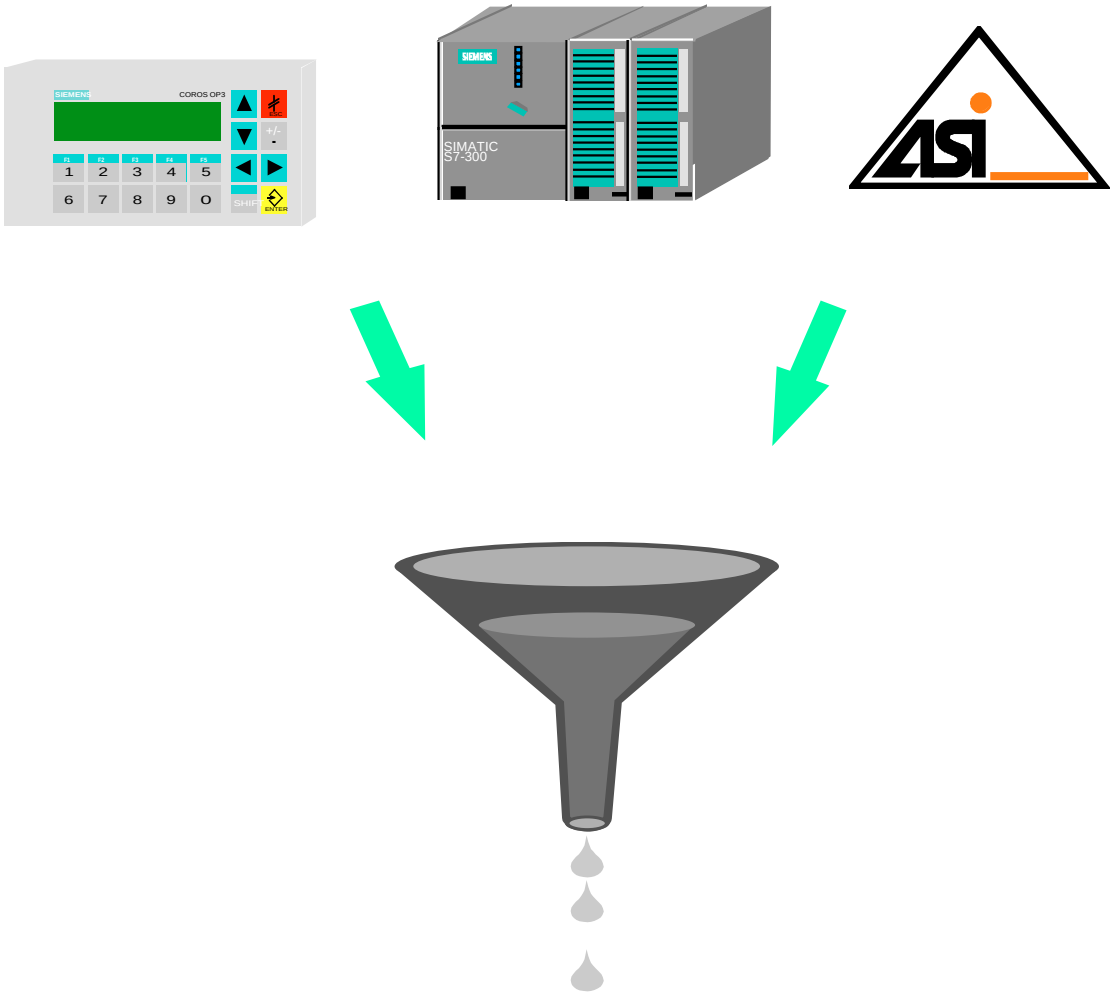
SIEMENS

SIMATIC
SIMATIC C7-621 AS-i Control System
First steps with STEP 7-Mini and ProTool/Lite

Guide

Edition 07/1999

Contents



MPI interface

Programming device connection and communication (global data)

AS-Interface master

- Can control up to 31 slaves
- Up to 248 binary elements

External I/O extension

Interface for connecting an expansion unit

Introduction

The SIMATIC C7-621-AS-i control system gives you a variety of options for clearly structured, convenient automation, operation and monitoring of your process. The integrated AS-Interface allows high-powered automation solutions at the process level.

This brochure shows you how easily and quickly you can solve your tasks with the C7-621-AS-i, the programming software STEP 7 or STEP 7-Mini*) and the configuring software ProTool or ProTool/Lite**) under Windows 95. We take a sample assignment from real life and show you **how to solve it step by step**.

In self-contained chapters, we explain the essential functions of the SIMATIC C7-621-AS-i, typical tasks on a sample system, and further tips and tricks.

All chapters are structured as follows:

First the task is explained.

Then the individual solution steps are described, with the help of selected dialog boxes.

Finally, we show you the result so that you can check your own result immediately after each programming/configuring step.

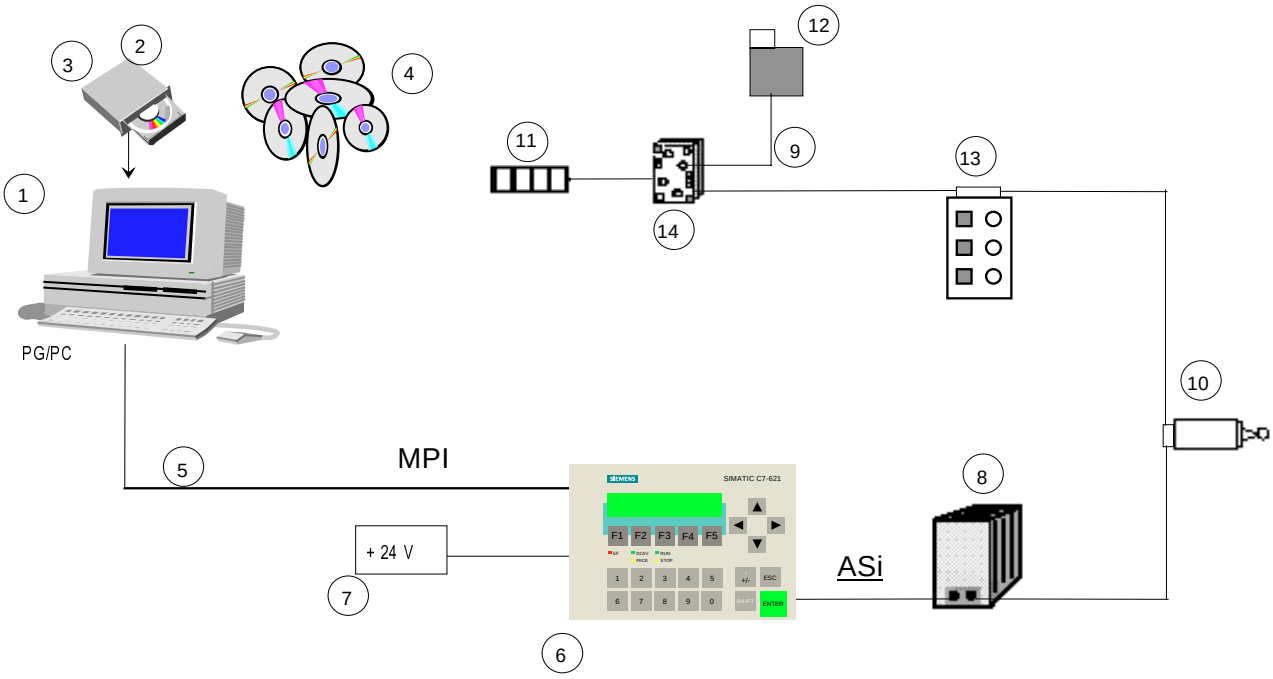
Conventions:

🖱	A mouse indicates that entries are to be made on the PC/programming device.
☞	This hand indicates that you are to make entries/perform operations on the C7-621-AS-i control system.
	A hand pointing upward indicates that you must work with AS-i slaves.
`system_1.pdb`	Texts to be configured, program parts to be programmed, or entries to be selected from existing possibilities appear in `Courier`.
File → New	Menus, menu items, dialog boxes or texts in dialog boxes that you select are written in *italics*.

*) referred to simply as STEP 7 below

**) referred to simply as ProTool below

Hardware configuration



Checklist of the required components

	Component	Order no.	Included in starter kit
1	PC or programming device		no
2	Programming software STEP 7-Mini	6ES7 810-3CC04-0YX0	yes
3	Configuring software ProTool/Lite	6AV6 580-3BX05-1AX0	yes
4	SIMATIC documentation on CD-ROM (in 5 languages)	6ES7 398-8AE00-8YE0	yes
5	PC/MPI adapter RS232 cable	6ES7 972-0CA22-0XA0 6ES7 901-1BF00 0XA0	yes yes
6	SIMATIC C7-621-AS-i control system	6ES7 621-6BD00-0AE3	yes
7	+24V power supply PS307	6ES7 307-1BA00-0AA0	no
8	AS-Interface power pack and AS-i cable	3RX9307-0AA00	yes
9	2 x connecting cable with M-12 socket and connector	3RX1634	yes
10	Position switch with AS-i connection	3SE3230-1GW-Z (Z=C01)	yes
11	Inductive proximity switch	3RG4022-3JB00	yes
12	Optical proximity switch	3RG7130-3AB00	yes
13	SIGNUM casing with AS-Interface	3SB803-4AZ	yes
14	AS-Interface user module	3RK1400-1DQ00-0AA3	yes
15	AS-Interface connection module	3RK1901-0CA00	yes

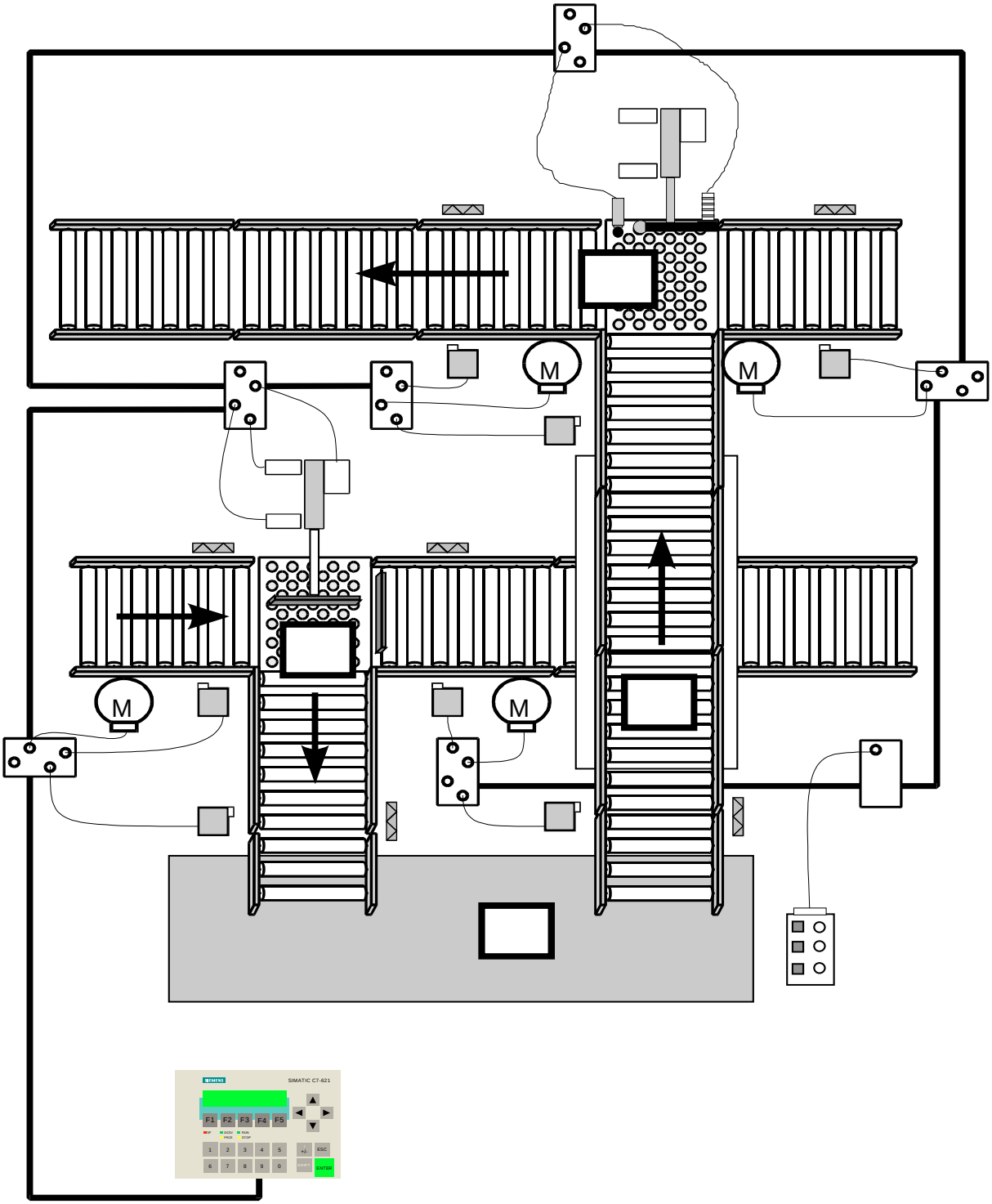
Checklist for startup

The following basic steps are necessary for starting up the SIMATIC C7-621-AS-i:

Install STEP 7 or STEP 7-Mini on PC/programming device
Install ProTool or ProTool/Lite integrated under STEP 7 or STEP 7-Mini on PC/programming device
Connect C7 to power supply (+24V)
Connect power pack to C7-AS-i port
Set up AS-i network
Set addresses of slaves and parameterize C7-AS-i-CP
Select STEP 7-Mini on programming device/PC and create PLC program
Connect C7 ↔ PC/programming device via PC/MPI cable
Overall reset of C7-CPU and C7-OP
Transfer PLC program to C7
Select ProTool/Lite on programming device/PC and create OP configuration
Transfer configuration to C7

Sample Project: Sorting System

AS-Interface is often used where sensors and actuators are distributed over a fairly large system. The sample system we have chosen shows a sorting and packing department in a large mail-order company. Parcels containing mail-order goods are transported to the relevant ejectors on conveyor belts. The current location of the parcels is recorded via sensors and transmitted to the SIMATIC via AS-i. The PLC processes this data and controls connected actuators via the AS-Interface. On the basis of the sample machine, you will learn how to handle the AS-i functions step by step. You will set up an AS-i network, program a PLC program and learn how to establish the link with the integrated C7 operator panel.



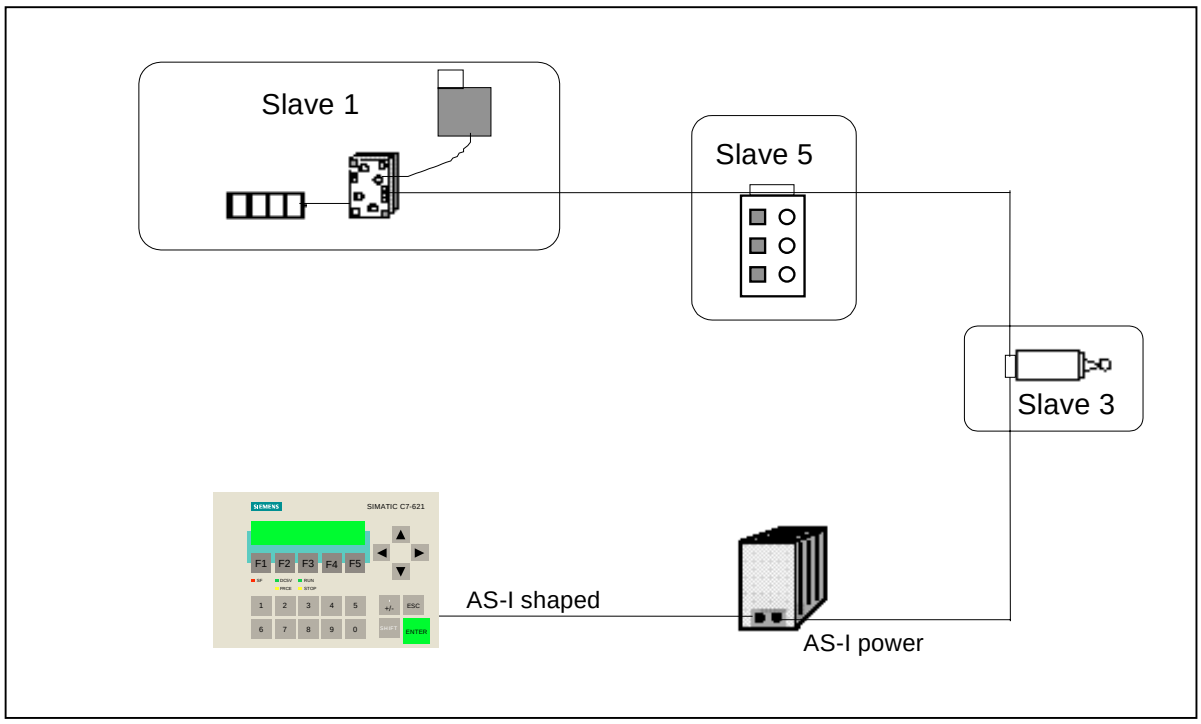
Setup and Configuration of the AS-i Network

Before you actually program your automation solution, you must set up your system and connect and parameterize the AS-i components involved.

The yellow AS-i shaped cable enables fast and easy installation of your slaves in the AS-i network. This cable is the transmission medium for communication between the master and the stations. It also carries the supply voltage for the stations. A slave is identified by its address, which is always stored in non-volatile memory in the slave.

On delivery, all slaves have the address “zero” by default. Each slave in the network must have a unique address that is not “zero”.

The C7-621-AS-i allows you to change the set address of a slave through operation on the C7. When using the C7 addressing function, it is therefore necessary to connect all new slaves to the AS-i cable consecutively to ensure that they are each assigned a unique address.



Set up your AS-i network according to the diagram above. Connect your slave 1 to your yellow AS-i shaped cable. If you have problems connecting the slaves to the AS-i cable, please read the setup instructions supplied with the AS-i components.

The C7-CPU must be in STOP mode for you to be able to configure your AS-i network.

On the C7-621-AS-i control system, select the System Functions menu by pressing the SHIFT 0 keys.

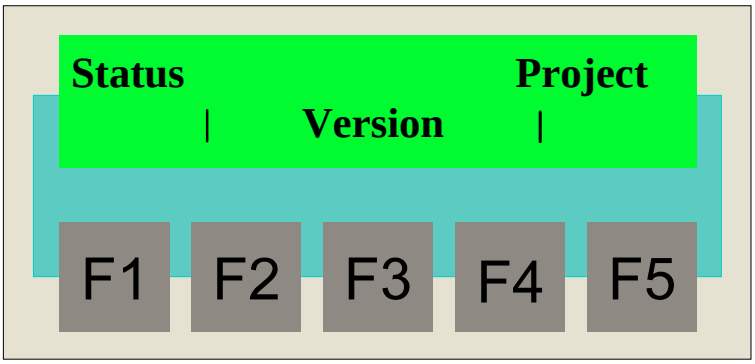
Press F1 to select the C7 System Functions menu.

Press F3 to select the operating mode STOP. The STOP LED lights up.

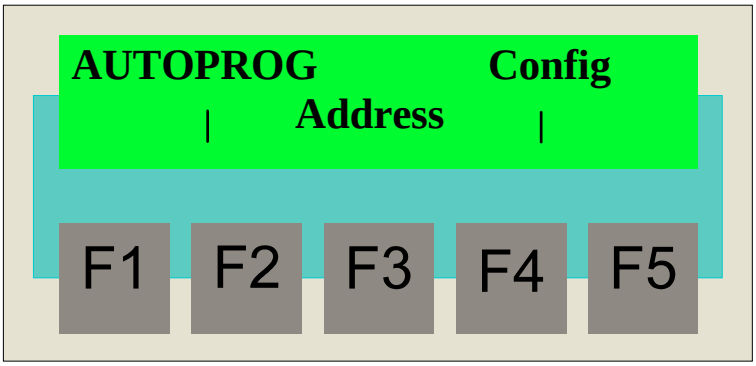
If a password has not yet been entered, the system requests one. When the C7 is shipped, the password is preset to 100. Enter the digits 100 via the numeric keypad and confirm your input with ENTER. Select the operating mode STOP.

To quit the mask, press the ESC key once.

Now press the F5 key to display the start menu for the individual AS-i functions.



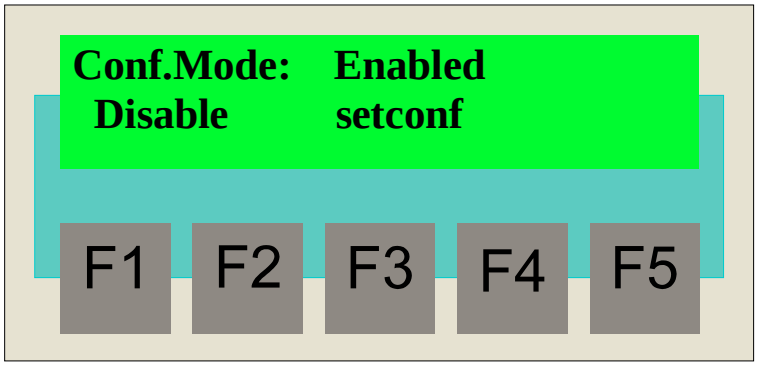
In the start menu for the AS-i functions, select *Project* by pressing F4 once.



For setting addresses, the mode set for the device must be the configuring mode. When the C7 is shipped, this mode is preset by default.

To check whether the device is in the configuring mode, select *Config* with the F4 key.

Note:
If the following mask appears, you can skip the next two steps.

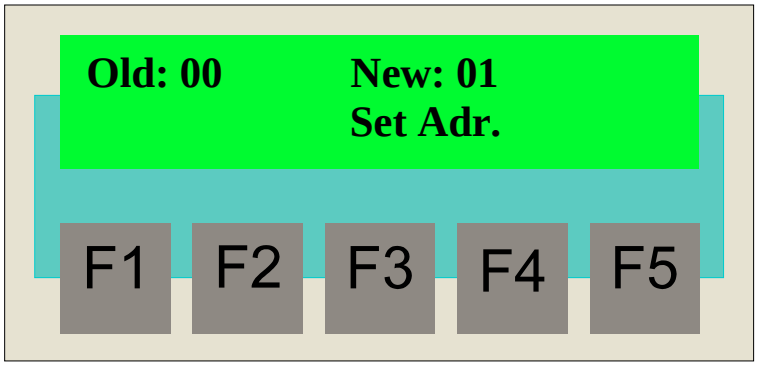


You must switch from protected mode to configuring mode. To do this, press F2.

Wait a moment, then press F5. If the above mask appears, you may proceed. Otherwise, repeat the last two steps.

Quit the mask by pressing the ESC key once.

In the *Project menu*, select the menu item *Address* by pressing the F3 key. Enter the old address in the first field, and the new address in the second field.



Press F4 to confirm your entry.

If you have made all the entries and settings correctly, the message *NO_ERROR* will appear in the display of the C7-621-AS-i control system.

Press F5 to complete the current addressing process.

Connect the next slave to your AS-i shaped cable according to the setup diagram.

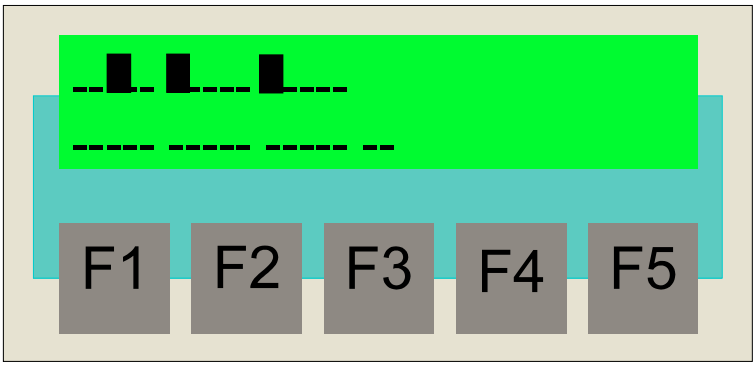
Repeat your entries in the *Address menu* for all slaves used in the application.

Once you have addressed all the slaves, quit the *Address menu* by pressing the ESC key twice.

In the menu that now appears, press F2 to select the *Status* menu.

Press F2 again to see the status display of the existing and activated slaves.

If you have set up your AS-i network as described, the screen will look like this.



If the display is different from your configuration, please check your settings against the descriptions in the system manual.

Quit the status display by pressing the ESC key twice.

Select the *Config menu* by pressing F4 twice.

Accept the actual configuration recognized by the system as the setpoint configuration. To do this, press F4 again to call the menu for setting the setpoint configuration.

If you wish you can view the actual configuration again by pressing F2. To close the display, press ESC.

Press F4 to accept the current actual configuration as the setpoint configuration.

Press F5 to confirm the *NO_ERROR* message.

Finally, switch your C7 control system from configuring mode to protected mode. To do this, press F4 to select the *Config menu* again. Press F2 to switch to protected mode. Confirm your input with F5.

Once the last step is complete, you have set up and configured your first AS-i network. You are now ready to program your control task.

Programming Preparations

Starting STEP 7

- Once STEP 7 has been installed, the “SIMATIC Manager” icon appears on the Windows 95 desktop and the “SIMATIC” program group appears in the Start menu. As with all other Windows 95 applications, you start the program by double-clicking on the SIMATIC Manager icon or by selecting the *Start menu* → *SIMATIC* → *STEP 7* → *SIMATIC_Manager*.
- Once STEP 7 is started, terminate the STEP 7 Assistant: `New Project`.

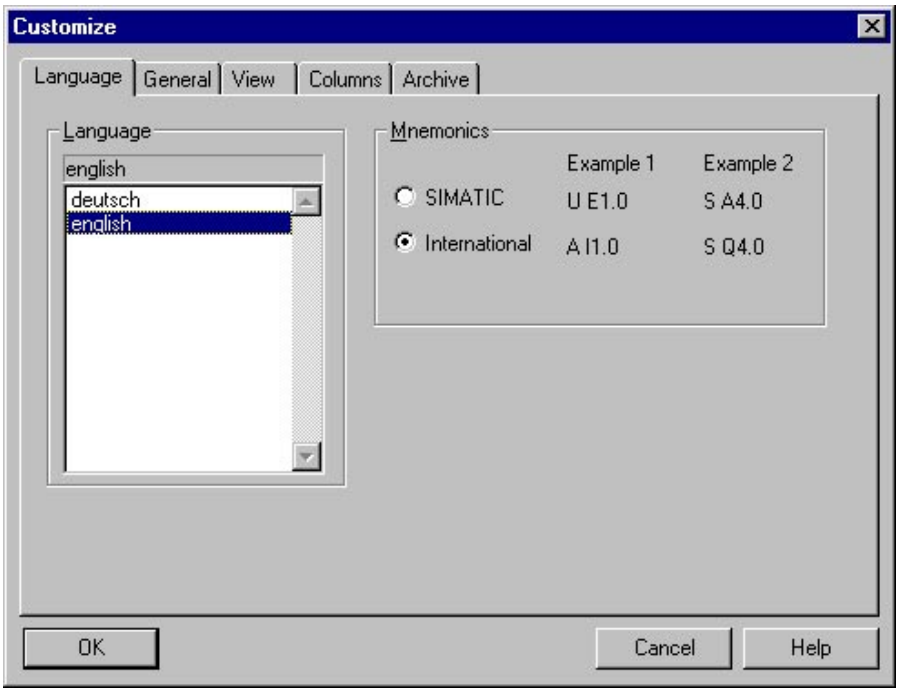
Online Help

If there is anything you are unsure of during programming, or if you want further information on specific points, press *F1*. This starts the Online Help, in which you will find explanations of the various STEP 7 topics.

General settings

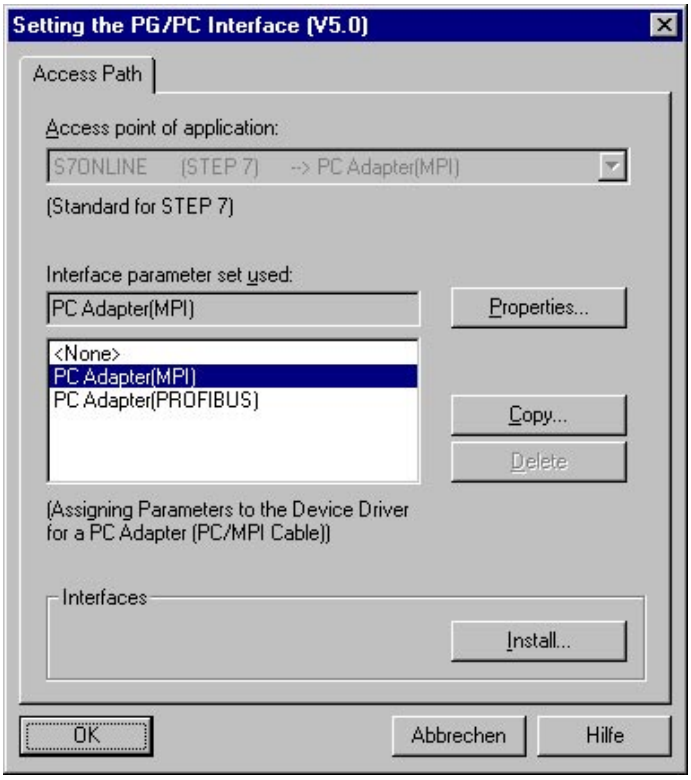
Before you start programming, you need to select one of two mnemonic options in the SIMATIC Manager for displaying program statements.

- You will find the *Language* catalog under *Options* → *Customize.* Select *English* as the language and *International* mnemonics*.*



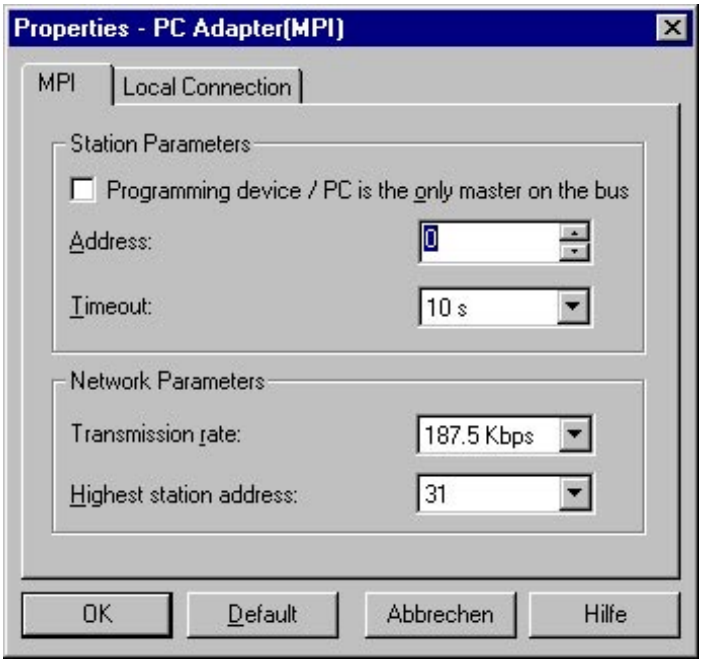
- Select *OK* to close the dialog box and save the settings.

You also have to set the PC/programming device interface. To do this, select the menu item *Options* → Set *PG/PC-Interface...* Set the *PC Adapter(MPI)* in the dialog box that appears.

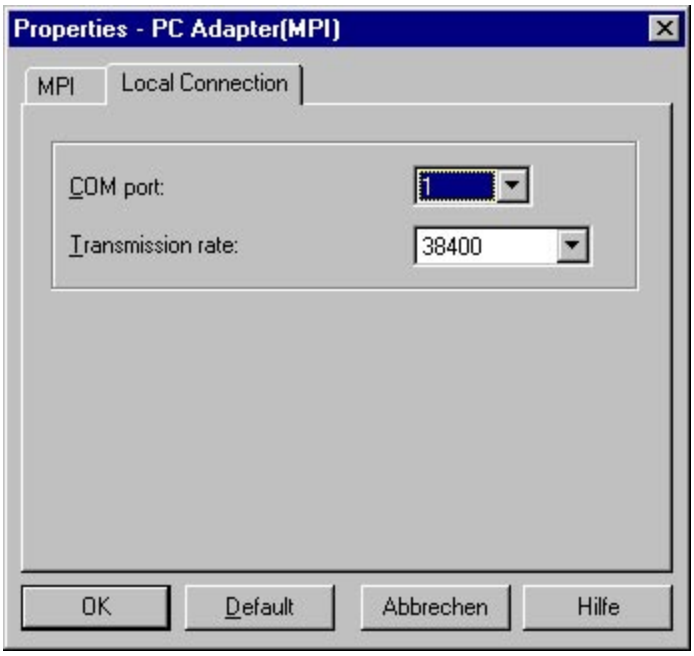


If the PC Adapter is not displayed in the window, you can install it now. Activate the *Install* button and follow the instructions.

Enter the following settings as the PC/programming device interface *Properties*:



- For the local connection, select the COM port to which you connected the PC/MPI cable.

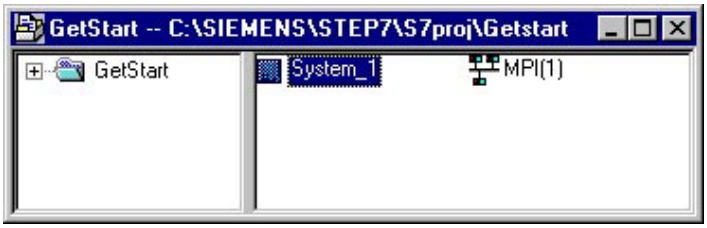


- Save the settings with *OK*.

You can now start to create your project.

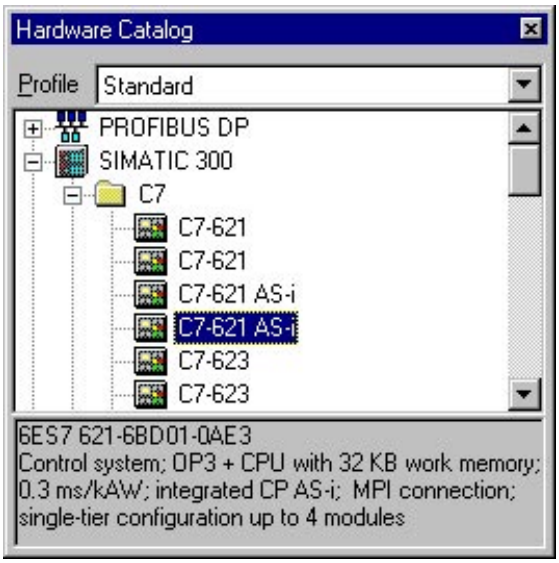
Creating a project

- Select the menu item *File* → *New*. In the dialog box that appears, create a new project with the name `GetStart`.
- Assign a hardware item to your project with the menu item *Insert* → *Station* → *2 SIMATIC 300 Station*. The SIMATIC 300 Station(1) folder appears. Overwrite the name of this station with the new name `Systen_1`.



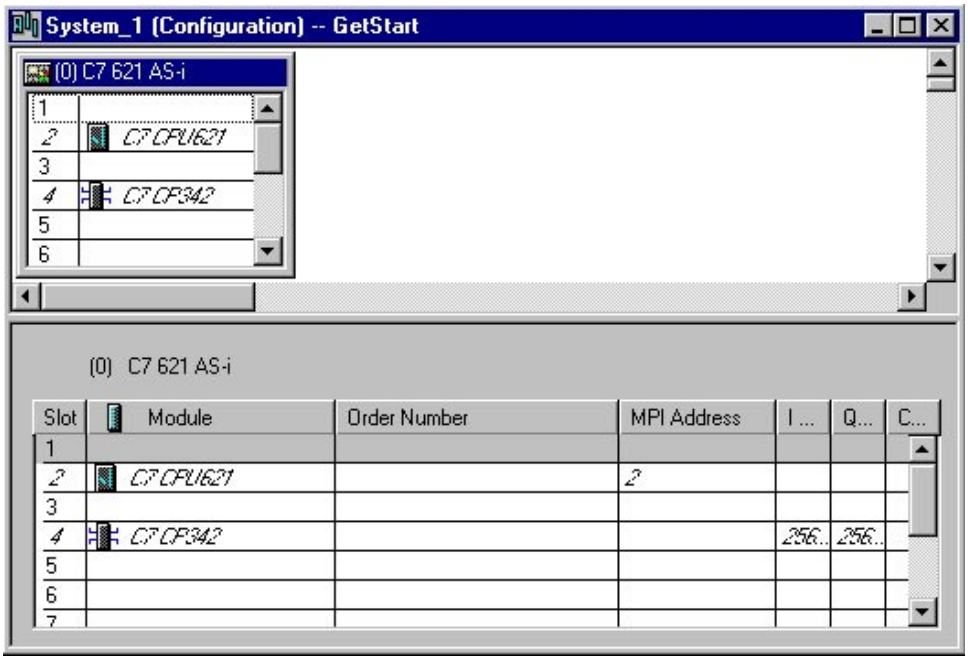
Defining the hardware

- Open the station system_1 by double-clicking on it. Select the Hardware folder and open it, again with a double click.
- In the Hardware Configuration window go to the Hardware Catalog via *Insert* → *Hardware Components*. Mark here the *C7-621 AS-i* via *SIMATIC 300* → *C7* to display brief information on the control station.



- Double-click on *C7-621 AS-i* to insert the device into slot 2 in the Hardware Configuration window.

  Here you will see information on the set MPI address of the C7-CPU (default setting for the MPI address is 2) and an address map.



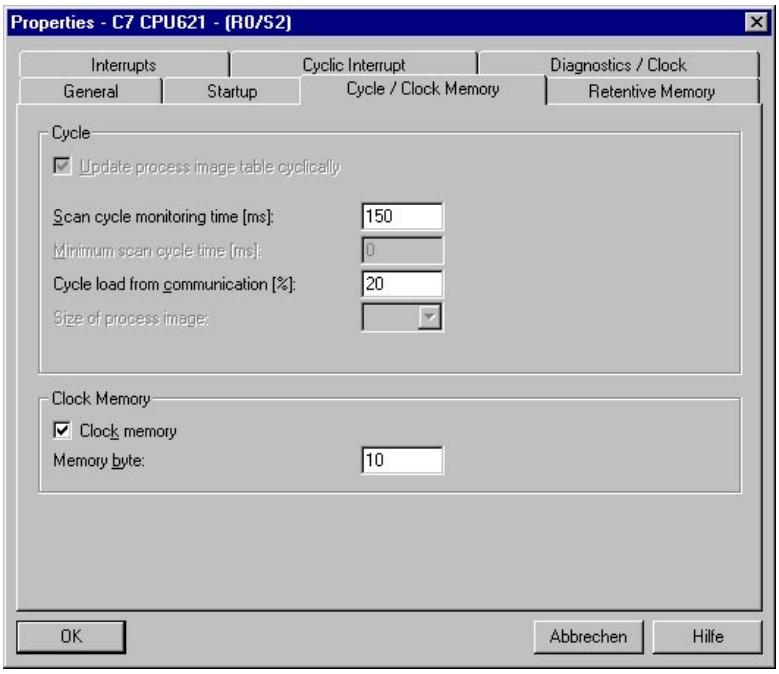
- To save the configuration, select *Station* → *Save and Compile* from the menu bar.

Setting up a bit memory address area for clock memories

Clock memories are bit memories which periodically modify their binary value (pulse-pause ratio: 1:1). You need these memories in the following programming example.

To enable you to set up the clock memory, you must make the following settings.

- In the Hardware Configuration window open the dialog window *Properties - C7-CPU621* by double-clicking on the *C7-CPU-621 icon.*
- In the dialog window displayed, click on the tab sheet *Cycle / Clock Memory* to select it.



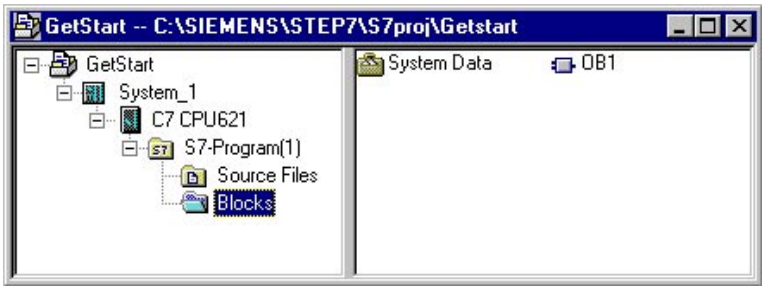
Activate the *Clock Memory* checkbox and enter 10 for the number of the memory byte.
Each bit of the clock memory byte is assigned a period time/frequency:

Bit	7	6	5	4	3	2	1	0
Period time (s)	2	1,6	1	0,8	0,5	0,4	0,2	0,1
Frequency (Hz)	0,5	0,625	1	1,25	2	2,5	5	10

- Confirm your entries with OK. To save the configuration, select *Station* → *Save and Compile* from the menu bar.
- To close the *Hardware Configuration* window select *Station* → *Exit* from the menu bar.

In the *SIMATIC_Manager* the folder C7 *CPU621* containing the S7 program is created automatically. This S7 Program folder in turn contains the folder Blocks with an empty organization block OB1.

- Open each folder with a double click.



Setting the address areas and accessing the AS-i user data

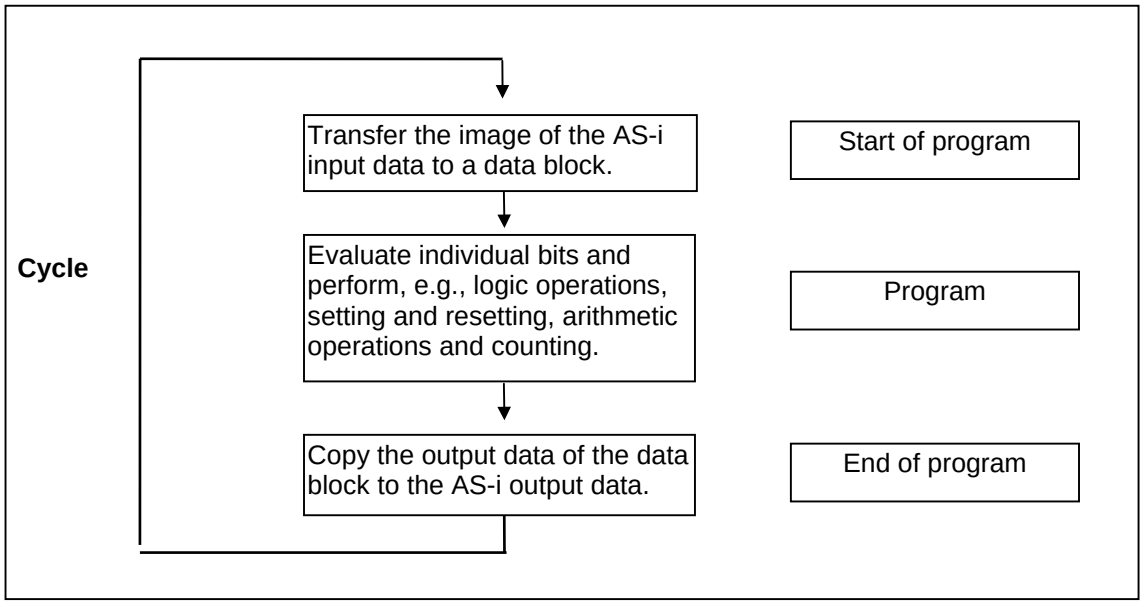
In standard operation, the AS-i communications processor behaves like an I/O module. It occupies 16 input and 16 output bytes in the analog area of the controller. Each slave on the AS-i cable is assigned four bits (a nibble) by the C7-AS-i-CP. The C7-CPU can access a nibble for reading and writing. The start address of this address area is fixed at 256 in the C7-AS-i. For the assignment of the slave I/O bits to the I/O bytes of the C7-CPU, see the AS-i interface table.

Assignment table

I/O-byte number	Bit 7-4	Bit 3-0	I/O byte number	Bit 7-4	Bit 3-0
256	reserved	Slave 1	264	Slave 16	Slave 17
257	Slave 2	Slave 3	265	Slave 18	Slave 19
258	Slave 4	Slave 5	266	Slave 20	Slave 21
259	Slave 6	Slave 7	267	Slave 22	Slave 23
260	Slave 8	Slave 9	268	Slave 24	Slave 25
261	Slave 10	Slave 11	269	Slave 26	Slave 27
262	Slave 12	Slave 13	270	Slave 28	Slave 29
263	Slave 14	Slave 15	271	Slave 30	Slave 31
	Bit 3 I Bit 2 I Bit 1 i Bit 0	Bit 3 I Bit 2 I Bit 1 i Bit 0		Bit 3 I Bit 2 I Bit 1 i Bit 0	Bit 3 I Bit 2 I Bit 1 IBit 0

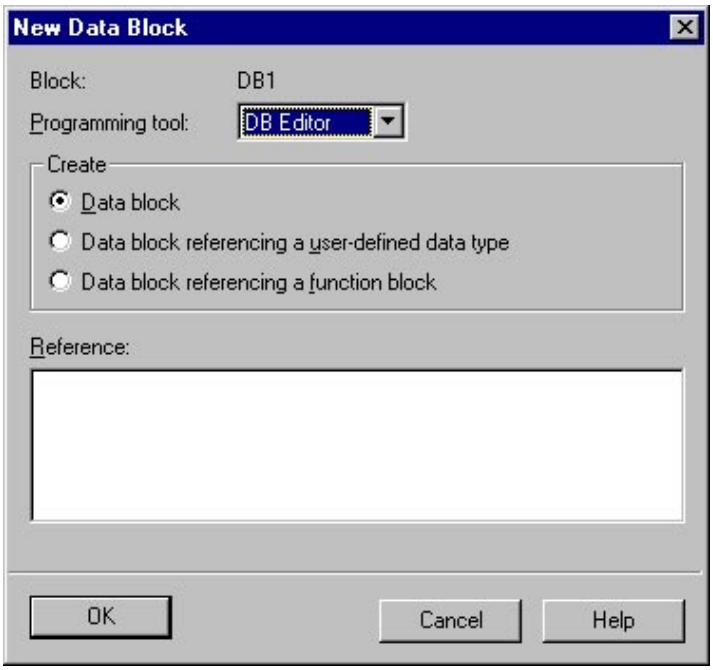
The parameters required in the application appear on a gray background.

The diagram below illustrates the access to the input and output data of the individual slaves.



Because the bits of the AS-i line can only be accessed in word mode or doubleword mode, it is necessary to set up a memory data block. In the data block the AS-i data can be accessed in bit mode.

- Select the *Blocks* folder in the SIMATIC Manager and insert a data block with *Insert* → *S7 Block* → *4 Data Block*. In the dialog box that appears, assign the internal identifier DB1.
- Open data block DB1 and select *Data Block* as the desired type. Accept the settings with *OK*.



- Select the second entry in the *Name* column and enter here the name `M1_In1`.

  Complete your input by pressing Return.
- The Type entry is automatically activated. Click on the entry with the right mouse button, enter the type *BOOL* via *Elementary Types*, and complete your input with Return.
- Enter *FALSE* as the initial value and press Return.
- In the Comment column you can add a comment to the entry `Module_no.1 Input_1.`
- Repeat your entries for all slaves.

Address	Name	Type	Initial Value	Comment
0.0		STRUCT		
+0.0	M1_IN1	BOOL	FALSE	Module_No.1 input_No.1
+0.1	M1_IN2	BOOL	FALSE	Module_No.1 input_No.2
+0.2	M1_IN3	BOOL	FALSE	Module_No.1 input_No.3
+0.3	M1_IN4	BOOL	FALSE	Module_No.1 input_No.4
+0.4	Statusbit_IN0	BOOL	FALSE	reserved
+0.5	Statusbit_IN1	BOOL	FALSE	reserved
+0.6	Statusbit_IN2	BOOL	FALSE	reserved
+0.7	Statusbit_IN3	BOOL	FALSE	reserved
+1.0	M3_IN1	BOOL	FALSE	Module_No.3 input_No.1
+1.1	M3_IN2	BOOL	FALSE	Module_No.3 input_No.2
+1.2	M3_IN3	BOOL	FALSE	Module_No.3 input_No.3
+1.3	M3_IN4	BOOL	FALSE	Module_No.3 input_No.4
+1.4	M2_IN1	BOOL	FALSE	Module_No.2 input_No.1
+1.5	M2_IN2	BOOL	FALSE	Module_No.2 input_No.2
+1.6	M2_IN3	BOOL	FALSE	Module_No.2 input_No.3
+1.7	M2_IN4	BOOL	FALSE	Module_No.2 input_No.4
+2.0	M5_IN1	BOOL	FALSE	Module_No.5 input_No.1
+2.1	M5_IN2	BOOL	FALSE	Module_No.5 input_No.2
+2.2	M5_IN3	BOOL	FALSE	Module_No.5 input_No.3
+2.3	M5_IN4	BOOL	FALSE	Module_No.5 input_No.4
+2.4	M4_IN1	BOOL	FALSE	Module_No.4 input_No.1
+2.5	M4_IN2	BOOL	FALSE	Module_No.4 input_No.2
+2.6	M4_IN3	BOOL	FALSE	Module_No.4 input_No.3
+2.7	M4_IN4	BOOL	FALSE	Module_No.4 input_No.4
+3.0	M7_IN1	BOOL	FALSE	Module_No.7 input_No.1
+3.1	M7_IN2	BOOL	FALSE	Module_No.7 input_No.2
+3.2	M7_IN3	BOOL	FALSE	Module_No.7 input_No.3
+3.3	M7_IN4	BOOL	FALSE	Module_No.7 input_No.4
+3.4	M6_IN1	BOOL	FALSE	Module_No.6 input_No.1
+3.5	M6_IN2	BOOL	FALSE	Module_No.6 input_No.2
+3.6	M6_IN3	BOOL	FALSE	Module_No.6 input_No.3
+3.7	M6_IN4	BOOL	FALSE	Module_No.6 input_No.4
+4.0	M1_OUT1	BOOL	FALSE	Module_No.1 output_No.1
+4.1	M1_OUT2	BOOL	FALSE	Module_No.1 output_No.2
+4.2	M1_OUT3	BOOL	FALSE	Module_No.1 output_No.3
+4.3	M1_OUT4	BOOL	FALSE	Module_No.1 output_No.4
+4.4	Statusbit_OUT0	BOOL	FALSE	reserved
+4.5	Statusbit_OUT1	BOOL	FALSE	reserved
+4.6	Statusbit_OUT2	BOOL	FALSE	reserved
+4.7	Statusbit_OUT3	BOOL	FALSE	reserved
+5.0	M3_OUT1	BOOL	FALSE	Module_No.3 output_No.1
+5.1	M3_OUT2	BOOL	FALSE	Module_No.3 output_No.2
+5.2	M3_OUT3	BOOL	FALSE	Module_No.3 output_No.3
+5.3	M3_OUT4	BOOL	FALSE	Module_No.3 output_No.4
+5.4	M2_OUT1	BOOL	FALSE	Module_No.2 output_No.1
+5.5	M2_OUT2	BOOL	FALSE	Module_No.2 output_No.2
+5.6	M2_OUT3	BOOL	FALSE	Module_No.2 output_No.3
+5.7	M2_OUT4	BOOL	FALSE	Module_No.2 output_No.4
+6.0	M5_OUT1	BOOL	FALSE	Module_No.5 output_No.1
+6.1	M5_OUT2	BOOL	FALSE	Module_No.5 output_No.2
+6.2	M5_OUT3	BOOL	FALSE	Module_No.5 output_No.3
+6.3	M5_OUT4	BOOL	FALSE	Module_No.5 output_No.4
+6.4	M4_OUT1	BOOL	FALSE	Module_No.4 output_No.1

+6.5	M4_OUT2	BOOL	FALSE	Module_No.4 output_No.2
+6.6	M4_OUT3	BOOL	FALSE	Module_No.4 output_No.3
+6.7	M4_OUT4	BOOL	FALSE	Module_No.4 output_No.4
+7.0	M7_OUT1	BOOL	FALSE	Module_No.7 output_No.1
+7.1	M7_OUT2	BOOL	FALSE	Module_No.7 output_No.2
+7.2	M7_OUT3	BOOL	FALSE	Module_No.7 output_No.3
+7.3	M7_OUT4	BOOL	FALSE	Module_No.7 output_No.4
+7.4	M6_OUT1	BOOL	FALSE	Module_No.6 output_No.1
+7.5	M6_OUT2	BOOL	FALSE	Module_No.6 output_No.2
+7.6	M6_OUT3	BOOL	FALSE	Module_No.6 output_No.3
+7.7	M6_OUT4	BOOL	FALSE	Module_No.6 output_No.4
=8.0		END_STR		

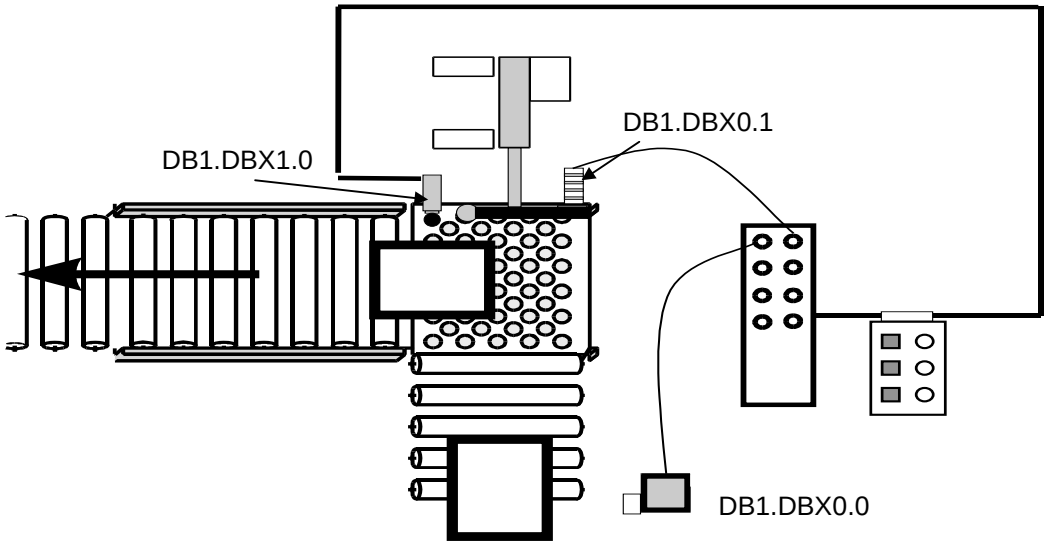
Save your data block *DB1* by clicking on the  icon in the toolbar.

In the application the following addresses in DB1 are significant:

Adress	Symbol	Status format	Meaning
0.0	M1_IN1	Bin	Optical Bero
0.1	M1_IN2	Bin	Inductive Bero
1.0	M3_IN1	Bin	Position switch
2.0	M5_IN2	Bin	ON button
2.1	M5_IN3	Bin	Acknowledgment button
2.3	M5_IN1	Bin	OFF button
4.0	M1_OUT1	Bin	Belt ON (bit memory)
6.0	M5_OUT1	Bin	Green lamp
6.1	M5_OUT2	Bin	Red lamp
6.2	M5_OUT3	Bin	White lamp

Program Generation

Once you have set up your AS-i network and preset all the necessary values in STEP 7, you can now program your control task. We will restrict this to configuring the eject process of the sorting system.



Program the belt control according to the following specifications:

The belt is activated via the start switch (DB1.DBX2.0) on the SIGNUM control unit.

The belt is deactivated via the ON/OFF switch (DB1.DBX2.3) on the SIGNUM control unit.

The system must have a defined initial position.

- no parcel in the field of vision of the optical sensor
- no parcel at the end of the belt (position switch inactive)
- ejector in initial position (checked by the inductive proximity switch).

If the initial position is defined, the belt is activated. The movement of the belt is simulated by the LED of the output 1 of slave 1 (DB1.DBX4.0). The display is only possible if auxiliary power for the outputs is supplied to the AS-Interface user module. Otherwise, DB1.DBX4.0 has the function of a bit memory.

Display of the operating modes

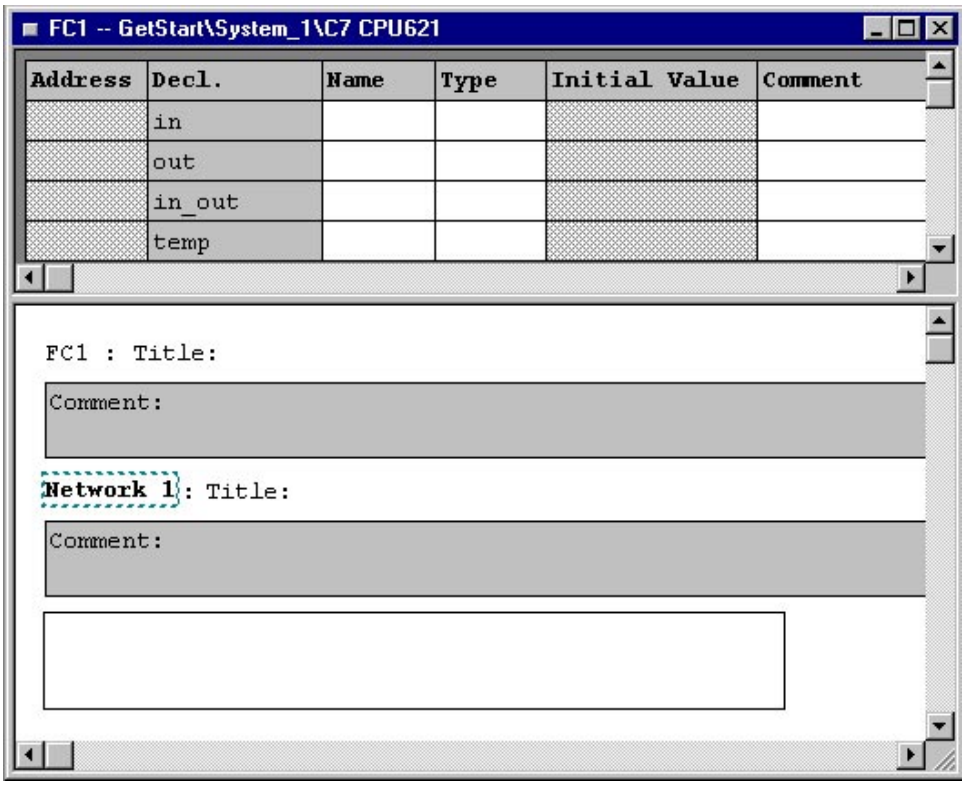
- When the belt is activated, the green lamp on the AS-i casing is illuminated (DB1.DBX6.0).

Inserting a block

In the SIMATIC Manager select the Blocks folder and insert a new function via *Insert* → *S7 Block* → *3 Function*. In the dialog box which appears, assign the internal ID *FC1*. Select *STL* as the generation language and close the dialog box with *OK*.

Editing a block

- Now open the LAD/STL/FBD editor by double-clicking on the newly created *Function FC1* in the SIMATIC MANAGER.



- Click on *Title* next to the block number FC1 and assign the block name `Belt control.`
- Now give the first network the name `Initial position.` To do this, click on the entry *Title* next to the network number.
- Click in the gray field below the line *Network 1*: to activate it. Enter a network comment in this field: `There must be no parcel on the belt.`
- Below the network comment you can now insert your program lines. To do this, click in the white area below the gray comment field. This opens a box with the current cursor position. When making your entry, make sure you include the relevant blanks (at least one blank each as a separator between operation code, operand and comment) in each program line, otherwise STEP 7 will not recognize the instruction and will signal this in red italics. Insert the following in the first network:

```
FC1: Belt control
Network 1 : Initial position
AN     DB1.DBX0.0   // Opto_Bero : no parcel
AN     DB1.DBX1.0   // Position switch: no parcel
A      DB1.DBX0.1   // Ejector in initial position
=      M 15.0       // Initial position
```

- To insert a new network, click on  in the toolbar. In this network, program the operating status of your system.

```
Network 2 : Belt ON

A      DB1.DBX2.0   // Belt_ON button on casing
A      M 15.0       // Initial position
S      DB1.DBX4.0   // Conveyor belt ON

Network 3 : Belt OFF

A      DB1.DBX2.3   // Belt_OFF button on casing
R      DB1.DBX4.0   // Output Belt_ON

Network 4 : Operating mode display

A      DB1.DBX4.0   // Belt ON
=      DB1.DBX6.0   // Green lamp on casing
=      M 21.0       // Message flag (required later)
```

Saving a block

- You have now fully programmed your belt control. Save your function *FC1* by clicking on the  icon in the toolbar.
- For an executable program you must still write the AS-i input data to *DB1* at the start of the cycle and the outputs from *DB1* to the AS-i output data at the end of the cycle. To do this, open *OB1* in the SIMATIC Manager and insert the following networks and program lines.

```
Network 1 : Route process image of AS-i line to DB

OPN   DB1
L     PIW  256
T     DBW    0
L     PIW  258
T     DBW    2

Network 2 : Call system component belt

CALL  FC 1      // Belt control

Network 3 : Write outputs
L     DBW    4
T     PQW  256
L     DBW    6
T     PQW  258
BE
```

- Now save your *OB1* by clicking on the  icon in the toolbar.

Setting the operating mode

- Select the System Function menu by pressing SHIFT 0 on the C7-621-AS-i.
- Select the C7 System Functions menu by pressing F1.

☞ Select the operating mode STOP by pressing F3. The STOP LED lights up.

☞ If a password has not yet been entered, the system requests one. When the C7 is shipped, the password is preset to 100. Enter the digits `100` via the numeric keypad and confirm your input with ENTER. Select the operating mode STOP again.

Deleting the C7-CPU memory / Overall reset of C7-OP

Before you load a project into the CPU for the first time, you must make sure the C7-621-AS-i is in a neutral state. To do this, you must delete both integrated C7 flash memories and then restart the C7-621-AS-i. To delete the C7 flash memories, proceed as follows:

Deleting C7-CPU memory:

In the SIMATIC Manager select the *Accessible Nodes* icon  . In the window which appears, open the folders *MPI=2* and *Blocks* by double-clicking on them.

Mark all OBs, FBs, FCs and DBs. Delete the marked objects from the C7-CPU. You have now deleted the load memory of the C7-CPU.

Mark the folder *MPI=2* and copy the contents of the load memory into the C7-CPU flash memory via *PLC* → *Save RAM to ROM.* You have now deleted the integrated CPU flash memory.

Close the *Accessible Nodes* window.

Overall reset of C7-OP:

Switch off the power supply of the C7-621-AS-i.

Now press the ESC and ▶ and ▼ keys simultaneously,
keep these keys depressed,
and switch on the power supply.

Do not release the keys until the message “Flash Test“ appears in the display. After the startup tests, the idle message is displayed and the overall reset of the C7-OP too is complete.

Loading blocks

You have two options for loading blocks into the CPU. Loading individual blocks is recommended for large projects if changes were only made in individual blocks which can be clearly identified. Loading all blocks is recommended for smaller projects or if many changes were made in various blocks.

1st option: Loading all blocks

In the SIMATIC Manager select the `Blocks` folder and click once on the  icon in the toolbar.

2nd option: Loading individual blocks

In the SIMATIC Manager select the function *FC1* and load this block into the CPU of the SIMATIC C7-621-AS-i by clicking once on the  icon in the toolbar.
Then load the organization block *OB1* into the CPU in the same way.

Select the System Functions menu by pressing SHIFT 0 on the C7 621-AS-i.

Press F1 to select the C7 System Functions menu.

Press F1 to select the operating mode **RUNP**. The **RUN** LED lights up.

If a password has not yet been entered, the system requests one. When the C7 is shipped, the password is preset to 100. Enter the digits `100` via the numeric keypad and confirm your input with *ENTER*. Select the operating mode RUNP again.

Test your program on the C7-621-AS-i control system using your AS-i components. The functions of the system, as specified in the first programming step, should be set up.

Program extension

Now you are going to extend your system. The system is to work as follows:

The number of parcels is counted if

- Parcel at end of belt (position switch active)
- Ejector in initial position (inductive proximity switch)

The maximum number of parcels to be ejected is predefined (default:10). The count process then starts from the beginning.

The minimum interval between parcels is monitored via Opto-Bero. A parcel can appear in the field of vision every 10 seconds at the most. Whenever the Bero detects a parcel, a white lamp on the casing illuminates. (DB1.DBX6.2).

A parcel at the end of the belt must be removed by the ejector (ejected) within 3 seconds.

If one or more of the requirements are not met, this constitutes a fault and the belt stops. The fault is indicated by a flashing red lamp (DB1.DBX6.1) on the casing.

The fault must be acknowledged via the acknowledgment button on the casing (DB1.DBX2.1).

- In the SIMATIC Manager go to your offline project  and insert another *function* in the *Blocks* folder. Give it the internal ID FC2, select *STL* again as the generation language, and open the block.
- Insert the following program lines in the individual networks:

```
FC2 : Eject conditions

Network 1 : Count

A     DB1.DBX1.0    // Position switch
A     DB1.DBX4.0    // Belt ON
A     DB1.DBX0.1    // Inductive Bero
FP    M30.0         // Rising edge
CV    C1            // Count forward
L     C1            // Transfer count to MW 22
T     MW22
AN    C1            // Count = 0
A     DB1.DBX4.0    // Belt ON
L     C#0           // Write preset count
S     C1            // Initialize counter
L     MW22          // If the value in MW 22 is greater than
L     10            // the maximum value set, the counter
>I
R     C1            // is reset

Network 2 : Parcel sequence

A     DB1.DBX4.0    // Belt_ON
A     DB1.DBX0.0    // Opto_Bero: parcel
FN    M30.1         // Edge formation
L     S5T#10S       // Parcel interval at least 10 seconds
SE    T5            // Pulse extension
A     T5            // Parcel interval too small
A     DB1.DBX0.0    // Opto_Bero: parcel
FP    M30.2         // Edge formation
S     M21.1         // Fault in parcel sequence

Network 3 : Display: parcel detected

A     DB1.DBX4.0    // Belt ON
A     DB1.DBX0.0    // Opto_Bero
=     DB1.DBX6.2    // Lamp: parcel detected
=     M21.3         // Message flag (required later)

Network 4 : Stop-monitoring

A     DB1.DBX4.0    // Belt_ON
A     DB1.DBX1.0    // Parcel at end of belt
L     S5T#5S        // Monitoring time 5 seconds
SD    T3            // ON delay
A     T3
S     M21.2         // Fault in parcel stop

Network 5 : Faults

O     M21.1        // Fault_parcel sequence
O     M21.2        // Fault_parcel stop
=     M16.0        // Fault
A     M16.0        // Fault
A     M10.4        // Flashing frequency
=     DB1.DBX6.1   // Red lamp on casing

A     DB1.DBX2.1   // Acknowledgment button
R     M21.1        // Fault_parcel sequence
R     M21.2        // Fault_parcel stop
```

- Programming of the *FC2* is now complete. The module can be saved and transferred to the CPU.
- Now you must also consider the possible faults in your belt control. In the SIMATIC Manager open the *FC1.* Insert the program line *AN M16.0* in *Network 1*. The complete network then looks like this:

```
Network 1 : Initial position

AN     DB1.DBX0.0   // Opto_Bero: no parcel
AN     DB1.DBX1.0   // Position switch: no parcel
A      DB1.DBX0.1   // Ejector in initial position
AN     M16.0        // No fault
=      M15.0        // Initial position
```

- In *Network 3* insert the program line *O M16.0* so that the conveyor belt will be deactivated if a fault occurs.

```
Network 3 : Belt OFF

A      DB1.DBX2.3   // Belt_OFF switch on casing
O      M16.0        // Belt OFF
R      DB1.DBX4.0   // Output Belt_ON
```

- Save the function *FC1* and overwrite the block in the CPU by reloading.
- Finally, the organization block *OB1* must be adjusted. In the SIMATIC Manager open the *OB1*, insert a network and call the function *FC2*.

```
Network 3 : FC 2 call

Call   FC2
```

- Save the OB1 and overwrite it in the CPU by reloading.

To save the PLC program in the C7-CPU so that it is powerfail-proof, you must transfer it to the C7-CPU flash memory. How to do this is described in the following section.

Saving RAM to ROM

Because the PLC program, when loaded into the C7-CPU, is only transferred into the unbuffered load memory and not automatically also into the C7-CPU flash memory, the program would be lost when the C7-621-AS-i was restarted. To prevent this, you must copy the PLC program into the flash memory explicitly. Proceed as follows:

☞ Call up the System Functions menu by pressing the SHIFT 0 keys on the C7-621-AS-i.

☞ Press F1 to call the C7 System Functions menu.

☞ Press F3 to select the operating mode STOP. The STOP LED lights up.

☞ If a password has not yet been entered, the system requests one. When the C7 is shipped, the password is preset to 100. Enter the digits `100` via the numeric keypad and confirm your input with *ENTER*. Select the operating mode STOP again.

🖱 In the SIMATIC Manager select the *Accessible Nodes* symbol  again. In the dialog window displayed, mark the folder *MPI=2*. Copy the contents of the load memory into the C7-CPU flash memory via the menu item *PLC* → *Save RAM to ROM*. The PLC program is now stored in non-volatile memory in the C7-CPU.

Close the *Accessible Nodes* window.

☞ On the C7 621-AS-i, press F1 to change back to the operating mode RUNP. The RUN LED lights up.

You have completed your first programming task in STEP 7. You can now test the functionality of your sorting system. We will test the programmed count function.

🖱 To control the function of the counter, click on  in the toolbar of the SIMATIC Manager to go to the online data management. Open the *Function FC2* and select the first network. Then in the menu bar, go into test mode via *Debug* → *Monitor*.

```
Network 1 : Count
A      DB1.DBX1.0
A      DB1.DBX0.1
A      DB1.DBX4.0
FP     M30.0
CV     C1
L      C1
T      MW22
AN     C1
A      DB1.DBX4.0
L      C#0
S      C1
L      MW22
L      10
>I
R      C1
```

VKE	STA	STANDARD
0	1	7
0	1	7
0	1	7
0	1	7
0	1	7

🖱 Close the LAD/STL/FBD editor and in the SIMATIC Manager your `GetStart online project.`

🖱 Open the `GetStart` folder.

Preparations for OP Configuration

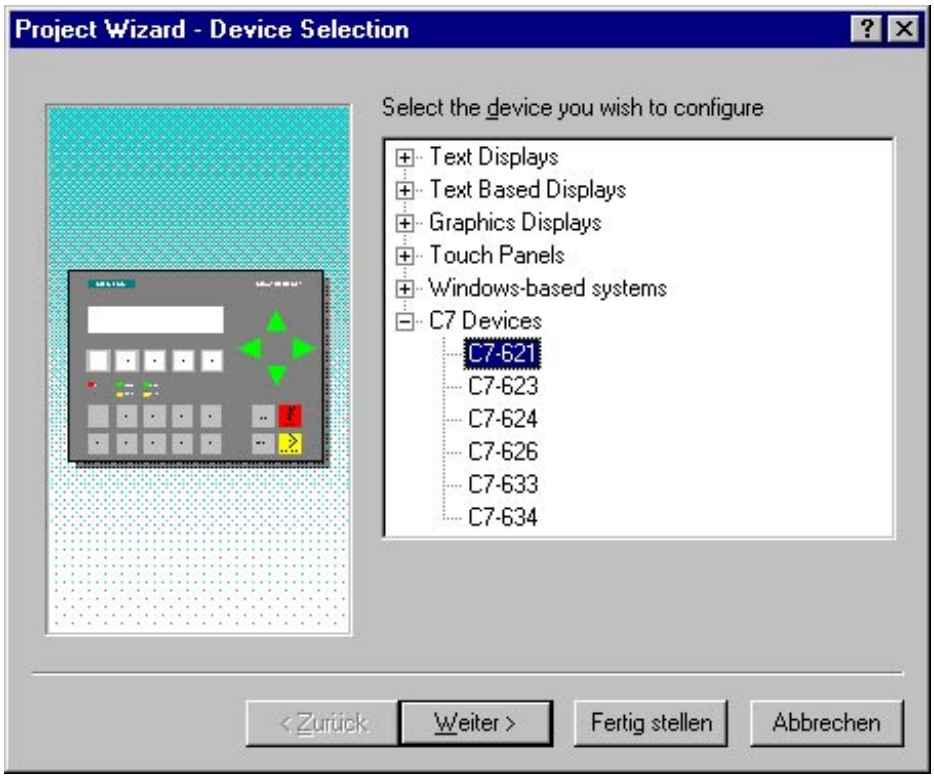
Starting ProTool, creating the configuration

There are two ways to create an OP configuration. You can create a new (empty) configuration and configure all the necessary system functions (e.g. change of operating mode, assignment of passwords etc.) yourself, or you can use a standard configuration delivered with ProTool as the basis for your configuration.

To make things easier for you during your first configuration, we advise you to take the second option of starting with a supplied standard configuration. The standard configuration contains basic settings, e.g. *Device*: `C7–621`, *Language*: `English`, and standard screens for easy access to frequently used functions, e.g. change of operating mode, assignment of passwords.

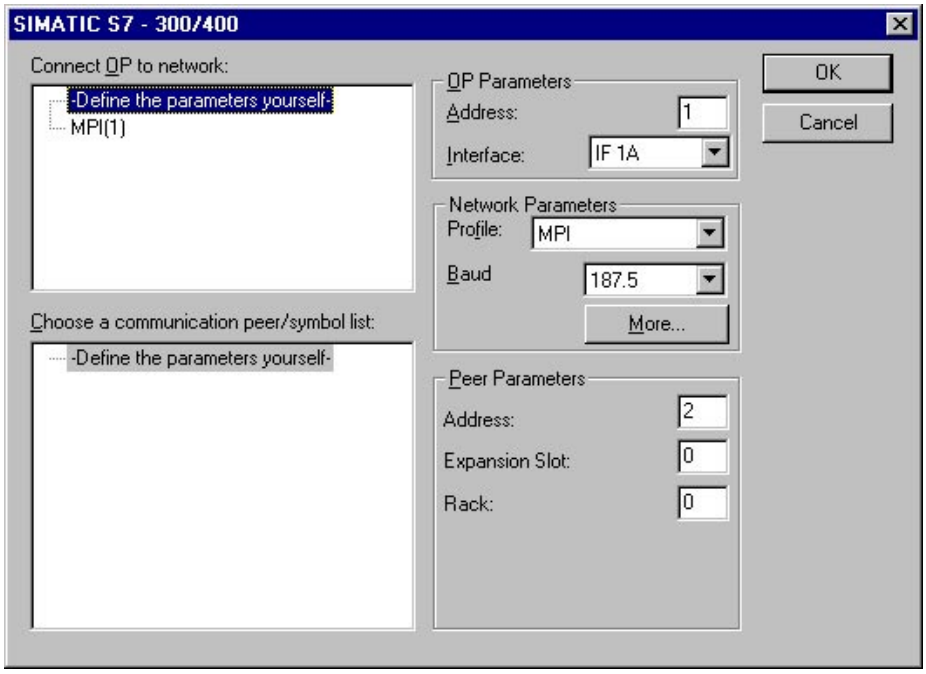
Creating a new configuration:

- In the SIMATIC Manager select *Insert → Station → 8 SIMATIC OP* and name the new OP station `OP_System_1`.
- Open the station (e.g. by double-clicking). ProTool/Lite and the Projekt Wizard are started automatically.



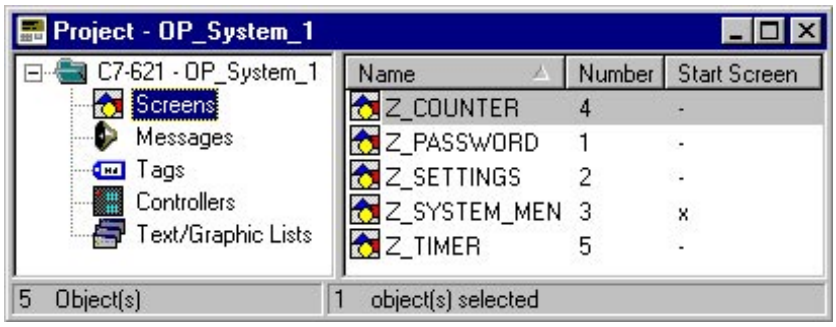
- Select the `C7-621` from the C7 Devices and confirm with *Weiter >*.
- Define a name for the PLC which you use to reference it in the configuration: `System_1`.

To check and, if necessary, correct the PLC parameters, display the dialog box with the PLC parameters from the Driver window by activating the *Parameters* button (see dialog box directly below).



When you have entered all the settings, close the dialog box by activating the button *OK*. In the Projekt Wizard confirm this step with *Weiter >.*

Select *Use Standard Projects* and close the Project Wizard with *Fertig stellen* to create the Project *OP_System_1* in ProTool.



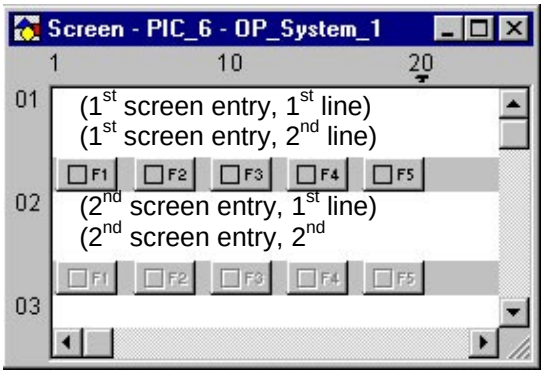
Online Help

If there is anything you are unsure of during configuration, or if you want further information on specific points, press *F1*. This starts the Online Help, in which you will find explanations of the various ProTool topics.

Displaying and Entering Values in Screens

You can start by configuring your first screen.

- Open the Screen Editor with the menu item *Insert* → *Screen*. This action calls up the Screen-PIC_6.



Configuring texts

The first screen is to be the start screen on the C7. It will display only the system name.

The system name is configured as the text.

- The cursor is located in the first line of the first screen entry (see above). Enter the system name there: `System_1`.

SIMATIC C7 startup always ends automatically with a display of the configured start screen. The screen you have just configured (display of the text: System_1) is now to be displayed after the next loading of the configuration. You must therefore mark this screen as the start screen.

- Select the menu item *Edit* → *Properties*. In the *PIC_6* dialog box, select *Start Screen*. Do not change the other settings.
- You can also define a new name for the screen: `Start_Sys1`.
- Close the dialog box with *OK*.

You have now created the first screen. Now, transfer the configuration to the OP to see what the screen looks like.

Transferring the configured data

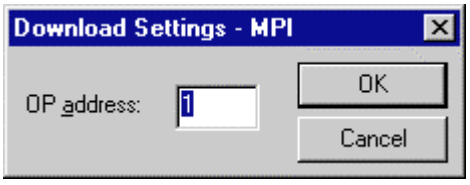
Before the actual transfer, you must perform three steps:

- Save
- Generate the project
- Define the transfer parameters (once only).

To save the project, select *File* → *Save* in the menu bar.

Then in the menu bar select *File* → *Generate* to generate from the configuration file a file that can be executed on the OP. During the generation process, a status window opens which displays any relevant notes, warnings or errors in the configuration.

Finally, set the parameters for the transfer.
In the menu bar, select *File* → *Settings* → *Download*. The following dialog box is displayed:



In the dialog box, specify the OP address (default = 1).

Note
The transfer parameters retain this value; they do not need to be reset before each transfer.

☞ Then put the C7-621 into transfer mode with an overall reset:
Switch off the power supply of the C7-621.
Then press the ESC and ▶ and ▼ keys simultaneously,
keep these keys depressed,
and switch on the power supply.

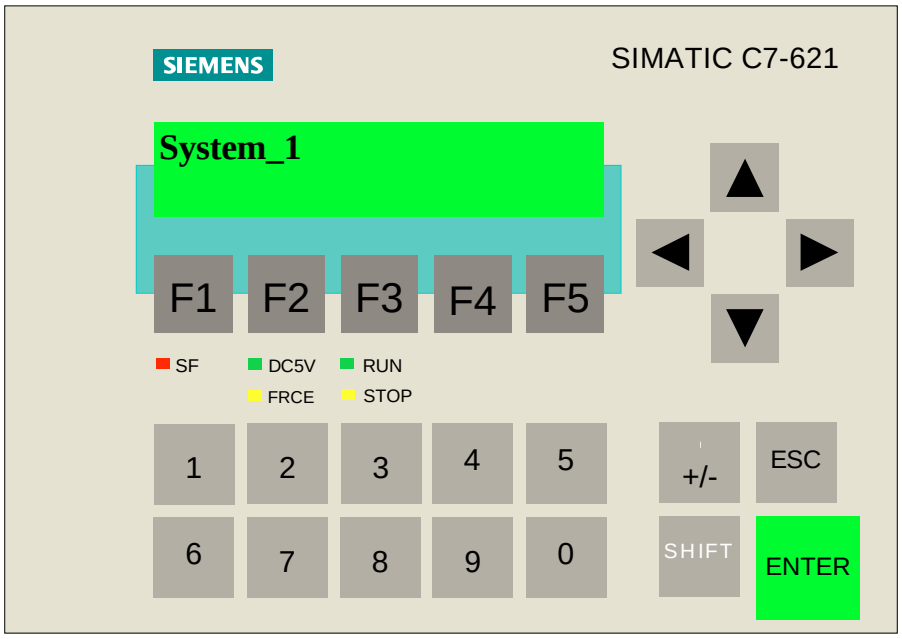
Do not release the keys until the message “Flash Test“ appears in the display. After the startup tests, the idle message is displayed and the overall reset of the C7-OP too is complete.

☞ Once the C7 has been started, select the system screens stored in the firmware with the ENTER key. Press F4 to select *System* and F2 to select *OpMode*. Press SHIFT and ▼ simultaneously to switch to *MPI down* and confirm your entries with *ENTER*. The message *Ready for transfer* appears on the C7-OP.

☞ If a password has not yet been entered, the system requests one. Enter the digits `100` again via the numeric keypad and confirm your input with *ENTER*. Select the operating mode *MPI down* again and confirm with *ENTER*.

Now select *File* → *Download* in the menu bar to initiate the data transfer from the PC/programming device to the C7.

Once the transfer is complete, the C7 starts up. Press the *ENTER* key. If the start screen appears on the C7, the transfer was successful.



If the transfer was not successful, repeat the steps beginning on page 33.

Extending the configuration

Now that you are an “experienced” ProTool user, you can extend your configuration by another screen.

- Open a new Screen with the menu item *Insert* → *Screen*.
- Now select *Edit* → *Properties* and change the screen name: `Parcels_1`.

In this screen, enter the number of parcels to be transported. At the same time you want to display the current counter status.

This is implemented as follows:

The maximum number of parcels is entered via an **input field**.

The number of currently counted parcels is displayed as the **output field**.

Configuring texts

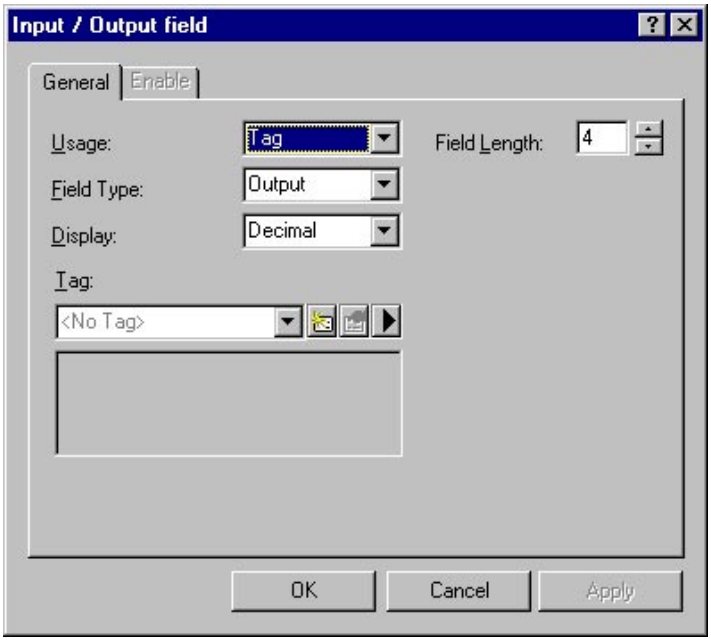
So that you can distinguish the input field from the output field, configure a text in front of each field.

- Select the first line of the first screen entry with the cursor and enter the text: `Max.number:`. Then position the cursor in the first line of the second screen entry and configure the text: `Curr.number:`

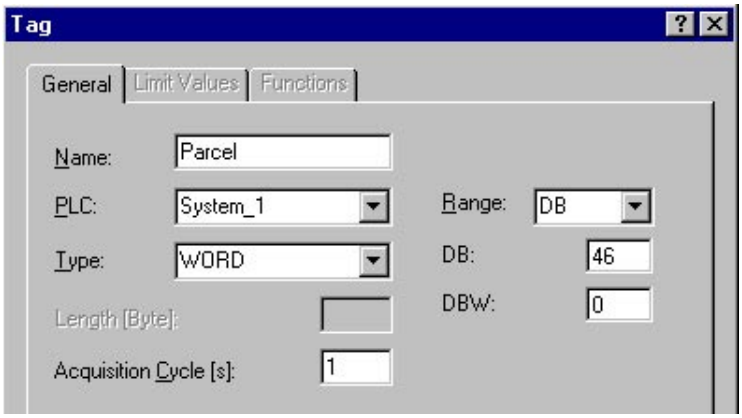
Then define the fields for the input and output.

Configuring the input field

- Use the cursor to select the first line of the first screen entry. Using the cursor control keys, position the cursor behind the text Filling time. Activate the menu item *Insert* → *Input/Output Field* or press the button {F} in the function bar. The *Input/Output field* dialog box appears.



- Set the *Field Type*: `Input` and specify a *Field Length* of `4`. Do not change the settings *Usage:* `Tag` or *Display:* `Decimal`.
- To establish the link between the field and the PLC, create a new variable with the button .
- Give this variable the name `Parcel` by overwriting the preset variable name. Then make the following entries: *Type:* `WORD`, address *DB:* `46`, *DBW:* `0`.



- Click the *OK* button to close the *Tag* and *Input/Output field* dialog boxes. You have now defined the input field. The variable is identified by `{Parcel}` in the Screen Editor.
- Position the cursor between the text `Max.number:` and the input field `{Parcel}`. Now enter blanks to make full use of the line. But make sure you do not exceed the maximum of 20 characters per line. 11 characters of text plus 4 characters of field length therefore mean a maximum of 5 blanks.

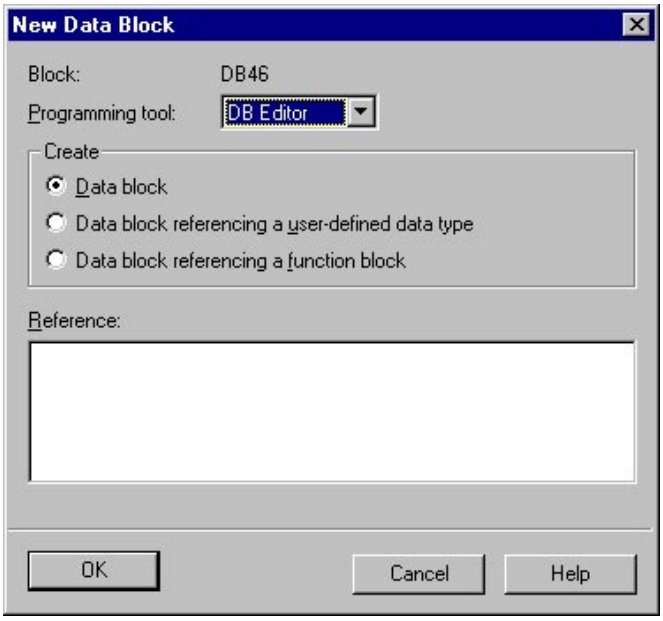
Configuring the output field

- Position the cursor in the first line of the second screen entry after the configured text `Curr.number:`. In the menu bar, select *Insert* → *Input/Output Field.*
- In the *Input / Output* dialog box, set the field type to `Output` and the field length to 4.
- Now click the button  . The *Tag* dialog box is displayed. Enter `Number` as the variable name, `WORD` as the type, and `DB46` and `DBW 2` as the interface range. Save your entries with *OK*.
- Position the cursor between the text `Curr.number:` and the output field `{Number}`. Now enter blanks to make full use of the line. But make sure you do not exceed the maximum of 20 characters per line. 11 characters of text plus 4 characters of field length therefore mean a maximum of 5 blanks.

Adjusting the control program

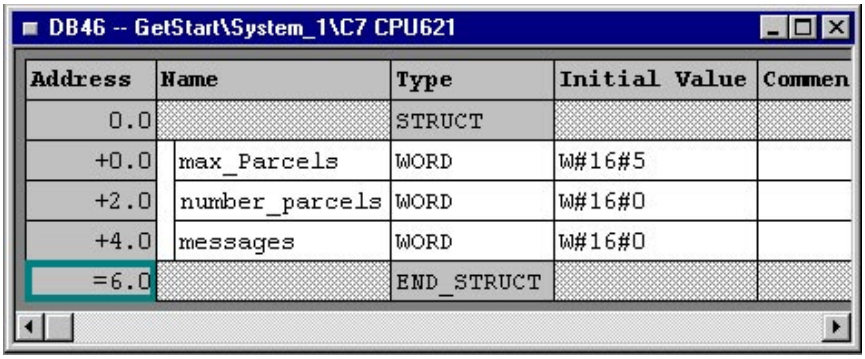
To allow the exchange of data between the C7 PLC and C7-OP you must still adjust your previous control program and reload it.

- In the PLC create the data block DB46. The length of the DB46 must be at least three data words. In the SIMATIC Manager select the *Blocks* folder and insert a data block via *Insert* → *S7 Block* → *4 Data Block*. In the dialog box which appears, assign the internal ID `DB46.`
- Open the data block DB46 and select *Data Block* as the desired type. Confirm the settings with *OK*.



- In the DB Editor, activate the second entry with the mouse in the *Name* column. Assign here the name `max.parcels` for the DW0 and complete your entry with Return.
- This automatically activates the entry Type. Click on the entry with the right mouse button, insert the type *WORD* via *Elementary Types*, and complete your entry with Return again.
- As the default for the highest count, enter *W#16#0005*.
- In the Comment column you can enter a comment for the data word. Complete your entry with Return.

- The editor automatically inserts a new line, in which you enter the next data block word. This data word 2 is to have the name `number_parcels`, the type *WORD*, and the initial value `W#16#0`.
- Create the data word 4 with the name `messages`, the type *WORD* and the initial value `W#16#0`. This data word is required for the event messages to be configured and is explained later in more detail.



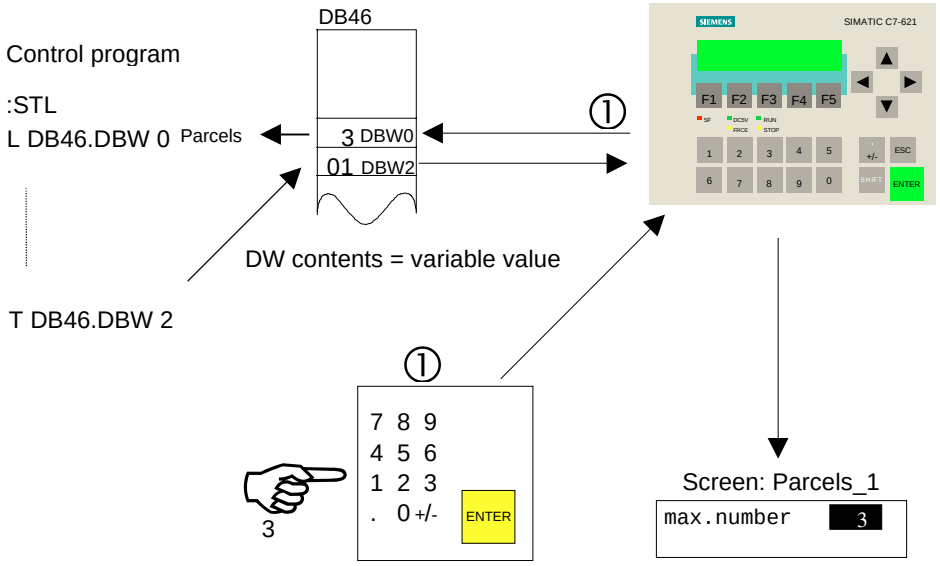
Address	Name	Type	Initial Value	Commen
0.0		STRUCT		
+0.0	max_Parcels	WORD	W#16#5	
+2.0	number_parcels	WORD	W#16#0	
+4.0	messages	WORD	W#16#0	
=6.0		END_STRUCT		

- You have now created the data block DB46. Save it and load it into the C7-621-AS-i control system.
- Now you must still modify the function FC2. Open the FC2 in the SIMATIC Manager and in the first network overwrite the load instruction of the counter with `L DB46.DBW0.` Then transfer the count to the second data word of the data block DB46 instead of to the MW22.

```
Network 1 : Count
A     DB1.DBX1.0    // Position switch
A     DB1.DBX4.0    // Belt ON
A     DB1.DBX0.1    // Inductive Bero
FP    M30.0         // Rising edge
CV    C1            // Count forward
L     C1            // Transfer count to Db46.DBW2
T     DB46.DBW2
AN    C1            // Count = 0
A     DB1.DBX4.0   // Belt ON
L     C#0           // Write preset count
S     C1            // Initialize counter
L     DB46.DW2      // If the value in DB46.DW2 is greater than
L     DB46.DW0      // the maximum value set, the counter is
>I
R     C1            // reset
```

- Save the block and load it into the CPU again. Via the menu item *Accessible Nodes* activate the function *Save RAM to ROM*, so that the current program is also stored in the flash memory. Make sure that the C7-CPU is in the operating mode STOP during this save process. Then select the CPU mode RUNP again.

The following diagram shows the connection between the value entered, the control program and the current number of parcels counted.



The values of the input are stored in the data interface (DB46).

The control program evaluates the current entries and updates the data in the interface for the output.

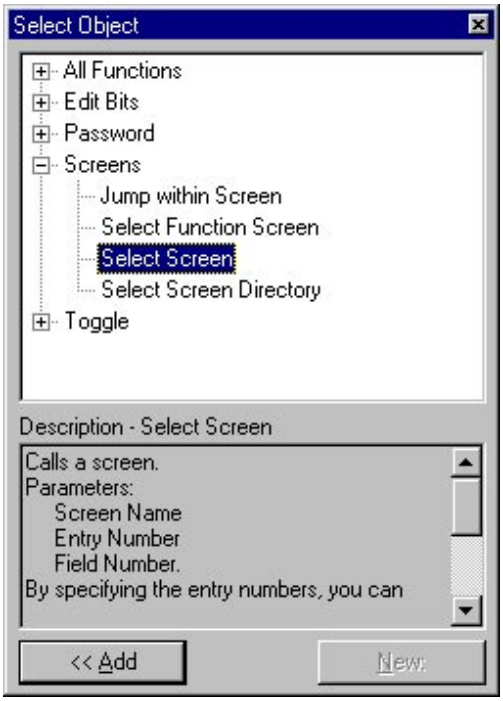
The C7-OP independently reads all values from the interface and updates its display.

Linking and branching between screens via softkeys

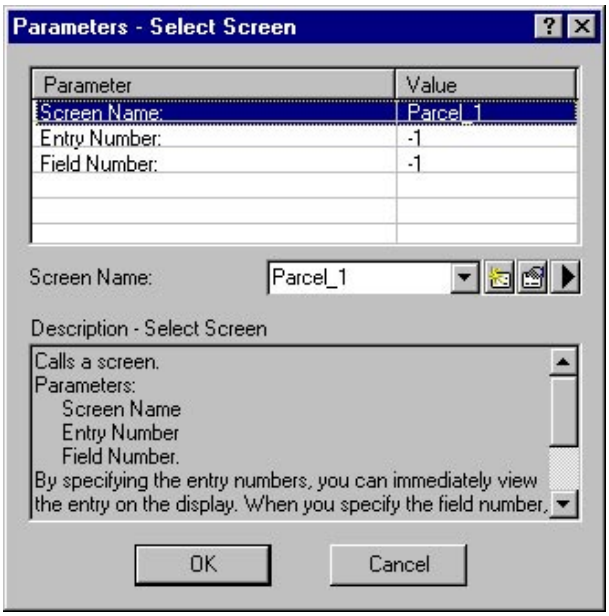
So that you can also call the second screen on the C7, you must configure the change from the start screen `Start_Sys1` to the system screen `Parcels_1` and back with ProTool/Lite. You must also be able to navigate in the system screen a screen branch from the first screen entry to the second screen entry and back.

To do this you assign the ‘Select Screen’ function to a softkey in both screens. These softkeys are used to change the screen. In the system screen you assign the ‘Navigation’ function to a softkey in both screen entries.

- Open the screen `Start_Sys1` and select the Softkey *F5*. The dialog boxes *Softkey-F5* and *Select Object* appear.
- In the dialog box *Select Objekt* choose the function *Select Screen* from the *Screens.* A short description of the function is displayed.



Click the button *<<Add*. The dialog box *Parameters - Select Screen* appears. In this dialog box, select the name of the screen you want to call up: `Parcel_1`. Do not change the parameters *Entry Number* or *Field Number*.



Close the dialog boxes *Parameters - Select Screen and Softkey F5* by clicking the *OK* button. A function is now assigned to the softkey.

The box 

in the function key is now checked. You can therefore see immediately which function keys have been configured in the screen.

Labeling softkey assignment

So that the C7 operator knows which softkey is occupied, you need to define a text for this softkey, which will be displayed in the relevant screen. Proceed as follows:

- Position the text cursor in the second line of the screen above the softkey you have assigned, by entering blanks. Enter the text `Par` there to indicate the association with the softkey.
- To return from the `Parcels_1` screen to the start screen `Start_Sys1`, proceed in the same way to configure the softkey *F1* in the `Parcels_1` screen. Use `Start_Sys1` as the screen name and enter `Back` as the text for the softkey description.
- For the screen branch, in the first screen entry of the system screen select the softkey *F5* and give it the function *Screen Branch.* As parameters, assign the entry number *2* and the field number *0*.
- In the system screen, label the softkey with the character >>.
- To return from the second screen entry to the first one, proceed in the same way to configure the softkey *F1* in the second screen entry. For the entry number, use 1 and as a character for the softkey description, enter <<.

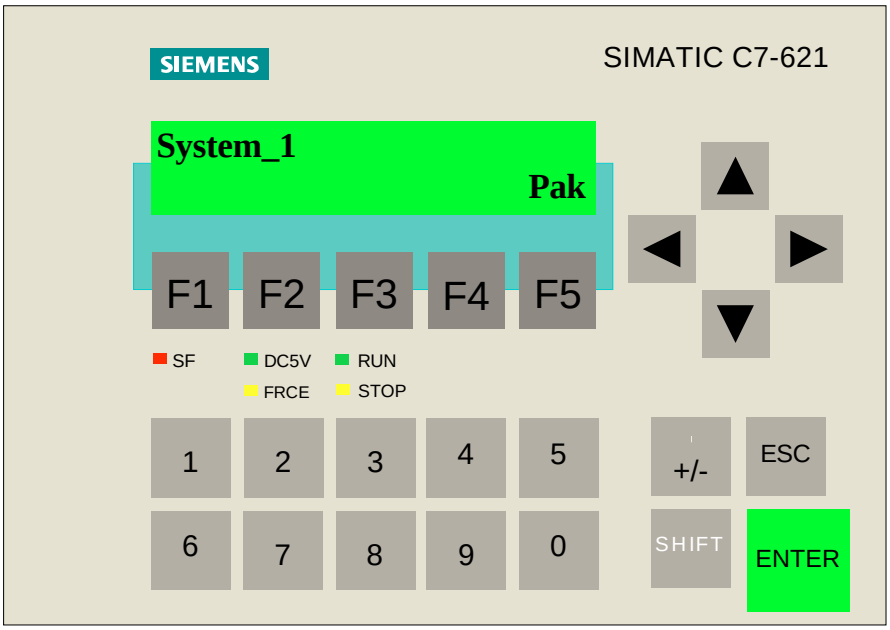
All extensions to the configuration are now complete. You have:

- configured a second screen with input and output fields,
- plus in each screen a softkey for switching between the two screens,
- plus in each screen entry a softkey for switching between the entries, and
- a text/character to identify each softkey.

Now you can start to display the configuration on the OP as well as change screens and perform inputs/outputs.

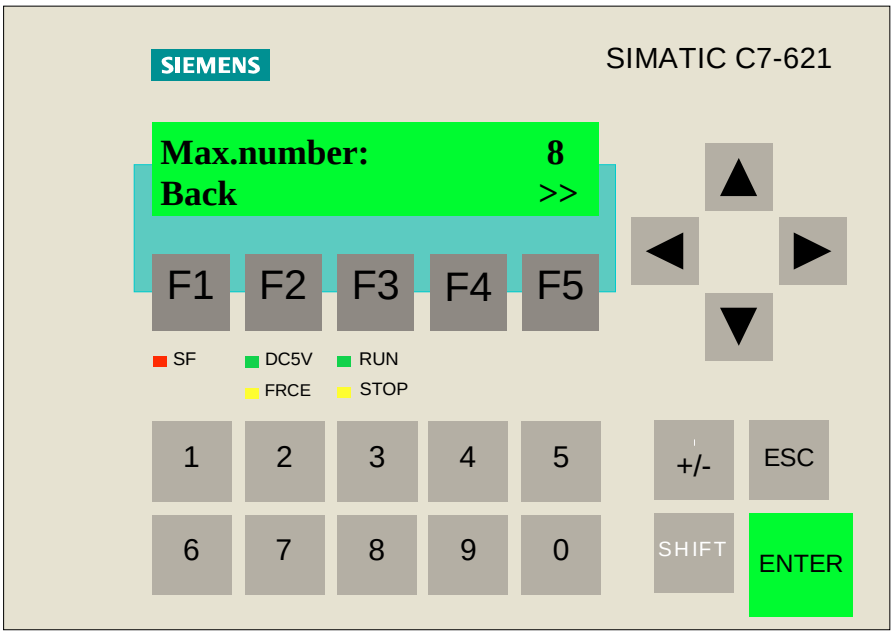
- Now put the C7-621-AS-i into transfer mode with an overall reset:
  Switch off the power supply of the C7-621-AS-i.
  Press the ESC and ▶ and ▼ keys simultaneously,
  keep these keys depressed,
  and switch on the power supply.
  Do not release the keys until the message “Flash Test“ appears in the display. After the startup tests, the idle message is displayed and the overall reset of the C7-OP too is complete.
- Once the C7 has started up, select the system screens stored in the firmware by pressing *ENTER*.
  Press F4 to select the *System* and F2 to select the *OpMode*. Switch to *MPI down* by pressing the SHIFT and down-arrow keys, and confirm your entries with *ENTER*. The message ‘Ready for transfer’ appears on the C7-OP.
- If a password has not yet been entered, the system requests one. Enter `100` again via the numeric keypad and confirm your input with *ENTER*. Select *MPI down* again and confirm with *ENTER*.
- Now select *File* → *Download* from the menu bar to initiate the data transfer from the PC/programming device to the C7. If you have made changes to the configuration, the steps ‘save’ and ‘generate’ are performed automatically after a query. Answer the question as to whether to save, with *Yes.*

☞ Once the transfer is complete, the C7 starts up. When you press the *ENTER* key, the start screen is displayed.



☞ Activate the softkey F5 to reach the system screen.

☞ Enter a value in the input field.



☞ Activate the softkey F5 to reach the second screen entry. Now check the functionality of your inductive proximity switch including the count function.

Incorporating Standard Screens into the Configuration

At the start of the configuration, you selected the standard screens as the basis for your configuration and saved the file under the new name `System_1`.

You will need the standard screens if you want to use the standard functions of the C7-621-AS-i. These functions include changing the operating mode, editing the password, logging on and off with the password, etc.

Now that you have marked the `Start_Sys1` screen you configured as the start screen, the standard screens incorporated in it can no longer be selected on the OP. So that you can use the standard screens again, define a softkey with which you can select them.

- In the start screen, select the softkey *F1* and proceed as described under “Linking and branching between screens via softkeys” on **page 38**. As the screen name, use the name of the standard basic screen `Z_SYSTEM_MEN`. As the assignment note, configure the abbreviation `Sys` at the beginning of the second line of the start screen.

Now you can transfer the extended configuration to the OP and try it out.

- Put the C7-621-AS-i control system in transfer mode with an overall reset:

  Switch off the power supply of the C7-621-AS-i, press the three keys ESC and ▶ and ▼ simultaneously and, keeping them depressed, switch on the power supply again.

  Do not release the keys until the message “Flash Test“ appears in the display. After the startup tests, the idle message is displayed and the overall reset of the C7-OP too is complete.

- Once the C7 has started up, select the system screens stored in the firmware with the ENTER key.

  Press F4 to select *System* and F2 to select *OpMode*. Press the SHIFT and down-arrow keys simultaneously to switch to *MPI down* and confirm your entries with *ENTER*. The message *Ready for transfer* appears on the C7-OP

- If a password has not yet been entered, the system requests one. Enter the digits 100 via the numeric keypad and confirm your input with *ENTER*. Select *MPI down* again and confirm with *ENTER*.

- Now select *File* → *Download* in the menu bar to initiate the data transfer from the PC/programming device to the C7. If you have made changes to the configuration, the steps ‘save’ and ‘generate’ are performed automatically after a query. Answer the question as to whether to save, with *Yes.*

Once the transfer is complete, the C7-OP starts up. When you press *ENTER*, the start screen appears with the cursor in the first screen entry.

- Now activate the softkey F1 to reach the standard screens. Select the various screens with which you can trigger already implemented functions.

- Activate the ESC key to quit the standard screens and display your own configuration.

Configuring Event Messages

In the previous steps you could test the functioning of your system. What you still need is information on the current operation of your system - the so-called event messages. For example, you want a message to be displayed on the OP when you switch the system on.

Defining communication areas

So that the PLC can communicate with the OP, you must define data areas which can be accessed by both sides. This is done via the *Area Pointers* dialog box.

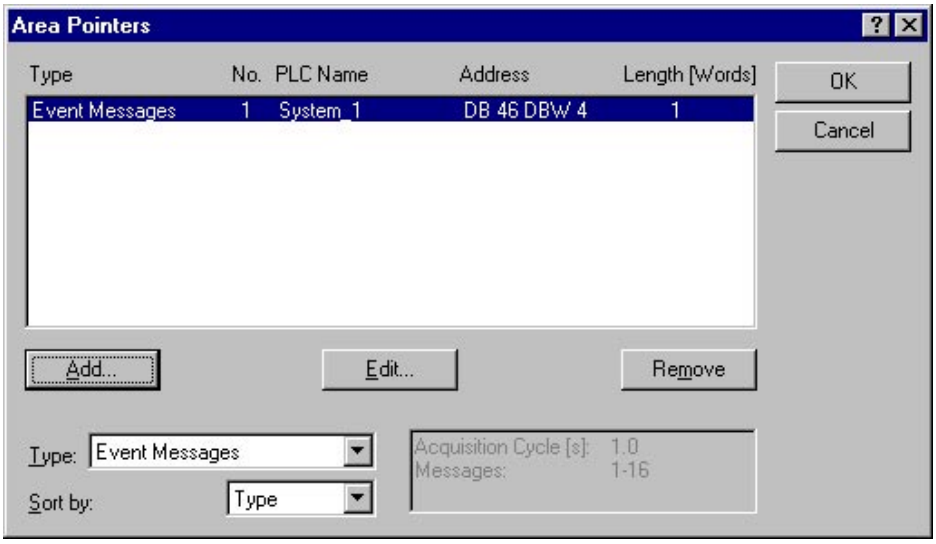
- Select this dialog box via *System* → *Area Pointers* in the menu bar.

You know that you want to configure screens with variable values (input, output) and messages. For the variables you do not need a special data area, but for the messages you need a data area for event or fault messages.

- Because with the C7-621 you cannot configure fault and event messages differently, select under *Type*: in the *Area Pointers* dialog box the entry `Event Messages`. Then click on the *Add...* button.

The *Event Messages* dialog box appears, in which you configure the message area as follows:

- As the address, enter for *DB:* `46`, for *DBW*: 4, and for *Length:* 1. Under *PLC name* select `System_1`.
- Click on *OK* to quit the *Event Messages* dialog box and return to the *Area Pointers* dialog box.

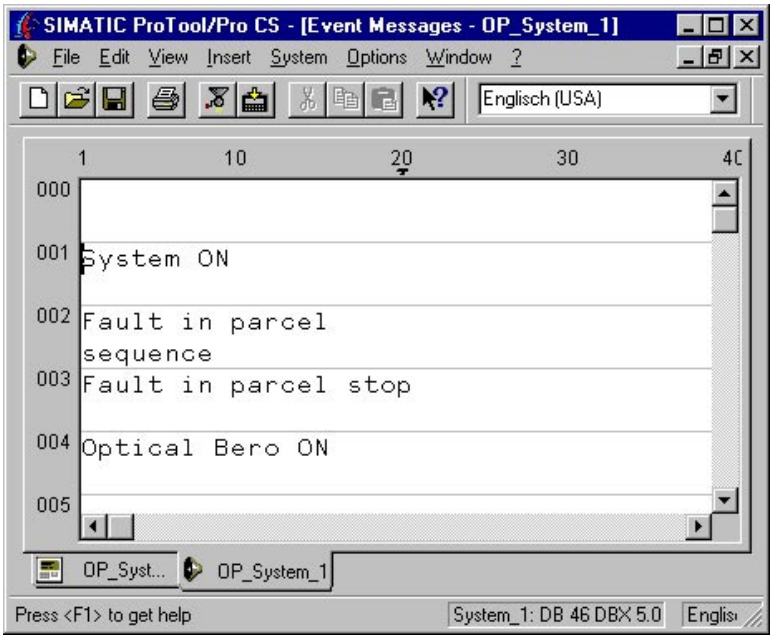


- Once you have made your entries, close the dialog box by clicking on *OK*. Your entries will be saved automatically.

Now you can proceed with the actual configuring of your screens and messages.

Configuring event message texts

- Open the Message Editor with the menu item *Insert* → *Message* → *Event Message*.
- Now configure four messages numbered 001 through 004, e.g. `System ON, Fault in parcel sequence, Fault in parcel stop and Optical Bero ON.`



In the status line (not shown in the figure), you will see the relevant address which connects the message to the PLC. In your example, for message no. 001 the address is `System ON: DB 46 DBX 5.0`.

Generating the control program

To allow the exchange of data between the C7-CPU and C7-OP you must still adjust your control program and reload it into the C7. In your user program you have programmed certain message flags for as soon as certain operating states occur. Transfer these message flags to DB46.DBW4

- In the SIMATIC Manager, open the function block *FC2* and create a new network with the following program lines.

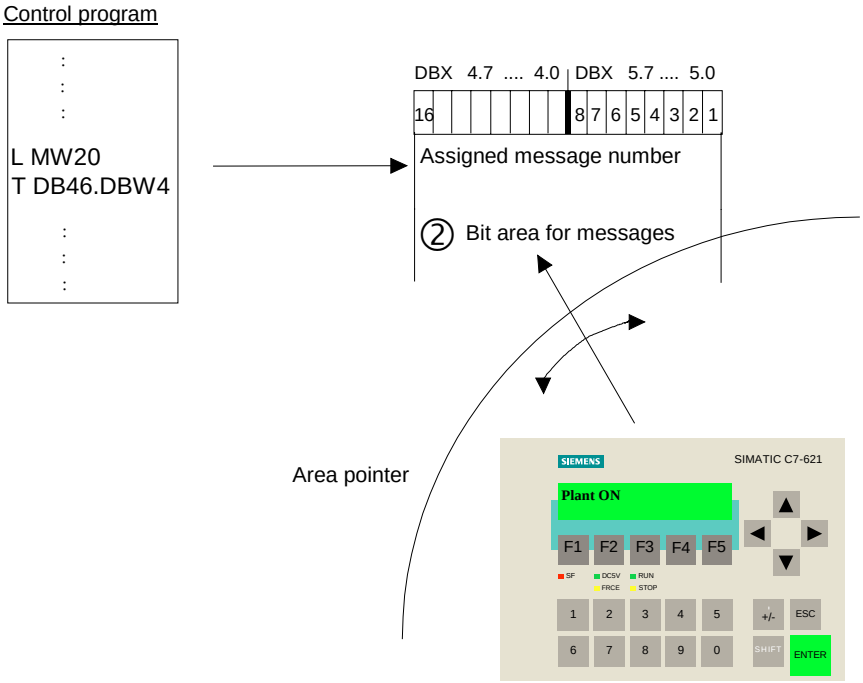
```
Network 6 : Data interface
L     MW20          // Message flags
T     DB46.DBW4     // Data block CPU_OP
```

- Save the block and reload it into the CPU. Also update the flash memory via the function *Save RAM to ROM*. Make sure that the C7-CPU is in the operating mode STOP during this save process. Then select the operating mode RUNP again.

- Using the softkey *F1* on the C7-621-AS-i, select the standard screens and put the device in transfer mode via *System* → *Mode*.

- Transfer the ProTool configuration back to the C7-621-AS-i control system.

With this control program and the configuration that you loaded, you can initiate the messages on the SIMATIC C7 device.



The above figure shows the connection between the PLC and the OP when a message appears. The process is described in detail below.

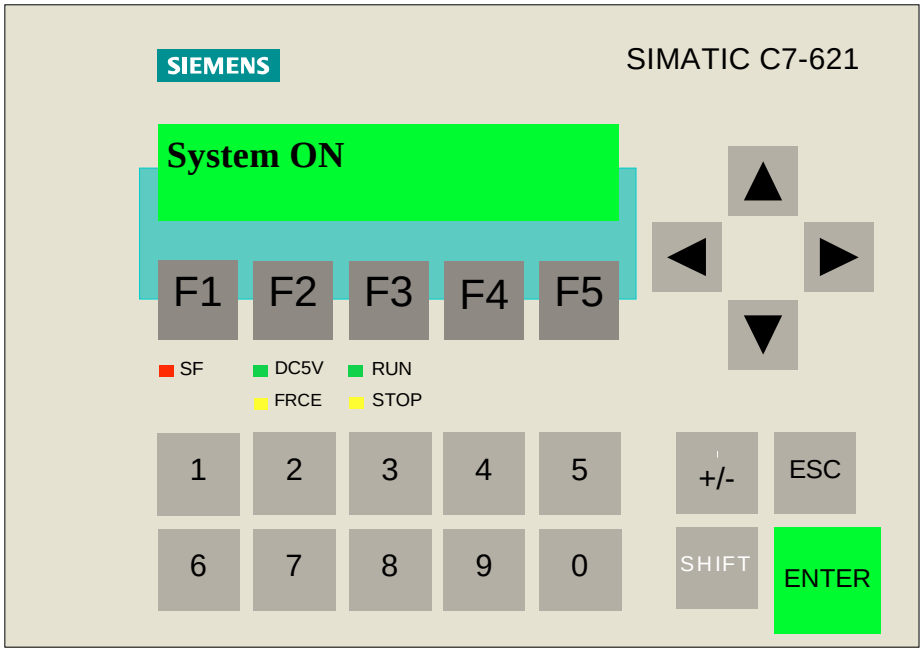
① The information that, for example, the system was switched on must be evaluated in the user program. This can be achieved, for example, by transferring the memory word MW20 containing the evaluated information of the AS-i input data to the data block.

A bit area displays the current status of the messages. Each bit that is set indicates that there is a message.

The area pointer which you have set at the beginning of the configuration “looks” cyclically in the bit area, detects whether a bit is set there, and displays the associated message on the C7 display.

After transfer of the configuration to the C7-OP (as described earlier), press the ENTER key. The start screen is displayed.

Switch the system on with the start switch on the control unit (make sure it is set to the initial position). This triggers an individual message. The message level is displayed and the message appears.



This completes the configuration.

Symbolic Addressing

When programming with STEP 7 you work with operands such as I/O signals, bit memories, counters, timers, data blocks and function blocks. So far you have addressed these operands in your program absolutely (e.g. on DB46). However, it is helpful to assign symbolic names for them (e.g. on DB_OP, Belt control). In the declaration section of the data block, you have already defined the symbolic alphanumeric names for your data elements in the memory block DB1, and defined the DB1 via the structure of UDT1. If the symbol name of the data block is accessed symbolically, this name must be entered in the symbol list. This allows full symbolic access to a data element in the data block. To define the symbolic names, proceed as follows:

- In the SIMATIC Manager select in the *S7 Program(1)* folder the *Symbols* folder and open it with a double click. The Symbol Editor with the symbol table is displayed.
- In the symbol table, activate the first field in the *Symbol* column by clicking on it, and enter a symbol name (e.g. DB_OP).
- Jump to the *Address* column using the TAB key and assign an address (e.g. DB 46) to the symbol name.
- Skip the *Data type* column by pressing the TAB key twice. A default value (e.g. WORD) is automatically entered for the data type and the *Comment* field becomes active.
- Enter a comment in the comment field and press the TAB key again. The second field in the Symbol column becomes active. Repeat the steps to enter additional symbol names. When you have finished, save the symbol table and close the Symbol Editor.

GetStart\System_1\C7 CPU621\S7-Pro...\Symbole

	Symbol	Address	Data Type	Comment
1	AS-i Slave	DB 1	DB 1	AS-i slave process image
2	Eject conditions	FC 2	FC 2	Funktion_2
3	Belt control	FC 1	FC 1	Funktion_1
4	Flashing frequency	M 10.4	BOOL	clock memory
5	DP_OP	DB 46	DB 46	Data exchange with OP
6	FN_memory_bit	M 30.1	BOOL	Edge memory bit, falling edge
7	FP_memory_bit	M 30.0	BOOL	Edge memory bit, rising edge
8	FP_memory_bit_1	M 30.2	BOOL	Edge memory bit, rising edge
9	Initial position	M 15.0	BOOL	Initial position
10	Aux_mem_bit_system	M 21.0	BOOL	Memory bit system ON
11	Aux_mem_bit_optical	M 21.3	BOOL	Parcel detected by optical sensor
12	Aux_mem_bit_parcel_stop	M 21.2	BOOL	Fault in parcel stop
13	Aux_mem_bit_seq.	M 21.1	BOOL	Fault in parcel sequence
14	Fault_memory_bit	M 16.0	BOOL	Aux.memorybit, faults
15	Timer_3	T 3	TIMER	Timer for stop-monitoring
16	Timer_5	T 5	TIMER	Timer for parcel journey
17	Counter_1	C 1	COUNTER	Counter_parcels
18				

Note
Although long symbolic names are more descriptive, they take longer to edit. With a combination of short symbolic names and detailed comments, you can satisfy the requirements of both good program documentation and effective program creation.

Setting symbolic representation

To also display the symbolic names in your program, you must set the appropriate type of representation.

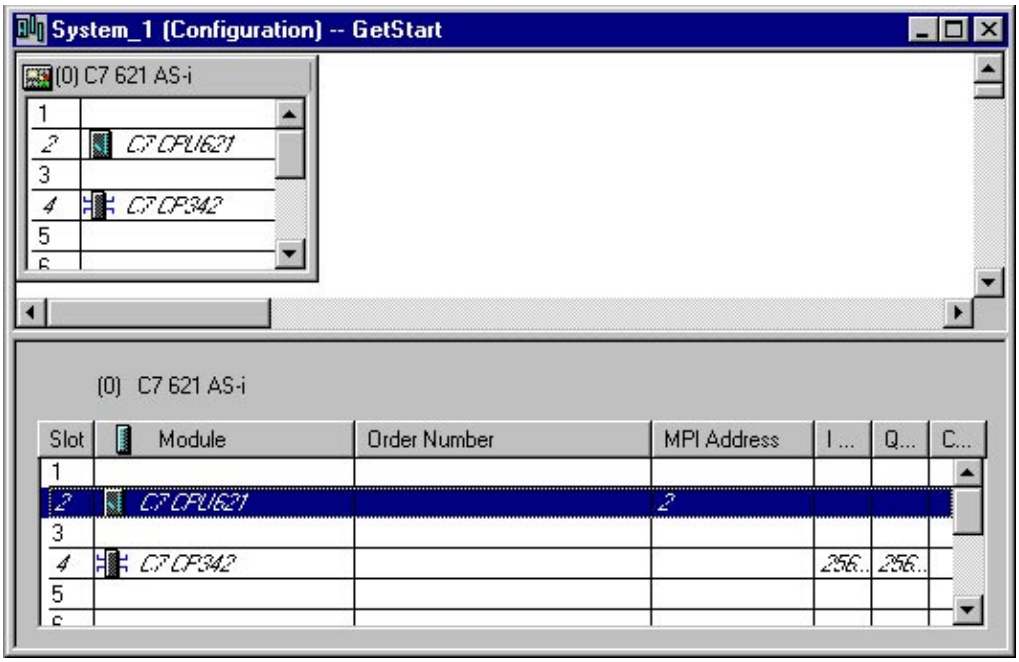
- In the offline data management, open the function FC1. In the LAD/STL/FBD Editor which appears, select the menu item *View* → *Display* → *Symbolic Representation*. The absolute addresses are replaced by the symbolic names.
- Via *View* → *Display* →*Symbolic Information* you can also display the absolute addresses and the comments from the symbol table. The network comments are then no longer visible.

Note
If you want to incorporate new operands during the programming, you can assign symbolic names to individual absolute addresses in the LAD/STL/FBD Editor via *Options* → *Symbol Table.* The entries are automatically inserted in the symbol table.

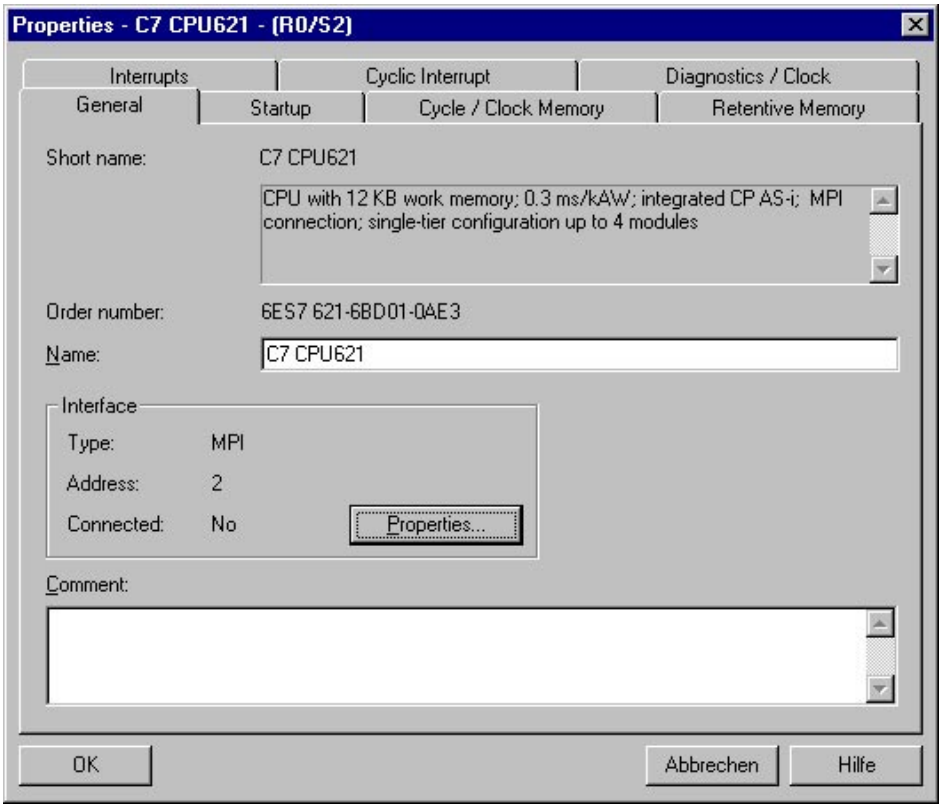
Using the symbolic names in ProTool

Before you can also use the symbolic names in ProTool, you must make some settings.

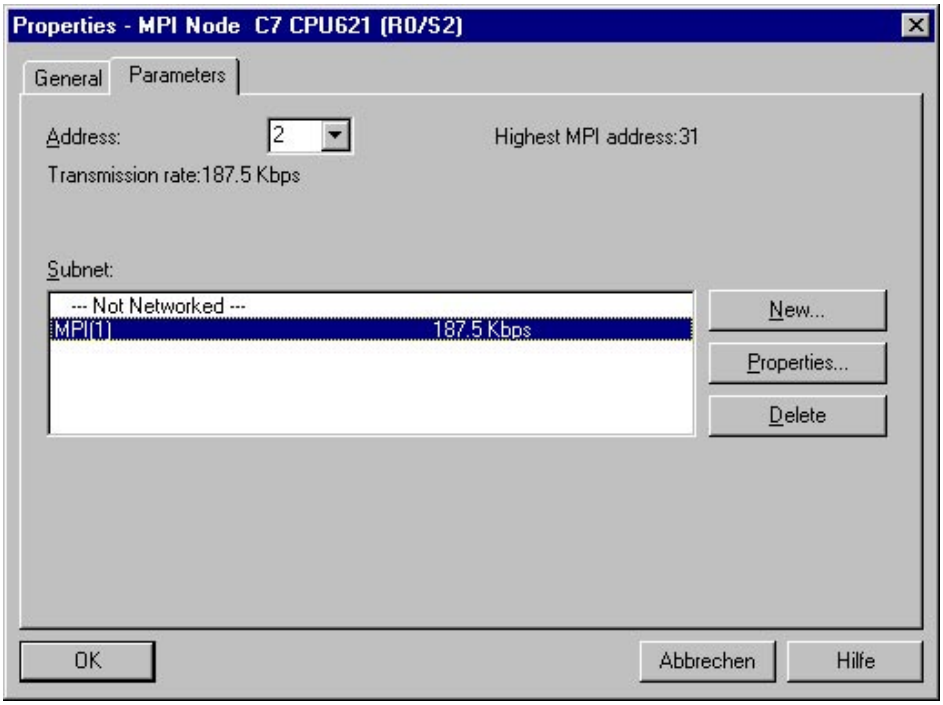
- In the *SIMATIC_Manager* open the *Hardware* folder by double-clicking on it. The Hardware Configuration window is displayed.



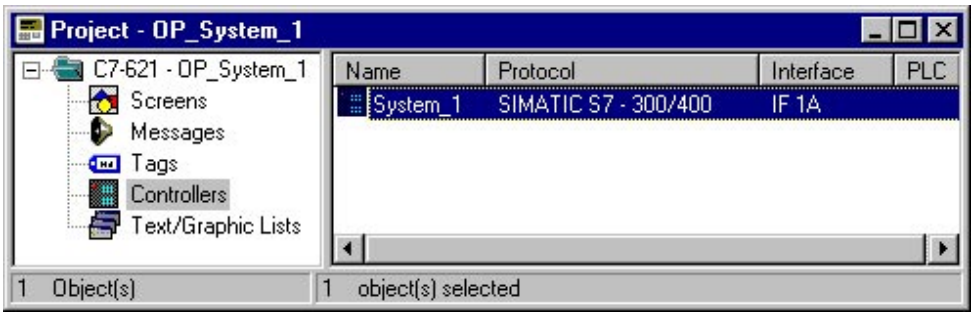
In the Hardware Configuration window, open the dialog window *Properties C7 CPU621* by double-clicking on the symbol *C7 CPU621*.



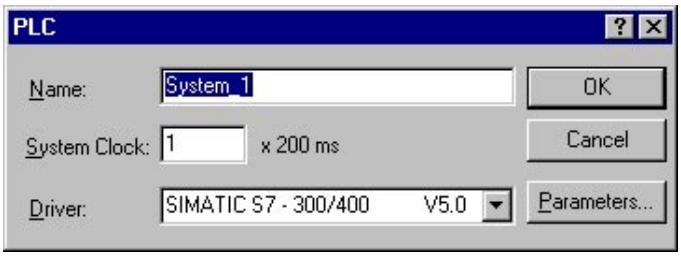
Open the *Properties - MPI Nodes* window by clicking the button *Properties ...*, and select the *Subnet: MPI(1)*. Accept the settings with *OK*, save and compile the hardware configuration, and load it into the C7 CPU again.



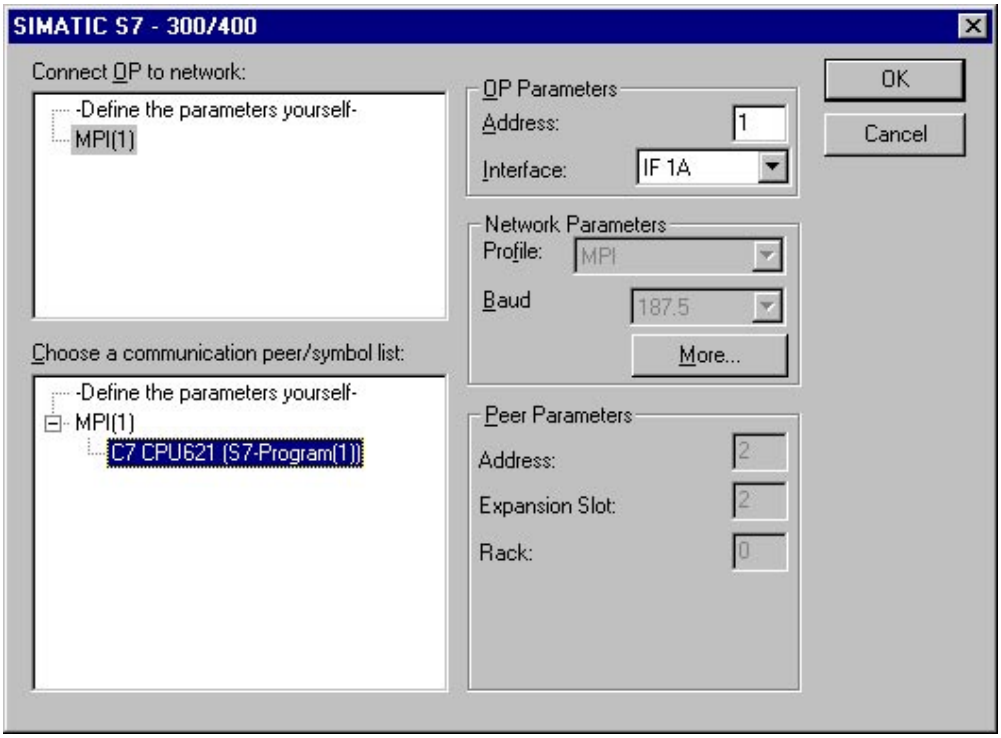
- Now open your C7-621 ProTool configuration and select the folder *Controllers.*



- Open the Controller `System_1` by double-clicking.

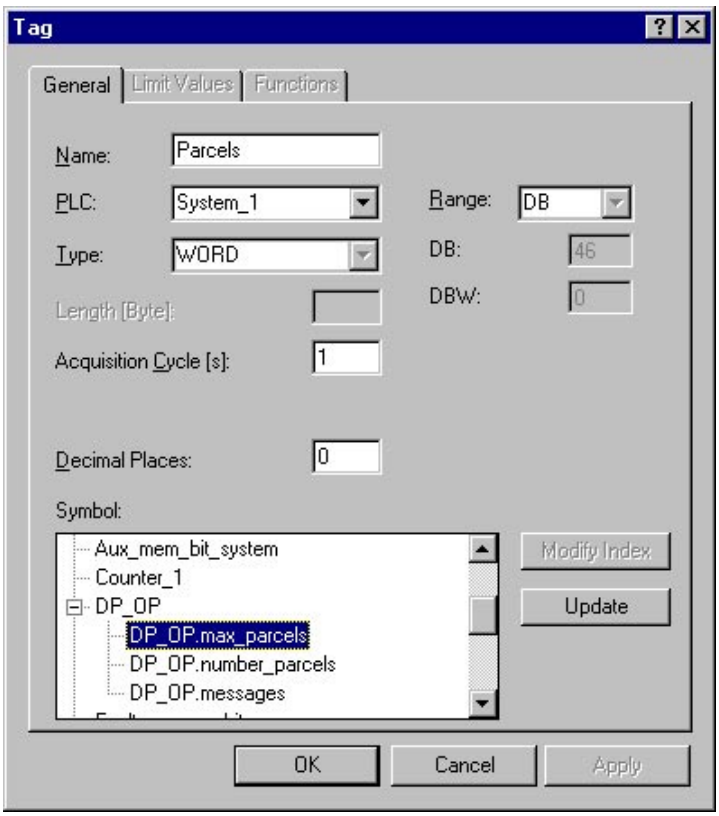


- Click the *Parameters...* button. Select *MPI(1)* under *Connect OP to network. MPI(1)* appears under *Choose a communication peer/symbol list*, *a*nd the network parameters are displayed on a gray background.
- Double-click *MPI(1)* under *Choose a communication peer/symbol list*. The PLC: *C7 CPU621(1)(S7-Program(1))* appears. Select the PLC by double-clicking. Then accept the entries with *OK.*



The initial settings are now complete and you can include the symbolic names in your configuration.

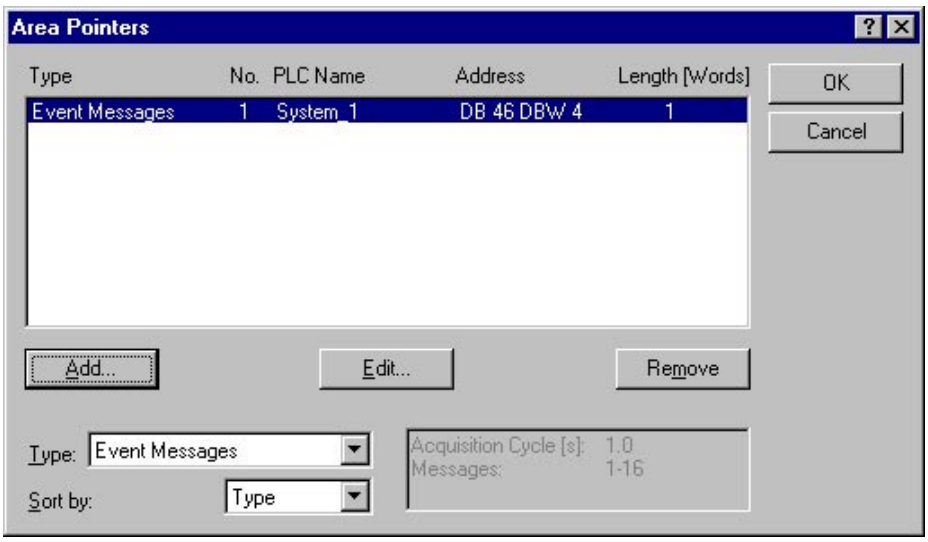
- Open the *Parcels_1* screen, double-click the variable *Parcels* and click the *Edit* button in the *Input/Output field* dialog window. In the dialog window that now appears, the symbolic names are displayed under *Symbol*.
- Select the name `DB_OP.max_parcels` under `DB_OP` in the variable list. The absolute addresses are displayed on a gray background. Confirm the entry with *OK*.



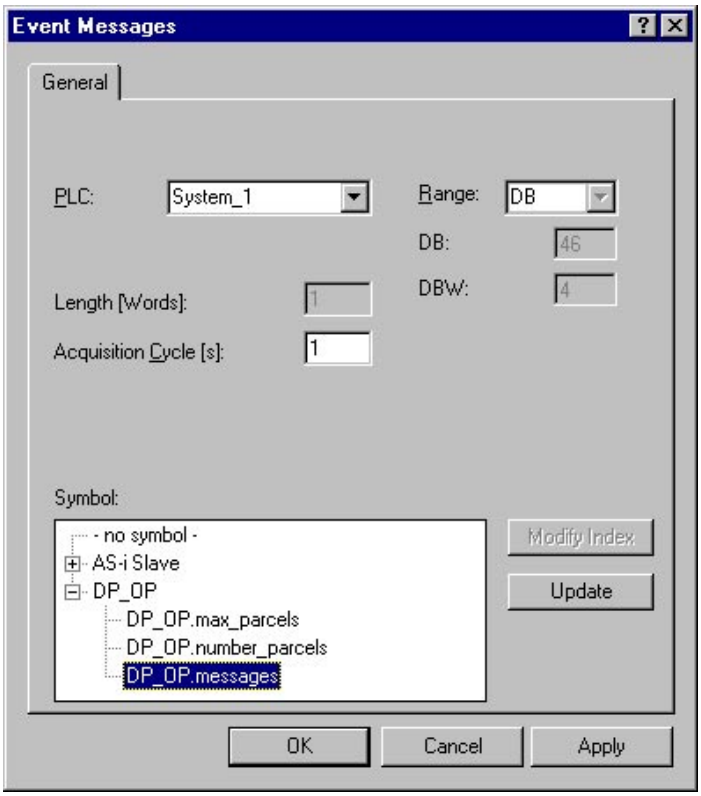
- Repeat the steps for the variable *Number* with the symbolic name DB_OP.number_parcels. Close the window with *OK*.

Now the event messages still have to be given their symbolic names.

- In ProTool, select the *Area Pointers* window via the menu item *System*. In the *Area Pointers* window click on the *Edit...* button.



- In the *Event Messages* window, select the symbolic name `DB_OP.messages` and confirm your entries with *OK*.

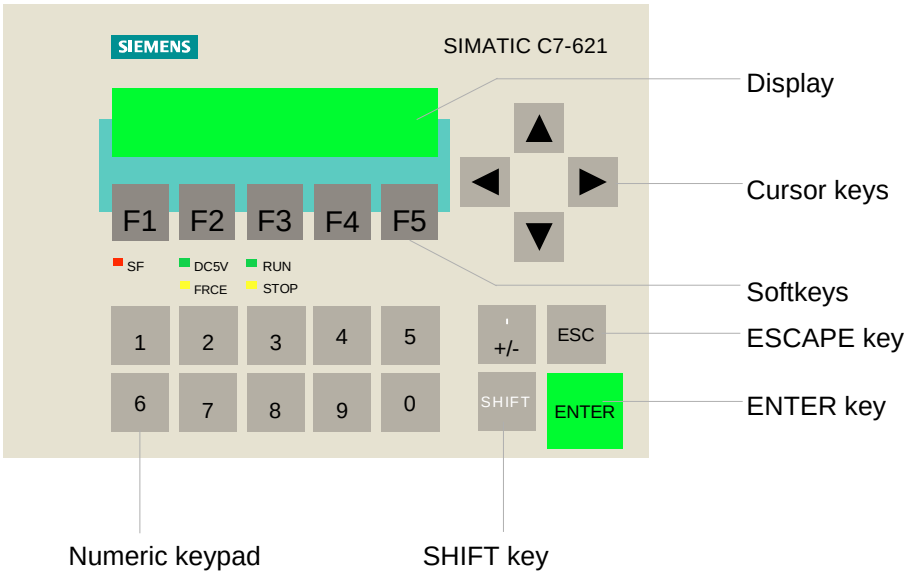


- Save the revised configuration and transfer it back to the C7-OP.

The conversion to symbolic addressing is now complete.

Operating the C7-621-AS-i

To help you operate the C7-621, the most important keys of the C7-621-AS-i are described briefly below.



ESCAPE key

→ ESC takes you from the current level to the superordinate level.

Example: If you press ESC, you quit the system screen `Parcels_1` and return to the start screen `Start_Sys1`. If you press ESC again you will reach the message level.

→ With ESC you can terminate inputs, i.e. the value you have just entered in the input field is discarded.

ENTER key

→ With ENTER you accept entries that have been made, i.e. the value you have entered in the input field is sent to the controller.

Cursor keys

→ With the up and down cursor keys you can page between several screen entries of a screen.

Example: In the screen `Parcels_1` you page down into the second screen entry with the cursor.

Program Example

You have created the following STEP 7 program and put it into operation by following the instructions.

DB1:

Address	Name	Type	Initial Value	Comment
0.0		STRUCT		
+0.0	M1_IN1	BOOL	FALSE	Module_No.1 input_No.1
+0.1	M1_IN2	BOOL	FALSE	Module_No.1 input_No.2
+0.2	M1_IN3	BOOL	FALSE	Module_No.1 input_No.3
+0.3	M1_IN4	BOOL	FALSE	Module_No.1 input_No.4
+0.4	Statusbit_IN0	BOOL	FALSE	reserved
+0.5	Statusbit_IN1	BOOL	FALSE	reserved
+0.6	Statusbit_IN2	BOOL	FALSE	reserved
+0.7	Statusbit_IN3	BOOL	FALSE	reserved
+1.0	M3_IN1	BOOL	FALSE	Module_No.3 input_No.1
+1.1	M3_IN2	BOOL	FALSE	Module_No.3 input_No.2
+1.2	M3_IN3	BOOL	FALSE	Module_No.3 input_No.3
+1.3	M3_IN4	BOOL	FALSE	Module_No.3 input_No.4
+1.4	M2_IN1	BOOL	FALSE	Module_No.2 input_No.1
+1.5	M2_IN2	BOOL	FALSE	Module_No.2 input_No.2
+1.6	M2_IN3	BOOL	FALSE	Module_No.2 input_No.3
+1.7	M2_IN4	BOOL	FALSE	Module_No.2 input_No.4
+2.0	M5_IN1	BOOL	FALSE	Module_No.5 input_No.1
+2.1	M5_IN2	BOOL	FALSE	Module_No.5 input_No.2
+2.2	M5_IN3	BOOL	FALSE	Module_No.5 input_No.3
+2.3	M5_IN4	BOOL	FALSE	Module_No.5 input_No.4
+2.4	M4_IN1	BOOL	FALSE	Module_No.4 input_No.1
+2.5	M4_IN2	BOOL	FALSE	Module_No.4 input_No.2
+2.6	M4_IN3	BOOL	FALSE	Module_No.4 input_No.3
+2.7	M4_IN4	BOOL	FALSE	Module_No.4 input_No.4
+3.0	M7_IN1	BOOL	FALSE	Module_No.7 input_No.1
+3.1	M7_IN2	BOOL	FALSE	Module_No.7 input_No.2

+3.2	M7_IN3	BOOL	FALSE	Module_No.7 input_No.3
+3.3	M7_IN4	BOOL	FALSE	Module_No.7 input_No.4
+3.4	M6_IN1	BOOL	FALSE	Module_No.6 input_No.1
+3.5	M6_IN2	BOOL	FALSE	Module_No.6 input_No.2
+3.6	M6_IN3	BOOL	FALSE	Module_No.6 input_No.3
+3.7	M6_IN4	BOOL	FALSE	Module_No.6 input_No.4
+4.0	M1_OUT1	BOOL	FALSE	Module_No.1 output_No.1
+4.1	M1_OUT2	BOOL	FALSE	Module_No.1 output_No.2
+4.2	M1_OUT3	BOOL	FALSE	Module_No.1 output_No.3
+4.3	M1_OUT4	BOOL	FALSE	Module_No.1 output_No.4
+4.4	Statusbit_OUT0	BOOL	FALSE	reserved
+4.5	Statusbit_OUT1	BOOL	FALSE	reserved
+4.6	Statusbit_OUT2	BOOL	FALSE	reserved
+4.7	Statusbit_OUT3	BOOL	FALSE	reserved
+5.0	M3_OUT1	BOOL	FALSE	Module_No.3 output_No.1
+5.1	M3_OUT2	BOOL	FALSE	Module_No.3 output_No.2
+5.2	M3_OUT3	BOOL	FALSE	Module_No.3 output_No.3
+5.3	M3_OUT4	BOOL	FALSE	Module_No.3 output_No.4
+5.4	M2_OUT1	BOOL	FALSE	Module_No.2 output_No.1
+5.5	M2_OUT2	BOOL	FALSE	Module_No.2 output_No.2
+5.6	M2_OUT3	BOOL	FALSE	Module_No.2 output_No.3
+5.7	M2_OUT4	BOOL	FALSE	Module_No.2 output_No.4
+6.0	M5_OUT1	BOOL	FALSE	Module_No.5 output_No.1
+6.1	M5_OUT2	BOOL	FALSE	Module_No.5 output_No.2
+6.2	M5_OUT3	BOOL	FALSE	Module_No.5 output_No.3
+6.3	M5_OUT4	BOOL	FALSE	Module_No.5 output_No.4
+6.4	M4_OUT1	BOOL	FALSE	Module_No.4 output_No.1
+6.5	M4_OUT2	BOOL	FALSE	Module_No.4 output_No.2
+6.6	M4_OUT3	BOOL	FALSE	Module_No.4 output_No.3
+6.7	M4_OUT4	BOOL	FALSE	Module_No.4 output_No.4
+7.0	M7_OUT1	BOOL	FALSE	Module_No.7 output_No.1
+7.1	M7_OUT2	BOOL	FALSE	Module_No.7 output_No.2
+7.2	M7_OUT3	BOOL	FALSE	Module_No.7 output_No.3
+7.3	M7_OUT4	BOOL	FALSE	Module_No.7 output_No.4
+7.4	M6_OUT1	BOOL	FALSE	Module_No.6 output_No.1
+7.5	M6_OUT2	BOOL	FALSE	Module_No.6 output_No.2
+7.6	M6_OUT3	BOOL	FALSE	Module_No.6 output_No.3
+7.7	M6_OUT4	BOOL	FALSE	Module_No.6 output_No.4
=8.0		END_STR1		

DB46:

Address	Name	Type	Initial Value	Comment
0.0		STRUCT		
+0.0	max_parcels	WORD	W#16#5	
+2.0	number_parcels	WORD	W#16#0	
+4.0	messages	WORD	W#16#0	
=6.0		END_STRUCT		

OB 1:

```
Network 1 : Route process image of AS-i line to DB
OPN   DB1
L     PIW  256
T     DBW    0
L     PIW  258
T     DBW    2

Network 2 : Call system component belt control
CALL  FC 1

Network 3 : Call system component ejector
Call  FC 2

Network 4 : Write outputs
L     DBW    4
T     PQW  256
L     DBW    6
T     PQW  258
BE
```

FC1: Belt control

```
Network 1 : Initial position
 AN     DB1.DBX0.0   // Opto_Bero: no parcel
 AN     DB1.DBX1.0   // Position switch: no parcel
 A      DB1.DBX0.1   // Ejector in initial position
 AN     M16.0        // No fault
 =      M15.0        // Initial position

Network 2 : Belt ON
A      DB1.DBX2.0   // Belt_ON switch on casing
A      M 15.0       // Initial position
S      DB1.DBX4.0   // Conveyor belt ON

Network 3 : Belt OFF
A      DB1.DBX2.3   // Belt_OFF switch on casing
O      M 16.0       // Fault
R      DB1.DBX4.0   // Output Belt_ON
```

```
Network 4 : Operating mode display

A      DB1.DBX4.0   // Belt ON
=      DB1.DBX6.0   // Green lamp on casing
=      M 21.0       // Message flag
```

FC2 : Eject conditions

```
Network 1 : Count

A     DB1.DBX1.0    // Position switch
A     DB1.DBX4.0    // Belt ON
A     DB1.DBX0.1    // Inductive Bero
FP    M30.0         // Rising edge
CV    C1            // Count forward
L     C1            // Transfer count to DB46.DBW2
T     DB46.DBW2
AN    C1            // Count = 0
A     DB1.DBX4.0    // Belt ON
L     C#0           // Write preset count
S     C1            // Initialize counter
L     DB46.DW2      // If the value in DB46.DW2 is greater than
L     DB46.DW0      // the maximum value set, the counter
>I
R     C1            // is reset

Network 2 : Parcel sequence

A     DB1.DBX4.0    // Belt_ON
A     DB1.DBX0.0    // Opto_Bero: parcel
FN    M30.1         // Edge formation
L     S5T#10S       // Parcel interval at least 10 seconds
SE    T5            // Pulse extension
A     T5            // Parcel interval too small
A     DB1.DBX0.0    // Opto_Bero: parcel
FP    M30.2         // Edge formation
S     M21.1         // Fault in parcel sequence

Network 3 : Display: parcel detected

A     DB1.DBX4.0    // Belt ON
A     DB1.DBX0.0    // Opto_Bero
=     DB1.DBX6.2    // Lamp: parcel detected
=     M 21.3        // Message flag

Network 4 : Stop-monitoring

A     DB1.DBX4.0  // Belt ON
A     DB1.DBX1.0  // Parcel at end of belt
L     S5T#5S      // Monitoring time 5 seconds
SD    T3          // ON delay
A     T3
S     M21.2       // Fault in parcel stop
```

```
Network 5 : Faults

O     M21.1       // Fault_parcel sequence
O     M21.2       // Fault_parcel stop
=     M16.0       // Fault

A     M16.0       // Fault
A     M10.4       // Flashing frequency
=     DB1.DBX6.1  // Red lamp on casing

A     DB1.DBX2.1  // Acknowledgment button
R     M21.1       // Fault_parcel sequence
R     M21.2       // Fault_parcel stop

Network 6 : Data interface

L     MW20        // Message flags
T     DB46.DBW4   // Data block CPU_OP
```