inserting the "OFF delay" operation, an instance data block is created in which the operation data is saved.

Placement

The "Off delay" operation requires a preceding logic operation for the edge evaluation. It can be located within or at the end of the logic string.

Pulse diagram

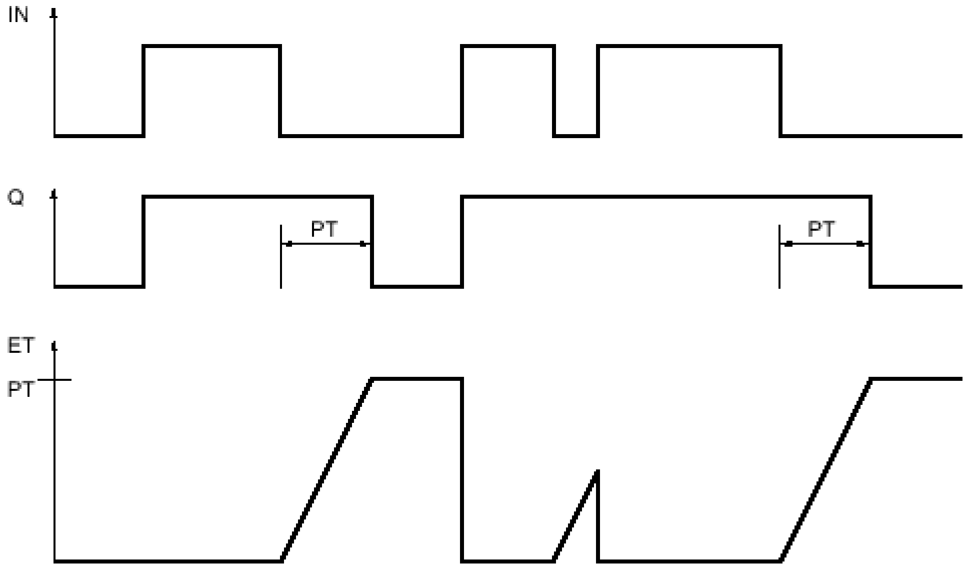


Figure7-2

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 TONR: Retentive on delay

Symbol

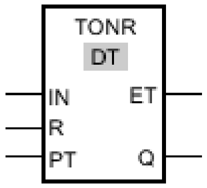


Figure7-2

Parameter	Data type	Memory area	Description
IN	BOOL	I, Q, M, D, L (Page 318)	Start input
R	BOOL	I, Q, M, D, L	Reset input
PT	TIME	I, Q, M, D, L or constant	Maximum duration of time recording
ET	TIME	I, Q, M, D, L	Accumulated time

Parameter	Data type	Memory area	Description
Q	BOOL	I, Q, M, D, L	Output that is set when the PT time expires.

Description

You can use the "Time accumulator" operation to accumulate time values within a period set with the PT parameter. When input IN changes to signal state "1", the operation is executed and the time set at PT starts. While the time set at PT is running, the time values are accumulated that are recorded at signal state "1" at input IN. The accumulated time is written to output ET and can be queried there. When the PT time expires, output Q has signal state "1".

Input R resets the timer function and output Q regardless of the signal state at the start input.

'When inserting the "Time accumulator" operation, an instance data block is created in which the operation data is saved.

Placement

The "Time accumulator" operation requires a preceding logic operation. It can be located within or at the end of the logic string.

Pulse diagram

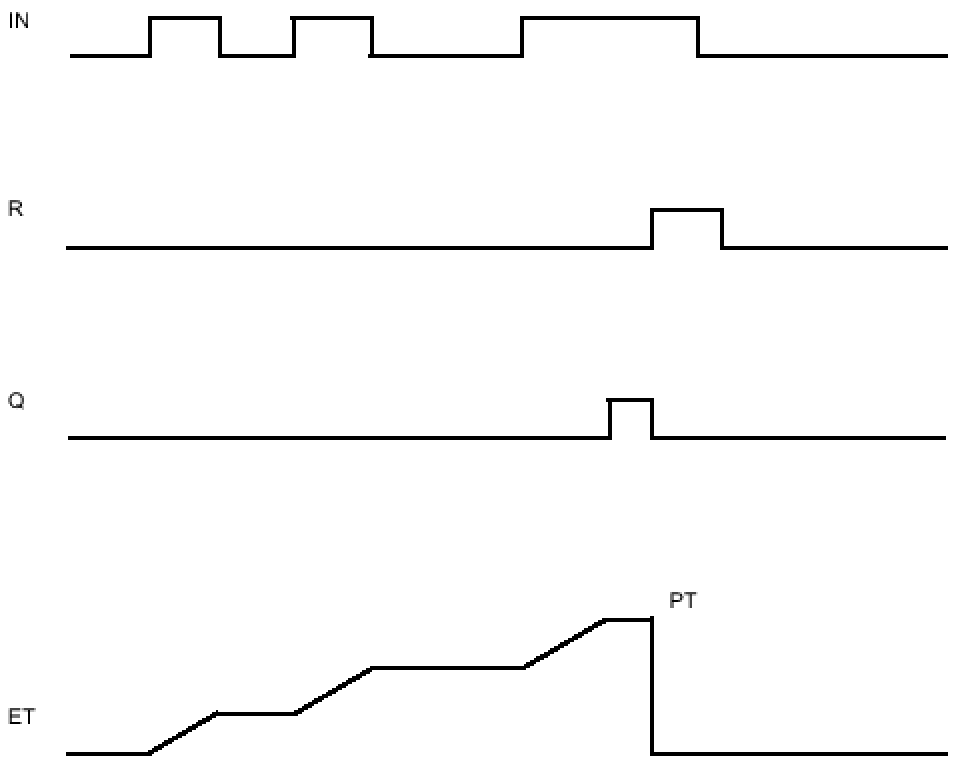


Figure7-2

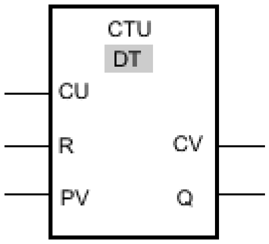
See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 Counters

7.8.1.2 CTU: Count up

Symbol



Parameter English	Data type	Memory area	Description
CU	BOOL	I, Q, M, D, L (Page 318)	Count input
R	BOOL	I, Q, M, D, L	Reset input
PV	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, D, L or constant	Preset count
CV	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, D, L	Actual count value
Q	BOOL	I, Q, M, D, L	Counter status

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Count up" operation to increment the value at the CV output. If the signal state at the CU input changes from "0" to "1" (positive edge), the operation is executed and the current count value at the CV output is incremented by one. The first time the operation is executed, the current count at the CV output is set to zero. The count is continually incremented each time a positive edge is detected, until it reaches the high limit for the data type specified at the CV output. When the high limit is reached, the signal state at the CU input no longer has an effect on the operation.

The counter status can be queried at the Q output. The signal state at output Q is determined by the PV parameter. If the current count value is greater than or equal to the value of the PV parameter, the Q output is set to signal state "1". In all other cases, the signal state at the Q output is "0".

The value at the CV output is reset to zero when the signal state at R input changes to "1". As long as there is the signal state "1" at R input, the signal state at input CU has no effect on the operation.

'When inserting the "Count up" operation, an instance data block is created in which the operation data is saved.

Placement

The "Count up" operation requires a preceding logic operation for the edge evaluation. It can be located within or at the end of the logic string.

Example

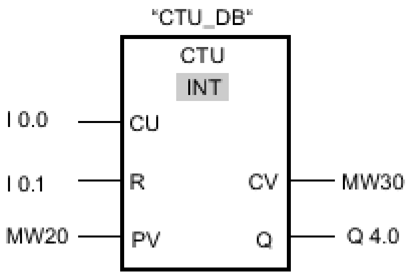


Figure7-2

When the signal state at the input I 0.0 changes from "0" to "1", the "Count up" operation is executed and the current count at the MW30 output is increased by one. With each further positive edge, the count value is incremented until the high limit value of the specified data type (32 767) is reached.

The value at the MW20 parameter is applied as the limit for determining the output Q 4.0. Output Q 4.0 has signal state "1" as long as the current count is greater than or equal to the value at the MW20 parameter. In all other cases, output Q 4.0 has signal state "0".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 CTD: Count down

Symbol

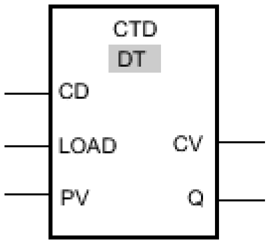


Figure7-2

Parameter English	Data type	Memory area	Description
CD	BOOL	I, Q, M, D, L (Page 318)	Count input
LOAD	BOOL	I, Q, M, D, L	Load input
PV	SINT, UINT, DINT, USINT, UINT, UDINT	I, Q, M, D, L or constant	Preset count
Q	BOOL	I, Q, M, D, L	Counter status
CV	SINT, UINT, DINT, USINT, UINT, UDINT	I, Q, M, D, L	Actual count value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Count down" operation to decrement the value at the CV output. If the signal state at the CD input changes from "0" to "1" (positive edge), the operation is executed and the current count value at the CV output is decremented by one. The first time the operation is executed, the current count at the CV output is set to zero. Each time a positive edge is detected, the count value is further decremented until it reaches the low limit value of the specified data type. When the low limit value is reached, the signal state at the CD input has no further effect on the operation.

The counter status can be queried at the Q output. If the current count value is less than or equal to zero, output Q is set to signal state "1". In all other cases, the signal state at the Q output is "0".

The value at the CV output is set to the value of the PV parameter when the signal state at LOAD input changes to "1". As long as there is the signal state "1" at the LOAD input, the signal state at the CD input has no effect on the operation.

'When inserting the "Count down" operation, an instance data block is created in which the operation data is saved.

Placement

The "Count down" operation requires a preceding logic operation for the edge evaluation. It can be located within or at the end of the logic string.

Example

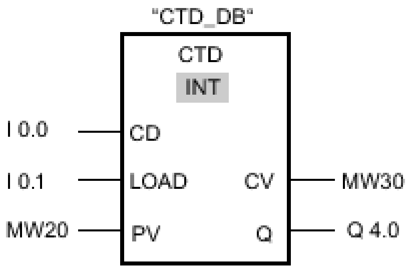


Figure7-2

When the signal state at the input I 0.0 changes from "0" to "1", the "Count down" operation is executed and the value at the MW30 input is decreased by one. With each further positive edge, the count value is decremented until the low limit value of the specified data type (-32 768) is reached.

Output Q 4.0 has signal state "1" as long as the current count value is less than or equal to zero. In all other cases, output Q 4.0 has signal state "0".

See also

Changing FBD elements (Page 492)
Inserting FBD elements (Page 484)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 CTUD: Count up and down

Symbol

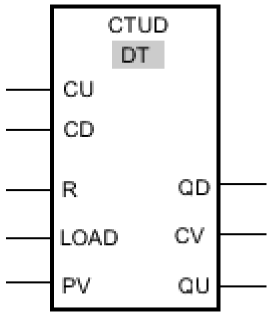


Figure7-2

Parameter English	Data type	Memory area	Description
CU	BOOL	I, Q, M, D, L (Page 318)	Count up input
CD	BOOL	I, Q, M, D, L	Count down input
R	BOOL	I, Q, M, D, L	Reset input
LOAD	BOOL	I, Q, M, D, L	Load input
PV	SINT, UINT, DINT, USINT, UINT, UDINT	I, Q, M, D, L or constant	Preset count
QU	BOOL	I, Q, M, D, L	Status of the incremental counter
QD	BOOL	I, Q, M, D, L	Status of the decremental counter
CV	SINT, UINT, DINT, USINT, UINT, UDINT	I, Q, M, D, L	Actual count value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Count up and down" operation to increment and decrement the count value at the CV output. If the signal state at CU input changes from "0" to "1" (positive edge), the current count value is incremented by one and stored in the CV output. If the signal state at CD input changes from "0" to "1" (positive edge), the count value at the CV output is decremented by one. If there is a positive edge at the CU and CD inputs in one program cycle, the current count value at the CV output remains unchanged.

The count value can be incremented until it reaches the high limit value of the data type specified at the CV output. When the high limit value is reached, the count value is no longer incremented on a positive edge. When the low limit value of the specified data type is reached, the count value is not decremented any further.

When the signal state at the LOAD input changes to "1", the count value at the CV output is set to the value of the PV parameter. As long as there is the signal state "1" at the LOAD input, the signal state at the CU and CD inputs has no effect on the operation.

The count value is set to zero when the signal state at input R changes to "1". As long as the signal state at the R input is "1", changes of signal state at inputs CU and CD and LOAD have no effect on the "Count up and down" operation.

The incremental counter status can be queried at QU output. If the current count value is greater than or equal to the value of the PV parameter, QU output has signal state "1". In all other cases, the signal state at the QU output is "0".

The decremental counter status can be queried at QD output. If the current count value is less than or equal to zero, output QD has signal state "1". In all other cases, the signal state at the QD output is "0".

'When inserting the "Count up and down" operation, an instance data block is created in which the operation data is saved.

Placement

The "Count up and down" operation requires a preceding logic operation for the edge evaluation. It can be located within or at the end of the logic string.

Example

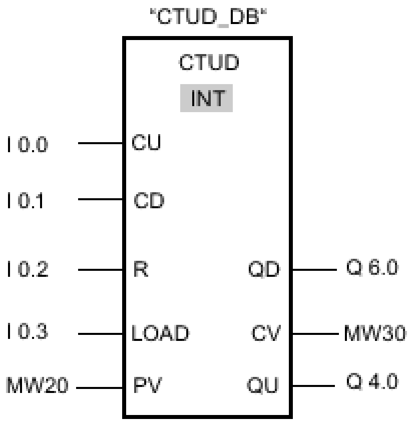


Figure7-2

If the signal state at input I 0.0 or at input I 0.1 changes from "0" to "1" (positive edge), the "Count up and down" operation is executed. When there is a positive edge at the input I 0.0, the current count is increased by one and stored at the output MW30. When there is a positive edge at the input I 0.1, the current count is decreased by one and stored at the output MW30. When there is a positive edge at CU input the count value is incremented until it reaches the high limit of 32 767. When there is a positive edge at input I 0.1, the count value is decremented until it reaches the low limit value of -32 768.

Output Q 4.0 has signal state "1" as long as the current count is greater than or equal to the value at the MW20 input. In all other cases, output Q 4.0 has signal state "0".

Output Q 6.0 has signal state "1" as long as the current count value is less than or equal to zero. In all other cases, output Q 6.0 has signal state "0".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Example of detecting the fill level of a storage area (Page 616)

7.8.1.2 High-speed counters

7.8.1.2 CTRL_HSC: Control high-speed counters in FBD

Symbol

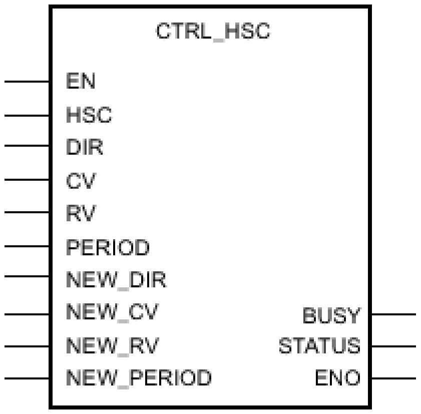


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
HSC	HW_HSC	L, D or constant	Hardware address of the high-speed counter (HW-ID)
DIR	BOOL	I, Q, M, L, D	Enables the new count direction (see NEW_DIR)
CV	BOOL	I, Q, M, L, D	Enables the new count value (see NEW_CV)
RV	BOOL	I, Q, M, L, D	Enables the new reference value (see NEW_RV)
PERIOD	BOOL	I, Q, M, L, D	Enables the new period of a frequency measurement (see NEW_PERIOD)
NEW_DIR	INT	I, Q, M, L, D	Count direction loaded when DIR = TRUE.
NEW_CV	DINT	I, Q, M, L, D	Count value loaded when CV = TRUE.

Parameter	Data type	Memory area	Description
NEW_RV	DINT	I, Q, M, L, D	Reference value loaded when CV = TRUE.
NEW_PERIOD	INT	I, Q, M, L, D	Period of the frequency measurement loaded when PERIOD = TRUE.
BUSY	BOOL	I, Q, M, L, D	Processing status
STATUS	WORD	I, Q, M, L, D	Status of the operation

Description

With the "Control high-speed counters" operation, you can make parameter settings and control the high-speed counters supported by the CPU by loading new values into the counter. The operation can only execute if a high-speed counter you want to control is enabled. You can only insert and execute one "Control high-speed counters" operation per high-speed counter in the program. You enter the hardware identifier of the high-speed counter (HW-ID), whose values you want to assign at the HSC input.

You can load the following parameter values into a high-speed counter using the "Control high-speed counters" operation:

- Count direction (NEW_DIR): The count direction defines whether a high-speed counter counts up or down. The count direction is defined by the following values at the NEW_DIR input: 1 = up, -1 = down.
  A change to the count direction with the "Control high-speed counters" operation is possible only when direction control is set in the parameters by the program.
  The count direction specified at the NEW_DIR input is loaded into a high-speed counter when the bit at the DIR input is set.
- Count value (NEW_CV): The count value is the initial value at which a high-speed counter starts counting. The count value can be in a range from - 2147483648 to 2147483647.
  The count value specified at the NEW_CV input is loaded into a high-speed counter when the bit at the CV input is set.
- Reference value (NEW_RV): The reference value is the highest value that a high-speed counter can reach. The reference value can be in a range from - 2147483648 to 2147483647.
  The reference value specified at the NEW_RV input is loaded into a high-speed counter when the bit at the RV input is set.
- Period of the frequency measurement (NEW_PERIOD): The period of the frequency measurement is specified by the following values at the NEW_PERIOD input: 10 = 0.01s, 100 = 0.1s, 1000 = 1s.
  The period can be updated when the "Frequency measurement" function is set in the parameters of the specified high-speed counter.
  The period specified at the NEW_PERIOD input is loaded into a high-speed counter if the bit at the PERIOD input is set.

The "Control high-speed counters" operation is only executed if the signal state at the EN input is "1". As long as the operation is executing, the bit at the BUSY output is set. Once the operation has executed completely, the bit at the BUSY output is reset.

The ENO enable output is set only when the EN input has signal state "1" and no errors occurred during execution of the operation.

'When inserting the "Control high-speed counters" operation, an instance data block is created in which the operation data is saved.

Parameter STATUS

At the STATUS output, you can query whether errors occurred during execution of the "Control high-speed counters" operation. The following table shows the meaning of the values output at the STATUS output:

Error code (hexadecimal)	Description
0	No error
80A1	Hardware identifier of the high-speed counter invalid
80B1	Count direction (NEW_DIR) invalid
80B2	Count value (NEW_CV) invalid
80B3	Reference value (NEW_RV) invalid
80B4	Period of the frequency measurement (NEW_PERIOD) invalid
80C0	Multiple access to the high-speed counter

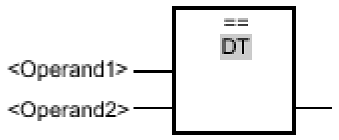
See also

Changing FBD elements (Page 492)
Inserting FBD elements (Page 484)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Configuring high-speed counters (Page 264)
Assigning parameters to hardware interrupt OBs (Page 417)

7.8.1.2 Compare

7.8.1.2 CMP ==: Equality

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Equal" operation to query whether the first value of the comparison is equal to the second value. Both values to be compared must be of the same data type.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'AA'	'AA'	1
'Hello World'	'HelloWorld'	0
'AA'	'aa'	0

Placement

The "Equal" operation can be placed at any position in the logic string.

Example

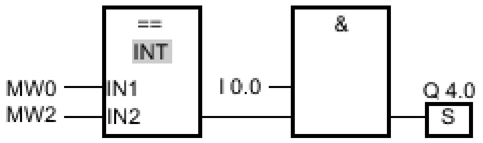


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

- The condition of the comparison operation is fulfilled (MW0 = MW2).
- Input I 0.0 has signal state "1".

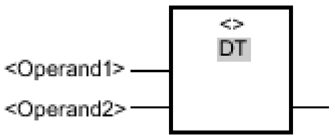
See also

Inserting FBD elements (Page 484)

Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 CMP <>: Inequality

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

With the "Not equal" operation, you can query whether the first value of the comparison is not equal to the second value. Both values to be compared must be of the same data type.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'AA'	'aa'	1
'Hello World'	'HelloWorld'	1
'AA'	'AA'	0

Placement

The "Not equal" operation can be placed at any position in the logic string.

Example

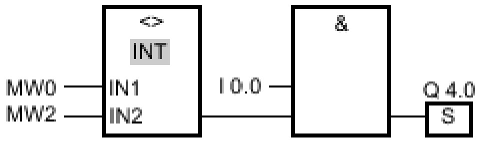


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

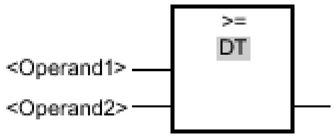
- The condition of the comparison operation is fulfilled (MW0 <> MW2).
- Input I 0.0 has signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 CMP >=: Greater than or equal to

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Greater or equal" operation to determine if a first comparison value is greater than or equal to the second comparison value. Both values to be compared must be of the same data type.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the longer string is considered greater.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'BB'	'AA'	1
'AAA'	'AA'	1
'Hello World'	'Hello World'	1
'Hello World'	'HelloWorld'	0
'AA'	'aa'	0
'AAA'	'a'	0

In comparing time values the RLO is "1" if the point of time at <Operand1> is greater (more recent) than or equal to the point of time at <Operand2>.

Placement

The "Greater or equal" operation can be placed at any position in the logic string.

Example

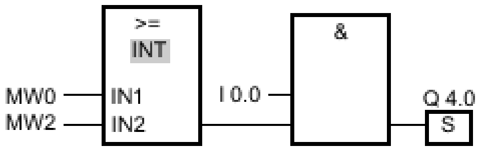


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

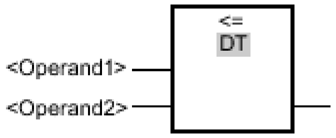
- The condition of the comparison operation is fulfilled (MW0 >= MW2).
- Input I 0.0 has signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Example of detecting the fill level of a storage area (Page 616)

7.8.1.2 CMP <=: Less than or equal to

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Less or equal" operation to determine if a first comparison value is less than or equal to a second comparison value. Both values to be compared must be of the same data type.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the shorter string is considered smaller.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'AA'	'aa'	1
'AAA'	'a'	1
'Hello World'	'Hello World'	1
'HelloWorld'	'Hello World'	0
'BB'	'AA'	0
'AAA'	'AA'	0

In comparing time values the RLO is "1" if the point of time at <Operand1> is smaller (less recent) than or equal to the point of time at <Operand2>.

Placement

The "Less or equal" operation can be placed at any position in the logic string.

Example

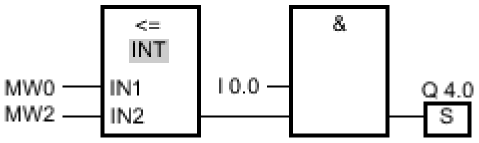


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

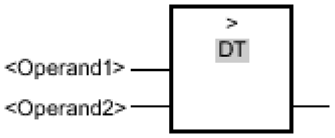
- The condition of the comparison operation is fulfilled (MW0 <= MW2).
- Input I 0.0 has signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 CMP >: Greater than

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

With the "Greater than" operation, you can query whether the first value of the comparison is greater than the second value. Both values to be compared must be of the same data type.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the longer string is considered greater.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'BB'	'AA'	1
'AAA'	'AA'	1
'AA'	'aa'	0
'AAA'	'a'	0

In comparing time values, the RLO is "1" if the point of time at <Operand1> is greater (more recent) than the point of time at <Operand2>.

Placement

The "Greater than" operation can be placed at any position in the logic string.

Example

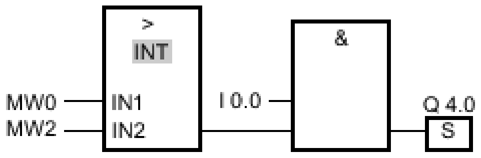


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

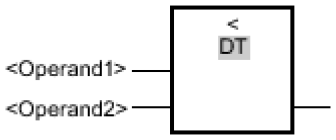
- The condition of the comparison operation is fulfilled (MW0 > MW2).
- Input I 0.0 has signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 CMP <: Less than

Symbol



Parameter	Data type	Memory area	Description
Operand1	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D (Page 318) or constant	First value to compare
Operand2	USINT, UINT, UDINT, SINT, INT, DINT, REAL, CHAR, STRING, TIME, DTL	I, Q, M, L, D or constant	Second value to compare

You can select the data type for the operation from the "DT" drop-down list.

Description

With the "Less than" operation, you can query whether the first value of the comparison is less than the second value. Both values to be compared must be of the same data type.

The individual characters are compared by means of their ASCII code (for example, 'a' is greater than 'A') during the comparison of the strings. The comparison is performed from left to right. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the shorter string is considered smaller.

The following table shows examples of string comparisons:

<Operand1>	<Operand2>	RLO of operation
'AA'	'aa'	1
'AAA'	'a'	1
'BB'	'AA'	0
'AAA'	'AA'	0

In comparing time values, the RLO is "1" if the point of time at <Operand1> is smaller (less recent) than the point of time at <Operand2>.

Placement

The "Less than" operation can be placed at any position in the logic string.

Example

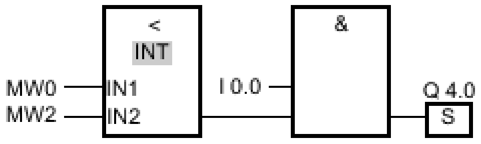


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

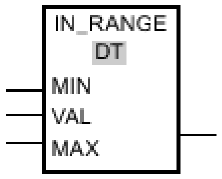
- The condition of the comparison operation is fulfilled (MW0 < MW2).
- Input I 0.0 has signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0   )

7.8.1.2 IN_RANGE: Value within range

Symbol



Parameter	Data type	Memory area	Description
MIN	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D (Page 318) or constant	Low limit of the value range
VAL	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Comparison value
MAX	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	High limit of the value range
Box output	BOOL	I, Q, M, L, D	Result of the comparison

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Value within range" operation to determine of the value at the VAL input is within a specific value range. You specify the limits of the value range with the MIN and MAX parameters. When the query is processed, the "Value within range" operation compares the value at the VAL input to the values of the MIN and MAX parameters and sends the result to the box output. If the value at the VAL input satisfies the comparison MIN <= VALUE <= MAX, the box output has signal state "1". If the comparison is not fulfilled, the signal state is "0" at the box output.

The comparison function can only execute if the values to be compared are of the same data type and the box output is interconnected.

Placement

The "Value within range" operation can be placed at the start of the logic string or within it.

Example

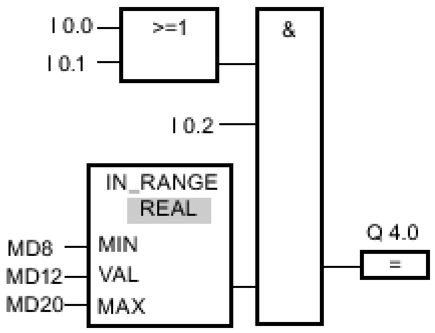


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

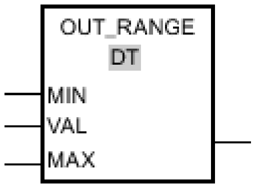
- The signal state at input I 0.0 OR at input I 0.1 is "1".
- Input I 0.2 has signal state "1".
- The value at the MD12 input is within the value range, which is specified by the current values at the inputs MD8 and MD20 (MIN <= VAL <= MAX).

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
GetError (Page 954)

7.8.1.2 OUT_RANGE: Value outside range

Symbol



Parameter	Data type	Memory area	Description
MIN	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D (Page 318) or constant	Low limit of the value range
VAL	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Comparison value
MAX	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	High limit of the value range
Box output	BOOL	I, Q, M, L, D	Result of the comparison

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Value outside range" operation to query whether or nor the value at the VAL input is outside a specific range. You specify the limits of the value range with the MIN and MAX parameters. When the query is processed, the "Value outside range" operation compares the value at the VAL input to the values of the MIN and MAX parameters and sends the result to the box output. If the value at the VAL input satisfies the comparison MIN > VAL or VAL > MAX, the box output has signal state "1". If the comparison is not fulfilled, the signal state is "0" at the box output.

The comparison function can only execute if the values to be compared are of the same data type and the box output is interconnected.

Placement

The "Value outside range" operation can be placed at the start of the logic string or within it.

Example

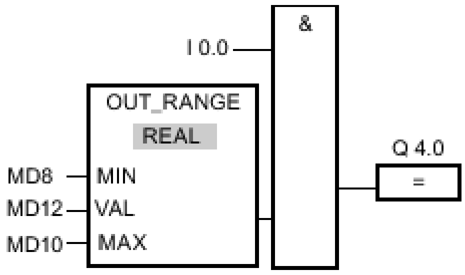


Figure7-2

Output Q 4.0 is set when the following conditions are fulfilled:

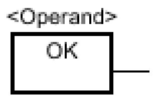
- The signal state at input I 0.0 is "1".
- The value at input MD12 is outside the range of values set by the values of inputs MD8 and MD10 (MIN > VAL or VAL > MAX).

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
GetError (Page 954)

7.8.1.2 OK: Test validity

Symbol



Parameter	Data type	Memory area	Description
<Operand>	REAL	I, Q, M, L, D (Page 318) or constant	Value to be checked.

Description

You can use the "Check validity" operation to check if the value of a tag (<operand>) is a valid floating-point number. The query starts in every program cycle. If the value of the tag is a valid floating-point number at the time of the query, the output to the right-hand connection has signal state "1". In all other cases, the signal state at the output of the "Check validity" operation is "0".

You can use the "Check validity" operation together with the EN mechanism. If you connect the OK box to an EN enable input, the enable input is set only when the result of the validity query of the value is positive. You can use this function to ensure that an operation is enabled only when the value of the specified tag is a valid floating-point number.

Placement

The "Check validity" operation can be placed at the start of the logic string or within it.

Example

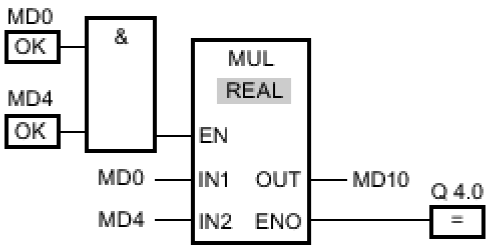


Figure7-2

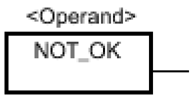
If MD0 AND MD4 are valid floating-point numbers, the "Multiply" operation (MUL) is performed and output ENO is set. When the "Multiply" (MUL) operation is executed, the value at input MD0 is multiplied by the value of MD4. The product of the multiplication is stored at output MD10. If no errors occur during execution of the operation, outputs ENO and Q 4.0 are set to signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 NOT_OK: Check invalidity

Symbol



Parameter	Data type	Memory area	Description
<Operand>	REAL	I, Q, M, L, D (Page 318) or constant	Value to be checked.

Description

You can use the "Check invalidity" operation to check if the value of a tag (<operand>) is an invalid floating-point number. The query starts in every program cycle. If the value of the tag is an invalid floating-point number at the time of the query and the signal state at the input of the box is "1", the output has signal state "1". In all other cases, the signal state at the output of the "Check invalidity" operation is "0".

Placement

The "Check invalidity" operation can be placed at the start of the logic string or within it.

Example

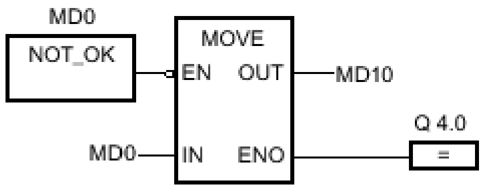


Figure7-2

If the value at input MD0 is an invalid floating-point number, the "Move value" (MOVE) operation is not executed. Output Q 4.0 is reset to signal state "0".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0   )

7.8.1.2 Math

7.8.1.2 ADD: Add

Symbol

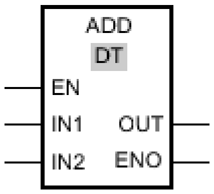


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output

Parameter	Data type	Memory area	Description
IN1	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	First value for addition
IN2	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Second value for addition
OUT	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D	Result of addition

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Add" operation to add the value at input IN1 and the value at input IN2 and query the sum at the OUT output (OUT =IN1+IN2).

The operation is only executed if the signal state at the enable input EN is "1". If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result of the operation is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

The "Add" operation can be placed at any position in the logic string.

Example

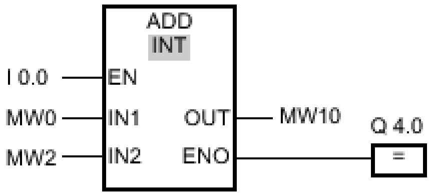


Figure7-2

If the input I 0.0 has signal state "1", the "Add" operation is executed. The value at the MW0 input is added to the value at the MW2 input. The result of the addition is stored at the MW10 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 SUB: Subtract

Symbol

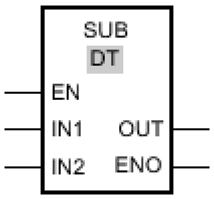


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	First value for subtraction
IN2	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Value to be subtracted.
OUT	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D	Result of subtraction

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Subtract" operation to subtract the value at input IN2 from the value at input IN1 and query the difference at the OUT output (OUT =IN1-IN2).

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result of the operation is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

You can place the "Subtract" operation at any position in the logic string.

Example

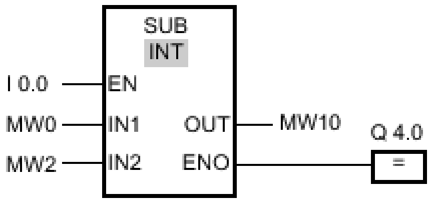


Figure7-2

If input I 0.0 has signal state "1", the "Subtract" operation is performed. The value at the MW2 input is subtracted from the value at the MW0 input. The result of the subtraction is stored at the MW10 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 MUL: Multiply

Symbol

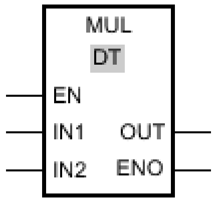


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	First value for multiplication

Parameter	Data type	Memory area	Description
IN2	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D or constant	Second value for multiplication
OUT	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, L, D	Result of multiplication

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Multiply" operation to multiply the value at the IN1 input to the value at the IN2 input and query the product at the OUT output (OUT =IN1*IN2).

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

The "Multiply" operation can be placed at any position in the logic string.

Example

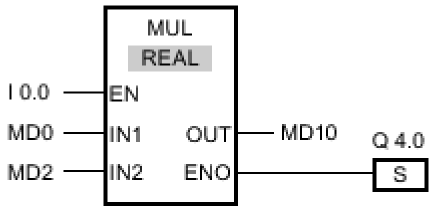


Figure7-2

If the input I 0.0 has signal state "1", the "Multiply" operation is executed. The value at input MD0 is multiplied by the value at input MD2. The product of the multiplication is stored in output MD10. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 DIV: Divide

Symbol

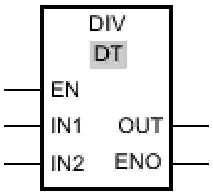


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Dividend
IN2	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Divisor
OUT	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D	Result of division

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Divide" operation to divide the value at the IN1 input by the value at the IN2 input and query the quotient at the OUT output (OUT =IN1/IN2).

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result of the operation is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

You can place the "Divide" operation at any position in the logic string.

Example

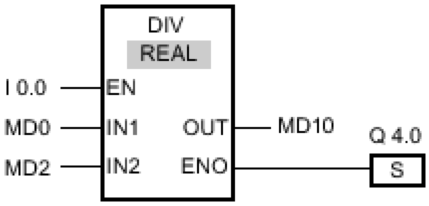


Figure7-2

If the input I 0.0 has signal state "1", the "Divide" operation is executed. The value at input MD0 is divided by the value at input MD2. The result of the division is stored at the MD10 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 MOD: Return remainder of division

Symbol

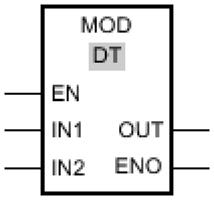


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, L, D or constant	Dividend
IN2	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, L, D or constant	Divisor
OUT	SINT, INT, DINT, USINT, UINT, UDINT	I, Q, M, L, D	Remainder of division

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Return remainder of division" operation to divide the value at the IN1 input by the value at the IN2 input and query the remainder at the OUT output.

The operation is only executed if the signal state at the EN input is "1". If no errors occur during execution of the operation, the ENO output also has signal state "1".

The operation is not executed if the signal state at the EN input is "0". In this case, the ENO output is reset.

Placement

The "Return remainder of division" operation can be placed at any position in the logic string.

Example

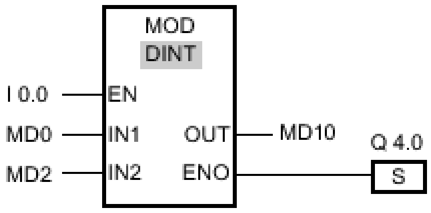


Figure7-2

If the input I 0.0 has signal state "0", the "Return remainder of division" operation is performed. The value at input MD0 is divided by the value at input MD2. The remainder of the division is provided at output MD10. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 NEG: Create twos complement

Symbol

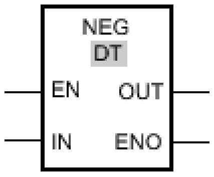


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	SINT, INT, DINT, REAL	I, Q, M, L, D or constant	Input value
OUT	SINT, INT, DINT, REAL	I, Q, M, L, D	Twos complement of the input value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Create twos complement" operation to change the sign of the value at the IN input and query the result at the OUT output. If there is a positive value at the IN input, for example, the negative equivalent of this value is sent to the OUT output.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The result of the operation is outside the range permitted for the data type specified at the OUT output.
- An input tag of the REAL data type has an invalid value.

Placement

The "Create twos complement" operation can be placed at any position in the logic string.

Example

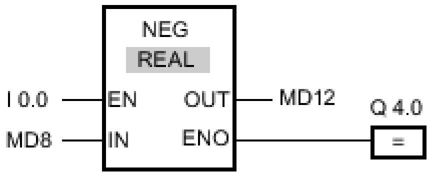


Figure7-2

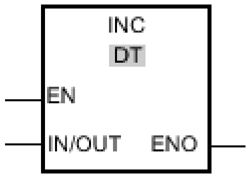
If input I 0.0 has signal state "1", the "Create twos complement" operation is performed. The sign of the value at input MD8 is changed and the result is provided at output MD12. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 INC: Increment

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN/OUT	SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, D, L	Value to be incremented.

You can select the data type for the operation from the "DT" drop-down list.

Description

With the "Increment" operation, you can change the value of the tag at the output IN/OUT output to the next higher value and query the result. The "Increment" operation can only be started when the signal state at the EN enable input is "1". If no overflow error occurs during execution, the ENO output also has signal state "1".

If the signal state is "0" at the enable input EN, the operation is not executed. In this case, the ENO enable output is reset.

Placement

The "Increment" operation can be placed at any position in the logic string.

Example

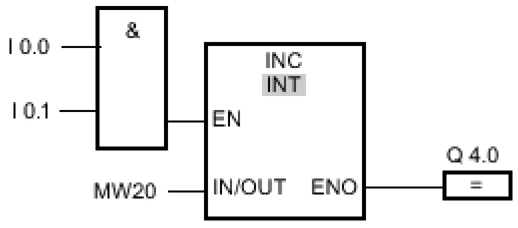


Figure7-2

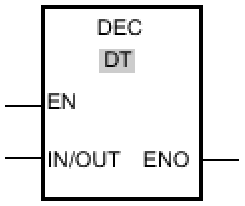
If the inputs I 0.0 AND I 0.1 have signal state "1", the value at the MW20 output is incremented by one and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 DEC: Decrement

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN/OUT	SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, D, L	Value to be decremented.

You can select the data type for the operation from the "DT" drop-down list.

Description

With the "Decrement" operation, you can change the value of the tag at the output IN/OUT output to the next lower value and query the result. Execution of the "Decrement" operation is started when the signal state at the enable input EN is "1". If no underflow error occurs during the execution, the ENO output also has signal state "1".

If the signal state is "0" at the enable input EN, the operation is not executed. In this case, the ENO enable output is reset.

Placement

The "Decrement" operation can be placed at any position in the logic string.

Example

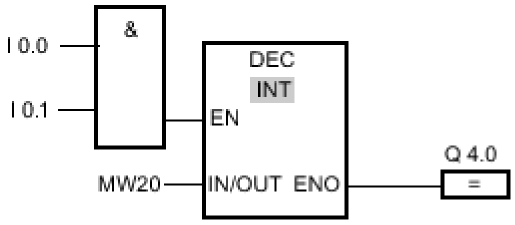


Figure7-2

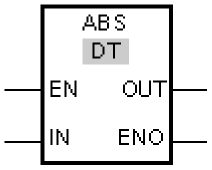
If the inputs I 0.0 AND I 0.1 have signal state "1", the value at the MW20 output is decremented by one and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 ABS: Form absolute value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	SINT, INT, DINT, REAL	I, Q, M, D, L or constant	Input value
OUT	SINT, INT, DINT, REAL	I, Q, M, D, L	Absolute value of the input value

Description

You can use the "Form absolute value" operation to calculate the absolute value of the value specified at input IN. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value of a specified REAL tag is not a valid floating-point number.

Placement

The "Form absolute value" operation can be placed at any position in the logic string.

Example

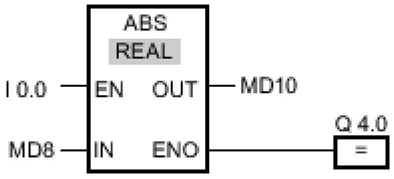


Figure7-2

IN	MD8 = - 6.234
OUT	MD10 = 6.234

If input I 0.0 has signal state "1", the "Form absolute value" operation is executed. The operation calculates the absolute value of the value at input MD8 and sends the result to output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 MIN: Get minimum

Symbol

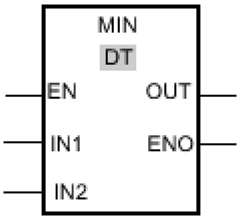


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	First input value
IN2	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Second input value
OUT	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

The "Get minimum" operation compares the value at the IN1 input to the value at the IN2 input and writes the lower value to the OUT output. The operation can only be executed if the tags set for all parameters are of the same data type.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO enable output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The specified tags are not of the same data type.
- An input tag of the REAL data type has an invalid value.

Placement

The "Get minimum" operation can be placed at any position in the logic string.

Example

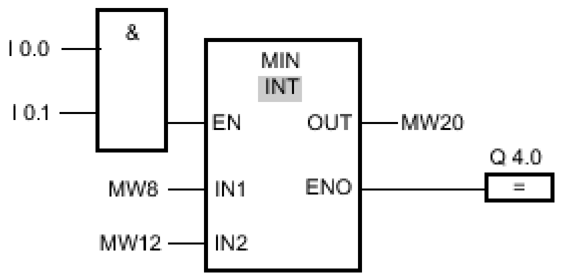


Figure7-2

IN1	MW8 = 12 666
IN2	MW12 = 14 444
OUT	MW20 = 12 666

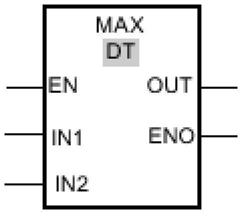
If the inputs I 0.0 AND I 0.1 have signal state "1", the "Get minimum" operation is executed. The operation compares the value at the MW8 input to the value at the MW12 input and selects the lower value (MW8). This value is copied to the MW20 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 MAX: Get maximum

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	First input value
IN2	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Second input value
OUT	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

The "Get maximum" operation compares the value at the IN1 input to the value at the IN2 input and writes the higher value to the OUT output. The operation can only be executed if the tags set for all parameters are of the same data type.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO enable output also has signal state "1".

The enable output has signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The specified tags are not of the same data type.
- An input tag of the REAL data type has an invalid value.

Placement

The "Get maximum" operation can be placed at any position in the logic string.

Example

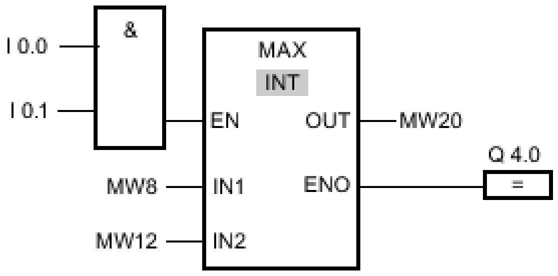


Figure7-2

IN1	MW8 = 12 666
IN2	MW12 = 14 444
OUT	MW20 = 14 444

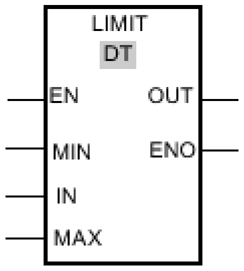
If the inputs I 0.0 AND I 0.1 have signal state "1", the "Get maximum" operation is executed. The operation compares the value at the MW8 input to the value at the MW12 input and selects the higher value (MW12). This value is copied to the MW20 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 LIMIT: Set limit value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
MIN	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Low limit
IN	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	Input value
MAX	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D or constant	High limit
OUT	SINT, USINT, INT, UINT, DINT, UDINT, REAL	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Set limit value" operation to limit the value at input IN to the values at the inputs MIN and MAX. If the value at input IN satisfies the condition MIN < IN < MAX, it is copied to output OUT. If the condition is not fulfilled and the input value is below the low limit, the output is set to the value of the MIN input. If the high limit is exceeded, output OUT is set to the value of the MAX input.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO enable output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The specified tags are not of the same data type.
- An input tag has an invalid value.
- The value at the MIN input is greater than the value at the MAX input.

Placement

The "Set limit value" operation can be placed at any position in the logic string.

Example

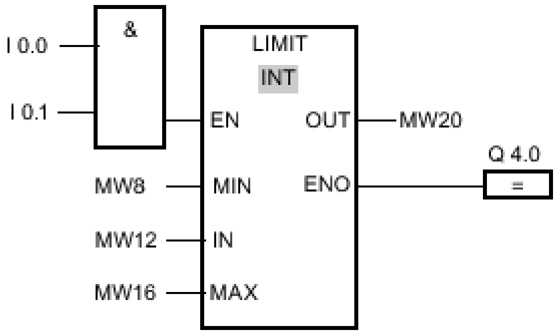


Figure7-2

MIN	MW8 = 12 000
IN	MW12 = 8 000
MAX	MW16 = 16 000
OUT	MW20 = 12 000

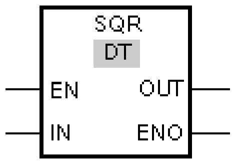
If the inputs I 0.0 AND I 0.1 have signal state "1", the "Set limit value" operation is executed. The value at the MW12 input is compared to the values at the inputs MW8 and MW16. Since the value at the MW12 input is less than the low limit, the MW8 input is copied to the MW20 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Selecting the data type of an FBD element (Page 0)
Example of calculating an equation (Page 620)

7.8.1.2 SQR: Form square

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	REAL	I, Q, M, D, L or constant	Input value
OUT	REAL	I, Q, M, D, L	Square of the input value

Description

You can use the "Form square" operation to square the value at the IN input and query the result at the OUT output.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form square" operation can be placed at any position in the logic string.

Example

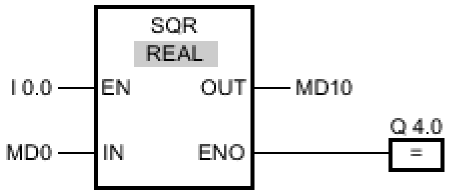


Figure7-2

IN	MD0 = 5
OUT	MD10 = 25

If input I 0.0 has signal state "1", the "Form square" operation is performed. The operation forms the square of the value at input MD0 and sends the result to output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

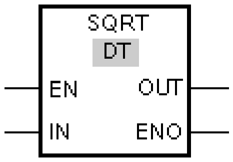
See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 SQRT: Form square root

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	REAL	I, Q, M, D, L or constant	Number
OUT	REAL	I, Q, M, D, L	Square root of the number

Description

You can use the "Form square root" operation to find the square root of the value at the IN input and query the result at the OUT output. The operation has a positive result if the input value is greater than zero. If input values are less than zero, the OUT output returns an invalid floating-point number. If the value at input IN is "-0", the result is also "-0".

The operation is only executed if the signal state is "1" at the enable input. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.
- The value at IN input is negative.

Placement

The "Form square root" operation can be placed at any position in the logic string.

Example

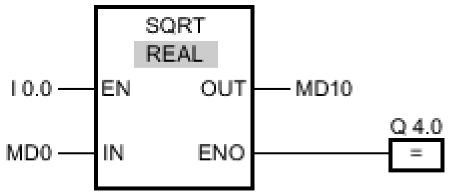


Figure7-2

IN	MD0 = 25
OUT	MD10 = 5

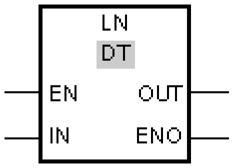
If the input I 0.0 has signal state "1", the "Form square root" operation is executed. The operation finds the square root of the value at input MD0 and sends the result at output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 LN: Form natural logarithm

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	REAL	I, Q, M, D, L or constant	Input value
OUT	REAL	I, Q, M, D, L	Result of the operation

Description

You can use the "Form natural logarithm" operation to calculate the natural logarithm of the value at input IN to base e (e=2.718282e+00). The result is provided at the OUT output and can be queried there. The operation has a positive result if the input value is greater than zero. If input values are less than zero, the OUT output returns an invalid floating-point number.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.
- The value at IN input is negative.

Placement

The "Form natural logarithm" operation can be placed at any position in the logic string.

Example

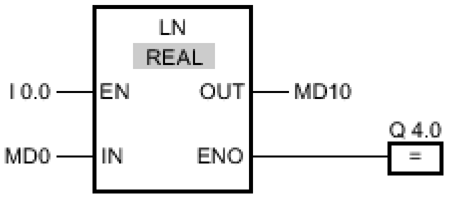


Figure7-2

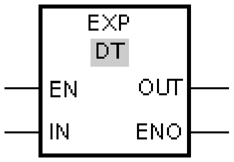
If input I 0.0 has signal state "1", the "Form natural logarithm" operation is executed. The operation forms the natural logarithm of the value at MD0 input and sends the result to MD10 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 EXP: Form exponential value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	REAL	I, Q, M, D, L or constant	Input value
OUT	REAL	I, Q, M, D, L	Output value

Description

You can use the "Form exponential value" operation to calculate the exponent from the base e (e = 2.718282e+00) and the value set at input IN. The result is provided at the OUT output and can be queried there (OUT = e^{IN}).

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form exponential value" operation can be placed at any position in the logic string.

Example

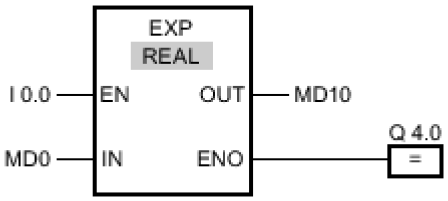


Figure7-2

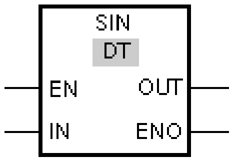
If input I 0.0 has signal state "1", the "Form exponential value" operation is performed. The operation forms the power to base e with the value at input MD0 and sends the result to output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 SIN: Form sine value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Size of angle in the radian measure
OUT	REAL	I, Q, M, L, D	Sine of the specified angle

Description

You can use the "Form sine value" operation to form the sine of the angle specified in the radian measure at the IN input. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form sine value" operation can be placed at any position in the logic string.

Example

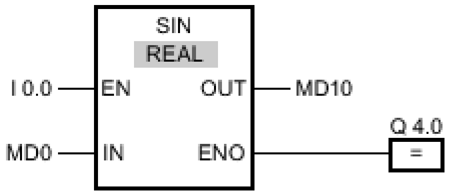


Figure7-2

IN	MD0 = +1.570796e+00 (π/2)
OUT	MD10 = 1

If input I 0.0 has signal state "1", the "Form sine value" operation is performed. The operation calculates the sine of the angle specified at the MD0 input and sends the result to the MD10 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 COS: Form cosine value

Symbol

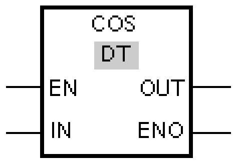


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Size of angle in the radian measure
OUT	REAL	I, Q, M, L, D	Cosine of the specified angle

Description

You can use the "Form cosine value" operation to calculate the cosine of an angle. The size of the angle is specified in the radian measure at input IN. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form cosine value" operation can be placed at any position in the logic string.

Example

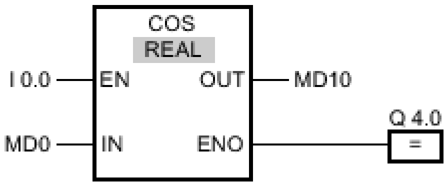


Figure7-2

IN	MD0 = +1.570796e+00 (π/2)
OUT	MD10 = 0

If input I 0.0 has signal state "1", the "Form cosine value" operation is performed. The operation calculates the cosine of the angle specified at the MD0 input and sends the result to the MD10 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 TAN: Form tangent value

Symbol

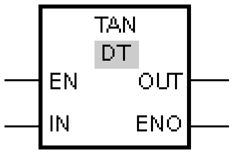


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Size of angle in the radian measure
OUT	REAL	I, Q, M, L, D	Tangent of the specified angle

Description

You can use the "Form tangent value" operation to calculate the tangent of an angle. The size of the angle is specified in the radian measure at input IN. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form tangent value" operation can be placed at any position in the logic string.

Example

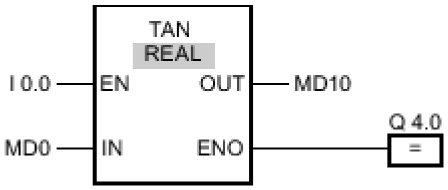


Figure7-2

IN	MD0 = +3.141593e++00 (π)

OUT	MD10 = 0

If input I 0.0 has signal state "1", the "Form tangent value" operation is performed. The operation calculates the tangent of the angle specified at the MD0 input and sends the result to the MD10 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 ASIN: Form arcsine value

Symbol

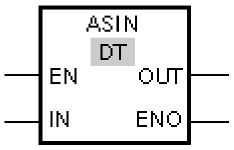


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Sine value
OUT	REAL	I, Q, M, L, D	Size of angle in the radian measure

Description

You can use the "Form arcsine value" operation to calculate the size of the angle from the sine value specified at the IN input, which corresponds to this value. Only valid floating-point numbers within the range -1 to +1 can be specified at the IN input. The calculated angle size is given in the radian measure at the OUT output and can range in value from -π/2 to +π/2.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.
- The value at input IN is outside the permitted range (-1 to +1).

Placement

The "Form arcsine value" operation can be placed at any position in the network.

Example

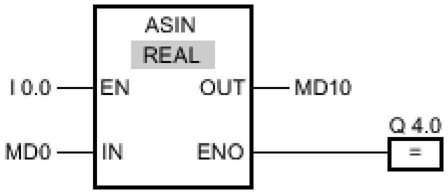


Figure7-2

IN	MD0 = 1
OUT	MD10 = +1.570796e+00 (π/2)

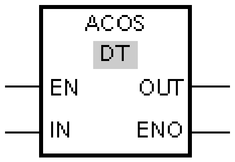
If input I 0.0 has signal state "1", the "Form arcsine value" operation is performed. The operation calculates the size of the angle corresponding to the sine value at input MD0. The result of the operation is stored at output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 ACOS: Form arccosine value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Cosine value
OUT	REAL	I, Q, M, L, D	Size of angle in the radian measure

Description

You can use the "Form arccosine value" operation to calculate the size of the angle from the cosine value specified at the IN input, which corresponds to this value. Only valid floating-point numbers within the range -1 to +1 can be specified at the IN input. The calculated angle size is given in the radian measure at the OUT output and can range in value from 0 to +π.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.
- The value at input IN is outside the permitted range (-1 to +1).

Placement

The "Form arccosine value" operation can be placed at any position in the logic string.

Example

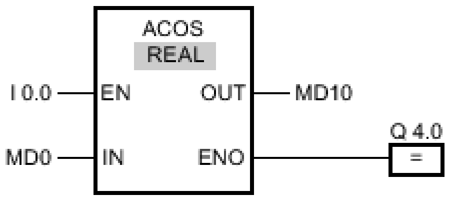


Figure7-2

IN	MD0 = 0
OUT	MD10 = +1.570796e+00 (π/2)

If input I 0.0 has the signal state "1", the "Form arccosine value" operation is performed. The operation calculates the size of the angle corresponding to the cosine value at input MD0. The result of the operation is stored at output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 ATAN: Form arctangent value

Symbol

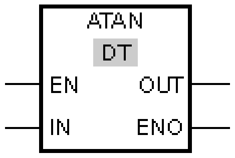


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Tangent value
OUT	REAL	I, Q, M, L, D	Size of angle in the radian measure

Description

You can use the "Form arctangent value" operation to calculate the value of the angle that corresponds to the tangent value specified at the IN input. Only valid floating-point numbers may be specified at the IN input. The calculated angle size is given in the radian measure at the OUT output and can range in value from -π/2 to +π/2.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at input IN is not a valid floating-point number.

Placement

The "Form arctangent value" operation can be placed at any position in the logic string.

Example

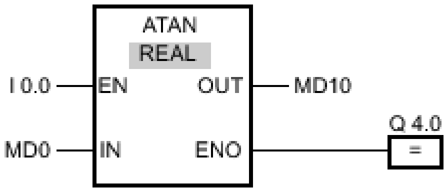


Figure7-2

IN	MD0 = 1
OUT	MD10 = +0.785398e++00 (π/4)

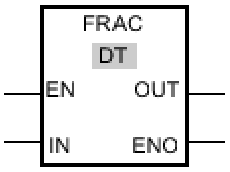
If input I 0.0 has signal state "1", the "Form arctangent value" operation is performed. The operation calculates the size of the angle corresponding to the tangent value at input MD0. The result of the operation is stored at output MD10. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 FRAC: Return fraction

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	REAL	I, Q, M, L, D or constant	Value, whose decimal places are to be determined.
OUT	REAL	I, Q, M, L, D	Decimal places of the value at the IN input

Description

You can use the "Return fraction" operation to find the decimal places of the value at the IN input. The result of the query is stored at the OUT output and can be queried there. If the value at input IN is, for example, 123.4567, output OUT returns the value 0.4567. The operation is started when there is a "1" at the EN input. In this case, the enable output ENO also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors occur during processing of the operation, for example there is no valid floating-point number at the input.

Placement

The "Return fraction" operation can be placed at any position in the logic string.

Example

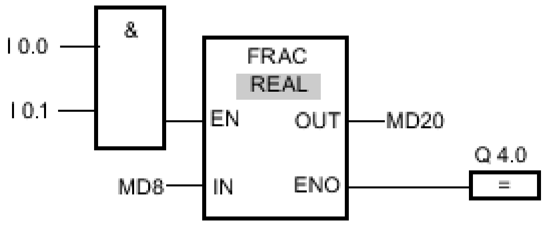


Figure7-2

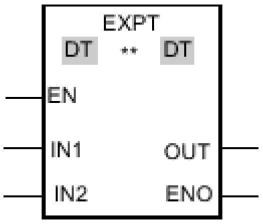
If the inputs I 0.0 AND I 0.1 have signal state "1", the "Return fraction" operation is started. The decimal places of the value at input MD8 are copied to output MD20. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 EXPT: Exponentiate

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	REAL	I, Q, M, L, D or constant	Base value
IN2	REAL, INT, UINT, USINT, SINT, DINT, UDINT	I, Q, M, L, D or constant	Value by which the base value is exponentiated.
OUT	REAL	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Exponentiate" operation to raise the value at the IN1 input by a power specified with the value at the IN2 input. The result of the operation is provided at the OUT output and can be queried there (OUT =$IN1^{IN2}$).

The value at input IN1 must be a valid floating-point number. Integers are also allowed for setting the IN2 input.

Execution of the "Exponentiate" operation requires a signal state of "1" at the enable input EN. In this case, the ENO enable output has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors occur during processing of the operation, for example there is an overflow.

Placement

The "Exponentiate" operation can be placed at any position in the logic string.

Example

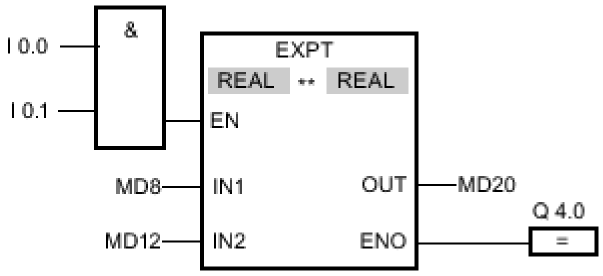


Figure7-2

If inputs I 0.0 AND I 0.1 have signal state "1", the "Exponentiate" operation is started. The value at the MD8 input is raised to the power specified by the value at the MD12 input. The result is stored at the MD20 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)
Example of calculating an equation (Page 620)

7.8.1.2 Move

7.8.1.2 MOVE: Copy value

Symbol

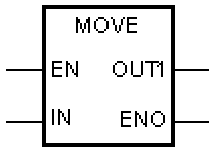


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	All elementary data types, DTL, STRUCT, ARRAY	I, Q, M, D, L or constant	Source value

Parameter	Data type	Memory area	Description
OUT1	All elementary data types, DTL, STRUCT, ARRAY	I, Q, M, D, L	Destination address

Description

You can use the "Move value" operation to transfer the content of the operand at the IN input to the operand at the OUT1 output. The transfer is always made in the direction of ascending addresses.

If IEC test is enabled the tags at IN input and OUT1 output must be of the same data type. If the IEC test is not enabled, the operand width at the IN input and the OUT1 output of the operation must be the same.

Copying entire arrays is possible only when the array components of the tags at input IN and output OUT1 are of the same data type.

For the "Move value" operation, you can insert additional outputs. In this case, the content of the operand at the IN input is transferred to all available outputs.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the EN input is "0", the enable output ENO is reset to "0".

The "Move block" (MOVE_BLK) and "Move block uninterruptible" (UMOVE_BLK) operations can also be used to copy tags of the ARRAY data type. You can copy tags of the STRING data type with the operation S_CONV.

Placement

The "Move value" operation can be placed at any position in the logic string.

Example

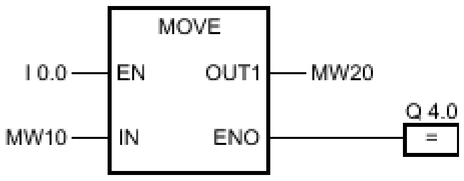


Figure7-2

IN	MW10 = 0011 1111 1010 1111
OUT1	MW20 = 0011 1111 1010 1111

If input I 0.0 has signal state "1", the "Move value" operation is executed. The operation copies the contents of the input operand (MW10) to the output operand (MW20) and sets the output Q 4.0 to the signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)

7.8.1.2 MOVE_BLK: Copy area

Symbol

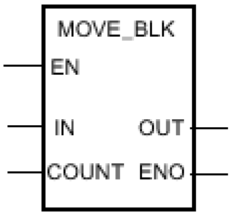


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	ARRAY	D, L	The first element of the source area to be copied.
COUNT	UINT	I, Q, M, D, L or constant	Number of elements to be copied from the source area to the destination area.
OUT	ARRAY	D, L	The first element of the destination area to which the content of the source area is copied.

Description

You can use the "Move block" operation to copy the content of a memory area (source area) to another memory area (destination area). The number of elements to be copied to the destination area is specified with the COUNT parameter. The width of the elements to be copied is defined by the width of the element at input IN. The copy operation takes place in the direction of ascending addresses.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- More data is copied than is available in the memory area at output OUT.

Placement

The "Move block" operation can be placed at any position in the logic string.

Example

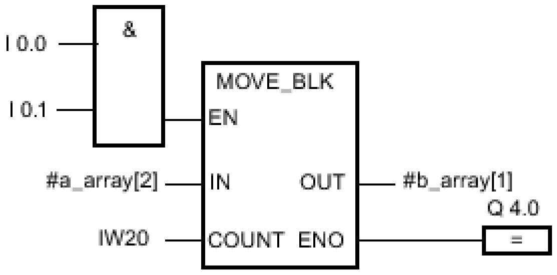


Figure7-2

IN	The tag "a_array" is an ARRAY data type and consists of 5 elements of the INT data type.
COUNT	IW20 = 3
OUT	The tag "b_array" is an ARRAY data type and consists of 6 elements of the INT data type.

If the inputs I 0.0 AND I 0.1 have signal state "1", the "Move block" operation is executed. The operation selects three INT elements from the "a_array" tag (a_array[2..4]) and copies the content to the output tag "b_array" (b_array[1..3]). If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)

7.8.1.2 UMOVE_BLK: Copy area uninterruptible

Symbol

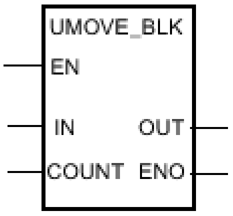


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	ARRAY	D, L	The first element of the source area to be copied.
COUNT	UINT	I, Q, M, D, L or constant	Number of elements to be copied from the source area to the destination area.
OUT	ARRAY	D, L	The first element of the destination area to which the content of the source area is copied.

Description

You can use the "Move block uninterruptible" operation to copy the content of a memory area (source area) to another memory area (destination area) without the function being interrupted. The number of elements to be copied to the destination area is specified with the COUNT parameter. The width of the elements to be copied is defined by the width of the element at input IN.

The content of the source area is copied to the destination area in the direction of the ascending address. The copy operation cannot be interrupted by other operating system activities. This is why the alarm reaction times of the CPU increase during the execution of the "Move block uninterruptible" operation.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- More data is copied than is made available at output OUT.

Placement

The "Move block uninterruptible" operation can be placed at any position in the logic string.

Example: using complex data types

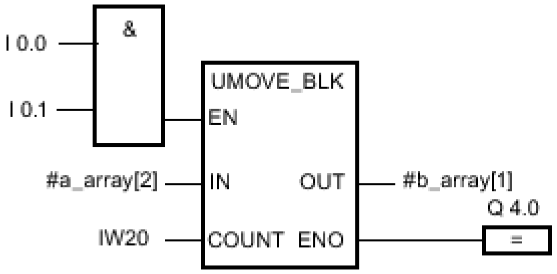


Figure7-2

IN	The tag "a_array" is an ARRAY data type and consists of 5 elements of the INT data type.
COUNT	IW2 = 3
OUT	The tag "b_array" is an ARRAY data type and consists of 6 elements of the INT data type.

If the inputs I 0.0 AND I 0.1 have signal state "1", the "Move block" operation is executed. The operation selects three INT elements from the "a_array" tag (a_array[2..4]) and copies the content to the output tag "b_array" (b_array[1..3]). The copy operation cannot be interrupted by other operating system activities. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)

7.8.1.2 FILL_BLK: Fill area

Symbol

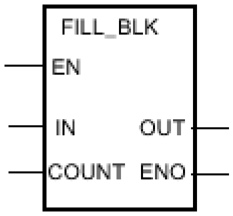


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	ARRAY	D, L or constant	Element used to fill the destination area.
COUNT	UINT	I, Q, M, D, L or constant	Number of repeated copy operations
OUT	ARRAY	D, L	Address in destination area where filling begins.

Description

You can use the "Fill block" operation to fill a memory area (destination area) with the value of the IN input. The destination area is filled beginning with the address specified at the OUT output. The number of repeated copy operations is specified with the COUNT parameter. When the operation is executed, the value at input IN is selected and copied to the destination area as often as specified by the value of the COUNT parameter.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- More data is copied than is available in the memory area at output OUT.

Placement

The "Fill block" operation can be placed at any position in the logic string.

Example

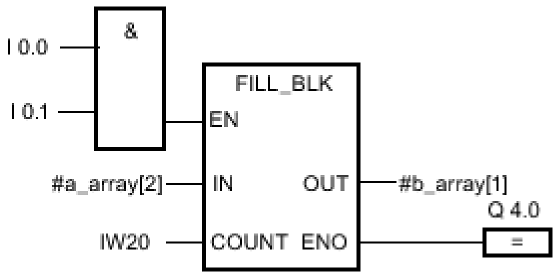


Figure7-2

IN	The tag "a_array" is an ARRAY data type and consists of 4 elements of the WORD data type (ARRAY[1..4] of WORD).
COUNT	IW20=3

OUT	The tag "b_array" is an ARRAY data type and consists of 5 elements of the WORD data type (ARRAY[1..5] of WORD).

If the inputs I 0.0 AND I 0.1 have signal state "1", the "Fill block" operation is executed. The operation copies the second element (a_array[2]) of the "a_array" tag three times to the output tag "b_array" (b_array[1..3]). If no errors occur during execution of the operation, outputs ENO and Q 4.0 are set to signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Pasting additional inputs and outputs (Page 494)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 UFILL_BLK: Fill area uninterruptible

Symbol

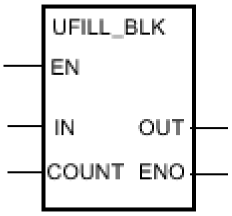


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	ARRAY	D, L or constant	Element used to fill the destination area.
COUNT	UINT	I, Q, M, D, L or constant	Number of repeated copy operations
OUT	ARRAY	D, L	Address in destination area where filling begins.

Description

You can use the "Fill block uninterruptible" operation to fill a memory area (destination area) with the value of the IN input without interruption. The destination area is filled beginning with the address specified at the OUT output. The number of repeated copy operations is specified with the COUNT parameter. When the operation is executed, the value at input IN is selected and copied to the destination area as often as specified by the value of the COUNT parameter.

The copy operation cannot be interrupted by other operating system activities. This is why the alarm reaction times of the CPU increase during the execution of the "Fill block uninterruptible" operation.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- More data is copied than is available in the memory area at output OUT.

Placement

The "Fill block uninterruptible" operation can be placed at any position in the logic string.

Example

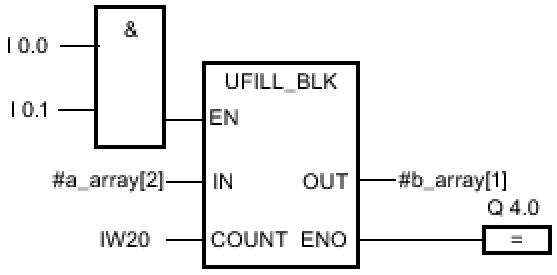


Figure7-2

IN	The tag "a_array" is an ARRAY data type and consists of 4 elements of the WORD data type (ARRAY[1..4] of WORD).
COUNT	IW20=3
OUT	The tag "b_array" is an ARRAY data type and consists of 5 elements of the WORD data type (ARRAY[1..5] of WORD).

If the inputs I 0.0 AND I 0.1 have signal state "1", the "Fill block" operation is executed. The operation copies the second element (a_array[2]) of the "a_array" tag three times to the output tag "b_array" (b_array[1..3]). The copy operation cannot be interrupted by other operating system activities. If no errors occur during execution of the operation, outputs ENO and Q 4.0 are set to signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)

7.8.1.2 SWAP: Swap

Symbol

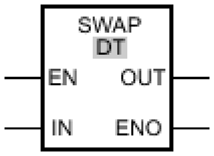


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	WORD, DWORD	I, Q, M, L, D or constant	Operand whose bytes are swapped.
OUT	WORD, DWORD	I, Q, M, L, D	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Swap" operation to change the order of the bytes within the tag at the IN input and query the result at the OUT output.

The following figure shows how the bytes of a DWORD data type tag are swapped using the "Swap" operation:

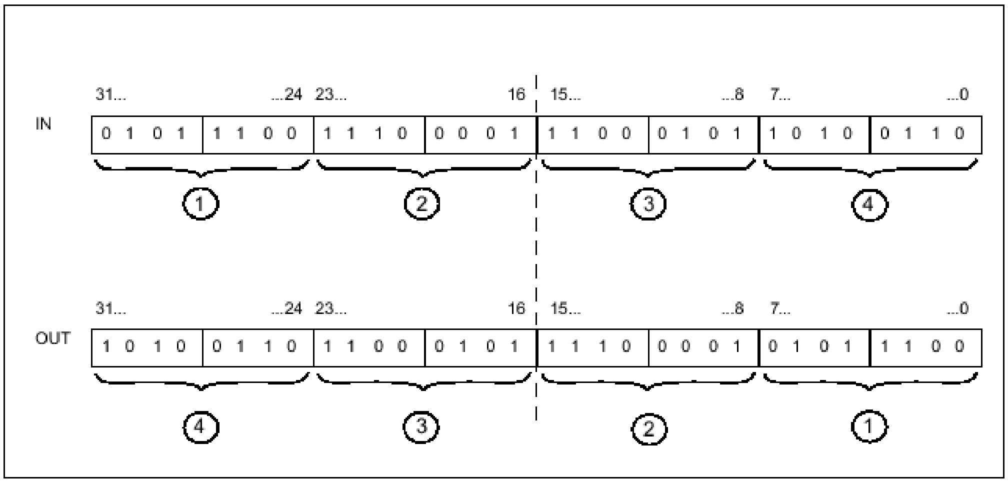


Figure7-2

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

If the signal state at the EN input is "0", the enable output ENO is reset to "0".

Placement

The "Swap" operation can be placed at any position in the logic string.

Example

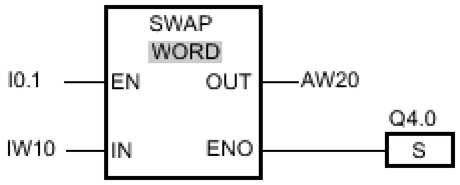


Figure7-2

IN	IW10 = 0000 1111 0101 0101
OUT	QW20 = 0101 0101 0000 1111

If input I 0.1 has signal state "1", the "Swap" operation is executed. The arrangement of the bytes is changed and stored in the QW20 tag. If no errors occur during execution of the operation, outputs ENO and Q 4.0 are set to signal state "1".

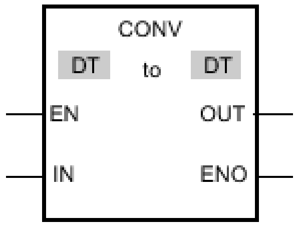
See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)
Pasting additional inputs and outputs (Page 494)

7.8.1.2 Convert

7.8.1.2 CONVERT: Convert value

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	BYTE, WORD, DWORD, SINT, INT, DINT, USINT, UINT, UDINT, BCD16, BCD32, REAL	I, Q, M, D, L or constant	Value to be converted.
OUT	BYTE, WORD, DWORD, SINT, INT, DINT, USINT, UINT, UDINT, BCD16, BCD32, REAL	I, Q, M, D, L	Result of the conversion

You can select the data type for the operation from the "DT" drop-down list.

Description

The "Convert" operation reads the content of the IN parameter and converts it according to the specified data types.

The "Convert" operation can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors such as an overflow occur during processing.

Placement

The "Convert" operation can be placed at any position in the logic string.

Example

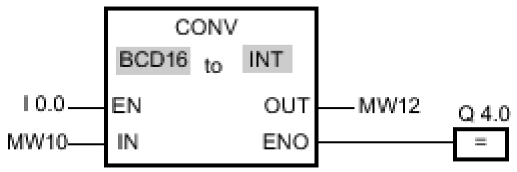


Figure7-2

If input I 0.0 = 1, the content of MW10 is read as a three-digit BCD-coded number and converted to an integer (16 bits). The result is stored in MW12. Output Q 4.0 is "1" if the conversion was executed (ENO = EN = 1).

See also

Inserting FBD elements (Page 484)

Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 ROUND: Round to double integer

Symbol

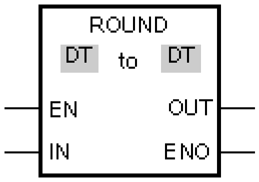


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	REAL	I, Q, M, D, L or constant	Input value to be rounded.
OUT	INT, USINT, UINT, SINT, UDINT, DINT, REAL	I, Q, M, D, L	Output value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Round numerical value" operation to round the value at the IN input to the nearest integer. The operation interprets the value at input IN as a floating-point number and converts this to the nearest double integer. If the input value is exactly between an even and odd number, the even number is selected. The result of the operation is provided at the OUT output and can be queried there.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors such as an overflow occur during processing.

Placement

The "Round numerical value" operation can be placed at any position in the logic string.

Example

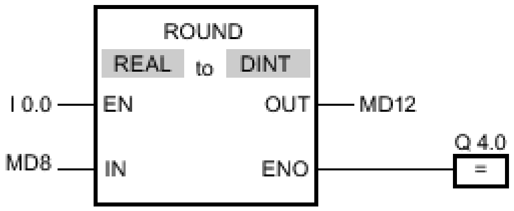


Figure7-2

IN	MD8 = 0.50000000
OUT	MD12 = 0

If input I 0.0 has signal state "1", the "Round numerical value" operation is performed. The floating-point number at input MD8 is rounded to the nearest even double integer and sent to the OUT output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 CEIL: Generate next higher integer from floating-point number

Symbol

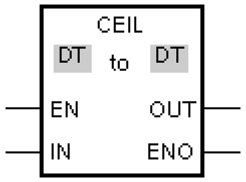


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	REAL	I, Q, M, D, L or constant	Input value
OUT	INT, USINT, UINT, SINT, UDINT, DINT, REAL	I, Q, M, D, L	Output value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Generate next higher integer from floating-point number" operation to round the value at the IN input to the next higher integer. The operation interprets the value at the IN input as a floating-point number and converts this to the next higher integer. The result of the operation is provided at the OUT output and can be queried there. The output value can be greater than or equal to the input value.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors such as an overflow occur during processing.

Placement

The "Generate next higher integer from floating-point number" operation can be placed at any position in the logic string.

Example

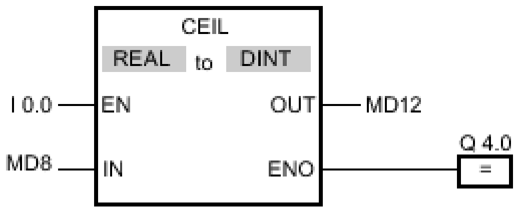


Figure7-2

IN	MD8 = 0.50000000
OUT	MD12 = 1

If input I 0.0 has signal state "1", the "Generate next higher integer from floating-point number" operation is executed. The floating-point number at input MD8 is rounded to the next higher integer and sent to the MD12 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 FLOOR: Generate next lower integer from floating-point number

Symbol

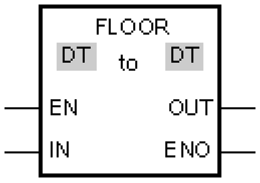


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	REAL	I, Q, M, D, L or constant	Input value
OUT	INT, USINT, UINT, SINT, UDINT, DINT, REAL	I, Q, M, D, L	Output value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Generate next lower integer from floating-point number" operation to round the value at the IN input to the next lower integer. The operation interprets the value at input IN as a floating-point number and converts this to the next higher integer. The result of the operation is provided at the OUT output and can be queried there. The output value can be less than or equal to the input value.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors such as an overflow occur during processing.

Placement

The "Generate next lower integer from floating-point number" operation can be placed at any position in the logic string.

Example

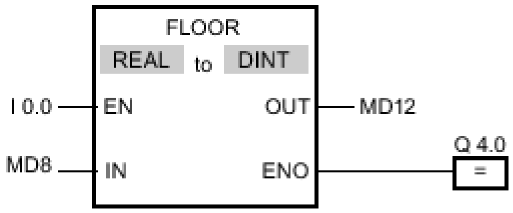


Figure7-2

IN	MD8 = 0.50000000
OUT	MD12 = 0

If input I 0.0 has signal state "1", the "Generate next lower integer from floating-point number" operation is executed. The floating-point number at input MD8 is rounded to the next lower integer and sent to the MD12 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Selecting the data type of an FBD element (Page 0)
Inserting FBD elements (Page 484)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 TRUNC: Truncate to integer

Symbol

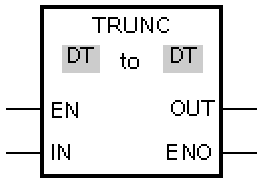


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	REAL	I, Q, M, D, L or constant	Input value
OUT	INT, USINT, UINT, SINT, UDINT, DINT, REAL	I, Q, M, D, L	Integer component of the input value

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Truncate numerical value" operation to form an integer without rounding the value at the IN input. The value at input IN is interpreted as a floating-point number. The operation selects only the integer part of the floating-point number and sends this to the OUT output without decimal places.

The operation is only executed if the signal state is "1" at the enable input EN. If no errors occur during execution of the operation, the ENO output also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- Errors such as an overflow occur during processing.

Placement

The "Truncate numerical value" operation can be placed at any position in the logic string.

Example

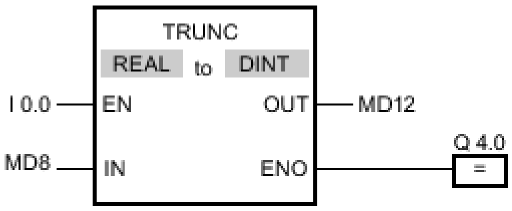


Figure7-2

IN	MD8 = 0.50000000
OUT	MD12 = 0

If the input I 0.0 has signal state "1", the "Truncate numerical value" operation is executed. The integer part of the floating-point number at input MD8 is converted to an integer and sent to the MD12 output. If no errors occur during execution of the operation, output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 SCALE_X: Scale

Symbol

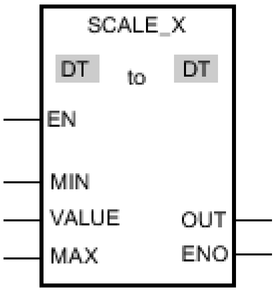


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
VALUE	REAL	I, Q, M, D, L or constant	Value to be scaled.
MIN	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	Low limit of the value range
MAX	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	High limit of the value range
OUT	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L	Result of scaling

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Scale" operation to scale the value at the VALUE input by mapping it to a specified value range. When the "Scale" operation is executed, the floating-point value at the VALUE input is scaled to the value range, which is defined by the MIN and MAX parameters. The result of the scaling is an integer, which is stored at the OUT output.

The following figure shows an example of how values can be scaled:

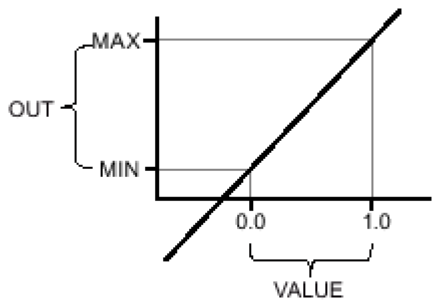


Figure7-2

The "Scale" operation is only executed if the signal state is "1" at the enable input EN. In this case, the enable output ENO also has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at the MIN input is greater than or equal to the value at the MAX input.
- The value of a specified REAL tag is outside the range of the normalized numbers according to IEEE-754.
- An overflow occurs.
- The value at input VALUE is NaN (result of an invalid arithmetic operation).

Placement

The "Scale" operation can be placed at any position in the logic string.

Example

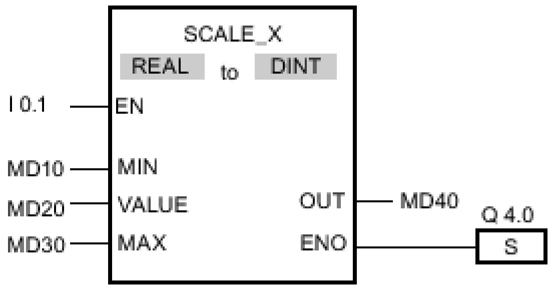


Figure7-2

VALUE	MD20 = 0.5
MIN	MD10 = 10
MAX	MD30 = 30
OUT	MD40 = 20

If the input I 0.1 has signal state "1", the "Scale" operation is performed. The value at input MD20 is scaled to the range of values defined by the values at inputs MD10 and MD30. The result is stored at output MD40. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 NORM_X: Normalize

Symbol

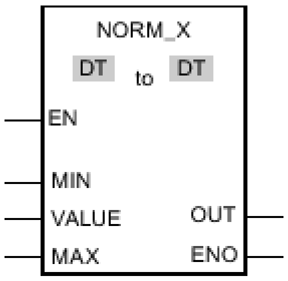


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
VALUE	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	Value to be normalized.
MIN	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	Low limit of the value range
MAX	SINT, INT, DINT, USINT, UINT, UDINT, REAL	I, Q, M, D, L or constant	High limit of the value range

Parameter	Data type	Memory area	Description
OUT	REAL	I, Q, M, D, L	Result of the normalization

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Normalize" operation to normalize the value of the tag at the VALUE input by mapping it to a linear scale. You can use the MIN and MAX parameters to define the limits of a value range that is applied to the scale. The result at the OUT output is calculated and stored as a floating-point number depending on the location of the normalized value in this value range. If the value to be normalized is equal to the value at the MIN input, the OUT output returns the value "0.0". If the value to be normalized is equal to the value at the MAX input, the OUT output has the value "1.0".

The following figure shows an example of how values can be normalized:

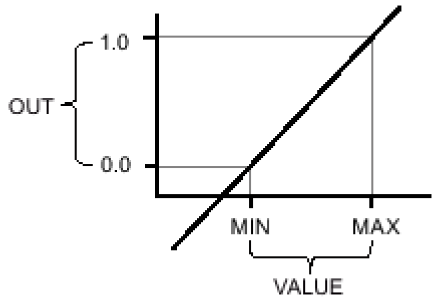


Figure7-2

The "Normalize" operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO enable output has signal state "1".

The enable output ENO returns signal state "0" if one of the following conditions applies:

- The EN input has signal state "0".
- The value at the MIN input is greater than or equal to the value at the MAX input.
- The value of a specified REAL tag is outside the range of the normalized numbers according to IEEE-754.
- An overflow occurs.
- The value at input VALUE is NaN (result of an invalid arithmetic operation).

Placement

The "Normalize" operation can be placed at any position in the logic string.

Example

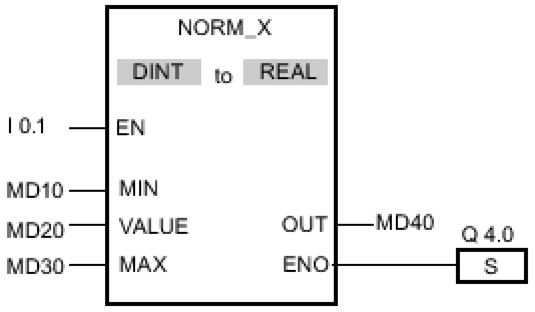


Figure7-2

VALUE	MD20 = 20
MIN	MD10 = 10
MAX	MD30 = 30
OUT	MD40 = 0.5

If the input I 0.1 has signal state "1", the "Normalize" operation is performed. The value at input MD20 is assigned to value range defined by the values at inputs MD10 and MD30. The tag value at the input MD20 is normalized corresponding to the defined value range. The result is stored as a floating-point number in output MD40. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 Program control

7.8.1.2 JMP: Jump in block if 1

Symbol

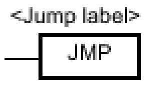


Figure7-2

Description

You can use the "Jump in block if 1 (conditionally)" operation to interrupt the linear execution of the program and resume it in another network. The target network must be identified by a jump label. The name of this jump label is specified for execution of the operation. The specified jump label is located above the operation.

The specified jump label must be in the same block in which the operation is executed. The name you specify can only occur once in the block.

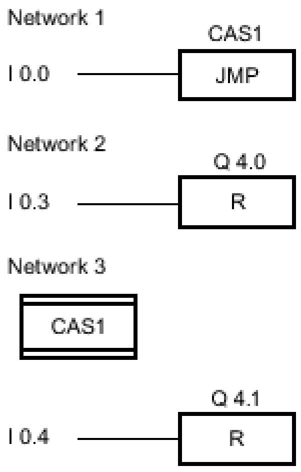
If the result of logic operation (RLO) at the input of the operation is "1", the jump to the network identified by the jump label is executed. The jump direction can be towards higher or lower network numbers.

If the condition at the input of the operation is not fulfilled (RLO = 0), execution of the program continues in the next network.

Placement

The "Jump in block if 1 (conditionally)" operation can only be placed at the right-side edge of the network.

Example



If input I 0.0 has signal state "1", the "Jump in block if 1 (conditionally)" operation is executed. The linear execution of the program is interrupted and continues in Network 3, which is identified by the jump label CAS1. If input I 0.4 has signal state "1", output Q 4.1 is reset.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 JMPN: Jump in block if 0

Symbol

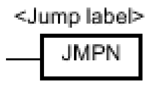


Figure7-2

Description

You can use the "Jump in block if 0 (conditionally)" operation to interrupt the linear execution of the program and resume it in another network, when the result of logic operation at the input of the operation is "0". The target network must be identified by a jump label. The name of this jump label is specified for execution of the operation. The specified jump label is located above the operation.

The specified jump label must be in the same block in which the operation is executed. The name you specify can only occur once in the block.

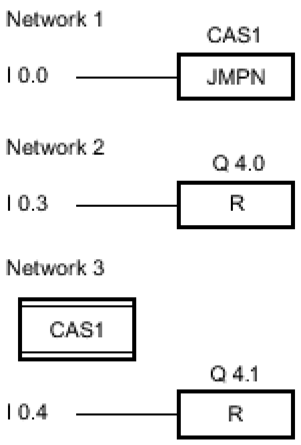
If the result of logic operation (RLO) at the input of the operation is "0", the jump to the network identified by the label is executed. The jump direction can be towards higher or lower network numbers.

If the condition at the input of the operation is not fulfilled (RLO = 1), execution of the program continues in the next network.

Placement

The "Jump in block if 0 (conditionally)" operation requires a preceding logic operation and can only be placed at the end of the logic string.

Example



If input I 0.0 has signal state "0", the "Jump in block if 0 (conditionally)" operation is executed. The linear execution of the program is interrupted and continues in Network 3, which is identified by the jump label CAS1. If input I 0.4 has signal state "1", output Q 4.1 is reset.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 LABEL: Jump label

Symbol

Figure7-2

Description

You can use "Jump label" to specify a destination network, in which the program execution should resume after a jump. The name of the jump label can consist of letters, numbers or underscores.

The jump label and the operation in which the jump label is specified must be located in the same block. The name of a jump label can only be assigned once in a block.

Each jump label can jump to several locations.

Example

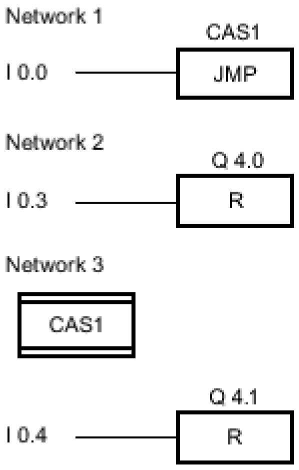


Figure7-2

If input I 0.0 has signal state "1", the "Jump in block if 1 (conditionally)" operation is executed. The linear execution of the program is interrupted and continues in Network 3, which is identified by the jump label CAS1. If input I 0.4 has signal state "1", output Q 4.1 is reset.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 RET: Return

Symbol

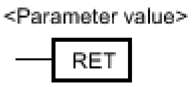


Figure7-2

Parameter values	Data type	Memory area	Description
TRUE	-	-	The status of the call function is set to "1".
FALSE	-	-	The status of the call function is set to "0".
<Operand>	BOOL	I, Q, M, L, D (Page 318)	The status of the call function is set to the signal state of the specified operand.

Description

You can use the "Return" operation to stop the execution of a block. The operation is then only executed if the signal state at the left connector is "1". If this condition is fulfilled, program execution is terminated in the currently called block and continued after the call function in the calling block (for example in the calling OB). The status of the call function is determined by the parameter of the "Return" operation. This can assume the following values:

- TRUE: Output ENO of the call function is set to "1".
- FALSE: Output ENO of the call function is reset to "0".
- <Operand>: Output ENO of the call function is determined by the signal state of the specified operand.

If an organization block is terminated by the "Return" operation, the CPU continues in the system program.

If the signal state at the input of the "Return" operation is "0", the operation is not executed. In this case, program execution continues in the next network of the called block.

Placement

The "Return" operation can be placed at the start or end of the logic string.

Example

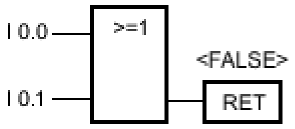


Figure7-2

If input I 0.0 OR I 0.1 has signal state "0", the "Return" operation is executed. Program execution in the called block is terminated and continues in the calling block. Output ENO of the call function is reset to signal state "0".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 Logical operations

7.8.1.2 AND: AND logic operation

Symbol

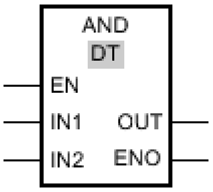


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	BYTE, WORD, DWORD	I, Q, M, L, D or constant	First value for logic operation
IN2	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Second value for logic operation
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "AND logic operation" to link the value at the IN1 input to the value at the IN2 input bit-by-bit by AND logic and query the result at the OUT output.

When the operation is executed, bit 0 of the value at the IN1 input is linked by AND to bit 0 of the value at the IN2 input. The result is stored in bit 0 of the OUT output. The same logic operation is executed for all other bits of the specified values.

The result bit has signal state "1" only when both of the bits in the logic operation also have signal state "1". If one of the two bits of the logic operation has signal state "0", the corresponding result bit is reset.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "AND logic operation" can be placed at any position in the logic string.

Example

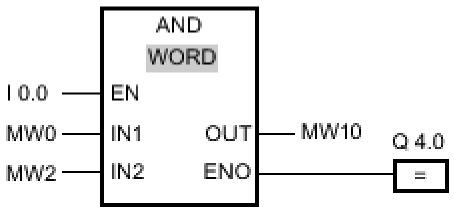


Figure7-2

IN1	MW0 = 01010101 01010101
IN2	MW2 = 00000000 00001111
OUT	MW10= 00000000 00000101

If input I 0.0 has the signal state "1", the "AND logic operation" is executed. The value at the MW0 input is linked by AND logic to the value at the MW2 input. The result is mapped bit-for-bit and sent to the MW10 output. Output ENO and output Q 4.0 are set to signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 OR: OR logic operation

Symbol

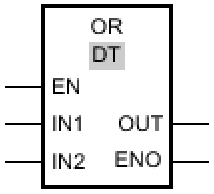


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	BYTE, WORD, DWORD	I, Q, M, L, D or constant	First value for logic operation
IN2	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Second value for logic operation
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "OR logic operation" to link the value at the IN1 input to the value at the IN2 input bit-by-bit by OR logic and query the result at the OUT output.

When the operation is executed, bit 0 of the value at the IN1 input is linked by OR to bit 0 of the value at the IN2 input. The result is stored in bit 0 of the OUT output. The same logic operation is executed for all bits of the specified tags.

The result bit has signal state "1" when at least one of the two bits in the logic operation has signal state "1". If both of the bits of the logic operation have signal state "0", the corresponding result bit is reset.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "OR logic operation" can be placed at any position in the logic string.

Example

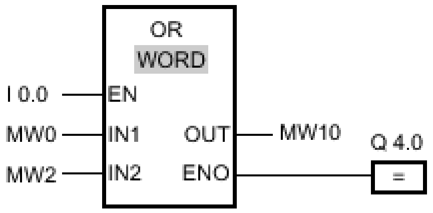


Figure7-2

IN1	MW0 = 01010101 01010101
IN2	MW2 = 00000000 00001111
OUT	MW10= 01010101 01011111

If input I 0.0 has signal state "1", the "OR logic operation" is executed. The value at the MW0 input is linked by OR logic to the value at the MW2 input. The result is mapped bit-for-bit and sent to the MW10 output. Output ENO and output Q 4.0 are set to signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 XOR: EXCLUSIVE OR logic operation

Symbol

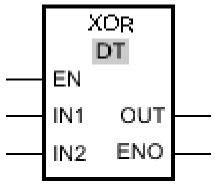


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN1	BYTE, WORD, DWORD	I, Q, M, L, D or constant	First value for logic operation

Parameter	Data type	Memory area	Description
IN2	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Second value for logic operation
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "EXCLUSIVE OR logic operation" to link the value at the IN1 input to the value at the IN2 input bit-by-bit by EXCLUSIVE OR logic and query the result at the OUT output.

When the operation is executed, bit 0 of the value at the IN1 input is linked by EXCLUSIVE OR to bit 0 of the value at the IN2 input. The result is stored in bit 0 of the OUT output. The same logic operation is executed for all other bits of the specified value.

The result bit has signal state "1" when one of the two bits in the logic operation has signal state "1". If both of the bits of the logic operation have signal state "1" or "0", the corresponding result bit is reset.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "EXCLUSIVE OR logic operation" can be placed at any position in the logic string.

Example

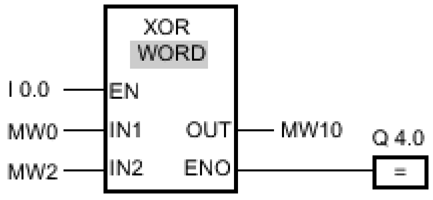


Figure7-2

IN1	MW0 = 01010101 01010101
IN2	MW2 = 00000000 00001111
OUT	MW10= 01010101 01011010

If input I 0.0 has signal state "1", the "EXCLUSIVE OR logic operation" is executed. The value at the MW0 input is linked by EXCLUSIVE OR logic to the value at the MW2 input. The result is mapped bit-for-bit and sent to the MW10 output. Output ENO and output Q 4.0 are set to signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 INV: Create ones complement

Symbol

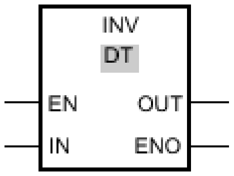


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
IN	BYTE, WORD, DWORD, USINT, UINT, UDINT, SINT, INT, DINT	I, Q, M, D, L or constant	Input value
OUT	BYTE, WORD, DWORD, USINT, UINT, UDINT, SINT, INT, DINT	I, Q, M, D, L	Ones complement of the value at input IN

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Create ones complement" operation to invert the signal status of the bits at the IN input. When the operation is executed, the value at the IN input is linked by EXCLUSIVE OR to a hexadecimal mask (W#16#FFFF for 16-bit numbers or DW#16#FFFF FFFF for 32-bit number). This inverts the signal state of the individual bits that are then stored in the OUT output.

The operation is only executed if the signal state is "1" at the enable input EN. In this case, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Create ones complement" operation can be placed at any position in the logic string.

Example

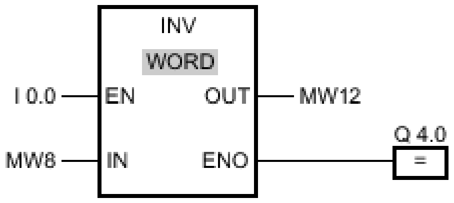


Figure7-2

IN	MW8 = W#16#000F
OUT	MW12 = W#16#FFF0

If input I 0.0 has signal state "1", the "Create ones complement" operation is executed. The operation inverts the signal state of the individual bits at the MW8 input and writes the result to the MW12 output. Output ENO and output Q 4.0 are set to signal state "1".

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 DECO: Decode

Symbol

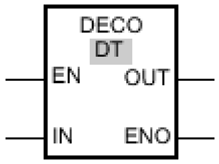


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L.	Enable output
IN	UINT	I, Q, M, D, L or constant	Input value
OUT	BYTE, WORD, DWORD	I, Q, M, D, L	Result

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Decode" operation to set a bit in the output value specified by the input value.

The "Decode" operation reads the value at the IN input and sets the bit in the output value, whose bit position corresponds to the value read. The other bits in the output value are filled with zeroes. When the value at the IN input is greater than 31, a modulo 32 operation is executed.

The "Decode" operation can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Decode" operation can be placed at any position in the logic string.

Example

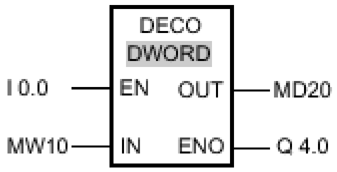


Figure7-2

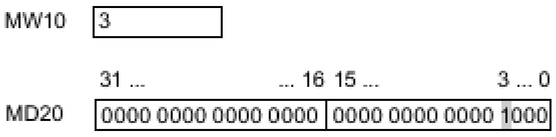


Figure7-2

If the input I 0.0 has signal state "1", the "Decode" operation is executed. The operation reads bit number "3" from the value at the MW10 input and set the third bit to the value at the MD20 output.

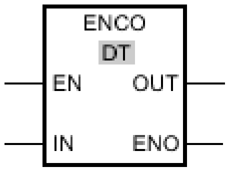
If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 ENCO: Encode

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L.	Enable output
IN	BYTE, WORD, DWORD	I, Q, M, D, L or constant	Input value
OUT	INT	I, Q, M, D, L	Output value

You can select the data type for the operation from the "DT" drop-down list.

Description

With the "Encode" operation, you can read the bit number of the least significant set bit in the input value and store it in the OUT output.

The "Encode" operation selects the least significant bit of the value at input IN and writes this bit number to the tag at the OUT output.

The "Encode" operation can only be started when the signal state at the EN enable input is "1". If no error occurs during execution, the ENO output also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Encode" operation can be placed at any position in the logic string.

Example

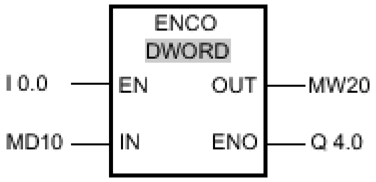


Figure7-2

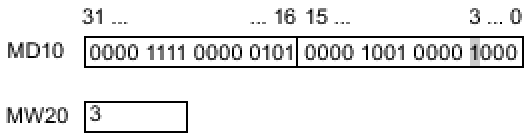


Figure7-2

If the input I 0.0 has signal state "1", the "Encode" operation is executed. The operation selects the least significant bit set at the MD10 input and writes bit position 3 to the tag at the MW20 output.

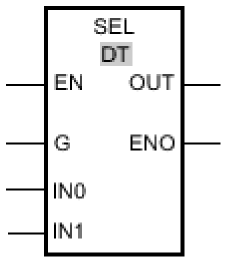
If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Changing FBD elements (Page 492)
Inserting FBD elements (Page 484)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 SEL: Select

Symbol



Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
G	BOOL	I, Q, M, D, L	Selection switch
IN0	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT, REAL, TIME, CHAR	I, Q, M, D, L or constant	First input value

Parameter	Data type	Memory area	Description
IN1	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT, REAL, TIME, CHAR	I, Q, M, D, L or constant	Second input value
OUT	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT, REAL, TIME, CHAR	I, Q, M, D, L	Value of the selected input

You can select the data type for the operation from the "DT" drop-down list.

Description

The "Select" operation selects one of the inputs IN0 or IN1 depending on a switch (parameter G) and copies its content to the OUT output. If parameter G has signal state "0", the value at input IN0 is copied. When the G parameter has signal state "1", the value at input IN1 is copied to the output OUT.

The operation is only executed if the signal state is "1" at the enable input EN. If no error occurs during execution, the ENO output also has signal state "1".

The ENO enable output is reset when the EN enable input has signal state "0" or errors occur during execution of the operation.

Placement

The "Select" operation can be placed at any position in the logic string.

Example

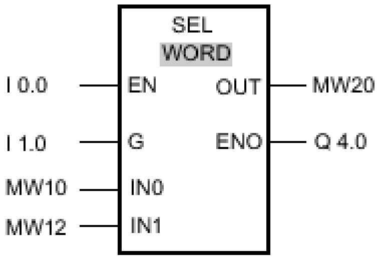


Figure7-2

G	I 1.0 = 1
IN0	MW10 = W#16#0000
IN1	MW12 = W#16#FFFF
OUT	MW20 = W#16#FFFF

If input I 0.0 has signal state "1", the "Select" operation is executed. Based on the signal status at the input I 1.0, the value at the MW12 input is selected and copied to the MW20 output. If no errors occur during execution of the operation, outputs ENO and Q 4.0 are set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0   )

7.8.1.2 MUX: Multiplex

Symbol

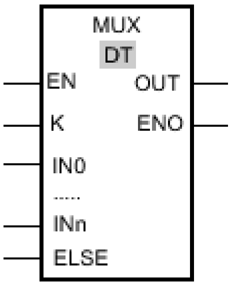


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, D, L (Page 318)	Enable input
ENO	BOOL	I, Q, M, D, L	Enable output
K	UINT	I, Q, M, D, L	Specifies the input whose content is to be copied.
IN0	BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, SINT, USINT, REAL, CHAR, TIME	I, Q, M, D, L or constant	First available input
INn	BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, SINT, USINT, REAL, CHAR, TIME	I, Q, M, D, L or constant	Available input

Parameter	Data type	Memory area	Description
ELSE	BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, SINT, USINT, REAL, CHAR, TIME	I, Q, M, D, L or constant	Specifies the value to be copied when K > n.
OUT	BYTE, WORD, DWORD, INT, DINT, UINT, UDINT, SINT, USINT, REAL, CHAR, TIME	I, Q, M, D, L	Output to which the value is to be copied.

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Multiplex" operation to copy the content of a selected input to the OUT output. The number of selectable inputs of the MUX box can be expanded. The inputs are numbered automatically in the box. Numbering starts at IN0 and is incremented continuously with each new input. You can use the K parameter to determine the input whose content should be copied to the OUT output. If the value of the K parameter is greater than the number of available inputs, the content of the ELSE parameter is copied to the OUT output and the enable output is assigned signal state "0".

The "Multiplex" operation can only execute when the tags at all inputs and at the OUT output are of the same data type. The exception here is the K parameter that can only be specified as an integer.

The operation is only executed if the signal state is "1" at the enable input EN. If no error occurs during execution, the ENO output also has signal state "1".

The enable output ENO is reset if one of the following conditions applies:

- The enable input EN has signal state "0".
- The value of the K parameter is greater than the number of available inputs.
- Errors occurred during processing of the operation.

Placement

The "Multiplex" operation can be placed at any position in the logic string.

Example

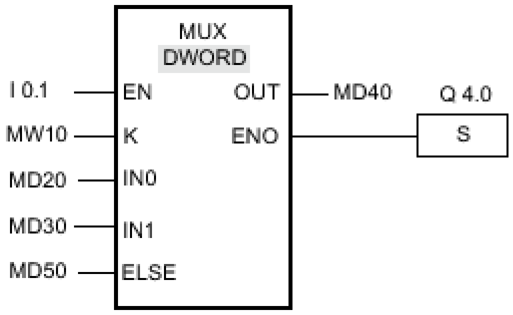


Figure7-2

K	MW10 = 1
IN0	MD20 = DW#16#00000000
IN1	MD30 = DW#16#FFFFFFFF
ELSE	MD50 = DW#16#FFFF0000
OUT	MD40 = DW#16#FFFFFFFF

If the input I 0.1 has signal state "1", the "Multiplex" operation is executed. Based on the value at the MW10 input, the value at the MD30 input is copied and assigned to the tag at the MD40 output. If no errors occur during execution of the operation, outputs ENO and Q 4.0 are set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 Shift + rotate

7.8.1.2 SHR: Shift right

Symbol

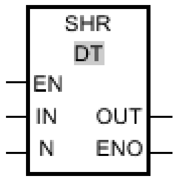


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, L, D or constant	Value to be shifted.
N	UINT	I, Q, M, L, D or constant	Number of bit positions by which the value is shifted.
OUT	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, L, D	Result of the shift operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Shift right" operation to shift the content of the tag at the IN input bit-by-bit to the right and query the result at the OUT output. You can use the N parameter to specify the number of bit positions by which the specified value should be shifted.

When the N parameter has the value "0", the value at the IN input is copied to the tag at the OUT output.

When the value at the N parameter is greater than the number of bit positions, the tag value at IN input is moved by the available number of bit positions to the right.

The freed bit positions in the left area of the tag are filled by zeroes when values without signs are shifted. If the specified value has a sign, the free bit positions are filled with the signal state of the sign bit.

The following figure show how the content of a integer data type tag is shifted four bit positions to the right:

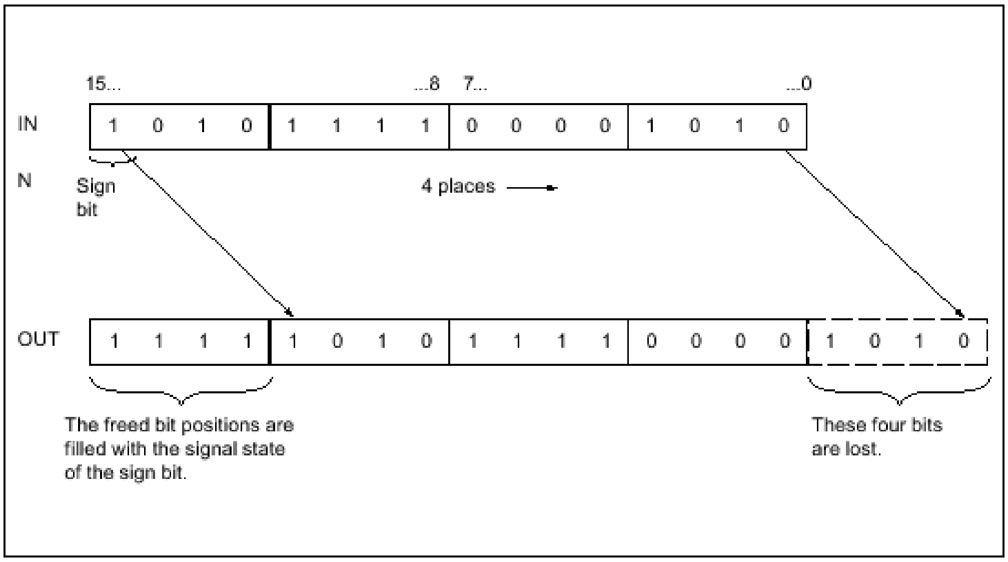


Figure7-2

The "Shift right" operation is only executed if the signal state is "1" at the enable input EN. In this case, the enable output ENO also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Shift right" operation can be placed at any position in the logic string.

Example

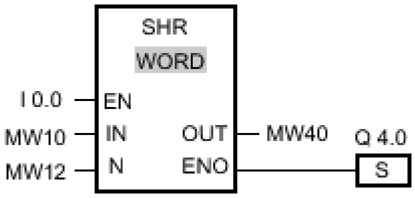


Figure7-2

IN	MW10 = 0011 1111 1010 1111
N	MW12 = 3
OUT	MW40 = 0000 0111 1111 010 1

If input I 0.0 has signal state "1", the "Shift right" operation is executed. The content of the MW10 tag is shifted three bit positions to the right. The result is stored at the MW40 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 SHL: Shift left

Symbol

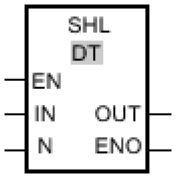


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, L, D or constant	Value to be shifted.
N	UINT	I, Q, M, L, D or constant	Number of bit positions by which the value is shifted.
OUT	BYTE, WORD, DWORD, SINT, USINT, INT, UINT, DINT, UDINT	I, Q, M, L, D	Result of the shift operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Shift left" operation to shift the content of the tag at the IN input bit-by-bit to the left and query the result at the OUT output. You can use the N parameter to specify the number of bit positions by which the specified value should be shifted.

When the N parameter has the value "0", the value at the IN input is copied to the tag at the OUT output.

When the value at the N parameter is greater than the number of bit positions, the tag value at IN input is moved by the available number of bit positions to the left.

The bit positions in the right part of the tag freed by shifting are filled with zeros.

The following figure show how the content of a WORD data type tag is shifted six bit positions to the left:

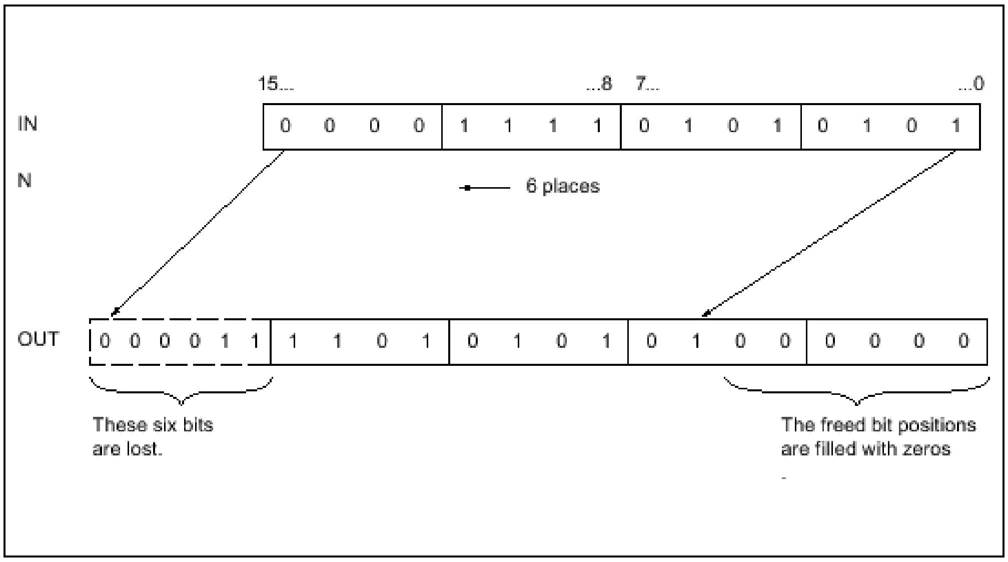


Figure7-2

The "Shift left" operation is only executed if the signal state is "1" at the enable input EN. In this case, the enable output ENO also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Shift left" operation can be placed at any position in the logic string.

Example

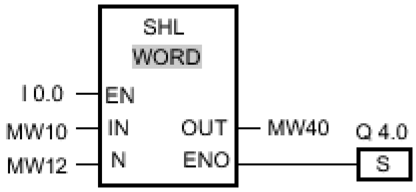


Figure7-2

IN	MW10 = 0011 1111 1010 1111
N	MW12 = 4
OUT	MW40 = 1111 1010 1111 0000

If input I 0.0 has signal state "1", the "Shift left" operation is executed. The content of the MW10 tag is shifted four bit positions to the left. The result is stored at the MW40 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.1.2 ROR: Rotate right

Symbol

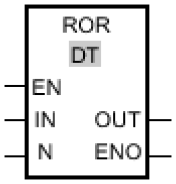


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Value to be rotated.
N	UINT	I, Q, M, L, D or constant	Number of bit positions by which the value is rotated.
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Rotate right" operation to rotate the content of the tag at the IN input bit-by-bit to the right and query the result at the OUT output. The N parameter specifies the number of bit positions by which the specified value will be rotated. The bit positions freed by rotating are filled with the bit positions that are pushed out.

When the N parameter has the value "0", the value at the IN input is copied to the tag at the OUT output.

When the value at the N parameter is greater than the number of bit positions, the tag value at IN input is rotated by the available number of bit positions.

The following figure show how the content of a DWORD data type tag is rotated three bit positions to the right:

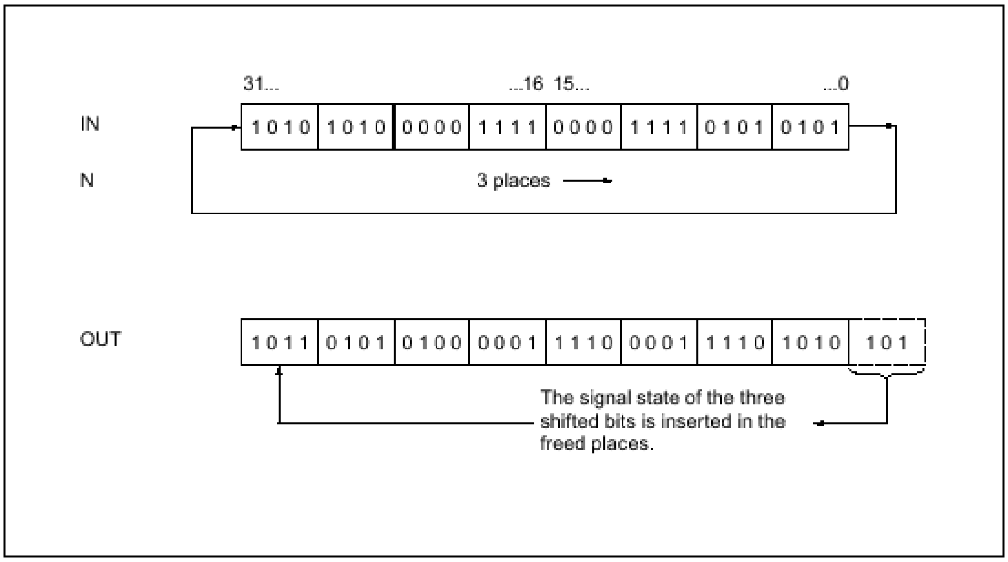


Figure7-2

The "Rotate right" operation is only executed if the signal state is "1" at the enable output ENO. In this case, the enable output ENO also has signal state "1".

If the signal state at the enable input EN is "0", the enable output ENO is reset to signal state "0".

Placement

The "Rotate right" operation can be placed at any position in the logic string.

Example

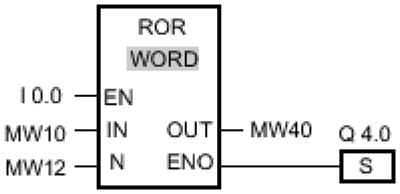


Figure7-2

IN	MW10 = 0000 1111 1001 0101
N	MW12 = 5
OUT	MW40 = 1010 1000 0111 1100

If input I 0.0 has signal state "1", the "Rotate right" operation is executed. The content of the MW10 tag is rotated five bit positions to the right. The result is stored at the MW40 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)
Changing FBD elements (Page 492)
Selecting the data type of an FBD element (Page 0)
Inserting operands into FBD instructions (Page 495)

7.8.1.2 ROL: Rotate left

Symbol

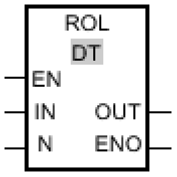


Figure7-2

Parameter	Data type	Memory area	Description
EN	BOOL	I, Q, M, L, D (Page 318)	Enable input
ENO	BOOL	I, Q, M, L, D	Enable output
IN	BYTE, WORD, DWORD	I, Q, M, L, D or constant	Value to be rotated.
N	UINT	I, Q, M, L, D or constant	Number of bit positions by which the value is rotated.
OUT	BYTE, WORD, DWORD	I, Q, M, L, D	Result of the operation

You can select the data type for the operation from the "DT" drop-down list.

Description

You can use the "Rotate left" operation to rotate the content of the tag at the IN input bit-by-bit to the left and query the result at the OUT output. The N parameter specifies the number of bit positions by which the specified value will be rotated. The bit positions freed by rotating are filled with the bit positions that are pushed out.

If the value on the parameter N is "0", the value on the input IN is copied to the tag on the output OUT.

If the value on the parameter N is greater than the number of available bit places, the tag value on the input IN rotates through the available bit places.

The following figure show how the content of a DWORD data type tag is rotated three bit positions to the left:

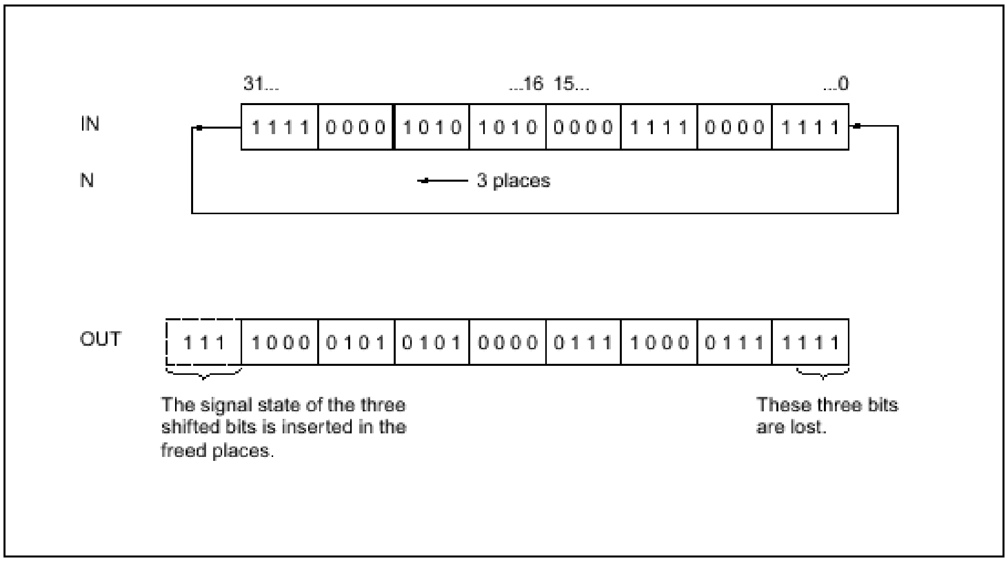


Figure7-2

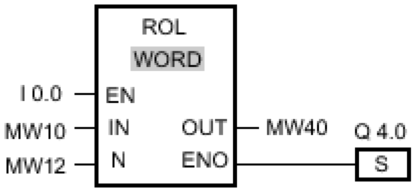
The "Rotate left" operation is only executed if the signal state is "1" at the enable output ENO. In this case, the enable output ENO also has signal state "1".

If the signal state on the enable input EN is “0”, the enable output ENO also has the signal state “0”.

Placement

The "Rotate left" operation can be placed at any position in the logic string.

Example



IN	MW10 = 1010 1000 1111 0110
OUT	MW12 = 5
N	MW40 = 0001 1110 1101 010 1

If input I 0.0 has signal state "1", the "Rotate left" operation is performed. The content of the MW10 tag is rotated five bit positions to the left. The result is stored at the MW40 output. If no errors occur during execution of the operation, the ENO output has signal state "1" and output Q 4.0 is set.

See also

Inserting FBD elements (Page 484)

Changing FBD elements (Page 492)
Inserting operands into FBD instructions (Page 495)
Selecting the data type of an FBD element (Page 0)

7.8.2 Extended instructions

7.8.2.1 Clock and calendar

7.8.2.1 Time-of-day functions

7.8.2.1 WR_SYS_T

Description

You can use WR_SYS_T to set the date and time of the CPU clock. You specify the date and time in the DTL format at the IN input of the instruction. At the RET_VAL output, you can query whether errors have occurred during execution of the instruction.

You cannot send information about the local time zone or daylight saving time using the "WR_SYS_T" instruction.

Parameter

Parameter	Declaration	Data type	Memory area	Description
IN	IN	DTL	M, D, L	Date and time
RET_VAL	OUT	INT	M, D, L	Status of the instruction

Parameter RET_VAL

Error code (W#16#...)	Description
0000	No error
8081	Year invalid
8082	Month invalid
8083	Day invalid

Error code (W#16#...)	Description
8084	Hour information invalid
8085	Minute information invalid
8086	Second information invalid
8087	Nanosecond information invalid
80B0	The realtime clock has failed.

7.8.2.1 RD_SYS_T

Description

You can use RD_SYS_T to read the current date and current time of the CPU clock. The data is provided in DTL format at the OUT output of the instruction. The provided value does not include information about the local time zone or daylight saving time. At the RET_VAL output, you can query whether errors have occurred during execution of the instruction.

Parameter

Parameter	Declaration	Data type	Memory area	Description
OUT	OUT	DTL	M, D, L	Date and time of CPU
RET_VAL	OUT	INT	M, D, L	Status of the instruction

Parameter RET_VAL

Error code (W#16#...)	Description
0000	No error
8222	The result is outside the permissible range of values
8223	The result cannot be saved with the specified data type

7.8.2.1 RD_LOC_T

Description

You can use RD_LOC_T to read the current local time from the CPU clock and output this in DTL format at the OUT output. Information about the time zone and the beginning of daylight saving time and standard time, which you have set in the configuration of the CPU clock, are included in the local time information.

Parameters

Parameter	Declaration	Data type	Memory area	Description
OUT	OUT	DTL	M, D, L	Local time
RET_VAL	OUT	INT	M, D, L	Status of the instruction

Parameter RET_VAL

Error code (W#16#...)	Description
0000	No error
8080	Cannot read the local time.

7.8.2.1 T_CONV

Description

Using T_CONV, you convert the value at the IN input to the data format specified at the OUT output. The following conversions are possible:

- Conversion of a time (TIME) to a numeric value (DINT)
- Conversion of a value (DINT) to a time (TIME)

You decide the type of conversion by selecting the data types for the input and output of the instruction. You can query the result of the conversion at the OUT output.

Parameter

Parameter	Declaration	Data type	Memory area	Description
IN	IN	TIME, DINT	M, D, L	Value to be converted
OUT	OUT	TIME, DINT	M, D, L	Result of the conversion

7.8.2.1 T_ADD

Description

Using T_ADD, you add the time at the IN1 input to the time at the IN2 input. You can query the result at the OUT output. You can add the following formats:

- Addition of a time period (TIME) and another time period (TIME). The result can be output to a tag with the TIME format.
- Addition of a time period (TIME) to a point in time (DTL). The result can be output to a tag with the DTL format.

You decide the formats at the IN1 input and OUT output by selecting the data types for input and output of the instruction. At the IN2 input, you can only specify times in the TIME format.

Parameter

Parameter	Declaration	Data type	Memory area	Description
IN1	IN	TIME, DTL	M, D, L	Summand
IN2	IN	TIME	M, D, L	Summand
OUT	OUT	TIME, DTL	M, D, L	Result of addition

7.8.2.1 T_SUB

Description

Using T_SUB, you subtract the time at the IN2 input from the time at the IN1 input. You can query the difference at the OUT output. You can subtract the following formats:

- Subtraction of a time period (TIME) from another time period (TIME). The result can be output to a tag with the TIME format.

- Subtraction of a time period (TIME) from a point in time (DTL). The result can be output to a tag with the DTL format.

You decide the formats at the IN1 input and OUT output by selecting the data types for input and output of the instruction. At the IN2 input, you can only specify times in the TIME format.

Parameter

Parameter	Declaration	Data type	Memory area	Description
IN1	IN	TIME, DTL	M, D, L	Minuend
IN2	IN	TIME	M, D, L	Subtrahend
OUT	OUT	TIME, DTL	M, D, L	Result of subtraction

7.8.2.1 T_DIFF

Description

Using T_DIFF, you subtract the time at the IN2 input from the time at the IN1 input. The result is output at the OUT output in the TIME format. Only values in the DTL format can be specified at the IN1 and IN2 inputs.

If the time specified at the IN2 input is greater than the time specified at the IN1 input, the result is output as a negative value at the OUT output. If the result of the instruction is outside the permitted range, the result is limited to the relevant value and the enable output ENO is set to "0".

Parameter

Parameter	Declaration	Data type	Memory area	Description
IN1	IN	DTL	M, D, L	Minuend
IN2	IN	DTL	M, D, L	Subtrahend
OUT	OUT	TIME	M, D, L	Difference in the TIME format

7.8.2.2 STRING and CHAR

7.8.2.2 S_CONV

Description

Using S_CONV, you convert the value at the IN input to the data format you specified at the OUT output. The following conversions are possible:

- Conversion of a character string (STRING) to a numeric value:
  The conversion is made for all characters of the string specified at the IN input. The characters permitted are the numbers 0 to 9, the decimal point and the plus and minus signs. The first character of the string may be a valid number or a sign. Leading spaces and exponential representations are ignored.
  The character conversion can be interrupted by invalid characters. In this case, the enable output ENO is set to "0".
  You decide the output format of the conversion by selecting a data type for the OUT output.
- Conversion of a numeric value to a character string (STRING):
  You decide the format of the numeric value to be converted by selecting a data type for the IN input. A valid tag of the STRING data type must be specified at the OUT output. The length of the character string after conversion depends on the value at the IN input. The result of the conversion is stored starting at the third byte of the character string, since the first byte contains the maximum length and the second byte the actual length of the string. Positive numeric value are output without a sign.
- Copying a character string:
  If you enter the STRING data type at the input and output of the instruction, the character string at the input IN will be copied to the output OUT. If the actual length of the character string at the IN input exceeds the maximum length of the character string at the OUT output, that part of the character string at IN will be copied that fits exactly in the character string at OUT, and the enable output ENO will be set to the value "0".

Parameters

Parameter for converting a character string into a a numeric value:

Parameter	Declaration	Data type	Memory area	Description
IN	IN	STRING	D, L or constant	Value to be converted
OUT	OUT	USINT, SINT, UINT, INT, UDINT, DINT, REAL	I, Q, M, D, L	Result of the conversion

Parameter for converting a numeric value into a character string:

Parameter	Declaration	Data type	Memory area	Description
IN	IN	USINT, SINT, UINT, INT, UDINT, DINT, REAL	I, Q, M, D, L or constant	Value to be converted
OUT	OUT	STRING	D, L	Result of the conversion

Parameter for copying a character string:

Parameter	Declaration	Data type	Memory area	Description
IN	IN	STRING	D, L or constant	Value to be copied
OUT	OUT	STRING	D, L	Result of the copy operation

Example

The following table shows examples of the conversion of a character string to a numeric value:

IN (STRING)	OUT (data type)	OUT (value)	ENO status
'123'	INT/DINT	123	1
'-00456'	INT/DINT	-456	1
'123.45'	INT/DINT	123	1
'+2345'	INT/DINT	2345	1
'00123AB'	INT/DINT	123	1
'123'	REAL	123.0	1
'123.45'	REAL	123.45	1
'1.23e-4'	REAL	1.23	1
'1.23E-4'	REAL	1.23	1
'12,345.67'	REAL	12345.67	1
'3.4e39'	REAL	3.4	1
'-3.4e39'	REAL	-3.4	1
'1.17549e-38'	REAL	1.17549	1
'12345'	SINT	0	0
'A123'	-/-	0	0
''	-/-	0	0
'++123'	-/-	0	0
'+-123'	-/-	0	0

Example

The following table shows examples of the conversion of a numeric value to a character string:

IN (value)	IN (data type)	OUT (STRING)	ENO status
123	UINT	'123'	1
0	UINT	'0'	1
12345678	UDINT	'12345678'	1
-Inf 1)	REAL	'Inf'	0
+Inf 2)	REAL	'Inf'	0
NaN 3)	REAL	'NaN'	0
1) -Inf: Floating-point number representing a negative infinite value. 2) +Inf: Floating-point number representing a positive infinite value. 3) NaN: Value returned as the result of invalid math operations.			

See also

STRING (Page 383)

7.8.2.2 STRG_VAL

Description

Using STRG_VAL, you convert a character string to a numeric value. You specify the character string to be converted at the IN input. You decide the format of the output value by selecting a data type for the OUT output. You can query the result at the OUT output.

The conversion starts at the character whose position you specified in the P parameter. If, for example, the value "1" is specified in the P parameter, the conversion starts at the first character of the specified character string. The characters permitted for the conversion are the numbers 0 to 9, the decimal point, the decimal comma, notations "E" and "e" and the plus and minus characters. The conversion can be interrupted by invalid characters. In this case, the enable output ENO is set to "0".

With the FORMAT parameter, you specify how the characters of a string are to be interpreted. Exponential values can also be converted and represented with the "STRG_VAL" instruction. Only tags of the USINT data type can be specified for the FORMAT parameter.

The following table shows the possible values of the FORMAT parameter and their meaning:

Value (W#16#....)	Notation	Decimal representation
0000	Decimal fraction	"."
0001		","

Value (W#16#....)	Notation	Decimal representation
0002	Exponential	"."
0003		","
0004 to FFFF	Invalid values	

Parameters

Parameter	Declaration	Data type	Memory area	Description
IN	IN	STRING	D, L or constant	Character string to be converted
FORMAT	IN	WORD	I, Q, M, D, L or constant	Output format of the characters
P	IN_OUT	UINT	I, Q, M, D, L	Character at which the conversion starts
OUT	OUT	USINT, SINT, UINT, INT, UDINT, DINT, REAL	I, Q, M, D, L	Result of the conversion

Example

The following table shows examples of the conversion of a character string to a numeric value:

IN (STRING)	FORMAT (W#16#....)	OUT (data type)	OUT (value)	ENO status
'123'	0000	INT/DINT	123	1
'-00456'	0000	INT/DINT	-456	1
'123.45'	0000	INT/DINT	123	1
'+2345'	0000	INT/DINT	2345	1
'00123AB'	0000	INT/DINT	123	1
'123'	0000	REAL	123.0	1
'-00456'	0001	REAL	-456.0	1
'+00456'	0001	REAL	456.0	1
'123.45'	0000	REAL	123.45	1
'123.45'	0001	REAL	12345.0	1
'123,45'	0000	REAL	12345.0	1
'123,45'	0001	REAL	123.45	1
'.00123AB'	0001	REAL	123.0	1

IN (STRING)	FORMAT (W#16#....)	OUT (data type)	OUT (value)	ENO status
'1.23e-4'	0000	REAL	1.23	1
'1.23E-4'	0000	REAL	1.23	1
'1.23E-4'	0002	REAL	1.23E-4	1
'12,345.67'	0000	REAL	12345.67	1
'12,345.67'	0001	REAL	12.345	1
'3.4e39'	0002	REAL	W#16#7F800000	1
'-3.4e39'	0002	REAL	W#16#FF800000	1
'1.1754943e-38'	0002	REAL	0.0	1
'12345'	-/-	SINT	0	0
'A123'	-/-	-/-	0	0
''	-/-	-/-	0	0
'++123'	-/-	-/-	0	0
'+-123'	-/-	-/-	0	0

See also

STRING (Page 383)

7.8.2.2 VAL_STRG

Description

Using VAL_STRG, you convert a numeric value to a character string. You specify the value to be converted at the IN input. You decide the format of the numeric value by selecting a data type. You query the result of the conversion at the OUT output.

With the P parameter, you specify the character in the string starting at which the result is written. If, for example, the value "2" is specified in the P parameter, the converted value is saved starting at the second character of the string.

With the SIZE parameter you specify how many characters of the string are written. This is counted from the character specified in the P parameter. If the length defined by the P and SIZE parameters is not adequate, the enable output ENO is set to "0". If the output value is shorter than the specified length, the result is written to the character string right-justified. The empty character positions are filled with blanks.

The characters permitted for the conversion are the numbers 0 to 9, the decimal point, the decimal comma, notations "E" and "e" and the plus and minus characters. The conversion can be interrupted by invalid characters. In this case, the enable output ENO is set to "0".

With the FORMAT parameter, you specify how the numeric value is interpreted during conversion and written to the character string. Only tags of the USINT data type can be specified for the FORMAT parameter.

The following table shows the possible values of the FORMAT parameter and their meaning:

Value (W#16#....)	Notation	Sign	Decimal representation
0000	Decimal fraction	"-"	"."
0001			","
0002	Exponential		"."
0003			","
0004	Decimal fraction	"+" and "-"	"."
0005			","
0006	Exponential		"."
0007			","
0008 to FFFF	Invalid values		

With the PREC parameter, you define the number of decimal places when converting floating-point numbers. A maximum precision of 7 numbers is supported for numeric values of the REAL data type. If the value to be converted is an integer, you use the PREC parameter to specify the position where the decimal point is placed.

Parameters

Parameter	Declaration	Data type	Memory area	Description
IN	IN	USINT, SINT UINT, INT UDINT, DINT REAL	I, Q, M, D, L or constant	Value to be converted
SIZE	IN	USINT	I, Q, M, D, L or constant	Number of character positions
PREC	IN	USINT	I, Q, M, D, L or constant	Number of decimal places
FORMAT	IN	WORD	I, Q, M, D, L or constant	Output format of the characters
P	IN_OUT	UINT	I, Q, M, D, L	Character starting at which the result is written.
OUT	OUT	STRING	D, L	Result of the conversion

Example

The following table shows examples of the conversion of numeric values to a character string.

IN (value)	IN (data type)	P	SIZE	FORMAT (W#16#....)	PREC	OUT (STRING)	ENO status
123	UINT	16	10	0000	0	`xxxxxxx123 C`	1
0	UINT	16	10	0000	2	`xxxxxx0.00 C`	1
12345678	UDINT	16	10	0000	3	`x12345.678 C`	1
12345678	UDINT	16	10	0001	3	`x12345.678 C`	1
123	INT	16	10	0004	0	`xxxxxx+123 C`	1
-123	INT	16	10	0004	0	`xxxxxx-123 C`	1
-0.00123	REAL	16	10	0004	4	`xxx-0.0012 C`	1
-0.00123	REAL	16	10	0006	4	`-1.2300E-3 C`	1
-Inf 1)	REAL	16	10	-/-	4	`xxxxxx-INF C`	0
+Inf 2)	REAL	16	10	-/-	4	`xxxxxx+INF C`	0
NaN 3)	REAL	16	10	-/-	4	`xxxxxxxNaN C`	0
12345678	UDINT	16	6	-/-	3	`xxxxxxxxxx C`	0

"x" represents blanks
1) -Inf: Floating-point number representing a negative infinite value.
2) +Inf: Floating-point number representing a positive infinite value.
3) NaN: Value returned as the result of invalid math operations.

See also

STRING (Page 383)

7.8.2.2 Instructions

7.8.2.2 LEN

Description

A tag of the STRING type contains two lengths: the maximum length and the current length (this is the number of currently valid characters). The maximum length of the string is specified for each tag in the STRING keyword in square brackets. The current length represents the number of the character places actually used. The current length must be less than or equal to the maximum length. The number of bytes occupied by a string is 2 greater than the maximum length.

You can use the "LEN" instruction to query the current length of the string specified at the IN input and output it as a numerical value at the OUT output. An empty string ('') has the length zero.

If errors occur during processing of the operation, an empty string will be output.

Parameters

Parameter	Declaration	Data type	Memory area	Description
IN	IN	STRING	D, L or constant	Character string
OUT	OUT	INT	I, Q, M, D, L	Number of valid characters

See also

STRING (Page 383)

7.8.2.2 CONCAT

Description

CONCAT joins the string parameters IN1 and IN2 to form one string provided at OUT. The destination string has to be of sufficient length, otherwise the resulting string is truncated and the enable output ENO is set to the value "0".

If errors occur during processing of the instruction and the OUT output can be written to, an empty string will be output.

Parameters

Parameter	Declaration	Data type	Memory area	Description
IN1	IN	STRING	D, L or constant	Character string
IN2	IN	STRING	D, L or constant	Character string
OUT	OUT	STRING	D, L	Result string

See also

STRING (Page 383)

7.8.2.2 LEFT

Description

You can use LEFT to extract a partial string beginning with the first character of the string at the IN input. You specify the number of characters to be extracted with the L parameter. The extracted characters are output at the OUT output in the STRING format.

If the number of character to be extracted is greater than the current length of the string, the OUT output returns the input string as a result. An empty string is return with the value "0" at the L parameter or with an empty string as the input value. If the value at the L parameter is negative, an empty string is output and the ENO enable output is set to the value "0".

If errors occur during processing of the instruction and the OUT output can be written to, an empty string will be output.

Parameter

Parameter	Declaration	Data type	Memory area	Description
IN	IN	STRING	D, L or constant	Character string
L	IN	INT	I, Q, M, D, L or constant	Number of characters to be extracted
OUT	OUT	STRING	D, L	Extracted partial string

See also

STRING (Page 383)

7.8.2.2 RIGHT

Description

You can use RIGHT to extract a partial string beginning with the last character of the string at the IN input. You specify the number of characters to be extracted with the L parameter. The extracted characters are output at the OUT output in the STRING format.

If the number of character to be extracted is greater than the current length of the string, the OUT output returns the input string as a result. An empty string is return with the value "0" at the L parameter or with an empty string as the input value. If the value at the L parameter is negative, an empty string is output and the ENO enable output is set to the value "0".

If errors occur during processing of the instruction and the OUT output can be written to, an empty string will be output.

Parameter

Parameter	Declaration	Data type	Memory area	Description
IN	IN	STRING	D, L or constant	Character string
L	IN	INT	I, Q, M, D, L or constant	Number of characters to be extracted
OUT	OUT	STRING	D, L	Extracted partial string

See also

STRING (Page 383)

7.8.2.2 MID

Description

You can use MID to extract a portion of the string at the IN input. You can specify the position of the first character to extract with the P parameter. You specify the length of the string to extract with the L parameter. The extracted partial string is output at the OUT output.

The following rules should be observed when executing the instruction:

- If the number of characters to be extracted exceeds the current length of the string at the IN input, a partial string is output, beginning with the character position P and continuing to the end of the string.
- If the character position specified with the P parameter is beyond the current length of the string at the IN input, an empty string is output at the OUT output and the ENO enable output is set to the value "0".
- If the value of the P or L parameter equals zero or is negative, an empty string is output at the OUT output and the ENO enable output is set to the value "0".

If errors occur during processing of the instruction and the OUT output can be written to, an empty string will be output.

Parameters

Parameter	Declaration	Data type	Memory area	Description
IN	IN	STRING	D, L or constant	Character string
P	IN	INT	I, Q, M, D, L or constant	Position of the first character to be extracted (first character = 1)
L	IN	INT	I, Q, M, D, L or constant	Length of the string to be extracted
OUT	OUT	STRING	D, L	Extracted partial string

See also

STRING (Page 383)

7.8.2.2 DELETE

Description

You can use DELETE to delete a portion of the string at the IN input. You can specify the position of the first character to be deleted with the P parameter. You can use the L parameter to specify the number of characters to be deleted. The remaining partial string is output at the OUT output in the STRING format.

The following rules should be observed when executing the instruction:

- If the value at the L or P parameter equals zero, the input string is returned at the OUT output.
- If the value at the P parameter is greater than the current length of the string at the IN input, the input string is returned at the OUT output.
- If the number of characters to be deleted is greater than the length of the string at the IN input, an empty string is output.
- If the value at the L or P parameter is negative, an empty string is output and the ENO enable output is set to the value "0".

If errors occur during processing of the instruction and the OUT output can be written to, an empty string will be output.

Parameters

Parameters	Declaration	Data type	Memory area	Description
IN	IN	STRING	D, L or constant	Character string
L	IN	INT	I, Q, M, D, L or constant	Number of characters to be deleted
P	IN	INT	I, Q, M, D, L or constant	Position of first character to be deleted
OUT	OUT	STRING	D, L	Result string

See also

STRING (Page 383)

7.8.2.2 INSERT

Description

Inserts string 2 into string 1 beginning at character position and stores the result in the string destination. You can use the P parameter to specify the position of the character at which the characters should be inserted. The result is output at the OUT output in the STRING format.

The following rules should be observed when executing the instruction:

- If the value at the P parameter P exceeds the current length of the string at the IN1 input, the string from the IN2 input is appended to the string from the IN1 input.
- If the value at the P parameter is negative or equals zero, an empty string is output at the OUT output. The ENO enable output is set to the value "0".
- If the results string is longer than the tag specified at the OUT output, the results string is limited to the available length. The ENO enable output is set to the value "0".

If errors occur during processing of the instruction and the OUT output can be written to, an empty string will be output.

Parameters

Parameters	Declaration	Data type	Memory area	Description
IN1	IN	STRING	D, L or constant	Character string
IN2	IN	STRING	D, L or constant	String to insert
P	IN	INT	I, Q, M, D, L or constant	Insert position
OUT	OUT	STRING	D, L	Result string

See also

STRING (Page 383)

7.8.2.2 REPLACE

Description

You can use REPLACE to replace a string at the IN1 input with the string at the IN2 input. You can specify the position of the first character to be replaced with the P parameter. You specify the number of characters to be replaced with the L parameter. The result is output at the OUT output in the STRING format.

The following rules should be observed when executing the instruction:

- If the value at the L parameter equals zero, the string at the IN1 input is returned at the OUT output.
- If P equals one, the string at the IN1 input is replaced beginning with (and including) the first character.

- If the value at the P parameter P exceeds the current length of the string at the IN1 input, the string from the IN2 input is appended to the string from the IN1 input.
- If the value at the P parameter is negative or equals zero, an empty string is output at the OUT output. The ENO enable output is set to the value "0".
- If the results string is longer than the tag specified at the OUT output, the results string is limited to the available length. The ENO enable output is set to the value "0".

If errors occur during processing of the instruction and the OUT output can be written to, an empty string will be output.

Parameters

Parameters	Declaration	Data type	Memory area	Description
IN1	IN	STRING	D, L or constant	String with characters to be replaced.
IN2	IN	STRING	D, L or constant	String with characters to be inserted.
L	IN	INT	I, Q, M, D, L or constant	Number of characters to be replaced
P	IN	INT	I, Q, M, D, L or constant	Position of first character to be replaced
OUT	OUT	STRING	D, L	Result string

See also

STRING (Page 383)

7.8.2.2 FIND

Description

You can use FIND to search through the string at the IN1 input to locate a specific character or a specific string of characters. You specify the value to be searched for at the IN2 input. The search is made from left to right. The position of the first hit is output at the OUT output. If the search returns no match, the value "0" is output at the OUT output.

If errors occur during processing of the instruction, an empty string will be output.

Parameters

Parameter	I/O	Data type	Memory area	Description
IN1	IN	STRING	D, L or constant	String searched through

Parameter	I/O	Data type	Memory area	Description
IN2	IN	STRING, CHAR	D, L or constant (For CHAR also I, Q, M)	Characters to search for
OUT	OUT	INT	I, Q, M, D, L	Character position

See also

STRING (Page 383)

7.8.2.3 Program control

7.8.2.3 RE_TRIGR

Description

With RE_TRIGR, you restart the CPU cycle monitoring. The cycle time monitoring then restarts with the time you set in the CPU configuration. By restarting the cycle monitoring time, you can prevent errors being triggered or the CPU changing to STOP.

The instruction "RE_TRIGR" can be used in blocks of the priority class 1 (for example, the program cycle OB) and in the blocks called in this.

If the instruction is called in a block with a higher priority, for example a hardware interrupt, a diagnostic error interrupt or a cyclic interrupt, the enable output ENO is set to "0" and "RE_TRIGR" is not executed.

Parameters

The "RE_TRIGR" instruction has no parameters.

See also

Events and OBs (Page 323)

7.8.2.3 STP

Description

With STP, you change the CPU to STOP mode and therefore terminate program execution. The effects of changing from RUN to STOP depend on the CPU configuration.

When the EN enable input is "1", the CPU changes to "STOP" mode and program execution is terminated. The signal state of "ENO" is not evaluated.

When the EN enable input is "0", ENO is also "0".

Parameters

The "STP" instruction has no parameters.

7.8.2.3 GetError

Description

With the "GetError" instruction, you can query the occurrence of errors within a block. If the system signals errors during block execution, detailed information about the first error that occurred is saved in the tag at the ERROR output.

Only tags of the "ErrorStruct" system data type can be specified at the ERROR output. The "ErrorStruct" system data type specifies the exact structure in which the information about the error is stored. Using additional instructions, you can evaluate this structure and program an appropriate response. When the first error has been eliminated, the instruction outputs information about the next error that occurred.

Parameters

Parameter	Declaration	Data type	Memory area	Description
ERROR	OUT	ErrorStruct	D, L	Error information

"ErrorStruct" data type

The following table shows which information a tag of the "ErrorStruct" data type can contain:

Structure components	Data type	Description
ERROR_ID	WORD	Error ID
FLAGS	BYTE	Shows if an error occurred during a block call. 16#01: Error during a block call. 16#00: No error during a block call.
REACTION	BYTE	Default reaction: 0: Ignore (write error), 1: Continue with substitute value "0" (read error), 2: Skip instruction (system error)
BLOCK_TYPE	BYTE	Type of block where the error occurred: 1: OB 2: FC 3: FB

Structure components	Data type	Description
PAD_0	BYTE	Internal byte that serves for dividing the separate structure areas of ErrorStruct. The content of this byte is irrelevant.
CODE_BLOCK_NUMBER	UINT	Number of the code block
ADDRESS	UDINT	Reference to the internal memory
MODE	BYTE	Access mode: Depending on the type of access, the following information can be output:

Mode	(A)	(B)	(C)	(D)	(E)
0					
1					Offset
2			Area		
3	Location	Scope		Number	
4			Area		Offset
5			Area	DB no.	Offset
6	PtrNo./ Acc		Area	DB no.	Offset
7	PtrNo./ Acc	Slot No. / Scope	Area	DB no.	Offset

Structure components	Data type	Description
PAD_1	BYTE	Internal byte that serves for dividing the separate structure areas of ErrorStruct. The content of this byte is irrelevant.
OPERAND_NUMBER	UINT	Operand number of the machine command
POINTER_NUMBER_ LOCATION	UINT	(A) Internal pointer
SLOT_NUMBER_SCOPE	UINT	(B) Storage area in internal memory
AREA	BYTE	(C) Memory area: L: 16#40 – 4E, 86, 87, 8E, 8F, C0 – CE E: 16#81 A: 16#82 M: 16#83 DB: 16#84, 85, 8A, 8B
PAD_2	BYTE	Internal byte that serves for dividing the separate structure areas of ErrorStruct. The content of this byte is irrelevant.
DB_NUMBER	UINT	(D) Number of the data block

Structure components	Data type	Description
OFFSET	UDINT	(E) Relative address of the operand

The enable output ENO of the "GetError" instruction is set only if the enable input EN returns signal state "1" and error information is present. If one of these conditions does not apply, then the remaining program execution is not affected by the "GetError" instruction.

The "GetError" instruction can also be used to forward an alarm about the error status to the calling block. To do this, the instruction must be positioned in the last network of the called block.

Note

The "GetError" instruction enables local error handling within a block. If "GetError" is inserted in the program code of a block, any predefined system responses are ignored when an error occurs.

Example

The following figure shows the LAD programming for this example.

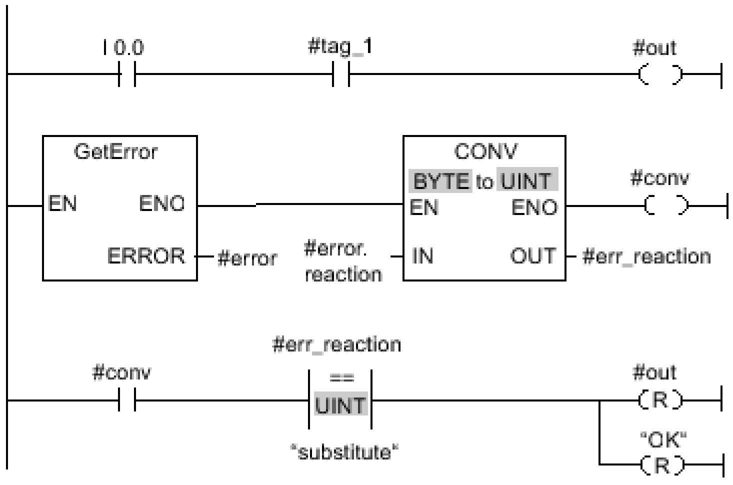


Figure7-2

When an error occurs, the "GetError" instruction returns the error information to the locally created "#error" structure at the ERROR output. The error information is converted and evaluated with the "equal to" comparison operation. Information about the type of error is the first comparison value assigned to the instruction. For the second comparison value, a value of "1" is specified in the "substitute" tag. If the error is a read error, the condition of the comparison instruction is satisfied. The outputs "#out" and "OK" are reset in this case.

See also

Local error handling (Page 508)

7.8.2.3 GetErrorID

Description

With the "GetErrorID" instruction, you can query the occurrence of errors within a block. If the system signals errors during block execution, the error ID of the first error that occurred is saved in the tag at the "ID" output. Only tags of the WORD data type can be specified at the "ID" output. When the first error has been eliminated, the instruction outputs the error ID of the next error that occurred.

The output of the "GetErrorID" instruction is only set if the input of the instruction returns signal state "1" and error information is present. If one of these conditions does not apply, the remaining program execution is not influenced by "GetErrorID".

The "GetErrorID" instruction can also be used to forward an alarm about the error status to the calling block. To do this, the instruction must be positioned in the last network of the called block.

Note

The "GetErrorID" instruction enables local error handling within a block. If "GetErrorID" is inserted in the program code of a block, any predefined system responses are ignored when an error occurs.

Parameters

Parameter	Declaration	Data type	Memory area	Description
ID	OUT	WORD	I, Q, M, D, L	Error ID

"ID" parameter

ID (hexadecimal)	ID (decimal)	Description
2503	9475	Invalid pointer
2522	9506	Read errors: Operand outside the valid range
2523	9507	Write errors: Operand outside the valid range
2524	9508	Read errors: Invalid operand
2525	9509	Write errors: Invalid operand
2528	9512	Read errors: Data alignment
2529	9513	Write errors: Data alignment
2530	9520	Write errors: Data block

ID (hexadecimal)	ID (decimal)	Description
253A	9530	Global data block does not exist
253C	9532	Faulty information or the function does not exist
253D	9533	System function does not exist
253E	9534	Faulty information or the function block does not exist
253F	9535	System block does not exist
2575	9589	Error in the program nesting depth
2576	9590	Error in the local data distribution
2942	10562	Read errors: Input
2943	10563	Write errors: Output

See also

Local error handling (Page 508)

7.8.2.4 Communication

7.8.2.4 Open user communication

7.8.2.4 TSEND_C

Description

TSEND_C is asynchronous and has the following functions:

- Setting up and establishing a communications connection:
  TSEND_C sets up a TCP or ISO-on-TCP communications connection and establishes it. After the connection is set up and established, it is automatically maintained and monitored by the CPU.
  The connection description specified at the CONNECT parameter is used to set up the communications connection. To establish a connection, the CONT parameter must be set to the value "1". When a connection is successfully established the DONE parameter for a cycle is set to "1".
  When the CPU goes to STOP mode an existing connection is terminated and the setup connection removed. TSEND_C must be executed again to set up and establish the connection again.
  For information on the number of possible communications connections, refer to the technical specifications of your CPU.
- Sending data via an existing communications connection:
  You specify the area to be sent with the DATA parameter. This includes the address and the length of the data to be sent. The send job executes when a rising edge is detected at the REQ parameter. With the LEN parameter, you specify the maximum number of bytes sent with a send job. The data

to be sent must not be edited until the send job has completed. If the send job executes successfully, the DONE parameter is set to "1". Signal state "1" at the DONE parameter does not imply confirmation that the sent data has been read by the communications partner.

- Terminating the communications connection:
  The communications connection is terminated when the CONT parameter is set to "0".

TSEND_C is executed again when the COM_RST parameter is set to "1". This terminates the existing communications connection and a new connection established. If data is being transferred when it executes again, this can lead to a loss of data.

Parameters

Parameters	Declaration	Data type	Memory area	Description
REQ	INPUT	BOOL	I, Q, M, D, L	Starts the send job on a rising edge.
CONT	INPUT	BOOL	I, Q, M, D, L	Controls the communications connection: • 0: Disconnect the communications connection • 1: Establish and maintain the communications connection
LEN	INPUT	UINT	I, Q, M, D, L or constant	Maximum number of bytes to be sent with the job .
CONNECT	IN_OUT	TCON_Param	D	Pointer to the connection description See: Creating and assigning parameters to connections (Page 235)
DATA	IN_OUT	VARIANT	I, Q, M, D, L	Pointer to the send area containing the address and the length of the data to be sent.
COM_RST	IN_OUT	BOOL	I, Q, M, D, L	Restarts the instruction: • 0: Irrelevant • 1: Complete restart of the instruction causing an existing connection to be terminated and a new connection to be established.
DONE	OUTPUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed free of error
BUSY	OUTPUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or already completed. • 1: Job not yet completed. A new job cannot be started.
ERROR	OUTPUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: No error • 1: Error occurred
STATUS	OUTPUT	WORD	I, Q, M, D, L	Status of the instruction

BUSY, DONE and ERROR parameters

You can check the status of the job with the BUSY, DONE, ERROR and STATUS parameters. The BUSY parameter indicates the processing status. With the DONE parameter, you can check whether or not a job executed successfully. The ERROR parameter is set when errors occurred during execution of TSEND_C. The error information is output at the STATUS parameter.

The following table shows the relationship between the BUSY, DONE and ERROR parameters:

BUSY	DONE	ERROR	Description
1	-	-	The job is being processed.
0	1	0	The job was completed successfully.
0	0	1	The job ended with an error. The cause of the error is specified in the STATUS parameter.
0	0	0	No new job was assigned.

Parameters ERROR and STATUS

ERROR	STATUS (W#16#...)	Description
0	0000	Job completed error-free
0	7000	No job processing active
0	7001	• Start execution of the job • Establish connection • Wait for connection partner
0	7002	Data are being sent
0	7003	Connection is terminated
0	7004	Connection established and monitored, no job processing active.
1	8085	LEN parameter has the value 0 or is greater than the highest permitted value.
1	8086	The CONNECT parameter is outside the permitted range.
1	8087	Maximum number of connections reached; no additional connection possible.
1	8088	The LEN parameter is longer than the area specified in DATA. The area for receiving data is too short.
1	8089	The parameter CONNECT does not point to a data block.
1	8091	Maximum nesting depth exceeded.
1	809A	The CONNECT parameter points to a field that does not match the length of the connection description.
1	809B	The ID of the local device in the connection description does not match the CPU.

ERROR	STATUS (W#16#...)	Description
1	80A1	Communications error: • The specified connection has not yet been established. • The specified connection is being terminated. A transfer over this connection is not possible. • The interface is being re-initialized.
1	80A3	Attempt being made to terminate a non-existent connection.
1	80A7	Communications error: You called TDISCON before TSEND_C had completed.
1	80B2	The CONNECT parameter points to a data block that was generated with the keyword UNLINKED.
1	80B3	Inconsistent parameters: • Error in the connection description • The local port already exists in a different connection description • The ID in the connection description is different from the ID specified as the parameter
1	80B4	You have violated one or both of the following conditions for passive connection establishment (active_est = FALSE) when using the ISO-on-TCP protocol variant (connection_type = B#16#12): "local_tsap_id_len >= B#16#02" and/or "local_tsap_id[1] = B#16#E0".
1	80C3	All connection resources are being used.
1	80C4	Temporary communications error: • The connection cannot be established at this time. • The interface is currently receiving new parameters. • The configured connection is being removed from a TDISCON instruction.
1	8722	CONNECT parameter: The source area is invalid. The area does not exist in the DB.
1	873A	CONNECT parameter: Access to the connection description is not possible (for example, DB does not exist).
1	877F	CONNECT parameter: Internal error.

See also

Basics of Open User Communication (Page 230)
Principle of operation of connection-oriented protocols (Page 299)
Parameters of communication connections (Page 301)
General status information of the communications blocks (Page 992)

7.8.2.4 TRCV_C

Description

TRCV_C is asynchronous and has the following functions:

- Setting up and establishing a communications connection:

TRCV_C sets up a TCP or ISO-on-TCP communications connection and establishes it. After the connection has been set up and established, it is automatically maintained and monitored by the CPU.
The communications connection is set up using the connection description specified with the CONNECT parameter. To establish a connection, the CONT parameter must be set to the value "1".
When a connection is successfully established the DONE parameter for a cycle is set to "1".
When the CPU goes to STOP mode an existing connection is terminated and the setup connection removed. TRCV_C must be executed again to set up and establish the connection again.
For information on the number of possible communications connections, refer to the technical specifications of your CPU.

- Receiving data via an existing communications connection:
  If the EN_R parameter is set to the value "1", reception of data is enabled. The received data is entered in a receive area. You specify the length of the receive area depending on the protocol variant being used either with the LEN parameter (if LEN <> 0) or the length information of the DATA parameter (if LEN = 0).
  After data has been received successfully, the signal state at the DONE parameter is "1". If errors occur in the data transfer, the DONE parameter is set to "0".
- Terminating the communications connection:
  The communications connection is terminated when the CONT parameter is set to "0".

TRCV_C is executed again when the COM_RST parameter is set. This terminates the existing communications connection and a new connection established. If data is being received when it executes again, this can lead to a loss of data

Receive modes of TRCV_C

The following table shows how the received data is entered in the receive area.

Protocol variant	Availability of data in the receive area	"connection_type" parameter with connection description	Parameter LEN	Parameter RCVD_LEN
TCP (ad-hoc mode)	The data are immediately available.	B#16#11	0	1 to x (x: length defined at the DATA parameter)
TCP (Data reception with specified length)	The data are available as soon as the specified data length was received at the LEN parameter.	B#16#11	1 to 8192	Identical with the value at the LEN parameter
ISO-on-TCP (protocol-controlled data transfer)	The data are available as soon as the specified data length was received at the LEN parameter.	B#16#12	• 1 to 1452, if a CP is used. • 1 to 8192, if no CP is used.	Identical with the value at the LEN parameter

TCP (ad-hoc mode)

The ad-hoc mode is only available with the TCP protocol variant. You set ad-hoc mode by assigning the value 0 to the LEN parameter. The length of the receive area is defined by the pointer at the DATA parameter. The actually received data length at the RCVD_LEN parameter must be identical with the length defined at the DATA parameter. A maximum of 8192 bytes can be received.

TCP (Data reception with specified length)

You use the value of the LEN parameter to specify the length for the data reception. The data specified at the DATA parameter are available in the receive area as soon as the length specified at the LEN parameter has been completely received.

ISO-on-TCP (protocol-controlled data transfer)

With the ISO-on-TCP protocol variant, data is transferred protocol-controlled.

The receive area is defined by the LEN and DATA parameters.

Parameters

Parameter	Declaration	Data type	Memory area	Description
EN_R	IN	BOOL	I, Q, M, D, L	Receive enable
CONT	IN	BOOL	I, Q, M, D, L	Controls the communications connection: • 0: Disconnect the communications connection • 1: Establish and maintain the communications connection
LEN	IN	UINT	I, Q, M, D, L or constant	Length of the receive area in bytes
CONNECT	IN_OUT	TCON_Param	D	Pointer to the connection description See: Creating and assigning parameters to connections (Page 235)
DATA	IN_OUT	VARIANT	I, Q, M, D, L	Pointer to the receive area
COM_RST	IN_OUT	BOOL	I, Q, M, D, L	Restarts the instruction: • 0: Irrelevant • 1: Complete restart of the instruction causing an existing connection to be terminated
DONE	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed error-free
BUSY	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or already completed • 1: Job not yet completed. A new job cannot be started

Parameter	Declaration	Data type	Memory area	Description
ERROR	OUT	BOOL	I, Q, M, D, L	ERROR status parameter: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	I, Q, M, D, L	Status of the instruction
RCVD_LEN	OUT	WORD	I, Q, M, D, L	Amount of data actually received in bytes

BUSY, DONE and ERROR parameters

You can check the status of the job with the BUSY, DONE, ERROR and STATUS parameters. The BUSY parameter indicates the processing status. With the DONE parameter, you can check whether or not a job executed successfully. The ERROR parameter is set when errors occurred during execution of TRCV_C. The error information is output at the STATUS parameter.

The following table shows the relationship between the BUSY, DONE and ERROR parameters:

BUSY	DONE	ERROR	Description
1	-	-	The job is being processed.
0	1	0	The job was completed successfully.
0	0	1	The job ended with an error. The cause of the error is output at the STATUS parameter.
0	0	0	No new job was assigned.

Parameters ERROR and STATUS

ERROR	STATUS (W#16#...)	Description
0	0000	Job completed error-free
0	7000	No job processing active
0	7001	• Start execution of the job • Establish connection • Wait for connection partner
0	7002	Data is being received
0	7003	Connection is being terminated
0	7004	• Connection established and monitored • No job processing active
1	8085	LEN parameter has the value 0 or is greater than the highest permitted value.

ERROR	STATUS (W#16#...)	Description
1	8086	The CONNECT parameter is outside the permitted range.
1	8087	Maximum number of connections reached; no additional connection possible
1	8088	The LEN parameter is longer than the area specified in DATA. The area for receiving data is too short.
1	8089	The parameter CONNECT does not point to a data block.
1	8091	Maximum nesting depth exceeded.
1	809A	The CONNECT parameter points to a field that does not match the length of the connection description.
1	809B	The ID of the local device (local_device_id) in the connection description does not match the CPU.
1	80A1	Communications error: • The specified connection has not yet been established. • The specified connection is being terminated. A transfer over this connection is not possible. • The interface is being re-initialized.

See also

Basics of Open User Communication (Page 230)
Principle of operation of connection-oriented protocols (Page 299)
Parameters of communication connections (Page 301)
General status information of the communications blocks (Page 992)

7.8.2.4 Others

7.8.2.4 TCON

Description

With TCON, you set up a communications connection and establish it. After the connection is set up and established, it is automatically maintained and monitored by the CPU. TCON is asynchronous.

To set up the communications connection, the connection data specified for the CONNECT and ID parameters is used. To establish the connection, a rising edge must be detected at the REQ parameter. If the connection establishment is successful, the DONE parameter is set to "1".

Number of possible connections

For information on the number of possible communications connections, refer to the technical specifications for your CPU.

Connection with TCP and ISO-on-TCP

Both communication partners call the "TCON" instruction to set up and establish the communications connection. In the parameters you specify which partner is the active communication end point and which is the passive one.

If the connection aborts, for example due to a line break or due to the remote communications partner, the active partner attempts to reestablish the configured connection. You do not have to call TCON again.

An existing connection is terminated and the set-up connection is removed when the "TDISCON" instruction executes or when the CPU has changed to STOP mode. To set up and establish the connection again, you will need to execute TCON again.

Parameters

Parameter	Declaration	Data type	Memory area	Description
REQ	IN	BOOL	I, Q, M, D, L	Starts the job to establish the connection specified in the ID on a rising edge.
ID	IN	CONN_OUC	L, D or constant	Reference to the assigned connection. Range: W#16#0001 to W#16#0FFF
CONNECT	IN_OUT	TCON_Param	D	Pointer to the connection description See: Creating and assigning parameters to connections (Page 235)
DONE	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed error-free
BUSY	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or already completed. • 1: Job not yet completed. A new job cannot be started
ERROR	OUT	BOOL	I, Q, M, D, L	ERROR status parameter: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	I, Q, M, D, L	Status of the instruction

BUSY, DONE and ERROR parameters

You can check the status of the job with the BUSY, DONE, ERROR and STATUS parameters. The BUSY parameter indicates the processing status. With the DONE parameter, you can check whether or not a job executed successfully. The ERROR parameter is set when errors occurred during execution of TCON. The error information is output at the STATUS parameter.

The following table shows the relationship between the BUSY, DONE and ERROR parameters:

BUSY	DONE	ERROR	Description
1	-	-	The job is being processed.
0	1	0	The job was completed successfully.
0	0	1	The job ended with an error. The cause of the error is output at the STATUS parameter.
0	0	0	No new job was assigned.

Parameters ERROR and STATUS

ERROR	STATUS (W#16#...)	Explanation
0	0000	Connection was established successfully
0	7000	No job processing active
0	7001	Start job execution, establish connection.
0	7002	Connection is being established (REQ irrelevant)
1	8086	The ID parameter is outside the permitted range
1	8087	Maximum number of connections reached; no additional connection possible
1	8089	The parameter CONNECT does not point to a data block.
1	809A	The CONNECT parameter points to a field that does not match the length of the connection description.
1	809B	The ID of the local device in the connection description does not match the CPU.
1	80A0	Group error for error codes W#16#80A1 and W#16#80A2
1	80A1	Connection or port already being used by user.
1	80A2	Local or distributed port is being used by system.
1	80A3	Attempt being made to re-establish an existing connection.
1	80A4	IP address of the distributed endpoint of the connection is invalid, in other words, it matches the IP address of the local partner.
1	80A7	Communications error: You executed TDISCON before TCON had completed.
1	80B3	Inconsistent parameter assignment: Group error for error codes W#16#80A0 to W#16#80A2, W#16#80A4, W#16#80B4 to W#16#80B9

ERROR	STATUS (W#16#...)	Explanation
1	80B4	You have violated one or more of the following conditions for passive connection establishment with the ISO-on-TCP protocol variant (connection_type = B#16#12): • local_tsap_id_len >= B#16#02 • local_tsap_id[1] = B#16#E0 • With local_tsap_id_len >= B#16#03, local_tsap_id[1] is an ASCII character. • local_tsap_id[1] is an ASCII character and local_tsap_id_len >= B#16#03.
1	80B6	Parameter assignment error in the "connection_type" parameter of the data block for connection description
1	80B7	Error in one of the following parameters of the data block for connection description: block_length, local_tsap_id_len, rem_subnet_id_len, rem_staddr_len, rem_tsap_id_len, next_staddr_len
1	80B8	Parameter in the local connection description and ID parameter are different.
1	80C3	All connection resources are being used.
1	80C4	Temporary communications error: • The connection cannot be established at this time. • The interface is currently receiving new parameters. • The configured connection is being removed from a TDISCON instruction.

See also

Basics of Open User Communication (Page 230)
Principle of operation of connection-oriented protocols (Page 299)
Parameters of communication connections (Page 301)
General status information of the communications blocks (Page 992)

7.8.2.4 TDISCON

Description

Using TDISCON, you terminate a communications connection. The job to terminate the communications connection begins when a rising edge is detected at the REQ parameter. In the ID parameter, you enter the reference of the connection you want to terminate. TDISCON is asynchronous.

After TDISCON has executed, the ID specified for TCON is no longer valid and can therefore not be used for sending or receiving.

Parameters

Parameter	Declaration	Data type	Memory area	Description
REQ	IN	BOOL	I, Q, M, D, L	Starts the job to terminate the connection specified in the ID on a rising edge.
ID	IN	CONN_OUC	L, D or constant	Reference to the connection established with TCON. Value range: W#16#0001 to W#16#0FFF
DONE	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed error-free
BUSY	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or already completed • 1: Job not yet completed. A new job cannot be started.
ERROR	OUT	BOOL	I, Q, M, D, L	ERROR status parameter: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	I, Q, M, D, L	Status of the instruction

BUSY, DONE and ERROR parameters

You can check the status of the job with the BUSY, DONE, ERROR and STATUS parameters. The BUSY parameter indicates the processing status. With the DONE parameter, you can check whether or not a job executed successfully. The ERROR parameter is set when errors occurred during execution of TDISCON. The error information is output at the STATUS parameter.

The following table shows the relationship between the BUSY, DONE and ERROR parameters:

BUSY	DONE	ERROR	Description
1	-	-	The job is being processed.
0	1	0	The job was completed successfully.
0	0	1	The job ended with an error. The cause of the error is output at the STATUS parameter.
0	0	0	No new job was assigned.

Parameters ERROR and STATUS

ERROR	STATUS (W#16#...)	Explanation
0	0000	Connection successfully terminated

ERROR	STATUS (W#16#...)	Explanation
0	7000	No job processing active
0	7001	Start of job execution, connection is being terminated.
0	7002	Connection being terminated (REQ irrelevant).
1	8086	The ID parameter is outside the permitted address range.
1	80A3	Attempt being made to terminate a non-existent connection.
1	80C4	Temporary communications error: The interface is receiving new parameters or the connection is being established.

See also

Basics of Open User Communication (Page 230)
Principle of operation of connection-oriented protocols (Page 299)
Parameters of communication connections (Page 301)
General status information of the communications blocks (Page 992)

7.8.2.4 TSEND

Description

With TSEND, you send data over an existing communications connection. TSEND is asynchronous.

You specify the send area with the DATA parameter. This includes the address and the length of the data to be sent. The send job executes when a rising edge is detected at the REQ parameter. With the LEN parameter, you specify the maximum number of bytes sent with a send job. The data to be sent must not be edited until the send job has completed. If the send job executes successfully, the DONE parameter is set to "1". Signal state "1" at the DONE parameter does not imply confirmation that the sent data has been read out by the communications partner.

Parameters

Parameter	Declaration	Data type	Memory area	Description
REQ	IN	BOOL	I, Q, M, D, L	Starts the send job on a rising edge.
ID	IN	CONN_OUC	L, D or constant	Reference to the connection established with TCON. Value range: W#16#0001 to W#16#0FFF
LEN	IN	UINT	I, Q, M, D, L	Maximum number of bytes to be sent with the job .

Parameter	Declaration	Data type	Memory area	Description
DATA	IN_OUT	VARIANT	I, Q, M, D, L	Pointer to the send area containing the address and the length of the data to be sent. The address references: • The process image input • The process image output • A memory bit • A data block
DONE	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed error-free
BUSY	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or already completed • 1: Job not yet completed. A new job cannot be started.
ERROR	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	I, Q, M, D, L	Status of the instruction

BUSY, DONE and ERROR parameters

You can check the status of the job with the BUSY, DONE, ERROR and STATUS parameters. The BUSY parameter indicates the processing status. With the DONE parameter, you can check whether or not a job executed successfully. The ERROR parameter is set when errors occurred during execution of TSEND. The error information is output at the STATUS parameter.

The following table shows the relationship between the BUSY, DONE and ERROR parameters:

BUSY	DONE	ERROR	Description
1	-	-	The job is being processed.
0	1	0	The job was completed successfully.
0	0	1	The job ended with an error. The cause of the error is specified in the STATUS parameter.
0	0	0	No new job was assigned.

Note

Because TSEND is asynchronous, you need to keep the data in the send area consistent until the DONE parameter or the ERROR parameter changes to the value "1".

Parameters ERROR and STATUS

ERROR	STATUS (W#16#...)	Description
0	0000	Send job completed without error.
0	7000	No job processing active.
0	7001	Start of job execution, data is being sent. When processing this job, the operating system accesses the data in the DATA send area.
0	7002	Job executing (REQ irrelevant). When processing this job, the operating system accesses the data in the DATA send area.
1	8085	LEN parameter has the value 0 or is greater than the highest permitted value.
1	8086	The ID parameter is outside the permitted address range.
1	8088	LEN parameter is greater than the area specified in DATA.
1	80A1	Communications error: • The specified connection has not yet been established. • The specified connection is being terminated. Transfer over this connection is not possible. • The interface is being re-initialized.
1	80C3	• A block with this ID is already being processed in a different priority group. • Internal lack of resources.
1	80C4	Temporary communications error: • The connection cannot be established to the partner at this time. • The interface is receiving new parameter settings or the connection is being established.

See also

Basics of Open User Communication (Page 230)
Principle of operation of connection-oriented protocols (Page 299)
Parameters of communication connections (Page 301)
General status information of the communications blocks (Page 992)

7.8.2.4 TRCV

Description

With TRCV, you receive data over an existing communications connection. TRCV is asynchronous.

Reception of data is enabled when the EN_R parameter is set to the value "1". The received data is entered in a receive area. You specify the length of the receive area depending on the protocol variant being used either with the LEN parameter (if LEN <> 0) or the length information of the DATA parameter (if LEN = 0).

After successful data reception, the NDR parameter is set to the value "1". You can query the amount of data actually received at the RCVD_LEN parameter.

Receive modes of TRCV

The following table shows how the received data is entered in the receive area.

Protocol variant	Availability of data in the receive area	"connection_type" parameter with connection description	Parameter LEN	Parameter RCVD_LEN
TCP (ad-hoc mode)	The data are immediately available.	B#16#11	0	1 to x (x: length defined at the DATA parameter)
TCP (Data reception with specified length)	The data are available as soon as the specified data length was received at the LEN parameter.	B#16#11	1 to 8192	Identical with the value at the LEN parameter
ISO-on-TCP (protocol-controlled data transfer)	The data are available as soon as the specified data length was received at the LEN parameter.	B#16#12	• 1 to 1452, if a CP is used. • 1 to 8192, if no CP is used.	Identical with the value at the LEN parameter

TCP (ad-hoc mode)

The ad-hoc mode is only available with the TCP protocol variant. You set ad-hoc mode by assigning the value 0 to the LEN parameter. The length of the receive area is defined by the pointer at the DATA parameter. The actually received data length at the RCVD_LEN parameter must be identical with the length defined at the DATA parameter. A maximum of 8192 bytes can be received.

TCP (Data reception with specified length)

You use the value of the LEN parameter to specify the length for the data reception. The data specified at the DATA parameter are available in the receive area as soon as the length specified at the LEN parameter has been completely received.

ISO-on-TCP (protocol-controlled data transfer)

With the ISO-on-TCP protocol variant, data is transferred protocol-controlled.

The receive area is defined by the LEN and DATA parameters.

Parameters

Parameter	Declaration	Data type	Memory area	Description
EN_R	IN	BOOL	I, Q, M, D, L	Receive enable
ID	IN	CONN_OUC	L, D or constant	Reference to the connection established with TCON. Value range: W#16#0001 to W#16#0FFF
LEN	IN	UINT	I, Q, M, D, L or constant	Length of the receive area in bytes
DATA	IN_OUT	VARIANT	I, Q, M, D	Pointer to the receive area
NDR	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed error-free
BUSY	OUT	BOOL	I, Q, M, D, L	Status parameter with the following values: • 0: Job not yet started or already completed • 1: Job not yet completed. A new job cannot be started
ERROR	OUT	BOOL	I, Q, M, D, L	ERROR status parameter: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	I, Q, M, D, L	Status of the instruction
RCVD_LEN	OUT	UINT	I, Q, M, D, L	Amount of data actually received in bytes

BUSY, NDR and ERROR parameters

You can check the status of the job with the BUSY, NDR, ERROR and STATUS parameters. The BUSY parameter indicates the processing status. With the NDR parameter, you can check whether or not a job executed successfully. The ERROR parameter is set when errors occurred during execution of TRCV. The error information is output at the STATUS parameter.

The following table shows the relationship between the BUSY, NDR and ERROR parameters:

BUSY	NDR	ERROR	Description
1	-	-	The job is being processed.
0	1	0	The job was completed successfully.
0	0	1	The job ended with an error. The cause of the error is output at the STATUS parameter.
0	0	0	No new job was assigned.

Note

Because TRCV is asynchronous, the data in the receive area is only consistent when the NDR parameter is set to the value "1".

Parameters ERROR and STATUS

ERROR	STATUS (W#16#...)	Explanation
0	0000	Job executed successfully. The current length of the received data is output at the RCVD_LEN parameter.
0	7000	Block not ready to receive.
0	7001	Block ready to receive, receive job was activated.
0	7002	Interim call, the receive job is executing. Note: While the job is being processed, data is written to the receive area. This means that an error can lead to inconsistent data in the receive area.
1	8085	• LEN parameter is higher than the highest permitted value. • The value of the LEN or DATA parameter was changed after the first call.
1	8086	The ID parameter is outside the permitted address range.
1	8088	• Receive area is too small. • The value of the LEN parameter is greater than the receive area specified with the DATA parameter.
1	80A1	Communications error: • The specified connection has not yet been established. • The specified connection is being terminated. Receive job over this connection is not possible. • The connection is being re-initialized.
1	80B3	Inconsistent parameter assignment
1	80C3	• A block with this ID is already being processed in a different priority group. • Internal lack of resources.
1	80C4	Temporary communications error: • The connection cannot be established to the partner at this time. • The interface is receiving new parameter settings or the connection is being established.

See also

Basics of Open User Communication (Page 230)
Principle of operation of connection-oriented protocols (Page 299)
Parameters of communication connections (Page 301)
General status information of the communications blocks (Page 992)

7.8.2.4 Point-to-point

7.8.2.4 PORT_CFG

Description

PORT_CFG allows dynamic configuration of communications parameters for a point-to-point communications port.

You set up the original static configuration of the port in the hardware configuration. You can change this configuration by executing the "PORT_CFG" instruction. With PORT_CFG, you can influence the following communications parameter settings:

- Parity
- Baud rate
- Number of bits per character
- Number of stop bits
- Type and properties of flow control

The changes made by the "PORT_CFG" instruction are not stored permanently on the target system.

You can transfer serial data via the electrical connections RS-232 (half and full duplex) and RS-485 (half duplex).

Parameters

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activates the configuration change on a rising edge
PORT	IN	PORT (UINT)	ID of the communications port (module ID)
PROTOCOL	IN	UINT	Transmission protocol: • 0: Point-to-point communication protocol • 1..n: Future definition for specific transmission protocols

Parameter	Declaration	Data type	Description
BAUD	IN	UINT	Baud rate of the port: • 1: 300 baud • 2: 600 baud • 3: 1200 baud • 4: 2400 baud • 5: 4800 baud • 6: 9600 baud (default) • 7: 19200 baud • 8: 38400 baud • 9: 57600 baud • 10: 76800 baud • 11: 115200 baud
PARITY	IN	UINT	Parity of the port: • 1: No parity (default) • 2: Even parity • 3: Odd parity • 4: Mark parity • 5: Space parity
DATABITS	IN	UINT	Bits per character: • 1: 8 bits per character (default) • 2: 7 bits per character
STOPBITS	IN	UINT	Number of stop bits: • 1: 1 stop bit (default) • 2: 2 stop bits
FLOWCTRL	IN	UINT	Data flow control: • 1: None (default) • 2: XON/XOFF • 3: Hardware flow control (RTS always activated) • 4: Hardware flow control (RTS can be deactivated during transmission)
XONCHAR	INPUT	CHAR	Indicates the character used as XON character. The character DC1 (11H) is set as default.
XOFFCHAR	INPUT	CHAR	Indicates the character used as XOFF character. The character DC3 (13H) is set as default.
WAITIME	IN	UINT	Specifies the wait time for XON or CTS after the start of the transmission. The specified value must be greater than 0. 2000 milliseconds are set as default.

Parameter	Declaration	Data type	Description
DONE	OUT	BOOL	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed error-free
ERROR	OUT	BOOL	Status parameter with the following values: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	Status of the instruction

Parameter STATUS

STATUS (W#16#...)	Description
80A0	The specified protocol is invalid.
80A1	The specified baud rate is invalid.
80A2	The specified parity rate is invalid.
80A3	The specified number of bits per character is invalid.
80A4	The specified number of stop bits is invalid.
80A5	The specified type of flow control is invalid.
80A6	Incorrect value at the WAITTIME parameter When the data flow control is enabled, the value at the WAITTIME parameter must be greater than zero

See also

General status information of the communications blocks (Page 992)
Point-to-point communication (Page 270)

7.8.2.4 SEND_CFG

Description

SEND_CFG allows dynamic configuration of serial transmission parameters for a point-to-point communications port. All the messages waiting for transfer are discarded after SEND_CFG executes.

You set up the original static configuration of the port in the hardware configuration. You can change this configuration by executing the "SEND_CFG" instruction. With SEND_CFG, you can influence the following transmission parameter settings:

- Time between the activating RTS and the start of the transmission

- Time between the end of transmission and the activating RTS
- Define bit times for breaks

The changes made by the "SEND_CFG" instruction are not stored permanently on the target system.

You can transfer serial data via the electrical connections RS-232 (half and full duplex) and RS-485 (half duplex).

Parameters

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activates the configuration change on a rising edge
PORT	IN	PORT (UINT)	ID of the communications port (HW ID)
RTSONDLY	IN	UINT	The time that should elapse after activating RTS and the start of transmission. Valid values for this parameter are as follows: • 0 (default) • 0 to 65535 ms in steps of 1 ms This parameter does not apply to RS-485 modules.
RTSOFFDLY	IN	UINT	Time that should elapse after the end of transmission until deactivation of RTS. Valid values for this parameter are as follows: • 0 (default) • 0 to 65535 ms in steps of 1 ms This parameter does not apply to RS-485 modules.
BREAK	IN	UINT	Specifies the bit times for a break, which are sent at the start of the message. 12 bit times are set as default. A maximum of 25000 bit times can be specified.
IDLELINE	IN	UINT	Specifies the bit times for idle line after the break at the start of the message. 12 bit times are set as default. A maximum of 25000 bit times can be specified.
DONE	OUT	BOOL	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed error-free
ERROR	OUT	BOOL	Status parameter with the following values: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	Status of the instruction

Parameter STATUS

STATUS (W#16#...)	Description
80B0	The configuration of a transmission interruption is not permitted.
80B1	The specified break time exceeds the permitted maximum of 25000 bit times.
80B2	The specified time for idle line exceeds the permitted maximum of 25000 bit times.

See also

General status information of the communications blocks (Page 992)
Point-to-point communication (Page 270)

7.8.2.4 RCV_CFG

Description

RCV_CFG allows dynamic configuration of serial receive parameters for a point-to-point communications port. You can use this instruction to configure the conditions that specify the start and end of the message to be transmitted. The receipt of messages that correspond to these conditions can be enabled by the "RCV_PTP" instruction.

You set up the original static configuration of the port in the properties of the hardware configuration. Execute the "RCV_CFG" instruction in your program to change the configuration. The changes made by the "RCV_CFG" instruction are not stored permanently on the target system.

All the messages waiting for transfer are discarded after the RCV_CFG instruction executes.

Parameters

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activates the configuration change on a rising edge.
PORT	IN	PORT (UINT)	ID of the communications port (HW ID)
CONDITIONS	IN	CONDITIONS	User-defined data structure defining the conditions for start and end.
DONE	OUT	BOOL	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed error-free
ERROR	OUT	BOOL	Status parameter with the following values: • 0: No error • 1: Error occurred.

Parameter	Declaration	Data type	Description
STATUS	OUT	WORD	Status of the instruction

Start and end conditions for the reception of message.

You can use the CONDITIONS data type to define the start and end conditions for the message transmission. The start and end conditions shows the receiver when the transmission of a message is completed and when the next message transmission begins. You can define one or more start and end conditions for this. If you specify multiple start or end conditions these are linked by an OR logic instruction.

The start of the message is recognized by the receiver if a configured start condition applies. The following conditions can be defined as start conditions for message reception:

- Start character: The start of a message is recognized when a certain character occurs. This character is stored as first character of the message. All characters received before the start character are rejected.
- Any character: Any character can defined the start of a message. This character is stored as first character of the message.
- Line Break: The receiver recognizes a message if the received data stream is interrupted for longer than one character.
- Idle Line: The start of a message is recognized when the send transmission line is in the idle state for a certain time (specified in bit times) followed by an event such as reception of a character.
- Character string (sequence): The start of a message is detected when a specified character sequence occurs in the data stream. You can specify up to four character sequences each with up to five characters.

The start of the message is recognized by the receiver if a configured end condition applies. The following conditions can be defined as end conditions for message reception:

- Reply timeout: The end of a message is recognized automatically when a selected maximum duration for the reception of a character is exceeded. The maximum duration is defined at the RCVTIME parameter. The defined time starts to run down as soon at the last transmission is completed and the RCV_PTP instruction enables the reception of the message. If no character was received within the defined time (RCVTIME), the RCV_PTP instruction reports an error.
- Message timeout: The end of a message is recognized automatically when a selected maximum duration for the reception of a character is exceeded. The maximum duration is defined at the MSGTIME parameter. The defined time starts to run down as soon as the first character of the message is received.
- Timeout within the character string: The end of the message is recognized when the time interval between the reception of two consecutive characters is longer than the value at the CHARGAP parameter.
- Maximum length: The end of a message is recognized when the length of the message defined at the MAXLEN parameter is exceeded.
- Reading message length (N+LEN+M): The end of a message is recognized when a certain message length is reached. This length is calculated by the values of the following parameter:
  - N: Position of the character in the message, from which the length field begins.

- LENGTHSIZE: Size of the length field in bytes
- LENGTHM: Number of end characters that follow the length field. These characters are not taken into account in the evaluation of the message length.

- Character string: The end of a message is recognized when a defined character sequence is received. The character string can contain a maximum of five characters. For each character of the character string, you can use the bit position to define if this will be considered or ignored in the evaluation.

CONDITIONS data type

The following table shows the structure of a tag of the CONDITIONS data type:

Parameter	Data type	Description
START	STRUCT	Start conditions

Parameter		Data type	Description
	STARTCOND	UINT	Specifies the start condition. The start condition can be specified as a 16-bit hexadecimal value. Possible values for the start condition are: • 1: Start character • 2: Any character (default) • 4: Line break • 8: Idle line • 16: Character string 1 • 32: Character string 2 • 64: Character string 3 • 128: Character string 4 Multiple start conditions can also be defined at the STARTCOND parameter. The total from the values of the individual conditions is specified for this. If, for example, you want to define "Idle line" OR "Character string 1" OR "Character string 4" are start condition, the value "152" must be specified.
	IDLETIME	UINT	Specifies the maximum idle time of the line before reception is started. Valid values for this parameter are as follows: • 40 bit times (default) • 0 to 2500 bit times
	STARTCHAR	BYTE	Specifies the start character. This setting is only enabled when the configured start condition is "Start character".. Valid values for this parameter are as follows: • 02 (STX): Default setting • B#16#00 to B#16#FF
	SEQ[1].CTL	BYTE	Character string 1: Control sequence for each character You can use the bit position of the character to define which characters of the character string will be considered or ignored. To evaluate the characters, the corresponding bits have to be set. • Bit 0: 1 character • Bit 1: 2 characters • Bit 2: 3 characters • Bit 3: 4 characters • Bit 4: 5 characters A character is ignored when the corresponding bit is reset.
	SEQ[1].STR	CHAR[5]	Character string 1: Start character (5 characters)
	SEQ[2].CTL	BYTE	Character string 2: Ignore/compare control sequence for each character
	SEQ[2].STR	CHAR[5]	Character string 2: Start character (5 characters)
	SEQ[3].CTL	BYTE	Character string 3: Ignore/compare control sequence for each character
	SEQ[3].STR	CHAR[5]	Character string 3: Start character (5 characters)
	SEQ[4].CTL	BYTE	Character string 4: Ignore/compare control sequence for each character
	SEQ[4].STR	CHAR[5]	Character string 4: Start character (5 characters)

Parameter	Data type	Description
END	STRUCT	End conditions

Parameter		Data type	Description
	ENDCOND	UINT	Specifies the end condition. The end condition can be specified as a 16-bit hexadecimal value. Possible values for the end condition are: • 1: Reply timeout • 2: Message timeout • 4: Timeout within the character string • 8: Maximum length • 16: N+LEN+M • 32: Character string 1 Multiple end conditions can also be defined at the ENDCOND parameter. The total from the values of the individual end conditions is specified for this. If, for example, you want to define the end condition "Maximum length" OR "Sequence 1", the value "40" must be specified.
	MAXLEN	UINT	Specifies the maximum number of characters in a message. Valid values for this parameter are as follows: • 1 character (default) • 0 to 4132 characters This setting is only enabled if the "Maximum length" end condition is set at the ENDCOND parameter.
	N	UINT	Offset of the length field in the message Valid values for this parameter are as follows: • 0 character (default) • 0 to 4131 characters This setting is only enabled if the "N+LEN+M" end condition is set at the ENDCOND parameter.
	LENGTHSIZE	UINT	Size of the length field in bytes Valid values for this parameter are as follows: • 0 bytes (default) • 1 bytes • 2 bytes • 4 bytes This setting is only enabled if the "N+LEN+M" end condition is set at the ENDCOND parameter.
	LENGTHM	UINT	Specifies the number of end characters that follow the length field but are not contained in the length of the message. Valid values for this parameter are as follows: • 0 character (default) • 0 to 255 characters This setting is only enabled if the "N+LEN+M" end condition is set at the ENDCOND parameter.
	RCVTIME	UINT	Specifies the maximum duration of the reception of a character. Valid values for this parameter are as follows: • 200 ms (default) • 0 to 65535 ms in steps of 1 ms This setting is only enabled if the "Reply timeout" end condition is set at the ENDCOND parameter.
	MSGTIME	UINT	Specifies the maximum duration of the reception of a message

Parameter STATUS

STATUS (W#16#...)	Description
80C0	Error in start condition
80C1	• Error in end condition • No end condition defined
80C2	Receive interrupt enabled
80C3	A value that is equal to 0 or greater than 4132 was entered at the MAXLEN parameter while the "Maximum length" end condition was set.
80C4	A value that is greater than 4131 was entered at the N parameter while the "N+LEN+M" end condition was set.
80C5	A value that is equal to 0 or invalid was entered at the LENGTHSIZE parameter while the "N+LEN+M" end condition was set.
80C6	A value that is greater than 255 was entered at the LENGTHHM parameter while the "N+LEN+M" end condition was set.
80C7	A message length greater than 4132 was calculated while the "N+LEN+M" end condition was set.
80C8	A value that is equal to 0 was entered at the RCVTIME parameter while the "Reply timeout" end condition was set.
80C9	A value that is equal to 0 or greater than 2500 was entered at the CHARGAP parameter while the "Timeout within a character string" end condition was set.
80CA	A value that is equal to 0 or greater than 2500 was entered at the IDLETIME parameter while the "Idle line" end condition was set.
80CB	All characters of the character string are marked as "Don't care" even though "Character string" is set as the end condition.
80CC	All characters of the character string are marked as "Don't care" even though "Character string" is set as the start condition.

See also

General status information of the communications blocks (Page 992)
Point-to-point communication (Page 270)

7.8.2.4 SEND_PTP

Description

With SEND_PTP, you start the transmission of data. The "SEND_PTP" instruction does not execute the actual transmission of the data. The data of the transmit buffer is transferred to the relevant communications partner. The communications partner handles the actual transmission.

Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Enables the requested transmission on a rising edge
PORT	IN	PORT (UINT)	ID of the communications port (module ID)
BUFFER	IN	VARIANT	Points to the start address of the transmit buffer.
LENGTH	IN	UINT	Length of the transmit buffer
PTRCL	IN	BOOL	Specifies the transmit buffer for freely programmable communication or for certain protocols provided by Siemens that are available on the connected communications partner or in the expansion modules.
DONE	OUT	BOOL	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed free of error
ERROR	OUT	BOOL	Status parameter with the following values: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	Status of the instruction

Parameter STATUS

STATUS (W#16#...)	Description
80D0	A new send request was received while a transmission was taking place.
80D1	The transmission was interrupted because the CTS signal was not confirmed within the specified wait time.
80D2	The send request was interrupted because the communications partner (DCE) signaled that it was not willing to receive (DSR).
8080	The port number is invalid.
7000	The send operation is not active.
7001	The send operation is processing the first call.
7002	The send operation is processing subsequent calls (queries following the first call).

See also

General status information of the communications blocks (Page 992)
Point-to-point communication (Page 270)

7.8.2.4 RCV_PTP

Description

With RCV_PTP, you enable receipt of a sent message. Each message must be enabled individually. The sent data is only available in the receive area when the message has been acknowledged by the relevant communications partner.

Parameters

Parameter	Declaration	Data type	Description
EN_R	IN	BOOL	Enables reception on a rising edge
PORT	IN	PORT (UINT)	ID of the communications port (HW ID)
BUFFER	IN	VARIANT	Points to the start address of the receive buffer
LENGTH	OUT	UINT	Length of the message in the receive buffer
NDR	OUT	BOOL	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed free of error
ERROR	OUT	BOOL	Status parameter with the following values: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	Status of the instruction

Parameter STATUS

STATUS (W#16#....)	Description
80E0	The message was terminated because the receive buffer is full.
80E1	The message was terminated as a result of a parity error.
80E2	The message was terminated as a result of a framing error.
80E3	The message was terminated as a result of an overrun error.
80E4	The message was terminated because the calculated message length (N+LEN+M) exceeds the size of the receive buffer.
8080	The port number is invalid.
0094	The message was terminated because the maximum character length was received.
0095	The message was terminated because the complete message was not received in the specified time.
0096	The message was terminated because the next character was not received in the specified time.
0097	The message was terminated because the first character was not received in the specified time.

STATUS (W#16#....)	Description
0098	The message was terminated because the "h+len+m" length condition has been satisfied.
0099	The message was terminated because the end sequence has been satisfied.

See also

General status information of the communications blocks (Page 992)
Point-to-point communication (Page 270)

7.8.2.4 RCV_RST

Description

With RCV_RST, you delete the receive buffer of a communications partner.

Parameter

Parameter	Declaration	Type	Description
REQ	IN	BOOL	Enables deleting of the receive buffer on a rising edge
PORT	IN	UINT	ID of the communications port (module ID)
DONE	OUT	BOOL	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed free of error
ERROR	OUT	BOOL	Status parameter with the following values: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	Status of the instruction (General information on the status of the communications blocks are output at the STATUS parameter.)

See also

General status information of the communications blocks (Page 992)
Point-to-point communication (Page 270)

7.8.2.4 SGN_GET

Description

With SGN_GET, you query the current state of several signals of an RS-232 communications module.

Parameters

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Enables the query on a rising edge
PORT	IN	PORT (UINT)	ID of the communications port (HW ID)
NDR	OUT	BOOL	Is set for one cycle if new data are ready for sending and the instruction was executed error-free.
DTR	OUT	BOOL	Date terminal ready, module ready
DSR	OUT	BOOL	Data set ready, communications partner ready
RTS	OUT	BOOL	Send request, module ready to send
CTS	OUT	BOOL	Clear to send, communications partner can receive data from the module (reaction to RTS = ON of the module).
DCD	OUT	BOOL	Data carrier detect, received signal level
RING	OUT	BOOL	Ring display, display of an incoming call
ERROR	OUT	BOOL	Status parameter with the following values: • 0: No error • 1: Error occurred
STATUS	OUT	WORD	Status of the instruction

Parameter STATUS

STATUS (W#16#....)	Description
80F0	The communication module is an RS-485 module and no signals are available.
80F1	No signals are settable because H/W flow control is enabled.
80F2	DSR cannot be set because the module is a DTE device.
80F3	DTR cannot be set because the module is a DCE device.

See also

General status information of the communications blocks (Page 992)
Point-to-point communication (Page 270)

7.8.2.4 SGN_SET

Description

With SGN_SET (set RS-232 signals), you set the status of the output signals of an RS-232 communications module.

Parameters

Paramete r	Declaration	Data type	Initial value	Description
REQ	IN	BOOL	FALSE	Activates the action on a rising edge
PORT	IN	PORT (UINT)	0	ID of the communications port (module ID)
SIGNAL	IN	BYTE	FALSE	Specifies the signals to be set: • Set 01H = RTS • Set 02H = DTR • Set 04H = DSR
RTS	IN	BOOL	FALSE	Send request, module ready to send
DTR	IN	BOOL	FALSE	Date terminal ready, module ready
DSR	IN	BOOL	FALSE	Data set ready (applies only to interfaces of the DCE type)
DONE	OUT	BOOL	FALSE	Status parameter with the following values: • 0: Job not yet started or is still executing • 1: Job completed free of error
ERROR	OUT	BOOL	FALSE	Status parameter with the following values: • 0: No error • 1: Error occurred
STATUS	OUTPUT	WORD	0	Status of the instruction

Parameter STATUS

STATUS (W#16#....)	Description
80F0	The communication module is an RS-485 module and no signals are available.
80F1	No signals are settable because H/W flow control is enabled.
80F2	DSR cannot be set because the module is a DTE device.
80F3	DTR cannot be set because the module is a DCE device.

See also

General status information of the communications blocks (Page 992)
Point-to-point communication (Page 270)

7.8.2.4 General status information of the communications blocks

General information on execution status of the communications blocks

The following table shows which general information can be output at the STATUS parameter of the communications blocks:

STATUS (W#16#....)	Description
8070	All internal instance memory is in use
8080	The identifier entered for the communications port is invalid
8081	Timeout, module error, internal error
8090	Message length invalid, module invalid, message invalid
8091	Incorrect version in parameterization message
8092	Invalid record length in parameterization message

7.8.2.5 Interrupts

7.8.2.5 ATTACH

Description

With ATTACH, you assign an organization block (OB) to an event.

You enter the symbolic or numeric name of the organization block in the OB_NR parameter. This will then be assigned to the event specified with the EVENT parameter.

If the event in the EVENT parameter occurs following error-free execution of the ATTACH instruction, the organization block specified by the OB_NR parameter is called and its program executed.

With the ADD parameter, you specify whether previous assignments of the organization block to other events should be canceled or retained. If the ADD parameter has the value "0", the existing assignments are replaced by the current assignment.

Parameter

Parameter	Declaration	Data type	Memory area	Description
OB_NR	IN	OB_ATT	M, D, L	Organization block
EVENT	IN	EVENT_ATT	M, D, L	Event
ADD	IN	BOOL	M, D, L	Effects on previous assignments: • ADD=0 (default): This event replaces all previous event assignments for this OB. • ADD=1: This event is added to the previous event assignments for this OB.
RET_VAL	OUT	INT	M, D, L	Status of the instruction

Parameter RET_VAL

RET_VAL (W#16#....)	Description
0	No error
8090	OB does not exist
8091	OB is incorrect type
8093	Event does not exist

7.8.2.5 DETACH

Description

With DETACH, you cancel the assignment of an organization block to one or more events during runtime.

If you have selected a single event, the assignment of the OB to this event will be cancelled. All other currently existing assignments remain active.

If you have selected no event, all currently existing assignments of the organization block to events will be canceled.

You enter the symbolic or numeric name of the organization block in the OB_NR parameter. The assignment of this organization block to the event specified with the EVENT parameter will then be canceled.

Parameters

Parameter	Declaration	Data type	Memory area	Description
OB_NR	IN	OB_ATT	M, D, L	Organization block
EVENT	IN	EVENT_ATT	M, D, L	Event
RET_VAL	OUT	INT	M, D, L	Status of the instruction

Parameter RET_VAL

RET_VAL (W#16#....)	Description
0	No error
1	No assignment exists (warning)
8090	OB does not exist
8091	OB is incorrect type
8093	Event does not exist

7.8.2.5 Time-delay interrupts

7.8.2.5 SRT_DINT

Description

You can use SER_DINT to start a delay interrupt that calls a delay interrupt OB after the delay time configured at the DTIME parameter has elapsed. The delay time is started when a negative edge is generated on the EN enable input.

If the countdown of the delay time is interrupted, the organization block specified at the OB_NR parameter is not executed.

Accuracy

The maximum time between the "SRT_DINT" instruction call and the start of the time-delay interrupt OB is one millisecond less than the assigned delay time, provided that no interruption events delay the call.

Parameters

Parameter	Declaration	Data type	Memory area	Description
OB_NR	IN	OB_ATT	M, D, L	Number of the OB to be executed after a delay time
DTIME	IN	TIME	M, D, L or constant	Time delay (1 to 60000 ms) You can realize longer times, for example, by using a counter in a time-delay interrupt OB.
SIGN	IN	WORD	M, D, L or constant	Note: You must assign a value to this parameter upon call. However, the value has no significance.
RET_VAL	OUT	INT	M, D, L	Status of the instruction

Parameter RET_VAL

OUT (W#16#...)	Description
0000	No error
8090	Incorrect parameter OB_NR
8091	Incorrect parameter DTIME

7.8.2.5 CAN_DINT

Description

You can use CAN_DINT to cancel a started time-delay interrupt and while also canceling the call of the time-delay interrupt OB that would normally be executed after the configured delay time. You use the OB_NR parameter to specify the number of the organization block, the call of which is to be cancelled.

Parameters

Parameter	Declaration	Data type	Memory area	Description
OB_NR	IN	OB_ATT	M, D, L	Number of the OB whose call will be canceled
RET_VAL	OUT	INT	M, D, L	Status of the instruction

Parameter RET_VAL

OUT (W#16#...)	Description
0000	No error
8090	Incorrect parameter OB_NR

7.8.2.5 Asynchronous statements

7.8.2.5 DIS_AIRT

Description

You can use DIS_AIRT to delay the processing of interrupt OBs whose priority are higher than the priority of the current organization block.

You can call DIS_AIRT multiple times in an organization block. The DIS_AIRT calls are counted by the operating system. Processing is delayed more and more each time DIS_AIRT is executed. To cancel a delay, you need to execute the "EN_AIRT" instruction. To cancel all delays, the number of EN_AIRT executions be equal the number of DIS_AIRT calls.

You can query the number of delays at the RET_VAL parameter of the DIS_AIRT instruction. There are no delays if the value at the RET_VAL parameter is "0".

Parameter

Parameter	Declaration	Type	Memory area	Description
RET_VAL	OUT	INT	M, D, L	Number of delays

7.8.2.5 EN_AIRT

Description

You can use EN_AIRT to enable processing of organization blocks when interrupts occur, which have been delayed by the "DIS_AIRT" instruction.

Each execution of EN_AIRT cancels a processing delay, which has been registered by the operating system by a DIS_AIRT call. To cancel all delays, the number of EN_AIRT executions be equal the number of DIS_AIRT calls. If, for example, you have called DIS_AIRT five times and thereby delayed the processing five times, you need to call the "EN_AIRT" instruction five times to cancel all five delays.

You can query the number of interrupt delays, which have not yet been enabled after the execution of EN_AIRT, at the RET_VAL parameter of the "EN_AIRT" instruction. The value "0" at the RET_VAL parameter means that all delays enabled by DIS_AIRT have been cancelled.

Parameter

Parameter	Declaration	Type	Memory area	Description
RET_VAL	OUT	INT	M, D, L	Number of configured delays

7.8.2.6 PID

7.8.2.6 PID_Compact: PID controller with self tuning

Description

The "PID_Compact" instruction provides a PID controller with optimizing self tuning for automatic and manual mode.

Requirements

The "PID_Compact" instruction is called at the constant intervals of the sampling time (preferably in a cyclic interrupt OB).

Parameters

Parameter	Declaration	Data type	Initial value	Description
Setpoint	INPUT	REAL	0.0	Setpoint of the PID controller in automatic mode
				In the inspector window of the "PID_Compact" call configure whether the "Input" or "Input_PER" input is to be used.
Input	INPUT	REAL	0.0	Variable of the user program as the source of the actual value
Input_PER	INPUT	WORD	W#16#0	Analog input as the source of the actual value
ManualEnable	INPUT	BOOL	FALSE	• A FALSE -> TRUE edge selects the "Manual mode" • A TRUE -> FALSE edge selects the most recently active operating mode
ManualValue	INPUT	REAL	0.0	Manipulated variable for manual mode

Parameter	Declaration	Data type	Initial value	Description	
Reset	INPUT	BOOL	FALSE	Restarts the controller. The following rules apply to Reset = TRUE: • "Inactive" operating mode • Manipulated variable = 0 • Interim values of the controller are reset (PID parameters are retained)	
ScaledInput	OUTPUT	REAL	0.0	Output of the scaled actual value	
				The outputs "Output", "Output_PER" and "Output_PWM" can be used at the same time.	
Output	OUTPUT	REAL	0.0	Variable of the user program for output of the manipulated variable	
Output_PER	OUTPUT	WORD	W#16#0	Analog output for outputting the manipulated variable	
Output_PWM	OUTPUT	BOOL	FALSE	Switching output for outputting the manipulated variable using pulse width modulation	
SetpointLimit_H	OUTPUT	BOOL	FALSE	TRUE	The absolute setpoint high limit has been reached or exceeded. In the CPU the setpoint is limited to the configured absolute high limit of the actual value.
SetpointLimit_L	OUTPUT	BOOL	FALSE	TRUE	The absolute setpoint low limit has been reached or underpassed. In the CPU the setpoint is limited to the configured absolute low limit of the actual value.
InputWarning_H	OUTPUT	BOOL	FALSE	TRUE	The actual value has reached or exceeded the high warning limit.
InputWarning_L	OUTPUT	BOOL	FALSE	TRUE	The actual value has reached or fallen below the low warning limit.
State	OUTPUT	INT	0	Current operating mode of the PID controller:	
				0	Inactive (manipulated variable is set to 0)
				1	Self tuning during initial start
				2	Self tuning in operating point
				3	Automatic mode
				4	Manual mode
Error	OUTPUT	DWORD	W#32#0	Error message	
				0000 0000	There is no error.
				> 0000 0000	One or several errors are pending. The PID controller enters the "inactive" mode. Refer to the "Error messages" to analyze the active error.

Monitoring of the sampling time

The "PID_Compact" instruction measures the time interval between two calls and evaluates the results for monitoring the sampling time. A mean value of the sampling time is generated at each mode changeover and during initial startup. This value is used as reference for the monitoring function and is used for calculation in the block. Monitoring includes the current measuring time between two calls and the mean value of the defined controller sampling time.

The following conditions set the PID controller to the "Inactive" operating mode:

- New mean value >= 1.5 x old mean value
- New mean value <= 0.5 x old mean value
- Current sampling time >= 2 x current mean value or 0

Operating modes

The following section explains the effects of the operating modes of the "PID_Compact" instruction.

Mode of operation	Description
Inactive	When the user program is downloaded the first time to the CPU after the "PID Compact" technology object has been configured, the PID controller remains in the "Inactive" operating mode. In this case carry out a "Self tuning during initial start" in the commissioning window. During ongoing operation the PID controller changes to the "Inactive" operating mode, when an error occurs or when the "Controller stop" icon is clicked in the commissioning window. Active errors are acknowledged when an alternative operating mode is selected.
Self tuning during initial start / Self tuning in the operating point	The "Self tuning during initial start" or "Self tuning at the operating point" operating mode executes when the function is called in the commissioning window.
Automatic mode	In auto mode, the "PID_Compact" technology object corrects the control loop in accordance with specified parameters. The controller changes to auto mode if the following conditions were met: • Self-tuning during initial startup was completed successfully. • Self-tuning at the operating point was completed successfully. • If the "Use manual PID parameters" check box is selected in the "PID parameters" configuration window: The "sRet.i_Mode" variable is set to 3.
Manual mode	The manipulated variable can be set manually if the PID controller is operated in manual mode. The manual mode can be selected as follows: • Value TRUE at parameter "ManualEnable" • Selecting the "Manual manipulated variable" check box in the commissioning window

Error messages at the "Error" parameter

Error (W#32#...)	Description
0000 0000	There is no error.
0000 0001	The actual value lies outside the configured actual value limits.
0000 0002	There is an invalid value at the "Input_PER" parameter. Check whether there is an error at the analog input.
0000 0004	Error during the "Self tuning in the operating point". Oscillation of the actual value could not be maintained.
0000 0008	Error while starting the "Self tuning during initial start". The actual value is too close to the setpoint. Start the self tuning in the operating point.
0000 0010	The setpoint has changed during the self tuning.
0000 0020	The "Self tuning during initial start" is in automatic mode and is not allowed during "Self tuning in the operating point".
0000 0040	Error during the "Self tuning in the operating point". The setpoint is too close to the manipulated variable limits.
0000 0080	The manipulated variable limits have not been configured correctly.
0000 0100	Error during the self tuning resulted in invalid parameters.
0000 0200	Invalid value at the "Input" parameter: • Value outside the number range (value less than -1e^{12} or greater than 1e^{12}) • Value with invalid number format
0000 0400	Invalid value at the "Output" parameter: • Value outside the number range (value less than -1e^{12} or greater than 1e^{12}) • Value with invalid number format
0000 0800	Sampling time error: The "PID_Compact" instruction is called in the cyclic program or the settings of the cyclic interrupt were changed.
0000 1000	Invalid value at the "Setpoint" parameter: • Value outside the number range (value less than -1e^{12} or greater than 1e^{12}) • Value with invalid number format

If several errors are pending, the values of the error codes are displayed by means of binary addition. The display of error code 0000 0003, for example, indicates that the errors 0000 0001 and 0000 0002 are pending.

See also

Calling the "PID_Compact" instruction in the user program (Page 656)
Configuring (Page 652)

7.8.2.7 Motion Control

7.8.2.7 MC_Power: Enable, disable axis

Description

The "MC_Power" Motion Control statement enables or disables an axis.

Prerequisites

- The technological object has been configured correctly.
- There is no pending enable-inhibiting error.
- The "MC_Power" Motion Control statement is called in the user program only one time per axis.

Override characteristics of the Motion Control command

An MC_Power command cannot be canceled by any other Motion Control command.

An MC_Power command does not cancel any other Motion Control commands with Enable = TRUE .

An MC_Power command cancels all other Motion Control commands on this technological object with Enable = FALSE.

Parameters

Parameter	Declaration	Data type	Initial value	Description	
Axis	INPUT	TO_Axis_PTO	-	Axis technological object	
Enable	INPUT	BOOL	FALSE	TRUE	Motion Control attempts to enable the axis. The axis is enabled if there are no pending enable-inhibiting errors.
				FALSE	All current commands are canceled according to the parameter settings of "StopMode".
StopMode	INPUT	INT	0	0	Emergency stop When disabled, the axis decelerates at the configured emergency stop deceleration rate. The axis is disabled after reaching standstill.
				1	Emergency stop When the axis is disabled, the axis is immediately blocked without delay. Pulse output is stopped immediately.

Parameter	Declaration	Data type	Initial value	Description	
Status	OUTPUT	BOOL	FALSE	Status of axis enable	
				FALSE	No enable signal. Axis disabled The axis does not execute any motion commands and does not accept any new motion commands. The axis is not homed. When the axis is disabled, a delay may occur before the status changes to FALSE.
				TRUE	Enabled The system is not enabled if there are pending enable-inhibiting errors.
Busy	OUTPUT	BOOL	FALSE	TRUE	The command is being executed.
Error	OUTPUT	BOOL	FALSE	FALSE	Technological object executed without error.
				TRUE	Command initiation with error. The command is rejected. The cause of error can be found in the "ErrorID"". The detailed information on the error can be found in the "ErrorInfo".
ErrorID	OUTPUT	WORD	0000	Error ID (Page 639) of the "Error"" output parameter	
ErrorInfo	OUTPUT	WORD	0000	Error ID (Page 639) of the "ErrorID" output parameter	

Notice

An axis switched off due to an error is re-enabled with Enable = TRUE after the error has been eliminated and acknowledged.

Recommended procedure for disabling an axis

To disable an axis:

1. Stop the drive.
2. Disable the axis after the drive has stopped (Enable = FALSE).

See also

List of ErrorIDs and ErrorInfos (Page 639)
MC_Reset: Acknowledge error (Page 1003)
MC_Home: Home axes, set home position (Page 1004)
MC_Halt: Halt axis (Page 1006)
MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveRelative: Relative positioning of axes (Page 1009)
MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
MC_MoveJog: Move axes in jog mode (Page 1012)

Motion Control guideline (Page 623)
Creating a user program (Page 634)

7.8.2.7 MC_Reset: Acknowledge error

Description

The "MC_Reset" Motion Control statement is used to acknowledge all Motion Control errors that require acknowledgment. Fatal errors can be acknowledged by cycling power or by downloading the project data to the module again.

If the cause of the errors has been eliminated, the values of the Error, ErrorID, and ErrorInfo parameters of the Motion Control statements are reset upon acknowledgment.

Prerequisites

- None

Override characteristics of the Motion Control statement

An MC_Reset command cannot be canceled by any other Motion Control command.

A new MC_Reset command does not cancel any current Motion Control commands.

Parameters

Parameter	Declaration	Data type	Initial value	Description	
Axis	INPUT	TO_Axis_PTO	-	Axis technological object	
Execute	INPUT	BOOL	FALSE	Start of the command at the positive edge	
Done	OUTPUT	BOOL	FALSE	TRUE	Error has been acknowledged.
Busy	OUTPUT	BOOL	FALSE	TRUE	The command is being executed.
Error	OUTPUT	BOOL	FALSE	FALSE	Command initiation without error.
				TRUE	Command initiation with error. The command is rejected. The cause of error can be found in the "ErrorID"". The detailed information on the error can be found in the "ErrorInfo".
ErrorID	OUTPUT	WORD	0000	Error ID (Page 639) of the "Error"" output parameter	
ErrorInfo	OUTPUT	WORD	0000	Error ID (Page 639) of the "ErrorID" output parameter	

See also

List of ErrorIDs and ErrorInfos (Page 639)
MC_Power: Enable, disable axis (Page 1001)
MC_Home: Home axes, set home position (Page 1004)
MC_Halt: Halt axis (Page 1006)

MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveRelative: Relative positioning of axes (Page 1009)
MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
MC_MoveJog: Move axes in jog mode (Page 1012)
Motion Control guideline (Page 623)
Creating a user program (Page 634)

7.8.2.7 MC_Home: Home axes, set home position

Description

The "MC_Home" Motion Control statement establishes a position-based correlation between the control and the mechanical system by means of a measuring system. Homing is required for absolute positioning of the axis. The following types of homing can be executed:

- Active homing

  The homing procedure is executed automatically.
- Passive homing

  The homing procedure must be executed by the user.
- Direct homing absolute

  The home position is set in absolute terms.
- Direct homing relative

  The home position is set relative to the current position.

Prerequisites

- The axis is enabled.

Override characteristics of the Motion Control statement

A new MC_Home command (Mode = 0, 1, 2) cancels the following current Motion Control commands:

- MC_Home command (Mode = 2)

Position-based motion commands continue according to the new position.

A new MC_Home command (Mode = 3) cancels the following current Motion Control commands:

- MC_Home command (Mode = 0, 1, 2, 3)
- MC_Halt command
- MC_MoveAbsolute command
- MC_MoveRelative command
- MC_MoveVelocity command
- MC_MoveJog command

Parameters

Parameter	Declaration	Data type	Initial value	Description	
Axis	INPUT	TO_Axis_PTO	-	Axis technological object	
Execute	INPUT	BOOL	FALSE	Start of the command at the positive edge The command can also be initiated when the axis is homed.	
Position	INPUT	REAL	0.0	• Absolute position when reaching the home position (Mode = 2 and 3) • Position setpoint (Mode = 1) • Position correction value (Mode = 2)	
Mode	INPUT	INT	0	Homing mode	
				0	Direct homing absolute. New axis position is value of Position parameter.
				1	Direct homing relative. New axis position is current axis position + value of Position parameter.
				2	Passive homing. Homing in accordance with axis configuration. The value of the Position parameter is used as the home position coordinate.
				3	Active referencing Homing procedure in accordance with axis configuration. The value of the Position parameter is used as the home position coordinate.
Done	OUTPUT	BOOL	FALSE	TRUE	Command completed
Busy	OUTPUT	BOOL	FALSE	TRUE	The command is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The command was canceled by another command or as a result of error during its execution.
Error	OUTPUT	BOOL	FALSE	FALSE	Command initiation without error.
				TRUE	Command initiation with error. The command is rejected. The cause of error can be found in the "ErrorID"". The detailed information on the error can be found in the "ErrorInfo".
ErrorID	OUTPUT	WORD	0000	Error ID (Page 639) of the "Error"" output parameter	
ErrorInfo	OUTPUT	WORD	0000	Error ID (Page 639) of the "ErrorID" output parameter	

Note

Axis homing is lost under the following conditions:

- Axis disabled by "MC_Power" statement
- After POWER OFF (POWER OFF -> POWER ON)
- After CPU restart (RUN-STOP -> STOP-RUN)

See also

List of ErrorIDs and ErrorInfos (Page 639)
MC_Power: Enable, disable axis (Page 1001)
MC_Reset: Acknowledge error (Page 1003)
MC_Halt: Halt axis (Page 1006)
MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveRelative: Relative positioning of axes (Page 1009)
MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
MC_MoveJog: Move axes in jog mode (Page 1012)
Homing (Page 624)
Configuration - Homing (Page 632)
Motion Control guideline (Page 623)
Creating a user program (Page 634)

7.8.2.7 MC_Halt: Halt axis

Description

The "MC_Halt" Motion Control statement stops all motions and brings the axis to a standstill. The standstill position is not defined. The command is completed when the axis has reached a standstill or it is canceled by a new motion command.

Prerequisites

- The axis is enabled.

Override characteristics of the Motion Control statement

A new MC_Halt command cancels the following current Motion Control commands:

- MC_Home command (Mode = 3)
- MC_Halt command
- MC_MoveAbsolute command
- MC_MoveRelative command
- MC_MoveVelocity command
- MC_MoveJog command

Parameters

Parameter	Declaration	Data type	Initial value	Description	
Axis	INPUT	TO_Axis_PTO	-	Axis technological object	
Execute	INPUT	BOOL	FALSE	Start of the command at the positive edge	
Done	OUTPUT	BOOL	FALSE	TRUE	Zero velocity reached
Busy	OUTPUT	BOOL	FALSE	TRUE	The command is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The command was canceled by another command or as a result of error during its execution.
Error	OUTPUT	BOOL	FALSE	FALSE	Command initiation without error.
				TRUE	Command initiation with error. The command is rejected. The cause of error can be found in the "ErrorID"". The detailed information on the error can be found in the "ErrorInfo".
ErrorID	OUTPUT	WORD	0000	Error ID (Page 639) of the "Error" output parameter	
ErrorInfo	OUTPUT	WORD	0000	Error ID (Page 639) of the "ErrorID" output parameter	

See also

List of ErrorIDs and ErrorInfos (Page 639)
MC_Power: Enable, disable axis (Page 1001)
MC_Reset: Acknowledge error (Page 1003)
MC_Home: Home axes, set home position (Page 1004)
MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveRelative: Relative positioning of axes (Page 1009)
MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
MC_MoveJog: Move axes in jog mode (Page 1012)
Motion Control guideline (Page 623)
Creating a user program (Page 634)

7.8.2.7 MC_MoveAbsolute: Absolute positioning of axes

Description

The "MC_MoveAbsolute" Motion Control statement starts the positioning motion of an axis to an absolute position. The command is terminated when the target position is reached.

Prerequisites

- The axis is enabled.
- The axis is homed.

Override characteristics of the Motion Control statement

A new MC_MoveAbsolute command cancels the following current Motion Control commands:

- MC_Home command (Mode = 3)
- MC_Halt command
- MC_MoveAbsolute command
- MC_MoveRelative command
- MC_MoveVelocity command
- MC_MoveJog command

Parameters

Parameter	Declaration	Data type	Initial value	Description	
Axis	INPUT	TO_Axis_PTO	-	Axis technological object	
Execute	INPUT	BOOL	FALSE	Start of the command at the positive edge	
Position	INPUT	REAL	0.0	Target position (negative or positive)	
Velocity	INPUT	REAL	10.0	Desired maximum velocity The maximum velocity is not always reached on account of the configured acceleration and deceleration and the target position. The velocity must be greater or equal to the configured start / stop velocity.	
Done	OUTPUT	BOOL	FALSE	TRUE	Target position reached
Busy	OUTPUT	BOOL	FALSE	TRUE	The command is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The command was canceled by another command or as a result of error during its execution.
Error	OUTPUT	BOOL	FALSE	FALSE	Command initiation without error.
				TRUE	Command initiation with error. The command is rejected. The cause of error can be found in the "ErrorID"". The detailed information on the error can be found in the "ErrorInfo".
ErrorID	OUTPUT	WORD	0000	Error ID (Page 639) of the "Error" output parameter	
ErrorInfo	OUTPUT	WORD	0000	Error ID (Page 639) of the "ErrorID" output parameter	

See also

List of ErrorIDs and ErrorInfos (Page 639)
MC_Power: Enable, disable axis (Page 1001)
MC_Reset: Acknowledge error (Page 1003)

MC_Home: Home axes, set home position (Page 1004)
MC_Halt: Halt axis (Page 1006)
MC_MoveRelative: Relative positioning of axes (Page 1009)
MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
MC_MoveJog: Move axes in jog mode (Page 1012)
Motion Control guideline (Page 623)
Creating a user program (Page 634)

7.8.2.7 MC_MoveRelative: Relative positioning of axes

Description

The "MC_MoveRelative" Motion Control statement starts a positioning motion relative to the start position.

Prerequisites

- The axis is enabled.

Override characteristics of the Motion Control statement

A new MC_MoveRelative command cancels the following current Motion Control commands:

- MC_Home command (Mode = 3)
- MC_Halt command
- MC_MoveAbsolute command
- MC_MoveRelative command
- MC_MoveVelocity command
- MC_MoveJog command

Parameters

Parameter	Declaration	Data type	Initial value	Description	
Axis	INPUT	TO_Axis_PTO	-	Axis technological object	
Execute	INPUT	BOOL	FALSE	Start of the command at the positive edge	
Distance	INPUT	REAL	0.0	Positioning distance (negative or positive)	
Velocity	INPUT	REAL	10.0	Desired maximum velocity The maximum velocity is not always reached on account of the configured acceleration and deceleration and the target position. The velocity must be greater or equal to the configured start / stop velocity.	
Done	OUTPUT	BOOL	FALSE	TRUE	Target position reached

Parameter	Declaration	Data type	Initial value	Description	
Busy	OUTPUT	BOOL	FALSE	TRUE	The command is being executed
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The command was canceled by another command or as a result of error during its execution.
Error	OUTPUT	BOOL	FALSE	FALSE	Command initiation without error.
				TRUE	Command initiation with error. The command is rejected. The cause of error can be found in the "ErrorID"". The detailed information on the error can be found in the "ErrorInfo".
ErrorID	OUTPUT	WORD	0000	Error ID (Page 639) of the "Error" output parameter	
ErrorInfo	OUTPUT	WORD	0000	Error ID (Page 639) of the "ErrorID" output parameter	

See also

List of ErrorIDs and ErrorInfos (Page 639)
MC_Power: Enable, disable axis (Page 1001)
MC_Reset: Acknowledge error (Page 1003)
MC_Home: Home axes, set home position (Page 1004)
MC_Halt: Halt axis (Page 1006)
MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
MC_MoveJog: Move axes in jog mode (Page 1012)
Motion Control guideline (Page 623)
Creating a user program (Page 634)

7.8.2.7 MC_MoveVelocity: Move axes at preset rotational speed

Description

The "MC_MoveVelocity" Motion Control statement causes the axis to move at the preset velocity.

Prerequisites

- The axis is enabled.

Override characteristics of the Motion Control statement

A new MC_MoveVelocity command cancels the following current Motion Control commands:

- MC_Home command (Mode = 3)
- MC_Halt command
- MC_MoveAbsolute command

- MC_MoveRelative command
- MC_MoveVelocity command
- MC_MoveJog command

Parameters

Parameter	Declaration	Data type	Initial value	Description	
Axis	INPUT	TO_Axis_PTO	-	Axis technological object	
Execute	INPUT	BOOL	FALSE	Start of the command at the positive edge	
Velocity	INPUT	REAL	10.0	Final velocity of the axis	
				0	permitted
				>0 and < start / stop velocity	not permitted
				>= start / stop velocity	permitted
Direction	INPUT	INT	0	Direction command	
				0	Direction of rotation corresponds to the sign of the value on the "velocity" parameter
				1	Positive direction of rotation
				2	Negative direction of rotation
Current	INPUT	BOOL	FALSE	Maintain current velocity	
				FALSE	"Maintain current velocity" is disabled.
				TRUE	The current velocity and direction are maintained. The "Velocity" and "Direction" parameters are not taken into account. When the axis resumes motion at the current velocity, the "InVelocity" parameter returns the value TRUE.
InVelocity	OUTPUT	BOOL	FALSE	TRUE	• "Current" = FALSE: The velocity defined in the "Velocity" parameter has been reached and is being maintained. • "Current" = TRUE: The last current velocity is maintained.
Busy	OUTPUT	BOOL	FALSE	TRUE	The command is being executed
CommandAborted	OUTPUT	BOOL	FALSE	TRUE	The command was canceled by another command or as a result of error during its execution.

Parameter	Declaration	Data type	Initial value	Description	
Error	OUTPUT	BOOL	FALSE	FALSE	Command initiation without error.
				TRUE	Command initiation with error. The command is rejected. The cause of error can be found in the "ErrorID"". The detailed information on the error can be found in the "ErrorInfo".
ErrorID	OUTPUT	BOOL	0000	Error ID (Page 639) of the "Error" output parameter	
ErrorInfo	OUTPUT	BOOL	0000	Error ID (Page 639) of the "ErrorID" output parameter	

See also

List of ErrorIDs and ErrorInfos (Page 639)
MC_Power: Enable, disable axis (Page 1001)
MC_Reset: Acknowledge error (Page 1003)
MC_Home: Home axes, set home position (Page 1004)
MC_Halt: Halt axis (Page 1006)
MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveRelative: Relative positioning of axes (Page 1009)
MC_MoveJog: Move axes in jog mode (Page 1012)
Motion Control guideline (Page 623)
Creating a user program (Page 634)

7.8.2.7 MC_MoveJog: Move axes in jog mode

Description

The "MC_MoveJog" Motion Control statement makes it possible to move an axis with closed-loop speed control in jog mode. Use this Motion Control statement for testing and commissioning purposes.

Prerequisites

- The axis is enabled.

Override characteristics of the Motion Control statement

A new MC_MoveJog command cancels the following current Motion Control commands:

- MC_Home command (Mode = 3)
- MC_Halt command
- MC_MoveAbsolute command
- MC_MoveRelative command
- MC_MoveVelocity command
- MC_MoveJog command

Parameters

Parameter	Declaration	Data type	Initial value	Description
Axis	INPUT	TO_Axis_PTO	-	Axis technological object
JogForward	INPUT	BOOL	FALSE	When this parameter is TRUE, the axis moves in the positive direction at the preset "Velocity".
JogBackward	INPUT	BOOL	FALSE	When this parameter is TRUE, the axis moves in the negative direction at the preset "Velocity".
				If both input parameters are TRUE, the axis stops and an error is issued on the "ErrorID" output parameter.
Velocity	INPUT	REAL	10.0	Preset velocity for jog mode
InVelocity	OUTPUT	BOOL	FALSE	The velocity defined at the "Velocity" parameter has been reached and is being maintained.
Busy	OUTPUT	BOOL	FALSE	The command is being executed.
CommandAborted	OUTPUT	BOOL	FALSE	The command was canceled by another command or as a result of error during its execution.
Error	OUTPUT	BOOL	FALSE	FALSE: Command initiation without error.
				TRUE: Command initiation with error. The command is rejected. The cause of error can be found in the "ErrorID"". The detailed information on the error can be found in the "ErrorInfo".
ErrorID	OUTPUT	WORD	0000	Error ID (Page 639) of the "Error" output parameter
ErrorInfo	OUTPUT	WORD	0000	Error ID (Page 639) of the "ErrorID" output parameter

See also

List of ErrorIDs and ErrorInfos (Page 639)
MC_Power: Enable, disable axis (Page 1001)
MC_Reset: Acknowledge error (Page 1003)
MC_Home: Home axes, set home position (Page 1004)
MC_Halt: Halt axis (Page 1006)
MC_MoveAbsolute: Absolute positioning of axes (Page 1007)
MC_MoveRelative: Relative positioning of axes (Page 1009)
MC_MoveVelocity: Move axes at preset rotational speed (Page 1010)
Motion Control guideline (Page 623)
Creating a user program (Page 634)

7.8.2.8 Pulse

7.8.2.8 CTRL_PWM

Description

With the "CTRL_PWM" instruction, you can enable and disable a pulse generator supported by the CPU using the software.

Note

Pulse generators are parameterized exclusively in the device configuration and not by means of the "CTRL_PWM" instruction. Any change of parameters that is intended to have an effect on the CPU must therefore be made while the CPU is in STOP mode.

You enter the hardware ID of the pulse generator you want to control with the instruction at the PWM input. Error-free execution of the instruction is possible only when the specified pulse generator is enabled in the hardware configuration.

Only tags of the data type "HW_PWM" can be specified at the "PWM" input. The hardware data type "HW_PWM" has a length of one WORD.

The pulse generator is enabled when the bit at the ENABLE input of the instruction is set. If ENABLE has the value TRUE, the pulse generator generates pulses that have the properties defined in the device configuration. When the bit at the ENABLE input is reset or the CPU changes to STOP, the pulse generator is disabled and no more pulses are generated.

The "CTRL_PWM" instruction is only executed if the signal state at the EN input is "1".

Since the S7-1200 enables the pulse generator when the CTRL_PWM instruction is executed, BUSY at S7-1200 always has the value FALSE.

The ENO enable output is set only when the "EN" enable input has signal state "1" and no errors occurred during execution of the instruction.

Parameters

Parameter	Declaration	Data type	Memory area	Description
PWM	IN	HW_PWM	L, D or constant	Hardware identification of the pulse generator (HW ID)
ENABLE	IN	BOOL	I, Q, M, L, D or constant	The pulse generator is enabled when ENABLE = TRUE and disabled when ENABLE = FALSE.
BUSY	OUT	BOOL	I, Q, M, L, D	Processing status
STATUS	OUT	BOOL	I, Q, M, L, D	Status of the instruction

Parameter STATUS

Error code (hexadecimal)	Description
0	No error
80A1	Hardware ID of the pulse generator is invalid

Visualize processes 8

8.1 Migration

8.1.1 Migration

Introduction

You can continue to use projects from WinCC flexible 2008 in WinCC V10.5. "Basic Panels" type HMI devices can be migrated. With other HMI devices, the HMI device type must first be changed in WinCC flexible 2008.

You cannot migrate projects from WinCC flexible 2008 SP1 directly to WinCC V10.5. If you wish to continue using such projects in WinCC V10.5, you must first migrate them to WinCC flexible 2008.

Projects from ProTool Pro and from earlier versions of WinCC flexible cannot be migrated directly to WinCC V10.5. If you wish to continue using such projects in WinCC V10.5, you first need to migrate them to WinCC flexible 2008 and then change the HMI device type.

You cannot continue using projects from WinCC Classic in WinCC V10.5.

See also

Migration basics (Page 1017)
Object support during migration (Page 1018)
Migrating projects from WinCC flexible 2008 (Page 1021)
Migration of data types (Page 1023)

8.1.2 Migration basics

Introduction

Note that WinCC 10.5 only supports the following HMI device types when migrating projects from WinCC flexible 2008:

- KTP400 Basic mono PN

- KTP400 Basic mono PN Portrait
- KTP600 Basic mono PN
- KTP600 Basic mono PN Portrait
- KTP600 Basic color PN
- KTP600 Basic color PN Portrait
- KTP1000 Basic PN
- TP1500 Basic PN

WinCC V10.5 only supports the functions offered by these HMI device types.

Only the SIMATIC S7 1200 communication driver is available in WinCC 10.5. SIMATIC S7 300/400 and SIMATIC S7 200 communication drivers are therefore not migrated.

Additional functions which are not migrated due to the limited selection of devices and communication drivers are documented in the following sections.

Adaptations before migration

If the HMI device has changed in the project being migrated, the project needs to be recompiled before migration. The compilation process will adjust the size of the screens and screen elements.

Migration of a project integrated in STEP 7

You cannot migrate a project that is integrated in STEP 7 directly to WinCC. To migrate an integrated project, you will first have to take it out of the integration. Open the project first in WinCC flexible and then select the menu command "Project > Copy from STEP 7". The WinCC flexible project will be taken out of the integration. Then migrate your WinCC flexible project.

See also

Migration (Page 1017)

8.1.3 Object support during migration

Introduction

During migration of projects from WinCC flexible 2008, all object types and functions that are available and can be mapped to the new project environment are fully migrated.

If an object is supported by migration, but has references to objects or functions that are not supported, then the object itself will be migrated. The reference will be lost during migration.

Example:

You have created a project in WinCC flexible 2008, which you wish to use for both the MP 277 and the KTP 1000 type of target device. Switching the device enables/disables functions supported by the specific device type.

Your project for the MP 277 HMI device contains a VB script that you can start by clicking a button in runtime. When you compile the project for the KTP 1000 HMI device, you get the warning about an invalid function.

If you want to migrate the project to WinCC V10.5, you need to set the KTP 1000 HMI device. The VB script is not migrated during the subsequent migration. The reference to the VB script is lost. The button is migrated.

Supported object types

The following object types are supported for migration:

- Animations
- Scheduler
- User administration
- Screens
- Screen template
- Data types
  The data types of external tags will be mapped to data types of internal tags because connections will not be migrated. See Migration of data types (Page 1023) for additional information.
- Events
- Function lists
- Graphics lists
- Display and operating elements
  Migration supports all display and operating elements available on the supported HMI devices.
- Alarms
- Alarm classes
- Alarm groups
- Project languages
- Recipes
- Runtime languages
- Runtime scripting
- System functions
- Texts
- Text lists
- Tags
- Cycles (cycles defined by the user are not supported by the migration).

Settings for download to the HMI device

The settings for the Ethernet interface are included in the migration. The computer name or IP address most recently used for download is migrated. The "Use device address for download to device" option is selected so that the project can be downloaded to an HMI device after the migration. The IP address of the currently connected HMI device is used when this option is selected. The destination address therefore does not have to be changed to download the project.

The following options for downloading are also migrated:

- Overwrite user administration
- Overwrite recipe data

If you have changed the type of HMI device in WinCC flexible without a transfer, you will have to update the settings for uploading to WinCC. Select the HMI device in the project tree and select "Properties" from the shortcut menu. The "Properties" dialog of the HMI device opens. Select the "Load" group and verify the interface settings. Click "OK" to confirm your settings.

Limitations and adaptations after migration

Some limitations apply during migration of the supported object types.

Migration of tags

Connections to PLCs will not be migrated because the configurable controls in WinCC flexible 2008 and WinCC V10.5 are different. External tags will be mapped to internal tags during migration. These internal tags have to be connected with the PLC tags after migration and configuration of a connection.

Additional information on migration of data types of external tags is available at Migration of data types (Page 1023) .

Names of tags, screens and screen objects

In WinCC flexible 2008, tags saved in different folders could have had the same name. In WinCC, the tag name must be unique on the configured HMI device. This means tags of the same name from different folders will be renamed during migration.

Renaming takes place based on the following scheme:

Before migration	After migration
Folder_1/Tag_1	Folder_1/Tag_1
Folder_1/Tag_2	Folder_1/Tag_2
Folder_2/Tag_1	Folder_2/Tag_1#Mig1
Folder_2/Tag_2	Folder_2/Tag_2#Mig1
Folder_3/Tag_1	Folder_3/Tag_1#Mig2
Folder_3/Tag_2	Folder_3/Tag_2#Mig2

Renaming of screens and screen objects takes place according to this scheme.

Object position not in valid range

The permitted value range for specifying the position of objects in screens was greater in WinCC flexible than in WinCC. If the value for specifying the position of a display object or operator control is outside the valid value range, it will be set to the maximum or minimum value by the migration.

Migration of alarm groups

Migration will migrate only those alarm groups actually in use.

Alarm groups with an ID from 1-31 will be migrated 1:1. The IDs of the alarm groups > 31 will be counted upwards during migration. This means for alarm groups with IDs > 31, the ID may change after migration when alarm group names have been assigned to the ID.

You should also note the following:

During migration of alarm groups with identical group name, the first alarm group to be migrated will receive the name without changes. All other alarm groups with the same group name will receive a name extension in form of a continuous number.

References to deleted objects

References to deleted objects are not migrated. If a reference to a deleted object is detected during migration, it will be logged.

Unsupported object types

The following object types are not supported by migration:

- Connections
- Area pointer
- References to deleted objects
- Libraries
- Dictionaries
- Change log
- Project versions
- Cycles defined by the user

You can configure area pointers and a connection in WinCC V10.5 later using the SIMATIC S7 1200 communication driver.

See also

Migration of data types (Page 1023)
Migration (Page 1017)

8.1.4 Migrating projects from WinCC flexible 2008

Introduction

When you migrate a project, data from a WinCC flexible 2008 project is loaded into a new project for WinCC V10.5. A new project is therefore created automatically for project migration. You cannot migrate to an existing project.

You can start the migration in both the Portal view and the Project view.

A migration should only take place in a newly started TIA Portal. Save the project after migration and restart the TIA Portal.

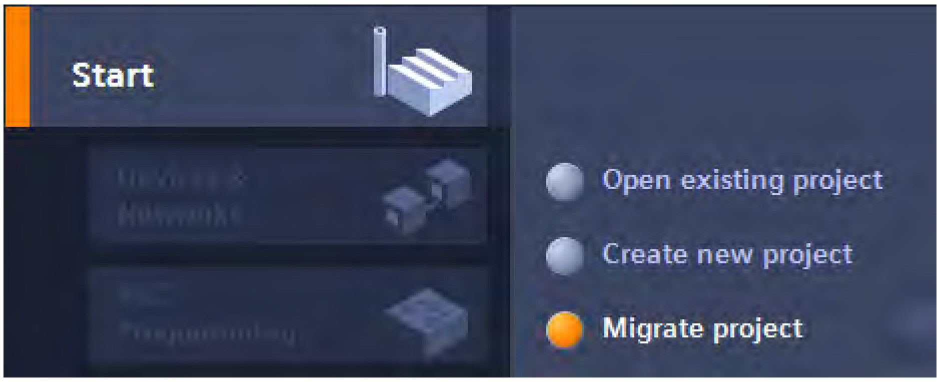
Requirement

- You are in the portal view.
- No project is open.
- A project from WinCC flexible 2008 is available.
- The project may not be open in WinCC flexible 2008.

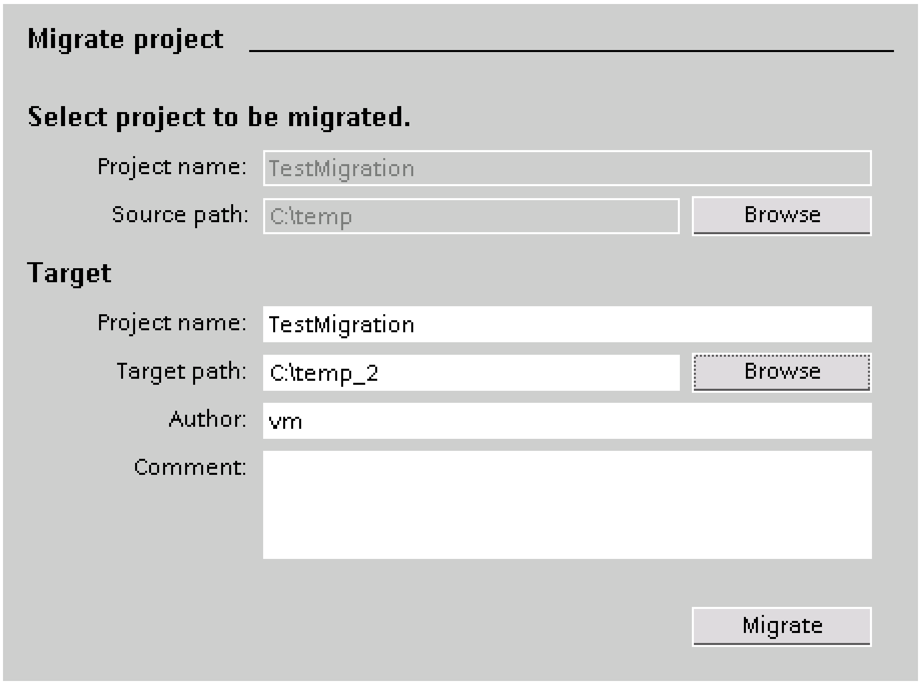
Procedure

You migrate a project as follows:

1. Select the action "Start > Migrate Project".



2. In the "Source path" box, navigate to the project you want to migrate.



Migrate project

Select project to be migrated.

Project name: TestMigration
Source path: C:\temp [Browse]

Target

Project name: TestMigration
Target path: C:\temp_2 [Browse]
Author: vm
Comment:

[Migrate]

3. Select the WinCC flexible project file "*.hmi".
4. Change the information for the project to be created, if necessary. For example, change the project name or project path. The data to be migrated is created in the new project.
5. Click "Migrate".
   A new project is created and migration of the data is started:
   - The progress of the migration is shown in a migration window.
   - If an error occurs during migration, an alarm will appear in the output window.
6. Once migration is completed, save the project.

When migration is complete, you will find a newly created device for each migrated HMI device in the project tree. These devices contain the migrated data, such as screens, alarms and tags.

Once the project is successfully migrated, a notice appears reporting the success.

Opening the migration log

Information about the migration is stored in a log file. You can read this file as follows:

1. Select the project.
2. Open the "Properties" menu.
3. Click "Project History."
4. Click on the log file.

See also

Migration (Page 1017)

8.1.5 Migration of data types

Introduction

The following table describes the mapping of data types from WinCC flexible 2008 to the data types in WinCC.

Migration of data types

The internal data types are mapped as follows during migration:

Internal data types WinCC flexible 2008	Internal data types WinCC
Bool	Bool
Char	SByte
Byte	UByte
Int	Short
UInt	UShort

Internal data types WinCC flexible 2008	Internal data types WinCC
Long	Long
ULong	ULong
Float	Float
Double	Double
String	WString
DateTime	DateTime

The data types of S7 300/400 are mapped to internal data types as follows:

S7 300/400 data type	Internal data type WinCC
Bool	Bool
Char	SByte
Byte	UByte
Int	Short
Word	UShort
DInt	Long
DWord	ULong
Real	Float
Double	Double
String	WString
StringChar	WString
Time	Long
Timer	ULong
Date and Time	DateTime
Date	DateTime
Time of Day	DateTime
Counter	UShort

The data types of S7 200 are mapped to internal data types as follows:

S7 200 data type	Internal data type WinCC
Bool	Bool
Char	SByte

S7 200 data type	Internal data type WinCC
Byte	UByte
Int	Short
Word	UShort
DInt	Long
DWord	ULong
Real	Float
Double	Double
StringChar	WString
Timer	ULong

See also

Migration (Page 1017)

8.2 Working with screens

8.2.1 Basics

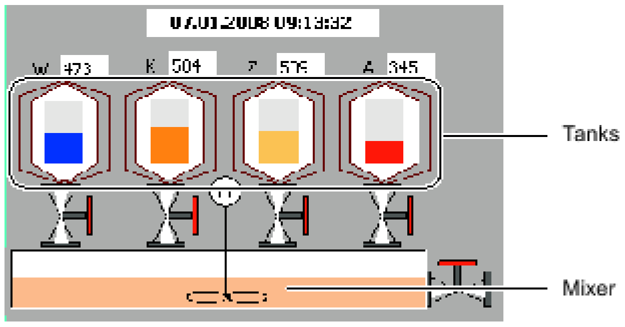
8.2.1.1 Screen basics

Introduction

In WinCC you create screens that an operator can use to control and monitor machines and plants. When you create your screens, the object templates included support you in visualizing processes, creating images of your plant, and defining process values.

Application example

The figure shows a screen that was created in WinCC. With the help of this screen, the operator can operate and monitor the mixing station of a fruit juice manufacturing system. Fruit juice base is supplied from various tanks to a mixing unit. The screen indicates the fill level of the tanks.



Screen design

Insert an object you need to represent a process into your screen. Configure the object to correspond to the requirements of your process.

A screen may consist of static and dynamic elements.

- Static elements such as text or graphic objects do not change their status in runtime. The tank labels (W, K, Z, A) shown in this example of a mixing unit are static elements.
- Dynamic elements change their status based on the process. Visual current process values as follows:
  - From the memory of the PLC
  - From the memory of the HMI device in the form of alphanumeric displays, trends and bars.

  Input fields on the HMI device are also considered dynamic objects. The fill level values of the tanks in our example of a mixing plant are dynamic objects.

Process values and operator inputs are exchanged between the controller and the HMI device via tags.

Screen properties

The screen layout is determined by the features of the HMI device you are configuring. It corresponds with the layout of the user interface of this device. The screen properties such as the screen resolution, fonts and colors are also determined by the characteristics of the selected HMI device. If the set HMI device has function keys, the screen shows these function keys.

A function key is a key on the HMI device. You can assign one or several functions in WinCC. These functions are triggered when the operator presses the relevant key on the HMI device.

A function key can be assigned global or local functions.

- Global function keys always trigger the same action, regardless of the currently displayed screen.
- Function keys with local assignment trigger different actions, based on the currently displayed screen on the operator station. This assignment applies only to the screen in which you have defined the function key.

Opening screens

In order for the operator to be able to call a screen in runtime, you must integrate each configured screen in the operating process. You have various options of configuring these functions:

- You use the "Screen" editor to configure buttons and function keys for opening other screens.

- You use the "Global Screen" editor to configure globally assigned function keys.

See also

Task cards (Page 1028)
Steps (Page 1032)
Basics on working with templates (Page 1036)
Availability of screens for specific HMI devices (Page 1027)
Overview of objects (Page 1042)
Basics on text lists (Page 1081)
Basic principles of graphics lists (Page 1089)
Working with function keys (Page 1106)
Basics on working with layers (Page 1117)
Basics on libraries (Page 1124)
Bar (Page 1136)
Basics for screen navigation (Page 1161)

8.2.1.2 Availability of screens for specific HMI devices

Introduction

The functions of the HMI device determine project visualization in WinCC and the functional scope of the editors.

While creating the project, select the corresponding HMI device for the project. Use the Project window to change the type of HMI device or add additional devices.

The following screen properties are determined by the functions of the selected HMI:

- Layout
- Screen resolution
- Color depth
- Fonts
- Objects available

Device layout

The device layout of a screen forms the image of the HMI device in your configuration. The device layout of the screen shows all the function keys available on the HMI device, for example.

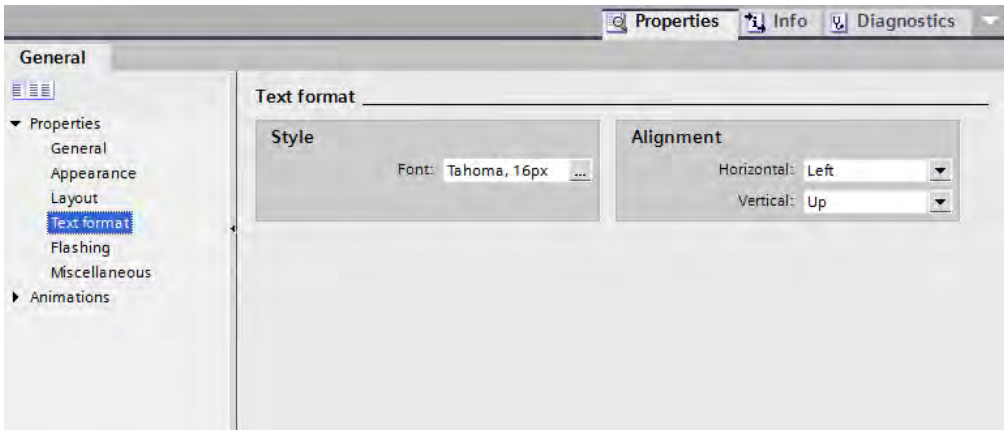
Color depth

You can assign colors to the screen objects. The number of possible colors is determined by the color depth and specific colors supported on the selected HMI device.

Fonts

You can customize the appearance of the texts in all the screen objects that contain static or dynamic text. You could, for example, identify the priority of individual texts within a screen. Select the font, font style and size, and set additional effects such as underscoring, for example.

Which fonts are available depends on the selected HMI device. The selected font determines which font properties are available.



Font: Tahoma, 16px
Horizontal: Left
Vertical: Up

The settings for the text markups such as font style and effects always refer to the entire text of a screen object. That is, you can display the complete title in bold format, but not its individual characters or words, for example.

Objects available

Some of the screen objects can not be configured globally for all HMI devices. These screen objects are not displayed in the toolbox. For a TP 170 touch panel unit you can not configure any buttons, for example.

See also

Screen basics (Page 1025)

8.2.1.3 Elements and basic settings

8.2.1.3 Task cards

Introduction

The following task cards are available in the "Screens" editor:

- Tools: Display and operating objects
- Animations: Templates for dynamic configuration
- Layout: Aid for customizing the display
- Libraries: Administration of the project library and of the global libraries

Note
Basic Panels

The "Animations" task card is not available for Basic Panels.

Tools

The "Tools" task card contains objects in different panes:

- Basic objects
- Elements
- Controls
- User controls (optional)
- Graphics

Objects are inserted from the panes into your screens by dragging-and-dropping them. The objects available for selection are determined by the features of the HMI device you are configuring. The following icons are used to change the display mode:

Icon	Meaning
☰	Displays the objects as a list.
▦	Displays the objects as a graphic.

Animations

The "Animations" task card contains the possible dynamizations of a screen object in the panes:

- Movements: Diagonal, direct, horizontal, vertical
- Display: Appearance, visibility
- Miscellaneous: Operability

Use drag-and-drop to add the animation to a screen object from the "Movements", "Display" and "Miscellaneous" panes.

Layout

The "Layout" task card contains the following panes for displaying objects and elements:

- Zoom: For selecting the detailed view
- Layers: Manages the objects of the screen. They are displayed in a tree view and contain information about visibility and the active layer.
- Grid: You specify whether the objects are to be aligned to a grid and set the grid size for a grid.
- Objects out of range: Objects that lie outside the visible area are displayed with name, position and type.

Libraries

The "Libraries" task card show the following libraries in separate panes:

- Project library: The project library is stored together with the project.
- Global library: The global library is stored in a separate file in the specified path on your configuration PC.

See also

Screen basics (Page 1025)
Move view (Page 1030)
Zooming the view (Page 1031)

8.2.1.3 Move view

Introduction

You have the following options to display only a section of the entire screen in the work area:

- With the icon of the "Screens" editor.
- With the miniature view of the entire screen in the "Zoom" palette of the "Layout" task card.

Requirement

- A screen is open.
- The view shows only a screen section.

Procedure

Proceed as follows to move a view:

1. Click the icon at the bottom right corner of the work area and press the left mouse button.

   A miniature view of the full screen is shown. An orange frame shows the currently selected area.
2. Hold down the mouse button and drag the frame to the desired area.

Note

The screen is scrolled when you drag a screen object from the visible to a currently hidden section.

See also

Task cards (Page 1028)

8.2.1.3 Zooming the view

Introduction

To view a small screen section in closer detail, use the zoom tool to magnify the screen in the working area. The maximum zoom amounts to 800%.

The following functions are available:

- Free zooming with the help of a selection frame.
- Enter the zooming factor.
- Use the icons

  and

  icons from the "Zoom" object group of the "Layout" task card to zoom in gradually.

Requirement

The screen is opened.

Procedure

Proceed as follows to zoom a view:

1. Click the

   toolbar button.
2. Use the mouse to draw a selection frame in the screen.

After you have released the mouse button, the section enclosed by the selection frame is zoomed to fit the complete work area.

In the "Zoom"

100%

toolbar, you may alternatively directly enter a zoom ratio in [%] units.

This toolbar also contains the icons

and

. These icons are used to zoom the view in or out step-by-step.

You can alternatively change the view of the screen by using the "Layout" task card.

Result

The selected screen section is magnified.

See also

Task cards (Page 1028)

8.2.1.4 Working with screens

8.2.1.4 Steps

Steps

To create screens, you need to take the following initial steps:

- Plan the structure of the process visualization: Number of screens and their hierarchic structure.

  Example: Subprocesses are visualized in separate screens, and merged in a master screen.
- Define your screen navigation control strategies.
- Adapt the templates.

  The templates that are stored in WinCC for the selected HMI device apply to all your project screens. You perform centralized configuration in the template objects and assign the function keys globally for the HMI devices with function keys. For some HMI devices, you can also store objects that are integrated into every screen in the permanent window. You can create, and administer multiple templates of your own for each HMI device.
- Create the screens. Use the following options of efficient screen creation:
  - Creating a screen structure in the "Screen navigation" editor
  - Working with libraries
  - Working with layers

Note
Basic Panels

The "Screen Navigation" editor is not available for Basic Panels.

See also

Screen basics (Page 1025)
Creating a new screen (Page 1033)
Managing Screens (Page 1034)
Defining the start screen of the project (Page 1035)

8.2.1.4 Creating a new screen

Introduction

You can set up a screen in two different ways:

- Without template

  All the changes apply only for the current screen.
- On the basis of a template

  In the template you carry out all changes centrally for all screens that use this template. With HMI devices featuring function keys, you centrally assign the function keys in a template to all screens that use the given template. The function keys you assign globally in the "Global Screen" editor apply to all screens of an HMI device.

The possibilities of using template and global elements simultaneously are described in the chapter "Basics on working with templates."

Requirement

- The project has been created.
- The Inspector window is open.

Procedure

Proceed as follows to create a screen:

1. Double-click "Add Screen" in the project tree.

   The screen is generated in the project and appears in your view. The screen properties are shown in the Inspector window.
2. Enter a meaningful name for the screen.
3. Configure the screen properties in the Inspector window:
   - Specify whether and on which template the screen is based.
   - Set the "Background Color" and the "Screen Number."
   - Specify a documenting text under "Infotext."
   - Specify the layers to be displayed under "Layers" in the engineering system.
   - Select dynamic screen update under "Animations."
   - Select "Events" to define which functions you want to execute in Runtime when you call and exit the screen or at other events.

Note
HMI device dependency

Not all the HMI devices support the "Visibility" animation for screens.

Result

You created the screen in your project. You can now add objects and control elements from the Toolbox window.

See also

Steps (Page 1032)

8.2.1.4 Managing Screens

Introduction

You can move screens within a project to other groups, or copy, rename, and delete them.

Moving screens in a group

WinCC allows you to create several screens and sort your screens into them.

Proceed as follows to move a screen into a group:

1. Select the "Screens" folder in the project tree.
2. Select the "Add group" command from the shortcut menu.

   A folder called "Group_x" is inserted.
3. Select the screen in the project tree.
4. Drag-and-drop the screen to the required group.

   The screen is moved into this group.

Copy screen

In WinCC you can cut a screen and paste it into the same or a different group.

Proceed as follows to copy a screen:

1. Select the screen in the project tree.
2. Select the "Copy" command in the shortcut menu to copy the screen to the clipboard.
3. In the project tree, select the screen insert position.
4. Select "Paste" from the shortcut menu to insert the screen.

   A copy of the screen is inserted. A consecutive number is appended to the name of the original in the copy.

Alternatively, press <Ctrl> while you drag the screen to the required position.

Note

If you copy a screen with interconnected template for several devices and projects, the template will also be copied. Any existing matching template is not used. This holds particularly true when you copy the screens with drag-and-drop.

Rename screen

Proceed as follows to rename a screen:

1. Select the screen in the project tree.
2. Select "Rename" from the shortcut menu.
3. Type in a new name.

   Do not use the special characters ?, ", /, \, *, <, >
4. Press <Enter>.

As an option, use the <F2> function key to rename the screen.

Delete screen

Proceed as follows to delete a screen:

1. Select the screen in the project tree.
2. Select "Delete" from the shortcut menu.

   The screen and all its objects are deleted from the current project.

See also

Steps (Page 1032)

8.2.1.4 Defining the start screen of the project

Introduction

The start screen is the initial screen opened at the start of project in Runtime. You can define a different start screen for each one of the HMI devices. Beginning at this start screen, the operator calls the other screens.

Requirement

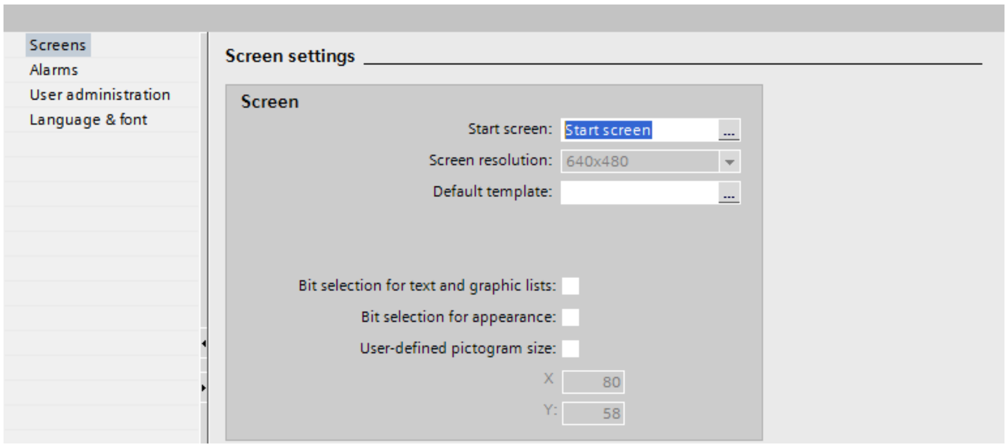
The project contains the screen you want to use as the start screen.

Defining the start screen in the "Runtime settings" editor

Proceed as follows:

1. Double-click "Runtime settings" in the project tree.

   You have opened the "Runtime settings" editor.
2. Double-click "Screens".



Screen settings

Screen

Start screen: Start screen

Screen resolution: 640x480

Default template:

Bit selection for text and graphic lists:

Bit selection for appearance:

User-defined pictogram size:

X: 80

Y: 58

3. Select the desired screen under "Start screen."

Result

The start screen opens on the HMI at the start of Runtime.

See also

Steps (Page 1032)

8.2.1.5 Working with Templates

8.2.1.5 Basics on working with templates

Templates and global screen

Every HMI device has a template in the project that takes the properties of the device into consideration. It is used when you add a screen. In the template you configure objects that are displayed in all the screens that are based on this template.

Note the following rules:

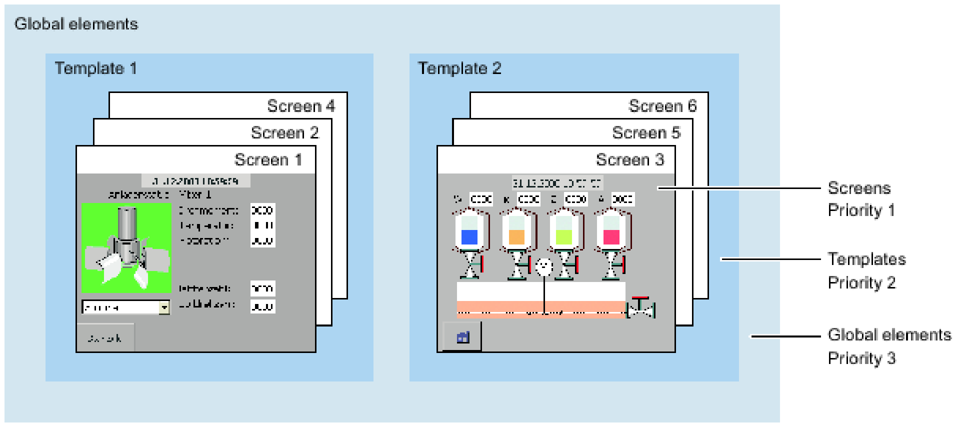
- A screen can only be based on one template.
- You can create several templates for one device.

You specify global elements for all the screens of an HMI device, regardless of the template used. The "Alarm window" and "Alarm indicator" objects that are available as global objects are configured within the "Global screen" editor.

The following rules apply:

- Configurations in the screen have priority 1 and overlap the configurations of the template.
- Configurations in the template have priority 2 and overlap the configurations of the screen.
- Configurations of objects in the global screen have priority 2.

The following figure shows the prioritizations of the configurations:



Objects for a template

You specify the following functions and objects within the template that are to apply for all the screens on the basis of this template:

- Operator controls: You can insert the same operator controls that you also use for a screen into a template.
- Assignment of function keys: You assign the function keys locally in the template for HMI devices with function keys. This assignment overwrites a possible global assignment.
- Permanent window: Some devices, such as the MP 370, support a permanent window for all the screens in the upper section of the screen. In contrast to the template, the permanent window occupies an area of the screen for itself alone.

Application examples

- You want to assign the ActivateScreen" function to a function key in the template. The operator uses this key to switch to another screen in runtime. This configuration applies to all screens that are based on this template.
- A graphic with your company logo can be added to the template. The logo appears on all screens that are based on this template.

Note

If an object from the template has the same position as an object in the screen, the template object is covered.

Permanent window

Note

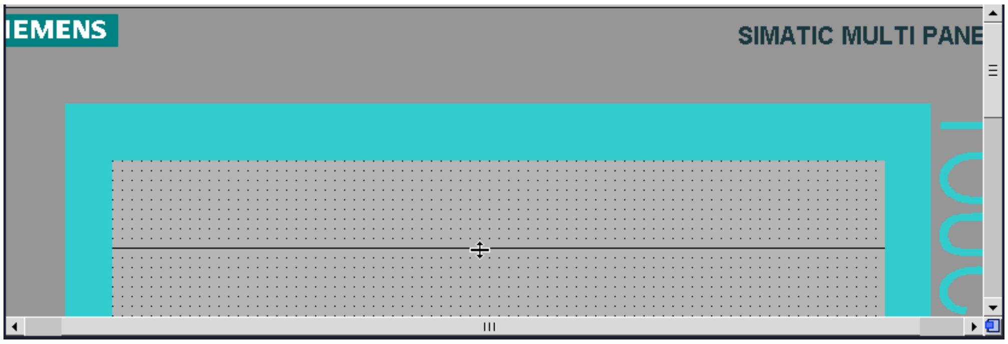
Availability for specific devices

The permanent window is not available for Basic Panels.

Proceed as follows to configure a permanent window:

1. Open a screen or a template for an HMI device with a permanent window.
2. Use the mouse (cursor shape:

) to drag the top edge of the editable screen area down.

   The permanent window area above this boundary is now shared by all the screens of this HMI device. All configured screen objects are moved downwards, by a factor determined by the height of the permanent window.
3. Configure the elements in the permanent window to suit your requirements.
4. The content of the permanent window appears on every screen, and in the template.

The default height of the permanent window is "0". The maximum height is the maximum height of the screen minus 10.

Show template in screen

When you edit a screen, you use an existing template and display it in the screen.

Proceed as follows to display a template in the screen:

1. Activate the "Show templates in screens" option in the "Options > Settings> Visualization" menu.

Note

You create the "Alarm window" and "Alarm indicator" objects using the "Global screen" editor.

See also

Customizing template (Page 1039)
Creating a new template (Page 1039)
Managing templates (Page 1040)
Global screen (Page 1041)
Screen basics (Page 1025)

8.2.1.5 Customizing template

Introduction

Every screen that is based on this template will contain the function keys and objects that you configured in the template. Changes to an object or of a soft key assignment in the template are applied to all object instances in the screens which are based on this template.

You configure local function keys in the templates. You create global function keys using the "Global Screen" editor. Local function keys overwrite global function keys.

Note
HMI device dependency

Function keys are not available on all HMI devices.

Requirement

The project has been created.

Procedure

Proceed as follows to create a template:

1. In the Project window, double-click on the template you want to change under "Screen Management > Templates."

   The template opens in your working area.
2. In this template, customize the function keys and objects to be shared by the screens which are based on this template.

Result

All of the screens which are based on this template share the objects configured in this template. The same applies to the soft key assignments you have set in the template. Change the special key assignments for each individual screen.

See also

Basics on working with templates (Page 1036)

8.2.1.5 Creating a new template

Introduction

A screen is always based on only one template. You can also create multiple templates for one HMI device. A template is not based on another template. The name of a new template is assigned automatically.

In a template, you can centrally modify objects and function keys. Changes in the template take immediate effect in all the screens based on the template.

Note
HMI device dependency

Function keys are not available on all HMI devices.

Requirement

- The project has been created.
- The Inspector window is open.

Procedure

Proceed as follows to create a template:

1. Select "Screen management > Templates" in the project tree and then double-click "Add template".

   The template is created in the project, and appears in your view. The properties of the template are displayed in the Inspector window.
2. Configure the template in the Inspector window:
   - Specify the template name under "General."
   - Add the objects of the template
   - Specify the layers in the engineering system that are displayed under "Layers."
3. Configure the function keys.

Result

The template is created in your project. You can now add objects and control elements from the toolbox and assign function keys.

See also

Basics on working with templates (Page 1036)

8.2.1.5 Managing templates

Introduction

You can move, copy, rename, and delete templates within a project in the Project window.

Moving a template into a group

Use WinCC to create several groups and sort your templates in them.

Proceed as follows to move a template into a group:

1. Select the "Screen management" folder in the project tree.
2. Select the "Add group" command from the shortcut menu.

   A folder called "Group_x" is inserted.
3. Select the template in the project navigation.
4. Drag-and-drop the template to the required group.

   The template is moved to this group.

Copying templates

You use Copy and Paste to copy a template in WinCC.

Proceed as follows to copy a template:

1. Select the template in the project navigation and select "Copy" from the shortcut menu.
2. Select the position in the project navigation where you want to paste the template.
3. Select "Paste" from the shortcut menu to insert the template.

   A unique name is assigned automatically to the copy.

Alternatively, you can hold down the <Ctrl> key, and drag the template into position.

Deleting a template

Proceed as follows to delete a template:

1. In the project navigation, select the template to be deleted.
2. Select "Delete" from the shortcut menu.

   The template, and all its objects are deleted from the current project.

Assigning a template to a screen

Proceed as follows to assign a template to a screen:

1. In the project navigation, select the screen to which you want to assign the template.
2. Select "General" in the Inspector window.
3. Select the desired template under "Template."

   The selected template and all the objects contained in it are assigned to the screen.

See also

Basics on working with templates (Page 1036)

8.2.1.5 Global screen

Introduction

A global screen is used to assign the following objects or functions to all the screens of an HMI device:

- Functions: Assignment of function keys for devices with function keys
- Indicator and control objects for alarms: Alarm windows, alarm indicators

The objects and function keys used in the global screen are configured in the respective Inspector window of the "Global screen" editor.

Function keys

The function keys for HMI devices are assigned globally within the "Global Screen" editor. This global assignment applies to all the screens of an HMI device unless there is another assignment in the template used or in the screen itself. Note the following rules:

- Local assignments in the screen overwrite the local assignments in the template and the global assignment within the "Global Screen" editor.
- Local assignments in the template overwrite the global assignment within the "Global Screen" editor.

Indicator and control objects for alarms

You can only insert alarm windows and alarm indicators into a screen as global elements.

Note

If you have configured a permanent window in the screen or the template, do not position the alarm window and alarm indicator in the area of the permanent window. Otherwise, the alarm window and the alarm indicator will not be displayed in Runtime. The permanent window is not visible in the "Global screen" editor.

See also

Basics on working with templates (Page 1036)

8.2.2 Working with objects

8.2.2.1 Overview of objects

Introduction

Objects are graphics elements which you use to design the screens of your project.

The "Tools" task card contains all objects that can be used for the HMI device. Display the Task Card with menu command "View" by activating the "Task Card" option.

The toolbox contains various palettes, depending on the currently active editor. If the "Screens" editor is open, the toolbox contains the following palettes:

- "Basic objects"

Basic objects include graphic objects such as "Line" or "Circle," and standard control elements, such as "Text field" or "Graphic display."

- "Elements"

  Elements include standard control elements, such as "IO field" or "Button."
- "Controls"

  The controls provide advanced functions. They also represent process operations dynamically, for example Trend view and Recipe view.
- "Graphics"

  Graphics are broken down into subjects in the form of a directory tree structure. The various folders contain the following graphic illustrations:

  – Machine and plant areas
  – Measuring equipment
  – Control elements
  – Flags
  – Buildings

  You can create links to your own graphic folders. The external graphics are located in these folders and subfolders. They are displayed in the toolbox and incorporated into the project using links.
- "Libraries" task card

  In addition to the display and operator controls, the library objects are available. They are located within the palettes of the "Libraries" task card. A library contains preconfigured objects such as graphics of pipes, pumps, or preconfigured buttons. You can also integrate multiple instances of library objects into your project without having to reconfigure them.

  The WinCC software package includes libraries.

Note
Availability for specific HMI devices

Some of the toolbox objects are either available with restricted functionality, or not at all. This depends on the HMI device you are configuring. Unavailable properties of an object are displayed as deactivated, and cannot be selected.

Basic objects

Icon	Object	Instructions
⁄	"Line"	-
⊿	"Polyline"	The polyline is an open object. Even if the start and end points have the same coordinates, the area they enclose cannot be filled in. If you want to fill a polygon, select the "Polygon" object.

Icon	Object	Instructions
◺	"Polygon"	-
⬭	"Ellipsis"	-
●	"Circle"	-
▬	"Rectangle"	-
A	"Text box"	One or more lines of text. The font and layout are adjustable.
	"Graphic view"	Displays graphics from external graphic programs, and inserts OLE objects. The following graphic formats can be used: "*.emf", "*.wmf", "*.dib", "*.bmp", "*.jpg", "*.jpeg", "*.gif" and "*.tif".

Elements

Icon	Object	Instructions
	"I/O field"	Outputs the values of a tag, and/or writes values to a tag. You can define limits for the tag values shown in the I/O field. To hide the operator input in Runtime, activate "Hidden input."
	"Button"	Executes a list of functions, or a script as configured.
	"Symbolic I/O field"	Outputs the values of a tag, and/or writes values to a tag. A text from a text list is displayed in relation to the tag value.
	"Graphic I/O field"	Outputs the values of a tag, and/or writes values to a tag. A graphic from a graphics list is displayed in relation to the tag value.
	"Date/time field"	Outputs the system date and time, or the time and date from a tag. This allows the operator to enter new values. The display format is adjustable.
	"Bar"	The bar represents a value from the PLC in the form of a scaled bar graph.
	"Switch"	Toggles between two defined states. You can label a switch with text, or a graphic.
	"Symbol library"	Used to add screen objects based on controls of the same name.
	"Slider"	Displays a current value from the PLC, or sends a numeric value to the PLC.
	"Gauge"	Displays numeric values. The appearance of the gauge is adjustable.
	"Clock"	Displays the system time in analog or digital format.

Controls

Icon	Object	Description
	"Alarm view"	Shows selected alarms or alarm events from the alarm buffer or alarm log.
	"Trend view"	Represents multiple curves with values from the PLC, or from a log.
	"User view"	Allows an administrator to administer users on the HMI device. It also allows an operator without administrator rights to change his password.
	"Status force"	This function gives the operator direct read / write access to individual address areas in the connected SIMATIC S7.
	"Recipe view"	Displays data records, and allows them to be edited.
	"Navigation button"	Changes to the root screen of the current screen hierarchy. Changes to the next screen that is positioned in the screen hierarchy on the same level to the left of the current screen. Changes to the parent screen. Changes to the screen that is positioned leftmost in the lower hierarchy level. Changes to the next screen that is positioned in the screen hierarchy on the same level to the right of the current screen.
	"Dynamic navigation button"	Reserves a button position for a dynamic navigation button. If a screen has child screens in the screen hierarchy, the dynamic navigation buttons are generated automatically at this position.

See also

Screen basics (Page 1025)
Options for Editing Objects (Page 1046)
Inserting an object (Page 1047)
Deleting an Object (Page 1049)
Positioning an object (Page 1050)
Resizing an object (Page 1051)
Selecting multiple objects (Page 1053)
Aligning objects (Page 1054)
Moving an object forward or backward (Page 1057)
Show objects outside the screen area (Page 1058)

Rotating objects (Page 1059)
Flipping objects (Page 1060)
Inserting multiple objects of the same type (stamping tool) (Page 1061)
Repositioning and resizing multiple objects (Page 1062)
External graphics (Page 1063)
Managing external graphics (Page 1064)
Storing an external image in the graphics library. (Page 1066)
Basics on groups (Page 1068)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.2 Options for Editing Objects

Introduction

Objects are graphics elements which you use to design the screens of your project.

You have the following options for editing objects:

- Copying, pasting or deleting objects using the shortcut menu If you copy an object in a screen and the screen already includes an object of the same name, the name of the object is changed.
- Maintaining the standard size of the objects you are inserting or customizing their size on insertion.
- Changing the properties of an object, e.g. the size
- Positioning an object
- Moving an object in front of or behind other objects
- Rotating objects
- Mirroring objects
- Changing default properties of the objects
- Defining the tab order for objects
- Stamping: Inserting several objects of the same type
- Selecting several objects simultaneously
- Repositioning and resizing multiple objects
- You can assign external graphics to objects, e.g. in the Graphic View.

  You can view only the images you have previously stored in the graphic browser of your WinCC project.

  You can save graphics in the graphic browser as follows:

  – Via drag & drop from the "Graphics" object group to the working area
  – As graphic files in the following formats: *.bmp, *.dib, *.ico, *.emf, *.wmf, *.gif, *.tif, *.jpeg or *.jpg
  – As an OLE object

    You either create a new OLE object or save an existing graphic file as an OLE object. To save an OLE object, an OLE-compatible graphics program must be installed on the configuration computer.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.3 Inserting an object

Introduction

You can add objects from the toolbox, or from the WinCC graphics folder to screens or reports in the "Screens" or "Reports" editor. Use the mouse to drag the objects into the work area. You either keep the objects in their original size, or scale them up or down when you paste them.

Every user can define his own standard sizes for the objects.

For lines and objects consisting of lines to be defined, define the size when you insert them into the work area.

Note
Basic Panels

The "Reports" editor is not available for Basic Panels.

Requirement

The "Tools" task card is open.

Inserting objects in their standard size

Proceed as follows to insert an object in its standard size:

1. In the "Toolbox" task card, select the desired graphic object or the desired graphic in the WinCC graphics folder.

   When you move the cursor across the work area, it turns into a crosshair with an appended object icon.
2. Click the location in the work area where you want to insert the object or graphic.

   The object is inserted with its standard size at the desired position in the work area.
3. You can always resize an object by dragging the resizing handle of its selection rectangle.

   You can also enter the required size in pixels in "Layout" in the "Position & Size" area in the Inspector window.
4. You can specify additional object properties in the Inspector window.

   To add further image objects, repeat steps 1 and 2.

Inserting objects and at the same time selecting their size

Proceed as follows to insert an object and select its size at the same time:

1. In the "Toolbox" task card, select the desired graphic object or the desired graphic in the WinCC graphics folder.
2. Move the cursor to the location in the work area where you want to insert the object.

   The mouse pointer is transformed into a crosshair with an appended object icon.
3. Press the left mouse button and drag the object to the required size.

   Release the mouse button to paste the object with the required size at the desired position in the work area.

   To add further image objects, repeat steps 1 and 2.

Inserting lines

Proceed as follows to insert lines:

1. Select the desired graphic object in the "Tools" task card.
2. Click on the location in the work area where you want the line to start.

   This fixes the starting point of the line.
3. Move the mouse pointer in the work area.

   This draws a line between the starting point and the position of the cursor.
4. Click on the location in the work area where you want the line to end.

   This fixes the end point of the line.

Inserting a polygon or polyline

Proceed as follows to insert line objects:

1. Select the desired object "Polyline" or "Polygon" in the "Tools" task card.
2. Click on the location in the work area where you want the object to start.

   This fixes the starting point of the object.
3. Click on location in the work area where you want a corner of the object.
4. Repeat step 3 for every other corner of the object.
5. Double-click on location in the work area where you want to define the last corner of the object.

   This fixes all the points of the polygon or polyline.

Note
Basic Panels

The "Polyline" and "Polygon" objects are not available for Basic Panels.

Note

If you want to insert several objects of the same type, use the "Stamp" function. This avoids having to reselect the object in the "Tools" task card every time before inserting it. To do so, select the

icon in the toolbar of the "Tools" task card.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.4 Deleting an Object

Introduction

You can delete objects individually or with a multiple selection.

Requirement

You have opened the work area containing at least one object.

Procedure

Proceed as follows to delete an object:

1. Select the object that you want to delete.

   To delete multiple objects, keep the <Shift> key pressed and select the objects to be deleted one after the other.
2. Select "Delete" from the shortcut menu.

Result

The selected objects are deleted.

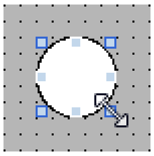
See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.5 Positioning an object

Introduction

When you select an object, it is enclosed by a rectangle with resizing handles. This rectangle is the selection rectangle. The position of the object is defined by the coordinates of the upper left corner of the selection rectangle.



Note

If the position is outside the work area, which means one of the coordinates assumes a negative value, the object cannot be visualized in runtime.

You have the following options of repositioning an object:

- Dragging the object into a new position
- Moving an object with the arrow keys
- Changing the "Position" property in the Inspector window

Grid

A grid is shown in the work area. If you want to position an object, or change its size using the mouse, the object is automatically snapped to the grid. If you hold down the <Alt> key, the object is no longer snapped to the grid.

Note

The grid and the "Snap to grid" function are always active for reports.

For screens you activate and deactivate the grid and the "Snap to grid" function as follows:

- In the "Options > Settings > Visualization" menu
- In the "Screens" editor: Open the "Layout" task card and activate the required functions in the "Grid" palette.

Requirement

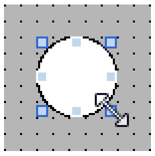
You have opened the work area containing at least one object.

Procedure

Proceed as follows to change the position of an object:

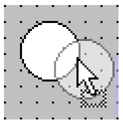
1. Select the object you want to move.

   The selected object is framed by a rectangle with resizing handles.

2. Left-click the object and keep the mouse button pressed.
3. Move the mouse pointer onto the new position.

   The contour of the object moves with the mouse and displays the new position for the object.

   The object initially remains at its original position.

4. Now release the mouse button.

   The object is moved into the position indicated by the contour of the selection rectangle.

   – When the "Snap to grid" function is activated, the object is snapped to the grid.

   – If you keep the <Alt> key pressed down whilst dragging the object, this function is deactivated.

Or:

1. In the Inspector window select "Properties > Layout."
2. Enter the X and Y values for the position under "Position & Size".

Result

The object appears at its new position.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.6 Resizing an object

Introduction

When you select an object, it is enclosed by a rectangle with resizing contacts. You have the following options of resizing an object:

- Drag the resizing contacts using the mouse.
- Modify the "Size" property in the Inspector window.

Grid

A grid is shown in the work area. If you want to position an object, or change its size using the mouse, the object is automatically snapped to the grid. If you hold down the <Alt> key, the object is no longer snapped to the grid.

Note

The grid and the "Snap to grid" function are always active for reports.

For screens you enable and disable the grid and the "Snap to grid" function as follows:

- In the "Options > Settings > Visualization" menu
- In the "Screens" editor: Open the "Layout" task card and activate the required functions in the "Grid" palette.

Requirement

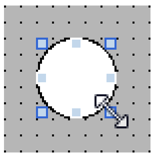
You have opened the work area containing at least one object.

Procedure

Proceed as follows to resize an object:

1. Select the object you want to resize.

   The selection rectangle appears. The following picture shows a selected object:

2. Drag a resizing contact of the rectangle to a new position.

   The size of the object changes.

   – The size of the object is aligned to the grid pattern, provided the "Snap to grid" function is set.

   – Press <ALT> to disable this function while you drag the object.

   Note

   In order to scale the object proportionally, keep the <Shift> key pressed while changing the size with the mouse.

Or:

1. Select "Layout" in the Inspector window.
2. Enter the size of the object under "Position & Size".

Result

The object now appears with its new size.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.7 Selecting multiple objects

Introduction

Select all objects you want to align with each other or to change global properties. This procedure is called "multiple selection."

The Inspector window shows all the properties of the selected objects.

You now have several options of selecting multiple objects:

- Draw a selection frame around the objects.
- Hold down the <Shift> key, and click the required objects.

Selection frame of a multiple selection

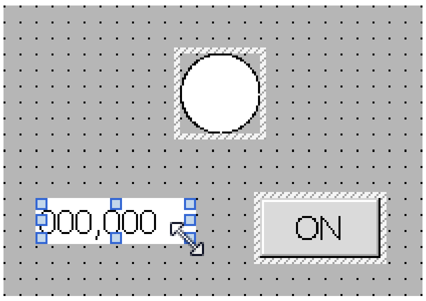
The selection frame surrounds all objects of a multiple selection. The selection frame is comparable with the rectangle that surrounds an individual object.

The selection frame is not visible. When you have made your multiple selection, the following frame is displayed:

- The reference object is indicated by the rectangle around it.
- The other selected objects are indicated by a dashed-line frame.

Specifying a reference object

The reference object is the object upon which the other objects are oriented. The reference object is framed by a rectangle with handles. The following picture shows a reference object with two other selected objects:



You have the following options to specify the reference object:

- Select the objects via multiple selection. The object selected first is then the reference object.

- Draw a selection frame around the objects. The reference object compiled automatically. If you wish to specify a different object within the selection as the reference object, click on the desired object. This action does not cancel your multiple selection.

Requirement

You have opened the work area containing at least two objects.

Selecting multiple objects with a selection frame

Proceed as follows to select several objects using a selection frame:

1. Position the mouse pointer in the work area close to one of the objects to be selected.
2. Hold down the mouse button, and draw a selection frame around the objects to be selected.

Or:

1. Hold down the <Shift> key.
2. Click the relevant objects, working in succession.

   All the selected objects are identified by frames.

   The object selected first is identified as reference object.

Note

To remove an object from the multiple selection, press <SHIFT>, hold it down and then click the relevant object once again.

Result

Multiple objects are selected. One of those is identified as the reference object. You can now perform the following steps:

- Changing the object properties of all the objects
- Resizing all the objects by the same ratio, by dragging the selection frame to increase or reduce the size
- Moving all the objects in one group
- Aligning the objects to the reference object

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.8 Aligning objects

Procedure

Proceed as follows to align objects:

1. Select the objects via multiple selection.
2. Specify an object as the reference object.
3. Select the command from the toolbar, or the shortcut menu (see table below.)

   The selected objects will be aligned.

Aligning objects flush

The selected objects will be aligned flush to the reference object.

Icon	Description
	Aligns the selected objects to the left edge of the reference object.
	Aligns the selected objects to the vertical center axis of the reference object.
	Aligns the selected objects to the right edge of the reference object.
	Aligns the selected objects to the upper edge of the reference object.
	Aligns the selected objects to the horizontal center axis of the reference object.
	Aligns the selected objects to the lower edge of the reference object.
	Centers the selected objects to the center points of the reference object.

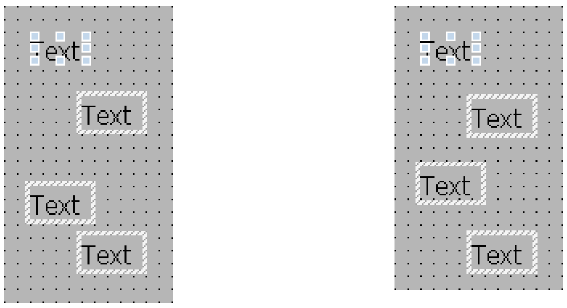
Distributing objects evenly

You need at least three selected objects. A reference object is not required.

1. Select the objects.
2. Click one of the buttons "Distribute horizontally equal" or "Distribute vertically equal."

   The selected objects are distributed at equal distances.

The following screen shows how you align the vertical spacing of the selected objects:



Icon	Description
	Aligns the horizontal distance between the objects. The position of the objects on the extreme left and right side remains unchanged. All other objects are distributed evenly between them.
	Aligns the vertical distance between the objects. The position of the objects at the extreme top and bottom (right and left) remains unchanged. All other objects are distributed evenly between them.

Harmonizing the object size

The selected objects are adapted in height or width to the height or width of the reference object.

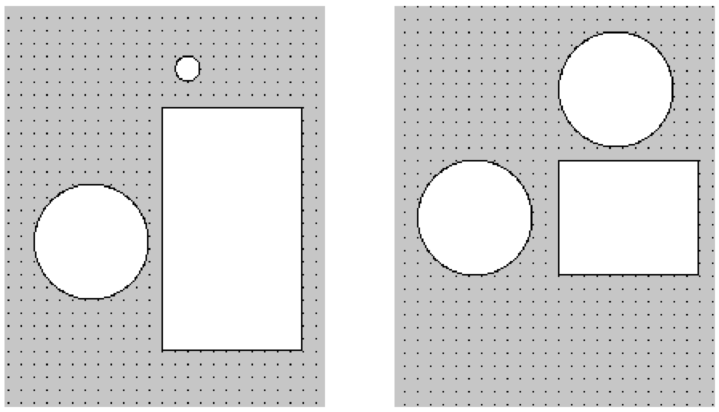
1. Select the objects.
2. Click one of the buttons,

   or

   .

   The size of the selected objects is matched to each other.

The following screen shows how the selected objects are adapted to the height of the reference object:



Icon	Description
	Aligns the selected objects to the width of the reference object.
	Aligns the selected objects to the height of the reference object.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.9 Moving an object forward or backward

Introduction

You can use the "Order" functions in the shortcut menu of a selected object or in the toolbar to move a selected object in front of or behind other objects within an object layer.

Note

ActiveX controls are always positioned in front of an object layer (.NET property).

Requirement

You have opened a screen which contains a layer with multiple objects.

Procedure

Proceed as follows to change the order of the objects within a layer:

1. Select the object you want to move forward or backward.
2. Select the "Sort" command and one of the following commands from the shortcut menu:

Icon	Description
🟩	Moves the selected object before all the other objects of the same layer
🟩	Moves the selected object to the lowest position in the same layer
🟩	Moves the selected object up by one position
🟩	Moves the selected object down by one position

Alternative procedure

Proceed as follows:

1. Open the "Layers" palette of the "Layout" task card.
2. Navigate to the required object.
3. Hold down the mouse button, and drag the object in the tree topology to the required position in the layer.
4. Now release the mouse button.

Result

The object is moved up or down.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.10 Show objects outside the screen area

Introduction

If you assign objects to positions that are outside the configurable area, these objects will be hidden. The functions of the "Objects outside the visible area" palette in the "Layout" task card are used to move these objects back into the screen.

Requirement

- You have opened a screen which contains objects that are outside the configurable area.
- The "Layout" task card is open.

Procedure

Proceed as follows:

1. Open the "Objects outside the area" palette of the "Layout" task card.

   This displays a list of objects that are outside the configurable area.
2. Select the objects that you want to move back into the screen.
3. Click "Move to screen" in the "Objects outside range" palette.

Alternatively open the "Layer" palette of the "Layout" task card. Objects outside the area are indicated by the

icon. If you click this icon, the object is moved back into the screen.

Result

The objects are displayed on the right-hand margin of the configurable area.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.11 Rotating objects

Introduction

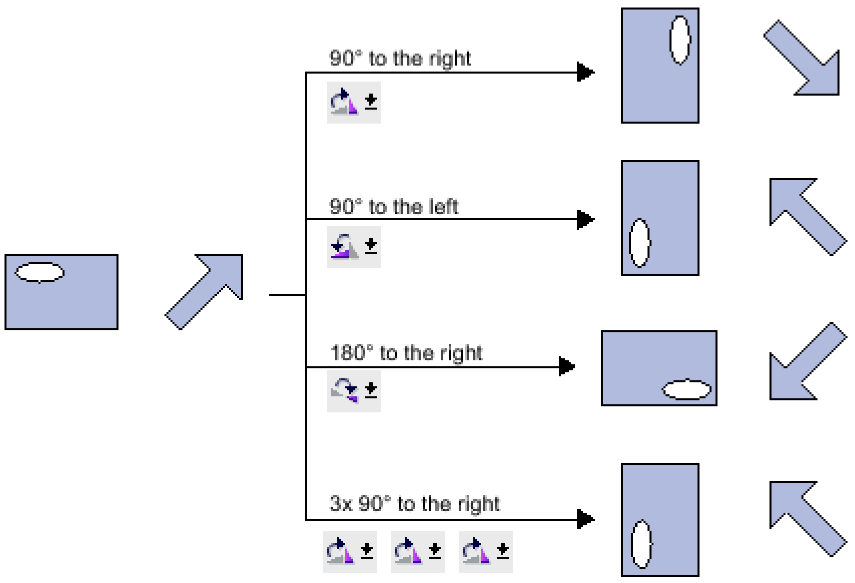
You can rotate a suitable object clockwise or counterclockwise around its center axis in steps of 90°.

Note

Not all the objects can be rotated. Some objects that can be rotated in screens cannot be rotated in reports.

You can also rotate multiple objects using the multiple selection function. Certain WinCC objects such as buttons cannot be rotated.

The alignment of elements in an object will change in a rotated object. The following figure shows how a rectangle and an ellipse behave under the different commands for rotating an object:



Requirement

You have opened the work area containing at least one object.

Procedure

Proceed as follows to rotate an object:

1. Select the object that you want to rotate.
2. Click one of the following toolbar icons:

, to rotate the object clockwise around its center point. The angle of rotation is 90°.

, to rotate the object counterclockwise around its center point. The angle of rotation is 90°.

, to rotate the object clockwise by 180°.

Result

The object is shown at its new angle.

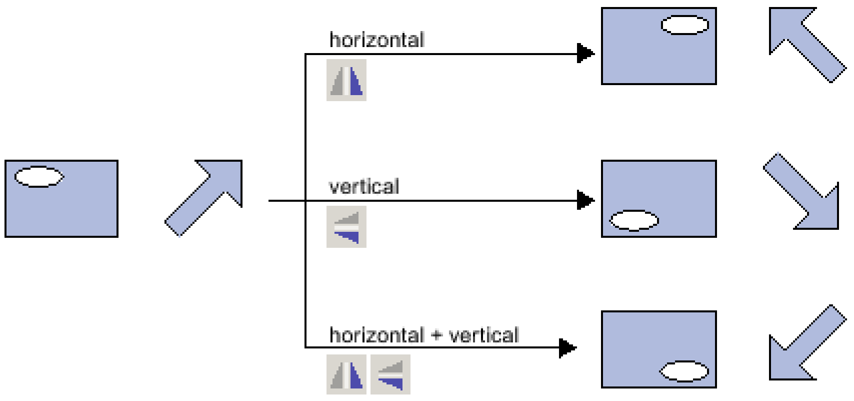
See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.12 Flipping objects

Introduction

You can flip an object along its vertical or horizontal center axis. The alignment of elements in an object will change when you flip an object. The following figure shows how a rectangle and an ellipse behave under the different commands for flipping an object.



Requirement

You have opened a screen which contains at least one object.

Procedure

Proceed as follows to flip an object:

1. Select the object that you want to flip.
2. Click the "Flip" command in the shortcut menu and select one of the options displayed:
   –

, to flip the selected object along its vertical center axis.

–

, to flip the selected object along its horizontal center axis.

Result

The object is shown at its flipped position.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.13 Inserting multiple objects of the same type

Introduction

WinCC offers the possibility of "stamping" or inserting several objects of the same type directly and consecutively. You then do not have to select the object each time again. In addition you have the possibility of multiplying an object that has already been inserted.

Requirement

The "Tools" task card is open.

Inserting several objects of one type

Proceed as follows to insert several objects of one type:

1. Select the object that you want to insert in the "Tools" task card.
2. Click the

   icon in the toolbar of the "Tools" task card.

   The "Stamp" function is activated.
3. To insert the object with its standard size, click the relevant insertion position in the work area.

   To insert the object with another size, position the mouse pointer at the desired location in the work area. Press the left mouse button and drag the object to the required size.

   The object is inserted in the work area as soon as you release the mouse button.
4. Repeat step 3 to insert further objects of the same type.
5. Click the

   icon again.

   The "Stamp" function is deactivated.

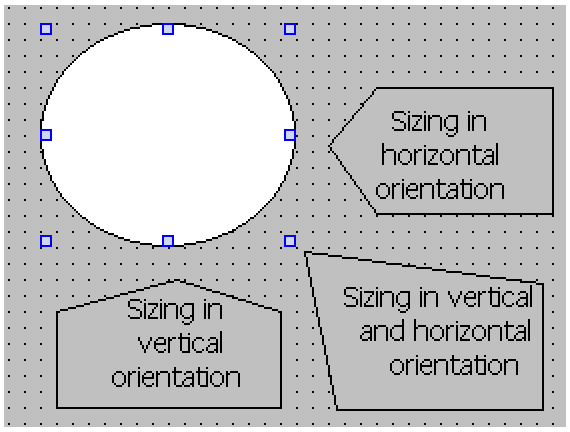
Note

You can copy existing objects using the drag-and-drop +<CTRL> function. The existing object is not moved in this case. You paste a copy of this object into the new position instead.

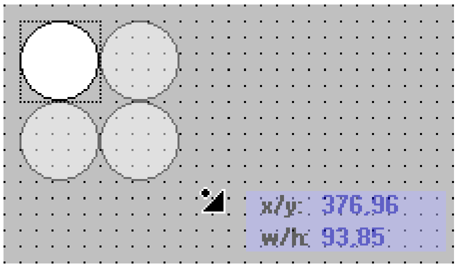
Inserting and multiplying an object

Proceed as follows to insert and multiply an object:

1. Insert the desired object from the "Tools" task card.
2. Press the <Ctrl> key and position the cursor on one of the handles displayed in the figure shown below.


Sizing in horizontal orientation
Sizing in vertical orientation
Sizing in vertical and horizontal orientation

3. Drag the handles to the right and/or down while keeping the left mouse button pressed.
4. The object is multiplied depending on available space if you keep moving the cursor.



See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.14 Repositioning and resizing multiple objects

Possible modifications

After you have selected multiple objects, you edit these as follows:

- Shift using the mouse

  - To change the absolute position of the marked objects, position the mouse pointer over an object, and shift the multiple selection with the mouse button pressed.
  - To resize all the objects by the same ratio, grab the resizing handles of the reference object.
- Move over the work area with the icons of the toolbar
  - Change the position of the marked objects with respect to each other
  - Align the height and width of the marked objects
- Moving with the shortcut menu commands of the work area
  - Change the position of the marked objects with respect to each other
  - Align the height and width of the marked objects

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.15 External graphics

Introduction

In WinCC you use graphics that were created with an external graphics editor. To use these graphics you store them in the graphic browser of the WinCC project.

You can save graphics in the graphic browser as follows:

- When you drag-and-drop graphics objects from the "Graphics" pane into the work area, these are stored automatically in the graphic browser. The graphic names are numbered in the order of their creation, for example, "Graphic_1." Use the <F2> function key to rename the graphic.
- As a graphic file with the following formats:

  *.bmp, *.ico, *.emf, *.wmf, *.gif, *.tif, *.jpeg or *.jpg
- As an OLE object that is embedded in WinCC and is linked to an external graphic editor. In the case of an OLE link, you open the external graphic editor from WinCC. The linked object is edited using the graphic editor. An OLE link only works if the external graphic editor is installed on your PC, and supports OLE.

Use of graphics from the graphic browser

Graphics from the graphic browser are used as follows in your screens:

- In a graphic view
- In a graphics list
- As labeling for a button/function key

Transparent graphics

In WinCC you also use graphics with a transparent background. When a graphic with a transparent background is inserted into a graphic object of WinCC, the transparency is replaced by the background color specified for the graphic object. The selected background color is linked firmly with the graphic. If you use the graphic in another graphic object of WinCC, this object is displayed with the same background color as the graphic object that was configured first. If you want to use the graphic with different background colors, include this graphic in the graphic browser again under a different name. The additional background color is configured when the graphic is used at the corresponding graphic object of WinCC.

Managing graphics

An extensive collection of graphics, icons and symbols is installed with WinCC, for example:

- Machine and plant areas
- Measuring equipment
- Control elements
- Flags
- Buildings

In the Toolbox window of the "Graphic" pane the graphic objects are structured by topic in the "WinCC graphics folder." The link to the WinCC graphics folder cannot be removed, edited or renamed.

The "Graphics" pane is also used to manage the external graphics. The following possibilities are available:

- Creating links to graphics folders

  The external graphic objects in this folder, and in the subfolders, are displayed in the toolbox and are thus integrated in the project.
- Folder links
  - Editing
  - Rename
  - Updating
  - Removing
- You open the program required for editing of the external graphic in WinCC.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.16 Managing external graphics

Introduction

External graphics that you want to use in WinCC are managed in the "Screens" editor by using the "Tools" task card in the "Graphics" pane.

Requirement

- The "Screens" editor is open.
- The "Tools" task card is open.

In order to display external graphics in the toolbox:

- The graphics files are available.
- The image files are in the following formats:

  *.bmp, *.ico, *.emf, *.wmf, *.gif, *.tif, *.jpeg or *.jpg

Creating a folder link

Proceed as follows to create folder links:

1. Click "My graphics folder."

   The "Create link to folder" dialog is opened. The dialog suggests a name for the folder link.
2. Edit the name as required. Select the path containing the graphic objects.
3. Click "OK" to confirm your input.

   The new folder link is added to the "Graphics" object group. The external graphics that are located in the target folder and in sub-folders are displayed in the toolbox.

Editing folder links

Proceed as follows to edit folder links:

1. Select the folder link to edit.
2. Select the "Edit link..." command from the shortcut menu.
   The "Create link to folder" dialog is opened.
3. Edit the name and path of the folder link as required.
4. Click "OK" to confirm your input.

Renaming the folder link

Proceed as follows to rename folder links:

1. Select the folder link to rename.
2. Select "Rename" from the shortcut menu.
3. Assign a name to the new folder link.

Removing a folder link

Proceed as follows to remove folder links:

1. Select the folder link you want to delete.
2. Select "Remove" in the shortcut menu.

Edit external graphics

Proceed as follows to edit external graphics:

1. Select the graphic you want to edit.
2. Select "Open screen editor..." from the shortcut menu.

   This opens the screen editor associated with the graphic object file.

Editing graphics folders from WinCC

Proceed as follows to edit graphics folders from WinCC:

1. Select the graphic you want to edit.
2. Select the "Open parent folder" command from the shortcut menu.

   The Windows Explorer opens.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.17 Storing an external image in the graphics library.

Introduction

To display graphics that have been created in an external graphics program in your screens, you will first have to store these graphics in the graphics browser of the WinCC project.

Requirement

- A screen has been created.
- A Graphic View is inserted in the screen.
- The Inspector window of the graphics view is open.

To store an external graphic in the image browser:

- A graphic is available.

To store an OLE object in the browser:

- An OLE-compatible graphics program is installed on your configuration computer.

Save graphics file

Proceed as follows to save a graphics file:

1. Open the Windows Explorer.
2. Select the graphic that you want to store.
3. Drag-and-drop the graphic into the graphic browser.

Creating and saving a new graphic as an OLE object

Proceed as follows:

1. Click the "General" group in the Inspector window of the graphics view.

2. Open the graphic selection list.
3. Click

   .
4. The "Insert object" dialog box opens.

   Note

   In addition, the dialog "External application running..." will open. The dialog will not close until you exit the external application.

   ---
5. From the "Insert object" dialog box, select "New" and an object type. The settings in "Settings > "OLE settings" determine which object types are shown.
6. Click "OK." The associated graphic program is opened.

   When you are finished creating graphics, end the graphic programming software with "File > Close" or "File > Close & return to WinCC."

   The graphic will be stored in the graphic programming software standard format and added to the graphic browser.

Inserting created graphics in WinCC

Note

A new graphic object created as OLE object may not be directly accepted in WinCC when you save it to an external graphics program.

Proceed as follows:

1. Reopen the dialog for inserting a graphic.
2. From the "Insert object" dialog box, select "Create from file."
3. Click the "Browse" button.
4. Navigate to the created graphic and select it.

Saving an existing graphic object as an OLE object

Proceed as follows:

1. Click the "General" group in the Inspector window of the graphics view.
2. Open the graphic selection list.
3. Click

   .

4. The "Insert object" dialog box opens.

Note

In addition, the dialog "External application running..." will open. The dialog will not close until you exit the external application.

5. From the "Insert object" dialog box, select "Create from file."
6. Click the "Browse" button.
7. Use the dialog to help you navigate to the folder in which the graphic file is saved.

   To import graphics files, note the following size restrictions:

   "*.bmp"≤4 MB

   "*.jpg"≤1 MB

   "*.jpeg"≤1 MB

Result

The image file is now stored in your image browser. It is viewed in a screen with a graphic display, or is added as a list element in an image list.

You can double-click OLE objects in your library to open them for editing in the corresponding graphic editor. When you have finished editing graphics, end the graphic programming software with "File > Close" or "File > Close & return to WinCC." The changes are applied to WinCC.

See also

Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.18 Working with object groups

8.2.2.18 Basics on groups

Introduction

Groups are several objects that are grouped together with the "Group" function. You edit a group in the same way as any other object.

Overview

WinCC offers the following methods for editing multiple objects:

- Multiple selection (Page 1053)
- Creating object groups (Page 1069)

Editing mode

To edit an object of a group individually select the object within the "Layout" task card in the "Layers" palette.

Hierarchical groups

You add further objects or groups to extend a group. The group will then be increased to include the new objects, and will be broken down hierarchically into main and subgroups or objects. Such hierarchical groups must be broken up in stages. You also break up the group in the same order in which you grouped the objects or groups. It takes exactly the same number of steps to break up these hierarchical groups as it did to create them.

Rectangle surrounding the object

With a group only one rectangle surrounding the object is shown for the entire group. However, in the case of a multiple selection, the rectangles surrounding all objects are displayed.

Layers

All objects of a group are located in the same layer.

See also

Ungroup (Page 1071)
Adding objects to a group (Page 1071)
Removing Objects from the Group (Page 1072)
Editing an Object in a Group (Page 1073)
Overview of objects (Page 1042)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.18 Creating object groups

Introduction

The "Group" command combines multiple objects to form a group.

You can change the size and position of the group. The following rules apply:

- The system automatically adapts the position coordinates of the grouped objects when you reposition the group. The relative position of the grouped objects to the group is not affected.
- The system automatically adapts the height and width of the grouped objects in proportion to a change of the group size.
- To change the size of the group proportionately, hold down the <Shift> key and drag the rectangle around the object until has the required size.

Note

To create a hierarchical group, organize the individual groups like objects.

Requirement

- You have opened a screen which contains at least two objects.

Creating object groups

Proceed as follows:

1. Select all the objects you want to organize in a group.
2. Select the command "Group > Group" from the shortcut menu.

The objects of the group are displayed with a rectangle around the objects.

Grouping objects within a group

Proceed as follows:

1. Select the group you want to edit.
2. Select the command "Group > Edit group" from the shortcut menu.

   The group you want to edit is highlighted by a red frame.
3. Select the objects of a group that you want to combine into a subgroup.
4. Select the command "Group > Group" from the shortcut menu.

A subgroup with the objects is created.

Adding objects into an existing group

Proceed as follows:

1. Select the group to which you want to add objects.
2. Press the <Shift> key and select the object you want to add to the group.
3. Select the "Group > Add to group" command from the shortcut menu.

The object is added to this group.

Alternative procedure

You can also edit groups in the "Layout" task card. Using drag-and-drop you can also easily edit nested groups in the "Layers" pane.

Result

The selected objects are combined in a group. The multiple selection rectangle becomes the rectangle surroundings the objects in the group. The handles are shown only for the group. The group in in the active layer.

See also

Basics on groups (Page 1068)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.18 Ungroup

Introduction

Select the "Ungroup" command to split a group into the original object fractions.

Requirement

- You have opened a screen that contains a group.

Ungroup

Proceed as follows:

1. Select the group.
2. Select the "Group > Ungroup" command from the shortcut menu.

Ungrouping a group within a group

Proceed as follows to ungroup a group within a group:

1. Select the higher-level group.
2. Select the command "Group > Edit group" from the shortcut menu.

   The group you want to edit is highlighted by a red frame.
3. Select the lower-level group.
4. Select the "Group > Ungroup" command from the shortcut menu.

The lower-level group is ungrouped. The objects are assigned to the next higher group.

Alternative procedure

You can also edit groups in the "Layout" task card. Using drag-and-drop you can also easily edit nested groups in the "Layers" pane.

See also

Basics on groups (Page 1068)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.18 Adding objects to a group

Introduction

The "Add objects to group" command is used to add objects to a group, without ungrouping it first.

Requirements

You have opened a group, and at least one object.

Adding objects to a group

Proceed as follows:

1. Select the group.
2. Press the <Shift> key and select the object you want to add to the group.
3. Select the "Group > Add to group" command from the shortcut menu.

The group consists of the original objects, and the newly-added objects. The added objects are arranged at the front of the group.

Alternative procedure

You can also edit groups in the "Layout" task card. Using drag-and-drop you can also easily edit nested groups in the "Layers" pane.

See also

Basics on groups (Page 1068)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.18 Removing Objects from the Group

Introduction

You use the "Remove objects from group" command to remove individual objects from a group, without ungrouping it first.

Removing objects from a group

Proceed as follows:

Note

You do not have to remove the object from the group to edit an object in a group. You can edit the objects of a group individually.

Requirement

- You have opened a screen that contains a group.

Removing objects from a group

Proceed as follows to remove an object from a group:

1. Select the group.
2. Select the command "Group > Edit group" from the shortcut menu.

The group you want to edit is highlighted by a red frame.

3. Select all objects in the group that you want to remove from the group.
4. Select the "Group > Remove from group" command from the shortcut menu.

The objects are removed from the group.

Note

The group is not automatically deleted even when all objects are removed from it.

Deleting objects from a group

To remove an object from the group, and from the screen, follow these steps:

1. Select the group.
2. Select the command "Group > Edit group" from the shortcut menu.

   The group you want to edit is highlighted by a red frame.
3. Select the objects in the group that you want to delete.
4. Select "Delete" from the shortcut menu.

Note

The group is not automatically deleted even when all objects are deleted from it.

Alternative procedure

You can also edit groups in the "Layout" task card. Using drag-and-drop you can also easily edit nested groups in the "Layers" pane.

See also

Basics on groups (Page 1068)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.18 Editing an Object in a Group

Introduction

You can edit the objects of a group individually.

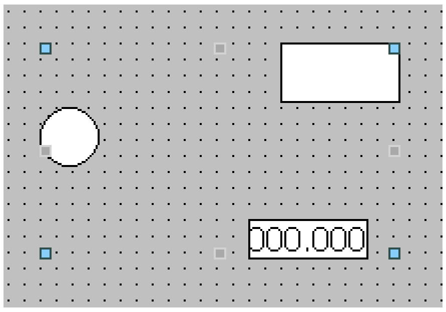
Requirement

You have opened a screen that contains a group.

Editing grouped objects

Proceed as follows:

1. Select the group.



The properties of the group are displayed in the Inspector window.

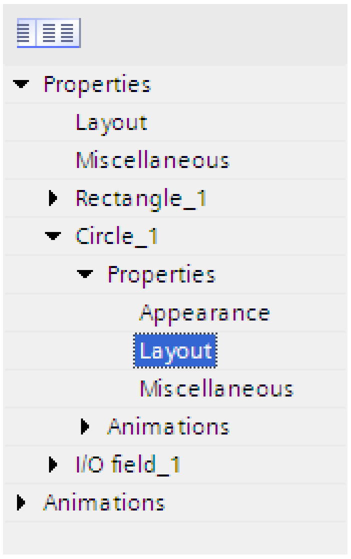
2. Change the position and size of the grouped objects in "Layout."
3. Change the name of the group under "Miscellaneous."

   Specify the active layer and activate the visibility of the group in Runtime.

Modifying the properties of an object within a group

Proceed as follows:

1. Select the group.
2. Select the object whose properties you want to change in the Inspector window.



The properties of the object are displayed.

3. Change the object properties.

Result

Although you have edited the object, it is still an element of the group. These changes do not affect the other objects of the group.

See also

Basics on groups (Page 1068)
Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.19 Configuring the keyboard access

8.2.2.19 Overview of keyboard access

Introduction

For keyboard units without a mouse, the operator activates control objects using the <Tab> key. You can set up keyboard input to make the process easier to run, and to make sure that the operator enters all the necessary values. If you are using the keyboard, use the <Tab> key to activate the objects in a certain order, and to enter the necessary values.

For HMI devices without key, you can simulate the <Tab> key by configuring the "SimulateSystemKey" system function to a function key.

Operator authorizations and operator control enables

If you configure an object for operator input with the <Tab> key, the object must have both an operator authorization, and an operator control enable.

Editing the tab sequence

The tab sequence is determined automatically when the control objects are created. The numbers of the tab sequence are assigned in the sequence in which the libraries are created.

It makes sense to change the tab sequence in the following cases:

- The operator changes directly to a specific control object.
- The screen requires a specific sequence

Change to the tab sequence mode to change the tab sequence. In this mode, the tab sequence number is displayed at the top left of the control objects. The tab sequence numbers of hidden objects are also shown. The distribution of these numbers is edited using the mouse.

Note

Other functions are not available in the tab sequence mode.

See also

Defining the Operator Authorization and Operator Control Enable for an Object (Page 1076)
Setting the tab sequence order (Page 1076)

8.2.2.19 Defining the Operator Authorization and Operator Control Enable for an Object

Introduction

If you configure an object for operator input with the <Tab> key, the object must have both an operator authorization, and an operator control enable.

Requirement

You have opened a screen which contains at least one object.

Procedure

Proceed as follows to specify the operator authorization and operator control enable for an object:

1. Select the object.
2. Select the "Security" group in the Inspector window.
3. Select the operator authorization under "Authorization."
4. Activate the authorization to operate.

Result

The operator can use the <Tab> key in Runtime to select the object.

See also

Overview of keyboard access (Page 1075)

8.2.2.19 Setting the tab sequence order

Introduction

All operable objects can be reached in runtime with the <Tab> key. You use the "Tab sequence" command to define the order in which the operator can activate objects in runtime.

Note

You cannot reach objects with the "Output" or "Two states" mode in runtime with the <Tab> key.

Alternatively, you can operate the screen in runtime as follows:

- Using the <Tab> key
- Using the mouse
- Using a configured hotkey

Requirement

- The active screen contains operable objects.
- No object is selected.
- The objects have been enabled for use in runtime, and have operator authorization.

Procedure

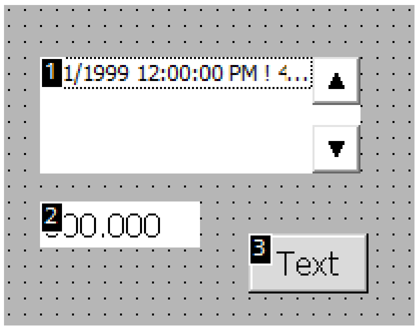
Proceed as follows:

1. Select "Edit tab sequence" command in the "Edit" menu.

   Tab sequence mode is activated. The tab sequence number is displayed for all objects that can be used. The tab sequence number is also displayed for hidden objects.

2. Use edit the tab sequence mode, click the accessible objects in the order in which you want them to be activated using <Tab> in runtime.

   The following figure shows how the tab sequence is defined in the screen. In runtime, the <Tab> key first activates the alarm view (number 1), then the I/O field (number 2), and then the button (number 3):

3. To exclude a screen object from the tab sequence, press the key combination <Shift+Ctrl> and click on the desired object.

   The tab sequence number is no longer displayed in the screen object. The screen object is now excluded from the tab sequence. The remaining tab sequence numbers are automatically decreased by 1.

4. To reenter an excluded screen object in the tab sequence, repeat step 3.

   The screen object entered as the first object in the tab sequence.

Result

The operator can use the <Tab> key in runtime to activate the objects in the defined order.

See also

Overview of keyboard access (Page 1075)

8.2.2.20 Examples

8.2.2.20 Example: Inserting and configuring a rectangle

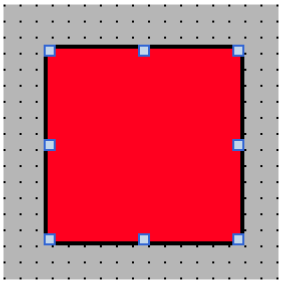
Task

In this example, you insert a rectangle in a screen. You can configure the following properties:

- Name = "MyRectangle"
- Position = (20, 20)
- Size = (100,100)
- Color = red
- Black frame 2 pixels wide

Principle

The rectangle is a closed object which can be filled with a color or pattern. The height and width of a rectangle can be adjusted to allow its horizontal and vertical alignment.



Overview

Carry out the following steps in order to create a rectangle:

- Inserting a rectangle
- Configuring a rectangle

See also

Example: Inserting a rectangle (Page 1079)
Example: Configuring a rectangle (Page 1079)
Overview of objects (Page 1042)

8.2.2.20 Example: Inserting a rectangle

Task

In this example, you insert and rename a rectangle. Do not use the special characters ?, ", /, \, *, <, > for the name.

Requirement

- A screen is open.
- The Inspector window is open.
- The "Tools" task card is open.

Procedure

Proceed as follows to insert the rectangle:

1. Click the "Basic objects" palette in the "Tools" task card.
2. Drag the "Rectangle" object into the screen.
3. Select "Miscellaneous" in the Inspector window.
4. Type in the new name "MyRectangle".

Result

The rectangle is now inserted and named "MyRectangle". The rectangle has the default properties of the "rectangle" object.

See also

Example: Inserting and configuring a rectangle (Page 1078)

8.2.2.20 Example: Configuring a rectangle

Task

In this example you configure a rectangle as follows:

- Color = red
- Black frame 2 pixels wide
- Position = (20, 20)
- Size = (100,100)

Changing the color of the rectangle

Proceed as follows to change the color of the rectangle:

1. Select the rectangle.
2. Select the "Color" red in the "Background" area under "Appearance" in the Inspector window.

3. In the "Background" area, select "Solid" as the "Fill pattern."
4. In the "Border" area, select black as the "Color."
5. In the "Border" area, enter the value "2" under "Width."
6. In the "Border" area, select "Solid" as the "Style."

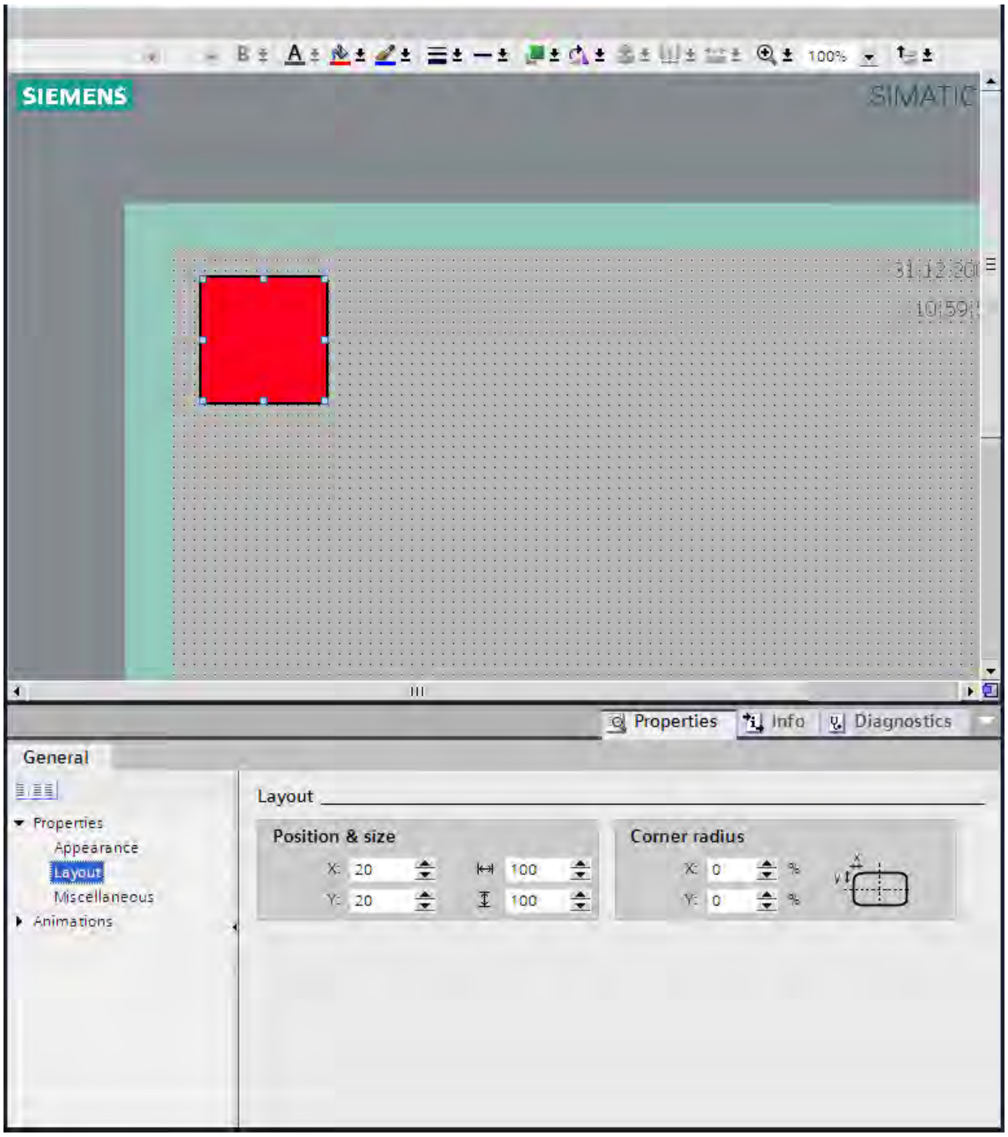
Interim result

The rectangle is red and has a black frame with a width of two pixels.

Repositioning and resizing the rectangle

Proceed as follows to change the position and size of the rectangle:

1. Select the rectangle.
2. Select "Layout" in the Inspector window.



Layout

Position & size
X: 20 · Y: 20 · 100 · 100

Corner radius
X: 0 % · Y: 0 %

3. Set "20" for the both the X and Y coordinates under "Position & Size".
4. Set "100" for the height and for the width.

Result

The rectangle is positioned at the coordinates (20, 20), and has a width and height of 100 pixels.

See also

Example: Inserting and configuring a rectangle (Page 1078)

8.2.3 Working with text lists and graphics lists

8.2.3.1 Working with text lists

8.2.3.1 Basics on text lists

Introduction

Texts are assigned to the values of a tag in a text list. During configuration, you can assign the text list, for example, to a symbolic I/O field. This supplies the text to be displayed to the object.

The text lists are created in the ""Text List" editor. You configure the interface between the text list and a tag at the object that uses the text list.

Note
Runtime dependency

The selection of objects that can have a text list assigned depends on the Runtime.

Application

The text list is used, for example, to display a drop-down list in a symbolic I/O field.

You can configure multiple languages for the texts in a text list. The texts will then be displayed in the set language in Runtime.

Note
HMI device dependency

The availability of the text list is determined by the HMI device used.

Function

If the symbolic I/O field is a display field, the associated texts will differ according to the value of the configured tags. If the symbolic I/O field is an input field, the configured tag assumes the associated value when the operator selects the corresponding text in Runtime.

Note
Runtime dependency

The display of tag values to which no text has been assigned depends on the Runtime:

- The display and operating object remains empty.
- Three asterisks *** are displayed.

Multilingual texts

You can configure multiple languages for the texts in a text list. To this purpose you set the languages in the Project window under "Language support > Project languages."

Configuration steps

The following steps are required to display texts, for example, in a symbolic I/O field:

1. Creating the text list
2. Assigning texts and values/value ranges to the text list
3. Assigning a text list in the display object, for example the symbolic I/O field

See also

Screen basics (Page 1025)
Creating a text list (Page 1082)
Assigning texts and values to a range text list (Page 1084)
Assigning texts and values to a bit text list (Page 1085)
Assigning texts and values to a bit number text list (Page 1087)
Configuring objects with a text list (Page 1088)

8.2.3.1 Creating a text list

Introduction

The text list allows you to assign specific texts to values and to output these in Runtime, for example in a symbolic I/O field. The type of symbolic I/O field can be specified, for example as a pure input field.

Note
Runtime dependency

The selection of the possible I/O field types depends on the Runtime used.

The following types of list are available:

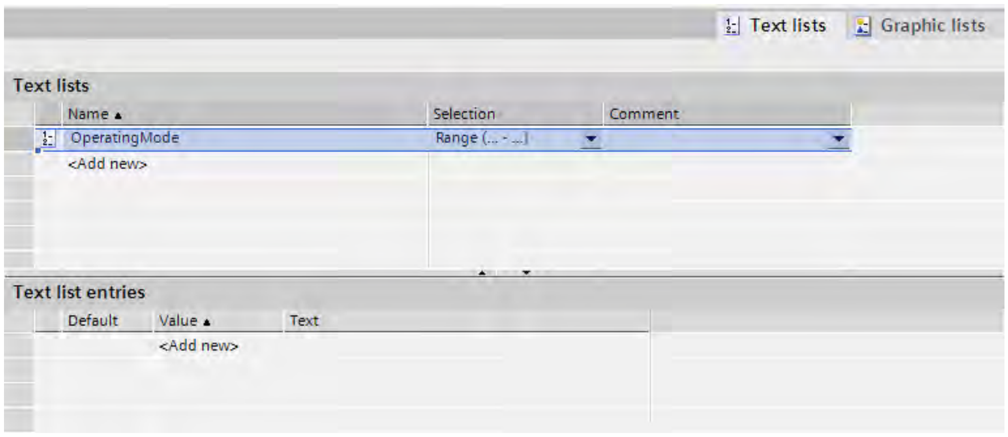
- Range
- Bit
- Bit Number

You define the content and properties of a text list using the "Text and graphics list" editor.

Procedure

Proceed as follows to create a text list:

1. Open the "Text and graphics lists" editor and the "Text lists" tab in the project tree.



Name ▲	Selection	Comment
OperatingMode	Range (... - ...)	
<Add new>		

Default	Value ▲	Text
	<Add new>	

2. Click in the first free table row of the upper work area.

   The Inspector window of the text list is open.
3. Assign a name to the text list that indicates its function.
4. Select the text list type under "Selection":
   – Range (... - ...): Text from the text list is displayed when the tag has a value that lies within the specified range.
   – Bit (0,1): A text from the text list is displayed when the tag has the value 0. A different text from the text list is displayed when the tag has the value 1.
   – Bit number (0-31): Text from the text list is displayed when the tag has the value of the assigned bit number.
5. Enter a comment for the text list.

Note
HMI device dependency

The availability of the text list is determined by the HMI device used.

Note

You must not use semicolons in the texts in a text list. The semicolon is a control character and is automatically deleted from a text.

Result

A text list is created.

See also

Basics on text lists (Page 1081)

8.2.3.1 Assigning texts and values to a range text list

Introduction

For each range text list you specify which texts are to be displayed at which value range.

Requirement

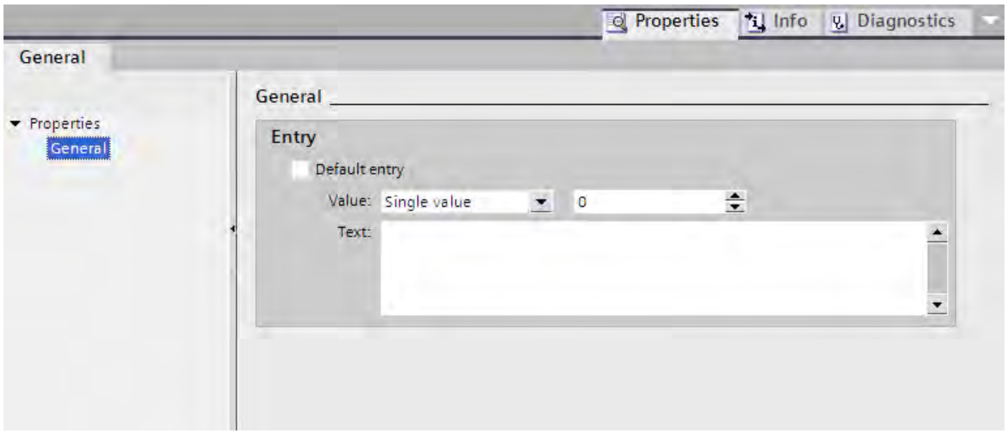
- The "Text and graphics list" editor is open.
- The "Text lists" tab is open.
- A range text list has been created and selected.

Procedure

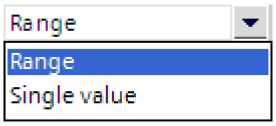
Proceed as follows to assign values and text to the range text list:

1. Click the first free line in the "List entries" editing area.

   The Inspector window for this list entry opens.



2. Select the type of value range:



   – "Range": Minimum tag value to maximum tag value, for example 1 ≦ Value ≦ 21
   – "Single value": Exactly one tag value, for example Value = 21
3. Enter the value or range of values at which a text from the text list is to be displayed under "Value".
4. Enter the text that is to be displayed in Runtime when the tag has the specified value or lies within the specified range of values under "Text."
5. Activate "Default entry" if the entered text is to be displayed whenever the tag has an undefined value. Only one default entry is possible per list.
6. Create further corresponding list entries for additional value ranges of the same text list.

Note

Do not use one of the following special characters in the texts of the text list: ?, ", /, \, *, <, > and semicolon. Control characters are deleted automatically in a text.

Result

A range text list is created. Texts that appear in Runtime are assigned to the possible values.

See also

Basics on text lists (Page 1081)

8.2.3.1 Assigning texts and values to a bit text list

Introduction

For each text list you specify which texts are to be displayed at which bit value.

Requirement

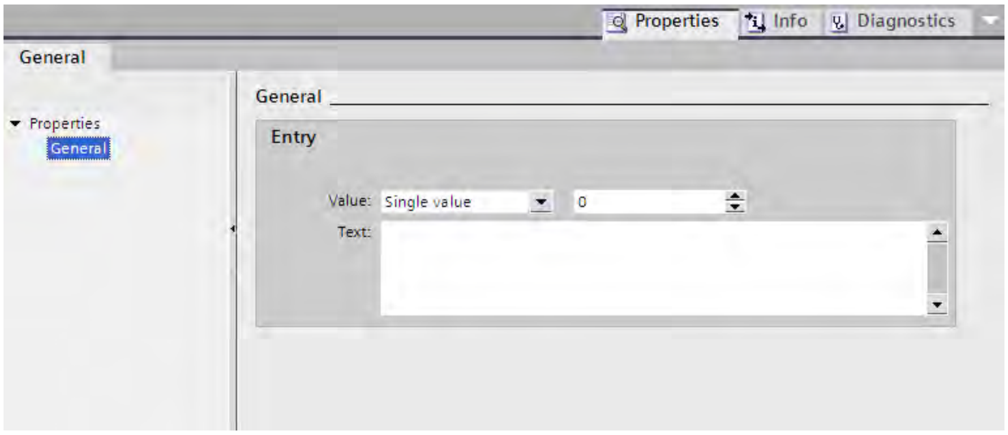
- The "Text and graphics list" editor is open.
- The "Text lists" tab is open.
- A bit text list has been created and selected.

Procedure

Proceed as follows to assign values and texts to the bit text list:

1. Click the first free line in the "List entries" editing area.

   The Inspector window for this list entry will open.



2. Enter "0" under "Value."
3. Enter the text that is to be displayed in Runtime when the tags have the value "0".

Note

Do not use one of the following special characters in the texts of the text list: ?, ", /, \, *, <, > and semicolon. Control characters are deleted automatically in a text.

---

4. Click the next free line in the "List entries" editing area.

   The Inspector window for the next list entry opens.
5. Enter "1" under "Value."
6. Enter the text that is to be displayed in Runtime when the tags have the value "1".

Result

A bit text list is created. Texts that appear in Runtime are assigned to the possible values "0" and "1".

See also

Basics on text lists (Page 1081)

8.2.3.1 Assigning texts and values to a bit number text list

Introduction

For each bit number text list you specify which texts are to be displayed at which bit number.

Requirement

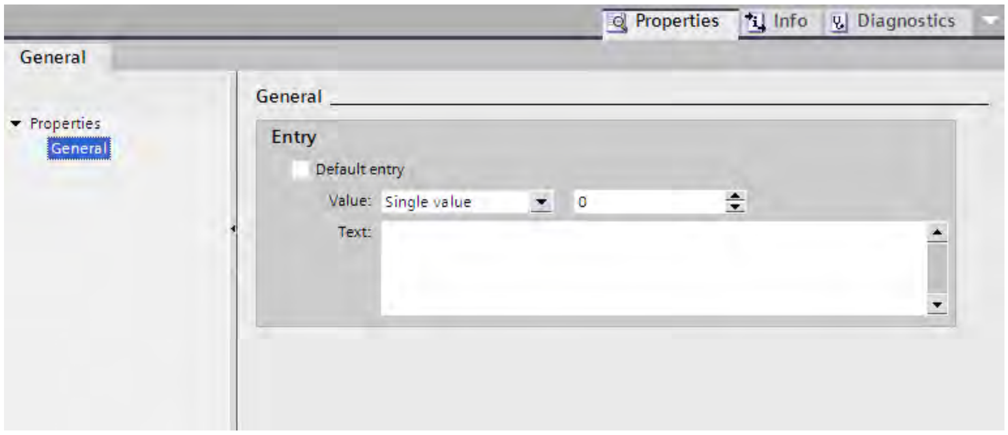
- The "Text and graphics list" editor is open.
- The "Text lists" tab is open.
- A bit number text list has been created and selected.

Procedure

Proceed as follows to assign values and texts to the bit number text list:

1. Click the first free line in the "List entries" editing area.

   The Inspector window for this list entry will open.
2. Enter the bit number at which a text of the text list is to be displayed under "Value".



Default entry
Value: Single value 0
Text:

3. Enter the text that is to be displayed in Runtime when the tag has the specified bit number.
4. Activate "Default entry" if the entered text is to be displayed whenever the tag has an undefined value. Only one default entry is possible per list.
5. Create further corresponding list entries for additional bit numbers of the same text list.

Note

Do not use one of the following special characters in the texts of the text list: ?, ", /, \, *, <, > and semicolon. Control characters are deleted automatically in a text.

Result

A bit number text list is created. Texts that appear in Runtime are assigned to the specified bit numbers.

See also

Basics on text lists (Page 1081)

8.2.3.1 Configuring objects with a text list

Introduction

The output value and value application for text lists are specified in the display and operating object that displays the texts of the text list in Runtime. The properties of these objects are configured as required.

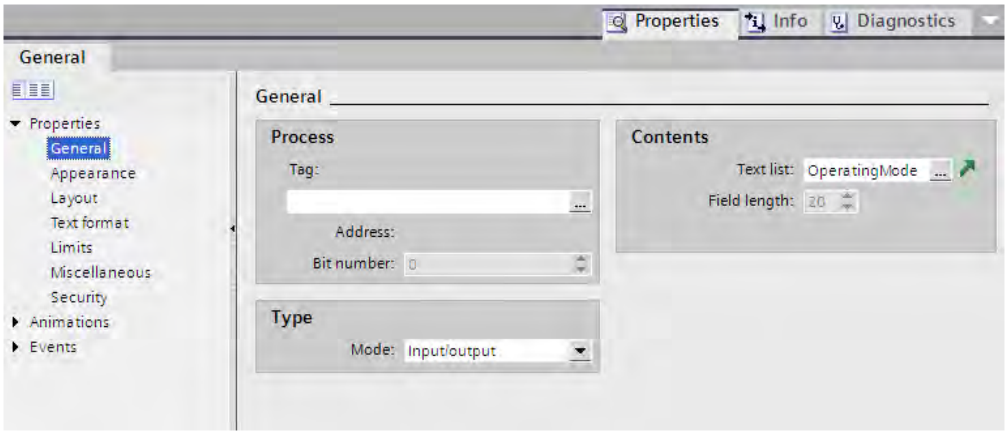
Requirement

- A text list has been created in the "Text and graphics list" editor.
- The values of the text list are defined and assigned texts.
- The "Screens" editor is open.
- A screen with a symbolic I/O field is open. The object is edited.

Procedure

Proceed as follows to have the texts of a text list displayed in Runtime in a symbolic I/O field:

1. Assign a name that indicates its function to the object under "Miscellaneous."
2. Select the text list under "General" in the "Text list" field whose defined texts you want to have displayed in Runtime.



Mode: Input/output
Text list: OperatingMode
Field length: 20
Bit number: 0

3. Select the data that the object is to display in the "Mode" field.

Note
Runtime dependency

Different field types are available for a symbolic I/O field depending on the Runtime.

4. Specify the number of entries that are to be visible in the object under "Visible entries."

5. Activate "Apply value on exit" under "Characteristics."

   The values are applied when you exit the object in Runtime.

Result

The defined texts of the text list are displayed in the symbolic I/O field in Runtime when the tag has the specified value.

See also

Basics on text lists (Page 1081)

8.2.3.2 Working with graphics lists

8.2.3.2 Basic principles of graphics lists

Introduction

The possible values of a tag are assigned to specific graphics in a graphics list. During configuration, you can create a graphics list for a button or a graphic I/O field. This supplies the graphics to be displayed to the object.

The graphics lists are created with the "Text and graphics list" editor. You configure the interface between the graphics list and a tag at the object that uses the graphics list.

Application

You can configure the graphics list for the following situations:

- Drop-down list with a graphic I/O field
- State-specific graphic for a button

The graphics in a graphics list can be configured as multilingual. The graphics will then be displayed in the set language in runtime.

Note
Availability for specific HMI devices

The availability of the graphics list is determined by the HMI device used.

Graphic sources

Graphics can be added to the graphics list from the following sources:

- By selecting from a graphic browser
- By selecting an existing file
  You can use the following file types:

*.bmp, *.ico, *.cur, *.emf, *.wmf, *.gif, *.tif, *.jpeg and *.jpg.

- By creating a new file

Function

If the graphic I/O field is a display field, the associated graphics will differ according to the value of the configured tags. If the graphic I/O field is an input field, the configured tag assumes the associated value when the operator selects a graphic in runtime.

Note
Availability for specific runtimes

The display of tag values to which no graphic has been assigned depends on the runtime:

- The display and operating object remains empty
- A defined default graphic is displayed

Configuration steps

The following tasks are required to display graphics, for example, in a graphic I/O field:

1. Creating the graphics list
2. Assigning graphics and values/value ranges to the graphics list
3. Assigning a graphics list in the display object, for example the graphic I/O field

See also

Screen basics (Page 1025)
Creating a graphics list (Page 1090)
Assigning a graphic and values to a range graphics list (Page 1092)
Assigning graphics and values to a bit graphics list (Page 1094)
Assigning graphics and values to a bit number graphics list (Page 1095)
Configuring objects with a graphics list (Page 1096)

8.2.3.2 Creating a graphics list

Introduction

The graphics list allows you to assign specific graphics to variable values and to output these in a graphic I/O field in Runtime. You can specify the type of graphic I/O field, for example as a pure output field.

Note
Runtime dependency

The selection of the possible I/O field types depends on the Runtime used.

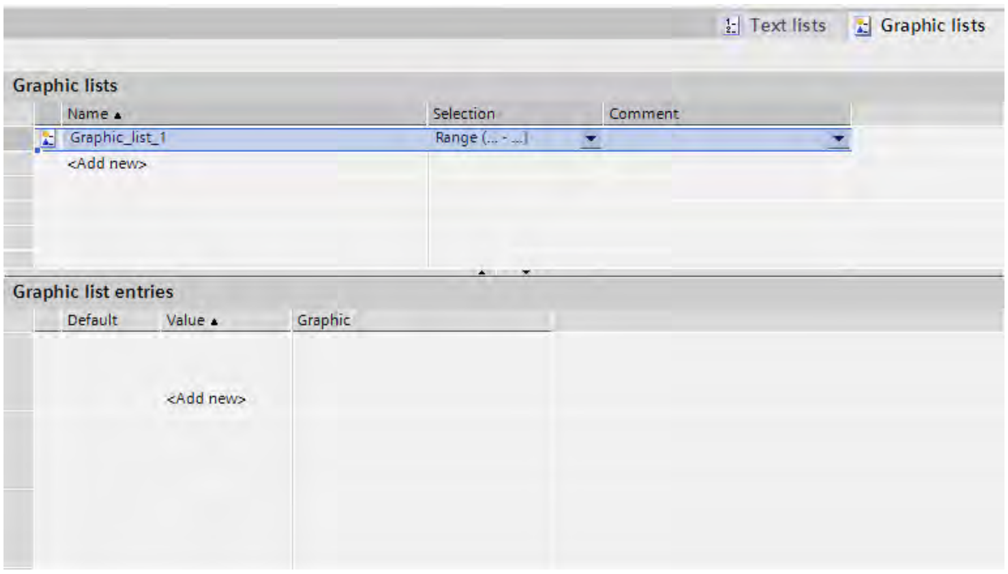
Note
HMI device dependency

The availability of the graphics list is determined by the HMI device used.

Procedure

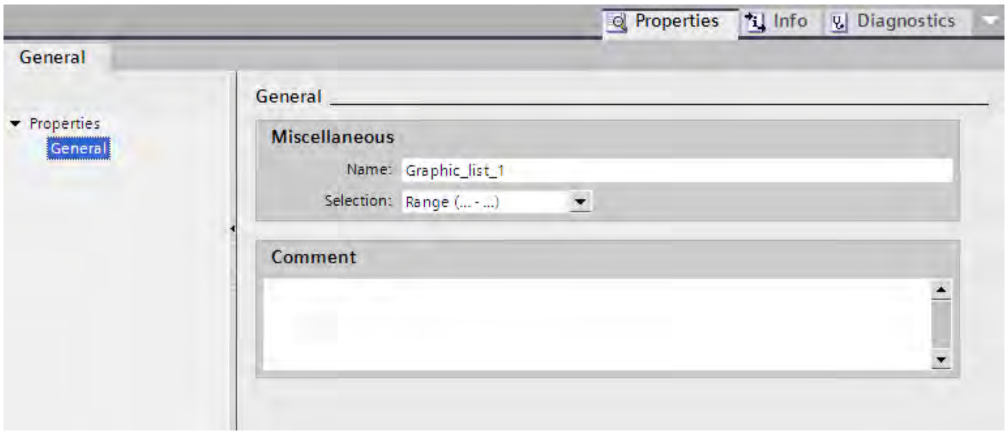
Proceed as follows to create a graphics list:

1. Open the "Text and graphics lists" editor and the "Graphics lists" tab in the project tree.



2. Click in the first free table row of the upper work area.

   The Inspector window of the graphics list will open up.



Name: Graphic_list_1
Selection: Range (... - ...)

3. Assign an expressive name to the graphics list.
4. Select the graphics list type under "Selection":
   – Range (... - ...): Graphic from the graphics list is displayed when the variable has a value that lies within the specified range.
   – Bit (0,1): A graphic from the graphics list is displayed when the variable has the value 0. A different graphic from the graphics list is displayed when the variable has the value 1.
   – Bit number (0-31): Graphic from the graphics list is displayed when the variable has the value of the assigned bit number.
5. Enter a comment for the graphics list.

Result

A range graphics list is created.

See also

Basic principles of graphics lists (Page 1089)

8.2.3.2 Assigning a graphic and values to a range graphics list

Introduction

For each range graphics list you specify which graphics are to be displayed at which value range.

Requirement

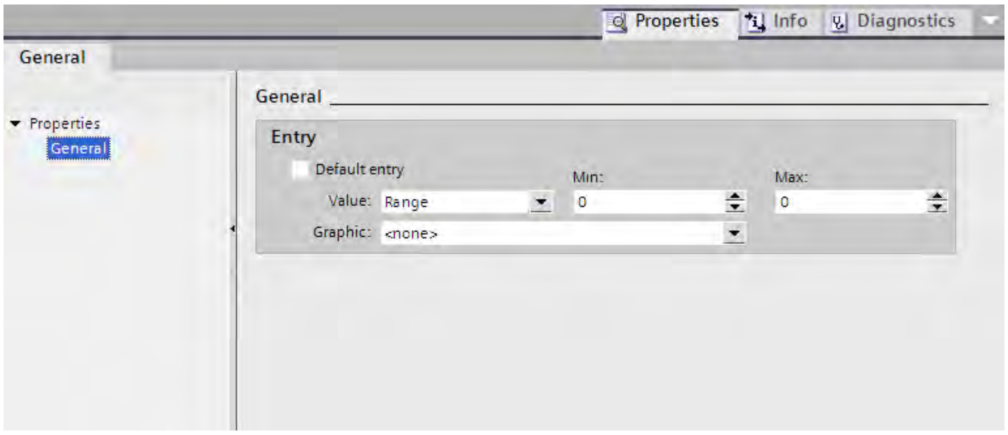
- The "Text and graphics list" editor is open.
- The "Graphics list" tab is open.
- A range graphics list has been created and selected.

Procedure

Proceed as follows to assign values and graphics to the range graphics list:

1. Click the first free line in the "List entries" editing area.

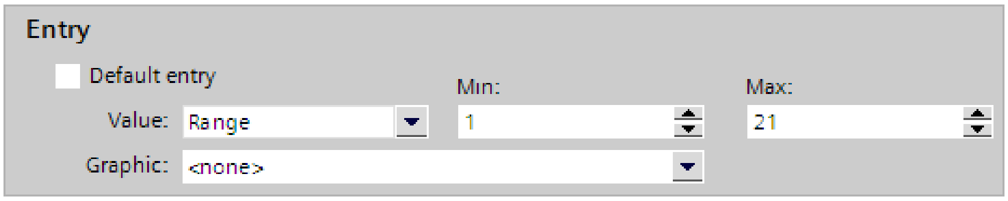
   The Inspector window for this list entry opens.



Default entry: [ ]
Value: Range
Min: 0
Max: 0
Graphic: <none>

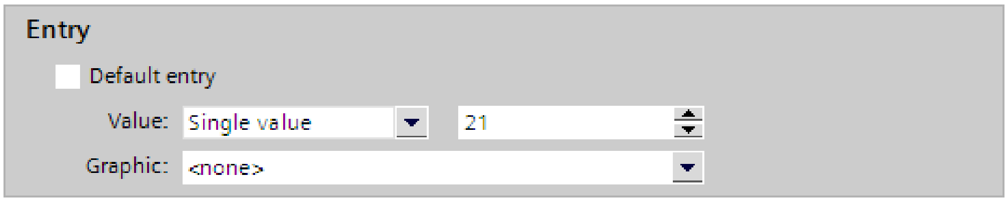
2. Select the type of value range under "Value":

   – "Range": Minimum tag value to maximum tag value, for example 1 ≦ Value ≦ 21



Default entry: [ ]
Value: Range
Min: 1
Max: 21
Graphic: <none>

   – "Single value": Exactly one tag value, for example Value = 21



Default entry: [ ]
Value: Single value
21
Graphic: <none>

3. Enter the value or range of values at which a graphic from the graphics list is to be displayed under "Value".
4. Select the graphic that is to be displayed in Runtime when the tags have the specified value or lie within the specified range of values under "Graphic."
5. Activate "Default entry" if the specified entry is to be displayed whenever the tag has an undefined value. Only one default entry is possible per list.

Result

A range graphics list is created. Graphics that appear in Runtime are assigned to the possible values.

See also

Basic principles of graphics lists (Page 1089)

8.2.3.2 Assigning graphics and values to a bit graphics list

Introduction

For each graphics list you specify which graphics are to be displayed at which bit value.

Requirement

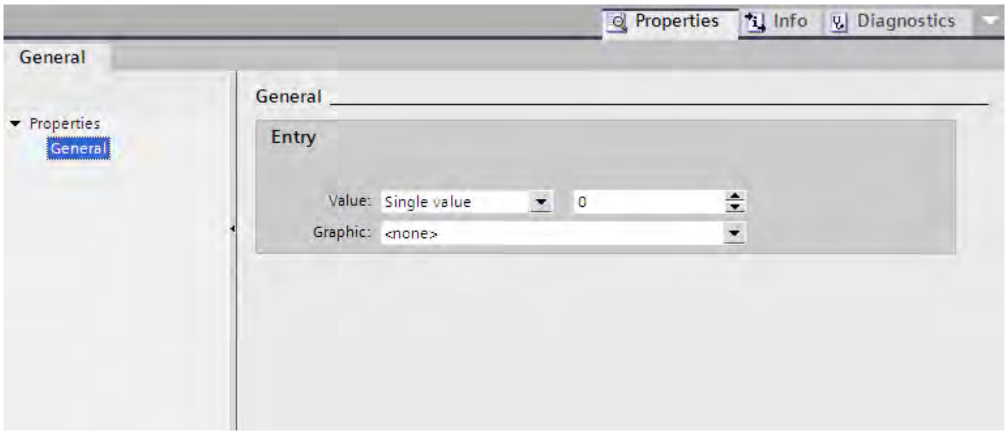
- The "Text and graphics list" editor is open.
- The "Graphics list" tab is opened.
- A bit graphics list has been created and selected.

Procedure

Proceed as follows to assign values and graphics to the bit graphics list:

1. Click the first free line in the "List entries" editing area.

   The Inspector window for this list entry opens.



Value: Single value 0
Graphic: <none>

2. Enter "0" under "Value."
3. Select the graphic that is to be displayed in Runtime when the tag has the value "0".
4. Click the next free line in the "List entries" editing area.

   The Inspector window for the next list entry opens.
5. Enter "1" under "Value."
6. Select the graphic that is to be displayed in Runtime when the tag has the value "1".

Result

A bit graphics list is created. Graphics that appear in Runtime are assigned to the values "0" and "1".

See also

Basic principles of graphics lists (Page 1089)

8.2.3.2 Assigning graphics and values to a bit number graphics list

Introduction

For each bit number graphics list you specify which graphics are displayed at which bit number.

Requirement

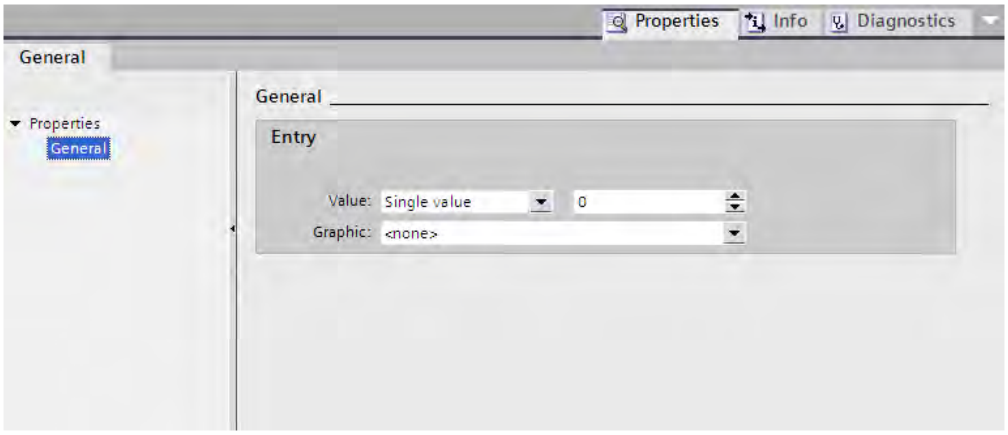
- The "Text and graphics list" editor is open.
- The "Graphics list" tab is open.
- A bit number graphics list has been created and selected.

Procedure

Proceed as follows to assign values and graphics to the bit number graphics list:

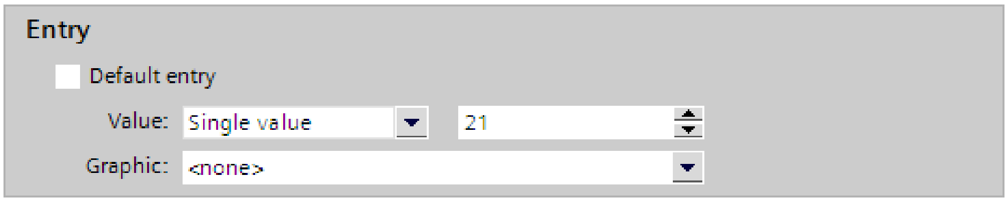
1. Click the first free line in the "List entries" editing area.

   The Inspector window for this list entry will open.



Value: Single value 0
Graphic: <none>

2. Enter the bit number at which a graphic of the graphics list is to be displayed under "Value."



Default entry
Value: Single value 21
Graphic: <none>

3. Select the graphic that is to be displayed in Runtime when the variable has the value of the specified bit number under "Graphic."
4. Activate "Default entry" if the specified entry is to be displayed whenever the tag has an undefined value. Only one default entry is possible per list.
5. Create additional corresponding list entries for more bit numbers of the same graphics list.

Result

A bit number graphics list is created. Graphics that appear in Runtime are assigned to the specified bit numbers.

See also

Basic principles of graphics lists (Page 1089)

8.2.3.2 Configuring objects with a graphics list

Introduction

The output value and value application for graphics list are specified in the display and operating object that displays the graphics of the graphics list in Runtime. The properties of these objects are configured as required.

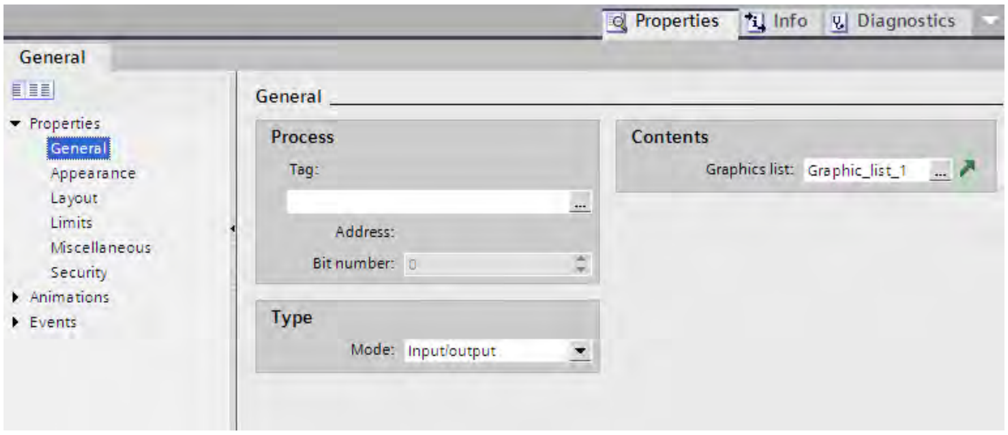
Requirement

- A graphics list has been created in the "Text and graphics list" editor. The values have been defined. Graphics have been assigned to the values.
- The "Screens" editor is open.
- A screen with a graphics I/O field is open. The object is edited.

Procedure

Proceed as follows to have a graphic of a graphics list displayed in Runtime in a graphic I/O field:

1. Assign a name that indicates its function to the object under "Miscellaneous."
2. Select the graphics list under "General" in the "Graphics list" field whose defined graphics you want to have displayed in Runtime.



3. Select the data that the object is to display under "Type" in the "Mode" field.

Note
Runtime dependency

Different field types are available for a graphic I/O field depending on the Runtime.

Result

The defined graphics of the graphics list are displayed in the graphic I/O field in Runtime when the tag has the specified value.

See also

Basic principles of graphics lists (Page 1089)

8.2.4 Dynamizing screens

8.2.4.1 Basics on dynamizing

Introduction

In WinCC, you can make object properties dynamic to map your plant onto HMI devices and to display process sequences. One example is the mapping of a tank, the liquid level of which rises or falls in relation to a process value.

Dynamization of object properties

You can assign dynamic properties to any graphic object. You use predefined animations for this purpose.

Operator control objects react to events, such as a mouse click. You can configure system functions to react to events. For additional information, refer to "Working with the System Functions (Page 1330) ".

The options for dynamization depend on the object involved. When you copy an object, its dynamization functions are included.

Animations

Note
HMI device dependency

The "Control enable" animation is not available for every HMI device.

WinCC helps you to implement dynamization using predefined animations. If you want to make an object property dynamic, first configure the required animation using tools from the toolbox or from the Inspector window of the object. Then customize the animation in the Inspector window to suit the requirements of your project.

Animations are available to make the following object properties dynamic:

- Appearance

The object changes its appearance, such as its color.

- Position

  The screen object is animated.
- Visibility

  The object is shown or hidden.
- Operability of operator control objects

  The object is enabled or locked for operation.

You can customize the default properties for the animations available in the toolbox just as you would customize the default properties of other graphic objects.

See also

Configuring a new animation (Page 1099)

8.2.4.2 Elements and basic settings

Introduction

In WinCC, you use dynamic objects to map the plant onto HMI devices and to display process sequences.

You can implement dynamization for all graphic objects that you have configured in a screen. Which dynamization functions and events are actually available depends on the selected object.

Note
HMI device dependency

The "Control enable" animation is not available for every HMI device.

"Animations" task card

The "Animations" task card contains the following groups and elements for configuration of animations:

- Movements: horizontal, vertical, diagonal, and direct movement
- Layout: Appearance and visibility
- Miscellaneous: Activate object

Note
Basic Panels

The "Animations" task card is not available for Basic Panels.

Inspector window

The Inspector window shows all the animations that are configured for the selected object in the "Animations" group:

- Diagonal, horizontal, vertical, or direct movement: The screen object is animated.
- Design: The object changes its appearance, such as its color or flashing properties.
- Visibility: The object is shown or hidden.
- Activate object: The object can or cannot be used.

8.2.4.3 Animations

8.2.4.3 Configuring a new animation

Introduction

You configure animations for graphic objects using simple mouse actions. You must only configure one animation of the same type for each object.

Requirement

- You have opened a screen which contains at least one dynamic object.
- The Inspector window is open.
- The Toolbox window is displayed.

Procedure

Proceed as follows to configure an animation:

1. Open the Inspector window or the property list of the object to be dynamized.
2. In the "Animation" group, double-click the "New animation" entry.
3. Select the animation you want to use.
4. Click "Add".

Alternative procedure

1. Open the object group containing the required animation in the "Animations" task card.
2. Drag the animation onto the object that you want to make dynamic.

   Otherwise: Select the required animation from the toolbox. Then click the object that you want to make dynamic.

Note
Basic Panels

The "Animations" task card is not available for Basic Panels.

Result

The animation appears in the Inspector window of the object. You can now configure the animation.

Administering configured animations

In the Inspector window the Animations shortcut menu contains the following menu items for administering animations:

- "Copy animation": This menu item is used to copy the selected animation.
- "Insert animation": Use this menu item to insert an animation from the Clipboard into the Inspector window of another object.
- "Remove animation": Use this option to delete animations that you no longer need.

See also

Dynamizing the appearance of an object (Page 1100)
Configuring movement (Page 1102)
Dynamizing the visibility of an object (Page 1104)
Animations for object groups and for multiple selection (Page 1105)
Basics on dynamizing (Page 1097)

8.2.4.3 Dynamizing the appearance of an object

Introduction

You can control the foreground and background color and the flashing properties of an object dynamically. In Runtime, the appearance of the object is controlled by the change in value of a tag. When the tag acquires a certain value, or changes its value within a certain interval, the object changes its color or flashing response according to its configuration.

Appearance variants

How many variants of the appearance you can configure depends on your setting for the data type of the tag:

- "Range":

  The range value of the tag is considered. You can define any number of values or intervals for controlling the appearance of an object. You may not define overlapping ranges.
- "Multiple bits"

  With multiple bits, the value of the tags is considered. The tag can have an integer value between 0 and 31. You can assign each one of these values to a variant of the object appearance. The "Multiple bits" data type does not allow you to define an interval, but only the values in the "From" column.

- "Single bit"

  Only the specified bit of the tag is considered. You can define two layout variants for the object appearance, namely for bit = 1 and bit = 0. The "Single bit" data type does not permit you to define an interval.

Note

You can make the appearance of the control element dependent on the operator's input. To do this, use the same tag in an I/O field to save the input and to control the appearance.

Example: The background color of the I/O field changes in Runtime in response to the input.

Requirement

- You have opened a screen which contains at least one dynamic object.
- The Inspector window is open.
- The Toolbox window is displayed.

Procedure

Proceed as follows to object property the flashing of the object:

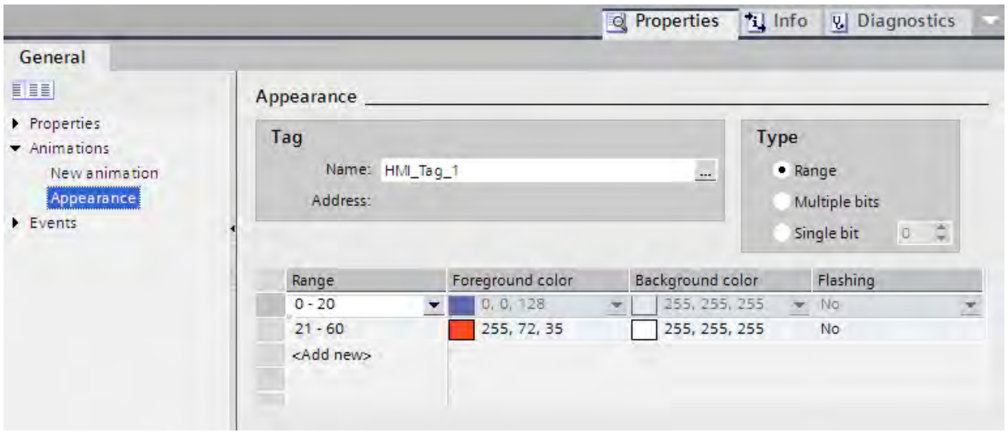
1. Select the screen object you want to control dynamically.

   The object properties are displayed in the Inspector window.
2. Click "Animations > New animation" in the Inspector window.

   The animations available for the selected object are displayed.
3. Select the "Appearance" animation.

   The parameters of the animation are displayed.
4. Click "Tag" to open the list of tags, then select which tag will be used to control the appearance of the object.

   The tag appears in the "Tag" field.
5. Select a data type for the tag. The number of values or intervals you can define for controlling the object appearance depends on the data type of the tag.
6. Click in the first cell of the "Value" or "Range" column.



Appearance

Tag

Name: HMI_Tag_1

Address:

Type

● Range

Multiple bits

Single bit 0

Range	Foreground color	Background color	Flashing
0 - 20	0, 0, 128	255, 255, 255	No
21 - 60	255, 72, 35	255, 255, 255	No
<Add new>			

7. Enter a tag value:

   Enter a tag value for "Single bit" and "Multiple bits" in the "Value" column.

   Enter a tag interval for a range, 0 - 60 for example, in the "Range" column.

8. In the "Foreground color" and "Background color" columns, select the colors the object is two acquire in Runtime when the tag reaches the set value or interval.

9. Select a flashing mode for the object from the "Flashing" list.

10. Repeat steps 6 to 10 if you want to define the appearance of another value or an interval of the tag.

Result

In Runtime, the flashing response, and color of the object change dynamically according to the process value returned in the tag.

See also

Configuring a new animation (Page 1099)

8.2.4.3 Configuring movement

Introduction

You can configure dynamic objects so that they move along a certain path, or to shift by a certain number of pixels relative to their current position. The movement is controlled via tags. Whenever the tags are updated, the object moves on one step.

You can only program one type of movement for each object. The following types of movement are available:

- "Diagonal movement", "Horizontal movement" or "Vertical movement":

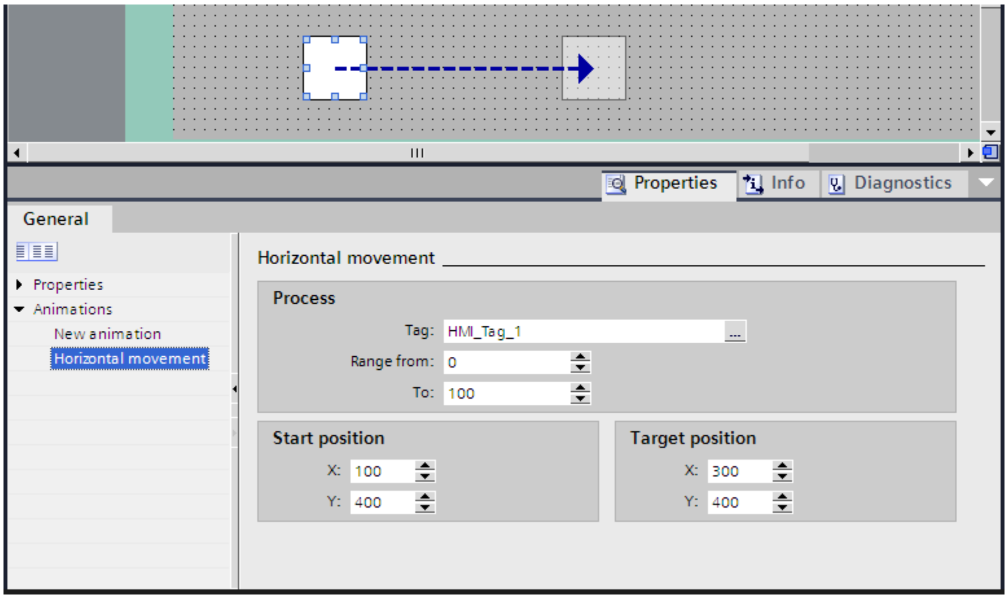
  The object moves along a path which has defined start and end points. The relative position of the object along this path is determined by the value of a tag.

- "Direct movement"

The object is moved in the X and Y directions by a certain number of pixels. The movement is defined by the absolute values in two variables.

Graphic programming support

The "Screens" editor allows graphic programming of diagonal, horizontal and vertical movements. During configuration, a transparent copy of the object is shown on screen. This copy is connected to the source object by an arrow. When you move the object copy to the desired destination, the system automatically saves the pixel values corresponding to the movement in the Inspector window.



Horizontal movement

Process

Tag: HMI_Tag_1

Range from: 0

To: 100

Start position

X: 100

Y: 400

Target position

X: 300

Y: 400

Requirement

- You have opened a screen which contains at least one dynamic object.
- The Inspector window is open.
- The Toolbox window is displayed.

Configuring "Diagonal movement", "Horizontal movement" or "Vertical movement"

Proceed as follows to configure the animations:

1. Select the screen object you want to control dynamically.

   The object properties are displayed in the Inspector window.
2. Click "Animations > New animation" in the Inspector window.

   The animations available for the selected object are displayed.
3. Select a type of movement.

   The parameters of the animation are displayed.
4. Select a tag for control of movement.

   A transparent copy of the object is shown in the work area, which is connected to the source object by means of an arrow.

5. Move the object copy to the relevant destination. The system automatically enters the pixel values of the final position in the Inspector window.
6. Customize the range of values for the tag as required.

Configuring "Direct movement"

Proceed as follows to configure the "Direct movement" animation:

1. Select the screen object you want to control dynamically.

   The object properties are displayed in the Inspector window.
2. Click "Animations > New animation" in the Inspector window.

   The animations available for the selected object are displayed.
3. Select "Direct movement".
4. Select a tag for controlling the offset in the X direction.
5. Select a tag for controlling the offset in the Y direction.

Result

In Runtime, the object moves in response to every change in value of the tag that is used to control the movement. The direction of movement corresponds to the configured type of movement.

See also

Configuring a new animation (Page 1099)

8.2.4.3 Dynamizing the visibility of an object

Introduction

You can control the visibility of an object dynamically. If a tag value falls within a configured interval, the object is shown, or hidden in Runtime.

The "Simple recipe view" and "Simple alarm view" objects are always visible.

Application example

Dynamization of the "Visibility" property allows you to output an alarm to your screen, which is triggered when the tag value exceeds a critical range, for example. The alarm is cleared when the tag value returns to the non-critical range.

Requirement

- You have opened a screen containing an object that you want to show or hide in Runtime.
- The Inspector window is open.

Procedure

1. Select the control element you want to control dynamically.

The object properties are displayed in the Inspector window.

2. Click "New Animation" in the "Animations" group of the Inspector window.

   The animations available for the selected object are displayed.

3. Select the "Visibility" animation.

   The parameters of the animation are displayed.

4. Set the required "Status": "Visible" or "Hidden."

   The selected status is set at the start of Runtime if you do not define a tag for controlling the status.

5. To control the display of an object using a tag, select a tag and define an interval.

   The set object status is applied as long as the tag value lies within the range of the set interval.

Result

The object is shown or hidden in Runtime, depending on the tag value.

See also

Configuring a new animation (Page 1099)

8.2.4.3 Animations for object groups and for multiple selection

Applying animations to object groups

You can configure all animations for an object group that are supported by an individual object from the object group. If you configure an animation for an object group, this animation will apply to all individual objects that support this animation.

Changing animations for multiple objects

For a multiple selection, the animations that are configured for the reference object appear in the Inspector window. You can change the animations as usual. The changes will apply to all the objects in the multiple selection that support the configured animation. This means that even objects for which you have not yet configured an animation will have the reference object's animation.

Application example

Select a button, and a circle at the same time. The button is the reference object. The "Appearance" animation is already configured for the button, so it appears in the Inspector window of the multiple selection. If you activate the "Flashing" property in the "Animations" group, the settings for the "Appearance" animation will then apply to both the button and the circle.

Configuring new animations for multiple objects

If you configure a new animation for the objects of a multiple selection, this animation will apply to all selected objects that support the configured animation. If the new animation replaces an existing animation, a security prompt appears.

Application example

You select a circle, and a rectangle. The "Diagonal movement" animation is already configured for the circle. You configure the "Horizontal movement" animation for the multiple selection. This animation applies to the rectangle since no animation of the Movement type is yet configured for it. For the circle, you are asked to confirm that you want to replace the existing "Diagonal movement" animation with the new "Horizontal movement" animation.

See also

Configuring a new animation (Page 1099)

8.2.5 Working with function keys

8.2.5.1 Working with function keys

Introduction

The function key is a physical key on your HMI device and its functions can be configured. A function list can be configured for the events "Key pressed" and "Release key".

A function key can be assigned global or local functions.

Note
Availability for specific HMI devices

Function keys are not available on all HMI devices.

Global function keys

Global function keys always trigger the same action, regardless of the displayed screen.

Global function keys are configured in the "Global Screen" editor. The global assignment applies for all the screens of the set HMI device.

Global function keys reduce programming considerably, because there is no need to assign these global keys to each individual screen.

Local function keys in screens

Local function keys in screens can trigger a different action in each screen. This assignment applies only to the screen in which you have defined the function key.

Using a local function key you can overwrite global function keys and the local function keys of a template.

Note

If a screen with local function keys is overlapped by an alarm view or an alarm window, then the function keys are still active in runtime. This may happen in particular on HMI devices with a small display.

Local function keys in templates

Local functions keys that are assigned in templates are valid for all the screens based on this template. They can trigger a different action in every screen. Function keys for templates are assigned in the template of the "Screens" editor. You overwrite the global assignment of a function key by a local assignment in the template.

Hotkey assignment

You can assign hotkeys, such as buttons, to control objects. The available hotkeys depend on the HMI device.

Note

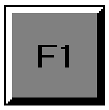
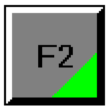
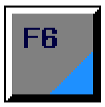
The function key has a local or global action assigned to it. If the function key also has a hotkey assigned to it, then the hotkey function will be executed in Runtime.

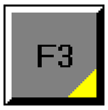
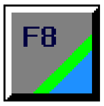
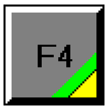
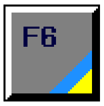
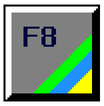
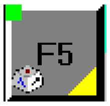
Graphics

When a function key is placed directly next to the display, you can assign a graphic to it to make the function of the function key more clear.

Display of assignment

Table8-1 The following table shows which symbols display the assignment of the function keys:

Function key	Description
	Not assigned
	Global assignment
	Assigned locally in the template

Function key	Description
	Local assignment
	Local assignment (local assignment of the template overwrites global assignment)
	Local assignment (local assignment overwrites global assignment)
	Local assignment (local assignment overwrites local assignment of the template)
	Local assignment (local assignment overwrites local assignment of the template, which already overwrites global assignment)
	Assigning buttons with screen navigation

Note
Basic Panels

The "Screen Navigation" editor is not available for Basic Panels.

See also

Screen basics (Page 1025)
Assigning function keys globally (Page 1109)
Local assignment of function keys (Page 1110)
Assigning a function key to a function (Page 1111)
Assigning operator authorization for a function key (Page 1112)
Assigning a function key to a graphic (Page 1114)
Example: Using function keys for screen navigation (Page 1115)

8.2.5.2 Assigning function keys globally

Introduction

You define the global assignment of a function key in the "Global Screen" editor. The global assignment applies to all screens of the set HMI device.

Note
Availability for specific HMI devices

Function keys are not available on all HMI devices.

Requirement

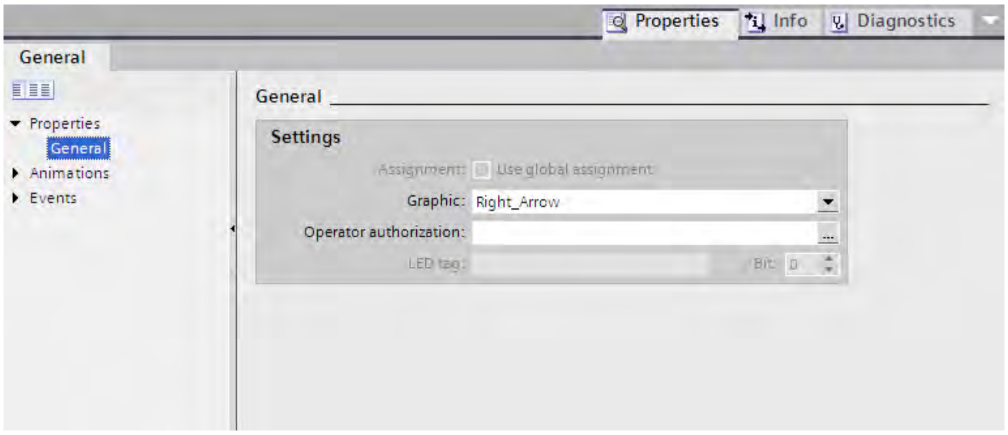
- You have opened the project.
- The Inspector window is open.

Procedure

Proceed as follows to assign a screen-based function to a function key:

1. To open the "Global Screen" editor, double-click "Global Screen" in the "Screen management" group of the Project window.
2. Select the desired function key.

   The properties of the function key are shown in the Inspector window.



Assignment: ☐ Use global assignment
Graphic: Right_Arrow
Operator authorization:
LED tag:
Bit: 0

3. Under "General", configure a graphic and an operator authorization for the function key.
4. Configure a function list for the required event under "Events".

Result

If a local assignment does not overwrite the global assignment, the assignment of the function key changes in all the screens of the set HMI device in accordance with your entry.

See also

Working with function keys (Page 1106)

8.2.5.3 Local assignment of function keys

Introduction

Function keys are assigned globally and locally. A local assignment of the function keys is only valid for the screen or the template in which it was defined. The following local function keys are available:

- Local function keys of a screen

  Different functions are assigned to the function key for each screen. This assignment applies only to the screen in which you have defined the function key.
- Local function keys of a template

  You assign the function keys in a template. The assignment applies to all the screens that are based on this template and are not overwritten by a local assignment in a screen.

A local assignment overwrites the global assignment of a function key.

Note

Availability for specific HMI devices

Function keys are not available on all HMI devices.

Using existing assignments

The option for using existing assignments is referred to as follows in the Inspector window:

- In a template: "Use global assignment"
- In a screen:
  - Screen based on a template: "Use local template"
  - Screen not based on a template: "Use global assignment"

The "Use local template" option includes the use of the local assignment in the template and the global assignment.

Requirement

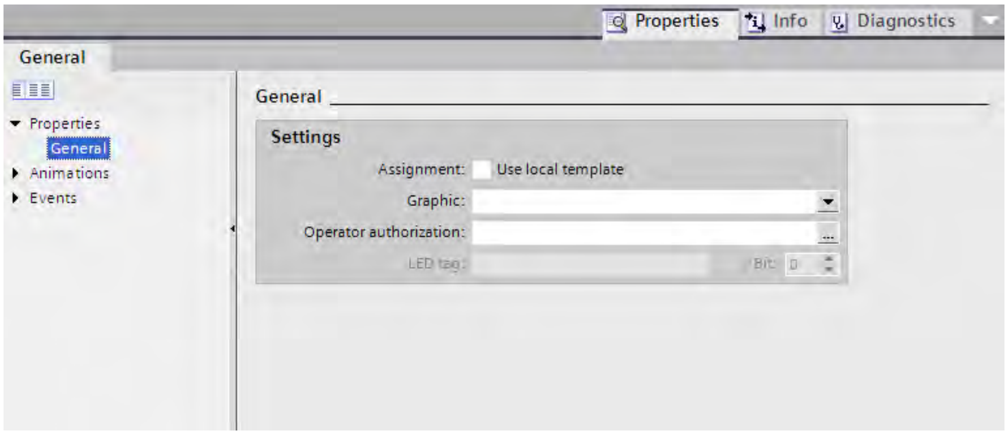
- You have opened the screen or the template in which you want to assign a function key locally.
- The Inspector window is open.

Procedure

Proceed as follows:

1. Select the desired function key in the screen or in the template.

   The properties of the function key are shown in the Inspector window.
2. Click "General" in the Inspector window.



Assignment: Use local template
Graphic:
Operator authorization:
LED tag:
Bit: 0

3. Disable the "Use local template" or "Use global assignment" option.
4. Under "General", configure a graphic and an operator authorization for the function key.
5. Configure a function list for the required event under "Events".

Result

The function key is assigned the configured function in the screen or in the template.

See also

Working with function keys (Page 1106)

8.2.5.4 Assigning a function key to a function

Introduction

A function key can have two states:

- Pressed: Defined by the "Key pressed" event.
- Released: Defined by the "Release key" event.

Both of these events are configured in the Inspector window of the function key. You can assign any event a function list which contains system functions or scripts. Execution of this function list is event-driven in runtime.

Note
Availability for specific HMI devices

Function keys are not available on all HMI devices.

Note
Basic Panels

Scripts are not available for Basic Panels.

Requirement

To assign the function key a global function:

- The "Global Screen" editor is open.

To assign the function key a local function:

- The screen in which you want to assign a function key is open.

If you want to assign a function key locally in a template:

- The template in which you want to assign a function key is open.
- The Inspector window is open.

Procedure

Proceed as follows:

1. Select the function key you want to define.

   The properties of the function key are shown in the Inspector window.
2. Configure the function list for the desired result in the Inspector window under "Properties" in the "General" group.

Result

The function list is executed in runtime when the operator presses or releases the function key.

See also

Working with function keys (Page 1106)

8.2.5.5 Assigning operator authorization for a function key

Introduction

In WinCC you can assign an operator authorization for a function key in runtime. This allows you to restrict access to the function keys to specific persons or operator groups when you configure your project. Only authorized personnel can then change important parameters and settings in runtime.

You configure access protection in order to avoid operator errors and increase plant or machine security.

Note
Availability for specific HMI devices

Function keys are not available on all HMI devices.

Requirement

- The user groups have been defined.

To protect a global function key:

- The "Global Screen" editor is open.

If you want to protect a local function key of a screen or of a template:

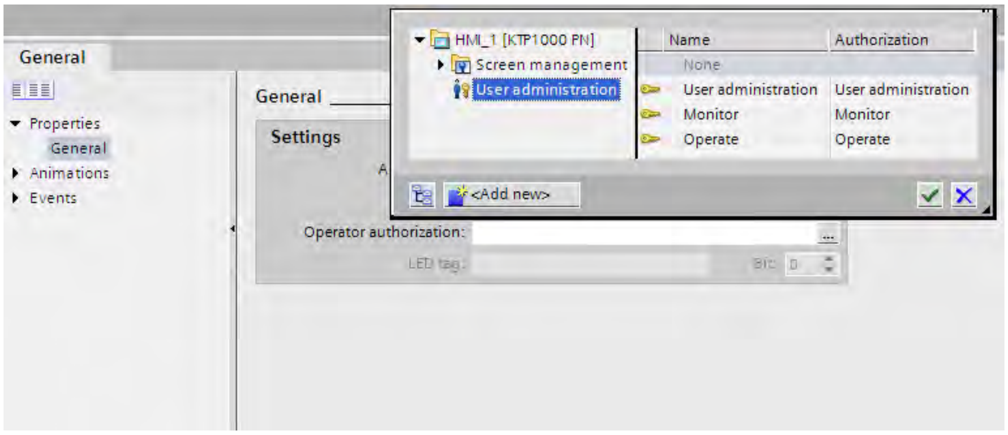
- The screen or the template which contains the function key is open.
- The Inspector window is open.

Procedure

Proceed as follows:

1. Select the relevant function key.

   The properties of the function key are shown in the Inspector window.
2. Click "General" in the Inspector window.



Name	Authorization
None	
User administration	User administration
Monitor	Monitor
Operate	Operate

3. In the "Authorization" list, select the user group you want to allow runtime access to the function key.

Result

The operator authorization is configured.

See also

Working with function keys (Page 1106)

8.2.5.6 Assigning a function key to a graphic

Introduction

In order to make the function of a key more clear, you can insert a graphic in the screen alongside the function key. Graphics can only be assigned to function keys that border the screen margin of the HMI device.

Note
Availability for specific HMI devices

Function keys are not available on all HMI devices.

Requirement

To assign a graphic to a global function key:

- The "Global Screen" editor is open.

If you want to assign a graphic to a local function key in a screen or template:

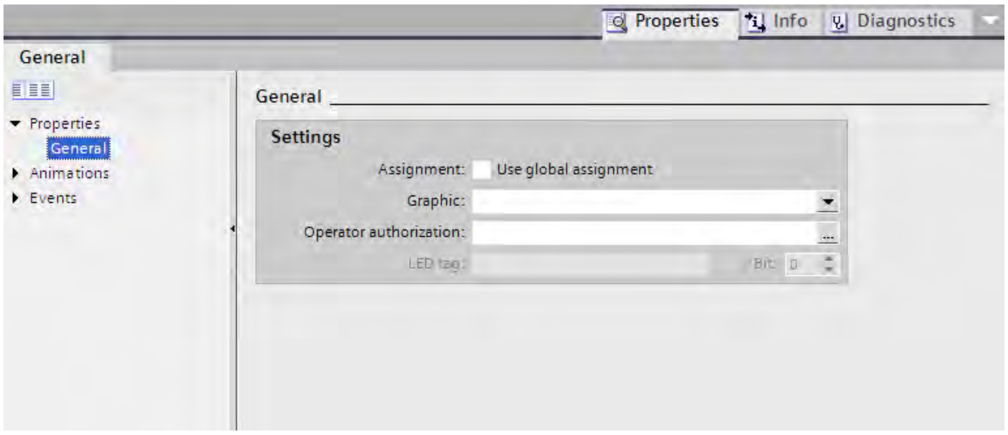
- The screen or the template that contains the corresponding function key is open.
- The Inspector window is open.
- You have created the graphic for the function key.

Procedure

Proceed as follows:

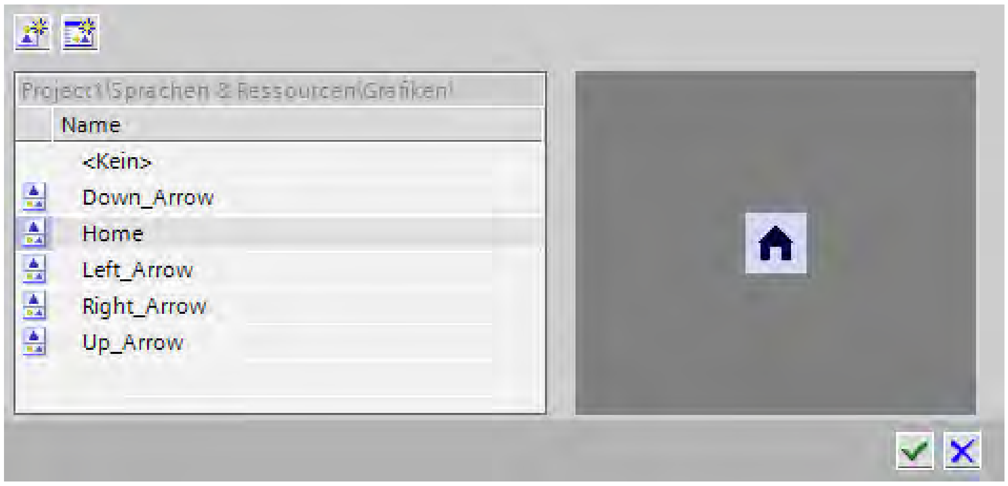
1. Select the relevant function key.

   The properties of the function key are shown in the Inspector window.
2. Click "General" in the Inspector window.



3. Click in the "Graphic" area of the list.

The graphic browser of your WinCC project appears. The pane on the left side shows the external graphics which are stored in the browser. The pane on the right side shows you a preview of the graphic you have selected in the browser.



Using the

and

icons, you can display the collection either in form of thumbnails or as a list.

In order to open and edit OLE objects with the associated graphics program, double-click on the object.

4. In the browser click the desired graphic or store the relevant graphic in the graphic browser.

   The graphic preview is shown in the right pane.

5. Click "Select" to add the graphic to the screen.

   Click "Clear" to remove the graphic from the screen.

Result

The graphic is displayed next to the function key.

See also

Working with function keys (Page 1106)

8.2.5.7 Example: Using function keys for screen navigation

Task

In this example you create a local function key in a screen. When the operator presses this function key, a screen change to a predefined screen is triggered, for example "Boiler 2".

Note

Availability for specific HMI devices

Function keys are not available on all HMI devices.

Requirement

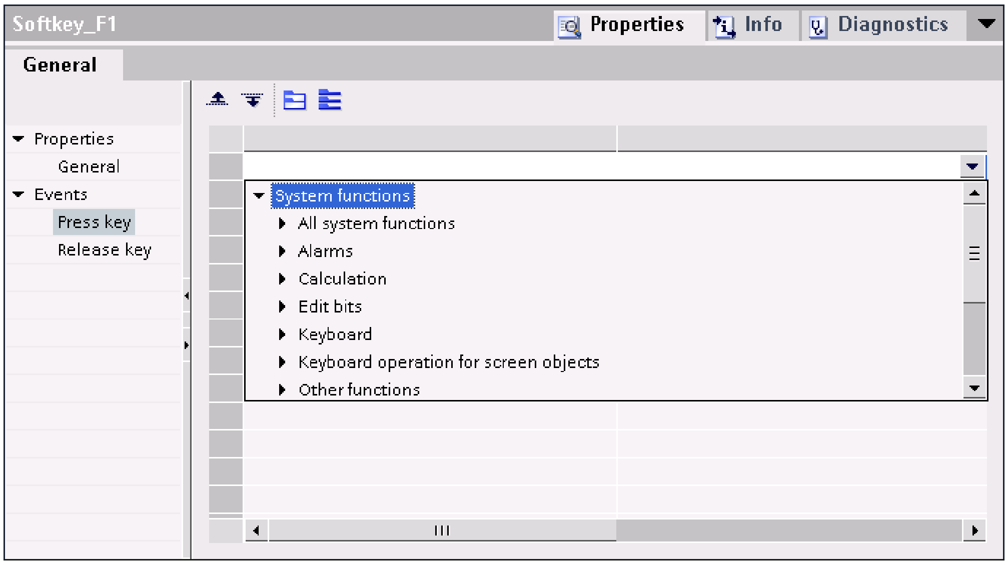
- The screen in which you want to assign the function key is open.
- You have created the "Boiler 2" screen.
- The Inspector window is open.

Procedure

Proceed as follows to use the "ActivateScreen" function:

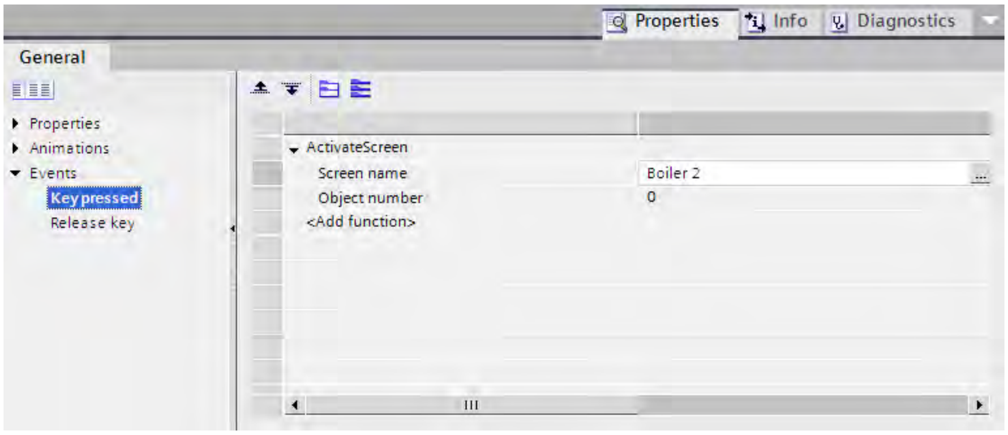
1. Select the desired function key.

   The properties of the function key are shown in the Inspector window.
2. Click "General."
3. To overwrite a global assignment, disable the "Use local template" option.
4. Click "Key pressed" under "Events".



5. Select the "ActivateScreen" system function from the list.

   The "ActivateScreen" function appears in the "Function list" dialog box, including the "Screen name" and "Object number" parameters.



ActivateScreen
Screen name: Boiler 2
Object number: 0
<Add function>

6. Select the "Boiler 2" screen from the "Screen name" list.

Result

The operator changes to the "Boiler 2" screen in runtime by pressing the selected function key.

See also

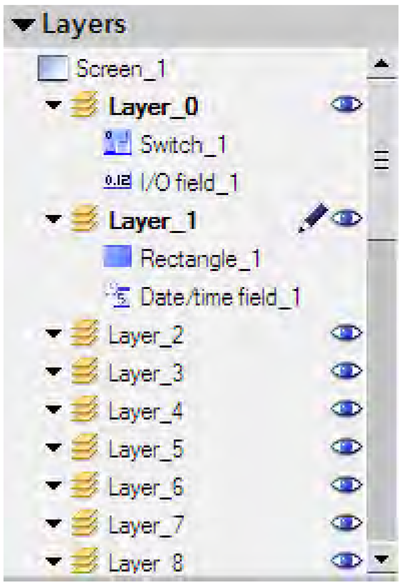
Working with function keys (Page 1106)

8.2.6 Working with layers

8.2.6.1 Basics on working with layers

Layers

Use layers in order to achieve differentiated editing of the objects in a screen. A screen consists of 32 layers that you can give any names. If you assign objects to the layers, you thereby define the screen depth. Objects of layer 0 are located at the screen background, while objects of layer 31 are located in the foreground.



The objects of a single layer are also arranged hierarchically. When you create a screen, the object inserted first is located at the rear within the layer. Each further object is placed one position towards the front. You can shift objects forwards and backwards within a layer.

Principle of the layer technique

Always one layer of the 32 layers is active. New objects you add to the screen are always assigned to the active layer. The number of the active layer is indicated in the "Layer" toolbar and in the Inspector window of the screen.

When you open a screen, all 32 layers of the screen are displayed. You can hide all layers except the active layer in the Inspector window of the screen. You then explicitly edit objects of the active layer.

Use the Inspector window of the screen to define if the layers are to be shown for the Engineering System only. This function is useful if you want to hide data in the screen.

In the tree view of the "Layers" palette in the "Layout" task card, you administer layers and objects with drag-and-drop and the context menu.

Application examples

Use layers, for example, in the following cases:

- To hide the labeling of objects when editing,
- To hide objects, such as alarm windows, while configuring further screens.

See also

Screen basics (Page 1025)
Moving objects between layers (Page 1119)
Setting the active layer (Page 1120)
Show and hide layers (Page 1121)
Renaming layers (Page 1122)

8.2.6.2 Moving objects between layers

Introduction

By default, a new object is inserted on the active layer. You can, however, assign an object to another layer at a later time.

Requirement

- A screen with an object is open.
- The Inspector window is open.

Moving objects to another layer

Proceed as follows to move objects to a different layer:

1. Select the object in the screen.

   The object properties are displayed in the Inspector window.
2. Click "Miscellaneous."
3. Under "Layer", enter the layer to which you want to move the object.

   Alternatively, select the object from the "Layout" task card and drag it to the required layer.

Changing the order of objects

Proceed as follows:

1. Select the object in the screen.

   The object properties are displayed in the Inspector window.
2. To move the object to the front or back, select the "Order" > "Move backward" or "Move forward" command from the shortcut menu.

   Alternatively, use the

   or

   icons in the toolbar.

Assign an object to an adjacent layer

Proceed as follows:

1. Select the object in the screen.

   The object properties are displayed in the Inspector window.
2. To assign the object to the next lowest or next highest layer, select the "Order" > "Move backward" or "Move forward" command from the shortcut menu.

   Alternatively, use the

   or

icons in the toolbar.

Result

The object is assigned to the selected layer, and positioned at the top of the layer.

See also

Basics on working with layers (Page 1117)

8.2.6.3 Setting the active layer

Introduction

The screen objects are always assigned to one of the 32 layers. There is always an active layer in the screen. New objects you add to the screen are always assigned to the active layer.

The number of the active layer is indicated in the "Layer" toolbar. The active layer is indicated by the

icon in the "Layout" task card in the "Layers" palette.

Layer 0 is the active layer when you start programming. You can activate a different layer during configuration, if necessary.

Requirement

- You have opened a screen which contains at least one object.
- The Inspector window of the active screen is open.

Activating a different layer

Proceed as follows to activate other layers:

1. Click "Layers" in the Inspector window of the current screen.
2. Enter the layer number in the "Active layer" field under "Settings."

Alternative procedure

Proceed as follows:

1. Select the "Layers" palette in the "Layout" task card.
2. Select the "Active layer" command from the context menu.

Result

The layer with the specified number is now active.

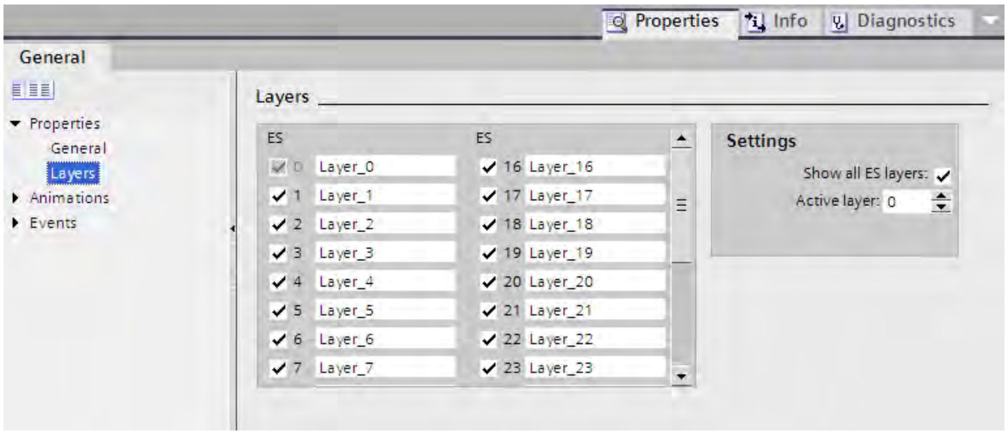
See also

Basics on working with layers (Page 1117)

8.2.6.4 Show and hide layers

Introduction

You can show or hide the layers of a screen as required. You specify the layers that are shown in the Engineering System. When you open a screen, all the layers are always shown.



ES			ES		
✓	0	Layer_0	✓	16	Layer_16
✓	1	Layer_1	✓	17	Layer_17
✓	2	Layer_2	✓	18	Layer_18
✓	3	Layer_3	✓	19	Layer_19
✓	4	Layer_4	✓	20	Layer_20
✓	5	Layer_5	✓	21	Layer_21
✓	6	Layer_6	✓	22	Layer_22
✓	7	Layer_7	✓	23	Layer_23

Settings
Show all ES layers: ✓
Active layer: 0

Requirement

- The screen is opened.
- The "Layout" task card is open.

Hiding or showing layers

Proceed as follows to hide or show layers:

1. Select the layers that you want to hide or show in the "Layout" task card of the "Layers" palette.
2. Click one of the icons next to the corresponding layer:
   –
     A shown layer is hidden
   –
     A hidden layer is shown

Note

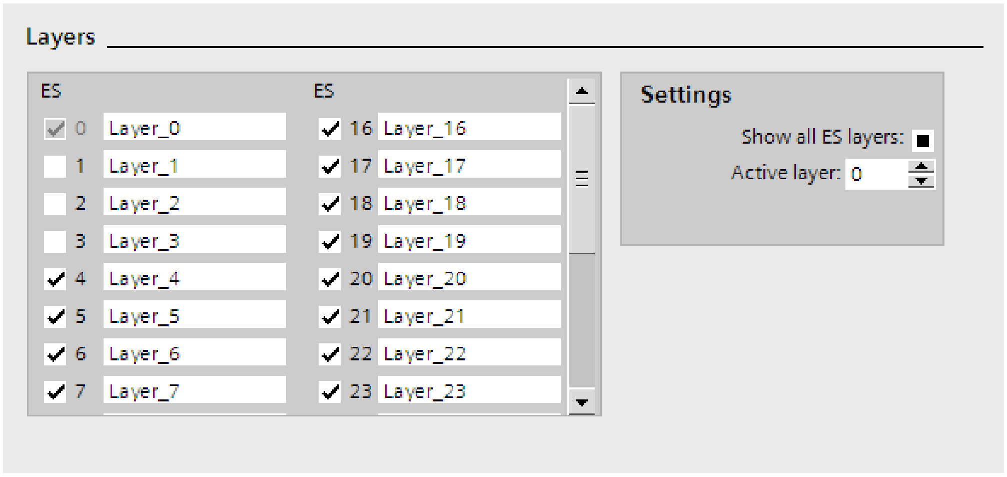
The active layer cannot be hidden.

Using the Inspector window to show or hide layers

Proceed as follows to show or hide layers using the Inspector window:

1. Click in an area of the screen that does not contain an object.

   The screen properties are shown in the Inspector window.
2. Click "Layers" in the Inspector window.



Layers

ES			ES		
✓	0	Layer_0	✓	16	Layer_16
	1	Layer_1	✓	17	Layer_17
	2	Layer_2	✓	18	Layer_18
	3	Layer_3	✓	19	Layer_19
✓	4	Layer_4	✓	20	Layer_20
✓	5	Layer_5	✓	21	Layer_21
✓	6	Layer_6	✓	22	Layer_22
✓	7	Layer_7	✓	23	Layer_23

Settings

Show all ES layers: ■

Active layer: 0

3. In the list, enable, or disable the layers that you want to show, or hide.

   If you activate "All ES layers" for a layer, the objects in this layer will be shown in the Engineering System.

Result

The layers are shown according to your settings.

See also

Basics on working with layers (Page 1117)

8.2.6.5 Renaming layers

Introduction

When you create a screen, the 32 layers are numbered consecutively by default. To improve clarity, you can rename the layers to suit your requirements.

Requirement

- The screen is opened.
- The "Layout" task card is open.

Renaming a layer in the "Layout" task card

Proceed as follows to rename a layer in the "Layout" task card:

1. Select the layer that you want to rename in the "Layers" palette.
2. Select "Rename" from the shortcut menu.

You can now edit the name of the layer.

3. Enter the new name.

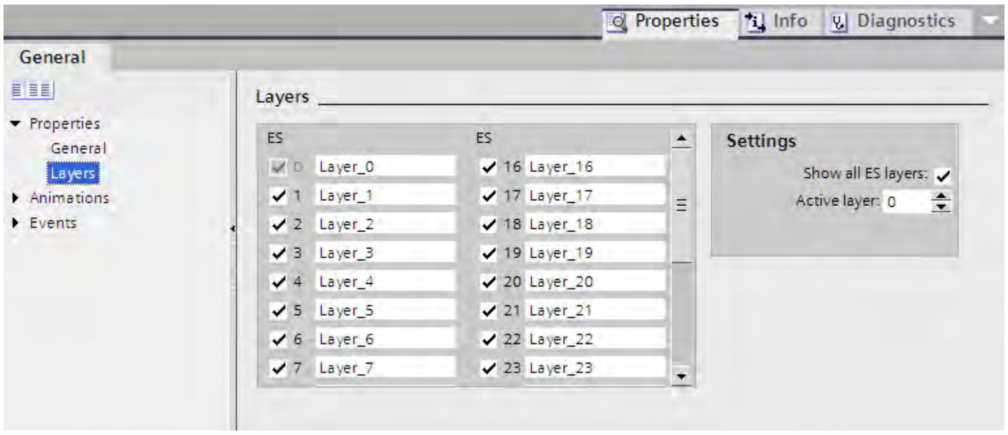
Renaming layers in the Inspector window

Proceed as follows to rename a layer in the Inspector window:

1. Click in an area of the screen that does not contain an object.

   The screen properties are shown in the Inspector window.

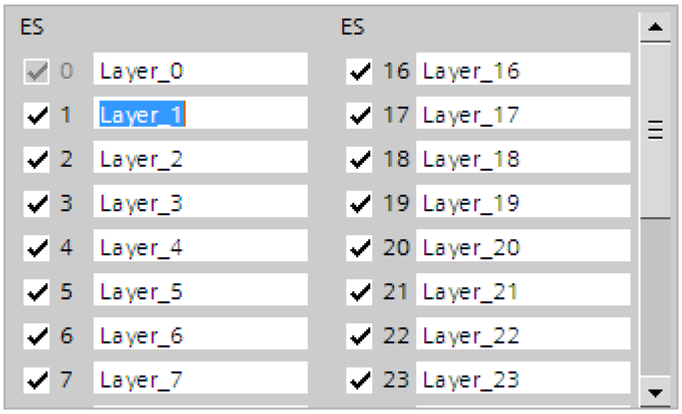
2. Click "Layers" in the Inspector window.



ES			ES		
✓	0	Layer_0	✓	16	Layer_16
✓	1	Layer_1	✓	17	Layer_17
✓	2	Layer_2	✓	18	Layer_18
✓	3	Layer_3	✓	19	Layer_19
✓	4	Layer_4	✓	20	Layer_20
✓	5	Layer_5	✓	21	Layer_21
✓	6	Layer_6	✓	22	Layer_22
✓	7	Layer_7	✓	23	Layer_23

Show all ES layers: ✓
Active layer: 0

3. Enter the new layer name.



ES			ES		
✓	0	Layer_0	✓	16	Layer_16
✓	1	Layer_1	✓	17	Layer_17
✓	2	Layer_2	✓	18	Layer_18
✓	3	Layer_3	✓	19	Layer_19
✓	4	Layer_4	✓	20	Layer_20
✓	5	Layer_5	✓	21	Layer_21
✓	6	Layer_6	✓	22	Layer_22
✓	7	Layer_7	✓	23	Layer_23

Result

The layer is displayed with the new name.

See also

Basics on working with layers (Page 1117)

8.2.7 Working with libraries

8.2.7.1 Basics on libraries

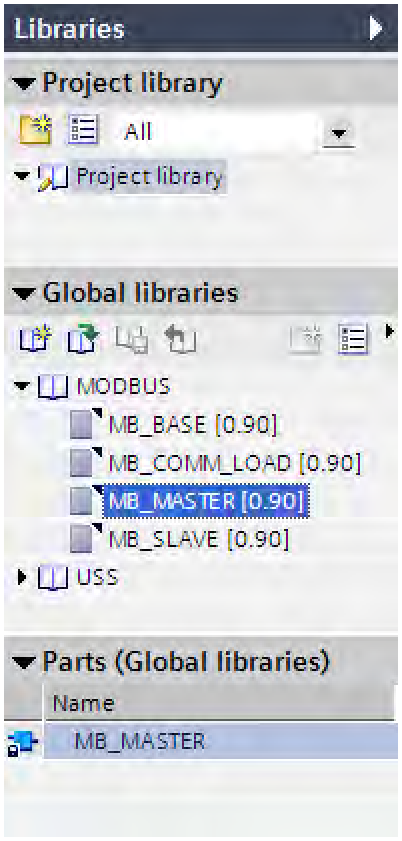
Introduction

Store all objects you need frequently in the libraries. An object that is stored in the library only has to be configured once. It can then be used repeatedly as often as required. Library objects extend the number of available screen objects and increase the effectiveness during configuration through the multiple usage of ready-to-use objects.

Your WinCC software package is supplied with comprehensive libraries that contain, for example, "Motor" or "Valve" objects. You may, however, define your own library objects.

Libraries are managed in the "Libraries" task card. The following libraries are available here if library objects are stored:

- Project library
- Global libraries



Note

There is a symbol library in the "Tools" task card in the "Elements" palette.

Library objects

A library can contain all WinCC objects. Examples:

- Complete HMI device
- Screens
- Display and control objects including tags and functions
- Object groups including tags and functions
- Graphics
- Tags
- Alarms
- Text and graphics lists
- Logs
- Scripts

To use a library object in a project, copy the object and all referenced objects to the project. The copied object looses its interconnection with the library. Changes in the library do not affect any of the copied library objects.

Note
Basic Panels

No scripts or logs are available for Basic Panels.

Project library

There is one library for each project. Objects of the project library are stored alongside with the project data and are available only for the project in which the library was created. When you move the project to a different computer, the project library created therein is included.

To use the library object of the project library in other objects, move or copy the object into a global library.

Global libraries

In addition to the objects from the project library, you can also incorporate objects from global libraries in your projects. A global library is stored independent of the project data in a separate file with the extension *.al10.

If you want to use a global library from another project, open the corresponding library.

A project can access several global libraries. A global library may be used concurrently in several projects.

When a library object is changed by a project, this library will be changed in all projects in which these libraries are open.

Among the global libraries you will also find the libraries supplied with your WinCC package.

Categories

To sort library objects by topics, you can either split a library into categories or create several global libraries. A particular global library may contain all of the objects you need to configure motor controls, for example. Another global library may contain all of the objects you need to configure the pump controls.

Parts

The components of a library element or the element are displayed in the "Parts" palette, depending on the element type:

- When a single object is assigned to the library, this object is shown in the "Parts" palette.
- If a group of several objects are assigned to the library, the group is shown in the "Parts" palette and not the objects it contains.
- When a selection of multiple objects is assigned to the library, only one of the objects with name is shown under "Global libraries". The "Parts" palette, however, contains all objects that were inserted with this object.
- When a complete screen is assigned to a library with all its objects, the name of the screen is shown under "Global libraries" and in the "Parts" palette. The individual objects are not displayed. If you change the name of this element in the global library, the name of the screen remains unchanged in the "Parts" palette.

See also

Screen basics (Page 1025)
Displaying library objects (Page 1126)
Managing library objects (Page 1129)
Storing an object in a library (Page 1130)
Inserting a library object (Page 1131)
Creating a global library (Page 1132)
Saving a global library (Page 1133)
Opening a global library (Page 1134)

8.2.7.2 Displaying library objects

Introduction

The libraries are displayed as file folders in the corresponding palette. The elements contained in the library are displayed in the file folder and in the "Elements" palette.

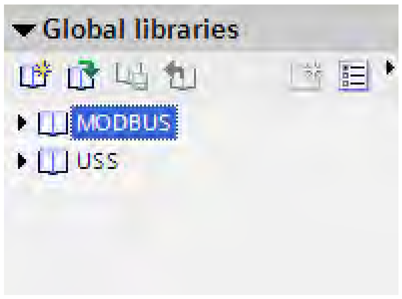
Requirement

- At least one library object has been created in a library.
- The "Libraries" task card is opened.

Displaying library elements

Proceed as follows to display the elements contained in a library:

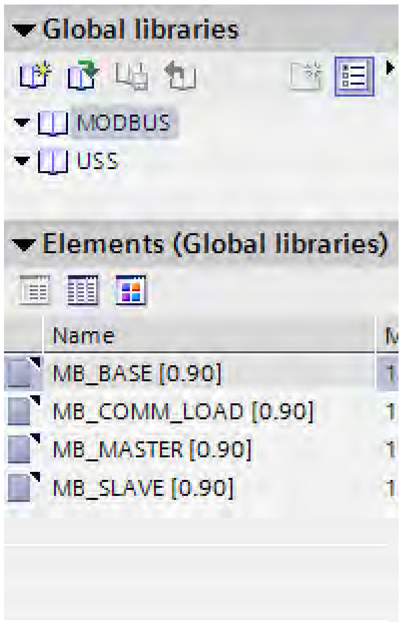
1. Select the library in the corresponding palette whose library objects you want to display.



2. Click

.

The contained library objects are displayed in the "Elements" palette.



3. Click one of the following icons:

Icon	Description
▦	Element view in detailed mode

Icon	Description
▦	Element view in list mode
▦	Element view in overview mode with icons

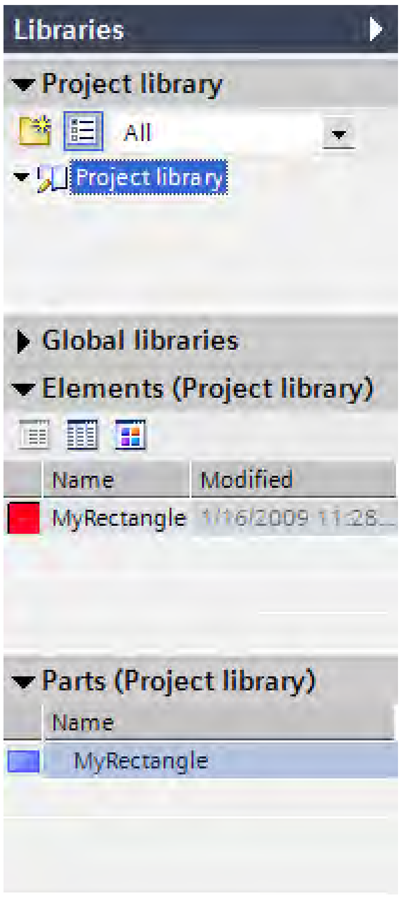
When several objects are assigned to the library with a multiple selection, only one of the objects is shown in the "Elements" palette. The individual components of this element are displayed in the "Parts" palette.

Displaying parts of library elements

Proceed as follows to display the objects assigned to a library with a multiple selection:

1. Select the library in the corresponding palette from which you want to view the components of an element.
2. Click ☰ .
3. The contained library objects are displayed in the "Elements" palette.
4. Select the element.

   The "Parts" palette shows the objects of which the element consists.



Result

The library objects are displayed in accordance with the configuration. The components of the faceplates are displayed.

See also

Basics on libraries (Page 1124)

8.2.7.3 Managing library objects

Introduction

You can always copy or move library objects within the categories of a library. Delete the library objects you do not require.

Requirement

- You have opened a library which contains several categories and at least one object.
- The library object is shown.

Moving a library object

Proceed as follows to move a library object:

1. Select the library object.
2. Drag-and-drop the object into the relevant category.

The library object is moved.

Copying a library object

Proceed as follows to copy a library object:

1. Select the library object.
2. Select "Copy" from the shortcut menu.
3. Select the destination category.
4. Select "Paste" from the shortcut menu.

The copy of the library object is pasted into the destination category.

Deleting a library object

Proceed as follows to delete a library object:

1. Select the library object that you want to delete.
2. Select "Delete" from the shortcut menu.

The library object is deleted.

Result

Depending on the selected action, the library object is either moved, or copied, or deleted.

See also

Basics on libraries (Page 1124)

8.2.7.4 Storing an object in a library

Introduction

You can store all of WinCC objects, such as screens, tags, graphic objects or alarms in your libraries. You can use drag-and-drop to move the corresponding object from the work area, project tree or detail view to the library. In a library you have divided into categories, you can directly add objects to a specific category.

Below you can see how to insert the display and operator control from the work area to the library.

Requirement

- The "Screens" editor is open.

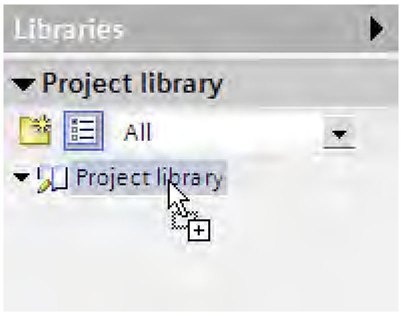
- The object which is to be saved to the library is shown in your work area.
- The created libraries are displayed.

Procedure

Proceed as follows to add an object to a library:

1. Select the object in the work area of the "Screens" editor.
2. Drag-and-drop the object from the work area to the desired library.

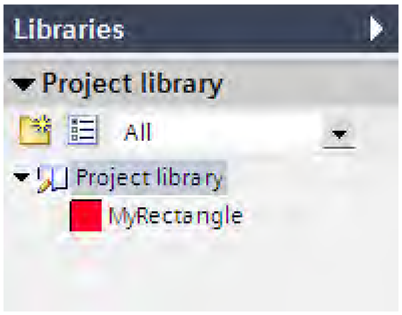
   The mouse pointer is transformed into a crosshair with an appended object icon.



In the same manner, drag other WinCC objects, such as screens, from the project tree to the library.

Result

The object is saved to the library for further use in multiple instances of your configuration.



See also

Basics on libraries (Page 1124)

8.2.7.5 Inserting a library object

Introduction

You can drag-and-drop library objects into the work area or project tree.

The system always assigns the inserted library object a name which consists of the name of the object type and of a consecutive number. If the inserted object already exists, you can use a dialog window to specify whether or not the existing object should be replaced or inserted under a new name. Enter a new name if you do not want to replace the existing object.

You cannot insert library objects that are not supported by the HMI device.

Note

If you insert a screen with interconnected template from the library, the template will also be inserted. Any existing matching template is not used.

Below, you can see an example of a library object in the work area of an editor.

Requirement

- The "Libraries" task card is opened.
- The library that contains the object is selected.
- The editor in which you want to insert the library object is open.

Procedure

Proceed as follows to insert a library object in an editor:

1. Select the library object that you want to insert in the library.
2. Drag-and-drop the library object to the position in the work area where you want to insert the object.

   The library folder is inserted.
3. Select the library object in the screen and resize it using the selection markers.

See also

Basics on libraries (Page 1124)

8.2.7.6 Creating a global library

Introduction

In the libraries you store the configured objects that you want to use several times in your configuration.

Create a global library if you want to use objects in several projects.

Requirement

- You have opened the project.
- The "Libraries" task card is opened.

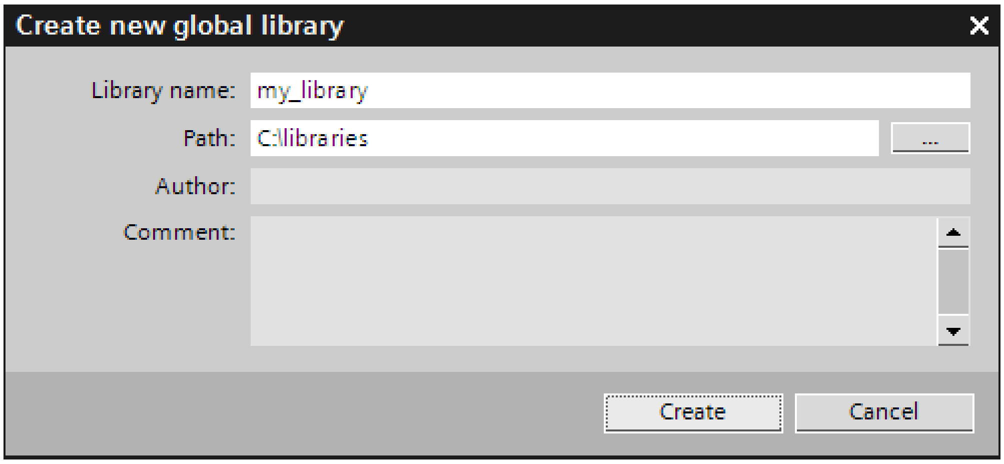
Procedure

Proceed as follows to create a global library:

1. Click the

   icon in the "Libraries" task card in the "Global libraries" palette.

   The "Create new global library" dialog is displayed.



Create new global library

Library name: my_library
Path: C:\libraries
Author:
Comment:

2. Enter a name for the new library and select the path in which the new library is to be stored.
3. Click "Save."

Result

The new library is shown in the "Global libraries" palette. You can save objects to the library.

See also

Basics on libraries (Page 1124)

8.2.7.7 Saving a global library

Introduction

A global library is stored in a separate file on your hard disk drive. The file contains the objects of the global library including the referenced objects. For example, the reference to a tag configured for an I/O field is also stored in the library.

WinCC prompts you to save the global libraries when you close WinCC or your project without saving. You also can store the global library during configuration, without having to store the entire project.

Requirement

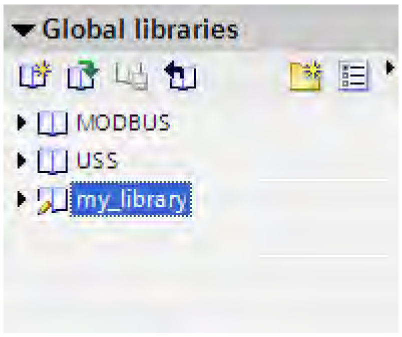
- You have opened a project which contains at least one library.

- The "Libraries" task card is opened.

Storing a library

Proceed as follows to store a global library:

1. Select the global library that you want to save.



2. Click the

icon in the "Libraries" task card in the "Global libraries" palette.

You can alternatively select the "Save Library" command in the shortcut menu.

If you want to save the global library in another folder, select the "Save As" command in the shortcut menu, select the path where the new library should be saved and enter a file name.

Result

The global libraries are saved under their current file name or a file name you have specified.

See also

Basics on libraries (Page 1124)

8.2.7.8 Opening a global library

Introduction

In WinCC, the global libraries are stored in separate files. You can use a global library in any project by opening the relevant library.

Requirement

- You have saved a global library.
- You have opened the project in which you want to use the global library.
- The "Libraries" task card is opened.

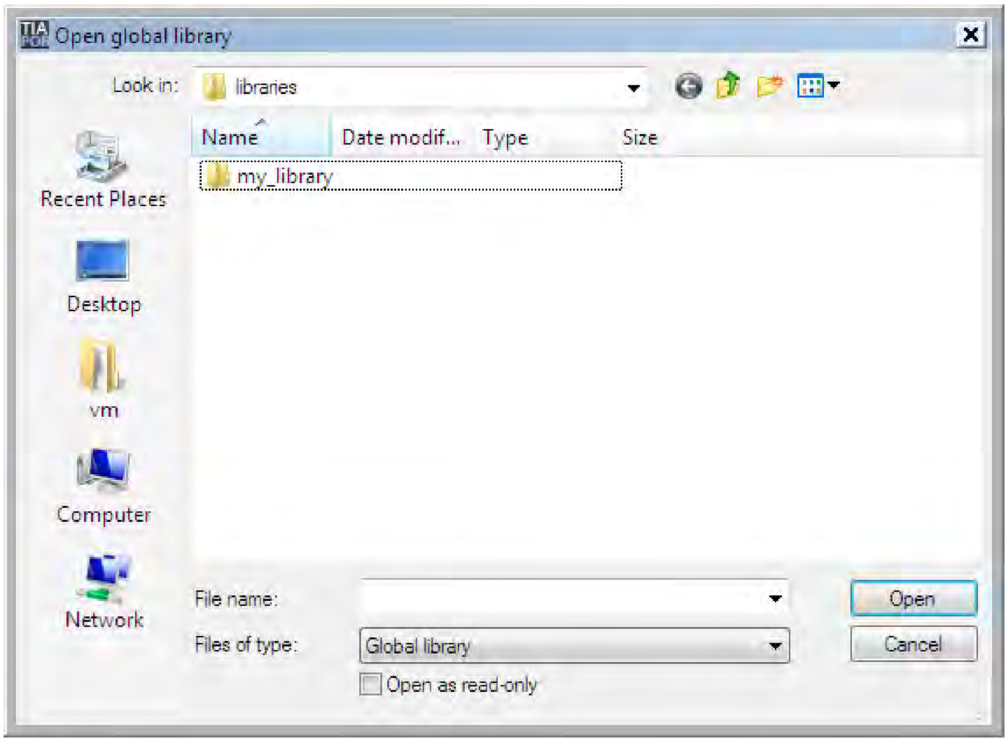
Procedure

Proceed as follows to open a global library:

1. Click the

   "Open global library" icon in the "Global libraries" palette.

   The "Open global library" dialog box is displayed.



2. Select the path, library folder and file name under which the library is to be saved.
3. Click "Open."
4. Deactivate "Open as read-only" if you want to change the library.

Note

If you want to access a global library from several projects, the global library will have to be read-only when you open it. To do this, enable the "Open as read-only" option in the "Open global library" dialog. As soon as a global library is read-only, access from other projects is blocked.

Result

WinCC displays the opened global library in the "Global libraries" palette.

See also

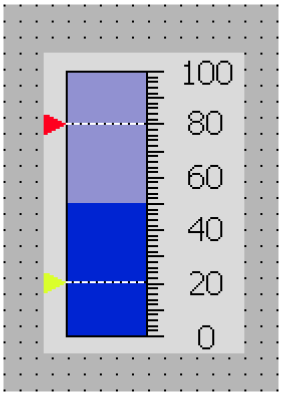
Basics on libraries (Page 1124)

8.2.8 Display and operating objects

8.2.8.1 Bar

Application

The process values are displayed graphically using the "Bar" object. Add a scale to label the bar display.



Layout

In the Inspector window, you customize the settings for the position, shape, style, color, and font types of the object. You can adapt the following properties in particular:

- Color transition: Specifies the change in color display when limit values are exceeded.
- Displaying the limit lines / limit marking: Shows the configured limit as a line or marker.
- Define bar segments: Defines the gradations on the bar scale.
- Define scale gradation: Defines the subdivisions, scale markings and intervals of a bar scale.

Color transition

You define how the color change is represented under "Appearance" in the "Properties" group in the Property window.

Color transition	Description
"Segmented"	The color changes segment by segment.
"Entire bar"	The color of the entire bar changes.

Displaying limit lines and limit marking

You display the configured limit in the bar as a line or marking in Runtime using the "Lines" and "Markings" property. Proceed as follows:

1. Click "Appearance" in the Inspector window.

2. Activate the "Lines" and "Markings" options in the "Limits" area.

Define bar segments

Use the "Number of subdivisions" property to define the number of segments into which the bar is divided by the main gradations on the scale.

Use the "Interval" property to divide the distance between the main gradations. The value appears as the difference in value between two adjacent main gradations. Proceed as follows:

1. Click "Scales" in the Inspector window.
2. Activate "Show scale."
3. Select the corresponding value under "Number of subdivision" in the "Settings" area.
4. Select the corresponding value under "Marks label" in the "Settings" area.
5. Select the corresponding value under "Interval" in the "Large interval" area.

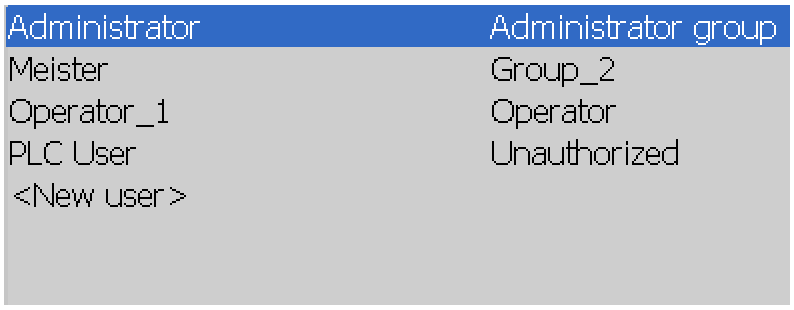
See also

Screen basics (Page 1025)
User view (Page 1137)
Date/time field (Page 1138)
I/O field (Page 1139)
Ellipse (Page 1141)
Graphic view (Page 1142)
Graphic I/O field (Page 1144)
Circle (Page 1145)
Trend view (Page 1146)
Line (Page 1148)
Alarm view (Page 1148)
Alarm window (Page 1151)
Alarm indicator (Page 1153)
Rectangle (Page 1154)
Recipe view (Page 1155)
Switch (Page 1156)
Button (Page 1157)
Symbolic I/O field (Page 1158)
Text field (Page 1160)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.2 User view

Application

The "User view" object is used to set up and administer users and authorizations.



Administrator	Administrator group
Meister	Group_2
Operator_1	Operator
PLC User	Unauthorized
<New user>	

Note

Do not use the simple user view in a group.

Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Number of lines: Specifies the maximum number of visible entries.

Number of lines

The number of lines in the user view displayed in Runtime is specified in the Inspector window. The setting for the number of lines is only effective if the property "Auto-sizing" is active.

1. Click the "General" group in the Inspector window.
2. Enter an integer value in the "Number of lines" field under "Settings".
3. In the Inspector window, activate "Properties > Layout > Size."
4. In the "Size" area, activate "Auto-sizing."

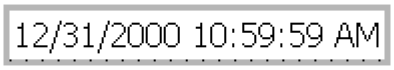
See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.3 Date/time field

Application

The "Date/time field" object shows the system time and the system date. The appearance of the "Date/time field" depends on the language set on the HMI device.



12/31/2000 10:59:59 AM

Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Display system time: Specifies that the system time is displayed.
- Using tags: Specifies that the time of the connected tag is displayed.
- Long date/time format: This setting defines the format displayed for the data and time.

Display system time

The time displayed in the "Date/time field" on the HMI device is specified in the Inspector window.

1. Click the "General" group in the Inspector window.
2. Activate the "System time" option in the "Format" area.

Using tags

The time of the interconnected tag is displayed in the date/time field.

1. Click the "General" group in the Inspector window.
2. In the "Format" area, select a tag with the "DateTime" data type, e.g. an internal tag. Information about data types which are available for connection to other PLCs can be found in the documentation about the respective communication drivers.

Long date/time format

The layout of the date and time is specified in the "Format" area under "General" in the Inspector window.

Option	Description
"Enabled"	Date and time are displayed in full, e.g. "Sunday, December 31, 2000 10:59:59 AM"
"Disabled"	Date and time are displayed in short form, e.g. "12/31/2000 10:59:59 AM"

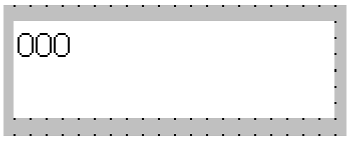
See also

Bar (Page 1136)
Screen basics (Page 1025)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.4 I/O field

Application

The "I/O field" object is used to enter and display process values.



Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Mode: Specifies the response of the object in Runtime.
- Display format: Specifies the display format in the I/O field for input and output of values.
- Hidden input: Specifies whether the input value is displayed normally or encrypted during input.

Note
Reports

Only the "Output" mode is available in reports.

The "Hidden input" option is not available in reports.

Mode

The response of the I/O field is specified in the "I/O field type" area in the "General" group of the Inspector window.

Mode	Description
"Input"	Values can only be input into the I/O field in runtime.
"Input/output"	Values can be input and output in the I/O field in runtime.
"Output"	The I/O field is used for the output of values only.

Layout

The display format for the input and output of values is specified in the "Format" area under "General" in the Inspector window.

Layout	
"Binary"	Input and output of values in binary form
"Decimal"	Input and output of values in decimal form
"Hexadecimal"	Input and output of values in hexadecimal form
"Date"	Input and output of date information. The format depends on the language setting on the HMI device.
"Date/time"	Input and output of date and time information. The format depends on the language setting on the HMI device.

Layout	
"Time"	Input and output of times. The format depends on the language setting on the HMI device.
"Character string"	Input and output of character strings.
"Time"	Input and output of times.

Hidden input

In Runtime the input can be displayed normally or encrypted, for example for hidden input of a password. A "*" is displayed for every character during hidden input. The data format of the value entered cannot be recognized.

1. Click "Characteristics" in the Inspector window.
2. Activate the option "Hidden input" in the "Field" area.

Avoiding overlaps at output fields of OP 73, OP 73micro, OP 77A, TP 177A, TP 177micro

If several I/O fields are configured as output fields with a transparent background in a screen, these I/O fields may overlap. The transparent part of the one field covers the digits of the other field. This may cause display problems in Runtime. In order to avoid such overlaps, set the margins of the I/O fields to zero in the object properties under "Properties > Layout". Activate the check box "Fit object to contents."

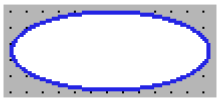
See also

Bar (Page 1136)
Screen basics (Page 1025)

8.2.8.5 Ellipse

Application

The "Ellipse" is an enclosed object that can be filled with a color or pattern.



Layout

In the Inspector window you can customize the settings for the object position, geometry, style, frame and color. You can adapt the following properties in particular:

- Radius X: Specifies the horizontal radius of the elliptical object.
- Radius Y: Specifies the vertical radius of the elliptical object.

Radius X

The horizontal radius of the "Ellipse" object is specified in the Inspector window. The value is entered in pixels.

1. Click "Layout" under "Properties."
2. Enter a value between 0 and 2500 under "Horizontal."

Radius Y

The vertical radius of the "Ellipse" object is specified in the Inspector window. The value is entered in pixels.

1. Click "Layout" under "Properties."
2. Enter a value between 0 and 2500 at "Vertical."

See also

Bar (Page 1136)

8.2.8.6 Graphic view

Application

The "Graphic view" object is used to display graphics.

Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Graphic: Specifies the graphic file that is displayed in the object.
- Stretch graphic: Specifies the automatic size stretching for objects with graphics.
- Transparent color: Specify whether or not the transparent color is used for the graphic.

Inserting graphics

The following graphic format is used in the "Graphic view" object: *.bmp, *.tif, *.png, *.ico, *.emf, *.wmf, *.gif, *.jpg or *.jpeg. You may also use graphics as OLE objects in the graphic view.

1. Click "General" in the Inspector window.
2. Select the graphic you want to add in the drop-down list under "Graphic".

   The graphic preview is shown in the right pane.
3. Click "Assign" to insert the graphic in the graphic view. Click "Delete" to delete a graphic from a graphic display.

Stretch graphic

Whether a graphic displayed in a graphic view is stretched to the size of the graphic view in runtime is specified in the Inspector window.

1. Click "Layout" in the Inspector window.
2. Select one of the following options from the "Fit to size" area:
   - Fit object size to content
   - Fit content to object size

Transparent color

This property defines whether the transparent color is used for the graphic to be displayed. The transparent color can only be used when the object is assigned a 3D frame or no frame.

1. Click "Layout" in the Inspector window.
2. Activate "Transparent color" in the "Color" area.

Note

The use of bitmaps in WinCC screens requires the "Transparent color" setting for their high-performance visualization on panel HMI devices. Visualization performance is enhanced by disabling the "Transparent color" setting in the properties of the relevant display object. This restriction applies in particular when bitmaps are used as background image.

Note
Basic Panels

The "Transparent color" property is not available for Basic Panels.

See also

Screen basics (Page 1025)
Availability of screens for specific HMI devices (Page 1027)
Bar (Page 1136)

8.2.8.7 Graphic I/O field

Application

The "Graphic I/O field" object can be used to configure a list for display and selection of graphic files.

Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Mode: Specifies the response of the object in Runtime.
- Scroll bar type: Specifies the graphic layout of the scroll bar.

Note
Basic Panels

The scroll bar is not available for Basic Panels.

Note
Reports

Only the "Output" mode is available in reports.

The scroll bar is not available in reports.

Mode

The response of the "Graphic I/O field" object is specified under "General > Type > Mode" in the Inspector window.

Mode	Description
"Input"	The "Graphic I/O field" object is only used to select graphics.
"Input/output"	The "Graphic I/O field" object is used to select and display graphics.
"Output"	The "Graphic I/O field" object is used to display graphics only.
"Two states"	The "Graphic I/O field" object is only used to display graphics and can have a maximum of two states.

Scroll bar type

The response for the graphic representation in the display window is specified under "Appearance > Scroll Bar > Type" in the Inspector window.

Type	Description
"Permanent"	The scroll bar is always visible.
"No scrollbar"	The scroll bar is not visible.
"Visible after clicking"	The scroll bar is made visible by a mouse click.

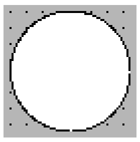
See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.8 Circle

Application

The "Circle" object is a closed object which can be filled with a color or pattern.



Layout

In the Inspector window you can customize the settings for the object position, geometry, style, frame and color. You can adapt the following properties in particular:

- Radius: Specifies the size of the circle.

Radius

The radius of the "Circle" object is specified in the Inspector window. The value is entered in pixels.

1. Click "Layout."
2. Enter a value between 0 and 2500 in the "Radius" area.

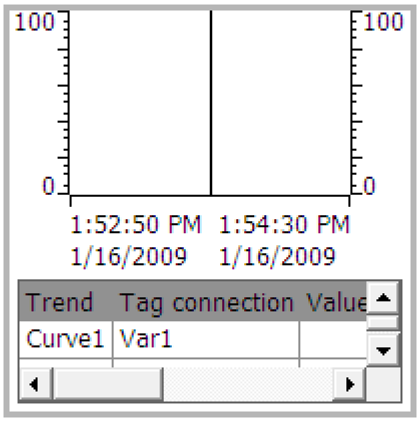
See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.9 Trend view

Application

The trend view is meant for the graphical representation of tag values from the current process or from a log in form of trends.



Trend	Tag connection	Value
Curve1	Var1	

Layout

In the Inspector window, you customize the position, shape, style, color, and font types of the object. You can adapt the following properties in particular:

- Display value table, ruler and grid: Specifies whether a value table, a ruler or a grid is displayed in addition to the coordinate system to improve legibility.
- Toolbars: Defines the display of the control elements.

Display value table, ruler and grid

For improved legibility a value table, a ruler and a grid can be displayed in Runtime.

1. Activate the "Show ruler" option under "Layout."
2. Activate the "Show table" option under "Table."
3. Activate the "Show grid" option under "Table."

Toolbars

The layout of the control elements is specified in the Inspector window under "Toolbar." They display the control elements either not at all, as a toolbar or as buttons.

Note
Basic Panels

The control elements are not available for Basic Panels.

Button	Toolbar	Brief description	Description
⏮	⏮	"Go to start"	Scrolls back to the beginning of the trend recording. The start values with which the trend recording started are displayed.
⊕	⊕	"Zoom in"	Zooms into the displayed time section.
⊖	⊖	"Zoom out"	Zooms out of the displayed time section.
⇠	⇠	"Ruler backward"	Moves the ruler back.
⇢	⇢	"Ruler forward"	Moves the ruler forward.
⏪	⏪	"Backward"	Scrolls back one display width.
⏩	⏩	"Forward"	Scrolls forward one display width.
⁝	⁝	"Ruler"	Shows or hides the ruler. The ruler displays the X-value associated with a Y-value.
▶ ■	▶ ■	"Start/stop"	Stops trend recording or continues trend recording.

Configuration behavior

Displaying column titles

The layout of the table in the trend view depends on the view settings in the Control Panel. Depending on the setting, the table headers may be truncated. This setting is found under "Display > Layout" in the control panel. To display column titles correctly, set the display in "Windows and buttons" to "Windows Classic" style.

This behavior only occurs during configuration. The column titles are displayed correctly in Runtime.

Consistency test

If warnings or errors are displayed in the output window during a consistency check in connection with curve displays, clicking "Go to Error/Tag" on the shortcut menu will not always take you to the exact error position. In some cases only the curve display is shown as cause of error.

Adding, configuring, and removing trends

The trends of the trend view are managed in the Inspector window of the trend view under "Properties > Trend." You can copy trends between different trend views.

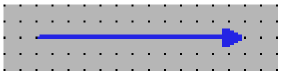
See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.10 Line

Application

The "Line" object is an open object. The line length and gradient slope are defined by the height and width of the rectangle enclosing the object.



Layout

In the Inspector window, you customize the settings for the object position, shape, style, and color. You can adapt the following properties in particular:

- Line style
- Line start and end

Line style

You define how the line is represented under "Appearance" in the "Properties" group in the Inspector window. The line is shown without interruption if you select "Solid", for example.

Note
Availability for specific HMI devices

The line styles available depend on the HMI device.

Line start and end

Define the start point and end point of the line in the Inspector window under "Line ends" in the "Appearance" of the "Properties" group.

Use arrow point, for example, as start and end point. The available start and end points depend on the device.

See also

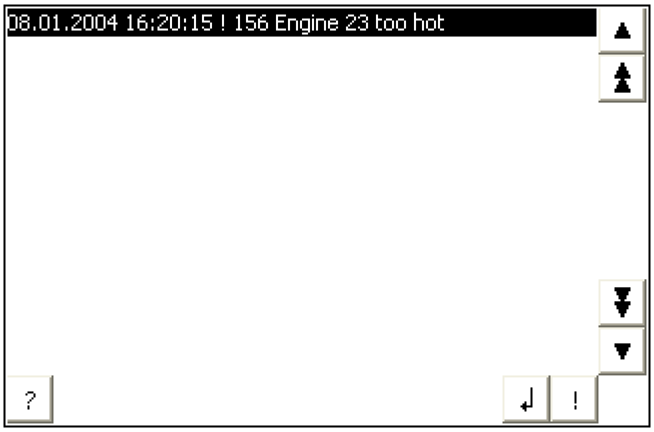
Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.11 Alarm view

Application

Alarms are indicated in the Alarm view or in the Alarm window of the HMI device.

The following screen contains a simple alarm view:


08.01.2004 16:20:15 ! 156 Engine 23 too hot

Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object.

Note

The fonts available for selection depend on the "Language and fonts" you have configured in the Runtime settings.

You can adapt the following properties in particular:

- Control elements: Defines the operator controls of the alarm display.
- Alarm classes: This setting defines which alarm classes are displayed in the alarm view.
- Columns: Specifies the displayed columns in runtime.

Note

If you have different alarm classes output, these will be initially sorted into alarm classes in runtime, and then by when the alarm occurred.

Control elements

The control elements that can be used to control the alarm display in runtime are specified in the Inspector window under "Display > Settings". The following table shows the control elements in the alarm view, and what they do:

Button		Function
"Info text"	🗔	Displays info text for an alarm.

Button		Function
"Acknowledge"		Acknowledges an alarm.
"Loop-In-Alarm"		Switches to the screen containing information about the error that has occurred.

Select alarm classes

1. Click "Properties" in the Inspector window.
2. Under "Alarm classes" activate the alarm classes to be displayed in the alarm view in runtime .

Define columns

Define the columns to be displayed in the alarm view in runtime in the Inspector window.

1. In the Inspector window, click "Properties > Columns".
2. Activate the columns that are to be displayed in runtime under "Columns".

Configuration behavior

Displaying column titles

The layout of the alarm view is dependent on the view settings in the control panel. Depending on the setting, the column titles may be truncated. This setting is found under "Display > Layout tab" in the control panel. To display column titles correctly, set the display in "Windows and buttons" to "Windows Classic" style.

This behavior only occurs during configuration. The column titles are displayed correctly in runtime.

Note

In the engineering system you can dynamically control the visibility of an object, for example, in the "Animations" group of the Inspector window. In runtime, the "Simple alarm view" does not support animations. If you have configured an animation and, for example, wish to perform a consistency check of the project, then an error alarm is issued in the Output window.

See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.12 Alarm window

Application

Alarms are indicated in the Alarm view or in the Alarm window of the HMI device. The layout and operation of the Alarm window are similar to that of the Alarm view. The Alarm window has the following characteristics that are the same as in the Alarm view:

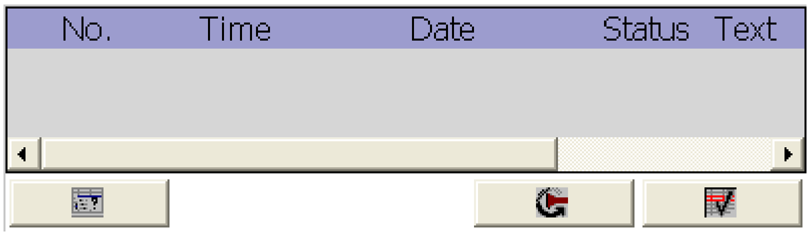
- Simple alarm window
- Advanced alarm window
- Alarm line

Note
Basic Panels

Only the simple alarm window is available for Basic Panels.

The Alarm window is configured in the "Global screen" editor.

The Alarm window is independent of the process screen. Depending on the configuration, the Alarm window opens automatically as soon as a new, unacknowledged alarm has been received. If applicable, the Alarm window is configured so that it only closes after all alarms have been acknowledged. The following figure shows an advanced Alarm window:



Note

In the engineering system you dynamize, for example, the visibility of an object in the "Animations" group in the Inspector window. In runtime, the "Simple alarm window" object does not support animations. If you have configured an animation and, for example, wish to perform a consistency check of the project, then an error alarm is issued in the Output window.

Note

The "Alarm window" object cannot be grouped.

Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You configure the Alarm window in the same way as the Alarm view. In addition you adapt the following properties:

- Fixed alarm windows: Specifies that the Alarm window retains the focus after a screen change.
- Window: You define the operator input and response of the Alarm window in runtime.

Note

If you have different alarm classes output, these will be initially sorted into alarm classes in runtime, and then by when the alarm occurred.

Control elements

The control elements that can be used to control the alarm display in runtime are specified in the Inspector window under "Display > Settings". The following table shows the control elements in the Alarm window, and what they do:

Button		Function
"Info text"		Displays info text for an alarm.
"Acknowledge"		Acknowledges an alarm.
"Loop-In-Alarm"		Switches to the screen containing information about the error that has occurred.

Access protection in runtime

Configure access protection in the "Properties > Security" group in the properties of the alarm view. If a logged-on user has the required authorization, he can acknowledge and edit alarms using the operator controls in the alarm view. If the logged-in user does not have the required authorization, or if no user is logged in, clicking the "Acknowledge" or "Edit" buttons or double-clicking an alarm line opens the login dialog box.

Note
Basic Panels

Access control is not available for Basic Panels.

Activating the focus of the Alarm window

Select the following option so that the Alarm window does not lose the focus after a screen change:

1. Click "Mode" in the "Properties" group in the Inspector window.
2. Enable "Label".

Window

Define the response of the Alarm window in the "Mode" category of the "Window" area in the Inspector window. The following table shows the possible properties:

Option	Function
Automatic display	The Alarm window is automatically displayed when a system alarm occurs, for example.
Closable	The window closes again after a set time has elapsed. You define the display duration in the alarm settings.
Modal	The Alarm window is linked to a confirmation, such as: Alarm must be acknowledged. If the modal alarm window has the focus, the buttons in the screen behind it cannot be used. The functions configured for a function key are carried out.
Sizeable	You can change the size of the Alarm window in runtime.

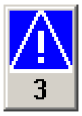
See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.13 Alarm indicator

Application

The alarm indicator is a graphic symbol that shows current errors or errors that need to be acknowledged, depending on the configuration. The alarm indicator is configured in the "Global screen" editor. The following picture contains an alarm indicator:



Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Alarm classes: Establishes the alarm classes where the alarm indicator is displayed.
- Operator control in Runtime: Defines the operator actions in Runtime that cause the Alarm window to open.

Alarm classes

You define which alarm classes are shown with an alarm indicator under "General > Alarm classes" in the Inspector window. Alarm classes include warnings, or errors.

Define operator control in Runtime

You define for which events the alarm window is visible, or hidden under "Events" in the Inspector window.

1. Select the alarm indicator in the screen.
2. Click on "Click" or "Click when flashing" in the "Events" group in the Inspector window.
3. The "function list" opens. Click the first line of the function list. The list of system functions, and scripts available in the project opens.
4. Select the "ActivateScreen" system function under "Alarms." Under "object name" select the name of the Alarm window from the selection list. Under "Layout", define whether the Alarm window should be visible, hidden, or should toggle between the two states.

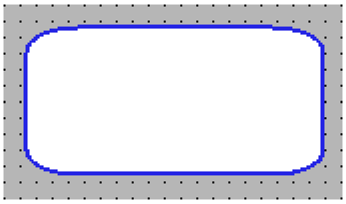
See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.14 Rectangle

Application

The "Rectangle" is a closed object which you can fill with a color.



Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Corner X radius and corner Y radius: Specifies the horizontal and vertical distance between the corner of the rectangle and the start point of a rounded corner.

Corner X radius and corner Y radius

The corners of the "Rectangle" object can be rounded to suit your requirements. If the "Corner X radius" and "Corner Y radius" properties are set to the value of 100%, the rectangle is displayed as ellipse. As soon as one of the properties has the value 0%, a normal rectangle without a rounded corner is shown.

1. Click "Layout" in the "Properties" group.
2. Enter a value for "Corner X radius" in the "Corner radius" area. The input value is the percentage proportion of half the width of the rectangle.
3. Enter a value for "Corner Y radius" in the "Corner radius" area. The input value is the percentage proportion of half the height of the rectangle.

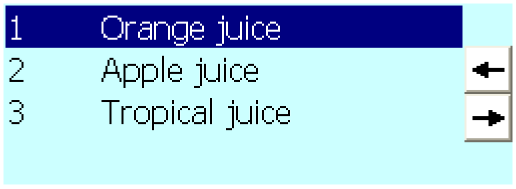
See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.15 Recipe view

Application

The "Recipe view" object is used to display and modify recipes.


1 Orange juice
2 Apple juice
3 Tropical juice

Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Control elements: Specifies the menu commands of the recipe view.

Control elements

The menu commands with which the recipe view is operated in runtime are configured under "Properties > Buttons" in the Inspector window.

Menu command	Description
"Info text"	Calls up the configured info text for the selected recipe.
"New record"	Creates a new recipe record in the recipe.
"Delete record"	Deletes the selected record.
"Saving"	Saves the modified record with its current name.
"Save as"	Saves the modified record with a new name.
"Write to PLC"	Sends the current value to the PLC.
"Read from PLC"	Reads the current value from the PLC.

Configuration behavior

Note

In the engineering system you can, for example, dynamically control the visibility of an object in the "Animations" group of the Properties window. In runtime, the "Simple recipe view" does not support animations. If you have configured an animation and, for example, want to check the consistency of the project, an error alarm is displayed in the Output window.

See also

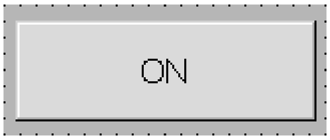
Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.16 Switch

Application

The "Switch" object is used to configure a switch that is used to switch between two predefined states in Runtime. The current state of the "Switch" object can be visualized with either a label or a graphic.

The following figure shows a "Switch" type switch.



Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. In particular, you can customize the following property:

- Type: Defines the graphic representation of the object.

Type

The switch is specified in the Inspector window in the "Settings" area in the "General" group.

Type	Description
"Switch"	The two states of the "Switch" are displayed in the form of a switch. The position of the switch indicates the current state. The state is changed in runtime by sliding the switch. You specify the direction of movement of the switch in "Switch orientation" with this type.

Type	Description
"Switch with text"	The switch is shown as a button. The current state is visualized with a label. In runtime click the button to actuate the switch.
"Switch with graphic"	The switch is shown as a button. The current state is visualized with a graphic. In runtime click the button to actuate the switch.

Note
Basic Panels

The "Switch" type is not available for Basic Panels.

See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.17 Button

Application

The "Button" object allows you to configure an object that the operator can use in runtime to execute any configurable function.

Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Type: Defines the graphic representation of the object.
- Text / Graphic: Defines whether the graphic view is static or dynamic.
- Define hotkey: Defines a key, or shortcut that the operator can use to actuate the button.

Note

You can only define a hotkey for HMI devices with keys.

Type

The button display is defined in the "Type" area under "General" in the Inspector window.

Type	Description
"Invisible"	The button is not visible in runtime.
"Text"	The current state of the button is visualized with a label.
"Graphic"	The current state of the button is visualized with a graphic.

Text / Graphic

The "Type" property settings are used to define whether the display is static or dynamic. The display is defined in the "Text" or "Graphic" area of the "General" group in the Inspector window.

Type	Option	Description
"Text"	"Text"	"Text OFF" is used to specify a text that appears in the button when the state is "OFF". If you enable "Text ON", you can enter a text for the "ON" state.
	"Text list"	The text in the button depends on the state. The entry from the text list corresponding to the state is displayed.
"Graphic"	"Graphic"	"Graphic OFF" is used to specify a graphic that is displayed in the button when the state is "OFF". If you enable "Graphic ON", you can enter a graphic for the "ON" state.
	"Graphic list"	The graphic in the button depends on the state. The entry from the graphic list corresponding to the state is displayed.

Define hotkey

In the Inspector window, a key or key combination is defined that the operator can use to control the button in runtime.

1. Click the "General" group in the Properties window.
2. Select a key or key combination from the selection list in the "Hotkey" area.

See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.18 Symbolic I/O field

Application

The "Symbolic I/O field" object can be used to configure a selection list for input and output of texts in Runtime.

Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Mode: Specifies the response of the object in Runtime.
- Text list: Specifies the text list that is linked to the object.
- Button for selection list: Specifies that the object has a button to open the selection list.

Note
Reports

Only the "Output" mode is available in reports.

The "Button for selection list" option is not available in reports.

Mode

The response of the symbolic I/O field is specified in the Inspector window in the "General" group in the "Type" area.

Mode	Description
"Output"	The symbolic I/O field is used to output values.
"Input"	The symbolic I/O field is used to input values.
"Input/output"	The symbolic I/O field is used for the input and output of values.
"Two states"	The symbolic I/O field is used only to output values and has a maximum of two states. The field switches between two predefined texts. This is used, for example, to visualize the two states of a valve: closed or open.

Note

The behavior possible for the symbolic I/O field depends on the Runtime.

Text list

In the Inspector window, you specify which text list is linked to the symbolic I/O field.

1. Activate "General" in the Inspector window.
2. Open the selection list in the "View" area at "Text list". Select the text list.

Button for selection list

The "Button for selection list" property is used to display a button for opening the selection list.

1. Activate "Layout" in the Inspector window.
2. Activate the "Button for selection list" option in the "Settings" area.

Note
Basic Panels

The "Button for selection list" option is not available for Basic Panels.

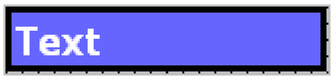
See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.8.19 Text field

Application

The "Text field" is a closed object which you can fill with a color.



Layout

In the Inspector window, you customize the position, shape, style, color and font types of the object. You can adapt the following properties in particular:

- Text: Specifies the text for the text field.
- Size of text field: Defines whether the size of the object is adapted to the space required by the largest list entry.

Text

Specify the text for the text field in the Inspector window.

1. Click the "General" group in the Inspector window.
2. Input a text of any length in the "Text" area. For texts over several lines you can set a line break by pressing <Enter>, with the key combination <Shift + Enter> or the key combination <Ctrl + Enter>.

Size of text field

In the Inspector window, you can define whether the size of the object is adapted to the space required by the largest list entry.

1. Click "Layout" in the "Properties" group in the Inspector window.
2. In the "Size" area, activate the "Auto-sizing" option.
3. Otherwise you can set the size manually. In the "Size" area, deactivate the "Auto-sizing" option. Press the mouse button and drag the text field to the required size.

See also

Bar (Page 1136)
Availability of screens for specific HMI devices (Page 1027)

8.2.9 Configuring screen navigation for Basic Panels

8.2.9.1 Basics for screen navigation

Types of navigation for the screen change

For a production process consisting of multiple subprocesses, you will configure multiple screens. You have the following options to enable the operator to switch from one screen to the next in Runtime:

- Assign buttons to screen changes
- Configuring screen changes at local function keys

Procedure

Before you create a screen change, define the plant structure and derive from it the screen changes that you want to configure. If you have not already defined a start screen in the project wizard, create the start screen in the Runtime settings.

See also

Screen basics (Page 1025)
Configuring a screen change (Page 1161)

8.2.9.2 Configuring a screen change

Introduction

To change between the screens on the HMI device during operation, you need to configure a button, function key, or both, on the screen using drag-and-drop.

You can configure a screen change as follows:

- To create a button in the screen that calls another screen, drag this second screen from the project tree into the open screen.
- To configure a function key in the screen that calls another screen, drag this second screen from the project tree into the function key.

Note

If you have set the "Visibility" of animations to "Hidden" in the Inspector window of a screen, this screen cannot be called up in Runtime.

Requirements

- An HMI device with at least two screens must be available.
- The screen from which the screen change is to be called must be open.

Assign screen change to button

Proceed as follows to assign a button to a screen change:

1. From the project tree drag the screen that is to be opened with the button into the opened screen.

   The system adds a button, and labels it with the screen name.
2. Click "Click" in the "Events" category in the Inspector window.

   The "ActivateScreen" function is displayed in the "Function list" group. This function has two parameters:

   – "Screen name"

     The "Screen name" parameter contains the name of the screen that is to be called when you change screens in Runtime.

   – "Object number".

     The optional "Object number" parameter is the tab order number of the object on which the focus is set after a screen change.
3. At the "Object number" attribute, define, if required, the tab order number of the object on which the focus is to be set after a screen change. You can also specify a tag that contains the object number.

Assign screen change to function key

Proceed as follows:

1. From the project tree, drag the screen that is to be opened with the function key onto the function key.

   The configured function key displays a yellow triangle.
2. Click "Press" in the "Events" category of the Inspector window.

   The "ActivateScreen" function is displayed in the "Function list" group. This function has two parameters:

   – "Screen name"

     The "Screen name" parameter contains the name of the screen that is to be called when you change screens in Runtime.

   – "Object number".

     The optional "Object number" parameter is the tab order number of the object on which the focus is set after a screen change.
3. At the "Object number" attribute, define, if required, the tab order number of the object on which the focus is to be set after a screen change. You can also specify a tag that contains the object number.

Result

In Runtime, the operator uses the button or function key to switch to the specified screen. If you have specified an object number, the object with this object number has the focus following a screen change.

See also

Basics for screen navigation (Page 1161)

8.3 Working with tags

8.3.1 Basics

8.3.1.1 Basics on tags

Introduction

Data is forwarded in a project using tags. A tag has an address and a symbolic name that is used in the project. The address is used in communication with the automation system.

WinCC works with two types of tag:

- Process tags
- Internal tags

WinCC also facilitates management of tags by providing tag groups.

Principle

In WinCC, tags that are supplied with values by the process are known as process tags or external tags. With process tags, the properties of the tag are used to define the connection that WinCC uses to communicate with the automation system and how the data is exchanged.

Tags that are not supplied with values by the process - the internal tags - are not connected to the automation system. In the tag's "Connection" property, this is identified by the "Internal tag" entry.

You can also compile tags into groups for greater clarity. When you create tag groups, a tree appears in the Project window. You can navigate through this tree as you would in Windows Explorer.

8.3.1.2 Internal tags

Introduction

Internal tags do not have any connection to the PLC.

Principle

Internal tags are stored in the memory of the HMI device. Therefore, only this HMI device has read and write access to the internal tags. You can create internal tags to perform local calculations, for example.

You can use the HMI data types for internal tags.

The following HMI data types are available:

HMI data type	Data format
SByte	Signed 8-bit value
UByte	Unsigned 8-bit value
Short	Signed 16-bit value
UShort	Unsigned 16-bit value
Long	Signed 32-bit value
ULong	Unsigned 32-bit value
Float	Floating-point number 32-bit IEEE 754
Double	Floating-point number 64-bit IEEE 754
Bool	Binary tag
WString	Text tag, 16-bit character set
DateTime	Date and time in the format 'DD.MM.YYYY hh:mm:ss'

8.3.1.3 External tags

Introduction

External tags allow communication (exchange of data) between the components of an automation system, such as between the HMI device and the PLC.

Principle

An external tag is the image of a defined memory location in the PLC. You have read and write access to this storage location from both the HMI device and from the PLC.

The PLC is accessed with symbolic addressing. This setup simplifies the configuration, since it enables you to access the PLC via the symbol table. See the "Basics of symbolic access (Page 1165) " section for additional details.

Since external tags are the image of a storage location in the PLC, the applicable data types depend on the PLC which is connected to the HMI device.

Data types

The HMI data types for using external tags are available within WinCC. In addition, you can also use other data types, which are intended specifically for the PLC to which a connection exists. The data types may vary even though they have the same name. For example, the version of the "Byte" data type for the connection via SIMATIC S7 protocol is "unsigned". The HMI data type "SByte" format in WinCC is "signed". The types for the HMI data types and the data type for the connected PLC are converted to match.

Note

During configuration for an HMI runtime, there are also area pointers for communication between the HMI device and PLC, in addition to the external tags. You can set up and enable the area indicators in the "Connections" editor.

Updating tag values in system functions

System functions always fetch the value of an external tag from runtime memory. When a tag value is requested, the current value is read from the PLC and written to runtime memory. Next, the tag value will be updated to the set cycle time. System functions first access tag values read from the PLC at the previous scan cycle checkpoint.

8.3.1.4 Basics of symbolic access

Introduction

With symbolic access, you enter a symbolic name as the destination in the PLC instead of a direct address. You define the symbolic name when you write the PLC program.

- You define symbolic names for global PLC tags in the PLC tag table.
- In the respective block, specify symbolic names for local tags in logic blocks or in global data blocks.

See Symbolic programming (Page 361) for additional information.

When you then interconnect an HMI tag to the PLC, you only select the symbolic name from the PLC tag table or from a data block.

When the addressing is changed in the PLC program, only the assignment of the address to the symbolic name in the symbol table changes. The symbolic name and therefore the interconnection to the HMI device does not change. You do not have to match the change in the configuration of the HMI device.

Requirement

You have to meet the following requirements for symbolic access of HMI tags:

- A PLC tag must be in the PLC program or a local tag must be in a program block.
- Program blocks have to be compiled for the local tags from the PLC to be available on the HMI device.

How symbolic access works

First, write the controller program for PLC control in WinCC. Use the symbolic declaration when writing the program.

Compile the PLC program when it is finished. When compiling is complete, the symbolic names are available to the HMI device.

If you want to subsequently change the PLC program, you need to perform a new compilation for the changes to be made available to the HMI device.

You then create the configuration for the HMI device. Interconnect the HMI tags directly to the symbols in the PLC tag table or in the program blocks of the PLC.

Advantages

With symbolic declaration in the PLC, the data are optimally organized for the employed CPU. This setup increases the performance in the PLC.

Symbolic access also increases the performance of the communication between the HMI device and PLC.

The configuration of the HMI device does not depend on changes at the PLC end, because the symbolic name does not change when the address in the PLC changes.

Restrictions

The following restrictions apply to symbolic access:

- The address multiplex is not available, you can only multiplex through the multiplex tag.
- The data type of an HMI tag and the PLC tag linked to it must basically be identical. This means only the full value of a tag can be read and written. You change individual bits, for example in a tag, that serve as triggers for HMI alarms with corresponding programming in the PLC. You can find additional information in the documentation on PLC programming.

Reaction to changes

Not all changes to the project need to be compiled and downloaded for symbolic access. The project needs to be compiled and downloaded for the following changes to the PLC program.
Changes to PLC tags

The PLC program needs to be compiled and downloaded when changes are made to a PLC tag.

The project does not need to be compiled and downloaded if only the address offset of a PLC tag changes, for example %MB5 to %MB10. The project also needs to be compiled and downloaded when changes are made to the address area, data type or tag name.

Changes in program blocks

The PLC program does not need to be compiled and downloaded if you change the name of a data block. The PLC program always needs to be compiled and downloaded if you make additional changes to a program block.

The project needs to be compiled and downloaded to the HMI device if you make the following changes:

- When a tag from a data block is already interconnected to an HMI tag and you change the tag name.
- When you have created a structure in a data block and you change a name within this structure.
- When you change the number of a data block.
- When you change the data type of a tag interconnected to the HMI device.
- When you change the name of a tag array.
- When you change the limits of an array.

The project does not need to be compiled and downloaded to the HMI device if you change, add or delete a tag in a block that is not interconnected to the HMI device.

8.3.2 Working with tags

8.3.2.1 Creating tags

8.3.2.1 Creating external tags

Introduction

You can access an address in the PLC via a PLC tag using an external tag. Access is performed via the symbol table in the PLC linked to the HMI device. You cannot directly specify the address in the PLC. Creating a PLC tag in the PLC automatically creates an entry in the symbol table. You have direct access to the symbol table via the "PLC tag" field when you create an HMI tag. There you select the PLC tag using its symbolic name.

For additional information on symbolic access see the section "Symbolic programming (Page 361) ".

Requirement

- You have opened the project.
- A PLC is included in the project.
- A connection is configured between the HMI device and the PLC.
- At least one PLC tag is available in the project.
- The Inspector window is open.

Procedure

To create an external tag, proceed as follows:

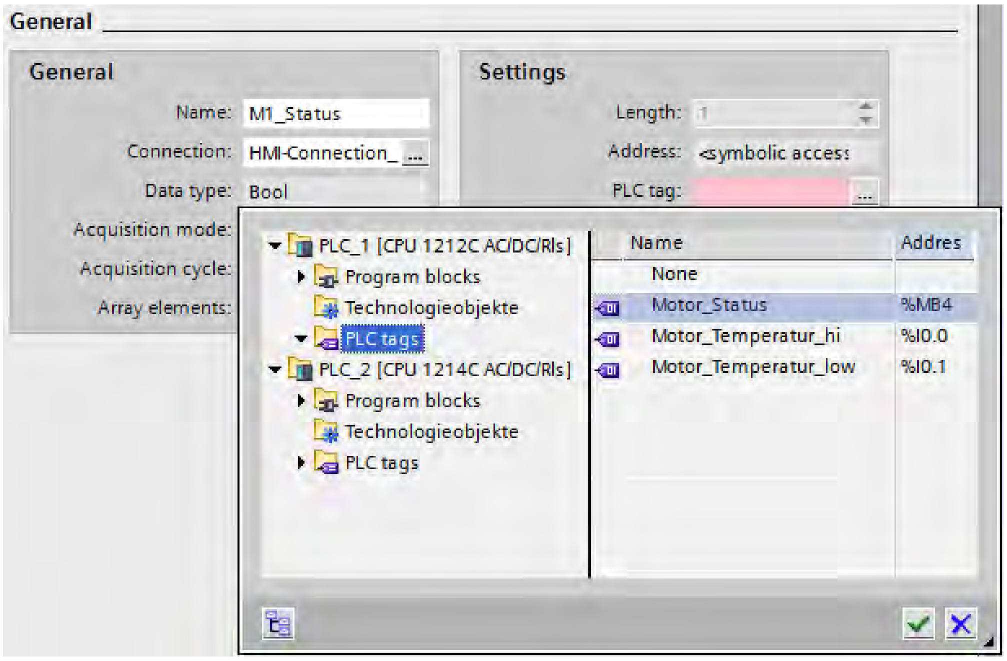
1. Open the "HMI tags" folder in the project tree and double-click "HMI tags". The " HMI tags" editor opens.
2. Double-click "Add" in the "Name" column of the editor table. A new tag is created.
3. Select the "General" category in the Inspector window and, if required, enter a unique tag name in the "Name" field. This tag name must be unique throughout the project.
4. Select the connection to the required PLC in the "Connection" box. If the connection you require is not displayed, you must first create the connection to the PLC. Create the connection in the "Hardware & Networks" editor.
5. In the "PLC tag" field, click on the

   ...

   button and select the desired PLC tag in the object list. Click the

✓

button to confirm the selection.



General

General

Name: M1_Status

Connection: HMI-Connection_

Data type: Bool

Acquisition mode:

Acquisition cycle:

Array elements:

Settings

Length: 1

Address: <symbolic acces

PLC tag:

- PLC_1 [CPU 1212C AC/DC/Rls]
  - Program blocks
  - Technologieobjekte
  - PLC tags
- PLC_2 [CPU 1214C AC/DC/Rls]
  - Program blocks
  - Technologieobjekte
  - PLC tags

Name	Addres
None	
Motor_Status	%MB4
Motor_Temperatur_hi	%I0.0
Motor_Temperatur_low	%I0.1

6. Select the required cycle time for updating the tag from the "Acquisition cycle" field.
7. Enter information about the use of the tag in the "Comment" field for documentation purposes.

You can optionally configure all the tag properties directly in the table of the "HMI Tags" editor. To view hidden columns, activate the column titles using the shortcut menu.

You can also create new tags directly at the point of use. by clicking the

<Add new>

button in the object list. You can then configure the new tag in the Properties window.

Result

An external tag has been created and linked to a PLC tag in the PLC. In additional steps, you can configure the tag, for example, by setting an event at a value change.

See also

Symbolic programming (Page 361)

8.3.2.1 Creating internal tags

Introduction

You must at least set the name and data type for internal tags. Select the "Internal tag" item, rather than a connection to a PLC.

For documentation purposes, it is a good idea to enter a comment for every tag.

Requirement

You have opened the project.

Procedure

1. Open the "HMI tags" folder in the project tree and double-click "HMI tags".
   The " HMI tags" editor opens.
2. If the Inspector window is not open, select the "Inspector Window" command in the "View" menu.
3. Under "General" in the "Properties" group of the Inspector window, enter a unique tag name in the "Name" field. This tag name must be unique throughout the project.
4. Select "Internal tag" as the connection in the "Connection" field.
5. Select the required data type in the "Data Type" field.
6. In the "Length" field, you must specify the maximum number of characters to be stored in the tag according to the selected data type. The length is automatically defined by the data type for numerical tags.
7. As an option, you can enter a comment regarding the use of the tag. To do so, click on "Comment" in the "Properties" group and enter the text of your comment.

You can optionally configure all the tag properties directly in the table of the "HMI Tags" editor. To view hidden columns, activate the column titles using the shortcut menu.

You can also create new tags directly at the point of use. by clicking the

button in the object list. You can then configure the new tag in the Properties window.

Result

An internal tag is created. You can now use this in your project.

You can now also configure your tag by defining the start value and limit values, for example.

8.3.2.1 Creating multiple tags

Introduction

In the "HMI Tags" editor, you can create a large number of identical tags by automatically filling the rows of the table below a tag.

When you use the auto fill function, the tag names and memory locations are automatically incremented.

You can also use the auto fill function to fill table cells below with a single tag property and thus modify the corresponding tags.

If you apply automatic filling to cells of the "HMI Tags" editor that are already filled, these cells will be overwritten.

Automatic filling is limited to 100 tags per action.

Requirement

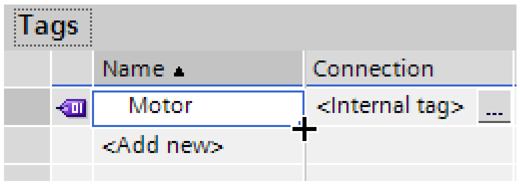
- You have opened the project.
- The "HMI Tags" editor is open.
- The tag which is to serve as a template for other tags is configured.

Procedure

1. If you want to create new tags, mark in the "Name" column the tag that should be used as a template for the new tags.

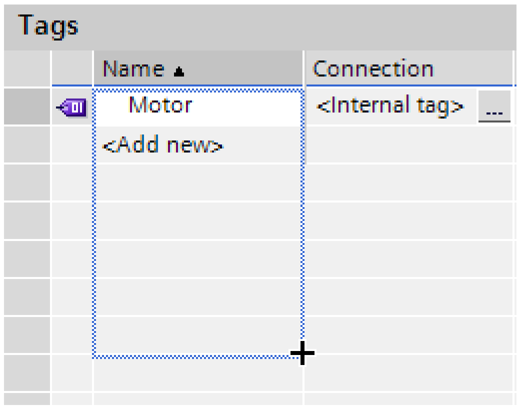
   If you want to copy a property of a tag to the tags below it, select the cell which contains this property.

   The selected cell will be highlighted in color and a small blue square will appear in its bottom right corner. If you move the mouse over this square, the cursor will change to a black cross.

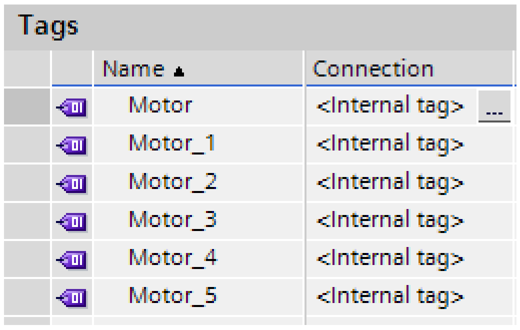
2. Hold down the mouse button and drag this square over the cells below that you wish to fill automatically.

   The marking will be extended to cover this area.

3. Now release the mouse button. All of the marked cells will be filled automatically.

   New tags will be created in all empty cells in the marked area.



Tags

Name ▲	Connection
Motor	<Internal tag>
Motor_1	<Internal tag>
Motor_2	<Internal tag>
Motor_3	<Internal tag>
Motor_4	<Internal tag>
Motor_5	<Internal tag>

Result

Depending on which cells were selected, the function may automatically fill individual properties or create new tags.

8.3.2.2 Editing tags

8.3.2.2 Editing a tag

Introduction

You can always rename, copy or delete tags.

If you rename a tag, the new name must be unique throughout the project.

If you use the "Copy" command to copy a tag to the clipboard, the objects and references linked to the tag will be copied as well. If a tag is linked to a PLC connection, for example, this connection will also be copied.

If you use the "Insert" command to add a tag to another device, the tag will be added without the connected references. Only the object name of the reference will be inserted. If a reference of the same name and valid properties exists in the target system, the existing reference will then be connected to the copied tag.

If you use the "Extended insert" command to add a tag to another device, the tag will be added together with the linked objects and references. If there are already objects and references with the same names in the target system, the name of the inserted objects and references will be extended by one digit.

Requirement

- The tag which you wish to rename, copy or delete must exist.
- The "Tags" editor is open.

Renaming tags

1. In the "Name" field, select the tags in the "HMI Tags" editor table.
2. Select "Rename" from the shortcut menu.

3. Type in a new name.

   The tag appears under its new name.

Alternatively, rename the tag in the Object window at the point of use.

Copying tags

1. Select one or more tags in the "HMI Tags" editor or in the Detail window.
2. Select "Copy" from the shortcut menu.
3. Click on the point at which you want to insert the tag. For example, click another tag group in the same device or on the "HMI Tags" editor in a second device.
4. Select the "Insert" or "Extended insert" command from the shortcut menu. The tag is inserted as described above.

Deleting a tag

1. Select one or more tags in the "HMI Tags" editor.
2. Select the "Cross-reference" command from the "Tools" menu. In the "Cross-reference" editor, check to see where the tags are used. In this manner, you can see what impact the deletion of the tag will have on your project.
3. Select "Delete" in the pop-up menu of the tag.

   All marked tags will be deleted.

8.3.2.2 Changing the tag configuration

Introduction

You can modify tags at any time to adapt them to changed requirements in the project.

Principle

WinCC provides several ways to change the configuration of tags.

- "HMI Tags" editor

  If you need a table to provide an overview of multiple tags, use the "HMI Tags" editor to configure the tags. In the "HMI Tags" editor, you can perform such tasks as comparing and adjusting the properties of multiple tags or sorting the tags by their properties.
- Object list

  You can use the object list if you want to modify a tag directly at the point of use. To do this, select the tag in the object list and open the properties window of the tag using the shortcut menu.

If you change a tag property and this change causes a conflict with another property, it will be highlighted in color to draw your attention to this fact. This could happen, for example, if you connect the tag to another PLC which does not support this data type.

8.3.2.2 Configuring multiple tags simultaneously

Introduction

In WinCC, you can assign the same properties to multiple tags in a single operation. This facilitates efficient programming.

Requirement

- You created the tags you want to configure.
- The Inspector window is open.

Procedure

1. In the "HMI Tags" editor, select all the tags that you want to configure at the same time.

   If the selected property is identical for all the tags, the setting for this property will appear in the Inspector window. The associated field will remain blank otherwise.
2. You can define the common properties in the Inspector window or directly in the "HMI Tags" editor.

Result

All marked tags will be reconfigured.

To edit tag properties which differ from one tag to the other, simply clear the multiple selection.

8.3.2.2 Using multiple tags simultaneously in a screen

Introduction

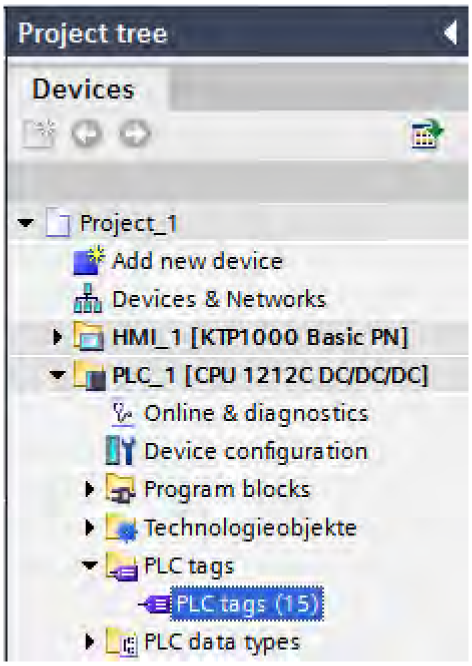
In WinCC, you can create multiple I/O fields that are linked with tags in one screen in a single operation. For process tags, you thereby create a network and a connection for the tag. This facilitates efficient programming.

Requirement

- Several tags are set up.
- A screen is open.

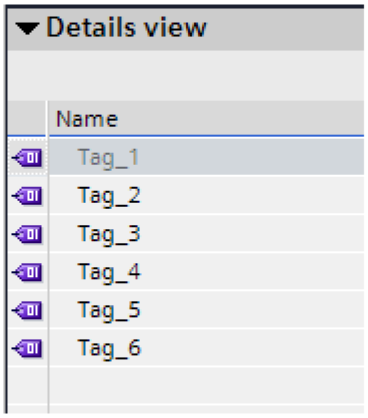
Procedure

1. In the project tree, select the required tag group under "Tags & Connections".



Project_1
Add new device
Devices & Networks
HMI_1 [KTP1000 Basic PN]
PLC_1 [CPU 1212C DC/DC/DC]
Online & diagnostics
Device configuration
Program blocks
Technologieobjekte
PLC tags
PLC tags (15)
PLC data types

2. Select the detail view at the bottom of the project tree. The detail view shows the tags that exist in the selected tag group.



Name
Tag_1
Tag_2
Tag_3
Tag_4
Tag_5
Tag_6

3. In the detail view, hold down the <Ctrl> or <Shift> key and select the required tags.
4. Drag the tags to the screen. For each tag, this creates an I/O field that is connected to the tag.

Note

When you drag a process tag into the detail window, a network and a connection is created in the "Hardware & Networks" editor.

8.3.2.3 Configuring tags

8.3.2.3 Tag limits

Introduction

You can restrict the value range with limits for numerical tags.

Principle

You can specify a value range defined by a high and low limit for numerical tags.

You can have an analog alarm output when the process value violates the limit of a tag.

If the process value exceeds the high or low limit of the value range, you can have an analog alarm output or trigger a function list. If the operator enters a value for the tag that is outside the configured value range, the input is rejected. The value is not accepted.

Note

You enter the text of the analog alarms for limit violations in the "Analog alarms" editor.

Application example

Use the limit to warn the operator in good time when the value of a tag enters a critical range, for example.

8.3.2.3 Defining limits for a tag

Introduction

For numerical tags, you can specify a value range by defining a low and high limit.

You can configure the system to send an analog alarm whenever one of these limits is violated.

Additionally, you configure the system to process a function list whenever a tag value drops below or exceeds its configured value range.

Requirement

- You created the tag for which you want to set limits.
- The Inspector window with the properties for this tag is open.

Procedure

To define limits for a tag, proceed as follows:

1. Click "Limits" in the "Properties" group in the Inspector window. If you want to define one of the limits as a constant value, select "Constant" using the

   button. Enter a number in the relevant field.

   If you want to define one of the limits as a tag value, select "HMI tag" using the

   button. Enter a value in the relevant field. Use the object list to define the tag for the limit.
2. If you want to output an analog alarm when the value violates the limit, enable the "Create analog alarm" option beside the limit.

   Enter the text of the analog alarm using the "Analog alarms" editor.
3. To set additional limits for the tag, repeat steps 2 and 3 with the appropriate settings.

Alternative procedure

Alternatively, you can configure the high and low limits and the display of an associated analog alarm directly in the "HMI Tags" editor table. To view hidden columns, activate the column titles using the shortcut menu.

Result

You have set a value range defined by a high and low limit for the selected tag. An analog alarm is output in Runtime when a limit is violated, according to the configuration. If the value range is exceeded or undershot, a function list is carried out.

Configuring a function list

You can configure a function list for exceeding the value range as follows:

1. If you want to start a function list when the value drops below the value range, click "Low limit violated" in the "Events" group. Create a function list in this dialog.
2. If you want to start a function list when the value exceeds the value range, click "High limit violated" in the "Events" group. Create a function list in this dialog.

8.3.2.3 Start value of a tag

Value of a tag at start of Runtime

You can configure a start value for numerical tags. The tag will be preset to this value when Runtime starts. In this way, you can ensure that the tag has a defined status when Runtime starts.

For external tags, the start value will be displayed on the HMI device until it is overwritten by the PLC or by input.

Application example

You can assign a default value to an I/O field. Enter the desired default value as start value for the tag that is linked to the I/O field.

8.3.2.3 Defining the start value of a tag

Introduction

In WinCC, you can configure a start value for a numerical tag that is assume when Runtime starts.

Requirement

- You have created the tag for which you want to define a start value.
- The Inspector window with the tag properties is open.

Procedure

To configure a start value, proceed as follows:

1. Click "Settings" in the "Properties" group in the Inspector window.
2. Enter the desired "Start value."

Alternative procedure

Alternatively, you can configure the start value directly in the "HMI Tags" editor. To view hidden columns, activate the column titles using the shortcut menu.

Result

The start value you selected for the tag is transferred to the project.

8.3.2.3 Updating the tag value in Runtime

Introduction

Tags contain process values which change while runtime is running. Value changes are handled differently at internal and external tags.

Principle

When runtime starts, the value of a tag is equal to its start value. Tag values change in runtime.

In runtime, you have the following options for changing the value of a tag:

- By running a system function for a value change, for example the "SetTag" system function.
- By input, for example, in an I/O field.
- A value change in an external tag in the PLC.

Updating the Value of External Tags

The value of an external tag is updated as follows:

- Cyclic in operation

  If you select the "Cyclic in operation" acquisition mode, the tag is updated in runtime as long as it is displayed in a screen. The acquisition cycle determines the update cycle for tag value updates on the HMI device. Cyclic acquisition is based on the selected scan cycle time.

- Cyclic continuous

  If you select the "Cyclic continuous" acquisition mode, the tag will be updated continuously in runtime, even if it is not in the currently-open screen. This setting is activated for tags that are configured to trigger a function list when their value changes, for example.

  Only use the "Cyclic continuous" setting for tags that must truly be updated. Frequent read operations increase communication load.

- On request

  If you select the "On request" acquisition mode, the tag is not updated cyclically. It will only be updated on request, for example, by using the "Update Tag" system function.

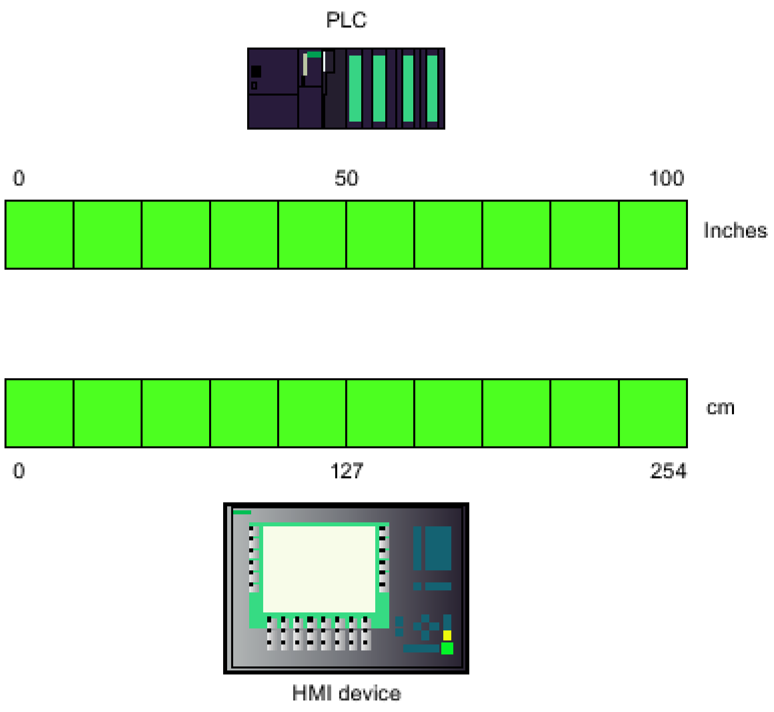
8.3.2.3 Linear scaling of a tag

Introduction

Numeric data types can be processed with linear scaling. The process values in the PLC for an external tag can be mapped onto a specific value range in the project.

Principle

To apply linear scaling to a tag, you must specify one value range on the HMI device and one on the PLC. The value ranges will be mapped to each other linearly.



As soon as data from the HMI device is written to an external tag, it will be automatically mapped to the value range of the PLC. As soon as data from the HMI device is read from the external tag, a corresponding transformation will be performed in the other direction.

Note

You can also use the system functions "LinearScaling" and "InverseLinearScaling" to automatically convert process values.

Application example

The user enters length dimensions in centimeters but the PLC is expecting inches. The entered values are automatically converted before they are forwarded to the controller. Using linear scaling, the value range [0 to 100] on the PLC can be mapped onto the value range [0 to 254] on the HMI device.

8.3.2.3 Linear tag scaling

Introduction

To apply linear scaling to a tag, you must specify one value range on the HMI device and one on the PLC. The value ranges will be mapped to each other linearly.

Requirement

- The external tag to which linear scaling is to be applied must exist.
- The Inspector window with the properties for this tag is open.

Procedure

To apply linear scaling to a tag, follow these steps:

1. Click on "Linear scaling" in the "Properties" group of the Inspector window.
2. Click on "Enable" to switch on linear scaling.

   Using this option, you can temporarily switch off linear scaling for testing purposes, for example. Settings which were made earlier for linear scaling remain unchanged.
3. In the "PLC" area, enter the start and end values of the value range to be applied to the process values on the PLC.
4. In the "HMI device" area, enter the end and start values of the value range to be applied to the process values on the HMI device.

Result

In Runtime the data will be automatically mapped from one value range to the other.

Note

You can also use the "LinearScaling" and "InverseLinearScaling" system functions to automatically convert process values.

8.3.2.3 Connecting a tag to another PLC

Introduction

In WinCC, you can change the connection of a tag to a PLC at any time. This is needed when you change the configuration of your plant, for example.

Depending on the PLC selected, you may need to modify the configuration of the tag. The tag properties which must be changed will be highlighted in color.

Requirement

- The external tag, whose connection you wish to change, must already exist.
- The connection to the PLC must already exist.
- The Properties window for this tag is open.

Procedure

To change the connection of a tag to the PLC, proceed as follows:

1. Click "General" in the "Properties" group in the Inspector window.
2. Select the new connection from the "General" area.

The tag properties that you want to change will be highlighted in color in the "HMI Tags" editor and in the Inspector window.

3. Change all highlighted properties of the tag to suit the requirements of the new PLC.

Result

The external tag is connected to the new PLC.

8.3.2.3 Indirect addressing of tags

Principle

In multiplexes, a type of indirect addressing, the tag used is first determined at runtime. A list of tags is defined for the multiplex tags. The relevant tag is selected from the list of tags in runtime. The selection of the tag depends on the value of the index tag.

In Runtime, the system first reads the value of the index tag. Then the tag which is specified in the corresponding place in the tag list is accessed.

Application example

Using indirect addressing, you could configure the following scenario:

The operator selects one of several machines from a selection list. Depending on the operator's selection, data from the selected machine will be displayed in an output field.

To configure such a scenario, configure the index tag for a symbolic I/O field. Configure the multiplex tag at an I/O field. Configure the tag list of the multiplex tag to reflect the structure of the selection list.

If the operator selects another machine, the value of the index tag will change. The selection field then displays the content of the tag which is pointed to in the tag list (in the multiplex tag) by the new index value.

8.3.2.3 Indirect tag addressing

Introduction

With indirect addressing, the tag used is first determined at runtime. Instead of a single tag, a list of tags is defined. The list entries consist of an index value and the name of the tag to be used. Using an index tag, you can control which entry in the tag list will be accessed.

Requirement

- The tag which you wish to address indirectly must already exist.
- The index tag must exist.
- The tags which will be contained in the tag list must already exist.
- The Inspector window with the tag properties is open.

Procedure

To address tags indirectly, proceed as follows:

1. Click "Multiplexing" in the "Properties" group in the Inspector window.
2. Click on "Enable" to switch on indirect addressing.

   Using this option, you can temporarily switch off indirect addressing for testing purposes, for example. Settings which were made earlier for indirect addressing remain unchanged.
3. Select an "Index tag" or define a new tag using the object list.
4. Click the first entry in the "Tags" column in the tag list.
5. Select a tag as a list entry or define a new tag using the object list.

   The entry in the "Index" column will be generated automatically.
6. Repeat step 5 for all tags that you wish to add to the tag list.
7. If necessary, you can use drag-and-drop to change the order of the entries in the list.

Result

In runtime, the system will dynamically access the tag in the tag list which has the same index value as the value currently in the index tag.

8.3.2.3 Using tags to trigger functions

Introduction

You can use the values of variables as the triggering event for an action in runtime. To start an action in Runtime, configure a function list for a tag. Include one or more system functions in the function list. The function list is processed when the configured event occurs.

The following events are available for a tag:

- Change in value of the tag

  Function list processing is triggered by each change in the value of the variable.

  If the tag contains arrays, the function list is processed whenever an element of the array changes.
- Violation of the tag's high limit

  The function list is processed when the high limit is violated.
- Violation of the tag's low limit

  The function list is processed when the low limit is violated.

Requirement

- The variable whose value you wish to use as an event already exists.
- The Inspector window with the properties for this tag is open.

Procedure

To configure a tag with a function list, proceed as follows:

1. In the "Events" group in the Inspector window, click the event for which you want to create a function list.

   The function list associated with the selected event is shown.
2. Click the line with the "<No function>" entry. The second table column contains a selection button.
3. Click the selection button and select a system function.
4. Define the parameter values.

Result

The function list is processed when the configured event occurs in Runtime.

8.3.2.3 Defining the acquisition cycle for a tag

Introduction

The value of an external tag can be changed in Runtime by the PLC to which the tag is linked. To ensure that the HMI device is informed of any changes in tag values by the PLC, the values must be updated on the HMI. The value is updated at regular intervals while the tag is displayed in the process screen. The interval for regular updates is set with the acquisition cycle. The update can also be made continuous.

Requirement

- You have created the tag for which you want to define an acquisition cycle.
- The Inspector window with the tag properties is open.

Procedure

To configure an acquisition cycle for a tag, proceed as follows:

1. Click "General" in the "Properties" group in the Inspector window.
2. If you want to update the tag at regular intervals as long as it is displayed or logged on screen, select "Cyclic in operation" as the acquisition mode.
   Or:
   If you want to update the tag at regular intervals even though it is not displayed on screen, select "Cyclic continuous" as the acquisition mode.
   The "Cyclic continuous" is selected for a tag, for example, which has a function list configured for a change of its value and which is not directly visible in a screen.
3. Select the required cycle time in the "Acquisition cycle" field or define a new acquisition cycle using the object list.

Alternatively, you can configure the acquisition cycle directly in the "HMI Tags" editor. To view hidden columns, activate the column titles using the shortcut menu.

Note

Only use the "Cyclic continuous" setting for tags that really have to be continuously updated. Frequent read operations generate a heavy communication load.

Result

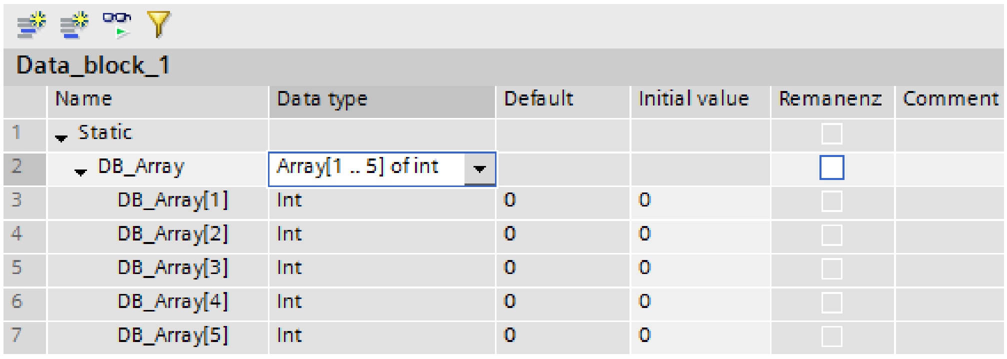
The configured tag is updated in Runtime with the selected acquisition cycle.

8.3.3 Working with arrays

8.3.3.1 Basics on arrays

Definition

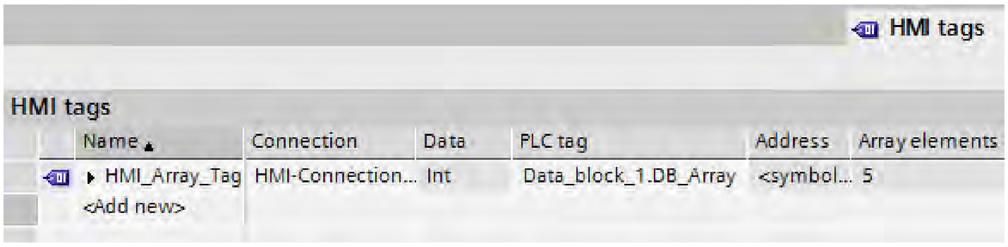
Array data of a uniform data type is successively arranged and is addressed within the address space to allow access to these data by means of an index. To address its individual array elements, the array uses an integer index that begins with "1". The properties of each array element are the same and are configured at the array tag in a data block of the PLC program.



Data_block_1

	Name	Data type	Default	Initial value	Remanenz	Comment
1	Static				☐	
2	DB_Array	Array[1 .. 5] of int			☐	
3	DB_Array[1]	Int	0	0	☐	
4	DB_Array[2]	Int	0	0	☐	
5	DB_Array[3]	Int	0	0	☐	
6	DB_Array[4]	Int	0	0	☐	
7	DB_Array[5]	Int	0	0	☐	

You then connect an HMI tag to the array tag in the data block. The HMI tag mirrors the array and thereby inherits the properties of the array tag in the data block.



HMI tags

HMI tags

Name	Connection	Data	PLC tag	Address	Array elements
HMI_Array_Tag	HMI-Connection...	Int	Data_block_1.DB_Array	<symbol...	5
<Add new>					

Advantages

You can configure multiple array elements with the same properties at one time using a single array tag. You can then use each array element as any other tag in your configuration.

Restrictions

The following restrictions apply to the use of arrays:

- Not all HMI devices support array tags.
- In terms of the properties: Not all array elements have limits, for example.

Application examples

Array tags can be used in the following situations:

- To group process values in profile trends: You map process values to trends which are acquired at different points in time, for example.
- To access specific values which are grouped in trends: You output all values of the profile trend by stepping up the index tag, for example.
- To configure discrete alarms with successive bit number.
- To save machine data records to a single tag.

License rule for runtime

An array tag is counted in WinCC Runtime as one PowerTag, regardless of the number of array elements.

Special features

Warning
Increased system load and performance losses

Read or write access to a single array element always includes read or write access to all array elements of the array tag. Transfer of the data of large arrays from and to the PLC usually takes longer compared to the transfer of a basic data type. This may cause communication overload and disruption as a result.

Example:

- An array tag which consists of 100 array elements of data type "Real" was configured.
- If an array element with a length of four bytes changes, 100 x 4 bytes are written to the PLC.

Caution
Data inconsistency at array tags

The entire array is read at the time t1 if an array element changes. The modified array element is replaced in the array. The array is written back to the PLC at the time t3 > t1. If the array has changed again within the time t2, the changed value t2 is overwritten with time value t1 at the time t3. Array data is therefore inconsistent at the time t3.

You should always prevent the HMI device and the PLC from concurrently writing values to the same array tag. Use synchronous transfer of recipe data records to synchronize an array tag with the PLC.

8.3.3.2 Creating array tags

Introduction

Create an array tag to configure a large number of tags of the same data type. The array elements are saved to a consecutive address space. You create an array tag in a data block in the PLC program of the connected PLC. You then connect the array tag to an HMI tag.

Requirement

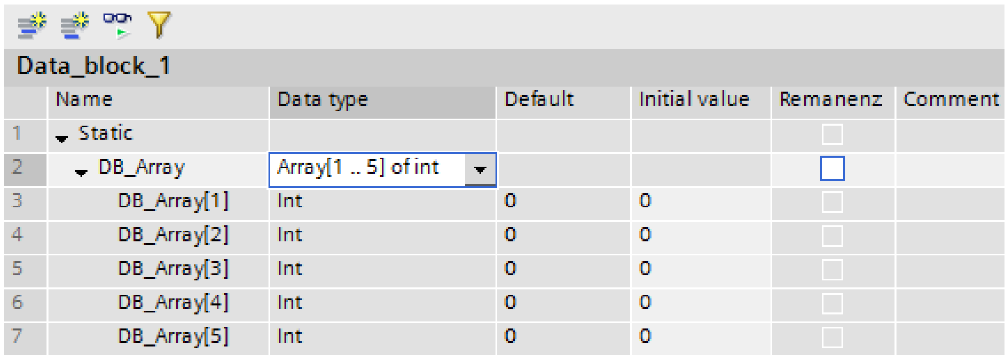
The project contains a PLC.

The "HMI Tags" editor is open.

Procedure

To create an array tag, follow these steps:

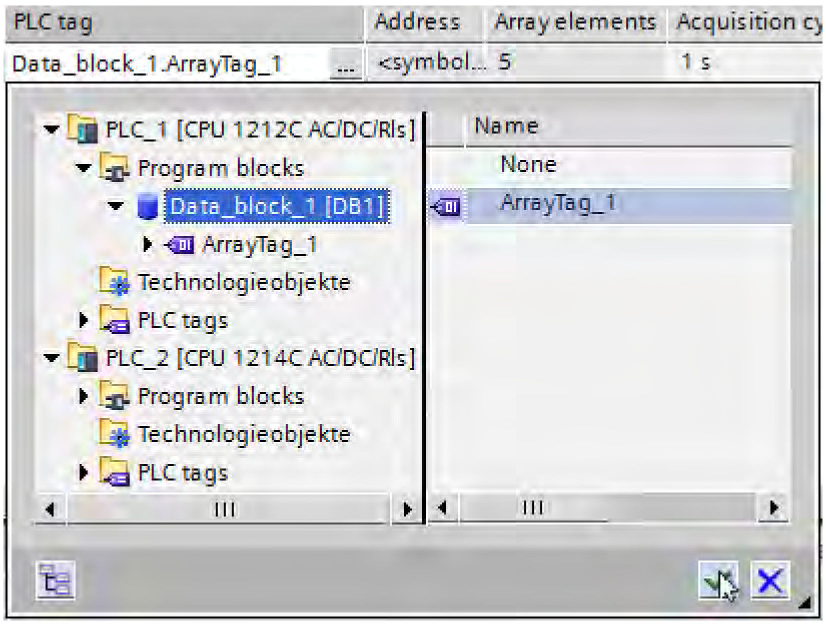
1. Open the node for the PLC in the project tree and double-click "Program blocks > Add new block". The dialog with this name opens.
2. Use the dialog to create a data block and open the block in the "Program blocks" editor.
3. Enter a name for the array tag in the first empty field of the "Name" column.
4. Select "Array[lo .. hi] of type" as the data type.
5. In the data type, replace "lo" and "hi" with corresponding numbers for numbering the array elements. Replace the "type" designation with the data type desired for the array tag. Pay attention to the spaces in the data type specification.
   Example: "Array[1 .. 5] of int" results in an array tag with 5 array elements of the same name and consecutive numbering from 1 to 5. The data type of the array elements is "Integer".



Data_block_1

	Name	Data type	Default	Initial value	Remanenz	Comment
1	Static				☐	
2	DB_Array	Array[1 .. 5] of int			☐	
3	DB_Array[1]	Int	0	0	☐	
4	DB_Array[2]	Int	0	0	☐	
5	DB_Array[3]	Int	0	0	☐	
6	DB_Array[4]	Int	0	0	☐	
7	DB_Array[5]	Int	0	0	☐	

6. Select the menu command "Edit > Compile." The data block is compiled and is then available in the project.
7. Create a new tag in the "HMI tags" editor.
8. Select the connection to the PLC in the "Connection" field.
9. In the "PLC tag" field, open the selection dialog and select the data block you have created under the corresponding PLC. Select the array tag in the right window and confirm the selection.



PLC tag	Address	Array elements	Acquisition cy
Data_block_1.ArrayTag_1	<symbol...	5	1 s

Result

You have created an array tag and connected it to an HMI tag. The HMI tag mirrors the array of the PLC on the HMI device. PLC memory space is allocated automatically. The properties of the array elements are inherited from the parent array tag.

8.3.3.3 Examples of arrays

Introduction

Array tags group multiple tags to form a data structure which, for example, consists of 100 array elements. Array elements are tags you can use anywhere in your configuration. Array tags can also be used at the following locations:

- In the "Alarms" editor
- In the "Recipes" editor
- For address multiplexing
- In the trend view

Examples

You can configure an array tag with the corresponding number of array elements to handle multiple tags of the same data type.

- The individual array elements can be accessed indirectly by means of a multiplex index tag, for example.
- Use these index tags to operate and monitor the array elements.
- Using an array tag you create multiple recipe elements which are interconnected automatically with the corresponding array elements.
- Synchronize the array tag with the PLC be means of the recipe.

8.3.4 Working with cycles

8.3.4.1 Basics on cycles

Introduction

Cycles are used to control actions that regularly occur in runtime. Common applications are the acquisition cycle and the update cycle.

Principle

In runtime, actions that are performed at regular intervals are controlled by cycles. Typical applications for cycles include the following:

- Acquisition of external tags
  The acquisition cycle determines when the HMI device will read the process value of an external tag from the PLC. Set the acquisition cycle to suit the rate of change of the process values. The temperature of an oven, for example, changes much more slowly than the speed of an electrical drive.
  Do not set the acquisition cycle too low, since this will unnecessarily increase the communication load of the process.

- Refreshing screens
  The update cycle determines how often a screen will be refreshed.

Note
Availability for specific devices

The update cycle is fixed on Basic Panels.

The smallest possible value for the cycle depends on the HMI device that will be used in your project. For most HMIs, this value is 100 ms. The values of all other cycles are always an integer multiple of the smallest value.

Application example

You can use cycles for the following tasks:

- To regularly update a tag.
- To draw attention to maintenance intervals.

8.3.5 Displaying tags

8.3.5.1 Outputting tag values in screens

Introduction

In runtime you can output tag values in the screens of the operator device in the form of a trend. A trend is a graphic representation of the values that a tag takes during runtime. Use the "Trend display" graphic object to represent it. Process values for the trend display are loaded by the PLC from the ongoing process.

The values to be displayed are determined individually within a fixed, configurable cycle. Cyclically-triggered trends are suitable for representing continuous curves, such as the changes in the operating temperature of a motor.

Displayed values

You will need to configure a trend view in a screen so that tag values are displayed on the HMI device. When configuring the trend view, specify which tag values are to be displayed.

You can control the updating of the trend display by defining the cycle time.

8.3.5.2 Configuring trend displays for values from the PLC

Introduction

You use a trend view to graphically represent values that a tag assumes during the process.

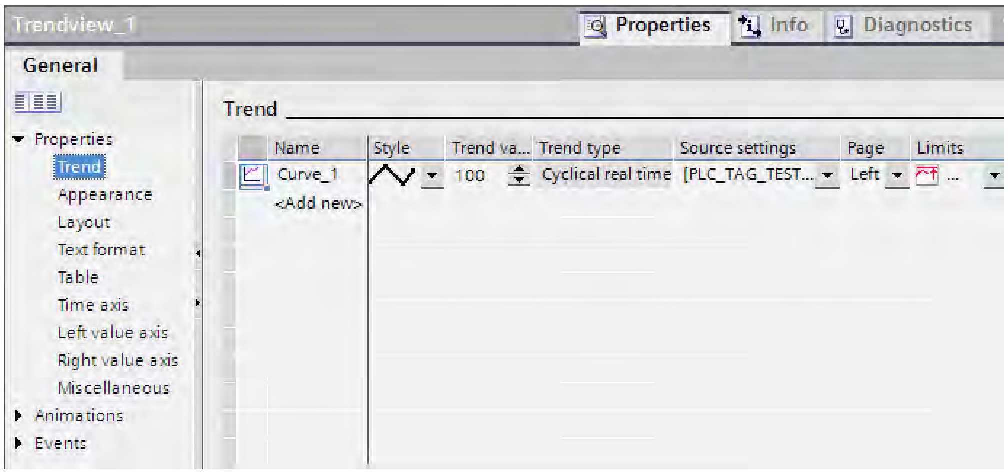
Requirement

- A screen is open.
- The Inspector window with the trend view properties is open.

Procedure

To configure a trend view, follow these steps:

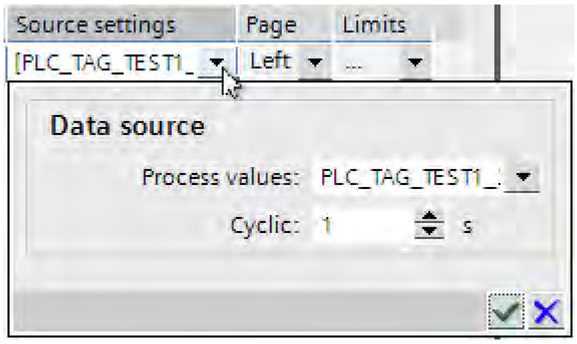
1. Add the "Trend view" object from the toolbox in the "Control" group to the screen.
2. Select the "Trend" category from the "Properties" group in the Inspector window and double-click "<Add>" in the "Name" column.



Name	Style	Trend va...	Trend type	Source settings	Page	Limits
Curve_1		100	Cyclical real time	[PLC_TAG_TEST...	Left	...
<Add new>						

3. Assign a name to the trend in the "Name" column.
4. In the "Style" column, use the selection button to open the "Style" dialog and select the style of the line.
5. Select the number of trend values in the "Trend values" column.
6. In the "Settings" column, use the selection button to open the "Data source" dialog and select the tags to supply the trend with values.

   Specify the cycle for reading the tags from the PLC.



Source settings	Page	Limits
[PLC_TAG_TEST1_	Left	...

Data source

Process values: PLC_TAG_TEST1_

Cyclic: 1 s

7. You can make other settings in the dialogs of the Inspector window. For example, you can select the "Display table" option in the "Table" category to display a value table beneath the trend view.

Note

If you hold down the <CTRL> key and double-click the trend view, the trend view is activated. You set the column width and the position of the columns in the table header of the values table in active mode. In order to activate the trend view the zoom factor has to be set to 100 %.

Result

In runtime, the values of the selected tags are displayed in the configured trend view.

8.4 Working with alarms

8.4.1 Basics

8.4.1.1 Alarm system in WinCC

Introduction

The alarm system allows you to display and record operating states and faults on the HMI device that are present or occur in a plant.

An alarm may have the following content:

No.	Time	Date	Alarm text	Status	Alarm class
5	12:50:24:590	24.02.2007	Boiler pressure above high limit.	Incoming Outgoing	Warning: Color Red

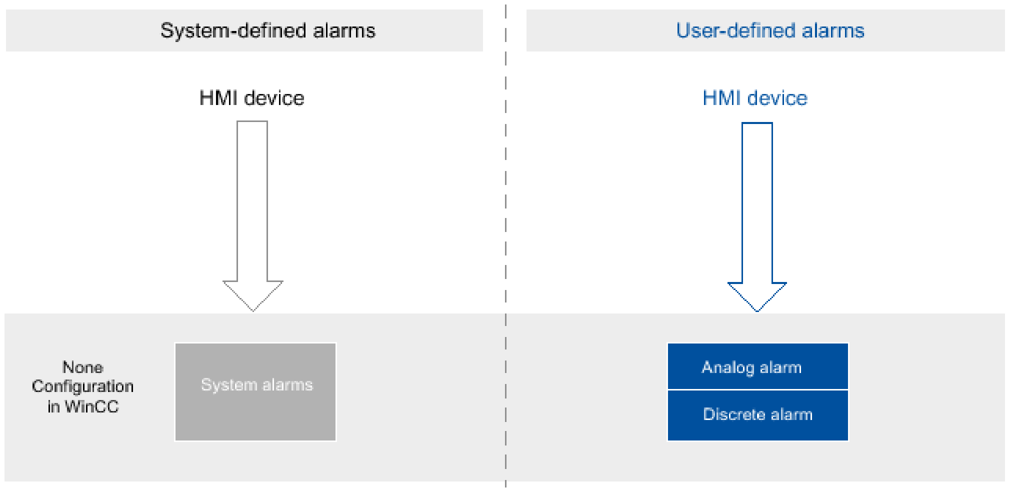
Alarm system in WinCC

The alarm system processes a variety of alarm types. The alarm procedures can be broken down into system-defined alarms and user-defined alarms:

- User-defined alarms are used to monitor the plant process.
- System-defined alarms monitor the HMI device.

The detected alarm events are displayed on the HMI device. Targeted access to the alarms combined with supplementary information about individual alarms ensures that faults are localized and cleared quickly. This reduces stoppages or even prevents them altogether.

The following figure shows the alarm system structure:



See also

Overview of the alarm types (Page 1192)
Alarm states (Page 1195)
Acknowledgment model (Page 1200)
Alarm groups (Page 1200)
Acknowledging alarms (Page 1198)
Alarm components and properties (Page 1201)
Alarms in Runtime (Page 1225)
System functions and events for alarms (Page 1231)
Overview of Alarm Configuration (Page 1202)

8.4.1.2 Alarm types

8.4.1.2 Overview of the alarm types

Introduction

The alarm types serve various purposes for monitoring the plant. The alarms from the individual alarm types are configured and triggered in different ways.

You can configure alarms using the individual alarm types on the relevant tab in the "Alarms" editor.

Alarm types in WinCC

WinCC supports the following alarm types:
User-defined alarms

- Analog alarms
  - Analog alarms are used to monitor limit violations.
- Discrete alarms
  - Discrete alarms are used to monitor states.
- PLC alarms
  - You configure PLC alarms in STEP 7.
  - You then further process the PLC alarms in WinCC.

Note
Availability for specific devices

PLC alarms are not available for Basic Panels.

System-defined alarms

- System-defined PLC alarms
  - System-defined PLC alarms consist of diagnostic alarms (SIMATIC S7) and system errors (SFM)
  - System-defined PLC alarms are used to monitor the PLC.

Note
Availability for specific devices

System-defined PLC alarms are not available for Basic Panels.

- System alarms
  - System alarms belong to the HMI device and are imported into the project.
  - System alarms monitor the HMI device.

See also

Alarm system in WinCC (Page 1191)

8.4.1.2 System-defined alarms

8.4.1.2 System alarms

Examples for alarms

- "Overflow of the buffer for printing lines in text mode"

- "An internal error has occurred. Runtime is terminated"

Description

A system alarm indicates the status of the system, plus communication errors between the HMI device and system.

Under "Runtime settings > Alarms" you specify how long a system alarm is shown on the HMI device.

Support

The manual for your HMI device contains a list of the possible system alarms, along with the cause and possible remedies. If you contact online support because of a system alarm on the HMI device, you will need the alarm number and tags used in the system alarm.

8.4.1.2 User-defined alarms

8.4.1.2 Analog alarms

Description

Analog alarms signal limit violations during the process.

Example

The speed of the mixer in a fruit juice mixing plant must not be too high or too low. You can configure analog alarms to monitor the speed of the mixer. If the high or low limit for the speed of the mixer is violated, an alarm is output on the HMI device containing the following alarm text, for example: "Mixer speed is too low".

See also

Discrete alarms (Page 1194)

8.4.1.2 Discrete alarms

Description

Discrete alarms indicate a status in the current process.

Example

A fruit juice mixing plant consists of several tanks containing the ingredients. To ensure the correct mixing ratio of water, fruit concentrate, sugar, and flavoring, the valves in the intakes open and close at the right moment. This operation should be monitored.

You configure a suitable discrete alarm for all the valve states. If a valve on one of the four tanks opens or closes, an alarm is displayed, such as "Water valve closed".

The operator can thus monitor whether the plant is producing correctly.

See also

Analog alarms (Page 1194)

8.4.1.3 Alarm states

Introduction

An alarm assumes various alarm states in Runtime. The user analyzes and reports on the process execution with reference to the alarm states.

Note
Basic Panels

Reporting and logging are not available for Basic Panels.

Description

Every alarm has an alarm status. The alarm states are made up of the following events:

- Incoming (I)

  The condition for triggering an alarm is satisfied. The alarm is displayed, such as "Boiler pressure too high."
- Outgoing (O)

  The condition for triggering an alarm is no longer satisfied. The alarm is no longer displayed as the boiler was vented.
- Acknowledge (A)

  The operator acknowledges the alarm.

Alarms without acknowledgment

The following table shows the alarm states for alarms that do not have to be acknowledged:

Display text	Status	Description
I	Incoming	The condition for an alarm is satisfied.
IO	Outgoing	The condition for an alarm is no longer satisfied.

Alarms with acknowledgment

The following table shows the alarm states for alarms that have to be acknowledged:

Display text	Status	Description
I	Incoming	The condition for an alarm is satisfied
IO	Outgoing not acknowledged	The condition for an alarm is no longer satisfied. The operator has not acknowledged the alarm.
IOA	Outgoing and subsequently acknowledged	The condition for an alarm is no longer satisfied. The operator has acknowledged the alarm after this time.
IA	Incoming, acknowledged	The condition for an alarm is satisfied. The operator has acknowledged the alarm.
IAO	Outgoing but acknowledged first	The condition for an alarm is no longer satisfied. The operator acknowledged the alarm while the condition was still satisfied.

Each occurrence of these states can be displayed and logged on the HMI device and a protocol printed.

Note

The display text for the alarm status can be configured as required.

See also

Alarm system in WinCC (Page 1191)

8.4.1.4 Alarm classes

Introduction

Many alarms occur in a plant. These are all of different importance. You can assign the alarms of your project to alarm classes to clearly show the user which of the alarms are most important.

Description

The alarm class defines how an alarm is displayed. The alarm class specifies if and how the user has to acknowledge alarms of this alarm class.

A new alarm class with mandatory acknowledgment is generated in WinCC.

Note

The choice of display modes for alarm classes depends on the options on your HMI device.

Examples of how to use alarm classes

- The alarm "Speed of fan 1 in upper tolerance range" has alarm class "Warning". The alarm is displayed with a blue text and white background. The alarm does not have to be acknowledged.
- The alarm "Speed of fan 2 has exceeded upper warning range" is assigned to the "Error" alarm class. The alarm is displayed with a red background and flashes at high frequency in runtime. The alarm is displayed until the user acknowledges it.

Using alarm classes

Use the following alarm classes to define the acknowledgment model and display of alarms for your project:

- Predefined alarm classes

  You cannot delete predefined alarm classes and edit them only to a limited extent. Up to four alarm classes have already been created for every HMI device.
- Custom alarm classes

  You can create new alarm classes, configure how you want the alarms to be displayed and define an acknowledgment model for the alarms from this alarm class. The possible number of custom alarm classes depends on which runtime is used in your project.
- Project-wide alarm classes

  Project-wide alarm classes are displayed under "Shared data > Alarm classes" in the project tree and can be used for the alarms of an HMI device. Project-wide alarm classes originate in the alarm configuration of STEP 7. If needed, you can create additional project-wide alarm classes in WinCC.

Note
Basic Panels

Project-wide alarm classes are not available for Basic Panels.

Predefined alarm classes

The following alarm classes already created in WinCC for every HMI device:
Alarm classes for user-defined alarms

- "Warnings"

  The "Warnings" alarm class is intended for discrete and analog alarms that show regular states and routines in the process. The user does not acknowledge alarms from this alarm class.
- "Error"

  The "Error" alarm class is intended for discrete and analog alarms that display critical or hazardous states or limit violations in the process. The user must acknowledge alarms from this alarm class.

Alarm classes for system-defined alarms

- "System"

  The "System" alarm class contains alarms that display states of the HMI device and the PLCs.
- "Diagnostics"

The "Diagnostics" alarm class contains alarms that display states and alarms in the SIMATIC S7. The user does not acknowledge alarms from this alarm class.

Note
Basic Panels

The "Diagnostics" alarm class is not available for Basic Panels.

8.4.1.5 Acknowledgment

8.4.1.5 Acknowledging alarms

Introduction

To make sure that an alarm was registered by the plant operator, configure this alarm so that it is displayed until acknowledged by the operator. Alarms that display critical or hazardous states in the process have to be acknowledged.

Description

The acknowledgment of an alarm is an event that is logged and reported as required. Acknowledging an alarm changes the alarm status of an alarm from "Incoming" to "Acknowledged". When the operator acknowledges an alarm, the operator confirms that he or she has processed the status that triggered the alarm.

Note
Basic Panels

Reporting and logging are not available for Basic Panels.

Triggering acknowledgment of an alarm

The acknowledgment of an alarm can be triggered as follows in Runtime:

- Acknowledgement by the authorized user at the HMI device
- Automatic acknowledgment by the system without operator input, via
  - Tags
  - System functions in function lists or scripts
  - PLC

Note
Basic Panels

Scripts are not available for Basic Panels.

Acknowledging alarms that belong together

To make the alarm system clearer and easier to use in Runtime, you can configure alarms that belong together and that the user can acknowledge together with a single operator action.

Acknowledgment by the PLC

Discrete alarms will be automatically acknowledged by the PLC, if necessary. The acknowledgment is triggered by a bit in the "Acknowledgment tag PLC". You define the bit and tag at the configuration stage.

Acknowledgment of an alarm on the HMI device

In Runtime, the user acknowledges an alarm in one of the following ways, depending on the configuration:

- Using the acknowledgment button <ACK> on the HMI device
- Using the button in the alarm view
- Using configured function keys or buttons in screens

Note
Acknowledgment button <ACK> on the HMI device

To ensure that critical alarms are only processed by authorized users, protect the "ACK" button on the HMI devices, and the operating controls and display objects in the alarms against unauthorized use by assigning a corresponding authorization.

Note
HMI device dependency

The acknowledgement key <ACK> is not available on all HMI devices.

See also

Alarm system in WinCC (Page 1191)
Acknowledgment model (Page 1200)

8.4.1.5 Acknowledgment model

Overview

You define the acknowledgment model for an alarm class. Alarms that are assigned to this alarm class will be acknowledged on the basis of this acknowledgment model. The following acknowledgment model is used in WinCC:

- Single alarm without acknowledgment

  This alarm comes and goes without having to be acknowledged. There is no visible response from the system.
- Single alarm with incoming acknowledgment

  This alarm must be acknowledged as soon as the event that triggers the alarm occurs. The alarm remains pending until it is acknowledged.

Acknowledgment model for multiple alarms

To acknowledge multiple alarms together, assign these alarms to an alarm group.

If the user acknowledges an alarm belonging to an alarm group in Runtime, all the alarms from this alarm group will be acknowledged at the same time.

See also

Alarm system in WinCC (Page 1191)
Acknowledging alarms (Page 1198)

8.4.1.6 Alarm groups

Introduction

Many alarms from different areas and processes occur in a plant. You can use alarm groups to acknowledge alarms with the same cause together.

Alarm groups

You can compile associated alarms into alarm groups. You can use the alarm groups to monitor the parts of the plant and to acknowledge the associated alarms together as required. If you acknowledge an alarm from this alarm group, all other alarms in the alarm group are also acknowledged.

Alarm groups can contain alarms from different alarm classes. It only makes sense to allocated alarms that require acknowledgment to alarm groups.

Using alarm groups

It is a good idea to compile alarm groups for alarms such as the following:

- Alarms that are caused by the same fault.
- Alarms of the same type

- Alarms from a machine unit, such as "Fault in drive XY"
- Alarms from an associated part of the process, such as "Fault in cooling water supply"

Display in runtime

In Runtime, the "Alarm group" column displays the number of the alarm group to which the alarm belongs.

See also

Alarm system in WinCC (Page 1191)

8.4.2 Working with alarms

8.4.2.1 Alarm components and properties

Overview

You configure the components of alarms in WinCC. The following table shows the basic components of alarms:

Alarm class	Alarm number	Time	Date	Alarm status	Alarm text	Alarm group	Infotext
Warning	1	11:09:14	06.08.2007	IO	Maximum speed reached	2	This alarm is ...
System	110001	11:25:58	06.08.2007	I	Switch to "Online" mode	0	This alarm is ...

Alarm class

Alarm classes, such as "Warning" or "Error." The alarm class defines the following for an alarm:

- Acknowledgment model
- Appearance in Runtime (e.g. color)
- Logging

Note
Basic Panels

Logging is not available for Basic Panels.

Alarm number

An alarm is identified by a unique alarm number. The alarm number is assigned by the system. You can change the alarm number to a sequential alarm number, if necessary, to identify alarms associated in your project.

Time and date

Every alarm has a time stamp that shows the time and date at which the alarm was triggered.

Alarm status

An alarm has the events "Incoming," "Outgoing," "Acknowledge." For each event, a new alarm is output with the current status of the alarm.

Alarm text

The alarm text describes the cause of the alarm.

The alarm text can contain output fields for current values. The values you can insert depend on the Runtime in use. The value is retained at the time at which the alarm status changes.

Alarm group

The alarm group bundles individual alarms.

Infotext

You can configure a separate infotext for each alarm; the user can display this infotext in Runtime.

See also

Overview of configuring alarm output (Page 1216)
Alarm system in WinCC (Page 1191)
Configuring acknowledgment of alarms using the message class (Page 1223)

8.4.2.2 Configuring alarms

8.4.2.2 Overview of Alarm Configuration

Steps to configure alarms

Configuring alarms in WinCC involves the following steps:

1. Edit and create alarm classes

   You use the alarm class to define how an alarm will be displayed in runtime and to define the acknowledgment model for it.

2. Create tags

   - You create the tags for your project in the "Tag" editor.
   - You can define limits for the tags. An alarm is triggered if these limits are exceeded.
   - You can also create alarms in the "Tags" editor, if necessary.
3. Create discrete alarms and analog alarms
   - You can discrete alarms and analog alarms, and assign them tags to be monitored, alarm classes, alarm groups and other properties.
   - You can also assign system functions or scripts to the alarm events.
4. Output of configured alarms

   To output configured alarms, configure in the "Screens" editor display and operator control object that outpus the alarms in runtime.

Additional configuration tasks

Additional tasks may be necessary for configuring alarms, depending on the requirements of your project:

1. Creating alarm groups

   You assign the alarms of your project to alarm groups according to their association, such as by the cause of the problem (power failure) or source of the error (Motor 1).
2. Configuring Loop-In-Alarm

   A Loop-In-Alarm is configured in order to change to a screen containing relevant information on an alarm received.

See also

Creating alarm classes (Page 1203)
Configuring alarm groups (Page 1205)
Alarm system in WinCC (Page 1191)
Configuring discrete alarms in the "Tags" editor (Page 1213)
Configuring discrete alarms (Page 1205)
Configuring analog alarms (Page 1207)
Adding an output field to alarm text (Page 1210)
Formatting alarm text (Page 1211)
Configuring loop-in alarm (Page 1212)

8.4.2.2 Creating alarm classes

Introduction

You create alarm classes in the "Alarm Classes" tab of the "Alarms" editor. There are four pre-defined alarm classes provided as standard for every project. You can create more custom alarm classes as required. You can create up to 32 alarm classes.

Requirement

- You have created a project.

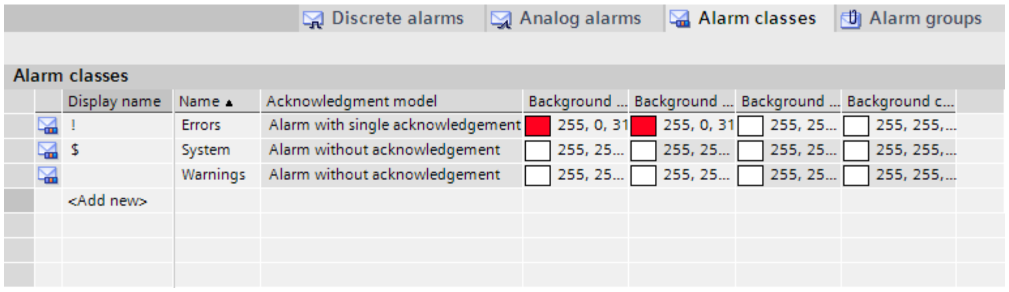
- The "Alarms" editor is open.
- The Inspector window is open.

Procedure

To create an alarm class, proceed as follows:

1. Click the "Alarm Classes" tab.

   The four predefined and existing custom alarm classes are displayed. A table of the pre-defined alarm classes is shown below:

   Alarm classes

Display name	Name ▲	Acknowledgment model	Background ...	Background ...	Background ...	Background c...
!	Errors	Alarm with single acknowledgement	🟥 255, 0, 31	🟥 255, 0, 31	☐ 255, 25...	☐ 255, 255,...
$	System	Alarm without acknowledgement	☐ 255, 25...	☐ 255, 25...	☐ 255, 25...	☐ 255, 255,...
	Warnings	Alarm without acknowledgement	☐ 255, 25...	☐ 255, 25...	☐ 255, 25...	☐ 255, 255,...
<Add new>						

2. Double-click the first empty line in the table in the work area.

   A new alarm class is created. A fixed ID is automatically assigned to every new alarm class.

   The properties of the new alarm class are shown in the Inspector window.
3. Configure the alarm class under "General" in the Inspector window. Enter a "Name" and the "Display name". Depending on the HMI device, you can make settings for logging or automatic sending of e-mails.
4. Define the acknowledgment model for the alarm class under "Acknowledgment" in the Inspector window.
5. Change the default text under "Status" in the Inspector window.

   This text indicates the status of an alarm in Runtime.
6. Change the default colors under "Colors" in the Inspector window. Depending on the HMI device, you can also change the flash characteristics.

These settings define how alarms from this alarm class are displayed in Runtime.

Note

To display the alarm classes color-coded in Runtime, the "Use alarm class colors" option must be selected under "Project Tree > Runtime Settings > Alarm Settings". This option is selected in a new project in WinCC.

See also

Overview of Alarm Configuration (Page 1202)

8.4.2.2 Configuring alarm groups

Introduction

You create alarm groups on the "Alarm Groups" tab in the "Alarms" editor. An alarm group is a compilation of single alarms. You assign alarms in an alarm group by association, such as cause of the problem or source of the error. If you acknowledge an alarm from this alarm group in Runtime, all other alarms in the alarm group are acknowledged automatically.

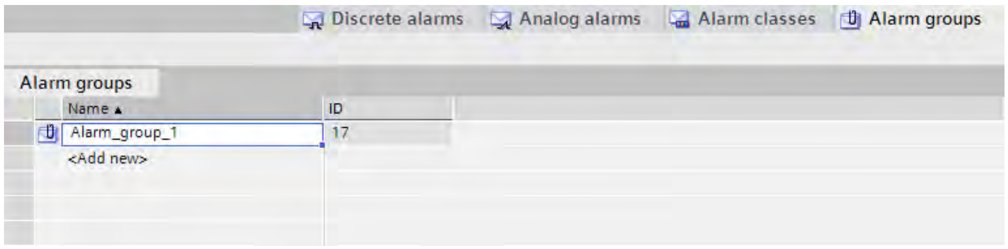
Requirement

- You have created a project.
- The "Alarms" editor is open.
- The Inspector window is open.

Creating a new alarm group

1. Click the "Alarm Groups" tab.

   The existing alarm groups are displayed.



Name ▲	ID
Alarm_group_1	17
<Add new>	

2. Double-click the first empty line in the table in the work area.

   A new alarm group is created. The properties of the new alarm group are shown in the Inspector window.
3. Enter a name for the alarm group.
4. Save the project.

Result

An alarm group is created. To acknowledge alarms in Runtime together, assign these associated alarms to an alarm group.

See also

Overview of Alarm Configuration (Page 1202)

8.4.2.2 Configuring discrete alarms

Introduction

Discrete alarms indicate status changes in a plant and are triggered by the PLC. They indicate that a valve is open or closed, for example.

The following paragraph describes the configuration process in the "Alarms" editor. Alternatively, you can configure discrete alarms in the "Tags" editor.

Requirement

- The "Alarms" editor is open.
- The Inspector window is open.
- The required alarm classes and alarm groups are created.

Procedure

To configure a discrete alarm, proceed as follows:

1. Click the "Discrete alarms" tab.
2. To create a new discrete alarm, double-click in the first empty line of the table.

   A new discrete alarm is created.
3. Configure the alarm under "General" in the Inspector window:
   - If required, change the object name of the alarm.
   - Select the alarm class and the alarm group, if necessary.
   - Enter the alarm text and insert output fields in the alarm text, if needed.
4. In the Inspector window, select the tag and the bit that triggers the alarm under "Properties > Trigger". Note the following information:
   - Use the data type "UShort" or "Short".
   - Use trigger tag bits only for alarms.
   - Do not use trigger tags for anything else.
   - If you want to acknowledge the alarm via the PLC, use this tag as a PLC acknowledgment tag.

Note

If the specified trigger bit is already used as the trigger for other actions, the system does not check this multiple assignment until the next compilation.

Notice

Note the method used to count bits in the utilized PLC when specifying the bit. For more information, refer to the section on "Communication" in the online Help for the PLC.

Note

If the object in the selection does not yet exist, create it directly in the object list and change its properties later.

Result

The discrete alarm is created.

Status-related alarm texts

Connect the value of a discrete alarm to text lists to output the relevant alarm texts for the two states displayed by a discrete alarm.

Additional settings for discrete alarms

Assign discrete alarm to an alarm class

To assign the alarm to an alarm group, proceed as follows:

1. Select the discrete alarm.
2. Select the alarm group under "General" in the Inspector window.

Creating info text

To assign the alarm to an info text, proceed as follows:

1. Select the discrete alarm.
2. Select "Properties > Info text" in the Inspector window and enter the required text.

Configuring event-driven tasks

To configure event-driven tasks, proceed as follows:

1. Select the discrete alarm.
2. In the Inspector window, select "Events".
3. Configure a function list for the required event.

See also

Overview of Alarm Configuration (Page 1202)

8.4.2.2 Configuring analog alarms

Introduction

Analog alarms indicate limit violations. For example, if the speed of a motor drops below a certain value, an analog alarm is triggered.

Requirement

- The "Alarms" editor is open.
- The Inspector window is open.
- The required alarm classes and alarm groups are created.

Procedure

To configure an analog alarm, proceed as follows:

1. Click the "Analog alarms" tab.

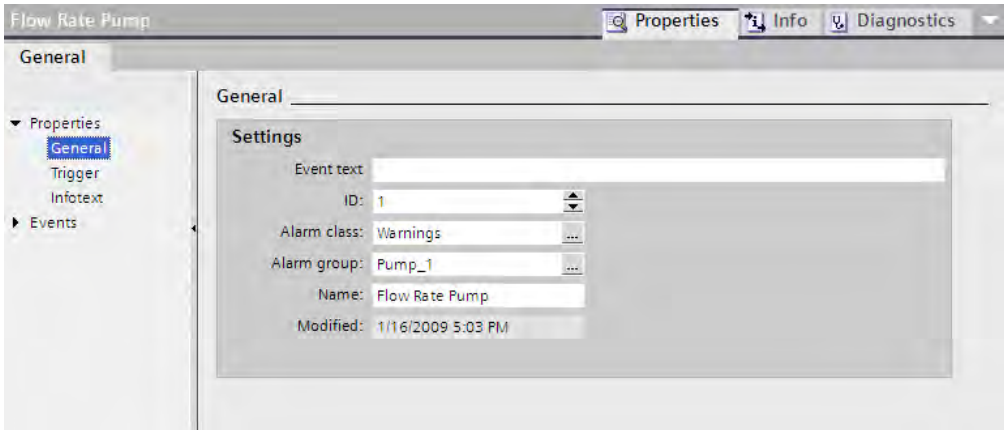
2. To create a new analog alarm, double-click in the first empty line of the table.

   A new analog alarm is created.

3. Configure the alarm under "General" in the Inspector window:

   – If required, change the object name of the alarm.

   – Select the alarm class and the alarm group, if necessary.



Event text	
ID:	1
Alarm class:	Warnings
Alarm group:	Pump_1
Name:	Flow Rate Pump
Modified:	1/16/2009 5:03 PM

4. Enter the alarm text.

5. You can format the alarm text on a character-by-character basis, and insert output fields for tag values or text lists in the text.

6. In the Inspector window, select the tag that triggers the alarm under "Properties > Trigger". Do not use trigger tags for anything else.

Configure limit values for an analog alarm

1. Select the analog alarm.

2. To use a constant as the limit, click the left button

   Const

   button under "Trigger > Value" in the Inspector window, and select the "String" option.

3. Enter the required limit value.

4. To use a tag as the limit, click the left button

   Const

   under "Trigger > Value" in the Inspector window, and select the "Tag" option.

   The right button

   ...

   appears.

5. Use this button to select the tag you want to use.

   "Synchronize" indicates whether the limits are synchronized with the limits for this alarm that were configured in the "Tags" editor.

6. Select the trigger mode:

   – "High limit": The alarm is triggered when the limit is exceeded.

– "Low limit": The alarm is triggered when the limit is undershot.

Note

If the object included in the selection does not yet exist, create it in the object list and change its properties later.

Optional settings for analog alarms

Setting the delay time

To set the delay time, proceed as follows:

1. In the Inspector window, select "Properties > Trigger".
2. Enter a time period under "Delay". The alarm is only triggered when the trigger condition is still present after the delay time has elapsed.

Setting the hysteresis

Note

If a process value fluctuates around the limit, the alarm associated with this fault may be triggered multiple times. In this case, configure a hysteresis or delay time.

To enter the hysteresis, proceed as follows:

1. In the Inspector window, select "Properties > Trigger".
2. Under "Hysteresis > Mode", select the change in alarm status for which the hysteresis is to be taken into account.
3. Enter a constant value under "Hysteresis > Value".
4. To define the hysteresis value as a percentage of the limit, enable the "%" check box.

Automatic reporting

1. Select the analog alarm.
2. In the Inspector window, select "Properties > Process", and enable "Report". If "Report" is enabled under the alarm settings, this alarm will be recorded in an alarm report.

Note
Basic Panels

Reporting is not available for Basic Panels.

Creating info text

1. Select the analog alarm.
2. Select "Properties > Info text" in the Inspector window and enter the required text.

Configuring event-driven tasks

1. Select the analog alarm.
2. Select "Events" in the Inspector window and configure a new list of functions for the desired event.

See also

Overview of Alarm Configuration (Page 1202)

8.4.2.2 Adding an output field to alarm text

Introduction

In WinCC, you can add selection fields to the alarm text. These fields display the content of text lists or tags.

Requirement

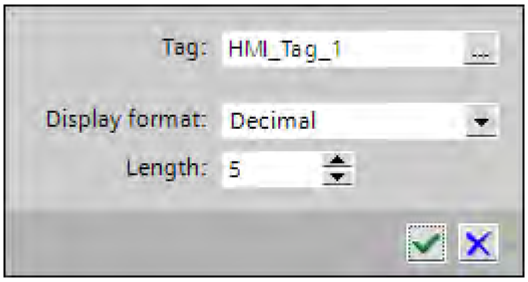
- The "Alarms" editor is open.
- An alarm has been created.

Procedure

To add an output field to an alarm text, proceed as follows:

1. Select the alarm that you want to edit.
2. Place the cursor at the required position in the alarm text.
3. To output the value of a tag directly, select the "Insert tag output field" command from the shortcut menu.

   The "Insert tag output field" dialog box opens.

   Tag: HMI_Tag_1

   Display format: Decimal

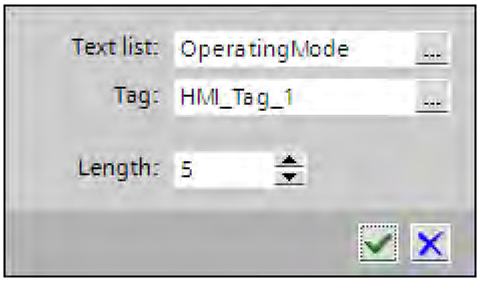
   Length: 5

4. Select the required tag from the "Tag" field. Select the format under "Display format" and the text length of the output field under "Length".
5. Click

   ✓

   to accept your input.
6. To output the value of a tag symbolically using a text list, select "Enter text list output field" from the shortcut menu.

   The "Enter text list output field" dialog box opens.



Text list: OperatingMode

Tag: HMI_Tag_1

Length: 5

7. Select the desired text list under "Text list" and the desired tag under "Tag". Define the length of the output field under "Length".
8. Click
   ✓
   to accept your input.

Note

The sequence of output fields for tags in the alarm text depends on the language. The sequence of the runtime language is used for logging alarms in a CSV log.

Changing the tag of an output field in one language causes the modified output field to appear at the end of the alarm text in all other languages. This changes the order of the output fields in the log.

Basic Panels

Logging is not available for Basic Panels.

See also

Overview of Alarm Configuration (Page 1202)

8.4.2.2 Formatting alarm text

Requirement

- The "Alarms" editor is open.
- Discrete or analog alarms have been created.

Procedure

To format an alarm text, proceed as follows:

1. Select the part of the alarm text to be formatted in the Inspector window.
2. Select "Format" from the shortcut menu of the alarm text.
3. Activate the formatting required for the alarm text.

Result

The alarm text will be displayed in Runtime with the formatting you have selected.

See also

Overview of Alarm Configuration (Page 1202)

8.4.2.2 Configuring loop-in alarm

Introduction

A Loop-In-Alarm is configured in order to change to a screen containing relevant information on an alarm received.

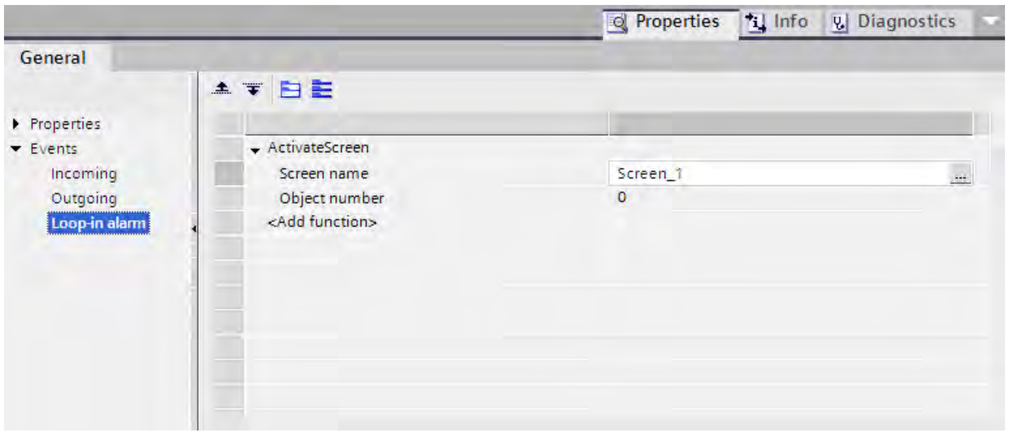
Requirement

- You have created a project.
- The screen to be called by the Loop-In-Alarm has been created.
- The "Alarms" editor is open.

Procedure

To configure a Loop-In-Alarm for an alarm, proceed as follows:

1. Click the tab that contains the alarm for which you want to configure the Loop-In-Alarm.
2. Select the alarm.
3. In the Inspector window, select "Events > Loop-In-Alarm"".
4. Select the "ActivateScreen" system function.



ActivateScreen
Screen name: Screen_1
Object number: 0

5. Select the screen to be called by the Loop-In-Alarm as its parameter.

Note

If you want to configure the Loop-In-Alarm for an alarm view with an "alarm line" form, use the "EditAlarm" system function to trigger the "Loop-In-Alarm" event. The alarm line has no buttons.

Result

If an alarm is displayed in runtime and you click the "Loop-In-Alarm" button for the alarm view, it opens a screen containing information about the error that occurred.

See also

Overview of Alarm Configuration (Page 1202)

8.4.2.2 Alarms in the "Tags" Editor

8.4.2.2 Configuring discrete alarms in the "Tags" editor

Introduction

In WinCC, you can create and edit discrete and analog alarms together with the trigger tags in the "Tags" editor.

Note

If you delete, move or copy in the "Tags" editor, the changes also take effect in the "Alarms" editor.

Requirement

The "HMI alarms" tab is open in the "Tags" editor.

Procedure

To configure a discrete alarm in the "Tags" editor, proceed as follows:

1. Click the first line of the table at the top of the work area.

   A tag is created.
2. Configure an internal or external tag with the data type ULong or UShort as required.
3. Select the tag, and click the "Discrete alarms" tab at the bottom of the work area.
4. Double-click on the first free line of the table.

   A new discrete alarm is created for the tag. If you have selected the wrong data type, the tag will be selected in the discrete alarm.

5. Enter the alarm text under "Properties > Text" in the Inspector window.
6. You can also add output fields to the alarm text.
7. Select an alarm class.
8. In the Inspector window, select the trigger bit of the tag that triggers the discrete alarm under "Properties > Trigger".
9. To create other discrete alarms for monitoring the tags, repeat the above configuration steps.

Note

A tag is only monitored using one alarm procedure. You should therefore create either analog alarms **or** discrete alarms for a tag.

Result

The configured discrete alarms are created in the "Tags" editor and are displayed in the "Alarms" and "Tags" editors.

See also

Configuring analog alarms in the "Tags" editor (Page 1214)
Overview of Alarm Configuration (Page 1202)

8.4.2.2 Configuring analog alarms in the "Tags" editor

Introduction

In WinCC, you can create and edit discrete and analog alarms together with the trigger tags in the "Tags" editor. You can create up to four limits for a tag. You monitor these limits with analog alarms.

Note
Availability for specific devices

You can configure up to two limits for Basic Panels.

Requirement

The "HMI alarms" tab is open in the "Tags" editor.

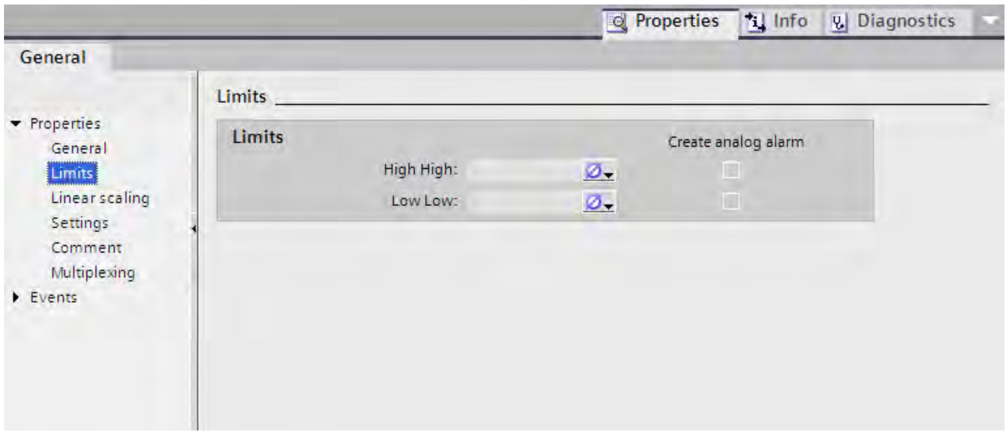
Procedure

To configure an analog alarm in the "Tags" editor, proceed as follows:

1. Click the first line of the table at the top of the work area.

   A tag is created.

2. Configure an internal or external tag as required.
3. In the Inspector window, click "Properties > Columns".



4. Select the desired limit, "Constant" or "HMITag". The object list opens if you selected "HMI tag". Select the tag you want to use.
5. Enable "Create analog alarm" for this limit.
6. Repeat the last two configuration steps for the required limits.
7. Click the "Analog Alarms" tab at the bottom of the work area.

   Analog alarms are created for the selected limits.
8. Select an analog alarm.
9. Enter the alarm text under "Properties" in the Inspector window.

   You can also add output fields to the alarm text.
10. Select an alarm class. The default alarm class is "Error".

Note

Please note the following points:

– A tag is only monitored using one alarm procedure. You should therefore create either analog alarms or discrete alarms for a tag.

– If you delete, move or copy in the "Tags" editor, the changes also take effect in the "Alarms" editor.

– When you create the analog alarms in the Inspector window of the tags, the limits are synchronized with the "Alarms" editor.

Result

The configured analog alarms are created in the "Tags" editor and are displayed in the "Alarms" and "Tags" editors.

See also

Configuring discrete alarms in the "Tags" editor (Page 1213)

8.4.2.3 Configuring alarm output

8.4.2.3 Overview of configuring alarm output

Steps to configure the alarm output

You configure the alarm output in WinCC in the following steps:

1. Create alarm view

   Use the display and control objects in the "Screens" editor to display alarms in Runtime. You can also configure an alarm view for logged alarms.
2. Configure acknowledgment

   In the "Screens" editor, you can set the operator action that will trigger the acknowledgment.
3. Configure reporting

   You can create reports in the "Reports" editor to print alarms in Runtime. In the "Scheduler", "Screens", "Alarms" or "Tags" editors, you define when and how the printing of a report is triggered.

Note

Basic Panels

Reporting and logging are not available for Basic Panels.

Additional configuration tasks

Additional tasks may be necessary for configuring alarm views, depending on the requirements of your project:

1. Setting up authorizations

   To make sure only authorized operators process the alarms, assign authorizations for the alarm view and the function keys of the HMI device.
2. Configuring the filtering of the alarm view

   You configure the filtering of the alarms in Runtime in the "Screens" editor. You can also configure alarm views that only display selected alarms.
3. Configure operator input alarms

   Configure the operator input alarms on the operator controls of the HMI device in the "Screens" editor. A preconfigured operator input alarm is output for an operator action. Operator actions include acknowledgment, disabling, and suppression of alarm display.

See also

Alarm components and properties (Page 1201)
Displaying alarms (Page 1217)
Configuring an alarm view (Page 1218)
Configuring an alarm window (Page 1220)
Configuring an alarm indicator (Page 1221)

8.4.2.3 Displaying alarms

Options for displaying alarms on the HMI device

WinCC offers the following options for displaying alarms on the HMI device:

- Alarm view

  The alarm view is configured in a screen. More than one alarm can be displayed simultaneously, depending on the configured size. You can configure multiple alarm views with different contents.

- Alarm window

  The Alarm window is configured in the "Global screen" editor. The alarm window can display multiple alarms at the same time, depending on the configured size. An event can trigger closing and reopening of the alarm window. To hide it during configuration, create an alarm window on its own level.

Additional signals

- Alarm indicator

  The alarm indicator is a configurable, graphical icon. When an alarm comes in, the alarm indicator is displayed on the HMI device. You configure the alarm indicator in the "Global Elements" editor.

  The alarm indicator has two states:

  - Flashing: At least one unacknowledged alarm is pending.
  - Static: The alarms are acknowledged but at least one of them is not yet deactivated.

    The alarm indicator also displays the number of pending alarms according to the HMI device.

- E-mail notification

  To inform someone other than the operator, such as an engineer, when an alarm with a specific alarm class arrives, assign the alarm class to an e-mail address.

Note
Basic Panels

E-mail notification is not available for Basic Panels.

- System functions

  You can configure a list of functions for the event associated with an alarm. These functions must be executed in Runtime when the event occurs.

  Use system functions for alarms in WinCC to control the alarm view or the alarm window other than via the toolbar.

Displaying the predefined alarm classes in Runtime

The following table shows the symbols used to display the predefined alarm classes in the alarm view:

Alarm class	Displayed icon
Diagnostic alarm	S7

Alarm class	Displayed icon
Error	!
System	$
Warnings	<No symbol>

Note
Basic Panels

Diagnostic alarms are not available for Basic Panels.

See also

Overview of configuring alarm output (Page 1216)

8.4.2.3 Configuring an alarm view

Introduction

Current alarms or alarms from the alarm log are displayed in the "Alarm view" display and control object. An alarm view displays alarms from all alarm classes.

Note
Basic Panels

The alarm log is not available for Basic Panels.

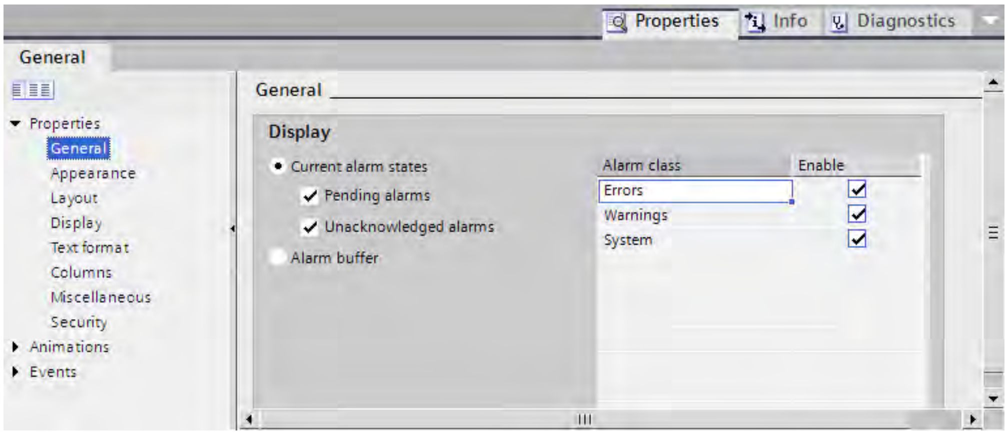
Requirement

- A screen is open in the "Screen" editor.
- The "Tools" task card is open.
- The project tree is open.

Configuring alarms for the alarm view

To specify the alarms that will be shown in the alarm view, proceed as follows:

1. Under "Controls" on the "Tools" task card, add an alarm view to the screen.
2. Select the alarm view.
3. Under "General > Display" in the Inspector window, decide whether you want to display alarm classes, alarm events or an alarm log.



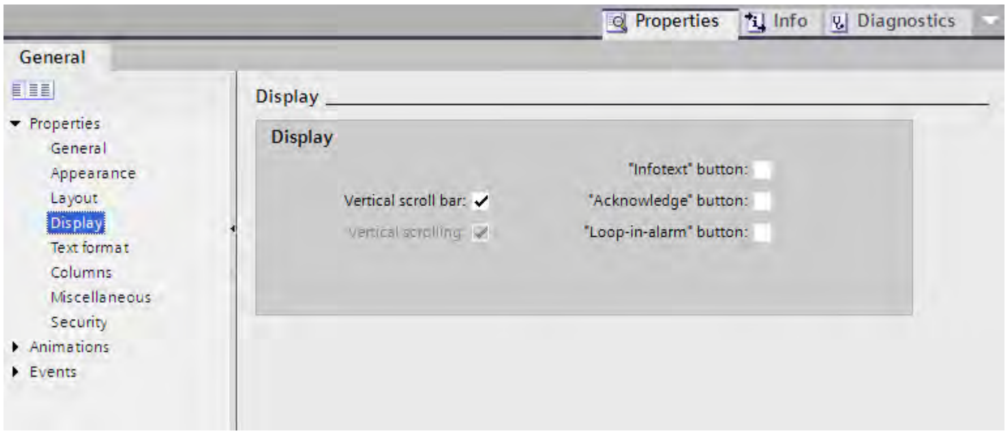
General

Display

- ● Current alarm states
  - ✓ Pending alarms
  - ✓ Unacknowledged alarms
- Alarm buffer

Alarm class	Enable
Errors	✓
Warnings	✓
System	✓

4. Under "Alarm classes", enable the alarm classes to be displayed in the alarm view.
5. In the Inspector window, click "Display".
6. Under "Control tag for display area", define the tag that returns the date from which the alarms will be displayed.



Display

Display

Vertical scroll bar: ✓
Vertical scrolling: ✓
"Infotext" button:
"Acknowledge" button:
"Loop-in-alarm" button:

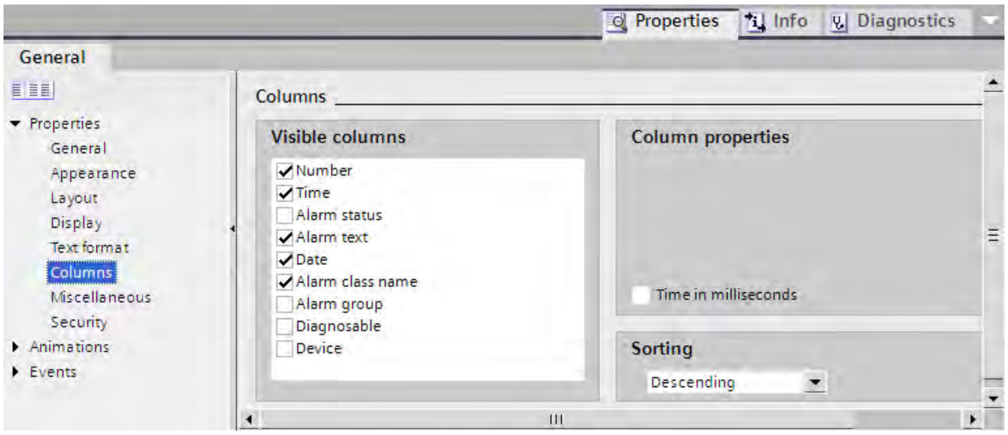
Note
Basic Panels

The "Control tag for display area" property is not available for Basic Panels.

Configuring the layout of the alarm view

To specify how the alarms are shown in the alarm view, proceed as follows.

1. Click "Layout" in the project tree.
2. Under "Lines per alarm", specify the number of lines to display for each alarm.
3. In the "Display" area, enable the control elements that are available on the HMI device.
4. In the Inspector window, click "Properties > Columns".



Columns

Visible columns

- [✓] Number
- [✓] Time
- [ ] Alarm status
- [✓] Alarm text
- [✓] Date
- [✓] Alarm class name
- [ ] Alarm group
- [ ] Diagnosable
- [ ] Device

Column properties

- [ ] Time in milliseconds

Sorting

Descending

5. Under "Visible columns" select the columns to be output in the alarm view.
6. Under "Sort", select the sort order of the alarms.
7. Under "Properties Column", define the properties of the columns.

Note

Select the "Edit" command in the shortcut menu for the alarm view to activate the alarm view. You can set the column width and position in active mode. To enable the alarm view, set the zoom factor to 100 %.

Result

Alarms of various alarm classes are output in the alarm view during runtime.

See also

Overview of configuring alarm output (Page 1216)

8.4.2.3 Configuring an alarm window

Introduction

The alarm window displays current alarms. The alarm window is configured in the "Global Screen" editor and opens regardless of the current screen. The HMI device can still be used, even if alarms are pending and displayed. An alarm window is displayed and configured like an alarm view.

To hide an alarm window during configuration, create it on its own level.

Requirement

- The "Global Screen" editor is open.
- The "Tools" task card is displayed.
- The Inspector window is open.

Procedure

Proceed as follows to configure an alarm window:

1. Insert the "Alarm window" object into the template from the "Controls" group on the "Tools" task card.
2. Configure the alarm window like an alarm view.
3. Under "Mode > Window" in the Inspector window, select how the alarm window reacts and is operated in Runtime.
4. Enable "Modal > Enabled".

   If you have enabled this option, the alarm window retains the focus in Runtime after a screen change. This option is important, as switching back and forth between the screen and different windows with <Ctrl+TAB> is not supported.

Result

During runtime, the alarms of the selected alarm class are displayed in the alarm window.

See also

Overview of configuring alarm output (Page 1216)

8.4.2.3 Configuring an alarm indicator

Introduction

The alarm indicator uses a warning triangle to indicate that alarms are pending or require acknowledgement. If an alarm of the configured alarm class occurs, the alarm indicator is displayed.

The alarm indicator has two states:

- Flashing: At least one unacknowledged alarm is pending.
- Static: At least one of the acknowledged alarms has not yet been deactivated.

You can configure Runtime to open an alarm window when the user operates the alarm indicator.

Requirement

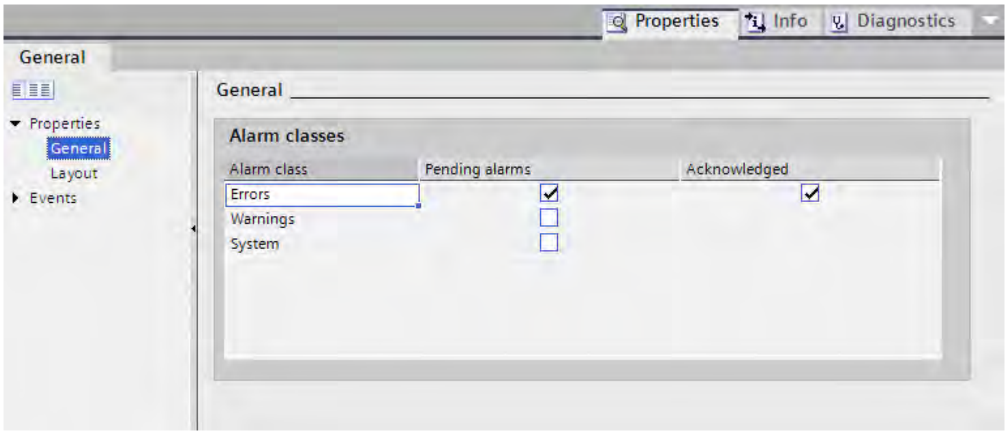
- The "Global Screen" editor is open.
- The "Tools" task card is open.
- The Inspector window is open.

Procedure

Proceed as follows to configure the alarm indicator:

1. Drag the "Alarm indicator" object into the work area from the "Controls" group on the "Tools" task card.
2. Select the alarm indicator.

3. Under "General > Alarm classes" in the Inspector window, select the alarm classes for which the alarm indicator is to be displayed.



Alarm classes

Alarm class	Pending alarms	Acknowledged
Errors	✓	✓
Warnings	☐	
System	☐	

Alarm classes that you created yourself are also displayed.

Enter whether pending alarms and / or those that are to be acknowledged should be shown by the alarm indicator.

4. Configure the system function "ShowAlarmWindow" for an event of the alarm indicator.

Note

If you have configured a permanent window in the screen or template, do not position the alarm window and alarm indicator in the vicinity of the permanent window. Otherwise the alarm window and the alarm indicator are not displayed in Runtime. You cannot see the permanent window in the "Global Elements" editor.

Result

The alarm indicator is displayed if alarms from the selected alarm class are pending or need to be acknowledged in Runtime. The alarm window opens when the user operates the alarm indicator.

See also

Overview of configuring alarm output (Page 1216)

8.4.2.4 Acknowledging alarms

8.4.2.4 Configuring acknowledgment of alarms using the message class

Introduction

Use the alarm class to define whether all and how the alarms of the alarm class should be acknowledged. When you assign an alarm to an alarm class, you define whether the alarm must be acknowledged.

Requirement

- The "Alarms" editor is open.
- The required alarm class has been created.
- The required alarm has been created.

Selecting the acknowledgment model for an alarm class

The acknowledgment model for a predefined alarm class has already been set. You can only set the acknowledgment model for custom alarm classes. To do this, proceed as follows:

1. In the "Alarms" editor, click the "Alarm Class" tab and select the required alarm class.
2. Select the required acknowledgment model under "Acknowledgment > Settings" in the Inspector window.

Assign alarms to an alarm class requiring acknowledgment

Proceed as follows to assign an alarm to an alarm class requiring acknowledgment.

1. In the "Alarms" editor, click the tab for the required alarm type, and select the required alarm.
2. Under "General" in the Inspector window, select the alarm class to which the alarm is to belong.

See also

Alarm components and properties (Page 1201)
Configuring the acknowledgment of alarms (Page 1223)

8.4.2.4 Configuring the acknowledgment of alarms

Introduction

You always specify the acknowledgment requirement for an alarm using the alarm class. The following options are also available for acknowledgment:

- Acknowledging an alarm via a system function
- Acknowledgment of a Discrete Alarm by the PLC
- Sending alarm acknowledgment to the PLC

- Configuring a button to acknowledge an alarm

Requirement

- The "Alarms" editor is open.
- The required alarm class has been created.
- The required alarm has been created.

Acknowledging an alarm via a system function

To have an alarm acknowledged by a system function, proceed as follows:

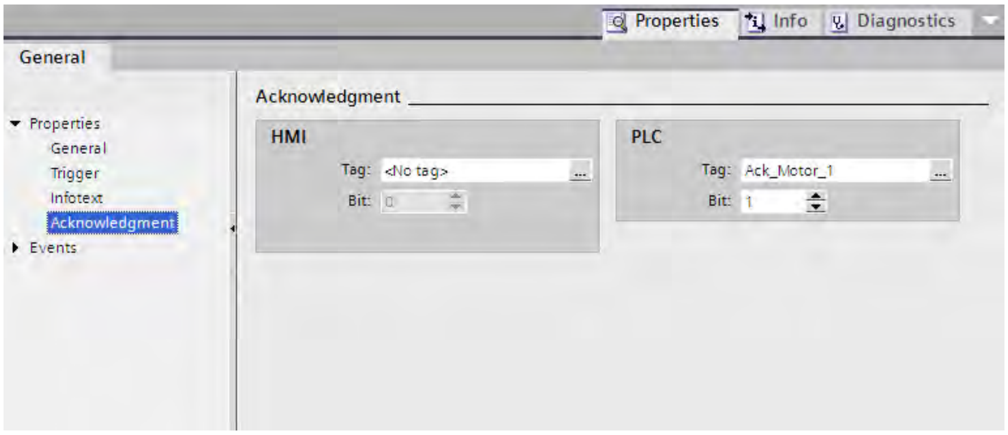
1. Select the required alarm in the "Alarms" editor.
2. Click the "Incoming" event under "Events" in the Inspector window.

   The function list opens.
3. Set the "SetBit" system function for the "Incoming" event in the "Function list" dialog.
4. Enter the acknowledgment tag of the "BOOL" data type as the "Variable (In/Out)" parameter.

Additional information is available in the "Working with system functions" section.

Acknowledgment of a Discrete Alarm by the PLC

1. In the "Alarms" editor, click the "Discrete Alarm" tab and select the required discrete alarm.
2. In the Inspector window, select "Properties > Acknowledgment".



HMI Tag: <No tag> Bit: 0

PLC Tag: Ack_Motor_1 Bit: 1

3. Under "PLC", select the tag and the bit that the PLC will use use to acknowledge the alarm.

Sending alarm acknowledgment to the PLC

To send the acknowledgment of an alarm to the PLC, proceed as follows:

1. In the "Alarms" editor, click the "Discrete Alarm" tab and select the required discrete alarm.
2. In the Inspector window, select "Properties > Acknowledgment".
3. Under "HMI", select the tag and the bit to be set by the alarm acknowledgment.

Configuring a button to acknowledge an alarm

To configure a button for acknowledging an alarm, proceed as follows:

1. Select the button or function key.
2. Set the "AlarmViewAcknowledgeAlarm" system function for the "Click" event.

You can find more detailed information in the "Working with Screens" section.

See also

Configuring acknowledgment of alarms using the message class (Page 1223)

8.4.3 Operating alarms in Runtime

8.4.3.1 Alarms in Runtime

Alarms

Alarms indicate events and states on the HMI device which have occurred in the system, in the process or on the HMI device itself. A status is reported when it is received.

An alarm could trigger one of the following alarm events:

- Incoming
- Outgoing
- Acknowledge
- Loop-in-alarm

The configuration engineer defines which alarms must be acknowledged by the user.

An alarm may contain the following information:

- Date
- Time
- Alarm text
- Location of fault
- Status
- Alarm class
- Alarm number
- Alarm group

Alarm classes

Alarms are assigned to various alarm classes.

- Warning

Alarms of this class usually indicate states of a plant such as "Motor switched on." Alarms in this class do not require acknowledgment.

- Error

  Alarms in this class must always be acknowledged. Error alarms normally indicate critical errors within the plant such as "Motor temperature too high."

- System

  System alarms indicate states or events which occur on the HMI device.

  System alarms provide information on occurrences such as operator errors or communication faults.

- Custom alarm classes

  The properties of this alarm class must be defined in the configuration.

Alarm buffer

Alarm events are saved to an internal, volatile buffer. The size of this alarm buffer depends on the HMI device type.

Alarm view

The alarm view shows selected alarms or alarm events from the alarm buffer. Whether alarm events have to be acknowledged or not is specified in your configuration.

Alarm window

An alarm window shows all pending alarms or alarms awaiting acknowledgement of a particular alarm class. The alarm window is displayed as soon as a new alarm occurs.

You can configure the order in which the alarms are displayed. You can choose to display the alarms in ascending or descending order of their occurrence. The alarm window can also be set to indicate the exact location of the fault, including the date and time of the alarm event. By means of configuration, the display can be filtered in such a way that only alarms that contain a specific character string will be shown.

Alarm indicator

The alarm indicator is a graphic icon that is displayed on the screen when an alarm of the specified alarm class is activated.

The alarm indicator can assume one of two states:

- Flashing: At least one unacknowledged alarm is pending.
- Static: The alarms are acknowledged but at least one of them is not yet deactivated. The number displayed indicates the number of pending alarms.

See also

Alarm system in WinCC (Page 1191)
Simple alarm view, simple alarm window in runtime (Page 1227)
Alarm Indicator in Runtime (Page 1229)
Acknowledging alarms (Page 1229)

8.4.3.2 Simple alarm view, simple alarm window in runtime

Application

The simple alarm view shows selected alarms or alarm events from the alarm buffer or alarm log. The layout and operation of the simple alarm window correspond to that of the simple alarm view.

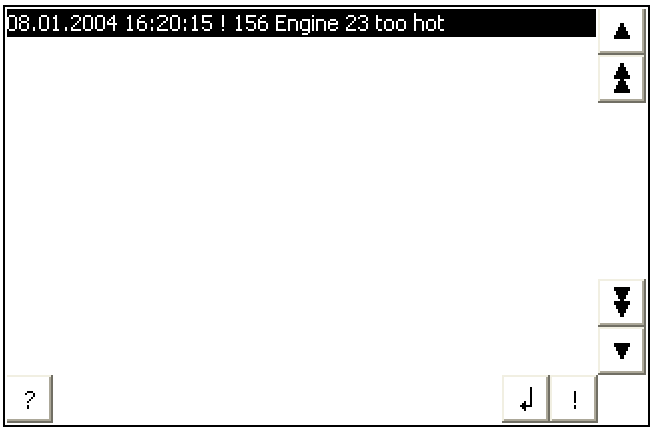
Note

The "Single alarm view" object cannot be operated dynamically with a script.

In the Engineering System you can dynamically control the visibility of an object, for example, in the "Animations" group of the Inspector window. In Runtime, the "Simple alarm view" does not support animations. If you have configured an animation, and, for example, want to carry out a consistency check on the project, an error message is output in the output window.

Note
Basic Panels

Logging is not available for Basic Panels.


08.01.2004 16:20:15 ! 156 Engine 23 too hot

Layout

Depending on the configuration, in the alarm view different columns with information regarding an alarm or an alarm event are displayed.

To differentiate between the different alarm classes, the first column in the alarm view contains an icon:

Icon	Alarm class
!	Error

Icon	Alarm class
empty	Warning
depends on the configuration	Custom alarm classes
$	System

Operation

You use the alarm view as follows, depending on how it is configured:

- Acknowledging alarms
- Editing alarms

Control elements

The buttons have the following functions:

Button	Function
!	Acknowledge alarm.
↲	Edit alarm.
?	Show Infotext for an alarm.
▶	Displays the full text of the selected alarm in a separate window - the alarm text window. In the alarm text window, you can view alarm text that requires more space than is available in the Alarm view. Close the alarm text window with the the ✕ button.
▲	Scrolls one alarm up.
⏫	Scrolls one page up in the alarm view.
⏬	Scrolls one page down in the alarm view.
▼	Scrolls one alarm down.

Format of the control elements

On the operating panels OP 73micro and TP 177micro the simple alarm view has a button that displays the message text in a separate window. This button is not displayed during the configuration of the simple alarm in the engineering system.

The display of the buttons for using the simple alarm view depends on the configured size. You should therefore check on the HMI device whether all the required buttons are available.

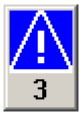
See also

Alarms in Runtime (Page 1225)

8.4.3.3 Alarm Indicator in Runtime

Application

The alarm indicator is displayed if alarms of the specified alarm class are pending or require acknowledgment.



Layout

The alarm indicator can have one of two states:

- Flashing: At least one unacknowledged alarm is pending.
- Static: The alarms are acknowledged but at least one of them is not yet deactivated. The number indicates the number of queued alarms.

Operation

Depending on the configuration, when operating the alarm indicator an alarm window is opened. The icons from the symbol library can only be operated with a mouse or touch screen.

Note
Basic Panels

Operation with mouse is not available for Basic Panels.

See also

Alarms in Runtime (Page 1225)

8.4.3.4 Acknowledging alarms

Introduction

You can acknowledge alarms in Runtime according to your project configuration settings. You can acknowledge alarms as follows:

- Using the display and control object buttons
- Using the "ACK" key on your HMI device

- Using individually-configured function keys or buttons

If an operator authorization is configured for an individual control, the alarms can only be acknowledged by authorized users.

To automatically acknowledge alarms in Runtime, use the system functions and scripts, plus the "Acknowledgment by the PLC" option.

Note
Basic Panels

Scripts are not available for Basic Panels.

Acknowledgment variants

You acknowledge individual alarms or multiple alarms together in Runtime. They are distinguished as follows:

- Single acknowledgment

  Acknowledgment of an alarm using a button or a function key.
- Acknowledge alarm groups

  Acknowledgment of all the alarms of an alarm group using a button or a function key.

Requirement

- An alarm is displayed on the HMI device.

Procedure

To acknowledge an alarm, proceed as follows:

1. Select the alarm.
2. If you are using an alarm view or an alarm window, click the

   button.
3. If you are using a simple alarm view or a simple alarm window, click the

   !

   button.
4. Press the "ACK" button on your HMI device to acknowledge an alarm in an alarm line.

Note
Basic Panels

Only the simple alarm view and simple alarm window are available for Basic Panels.

Result

The alarm status changes to "Acknowledged". If the condition for triggering an alarm no longer applies, the alarm status also changes to "Outgoing", and it is no longer displayed on the HMI device.

See also

Alarms in Runtime (Page 1225)

8.4.4 Reference

8.4.4.1 System functions and events for alarms

System functions

System functions are predefined functions you can use to implement many tasks in runtime, even with no programming knowledge. You use system functions in a function list or in a script.

Note
Basic Panels

Scripts are not available for Basic Panels.

The table shows all the system functions available for displaying and editing alarms.

System function	Effect
EditAlarm	Triggers the Loop-In-Alarm event for all selected alarms.
ClearAlarmBuffer	Deletes alarms from the alarm buffer on the HMI device.
ClearAlarmBufferProtoolLegacy	Function like "ClearAlarmBuffer". This system function has been retained to ensure compatibility and uses the old ProTool numbering.
AlarmViewEditAlarm	Triggers the event Loop-In-Alarm for all alarms selected in the specified alarm view.
AlarmViewAcknowledgeAlarm	Acknowledges the alarms that are selected in the specified alarm view.
AlarmViewShowOperatorNotes	Displays the configured info text for the alarm selected in the specified alarm screen.

System function	Effect
AcknowledgeAlarm	Acknowledges all selected alarms.
SetAlarmReportMode	Switches the automatic reporting of alarms on the printer on or off.
ShowAlarmWindow	Hides or shows the alarm window on the HMI device.
ShowSystemAlarm	Displays the value of the delivered parameter as a system alarm on the HMI device.

Note
Basic Panels

The "SetAlarmReportMode" and "ShowSystemAlarm" system functions are not available for Basic Panels.

For details on system functions, see the "Visualizing Processes > Working with System Functions > Reference > System Functions" section.

Events for alarms and their display and control objects

In runtime, the following events occur in response to alarms and their display and control objects. You can configure a function list for every event.

Object	Configurable events
Alarms	Incoming Outgoing Acknowledge Loop-In-Alarm
Alarm view	Enable Disable Establish Alarm number changed
Alarm indicator	Click Click when flashing

Note
Basic Panels

The "Establish" and "Alarm number changed" events are not available for Basic Panels.

For details on events, see the "Visualizing Processes > Working with System Functions > Reference > System Functions > Events" section.

See also

Alarm system in WinCC (Page 1191)
System alarms (Page 1233)

8.4.4.2 System alarms

Introduction

System alarms on the HMI device provide information about internal states of the HMI device and PLC.

The following overview illustrates when a system alarm occurs and how to eliminate the cause of error.

Note
Availability for specific HMI devices

Some of the system alarms described in this section apply to the individual HMI devices based on their scope of functions.

Note

System alarms are output in an alarm view. System alarms are output in the language currently set on your HMI device.

System alarm parameters

System alarms may contain encrypted parameters. The parameters of relevance when troubleshooting because they provide a reference to the source code of the Runtime software. These parameters are output after the "Error code:" text.

Meaning of the system alarms

The following table contains all the system alarms. The system alarms are divided into different ranges:

Table8-2 10000 - Printer alarms

Number	Effect/cause	Remedy
10000	The print job could not be started or was canceled due to an unknown error. Faulty printer setup. Or: No authorization is available for accessing the network printer. Power supply failure during data transfer.	Check the printer settings, cable connections and the power supply. Set up the printer once again. Obtain a network printer authorization. If the error persists, contact the Hotline!
10001	No printer is installed or a default printer has not been set up.	Install a printer and/or select it as the default printer.
10002	Overflow of the graphics buffer for printing. Up to two images are buffered.	After a print job, wait before you trigger further print jobs.
10003	Images can now be buffered again.	--
10004	Overflow of the buffer for printing lines in text mode (e.g. alarms). Up to 1000 lines are buffered.	After a print job, wait before you trigger further print jobs.
10005	Text lines can now be buffered again.	--
10006	The Windows printing system reports an error. Refer to the output text and the error ID to determine the possible causes. Nothing is printed or the print is faulty.	Repeat the action.

Table8-3 20000 - Global script alarms

Number	Effect/causes	Remedy
20010	An error has occurred in the specified script line. Execution of the script was therefore aborted. Note the system alarm that may have occurred prior to this.	Select the specified script line in the configuration. Ensure that the tags used are of the allowed types. With system functions, check that the number and types of parameter are correct.
20011	An error has occurred in a script that was called by the specified script. Execution of the script was therefore aborted in the called script. Note the system alarm that may have occurred prior to this.	In the configuration, select the script that has been called directly or indirectly by the specified script. Ensure that the tags used are of the allowed types. With system functions, check that the number and types of parameter are correct.
20012	The project data are inconsistent. The script could therefore not be generated.	Recompile the configuration.
20013	The scripting component of WinCC Runtime is not correctly installed. Therefore, no scripts can be executed.	Reinstall WinCC Runtime on your PC. Rebuild your project with "Project > Generator > Generate" and download the project to the HMI device.
20014	The system function returns a value that is not written in any return tag.	Select the specified script in the configuration. Check whether the script name has been assigned a value.

Number	Effect/causes	Remedy
20015	Too many successive scripts have been triggered in short intervals. When more than 20 scripts are queued for processing, any subsequent scripts are rejected. In this case, the script indicated in the alarm is not executed.	Check what is triggering the scripts. Extend the times, e.g. the polling time of the tags which trigger the scripts.

Table8-4 30000 - Alarms for IFwSetValue: SetValue()

Number	Effect/causes	Remedy
30010	The tag could not accept the function result, e.g. when it has exceeded the value range.	Check the data type of the system function parameters.
30011	A system function could not be executed because the function was assigned an invalid value or type in the parameter.	Check the parameter value and data type of the invalid parameter. If a tag is used as a parameter, check its value.
30012	A system function could not be executed because the function was assigned an invalid value or type in the parameter.	Check the parameter value and data type of the invalid parameter. If a tag is used as a parameter, check its value.

Table8-5 40000 - Linear scaling alarms

Number	Effect/causes	Remedy
40010	The system function could not be executed because the parameters could not be converted to a common data type.	Check the parameter types in the configuration.
40011	The system function could not be executed because the parameters could not be converted to a common data type.	Check the parameter types in the configuration.

Table8-6 50000 - Data server alarms

Number	Effect/causes	Remedy
50000	The HMI device is receiving data faster than it is capable of processing. Therefore, no further data is accepted until all current data have been processed. Data exchange then resumes.	--
50001	Data exchange has been resumed.	--

Table8-7 60000 - Win32 function alarms

Number	Effect/causes	Remedy
60000	This alarm is generated by the “DisplaySystemAlarms” function. The text to be displayed is transferred to the function as a parameter.	--

Number	Effect/causes	Remedy
60010	The file could not be copied in the direction defined because one of the two files is currently open or the source/target path is not available. It is possible that the Windows user has no access rights to one of the two files.	Restart the system function or check the paths of the source/target files. Using Windows NT/2000/XP: The user who is running the WinCC Runtime must be granted access rights for the files.
60011	An attempt was made to copy a file to itself. It is possible that the Windows user has no access rights to one of the two files.	Check the path of the source/target file. Using Windows NT/2000/XP with NTFS: The user who is running the WinCC Runtime must be granted access rights for the files.

Table8-8 70000 - Win32 function alarms

Number	Effect/causes	Remedy
70010	The application could not be started because it could not be found in the path specified or there is insufficient memory space.	Check whether the application exists on the specified path or close other applications.
70011	The system time could not be modified. The error alarm only appears in connection with area pointer "Date/time PLC". Possible causes: • An invalid time was transferred in the job mailbox. • The Windows user has no right to modify the system time. If the first parameter in the system alarm is displayed with the value 13, the second parameter indicates the byte containing the incorrect value.	Check the time which is to be set. Using Windows NT/2000/XP: The user who is running the WinCC Runtime have the right to change the system time of the operating system.
70012	An error occurred when executing the function "StopRuntime" with the option "Runtime and operating system". Windows and WinCC flexible Runtime are not closed. One possible cause is that other programs cannot be closed.	Close all programs currently running. Then close Windows.
70013	The system time could not be modified because an invalid value was entered. Incorrect separators may have been used.	Check the time which is to be set.
70014	The system time could not be modified. Possible causes: • An invalid time was transferred. • The Windows user has no right to modify the system time. Windows rejects the setting request.	Check the time which is to be set. Using Windows NT/2000/XP: The user who is running the WinCC Runtime have the right to change the system time of the operating system.
70015	The system time could not be read because Windows rejects the reading function.	--

Number	Effect/causes	Remedy
70016	An attempt was made to select a screen by means of a system function or job. This is not possible because the screen number specified does not exist. Or: A screen could not be generated due to insufficient system memory. Or: The screen is blocked. Or: Screen selection has not been executed correctly.	Compare the screen number in the system function or in the job against the configured screen numbers. Assign the number to a screen. Check the details for the screen selection and whether the screen is blocked for specific users.
70017	Date/time is not read from the area pointer because the address set in the PLC is either not available or has not been set up.	Change the address or set up the address in the PLC.
70018	Acknowledgment that the password list has been successfully imported.	--
70019	Acknowledgment that the password list has been successfully exported.	--
70020	Acknowledgment for activation of alarm reporting.	--
70021	Acknowledgment for deactivation of alarm reporting.	--
70022	Acknowledgment to starting the Import Password List action.	--
70023	Acknowledgment to starting the Export Password List action.	--
70024	The value range of the tag has been exceeded in the system function. The calculation of the system function is not performed.	Check the desired calculation and correct it.
70025	The value range of the tag has been exceeded in the system function. The calculation of the system function is not performed.	Check the desired calculation and correct it.
70026	No other screens are stored in the internal screen memory. No other screens can be selected.	--
70027	The backup of the RAM file system has been started.	--
70028	The files from the RAM have been copied in the Flash memory. The files from the RAM have been copied in the Flash memory. Following a restart, these saved files are copied back to the RAM file system.	--
70029	Backup of the RAM file system has failed. No backup copy of the RAM file system has been made.	Check the settings in the "Control Panel > OP" dialog. Use the "Save Files" button on the "Persistent Storage" tab to save the RAM file system.

Number	Effect/causes	Remedy
70030	The parameters configured for the system function are faulty. The connection to the new PLC was not established.	Compare the parameters configured for the system function with the parameters configured for the PLCs and correct them.
70031	The PLC configured in the system function is not an S7 PLC. The connection to the new PLC was not established.	Compare the S7 PLC name parameter configured for the system function with the parameters configured for the PLC and correct them.
70032	The object configured with this number in the tab order is not available in the selected screen. The screen changes but the focus is set to the first object.	Check the number of the tab order and correct it.
70033	An e-mail cannot be sent because a TCP/IP connection to the SMTP server no longer exists. This system event is generated only at the first attempt. All subsequent unsuccessful attempts to send an e-mail will no longer generate a system alarm. The alarm is not generated again unless an e-mail has been successfully sent in the meantime. The central e-mail component in WinCC Runtime attempts, at regular intervals (1 minute), to establish the connection to the SMTP server and to send the remaining e-mails.	Check the network connection to the SMTP server and reconnect.
70034	Following a disruption, the TCP/IP connection to the SMTP server could be re-established. The queued e-mails are then sent.	--
70036	No SMTP server for sending e-mails is configured. An attempt to connect to an SMTP server has failed, and it is not possible to send e-mails. WinCC Runtime generates the system event after the first attempt to send an e-mail.	Configure an SMTP server: In WinCC Engineering System using "Device settings ▸ Device settings" In the Windows CE operating system using "Control Panel > Internet Settings > E-mail > SMTP Server"
70037	n e-mail cannot be sent for unknown reasons. The contents of the e-mail are lost.	Check the e-mail parameters, such as "Recipient".
70038	The SMTP server has rejected sending or forwarding an e-mail because the domain of the recipient is unknown to the server or because the SMTP server requires authentication. The contents of the e-mail are lost.	Check the domain of the recipient's address. Or: Disable the authentication on the SMTP server, if possible. SMTP authentication is not currently used in WinCC Runtime.
70039	The syntax of the e-mail address is incorrect or contains illegal characters. The contents of the e-mail are discarded.	Check the e-mail address of the recipient.
70040	The syntax of the e-mail address is incorrect or contains illegal characters.	--
70041	The import of the user management was aborted due to an error. Nothing was imported.	Check your user administration or download it again to the panel.

Number	Effect/causes	Remedy
70042	The value range for the tags has been exceeded while executing the system function. The system function calculation has not been carried out.	Check the desired calculation and correct it.
70043	The value range for the tags has been exceeded while executing the system function. The system function calculation has not been carried out.	Check the desired calculation and correct it.

Table8-9 80000 - Archive alarms

Number	Effect/causes	Remedy
80001	The log specified is filled to the size defined (in percent) and must be stored elsewhere.	Store the file or table by executing a ‘move’ or ‘copy’ function.
80002	A line is missing in the specified log.	--
80003	The copying process for logging was not successful. In this case, it is advisable to check any subsequent system alarms, too.	--
80006	Since logging is not possible, this causes a permanent loss of the functionality.	For databases, check whether the relevant data source exists and restart the system.
80009	A copying action has been completed successfully.	--
80010	The storage location was incorrectly entered in WinCC, so this causes a permanent loss of functionality.	Reconfigure the storage location for the log and restart the system if the full functionality is required.
80012	Log entries are stored in a buffer. If the values are read to the buffer faster than they can be physically written (using a hard disk, for example), overloading may occur and recording is then stopped.	Archive fewer values. Or: Increase the logging cycle.
80013	The overload status no longer applies. Archiving resumes the recording of all values.	--
80014	The same action was triggered twice in quick succession. Since the process is already in operation, the action is only carried out once.	--
80015	This system alarm is used to report DOS or database errors to the user.	--
80016	The logs are separated by the system function "CloseAllLogs" and the incoming entries exceed the defined buffer size. All entries in the buffer are deleted.	Reconnect the logs.

Number	Effect/causes	Remedy
80017	The number of incoming events cause a buffer overflow. This situation can be caused, for example, when several copy jobs are activated at the same time. All copy jobs in the buffer will be deleted.	Stop the copy action.
80019	The connection between WinCC and all logs was dropped after running the "CloseAllLogs" system function, for example. Entries are written to the buffer and are then written to the logs when a connection is re-established. There is no connection to the storage location and the storage medium may be replaced.	--
80020	The maximum number of simultaneous copy jobs has been exceeded. Copying is not executed.	Wait until the current copy jobs have been completed, then restart the last copy job.
80021	An attempt was made to delete a log that is still copying. Deletion has not been executed.	Wait until the current copy job is complete, then restart the last action.
80022	An attempt was made to use the system function "StartSequenceLog" to start a log segment for a log which is not configured as a segmented circular log. No log segment file is created.	In your project, check the following: • Was the "StartSequenceLog" system function configured correctly? • Were the tag parameters correctly supplied with data on the HMI device?
80023	An attempt was made to copy a log to itself. The log is not copied.	In your project, check the following: • Was the "CopyLog" system function configured correctly? • Were the tag parameters correctly supplied with data on the HMI device?
80024	The "CopyLog" system function does not allow copying when the target log already contains data ("Mode" parameter). The log is not copied.	Edit the "CopyLog" system function in your configuration. Before you initiate the system function, delete the destination log file.
80025	You have canceled the copy job. Data written up to this point will be retained. The destination log file (if configured) is not deleted. The cancellation is reported by an error entry RT_ERR at the end of the destination log.	--
80026	This alarm is output after all logs are initialized. Values are written to the logs from then on. Prior to this, no entries are written to the logs, even though WinCC Runtime is running.	--
80027	The internal Flash memory has been specified as the storage location for a log. This is not permissible. No values are written to this log and the log file is not created.	Configure a memory card or a network path as the storage location.
80028	The alarm returns a status report indicating that the logs are currently being initialized. No values are logged until the alarm 80026 is output.	--

Number	Effect/causes	Remedy
80029	The number of logs specified in the alarm could not be initialized. The logs are initialized. The faulty log files are not available for logging jobs.	Evaluate the additional system alarms associated with this alarm. Check the configuration, the ODBC (Open Database Connectivity) and the specified drive.
80030	The structure of the existing log file does not match the expected structure. Logging is stopped for this log.	Delete the existing log data manually, in advance.
80031	The log in CSV format is corrupt. The log can no longer be used.	Delete the faulty file.
80032	Logs can be assigned events. These are triggered as soon as the log is full. If WinCC Runtime is started and the log is already full, the event would never be triggered. The specified log will no longer log data because it is full.	Exit WinCC Runtime. Delete the log and restart WinCC Runtime. Or: Configure a button which contains the same actions as the event. Click the button.
80033	"System Defined" is set in the data log file as the data source name. This causes an error. No data is written to the database logs, whereas logging to the CSV logs works.	Reinstall MSDE.
80034	An error has occurred in the initialization of the logs. An attempt has been made to create the tables as a backup. This action was successful. A backup has been made of the tables of the corrupted log file and the cleared log was restarted.	Save or delete the backups to free up the memory.
80035	An error has occurred in the initialization of the logs. An attempt has been made to create backups of the tables and this has failed. No logging or backup has been performed.	Save or delete the backups to free up the memory.
80044	The export of a log was interrupted because Runtime was closed or due to a power failure. It was detected that the export needed to be resume when Runtime restarted.	The export resumes automatically.
80045	The export of a log was interrupted due to an error in the connection to the server or at the server itself.	The export is repeated automatically. Check the following: • Is the connection to the server intact? • Is the server running? • Is there enough free space on the server?
80046	The destination file or associated folder could not be created on the server.	Check whether there is enough space on the server and whether you have the necessary authorization to save the log file.
80047	The log could not be read while exporting it.	Check whether the storage medium is correctly inserted.
80049	The log could not be renamed while preparing to export it. The job can not be completed."	Check whether the storage medium is correctly inserted and if there is sufficient space on the medium.

Number	Effect/causes	Remedy
80050	The log which shall be exported is not closed. The job can not be completed.	Make sure the "CloseAll Logs" system function is called before using the "ExportLog" system function. Change the configuration as required.

Table8-10 90000 - FDA alarms

Number	Effect/causes	Remedy
90024	No operator actions can be logged due to lack of space on the storage medium for log. The operator action will therefore not be executed.	Make more space available by inserting an empty storage medium or swapping out the log files on the server using "ExportLog".
90025	No user actions can be logged because of error state of the archive. Therefore the user action will not be executed.	Check whether the storage medium is correctly inserted.
90026	No operator actions can be logged because the log is closed. The operator action will therefore not be executed.	Before performing any other actions, open the log again using the "OpenAllLogs" system function. Change the configuration as required.
90028	The password is incorrect.	Enter the correct password.
90029	Runtime was closed during ongoing operation (perhaps due to a power failure) or a storage medium in use is incompatible with Audit Trail. An Audit Trail is not suitable if it belongs to another project or has already been archived.	Ensure that you are using the correct storage medium.
90030	Runtime was closed during ongoing operation (perhaps due to a power failure).	--
90031	Runtime was closed during ongoing operation (perhaps due to a power failure).	--
90032	Running out of space on the storage medium for log.	Make more space available, either by inserting an empty storage medium or by saving the log files on the server using the "ExportLog" system function.
90033	No more space on the storage medium for log. As of now, no more operator actions requiring logging will be executed.	To free up memory, save the log files on the server using the "ExportLog" system function. Or: Insert a blank storage medium.
90039	You do not have the necessary authorization to perform this action.	Adapt or upgrade your authorizations.
90040	Audit Trail is switched off because of a forced user action.	Activate the "Audit Trail" again using the "StartLog" system function.
90041	A user action which has to be logged has been executed without a logged on user.	A user action requiring logging should only be possible with permission. Change the configuration by configuring an authorization for the operating object.
90044	A user action which has to be confirmed was blocked, because there is another user action pending.	Repeat the user action if necessary.

Table8-11 110000 - Offline function alarms

Number	Effect/causes	Remedy
110000	The operating mode was changed. "Offline" mode is now set.	--
110001	The operating mode was changed. "Online" mode is now set.	--
110002	The operating mode was not changed.	Check the connection to the PLCs. Check whether the address range for the “Coordination" area pointer is present in the PLC.
110003	The operating mode of the specified PLC was changed by the system function "SetConnectionMode". The operating mode is now "offline".	--
110004	The operating mode of the specified PLC has been changed by the system function "SetConnectionMode". The operating mode is now "online".	--
110005	An attempt was made to use the system function SetConnectionMode to switch the specified PLC to "online" mode, although the entire system is in "offline" mode. This changeover is not allowed. The PLC remains in "offline" mode.	Switch the complete system to "online" mode, then execute the system function again.
110006	The content of the "project ID" area pointer does not match the project ID configured in WinCC. That is why WinCC Runtime closes.	Check: • Is the project ID entered on the PLC correct? • Is the project ID entered in WinCC correct?

Table8-12 120000 - Trend alarms

Number	Effect/causes	Remedy
120000	The trend is not displayed because you configured an incorrect axis to the trend or an incorrect trend.	Change the configuration.
120001	The trend is not displayed because you configured an incorrect axis to the trend or an incorrect trend.	Change the configuration.
120002	The trend is not displayed because the tag assigned attempts to access an invalid PLC address.	Check: • Does the data area exist for the tags in the PLC? • Is the configured address correct? • Is the range of values for the tags correct?

Table8-13 130000 - System information alarms

Number	Effect/causes	Remedy
130000	The action was not executed.	Close all other programs. Delete files no longer required from the hard disk.
130001	The action was not executed.	Delete files no longer required from the hard disk.

Number	Effect/causes	Remedy
130002	The action was not executed.	Close all other programs. Delete files no longer required from the hard disk.
130003	No data medium found. The operation is canceled.	Check: • Was the correct data medium accessed? • Is the data medium inserted?
130004	The data medium is write-protected. The operation is canceled.	Check: • Was the correct data medium accessed? • Is the file write-protected?
130005	The file is read only. The operation is canceled.	Check whether the correct file was accessed. Change the file attributes if necessary.
130006	Access to file failed. The operation is canceled.	Check: • Was the correct file accessed? • Does the file exist? • Is another action preventing access to the file at the same time?
130007	The network connection is interrupted. Records cannot be saved or read over the network connection.	Check the network connection and eliminate the cause of error.
130008	The memory card is not available. Records cannot be saved to / read from the memory card.	Insert the memory card.
130009	The specified folder does not exist on the memory card. Any files saved to this folder are not backed up when you switch off the HMI device.	Insert the memory card.
130010	The maximum nesting depth can be exhausted when, for example, a value change in a script results in the call of another script and the second script in turn has a value change that results in the call of yet a further script etc. The configured functionality is not supported.	Check the configuration.

Table8-14 140000 - Connection alarms: chns7: Connection + device

Number	Effect/causes	Remedy
140000	An online connection to the PLC is established.	--
140001	The online connection to the PLC was shut down.	--
140003	No tag updating or writing is executed.	Check the connection and if the PLC is switched on. Check the parameter definitions in the Control Panel using "Set PG/PC interface". Restart the system.

Number	Effect/causes	Remedy
140004	No tag update or write operations are executed because the access point or the module configuration is faulty.	Verify the connection and check whether the PLC is switched on. Check the access point or the module configuration (MPI, PPI, PROFIBUS) in the Control Panel with "Set PG/PC interface". Restart the system.
140005	No tag updating or writing is executed because the HMI device address is incorrect (possibly too high).	Use a different HMI device address. Verify the connection and check whether the PLC is switched on. Check the parameter definitions in the Control Panel using "Set PG/PC interface". Restart the system.
140006	No tag updating or writing is executed because the baud rate is incorrect.	Select a different baud rate in WinCC (according to module, profile, communication peer, etc.).
140007	Tags are not updated or written because the bus profile is incorrect (see %1). The following parameters could not be written to the registry: 1: Tslot 2: Tqui 3: Tset 4: MinTsdr 5: MaxTsdr 6: Trdy 7: Tid1 8: Tid2 9: Gap Factor 10: Retry Limit	Check the user-defined bus profile. Check the connection and if the PLC is switched on. Check the parameter definitions in the Control Panel using "Set PG/PC interface". Restart the system.
140008	No tag updating or writing is executed because the project data are incorrect. The following parameters could not be written to the registry: 0: General error 1: Wrong version 2: Profile cannot be written to the registry. 3: The subnet type cannot be written to the registry. 4: The Target Rotation Time cannot be written to the registry. 5: Faulty Highest Address (HSA).	Check the connection and if the PLC is switched on. Check the parameter definitions in the Control Panel using "Set PG/PC interface". Restart the system.
140009	Tags are not updated or written because the module for S7 communication was not found.	Reinstall the module in the Control Panel using "Set PG/PC interface".
140010	No S7 communication partner found because the PLC is shut down. DP/T: The option “PG/PC is the only master” is not set in the Control Panel under “Set PG/PC interface.”	Switch the PLC on. DP/T: If only one master is connected to the network, disable "PG/PC is the only master" in "Set PG/PC interface". If several masters are connected to the network, enable these. Do not change any settings, for this will cause bus errors.

Number	Effect/causes	Remedy
140011	No tag updating or writing is executed because communication is down.	Check the connection and that the communication partner is switched on.
140012	There is an initialization problem (when WinCC Runtime was closed in Task Manager). Or: Another application (e.g.STEP7) with different bus parameters is active and the driver cannot be started with the new bus parameters (transmission rate, for example).	Restart the HMI device. Or: Start WinCC Runtime first, then start your other applications.
140013	The MPI cable is disconnected and, thus, there is no power supply.	Check the connections.
140014	The configured bus address is in already in use by another application.	Change the HMI device address in the PLC configuration.
140015	Wrong transmission rate Or: Faulty bus parameters (e.g. HSA) Or: OP address > HSA or: Wrong interrupt vector (interrupt does not arrive at the driver)	Correct the relevant parameters.
140016	The hardware does not support the configured interrupt.	Change the interrupt number.
140017	The set interrupt is in use by another driver.	Change the interrupt number.
140018	The consistency check was disabled by SIMOTION Scout. Only a corresponding note appears.	Enable the consistency check with SIMOTION Scout and once again download the project to the PLC.
140019	SIMOTION Scout is downloading a new project to the PLC. Connection to the PLC is canceled.	Wait until the end of the reconfiguration.
140020	The version in the PLC and that of the project (FWX file) do not match. Connection to the PLC is canceled.	The following remedies are available: Download the current version to the PLC using SIMOTION Scout. Regenerate the project using WinCC ES, close WinCC Runtime, and restart with a new configuration.

Table8-15 150000 - Connection alarms: chnAS511: Connection

Number	Effect/causes	Remedy
150000	No more data is read or written. Possible causes: • The cable is defective. • The PLC does not respond, is defective, etc. • The wrong port is used for the connection. • System overload	Ensure that the cable is plugged in, the PLC is operational, the correct port is being used. Restart the system if the system alarm persists.
150001	Connection is up because the cause of the interruption has been eliminated.	--

Table8-16 160000 - Connection alarms: IVar (WinLC) / OPC: Connection

Number	Effect/causes	Remedy
160000	No more data is read or written. Possible causes: • The cable is defective. • The PLC does not respond, is defective, etc. • The wrong port is used for the connection. • System overload	Ensure that the cable is plugged in, the PLC is operational, the correct port is being used. Restart the system if the system alarm persists.
160001	Connection is up because the cause of the interruption has been eliminated.	--
160010	No connection to the server because the server identification (CLS-ID) cannot be determined. Values cannot be read or written.	Check access rights.
160011	No connection to the server because the server identification (CLS-ID) cannot be determined. Values cannot be read or written.	Check: • Is the server name correct? • Is the computer name correct? • Is the server registered?
160012	No connection to the server because the server identification (CLS-ID) cannot be determined. Values cannot be read or written.	Check, for example, if • The server name is correct. • The computer name is correct. • The server is registered. Note for advanced users: Interpret the value from HRESULT.
160013	The specified server was started as InProc server. This has not been released and may lead to undefined behavior because the server is running in the same process area as WinCC Runtime.	Configure the server as OutProc Server or Local Server.
160014	Only one OPC server project can be started on a PC/ MP. An alarm is output when an attempt is made to start a second project. The second project has no OPC server functionality and cannot be located as an OPC server by external sources.	Do not start a second project with OPC server functionality on the computer.

Table8-17 170000 - S7 dialog alarms

Number	Effect/causes	Remedy
170000	S7 diagnostics events are not indicated because it is not possible to log on to the S7 diagnostics functions at this device. The service is not supported.	--
170001	The S7 diagnostics buffer cannot be viewed because communication with the PLC is shut down.	Set the PLC to online mode.

Number	Effect/causes	Remedy
170002	The S7 diagnostics buffer cannot be viewed because reading of the diagnostics buffer (SSL) was canceled with error.	--
170003	An S7 diagnostics event cannot be visualized. The system returns internal error %2.	--
170004	An S7 diagnostics event cannot be visualized. The system returns an internal error of error class %2, error number %3.	--
170007	It is not possible to read the S7 diagnostics buffer (SSL) because this operation was canceled with an internal error of class %2 and error code %3.	--

Table8-18 180000 - Misc/common alarms

Number	Effect/causes	Remedy
180000	A component/OCX received project data with a version ID which is not supported.	Install a newer component.
180001	System overload because too many actions running in parallel. Not all the actions can be executed, some are rejected.	Several remedies are available: • Generate the alarms at a slower rate (polling). • Initiate scripts and functions at greater intervals. If the alarm appears more frequently: Restart the HMI device.
180002	The screen keyboard could not be activated. Possible causes: "TouchInputPC.exe" was not registered due to a faulty Setup.	Reinstall WinCC Runtime.

Table8-19 190000 - Tag alarms

Number	Effect/causes	Remedy
190000	It is possible that the tag is not updated.	--
190001	The tag is updated after the cause of the last error has been eliminated (return to normal operation).	--
190002	The tag is not updated because communication with the PLC is down.	Select the system function "SetOnline" to go online.
190004	The tag is not updated because the configured tag address does not exist.	Check the configuration.
190005	The tag is not updated because the configured PLC type does not exist for this tag.	Check the configuration.
190006	The tag is not updated because it is not possible to map the PLC type in the data type of the tag.	Check the configuration.

Number	Effect/causes	Remedy
190007	The tag value is not modified because the connection to the PLC is interrupted or the tag is offline.	Set online mode or reconnect to the PLC.
190008	The threshold values configured for the tag have been violated, for example, by • A value entered • A system function • A script	Observe the configured or current threshold values of the tag.
190009	An attempt was made to assign a value to this tag that is outside the value range approved for this data type. Example: "260" for a tag of the type "Byte" "-3" for a tag of the type "String"	Observe the range of values for the data type of the tags.
190010	Too many values are written to the tag (for example, in a loop triggered by a script). Values are lost because only up to 100 actions are saved to the buffer.	The following remedies are available: • Increase the time interval between multiple write actions. • Do not use an array tag longer than 6 words when you configure an acknowledgment on the HMI device using "Acknowledgment HMI".
190011	Possible cause 1: The value entered could not be written to the configured PLC tag because the high or low limit was exceeded. The system discards the entry and restores the original value. Possible cause 2: The connection to the PLC was interrupted.	Make sure that the value entered lies within the range of values of the control tags. Check the connection to the PLC.
190012	It is not possible to convert a value from a source format to a target format, for example: An attempt is being made to assign a value to a counter that is outside the valid, PLC-specific value range. A tag of the type Integer should be assigned a value of the type String.	Check the range of values or the data type of the tags.
190013	The user has entered a string that is longer than the tag. The string is automatically shortened to the permitted length.	Only enter strings that do not exceed the permitted tag length.

Table8-20 190100 - Area pointer alarms

Number	Effect/causes	Remedy
190100	The area pointer is not updated because the address configured for this pointer does not exist. Type 1 Warnings 2 Errors 3 PLC acknowledgment 4 HMI device acknowledgment 5 LED mapping 6 Trend request 7 Trend transfer 1 8 Trend transfer 2 No.: Consecutive number displayed in WinCC ES.	Check the configuration.
190101	The area pointer is not updated because it is not possible to map the PLC type to the area pointer type. Parameter type and no.: see alarm 190100	--
190102	The area pointer is updated after the cause of the last error has been eliminated (return to normal operation). Parameter type and no.: See alarm 190100.	--

Table8-21 200000 - PLC coordination alarms

Number	Effect/causes	Remedy
200000	Coordination is not executed because the address configured in the PLC does not exist/is not set.	Change the address or set up the address in the PLC.
200001	Coordination is canceled because the write access to the address configured in the PLC is not possible.	Change the address or set the address in the PLC at an area which allows write access.
200002	Coordination is not carried out at the moment because the address format of the area pointer does not match the internal storage format.	Internal error
200003	Coordination can be executed again because the last error is eliminated (return to normal operation).	--
200004	The coordination may not be executed.	--
200005	No more data is read or written. Possible causes: • The cable is defective. • The PLC does not respond, is defective, etc. • System overload	Ensure that the cable is plugged in and the PLC is operational. Restart the system if the system alarm persists.

Table8-22 200100 - PLC user version alarms

Number	Effect/causes	Remedy
200100	Coordination is not executed because the address configured in the PLC does not exist/is not set.	Change the address or set up the address in the PLC.
200101	Coordination is canceled because the write access to the address configured in the PLC is not possible.	Change the address or set the address in the PLC at an area which allows write access.
200102	Coordination is not carried out at the moment because the address format of the area pointer does not match the internal storage format.	Internal error
200103	Coordination can be executed again because the last error is eliminated (return to normal operation).	--
200104	The coordination may not be executed.	--
200105	No more data is read or written. Possible causes: • The cable is defective. • The PLC does not respond, is defective, etc. • System overload	Ensure that the cable is plugged in and the PLC is operational. Restart the system if the system alarm persists.

Table8-23 210000 - PLC job alarms

Number	Effect/causes	Remedy
210000	Jobs are not processed because the address configured in the PLC does not exist/has not been set up.	Change the address or set up the address in the PLC.
210001	Jobs are not processed because read/write access to the address configured in the PLC is not possible.	Change the address or set up the address in the PLC in an area which allows read/write access.
210002	Jobs are not executed because the address format of the area pointer does not match the internal storage format.	Internal error
210003	The job buffer is processed again because the last error has been eliminated (return to normal operation).	--
210004	It is possible that the job buffer will not be processed.	--
210005	A control request with an illegal number was initiated.	Check the PLC program.
210006	An error occurred while attempting to execute the control request. As a result, the control request is not executed. Observe the next/previous system alarms.	Check the parameters of the control request. Recompile the configuration.

Table8-24 220000 - WinCC channel adapter alarms

Number	Effect/causes	Remedy
220001	The tag is not downloaded because the associated communication driver / HMI device does not support the download of Boolean/ discrete data types.	Change the configuration.
220002	The tag is not downloaded because the associated communication driver / HMI device does not support write access to the data type BYTE.	Change the configuration.
220003	The communication driver cannot be loaded. The driver may not be installed.	Install the driver by reinstalling WinCC Runtime.
220004	Communication is down and no update data is transferred because the cable is not connected or defective etc.	Check the connection.
220005	Communication is up.	--
220006	The connection between the specified PLC and the specified port is active.	--
220007	The connection to the specified PLC is interrupted at the specified port.	Check whether • The cable is plugged in • The PLC is OK • The correct port is used. • Your configuration is OK (port parameters, protocol settings, PLC address). Restart the system if the system alarm persists.
220008	The communication driver cannot access or open the specified port. The port may be in use by another application or the port used is not available on the target system. There is no communication with the PLC.	Close all the applications which access this port and restart the computer. Use another port of the system.

Table8-25 230000 - View alarms

Number	Effect/causes	Remedy
230000	The value entered could not be accepted. The system discards the entry and restores the previous value. Either • The value range has been exceeded • Illegal characters have been entered • The maximum permitted number of users has been exceeded.	Enter a practical value or delete any unneeded users.
230002	The currently logged in user has not the required authorization. The system therefore discards the input and restored the previous value.	Log on as a user with appropriate authorization.

Number	Effect/causes	Remedy
230003	Changeover to the specified screen failed because the screen is not available/configured. The current screen remains selected.	Configure the screen and check the screen selection function.
230005	The value range of the tag has been exceeded in the I/O field. The original value of the tag is retained.	Observe the range of values for the tag when entering a value.
230100	During navigation in the Web browser, the system returned a message which may be of interest to the operator. The Web browser continues to run but may not (fully) show the new page.	Navigate to another page.
230200	The connection to the HTTP channel was interrupted due to an error. This error is explained in detail by another system alarm. Data is no longer exchanged.	Check the network connection. Check the server configuration.
230201	The connection to HTTP channel was established. Data is exchanged.	--
230202	WININET.DLL has detected an error. This error usually occurs when an attempt to connect to the server fails or the server refuses to connect because the client lacks the proper authorization. An unknown server certificate may also be the cause if the connection is encrypted by means of SSL. The alarm text provides details. This text is always in the language of the Windows installation because it is returned by the Windows OS. Process values are no longer exchanged.	Depending on the cause: When an attempt to connect fails or a timeout error occurs: • Check the network connection and the network. • Check the server address. • Check whether the WebServer is actually running on the destination station. Faulty authorization: • The configured user name and/or password do not match those on the server. Establish consistency When the server certificate is rejected: Certificate signed by an unknown CA ( ): • Either ignore this item in your project or • Install a certificate that has been signed with a root certificate known to the client computer. The date of the certificate is invalid: • Either ignore this item in your project or • Install a certificate with a valid date on the server. Invalid CN (Common Name or Computer Name): • Either ignore this item in your project or • Install a certificate with a name that corresponds to that of the server address.

Number	Effect/causes	Remedy
230203	Although a connection can be made to the server, the HTTP server refuses to connect because • WinCC Runtime is not running on the server, or • The HTTP channel is not supported (503 Service unavailable). Other errors can only occur if the Webserver does not support the HTTP channel. The language of the alarm text depends on the Webserver. Data is not exchanged.	Error 503 Service unavailable: Check that WinCC Runtime is running on the server and the HTTP channel is supported.
230301	An internal error has occurred. An English text explains the error in more detail. This may be caused by insufficient memory. OCX does not work.	--
230302	The name of the remote server cannot be resolved. The attempt to connect failed.	Check the configured server address. Check if the DNS service is available on the network.
230303	The remote server is not running on the addressed computer. Wrong server address. The attempt to connect failed.	Check the configured server address. Check whether the remote server is running on the target computer.
230304	The remote server on the addressed computer is incompatible with VNCOCX. The attempt to connect failed.	Use a compatible remote server.
230305	The authentication has failed because the password is incorrect. The attempt to connect failed.	Configure the correct password.
230306	Error in the connection to the remote server. This situation may be the result of network problems. Connection has failed.	Check whether • the bus cable is plugged in. • There are network problems.
230307	The connection to the remote server was shut down because • The remote server was shut down, or • The user instructed the server to close all connections. The connection is closed.	--
230308	This alarm provides information on the connection status. An attempt is made to connect.	--

Table8-26 240000 - Authorization alarms

Number	Effect/causes	Remedy
240000	WinCC Runtime is running in demo mode. You have no authorization or your authorization is incorrect.	Install the authorization.
240001	WinCC Runtime is running in demo mode. Too many tags are configured for the installed version.	Load an adequate authorization / powerpack.
240002	WinCC Runtime is running with a time-limited emergency authorization.	Restore the full authorization.
240004	Error while reading the emergency authorization. WinCC Runtime is running in demo mode.	Restart WinCC Runtime, install the authorization or repair the authorization (see Commissioning Instructions for Software Protection).
240005	The Automation License Manager has detected an internal system fault. Possible causes: • A corrupt file • A defective installation • No free space for the Automation License Manager etc.	Reboot the HMI device or PC. If this does not solve the problem, remove the Automation License Manager and install it again.

Table8-27 250000 - S7 Force alarms

Number	Effect/causes	Remedy
250000	The tag in the specified line in "Status Force" is not updated because the address configured for this tag is not available.	Check the set address and then verify that the address is set up in the PLC.
250001	The tag in the specified line in "Status Force" is not updated because the PLC type configured for this tag does not exist.	Check the set address.
250002	The tag in the specified line in "Status Force" is not updated because it is not possible to map the PLC type in the data type.	Check the set address.
250003	An attempt to connect to the PLC failed. The tags are not updated.	Check the connection to the PLC. Check that the PLC is switched on and is online.

Table8-28 260000 - Password alarms

Number	Effect/causes	Remedy
260000	An unknown user or an unknown password has been entered in the system. The current user is logged off from the system.	Log on to the system as a user with a valid password.
260001	The logged in user does not have sufficient authorization to execute the protected functions on the system.	Log on to the system as a user with sufficient authorization.

Number	Effect/causes	Remedy
260002	This alarm is triggered by the system function "TrackUserChange".	--
260003	The user has logged off from the system.	--
260004	The user name entered into the user view already exists in the user management.	Select another user name because user names have to be unique in the user management.
260005	The entry is discarded.	Enter a shorter user name.
260006	The entry is discarded.	Use a shorter or longer password.
260007	The logon timeout value entered is outside the valid range of 0 to 60 minutes. The new value is discarded and the original value is retained.	Enter a logon timeout value between 0 and 60 minutes.
260008	An attempt was made to read a PTProRun.pwl file created with ProTool V 6.0 in WinCC. Reading the file was canceled due to incompatibility of the format.	--
260009	You have attempted to delete the user "Admin" or "PLC User". These users are fixed components of the user management and cannot be deleted.	If you need to delete a user, because perhaps you have exceeded the maximum number permitted, delete another user.
260012	The passwords entered in the "Change Password" dialog and the confirmation field are not identical. The password has not been changed. User will be logged off.	You have to log on to the system again. Then enter the identical password twice to be able to change the password.
260013	The password entered in the "Change Password" dialog is invalid because it is already in use. The password has not been changed. User will be logged off.	You have to log on to the system again. Then enter a new password that has not been used before.
260014	You have tried unsuccessfully to log on three times in succession. You will be locked out and assigned to Group No. 0.	You can log on to the system with your correct password. Only an administrator can change the assignment to a group.
260023	The password you have entered does not meet the necessary password guidelines.	Enter a password that contains at least one number.
260024	The password you have entered does not meet the necessary password guidelines.	Enter a password that contains at least one character.
260025	The password you have entered does not meet the necessary password guidelines.	Enter a password that contains at least one special character.

Number	Effect/causes	Remedy
260028	The system attempts to access the SIMATIC Logon Server upon Runtime startup, an attempt to log on or when trying to change the password of a SIMATIC Logon user. If attempting to log on, the new user is not logged in. If a different user was logged on before, then this user is logged off.	Check the connection to the SIMATIC Logon Server and its configuration; for example: 1. Port number 2. IP address 3. Server name 4. Functional transfer cable Or use a local user.
260029	The SIMATIC Logon user is not associated to any or several groups. The new user is not logged in. If a different user was logged on before, then this user is logged off.	Check the user data on the SIMATIC Logon Server and the configuration in your project. A user may only be assigned to one group.
260030	The SIMATIC Logon user could not change his password on the SIMATIC Logon Server. The new password may not comply with the password guidelines on the server or the user does not have the right to change the password. The old password remains and the user is logged off.	Log in again and choose a different password. Check the password guidelines on the SIMATIC Logon Server.
260031	It was not possible to log the user on to the SIMATIC Logon Server. The user name or the password could be incorrect or the user does not have sufficient rights to log on. The new user is not logged in. If a different user was logged on before, then this user is logged off.	Try again. If necessary, check the password data on the SIMATIC Logon Server.
260032	It was not possible to log the user on to the SIMATIC Logon Server as his account is blocked. The new user is not logged in. If a different user was logged on before, then this user is logged off.	Check the user data on the SIMATIC Logon Server.
260033	The action change password or log on user could not be carried out.	Check the configuration of the SIMATIC Logon Server.
260034	The last logon operation has not yet ended. A user action or a logon dialog can therefore not be called. The logon dialog is not opened. The user action is not executed.	Wait until the procedure is complete.
260035	The last attempt to change the password was not completed. A user action or a logon dialog can therefore not be called. The logon dialog is not opened. The user action is not executed.	Wait until the procedure is complete.
260036	There are insufficient licenses on the SIMATIC Logon Sever. The logon is not authorized.	Check the licensing on the SIMATIC Logon Server.

Number	Effect/causes	Remedy
260037	There is no license on the SIMATIC Logon Sever. A logon is not possible. It is not possible to log on via the SIMATIC Logon Server, only via a local user.	Check the licensing on the SIMATIC Logon Server.

Table8-29 270000 - System events

Number	Effect/causes	Remedy
270000	A tag is not indicated in the alarm because it attempts to access an invalid address in the PLC.	Check whether the data area for the tag exists in the PLC, the configured address is correct and the value range for the tag is correct.
270001	There is a device-specific limit as to how many alarms may be queued for output (see the operating instructions). This limit has been exceeded. The view no longer contains all the alarms. However, all alarms are written to the alarm buffer.	--
270002	The view shows alarms of a log for which there is no data in the current project. Wildcards are output for the alarms.	Delete older log data if necessary.
270003	The service cannot be set up because too many devices want to use this service. A maximum of four devices may execute this action.	Reduce the number of HMI devices which want to use the service.
270004	Access to persistent buffer is not possible. Alarms cannot be restored or saved.	If the problems persist at the next startup, contact Customer Support (delete Flash).
270005	Persistent buffer damaged: Alarms cannot be restored.	If the problems persist at the next startup, contact Customer Support (delete Flash).
270006	Project modified: Alarms cannot be restored from the persistent buffer.	The project was generated and downloaded again to the HMI device; The error should no longer occur the next time you start the device.
270007	A configuration problem is preventing the restore (a DLL is missing, a folder is unknown, etc.).	Update the operating system and then download your project again to the HMI device.

Table8-30 280000 - DPHMI alarms Connection

Number	Effect/causes	Remedy
280000	Connection is up because the cause of the interruption has been eliminated.	--

Number	Effect/causes	Remedy
280001	No more data is read or written. Possible causes: • The cable is defective • The PLC does not respond, is defective, etc. • The wrong port is used for the connection • System overload	Check whether • The cable is plugged in • The PLC is OK • The correct port is used Restart the system if the system alarm persists.
280002	The connection used requires a function block in the PLC. The function block has responded. Communication is now enabled.	--
280003	The connection used requires a function block in the PLC. The function block has not responded.	Check whether • The cable is plugged in • The PLC is OK • The correct port is used Restart the system if the system alarm persists. Remedy depends on the error code: 1: The function block must set the COM bit in the response container. 2: The function block must not set the ERROR bit in the response container. 3: The function block must respond within the specified time (timeout). 4: Go online to the PLC.
280004	The connection to the PLC is interrupted. There is no data exchange at present.	Check the connection parameters in WinCC. Ensure that the cable is plugged in, the PLC is operational, and the correct port is being used. Restart the system if the system alarm persists.

Table8-31 290000 - Recipe system events

Number	Effect/causes	Remedy
290000	The recipe tag could not be read or written. It is assigned the start value. The alarm can be entered in the alarm buffer for up to four more failed tags if necessary. After that, alarm 290003 is output.	Check in the configuration that the address has been set up in the PLC.
290001	An attempt has been made to assign a value to a recipe tag which is outside the value range permitted for this type. The alarm can be entered in the alarm buffer for up to four more failed tags if necessary. After that, alarm 290004 is output.	Observe the value range for the data type.

Number	Effect/causes	Remedy
290002	It is not possible to convert a value from a source format to a target format. The alarm can be entered in the alarm buffer for up to four more failed recipe tags if necessary. After that, alarm 290005 is output.	Check the value range or type of the tag.
290003	This alarm is output when alarm number 290000 is triggered more than five times. In this case, no further alarms are generated.	Check in the configuration that the tag addresses have been set up in the PLC.
290004	This alarm is output when alarm number 290001 is triggered more than five times. In this case, no further alarms are generated.	Observe the value range for the data type.
290005	This alarm is output when alarm number 290002 is triggered more than five times. In this case, no further alarms are generated.	Check the value range or type of the tag.
290006	The threshold values configured for the tag have been violated by values entered.	Observe the configured or current threshold values of the tag.
290007	There is a difference between the source and target structure of the recipe currently being processed. The source structure contains an additional data recipe tag which is not available in the target structure and therefore cannot be assigned. The value is rejected.	Remove the specified data recipe tag in the specified recipe from the project.
290008	There is a difference between the source and target structure of the recipe currently being processed. The target structure contains an additional data recipe tag which is not available in the source structure. The data recipe tag specified is assigned its start value.	Insert the specified data recipe tag in the source structure.
290010	The storage location configured for the recipe is not permitted. Possible causes: Illegal characters, write protection, data carrier out of space or does not exist.	Check the configured storage location.
290011	The record with the specified number does not exist.	Check the source for the number (constant or tag value).
290012	The recipe with the specified number does not exist.	Check the source for the number (constant or tag value).
290013	An attempt was made to save a record under a record number which already exists. The action is not executed.	The following remedies are available: • Check the source for the number (constant or tag value). • First, delete the record. • Change the "Overwrite" function parameter.

Number	Effect/causes	Remedy
290014	The file specified to be imported could not be found.	Check: • The file name • Ensure that the file is in the specified folder.
290020	Alarm reporting that the download of records from the HMI device to the PLC has started.	--
290021	Alarm reporting that the download of records from the HMI device to the PLC was completed.	--
290022	Alarm reporting that the download of records from the HMI device to the PLC was canceled due to an error.	Check in the configuration whether: • The tag addresses are configured in the PLC • The recipe number exists • The record number exists • The "Overwrite" function parameter is set
290023	Alarm reporting that the download of records from the PLC to the HMI device has started.	--
290024	Alarm reporting that the download of records from the PLC to the HMI device was completed.	---
290025	Alarm reporting that the download of records from the PLC to the HMI device was canceled due to an error.	Check in the configuration whether: • The tag addresses are configured in the PLC • The recipe number exists • The record number exists • The "Overwrite" function parameter is set
290026	An attempt has been made to read/write a record although the record is not free at present. This error may occur in the case of recipes for which downloading with synchronization has been configured.	Set the record status to zero.
290027	Unable to connect to the PLC at present. As a result, the record can neither be read nor written. Possible causes: No physical connection to the PLC (no cable plugged in, cable is defect) or the PLC is switched off.	Check the connection to the PLC.
290030	This alarm is output after you selected screen which contains a recipe view in which a record is already selected.	Reload the record from the storage location or retain the current values.
290031	While saving, it was detected that a record with the specified number already exists.	Overwrite the record or cancel the action.
290032	While exporting records it was detected that a file with the specified name already exists.	Overwrite the file or cancel the process.
290033	Confirmation request before deleting records.	--

Number	Effect/causes	Remedy
290040	A record error with error code %1 that cannot be described in more detail occurred. The action is canceled. It is possible that the record was not installed correctly on the PLC.	Check the storage location, the record, the "Data record" area pointer and if necessary, the connection to the PLC. Restart the action after a short time. If the error persists, contact Customer Support. Forward the relevant error code to Customer Support.
290041	A record or file cannot be saved because the storage location is full.	Delete files no longer required.
290042	An attempt was made to execute several recipe actions simultaneously. The last action was not executed.	Trigger the action again after waiting a short period.
290043	Confirmation request before storing records.	--
290044	The data store for the recipe has been destroyed and is deleted.	--
290050	Alarm reporting that the export of records has started.	--
290051	Alarm reporting that the export of records was completed.	--
290052	Alarm reporting that the export of records was canceled due to an error.	Ensure that the structure of the records at the storage location and the current recipe structure on the HMI device are identical.
290053	Alarm reporting that the import of records has started.	--
290054	Alarm reporting that the import of records was completed.	--
290055	Alarm reporting that the import of records was canceled due to an error.	Ensure that the structure of the records at the storage location and the current recipe structure on the HMI device are identical.
290056	Error when reading/writing the value in the specified line/column. The action was canceled.	Check the specified line/column.
290057	The tags of the recipe specified were toggled from "offline" to "online" mode. Each change of a tag in this recipe is now immediately downloaded to the PLC.	--
290058	The tags of the specified recipe were toggled from "offline" to "online" mode. Modifications to tags in this recipe are no longer immediately transferred to the PLC but must be transferred there explicitly by downloading a record.	--
290059	Alarm reporting that the specified record was saved.	--

Number	Effect/causes	Remedy
290060	Alarm reporting that the specified record memory was cleared.	--
290061	Alarm reporting that clearing of record memory was canceled due to an error.	--
290062	The record number is above the maximum of 65536. This record cannot be created.	Select another number.
290063	This occurs with the system function "ExportDataRecords" when the parameter "Overwrite" is set to No. An attempt has been made to save a recipe under a file name which already exists. The export is canceled.	Check the "ExportDataRecords" system function.
290064	Alarm reporting that the deletion of records has started.	--
290065	Alarm reporting that the deletion of records has successfully completed.	--
290066	Confirmation request before deleting records.	--
290068	Security request to confirm if all records in the recipe should be deleted.	--
290069	Security request to confirm if all records in the recipe should be deleted.	--
290070	The record specified is not in the import file.	Check the source of the record number or record name (constant or tag value).
290071	During the editing of record values, a value was entered which exceeded the low limit of the recipe tag. The entry is discarded.	Enter a value within the limits of the recipe tag.
290072	When editing record values, a value was entered which exceeds the high limit of the recipe tag. The entry is discarded.	Enter a value within the limits of the recipe tag.
290073	An action (e.g. saving a record) failed due to an unknown error. The error corresponds to the status alarm IDS_OUT_CMD_EXE_ERR in the large recipe view.	--
290074	While saving, it was detected that a record with the specified number already exists but under another name.	Overwrite the record, change the record number or cancel the action.
290075	A record with this name already exists. The record is not saved.	Please select a different record name.
290110	The default values could not be set due to an error.	--

Number	Effect/causes	Remedy
290111	The Recipes subsystem cannot be used. Recipe views have no content and recipe-specific functions will not be performed. Possible causes: • An error occurred while loading the recipes. • The recipe structure was changed in ES. When the project was downloaded again, the recipes were not transferred with it. This means that the new project data is not being transferred to the old recipes on the device.	Download the project to the device again, including recipes (select the corresponding option in the dialog).

Table8-32 300000 - Alarm_S alarms

Number	Effect/causes	Remedy
300000	Faulty configuration of process monitoring (e.g. using PDiag or S7-Graph): More alarms are queued than specified in the specifications of the CPU. No further ALARM_S alarms can be managed by the PLC and reported to the HMI devices.	Change the PLC configuration.
300001	ALARM_S is not registered on this PLC.	Select a controller that supports the ALARM_S service.

Table8-33 310000 - Report system events

Number	Effect/causes	Remedy
310000	An attempt is being made to print too many reports in parallel. Only one log file can be output to the printer at a given time; the print job is therefore rejected.	Wait until the last active log was printed. Repeat the print job, if necessary.
310001	An error occurred on triggering the printer. The report is either not printed or printed with errors.	Evaluate the additional system alarms related to this alarm. Repeat the print job if necessary.

Table8-34 320000 - Alarms

Number	Effect/causes	Remedy
320000	The movements have already been indicated by another device. The movements can no longer be controlled.	Deselect the movements on the other display units and select the motion control screen on the required display unit.
320001	The network is too complex. The faulty addresses cannot be indicated.	View the network in STL.

Number	Effect/causes	Remedy
320002	No diagnosable alarm message (error) selected. The unit associated with the alarm message could not be selected.	Select a diagnostics alarm from the ZP_ALARM alarm screen.
320003	No alarm message (error) exists for the selected unit. The detail view cannot visualize any networks.	Select the defective unit from the overview screen.
320004	The required signal states could not be read by the PLC. The faulty addresses cannot be found.	Check the consistency between the configuration on the HMI device unit and the downloaded PLC program.
320005	The project contains ProAgent elements which are not installed. ProAgent diagnostic functions cannot be performed	In order to run the project, install the optional ProAgent package.
320006	You have attempted to execute a function which is not supported in the current constellation.	Check the type of the selected unit.
320007	No error-triggering addresses were found on the networks. ProAgent cannot indicate any faulty addresses.	Switch the detail screen to STL layout mode and check the status of the addresses and exclusion addresses.
320008	The diagnostic data stored in the configuration are not synchronized with those in the PLC. ProAgent can only indicate the diagnostic units.	Download the project to the HMI device again.
320009	The diagnostic data stored in the configuration are not synchronized with those in the PLC. The diagnostic screens can be operated as usual. ProAgent may be unable to show all diagnostic texts.	Download the project to the HMI device again.
320010	The diagnostic data stored in the configuration are not synchronized with those in STEP7. The ProAgent diagnostics data is not up-to-date.	Download the project to the HMI device again.
320011	A unit with the corresponding DB number and FB number does not exist. The function cannot be executed.	Check the parameters of the "SelectUnit" function and the units selected in the project.
320012	The "Step sequence mode" dialog is no longer supported.	Use the ZP_STEP step sequence screen from the corresponding standard project for your project. Instead of calling the Overview_Step_Sequence_Mode function, call the "FixedScreenSelection" function using ZP_STEP as the screen name.
320014	The selected PLC cannot be evaluated for ProAgent. The Alarm view assigned to the "EvaluateAlarmDisplayFault" system function could not be found.	Check the parameters of the "EvaluateAlarmDisplayFault" system function.

Table8-35 330000 - GUI alarms

Number	Effect/causes	Remedy
330022	Too many dialogs are open on the HMI device.	Close all dialogs you do not require on the HMI device.
330026	The password will expire after the number of days shown.	Enter a new password.

Table8-36 350000 - GUI alarms

Number	Effect/causes	Remedy
350000	PROFIsafe packages have not arrived within the necessary period. There is a communication problem with the F-CPU. RT is terminated.	Check the WLAN connection.
350001	PROFIsafe packages have not arrived within the necessary period. There is a communication problem with the F-CPU. The PROFIsafe connection is re-established.	Check the WLAN connection.
350002	An internal error has occurred. Runtime is terminated.	Internal error
350003	Feedback concerning the connection established with the F-CPU. The Emergency-Off buttons are active immediately.	--
350004	PROFIsafe communication was set and the connection was cleared. The Runtime can be terminated. The Emergency-Off buttons are deactivated immediately.	--
350005	Incorrect address configured for the F-slave. No PROFIsafe connection.	Check and modify the address of the F slave in WinCC ES.
350006	The acknowledgment buttons in the "Acknowledgment" and "Panic" functions were not tested before logging on. It is not possible to log onto the effective range.	Press the two acknowledgment buttons one after another in the "Acknowledgment" and "Panic" positions.
350008	An incorrect number of failsafe buttons was configured. No PROFIsafe connection.	Change the number of failsafe buttons in the project.
350009	The device is in Override mode. It may no longer be possible to detect the location because transponder detection fails.	Exit Override mode.

Number	Effect/causes	Remedy
350010	Internal error: The device has no failsafe buttons.	Send the device back. Worldwide contact person

See also

System functions and events for alarms (Page 1231)

8.5 Working with recipes

8.5.1 Basics

8.5.1.1 Basics on recipes

Introduction

Recipes are collections of data that belongs together, for example machine parameter settings or production data.

Examples:

- Machine parameter settings that are needed to convert production to a different product variant.
- Product components that result in different compositions for different end products.

A recipe has a fixed data structure. The structure of a recipe is defined once at the configuration stage. A recipe contains recipe data records. These differ in terms of their values, but not their structure. Recipes are stored on the HMI device or on an external storage medium. If, for example, production data is stored on a server in a database, you can import the production data via a CSV file at runtime.

Note
Basic Panels

It is not possible to export or import the recipes for Basic Panels. There is no external storage medium.

A recipe data record is transferred in full between the HMI device, and PLC in a single step.

Using recipes

Recipes can be used in the following situations:

- Manual production

  You select the required recipe data and display it on the HMI device. You modify the recipe data as required and save it on the HMI device. You transfer the recipe data to the PLC.
- Automatic production

  The control program starts transfer of the recipe data between the PLC and HMI device. You can also start the transfer from the HMI device. Production is then implemented automatically. It is not essential to display or modify the data.
- Teach-in mode

  You optimize production data that was optimized manually on the system, e.g. axis positions or filling volumes. The values thus determined are transferred to the HMI device and saved in a recipe data record. You can then transfer the saved recipe data back to the PLC at a later date.

Entering and modifying the recipe data

You enter the data in the individual recipe data records, and modify it as required. The following options are available:

- Data entry during configuration

  If the production data exists already, you enter the data in the "Recipes" editor during recipe configuration.
- Data entry during runtime

  If you have to frequently modify production data, you can do this directly in Runtime as follows:
  - Enter the data directly on the HMI device.
  - Set the parameters directly on the machine. You then transfer the data from the PLC to the HMI device, and save it in the recipe.

See also

"Recipes" editor (Page 1273)
Simple recipe view (Page 1276)
General configuration procedure (Page 1279)
Description of the simple recipe view (Basic, Advanced) (Page 1289)
Examples for using recipes (Page 1268)
Structure of recipes (Page 1269)
Displaying recipes (Page 1270)
Flow of data for recipes (Page 1271)
Synchronization of recipe data records with the PLC (Page 1272)

8.5.1.2 Examples for using recipes

Recipes are used in the manufacturing industry and mechanical engineering, for example. The following examples illustrate typical applications that you can implement with the recipe functionality of the WinCC Engineering System:

- Machine parameter assignment

One field of application for recipes is the assignment of machine parameters in the manufacturing industry: A machine cuts wooden boards to specified dimensions, and drills holes. The guide rails and drill have to be moved to new positions according to the board size. The required position data are stored as data records in a recipe. You reassign the machine parameters using "Teach in" mode if, for example, a new board size is to be processed. You transfer the new position data directly from the PLC to the HMI device and save it as a new data record.

- Batch production

  Batch production in the food processing industry represents another field of application for recipes: A filling station in a fruit juice plant produces juice, nectar, and fruit drinks in a variety of flavors. The ingredients are always the same, differing only in their mixing ratios. Each flavor corresponds to a recipe. Each mixing ratio corresponds to a data record. All of the required data for a mixing ratio can be transferred to the machine control at the touch of a button.

See also

Basics on recipes (Page 1267)

8.5.1.3 Structure of recipes

Introduction

The basic structure of a recipe is illustrated with reference to the filling station in a fruit juice plant.

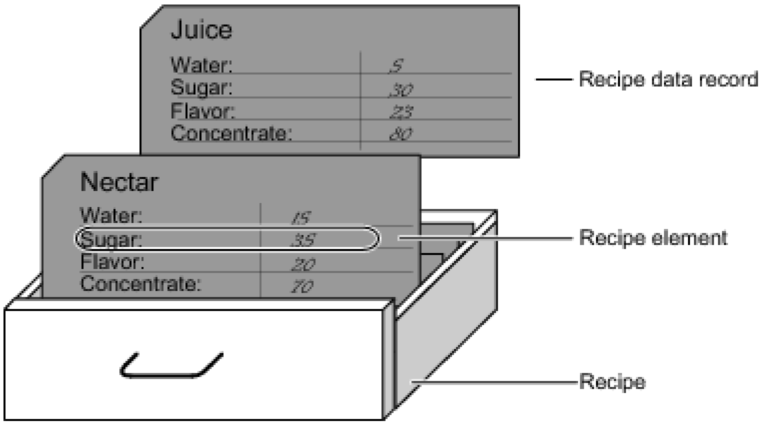
There may be several different recipes in an HMI device. A recipe can be compared to an index card box that contains several index cards. The index card box contains several variants for manufacturing a product family. All the data for each manufacturing variant is contained on a single index card.

Example:

In a soft drinks production plant, a recipe is needed for different flavors. Drink variants include fruit juice drink, juice and nectar.

Recipe

The recipe contains all the recipe data records for the different drink variants.



Recipe data records

Each index card represents a recipe data record needed to manufacture a product variant.

Recipe entries

Each index card in a drawer has the same structure. All the index cards contain fields for the different ingredients. Each field corresponds to a recipe entry. All the records of a recipe thus contain the same entries. The records differ, however, in the value of the individual entries.

Example:

All the drinks contain the following ingredients:

- Water
- Concentrate
- Sugar
- Flavoring

The records for juice drink, fruit juice or nectar differ, however, in the quantity of sugar used in production.

See also

Basics on recipes (Page 1267)

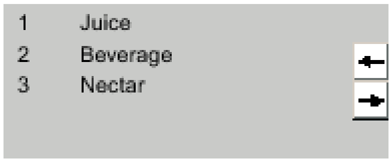
8.5.1.4 Displaying recipes

Introduction

You need to configure the recipe view to display recipes. You can change the values of a recipe in the recipe view and thereby influence the manufacturing process or a machine.

Recipe view

The recipe view is an off-the-shelf WinCC display and operator control for managing recipe data records. The recipe view is always part of a screen. The recipe view shows recipe data records in tabular form. You adapt the appearance and the possible operations to suit your specific needs.



1	Juice
2	Beverage
3	Nectar

If you are editing recipes with a recipe view in your project, the values are saved in recipe data records. The values are not transferred between the HMI device and PLC until you use the relevant operator control.

See also

Basics on recipes (Page 1267)

8.5.1.5 Flow of data for recipes

Interaction between the components

There is interaction between the following components at runtime:

- Recipe view

  Recipes are displayed and edited in the recipe view on the HMI device.

  The recipe data records from the internal memory of the HMI device are displayed and edited in the recipe view.

- HMI device recipe memory

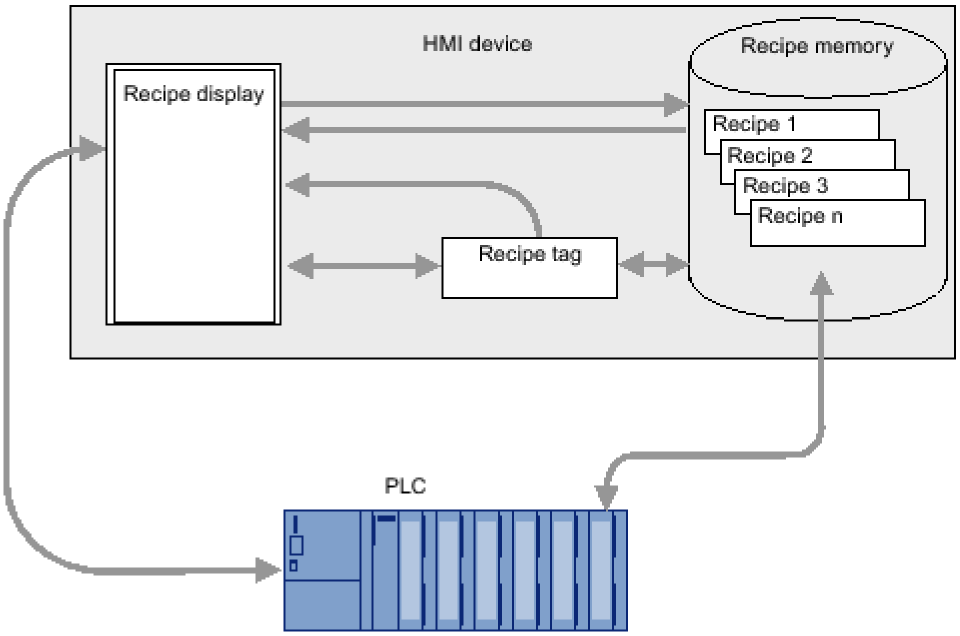
  Recipes are saved in the form of recipe data records in the HMI device's recipe memory.

- Recipe tags

  The recipe tags contain recipe data.

Overview of the flow of data

The following figure illustrates the flow of data in recipes:



To transfer recipe data records to the PLC, use the "To PLC" button in the recipe view or an operator control with the system function "RecipeViewSetDataRecordToPLC".

See also

Basics on recipes (Page 1267)

8.5.1.6 Synchronization of recipe data records with the PLC

Overview

When recipe data records are transferred between the HMI device and PLC, both communication peers access common communication areas on the other peer.

Recipe data records are always transferred directly. The values of the tags are written directly to or read directly from the configured addresses without being placed on the clipboard.

Data transfer types

There are two ways to transfer recipe data records between the HMI device and PLC:

- Transfer without synchronization
- Transfer with synchronization via the "Data record" area pointer.

Note
Transfer with synchronization

Transfer with synchronization is used to prevent the uncontrolled overwriting of data in either direction in your control program.

Requirements for transfer with synchronization

Requirements for transfer with synchronization:

- The "Data record" area pointer must be set up for the required connection in the "Communication > Connections" editor.
- The PLC with which the HMI device synchronizes the transfer is specified in the recipe properties in the "Recipes" editor.

Transfer with synchronization

In the case of synchronous transfer, both the PLC and the HMI device set status bits in the shared data compartment.

Synchronous data record transfer can be a useful solution, for example, when:

- The PLC is the "active partner" for the transfer of recipe data records.
- The PLC evaluates information about the recipe number and name, as well as the recipe data record number and name.
- The transfer of recipe data records is started by the following PLC jobs:
  - "Set_data_record_in_PLC"
  - "Get_data_record_from_PLC"

See also

Basics on recipes (Page 1267)

8.5.2 Elements and basic settings

8.5.2.1 "Recipes" editor

Introduction

You can create, configure and edit recipes, recipe entries and recipe data records in the "Recipes" editor. The "Recipes" editor also allows you to enter values in recipe data records.

Structure of the "Recipes" editor

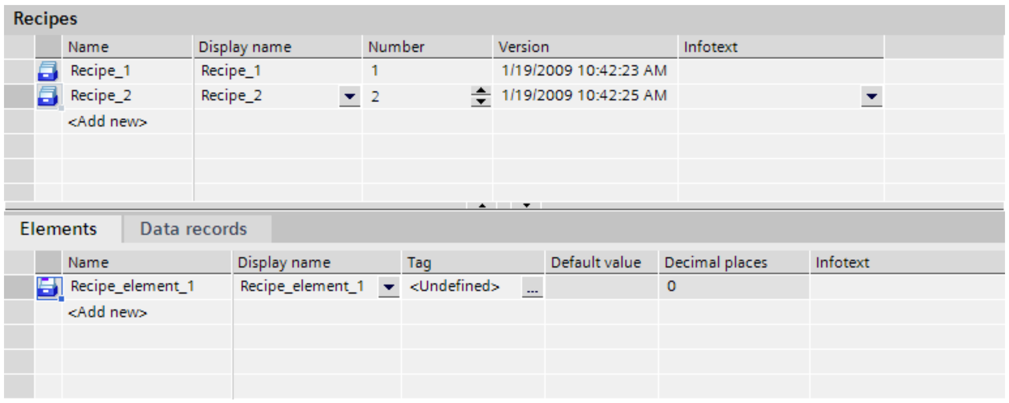
You create recipes in the top part of the table editor. You can also configure them there or in the Inspector window.

The bottom part of the table editor has the following tabs:

- Elements

  Define the elements of the selected recipe using the table cells provided here.
- Data records

Define the values of the data records of the selected recipe using the table cells provided here.



Recipes

Name	Display name	Number	Version	Infotext
Recipe_1	Recipe_1	1	1/19/2009 10:42:23 AM	
Recipe_2	Recipe_2	2	1/19/2009 10:42:25 AM	
<Add new>				

Elements | Data records

Name	Display name	Tag	Default value	Decimal places	Infotext
Recipe_element_1	Recipe_element_1	<Undefined>		0	
<Add new>					

You can then configure the selected recipe, the recipe element or the recipe data record in the Inspector window. You will find further notes on configuring the components of a recipe under "Configuring Recipes".

Recipe settings

The following settings are available for recipes:

Setting	Description
Recipe name	This is a unique identification for the recipe within the HMI device.
Display name	Appears in the recipe view, for example, in Runtime. You can configure display names in multiple languages. Enter meaningful names or designations which you can assign directly to a product, such as "Fruit_juice_Orange".
Recipe number	This is a unique identification for the recipe within the HMI device.
Version	Displays information with regard to the recipe. The date and time of the last change to the recipe is set by default.
Path	Defines the storage location for recipes.
Infotext	Infotext about the recipe element that the operator sees in Runtime.

Note
Basic Panels

The "Path" setting is not available for Basic Panels.

Recipe element settings

You can make the following settings on the "Elements" tab:

Setting	Description
Recipe element name	Identifies a recipe element uniquely within the recipe. Enter meaningful names or labels that you can allocate uniquely, such as axis labels on a machine or ingredients such as "Flavoring".
Display name	Appears in the recipe view, for example, in Runtime. You can configure display names in multiple languages. Enter meaningful names or designations which you can assign directly to a product, such as "Fruit_juice_Orange".
Assigned tag	Every recipe element is assigned a recipe tag in which the value of the recipe data record will be stored in Runtime.
Text list	Text is assigned to a value or range of values in a text list. You can display this text in an output field, for example. The tag assigned must be of the type "integer" to allow the use of text lists in recipe elements. The tag value must be within the range of values of the text list.
Default value	This is used as the default entry when you create a new recipe data record.
Decimal point	Determines the number of decimal places used to display the value of the recipe data record in Runtime.

Recipe data record settings

You can make the following settings on the "Data records" tab:

Setting	Description
Recipe data record name	Identifies a recipe data record uniquely within the recipe.
Display name	Appears in the recipe view, for example, in Runtime. You can configure display names in multiple languages. Enter meaningful names or labels that you can assign directly to a product, such as "Product_numbers".
Recipe data record number	Identifies a recipe data record uniquely within the recipe.
Entered values	You can enter values in a recipe data record during configuration. The recipe data records are included when you download the project to the HMI device. If there are data records on the HMI device already, a prompt will appear and the records will be overwritten according to the download settings.
Comment	Comment about the recipe data record

See also

Basics on recipes (Page 1267)

8.5.3 Displaying and editing recipes in Runtime

8.5.3.1 Simple recipe view

Recipe view

The simple recipe view is a ready-made display element and operator control that is used to manage recipe data records. The recipe view shows recipe data records in tabular form.

The operator control of the simple recipe view is configurable.

The values displayed or entered in the recipe view are saved in recipe data records. The recipe data records are exchanged with the PLC via system functions.

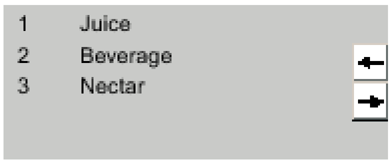
Layout of the display

The simple recipe view consists of three areas:

- Recipe list
- Data record list
- Element list

In the simple recipe view, each area is shown separately on the HMI device. Depending on the configuration, the simple recipe view starts with the recipe list.

The figure below shows an example of the data record list.



```
1    Juice
2    Beverage
3    Nectar
```

Display of values

Notice
Changing the recipe data record in the background

Applies to the processing of a recipe data record:
If values of the corresponding recipe data record are changed by a control job, the recipe view is not updated automatically.

To update the recipe view, reselect the respective recipe data record.

See also

Basics on recipes (Page 1267)
Configuration options of the simple recipe view (Page 1277)
Behavior of the recipe view in Runtime (Page 1278)

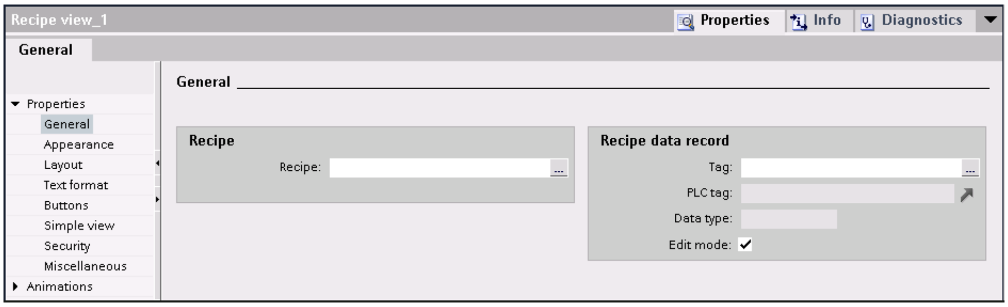
8.5.3.2 Configuration options of the simple recipe view

You can define the behavior of the recipe view and the recipes that are displayed in the recipe view Inspector window.

Displaying recipe data record values only

To display the recipe data in a recipe view for checking only, proceed as follows:

1. Deselect "Edit mode" in the "General" group.



It is now not possible to edit recipe data records.

Configuring an event on the recipe view

To configure an event for the recipe view, proceed as follows:

1. Select the recipe view that was added to the screen in the "Screens" editor.

   The properties of the recipe view are shown in the Inspector window.
2. In the Inspector window, click the event you want to configure under "Properties > Events".

   The "Function list" dialog box opens.
3. Configure a function list for the selected event.

The function list is processed when the configured event occurs.

Note
HMI device dependency

You can only configure events for the OP 77A and TP 177A HMI devices for the simple recipe view.

Constraints on the simple recipe view

Note

The "Simple recipe view" object cannot be operated dynamically with a script.

In the Engineering System you can dynamically control the visibility of an object, for example, in the "Animations" group of the Inspector window. In Runtime, the "Simple recipe view" does not support animations. If you have configured an animation and, for example, wish to perform a consistency check of the project, then an error alarm is issued in the Output window.

The following functions are not possible in the simple recipe view:

- Synchronize tags
- Save recipe and data record to a tag or read from a tag

See also

Simple recipe view (Page 1276)

8.5.3.3 Behavior of the recipe view in Runtime

Screen change

If you change to another screen and have not yet saved changes to the recipe data in the recipe view, you will be prompted to save the recipe data. The recipe name and the name of the recipe data record are displayed to show which recipe data have not been saved yet.

When you switch to a screen that contains a recipe view with loaded recipe data, the recipe data will be automatically updated.

Create, change, copy or delete recipe data records

If you attempt to create a new recipe data record and a recipe data record already exists, a system alarm will appear on screen.

Operating the recipe view with function keys

The Recipe view can be operated with function keys, e.g. if the HMI device does not have touch functionality. You can assign functions such as "SaveDataRecord" to the function keys on the HMI device.

Display after import of recipe data

If you open the recipe view during the import of recipe data, only the recipe data that is already completely imported will be displayed. The recipe view is not automatically updated with a data import. In order to have a complete view of all the recipe data, do not open the recipe view until the system prompts you that the recipe data has been imported successfully. Alternatively, update the recipe view after successful completion of the import procedure.

Note
Basic Panels

Recipe data import and export is not available for Basic Panels.

Updating tag for recipes and recipe data records

The current recipe data record or its number can be saved to a tag, depending on the configuration. The tag will be updated under the following conditions:

- The recipe data record has been loaded.
- The screen with the recipe view was not exited during loading.

This operation may take some time.

See also

Simple recipe view (Page 1276)

8.5.4 Configuring recipes

8.5.4.1 General configuration procedure

Carry out the following configuration steps when you create a new recipe:

Step	Description
1	Define the structure of the recipe.
2	Create tags according to the recipe structure. Assign process names to these tags.
3	Create the recipe.
4	Enter the required properties for the recipe: • Recipe storage location • Match the values of recipe tags and recipe data records • Synchronization with the PLC
5	Create the recipe elements and enter the required properties: • Enter default values for the recipe entries if required. • Enter the language-specific display names for the recipe entries. • Connect the recipe entries to the tags.

Step	Description
6	Create the recipe data records. Enter the language-specific display names for the recipe data records.
7	Configure a screen with recipe view or a recipe screen.

Note
Basic Panels

The selection of the storage location is not available for Basic Panels. The recipes are always stored in the recipe memory.

The recipe screen is not available for Basic Panels.

See also

Basics on recipes (Page 1267)
Creating a new recipe (Page 1282)
Configuring the simple recipe view (Page 1280)

8.5.4.2 Configuring the display of recipes

8.5.4.2 Configuring the simple recipe view

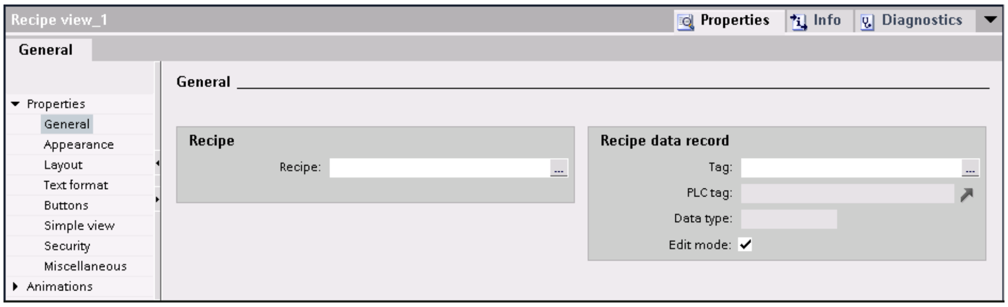
Requirement

- You have created the recipe.
- The "Screens" editor is open.
- The screen has been created and opened.

Procedure

To configure a simple recipe view, proceed as follows:

1. Paste the recipe view into the screen. You will find the recipe view under "Controls" in the "Tools" task card.
2. Select "Simple view" under "General > Display type".



General

Recipe

Recipe:

Recipe data record

Tag:

PLC tag:

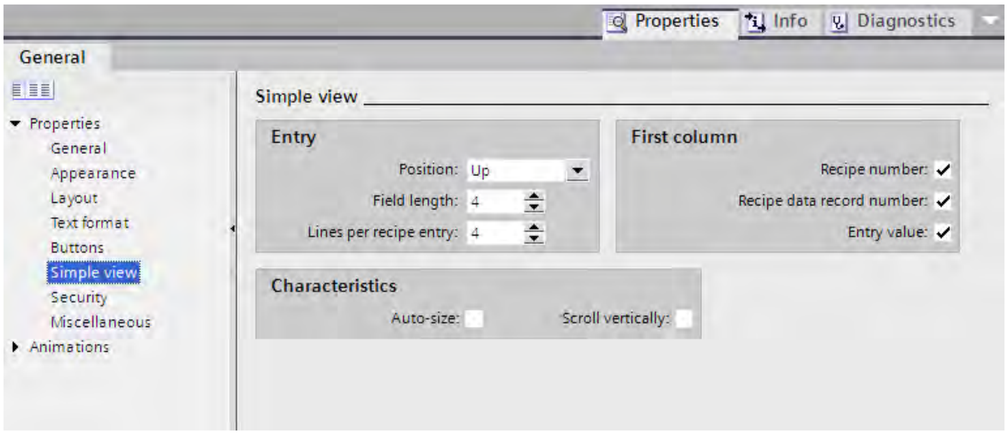
Data type:

Edit mode: ✓

3. If you want to display only the recipe data records of a specific recipe in the recipe view, select the recipe under "Recipe".
4. If you only want to display the recipe data in the recipe view, deselect "Edit mode" in the "Data record" area.
5. You can define additional options for the recipe view under "Properties > Appearance" and "Properties > Layout".
6. Select "Properties > Simple view" to select the position, the field length, and the number of lines required.

   Select "Position > Top" to display the recipe value in the first line of the recipe entry.

   Select "Position > Bottom" to display the recipe value in the last line of the recipe entry.



Simple view

Entry

Position: Up

Field length: 4

Lines per recipe entry: 4

First column

Recipe number: ✓

Recipe data record number: ✓

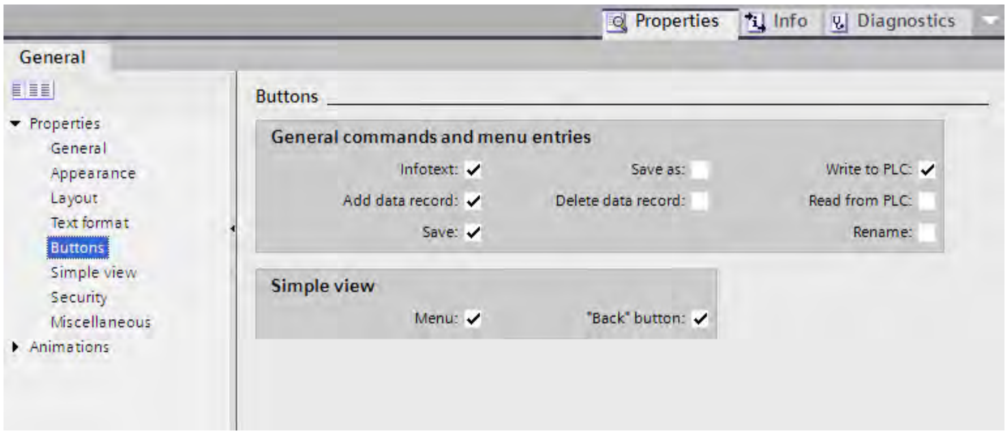
Entry value: ✓

Characteristics

Auto-size:

Scroll vertically:

7. Under "Properties" > "Buttons", specify which menu commands are to be available in the recipe view in Runtime.



Buttons

General commands and menu entries

Infotext:	✓	Save as:		Write to PLC:	✓
Add data record:	✓	Delete data record:		Read from PLC:	
Save:	✓			Rename:	

Simple view

Menu:	✓	"Back" button:	✓

Result

The simple recipe view is configured. You can use the recipe view to display and edit recipe data during runtime.

See also

General configuration procedure (Page 1279)

8.5.4.3 Creating and Editing Recipes

8.5.4.3 Creating a new recipe

Introduction

To create a complete recipe, start by creating a new recipe, assign the corresponding recipe elements and then define the associated values in a recipe data record.

Requirement

- The tags for the recipe have been created.
- The "Recipes" editor is open.

Create recipe

Create a recipe as follows:

1. Click "Add" in the first free row of the table in the "Recipes" editor.

   The new recipe is created and displayed on a line.
2. Enter a descriptive name for the recipe under "Name".

   This name identifies the recipe unambiguously within the project.
3. Select "Display name" to enter the language-specific name to be displayed in runtime.

4. Select a recipe number in "Number".

   The number identifies the recipe unambiguously within the HMI device.

   The recipe is automatically assigned a version that indicates the date and time of the last change. As an alternative, you can enter specific information relating to the recipe.

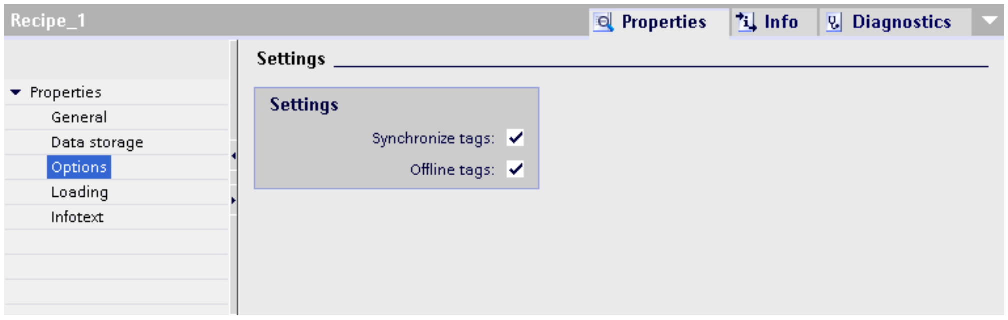
5. Specify the storage location for recipe data records in "Data medium". The options offered depend on the specific HMI device used.

Note
Basic Panels

The "Data storage" category is not available for Basic Panels. The recipe data records are stored in the internal flash memory.

---

6. Enter an info text that the operator will see in runtime.
7. To match recipe tags configured in I/O fields with the recipe view in runtime, select "Synchronize tags" under "Properties > Options" in the Inspector window.
8. Disable "Offline tags" to specify that the recipe tags should be automatically transferred to the PLC when editing the I/O fields.



Settings
Synchronize tags: ✓
Offline tags: ✓

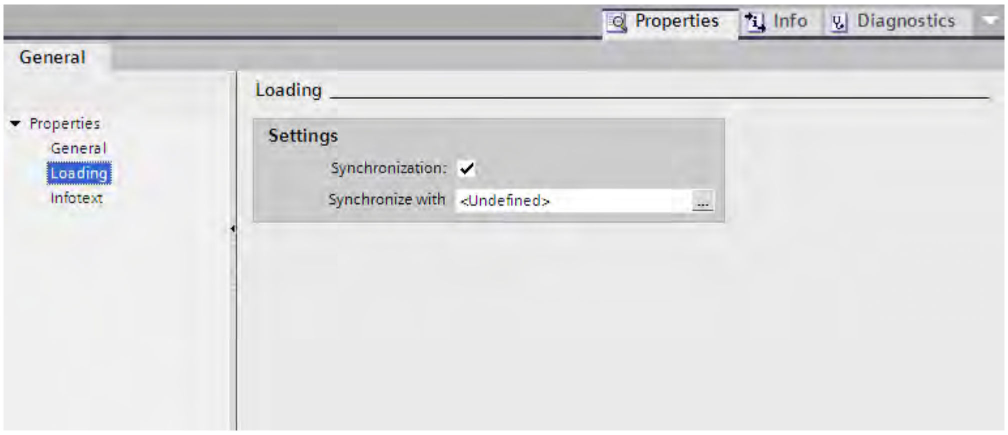
Note
Basic Panels

Since the recipe tags cannot be additionally used in I/O fields in screens with Basic Panels, the "Options" category is not available.

---

9. Enable "Synchronization" under "Properties > Download " to monitor the recipe data download during runtime using area pointers.

1 Select the relevant PLC under "Synchronize with ...".
0.



Loading

Settings

Synchronization: ✓

Synchronize with <Undefined>

Create recipe element

To create recipe elements, proceed as follows:

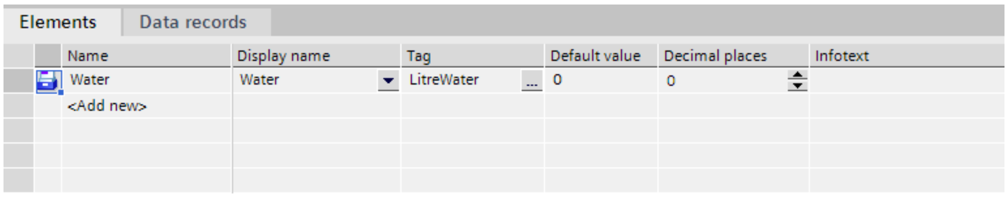
1. Click the "Elements" tab.
2. Click "Add" in the first free line of the table editor.

   A new recipe element is created.
3. Enter a descriptive name for the element under "Name".

   The name identifies the element uniquely within the recipe.
4. Enter a language-specific display name for the element under "Display name".

   The display name appears in the recipe view, for example, in runtime.
5. Select the tag you want to link to the recipe element under "Tag".

   The value of the recipe data record is saved in this tag in runtime.



Name	Display name	Tag	Default value	Decimal places	Infotext
Water	Water	LitreWater	0	0	
<Add new>					

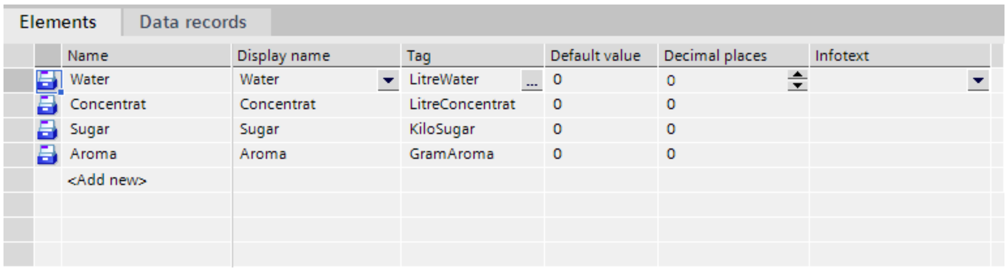
6. Enter an info text.

   The info text is displayed to the operator in runtime.
7. Under "Default value", enter the value that you want to use as the default entry when you create a new recipe data record.
8. To assign text to a value or range of values, select the relevant text list here.

   The tag assigned must be of the type "integer" to allow the use of text lists in recipe elements. The tag value must be within the range of values of the text list.

   The text stored in the text list is displayed in an output field, for example, in runtime.
9. The exact number of decimal places of the data record values displayed at runtime is set in the "Decimal places" column.

1 Create as many recipe entries as needed for the recipe. The maximum number of recipe entries
0. possible depends on the HMI device being used.


Elements | Data records

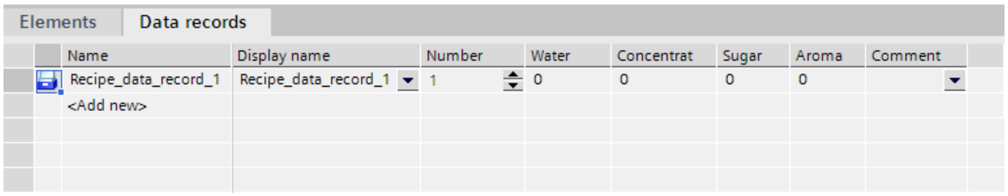
Name	Display name	Tag	Default value	Decimal places	Infotext
Water	Water	LitreWater	0	0	
Concentrat	Concentrat	LitreConcentrat	0	0	
Sugar	Sugar	KiloSugar	0	0	
Aroma	Aroma	GramAroma	0	0	
<Add new>					

Create recipe data record with known recipe values

To create recipe elements, proceed as follows:

1. Click the "Data records" tab.
2. Click "Add" in the first free line of the table editor.

   A new recipe data record is created. The recipe data record has a separate column for every recipe element created in the recipe.


Elements | Data records

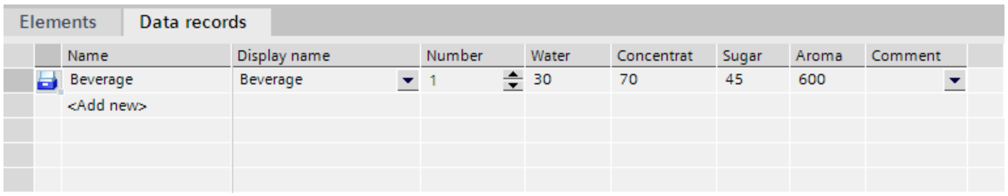
Name	Display name	Number	Water	Concentrat	Sugar	Aroma	Comment
Recipe_data_record_1	Recipe_data_record_1	1	0	0	0	0	
<Add new>							

3. Enter a descriptive name under "Name".

   The name identifies the data record uniquely within the recipe.
4. Enter a language-specific name under "Display name".

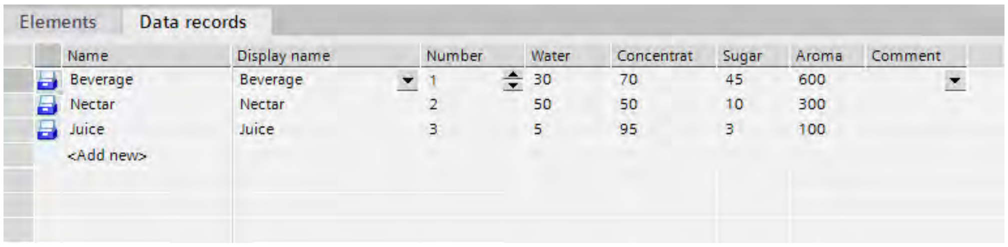
   The display name appears in the recipe view, for example, in runtime.
5. Enter a recipe data record number under "Number".

   The recipe data record number identifies the recipe data record uniquely within the recipe.
6. If you already know the recipe values at the configuration stage, you can enter the relevant value for each recipe element.


Elements | Data records

Name	Display name	Number	Water	Concentrat	Sugar	Aroma	Comment
Beverage	Beverage	1	30	70	45	600	
<Add new>							

7. Create as many data records as needed for the recipe.



Name	Display name	Number	Water	Concentrat	Sugar	Aroma	Comment
Beverage	Beverage	1	30	70	45	600	
Nectar	Nectar	2	50	50	10	300	
Juice	Juice	3	5	95	3	100	
<Add new>							

Enter the values in runtime

The following options are available for entering values in the recipe data records at runtime:

- Transfer data directly from the PLC (Teach-in mode)
- Import of values from a CSV file
- Input values on the HMI device

Note
Basic Panels

Importing of values is not available for Basic Panels.

Result

The complete recipe is configured.

Recipe data records with date or time stamp

If you specify dates or times in recipes, the following must agree:

- System settings for time and date on the configuration computer
- System settings for time and date on the target system

After downloading to the target system, check the recipes with date or time stamps on the target system.

See also

General configuration procedure (Page 1279)
Editing a recipe (Page 1286)
Managing recipes (Page 1287)

8.5.4.3 Editing a recipe

Purpose

You want to modify, extend or delete parts of a recipe.

Requirement

- You have created at least one recipe.
- The "Recipes" editor is open.

Changing recipe settings

To change the recipe settings, proceed as follows:

1. Select the recipe that you want to change in the "Recipes" editor.

   The Inspector window opens.
2. Change the recipe configuration in the Inspector window.

You change recipe elements and recipe data records in the same way.

Change recipe values

To change recipe values, proceed as follows:

1. Select the recipe whose values you want to change.
2. Click the "Data records" tab.
3. Enter the new values in the value columns.

Adding a recipe element

To add more recipe elements to a recipe, proceed as follows:

1. Select the recipe to which you want to add more elements in the "Recipes" editor.
2. Click the "Elements" tab.
3. Click "Add" in the first free line.

   The recipe element is created.
4. Configure the recipe element.

You add recipe data records in the same way.

See also

Creating a new recipe (Page 1282)

8.5.4.3 Managing recipes

Requirement

- You have created a recipe with recipe elements and recipe data record.
- The "Recipes" editor is open.

Renaming recipes

We distinguish between internal names and display names for recipes, recipe entries and recipe data records.

To rename recipe elements, proceed as follows:

1. Select the recipe that you want to rename.

   The Inspector window opens.
2. Select the "Rename" command from the shortcut menu.
3. Enter the new name.

   You rename recipe elements and recipe data records on the relevant tab in the same way.

Note

You can also change the display names of recipes and recipe data records by selecting "Language support > Project texts". This option applies, for example, if you have already made configuration settings in several languages.

Copying and pasting recipes

To copy and paste recipes, proceed as follows:

1. Select the recipe that you want to copy.
2. Select the "Copy" command from the shortcut menu.
3. Select the "Paste" command from the shortcut menu in the first free table row.

The copied recipe is pasted into the table.

You copy recipe elements and recipe data records on the relevant tab in the same way.

If a recipe data record with the same name already exists, a digit will be appended to the name of the copied recipe data record. This ensures that the name is unique. Recipe data records can only be copied or pasted within the same recipe.

Deleting a recipe

To delete a recipe, proceed as follows:

1. Select the recipe that you want to delete.
2. Select the "Delete" command from the shortcut menu.

   The recipe is deleted.

You delete recipe elements and recipe data records on the relevant tab in the same way.

Note

When a recipe is deleted, the recipe data records contained in the recipe are also deleted.

Note

When you delete a recipe element, the associated values in the recipe data records are also deleted. The assigned tags are retained.

See also

Creating a new recipe (Page 1282)

8.5.5 Using recipes in Runtime

8.5.5.1 Using the simple recipe view

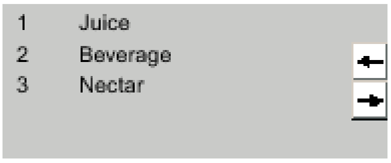
8.5.5.1 Description of the simple recipe view

Layout

The simple recipe view consists of the following display areas:

- Recipe list
- Data record list
- Element list

This application is illustrated below:


1 Juice
2 Beverage
3 Nectar

In the simple recipe view, each area is shown separately on the HMI device. You can use the shortcut menu to operate each of these display areas.

The simple recipe view always begins with the recipe list.

Operation

You have the following options for using the simple recipe view, according to the configuration:

- Create, change, copy or delete recipe data records
- Read recipe data records from the PLC or transfer to the PLC

Using the display area and shortcut menu

Toggle between the display areas and the shortcut menus to operate the simple recipe views.

The table below shows the operation of the display area.

Button	Key	Function
	<Enter>	The next lowest display area is opened, i.e. the data record list or the element list.
←	<Esc>	The previous display area opens.
→	<Right>	The shortcut menu of the display area opens.
	<Up>/<Down>	Selects the previous/next entry.
	<Pg Up>/<Pg Down>	Moves the display up or down one page.
	<Home>/<End>	Selects the first/last entry. The first/last entry is selected.

The table below shows the operation of the shortcut menu:

Button	Key	Function
←	<Esc>	The menu is closed. The display area opens.
	Input of the number of the menu command	The menu command is executed.

Shortcut menus of the simple recipe view

You can click the

→

button in each display area to call up a selection of commands. The command selection lists those commands that are available in the current display area. A number is assigned to each command. The command is executed when you enter this number.

Shortcut menus in the recipe list

Menu command	Function
New	A new recipe data record is created for the selected recipe. If a start value is configured, it is displayed in the input field.
Displaying infotext	Displays the infotext configured for the simple recipe view.
Open	The record list of the selected recipe opens.

Shortcut menus in the data record list

Menu command	Function
New	Creates a new recipe data record. If a start value is configured, it is displayed in the input field.
Deleting	The displayed record is deleted.
Save as	The selected data record is saved under a different name. A dialog box opens where you can enter the name.
Rename	Renames the selected data record. A dialog box opens where you can enter the name.
Open	The element list of the selected data record opens.
Previous	The recipe list opens.

Shortcut menus in the element list

Menu command	Function
Save	The selected record is renamed.
To PLC	The displayed values of the selected data record are transferred from the HMI device to the PLC.
From PLC	The recipe values from the PLC are displayed in the recipe view of the HMI device.
Save as	The data record is saved under a new name. A dialog box opens where you can enter the name.
	Press the <ESC> key to open the data record list.

Note
HMI device dependency

The following menu commands can also be configured on the TP 177A and OP 77A HMI devices and all Basic Panels:

Shortcut menus in the data record list

Menu command	Function
To PLC	The displayed values of the selected data record are transferred from the HMI device to the PLC.
From PLC	The recipe values from the PLC are displayed in the recipe view of the HMI device.
Displaying infotext	Displays the infotext configured for the simple recipe view.

Shortcut menus in the element list

Menu command	Function
Displaying infotext	Displays the infotext configured for the simple recipe view.
Rename	Renames the selected data record. A dialog box opens where you can enter the name.
Previous	The data record list opens.

See also

Basics on recipes (Page 1267)
Managing recipe data records (Basic, Advanced) (Page 1292)
Reading a recipe data record from the PLC (Basic, Advanced) (Page 1294)
Transferring a recipe data record to the PLC (Basic, Advanced) (Page 1294)

8.5.5.1 Managing recipe data records

Recipe data record administration

You have the following options for managing the simple recipe view, according to the configuration:

- Creating new recipe data records
- Copy recipe data records
- Edit recipe data records
- Delete recipe data records

Creating new recipe data records

To create a new recipe data record, proceed as follows:

1. Select the recipe on the HMI device in which you want to create a new recipe data record.
2. Select the "New" command from the shortcut menu for the recipe list.

   A new data record with the next available number will be created.

   The element list of the new recipe data record opens.
3. Enter values for the elements of the recipe data record.

   The configuration data may already contain default values for the recipe data record.
4. Select the "Save" command from the shortcut menu for the element list.

   The dialog "Save as" opens.
5. Enter the name and number of the recipe data record.
6. Click the "OK" button.

Result

The new recipe data records will be saved to the selected recipe. If the recipe data records already exists, a system alarm will be output to the screen.

Copying a recipe data record

To copy a recipe data record, proceed as follows:

1. Select the recipe on the HMI device in which you want to copy an existing recipe data record.
2. On the HMI device, select the recipe data record of which you want to save a copy.
3. Select the "Save As" command from the shortcut menu for the data record list.

   The dialog "Save as" opens. The recipe data record is automatically given the next free recipe data record number.
4. Under name, enter the name of the record.
5. Click the "OK" button.

Result

The recipe data record is stored under the new name.

Modify recipe data record

To change a recipe data record, proceed as follows:

1. Select the recipe on the HMI device in which you want to edit an existing recipe data record.
2. Select the recipe data record that you want to edit on the HMI device.
3. Select the recipe data record.

   The element list of the recipe data record is displayed.
4. Replace the old values with new ones.
5. Select the "Save" command from the shortcut menu for the element list.

Result

The modified values are applied to the recipe data record.

Deleting a recipe data record

To delete a recipe data record, proceed as follows:

1. Select the recipe on the HMI device from which you want to delete an existing recipe data record.
2. Select the recipe data record that you want to delete on the HMI device.
3. Select the "Delete" command from the shortcut menu for the data record list.
4. Confirm this security prompt to delete the data record.

Result

The recipe data record is deleted.

See also

Description of the simple recipe view (Basic, Advanced) (Page 1289)

8.5.5.1 Reading a recipe data record from the PLC

Introduction

In Runtime, you can change values directly in the plant that are also stored in recipes in the HMI device. This applies if a valve was opened further directly in the plant than was specified in the recipe. The values of the recipe data records saved in the HMI device possibly no longer match the values in the PLC.

You can read the values of the recipe tags from the PLC and write them to a recipe data record.

The read values are written to the recipe data record that is currently displayed on the HMI device.

Procedure

To read a recipe data record from the PLC, proceed as follows:

1. Open the recipe on the HMI device.

   The data record list opens.
2. Select the element list of the recipe data record to which you want to apply the values from the PLC.
3. Select the "From PLC" command from the shortcut menu for the element list.

   The values are read from the PLC and displayed in the current recipe data record.
4. If you want to save the values, select the "Save" or "Save As" command.

Result

The values are read from the PLC, visualized on the HMI device and saved to the recipe data record.

Note
Basic Panels

With Basic Panels, the "From PLC" menu command can also be configured for the data record list: In this case, you can also select the "From PLC" menu command in the data record list.

See also

Description of the simple recipe view (Basic, Advanced) (Page 1289)

8.5.5.1 Transferring a recipe data record to the PLC

Introduction

For the values of a data record that was changed in the recipe view to take effect, you must transfer the values to the PLC.

The values displayed in the recipe view are always transferred to the PLC.

Procedure

To transfer a recipe data record to the PLC, proceed as follows:

1. Open the recipe you want to use.

   The data record list opens.
2. Select the element list of the recipe data record whose values you want to transfer to the PLC.
3. Select the "To PLC" command from the shortcut menu for the element list.

Result

The values of the recipe data record are transferred to the PLC.

Note
Basic Panels

With Basic Panels, the "To PLC" menu command can also be configured for the data record list: In this case, you can also select the "To PLC" menu command in the data record list.

See also

Description of the simple recipe view (Basic, Advanced) (Page 1289)

8.6 Working with the user administration

8.6.1 Field of application of the user administration

Principle

The access protection controls access to data and functions in Runtime. This feature protects your applications against unauthorized operation. Safety-related operations are already limited to specific user groups when a project is being created. To this purpose you set up users and user groups that you equip with characteristic access rights, so-called authorizations. You then configure the authorizations required for operation of safety-related objects. Operators only have access, for example, to specific operator controls. Commissioners, for example, have unlimited access in Runtime.

Definition

You administer users, user groups and authorizations centrally in the user administration of WinCC. You transfer users and user groups together with the project to the HMI device. The users and passwords are managed on the HMI device in the User view.

Application example

You configure the "Service" authorization so that only service technicians have access to the configuration parameters. You assign the authorization to the "Service technician" user group. This allows all members of this group to set the protected configuration parameters.

Caution

Access protection does not protect against incorrect operations. It is your job to ensure that only authorized personnel with appropriate training will design, commission, operate and maintain plants and machines.

Access protection is not suitable for defining work routines and monitoring their observance.

See also

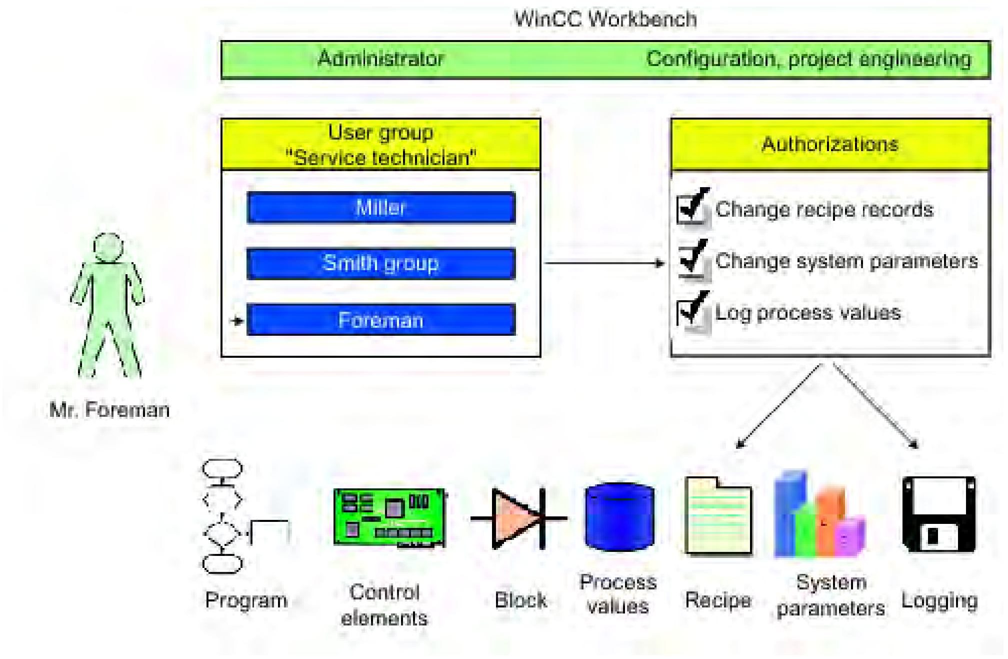
Users work area (Page 1298)
Basics on user administration (Page 1302)
Objects with access protection (Page 0)
Example: Configuring a button with logon dialog box (Page 1321)
Form of the user administration (Page 1296)
Example: Structure of user management (Page 1322)

8.6.2 Form of the user administration

Introduction

In case of a project in manufacturing engineering, the environment at the equipment manufacturer has to be differentiated from the environment at the end customer as plant operator.

The equipment manufacturer allows users, for example Mr. Foreman, a specific access within the application or HMI device. However, a user Foreman does not exist at the end customer. On the other hand, the OEM cannot know the users at the end customer and their jobs during the configuration. The final users are usually set after commissioning at the end customer.



Principle

To minimize the work required for management, authorizations are assigned via user groups and not directly to individual users.

A user group assembles configured authorizations according to common jobs. For example, all permissions required for a service job are collected in a "Service technician" group. When you create a user who should be responsible for servicing, you simply assign him to the "Service technician" group.

The User display is provided to manage users in Runtime; it is linked to the configuration in the application or HMI device. The User display enables you to create and delete users, and assign authorizations to them.

The user administration separates the administration of the users from the configuration of the authorizations. This ensures flexibility at the access protection.

Defaults can be set for the user administration during the configuration phase in the Engineering System.

See also

Field of application of the user administration (Page 1295)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.3 Elements and basic settings

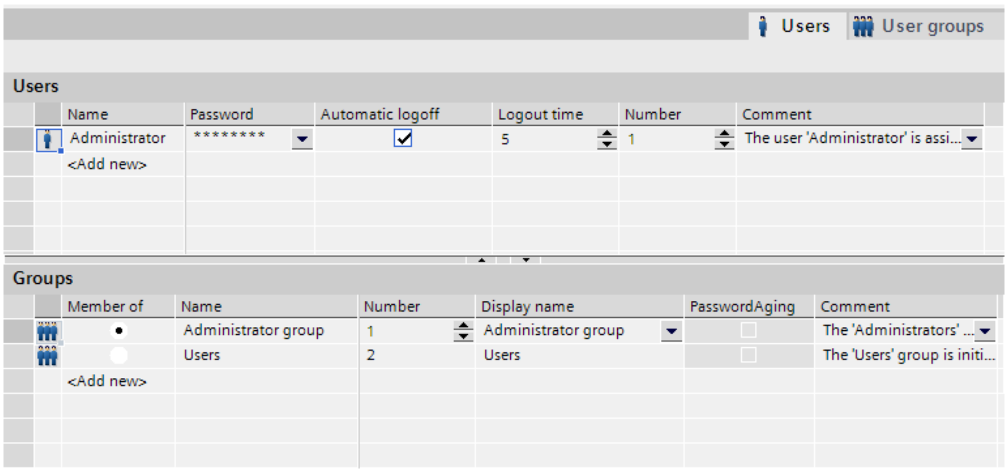
8.6.3.1 Users work area

Introduction

The "Users" work area lists the users and user groups in table form. You administrate the users and assign them to a user group.

Principle

The work area consists of the "Users" and "Groups" tables.



Users

	Name	Password	Automatic logoff	Logout time	Number	Comment
	Administrator	********	✓	5	1	The user 'Administrator' is assi...
	<Add new>					

Groups

Member of	Name	Number	Display name	PasswordAging	Comment
●	Administrator group	1	Administrator group		The 'Administrators' ...
	Users	2	Users		The 'Users' group is initi...
<Add new>					

The "Users" table shows the existing users. When you select a user in this table, the "Member of" column in the "Groups" table displays the user group to which the user belongs.

See also

Field of application of the user administration (Page 1295)
User groups work area (Page 1298)
"Users" user administration (Page 1299)
"User groups" user administration (Page 1300)
Settings for the user administration (Page 1301)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

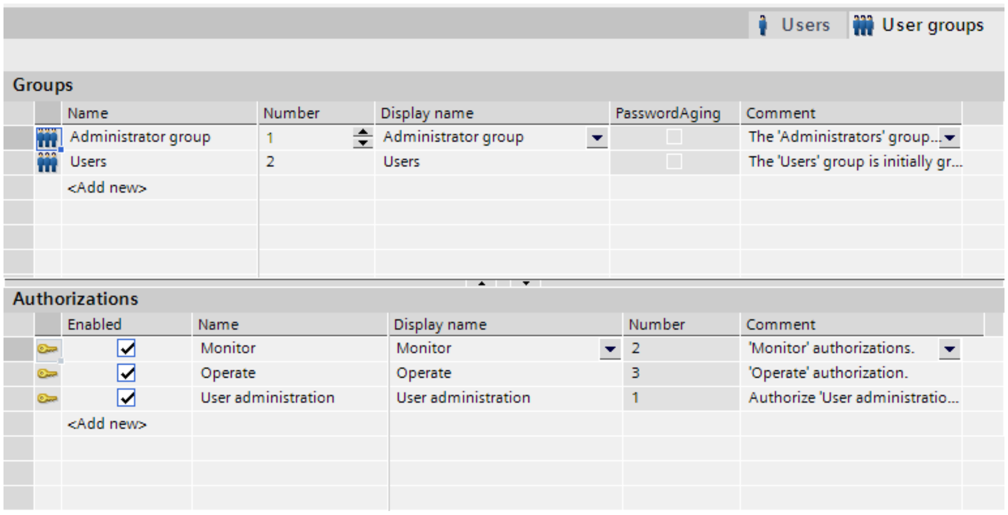
8.6.3.2 User groups work area

Introduction

The "User groups" work area shows a table of the groups and their authorizations. You administer the user groups and assign authorizations to them.

Principle

The work area consists of the "Groups" and "Authorizations" tables.



Groups

Name	Number	Display name	PasswordAging	Comment
Administrator group	1	Administrator group	☐	The 'Administrators' group...
Users	2	Users	☐	The 'Users' group is initially gr...
<Add new>				

Authorizations

Enabled	Name	Display name	Number	Comment
☑	Monitor	Monitor	2	'Monitor' authorizations.
☑	Operate	Operate	3	'Operate' authorization.
☑	User administration	User administration	1	Authorize 'User administratio...
<Add new>				

The "Groups" table shows the existing user groups. When you select a user group in this table, the "Active" column of the "Authorizations" table shows the authorizations which were assigned to the user group.

The number of the user group and of the authorization is assigned by the user administration. The designations and descriptions are assigned by you.

The number of predefined authorizations are fixed. Authorizations you have created yourself can be freely edited, although you should ensure they always have unique numbers.

See also

Users work area (Page 1298)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.3.3 "Users" user administration

Introduction

You can create users in the "Users" tab of the "Runtime user administration" editor and assign them to user groups. The "Users" tab is part of the user administration in WinCC.

Open

To open the "Users" tab, double-click "Runtime user administration" in the project window.

Menu bar

The menu bar contains all commands required for operating WinCC.
Toolbar

The toolbars contain the most important commands from the menus.

Work area

The users are managed in the work area:

- You create or delete users.
- You assign users to user groups.

Note

You can assign a user to exactly one user group.

Inspector window

When you have selected a user, you can change the password in the "General" group. In the "Automatic logoff" group, specify if the user is to be logged off automatically from the HMI device.

See also

Users work area (Page 1298)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.3.4 "User groups" user administration

Introduction

You can create users and authorizations in the "User groups" tab of the "User Administration" editor. The "User groups" tab is part of the user administration in WinCC.

Open

Double-click the "User administration" in the project window. Open the "User groups" tab.

Menu bar

The menu bar contains all commands required for operating WinCC. If shortcuts are available, they are displayed next to the menu command.

Toolbar

The toolbars contain the most important commands from the menus.

Work area

The user groups and authorizations are managed in the work area:

- You create new user groups and authorizations or delete them.
- You assign the authorizations to the user groups.

Property window

When a user group or an authorization is selected, you can edit the name in the "General" group. You can also enter a brief description in the "Comment" group.

See also

Users work area (Page 1298)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.3.5 Settings for the user administration

Introduction

In the "Runtime settings > User administration" editor, configure the security settings for users and their passwords in runtime.

Open

Double-click the "Runtime settings" editor in the project window. Click "User administration."

Work area

You carry out the settings for the validity of passwords in runtime in the work area. You determine the complexity of the password, for example.

Effects in runtime

The security settings have the following effects in runtime, depending on the configuration.

- "Runtime services" group
  - "Enable limit for logon attempts" check box selected

    The number entered in the "Number of incorrect logon attempts" field defines the number of login attempts a user is allowed before being assigned to the "Unauthorized" group.

    "Enable limit for logon attempts" check box not selected

    The user has an unlimited number of logon attempts in runtime.
  - "Number of incorrect logon attempts" field

    If you enter "4" in the field, for example, and the fourth logon attempt fails, the user is automatically assigned to the "Unauthorized" group.

    Enter 1 to 9 attempts.
  - "Logon only with password" check box

    When the check box is selected, the user is authenticated by the password. The user name is not required.

    To match users to passwords, you cannot configure passwords more than once.
- "Hierarchy level" group
  - "Group-specific rights for user administration" check box

    When this check box is selected, administrators only manage users whose group number is less than or equal to their own.

For example, an administrator whose group number is 5 can only manage users whose group number is less than or equal to 5. This means that the administrator can assign users only to groups with a group number less than or equal to 5.

- "Password" group
  - "Enable password aging" checkbox selected

    The password expires after the number of days set in the "Validity of the password (days)" field.

    The "Password aging" column is selected in the "User groups" editor. This enables you to specify group-by-group, if the passwords should expire or if the password generations should be saved. Passwords never expire for groups for which password aging is not enabled.
  - "Pre-warning time (days)" field

    The user is informed that the password will expire the specified number of days before the password expires.
  - "Password generations" field

    If the user changes the password, the new password must be different from the specified number of previous passwords. The number of password generations ranges from 1 to 5.
- "Password complexity" group
  - "Must include special characters" check box selected

    The user must enter a password containing at least one special character, at any position.
  - "Must include number" check box selected

    The user must enter a password containing at least one digit, at any position.
  - "Minimum password length" field

    The user must enter a password with a minimum length, as specified in the "Minimum password length" field.

    The minimum length of the password is 3 characters.

See also

Users work area (Page 1298)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4 Setting up the user administration

8.6.4.1 Basics on user administration

Principle

This section addresses four target groups. The topics are organized correspondingly. The target groups serve as examples for different groups of persons who use the user administration.

1. Administrator OEM
2. Administrator RT
3. Planners
4. Operator

As Administrator OEM you create the user groups, users and authorizations for Runtime in the Engineering System of, for example, an equipment manufacturer.

As Administrator RT you administer users in Runtime by means of the "User view."

As the project engineer you assign the authorizations to the user groups in the Engineering System. In addition, you configure the authorizations for objects.

As Operator you log on in runtime. You can only access a protected object if you have the required authorization.

Note

The Administrator RT target group already exists in the Runtime user administration as the predefined user group "Administrator group." For a better understanding the predefined user groups and authorizations are not used below.

See also

Field of application of the user administration (Page 1295)
Creating an authorization (Page 1303)
Users in Runtime (Page 1310)
Access protection (Page 1319)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.2 Administering users for Runtime

8.6.4.2 Creating an authorization

Introduction

You create an authorization and assign it to one or more user groups.

Requirements

The "User groups" work area is open.

Procedure

1. Double-click "Add..." in the "Authorizations" table.

2. Enter "Archive data" as the name of the authorization.
3. Enter a brief description as the "Comment."

See also

Basics on user administration (Page 1302)
Creating a user group (Page 1304)
Assigning an authorization (Page 1305)
Creating users (Page 1305)
Assigning a user to a user group (Page 1307)
User administration (Page 1307)
Managing user groups (Page 1309)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.2 Creating a user group

Introduction

User groups are created so that you do not have to assign an authorization to every single user. You create a user group, allocate authorizations and assign users to it.

Note

The name of the user group has to be unique within the project. Otherwise the input is not accepted.

Requirements

The "User groups" work area is open.

Procedure

1. Double-click "Add..." in the "Groups" table.
2. Enter "Operators" as the name of the user group.
3. Enter a brief description as the "Comment."

Note

The name of the user group is language-dependent. You specify the designation in several languages and switch between languages in runtime.

See also

Creating an authorization (Page 1303)
Example: Configuring a button with logon dialog box (Page 1321)

Example: Structure of user management (Page 1322)

8.6.4.2 Assigning an authorization

Introduction

When you allocate an authorization to a user group, all assigned users have this authorization.

Requirements

- An "Archive data" authorization has been created.
- An "Operators" user group has been created.
- The "User groups" work area is open.

Procedure

1. Click on the "Operators" user group in the "Groups" table. The "Authorizations" table shows all authorizations.
2. Activate the "Archive data" authorization in the "Authorizations" table.

Notice

The "Archive data" authorization is only a designation and does not having any relation to the function "Archiving." You have to establish this relation yourself. To do so, configure the "StartArchiving" system functions at a control button and select "Archive data" as the "Authorization."

See also

Creating an authorization (Page 1303)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.2 Creating users

Introduction

You create a user so that users can log on under the user name in Runtime once the project has been transferred.

As an alternative, you can create and change users by means of the "User view" in Runtime.

The logon is successful when the user name entered during the logon matches a user in Runtime. In addition, the entered password must agree with the stored password of the user.

Note

Pay attention to capitalization on HMI devices with Runtime Professional.

Note

The user name must be unique within the project. Otherwise the input is not accepted.

Notice

In order for a created user to have authorizations you have to assign him to a user group and allocate authorizations to the user group.

Requirements

The "Users" work area is open.

Procedure

1. Double-click "Add..." in the "Users" table.
2. Enter "Foreman" as the user name.
3. Click the ▾ button in the "Password" column. A dialog box for entering the password is displayed.
4. Enter the password of the user.
5. To confirm the password enter it a second time in the lower field.
6. Close the dialog box by using the ✓ icon.
7. If a user is to be logged off after a specific time period, activate "Automatic logoff".
8. Click in the "Logoff time" column. The preset value for "Logoff time" is 5 minutes.
9. Enter a brief description as the "Comment".

See also

Creating an authorization (Page 1303)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.2 Assigning a user to a user group

Introduction

When you assign a user to a user group, the user has the authorizations of the user group.

Note

You have to assign a user to exactly one user group. The assignment is checked during the consistency check and generation of the project.

Requirements

- The user "Foreman" has been created.
- An "Operators" user group has been created.
- The "Users" work area is open.

Procedure

1. Click on the "Foreman" user in the "Users" table. The "Groups" table shows all user groups.
2. Activate the "Operators" user group in the "Groups" table.

See also

Creating an authorization (Page 1303)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.2 User administration

Introduction

In the work area, you can administer users and assign them to user groups.

Requirements

The "Users" work area is open.

Changing the name of the user

1. In the "Users" table, double-click the field in the "Name" column to change the user name.
2. Change the user name.
3. Confirm your entry with <Return>.

As an alternative, select the user in the work area; the properties of the user are then displayed in the Inspector window. In the "Properties" tab, select the "General" group. Change the user name in the "Name" field.

Changing the password of the user

1. Click the
   ▾
   button in the "Password" column of the "Users" table. A dialog for entering the password opens.
2. In the "Enter password" field, enter the new password.
3. Reenter the new password in the "Confirm password" field.
4. Confirm your entry with <Return>.

As an alternative, select the user in the work area; the properties of the user are then displayed in the Inspector window. In the "Properties" tab, select the "General" group. Change the password in the "Password" area.

Displaying invisible columns

1. Position the mouse cursor on the header of the "Users" table.
2. Open the shortcut menu with the right mouse button and enable, for example, the display of the "Logoff time" column.

Changing the logoff time of the user

1. In the "Users" area, double-click on the field in the "Logoff time" column to change the logoff time.
2. Change the logoff time.
3. Confirm your entry with <Return>.

As an alternative, select the user in the work area; the properties of the user are then displayed in the Inspector window. In the "Properties" tab, select the "Automatic logoff" group. Change the logoff time in the "Logoff time" field.

Deleting a user

1. Select the line of the user to be deleted.
2. Open the shortcut menu with the right mouse button and select the "Delete" command.

Note

Predefined users cannot be deleted.

See also

Creating an authorization (Page 1303)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.2 Managing user groups

Introduction

In the workplace you administer user groups and assign authorizations for use in runtime.

Requirements

The "User groups" work area is open.

Changing the name of the user group

1. In the "Groups" table, double-click the field in the "Name" column to change the name of the user group.
2. Change the name of the user group.
3. Confirm your entry with <Return>.

As an alternative, select the user group in the work area; the properties of the user group are then displayed in the Properties window. In the Properties window, select the "General" group. Change the name in the "Name" field.

Note

Predefined user groups cannot be deleted.

Displaying invisible columns

1. Position the mouse cursor on the header of the "Users" table.
2. Open the shortcut menu with the right mouse button and enable, for example, the display of the "Display name" column.

Changing the displayed name of the user group

1. In the "Groups" table, double-click the field in the "Display name" column to change the display name of the user group.
2. Change the displayed name of the user group.
3. Confirm your entry with <Return>.

As an alternative, select the user group in the work area; the properties of the user group are then displayed in the Properties window. In the Properties window, select the "General" group. Change the displayed name in the "Display name" field.

Deleting a user group

1. Mark the line of the user group to be deleted.
2. Open the shortcut menu with the right mouse button and select the "Delete" command.

Note

Predefined user groups cannot be deleted.

Changing the name of the authorization

1. In the "Authorizations" table, double-click the field in the "Name" column to change the name of the authorization.
2. Change the name of the authorization.
3. Confirm your entry with <Return>.

As an alternative, select the authorization in the work area; the properties of the authorization are displayed in the Properties view. In the Properties window, select the "General" group. Changing the name of the authorization in the "Display name" field.

Deleting authorizations

1. Mark the line of the authorization to be deleted.
2. Open the shortcut menu with the right mouse button and select the "Delete" command.

Note

Predefined authorizations cannot be deleted.

See also

Creating an authorization (Page 1303)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.3 Managing users in Runtime

8.6.4.3 Users in Runtime

Principle

You create users and user groups and allocate authorizations to them the engineering system. You configure objects with authorizations. After download to the HMI device, all objects which were configured with an authorization are protected against unauthorized access in Runtime.

User view

When you configure a user view in the Engineering System, you administer users in this user view following download to the HMI device.

Caution

Changes in the user view are effective immediately in Runtime. Changes in Runtime are not updated in the Engineering System. When downloaded from the Engineering System to the HMI device, all changes in the user view are overwritten after a user prompt and based on the downloading settings.

Some HMI devices do not support the user view. These HMI devices only support the functions "Log on" and "Log off": The only user "Administrator" is logged on and logged off. The "Administrator" is assigned to the only user group "Administrators group."

Exporting and importing user data

The users and passwords existing at an HMI device are exported and imported to a different operator panel by means of a system function. This ensures that the user administrations of the different HMI devices have the same status.

See also

Basics on user administration (Page 1302)
User view (Page 1311)
Configuring a user view (Page 1313)
Creating users (Page 1314)
Managing users in Runtime (Page 1315)
Unlocking users (Page 1317)
Logging on as a user (Page 1317)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.3 User view

Purpose

You configure a user view in the engineering system to also administer the users in Runtime.

Introduction

You create the users and user groups in the Engineering System and download them to the HMI device. Users who have a "User Management" authorization have unlimited access to the user view. This allows them to administer all users. Any other user has only limited access to the user view for self administration.

Caution

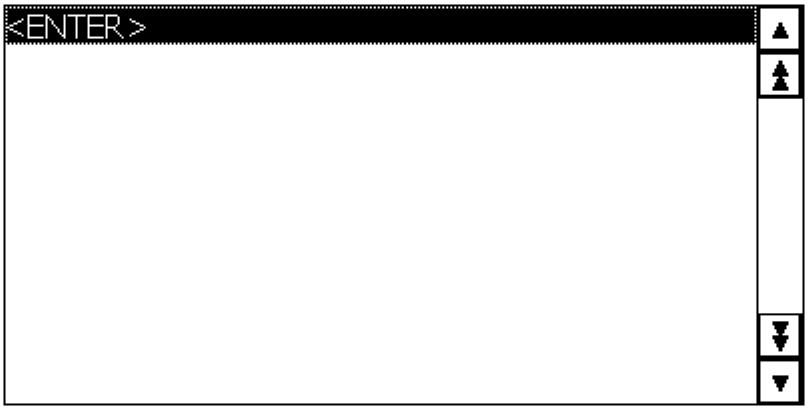
Changes in the user view are effective immediately in Runtime. Changes in Runtime are not updated in the Engineering System.

When the user management is downloaded to the HMI device, all changes in the user view are overwritten.

Structure

The user view shows the following in each line:

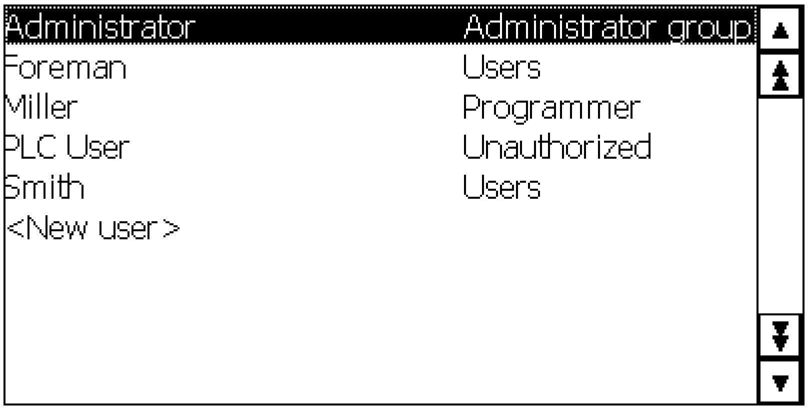
- The user
- The encrypted password
- The corresponding user group
- The logoff time



Note

If no user is logged on, the user view is empty. The content of the individual fields is displayed after logon.

User view of an administrator

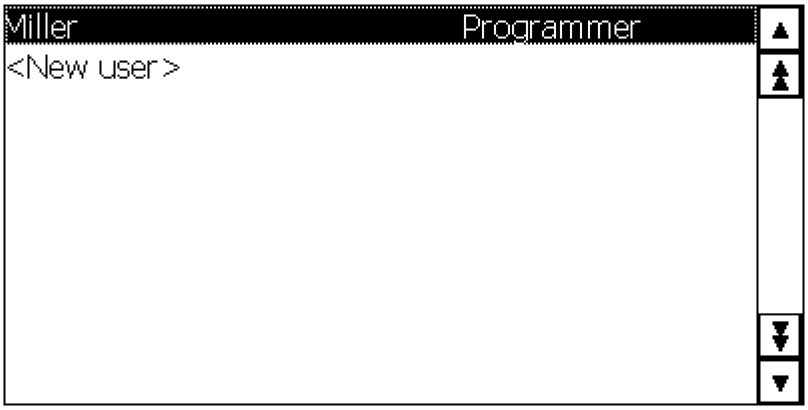


Administrator	Administrator group
Foreman	Users
Miller	Programmer
PLC User	Unauthorized
Smith	Users
<New user>	

Figure8-1

When an administrator is logged on, the user view shows all the users. The administrator changes the user name and the password. The administrator creates new users and assigns them to an existing user group.

User view of a user



Miller	Programmer
<New user>	

Figure8-1

When no administrator is logged on, the user view shows only the logged-on user. Users can change their own passwords. The user has to be logged on as an administrator to change the name.

See also

Users in Runtime (Page 1310)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.3 Configuring a user view

Introduction

You configure a user view in the Engineering System to also administer users in Runtime.

Requirements

A screen has been created.

Procedure

1. Select the "User view" object from the "Controls" category in the toolbox.
2. Drag-and-drop the "User view" object into the screen.
3. Click on the "General" group in the properties window of the "User view."
4. Specify the appearance of the "User view." Select, for example, the "Number of lines" and "Font."

See also

Users in Runtime (Page 1310)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.3 Creating users

Introduction

You create a user so that users can log on under their user name in runtime.

As an alternative, you can create users in the engineering system and download them to the HMI device.

The logon is successful only when the user name entered during the logon matches a user in runtime. In addition, the password entered at logon has to match that of the user.

Note

Pay attention to capitalization on HMI devices with Runtime Professional.

You assign the user to a user group. The user then has the authorizations of the user group.

Notice

Runtime users must be assigned to a user group. The user group is created in the Engineering System. The designation of the user group is language-dependent.

Requirements

- The user view is open.
- A "Group 2" user group has been created.

Procedure

1. Click "<New User>" in the user view. A dialog opens.
2. Enter "Foreman" as the user name.
3. Press the <Return> button.
4. Click "Password."
5. Enter the password of the user.
6. Press the <Return> button. The password is hidden.
7. Click in the "Group" column.
8. Select "Group 2" as the "Group".
9. Press the <Return> button.
10. Click in the "Logoff time" column.
11. Enter the time after which the user is logged off automatically.

See also

Users in Runtime (Page 1310)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.3 Managing users in Runtime

Introduction

If you have configured a user view in the engineering system, the users and user groups can be managed in runtime.

Caution

Changes in the user view are effective immediately in runtime. Changes in runtime are not updated in the engineering system. When downloading from the engineering system to the HMI device, all changes in the user view are overwritten after a user prompt and based on the download settings.

Requirements

- Runtime is activated.
- The user view is open.
- You have the predefined "User administration" authorization.

Notice

If you do not have a "User administration" authorization, you can only change your own password and your logoff time.

Changing the name of the user

1. Enter a new user name in the "Users" column in the user display.
2. Confirm your entry with <Return>.

Notice

The user can then no longer log on with his previous password in runtime. If you delete the name and press <Return>, the user is deleted.

Changing the user password in basic user display

1. Enter a new password in the "Password" column in the user display.
2. Confirm your entry with <Return>.

Notice

The user can then no longer log on with his previous password in runtime.

If you delete the password in the basic user view and press <Return>, a message will be generated. The message specifies that the password does not lie within the defined limits.

Changing the user password in complex user display

Availability of complex user display in selected devices only.

1. Enter a new password in the "Password" column in the user display.
2. Confirm your entry with <Return>.

Notice

The user can then no longer log on with his previous password in runtime.

If you delete the password in the complex user view and press <Return>, the user will be deleted.

Changing the logoff time of the user

1. Enter a new logoff time in the "Logoff time" column in the user display.
2. Confirm your entry with <Return>.

Deleting a user

1. Click the name of the user to be deleted.

2. Delete the name.
3. Press the <Return> button.

Notice

The user can no longer log on in runtime.

Assigning a user to a different user group

1. Activate the user group field for the corresponding user.
2. Select a user group.
3. Confirm your selection with <Return>.

See also

Users in Runtime (Page 1310)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.3 Unlocking users

Enable locked out users

The check box "Activate limit for login attempts" is activated in the "Runtime settings > User administration".
The number 3 is entered in the field "Number of invalid login attempts".

If users have three failed attempts at login, e.g. by entering an incorrect password, they are assigned to the "Unauthorized" group. The user loses all authorizations. The user can still log on, but no longer has any authorizations. Only a user with administrator rights re-assigns the unauthorized user to a user group.

See also

Users in Runtime (Page 1310)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.3 Logging on as a user

Introduction

As a rule you log-on as a user by means of a special button. The logon dialog box is displayed to this purpose.

The system always opens the logon dialog on OP 73micro, TP 177micro, OP 73, OP 77A and TP 177A HMI devices when you operate an access protected button:

Note

The logon dialog box is displayed by default during access to a protected object if

- No user is logged on in Runtime.
- The logged-on user does not have the required authorization.

Requirements

- Under "Runtime settings > User administration" the
  - "Enable limit for logon attempts" check box has been selected.
  - The number 3 is entered in the field "Number of invalid login attempts".
- The "ShowLogonDialog" system function is configured on a button called "Logon".

Procedure

1. Click the "Logon" button. The logon dialog box is displayed.

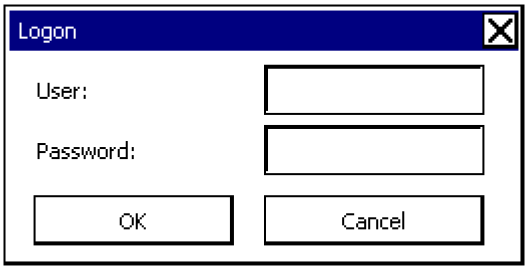


Figure8-1

2. Enter your user name as it was specified in the user management, for example "Foreman".

   If a user has logged on before you, his user name is displayed.
3. Enter the corresponding password. The input is concealed.
4. Click "OK" to close the dialog box.

Logon was successful

If you have entered the user name "Foreman" and the entered password corresponds with the stored password, you are logged on as the user "Foreman" in Runtime. You have the authorizations of the user "Foreman".

When the user "Foreman" accesses a protected object, access to this protected object is authorized only if the user "Foreman" has the required authorization. The programmed function is executed immediately.

If you do not have the required authorization after the successful log-on, a corresponding error message is displayed. However, you remain logged on in Runtime.

Logon was unsuccessful

An error message is displayed.

In order to maintain security, you or the user logged-on before you no longer has any authorizations. However, access to unprotected objects remains possible. The user view does not, however, show any entries. The user view and the authorizations change after the next successful log-on.

If the third login attempt has failed, the user will be assigned to the "Unauthorized" group. For this reason, do not configure a user group with this display name.

If the "Log off" function is called up or the logoff time of the user has expired, the user is logged off.

See also

Users in Runtime (Page 1310)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.4 Configuring access protection

8.6.4.4 Access protection

Introduction

You configure an authorization at an object in order to protect it against access. All logged-on users who have this authorization can then access the object. If a user does not have authorization to operate an object, the logon dialog is displayed automatically.

Note

Several system functions are available under "User administration" so that user, password, and user group can be edited, for example, in the PLC.

See also

Basics on user administration (Page 1302)
Objects with access protection (Page 0)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.4.4 Objects with access protection

Introduction

The following objects can be configured with an authorization:

- Date/time field
- I/O field
- Graphic I/O field
- Recipe view
- Switch
- Button
- Symbolic I/O field

See also

Field of application of the user administration (Page 1295)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.5 Reference

8.6.5.1 Objects with access protection

Introduction

The following objects can be configured with an authorization:

- Date/time field
- I/O field
- Graphic I/O field
- Recipe view
- Switch
- Button
- Symbolic I/O field

See also

Field of application of the user administration (Page 1295)
Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.6 Examples

8.6.6.1 Example: Configuring a button with logon dialog box

Task

In the following example you configure the function "ShowLogonDialog" at a button. A different user can then, for example, log on in runtime when the shift changes. In the process the user previously logged on is logged off.

Note

In runtime the logon dialog box is not displayed by default until you access a protected object. Either no user is logged on or the logged-on user does not have the required authorization.

Requirements

- A screen has been created.
- A button has been created in the screen.

Procedure

1. Click in the screen on the button.
2. Click on "Release" in the Inspector window of the "Properties" tab in the "Events" group.
3. Click the entry "No function" in the first line of the "Function list" table.
4. Select the system function "ShowLogonDialog" from the "User Management" group.

Result

If the user clicks on the button in runtime, the function "ShowLogonDialog" is called up. When the function "ShowLogonDialog" is called up, the logon dialog box is displayed. The user logs on with his user name and password.

See also

Field of application of the user administration (Page 1295)
Example: Structure of user management (Page 1322)
Example: Logging the logon and logoff events (Page 1322)

8.6.6.2 Example: Logging the logon and logoff events

Task

In the following example you configure the function "TraceUserChange" to the event "User change."

Principle

When a user logs on or off, the "TraceUserChange" function is called up. When a function is called up, a system message with information about the corresponding user is output.

This system message can be archived. When archiving, the system message is provided with a date stamp and time stamp. This ensures that you can track which user was logged on at the HMI device at which time and for how long.

Requirements

- You have created an HMI device with Runtime Advanced.

Procedure

1. Double-click the "Scheduler" in the Project view.
2. Double-click "Add..." in the table of the field of activities.
3. Enter "Logon-Protocol" as the "Name".
4. Select "User change" as the "Event."
5. Click the entry "No function" in the first line of the "Function list" table.
6. Select the system function "TraceUserChange" from the "User Management" group.

Result

A system message is output when a user logs on or logs off.

See also

Example: Configuring a button with logon dialog box (Page 1321)
Example: Structure of user management (Page 1322)

8.6.6.3 Example of user management

8.6.6.3 Example: Structure of user management

Task

In the following example you set up a user administration for different users and user groups. The example orientates itself to a typical requirement profile from manufacturing engineering.

Principle

Completely different groups of persons are involved in a plant or project. Each group of persons protects its respective data and functions against access by others. For this purpose, users are created and assigned to a user group.

You can reproduce different views through user groups.

Example:

- Organizational view: Commissioners, Operators, Shift I, Shift II
- Technological view: Axis control, Tool changers, Plant North, Plant South

The following example orientates itself to the organizational view.

Every user group has characteristic requirements regarding access protection: A user group has operating authorizations for specific application cases. A programmer changes, for example, recipe data records.

In the example the users Miller, Group Smith and Foreman are created and assigned to different user groups.

Ms. Miller works as a programmer in the engineering system. The Group Smith are commissioners. Mr. Foreman is an operator.

Requirements

- A new project has been created.
- The "Runtime user administration" editor is opened.

Procedures overview

Working with user administration has the following procedure in the example:

1. Creating authorizations The planner specifies which authorizations are required for access protection.
2. Configuring authorizations: The planner specifies which objects may be operated and which functions may be executed.
3. Creating user groups and allocating authorizations: The administrator creates the user groups together with the planner. The planner uses the authorizations to specify who may operate objects and change parameters.
4. Creating users and assigning them to a user group: The administrator administers the users.

Result

The aim is the following structure of the user administration of users, user groups and authorizations:

Users			User groups	Authorizations			
Miller	Smith	Foreman	Roles	Changing recipe records	Changing system parameters	Changing process parameters	Managing
			Administrator group				x

Users			User groups	Authorizations			
Miller	Smith	Foreman	Roles	Changing recipe records	Changing system parameters	Changing process parameters	Managing
X			Programmer	X			
	X		Commissioning engineers	X	X	X	
		X	Operators	x			

The user "Foreman" who belongs to the "Operators" user group has access to the configured "To Recipe view" button.

Note

Alternatively you can create several users as "Operators" with different operating authorizations, for example Operator Level 1, Operator Level 2.

See also

Example: Configuring a button with logon dialog box (Page 1321)
Example: Creating and configuring authorizations (Page 1324)
Example: Configuring a button with access protection (Page 1325)
Example: Creating user groups and assigning authorizations: (Page 1327)
Example: Creating users and assigning them to a user group (Page 1328)
Example: Logging the logon and logoff events (Page 1322)

8.6.6.3 Example: Creating and configuring authorizations

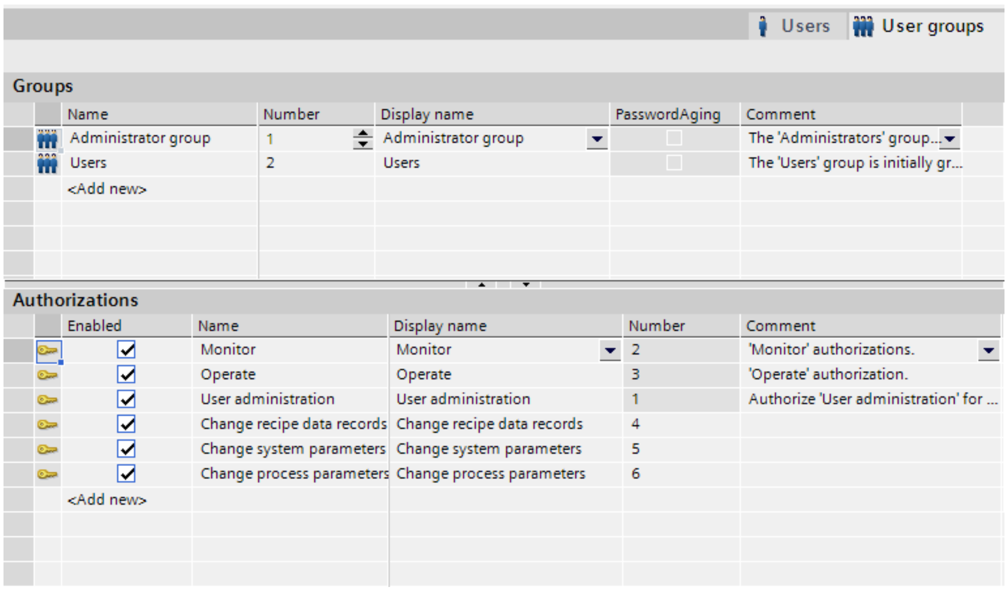
Task

The following example shows you how to create the authorizations

Procedure

1. Open the "User groups" work area.
2. Double-click "Add..." in the "Authorizations" table.
3. Enter "Change recipe data records" as the "Name" of the authorization.
4. Repeat steps 2 and 3 to create additional authorizations: "Change system parameters", "Change process parameters".

Result



Groups

Name	Number	Display name	PasswordAging	Comment
Administrator group	1	Administrator group	☐	The 'Administrators' group...
Users	2	Users	☐	The 'Users' group is initially gr...
<Add new>				

Authorizations

Enabled	Name	Display name	Number	Comment
✓	Monitor	Monitor	2	'Monitor' authorizations.
✓	Operate	Operate	3	'Operate' authorization.
✓	User administration	User administration	1	Authorize 'User administration' for ...
✓	Change recipe data records	Change recipe data records	4	
✓	Change system parameters	Change system parameters	5	
✓	Change process parameters	Change process parameters	6	
<Add new>				

See also

Example: Structure of user management (Page 1322)

8.6.6.3 Example: Configuring a button with access protection

Task

In the following example you use a system function to create a button for a screen change. You protect the "To Recipe view" button against unauthorized operation. To do so, you configure the "Change recipe data records" authorization at the "To Recipe view" button.

Requirements

- A "Change recipe data records" authorization has been created.
- A "Recipes" screen has been created.
- A "Start" screen has been created and opened.
- A button has been created and marked in the "Start" screen.

Procedure

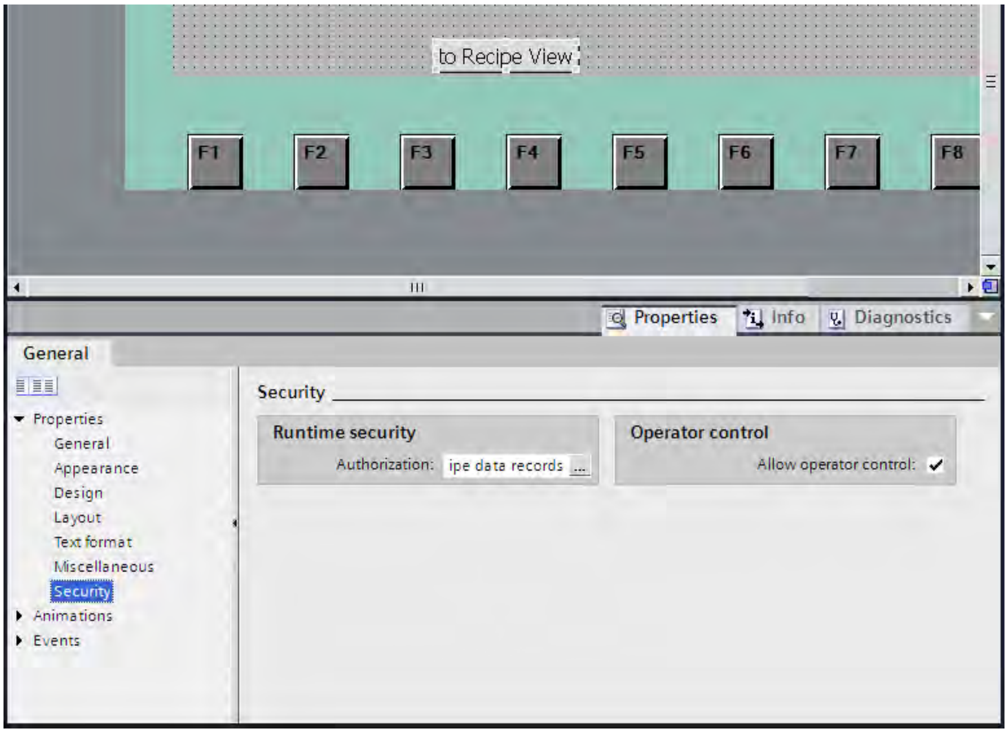
1. Select the "Properties" group in the properties window, then click "General."
2. Enter "To Recipe view" as the text.
3. Click "Click" in the "Events" group of the Properties view.
4. Click the entry "No function" in the first line of the "Function list" table.
5. Select the "ActivateScreen" system function in the "Screens" group.

6. Click the

   button in the "Screen name" field. A dialog box for selecting the screen opens.
7. Select the "Recipes" screen and use the

   button to close the dialog box.
8. Select the "Properties" group in the properties view, then click "Security."
9. Select "Change recipe data records" as the "Authorization."

Result



Authorization: ipe data records

Allow operator control: ✓

Figure8-1

Access to the "To Recipe view" button is protected. If, for example, the user "Smith" clicks the button in Runtime, the function "Recipe view" screen is called up. Prerequisite is that the user "Smith" has logged on correctly and has the required authorization. The "Recipes" screen contains a recipe view and other screen objects.

If the logged-on user does not have the required authorization or if no user is logged on, the "Logon dialog box" is displayed.

See also

Example: Structure of user management (Page 1322)

8.6.6.3 Example: Creating user groups and assigning authorizations:

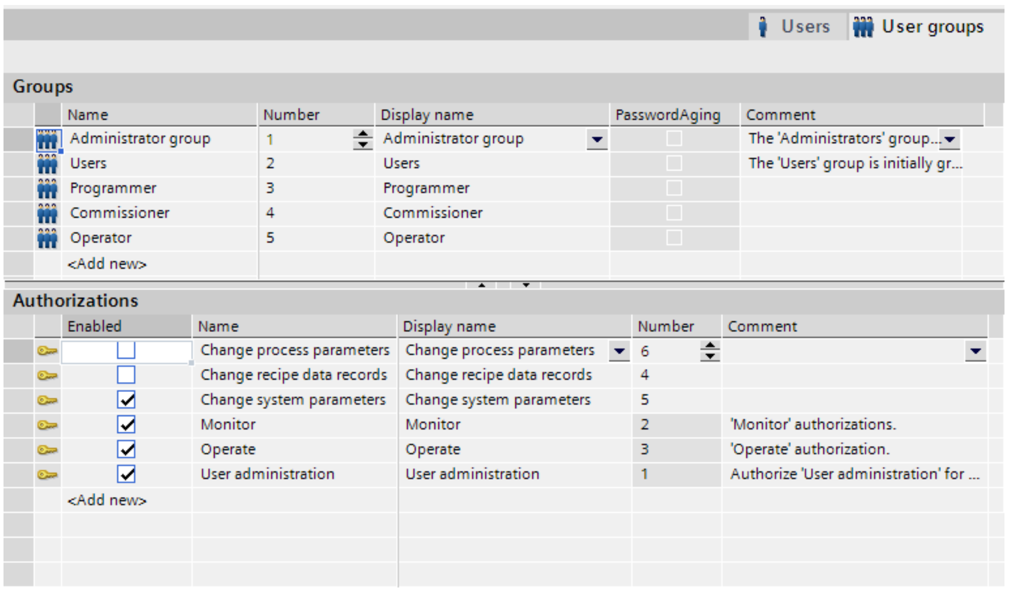
Task

In the following example you create the user groups and assign authorizations to them.

Procedure

1. Open the "User groups" work area.
2. Double-click "Add..." in the "Groups" table.
3. Enter "Programmer" as the "Name".
4. Repeat steps 2 and 3 to create the "Commissioner" and "Operator" user groups.
5. Click "Administrator" in the "Groups" table.
6. Activate the "Change system parameters" authorization in the "Authorizations" table.

Interim result



Groups

Name	Number	Display name	PasswordAging	Comment
Administrator group	1	Administrator group	☐	The 'Administrators' group...
Users	2	Users	☐	The 'Users' group is initially gr...
Programmer	3	Programmer	☐	
Commissioner	4	Commissioner	☐	
Operator	5	Operator	☐	
<Add new>				

Authorizations

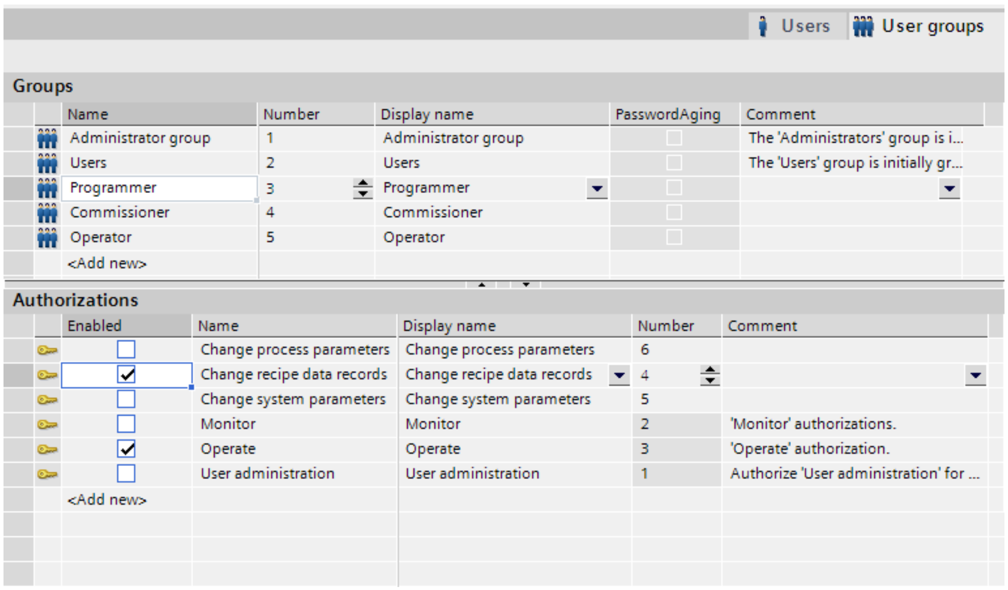
Enabled	Name	Display name	Number	Comment
☐	Change process parameters	Change process parameters	6	
☐	Change recipe data records	Change recipe data records	4	
✓	Change system parameters	Change system parameters	5	
✓	Monitor	Monitor	2	'Monitor' authorizations.
✓	Operate	Operate	3	'Operate' authorization.
✓	User administration	User administration	1	Authorize 'User administration' for ...
<Add new>				

Figure8-1

Procedure

1. Click "Operator" in the "Groups" table.
2. Activate the "Change recipe data records" authorization in the "Authorizations" table.
3. Click "Commissioner" in the "Groups" table.
4. Activate the authorizations "Change recipe data records", "Change system parameters" and "Change process parameters" in the "Authorizations" table.
5. Click "Programmer" in the "Groups" table.
6. Activate the "Change recipe data records" authorization in the "Authorizations" table.

Result


Users | User groups

Groups

Name	Number	Display name	PasswordAging	Comment
Administrator group	1	Administrator group	☐	The 'Administrators' group is i...
Users	2	Users	☐	The 'Users' group is initially gr...
Programmer	3	Programmer	☐	
Commissioner	4	Commissioner	☐	
Operator	5	Operator	☐	
<Add new>				

Authorizations

Enabled	Name	Display name	Number	Comment
☐	Change process parameters	Change process parameters	6	
✓	Change recipe data records	Change recipe data records	4	
☐	Change system parameters	Change system parameters	5	
☐	Monitor	Monitor	2	'Monitor' authorizations.
✓	Operate	Operate	3	'Operate' authorization.
☐	User administration	User administration	1	Authorize 'User administration' for ...
<Add new>				

See also

Example: Structure of user management (Page 1322)

8.6.6.3 Example: Creating users and assigning them to a user group

Task

In the following example you create the users and assign user groups to them. The users are sorted alphabetically immediately after the name has been entered.

Procedure

1. Open the "Users" work area.
2. Double-click "Add..." in the "User" table.
3. Enter "Miller" as the user name.
4. Click the

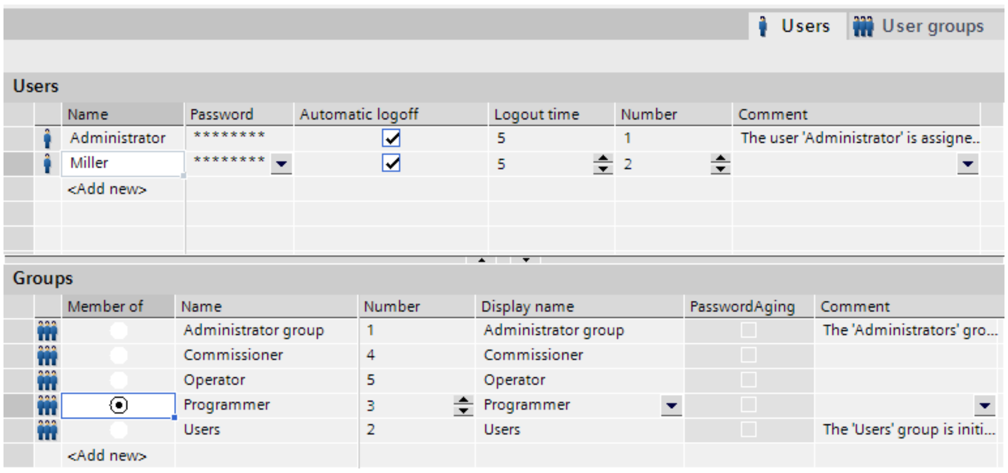
   ▼

   button in the "Password" column. The dialog box for entering the password is displayed.
5. Enter "miller" as the password.
6. To confirm the password enter it a second time in the lower field.
7. Close the dialog box by using the

   ✓

   icon.
8. Activate the "Programmer" user group in the "Groups" table.

Intermediate result



Users

Name	Password	Automatic logoff	Logout time	Number	Comment
Administrator	********	✓	5	1	The user 'Administrator' is assigne..
Miller	********	✓	5	2	
<Add new>					

Groups

Member of	Name	Number	Display name	PasswordAging	Comment
	Administrator group	1	Administrator group		The 'Administrators' gro...
	Commissioner	4	Commissioner		
	Operator	5	Operator		
●	Programmer	3	Programmer		
	Users	2	Users		The 'Users' group is initi...
<Add new>					

Figure8-1

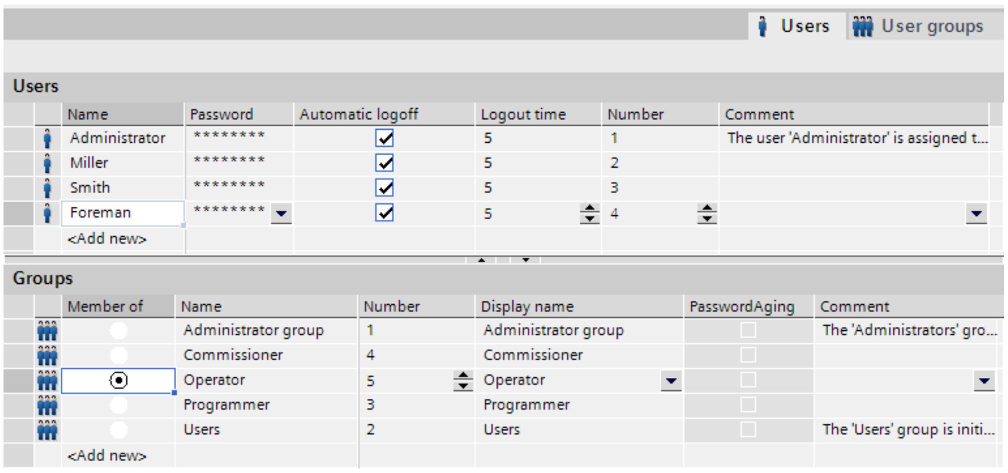
Procedure

1. Double-click "Add..." in the "User" table.
2. Enter "Smith" as the user name.
3. Click the

   button in the "Password" column. The dialog box for entering the password is displayed.
4. Enter "smith" as the password.
5. To confirm the password enter it a second time in the lower field.
6. Close the dialog box by using the

   icon.
7. Activate the "Commissioner" user group in the "Groups" table.
8. Repeat steps 2 to 6 for the user "Foreman."
9. Activate the "Operators" user group in the "Groups" table.

Result



Users

Name	Password	Automatic logoff	Logout time	Number	Comment
Administrator	********	✓	5	1	The user 'Administrator' is assigned t...
Miller	********	✓	5	2	
Smith	********	✓	5	3	
Foreman	********	✓	5	4	
<Add new>					

Groups

Member of	Name	Number	Display name	PasswordAging	Comment
○	Administrator group	1	Administrator group	☐	The 'Administrators' gro...
○	Commissioner	4	Commissioner	☐	
◉	Operator	5	Operator	☐	
○	Programmer	3	Programmer	☐	
○	Users	2	Users	☐	The 'Users' group is initi...
<Add new>					

See also

Example: Structure of user management (Page 1322)

8.7 Working with system functions

8.7.1 Basics

8.7.1.1 System functions

Introduction

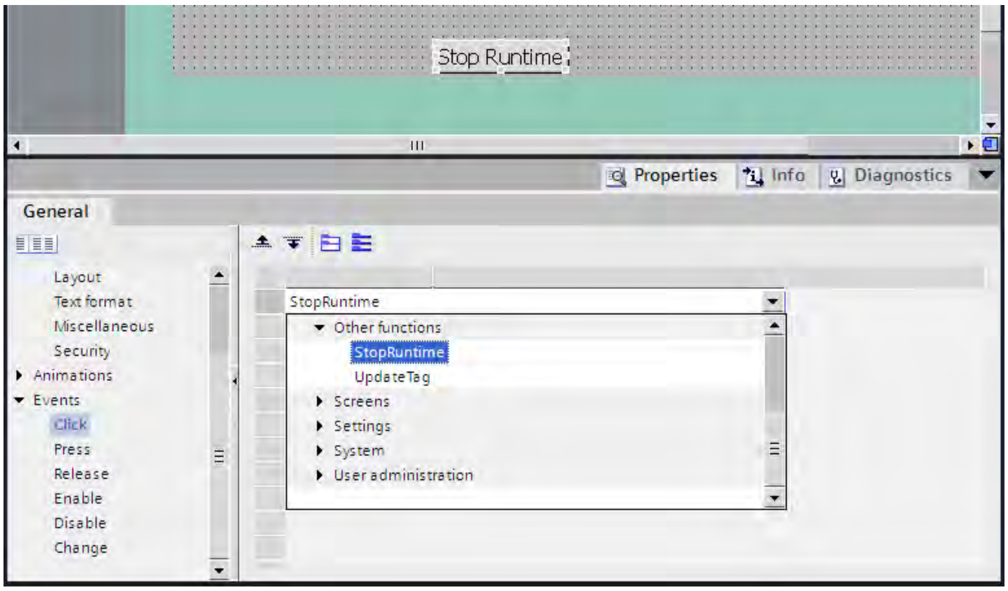
System functions are pre-defined functions you use to implement many tasks in Runtime even without having any programming knowledge, for example:

- Calculations, e.g. increasing a tag value by a specific or variable amount.
- Logging functions, e.g. starting a process value log.
- Settings, for instance changing the PLC or setting a bit in the PLC.
- Alarms, e.g after a different user logs on.

Application

You use system functions in a function list. System functions are predefined functions and cannot be changed.

When configuring a function list, select the system functions from a selection list that is sorted by categories:



Each system function in WinCC is logically linked with an object and an event. As soon as the event occurs, the system function is triggered.

Language dependency

The names of the system functions are dependent on the set project language. The functionality can then be recognized immediately by the project planner.

Availability

You only configure system functions within a function list which are supported by the selected HMI device. If you use a project for several operating units, the system functions that are not supported by a operating unit are marked in color.

Events

The object and the selected function determine which events can be defined as triggers for executing a system function.

For example, the "Change value", "Low limit violated" and "Upper limit exceeded" events are associated with the "Tag" object. The "Loaded" and "Cleared" events are associated with the "Screen" object.

See also

Changing the operating mode on the HMI device with the current display (Page 1338)
Use of system functions (Page 1332)
Basics on dynamizing (Page 1097)
Device-based dependency of system functions (Page 1341)
System functions (Page 1344)

8.7.1.2 Use of system functions

Introduction

A function list is processed when a configured event occurs in runtime. The operator can trigger an event, for instance by pressing a function key on the HMI device. The system could also trigger an event if a process value falls below a specified limit, for example.

Applications

You can configure system functions on all the objects that are able to react to an event. You can use system functions directly in function lists and thereby control the sequence.

- Function lists for WinCC Runtime

  The system functions will be processed one line at a time in a function list. To avoid wait times, system functions in WinCC Runtime with a longer running time are executed simultaneously. For instance, a subsequent system function can already be performed even though the previous system function has not yet been completed.

An example for the configuration of a function list can be found under "Changing the operating mode on the HMI device with the current display (Page 1338) ".

See also

System functions (Page 1330)
Changing the operating mode on the HMI device with the current display (Page 1338)

8.7.2 Working with function lists

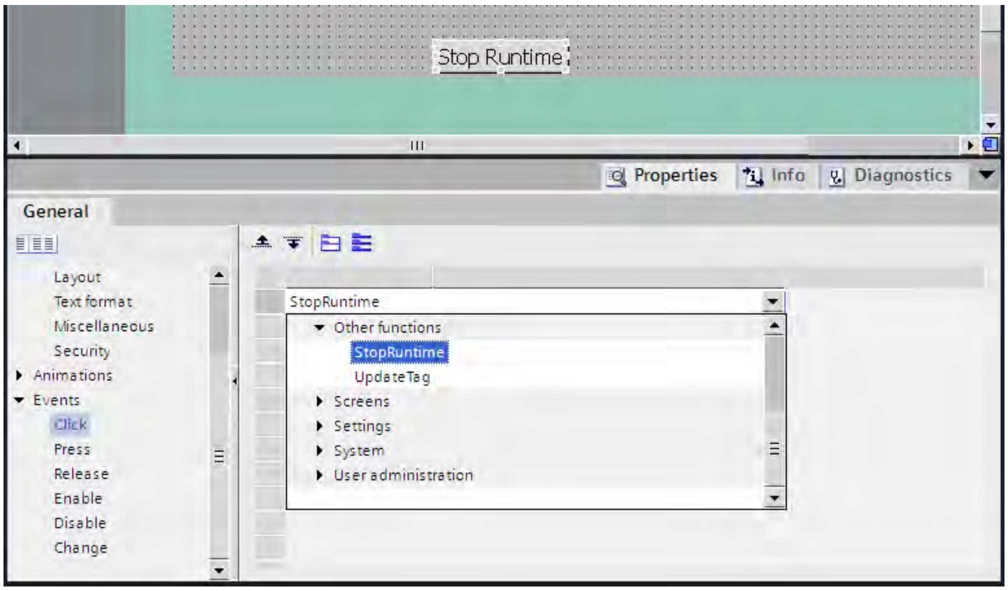
8.7.2.1 Basic of the functions list

Introduction

When the configured event occurs, several system functions can be performed with the function list.

Principle

The function list is configured for an event of an object, e.g. a screen object or a tag. The events which are available depend on the selected object and the HMI device.



Events occur only when the project is in Runtime. Events include:

- Value changes of a tag
- Pressing of a button
- Activation of Runtime

You can configure exactly one function list for each event.

Note

The choice of configurable system functions in a function list depends on the HMI device chosen.

See also

Properties of a function list (Page 1334)
Configuring a function list (Page 1334)
Editing a function list (Page 1336)
Executing a function list in Runtime (Page 1337)
Changing the operating mode on the HMI device with the current display (Page 1338)
Device-based dependency of system functions (Page 1341)

8.7.2.2 Properties of a function list

Availability for specific HMI devices

You can use a project for different HMI devices. When you change the HMI device in a project, all system functions which are not supported by the selected HMI device are marked in yellow. The system functions that are not supported are not executed in runtime.

Status information

During configuration the project data is tested in the background. A status information returns in each function list the status of the respective system functions.

The status information has the following meaning:

- Orange: Function list is not performed in runtime because at least one system function has not been supplied completely with parameters.
- Yellow: Function list is performed in runtime. However, the function list contains at least one system function which is not supported by the HMI device (e.g. due to the change of device type).

Executing system functions

System functions in a function list are executed in runtime sequentially from top to bottom. In order to avoid waiting times, system functions with a longer running time (for instance file operations) are processed simultaneously. For instance, a subsequent system function can already be performed even though the previous system function has not yet been completed.

To avoid programming sequential and conditional procedures, use a script with loops, conditional statements and cancellation requirements.

Note
Availability for specific devices

Scripts are not available on Basic Panels.

See also

Basic of the functions list (Page 1332)
Changing the operating mode on the HMI device with the current display (Page 1338)

8.7.2.3 Configuring a function list

Introduction

You can configure a function list by selecting system functions from a drop-down list. The system functions are arranged in the drop-down list according to categories.

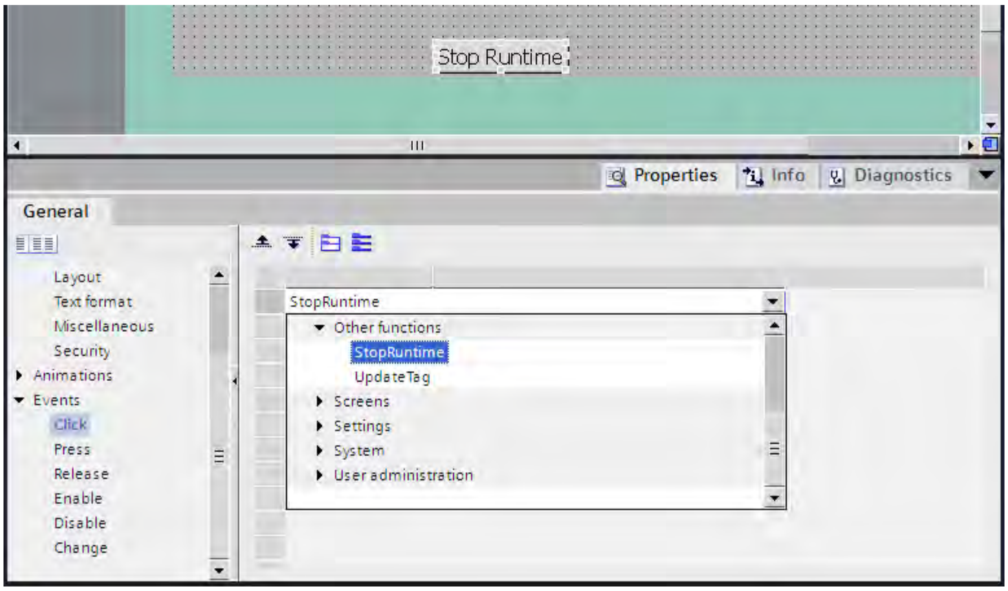
Requirement

Object has at least one configurable event.

Procedure

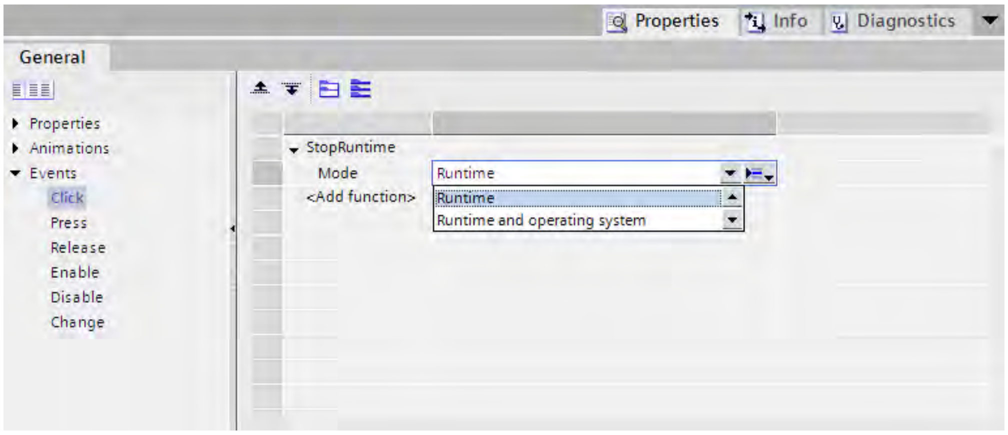
Proceed as follows to configure a function list:

1. Open the editor in WinCC in which the object is located.
2. Select the object.
3. Click the event at which you want to configure the function list under "Events" in the Inspector window.
4. Select the "<No Function>" entry in the drop-down list of the Inspector window.
5. Select the required system function in the drop-down list.
6. You can also enter the name of the system function.



The system function is entered in the function list.

7. If the system function has parameters, specify the values for the parameters.



8. If you want to add other system functions or functions to the function list, then repeat steps four to seven.

Result

The function list is configured. In addition, to the configured event, the status of the function list is displayed in the Inspector window. When the configured event occurs in Runtime, the function list is completed from top to bottom.

See also

Editing a function list (Page 1336)
Basic of the functions list (Page 1332)
Changing the operating mode on the HMI device with the current display (Page 1338)

8.7.2.4 Editing a function list

Introduction

A function list can be edited as follows:

- Changing the order of execution for system functions
- Removing a system function

For additional information, refer to "Configuring a function list (Page 1334) ".

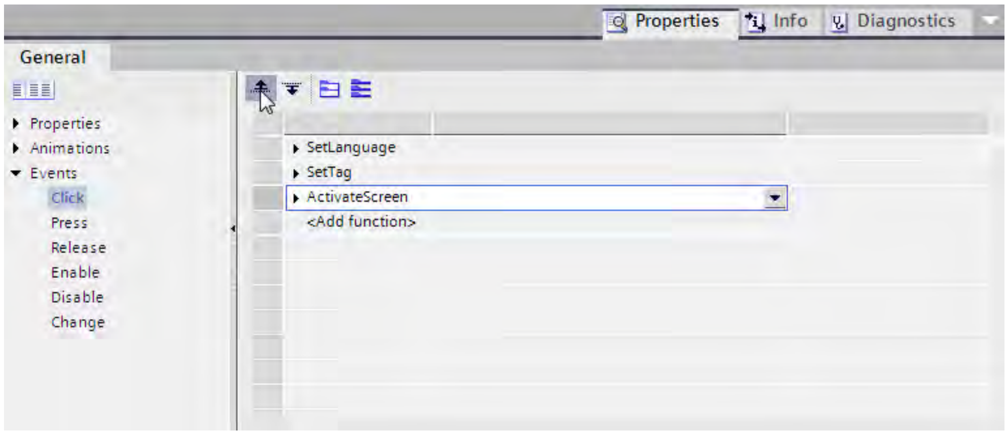
Requirement

The function list is configured.

Procedure

Proceed as follows to edit a function list:

1. Open the editor in WinCC in which the object is located.
2. Select the object.
3. Click the event whose function list you want to edit under "Events" in the Inspector window.
4. Select the system function in the drop-down list to change the order of execution in the function list.
5. In the Inspector window, keep clicking the corresponding arrow until you have moved the system function to the desired position.



6. To remove a system function from the function list, select the respective system function and then use the "Delete" command in the shortcut menu.

Alternative procedure

If you want to move several system functions at once, select them together in the function list. Press and hold <Ctrl> while selecting the desired system functions.

You can also use the drag-and-drop function to move.

See also

Basic of the functions list (Page 1332)
Changing the operating mode on the HMI device with the current display (Page 1338)

8.7.2.5 Executing a function list in Runtime

Principle

In runtime a function list is completed from top to bottom. A distinction is made between synchronous completion and asynchronous completion, so that no waiting periods ensue during completion. The distinction is made by the system by evaluating the different runtimes of the system functions. Scripts are always processed synchronously independent of the runtime. If a system function returns an error status, the completion of the function list is cancelled.

Synchronous completion

During synchronous completion, the system functions in a function list are performed one after another. The previous system function must be finished before the next system function can be performed.

Asynchronous completion

System functions, which perform file operations such as storing and reading, have a longer runtime than system functions which, for example, set a tag value.

Therefore, system functions with longer runtimes are performed asynchronously. While a system function writes to a storage medium, e.g. a recipe record, the next system function is already being performed. Due to the parallel completion of system functions, waiting periods at the HMI device are avoided.

See also

Basic of the functions list (Page 1332)
Changing the operating mode on the HMI device with the current display (Page 1338)

8.7.3 Example

8.7.3.1 Changing the operating mode on the HMI device with the current display

Task

In this example, use the system function "SetDeviceMode" to switch between the operating modes "online" and "offline" on the HMI device. You also display the current set operating mode on the HMI device.

Requirements

A screen has been created.

Settings

For this example you require a tag and a text list with the following settings:

Tag:

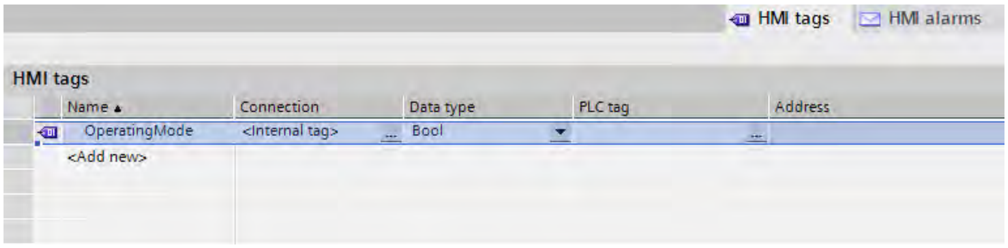
Name	PLC connection	Type
Operating mode	No	Bool

Text list:

Name	Contains	Values
Show operating mode	Boolean (0/1)	1: Operating mode: "Online" 0: Operating mode: "Offline"

Procedure

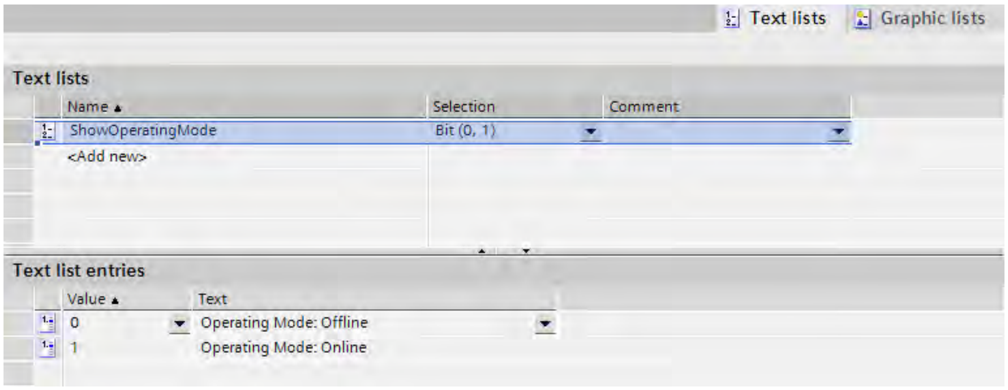
1. Create the above-named tag "OperatingMode".



HMI tags

Name	Connection	Data type	PLC tag	Address
OperatingMode	<Internal tag>	Bool		
<Add new>				

2. Create the above-named text list "ShowOperatingMode".



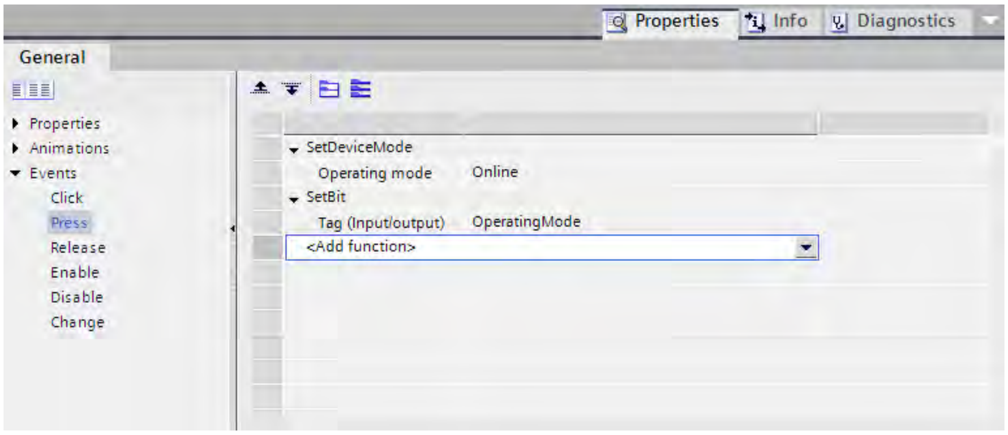
Text lists

Name	Selection	Comment
ShowOperatingMode	Bit (0, 1)	
<Add new>		

Text list entries

Value	Text
0	Operating Mode: Offline
1	Operating Mode: Online

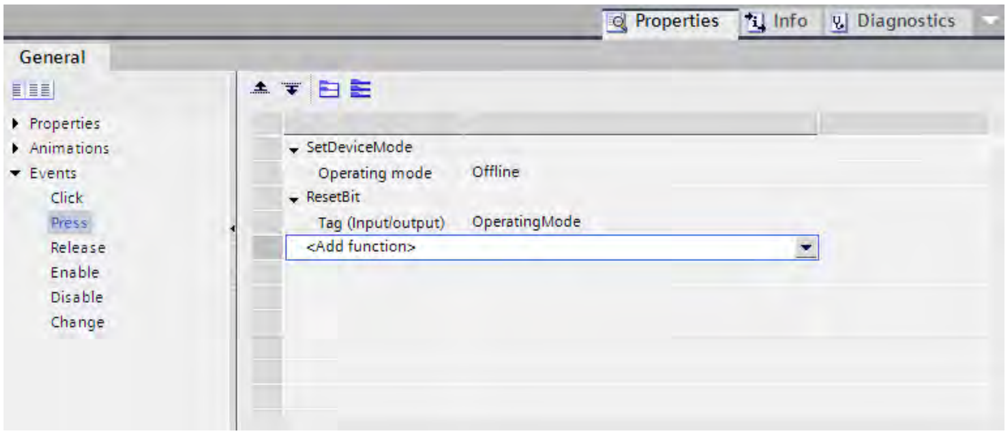
3. Open the process screen and add a button with which you can configure the operating mode change to "online".
4. Click "Press" in the "Events" group of the Inspector window.
5. Configure the system function "SetDeviceMode" on the event "Press". The system function is found in the selection list under "Settings".
6. Select the entry "online" from the selection list for the parameter "Mode".
7. Configure the system function "SetBit" on the event "Press". The system function is found in the selection list under "Bit processing".
8. Select the tag "Operating mode" from the selection list for the parameter "Tag".



SetDeviceMode
Operating mode Online
SetBit
Tag (Input/output) OperatingMode
<Add function>

9. Add a button in the process screen with which you can configure the operating mode change to "offline".

1 Repeat steps four to seven. Select the entry "Offline" from the selection list for the parameter "Mode".
0. Configure the system function "ResetBit" in place of the system function "SetBit."



SetDeviceMode
Operating mode Offline
ResetBit
Tag (Input/output) OperatingMode
<Add function>

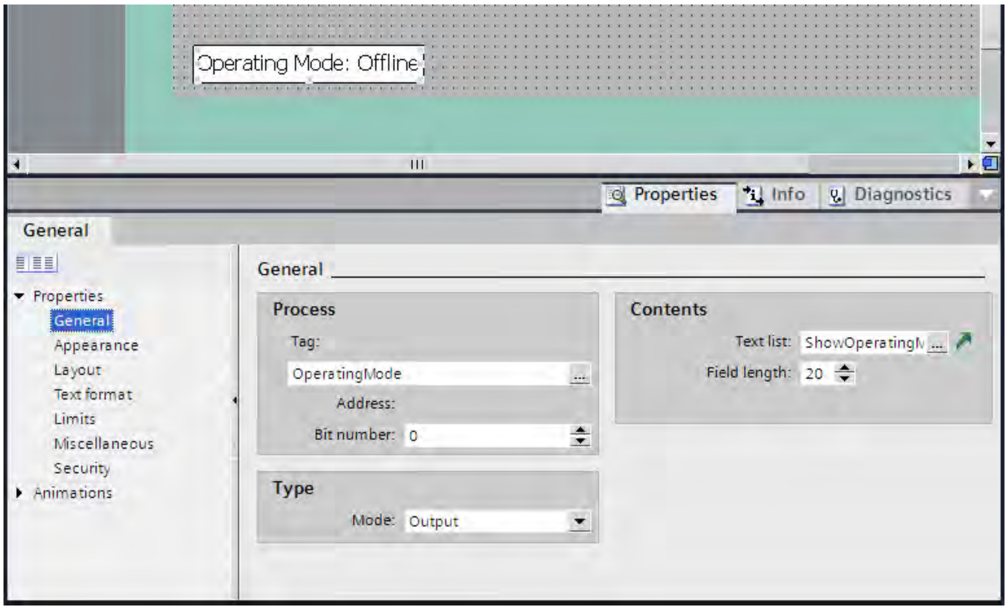
Interim result

You can toggle the operating mode of the HMI device with the two buttons.

You want to display the current set operating mode in an output field on the HMI device.

Procedure

1. In the process screen, create a "Symbolic I/O field" and make the following settings in the "General" tab of the Inspector window.
   – Select "Output" as the "Mode".
   – Select the text list "Show operating mode" as "Text list".
   – Select "Operating mode" as "Tag".



Tag: OperatingMode
Address:
Bit number: 0
Text list: ShowOperatingM
Field length: 20
Mode: Output

Result

When you change the operating mode with the buttons, the currently set operating mode on the HMI device is always shown.

See also

System functions (Page 1330)
Basic of the functions list (Page 1332)
Device-based dependency of system functions (Page 1341)

8.7.4 Reference

8.7.4.1 Device-based dependency of system functions

Availability of system functions

The following tables show the availability of the system functions and scripts on the HMI devices.

Technical data subject to change.

Basic Panels

	KTP400 mono PN	KTP600 mono PN	KTP600 color PN	KTP1000 PN	TP1500 PN
Scripts	No	No	No	No	No
Logoff (Page 1344)	Yes	Yes	Yes	Yes	Yes
AdjustContrast (Page 1344)	Yes	Yes	No	Yes	Yes
ActivateScreen (Page 1345)	Yes	Yes	Yes	Yes	Yes
ActivateScreenByNumber (Page 1346)	Yes	Yes	Yes	Yes	Yes
ActivateCleanScreen (Page 1346)	Yes	Yes	Yes	Yes	Yes
ActivatePreviousScreen (Page 1347)	Yes	Yes	Yes	Yes	Yes
UpdateTag (Page 1348)	Yes	Yes	Yes	Yes	Yes
Logon (Page 1348)	Yes	Yes	Yes	Yes	Yes
EditAlarm (Page 1349)	Yes	Yes	Yes	Yes	No
ScreenObjectCursorDown (Page 1350)	Yes	Yes	Yes	Yes	Yes
ScreenObjectCursorUp (Page 1349)	Yes	Yes	Yes	Yes	Yes
ScreenObjectPageDown (Page 1351)	Yes	Yes	Yes	Yes	Yes
ScreenObjectPageUp (Page 1350)	Yes	Yes	Yes	Yes	Yes

	KTP400 mono PN	KTP600 mono PN	KTP600 color PN	KTP1000 PN	TP1500 PN
IncreaseFocusedValue (Page 1352)	Yes	Yes	Yes	Yes	No
IncreaseTag (Page 1352)	Yes	Yes	Yes	Yes	Yes
GoToHome (Page 1353)	Yes	Yes	Yes	Yes	No
GoToEnd (Page 1353)	Yes	Yes	Yes	Yes	No
InvertBit (Page 1354)	Yes	Yes	Yes	Yes	Yes
InverseLinearScaling (Page 1354)	Yes	Yes	Yes	Yes	Yes
CalibrateTouchScreen (Page 1355)	Yes	Yes	Yes	Yes	Yes
TrendViewScrollForward (Page 1356)	Yes	Yes	Yes	Yes	Yes
TrendViewScrollBack (Page 1356)	Yes	Yes	Yes	Yes	Yes
TrendViewExtend (Page 1357)	Yes	Yes	Yes	Yes	Yes
TrendViewCompress (Page 1357)	Yes	Yes	Yes	Yes	Yes
TrendViewRulerForward (Page 1358)	Yes	Yes	Yes	Yes	Yes
TrendViewRulerBackward (Page 1358)	Yes	Yes	Yes	Yes	Yes
TrendViewSetRulerMode (Page 1359)	Yes	Yes	Yes	Yes	Yes
TrendViewStartStop (Page 1360)	Yes	Yes	Yes	Yes	Yes
TrendViewBackToBeginning (Page 1360)	Yes	Yes	Yes	Yes	Yes
GetUserName (Page 1361)	Yes	Yes	Yes	Yes	Yes
GetGroupNumber (Page 1361)	Yes	Yes	Yes	Yes	Yes
GetPassword (Page 1362)	Yes	Yes	Yes	Yes	Yes
LinearScaling (Page 1362)	Yes	Yes	Yes	Yes	Yes
ClearAlarmBuffer (Page 1363)	Yes	Yes	Yes	Yes	Yes
ClearAlarmBufferProtoolLegacy (Page 1364)	Yes	Yes	Yes	Yes	Yes
AlarmViewEditAlarm (Page 1364)	Yes	Yes	Yes	Yes	Yes
AlarmViewAcknowledgeAlarm (Page 1365)	Yes	Yes	Yes	Yes	Yes
AlarmViewShowOperatorNotes (Page 1366)	Yes	Yes	Yes	Yes	Yes
AcknowledgeAlarm (Page 1366)	Yes	Yes	Yes	Yes	No
RecipeViewNewDataRecord (Page 1367)	Yes	Yes	Yes	Yes	Yes
RecipeViewGetDataRecordFromPLC (Page 1367)	Yes	Yes	Yes	Yes	Yes
RecipeViewDeleteDataRecord (Page 1368)	Yes	Yes	Yes	Yes	Yes

	KTP400 mono PN	KTP600 mono PN	KTP600 color PN	KTP1000 PN	TP1500 PN
RecipeViewMenu (Page 1369)	Yes	Yes	Yes	Yes	Yes
RecipeViewOpen (Page 1369)	Yes	Yes	Yes	Yes	Yes
RecipeViewSetDataRecordToPLC (Page 1370)	Yes	Yes	Yes	Yes	Yes
RecipeViewSaveDataRecord (Page 1370)	Yes	Yes	Yes	Yes	Yes
RecipeViewSaveAsDataRecord (Page 1371)	Yes	Yes	Yes	Yes	Yes
RecipeViewRenameDataRecord (Page 1371)	Yes	Yes	Yes	Yes	Yes
RezepturanzeigeZeigeHilfetext (Page 1372)	Yes	Yes	Yes	Yes	Yes
RecipeViewBack (Page 1373)	Yes	Yes	Yes	Yes	Yes
ResetBit (Page 1373)	Yes	Yes	Yes	Yes	Yes
ButtonPress (Page 1374)	Yes	Yes	Yes	Yes	No
ButtonRelease (Page 1374)	Yes	Yes	Yes	Yes	No
ShiftAndMask (Page 1375)	Yes	Yes	Yes	Yes	Yes
PageDown (Page 1377)	Yes	Yes	Yes	Yes	No
PageUp (Page 1376)	Yes	Yes	Yes	Yes	No
SetDeviceMode (Page 1377)	Yes	Yes	Yes	Yes	Yes
SetBit (Page 1378)	Yes	Yes	Yes	Yes	Yes
SetBitWhileKeyPressed (Page 1378)	Yes	Yes	Yes	Yes	No
SetLanguage (Page 1379)	Yes	Yes	Yes	Yes	Yes
SetConnectionMode (Page 1381)	Yes	Yes	Yes	Yes	Yes
SetTag (Page 1380)	Yes	Yes	Yes	Yes	Yes
SimulateSystemKey (Page 1382)	Yes	Yes	Yes	Yes	No
SimulateTag (Page 1382)	Yes	Yes	Yes	Yes	Yes
StopRuntime (Page 1383)	Yes	Yes	Yes	Yes	Yes
TraceUserChange (Page 1384)	Yes	Yes	Yes	Yes	Yes
DecreaseFocusedValue (Page 1384)	Yes	Yes	Yes	Yes	No
DecreaseTag (Page 1384)	Yes	Yes	Yes	Yes	Yes
ChangeConnection (Page 1385)	Yes	Yes	Yes	Yes	Yes
ShowLogonDialog (Page 1386)	Yes	Yes	Yes	Yes	Yes
ShowOperatorNotes (Page 1387)	Yes	Yes	Yes	Yes	Yes

	KTP400 mono PN	KTP600 mono PN	KTP600 color PN	KTP1000 PN	TP1500 PN
ShowAlarmWindow (Page 1388)	Yes	Yes	Yes	Yes	Yes

See also

System functions (Page 1330)
Basic of the functions list (Page 1332)
Changing the operating mode on the HMI device with the current display (Page 1338)

8.7.4.2 System functions

8.7.4.2 Logoff

Application

Logs off the current user on the HMI device.

Syntax

Logoff

Useable in script: yes (Logoff), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

--

8.7.4.2 AdjustContrast

Application

Changes the contrast of the display one level on the HMI device.

Syntax

AdjustContrast (Adjust)

Useable in script: yes (AdjustContrast), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Adjust

Specifies how the contrast is changed:

0 (hmiDecrease) = Decrease: Decreases the contrast one level.

1 (hmiIncrease) = Increase: Increases the contrast one level.

Application example

Objective

One button each for increasing and decreasing the screen contrast is desired.

Notes on configuring

Configure two buttons and configure the "AdjustContrast" system function on the "Press" event. The parameters "Increase" and "Decrease" are allocated.

Procedure on HMI device

When one of the two buttons is pressed in runtime, the contrast is increased or decreased one level.

8.7.4.2 ActivateScreen

Application

Performs a screen change to the given screen.

Use the "ActivateScreenByNumber" system function to change from the root screen to the permanent window or vice versa.

Syntax

ActivateScreen (Screen name, Object number)

Useable in script: yes (ActivateScreen), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Screen name

Name of the screen to which you want to change.

Object number

The operator control element which receives the focus in the given screen after the screen change. The number of the operator control element is to be determined using the tabulator sequence during configuration.

When "0" is specified:

If the focus is in the permanent window when the system function is called up, the permanent window maintains the focus.

If the focus is in the root screen when the system function is called up, the first operator control element in the given screen receives the focus.

Note

If the "Reach margin" event is assigned to the "ActivateScreen" system function, only the value "0" is valid for the "Object number" parameter. The active object is not defined by the object number, but rather by the X position it had prior to the screen change.

8.7.4.2 ActivateScreenByNumber

Application

Performs a screen change to a screen based on a tag value.

The screen is identified by its screen number.

Syntax

ActivateScreenByNumber (Screen number, Object number)

Useable in script: yes (ActivateScreenByNumber), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Screen number

Tag which contains the screen number of the destination screen.

When a change from the root screen to the permanent window is desired, "0" or "-1" is specified:

0 = Change from root screen to permanent window

-1 = Change from permanent window to root screen

Object number

The number of the screen object which receives the focus in the given screen after the screen change. The number of the operator control element is to be determined using the tabulator sequence during configuration.

When "0" is specified:

- If the focus is in the permanent window when the system function is called up, the permanent window maintains the focus.
- If the focus is in the root screen when the system function is called up, the first operator control element in the given screen receives the focus.

8.7.4.2 ActivateCleanScreen

Application

Activates the clean screen on the HMI device. The display of the HMI device is disabled for the given time period.

When the display of the HMI device is deactivated, it can be cleaned without triggering touch functions by mistake.

Syntax

ActivateCleanScreen (Time period)

Useable in script: No

Parameters

Time period

Time period for which the display is disabled. The time remaining is displayed as a progress bar.

Value range in seconds from 10 through 300.

Note

The system function ActivateCleanScreen cannot be simulated.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 ActivatePreviousScreen

Application

Performs a screen change to the screen which was activated before the current screen. The screen change is not performed if no screen was activated beforehand.

The last 10 screens that were called up are saved. A system alarm is output when you change to a screen which is no longer saved.

Note

If you want to use the function, the screen change has to be used in the navigation structure.

Syntax

ActivatePreviousScreen

Useable in script: yes (ActivatePreviousScreen), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

--

8.7.4.2 UpdateTag

Application

Reads the current value of the tag with the specified Update ID from the PLC. .

Syntax

UpdateTag (Update ID)

Useable in script: No

Parameters

Update ID

Update ID assigned to the tag that will be updated.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 Logon

Application

Logs on the current user on the HMI device.

Syntax

Logon (Password, User name)

Useable in script: yes (Logon), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Password

The tag from which the password for the user logging on is read.

If the user is logged on, the password in the tag is deleted.

User name

The tag from which the user name for the user logging on is read.

8.7.4.2 EditAlarm

Application

Triggers the "Edit" event for all selected alarms.

If the alarms to be edited have not yet been acknowledged, the acknowledgment takes place automatically when this system function is called up.

The system function can be used for the following function keys:

Syntax

EditAlarm

Useable in script: yes (EditAlarm), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

--

8.7.4.2 ScreenObjectCursorUp

Application

Performs the key function <Up> in the given screen object.

This system function is used when the integrated buttons of the screen object should not be used. The system function can be used for the following screen objects:

- User view
- Alarm view
- Recipe view

Syntax

ScreenObjectCursorUp (Screen object)

Useable in script: No

Parameters

Screen object

Name of the screen object in which the key function is triggered.

Note

The HMI devices listed below do not support this function for the screen object: OP 73, OP 73micro, OP 77A, TP 177A, TP 177micro.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 ScreenObjectCursorDown

Application

Performs the key function <Down> in the given screen object.

This system function is used when the integrated buttons of the screen object should not be used. The system function can be used for the following screen objects:

- User view
- Alarm view
- Recipe view

Syntax

ScreenObjectCursorDown (Screen object)

Useable in script: No

Parameters

Screen object

Name of the screen object in which the key function is triggered.

Note

The HMI devices listed below do not support this function for the screen object: OP 73, OP 73micro, OP 77A, TP 177A, TP 177micro.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 ScreenObjectPageUp

Application

Performs the key function <Up> in the given screen object.

This system function is used when the integrated buttons of the screen object should not be used. The system function can be used for the following screen objects:

- User view
- Alarm view

- Recipe view

Syntax

ScreenObjectPageUp (Screen object)

Useable in script: No

Parameters

Screen object

Name of the screen object in which the key function is triggered.

Note

The HMI devices listed below do not support this function for the screen object: OP 73, OP 73micro, OP 77A, TP 177A, TP 177micro.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 ScreenObjectPageDown

Application

Performs the key function <Down> in the given screen object.

This system function is used when the integrated buttons of the screen object should not be used. The system function can be used for the following screen objects:

- User view
- Alarm view
- Recipe view

Syntax

ScreenObjectPageDown (Screen object)

Useable in script: No

Parameters

Screen object

Name of the screen object in which the key function is triggered.

Note

The HMI devices listed below do not support this function for the screen object: OP 73, OP 73micro, OP 77A, TP 177A, TP 177micro.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 IncreaseFocusedValue

Application

Adds the given value to the value of the tag which is connected to the input field (drop-down list, graphic selection list, slider bar) which has the current focus.

Syntax

IncreaseFocusedValue (Value)

Useable in script: No

Parameters

Value

The value which is added to the tag value.

8.7.4.2 IncreaseTag

Application

Adds the given value to the value of the tags.

X = X + a

Note

The system function uses the same tag as input and output values. Work with an auxiliary tag if you want to use this system function to convert a value. The auxiliary tags can be assigned to the tag value with the "SetTag" system function.

If you configure the function on the events of an alarm and the tag is not being used in the current screen, it is not ensured that the actual value of the tags is being used in the PLC. You can improve the situation by setting the "Cyclic continuous" acquisition mode.

Syntax

IncreaseTag (Tag, Value)

Useable in script: yes (IncreaseTag), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Tag

The tag to which the given value is added.

Value

The value which is added.

8.7.4.2 GoToHome

Application

Executes the key function <Home> on the HMI device.

This system function is used when the HMI device does not have this functionality by default.

The system function can be used for the following function keys:

Syntax

GoToHome

Useable in script: yes (GoToHome), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

--

8.7.4.2 GoToEnd

Application

Executes the key function <End> on the HMI device:

This system function is used when the HMI device does not have this functionality by default.

The system function can be used for the following function keys:

Syntax

GoToEnd

Useable in script: yes (GoToEnd), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

--

8.7.4.2 InvertBit

Application

Inverts the value of the given tag of the "Bool" type:

- If the tag has the value of 1 (TRUE), it will be set to 0 (FALSE).
- If the tag has the value of 0 (FALSE), it will be set to 1 (TRUE).

Syntax

InvertBit (Tag)

Useable in script: yes (InvertBit), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Tag

The tag whose bit is set.

8.7.4.2 InverseLinearScaling

Application

Assigns a value to the tag X, which is calculated from the value of the given tag Y using the linear function X = (Y - b) / a.

The tags X and Y must not be identical. This system function is the inverse of the "LinearScaling" system function.

Note

The tags X and Y must not be identical. If a tag is to be converted into itself, a auxiliary tag must be used.

The "SetTag" system function can be used to assign the value of the tags to be converted to the auxiliary tags.

Syntax

InverseLinearScaling (X, Y, b, a)

Useable in script: yes (InverseLinearScaling), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

X

The tag which is assigned the value calculated from the linear equation.

Y

The tag whose value is used for the calculation.

b

The value which is subtracted.

a

The value through which is divided.

8.7.4.2 CalibrateTouchScreen

Application

Calls up a program for calibrating the touch screen.

During the calibration process, there is a prompt to touch five positions on the screen display. Touch the screen display within 30 seconds, to confirm the calibration process. If the calibration is not completed within this time span, the calibration settings are discarded. The user prompt is in English.

Use this system function the first time you start the HMI device.

Syntax

CalibrateTouchScreen

Useable in script: yes (CalibrateTouchScreen), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

--

Note

The CalibrateTouchScreen system function cannot be simulated.

8.7.4.2 TrendViewScrollForward

Application

Scrolls forward one display width in the Trend view.

Syntax

TrendViewScrollForward (Screen object)

Useable in script: No

Parameters

Screen object

Name of the trend view in which is scrolled forward.

Note

The TP 177A and TP 177micro HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 TrendViewScrollBack

Application

Scrolls back one display width to the left in the trend view.

Syntax

TrendViewScrollBack (Screen object)

Useable in script: No

Parameters

Screen object

Name of the trend view in which is scrolled back.

Note

The TP 177A and TP 177micro HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 TrendViewExtend

Application

Reduces the time period which is displayed in the trend view.

Syntax

TrendViewExtend (Screen object)

Useable in script: No

Parameters

Screen object

Name of the trend view in which the displayed time period is reduced.

Note

The TP 177A and TP 177micro HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 TrendViewCompress

Application

Increases the time period which is displayed in the trend view.

Syntax

TrendViewCompress (Screen object)

Useable in script: No

Parameters

Screen object

Name of the trend view in which the displayed time period is increased.

Note

The TP 177A and TP 177micro HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 TrendViewRulerForward

Application

Moves the read-line forwards (to the right) in the trend view.

Note

In order to be able to move the read-line, the read-line must have been switched on. This is done using the "TrendViewSetRulerMode" system function.

Syntax

TrendViewRulerForward (Screen object)

Useable in script: No

Parameters

Screen object

Name of the trend view in which the read-line is moved forward.

Note

The TP 177A and TP 177micro HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 TrendViewRulerBackward

Application

Moves the read-line backwards (to the left) in the trend view.

Note

In order to be able to move the read-line, the read-line must have been switched on. This is done using the "TrendViewSetRulerMode" system function.

Syntax

TrendViewRulerBackward (Screen object)

Useable in script: No

Parameters

Screen object

Name of the trend view in which the read-line is moved backwards.

Note

The TP 177A and TP 177micro HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 TrendViewSetRulerMode

Application

Hides or shows the read-line in the trend view. The read-line displays the Y value belonging to the X value.

Syntax

TrendViewSetRulerMode (Screen object)

Useable in script: No

Parameters

Screen object

Name of the trend view in which the read-line is hidden or shown.

Note

The TP 177A and TP 177micro HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 TrendViewStartStop

Application

Stops the trend recording or continues the trend recording in the trend view.

Syntax

TrendViewStartStop (Screen object)

Useable in script: No

Parameters

Screen object

Name of the trend view in which the recording of the trend is started or stopped.

Note

The TP 177A and TP 177micro HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 TrendViewBackToBeginning

Application

Scrolls back to the beginning of the trend recording in the trend view. The start values of the trend recording are displayed there.

Syntax

TrendViewBackToBeginning (Screen object)

Useable in script: No

Parameters

Screen object

Name of the trend view in which the displayed time period is increased.

Note

The TP 177A and TP 177micro HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 GetUserName

Application

Writes the user name of the user currently logged on to the HMI device in the given tag.

If the given tag has a control connection, the user name is also available in the PLC. This system function makes it possible, for example, to implement a user-dependent release of certain functionalities.

Syntax

GetUserName (Tag)

Useable in script: yes (GetUserName), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Tag

The tag to which the user name is written.

8.7.4.2 GetGroupNumber

Application

Reads the number of the group to which the user logged on to the HMI device belongs, and writes it to the given tag.

Syntax

GetGroupNumber (Tag)

Useable in script: yes (GetGroupNumber), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Tag

The tag to which the number of the group is written.

8.7.4.2 GetPassword

Application

Writes the password of the user currently logged on to the HMI device in the given tag.

Note

Make sure that the value of the given tag is not displayed in another place in the project.

Note

The passwords of SIMATIC Logon users cannot be read.

Syntax

GetPassword (Tag)

Useable in script: yes (GetPassword), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Tag

The tag to which the result is written.

8.7.4.2 LinearScaling

Application

Assigns a value to the tag Y, which is calculated from the value of the given tag X using the linear function Y= (a *X) + b.

The inverse of this function is the "InverseLinearScaling" system function.

Note

The tags X and Y must not be identical. If a tag is to be converted into itself, a auxiliary tag must be used.

The "SetTag" system function can be used to assign the value of the tags to be converted to the auxiliary tags.

Syntax

LinearScaling (Y, X, a, b)

Useable in script: yes (LinearScaling), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Y

The tag which is assigned the value calculated from the linear equation.

X

The tag whose value is used for the calculation.

a

The value with which is multiplied.

b

The value which is added.

8.7.4.2 ClearAlarmBuffer

Application

Deletes alarms from the alarm buffer on the HMI device.

Note

Alarms which have not yet been acknowledged are also deleted.

Syntax

ClearAlarmBuffer (Alarm class number)

Useable in script: yes (ClearAlarmBuffer), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Alarm class number

Determines which alarms are to be deleted from the alarm buffer:

0 (hmiAll) = All alarms/events

1 (hmiAlarms) = Errors

2 (hmiEvents) = Warnings

3 (hmiSystem) = System events

4 (hmiS7Diagnosis) = S7 diagnostic alarms

Note
Availability for specific devices

S7 diagnostic alarms are not available on Basic Panels.

8.7.4.2 ClearAlarmBufferProtoolLegacy

Application

The system function exists to ensure compatibility.

It has the same functionality as the "ClearAlarmBuffer" system function, but uses the old ProTool numbering.

Syntax

ClearAlarmBufferProtoolLegacy (Alarm class number)

Useable in script: yes (ClearAlarmBufferProtoolLegacy), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Alarm class number

Alarm class number whose messages are to be deleted:

-1 (hmiAllProtoolLegacy) = All alarms/events

0 (hmiAlarmsProtoolLegacy) = Errors

1 (hmiEventsProtoolLegacy) = Warnings

2 (hmiSystemProtoolLegacy) = System events

3 (hmiS7DiagnosisProtoolLegacy) = S7 diagnostic alarms

Note
Availability for specific devices

S7 diagnostic alarms are not available on Basic Panels.

8.7.4.2 AlarmViewEditAlarm

Application

Triggers the event "Edit" for all alarms selected in the given alarm screen.

This system function is used when the integrated buttons of the ActiveX control should not be used.

A system function can in turn be configured on the "Edit" event. For example, it is possible to change to the process screen in which the alarm appeared.

Note

If the alarms to be edited have not yet been acknowledged, the acknowledgment takes place automatically when this system function is called up.

Syntax

AlarmViewEditAlarm (Screen object)

Useable in script: No

Parameters

Screen object

Name of the alarm screen in which the event is triggered.

Note

The HMI devices listed below do not support this function for the screen object: OP 73, OP 73micro, OP 77A, TP 177A, TP 177micro.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 AlarmViewAcknowledgeAlarm

Application

Acknowledges the alarms selected in the given alarm view.

This system function is used when the integrated buttons of the ActiveX control should not be used.

Syntax

AlarmViewAcknowledgeAlarm (Screen object)

Useable in script: No

Parameters

Screen object

Name of the alarm screen in which the event is triggered.

Note

The HMI devices listed below do not support this function for the screen object: OP 73, OP 73micro, OP 77A, TP 177A, TP 177micro.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 AlarmViewShowOperatorNotes

Application

Displays the configured operator notes of the alarm selected in the given alarm screen.

Syntax

AlarmViewShowOperatorNotes (Screen object)

Useable in script: No

Parameters

Screen object

Name of the alarm screen in which the event is triggered.

Note

The HMI devices listed below do not support this function for the screen object: OP 73, OP 73micro, OP 77A, TP 177A, TP 177micro.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 AcknowledgeAlarm

Application

Acknowledges all selected alarms.

This system function is used when the HMI device does not have an ACK key or when the integrated key of the alarm screen should not be used.

The system function can be used for the following function keys:

Syntax

AcknowledgeAlarm

Useable in script: No

Parameters

--

8.7.4.2 RecipeViewNewDataRecord

Application

Creates a new data record in the given recipe view.

Syntax

RecipeViewNewDataRecord (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view in which the new recipe data record is created.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RecipeViewGetDataRecordFromPLC

Application

Transfers the data record that is currently loaded in the PLC to the HMI device and displays it in the recipe view.

Syntax

RecipeViewGetDataRecordFromPLC (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view in which the recipe data record from the PLC is displayed.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RecipeViewDeleteDataRecord

Application

Deletes the data record which is currently displayed in the recipe view.

Syntax

RecipeViewDeleteDataRecord (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view in which the displayed recipe data record is deleted.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RecipeViewMenu

Application

Opens the menu of the specified simple recipe view.

Only use this system function at a simple recipe view.

Syntax

RecipeViewMenu (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view in which the menu is to be opened.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RecipeViewOpen

Application

Displays the data record values in the given recipe view. The system function is not performed if the recipe data record values are already displayed on the HMI device.

This system function is used when a simple recipe view has been configured. In the simple recipe view, only one selection list is displayed at a time on the HMI device. The "RecipeViewBack" system function is used to display the previous selection list.

Syntax

RecipeViewOpen (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view in which the recipe data record is displayed.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RecipeViewSetDataRecordToPLC

Application

Transfers the recipe data record which is currently displayed in the recipe view to the PLC.

Syntax

RecipeViewSetDataRecordToPLC (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view from which the recipe data record is transferred to the connected PLC.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RecipeViewSaveDataRecord

Application

Saves the recipe data record which is currently displayed in the recipe view.

Syntax

RecipeViewSaveDataRecord (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view in which the recipe data record is saved.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RecipeViewSaveAsDataRecord

Application

Saves the data record currently being displayed in the recipe view under a new name.

Syntax

RecipeViewSaveAsDataRecord (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view in which the recipe data record is saved under a new name.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RecipeViewRenameDataRecord

Application

Renames the selected data record in the given recipe view.

Only use this system function at a simple recipe view.

Syntax

RecipeViewRenameDataRecord (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view in which the recipe data record is renamed.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RezepturanzeigeZeigeHilfetext

Application

Displays the configured infotext of the given recipe view.

Syntax

RecipeViewShowOperatorNotes (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view whose configured help text is displayed.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 RecipeViewBack

Application

Returns to the previous selection list in the given recipe view.

The system function has no effect if the selection field for the recipe is displayed on the HMI device. Operation sequence of the selection lists in runtime:

- Recipe name
- Data record name
- RecipeDataRecordValues

This system function is used when a simple recipe view has been configured. In the simple recipe view, only one selection list is displayed at a time on the HMI device. The "RecipeViewOpen" system function is used to display the recipe data record values.

Syntax

RecipeViewBack (Screen object)

Useable in script: No

Parameters

Screen object

Name of the recipe view in which the command is triggered.

Note

The OP 77A and TP 177A HMI devices do not support this function for the screen object.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 ResetBit

Application

Sets the value of a "Bool" type tag at 0 (FALSE).

Syntax

ResetBit (Tag)

Useable in script: yes (ResetBit), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Tag

The BOOL type tag which is set to 0 (FALSE).

8.7.4.2 ButtonPress

Application

Triggers the event "Press" on the given screen object.

This system function is used, for example when you want to operate a screen button using a function key of the HMI device.

Note

The "ButtonPress" and "ButtonRelease" system functions must always be configured together. Thus, if the "ButtonPress" system function is configured on the "Press" event for a function key, then the "ButtonRelease" system function is configured on the "Release" event for the same function key.

Syntax

ButtonPress (Screen object)

Useable in script: No

Parameters

Screen object

Name of the screen object on which the event is triggered.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 ButtonRelease

Application

Triggers the event "Release" on the given screen object.

This system function is used, for example when you want to operate a screen button using a function key of the HMI device.

Note

The "ButtonPress" and "ButtonRelease" system functions must always be configured together. Thus, if the "ButtonPress" system function is configured on the "Press" event for a function key, then the "ButtonRelease" system function is configured on the "Release" event for the same function key.

Syntax

ButtonRelease (Screen object)

Useable in script: No

Parameters

Screen object

Name of the screen object on which the event is triggered.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 ShiftAndMask

Application

This system function converts the input bit pattern of the source tags into an output bit pattern of the target tags. This involves bit shifting and masking.

Note

If the source and target tag have a different number of bits, using the system function in the target tag can result in a violation of the value range.

Syntax

ShiftAndMask (Source tag, Target tag, Bits to shift, Bits to mask)

Useable in script: yes (ShiftAndMask), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Source tag

The tag includes the input bit pattern. Integer-type tags, e.g. "Byte", "Char", "Int", "UInt", "Long" and "ULong" are permitted.

Example: The actual value 72 is set at the 16-bit integer source tag: 0000000001001000.

Bits to shift

Number of bits by which the input bit pattern is shifted right. A negative value shifts the input bit pattern to the left.

Example: "Bits to shift" has the value "+3". The input bit pattern is shifted right by three bits when the system function is called: 0000000000001001.
Bits to the left are padded with "0". Three bits are truncated on the right. The new decimal value is "9".

Note

The left bit is "1" in a source tag of the data type with negative signed integer. This sign bit is padded with "0" when the bits are shifted right. The sign changes to "+".

Bits to mask

An integer serves as bit mask. The bit pattern is used to multiply the shifted input bit pattern. Example: Integer "2478" with the bit pattern "0000100110101110".

You can enter the bit mask in three different ways:

- Hexadecimal: First enter the prefix "0h" or "0H", followed by an optional space for better readability. Then group the bit pattern in blocks of four (0000)(1001)(1010)(1110) and set each block in hexadecimal code: (0)(9)(A)(E). Only the characters 0-9, A-F, a-f are allowed: "0h 09AE".
- Binary: First enter the prefix "0h" or "0H", followed by an optional space for better readability. Then group the binary bit pattern into blocks of four 0000 1001 1010 1110 with spaces in between as a check. Only the characters "0" or "1" are allowed: "0b 0000 1001 1010 1110".
- Decimal: Enter the value "2478" directly, without a prefix.

Target tag (output)

The output bit pattern is saved in the tag. Integer-type tags, e.g. "Byte", "Char", "Int", "UInt", "Long" and "ULong" are permitted.

Example: The shifted input bit pattern is multiplied by the bit mask, with bit-by-bit logical AND operation: 0000000000001001. The resultant decimal value "8" is saved to the target tag.

Please note the following:

- The source and target tags have the same number of bits.
- The number of bits to shift is less than the number of bits in the source tag and target tag.
- Bits to mask does not have more bits than the source tag and the target tag.

8.7.4.2 PageUp

Application

Executes the key function <PageUp> on the HMI device.

The system function can be used for the following function keys:

Syntax

PageUp

Useable in script: yes (PageUp), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

-

8.7.4.2 PageDown

Application

Executes the key function <Pagedown> on the HMI device.

The system function can be used for the following function keys:

Syntax

PageDown

Useable in script: yes (PageDown), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

-

8.7.4.2 SetDeviceMode

Application

Toggles the operating mode on the HMI device. The following types of operation are possible: "Online", "Offline" and "Transfer."

Syntax

SetDeviceMode (Operating mode)

Useable in script: yes (SetDeviceMode), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Operating mode

Determines the operating mode of the HMI device:

0 (hmiOnline) = Online: The connection to the PLC is established.

1 (hmiOffline) = Offline: The connection to the PLC is disconnected.

2 (hmiTransfer) = Transfer: A project can be transferred from the configuration computer to the HMI device.

Note

If a PC is used as an HMI device, when toggling the operating mode after the transfer the runtime software is exited.

8.7.4.2 SetBit

Application

Sets the value of a "Bool" type tag to 1 (TRUE).

Syntax

SetBit (Tag)

Useable in script: yes (SetBit), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Tag

The BOOL type tag which is set to 1 (TRUE).

8.7.4.2 SetBitWhileKeyPressed

Application

Sets the bit of the given tag to 1 (TRUE) as long as the user keeps the configured key pressed.

After changing the given bit, the system function transfers the entire tag back to the PLC. It is not checked whether In the meantime, other bits in the tags have changed. Operator and PLC may only read the tag until it is transferred back to the PLC. You should only access tag of the type BOOL with this function in order to avoid problems with overlapping accesses to the same tag.

Note

All functions on the event "Release" are performed immediately by means of a screen change configured for a key, even if the key is kept pressed.

If the "SetBitWhileKeyPressed" system function is configured for a function key, the bit is reset immediately following the screen change. This action is necessary since the key assignments change after the screen change.

If the PLC supports BOOL tags, do not use this system function. Use the "SetBit" system function instead.

Syntax

SetBitWhileKeyPressed (Tag, Bit)

Useable in script: no

Parameters

Tag

The tag in which a bit is temporarily set to 1 (TRUE). Use only tags of the type BOOL, as far as allowed by the PLC.

Bit

The number of the bit that is temporarily set to 1 (TRUE).

Note

The guaranteed update of the tags used with actual process values is absolutely conditional in terms of reliable functionality. You should therefore configure the tag in an IO field, or assign the function to a screen element such as a button.

If you configured a short event such as the activation of an alarm for the function you can only access the actual process values by setting the tag for continuous reading.

8.7.4.2 SetLanguage

Application

Toggles the language on the HMI device. All configured text and system events are displayed on the HMI device in the newly set language.

Syntax

SetLanguage (Language)

Useable in script: yes (SetLanguage), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Language

Determines which language is set on the HMI device. The following specifications are possible:

- -1 (hmiToggle) = Toggle: Changes to the next language. The sequence is determined during configuration in the "Project languages" editor.
- Number which you have specified in the "Project languages" editor under "Order for language switching": Changes to the language with the given number.
- Language abbreviation in accordance with the VBScript5 reference: This changes to the language corresponding to the specified language code, e.g. "de-DE" for German (Germany) or "en-US" for English (United States of America).

  An overview of the language abbreviations is available in the basic information of VBScript under the topic "Area diagram-ID (LCID) Diagram".

8.7.4.2 SetTag

Application

Assigns a new value to the given tag.

Note

This system function can be used to assign strings and numbers, depending on the type of tag.

Syntax

SetTag (Tag, Value)

Useable in script: yes (SetTag), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Tag

The tag to which the given value is assigned.

Value

The value which the given tag is assigned.

Note

The "SetTag" system function is only executed after a connection has been established.

8.7.4.2 SetConnectionMode

Application

Connects or disconnects the given connection.

Note

A connection to the PLC cannot be established until the operating mode ONLINE has been set on the HMI device. This is done using the "SetDeviceMode" system function.

Syntax

SetConnectionMode (Mode, Connection)

Useable in script: yes (SetConnectionMode), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Mode

Determines whether a connection to the PLC is established or disconnected:

0 (hmiOnline) = Online: Connection is established.

1 (hmiOffline) = Offline: Connection is disconnected.

Connection

The PLC to which the HMI device is connected. You specify the name of the PLC in the connection editor.

Multiple use of the system function in a script

If you use the "SetConnectionMode" system function in a script for different connections, it may not be possible to execute all the functions correctly. Proceed as follows to prevent this situation:

1. Create a "BOOL" type tag with the start value "0".
2. Configure the "SetConnectionMode" function on the "Value change" event for the tags. If, for example, you wish to disconnect 3 connections, then you must configure the function three times.
3. In the script, apply the "InvertBit" function to the tag.

Application example

Two typical application examples for this system function are as follows:

- Test

  As long as no PLC is connected to the HMI device, no error messages will be output during the test on the HMI device. If the HMI device is connected to a PLC, the connection to the PLC can be established by pressing a key.

- Start up

  Several PLCs are to be configured for a system. At first, all PLCs except one are configured "Offline". After start up of the first PLC, the connection to each of the other PLCs is established by pressing a key. In this way, the other PLCs are started up one after another.

8.7.4.2 SimulateSystemKey

Application

Simulates the behavior of a System Key. Use this system function if a system key, such as the "ACK" key, "Input" key or the number pad is not available on the HMI device.

Syntax

SimulateSystemKey (System key)

Useable in script: No

Parameters

System Key

System Key, the behavior for which is to be simulated.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 SimulateTag

Application

Simulates the behavior of tags and dynamic objects such as text lists, without having the HMI device connected to a PLC.

This system function is used, for example, to demonstrate the functionality of a project.

Notice

Only tags of the data type Integer can be used for simulation. Tags of the data types Integer and Double integer can be used with OP 73, OP 73 micro, OP 77A, TP 177A and TP 177micro, however.

Syntax

SimulateTag (Tag, Cycle, Maximum value, Minimum value, Value)

Useable in script: No

Parameters

Tag

The tag whose value is changed.

Cycle

The factor by which the basic cycle of 200 milliseconds is multiplied. The cycle defines when the tag value is changed by the specified value. Possible cycles between 1 and 32767.

Maximum value

The maximum value that the tag can assume during simulation. The maximum value must be greater than the minimum value, but less than or equal to 32767. If the maximum value is reached, the tag value is set to the minimum value after the next update cycle.

Minimum value

The minimum value that the tag can assume during simulation. The minimum value must be less than the maximum value, but greater than or equal to -32768. If the minimum value is reached, the tag value is set to the maximum value after the next update cycle.

Value

The value by which the tag value is changed during each cycle. A negative value reduces the tag value. Possible values between -32768 and 32767.

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 StopRuntime

Application

Exits the runtime software and thereby the project running on the HMI device.

Syntax

StopRuntime (Mode)

Useable in script: yes (StopRuntime), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Mode

Determines whether the operating system is shut down after exiting runtime.

0 (hmiStopRuntime) = Runtime: Operating system is not shut down

1 (hmiStopRuntimeAndOperatingSystem) = Runtime and operating system: The operating system is shut down (not possible with WinCE)

8.7.4.2 TraceUserChange

Application

Outputs a system event that shows which user is currently logged in on the HMI device.

This system function can only be used in the Scheduler.

Syntax

TraceUserChange

Useable in script: No

Parameters

--

8.7.4.2 DecreaseFocusedValue

Application

Subtracts the given value from the value of the tag which is connected to the input field or to the drop-down list, graphic selection list, slider bar which has the current focus.

Syntax

DecreaseFocusedValue (Value)

Useable in script: No

Parameters

Value

The value which is subtracted from the tag value.

8.7.4.2 DecreaseTag

Application

Subtracts the given value from the tag values.

X = X - a

Note

The system function uses the same tag as input and output values. Work with an auxiliary tag if you want to use this system function to convert a value. The auxiliary tags can be assigned to the tag value with the "SetTag" system function.

If you configure the function on the events of an alarm and the tag is not being used in the current screen, it is not ensured that the actual value of the tags is being used in the PLC. You can improve the situation by setting the "Cyclic continuous" acquisition mode.

Syntax

DecreaseTag (Tag, Value)

Useable in script: yes (DecreaseTag), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Tag

The tag from which the given value is subtracted.

Value

The value which is subtracted.

8.7.4.2 ChangeConnection

Application

Disconnects the connection to the currently used PLC in use and establishes a connection to a PLC with another address.

Note

When changing to another address, ensure that the address is not already being used by another HMI device.

The following address types are supported:

- IP address

The following PLC types are supported:

- SIMATIC S7 1200

Syntax

ChangeConnection (Connection, Address, Slot, Rack)

Useable in script: yes (ChangeConnection), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Connection

Name of the connection to be disconnected. The name is set during configuration, for example, in the "Connections" editor.

Address

IP address of the PLC to which the connection is to be established.

Note

Use a tag to specify the address. The object list shows you tags of all data types. Only select tags of the following data types:

- Ethernet connection: "String" data type

Slot

Slot of the PLC to which the connection is to be established.

Rack

Rack of the PLC to which the connection is to be established.

Application example

Objective

You want to operate one HMI device on several machines. Configure the necessary PLCs in the project, to which you want to change by pressing a key. When changing the PLC, the connection to the PLC in use is disconnected. Then the connection to the new PLC with other address parameters is reestablished. To be able to access the values of the new PLC, the same tags are to be configured for the PLC used.

The PLC which was given when creating the project is used as default.

1. Enter the name and address of the PLC in the "Connections" editor.
2. Configure a button in the process screen.
3. Configure the "ChangeConnection" system function on the "Press" event.
4. Enter the name of the connection and address of the PLC as parameters.

8.7.4.2 ShowLogonDialog

Application

Opens a dialog on the HMI device with which the user can log on to the HMI device.

Syntax

ShowLogonDialog

Useable in script: No

Parameters

--

See also

Device-based dependency of system functions (Page 1341)

8.7.4.2 ShowOperatorNotes

Application

Displays the configured info text of the selected object.

If the function is configured on a funktion key, the help text for the screen object that currently has the focus is displayed. If operator notes are configured for the screen itself, you can switch to this text by pressing <Enter> or by double-clicking on the help window.

If the function is configured on a button, only the help text for the current screen is displayed. If a help text is configured on the button itself, initially only the help text for the button will be displayed. You can press <Enter> or double-click on the help window to switch to the operator notes for the current screen.

Note

No other screen object can be used while the help window is open. To use the screen object, close the help window.

Closing the help window

You can close the help window in the following ways:

Using the keys:

- By pressing the <HELP> key again
- By pressing the <ESC> key

Using the touch screen:

- By pressing the ❎ button

Syntax

ShowOperatorNotes (Display mode)

Useable in script: yes (ShowOperatorNotes), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Display mode

Determines whether the configured help text is hidden or shown:

0 (hmiOff) = Off: Configured help text is hidden

1 (hmiOn) = On: Configured help text is shown

-1 (hmiToggle) = Toggle: Toggles between the two modes

8.7.4.2 ShowAlarmWindow

Application

Hides or shows the alarm window on the HMI device.

Syntax

ShowAlarmWindow (Object name, Display mode)

Useable in script: yes (ShowAlarmWindow), if the configured device supports scripts. Additional information is available under Device-based dependency of system functions (Page 1341) .

Parameters

Object name

Name of the alarm screen which is hidden or shown.

Display mode

Determines whether the alarm window is hidden or shown:

0 (hmiOff) = Off: Alarm screen is hidden

1 (hmiOn) = On: Alarm screen is shown

-1 (hmiToggle) = Toggle: Toggles between the two modes

8.7.4.3 Events

8.7.4.3 Cleared

Description

Occurs when the active screen on the HMI device is cleared.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Loaded

Description

Occurs when all configured display and operating objects are loaded in the active screen after a screen change.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

Note

Enable a screen change to ensure that the connection with the control is established after switch-on.

8.7.4.3 Enable

Description

Occurs when the user selects a display or operating object using the configured tab sequence.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

Note

If the user e.g. clicks a button with the mouse, the "Click" event is triggered. Users wishing to trigger the "Enable" event must select the button using the tab key.

8.7.4.3 Adjust

Description

Occurs if the status of a display and operator control object changes.

The status of an object changes if, for example, the user presses the key.

Note

Please note that the availability of the event depends on the HMI device and object type.

8.7.4.3 When dialog is opened

Description

The event is triggered when a modal dialog opens.

Note

Please note that the availability of the event depends on the HMI device and object type.

8.7.4.3 When dialog is closed

Description

The event is triggered when a modal dialog closes.

Note

Please note that the availability of the event depends on the HMI device and object type.

8.7.4.3 User change

Description

Occurs when a user logs off at an HMI device or another user logs on at the HMI device.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Screen change

Description

Occurs when all configured display and operating objects are loaded in the screen after a screen change.

Use the "Loaded" event if you want to perform other system functions during a screen change to a certain screen.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Disabling

Description

Occurs when the user takes the focus from a display and operating object.

A screen object can be disabled using the configured tab order or by performing another action with the mouse.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

Note

System functions or scripts on the "Deactivate" event of a screen are not executed when a screen is being closed.

8.7.4.3 Pressing

Description

Occurs when the user clicks on a button with the left mouse button, presses <RETURN> or <SPACE>.

Occurs when the user right-clicks on an object from the symbol library.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Outgoing

Description

Occurs when an alarm is deactivated.

Note

Please note that the availability of the event depends on the HMI device and object type.

8.7.4.3 Incoming

Description

Occurs when an alarm is triggered and displayed in the alarm view.

Note

Please note that the availability of the event depends on the HMI device and object type.

8.7.4.3 Limit "high limit error" violated

Description

Occurs when the limit "high limit error" of a tag is exceeded.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Limit "low limit error" violated

Description

Occurs when the limit "low limit error" of a tag is violated.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Click

Description

Occurs if the user clicks a display and operating object with the mouse or touches the touch display with a finger.

In case you click the incorrect object, prevent processing of configured function list as follows:

- Move the mouse pointer away from the object while keeping the mouse button pressed. Release the mouse button as soon as the mouse pointer leaves the object. The function list will then not be completed.
- On touch displays, the display must be touched with the finger until a reaction occurs, e.g. a screen change.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Loop-in alarm

Description

Occurs as soon as the user selects an alarm in the alarm view and then clicks on the "Loop-In-Alarm" button or double clicks on the alarm.

Using the event "Loop-In-Alarm" you can configure a system function, e.g. you change to a screen in which the alarm has occurred.

Note

Please note that the availability of the event depends on the HMI device and object type.

8.7.4.3 Releasing

Description

Occurs when the user releases a button.

This even does not occur, as long as the button remains pressed.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Alarm buffer overflow

Description

Occurs when the configured size of the alarm buffer is reached.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Acknowledging

Description

Occurs when the user acknowledges an alarm.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Runtime stop

Description

Occurs when the user exits the runtime software on the HMI device.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

Note

No script may be configured on the "Runtime Stop" event.

8.7.4.3 Pressing the key

Description

Occurs when the user presses a key on the keyboard.

The keys <F10> and <ALT+PRINT> are not used by the operator for process operations.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Releasing the key

Description

Occurs when the user releases a key on the keyboard.

The keys <F10> and <ALT+PRINT> are not used by the operator for process operations.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Switching

Description

Occurs when the user toggles a display and operating object, e.g. a switch from "ON" to "OFF".

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.7.4.3 Value change

Description

Occurs when the value of an object or the value of an array element changes.

The value change of a tag is triggered by the PLC or by the user, e.g. when a new value is entered.

Note

Please note that the availability of the event is dependent upon the HMI device and object type.

8.8 Working with the Scheduler

8.8.1 Field of application of the Scheduler

Definition

You can use the Scheduler to configure tasks to be run in the background. You create tasks by linking system functions to a trigger. When the triggering event occurs, the linked function is executed.

Application example

The Scheduler is used to execute event-controlled tasks automatically. For example, you can use a task to automate the monitoring of user actions.

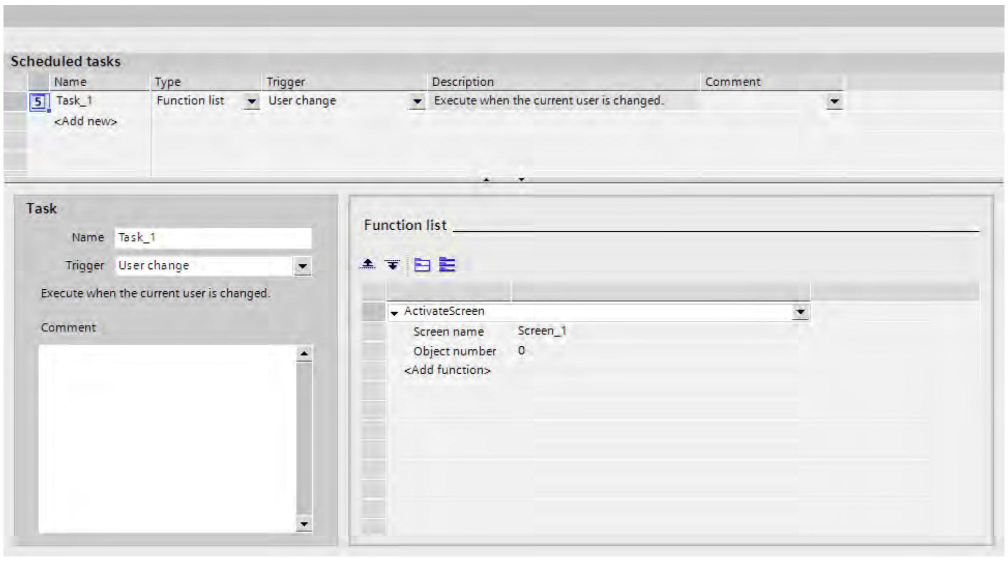
See also

Working with tasks and triggers (Page 1396)
Scheduler (Page 1397)
Example: Update user following change of user (Page 1401)

8.8.2 Working with tasks and triggers

Introduction

A task consists of a trigger and a task type.



Scheduled tasks

Name	Type	Trigger	Description	Comment
Task_1	Function list	User change	Execute when the current user is changed.	
<Add new>				

Task

Name: Task_1

Trigger: User change

Execute when the current user is changed.

Comment

Function list

ActivateScreen

Screen name	Screen_1
Object number	0

<Add function>

Figure8-1

Starting a task

Controlled by a trigger, the Scheduler starts the task linked to the trigger.

See also

Field of application of the Scheduler (Page 1396)
Example: Update user following change of user (Page 1401)

8.8.3 Elements and basic settings

8.8.3.1 Scheduler

Introduction

In the Scheduler, you plan a task by configuring a task type with a trigger.
Open

Double-click on "Scheduler" to open it in the project view.

Work area

The work area shows the planned tasks.

See also

Work area of the "Scheduler" editor (Page 1398)
Planning tasks with event triggers (Page 1400)
Field of application of the Scheduler (Page 1396)
Function list (Page 1399)

Triggers (Page 1399)
Example: Update user following change of user (Page 1401)

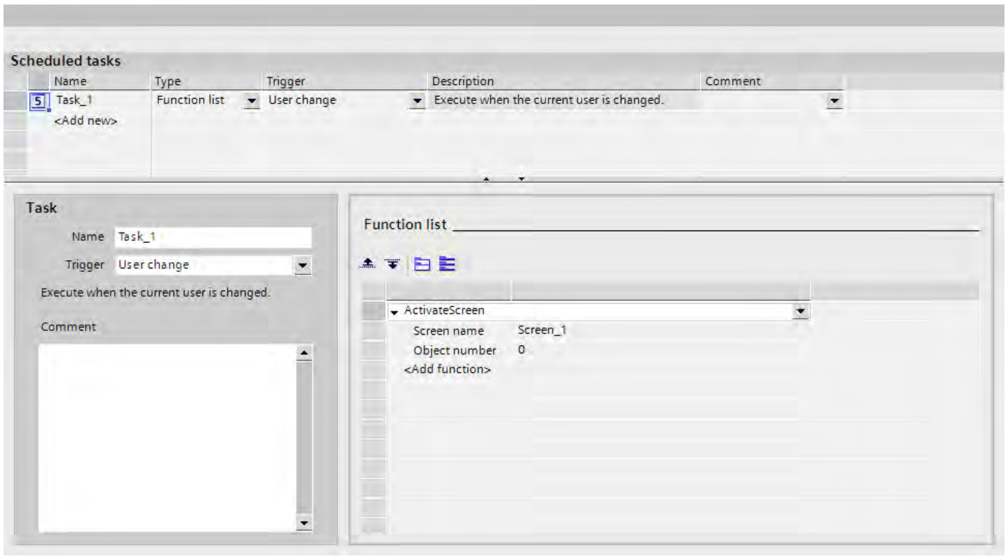
8.8.3.2 Work area of the "Scheduler" editor

Introduction

The work area shows the planned tasks, which consist of the trigger and the task type, such as the function list.

Structure

The work area consists of the table of tasks, the "Scheduler" area and the function list.



Scheduled tasks

Name	Type	Trigger	Description	Comment
Task_1	Function list	User change	Execute when the current user is changed.	
<Add new>				

Task

Name: Task_1
Trigger: User change
Execute when the current user is changed.
Comment

Function list

ActivateScreen
Screen name: Screen_1
Object number: 0
<Add function>

The table of tasks shows specified tasks with their properties, such as triggers. You select a task type and a trigger. You assign a name and a comment to the task. The Scheduler compiles a description of the task.

The "Scheduler" area also shows the task along with the trigger. The "Scheduler" area differs depending on the trigger selected.

Use the function list to configure the system functions that will be executed in the task.

Note

The compiled description provides a written summary of the task including the timing for the task. You can obtain more detailed information about the elements of the user interface using the tooltips. To do this, move the mouse pointer over the selected element.

See also

Scheduler (Page 1397)
Example: Update user following change of user (Page 1401)
System functions (Page 1344)

8.8.3.3 Function list

Function list

A trigger starts the function list. The function list is executed line-for-line. Each line contains a system function. You can configure exactly one function list for each task.

Note

The choice of configurable system functions in a function list is dependent on the selected HMI device.

See also

Scheduler (Page 1397)
Example: Update user following change of user (Page 1401)

8.8.3.4 Triggers

Introduction

A trigger is linked to a task and forms the triggering event for a task. The task is executed when the trigger occurs.

Event trigger

When a task is linked to a system event, the task will be triggered by the event. A runtime stop is a system event, for example.

Deactivated task

Tasks associated with this trigger are temporarily disabled, for example, during reconfiguration. You disable a task in the engineering system and not in runtime.

You also use this trigger to make a previously configured system event available. Example: Task "A" is planned with the system event "Shutdown". This system event is then no longer available for another task "B". Select "Disabled" as the trigger for task "A" to make the "Runtime stop" system event available again.

Note

The system events and triggers available to you depend on the HMI device in use.

See also

Events (Page 1388)
Scheduler (Page 1397)
Example: Update user following change of user (Page 1401)

8.8.3.5 Planning tasks with event triggers

Introduction

You plan a task that generates a screen change when the user changes.

Requirements

- The "Scheduler" work area is open.
- You have created the "Start" screen.

Procedure

1. Click "<Add>" in the table of the task area.
2. Enter "Screen change at user change" as the "Name."
3. Select "User change" as the "Trigger."
4. Click the entry "<Add function>" in the first line of the "Function list" table.
5. Select "Screens/ActivateScreen" as the function.
6. Select the "Start" screen in the screen name field.

Result

The task is executed with the "User change" event. When a new user logs on successfully, the "Start" screen is called up.

See also

Scheduler (Page 1397)
Example: Update user following change of user (Page 1401)

8.8.4 Examples

8.8.4.1 Example: Update user following change of user

Task

Configure an I/O field which displays the logged on user. Configure a task which updates the I/O field when the logged on user changes.

Requirements

- You have created an HMI device with Runtime Advanced and Panels.
- A "CurrentUser" tag of the "String" type is created.
- A screen has been created and opened.
- An I/O field is created in the screen.

Procedure

1. Click on the "I/O field" object.
2. Click the "General" group of the "Properties" tab in the Inspector window.
   - Select "Character string" as the "Display format."
   - Select "CurrentUser" as the "Variable."
   - Select "Output" as the mode.
3. Change to the work area of the Scheduler.
4. Click "Add..." in the table of the task area.
5. Enter "CurrentUser" as the "Name".
6. Select "User change" as the "Trigger."
7. Click the entry "No function" in the first line of the "Function list" table.
8. Select the system function "ReadUserName" from the "User Management" group.
9. Select "CurrentUser" as the "Variable."

Result

When a new user logs on successfully, the "ReadUserChange" function is called up. The "CurrentUser" tag is updated and displayed in the I/O field of the newly logged on user.

If a user does not log on successfully, the logged on user is logged off. The I/O field continues to display the user previously logged on until a new user logs on successfully.

See also

Working with tasks and triggers (Page 1396)
Field of application of the Scheduler (Page 1396)
Scheduler (Page 1397)

Work area of the "Scheduler" editor (Page 1398)
Function list (Page 1399)
Triggers (Page 1399)
Planning tasks with event triggers (Page 1400)

8.9 Working with connections

8.9.1 Basics

8.9.1.1 Basics of communication

Introduction

The data exchange between two communication partners is known as communication. The communication partners can be interconnected via direct cable connection or network.

Communication partners

A communication partner can be any node which is capable of communicating and exchanging data with other nodes on the network. In the WinCC environment, the following nodes can be communication partners:

- Central modules and communication modules in the automation system
- HMI devices and communication processors in the PC

Data transferred between the communication partners may serve different purposes:

- process control
- process data acquisition
- reporting states in a process

See also

Principles of communication (Page 1403)
SNMP and MIB on HMIs (Page 1404)
Configuring a connection (Page 1405)
Area pointers for connections (Page 1411)
Commissioning components (Page 1432)
Networking devices (Page 1404)

8.9.1.2 Principles of communication

Introduction

WinCC controls communication between the HMI device and the PLC using tags and area pointers.

Communication using tags

In WinCC, tags are centrally managed in the "Tag" editor. There are external and internal tags. External tags are used for communication and represent the image of defined memory locations on the PLC. The HMI and the PLC both have read and write access to this storage location. Those read and write operations may cyclic or event-triggered.

In your configuration, create tags that point to specific PLC addresses. The HMI reads the value from the defined address, and then displays it. The operator may also enter values on the HMI device which is then written to the relevant PLC address.

Communication using area pointers

The area pointers are managed centrally in the "Connections" editor. Area pointers are used to exchange data of specific user data areas. Area pointers are parameter fields. In Runtime, WinCC receives information about the location and size of data areas in the PLC from these parameter fields. During communication, the PLC and the HMI device alternately access those data areas for read and write operations. Based on the evaluation of data stored in the data areas, the PLC and HMI device trigger defined actions.

WinCC uses the following area pointers:

- Data record
- Date/time
- Coordination
- Control request
- Date/time PLC
- Project ID
- Screen number

The availability of the various area pointers is determined by the HMI used.

Communication between WinCC and automation systems

Industrial communication using WinCC means that data are exchanged using tags and area pointers. To acquire the data, the HMI sends request messages to the automation system using a communication driver. The automation system (AS) returns the requested data to the HMI in a response frame.

Communication drivers

A communication driver is a software component that develops a connection between an automation system and an HMI device. The communication driver hence enables the tags in WinCC to be supplied with process values.

You can select the interface, the profile, and the transmission speed depending on the employed HMI device and the connected communication partner.

See also

Basics of communication (Page 1402)

8.9.1.3 SNMP and MIB on HMIs

SNMP

The SNMP (Simple Network Management Protocol) is the Internet standard protocol for monitoring network components or terminals, for example HMI devices. SNMP is part of the TCP/IP protocol suite and works in accordance with the client / server model.

SNMP was developed by the Internet Engineering Task Force (IETF). HMI devices support Version 1 (SNMPv1) and community-based SNMP Version 2 (SNMPv2c).

HMI devices have SNMP agents. The SNMP agents give information about the device configuration. This information is managed in a data structure, the Management Information Base (MIB).
MIB

The MIB is a standardized data structure made up of different SNMP tags. The devices use MIB II (RFC1213).

The "public" community is supported for the reading and writing of SNMP tags on HMI devices.

See also

Basics of communication (Page 1402)

8.9.2 Working with connections

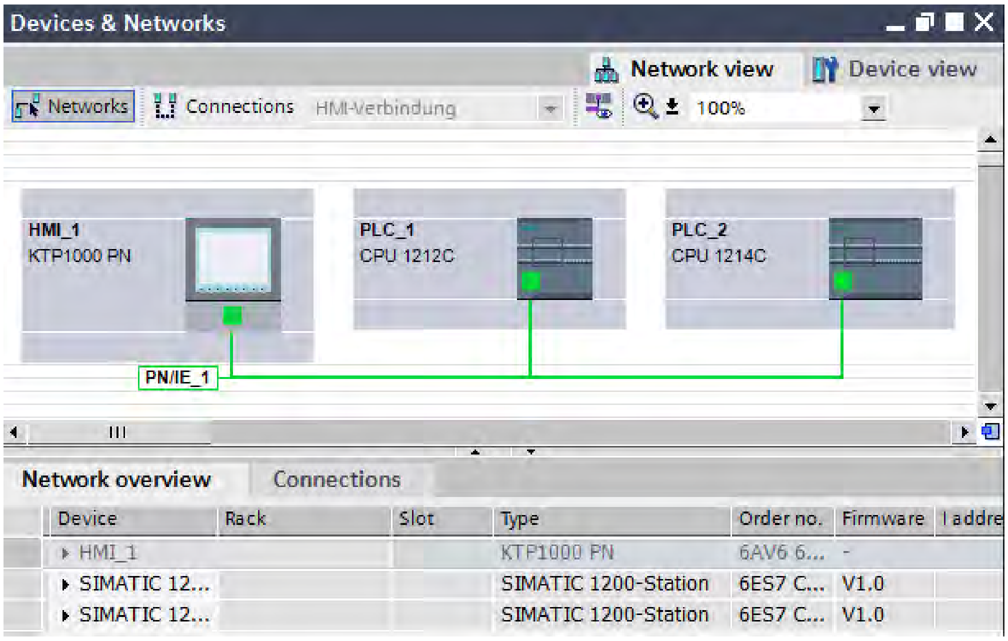
8.9.2.1 Networking devices

Introduction

The "Devices & Networks" editor is provided for configuring connections. You can network devices in the editor. You can also configure and assign parameters to devices and interfaces. You then configure the required connections between the networked devices.

Networking devices

The "Devices & Networks" editor provides a graphics area and a tabular area for network configuration. You can use the graphics area to network the devices in the project with drag-and-drop. The tabular area provides an overview of the devices and their components.



Device	Rack	Slot	Type	Order no.	Firmware	I addre
HMI_1			KTP1000 PN	6AV6 6...	-	
SIMATIC 12...			SIMATIC 1200-Station	6ES7 C...	V1.0	
SIMATIC 12...			SIMATIC 1200-Station	6ES7 C...	V1.0	

The required subnet is created automatically when networking the devices. Consistent address parameters are set automatically for the interfaces.

The network of devices is represented by green lines. The name of the employed subnet is displayed.

See the "Networking devices (Page 220) " section for additional details.

See also

Networking devices (Page 220)
Configuring a connection (Page 1405)
Basics of communication (Page 1402)

8.9.2.2 Configuring a connection

Introduction

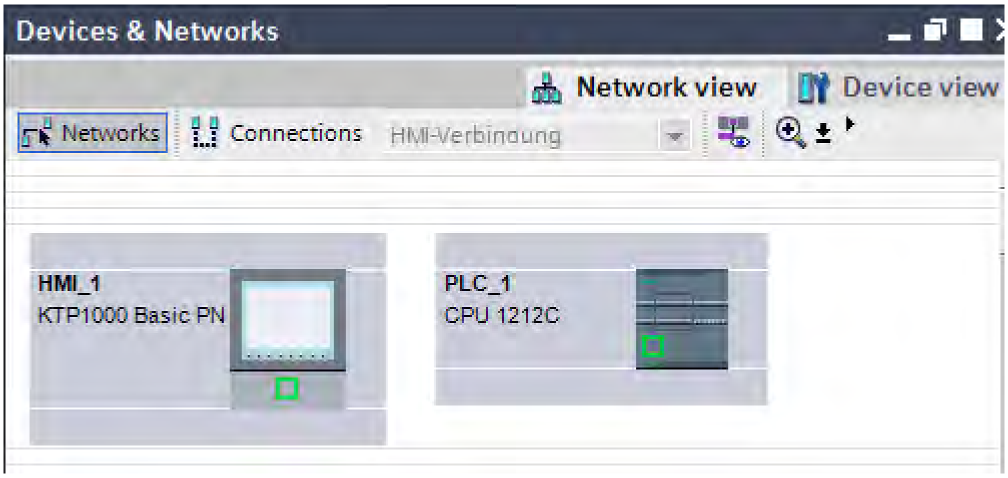
You can configure a connection to a communication partner in the "Devices & Networks" editor. The devices you want to connect must feature the same type of interface.

Requirement

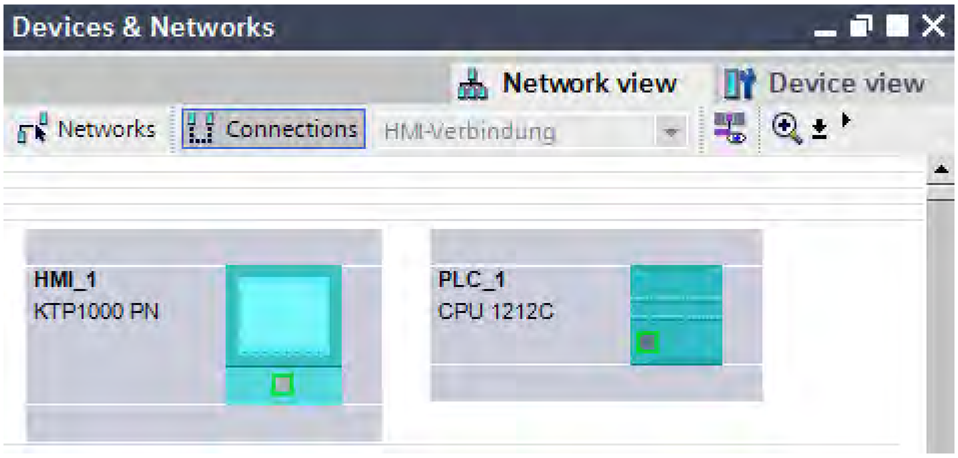
- A project has been created in WinCC and is open.
- The communication partners are inserted into the project.

Procedure

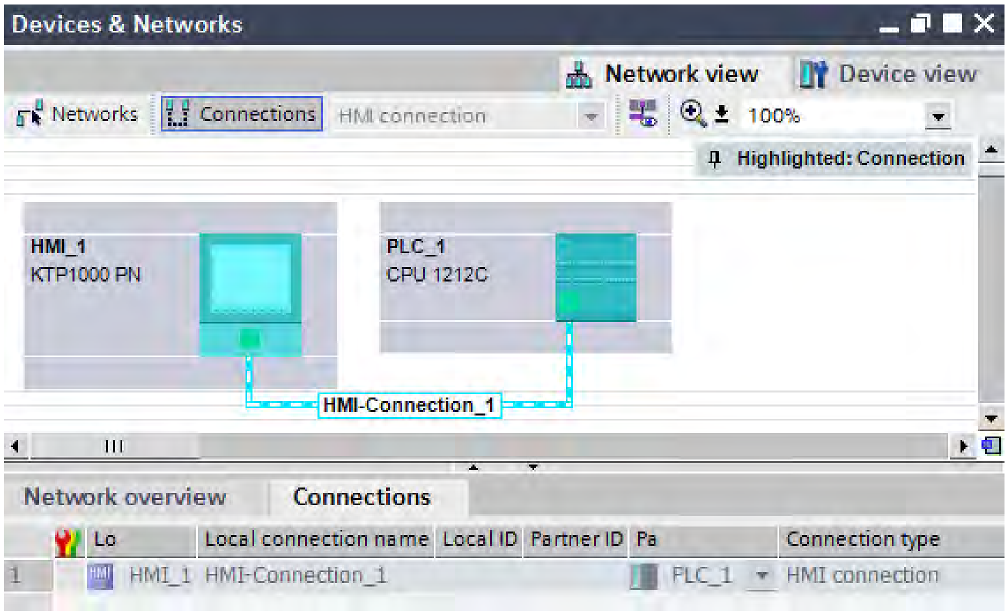
1. Double-click on the "Devices & Networks" item in the project tree. The editor with this name opens.
2. The available communication partners in the project are displayed graphically in the network view.



3. Click the "Connections" tab. The devices available for connection are highlighted in color.

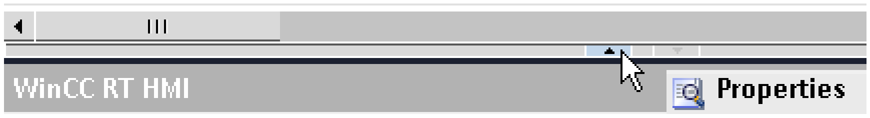


4. Place the mouse pointer on the green square of the first communication partner, hold down the left mouse button and drag a connection to the desired communication partner. The connection is created, the corresponding subnet and the parameters suitable for the connection are created automatically. The connection contains a local connection name as an identifier for unique identification of the connection.



Lo	Local connection name	Local ID	Partner ID	Pa	Connection type
HMI_1	HMI-Connection_1			PLC_1	HMI connection

5. In the network view, click on the green square of a connection partner. The IP address and the subnet mask are displayed in the Inspector window under "Properties > Ethernet addresses". Change the address parameters as required.
6. Repeat step 5 for each additional connection partner.
   To upload the project, you will have to set the same address parameters on the HMI device as in the WinCC project. Additional information is available under Settings for loading (Page 1440) .
   Be sure to remain consistent within the network when making changes.
7. To open the tabular area of the editor, click on the small arrow button in the lower corner of the graphics area.



8. The created connection is also shown in the tabular area of the editor in the "Connections" tab. Use the table to monitor the connection parameters and change the connection partner. You can change the local name for the connection only in the table.
9. Save the project.

You can alternatively configure a connection using the "Create new connection" dialog. To do this, select one of the devices highlighted in color in the graphics area of the "Connections" tab and select the "Create new connection" command from the shortcut menu.

Result

A new connection has been created. The connection parameters have been configured.

Caution
Ethernet communication

In Ethernet-based communication, the end user is responsible for the security of his data network. The proper functioning of the device cannot be guaranteed in all circumstances; targeted attacks, for example, can lead to overload of the device.

See also

Automatic creation of a connection (Page 1408)
Optimizing the configuration (Page 1410)
Networking devices (Page 1404)

8.9.2.3 Automatic creation of a connection

Introduction

You can automatically create and configure a connection between an HMI device and PLC with WinCC.

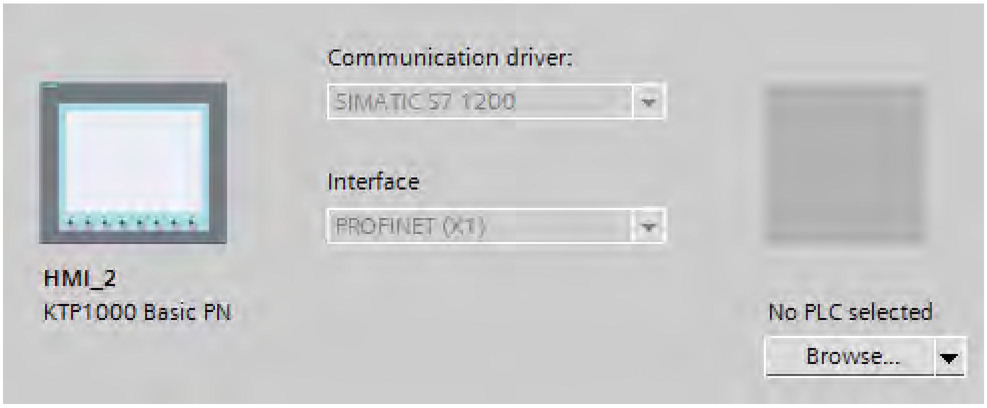
Requirement

- You have created a WinCC project.
- You have opened the project.
- The project contains a SIMATIC PLC.

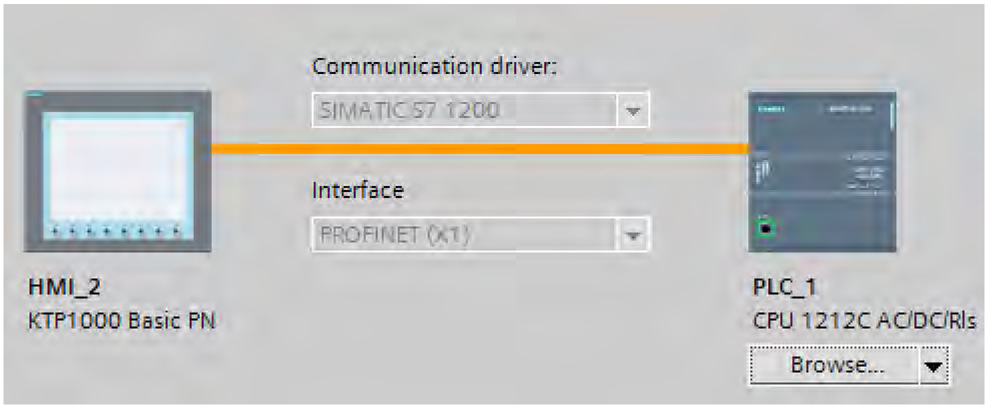
Creating a connection using the device wizard

1. In the portal view, click "Start > Visualization" and then click the

   button to open the "Add new device" dialog.
2. Select the desired HMI device and select the "Start Device Wizard" option.
3. Click "OK." The device wizard opens.


Communication driver: SIMATIC S7 1200
Interface: PROFINET (X1)
HMI_2
KTP1000 Basic PN
No PLC selected

4. Open the selection dialog on the "PLC connections" page and select the SIMATIC PLC.
5. Confirm the selection of the PLC. The connection between the devices is created.

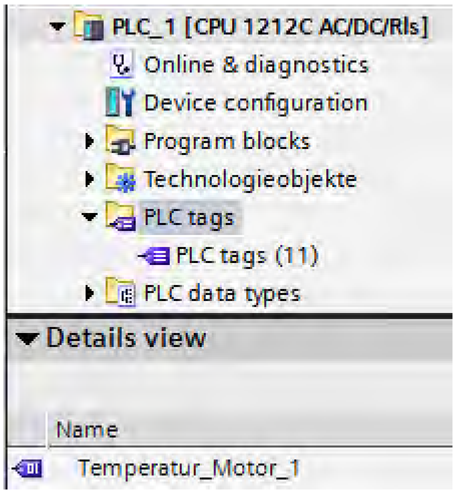


6. Make additional settings in the device wizard as required and click "Finish".
   The settings from the device wizard are applied to the project.

Creating a connection using a PLC tag

If a PLC tag is available in the project, you can use it to automatically create a connection in a screen.

1. Open the desired screen in the "Screens" editor.
2. Select the "PLC tags" folder in the project tree. The existing PLC tags are shown in the Details view.



3. Drag the PLC tag from the Details view into the open screen.
   An I/O field is created in the screen and linked to the PLC tag via an HMI tag. A connection is also automatically created between the HMI device and PLC.

See also

Configuring a connection (Page 1405)

8.9.2.4 Optimizing the configuration

Acquisition cycle and update time

The acquisition cycles for the "Area pointers" and tags defined in the engineering software are decisive factors for the update times which can actually be achieved.

The update time is equivalent to the acquisition cycle + transmission time + processing time.

To achieve optimum update times, remember the following points during configuration:

- Set up the minimum and maximum size of the various data areas to suit requirements.
- Define associated data areas. You can improve the update time by setting up one large data area instead of several small areas.
- If the acquisition cycles you select are too short, this is detrimental to the overall performance. Set the acquisition cycle to suit the rate of change of the process values. The rate of temperature changes at a furnace, for example, is significantly slower compared to the speed rate of an electrical drive. Guideline value of the acquisition cycle: approx. 1 s.
- To improve update times, you could do without the cyclic transfer of large numbers of tags. Enter "On request" as the acquisition cycle. Instead of the cyclic transfer, use a deliberate, spontaneous, event-controlled transfer of tags (Job mailbox).
- Write the tags of an alarm or a screen without gaps to a single data area.
- To allow changes in the PLC to be recognized reliably, the changes must be available at least during the actual acquisition cycle.
- Set the transmission rate to the highest possible value.

Screens

The actually feasible update rate of screens depends on the data type and volume to be visualized.

Configure short acquisition cycles only for objects which actually require shorter refresh cycles.

Trends

When using bit-triggered trends, if the group bit is set in the "Trend transfer area", the HMI device always updates all the trends whose bit is set in this area. It then resets the bits.

The group bit in the S7 program can only be set again after all bits have been reset by the HMI.

Note

Availability for specific devices

Bit-triggered trends are not available on Basic Panels.

Job mailboxes

A large transfer volume of job mailboxes transferred rapidly and in succession, may cause an overload in the communication between the HMI and the PLC.

The HMI device confirms acceptance of the Job mailbox by entering the value zero in the first data word of the job mailbox. The HMI now processes the job, for which it requires further time.

If a new job is entered again immediately in the job mailbox, it may take some time before the HMI device can process the next job. The next Job mailbox will not be accepted unless the system provides sufficient computing capacity.

Timeout response with TCP/IP (Ethernet)

Due to the use of the TCP/IP protocol, the breakdown of a connection is detected at the earliest after approximately one minute. Communication failure cannot be reliably detected if no tags are requested, for example, no output tags in the current screen.

Configure area pointer coordination for each PLC. This ensures that a communication failure is recognized after approximately two minutes, even in the aforementioned scenario.

See also

Configuring a connection (Page 1405)

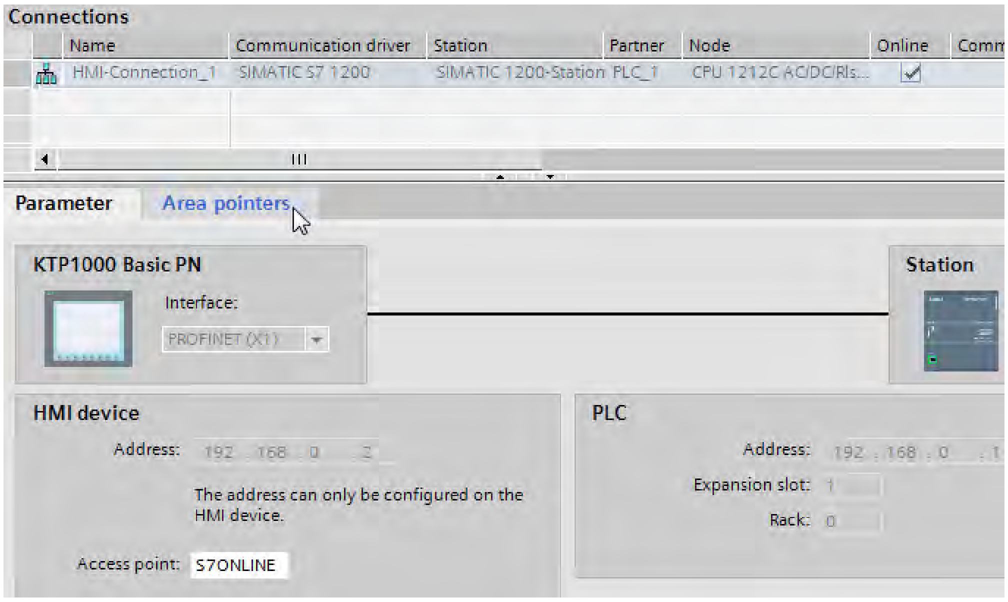
8.9.3 User data area

8.9.3.1 Area pointers for connections

Introduction

Using the "Area pointer" tab of the "Connections" editor, you can configure the usage of the available area pointers.

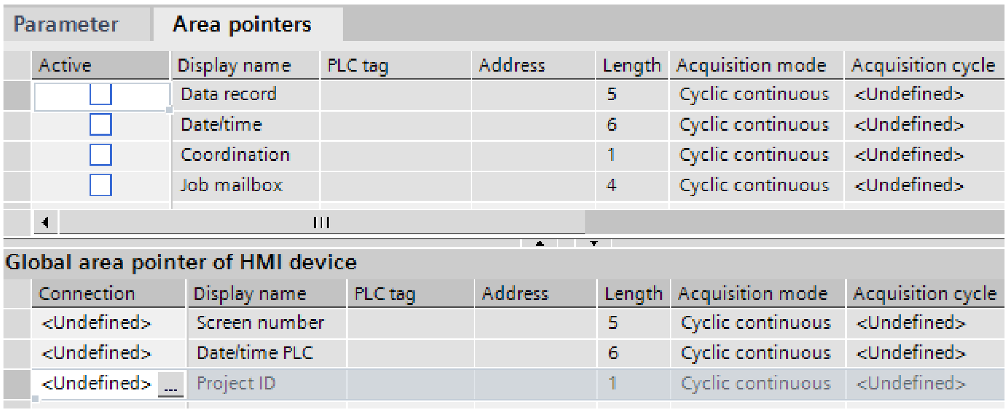
To configure the area pointers, open the "Connections" editor and open the "Area pointer" tab.



Structure

The "Area pointer" tab contains two tables of area pointers. The top part of the table contains the area pointers you can create and enable separately for each available connection.

The "Global area pointers of HMI device" table contains the area pointers which are created only once in the project and can be used for only one connection.



Active	Display name	PLC tag	Address	Length	Acquisition mode	Acquisition cycle
☐	Data record			5	Cyclic continuous	<Undefined>
☐	Date/time			6	Cyclic continuous	<Undefined>
☐	Coordination			1	Cyclic continuous	<Undefined>
☐	Job mailbox			4	Cyclic continuous	<Undefined>

Global area pointer of HMI device

Connection	Display name	PLC tag	Address	Length	Acquisition mode	Acquisition cycle
<Undefined>	Screen number			5	Cyclic continuous	<Undefined>
<Undefined>	Date/time PLC			6	Cyclic continuous	<Undefined>
<Undefined> ...	Project ID			1	Cyclic continuous	<Undefined>

See "General information on area pointers (Page 1414) " for additional information.

See also

Basics of communication (Page 1402)
Configuring area pointers (Page 1412)

8.9.3.2 Configuring area pointers

Introduction

You use the area pointer to access a data area in the PLC. The data area is saved in the PLC. Set up the data area as tag array in a global data block or an instance data block for area pointers with a length >= 1. You have the option to use a PLC tag for area pointers with a length = 1. The configuration of the tags in a data block is based on the length of the area pointer you want to use. The unit for the length of an area pointer is a 16-bit word. If, for example, you want to use an area pointer with a length of "5", you need to create an array of 5 array elements in the data block. See "Programming data blocks" in the "Programming the PLC" section for additional details.

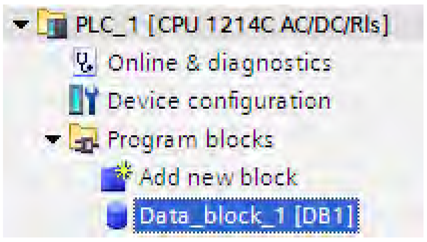
Requirement

- The project contains a PLC.
- A connection is configured between the PLC and the HMI device.
- The PLC program contains a global data block.

Procedure

To configure an area pointer, proceed as follows:

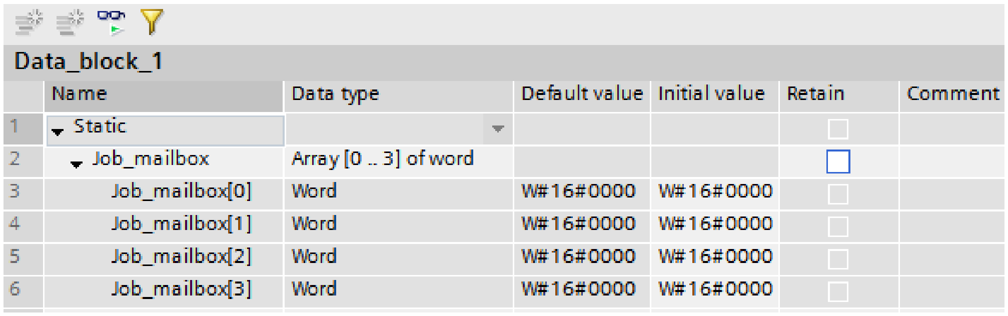
1. Expand the view of the PLC in the project tree, open the "Program blocks" folder and double-click on the global data block. The data block opens.



2. Enter a tag name in the "Name" column.
3. Select "Array[lo .. hi] of type" as the data type in the "Data type" column. Replace the "lo" and "hi" entries in the brackets with the high and low values for the dimensions of the array.

   Example: If you configure an area pointer with the length "4", enter the value "0" for "lo" in the brackets and the value "3" for "hi".
4. Replace the "type" designation with the "word" data type. The full data type for an array of 4 tags appears as follows: "Array[0 .. 3] of word".

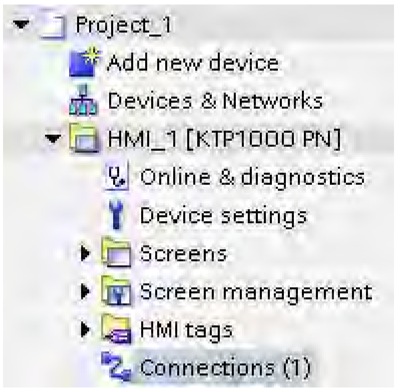
   The tag array is created after the entry is confirmed.



Data_block_1

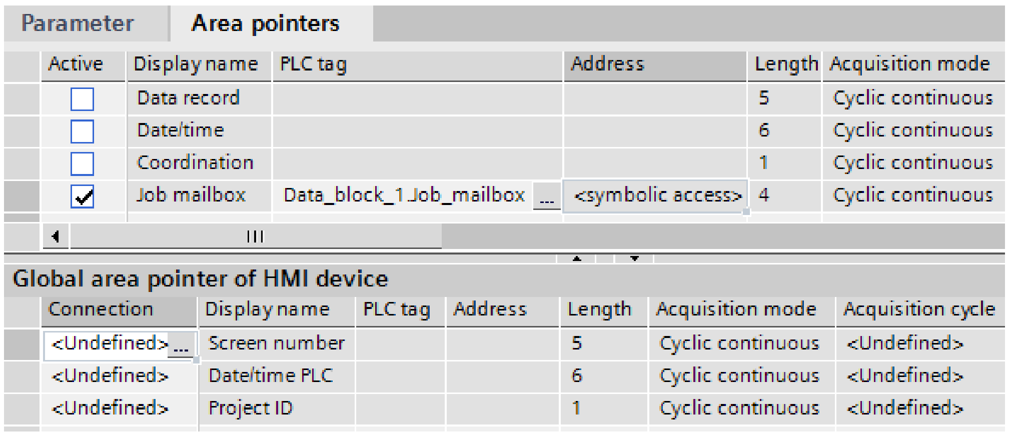
	Name	Data type	Default value	Initial value	Retain	Comment
1	Static				☐	
2	Job_mailbox	Array [0 .. 3] of word			☐	
3	Job_mailbox[0]	Word	W#16#0000	W#16#0000	☐	
4	Job_mailbox[1]	Word	W#16#0000	W#16#0000	☐	
5	Job_mailbox[2]	Word	W#16#0000	W#16#0000	☐	
6	Job_mailbox[3]	Word	W#16#0000	W#16#0000	☐	

5. Select the PLC in the project tree and select the "Compile > Software" command in the shortcut menu. The data block is compiled. Following compilation, the tag array is available for further use in the project.
6. Expand the view of the HMI device in the project tree and double-click the "Connections" entry. The "Connections" editor opens.



7. Open the "Area pointer" tab and enable the desired area pointer. A global area pointer is enabled by selecting the connection in the "Connection" field.

8. Click the navigation button in the "PLC tag" field. The object list opens. Navigate to the data block in the object list and select the tag in the right window.



Parameter | Area pointers

Active	Display name	PLC tag	Address	Length	Acquisition mode
☐	Data record			5	Cyclic continuous
☐	Date/time			6	Cyclic continuous
☐	Coordination			1	Cyclic continuous
✓	Job mailbox	Data_block_1.Job_mailbox ...	<symbolic access>	4	Cyclic continuous

Global area pointer of HMI device

Connection	Display name	PLC tag	Address	Length	Acquisition mode	Acquisition cycle
<Undefined> ...	Screen number			5	Cyclic continuous	<Undefined>
<Undefined>	Date/time PLC			6	Cyclic continuous	<Undefined>
<Undefined>	Project ID			1	Cyclic continuous	<Undefined>

You do not need an array tag to configure an area pointer with the length of "1". Select the "Word" data type to create the tag in the data block.

Set additional parameters, such as the acquisition cycle, during the configuration.

Result

The area pointer is enabled and linked to the PLC tag in the global data block.

See also

Area pointers for connections (Page 1411)

8.9.3.3 Area pointer

8.9.3.3 General information on area pointers

Introduction

You use the area pointer to access a data area in the PLC. The PLC and the HMI device interactively communicate read and write data for these data areas . The PLC and the HMI device trigger defined interactions based on the evaluation of stored data.

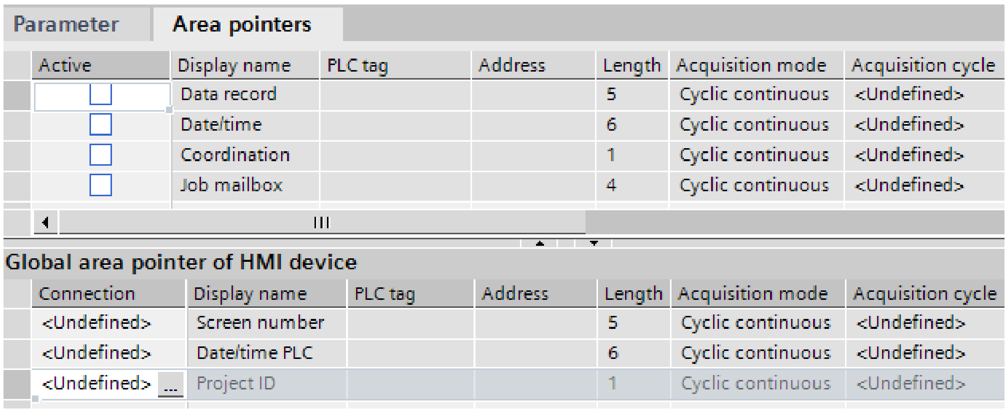
The Basic Panels support the following area pointers:

- Job mailbox
- Project ID
- Screen number
- Data record
- Date/time
- Date/time PLC

- Coordination

Application

Configure and enable the area pointer in "Connections ▸ Area Pointer" before you put it into use.



Active	Display name	PLC tag	Address	Length	Acquisition mode	Acquisition cycle
☐	Data record			5	Cyclic continuous	<Undefined>
☐	Date/time			6	Cyclic continuous	<Undefined>
☐	Coordination			1	Cyclic continuous	<Undefined>
☐	Job mailbox			4	Cyclic continuous	<Undefined>

Global area pointer of HMI device

Connection	Display name	PLC tag	Address	Length	Acquisition mode	Acquisition cycle
<Undefined>	Screen number			5	Cyclic continuous	<Undefined>
<Undefined>	Date/time PLC			6	Cyclic continuous	<Undefined>
<Undefined>	Project ID			1	Cyclic continuous	<Undefined>

- Active

  Enables the area pointer.
- Display name

  Name of the area pointer specified by WinCC.
- Control variable

  This is where you select the PLC tag of the tag array that you have configured as the data area for the area pointer.
- Address

  No address is entered into this field because of the symbolic access.
- Length

  WinCC specifies the length of the area pointer.
- Acquisition cycle

  Define an acquisition cycle in this field to allow cyclic reading of the area pointer by the HMI device. An extremely short acquisition time may have a negative impact on HMI device performance.
- Comment

  Save a comment, for example, to describe the purpose of the area pointer.

Accessing data areas

The table shows how the PLC and HMI device handle read (R) and write (W) access to the data areas.

Data area	Required for	HMI device	PLC
Screen number	Evaluation by the PLC in order to determine the active screen.	W	R
Data record	Transfer of data records with synchronization	R/W	R/W

Data area	Required for	HMI device	PLC
Date/time	Transfer of the date and time from the HMI device to the PLC	W	R
Date/time PLC	Transfer of the date and time from the PLC to the HMI device	R	W
Coordination	Requesting the HMI device status in the control program	W	R
Project ID	Runtime checks the consistency between the WinCC project ID and the project in the PLC.	R	W
Job mailbox	Triggering of HMI device functions by the control program	R/W	R/W

The next sections describe the area pointers and their associated job mailboxes.

See also

Area pointer "Screen number" (Page 1416)
Area pointer "Project ID" (Page 1420)
Area pointer "Job mailbox" (Page 1421)
"Data mailbox" area pointer (Page 1424)
Area pointers for connections (Page 1411)
Configuring area pointers (Page 1412)
Area pointer "Date/time" (Page 1417)
Area pointer "Date/time PLC" (Page 1418)
Area pointer "Coordination" (Page 1419)

8.9.3.3 Area pointer "Screen number"

Function

The HMI devices store information on the screen called up on the HMI device in the "Screen number" area pointer.

This allows the transfer of the current screen contents from the HMI device to the PLC. The PLC can trigger specific reactions such as the call of a different screen.
Application

Before the "Screen number" area pointer can be used, it must be set up and activated by selecting "Communication ▸ Area pointer". You can create only **one** instance of the "Screen number" area pointer and only on **one** PLC.

The screen number is transferred spontaneously to the PLC. That is, it is always transferred when a new screen is activated on the HMI device. The configuration of an acquisition cycle is therefore unnecessary.
Structure

The area pointer is a data area in the memory of the PLC with a fixed length of 5 words.

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1. Word	Current screen type															
2. Word	Current screen number															
3. Word	Reserved															
4th word	Current field number															
5. Word	Reserved															

- Current screen type

  "1" for root screen or
  "4" for permanent window
- Current screen number

  1 to 32767
- Current field number

  1 to 32767

Note
Availability for specific devices

Permanent windows are not available on Basic Panels.

See also

General information on area pointers (Page 1414)

8.9.3.3 Area pointer "Date/time"

Function

This area pointer is used to transfer the date and time from the HMI device to the PLC.

The PLC writes the control job "41" to the job mailbox.

When it evaluates the control job, the HMI device writes its current date and the time in the data area configured in the "Date/time" area pointer.

Use data type "DTL" with communication driver S7 1200. A tag of the "DTL" data type has a length of 12 bytes and saves information on date and time in a predefined structure.

The "DTL" data type has the following structure:

Byte	Component	Data type	Value range
0	Year	UINT	1970 to 2554
1			
2	Month	USINT	0 to 12
3	Tag	USINT	1 to 31
4	Day of week	USINT	1(Sunday) to 7(Saturday) The weekday is not considered in the value entry.
5	Hour	USINT	0 to 23
6	Minute	USINT	0 to 59
7	Second	USINT	0 to 59
8	Nanoseconds	UDINT	0 to 999 999 999
9			
10			
11			

See also

General information on area pointers (Page 1414)

8.9.3.3 Area pointer "Date/time PLC"

Function

This area pointer is used to transfer the date and time from the PLC to the HMI device. Use this area pointer if the PLC is the time master.

The PLC loads the data area of the area pointer.

The HMI device reads the data cyclically within the configured acquisition cycle and synchronizes itself.

Note

Set an acquisition cycle of sufficient length for the date/time area pointer PLC to avoid any negative impact on HMI device performance.
Recommended: Acquisition cycle of 1 minute, if the process allows this.

Date/time PLC is a global area pointer and can be configured only once in a project.

Use data type "DTL" with communication driver S7 1200. A tag of the "DTL" data type has a length of 12 bytes and saves information on date and time in a predefined structure.

The "DTL" data type has the following structure:

Byte	Component	Data type	Value range
0	Year	UINT	1970 to 2554
1			
2	Month	USINT	0 to 12
3	Tag	USINT	1 to 31
4	Day of week	USINT	1(Sunday) to 7(Saturday) The weekday is not considered in the value entry.
5	Hour	USINT	0 to 23
6	Minute	USINT	0 to 59
7	Second	USINT	0 to 59
8	Nanoseconds	UDINT	0 to 999 999 999
9			
10			
11			

The HMI devices do not support the use of nanoseconds. Values in the nanosecond range will be ignored during processing in Runtime.

See also

General information on area pointers (Page 1414)

8.9.3.3 Area pointer "Coordination"

Function

The "Coordination" area pointer is used to implement the following functions:

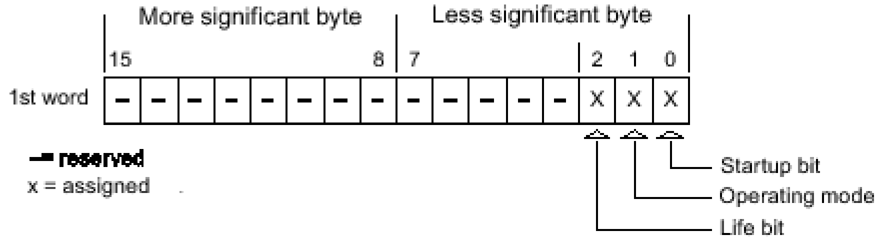
- Detecting the startup of the HMI device in the control program
- Detecting the current operating mode of the HMI device in the control program
- Detecting whether the HMI device is ready to communicate in the control program

The "Coordination" area pointer has a length of one word.
Application

Note

Each time the area pointer is updated by the HMI device, the entire coordination area is always written.
For this reason, the PLC program must not make any changes in the coordination area.

Assignment of the bits in the "Coordination" area pointer



Startup bit

The startup bit is set briefly to "0" by the HMI device during startup. After startup, the bit is set permanently to "1".

Operating mode

As soon as the HMI device is switched offline by the user, the operating mode bit is set to 1. In normal operation of the HMI device, the state of the operating mode bit is "0". You can find out the current operating mode of the HMI device by querying this bit.

Life bit

The life bit is inverted by the HMI device at intervals of approximately one second. By querying this bit in the PLC program, you can check whether or not the connection to the HMI device still exists.

Processing in the PLC

For a simpler evaluation in the PLC program, use a Bool array for this area pointer when using the SIMATIC S7 1200 communication driver. You will have to map the complete 16-bit word of the area pointer. Configure a tag of the data type "Array [0 .. 15] of bool" for this purpose.

See also

General information on area pointers (Page 1414)

8.9.3.3 Area pointer "Project ID"

Function

When runtime starts it can check to see if the HMI device is connected to the correct PLC. This check is important when operating with several HMI devices.

The HMI device compares a value stored on the PLC with the value specified in the configuration data. This ensures the compatibility of the configuration data and the PLC program.

A missing compatibility results in a corresponding alarm and Runtime will not be started.

Application

In order to use this area pointer you must set up the following during the configuration:

- Specify the version of the configuration data. Possible values between 1 and 255.

  Enter the version in the "Device settings ▸ Screens" editor under "Project ID".
- This is where you select the PLC tag or the tag array that you have configured as the data area for the area pointer.

Connection failure

A connection failure to a device on which the "project ID" area pointer is configured results in all the other connections in the project being switched to "offline".

This behavior has the following requirements:

- You have several connections configured in a project.
- You are using the "project ID" area pointer in at least one connection.

Causes which may set connections "offline":

- The PLC is not available.
- The connection has been switched to offline in the engineering system.

See also

General information on area pointers (Page 1414)

8.9.3.3 Area pointer "Job mailbox"

Function

The PLC can use the job mailbox to transfer jobs to the HMI device to trigger corresponding actions on the HMI device. These functions include, for example:

- Display screen
- Set date and time

Data structure

The first word of the job mailbox contains the job number. Depending on the job mailbox, up to three parameters can be transferred.

Word	Most significant byte	Least significant byte
n+0	0	Job number
n+1	Parameter 1	

Word	Most significant byte	Least significant byte
n+2	Parameter 2	
n+3	Parameter 3	

The HMI device evaluates the job mailbox if the first word of this job is unequal to zero. This means that the parameters must be entered in the job mailbox first, followed by the job number.

When the HMI device accepts the job mailbox, the first word is set to 0 again. The execution of the job mailbox is generally not completed at this point in time.

Job mailboxes

All job mailboxes and their parameters are listed below. The "No." column contains the job number of the job mailbox. Job mailboxes can only be triggered by the PLC when the HMI device is online.

No.	Function	
14	**Set time (BCD-coded)**	
	Parameter 1	Left byte: - Right byte: hours (0-23)
	Parameter 2	Left byte: minutes (0-59) Right byte: seconds (0-59)
	Parameter 3	-
15	**Set date (BCD-coded)**	
	Parameter 1	Left byte: - Right byte: weekday (1-7: Sunday-Saturday)
	Parameter 2	Left byte: day (1-31) Right byte: month (1-12)
	Parameter 3	Left byte: year
23	**User login**	
	Logs the user on with the name "PLC user" at the HMI device with the group number transferred in parameter 1. The logon is possible only when the transferred group number exists in the project.	
	Parameter 1	Group number 1 - 255
	Parameter 2, 3	-
24	**User logoff**	
	Logs off the currently logged on user. The function corresponds to the "logoff" system function)	
	Parameter 1, 2, 3	-
40	**Transferring date/time to PLC**	

No.	Function	
14	**Set time (BCD-coded)**	
	An interval of at least 5 seconds must be maintained between successive jobs to prevent overload of the HMI device.	
	Parameter 1, 2, 3	-
41	**Transferring date/time to PLC**	
	An interval of at least 5 seconds must be maintained between successive jobs to prevent overload of the HMI device.	
	Parameter 1, 2, 3	-
46	**Updating tags**	
	Causes the HMI device to read the current value of the tags from the PLC whose update ID matches the value transferred in parameter 1. (Function corresponds to the "UpdateTag" system function.)	
	Parameter 1	1 - 100
49	**Clear event buffer**	
	Parameter 1, 2, 3	-
50	**Clear error alarm buffer**	
	Parameter 1, 2, 3	-
51	**Display selection**	
	Parameter 1	Screen number
	Parameter 2	-
	Parameter 3	Field number
69	**Reading data record from PLC** 1)	
	Parameter 1	Recipe number (1-999)
	Parameter 2	Data record number (1-65535)
	Parameter 3	0: Do not overwrite existing data record 1: Overwrite existing data record
70	**Writing data record from PLC** 1)	
	Parameter 1	Recipe number (1-999)
	Parameter 2	Data record number (1-65535)
	Parameter 3	-

See also

General information on area pointers (Page 1414)

8.9.3.3 Area pointer "Data record"

8.9.3.3 "Data mailbox" area pointer

Function

When data records are transferred between the HMI device and PLC, both partners access common communications areas on the PLC.

Data transfer types

There are two ways of transferring data records between the HMI device and PLC:

- Transfer without synchronization
- Transfer with synchronization over the data record

Data records are always transferred directly. That is, the tag values are read from an address or written to an address configured for this tag directly, without redirecting the values by means of interim memory.

Initiating the transfer of data records

There are three ways of triggering the transfer:

- Operator input in the recipe view
- Job mailboxes

  The transfer of data records can also be triggered by the PLC.
- Triggering by configured functions

If the transfer of data records is triggered by a job mailbox, the data in the recipe view will be updated as well. Avoid operating the recipe view while PLC jobs for transfer of data records are being triggered. If you have already started editing a data record and a PLC job is triggered for transfer of data records, then this PLC job will be rejected.

See also

General information on area pointers (Page 1414)
Transfer without synchronization (Page 1424)
Transfer with synchronization (Page 1425)
Sequence of a transfer started by the operator in the recipe display (Page 1426)
Sequence of the transfer triggered by a job mailbox SIMATIC S7 (Page 1428)
Sequence of the transfer when triggered by a configured function (Page 1429)
Possible causes of error when transferring data records (Page 1430)

8.9.3.3 Transfer without synchronization

If you select asynchronous transfer of data records between the HMI device and PLC, there is no coordination over the common data areas. It is therefore unnecessary to set up a data area during configuration.

Asynchronous data record transfer can be a useful alternative, for example, when:

- The system is capable of excluding the risk of uncontrolled overwriting of data by the communication peer.
- The PLC does not require information about the recipe number and data record number.
- The transfer of data records is triggered by the operator of the HMI device.

Reading values

When a read job is triggered, the values are read from the PLC addresses and transferred to the HMI device.

- Triggering by the operator in the recipe view:

  The values are downloaded to the HMI device. You can then process, edit, or save these values, for example.
- Triggering by a function or PLC job:

  The values are saved immediately to the data volume.

Writing values

When a write job is triggered, the values are written to the PLC addresses.

- Triggering by the operator in the recipe view:

  The current values are written to the PLC.
- Triggering by a function or PLC job:

  The current values are written to the PLC from the data medium.

See also

"Data mailbox" area pointer (Page 1424)

8.9.3.3 Transfer with synchronization

If you select synchronous transfer, both communication partners set status bits in the common data area. Use this mechanism to prevent uncontrolled overwriting of data in either direction of your control program.

Application

Synchronous data record transfer can be a useful solution, for example, when:

- The PLC is the "active partner" in the transfer of data records.
- The PLC evaluates the information about the recipe number and data record number.
- The transfer of data records is triggered by means of a Job mailbox.

Requirements

In order to synchronize transfer of data records between the HMI device and the PLC, the following requirements must be met during configuration:

- An area pointer has been set up: "Connections ▸ Area pointer" editor.
- The PLC with which the HMI device synchronizes transfer of data records is specified in the recipe: "Recipes" editor, properties view of the recipe in the Inspector window, "Properties ▸ Download" group.

Structure of the data area

The data area has a fixed length of 5 words. Structure of the data area:

	15		0
1. Word	Current recipe number (1 - 999)		
2. Word	Current data record number (0 - 65535)		
3. Word	Reserved		
4. Word	Status (0, 2, 4, 12)		
5. Word	Reserved		

- Status

  The status word (word 4) can adopt the following values:

Value		Meaning
Decimal	Binary	
0	0000 0000	Transfer permitted, data record free
2	0000 0010	Transfer is busy
4	0000 0100	Transfer completed without error
12	0000 1100	Transfer completed with error

See also

"Data mailbox" area pointer (Page 1424)

8.9.3.3 Sequence of a transfer started by the operator in the recipe display

Reading from the PLC started by the operator in the recipe display

Step	Action	
1	Check: Status word = 0?	
	Yes	No
2	The HMI device enters the recipe number to be read and the status "Transfer active" in the data record and sets the data record number to 0.	Abort with system alarm.

Step	Action	
3	The HMI device reads the values from the PLC and displays them in the recipe display. If the recipes have synchronized tags, the values from the PLC are also written to the tags.	
4	The HMI device sets the status "Transfer completed."	
5	The control program must reset the status word to zero in order to enable further transfers.	

Writing to the PLC started by the operator in the recipe display

Step	Action	
	Check: Status word = 0?	
1	Yes	No
	The HMI device enters the recipe and data record number to be written and the status "Transfer active" in the data record.	Abort with system alarm.
2	The HMI device writes the current values to the PLC. If the recipes have synchronized tags, the changed values are synchronized between the recipe display and tags and then written to the PLC.	
3	The HMI device sets the status "Transfer completed."	
4	If required, the control program can now evaluate the transferred data.	
5	The control program must reset the status word to zero in order to enable further transfers.	

Note

The status word may only be set by the HMI device. The PLC may only reset the status word to zero.

Note

The PLC may only evaluate the recipe and data record numbers when data inconsistency is detected if one of the conditions outlined below has been met:

- The data mailbox status is set to "Transfer completed".
- The data mailbox status is set to "Transfer completed with error".

See also

"Data mailbox" area pointer (Page 1424)

8.9.3.3 Sequence of the transfer triggered by a job mailbox SIMATIC S7

The transfer of data records between the HMI device and the PLC can be initiated by either one of these stations.

The two PLC jobs No. 69 and No. 70 are available for this type of transfer.

No. 69: Read data mailbox from PLC ("PLC → DAT")

Job mailbox no. 69 transfers data mailboxes from the PLC to the HMI device. The job mailbox is structured as follows:

	Most significant byte	Least significant byte
Word 1	0	69
Word 2	Recipe number (1-999)	
Word 3	Data mailbox number (1-65,535)	
Word 4	Do not overwrite existing data mailbox: 0 Overwrite existing data mailbox: 1	

No. 70: Write data mailbox to PLC ("DAT → PLC")

Job mailbox no. 70 transfers data mailboxes from the HMI device to the PLC. The job mailbox is structured as follows:

	Most significant byte	Least significant byte
Word 1	0	70
Word 2	Recipe number (1-999)	
Word 3	Data mailbox number (1-65,535)	
Word 4	—	

Sequence when reading from the PLC with job mailbox "PLC → DAT" (no. 69)

Step	Action	
1	Check: Status word = 0?	
	Yes	No
2	The HMI device enters the recipe and data mailbox number specified in the job and the status "Transfer active" in the data mailbox.	Abort without return message.
3	The HMI device reads the values and stores the values in the data mailbox specified in the job mailbox.	

Step	Action	
4	• If "Overwrite" was selected in the job, an existing data mailbox is overwritten without any prompt for confirmation. The HMI device sets the status "Transfer completed". • If "Do not overwrite" was selected in the job, and the data mailbox already exists, the HMI device aborts the job and enters 0000 1100 in the status word of the data mailbox.	
5	To allow further transfers, the PLC program must set the status word to 0 again.	

Sequence writing to the PLC with job mailbox "DAT → PLC" (no. 70)

Step	Action	
1	Check: Status word = 0?	
	Yes	No
2	The HMI device enters the recipe and data mailbox number specified in the job and the status "Transfer active" in the data mailbox.	Abort without return message.
3	The HMI device fetches the values of the data mailbox specified in the job from the data medium and writes the values to the PLC.	
4	The HMI device sets the status "Transfer completed".	
5	The PLC program can now evaluate the transferred data. To allow further transfers, the PLC program must set the status word to 0 again.	

See also

"Data mailbox" area pointer (Page 1424)

8.9.3.3 Sequence of the transfer when triggered by a configured function

Reading from the PLC using a configured function

Step	Action	
1	Check: Status word = 0?	
	Yes	No
2	The HMI device enters the recipe and data record number specified in the function and the status "Transfer active" in the data record.	Abort with system alarm.

Step	Action	
3	The HMI device reads the values from the PLC and stores them in the data record specified in the function.	
4	• If "Yes" was selected for the "Overwrite" function, an existing data record is overwritten without any prompt for confirmation. The HMI device sets the status "Transfer completed." • If "No" was selected for the "Overwrite" function and the data record already exists, the HMI device aborts the job and enters 0000 1100 in the status word of the data record.	
5	The control program must reset the status word to zero in order to enable further transfers.	

Writing to the PLC by means of configured function

Step	Action	
1	Check: Status word = 0?	
	Yes	No
2	The HMI device enters the recipe and data record number specified in the function and the status "Transfer active" in the data record.	Abort with system alarm.
3	The HMI device fetches the values of the data record specified in the function from the data medium and transfers the values to the PLC.	
4	The HMI device sets the status "Transfer completed."	
5	The control program can now evaluate the transferred data. The control program must reset the status word to zero in order to enable further transfers.	

See also

"Data mailbox" area pointer (Page 1424)

8.9.3.3 Possible causes of error when transferring data records

Possible causes of error

The section below shows possible error causes which lead to the cancellation of data record transfer:

- Tag address not set up on the PLC
- Overwriting data records not possible

- Recipe number does not exist
- Data record number does not exist

Note

The status word may only be set by the HMI device. The PLC may only reset the status word to zero.

Note

The PLC may only evaluate the recipe and data record numbers when data inconsistency is detected if one of the conditions outlined below has been met:

- The data mailbox status is set to "Transfer completed".
- The data mailbox status is set to "Transfer completed with error".

Reaction to an aborted transfer due to errors

If the transfer of data records is aborted due to errors, the HMI device reacts as follows:

- Triggering by the operator in the recipe display

  Information in the status bar of the recipe view and output of system alarms
- Triggered by function

  Output of system alarms
- Triggering by PLC job

  No feedback message on the HMI device

You can nonetheless evaluate the status of the transfer by querying the status word in the data record.

Note
Availability for specific devices

Notes in the status bar of the recipe view are not available in Basic Panels.

See also

"Data mailbox" area pointer (Page 1424)

8.9.4 Commissioning components

8.9.4.1 Commissioning components

Transferring the PLC program to the PLC

1. Interconnect the PC with the CPU using the appropriate cable.
2. Download the program files to the CPU.
3. Then set the CPU to RUN.

Transferring the project to the HMI device

1. The HMI device must be in transfer mode in order to accept the project transfer.

   Possible scenarios:

   – Initial startup

     The HMI device does not yet contain any configuration data in the initial startup phase. The project data and runtime software required for operation must be transferred from the configuration computer to the device: The HMI device automatically changes to transfer mode.
     The message "Transfer mode" appears on the HMI device.

   – Recommissioning

     Recommissioning means that you overwrite existing project data on the HMI device.

     For corresponding detailed instructions, refer to the HMI device manual.
2. Check if the alarm settings in your WinCC project meet your requirements.
3. Check the download settings before transferring the project to the HMI device. Additional information is available under Settings for loading (Page 1440) .
4. To transfer the project to the HMI device, open the shortcut menu in the project tree of the HMI device and select the command "Download to device > Software.

   – The project is compiled automatically.

   – in the "Load preview" window you can specify if the existing user data should be overwritten.
5. Click "Download". The download is performed.

   You will see a message following the download on the configuration computer.

   The start screen appears on the HMI device.

Interconnecting the PLC with the HMI device

1. Interconnect the PLC with the HMI device using a suitable cable.
2. The connection message appears on the HMI device. Note that users can edit the system event texts in WinCC.

Notice

Always observe the safety-related information in the HMI device manual when commissioning the device.

RF radiation emitted from devices such as mobile phones may cause unwanted operating states.

See also

Basics of communication (Page 1402)

8.10 Importing and exporting project data

8.10.1 Importing and exporting project data

Introduction

WinCC enables you to export data from a project and import it into another project.

You export or import the following project data:

- Recipes

Exporting and importing reduces the workload. Instead of creating new data records in recipes, for example, you use the data you have already created in previous projects.

Exporting project data

When data is exported, all information is stored in a CSV file.

You can set the options for the export and determine, for example, the list separators.

Editing project data

You can edit the import file in Excel or a text editor.

Start Excel and select "Open" from the "File" menu. Select the type of "Text files (*.prn; *.txt; *csv)" from the "File type" list. Do not open the import file in Excel by double-clicking it, because this will corrupt its data structure and prevent its import.

Open the file in a simple text editor to check that the file has the correct format.

Importing project data

When project data is imported, the data are displayed on an HMI device.

You can set the options for the import and determine, for example, the list separators.

The syntax of the import file is checked during import of csv files. The meaning of the properties or dependencies between the properties is not checked. Errors are reported during compiling.

See also

Exporting recipes (Basic, Advanced) (Page 1434)
Importing recipes (Basic, Advanced) (Page 1435)

8.10.2 Importing and exporting recipes

8.10.2.1 Exporting recipes

Introduction

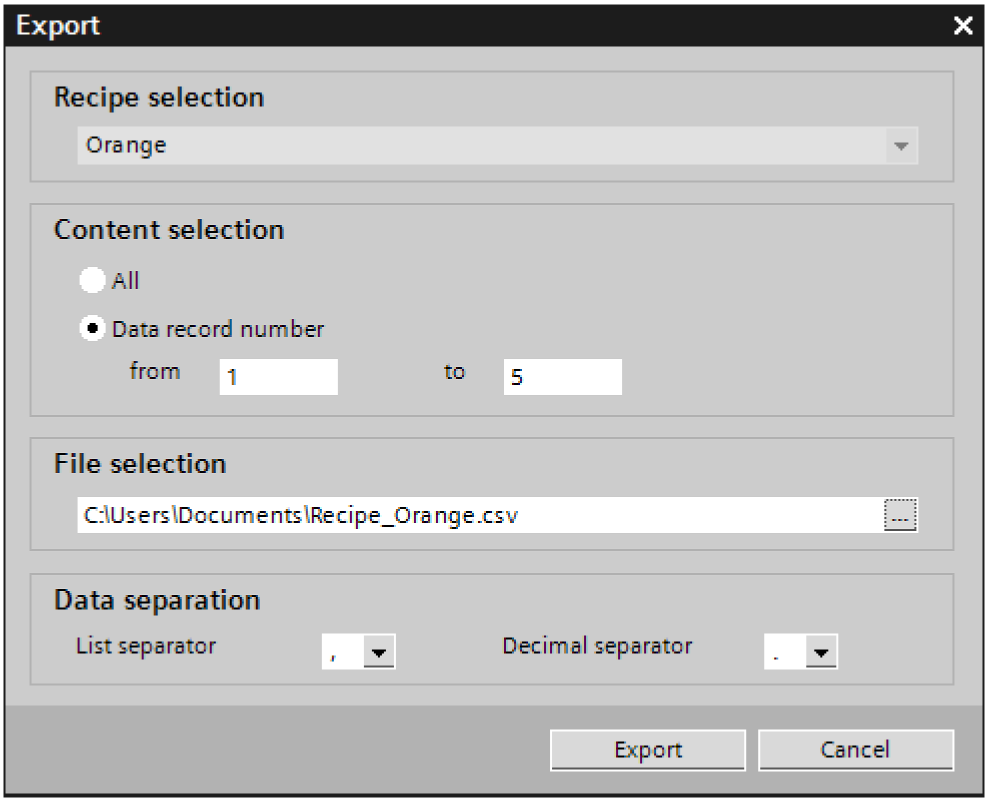
WinCC features an export function for exporting data records from recipes.

Requirements

- The WinCC project to be exported is open.
- Recipes have been created in a project.
- The "Recipes" editor is open.

Exporting recipes

1. In the "Recipes" editor, select the recipe with the data records you want to export.
2. Click
   .
   The "Export" dialog box opens.


Export

Recipe selection
Orange

Content selection
All
Data record number
from 1 to 5

File selection
C:\Users\Documents\Recipe_Orange.csv

Data separation
List separator ,
Decimal separator .

The selected recipe is shown under "Recipe selection".

3. Under "Content selection", specify if all or only selected data records are to be exported.
4. Under "File selection", specify the file in which the recipe data records should be stored.
5. Specify the list separator and decimal separator under "Data separation".
6. Click "Export."

   The export starts.

Result

The exported data has been written to a CSV file. The CSV file is stored in the specified folder.

See also

Importing recipes (Basic, Advanced) (Page 1435)
Format of recipe data (Basic, Advanced) (Page 1437)

8.10.2.2 Importing recipes

Introduction

Recipes are identified by their name. This means recipe names have to be unique. Specify whether or not existing data records should be overwritten by records with the same name during the import.

Requirements

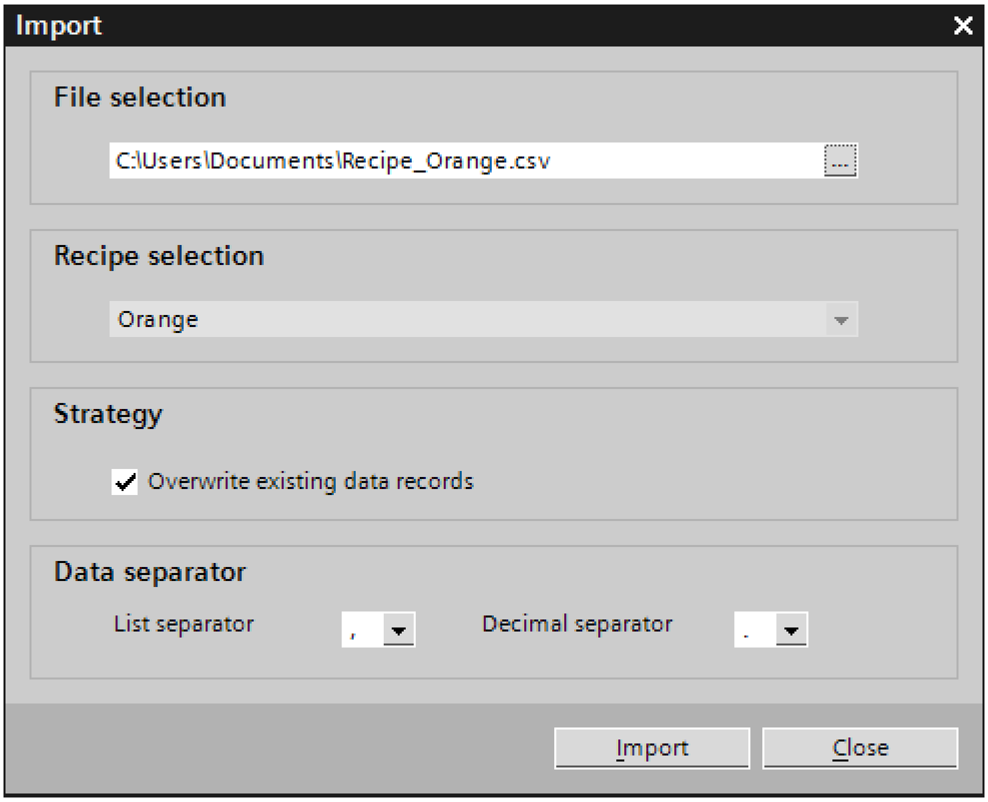
- A CSV file containing at least one recipe has been created.
- The WinCC project to be imported is open.
- The "Recipes" editor is open with at least one recipe.

Importing a recipe

1. In the "Recipes" editor, select the recipe with the data records you want to import.
2. Click

   .

   The "Import" dialog box opens.

   Import

   File selection

   C:\Users\Documents\Recipe_Orange.csv

   Recipe selection

   Orange

   Strategy

   ✓ Overwrite existing data records

   Data separator

   List separator ,   Decimal separator .

   The selected recipe is shown under "Recipe selection".
3. Select the file you want to import under "File selection".
4. Under "Strategy", specify if existing data records should be overwritten by records of the same name.
5. Under "Data separation", select the list separator and the decimal separator to use in the CSV file.
6. Click "Import."

   The import starts.

Result

The data records are created in the selected recipe. Depending on the setting for "Strategy", existing data records are overwritten by records with the same name from the CSV file.

See also

Exporting recipes (Basic, Advanced) (Page 1434)
Format of recipe data (Basic, Advanced) (Page 1437)

8.10.2.3 Format of recipe data

Introduction

This section describes the required format of the file for the import of recipes. The file containing the data of the recipes must be available in "*.csv" format. :

Structure of recipe data

The structure of the import file is fixed. The following example shows the structure for a recipe containing two recipe elements each with two data records each containing two values in turn:

List separator=<List separator>

Decimal symbol=<Decimal separator><List separator>

<Name of the recipe><List separator><List separator><Line break>

LANGID_<ID of the language><List separator>

<Name data record 1><List separator>

<Name data record 2><List separator><Line break>

<Number recipe><List separator>

<Number data record 1><List separator>

<Number data record 2><List separator><Line break>

<Tag recipe element 1><List separator>

<Value data record 1><List separator>

<Value data record 2><List separator><Line break>

<Tag recipe element 2><List separator>

<Value data record 1><List separator>

<Value data record 2><List separator><Line break>

ID of the language

Use the "Windows language ID" in decimal notation, e.g. "1033" for English. Additional information is available in the documentation for the Windows operating system.

8.11 Compiling and loading

8.11.1 Compiling and loading projects

8.11.1.1 Overview of compiling and loading projects

Overview

The project is compiled in the background even as you are configuring it in WinCC. Compiling results in a file that can be run on the corresponding HMI device.

If an error occurs during compilation, WinCC provides support in locating and correcting it.

Once you have corrected any problems, you load the compiled project to the HMI devices on which the project is to run.

Before you start productive operation with your project, compile the project completely using the command "Compile > Software (complete compilation)" in the shortcut menu of the HMI device. If you are using HMI tags that are connected to the control tags in your project, compile all modified blocks with the command "Compile > Software" in the shortcut menu before you compile the HMI device.

To reduce the amount of time required for delta compilation during active configuration, we recommend using the command "Compile > Software (complete compilation)" from time to time.

8.11.1.2 Compiling a project

Introduction

Before a project can run on an HMI device, it must first be compiled. You then load the compiled project on one or more HMI devices.

The changes made to the project are compiled in the background even as you are configuring a project in WinCC. A project is automatically compiled each time you load a project. This ensures that the latest version of the project is loaded at all times.

Note

The ongoing compilation in the background is interrupted as long as Runtime is running on the Engineering Station.

You can also start compilation of a project manually, if necessary.

WinCC checks consistency of the project during compilation. The error locations in the project are listed in the Inspector window. You can jump directly to the source of the error from the entry in the Inspector window. Check the errors found and correct them.

Scope of the compilation

Initial compilation covers the entire project. Only the changes made to the project are compiled after initial compilation.

However, you can always run a complete compilation of the project.

Requirement

- A project is open.

Procedure

Proceed as follows to compile a project:

1. If you want to compile a project for several HMI devices at the same time, select all desired HMI devices with a multiple selection in the project tree.
2. Select the "Compile > Software" command in the shortcut menu of the HMI device.
3. If you want to compile the entire project: Select the "Compile > Software (compile all)" command in the shortcut menu.

Result

The project is compiled for all selected HMI devices. Any errors that occur during compilation are shown in the Inspector window.

8.11.1.3 Loading projects

8.11.1.3 Overview for loading of projects

Overview

Delta data of the project is automatically compiled before you load it to one or several HMI devices. This always ensures that the latest version of the project is transferred. You can activate the option "Overwrite all" before you start the loading process.

Define the load settings in the properties of each HMI device.

Before you start productive operation with your project, compile the project completely using the command "Compile > Software (complete compilation)" in the shortcut menu of the HMI device. If you are using HMI tags that are connected to the control tags in your project, compile all modified blocks with the command "Compile > Software" in the shortcut menu before you compile the HMI device.

To reduce the amount of time required for delta compilation during active configuration, we recommend using the command "Compile > Software (complete compilation)" from time to time.

8.11.1.3 Settings for loading

Introduction

You make the settings for loading in the properties of every HMI device.

Requirement

You have created an HMI device in the project.

Procedure

Proceed as follows to make the settings for loading a project:

1. Select the "Properties" command in the shortcut menu of the HMI device.
2. Click "Load" in the properties of the HMI device.

   The settings for loading are displayed.
3. Select the same interface set on the HMI device.
4. Set the parameters for the connection. The displayed parameters depend on the interface selected.
5. Check the setting for the "Load names" check box. The "Load names" check box is activated by default. The names of the configured objects are compiled and loaded with the project in this case. If you disable the check box, the compile project requires less space on the HMI device.
6. Specify whether or not the user management data and recipes already on the HMI device should be overwritten.

   You can change both settings under "Load preview" before each load.

Result

The settings for loading are specified. The settings are put into effect the next time the project is loaded on the respective HMI device.

8.11.1.3 Loading a project

Introduction

Before a project can run on an HMI device, it first must be loaded to the HMI device.

Actions performed before the data is actually loaded:

- The project is compiled. Any errors that occur during compilation are shown in the Inspector window. WinCC opens the invalid configuration in the corresponding editor if you double-click on the error message.

Clear all errors displayed before you reload the project.

- A load preview is displayed after compilation was successfully completed. The preview shows you the following information, separated by HMI device:
  - The individual steps for loading
  - Presettings that take effect at loading. You can edit those settings once before you start the next load operation or edit the settings directly in the preview.
  - Any warnings that may occur. The project can be compiled and loaded even if warnings occur for a project. The functionality may be restricted in Runtime.
  - Any errors that may occur. The project is not compiled and loaded if errors occurred with it.

Before you start productive operation with your project, compile the project completely using the command "Compile > Software (complete compilation)" in the shortcut menu of the HMI device. If you are using HMI tags that are connected to the control tags in your project, compile all modified blocks with the command "Compile > Software" in the shortcut menu before you compile the HMI device.

Requirement

- You have created an HMI device in the project.
- The HMI device is connected to the Engineering Station. The connection corresponds to the "Load" group settings.

Procedure

Proceed as follows to load a project:

1. If you want to load a project to several HMI devices at one time, select all desired HMI devices with a multiple selection in the project tree.
2. Select the "Load to target system > Software" command in the shortcut menu of the HMI device.

   The project is compiled.

   If errors are shown: Double-click on a listed error to correct it. The cause of the error is shown in the configuration. Restart loading after you cleared all errors.

   The "Load preview" dialog opens after compilation was successfully completed.
3. Check the displayed presettings and change them as necessary.
4. Click the "Update" button to see how the changes affect the loading process. The preview is updated.

   If the preview indicates that the loading can be performed successfully, click "Load" to load the project to the selected HMI device.

Result

The project is loaded to all selected HMI devices. Any existing project will be updated in the process.

If errors or warnings occur during loading, appropriate alarms are shown in the Inspector window under "Load".

The project can be executed on the HMI device after it was successfully loaded.

8.11.1.3 Error messages during loading of projects

8.11.1.3 Updating the operating system of an HMI device

Introduction

When you transfer a WinCC project to an HMI device, WinCC checks if the HMI device operating system version matches the one used in the project. If the operating system versions do not match, you will see a warning before the loading starts.

If the wrong operating system version is detected, you are given the opportunity of updating the operating system.

Notice

If you update the operating system, all recipes and user data on the HMI device will be irretrievably lost.

Perform a backup beforehand to save these data.

Requirement

The HMI device is connected to the configuration computer.

The interface between the configuration computer and the HMI device is correctly configured.

Updating the operating system during the loading process

1. If the HMI device operating system version does not match the configuration, you will see a message in the "Load" dialog during the loading process. This dialog allows you to update the operating system immediately.
   To start the update, click "Yes" in the "Load" dialog.
   The update of the operating system starts. When the update is complete, the project is loaded to the HMI device.
2. Recipes, user data, and some system parameters will be deleted during the update. Cancel the update to retain the data. Click "No" in the "Load" dialog to cancel. The update of the operating system and the loading process are canceled.

After canceling the update, you can backup the specified data and then update the operating system of the HMI device.

Backing up recipes and user data

1. Select the WinCC project in the project tree.
2. Select the menu command "Online > Device maintenance > Backup". The "SIMATIC ProSave" dialog box opens.
3. Select "Recipes" from the "Data type" box.
4. In the "Save as" box, enter the destination or navigate to the desired location using the dialog.

5. Click the "Start Backup" button. The recipe data are backed up.
6. Repeat the procedure to back up user data. Select "User administration" from the "Data type" box.

Updating the operating system after data backup

1. Select the desired HMI device in the project tree.
2. Select the menu command "Online > Load to device".
   The "Load" dialog opens and the loading process starts.
   In the "Load" dialog you are asked if you want to update the operating system.
3. Confirm the prompt for updating the operating system by clicking "Yes".
   The operating system is updated. When the update is complete, the project is loaded to the HMI device.

Restoring backed up recipes and user data

After you have updated the operating system and loaded the project to the HMI device, restore the backed up data.

1. Select the WinCC project in the project tree.
2. Select the menu command "Online > Device maintenance > Restore". The "SIMATIC ProSave" dialog box opens.
3. Click the navigation button in the "Opening" box and navigate to the location of the desired data in the dialog that opens.
4. Select the file with the backed up recipe data and click "Open".
5. Click "Start Restore" in the "SIMATIC ProSave" dialog.
   The restoration starts.
6. Repeat the procedure to restore the user data.

8.11.1.3 Adapting the project for another HMI device

Introduction

When you transfer a WinCC project to an HMI device, WinCC checks if the HMI device is compatible with the type of HMI device used in the project. If the types of HMI device do not match, you will see a message before the download starts.

The download is aborted.

Adapting the project for the HMI device

You need to adapt the project accordingly to be able to download the project to the connected HMI device.

- Add a new HMI device in the project tree. Select the correct type of HMI device from the HMI device selection.
- Copy the configured components from the previously used HMI device into the newly created HMI device.
  You can copy many of the components directly in the project tree and detail view.

For example, you can copy the complete "Screens" folder using the shortcut menu in the screens folder of the new HMI device.

- Use the detail view to copy entries in the project tree for which the "Copy" command is not available in the shortcut menu.
- Select the "Recipes" entry in the project tree, for example. The recipes are displayed in the detail view.
- Select the recipes in the detail view and drag them to the "Recipes" entry of the new HMI device. The recipes are copied. You can also select multiple objects in the detail view.
- Configure those components you cannot copy, such as connections, area pointers, and alarms.
- Save the project at various points in time.
- Compile the full project.
- When the compilation is successfully completed, download the project to the HMI device.

Linking references

References to linked objects are included in the copying. The references are linked again once the linked objects are copied.

Example:

You copy a screen in which objects are linked to tags. The tag names are entered at the individual objects after the screen is added to the new HMI device. The tag names are marked in red because the references are open. When you then copy the tags and insert them into the new HMI device, the open references are closed. The red marking for the tag names disappears.

For complete references to connected objects in the PLC, you first need to configure a connection to the PLC.

Using the information area

When you compile the project for the HMI device, errors and warnings are displayed in the "Info" tab of the Inspector window. You can use the shortcut menu command "Go to" to go directly to the location where the error or warning can be corrected.

Work through the list of errors and warnings from top to bottom.

When the compilation is successfully completed, download the project to the HMI device.

8.11.1.3 Establishing a connection to the HMI device

Introduction

To load a WinCC project to an HMI device, a connection needs to be established between the configuration computer and the HMI device and the connection needs to be correctly configured. If no connection can be made, the loading process is aborted.

Establishing a connection between the configuration computer and HMI device

1. Check the cable connection between the HMI device and configuration computer.
2. Open the "Devices & Networks" editor in WinCC and start the network view.
3. Select the subnet in the network view and check the settings for the subnet.
4. Select the interface of the HMI device in the network view or device view and check the connection parameters in the Inspector window.
5. Switch on the HMI device and press the "Control Panel" button in the loader. The Control Panel opens.
6. Press "Transfer" twice in the Control Panel. The "Transfer Settings" dialog box opens.
7. Check the settings and then press "Advanced". The "Profibus Settings" dialog box opens.
8. Check the advanced settings and close the dialog with "OK".

Important settings

Carefully check the following parameters when reviewing the connection settings:

- Network addresses or station addresses
- Selected transmission rate
- Master on the bus, only one master is permitted.

If you use a configurable adapter for the connection, check the settings for it as well, for example, transfer rate, master on the bus.

8.11.1.4 Runtime start

8.11.1.4 Starting Runtime on the Engineering Station

Introduction

You can start your project in Runtime at the engineering station while performing the configuration in WinCC. However, this so-called online configuration is subject to certain limitations.

The project cannot be compiled in the background while Runtime is active on the Engineering Station. The delta data of the project is compiled automatically when you load the project to an HMI device after having closed Runtime. You can also start compilation manually.

When the project is started in Runtime, the settings you have stored in your project for the HMI device in the "Configuration" editor take effect.

Requirement

A project is open on the Engineering Station.

Procedure

Proceed as follows to start Runtime on the Engineering Station:

1. Select the desired HMI device in the project tree.
2. Select the menu command "Online > Start Runtime".
3. If you want to edit project data after Runtime was started on the Engineering Station, select the "Compile > Software" command in the shortcut menu of the HMI device.

The updated project is displayed in the Runtime on the Engineering Station.

8.11.1.4 Starting Runtime on the HMI device

Introduction

You can start the project in Runtime as soon as it is loaded to an HMI device.

When the project is started in Runtime, the settings you have stored in your project for the HMI device in the "Configuration" editor take effect.

Requirement

WinCC Runtime is installed on the HMI device.

Runtime start on a Basic Panel

The loaded project starts automatically on a Basic Panel after a delay specified by the configuration.

If you want to start the project manually on a Basic Panel, press the "Start" button in the Loader of the HMI device.

The Loader is displayed when the HMI device is switched on.

8.11.2 Simulating projects

8.11.2.1 Simulation basics

Introduction

Use the simulator to test configuration performance on the engineering station based on defined tag values. This allows you to quickly locate any logical configuration errors before productive operation.

You can start the simulator in two different ways:

- Menu command "Online > Simulate Runtime"
- Menu command "Start > Programs > Siemens Automation > Simulation"

Requirement

The Simulation/Runtime component must be installed on the engineering station for simulation.

Field of application

You can use the simulator to test the following functions of the HMI system, for example:

- Checking limit levels and alarm outputs
- Consistency of interrupts
- Configured interrupt simulation
- Configured warnings
- Configured error messages
- Check of status displays
- Digital and analog I/O:
  - Setting defaults
  - Reading
  - Modifying

How it works

You use the simulator to simulate the tag assignments in your project with a variety of values.

The process values and alarm are saved to a simulation log. The data generated is deleted from this log when you exit simulation mode.

8.11.2.2 Simulating a project

Introduction

You simulate your project with one of the following two methods:

- Without a connected PLC

  You change the value of area pointers and tags in a simulation table that is read for the simulation of WinCC Runtime.
- With a connected PLC without a running process

  You simulate your project by running it directly in Runtime. The tags and area pointers become active. This allows you to create an authentic simulation of your configured HMI device in Runtime.

Requirement

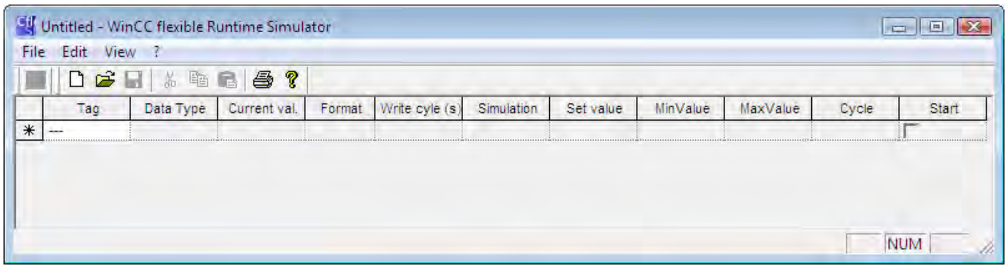
A project has been created with tags and area pointers.

Simulating a project for the first time

Proceed as follows to simulate a project using the simulation table:

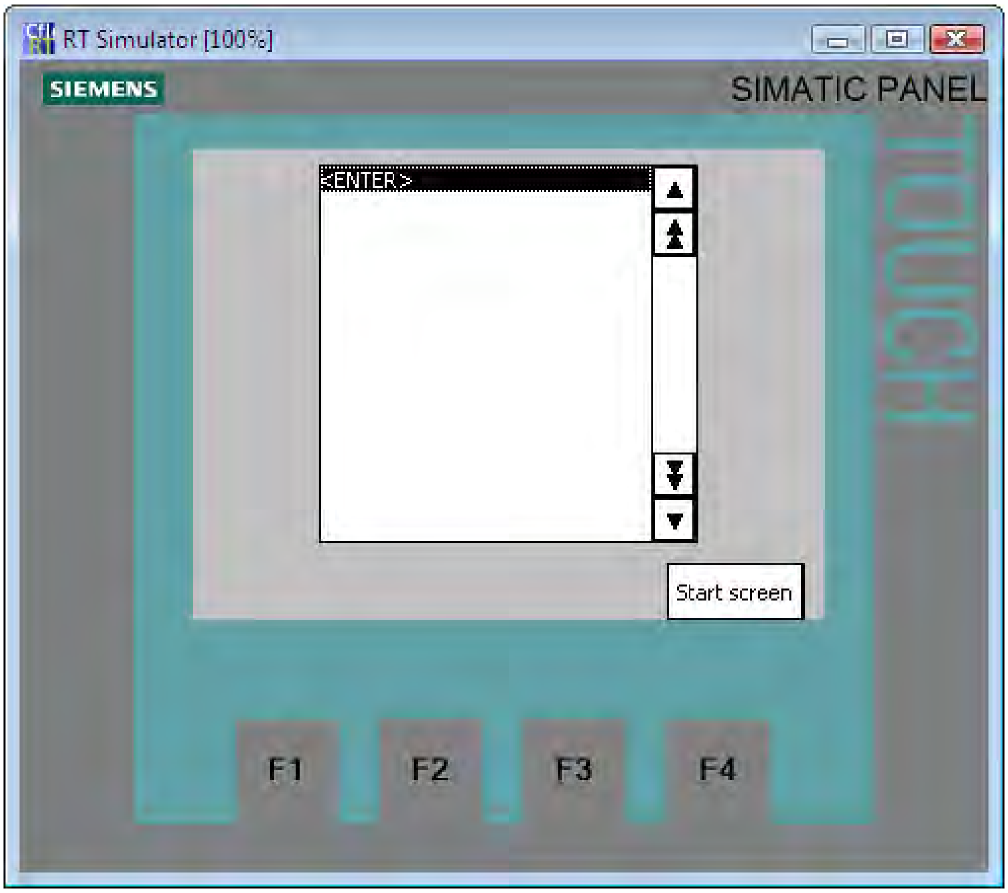
1. Open the project.
2. Select the menu command "Online > Simulate Runtime > With tag simulator".

   When you simulate the project for the first time, the simulator is started with a new, empty simulation table.

	Tag	Data Type	Current val.	Format	Write cyle (s)	Simulation	Set value	MinValue	MaxValue	Cycle	Start
*	---										

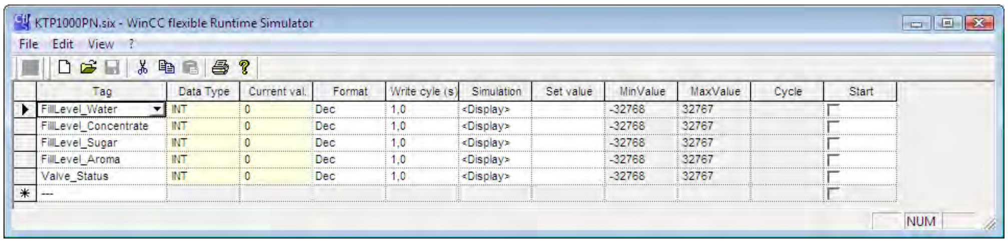
   The project opens in Runtime at the same time:

   You can toggle between the simulation table and Runtime with the <Alt + Tab> keys.
3. Click on the cells in the "Tag" column in the simulation table and select a tag configured in the simulation table from the drop-down list. You can select all the tags you want to simulate this way.

   The drop-down list contains all configured tags. You create a new tag in the "Tags" editor in WinCC.

   You can simulate up to 300 tags with the simulator.
4. In the drop-down list, select the desired simulation mode in the "Simulation" column.



Tag	Data Type	Current val.	Format	Write cyle (s)	Simulation	Set value	MinValue	MaxValue	Cycle	Start
FillLevel_Water	INT	0	Dec	1,0	<Display>		-32768	32767		☐
FillLevel_Concentrate	INT	0	Dec	1,0	<Display>		-32768	32767		☐
FillLevel_Sugar	INT	0	Dec	1,0	<Display>		-32768	32767		☐
FillLevel_Aroma	INT	0	Dec	1,0	<Display>		-32768	32767		☐
Valve_Status	INT	0	Dec	1,0	<Display>		-32768	32767		☐
---										☐

5. Change the value of tags and area pointers in the respective columns.
6. Activate the "Start" check box to start the simulation for this tag.
7. Observe how the changed value effects your project.

   This way you simulate each individual tag or several tags at the same time.
8. Save the settings for the simulation using the menu command "File > Save". Enter a name to save the file. The file is automatically given the *.six extension.

Note

You cannot simulate the following system functions:

– CalibrateTouchScreen

– ActivateCleanScreen

Managing simulator data

If you have saved data from a previous simulation, you can open the file at a later point in time and simulate your project again. This requires that the tags and area pointers in the simulation table are still in the project.

Proceed as follows to open a simulation file:

1. Select the menu command "Online > Simulate Runtime > With tag simulator".
2. In the simulation table, select the menu command "File > Open".
3. Select the corresponding simulation table and click "Open".

   The simulator loads the stored data.

Enabling and disabling tags

You can start and stop the simulation for each individual tag to enable a bumpless transition from the offline configuration to online configuration. To do so, activate the "Start" check box.

When a tag is enabled, the values of the simulation are calculated and passed to the WinCC simulator.

Deleting a tag

Proceed as follows to delete a tag from the simulation table:

1. Select the name of the tag.
2. Select the menu command "Edit > Cut".

The deleted tag is removed from the table.

8.11.2.3 Working with the tag simulator

Notes on the simulation table

The simulation table has the following columns:

Column	Description
Tag	Specifies the tags for the simulation.
Data type	Shows the data type of the selected tag
Current value	Shows the simulated value of the defined tags
Format	Specifies the selected format in which the values of the tags are simulated: • Decimal (1, 2, 3, 4, ...) • Hexadecimal (03CE, 01F3, ...) • Binary (0 and 1)
Write cycle	Specifies the selected time interval in which the current values of the tags are simulated. If you enter a value of 2, the current value of the tag is shown every 2 seconds.
Simulation	Shows the method by which the values of the tags are processed during the simulation.
Set value	Sets the selected value for the respective tag. The simulation start with the specified value.
minWert and maxWert	Specifies the value range of the tag. You set a minimum and maximum value for this range. The default values are -32767 for the minimum and 32767 for the maximum.
Period	Contains the period in which the value of the tag is repeated for the "Increment" and "Decrement" simulation modes.
Start	Starts simulation of the tag based on the previously entered information.

Simulation modes

The simulator has six different simulation modes. The configured tags are supplied with nearly realistic values during the simulation.

Simulation mode	Description
Sinusoidal	Changes the value of the tag to form a sinusoidal curve. The value is visualized as a periodic, non-linear function.
Random	Provides randomly generated values. The tag value is changed by means of a random function.

Simulation mode	Description
Increment	Increases the value of the tag continuously up to a specified maximum value. Begins again at the minimum after the maximum has been reached. The value trend corresponds to a positive saw-tooth curve.
Decrement	Decreases the value of the tag continuously down to a specified minimum value. Begins again at the maximum after the minimum has been reached. The value curve corresponds to a negative saw-tooth curve.
Shift bit	Shifts a set bit continuously by one position. The previous position is always reset. This allows you to test the alarms for an HMI device, for example.
<Display>	The current tag value is displayed statically.

Example: Simulate tags with the "Shift bit" simulation mode

Proceed as follows to simulate tags with the "Shift bit" simulation mode:

1. Open the project you want to simulate.
2. Select the menu command "Online > Simulate Runtime > With tag simulator".

   The simulation table opens.
3. In the "Tag" column, select a tag from your project.
4. Select "Bin" in the "Format" column.
5. Enter the value "1" in the "Write cycle" column.
6. Select the "Shift bit" simulation mode in the "Simulation" column.
7. Enter the value "1" in the "Set value" column.
8. Enable the tag with the "Start" check box.

Result

The simulator tests the selected tag bit-by-bit as follows:

Simulation values	Byte for alarms
Set start value	00000001
1. Simulation values	00000010
2. Simulation values	00000100
3. Simulation values	00001000
....	...

In Runtime you see if the desired alarm is output at a given value.

8.11.3 Servicing the HMI device

8.11.3.1 ProSave

Introduction

The ProSave service tool is supplied with WinCC. The functions of ProSave are integrated in the WinCC user interface on the engineering station.

ProSave can also be installed as a separate program ("stand-alone mode") on a computer without a WinCC installation.

Functional scope

ProSave provides all of the functions needed to transfer files to the HMI device.

- Data backup and restoration of backed-up data
- Operating system update
- Communication settings

Integrated operation on the engineering station

ProSave is installed by default on the engineering station by WinCC Setup. The entire range of functions from ProSave is integrated in the menu "Online > Device maintenance" within WinCC.

Stand-alone operation on a computer

ProSave can also be installed from the WinCC CD on a computer and without a WinCC installation, for servicing purposes, for example. In this case, in the "Communication settings" you need to specify which HMI device you want to transfer to or from and the mode to use for file transfer.

For example, with ProSave you can save a project from the original HMI device and restore it on a replacement device without a WinCC installation.

If you use ProSave outside WinCC, you have the option of changing the language of the user interface. To select a language, use the "Language" menu command in ProSave. ProSave must be restarted for the language switch to take effect.

8.11.3.2 Backup of HMI device data

Introduction

Backup the data of an HMI device at regular intervals.

A data backup allows you to quickly resume operation after a system failure or when a device was replaced. The backed up data are simply transferred to the new HMI device and the original state is thus restored.

Data backup with WinCC or ProSave

Working from the engineering station to which an HMI device is connected, you can backup and restore the data of this HMI device using WinCC.

You have the option of conveniently performing a central data backup using ProSave on a computer without WinCC installation.

Scope of data backup

The backup and restore operation depends on the type of HMI device and can include the following project data:

- Full backup (depending on the HMI device: Runtime, firmware, operating system image, configuration, recipes, passwords)
- Recipes only
- Passwords only

A backup file with the extension *.psb is generated when you backup the HMI data.

The backup can be performed to any storage medium, such as a data server, as long as there is an appropriate connection between the HMI device and the storage medium.

Note

Only use the restore function for project data on operating devices configured using the same configuration software.

Note

Note the following when performing a complete data backup and restore operation:

- When a complete data restoration is carried out, all of the data previously on the device and the operating system are irrevocably deleted.
- If the restoration of the data is interrupted, the operating system first needs to be reloaded with "Reset to factory settings" to the HMI device before the restore can be triggered again.

8.11.3.3 Backing up and restoring data of the HMI device

Introduction

Backup the data of an HMI device at regular intervals.

Working from the engineering station to which an HMI device is connected, you can backup and restore the data of this HMI device using WinCC.

You have the option of conveniently performing a central data backup using ProSave on a computer without WinCC installation.

Requirement

- The HMI device is interconnected with the Engineering Station or the computer is connected with ProSave.
- The HMI device whose data should be backed up or restored is selected in the project tree.
- The settings for loading are correctly set in the properties of the HMI device.
- When using a special storage medium, such as a data server: The HMI device is connected to the storage medium.

Procedure

Proceed as follows to back up the data:

1. Select the "Backup" command from the "Online > Device maintenance" menu.
2. Select the scope of the backup: "Complete backup," "Recipes," or "User administration."
3. Click "...", select the storage location in the "Select backup file" dialog, and specify a file name.
4. Click "OK."

This starts the data backup. The backup can take some time.

Procedure for restoring data

1. Select the "Restore" command from the "Online > Device maintenance" menu.
2. Click "...", and select the storage location and file in the "Open" dialog.

   The "Content" area indicates which HMI device is the origin of the data backup and the scope of the data backup.
3. Click "OK."

This starts the restoration. This process can take some time.

8.11.3.4 Updating the operating system

Introduction

If the operating system of an HMI device has a version that is incompatible with the configuration, loading of the configuration is aborted. An alarm appears indicating the operating system must be updated.

Updating the operating system

The operating system of an HMI device that is interconnected with an engineering station can be update using WinCC on the engineering station.

You have the option of updating the operating system of the HMI device using ProSave on a PC without WinCC installation.

When an operating system is updated, all of the data on the target system are deleted.

If you want to use the user data (such as passwords and recipes) stored on the internal Flash memory after updating the operating system, export them to an external data medium before you start the update. Import the data back to the HMI device after performing the update.

"Reset to factory settings"

If the operating system update was terminated prematurely, an operating system is no longer available on the HMI device. The only way to load an operating system then is "Reset to factory settings".

Communication between the engineering station and the HMI device for operating system updates is controlled by the operating system of the HMI device. With "Reset to factory settings", the Engineering Station will communicate with the boot loader of the HMI device instead.

This process can take some time.

Switch the HMI device off and on again after performing the "Reset to factory settings" in WinCC. This way you make contact with the HMI device via the boot loader.

Note

Before you reset the factory settings via Ethernet, you will need the MAC address of the HMI device and a PG/PC interface on the configuration PC set to Ethernet TCP/IP.

You alter the settings of the PG/PC interface via "Start > System Control > Set PG/PC interface". Select" "S7ONLINE (STEP7) -> TCP/IP" in the "Access point of application" field.

8.11.4 Reference

8.11.4.1 Error messages during loading of projects

Possible problems during loading

When a project is being loaded to the HMI device, status messages regarding the progress of the loading process are displayed in the output window.

Any problems developing when a project is being loaded to the HMI device are usually caused by incorrect transmission rates or by simultaneous use of other drivers on the Engineering Station (if connected to a network, for example).

The most common loading failure cases are listed below.

The serial transfer is terminated.

Possible remedy: Select a lower transmission rate.

The transfer is terminated, and a compatibility conflict alarm is issued.

Possible cause	Remedy
Conflict between versions of the configuration software and the operating system of the HMI device.	Synchronize the operating system of the HMI device with the version of the configuration software. Use the "Device maintenance > Update operating system" command in the "Online" menu to update the operating system. For additional information, refer to the operating instructions for the HMI device. Alternatively, you can use the "ProSave" service tool to update the operating system. For additional information, refer to the online Help for ProSave.
The configuration computer is connected to an illegal device (such as a PLC).	Check and correct cabling and communication parameters.

The transfer operation does not take place

Possible cause	Remedy
Connection to the HMI device cannot be established (alarm in the output window)	Check the physical connection between the configuration computer and the HMI device. The HMI device must also be in transfer mode (except in the case of remote control).
The default communication driver is not listed in the Windows Device Manager.	Check the device status of the COM connection in the properties window of the Device Manager.

MPI/DP download is not functioning.

Possible cause	Remedy
The CP to be used for the download is set to "configured mode" (for example, when SIMATIC NET CD 7/2001 is used).	Go to the "Set PC station" tool and set the CP to "PG mode." Check the network parameters (transmission rate, MPI address). Perform the download from WinCC ES. Set the CP back to "configured mode."

Possible cause	Remedy
In the programming device/PC panel, the S7ONLINE access point is not on a physical device (such as CP5611 (MPI)). This can occur, for example, when the SIMATIC NET CD 7/2001 is installed.	Go to the "PG/PC panel" tool or, when the SIMATIC NET CD 7/2001 is being used, the "Set PC station" tool, and place the S7ONLINE access point to your required device. Check the network parameters (transmission rate, MPI address). Perform the download from WinCC ES. Reposition the S7ONLINE access point back to the original device.

Complexity of the configuration is too great

Possible cause	Remedy
The configuration contains too many different objects and options for the device selected.	Clear all objects of a type (e.g. all graphic indicators).

8.12 Operation in Runtime

8.12.1 Basics

8.12.1.1 Overview

Configuration and process control phases

HMI devices are used to operate and monitor tasks in process and production automation. The plant screens on the HMI devices provide a clear overview of active processes. The HMI device project, which includes the plant screens, is created during the configuration phase.

Transfer the project to the HMI device for the process control phase. Another requirement for the process control phase is that the HMI device must be connected online to a PLC. The process control phase, operator control, and monitoring can then be carried out during an ongoing work process.

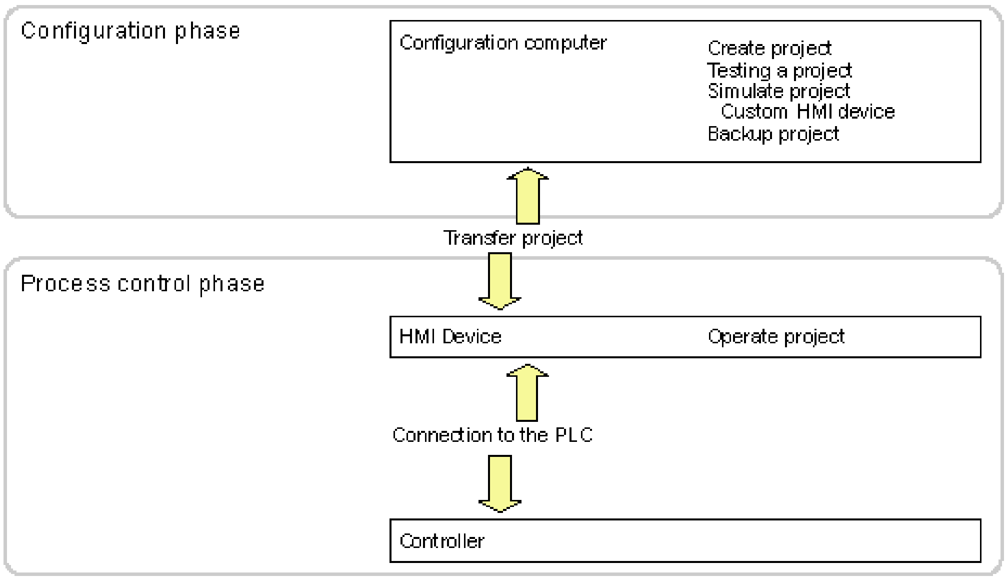


Figure8-1 Configuration and process control phases

Downloading the project to the HMI device

The following procedures are available to download a project to an HMI device:

- Downloading from the configuration PC
- Restore the project from a PC using ProSave

  In this case, an archived project is downloaded from a PC to the HMI device. The configuration software need not be installed on this PC.

These procedures are available for commissioning and recommissioning a project.

Commissioning and Recommissioning

- When the HMI device is commissioned there is no project at first.

  The HMI device is also in this state after the operating system has been updated.
- When recommissioning, any project on the HMI device is replaced.

See also

Settings in the Runtime software (Page 1460)
Overview of operator control over a project (Page 1469)
Bar (Page 1479)
Overview (Page 1494)
Overview (Page 1502)
Structure of a recipe (Page 1512)
Tags in Runtime (Page 1459)
System functions in Runtime (Page 1459)

8.12.1.2 Tags in Runtime

Definition

Tags correspond to defined memory areas on the HMI device, to which values are written and/or from which values are read. This action can be initiated by the PLC, or by the operator at the HMI device.

See also

Overview (Page 1457)

8.12.1.3 System functions in Runtime

Application

System functions are used in Runtime for the following purposes:

- To control the process.
- To utilize the properties of the HMI device.
- To configure system setting on the HMI device in online mode.

Each system function in WinCC is logically linked with an object and an event. As soon as the event occurs, the system function is triggered.

System functions

These default system functions are used to implement many tasks in Runtime, such as:

- Calculations, e.g. increasing a tag value by a specific or variable amount.
- Logging functions, e.g. starting a process value log.
- Settings, e.g. PLC changes, or setting a bit in the PLC.
- Alarms, e.g after a different user logs on.

Events

The object and the selected function determine the event that can be defined as a trigger for executing a system function.

For example, the "Change value", "Low limit violated" and "Upper limit exceeded" events are associated with the "Tag" object. The "Loaded" and "Cleared" events are associated with the "Screen" object.

See also

Overview (Page 1457)

8.12.2 Commissioning projects

8.12.2.1 Settings in the Runtime software

Open the WinCC configuration software and make the following settings for the runtime software:

Display on the PLC

In WinCC, configure the visual representation of the generated project in runtime. The screen resolution is fixed for Basic Panels. If the picture is bigger than the configured screen resolution, scroll bars appear.

To switch the taskbar off, select the Start menu command "Settings > Taskbar". In the "Properties of the Taskbar" dialog, disable the options "Always on top" and "Auto hide".

Dialog fonts

The dialog text is shown in the standard font. Define the default font by selecting "Language & Font" in the "Device Settings" editor.

Disabling program switching

You lock program switching to prevent operators from calling other applications in runtime.

Click "Window" in the "Device Settings" editor and select the option "Disable program switching". Also hide the Windows taskbar.

Note

Stop runtime

Always configure a softkey or button for calling the "StopRuntime" system function if you lock program switching. Otherwise, you cannot close runtime or Windows.

Screen saver

A screensaver is no longer required for most modern screens and can, in fact, even cause damage. These monitors switch to hibernate mode as soon as the video signal has not changed for a specified time. A conventional screensaver would prevent this and thus reduce the service life of your monitor.

Note

Approved screensavers

If you do want to use a screensaver, note that only the standard Windows screensavers are approved for use in runtime.

Make sure that the correct time zone is set on the PC on which the runtime software is installed. To set the time zone in Windows, select Start > Settings > Control Panel > Date and Time.

See also

Overview (Page 1457)
Loading projects (Page 1461)
Closing a project (Page 1464)

8.12.2.2 Loading projects

Overview

Various scenarios are possible for loading the project:

- The Runtime software is installed on the same system as the configuration software.
- The Runtime software and the configuration software are installed on different systems. The project must be loaded from the configuration computer to the target system. The HMI devices must be connected to the configuration PC for the transfer. Another requirement is that the transfer mode must match on the HMI devices and in WinCC.

Note

Security prompts may appear during the loading process, depending on the configuration. The recipe data and password list on the HMI device are overwritten following a prompt.

The configuration software and the Runtime software are installed on the same system

If the configuration software and the Runtime software are installed on the same system, proceed as follows:

1. Create and compile your project.
2. Start Runtime directly from the active configuration software. Select the "Start Runtime" command from the "Online" menu.
3. You may test and operate the project online with the controller if you have configured the corresponding communication.

The configuration software and the Runtime software are installed on different systems

If the configuration software and the Runtime software are installed on different systems, proceed as follows:

1. Create and compile your project. For additional information, refer to "Compiling a project (Page 1438) ".
2. To download the file via cable:

   Connect the HMI device to the configuration computer using a standard cable to match the desired transfer mode and then switch on the HMI device.
3. Set the HMI device to transfer mode.

   To start transfer mode, press the "Transfer" button in the Loader. You can also assign the system function "SetDeviceMode" to an operator control.

4. Load the project from the configuration computer to your target device. For further information, refer to "Loading projects (Page 1440) ".

Note

If the HMI device is a PC, you can transfer the compiled file without using the loader, for example, via Ethernet. Double-click the corresponding file on your PC to start Runtime.

See also

Settings in the Runtime software (Page 1460)
Changing the operating mode on the HMI device with the current display (Page 1338)

8.12.2.3 Starting Runtime on the Engineering Station

Introduction

You can start your project in Runtime at the engineering station while performing the configuration in WinCC. However, this so-called online configuration is subject to certain limitations.

The project cannot be compiled in the background while Runtime is active on the Engineering Station. The delta data of the project is compiled automatically when you load the project to an HMI device after having closed Runtime. You can also start compilation manually.

When the project is started in Runtime, the settings you have stored in your project for the HMI device in the "Configuration" editor take effect.

Requirement

A project is open on the Engineering Station.

Procedure

Proceed as follows to start Runtime on the Engineering Station:

1. Select the desired HMI device in the project tree.
2. Select the menu command "Online > Start Runtime".
3. If you want to edit project data after Runtime was started on the Engineering Station, select the "Compile > Software" command in the shortcut menu of the HMI device.

The updated project is displayed in the Runtime on the Engineering Station.

8.12.2.4 Starting Runtime on the HMI device

Introduction

You can start the project in Runtime as soon as it is loaded to an HMI device.

When the project is started in Runtime, the settings you have stored in your project for the HMI device in the "Configuration" editor take effect.

Requirement

WinCC Runtime is installed on the HMI device.

Runtime start on a Basic Panel

The loaded project starts automatically on a Basic Panel after a delay specified by the configuration.

If you want to start the project manually on a Basic Panel, press the "Start" button in the Loader of the HMI device.

The Loader is displayed when the HMI device is switched on.

8.12.2.5 Testing a project

Introduction

You have the following options for testing a WinCC project:
Testing projects on the configuration computer.

- Simulator

  The Simulator is used to test WinCC projects with internal tags and process tags. For additional information, refer to "Simulating a project (Page 1447) ".

  The simulator enables you to test the following:

  – Offline testing of a configuration without connection to a PLC.

  – Online testing of a configuration with connection to a PLC and inactive process.

  – Implementation of a demo project.

Testing projects on the HMI device

- Offline testing of the project on the HMI device

  Offline testing means that communication between the HMI device and the PLC is down for the duration of the test. You can operate the HMI device, but you cannot exchange data with the PLC and vice versa. Set the "Offline" mode on the HMI device by assigning the system function "SetDeviceMode (Page 1377) " to an operator control.

- Online testing of the project on the HMI device

  Online testing means that communication between the HMI device and the PLC is up for the duration of the test. You control the plant using the HMI device based on the configuration. Set the "Online" mode on the HMI device by assigning the system function "SetDeviceMode" to an operator control.

Procedure

Proceed as follows to simulate a project without a PLC connection to the configuration PC:

1. Create a project as it is going to be run later with an interconnected PLC.

2. Save and compile the project.
3. Start the Simulator directly from the active configuration software. Select the menu command "Online > Simulate Runtime > With tag simulator".

   When you simulate the project for the first time, the simulator is started with a new, empty simulation table. If you have already created a simulation table for your project, it is opened.

   The simulation table "*.six" contains all the settings required for the simulation. For additional information, refer to "Working with the tag simulator (Page 1450) ".
4. Make any changes to the tags and area pointers of your project in the simulation table.

   Toggle between the simulation table and Runtime using the <ALT+TAB> key shortcut.

   Save the settings for the simulation using the menu command "File > Save." Enter a name to save the file.. The file name is automatically assigned the extension "*.six".

8.12.2.6 Closing a project

Introduction

You define the steps in closing Runtime in the user program:

Procedure

Exit Runtime as follows:

1. When Runtime is running, you can close it using the close symbol or the Task Manager.
2. When Runtime is running, press the relevant button to close Runtime. The close of Runtime is especially configured.

See also

Settings in the Runtime software (Page 1460)

8.12.2.7 Backing up and restoring data of the HMI device

Introduction

Backup the data of an HMI device at regular intervals.

Working from the engineering station to which an HMI device is connected, you can backup and restore the data of this HMI device using WinCC.

You have the option of conveniently performing a central data backup using ProSave on a computer without WinCC installation.

Requirement

- The HMI device is interconnected with the Engineering Station or the computer is connected with ProSave.
- The HMI device whose data should be backed up or restored is selected in the project tree.

- The settings for loading are correctly set in the properties of the HMI device.
- When using a special storage medium, such as a data server: The HMI device is connected to the storage medium.

Procedure

Proceed as follows to back up the data:

1. Select the "Backup" command from the "Online > Device maintenance" menu.
2. Select the scope of the backup: "Complete backup," "Recipes," or "User administration."
3. Click "...", select the storage location in the "Select backup file" dialog, and specify a file name.
4. Click "OK."

This starts the data backup. The backup can take some time.

Procedure for restoring data

1. Select the "Restore" command from the "Online > Device maintenance" menu.
2. Click "...", and select the storage location and file in the "Open" dialog.

   The "Content" area indicates which HMI device is the origin of the data backup and the scope of the data backup.
3. Click "OK."

This starts the restoration. This process can take some time.

8.12.3 Languages in runtime

8.12.3.1 Languages in runtime

Using multiple runtime languages

You can decide which project languages are to be used in runtime on a particular HMI device. The number of runtime languages that can be available at one time on the HMI device depends on the device. To enable the operator to switch between languages during runtime, you must configure a corresponding operator control.

When runtime starts, the project is displayed according to the most recent language setting. When runtime starts the first time, the language with the lowest number in the "Language order" is displayed.

Setting runtime languages during configuration

You can specify the following in the "Language and Font" editor:

- The project languages available as runtime languages for the HMI device.
- The order in which the languages are switched.

See also

Setting a runtime language (Page 1466)
Setting the font for a runtime language (Page 1467)
Configuring language switching (Page 1468)
Specific features of Asian and Eastern languages in runtime (Page 1468)

8.12.3.2 Setting a runtime language

Introduction

The "Language & Font" editor shows all project languages available in the project. You can select the project languages to be available as runtime languages on the HMI device. In addition, you specify the order in which the languages will be switched.

Requirement

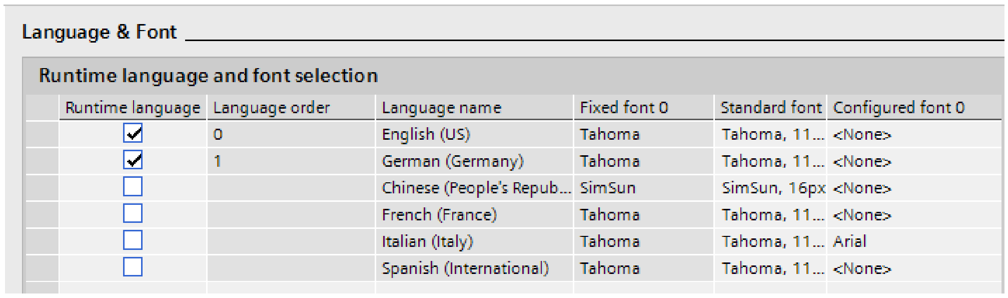
Multiple languages are enabled in the "Project languages" editor.

Procedure

1. Open the "Language & Font" editor under "Device settings".
2. In the "Runtime language" column, select the the languages to be used when runtime first starts.

   The selected language is assigned the number "0" in the "Language order" column.
3. In the "Runtime language" column, select the language to be activated next when the language is switched.

   The selected language is assigned the number "1" in the "Language order" column.



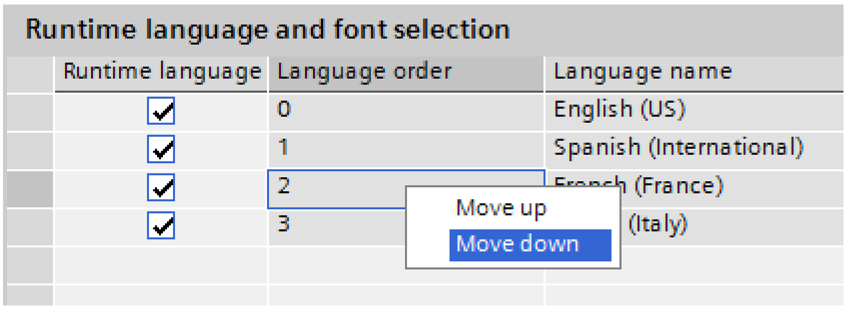
Language & Font

Runtime language and font selection

Runtime language	Language order	Language name	Fixed font 0	Standard font	Configured font 0
✓	0	English (US)	Tahoma	Tahoma, 11...	<None>
✓	1	German (Germany)	Tahoma	Tahoma, 11...	<None>
☐		Chinese (People's Repub...	SimSun	SimSun, 16px	<None>
☐		French (France)	Tahoma	Tahoma, 11...	<None>
☐		Italian (Italy)	Tahoma	Tahoma, 11...	Arial
☐		Spanish (International)	Tahoma	Tahoma, 11...	<None>

4. Select additional languages in the order in which they are to be activated when the language is switched.

   If the number of languages selected exceeds the number that can be loaded on the HMI device, the table background changes in color.
5. If you want to change the order of a language, select the desired row and then select the shortcut menu command "Move up" or "Move down".


Runtime language and font selection

Runtime language	Language order	Language name
✓	0	English (US)
✓	1	Spanish (International)
✓	2	French (France)
✓	3	(Italy)

Result

The enabled runtime languages are transferred with the compiled project to the HMI device.

When runtime starts the first time, the project is displayed in the language with the lowest number in the "Language order."

If language switching by means of the "SetLanguage" system function has been configured, the specified number sequence determines the order in which the languages are switched.

8.12.3.3 Setting the font for a runtime language

Introduction

You can specify the font used to display the texts for each runtime language on the HMI device in the "Language & Font" editor. The default font is used in all texts if you cannot define a specific font.

WinCC offers only fonts supported by the HMI device.

The default font is also used for the representation of dialogs in the operating system of the HMI device. Select a smaller font as default if the full length of the dialog texts or headers is not displayed.

Requirement

Multiple languages are enabled in the "Project languages" editor.

Procedure

1. Open the "Language & Font" editor under "Device settings".
2. Enable the languages to be displayed on the HMI device in the "Runtime language" column.

   In the "Fixed font 0" column, WinCC shows the fonts used by default in runtime.
3. In the "Configured font 0" column, select another font for each language you want to have available during configuration.

   These fonts are transferred to the HMI device during a transfer operation.
4. In the "Standard font" column, select the font to be used by default if a font cannot be selected for a text.

Result

The project texts for the selected language are displayed in the selected font on the HMI device.

8.12.3.4 Configuring language switching

Introduction

You need to configure language switching if you want to have multiple runtime languages available on the HMI device. This is necessary to enable the operator to switch between the various runtime languages.

Methods for language switching

You can configure the following methods for language switching:

- Direct language selection

  Each language is set by means of a separate button. In this case, you create a button for each runtime language. Configure the "SetLanguage" system function for each font with the number of the language or the language ID as a parameter.

- Language switching

  The operator toggles through all languages using a button.

  Configure "SetLanguage" system function for the button with the "Toggle" parameter. The language is enabled in the order you have specified in the "Language & Font" editor.

Regardless of the method used, the button names must be translated into each of the languages used. You can also configure an output field that displays the current language setting.

8.12.3.5 Specific features of Asian and Eastern languages in runtime

Introduction

When configuring for Asian languages some specific features should be observed for operation in runtime.

Note

You can only use Asian fonts supported by your configuration computer during configuration.

Memory requirement for Asian character sets

The memory requirement is of course greater when using Asian languages. Therefore, pay attention to any error messages when compiling the project.

Inputting Eastern and Asian characters (not ANSI)

You cannot enter Eastern and Asian characters in runtime on the Basic Panels.

Interpretation of Asian characters

When using Sm@rtAcess and Sm@rtService, only the characters known on the HMI device can be used. To be able to use Asian characters, these must be configured in the engineering system. Additionally configured characters require additional memory on the HMI device. Pay attention to the amount of available memory on the HMI device.

Font size for Asian character sets

Use at least a font size of 10 points to display the text of projects created for Asian languages in runtime. Asian characters will become illegible if smaller font sizes are used. This also applies to the default font used in the "Language & Font" editor.

Text field length for Asian languages

Make allowances for an appropriate length of the text fields when working on multilingual projects with Asian languages. Field contents may be partially hidden, depending on the font and the font size.

1. Open the "Properties > Appearance" text box in the Inspector window.
2. Under "Fit to size", disable the "Auto-size" option.
3. Verify the proper display in runtime.

8.12.4 Operating projects

8.12.4.1 Basics

8.12.4.1 Overview of operator control over a project

All Basic HMI devices feature a touch screen. Certain Basic HMI devices feature function keys. Use the touch screen and function keys to operate the Control Panel or the project running on your HMI device.

Danger
Incorrect operation

A project can contain certain operations that require in-depth knowledge about the specific plant on the part of the operator.

Ensure that only trained professional personnel operate the plant.

Operating the touch screen

Caution
Damage to the touch screen

Pointed or sharp objects can damage the plastic surface of the touch screen.

Always operate the touch screen with your fingers or with a touch pen only.
Triggering unintended actions

Touching several operator controls at the same time can trigger unintended actions.

Touch only one operator control on the screen at a time.

Operator controls are touch-sensitive symbols on the screen of the HMI device.

They are basically operated in the same way as mechanical keys. You activate operator controls by touching them with your finger.

Note

The HMI device returns a visual feedback as soon as it detects that an operator control has been touched.

The visual feedback is independent of any communication with the PLC. The visual feedback signal therefore does not indicate whether or not the relevant action is actually executed.

Examples of operator controls:

- Buttons

  Buttons can assume the following states:

"Untouched"

"Touched"

- Invisible buttons

  The focus of invisible buttons is by default not indicated following selection. No optical operation feedback is provided in this case.

  The configuration engineer may, however, configure invisible buttons so that their outline appears as lines when touched. This outline remains visible until you select another operator control.

- I/O fields

A screen keyboard appears as visual feedback after you touched an I/O field, for example, to enter a password.

Depending on the HMI device and the configured operator control, the system displays different screen keyboards for entering numerical or alphanumerical values.

The screen keyboard is automatically hidden again when input is complete.

Operating function keys

The function keys can be assigned global or local functions:

- Function keys with global function assignment

  A function key with global function assignment always triggers the same action on the HMI device or in the PLC, regardless of the currently displayed screen. The activation of a screen or the closing an alarm window, for example, is such an action.

- Function keys with local function assignment

  A function key with local function assignment is screen-specific and is therefore only effective within the active screen.

  The function assigned to a function key can vary from screen to screen.

The function key could be assigned only a single function within a screen only, that is, either a global or a local function. Local function assignments override global function assignments.

See also

Overview (Page 1457)
General functions of the screen keyboard (Page 1471)
Entering data on the KTP400 Basic (Page 1472)
Entering data on the KTP600, KTP1000, TP1500 Basic (Page 1475)
Displaying infotext (Page 1477)
Setting the project language (Page 1478)

8.12.4.1 General functions of the screen keyboard

The following keys are available on the screen keyboard of all Basic HMI devices:

←	Cursor left
→	Cursor right
BSP	Deleting a character
ESC	Cancel input
↵	Confirm input

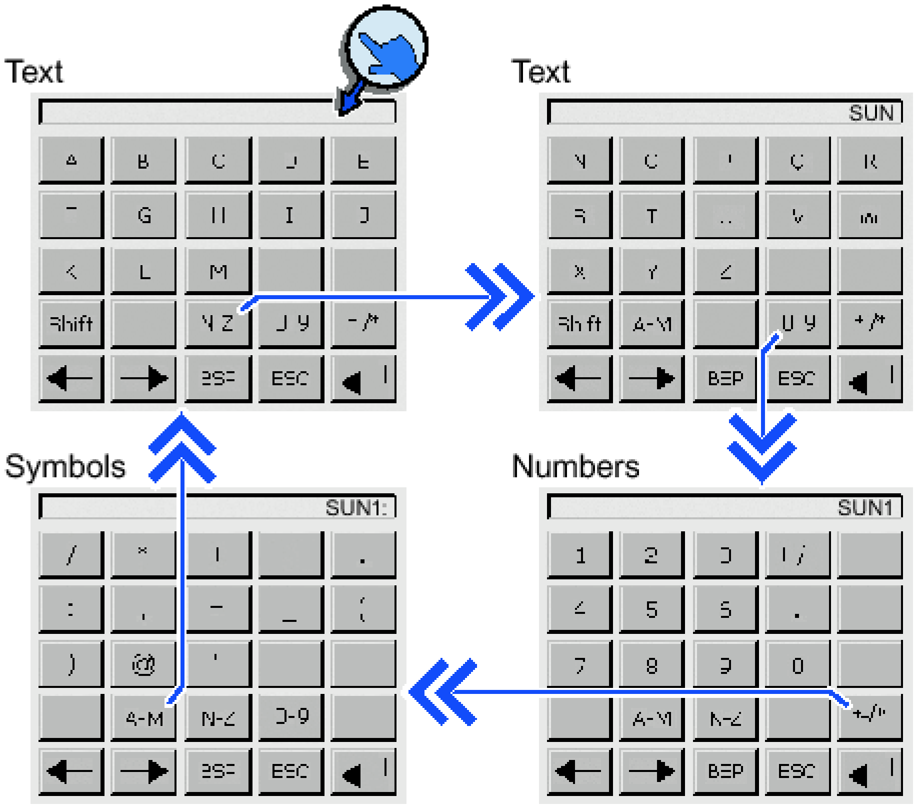
Help	Displaying infotext. This key only appears when an infotext has been configured for the operator control.

See also

Overview of operator control over a project (Page 1469)

8.12.4.1 Entering data on the KTP400 Basic

Due to the small display, the screen keyboard and the input concept of the KTP400 Basic differs compared to other Basic HMI devices.



The screen keyboard appears on the HMI device touch screen when you touch an operator control that requires input.

The screen keyboard of the KTP400 features four views. You can change the view while making entries using the buttons in the fourth row of the screen keyboard:

Button	Changes to the view
A-M	Entering text, characters "A" to "M"

Button	Changes to the view
N-Z	Entering text, characters "N" to "Z"
0-9	Entering numbers, "0" to "9," signed or unsigned and with or without decimal places
+-/*	Entering special characters
Shift	Entering text, shift to lower case letters

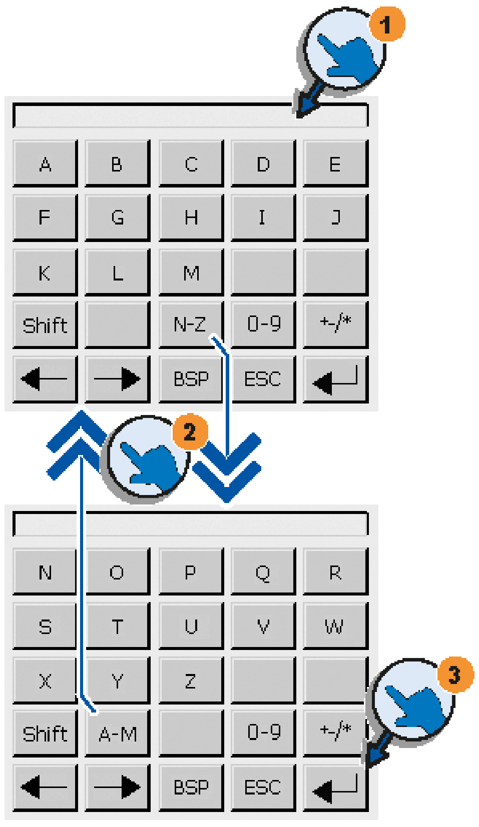
Note
Job mailbox has no effect

PLC job 51 "Select screen" has no effect while the screen keyboard is open.

Key assignment

The alphanumerical keyboard layout is monolingual.
A language change within the project does not have any effect on the layout of the alphanumerical screen keyboard.

Entering alphanumerical values



1. Touch the desired operator control on the screen.

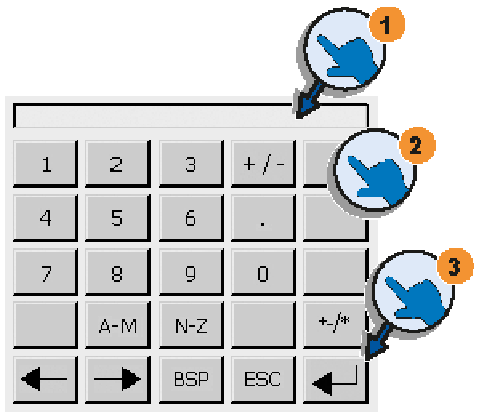
   The alphanumerical screen keyboard opens.
2. Enter the value. Depending on the settings, the HMI device outputs an audible signal.

   You can change the view of the screen keyboard using the keys <N-Z> and <A-M>.

   Use the <Shift> key to enter lower-case letters.
3. Press <Return> key to confirm your entries, or cancel them with <ESC>.

   Either action closes the screen keyboard.

Entering numerical values



1. Touch the desired operator control on the screen.

   The numerical screen keyboard opens.
2. Enter the value. Depending on the settings, the HMI device outputs an audible signal.

   You can change the view of the screen keyboard for entering numbers with hexadecimal notation using the <N-Z> and <A-M> keys.
3. Press <Return> key to confirm your entries, or cancel them with <ESC>.

   Either action closes the screen keyboard.

Checking numerical value limits

Tags can be assigned limit values. Any entry of a value outside this limit is rejected. If an alarm view is configured, a system event is triggered and the original value is displayed again.

Decimal places of numerical values

The configuration engineer can define the number of decimal places for a numerical text box. The number of decimal places is checked when you enter a value in this type of I/O field.

- Decimal places that exceed the limit are ignored.
- Unused decimal places are padded with "0" entries.

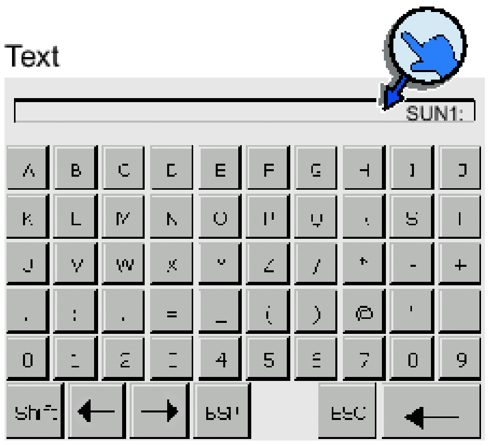
See also

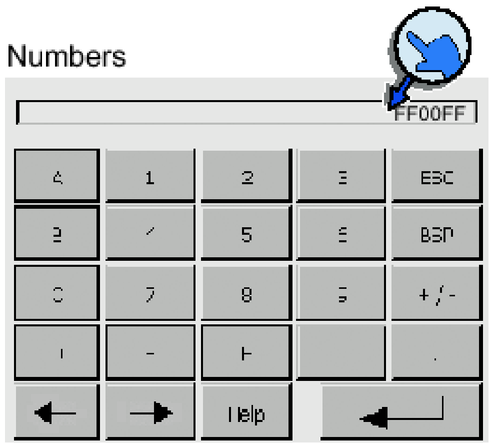
Overview of operator control over a project (Page 1469)

8.12.4.1 Entering data on the KTP600, KTP1000, TP1500 Basic

Alphanumerical screen keyboard

The screen keyboard appears on the HMI device touch screen when you touch an operator control that requires input.





Note

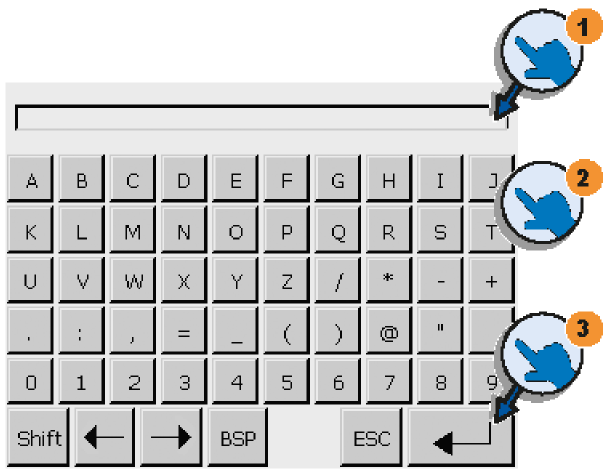
Job mailbox has no effect

PLC job 51 "Select screen" has no effect while the screen keyboard is open.

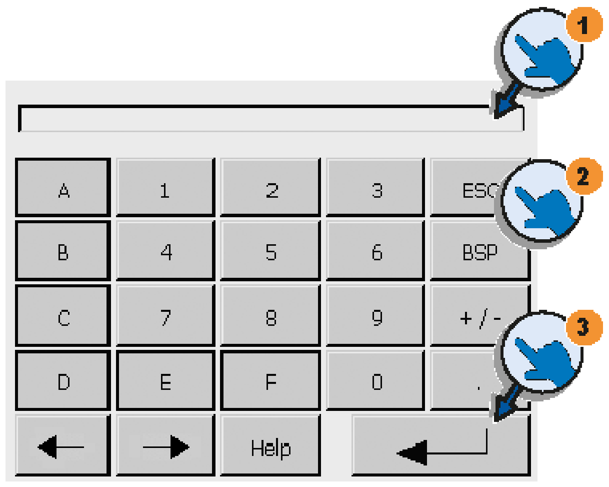
Key assignment

The alphanumerical keyboard layout is monolingual.
A language change within the project does not have any effect on the layout of the alphanumerical screen keyboard.

Entering alphanumerical values

 1 2 3 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z / * - + . : , = _ ( ) @ " 0 1 2 3 4 5 6 7 8 9 Shift BSP ESC	1. Touch the desired operator control on the screen. The alphanumerical screen keyboard opens. 2. Enter the value. Depending on the settings, the HMI device outputs an audible signal. Use the <Shift> key to enter lower-case letters. 3. Press <Return> key to confirm your entries, or cancel them with <ESC>. Either action closes the screen keyboard.

Entering numerical values

 1 2 3 A 1 2 3 ESC B 4 5 6 BSP C 7 8 9 + / - D E F 0 . Help	1. Touch the desired operator control on the screen. The numerical screen keyboard opens. 2. Enter the value. Depending on the settings, the HMI device outputs an audible signal. 3. Press <Return> key to confirm your entries, or cancel them with <ESC>. Either action closes the screen keyboard.

Checking numerical value limits

Tags can be assigned limit values. Any entry of a value outside this limit is rejected. If an alarm view is configured, a system event is triggered and the original value is displayed again.

Decimal places of numerical values

The configuration engineer can define the number of decimal places for a numerical text box. The number of decimal places is checked when you enter a value in this type of I/O field.

- Decimal places that exceed the limit are ignored.

- Unused decimal places are padded with "0" entries.

See also

Overview of operator control over a project (Page 1469)

8.12.4.1 Displaying infotext

Application

The configuration engineer uses info text to provide additional information and operating instructions. The configuration engineer can configure info text on screens and operator controls.

The info text of an I/O field may contain, for example, information on the value to be entered.

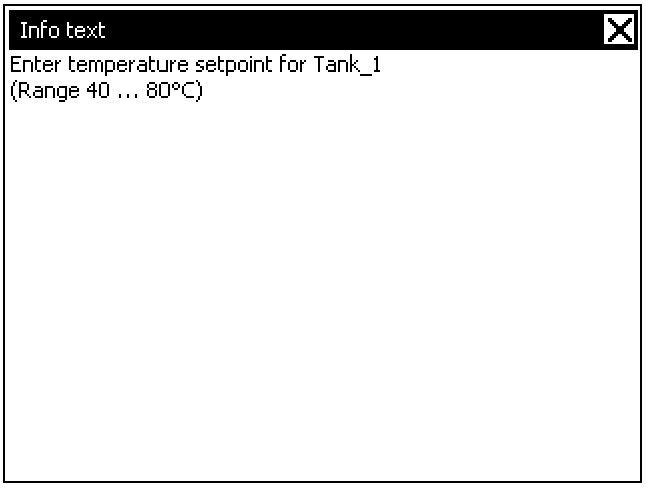

Info text
Enter temperature setpoint for Tank_1
(Range 40 ... 80°C)

Figure8-2 Info text for an I/O field, example

Procedure

Proceed as follows to open the info text for operator controls:

1. Touch the required operator control.

   The screen keyboard opens. You can see from the appearance of the

   Help

   key whether info text has been configured for the operator control or the current screen.

2. Touch the

   Help

   key on the screen keyboard.

   The info text for the operator control is displayed. If there is no info text for the selected screen object, the info text for the current screen is displayed, if it has been configured.

   You can scroll through the contents of long info text with

▼
and
▲
.

Note
Switching between displayed info text

The configuration engineer can configure info text for an I/O field and the associated screen. You can switch between two info texts by touching the info text window.

---

3. Close the displayed info text by pressing
   ☒
   .

Alternative procedure

Depending on your configuration, info text can also be called via a configured operator control.

See also

Overview of operator control over a project (Page 1469)

8.12.4.1 Setting the project language

Introduction

The HMI device supports multilingual projects. You must have configured a corresponding operating element which lets you change the language setting on the HMI device during runtime.

The project always starts with the language set in the previous session.

Requirement

- The required language for the project must be available on the HMI device.
- The language switching function must be logically linked to a configured operating element such as a button.

Selecting a language

You can change project languages at any time. Language-specific objects are immediately output to the screen in the new language when you switch languages.

The following options are available for switching the language:

- A configured operating element switches from one language to the next in a list.
- A configured operating element directly sets the desired language.

See also

Overview of operator control over a project (Page 1469)

8.12.4.2 Operating objects

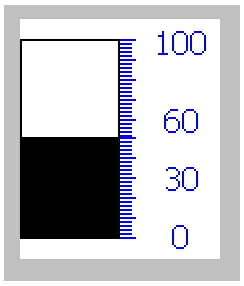
8.12.4.2 Bar

Application

The bar is a dynamic display object. The bar displays a value from the PLC as a rectangular area. The bar allows you to recognize the following at a glance:

- The distance of the current value from the configured limit values
- Whether a set point value has been reached

The bar can display values such as fill levels or batch counts.



Layout

The layout of the bar depends on the configuration:

- The bar may feature a scale of values
- The configured limit values can be indicated by lines
- Color changes can signal when a limit value has been exceeded or has not been reached

See also

Overview (Page 1457)
Overview (Page 1485)
Overview (Page 1490)
Overview (Page 1491)
Overview (Page 1492)

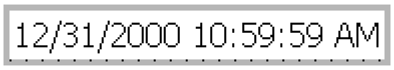
8.12.4.2 Date/time field

8.12.4.2 Overview

Application

A "Date / time box" may have the following runtime functions:

- Output of the date and time
- Combined input and output; here the operator can edit the output values so as to reset the date and time.



Layout

The appearance of the date/time field depends on the language set in the HMI device.

The date can be displayed in detail (e.g. Tuesday, 31 December 2003) or in short form (31.12.2003).

Operation

Depending on the configuration, you can operate the date/time field in the following ways:

- Standard operation: Change date and time.

Runtime behavior

When the operator ignores the syntax when entering values, or enters illegal values, the system rejects these. Instead, the original values (plus the time that has elapsed in the meantime) appears in the date/time field and a system alarm is displayed on the HMI device.

8.12.4.2 Touch and key operation

Touch operation

Proceed as follows to operate the date/time field:

1. Touch the date/time field on the touch screen of the HMI device. The on-screen keyboard is displayed automatically.
2. Enter the required value using the on-screen keyboard.
3. Press <ENTER> to confirm your entry, or cancel it with <ESC>. The on-screen keyboard is cleared automatically after you have confirmed or canceled your entries.

Key operation

Activate the date/time field, for example, with one or several

TAB

according to the configured tab sequence. A color frame signals the selected state of the field content.

Procedure

Proceed as follows to operate the date/time field:

1. Position the cursor using the cursor keys and enter the value.
2. Press

   ENTER

   . The object changes to the special editing mode. Only one character at any time is marked in the field.

   – Use the cursor keys

     ▲

     /

     ▼

     to scroll a character table.

   – The cursor keys

     ◀

     /

     ▶

     will take you to the next or previous cursor position.
3. Confirm your entry with

   ENTER

   , or discard it with

   ESC

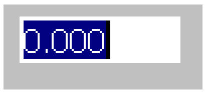
   .

8.12.4.2 I/O field

8.12.4.2 Overview

Application

You enter numeric or alphanumeric values in an I/O field. For example, a numeric value could be the number 80 as a temperature reference; an alphanumeric value could be the text "Service" as a user name.



Layout

The appearance of the I/O field depends on the configuration:

- Numeric I/O field

  For input of numbers in decimal, hexadecimal or binary format.
- Alphanumeric I/O field

  For input of character strings.
- I/O field for date and time

  For input of calendar dates or time information. The format depends on the set configuration.
- I/O field for password entry

  For concealed entry of a password. The entered character string is displayed with placeholders (*).

Operation

Depending on the configuration, you can operate the I/O field in the following ways:

- Standard operation: Enter a value in the I/O field.
- Event: An event is triggered when you operate the I/O field, for example, when you activate it. The processing of a function list can be configured to the event.

Runtime behavior

Limit value test of numerical values

Tags can be assigned limit values. If you enter a value that lies outside of this limit, it will not be accepted; for example, 80 with a limit value of 78. In this case the HMI device will deliver a system alarm, if an alarm window is configured. The original value is displayed again.

Decimal places for numerical values

The configuration engineer can define the number of decimal places for a numerical text box. The number of decimal places is checked when you enter a value in this type of I/O field.

- Decimal places in excess of the limit are ignored.
- Empty decimal places are filled with "0".

Hidden input

A "*" is displayed for every character during hidden input. The data format of the value entered cannot be recognized.

Behavior when switching between input fields

When you change to another input field within the same screen, and the screen keyboard appears, the "Exit field" event is not executed for the previous field unless you close the screen keyboard.

8.12.4.2 Touch and key operation

Touch operation

Proceed as follows to operate the IO field:

1. Touch the IO field on the touch screen of the HMI device. The on-screen keyboard is displayed automatically.
2. Enter the required value using the on-screen keyboard.
3. Press <ENTER> to confirm your entry, or cancel it with <ESC>.

The on-screen keyboard is cleared automatically after you have confirmed or canceled your entries.

Key operation

Activate the IO field,for example, with one or several

TAB

according to the tab sequence configured. A color frame signals the selected state of the field content.

Procedure

Proceed as follows to operate the IO field:

1. Position the cursor using

   SHIFT

   and a cursor key.
2. This step cancels the field content selection. Enter the desired value.
3. Press

   ENTER

   . The object changes to the special editing mode. Only one character at any time is marked in the field.

   – Use the cursor keys

     ▲

     /

     ▼

     to scroll a character table.

   – Use the cursor keys

     ▶

     /

     ◀

     to move the cursor to the next or previous input position.
4. Confirm your entry with

   ENTER

   , or discard it with

   ESC

   .

Note

Enable the input of hexadecimal characters "A" to "F" for numerical values by toggling the input keys to character mode using the key

A-Z

.

8.12.4.2 Graphic view

Application

The graphic view displays graphics.

Layout

The appearance of the graphic depends on the configuration. The graphic view, for example, adapts automatically to the size of the graphic.

Note

If you use bitmaps with the "Transparent color" setting in WinCC screens, requires high-performance display on the Panel HMI devices. Performance is enhanced by disabling the "Transparent color" setting in the properties of the respective graphic object. This restriction applies in particular when bitmaps are used as background image.

Operation

The graphic display is for display only and cannot be operated.

See also

Bar (Page 1479)

8.12.4.2 Graphic I/O field

8.12.4.2 Overview

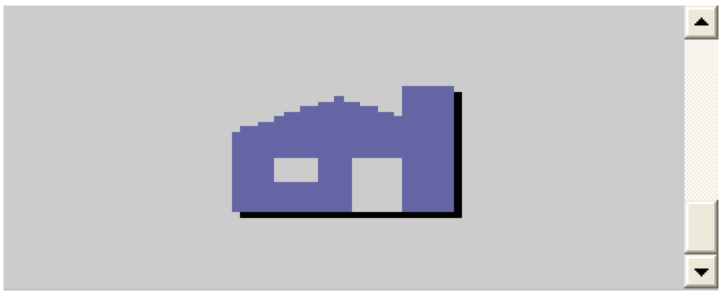
Application

A graphic IO field can have the following Runtime functions:

- Output of graphic list entries
- Combined input and output

Example of its use as output field:

To indicate the Runtime status of a valve, the graphic IO field outputs the image of a closed or open valve.



Operation

Depending on the configuration, you can operate the graphic IO field in the following ways:

- Standard operation: Select an entry from the graphic list.
- Event: An event is triggered when you operate the graphic IO field, e.g. when you activate it. The processing of a function list can be configured to the event.

Runtime behavior

If the graphic IO field displays a cactus image, you have not defined a graphic to be output for a specific value in your project.

The contents of the graphic IO field change color to show that it is now activated.

The frame in 3D is only shown graphically in an output field.

See also

Bar (Page 1479)
Touch and key operation (Page 1486)

8.12.4.2 Touch and key operation

Touch operation

Touch the graphic IO field on the touch screen of the HMI device. Selection mode is now enabled.

Select the graphic object using the scroll bar.

Touch the selected graphic object to save it or discard the selection by touching a different screen object.

Key operation

How to use a graphic IO field on the keyboard device:

Step		Procedure	
1	Select the graphic IO field	e.g. ▶	The graphic IO field is marked.
2	Enable the selection mode	ENTER	The selection mode is now enabled.
3	Select an entry	▲ ▼ ◀ ▶	Moves the cursor by lines.
4	Accept selection or	ENTER	The entry selected is now valid. The selection mode is closed.
	Cancel selection	ESC	The original value is restored.

See also

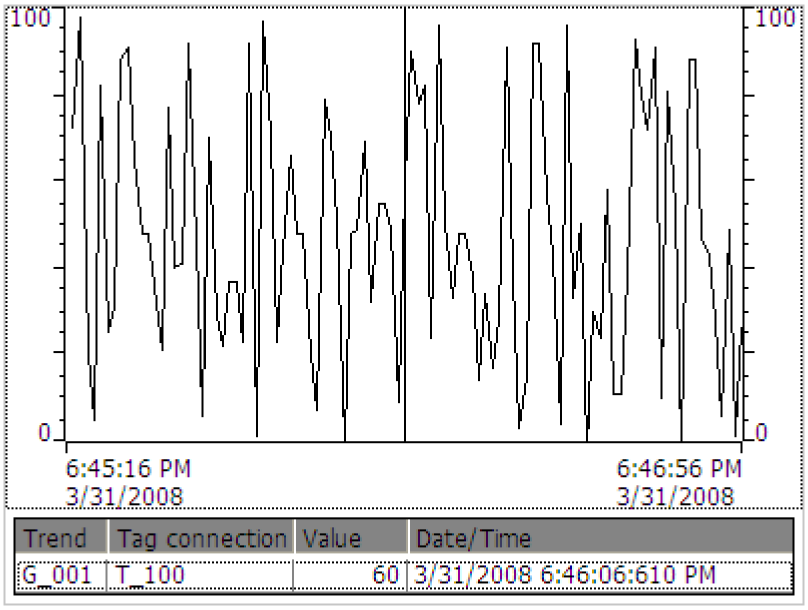
Overview (Page 1485)

8.12.4.2 Trend view

8.12.4.2 Overview

Application

The trend view is a dynamic display object. The Trend view can display actual process data and process data from a log continuously when it is supported by the HMI device.



Trend	Tag connection	Value	Date/Time
G_001	T_100	60	3/31/2008 6:46:06:610 PM

Layout

The layout of the trend view is based on the configuration. A trend view can show multiple curves simultaneously to allow the user, for example, to compare different process sequences. If the displayed process value exceeds or falls below the configured limit values, the violation of the limit can be displayed by a change of color in the curve.

A ruler can also simplify the reading of the process values from the trend view. The ruler displays the Y-value that belongs to an X-value.

Operation

Depending on the configuration you can:

- The displayed time section extends.
- The displayed time section reduces.
- Scroll back by one display width.
- Scroll forwards by one display width.
- Stop or continue the trend recording.

Operator controls

The buttons have the following functions:

Operator control	Function
⏮	Scrolls back to the start of trend recording. The start values of the trend recording are displayed there.
⊕	Zooms the displayed time section
⊖	Zooms out of the displayed time section
⇠	Moves the ruler backwards (to the left).
⇢	Moves the ruler forward (to the right).
⏪	Scrolls back by one display width (to the left).
⏩	Scrolls forward by one display width (to the right).
┆	Shows or hides the ruler. The ruler displays the X-value associated with a Y-value.
■	Stops or continues trend recording

See also

Bar (Page 1479)
Touch and key operation (Page 1488)

8.12.4.2 Touch and key operation

Procedure

Touch the relevant operator controls of the trend view on the touch screen of the HMI device.

Procedure

Select the trend view with the
TAB
key using the configured tab sequence.

The table below lists the key shortcuts available:

Keys	Function
CTRL + ENTER	Scrolls back to the start of trend recording. The start values of the trend recording are displayed there.
CTRL + +	Enlarges the time section displayed.
CTRL + −	Reduces the time section displayed.
CTRL + ALT + ◀	Moves the ruler backwards (to the left).
CTRL + ALT + ▶	Moves the ruler forward (to the right).
SHIFT + ◀	Scrolls back by one display width (to the left).
SHIFT + ▶	Scrolls forward by one display width (to the right).

See also

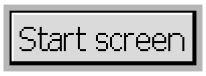
Overview (Page 1487)

8.12.4.2 Button

8.12.4.2 Overview

Application

A button is a virtual key on the screen of the HMI device that can have one or more functions.



Layout

The layout of the button depends on the button type.

- Button with text: The text shown on the button gives information regarding the status of the button.
- Button with graphic: The graphic shown on the button gives information regarding the status of the button.
- Invisible: The button is not visible during Runtime.

Operation

Depending on the configuration, you can operate the button in the following ways:

- Standard operation: Click the button.
- Event: An event is triggered when you operate the button, e.g. when you click it. The processing of a function list can be configured to the event.

Runtime behavior

The operation may be followed with a optical feedback. However, note that the optical feedback only indicates a completed operation and not whether the configured functions were actually executed.

See also

Bar (Page 1479)
Touch and key operation (Page 1490)

8.12.4.2 Touch and key operation

Procedure

Touch the button on the touch screen of the HMI device.

Procedure

How to operate a button on the keyboard device:

1. Select the button using a cursor key, e.g.

▶

2. Next, press the
   ENTER
   or the
   ␣
   key.

See also

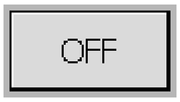
Overview (Page 1490)

8.12.4.2 Switch

8.12.4.2 Overview

Application

The switch is an operating element and display object with two states: "pressed" and "released." Switches can signal the state of a system component that cannot be seen from the HMI device, e.g. a motor. You can also change the state of that system component at the HMI device.



Layout

The layout of the switch depends on the switch type.

- Switches: The switch has a slider. The position of this slider gives information about the status of the switch.
- Switch with text: The text shown on the switch gives information regarding the status of the switch.
- Switch with graphic: The graphic shown on the switch gives information regarding the status of the switch.

Operation

Depending on the configuration, you can operate the switch in the following ways:

- Standard operation: Click the switch.
- Event: An event is triggered when you operate the switch, e.g. when you click it. The processing of a function list can be configured to the event.

Runtime behavior

A switch has two stable states: When you activate the switch, it changes to the other state. The switch retains this state until the next operation.

See also

Bar (Page 1479)
Touch and key operation (Page 1492)

8.12.4.2 Touch and key operation

Touch operation

Touch operation of the switch differs, depending on its type:

- If a slider is displayed for the switch:

  Drag the slider to the new position on the touch screen of the HMI device or double-click in the slider range.
- If only a text or graphic object is displayed for the switch:

  Touch the switch on the touch screen of the HMI device.

Key operation

How to operate a switch on the keyboard device:

- Select the switch using a cursor key, e.g.
  ▶
- Next, press the
  ENTER
  or the
  ␣
  key.

See also

Overview (Page 1491)

8.12.4.2 Symbolic I/O field

8.12.4.2 Overview

Application

A symbolic IO field can be assigned the following functions in Runtime:

- Output of text list entries
- Combined input and output

Example of its use as combination IO field:

You control a motor in Runtime by selecting the "Motor OFF" or "Motor ON" text from the text list. The motor is started or stopped in accordance with the selection. The symbolic IO field visualizes the current status of the motor.

Operation

The following options of operating the symbolic IO field are available, depending on the configuration:

- Standard operation: Select an entry from the text list.
- Event: You trigger an event by operating the symbolic IO field, e.g. by enabling it. The processing of a function list can be configured to the event.

Runtime behavior

The selection list of the symbolic IO field displays an empty text line if a corresponding entry was not defined in project data. The active state is indicated on the HMI device by changing the color of contents of the symbolic IO field.

See also

Bar (Page 1479)
Touch and key operation (Page 1493)

8.12.4.2 Touch and key operation

Touch operation

Touch the symbolic IO field on the touch screen of the HMI device. The selection list displays the default entries.

If the selection list displays a scroll bar: Touch the scroll bar on the touch screen of the HMI device. Touch the scroll bar and drag to the required position on the touch screen.

Select the entry and accept the corresponding tag value by touching the entry on the screen. The selection list closes and the entry is displayed. The focus is still set on the symbolic IO field.

Key operation

How to operate a symbolic IO field on the keyboard device:

Step		Procedure	
1	Select the symbolic IO field	e.g. ▶	The symbolic IO field is marked.
2	Open selection list	ENTER	The drop down list box opens.
3	Select an entry	▲ ◀ ▼ ▶	Moves the cursor by lines.
4	Accept the selection Or	ENTER	The entry selected is now valid. The selection list is closed.
	Canceling the selection	ESC	The original value is restored. The selection list is closed.

See also

Overview (Page 1492)

8.12.4.3 Project security

8.12.4.3 Overview

Design of the security system

The configuration engineer can protect the operation of a project by implementing a security system.

The security system is based on authorizations, user groups and users.

If you use an operator control with access protection, the HMI device first requests that you log on. A logon screen is displayed in which you enter your user name and password. After logging on, you can operate the operator controls for which you have the necessary authorizations.

The logon dialog can be set up by the configuration engineer via an individual operator control.

In the same way, the configuration engineer can set up an operator control to log off. After logging off, objects assigned access protection can no longer be operated; to do so, log on again.

User groups and authorizations

Project-specific user groups are created by the configuration engineer. The "Administrators" and "Users" groups are included in all projects by default. User groups are assigned authorizations. Authorization required for an operation is specifically defined for each individual object and function in the project.

Users and passwords

Each user is assigned to exactly one user group.

The following people are allowed to create users and assign them passwords:

- The configuration engineer during configuration
- The administrator on the HMI device
- A user with user administration authorization on the HMI device

Irrespective of the user group, each user is allowed to change his own password.

Logoff times

A logoff time is specified in the system for each user. If the time between any two user actions, such as entering a value or changing screens, exceeds this logoff time, the user is automatically logged off. The user must then log on again to continue to operate objects assigned access protection.

Backup and restore

The user data is encrypted and saved on the HMI device to protect it from loss due to power failure.

The users, passwords, group assignments and logoff times set up on the HMI device can be backed up and restored. This prevents you having to enter all of the data again on another HMI device.

Notice

The currently valid user data is overwritten in the following cases:

- Depending on settings for a new download of the project.
- Upon restore of a backed-up project
- Upon import of the user administration via an operator control. The newly downloaded or restored user data and passwords take effect immediately.

See also

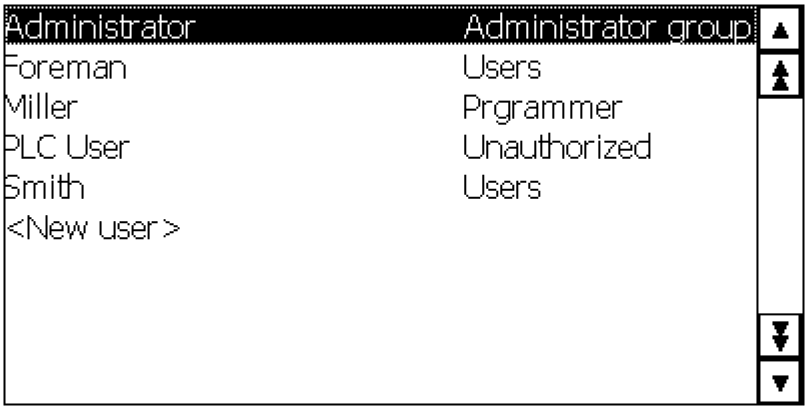
Overview (Page 1457)
Simple user view (Page 1496)
User logon (Page 1497)
User logoff (Page 1498)

Creating users (Page 1499)
Changing the user (Page 1500)
Deleting a user (Page 1501)

8.12.4.3 Simple user view

Application

On HMI devices with a small display, the simple user view is used to display users on the HMI device.



Administrator	Administrator group
Foreman	Users
Miller	Prgrammer
PLC User	Unauthorized
Smith	Users
<New user>	

Note

The "simple user view" object cannot be operated dynamically with a script.

Layout

The appearance depends on the authorizations.

- All users on the HMI device system are displayed in the User view to the administrator or to a user with administrator authorizations.
- When user administration authorization is lacking, only the personal user entry is displayed.

Operation

Depending on the configuration you can:

- Manage users, e.g. create, delete.
- Change existing user data.
- Export or import user data.

Note

An HMI device supports up to 100 users. This restriction does not apply to PCs. On a PC, the maximum number of users is restricted by the physical memory.

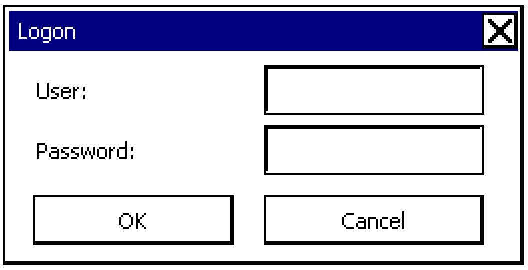
See also

Overview (Page 1494)

8.12.4.3 User logon

Logon dialog

Use the logon dialog to log on to the security system of the HMI device. Enter your user name and password in the logon dialog.



The logon dialog opens in the following cases:

- You use an operator control with access protection.
- You press an operator control that was configured for displaying the logon dialog.
- Select the "<ENTER>" entry in the simple user view.
- Select a blank entry in the extended user view.
- The logon dialog will be automatically displayed when the project is started, depending on the configuration.

Requirement

The logon dialog is open.

Procedure for touch operation

Proceed as follows:

1. Enter the user name and password.

   Touch the corresponding text box. The alphanumerical on-screen keyboard is displayed.
2. Select "OK" to confirm logon.

Procedure for key operation

Proceed as follows:

1. Select the "User" input field within the logon dialog by pressing the
   TAB
   key.
2. Enter the user name using the system keys.

   Switch the numerical keypad to alphabetic mode using the key
   A-Z
   to enter letters.
3. Use the
   TAB
   key to select the "Password" input field.
4. Enter the password using the system keys.
5. Confirm your entries with "OK."

Note

The user name is not case-sensitive.

The password is case-sensitive.

Result

After successful logon to the security system, you can execute functions on the HMI device which are access protected and for which you have authorization.

An alarm is output if an incorrect password has been entered and if an alarm view was configured.

See also

Overview (Page 1494)

8.12.4.3 User logoff

Requirement

You have logged into the security system of the HMI device.

Procedure

You have the following options for logging off:

- You press an operator control that was configured for logoff.
- You will be logged off automatically if you are not operating the project and if the logoff time has been exceeded.

You will also be automatically logged off if you enter an incorrect password.

Result

You are no longer logged into the project. In order to use an operator control with access protection, you first have to log on again.

See also

Overview (Page 1457)
Overview (Page 1494)

8.12.4.3 Creating users

Requirement

- The user view is open.
- You are either authorized for user administration or you are an administrator.
- A user group has been created.

Notice

Runtime users must be assigned to a user group. The user group is created in the Engineering System. The designation of the user group is language-dependent.

Notice

The following characters cannot be used in passwords:

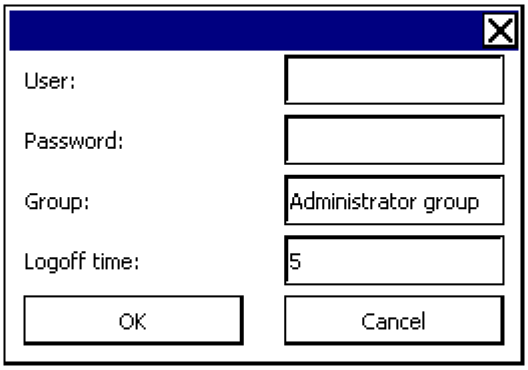
– Blanks

– Special characters * ? . % / \ ' "

Creating users in the simple user view

Proceed as follows:

1. Click the "<New user>" entry in the user view. A dialog opens.



User:	
Password:	
Group:	Administrator group
Logoff time:	5

2. Enter the desired user name and password.

   Touch the corresponding text box. The alphanumerical on-screen keyboard is displayed.
3. Click on the text box of the group. A dialog opens.
4. Assign the user to a group. Select
   ▲
   and
   ▼
   to scroll the selection list.
5. Touch the required entry in the drop down list box.

   The selected entry is accepted as input.
6. Touch the text box "Logoff time". The on-screen keyboard is displayed.
7. Enter a logoff time between 0 and 60 minutes. The value 0 stands for "no automatic logoff."
8. Confirm your entries with "OK."

Result

The new user is created.

See also

Overview (Page 1494)

8.12.4.3 Changing the user

Requirement

The user view is open.

Your authorization level determines the data you can change:

- You are an administrator or a user with user administration authorization. In these cases you are allowed to change the data for all the users on the HMI device in the user view:
  - User name
  - Group assignment
  - Password
  - Logoff time
- You are a user without user management authorization. In this case you are only allowed to change your personal user data:
  - Password
  - Logoff time, if configured

Note

You can only change the logoff time and password for the "Admin" user.

You can only change the logoff time for the "PLC_User". This user is used for logging on via the PLC.

Notice

Changes in the user view are effective immediately in Runtime. Changes in Runtime are not updated in the Engineering System.

When the user management is downloaded to the HMI device, all changes in the user view are overwritten.

Changing user data in the simple user view

Proceed as follows:

1. In the user view, touch the user whose user data you want to change.
2. When entering the data, use exactly the same procedure as for creating a user.

Changing user data in the advanced user view

Proceed as follows:

1. In the user view, touch the user whose user data you want to change.
2. When entering the data, use exactly the same procedure as for creating a user.

Result

User data have been changed.

See also

Overview (Page 1494)

8.12.4.3 Deleting a user

Requirement

- You have opened a screen that contains the user view.
- You must be logged on with administrator rights or be authorized for user management to delete users.

Notice

Changes in the user view are effective immediately in Runtime. Changes in Runtime are not updated in the Engineering System.

When the user management is downloaded to the HMI device, all changes in the user view are overwritten.

Procedure for touch operation

Proceed as follows:

1. Touch the user to be deleted in the user view.
2. Delete the user name.

Procedure for key operation

Proceed as follows:

1. Select the user view using the
   TAB
   key or the cursor keys.
2. Select the user in the user view by means of cursor keys.
3. Press
   INS DEL
   to delete the user.

Result

The user has been deleted and may no longer log onto the project.

See also

Overview (Page 1494)

8.12.4.4 Operating alarms

8.12.4.4 Overview

Alarms

Alarms indicate events and states on the HMI device which have occurred in the system, in the process or on the HMI device itself. A status is reported when it is received.

An alarm could trigger one of the following alarm events:

- Incoming
- Outgoing

- Acknowledge

The configuration engineer defines which alarms must be acknowledged by the user.

An alarm may contain the following information:

- Date
- Time
- Alarm text
- Event text
- Location of fault
- Status
- Alarm class
- Alarm number
- Alarm group
- Supports diagnostics

Alarm classes

Alarms are assigned to various alarm classes. The selection depends on the HMI device.

- Warning

  Alarms of this class usually indicate states of a plant such as "Motor switched on." Alarms in this class do not require acknowledgment.
- Error

  Alarms in this class must always be acknowledged. Alarms normally indicate critical errors within the plant such as "Motor temperature too high".
- System

  System alarms indicate states or events which occur on the HMI device.

  System alarms provide information on occurrences such as operator errors or communication faults.
- Diagnostic alarm

  SIMATIC diagnostic alarms show states and events in the SIMATIC S7 controllers.

Note
Availability for specific devices

Diagnostic alarms are not available for Basic Panels.

- STEP 7 alarm classes

  The alarm classes configured in STEP 7 are also available to the HMI device.

Note
Availability for specific devices

STEP 7 alarm classes are not available for Basic Panels.

- Custom alarm classes

  The properties of this alarm class must be defined in the configuration.

Alarm buffer

Alarm events are saved to an internal, volatile buffer. The size of this alarm buffer depends on the HMI device type.

Alarm log

When alarm logging is enabled, alarm events are output directly to the printer.

You can set the logging function separately for each alarm. The system outputs "Incoming" and "Outgoing" alarm events to the printer.

The output of alarms of the "System" class to a printer must be initiated by means of the corresponding alarm buffer. This outputs the content of the alarm buffer to the printer. To be able to initiate this print function, you need to configure a corresponding control object in the project.

Note
Availability for specific devices

Alarm logs are not available for Basic Panels.

Alarm log

Alarm events are stored in an alarm log, provided this log file is configured. The capacity of the log file is limited by the storage medium and system limits.

Note
Availability for specific devices

Alarm logs are not available for Basic Panels.

Alarm view

The alarm view shows selected alarms or events from the alarm buffer or alarm log. Whether alarm events have to be acknowledged or not is specified in your configuration. By means of configuration, the display can be filtered in such a way that only alarms that contain a specific character string will be shown.

Alarm window

If configured, an alarm window shows all pending alarms or alarms awaiting acknowledgment of a particular alarm class. The alarm window is displayed as soon as a new alarm occurs.

You can configure the order in which the alarms are displayed. Either the current alarm or the oldest alarm is displayed. The alarm window can also be set to indicate the exact location of the fault, including the date and time of the alarm event. By means of configuration, the display can be filtered in such a way that only alarms that contain a specific character string will be shown.

Alarm indicator

The alarm indicator is a graphic icon that is displayed on the screen when an alarm of the specified alarm class is activated.

The alarm indicator can assume one of two states:

- Flashing: At least one unacknowledged alarm is pending.
- Static: The alarms are acknowledged but at least one of them is not yet deactivated. The number displayed indicates the number of pending alarms.

See also

Overview (Page 1457)
Detecting pending alarms (Page 1507)
Display infotext for alarm (Page 1508)
Acknowledge alarm (Page 1509)
Editing an alarm (Page 1510)
Simple alarm view, alarm window (Page 1505)

8.12.4.4 Simple alarm view, alarm window

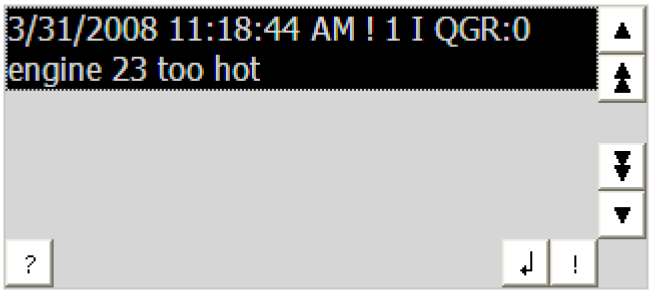
Application

The simple alarm view shows selected alarms or alarm events from the alarm buffer or alarm log. The layout and operation of the simple alarm window correspond to that of the simple alarm view.

Note

The "Single alarm view" object cannot be operated dynamically with a script.

In the Engineering System you can, for example, dynamically control the visibility of an object in the "Animations" group of the properties window. In Runtime, the "Simple alarm view" does not support animations. If you have configured an animation and, for example, wish to perform a consistency check of the project, then an error alarm is issued in the output window.



3/31/2008 11:18:44 AM ! 1 I QGR:0 engine 23 too hot

Layout

Depending on the configuration, in the alarm view different columns with information regarding an alarm or an alarm event are displayed.

To differentiate between the different alarm classes, the first column in the alarm view contains an icon:

Symbol	Alarm class
!	Error
(empty)	Warning
(depends on the configuration)	Custom alarm classes
$	System

Operation

Depending on the configuration you can:

- Acknowledge alarms
- Editing alarms

Operator controls

The buttons have the following functions:

Button	Function
!	Acknowledge alarm
↲	Edit alarm
?	Display info text for an alarm

Button	Function
▶	Shows the full text of the selected alarm in a separate window, the alarm text window. In the alarm text window, you can view alarm text that requires more space than is available in the Alarm view. Close the alarm text window with ✕ .
▲	Scrolls one alarm up
⏫	Scrolls one page up in the alarm view
⏬	Scrolls one page down in the alarm view
▼	Scrolls one alarm down

Layout of the operator controls

The appearance of the buttons for using the simple alarm view depends on the configured size. You should therefore check if all the necessary buttons are available on the HMI device.

See also

Overview (Page 1502)

8.12.4.4 Detecting pending alarms

Introduction

You can recognize the presence of alarms which must be acknowledged by the following:

- For an HMI device with keys: The LED of the key
  ACK
  is lit.
- Depending on the configuration: An alarm indicator is displayed on screen.

The configuration determines whether an alarm has to be acknowledged or not. This is also defined by the alarm class which an alarm belongs to.

LED in the "ACK" key

An LED is integrated in the
ACK
key on HMI devices with keyboard. The LED is lit if there are alarms requiring acknowledgment which must still be acknowledged.

The LED goes out when you acknowledge all alarms requiring acknowledgment.

Alarm indicator

The alarm indicator is a graphic symbol indicating pending alarms or alarms requiring acknowledgment, depending on the configuration.

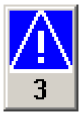


Figure8-3 Alarm indicator with three pending alarms

Layout

The alarm indicator can assume one of two states:

- Flashing:

  The alarm indicator flashes as long as alarms are pending for acknowledgment. The number displayed indicates the number of pending alarms. The project engineer can configure specific functions to be executed by operating the alarm indicator.
- Static: The alarms are acknowledged but at least one of them is not yet deactivated.

Runtime behavior

Displaying dialogs

The displayed alarm indicator view is covered, for example, by the logon dialog, help dialog or alarm text windows. The alarm indicator is visible once you close these dialogs.

See also

Overview (Page 1502)

8.12.4.4 Display infotext for alarm

Procedure for touch operation

Proceed as follows to display the info text:

1. Touch the relevant alarm in the alarm view or in the alarm window.

   The alarm is selected.
2. Touch the

   ?

   button in the simple alarm view or

   in the advanced alarm view.

   If configured, the info text assigned to this alarm is displayed.
3. Close the screen for displaying the Info text by means of the

   button.

Procedure for key operation

Proceed as follows to display the info text:

1. Select the desired alarm in the alarm view.
2. Press the key
   HELP
   .
   If configured, the info text assigned to this alarm is displayed.
3. Close the info text by pressing the
   HELP
   key.

See also

Overview (Page 1502)

8.12.4.4 Acknowledge alarm

Requirement

The alarm to be acknowledged is displayed in the alarm window or the alarm view.

Procedure for touch operation

To acknowledge an alarm, proceed as follows:

1. Touch the relevant alarm in the alarm view or in the alarm window.
   The alarm is selected.
2. Touch the
   !
   button in the simple alarm view or

   in the advanced alarm view.

Procedure for key operation

The alarm view and the alarm window have a tab sequence with which you can select operator controls and the last selected alarm using the keyboard.

To acknowledge an alarm, proceed as follows:

1. Select the desired alarm view or alarm window using the
   TAB
   key.
2. Select the desired alarm. Use the

,

,

or

keys accordingly.

3. Press the key

   .

Alternative operation

Depending on the configuration, you can also acknowledge an alarm with a function key.

Result

The alarm is acknowledged. If the alarm belongs to an alarm group, all the alarms of the associated group are acknowledged.

See also

Overview (Page 1502)

8.12.4.4 Editing an alarm

Introduction

The configuration engineer can assign additional functions to each alarm. These functions are executed when the alarm is processed.

Note

When you edit an unacknowledged alarm, it is acknowledged automatically.

Requirement

The alarm to be edited is displayed in the alarm window or the alarm view.

Procedure for touch operation

Proceed as follows to edit an alarm:

1. Touch the relevant alarm in the alarm view or in the alarm window. The alarm is selected.

2. Touch the
   ↲
   button in the simple alarm view or
   in the enhanced alarm view.

Procedure for key operation

Proceed as follows to edit an alarm:

1. Select the desired alarm view or alarm window with
   TAB
   .
2. Select the desired alarm. Use the
   HOME
   ,
   END
   ,
   ▲
   or
   ▼
   keys.
3. Continue to press the key
   TAB
   until the button
   ↲
   is selected in the simple alarm view or
   in the extended alarm view.
4. Confirm your entry by pressing the key
   ENTER
   .

Result

The system executes the additional functions of the alarm. Additional information on this topic may be available in your plant documentation.

See also

Overview (Page 1502)

8.12.4.5 Operating recipes

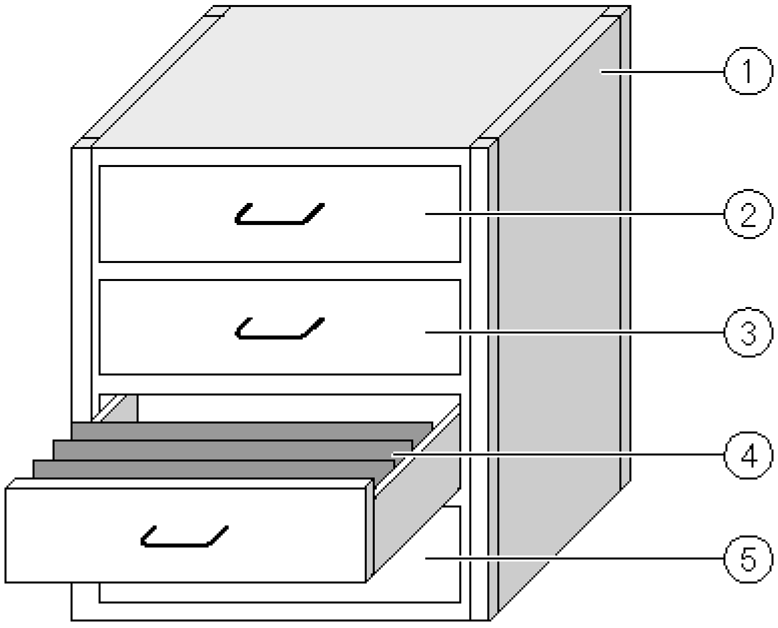
8.12.4.5 Structure of a recipe

Recipes

The recipe collection for the production of a product family can be compared to a file cabinet. A recipe which is used to manufacture a product corresponds to a drawer in a file cabinet.

Example:

In a plant for producing fruit juice, recipes are required for different flavors. There is a recipe, for example, for the flavors orange, grape, apple and cherry.



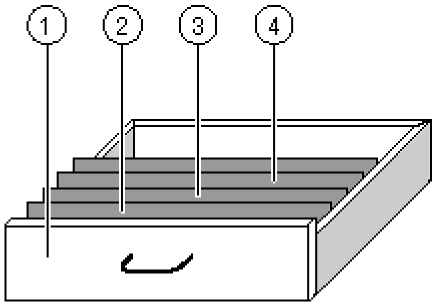
①	File cabinet	Recipe collection	Recipes for a fruit juice plant
②	Drawer	Recipe	Orange flavored drinks
③	Drawer	Recipe	Grape flavored drinks
④	Drawer	Recipe	Apple flavored drinks
⑤	Drawer	Recipe	Cherry flavored drinks

Recipe data records

The drawers of the file cabinet are filled with suspension folders. The suspension folders in the drawers represent records required for manufacturing various product variants.

Example:

Product variants of the flavor apple might be a soft drink, a juice or nectar, for example.



①	Drawer	Recipe	Product variants of apple flavored drinks
②	Suspension folder	Recipe data record	Apple drink
③	Suspension folder	Recipe data record	Apple nectar
④	Suspension folder	Recipe data record	Apple juice

Elements

In the figure showing the file cabinet, each suspension folder contains the same number of sheets. Each sheet in the suspension folder corresponds to an element of the recipe data record. All the records of a recipe contain the same elements. The records differ, however, in the value of the individual elements.

Example:

All drinks contain the same components: water, concentrate, sugar and flavoring. The records for soft drink, fruit juice or nectar differ, however, in the quantity of sugar used in production.

See also

Overview (Page 1457)
Recipes in the project (Page 1513)
Simple recipe view (Page 1515)
Creating a recipe data record (Page 1519)
Editing a recipe data record (Page 1519)
Deleting a recipe data record (Page 1520)
Reading a recipe data record from the PLC (Page 1521)
Transferring a recipe data record to the PLC (Page 1522)

8.12.4.5 Recipes in the project

Overview

If recipes are used in a project, the following components interact:

- HMI device recipe memory

Recipes are saved in the form of data records in the HMI device recipe memory.

- Recipe view / recipe screen

  On the HMI device, recipes are displayed and edited in the recipe view or in a recipe screen.

  – The recipe data records from the internal memory of the HMI device are displayed and edited in the recipe view.

  – The values of the recipe tags are displayed and edited in the recipe screen.

Note

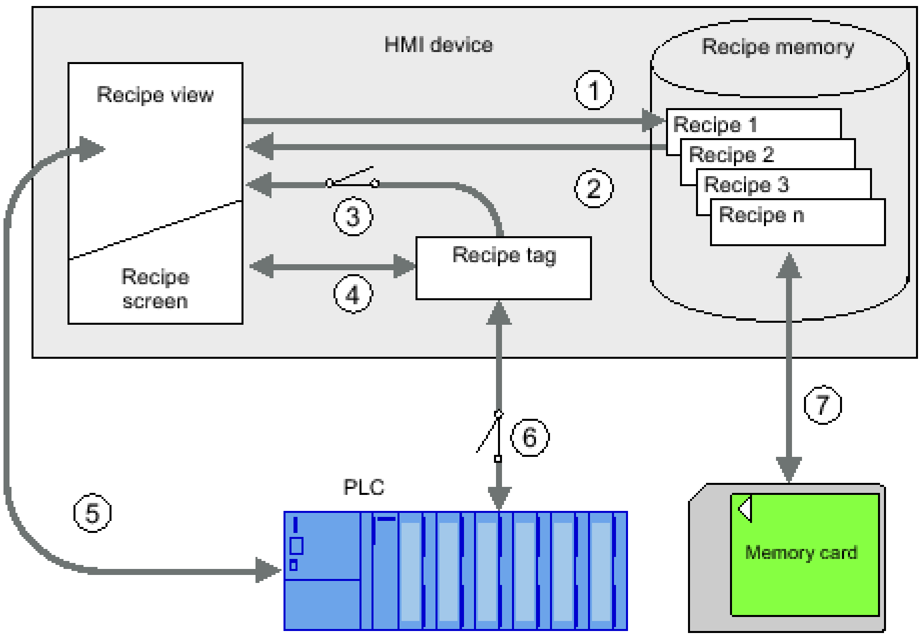
The same recipe tags can be configured in a variety of recipes. If you modify the value of a recipe tag, the synchronization changes the value of the recipe tag in all recipes.

- Recipe tags

  The recipe tags contain recipe data. When you edit recipes in a recipe screen, the recipe values are stored in recipe tags. The point at which the recipe tag values are exchanged with the PLC depends on the configuration.

Data flow

The following figure shows the data flow in a project with recipes:



①	Editing, saving or deleting a recipe data record
②	Display recipe data record
③	Synchronize or do not synchronize recipe tags
④	Display and edit recipe tags in the recipe screen

⑤ Write records from the recipe view to the PLC or read records from the PLC and display them in the recipe view.

⑥ Recipe tags are to the PLC online or offline

⑦ Export or import recipe data record to memory card

See also

Structure of a recipe (Page 1512)

8.12.4.5 Simple recipe view

Layout

The simple recipe view consists of three areas:

- Recipe list
- Data record list
- Element list

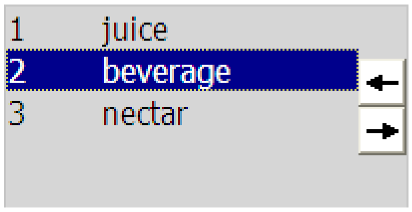

1 juice
2 beverage
3 nectar

Figure8-4 Simple recipe view - example with data record list

In the simple recipe view, each area is shown separately on the HMI device. You can use the shortcut menu to operate each of these display areas.

The simple recipe view always begins with the recipe list.

Operation

You can use the simple recipe view as follows, depending on the configuration:

- Create, change, copy or delete recipe data records
- Read recipe data records from the PLC or transfer to the PLC

Operator controls of the simple recipe view

Toggle between the display areas and the shortcut menus to operate the simple recipe views.

The table below shows the operation of the display area.

	Key	Function
Touching an entry	ENTER	The next lowest display area is opened, i.e. the data record list or the element list.
←	ESC	The previous display area opens.
→	▶	The shortcut menu of the display area opens.

The table below shows the operation of the shortcut menu:

	Key	Function
→	ESC	The menu is closed. The display area opens.
Touching the menu command	Input of the number of the menu command	The menu command is executed.

Shortcut menus of the simple recipe view

A shortcut menu can be called for each view area by pressing the

→

button or the

▶

key. The shortcut menu lists the commands that are available in the active view area. A number is assigned to each command. You execute the command by entering its number. You can also use the system keys to execute certain commands.

The scope depends on the HMI device.

- Recipe list

No.	Menu command	Keys	Function
0	New	SHIFT + INS DEL	A new recipe data record is created for the selected recipe. If a start value is configured, it is displayed in the input field.
1	Displaying infotext	HELP	Displays the infotext configured for the simple recipe view.
2	Open	ENTER	The record list of the selected recipe opens.

- Data record list

	Menu command	Keys	Function
	New	SHIFT + INS DEL	Creates a new recipe data record. If a start value is configured, it is displayed in the input field.
	Deleting	INS DEL	The displayed record is deleted.
	Save as		The selected data record is saved under a different name. A dialog box opens where you can enter the name.
	Rename		Renames the selected data record. A dialog box opens where you can enter the name.
	Open	ENTER	The element list of the selected data record opens.
	Previous	ESC	The recipe list opens.
	To PLC		The displayed values of the selected data record are transferred from the HMI device to the PLC.
	From PLC		The recipe values from the PLC are displayed in the recipe view of the HMI device.
	Displaying infotext	HELP	Displays the infotext configured for the simple recipe view.

- Element list

	Menu command	Keys	Function
	Save		The selected record is renamed.
	To PLC		The displayed values of the selected data record are transferred from the HMI device to the PLC.
	From PLC		The recipe values from the PLC are displayed in the recipe view of the HMI device.
	Save as		The data record is saved under a new name. A dialog box opens where you can enter the name.
	Displaying infotext	HELP	Displays the infotext configured for the simple recipe view.
	Rename		Renames the selected data record. A dialog box opens where you can enter the name.
	Previous	ESC	The data record list opens.

Mouse control or touchscreen control of the simple recipe view

1. Select the desired recipe from the recipe view.

2. Click on the

   →

   button.

   The shortcut menu is opened.
3. Select the desired menu command.

   The menu command is executed.
4. Alternatively, open the desired recipe in the recipe view.

   The data record list is displayed.
5. Open the desired data record. You could also use the

   →

   button to open the shortcut menu and select a menu command.

   The menu command is executed.

Using the keyboard with the simple recipe view

1. Press the

   TAB

   key as many times as required to select the simple recipe view.
2. Select the desired recipe with the cursor keys.
3. Press the

   ▶

   key.

   The shortcut menu is opened.
4. Press the

   ▼

   cursor key as many times as required to select the menu command.
5. Confirm the menu command by pressing the key

   ENTER

   .
6. Alternatively, press the number of the desired menu command.

   The menu command is executed.

See also

Structure of a recipe (Page 1512)

8.12.4.5 Creating a recipe data record

Introduction

Create a new recipe data record in the recipe list or in the record list. Then enter the values for the new record in the element list and save the record.

Requirement

A screen with a simple recipe view is displayed.

Procedure

Proceed as follows to create a recipe data record:

1. If the recipe list contains several recipes: Select the recipe for which you want to create a new recipe data record.
2. Open the recipe list menu.
3. Select the "0 new" menu command.

   Creates a new record.

   The element list of the new record opens.
4. Enter values for the data record elements.

   The tags of the record can be assigned default values depending on the configuration.
5. Open the menu of the element list and select the "0 Save" menu command.
6. Enter a name for the new record.
7. Confirm your entries.

   An existing data record is overwritten if you assign its number to a new data record.

Result

The new recipe data record is saved to the selected recipe.

See also

Structure of a recipe (Page 1512)

8.12.4.5 Editing a recipe data record

Introduction

Edit the values of the recipe data records and save them to a recipe view.

Synchronization with the PLC

To display the current recipe values from the PLC in the simple recipe view, you first have to read the actual values in the element list from the PLC using menu command "2 From PLC".

Values changed in the recipe view are only activated after you transferred the modified data record to the PLC by means of menu command "1 To PLC".

Requirement

A screen with a recipe view is displayed.

Procedure

Proceed as follows to copy a recipe data record:

1. If the recipe list contains several recipes: Select the recipe which contains the relevant recipe data record.
2. Open the data record list.
3. Select the recipe data record you want to edit.
4. Open the element list.
5. Edit the element values as required.
6. Save your changes using menu command "0 Save".

Result

The edited recipe data record is saved to the selected recipe.

See also

Structure of a recipe (Page 1512)

8.12.4.5 Deleting a recipe data record

Introduction

You can delete all the data records which are not required.

Requirement

A screen with a simple recipe view is displayed.

Procedure for touch operation

Proceed as follows to delete a new recipe data record:

1. If the recipe list contains several recipes: Select the recipe which contains the relevant recipe data record.
2. Open the data record list.
3. Select the data record you want to delete.
4. Open the menu.
5. Select the menu command "1 Delete".

Procedure for key operation

Proceed as follows to delete a new recipe data record:

1. If the recipe list contains several recipes: Select the recipe which contains the relevant recipe data record.
2. Open the data record list.
3. Select the data record you want to delete.
4. Press
   INS DEL
   .

Result

The data record is deleted.

See also

Structure of a recipe (Page 1512)

8.12.4.5 Reading a recipe data record from the PLC

Introduction

The values of recipe elements are exchanged with the PLC via tags.

You can edit values which were saved to the recipes in the HMI device directly at plant level within the active project; this may be the case if a valve in the plant opens more than is indicated in the recipe. The values of the tags on the HMI device possibly no longer match the values in the PLC.

Read the values from the PLC and output these to the recipe view to synchronize the recipe values.

Requirement

A screen with a simple recipe view is displayed.

Procedure

To transfer a recipe data record to the PLC, proceed as follows:

1. If the recipe list contains several recipes: Select the recipe which contains the relevant recipe data record.
2. Select the element list of the recipe data record to which you want to apply the values from the PLC.
3. Open the menu.
4. Select menu command "2 From PLC".

   The values are read from the PLC.
5. Save the displayed values to the HMI device using menu command "0 Save".

Result

The values were read from the PLC, are visible on the HMI device and were saved to the selected recipe data record.

Note
Basic Panels

With Basic Panels, the "From PLC" menu command can also be configured for the data record list: In this case, you can also select the "From PLC" menu command in the data record list.

See also

Structure of a recipe (Page 1512)

8.12.4.5 Transferring a recipe data record to the PLC

Introduction

You must transfer the values to the PLC to activate a changed recipe data record for the process.

The values displayed in the recipe view are transferred to the PLC.

Requirement

A screen with a simple recipe view is displayed.

Procedure

To transfer a recipe data record to the PLC, proceed as follows:

1. If the recipe list contains several recipes: Select the recipe which contains the relevant recipe data record.
2. Select the element list of the recipe data record whose values you want to transfer to the PLC.
3. Open the menu.
4. Select menu command "1 To PLC".

Result

The values of the recipe data record were transferred to the PLC and are active in the process.

Note
Basic Panels

With Basic Panels, the "To PLC" menu command can also be configured for the data record list: In this case, you can also select the "To PLC" menu command in the data record list.

See also

Structure of a recipe (Page 1512)

8.13 Performance features

8.13.1 Engineering system

Engineering system

Configuration in the engineering system is limited by main memory resources. WinCC uses up to 2 GB of RAM, depending on the operating system.

It is nonetheless useful to install more than 2 GB of RAM on the PC if running many applications with high memory requirements in parallel.

The configurations shown below have a heavy impact on main memory load:

- high number of animations
- use of large graphic objects
- several devices within a project configuration

Performance specifications of the HMI devices

The following tables provide assistance in estimating whether or not your project meets the performance specifications of the HMI device.

Basic Panel (Page 1523)

8.13.2 Basic Panel

Introduction

The following table provides assistance in estimating whether or not your project meets the performance specifications of the HMI device.

The specified maximum values are not additive. The operation of configurations running at the full system limits cannot be guaranteed on the devices.

In addition to the limitations specified, allowances must be made for restrictions in configuration memory resources.

Basic Panel

		KTP400 Basic	KTP600 Basic	KTP1000 Basic	TP1500 Basic
Tags					
	Number of tags in the project	128	128	256	256
	Number of PowerTags	--	--	--	--
	Number of elements per array	100	100	100	100
	Number of local tags	--	--	--	--
Alarms					
	Number of alarm classes	32	32	32	32
	Number of discrete alarms	200	200	200	200
	Number of analog alarms	15	15	15	15
	Character length of an alarm	80	80	80	80
	Number of process values per alarm	8	8	8	8
	Size of the alarm buffer	256	256	256	256
	Number of queued alarm events	64	64	64	64
Screens					
	Number of screens	50	50	50	50
	Number of fields per screen	30	30	30	30
	Number of tags per screen	30	30	30	30
	Number of complex objects per screen	5	5	5	5
Recipes					
	Number of recipes	5	5	5	5
	Number of elements per recipe	20	20	20	20
	User data length in bytes per data record	--	--	--	--
	Number of data records per recipe	20	20	20	20
	Number of recipe elements in the project	--	--	--	--
	Reserved memory for data records in the internal Flash	40 KB	40 KB	40 KB	40 KB
Logs					
	Number of logs	--	--	--	--
	Number of entries per log file (including all log segments) 1)	--	--	--	--

		KTP400 Basic	KTP600 Basic	KTP1000 Basic	TP1500 Basic
	Number of log segments	--	--	--	--
	Cyclical trigger for tag logging	--	--	--	--
	Number of tags that can be logged [4)]	--	--	--	--
Trends					
	Number of trends	25	25	25	25
Text lists and graphic lists					
	Number of graphics lists	100	100	100	100
	Number of text lists	150	150	150	150
	Total number of lists	150	150	150	150
	Number of entries per text or graphics list	30	30	30	30
	Number of graphic objects	500	500	500	500
	Number of text elements	500	500	500	500
Scripts					
	Number of scripts	--	--	--	--
Communication					
	Number of connections	4	4	4	4
	Number of connections based on the "SIMATIC HMI http Protocol"	--	--	--	--
Help system					
	Number of characters in a help text	320	320	320	320
Languages					
	Number of runtime languages	5	5	5	5
Scheduler					
	Tasks	--	--	--	--
User administration					
	User groups	50	50	50	50
	Authorizations	32	32	32	32
	Passwords	50	50	50	50
Project					
	Size of the project file "*.fwx"	512 KB	512 KB	1024 KB	1024 KB

1)	The number of entries for all segmented circular logs is valid for the "segmented circular log" logging method. The product derived from the number of circular logs times the number of data records in this log may not be exceeded.

See also

Engineering system (Page 1523)

8.14 Displaying cross-references

8.14.1 General information about cross references

Introduction

The cross-reference list provides an overview of the use of objects within the project.

Uses of cross-references

The cross-reference list offers you the following advantages:

- When creating and changing a program, you retain an overview of the objects, tags, and alarms etc. you have used.
- From the cross-references, you can jump directly to the object location of use.
- You can learn the following when debugging:
  - The objects used in a specific screen.
  - The alarms and recipes shown in a specific display.
  - The tags used in a specific alarm or object.
- As part of the project documentation, the cross-references provide a comprehensive overview of all object, alarms, recipes, tags and screens.
- You can display the object location of use, for example to modify or delete it.
- You can display the points of use for deleted objects and adapt them.

8.14.2 Displaying the cross-reference list

Requirement

You have created a project.

Introduction

You can show cross-references for the following objects in the project view:

- HMI device
- All folders
- All editors

Displaying cross-references

Proceed as follows to display cross-references:

1. In the project view, select the desired entry and select the shortcut menu command "Cross-reference".

   The cross-reference list is displayed.
2. Click the "Used by" button to display where the objects shown in the cross-reference list are used.
3. Click the "Uses" button to view the users of the objects displayed in the cross-reference list.
4. You can perform the following actions using the buttons in the toolbar:
   - Update cross-reference list
   - Making settings for the cross-reference list
   - Collapse entries
   - Expand entries
5. You can sort the entries in the "Object" column in ascending or descending order by clicking on the corresponding column title.
6. To go to the location of use for a specific object, click on the displayed link.

8.14.3 Structure of the cross-reference list

Views of the cross-reference list

There are two views of the cross-reference list. The difference between the two views is in the objects displayed in the first column:

- Used by:

  Display of the referenced objects. Here, you can see where the object is used.
- Used:

  Display of the referencing objects. The users of the object are shown here.

The assigned tool tips provide additional information about each object.

Structure of the cross-reference list

The cross-reference list has the following structure:

Column	Content/meaning
Object	Name of the object that uses the lower-level objects or that is being used by the lower-level objects.
Numbers	Number of uses
Location of use	Each location of use, for example an object or event
Property	Function of the referenced objects, for example tag for data record or process value

Column	Content/meaning
Connected to	PLC tag with which the object is connected.
Type	Type of object
Path	Path of object

Depending on the installed products, additional columns or different columns are displayed for the cross-references.

Settings in the cross-reference list

You can make the following settings using the icons in the toolbar for the cross-reference list:

- Update cross-reference list

  Updates the current cross-reference list.
- Making settings for the cross-reference list

  Here, you specify whether all used, all unused, all defined or all undefined objects will be displayed. If the "Undefined objects" option is enabled, references to previously deleted objects are also displayed.
- Collapse entries

  Reduces the entries in the current cross-reference list by closing the lower-level objects.
- Expand entries

  Expands the entries in the current cross-reference list by opening the low-level objects.

Sorting in the cross-reference list

You can sort the entries in the "Object" column in ascending or descending order. Click on the column header to do this.

8.14.4 Displaying cross-references in the Inspector window

Introduction

The Inspector window displays cross-reference information about an object you have selected in the "About > Cross-reference" tab. This tab displays the instances where a selected object is being used and the other objects using it.

Structure

The Inspector window displays the cross-reference information in tabular format. Each column contains specific and detailed information on the selected object and its application. The table below shows the additional information listed in the "About > Cross-reference" tab:

Column	Meaning
Object	Name of the object that uses the lower-level objects or that is being used by the lower-level objects.
Numbers	Number of uses
Location of use	Each location of use, for example an object or event
Property	Function of the referenced objects, for example tag for data record or process value
Connected to	PLC tag with which the object is connected.
Type	Type of object
Path	Path of object

Depending on the installed products, additional columns or different columns are displayed for the cross-references.

Using online and diagnostics functions 9

9.1 General information about online mode

Online mode

In online mode, there is an online connection between your programming device / PC and one or more devices.

An online connection between the programming device / PC and the device is required for loading programs and configuration data to the device as well as for activities such as the following:

- Testing user programs
- Displaying and changing the operating mode of the CPU
- Displaying and setting the date and time of day of the CPU
- Displaying module information
- Comparing online and offline blocks
- Hardware diagnostics

Before you can establish an online connection, the programming device / PC and the device must be connected via the Industrial Ethernet interface. You can then access the data on the device in the online and diagnostics view, or using the "Online tools" task card. The current online status of a device is indicated by an icon to the right next to the device in the project tree. You will find the meaning of the individual status icons in the relevant tooltip.

Note

Some online functions depend on the range of the installed software or whether a project is open.

Online displays

After the online connection has been established successfully, the user interface changes as follows:

- The title bar of the active window now has an orange background.

- The title bars of inactive windows for the relevant station now have an orange line below them.
- An orange bar appears at the right-hand edge of the status bar.
- The objects for the associated operating mode or diagnostics symbols for the station are shown in the project tree.
- The "Diagnostics > Device information" area is brought to the foreground in the Inspector window.

9.2 Online access

Online access of the project

In the "Online access" area of the project tree, you will find all of the available network accesses of your programming device / PC for establishing online connections to connected target systems.

Each interface icon provides you with information on the status of the interface. You can also display the accessible devices and can display and edit the properties of the interface.

Status display

The current status of an interface is indicated by an icon to the right of the name. You can see the meaning of the icon in the tooltip.

Displaying or updating accessible devices

You have the following options if you want to display all devices accessible online on your programming device / PC:

- Display of the accessible devices on a single interface of the programming device / PC in the project tree. In the project tree, you can also display additional information about the individual accessible devices.
- Display of the accessible devices of all interfaces in a list.

Properties of an interface

For each interface, you can display and, in some cases, modify properties, for example the network type, address, and status.

See also

Displaying accessible devices (Page 1533)
Opening the properties of an interface (Page 1534)

9.3 Displaying accessible devices

Accessible devices

Accessible devices are all devices connected to an interface of the programming device / PC and that are turned on. Devices that allow only restricted configuration using the currently installed products or that cannot be configured at all can also be displayed.

Displaying accessible devices on an interface of the programming device / PC in the project tree

To display accessible devices on a single interface of the programming device / PC, follow these steps:

1. Open the "Online access" folder in the project tree.
2. Click on the arrow to the left of the interface to show all the objects arranged below the interface.
3. Double-click on the "Update accessible devices" command below the interface.

All devices that are accessible over this interface are displayed in the project tree.

Displaying accessible devices in a list

To display the accessible devices on all available interfaces in an overview list, follow these steps:

1. Select the "Accessible devices" command in the "Online" menu.

   The "Accessible devices" dialog is displayed.
2. If your programming device / PC has multiple interfaces, choose the interface you require, for example Ethernet, in the "PG/PC interface to show accessible devices for:" box.

   If no devices are available on an interface, the connecting line between the programming device / PC and the device is displayed as broken. If devices are accessible, the connecting line is shown not broken and the devices accessible on the selected interface of the programming device / PC are displayed in a list.
3. If you have installed a new device, click the "Refresh" button.
4. To go to a device in the project tree, select the device from the list of accessible devices and click the "Show in project tree" button.

   The interface to which the selected device is connected is shown as selected in the project tree.

Displaying additional information about the accessible devices in the project tree

To display additional information on the accessible devices in the project tree, follow these steps:

1. Click on the arrow to the left of one of the accessible devices in the project tree.

   All data available online, for example blocks and system data, are displayed for known devices.

9.4 Opening the properties of an interface

Introduction

For each interface, you can display and, in some cases, modify properties, for example the network type, address, and status.

Procedure

To open the properties, follow these steps:

1. Right-click on the required interface below "Online access" in the project tree.
2. Select the "Properties" command from the shortcut menu.

   The "Properties" dialog opens. On the left of the dialog, you will see the area navigation. You can view the current parameter settings in the individual entries in the area navigation and, if necessary, change them.

9.5 Setting parameters for the Ethernet interface

9.5.1 Setting parameters for the Industrial Ethernet interface

Options in the parameter settings for the Industrial Ethernet interface

When setting parameters for the Industrial Ethernet interface, you have the following options:

- Parameters dependent on the operating system

  The Industrial Ethernet interface has parameters that are set in the operating system and are valid for all connected devices. These parameter settings are only displayed here, they can, however, be changed in the network settings of the operating system.
- Parameters that can be set in the software

Note

Note that changes to interface parameters have a direct influence on the operating system and the programming device / PC. Remember that some parameter settings can only be changed if you have adequate user rights.

Parameters for the Industrial Ethernet interface

The following table contains an overview of the parameters of the Industrial Ethernet interface that are set by the operating system and can be changed by the user.

Parameter settings that cannot be changed	Parameters that can be set
MAC address	Fast acknowledge at the IE-PG access and for TCP/IP
DHCP server activated/deactivated	Timeout at the IE-PG access and for TCP/IP
APIPA activated/deactivated	LLDP
IP address	Additional, dynamic IP addresses for the network adapter
Subnet mask	
DNS addresses	
DHCP addresses	

See also

Displaying operating system parameters (Page 1535)
Connecting the PG/PC interface to a subnet (Page 1536)
Setting parameters for the Ethernet interface (Page 1536)
Assigning a temporary IP address (Page 1537)
Managing temporary IP addresses (Page 1538)
Influence of user rights (Page 111)

9.5.2 Displaying operating system parameters

The Ethernet interface is part of the operating system. All parameters of the network adapter can therefore be adapted in the network settings of the operating system.

You can display the following parameters in the software:

- Physical address of the network adapter
- Assignment of the IP address by a DHCP server activated or deactivated
- Assignment of a private IP address by the operating system activated or deactivated
- Current static IP address
- Assigned subnet mask
- DNS addresses
- DHCP addresses

If you want to modify the parameter settings, please refer to the documentation of the operating system or the network adapter.

Displaying current parameters of the Ethernet interface

To display the current parameters of the Ethernet interface, follow these steps:

1. Select the Ethernet interface in the project tree in "Online access".

2. Select the "Properties" command in the shortcut menu of the interface.

   The dialog for configuring the interface opens.
3. Select "Configurations > Industrial Ethernet" in the area navigation.

See also

Setting parameters for the Ethernet interface (Page 1536)

9.5.3 Connecting the PG/PC interface to a subnet

If you have created several subnets, you can specify the subnet to which the Ethernet interface is connected.

Procedure

To select the subnet to which the Ethernet interface is connected, follow these steps:

1. Select the Ethernet interface in the project tree in "Online access".
2. Select the "Properties" command in the shortcut menu of the interface.

   The dialog for configuring the interface opens.
3. Go to "General > Assignment" and select the subnet to which you want to connect the Ethernet interface of the programming device / PC in the "Connection to subnet" drop-down list.
4. Close the dialog with "OK".

9.5.4 Setting parameters for the Ethernet interface

You can adapt some parameter settings relating to the network protocol directly in the software.

Requirement

You must have adequate user rights.

See also: Influence of user rights (Page 111) .

Procedure

To change parameter settings relating to the network protocol, follow these steps:

1. Select the Ethernet interface in the project tree in "Online access".
2. Select the "Properties" command in the shortcut menu of the interface.

   The dialog for configuring the interface opens.
3. Select "Configurations > IE-PG access" to adapt the protocol settings relevant to network management.
   – Select the "Fast acknowledge" check box to achieve faster reaction times with smaller network packets.

   - From the "Timeout" drop-down list, select the maximum time that can elapse before a network node is detected.
4. To activate the LLDP protocol and discover the network topology more accurately, set the "LLDP active" check box in "Configurations > LLDP".
5. Select "Configurations > TCP/IP" to adapt the TCP/IP protocol for network traffic during runtime.
   - Select the "Fast acknowledge" check box to achieve faster reaction times with smaller network packets.
   - From the "Timeout" drop-down list, select the maximum time that can elapse before there is a timeout during communication with a network node.

See also

Influence of user rights (Page 111)
Displaying operating system parameters (Page 1535)

9.5.5 Assigning a temporary IP address

Adding a dynamic IP address

If the IP address of a device is located in a different subnet from the IP address of the network adapter, you will first need to assign an additional IP address with the same subnet address as the device. Only then is communication between the device and the programming device / PC possible.

The assignment of an additional temporary IP address is also proposed automatically if you want to perform an online action and the current IP address of the programming device/PC is not yet in the correct subnet.

A temporarily assigned IP address remains valid until the next time the programming device/ PC is restarted or until you delete it manually.

Note

You require adequate permissions to be able to assign a temporary IP address.

See also: Influence of user rights (Page 111)

See also

Managing temporary IP addresses (Page 1538)

9.5.6 Managing temporary IP addresses

If the IP address of a device is located in a different subnet from the current static IP address of the network adapter, you can assign a suitable dynamic IP address from the subnet of the device.

You can display all temporarily assigned addresses and delete them.

Requirement

To delete, you require adequate permissions.

Procedure

To display and delete temporarily assigned addresses, follow these steps:

1. Select the Ethernet interface in the project tree in "Online access".
2. Select the "Properties" command in the shortcut menu of the interface.

   The dialog for configuring the interface opens.
3. Select "Configurations > IE-PG access".

   A table with the assigned IP addresses is displayed.
4. Click the "Delete project-specific IP addresses" button to delete all the IP addresses at one time.

See also

Influence of user rights (Page 111)

9.6 Establishing and canceling an online connection

Requirement

- At least one PG/PC interface is installed and is physically connected to a device, for example with an Ethernet cable.
- The IP address of the device must be in the same subnet as the IP address of the programming device / PC.

Going online

To establish an online connection, follow these steps:

1. In the project tree, select the device to which you want an online connection to be established.
2. Select the "Go online" command in the "Online" menu.

   If the device was already connected to a specific PG/PC interface, the online connection is automatically established to the previous PG/PC interface. If there was no previous connection, the "Go online" dialog opens.
3. If necessary, select the interface on which you want to connect to the device from the "PG/PC interface to go online with" drop-down list in the "Go online" dialog.

All the devices that can be accessed via the selected interface are displayed under "Accessible devices in target subnet".

4. Optional: Click the "Update" button to redisplay the list of accessible devices.
5. Optional: Click the "Flash LED" button on the left of the graphic to run an LED flash test. With this function, you can check that you have selected the correct device. The LED flash test is not supported by all devices.
6. Select the node and click the "Go online" button.

   The online connection to the selected target device is established.

Result

After the online connection has been established, the title bars of the editors change to orange. An orange activity bar is also shown in the title bar of an editor and in the status bar.

The connection path is stored for future connection attempts. It is no longer necessary to open the "Go online" dialog unless you want to select a new connection path.

Note

If no accessible device is displayed, select a different network access for the PG/PC interface or check the settings of the interface.

Canceling an online connection

To disconnect the existing online connection, follow these steps:

1. Select the device you want to disconnect from in the project tree.
2. Select the "Go offline" command in the "Online" menu.

See also

Assigning a temporary IP address (Page 1537)
Influence of user rights (Page 111)

10 Source documents

List of all documents used.

- STEP 7 V10.5 SP2 (12/2009, en-US)

Index