SIEMENS

SIMATIC

C7-626 / C7-626 DP Control Systems

Volume 2 Working with C7

Manual

Contents

C79000-G7076-C627-01

Safety Guidelines

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:

Danger

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

Warning

indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.

Caution

indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

Qualified Personnel

The device/system may only be set up and operated in conjunction with this manual.

Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Correct Usage

Note the following:

Warning

This device and its components 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.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

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Disclaimer of Liability

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

Siemens Aktiengesellschaft

C79000-G7076-C627

Contents

1 Introduction

Overview

This chapter will inform you about the prerequisites for programming the C7 and its functionality as an operator interface device.

Note

The C7 consists of two independent units, each with its own processor:
- C7 CPU and
- C7 OP
These components are explicitly named as required.

What do you Require to Operate the C7?

You require the following equipment and tools:

- A programming device or PC with multipoint interface, and a programming device cable
- STEP 7 applications from version 2, including documentation
- The ProTool configuring tool from version 2.10, including documentation
- C7 connector set for I/O and power supply

Summary of Sections

1.1 Controlling with C7

Overview

The user program which controls the process that is to be visualized by the operator interface part of the C7 runs on the C7 CPU.

C7 CPU

The operation of the C7 CPU is determined by the following functional elements:

Program Memory

This contains the user program.

Processor

The processor executes the program cyclically:

- At the beginning of the cycle, the processor reads the signal states of all inputs and generates the process-image input table (PII).
- The program is processed step-by-step, taking into account all counter and timer values and bit memories.
- The processor stores the signal states resulting from program execution in the process-image output table (PIQ). The states are then transferred to the outputs.

The C7 CPU is independent of the C7 OP. It has a separate MPI address and is connected to the C7 OP via the multipoint interface.

Programming Languages

At present, the C7 CPU generally supports two programming languages:

- STL: Statement List consists of a series of statements. Each statement in your program contains instructions which mnemonically represent a function of the C7 CPU.
- LAD: A Ladder diagram is a graphic programming language that resembles electrical circuit diagrams.

Other programming languages are, for example, SCL and HiGraph.

What to Program With

The tool with which you create user programs is STEP 7 for Statement List, Ladder Logic and IDE (Integrated Development Environment). You can find the operation notes necessary for programming in the *User Manual* ***/231/***. Use the manuals listed in the preface for the individual languages.

Which Devices to Use

STEP 7 and C IDE run on a programming device or PC. You can operate these devices independently of the C7. You should connect the programming device/PC to the C7 via the multipoint interface only when you wish to load your user program into the C7.

1.2 Operating and Monitoring with C7

Machine-Type Monitoring and Control

Electronically controlled machines are usually supervised and controlled “on the spot”. Depending on the size and complexity of the machine or system, the requirements for O/I systems differ greatly.

C7 Devices with Graphics

The C7-626 and the C7-626 DP are control systems with graphics capability.

These devices enable you to:

- Visualize processes, machines and systems as semigraphic or full graphic images.
- Intervene in the process flow using the integrated keyboard.

C7 OP

The C7 OP processes the O/I functions configured for the C7. It is independent of the C7 CPU and is still operable, for example, if the C7 CPU is in STOP mode. The C7 OP is assigned a separate MPI address and connected to the C7 CPU via the multipoint interface. This interface forms the link between the C7 OP and the computer used for configuring (programming device/PC).

Displays

“One picture is worth a thousand words” goes the familiar saying.

This is particularly true of machine and system monitoring where it is important to provide the operator with clear and easy-to-understand information about the state of the process.

Process values and process sequences are shown by displays which can contain graphics, texts and values. Process values in a system are often related in some way. Displays show this relationship and thus represent an image of the process.

Full Graphic Plant Screens

The C7 enables you to represent machines and plants as **full graphic screens**. This improves operator orientation.

Bars and Curves

You can show current process values (for example, filling level and speed) as numeric values, or symbolically as text or **bars**.
Curves are a particularly good way of showing changeable process values (for example, changes in temperature) over a period of time.

Symbolic Graphics

Symbolic graphics are another way to indicate process values. Symbolic graphics are graphic elements (that is, bit maps) which are indicated alternately to show different process states (for example, valve open or closed).

Process Manipulation

The operator can use the integrated keyboard in the C7 to intervene in the process sequence.

For example, you can control actuators (for example, valves) by specifying process values (for example, setpoints).

Features important to operator control include ease of handling, short training periods, and a high degree of reliability.

You can configure the structure of the C7 operating environment as required (in other words, you can tailor operator control to your particular application).

A few features:

- Freely configurable function keys
- Softkeys
- Pop-up windows for symbolic entries

Messages

Process or machine states (for example, the current operating mode) are displayed by the C7 as plain-text event messages.

Alarm messages provide information on critical machine states.

Current measured values (for example, temperatures, speeds, etc.) can also be included in the text of event or alarm messages.

Event and alarm messages are stored with date and time in a message buffer. At the same time, all message events can be printed (if message logging is switched on and a printer is connected).

Information Texts

Information texts can be configured. You can use them to give the operator additional information which will help him/her to correct a malfunction.

Recipes

Complete blocks of machine data can be stored as recipes on the C7.

The structure of a recipe is specified during configuration. It makes no difference whether the recipes are “real recipes” or only piece number specifications, traversing paths or temperature progressions.

You can change or redefine recipe data directly on the C7.

Password Protection

The C7 offers password protection. Each operator can be assigned a different password. A password level can then be used to enable or disable each operator’s access to special operating functions. This prevents incorrect entries and improves system security.

Multiple Languages

All messages and texts for screens can be stored in the C7 in up to three different languages.

This permits international use even when operating personnel speak different languages.

Programming Device Functions

The “Status/Force Variable” programming device functions are available for testing and troubleshooting. They can be used on the C7 OP to specify and change address areas in the C7 CPU. This makes on-site troubleshooting fast even without a programmer.

1.3 Overview of C7

The SIMATIC C7-626/C7-626 DP control systems consist of several components that are optimally tuned to one another:

- A CPU from the SIMATIC S7-300 PLC range (C7 CPU)
- A graphic-oriented COROS OP (C7 OP) with printer port
- Integral digital and analog I/O (C7 I/O)
- An integrated IM 360 module (C7 IM) for expanding the C7-626 or C7-626 DP with S7-300 modules
- An interface for communicating with programming devices/PCs and further S7 CPUs, C7 control systems and OPs.
- A DP interface to connect DP slaves.

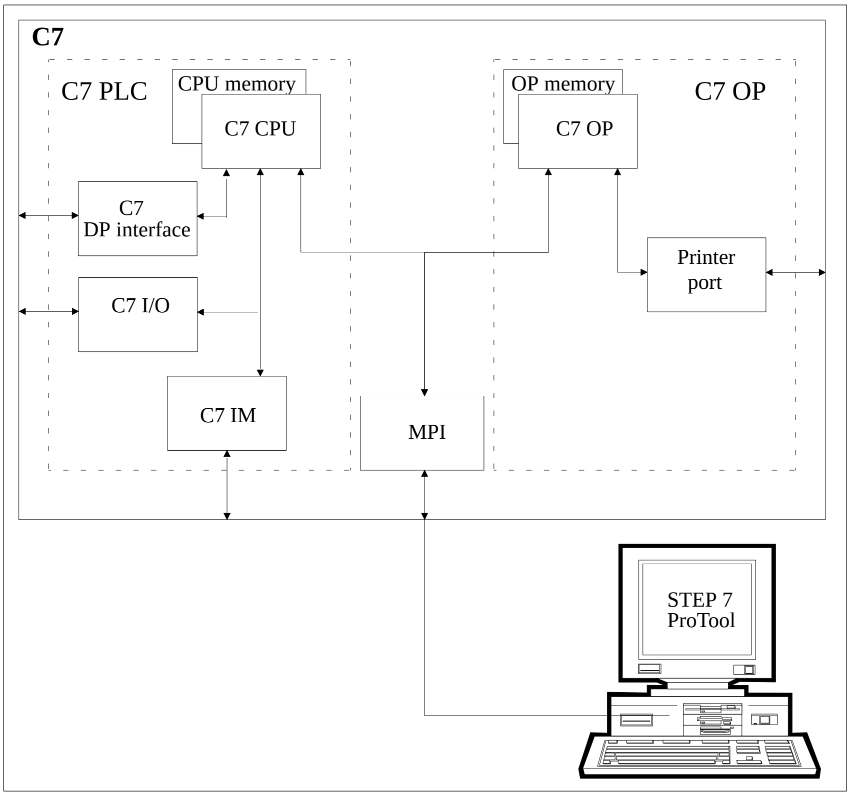

Figure 1-1 Components of the C7

The individual functional units integrated in the SIMATIC C7 correspond to the modules and devices that can be used in modular configurations comprising S7-300 CPUs, COROS OPs, etc. The C7's I/O expansion capability via its IM interface permits the connection of SIMATIC S7-300 modules distributed over three racks with a maximum of 24 S7-300 modules.

The general functionality of the C7 also corresponds to a configuration with standard modules in the PLC and OP ranges. The individual components operate independently of one another and each processor has a separate memory.

STEP 7 is used for programming the C7 CPU whereas the C7 OP is programmed with ProTool. Both tools run under Windows either on programming devices or PCs.

Commissioning (Startup)

2

Overview

In this chapter, you will learn:

- How the C7 behaves on startup
- What you must do if the configuration has (not) been loaded
- How you can activate the C7 CPU operating modes RUN-P, RUN, STOP and MRES
- How you can activate the DI/DO status display
- How you perform a memory reset of the C7 controller

Summary of Sections

2.1 Starting Up

Overview

The following diagram shows the basic steps when starting up:

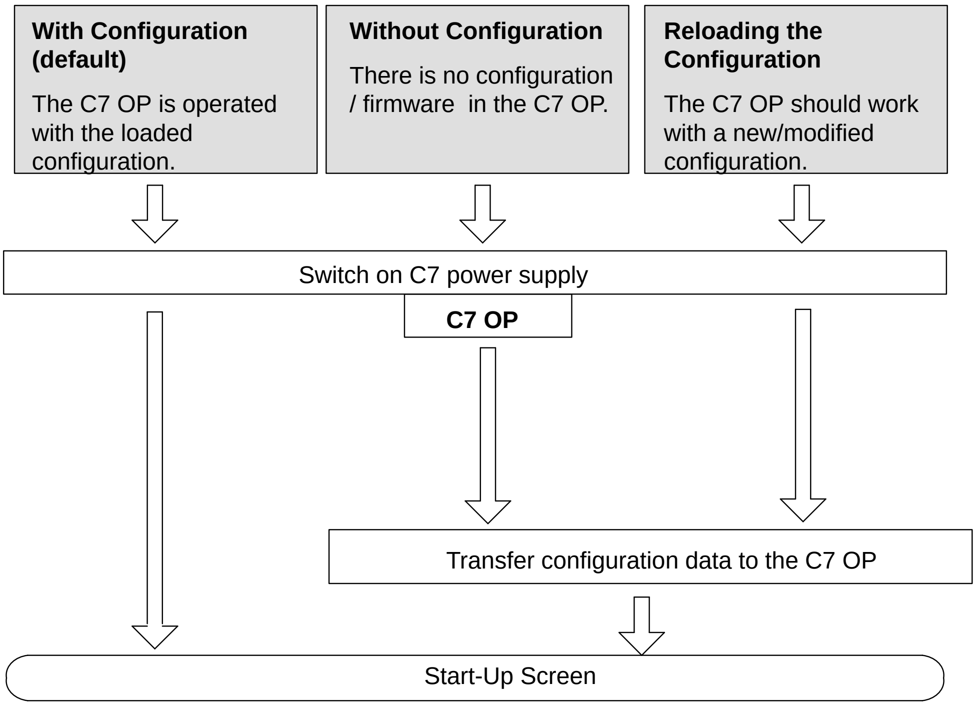

Figure 2-1 Start-Up Process

2.2 With a Loaded Configuration in the C7 OP

Startup

After connecting the power supply, the C7 performs a self-test. During this test, it checks the functionality of the most important device components and shows the test results via the status LEDs and display. The following start-up procedure is carried out:

1. The C7 performs a self-test after power on.
2. If the configuration has not been loaded, a contrast setting is requested. The C7 performs an operating system test for both units (C7 CPU and C7 OP).
3. During the start-up phase (1 and 2), the C7 CPU remains in the STOP mode.

   After the C7 OP has been started up, the following standard screen is displayed:

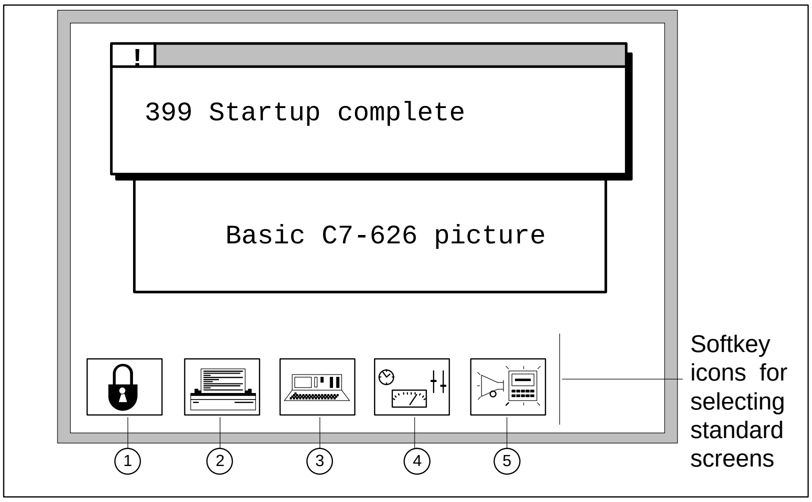

Figure 2-2 Basic C7 Picture (Example)

4. The start-up message displayed can be confirmed by pressing ESC.

Load Control Program

The C7 OP must access data in the C7 CPU in order to operate and monitor the process. Therefore, the user program must first be loaded, if this has not already been done. Load the user program as follows:

1. Transfer the user program and the data blocks on your programming device/PC using STEP 7.
2. Set the C7 CPU to STOP mode (see Section 2.5).
3. Start the copy procedure from the programming device/PC.

2.3 Without a Loaded Configuration in the C7 OP

Overview

There is no configuration loaded on startup. This must, however, be loaded in order to operate the C7 OP, otherwise the operating function “C7 CPU Operating Mode Selection” will not be available. You can only set the C7 CPU operating modes RUN-P, RUN, STOP and MRES on the C7 if a configuration is loaded.

Note

When starting up the C7 without configuration data, you **must** load the configuration data via the V.24 serial interface.

Loading the Configuration

Load the basic configuration so that the explanations in this manual relate to this configuration.

Proceed as follows:

1. Connect the V.24 serial interface of the C7 OP (see Figure 2-8 in Volume 1) to the programming device/PC using a suitable standard cable.
2. Switch on the C7 power supply.

   As no configuration is loaded, the C7 automatically goes into transfer mode and waits for a data transfer.
3. Transfer the basic configuration from the programming device/PC to the C7 OP.

   The firmware of the C7 OP is automatically transferred as well.

Note

The exact procedure is explained in the ProTool description.

After a successful transfer, the C7 OP is restarted.

4. The displayed message can be removed by pressing [ESC].

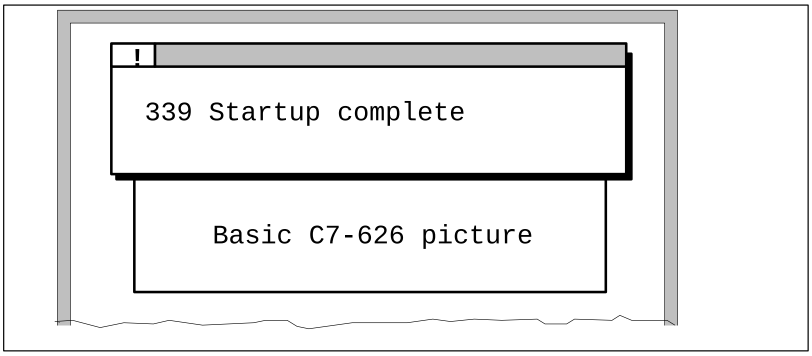

Figure 2-3 Basic C7 Picture with Message 339

2.4 Reloading a Configuration

Overview

There are two ways of loading a configuration onto the C7 OP:

- via the multipoint interface (see Figure 2.9, Volume 1)
- via the V.24 serial interface.

Below, you will find a description of how to replace an existing configuration on the C7 OP with another.

MPI Transfer

C7 OP configurations can be transferred via an MPI connection to the C7 OP.

The only requirement is that the C7 OP must already have a loaded configuration and the MPI transfer function must be configured.

Loading the Configuration

To load the configuration, proceed as follows:

1. Connect the multipoint interface of the C7 to the configuring computer using a programming device/PC cable.

Note

- If the C7 OP and the configuring computer are already included in the MPI bus, then there is no need to change cables when transferring the configuration.

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2. Connect the OP to the power supply.
3. Select MPI transfer in the standard screen *System Settings → Operating Modes.* The C7 OP is now restarted.
4. The following screen is displayed in MPI transfer mode.

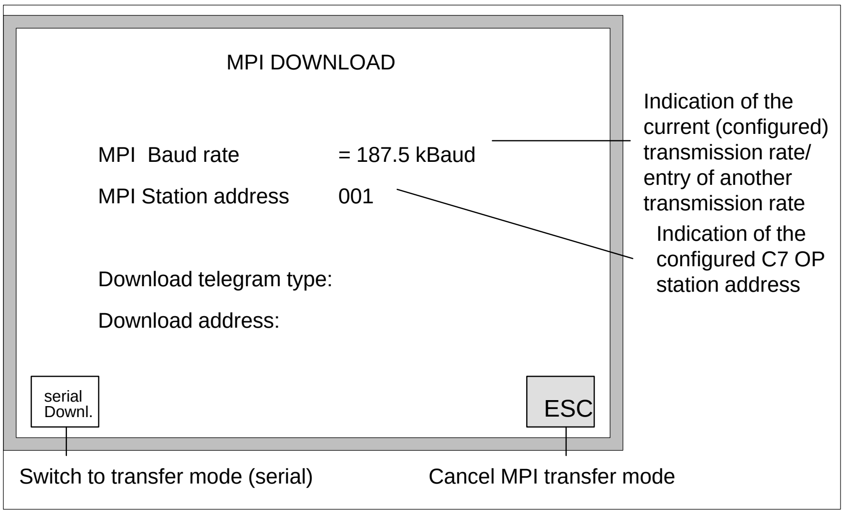


Figure 2-4 MPI Transfer

5. Transfer the configuration from the configuring computer (programming device/PC) to the C7 OP. This procedure is described in the ProTool User's Guide.

Note

The transmission rate is fixed at 187.5 Kbps.

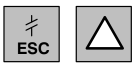
Transferring via a V.24 Interface

With serial transfers, the transfer of the configuration is carried out via a V.24 connection between the programming device/PC and the C7 OP.

Loading the Configuration

To load the configuration, proceed as follows:

1. Connect the V.24 interface of the C7 OP with the configuring computer (programming device/PC) using a suitable standard cable.
2. Switch on the C7 power supply.
3. During startup, press the key combination

   to switch to the transfer mode of the C7 OP.

   In the top line of the display, the following line appears: `Trans-Mode`.
4. Transfer the configuration from the programming device/PC to the C7 OP.

   The existing configuration in the C7 OP will then be overwritten with the new configuration.

   Once the transfer has been successfully completed, the C7 OP will restart and display the start-up screen of the loaded configuration.

2.5 Selecting the C7 CPU Operating Mode and the DI/DO Status Display

System Function Menu

You can select the system function menu from all operating modes. From this menu, the following functions can be selected:

- RUN-P
- RUN
- STOP
- MRES

The DI/DO status bits are displayed as soon as the system function menu has been selected:

Selecting the System Function Menu

You select the menu by pressing  and  simultaneously.

The following menu is displayed:

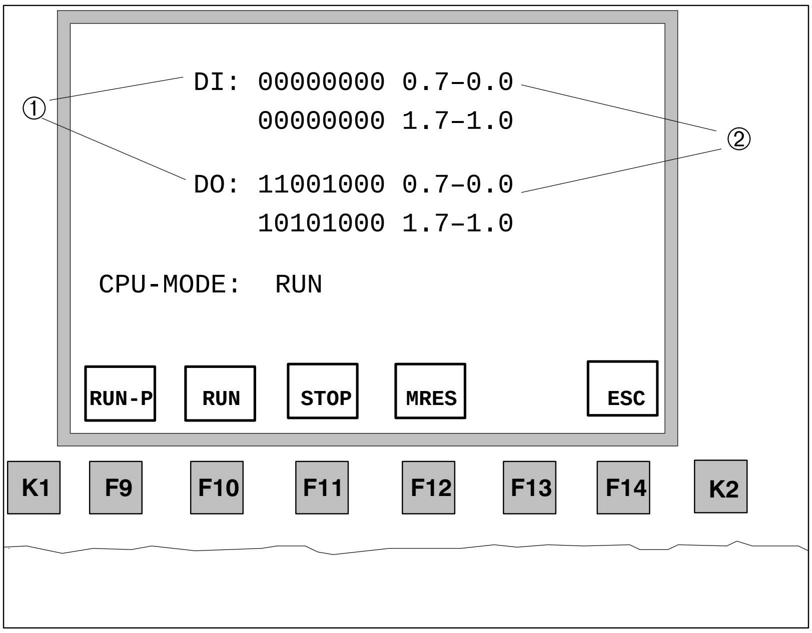


Figure 2-5 System Function Menu with Associated Function Keys

Selecting the C7 CPU Operating Modes

You select the individual C7 CPU operating modes as follows:

Table 2-1 Selecting the C7 CPU Operating Mode

Mode	Keys	Explanation
RUN-P	F9	The C7 CPU processes the user program. Programs and data can be: • Displayed from the C7 CPU with the programming device (C7 → PG) • Transferred to the C7 CPU (PG → C7)
RUN	F10	The C7 CPU processes the user program. Programs and data in the C7 CPU can be displayed using the programming device (C7 → PG). The program cannot be loaded or modified. Data cannot be loaded or modified.
STOP	F11	The C7 CPU is not processing a user program. Programs can be: • Displayed from the C7 CPU using the programming device (C7 → PG) • Transferred to the C7 CPU (PG → C7) **Note:** The operating mode STOP is valid only for the C7 CPU. It is not valid for the C7 OP. Further processing with the C7 OP is possible.
MRES	F12	**Memory reset** Resetting the C7 CPU (erase memory, reload user program from flash memory) requires a special operating sequence of the modes STOP and MRES (see Section 2.3). If data that are required by the configuration are destroyed during the memory reset, then a corresponding error message is issued by the C7 OP. **Note:** The MRES position is not a momentary-contact state, which means that the MRES status persists. For the C7 CPU, the MRES status is only a control mode. When this mode is set permanently, the C7 CPU does not function properly. This mode **must** therefore always be reset prior to exiting the menu with STOP, RUN or RUN-P.

DI/DO Status Display

Table 2-2 explains the status display.

Table 2-3 Explanation of the DI/DO Status Display in Figure 2-5

Point	Explanation
①	Signal state of the DI/DO • 1 DI/DO set • 0 DI/DO reset
②	Pin number from - to (See also pin assignment in Section 2.5 of Volume 1.)

Note

The values of the DI/DO are read and displayed every 500 ms (unless otherwise configured). Changes which occur between these times are not displayed.

Mode Change Protected by Password

To prevent uncontrolled C7 CPU mode changes during process control operations, password protection is activated when a configuration has been loaded. The procedure is as follows:

1. If the C7 CPU mode is to be changed, the active password level is checked (password level >=8 is necessary).
2. If the password level is not sufficient, the *Login* screen for password entry is automatically displayed (see Section 6.7.1).
3. Enter password
   - You can only change the C7 CPU mode with a valid password.
   - If no keys are operated within a time specified in the configuration, an automatic log-off is initiated (reset of the current password level to 0 = lowest level).
   - If a password for level = 8 has not yet been allocated, you can only change the C7 CPU mode by means of the configured superuser password **(default 100)**.
4. If the password has been recognized as valid, you can now change the C7 CPU mode.

Exiting the Operating Mode Menu

You exit the **C7 CPU Operating Modes** menu by pressing
F14 (ESC). The basic screen is then displayed again.

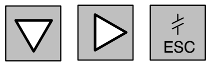
2.6 Resetting the C7

Overview

If you wish to achieve a neutral state of the C7, you must completely erase the C7 CPU and possibly also the C7 OP.

Resetting the C7 OP

The C7 must be switched off. To reset the C7 OP, proceed as follows:

1. Depress and hold the following keys simultaneously 

2. Switch on the C7 power supply.
3. The startup of the C7 OP is delayed and the following message displayed:
   `Press ’DEL’ to erase total intern FLASH!`

   The following procedure is possible:

   – If you confirm this message within the delay time with the DEL key, the memory of the C7 OP will be completely deleted (configuration and OP firmware).

   – If you do **not** confirm the message, nothing is deleted, and the C7 OP will start up as usual and the existing configuration will be started.

If the C7 OP is reset, the configuration can only be loaded via the serial V.24 interface (see Section 2.3).

What Remains after a Memory Reset of the C7 OP?

Resetting the C7 CPU means that the C7 CPU is reinitialized, the current control program is deleted and any user program found in the flash memory of the C7 CPU is reloaded.

- Erase with the C7 system function **C7 CPU Operating Modes**
- Erase with the programming function (see programming device manual)

A reset using the programming device function is only possible when the C7 CPU is in STOP mode.

How to Reset the C7 CPU

The following describes how to clear the C7 CPU with the help of the system function **C7 CPU OperatingModes.**

1. Switch on the power supply to the C7 and wait until the start-up tests have been completed.

The standby message will be displayed.

2. Select the system function menu by pressing the keys  .

   The menu with the **C7 CPU Operating Modes** RUN-P, RUN, STOP, MRES will be displayed.

3. Select the STOP function by pressing the corresponding function keys. The STOP LED lights up.
4. Select the MRES function (memory reset) and wait (approximately three seconds) until the STOP LED lights up again.
5. Immediately after, the STOP LED lights up again: select STOP with the corresponding function keys and then MRES a second time.

   Result:

   – If the STOP LED flashes for approximately three seconds and then lights up again: everything is O.K.; the C7 CPU has been completely reset.

   – If the STOP LED does not flash, or other indicators light up or flash (exception: BATF LED): repeat steps 4 and 5; perhaps evaluate the diagnostic buffer of the C7 using the programming device.

   – If the BATF and the SF LEDs on the C7 light up, the back-up battery is missing. If a back-up battery is indeed fitted, then you must search the diagnostic buffer of the C7 CPU for additional error entries.

6. In order to be able to continue working, you must set the C7 CPU to STOP or RUN / RUN-P.

Note

The contents of the flash memory remain (see also Section 3.10).

Procedure in the C7 CPU During Memory Reset

The STOP LED flashes during the memory reset of the C7 CPU and the following process is carried out:

1. The C7 CPU erases the entire user program in the work memory and in the load memory.
2. The C7 CPU erases the back-up memory.
3. The C7 CPU tests the hardware.
4. If an application is stored in the integrated flash memory of the C7 CPU, its contents will be automatically copied into the load memory and compiled in the work memory (see Section 3.10).

   If no application is stored, then the load memory remains empty and the C7 CPU has the memory content “0”.

What Remains after Resetting the C7 CPU ...

After resetting the C7 CPU, the following items remain:

- The contents of the diagnostic buffer

  The contents can be displayed using the programming device.
- System diagnostic parameters
- Perhaps a user program loaded from the flash memory with reinitialized data
- The MPI parameters last set.

Controlling with the C7 CPU

3

Summary of Sections

3.1 C7 CPU: Overview

Properties of the C7-626

The CPU of the C7-626 has the following characteristics:

- 96 Kbyte work memory
- 160 Kbyte integrated load memory RAM
- 512 Kbyte integrated flash memory
- Integrated IM 360
- Speed: approximately 0.3 ms per 1000 binary instructions
- Maximum 512 digital I/Os connectable
- Maximum 128 analog I/Os connectable
- Back-up battery

Properties of the C7 626 DP

The CPU of the C7-626 DP has the following characteristics:

- 96 Kbyte work memory
- 160 Kbyte integrated load RAM memory
- 512 Kbyte integrated flash memory
- Integrated IM 360
- Speed: approximately 0.3 ms per 1000 binary instructions
- Free addressing
- Additional system status lists for DP
- Maximum 1024 digital I/Os connectable
- Maximum 128 analog I/Os connectable
- Back-up battery

3.2 Programming the C7 CPU

Overview

The user program that controls the process to be visualized on the C7 OP runs on the C7 CPU.

Required Tools

You require the following tools to develop the user program:

- Programming device/PC with multipoint interface and corresponding cable
- STEP 7 with the appropriate manuals
- C7

Programming Languages

Two programming languages are currently relevant to the C7 CPU:

- STL: Statement List consists of a series of statements. Each statement in your program contains instructions which mnemonically represent a function of the C7 CPU.
- LAD: A Ladder diagram is a graphic programming language that resembles electrical circuit diagrams.

Other programming languages are, for example, SCL and HiGraph.

3.3 Performance Characteristics of the C7 CPU

Overview

Table 3-1 lists the most significant performance characteristics of the C7 CPU.

Table 3-1 Performance Characteristics of the C7 CPU

Performance Characteristic	C7 CPU
Load memory Integrated	• 160 Kbyte RAM • 512 Kbyte integrated flash memory
Work memory Integrated	96 Kbytes
Speed	Approx. 0.3 ms per 1000 binary instructions
Digital inputs/outputs	16/16
Analog inputs/outputs	4/1
Universal inputs	4
DP address space	**Only C7-626 DP** • 2 Kbytes with SFC 14 “DPRD_DAT” and SFC 15 “DPWR_DAT” • of which 512 bytes (with load and transfer commands)
Connectable DP slaves	**Only C7-626 DP** 64
Bit memories	2048 From M0.0 to M255.7 Selectable retentivity; Preset: 16 retentive memory bytes (from 0 to 15)
Counters	64 From C0 to C63 Selectable retentivity (memory required: 2 bytes/counter); Preset: 8 retentive counters (from 0 to 7)
Timers	128 From T0 to T127 Selectable retentivity (memory required: 2 bytes/timer); Preset: no retentive timers
Retentive data area	Max. 8 data areas from one or more data blocks Maximum of 4096 retentive data bytes
Maximum total of all retentive data areas	4736 bytes
Clock memory	Memory that can be used in the user program to obtain a clock beat. Number: 8 (1 memory byte); freely selectable address of a memory byte
Local data	Total 1536 bytes 256 bytes for each priority class

Table 3-1 Performance Characteristics of the C7 CPU

Performance Characteristic	C7 CPU
Process image area	From 0 to 127 Digital inputs: from I0.0 to I127.7 Digital outputs: from Q0.0 to Q127.7
Nesting level	8 for each priority class 4 additional within an error OB
Blocks	
OBs	14
FBs	128
FCs	128
DBs	127
SDBs	9
SFCs	37 for C7-626 DP = 40
SFBs	-
Clock	Hardware clock
Run-time meter	1

3.4 C7 CPU Blocks

Overview

Table 3-2 lists all blocks that the C7 CPU can process.

Table 3-2 Overview: C7 CPU Blocks

Block	Number	Range	Maximum Size	Comment
OB	14	-	8 Kbytes	A complete list of all possible OBs can be found at the end of this table.
FB	128	0 - 127	8 Kbytes	-
FC	128	0 - 127	8 Kbytes	-
DB	127	1 - 127	8 Kbytes	0 is reserved
SFC	34	-	-	A complete list of all SFCs in the C7 CPU can be found in Appendix A. A detailed description can be found in the reference manual **/235/** .

Organization Block (OB)

The operating system of the C7 CPU is based on event-controlled user program processing. The following table shows which organization blocks (OBs) are automatically called up by the operating system for which event.

Description of the OBs

A detailed description of the various OBs and their users can be found in the manual **/235/**.

Size of an OB

An OB can have a maximum size of 8 Kbytes.

OBs for Scan Cycle and Startup

Table 3-3 lists the OBs which determine the behavior of the C7 CPU during the scan cycle and startup.

Table 3-3 List of OBs for Scan Cycle and Startup

Scan Cycle and Startup	Activated OB	Possible Start Events	Preset Priority of the OB
Scan cycle	OB1	1101_H, 1103_H	Lowest priority
Startup (STOP-RUN transition)	OB100	1381_H, 1382_H	-

OB for Internal and External Interrupts

Table 3-4 lists OBs which determine the behavior of the C7 CPU after interrupt events.

The priority of the OBs cannot be changed.

Table 3-4 List with C7 CPU Interrupt Events

Interrupts (Internal and External)	Activated OB	Possible Start Events	Priority of the OB	Priority
Time-of-day interrupt	OB10	1111_H	2	Low
Time-delay interrupt Range: 1 ms to 60000 ms (adjustable in 1 ms increments)	OB20	1121_H	3	↓
Cyclic interrupt Range: 1 ms to 60000 ms (adjustable in 1 ms increments) (Default value: 100 ms)	OB35	1136_H	12	
Hardware interrupt	OB40	1141_H	16	
Diagnostic interrupt	OB82	3842_H, 3942_H	26	High

Behavior of the C7 CPU with Missing OB

The C7 CPU reverts to STOP if a

- Time-of-day interrupt
- Time-delay interrupt
- Hardware interrupt
- Diagnostic interrupt

occurs, but the corresponding OB has not been programmed.

The C7 CPU does not revert to STOP if a cyclic interrupt occurs and OB35 has not been programmed.

OB for Error Responses

Table 3-5 lists the OBs which determine the behavior of the C7 CPU in an error situation.

The C7 CPU reverts to STOP if an error occurs, but the corresponding OB has not been programmed.

Table 3-5 List of OBs

Error	Activated OB	Possible Start Events	Preset Priority of the OB
Time error (for example, initiated by the scan cycle time monitor)	OB80	3501_H, 3502_H, 3505_H, 3507_H	26
Power supply error (for example, missing back-up battery)	OB81	3822_H, 3922_H	26
One of the following errors has occurred: • Event that triggers OB start (for example, time-delay interrupt) has occurred but the relevant OB cannot be executed • Error during update of the process image	OB85	$35A1_H$, $39B1_H$, $39B2_H$	26
Failure/return of a node in the PROFIBUS-DP network	OB86	$38E1_H$, $39E2_H$,	26

Table 3-5 List of OBs, continued

Error	Activated OB	Possible Start Events	Preset Priority of the OB
Communications error • Wrong message frame identifier when receiving global data • The data block for the global data status is not available or too short	OB87	$35E1_H$, $35E2_H$, $35E6_H$	26
Programming error (for example, the addressed timer does not exist)	OB121	2521_H, 2522_H, 2523_H, 2524_H, 2525_H, 2526_H, 2527_H, 2528_H, 2529_H, 2530_H, 2531_H, 2532_H, 2533_H, 2534_H, 2535_H, $253A_H$, $253C_H$, $253E_H$	The same priority as the OB in which the error has occurred
Error during direct I/O access (defective or missing module)	OB122	2944_H, 2945_H	The same priority as the OB in which the error has occurred

OB121 and OB122

Please note the following feature of the C7 CPU in connection with OB121 and OB122:

Note

Please note the following feature for OB121 and OB122:

The C7 CPU enters the value “0” in the following temporary variables of the variable declaration table in the local data of the OBs:

- **Byte no. 4**: OB121_BLK_TYPE or OB122_BLK_TYPE (type of block where error occurred)
- **Byte nos. 8 and 9**: OB121_BLK_NUM or OB122_BLK_NUM (number of block where error occurred)
- **Byte nos. 10 and 11**: OB121_PRG_ADDR or OB122_PRG_ADDR (address in block where error occurred)

CPU Behavior with Missing Error OB

If you do not program an error OB, the C7 CPU behaves as follows:

C7 CPU goes to STOP mode with missing...		**C7 CPU remains in RUN mode with missing...**	
OB80	(time error)	OB81	(power supply error)
OB85	(program execution error)		
OB86	(station failure in PROFIBUS-DP network)		
OB87	(communication error)		
OB121	(programming error)		
OB122	(direct I/O access error)		

3

3.5 DP Interface of the C7-626 DP

Overview

This section describes all the data which define the C7-626 DP as a DP master. You need to know these data in order to configure a PROFIBUS-DP network with the C7-626 DP.

Reference Information

You will find descriptions and information about the design and configuration of a PROFIBUS-DP network and diagnostics on the PROFIBUS-DP network in the *STEP 7* on-line help and in the *STEP 7* documentation.

C7-626 DP as a DP Master

Table 3-6 contains important specifications for operating the C7-626 DP as a DP master:

Table 3-6 Important Specifications for Operating the C7-626 DP as a DP Master

Specifications	C7-626 DP as a DP Master	
Transmission rates	9.6 Kbps	1.5 Mbps
	19.2 Kbps	3 Mbps
	93.75 Kbps	6 Mbps
	187.5 Kbps	12 Mbps
	500 Kbps	
The following DP stations (DP slaves) can be connected:	ET 200	
	DP/ASI link	
	PLC 95 DP (DP slave)	
	S5-115U to 155U with IM308C (as DP slave)	
	Field devices to DIN E 19245 Part 3	
Number of addressable slaves	64	

Address Space of the C7-CPU DP

Table 3-7 lists the address spaces and their size for operating the C7-626 DP as a DP master:

Table 3-7 Address Spaces and their Size for Operating the C7-626 DP as a DP Master

Address Space User Data	Size
Unassigned addresses in normal I/O area (P) in process image	Bytes 0 to 1023 Up to 512 bytes via load and transfer instructions Bytes 0 to 128
Total on DP	2 Kbytes with SFC14 “DPRD_DAT” readable and SFC15 “DPWR_DAT” writeable of which 512 bytes via load and transfer instructions
Size of an area for consistent user data	Up to 32 bytes
User data of a station (node)	Input: 122 bytes Output: 122 bytes

3

3.6 C7 CPU Parameters

Configurable Characteristics of the C7 CPU

The characteristics and behavior of the C7 CPU can be assigned parameters.

Parameter blocks of the C7 CPU:

- Clock memory
- Start-up characteristics
- System diagnostics
- Retentive areas
- Hardware interrupt
- Real-time clock
- Time-of-day interrupt
- Cyclic interrupt
- Cycle behavior
- MPI station addresses

Tool for Parameter Assignment

The tool that you use to assign the parameters to the C7 CPU is the STEP 7 function *Hardware Configuration*. Working with *Hardware Configuration* is described in manual **/231/**.

When Does the C7 CPU “Accept” the Parameters?

The C7 CPU accepts the selected parameters

- After power on
- After the parameters have been transferred on-line and error-free to the C7 CPU in STOP mode.
- After erasing the C7 CPU (see Section 2.6)
  If an SDB0 is available in the integrated flash memory, then the stored parameters will be loaded with the exception of the MPI parameters. If no SDB0 is present in the flash memory, then the standard parameters of SDB2 will be set.

Caution

If, after the last storage of the program in the flash memory of the C7, additional parameters are modified (in the RAM), these will be lost the next time the memory is reset, with the exception of the MPI parameters.

3.6.1 Parameter Block “Clock Memory”

Definition: Clock Memory

Clock memories are memories which periodically change their binary states at regular intervals in a pulse-pause ratio 1:1. Eight fixed frequencies are defined for the C7; these can be allocated to any memory byte. The period time can be found in Figure 3-1.

Clock Period Time

Figure 3-1 shows the period times and the corresponding clock frequencies generated by the “clock memory byte”.

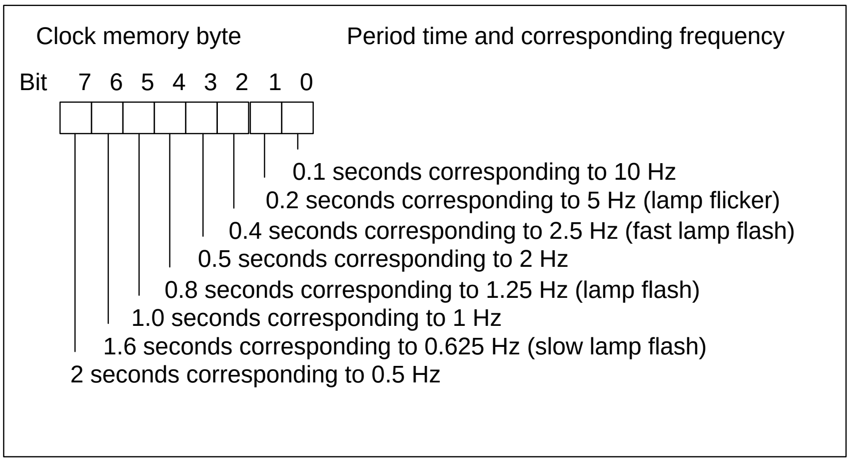


Figure 3-1 Clock Period Times in the “Clock Memory Byte”

Parameter Block “Clock Memory”

Table 3-8 lists the parameters of the parameter block “Clock Memory”.

Table 3-8 Parameter Block “Clock Memory”

Parameter	Explanation	C7 CPU Value Range	Default Setting
Clock memory	For “Clock memory = yes”, a memory byte must be defined	Yes/No	No
Memory byte	Memory byte that should be used for the “clock memory byte”	From 0 to 255	-

3.6.2 Parameter Block “Start-Up Characteristics”

Parameter Block “Start-Up Characteristics”

Table 3-9 lists the parameters of the parameter block “Start-Up Characteristics”.

Table 3-9 Parameter Block “Start-Up Characteristics”

Parameter	Explanation	Value Range	Default Setting
Self-test after power on and reset	For “Self-test on cold restart = yes”, the C7 CPU tests its internal RAM after every power on	Yes/No	Yes
Startup • Manual	Only “Complete restart” can be set for the C7 CPU.	Restart	Restart
Restart • Automatic			
Module time limits • Parameter assignment during startup (in ms)	Maximum time for the “distribution” of the parameters to the modules within the rack	From 1 to 10,000	100
Module time limits • Ready message after power on (in ms)	Maximum time for the ready message of all modules after power on If the modules do not transmit a ready message to the C7 CPU within this time, then the C7 CPU reverts to STOP.	From 1 to 65,000	65000

Tip:

You should assign the highest values to the parameters for the “module time limits” if you are not sure of the required times in the C7.

3.6.3 Parameter Block “System Diagnostics”

Definition: System Diagnostics

System diagnostics perform the acquisition, evaluation and reporting of an error within the programmable controller. The wiring to the process is also included in the system diagnostics so that, for example, “wire breaks” can be recognized by the system diagnostics.

Example

Examples of errors that can be identified, evaluated and reported by the system diagnostics are:

- Errors in the user program
- Failure of hardware modules
- Breaks in wiring to transducers

Parameter Block “System Diagnostics”

Table 3-10 lists the parameters of the parameter block “System Diagnostics”.

Table 3-10 Parameter Block “System Diagnostics”

Parameter	Explanation	Value Range	Default Setting
Extended diagnostic buffer entries	For “Extended diagnostics buffer entries = yes”, the C7 CPU enters not only the error events into the diagnostic buffer but also all OB calls.	Yes/No	No
Transmission of diagnostic messages after reversion to the STOP mode	For “Transmission of diagnostics messages.... = yes”, the C7 CPU transmits the cause of STOP via the multipoint interface to the display system (programming device, OP). This diagnostic message is the “newest” entry in the diagnostic buffer.	Yes/No	Yes

Undetected Errors

Errors that occur in the process, that is outside the automation system, are not detected by the system diagnostics. Such errors are for example “motor failure”. These errors fall within the area of the process error diagnostics.

3.6.4 Parameter Block “Retentive Areas”’

Definition: Retentivity

A memory area is retentive when its contents are retained even after a power failure and a transition from STOP to RUN. The non-retentive areas for the bit memory, timers and counters are reset after a power failure and after a transition STOP - RUN.

The following can be retentive:

- Bit memory
- Timers
- Counters
- Data areas

Retentivity Without Battery Backup

Areas that you declare to be “retentive areas” in the parameter block will be preserved without a back-up battery after a power failure and after a transition from STOP to RUN. The boundary defined for the retentive and non-retentive areas is not influenced by the use of a back-up battery in the C7.

Note

The C7 must always be supplied with a back-up battery.

Retentivity With Data Blocks

All data blocks are retentive. Because of their retentive nature, any new settings made in the data blocks are ineffective while the back-up battery is supplying enough power.

Parameter Block “Retentive Areas”

Table 3-11 lists the parameters of the parameter block “Retentive Areas”. The retentive area for all areas (bit memory, timers, counters and data bytes) may not be larger than for the sum of all the parameters listed in Table 3-11.

3

Table 3-11 Parameter Block “Retentive Areas”

Parameter	Explanation	Value Range C7	Default Setting
Memory bytes	The parameter value entry is the number of retentive memory bytes from memory byte 0	0 to 256	16
Timers	The parameter value entry is the number of retentive S7 timers from timer 0 (space required: 2 bytes/timer)	0 to 128	0
Counters	The parameter value entry is the number of retentive S7 counters from counter 0 (space required: 2 bytes/counter)	0 to 64	8
Data areas • Data block number	Max. 8 data areas may be retentive with a maximum of 4096 bytes. The start address of the data area + the number of data bytes may not exceed 8191.	• From 1 to 127	• 1
• Number of bytes		• From 0 to 4096	• 0
• Byte address (start address of the data area)		• From 0 to 8191	• 0
Sum of all retentive data		4736 bytes	

3.6.5 Parameter Block “Hardware Interrupts”

Parameter Block “Hardware Interrupts”

Table 3-12 lists the parameters of the parameter block “Hardware Interrupts”.

The priority of the hardware interrupt OB40 cannot be altered.

Table 3-12 Parameter Block “Hardware Interrupts”

Parameter	Explanation	Value Range	Default Setting
Priority OB40	The priority of OB40 cannot be altered.	16	16

3.6.6 Parameter Block “Real-Time Clock”

Setting the Time

You set the C7 CPU clock using STEP 7 or via the SFC0 “SET_CLK” in the user program (see Appendix A and reference manual **/235/**).

Parameter Block “Real-Time Clock”

Table 3-13 lists the parameters of the parameter block “Real-Time Clock”.

Table 3-13 Parameter Block “Real-Time Clock”

Parameter	Explanation	Value Range	Default Setting
Synchronization: on C bus	The synchronization of the real-time clock is performed via the C bus.	None as master	None
Synchronization: on the MPI	Not possible	None	None
Synchronization: interval	Interval during which the real-time clock is synchronized.	None Seconds 10 seconds Minute 10 minutes Hour 12 hours 24 hours	None
Correction factor	A deviation of the real-time clock is compensated with the correction factor within 24 hours. Example: if the real-time clock is slow by 4 ms after 24 hours, then you must set a correction factor of “+4 ms”. Example: If the real-time clock is two seconds slow after seven days, the correction factor is to be calculated as follows: 2 seconds : 7 days = 286 ms/day; consequently, you have to set a correction factor of +286.	From - 10000 to + 10000	0

3.6.7 Parameter Block “Time-Of-Day Interrupts”

Overview

The C7 CPU can trigger time-of-day interrupts which you can activate and assign parameters to via the parameter block “Time-Of-Day Interrupts”.

Priority

The priority of OB10 is fixed at 2. You cannot change this value.

Parameter Block “Time-Of-Day Interrupts”

Table 3-14 lists the parameters of the parameter block “Time-Of-Day Interrupts”.

Table 3-14 Parameter Block “Time-Of-Day Interrupts”

Parameter	Explanation	Value Range	Default Setting
Active OB10	Activation of OB10	Yes/No	No
Execution OB10	Here you set the execution intervals in which the time-of-day interrupt should be triggered. The execution interval refers to the start date and the start time setting.	None Once only Every minute Every hour Every day Every week Every month Every year	None
Start date OB10	The start date on which the time-of-day interrupt should be triggered.	-	1994-01-01
Start time OB10	The start time at which the time-of-day interrupt should be triggered. The start time can only be entered in hours and minutes.	-	00:00:00

3.6.8 Parameter Block “Cyclic Interrupts”

Overview

A cyclic interrupt is a periodic signal that the C7 CPU generates internally and leads to the automatic call-up of a “cyclic interrupt OB” (OB35).

Priority

The priority of OB35 is fixed at 12. You cannot change this value.

Parameter Block “Cyclic Interrupts”

Table 3-15 lists the parameters of the parameter block “Cyclic Interrupts”.

Table 3-15 Parameter Block “Cyclic Interrupts”

Parameter	Explanation	Value Range	Default Setting
Periodicity of OB35 (in ms)	Call-up interval of OB35	From 1 to 60000	100

3.6.9 Parameter Block “Cycle Behavior”

Parameter Block “Cycle Behavior”

Table 3-16 list the parameters of the parameter block “Cycle Behavior”.

Table 3-16 Parameter Block “Cycle Behavior”

Parameter	Explanation	Value Range	Default Setting
Cycle loading due to communication (via the MPI) (in %)	To limit the extent of “slowing down” program processing due to communications processes, you can define the maximum percentage of cycle loading. The communication between C7 CPU and programming device or between communicating C7 CPUs can slow down due to the cycle loading limit. Operating system services such as the collection and provision of data for the communication will not be influenced. Functions that require continuous reading of data “slow down” program execution irrespective of the value set for this parameter. Example: block status, displaying system data (*STEP 7*).	From 5 to 50	20
Maximum scan cycle time (in ms)	If the scan cycle time exceeds the “maximum scan cycle time”, then the C7 CPU reverts to STOP mode if no OB80 is loaded for error handling. The maximum scan cycle time can be exceeded due to: • communications processes • accumulation of interrupt events • errors in the user program (for example, “continuous loops”)	From 1 to 6000	150
Cycle loading due to self-test (in s)	For “Cyclic self-test $\neq$ 0”, the C7 CPU tests its internal RAM during the program cycle. This self-test consumes cycle time. You can define the time by which the program cycle may be lengthened in multiples of 10 μs (“0” = no cyclic self-test).	From 0 to 65000	0

3.6.10 Parameter Block “MPI Addresses”

Multipoint Interface (MPI)

The characteristics of the multipoint interface (MPI) of the C7 CPU can be assigned parameters with the parameter block “MPI addresses”. You need only process this parameter block if several C7 or S7/M7 devices are networked via the multipoint interface.

Values after Memory Reset

The parameters of the parameter block “MPI Addresses” have a special feature: the parameter values are preserved even after a memory reset. Reason: the communications ability of an “erased” C7 CPU must be preserved even after a memory reset.

C7 MPI Addresses

The C7 occupies two MPI addresses:

- One for the C7 CPU (default address 2)
- One for C7 OP (default address 1)

Parameter Block “MPI Addresses”

Table 3-17 lists the parameters of the parameter block “MPI Addresses”.

Table 3-17 Parameter Block “MPI Addresses”

Parameter	Explanation	Value Range	Default Setting
Highest MPI address	The definition of the highest MPI address in the network is necessary in order that: • Every (network) station can be addressed • The communications process operates effectively Note: assign only as many MPI addresses as are necessary. You will then reduce the communication times. The “highest MPI address” must be the same for all MPI nodes.	15 31 63 126	15
C7 CPU MPI address	Each station that is networked via the MPI must possess an address. The specified address may only be allocated once in the network. The C7 OP has its own MPI address (default = 1).	From 2 to 126	2 1

Note

The MPI is the only communications interface of the C7. Parameters should only be modified with utmost care.

3.7 Calculating the Scan Cycle Time and Response Time of the C7 CPU

Overview

This section explains how the scan cycle and response times of a user program are structured.

Use the programming device to read the scan cycle time of the user program on the C7 CPU (see programming manual **/280/**).

An example is used to show you how to calculate the scan cycle time.

The response time is of greater interest, however. This section includes a detailed description of how to calculate the response time. If you use the C7-DP CPU as a master in the PROFIBUS-DP network, you must also take into account bus processing times.

Definition: Scan Cycle Time

The scan cycle time is the time that passes during a program cycle.

Elements of the Scan Cycle Time

The scan cycle time comprises the following elements:

- Process-image transfer time (PII and PIQ)
- Operating system execution time
- User program execution time
- Communication via the multipoint interface

Figure 3-2 shows the elements of the scan cycle time.

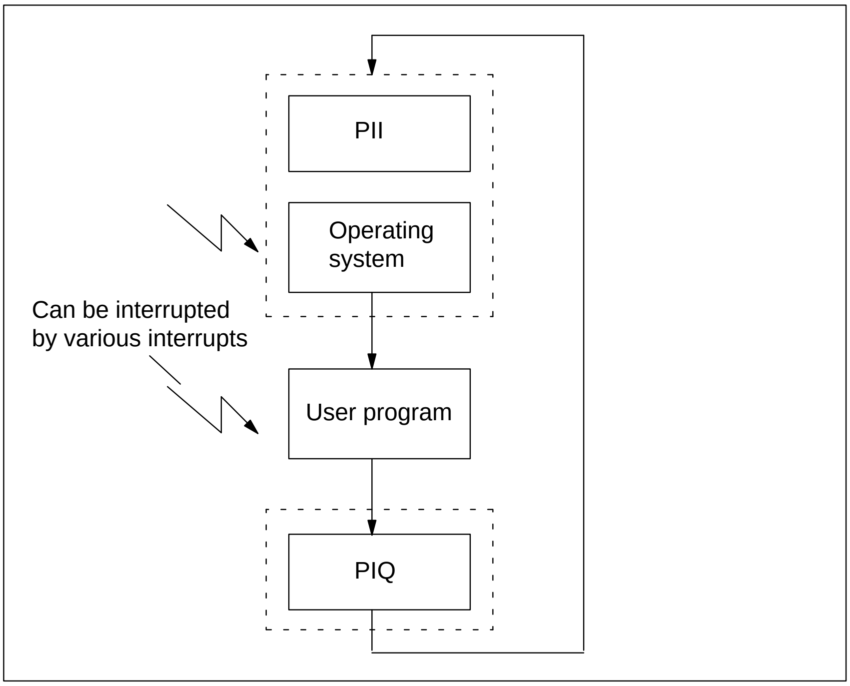


Figure 3-2 Elements of the Scan Cycle Time

Definition: Response Time

The response time is the time that elapses between the recognition of an input signal and the change to the associated output signal.

Factors

The response time is dependent upon the following factors:

- Process-image transfer time
- Operating system time
- User program execution time
- Communication via the MPI
- Input and output delay times
- Additional bus processing times in the PROFIBUS-DP network (only C7 DP CPU).

Variation Range

The actual response time lies between the shortest and the longest response time. During the configuration of your system, you must always assume the longest response time.

The shortest and longest response times will be considered below, so that you can form a picture of the variation range of the response time.

Shortest Response Time

Figure 3-3 illustrates the conditions for the shortest response time.

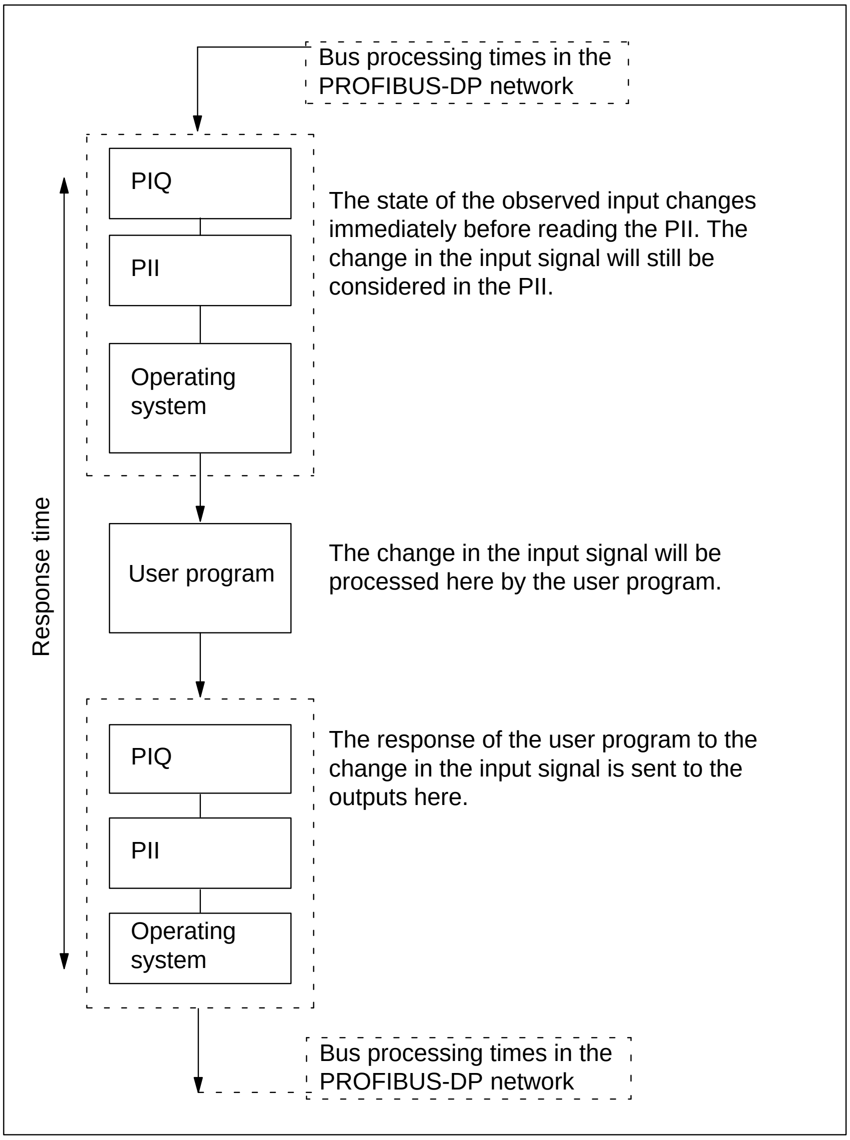


Figure 3-3 Shortest Response Time

Calculation

The (shortest) response time can be calculated as follows:

- 1 x process input image transfer time +
- 1 x operating system execution time +
- 1 x program execution time +
- 1 x process output image transfer time +
- Processing time for S7 timers+
- Input and output delay times

The input delays are not marked in the diagram. Depending on the module, however, you have to take into account the following delay times:

- For digital inputs: input delay time
- For digital outputs: negligible delay times
- For analog inputs: scan cycle time of the analog input
- For analog outputs: response time of the analog output

Longest Response Time

Figure 3-4 illustrates the conditions for the longest response time:

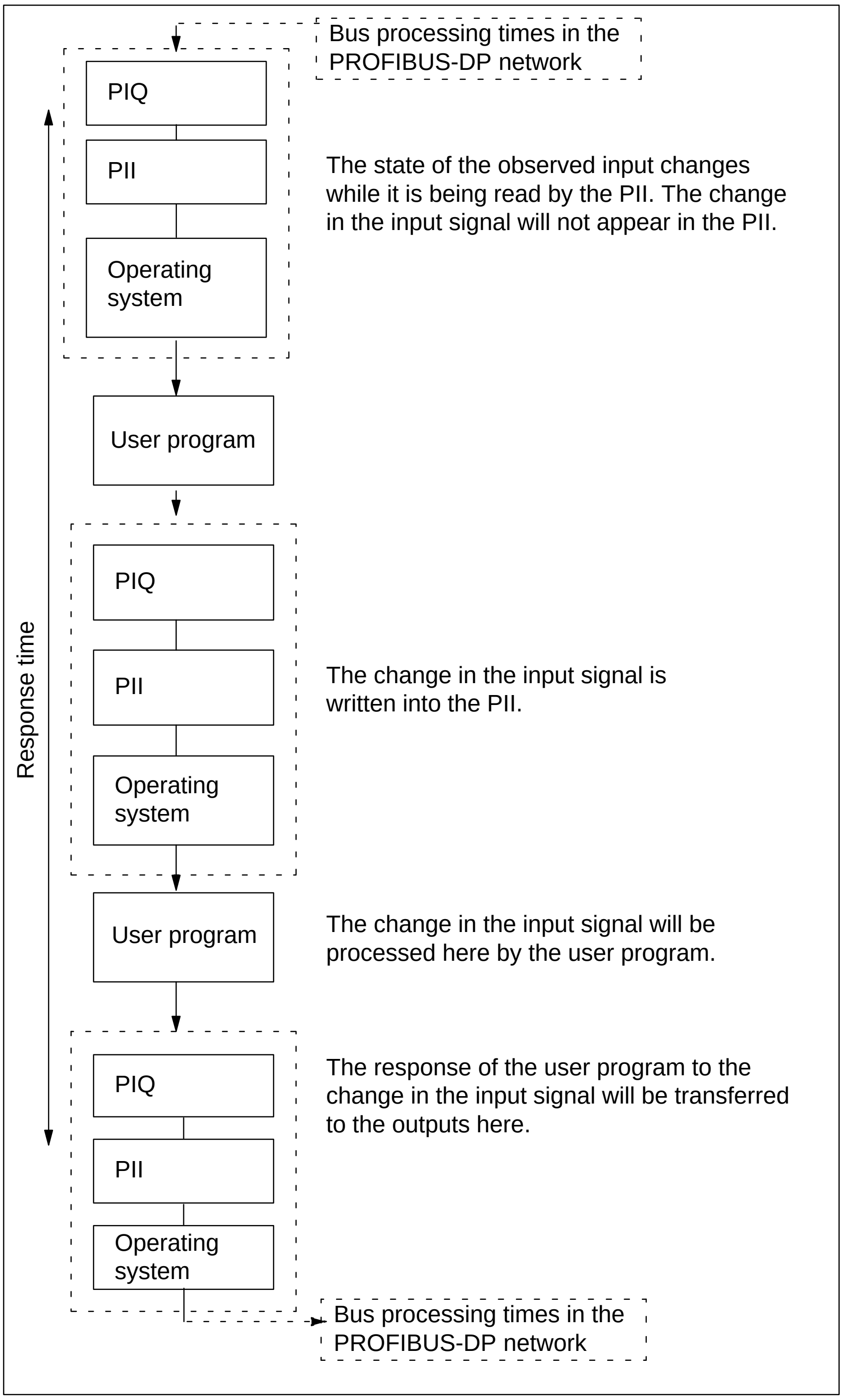


Figure 3-4 Longest Response Time

Calculation

The (longest) response time can be calculated as follows:

- 2 x process input image transfer time +
- 2 x process output image transfer time +
- 2 x operating system execution time +
- 2 x program execution time +
- Processing time for S7 timers +
- Input and output delay times

The input delays are not marked in the diagram. Depending on the module, however, you have to take into account the following delay times:

- For digital inputs: input delay time
- For digital outputs: negligible delay times
- For analog inputs: scan cycle time of the analog input
- For analog outputs: response time of the analog output

Extending the Scan Cycle Time

As a rule, you should remember that the scan cycle time of a user program will be increased by:

- Time-controlled processing
- Hardware interrupt processing
- Diagnostics and error processing
- Communication via the multipoint interface

Reducing the Response Time

You will achieve faster response times by means of direct access to the I/Os in the user program, for example, with L PIB or T PQW. This method helps you avoid prolonged scan cycle times, as described in Figure 3-4.

Operating System Execution Time

The operating system execution time is caused by various sequences in the C7 CPU.

System Execution Times

Table 3-18 lists all times relevant for determining the operating system execution times of the C7 CPU.

Table 3-18 Operating System Execution Times of the C7 CPU

Task	C7 CPU
Cycle control	Approximately 870 µs
Communication via the multipoint interface	Block functions (load/delete/copy) extend the cycle by up to 10 %. Communication via the MPI may load the cycle by up to 50 %, depending on the parameter assignment in STEP 7 (see Section 3.6.9).
Updating the S7 timers	7 µs x number of timers currently running
C7 CPU self-test	From 0 to 65,000 µs; depending on parameter assignment (see Section 3.6.9)
Rack monitoring	Per rack: 50 µs

Process Image Update

Table 3-19 contains the C7 CPU times that are applicable to the process image update. The quoted figures are “ideal values”, which can be increased by interrupts or communications via the multipoint interface of the C7 CPU.

Table 3-19 Process Image Update of the C7 CPU

I/O Configuration	Process Image Update Times
1 C7 (16 bytes)	PII: approx. 0.3 ms PIQ: approx.0.27 ms
C7 + 3 racks (64 bytes)	PII: approx. 1.4 ms PIQ: approx. 1.2 ms
C7 + 3 racks (128 bytes = max. configuration)	PII: approx. 1.7 ms PIQ: approx. 1.4 ms

3.7.1 Calculation Example for the Scan Cycle Time

Components of the Scan Cycle Time

To recap: The scan cycle time consists of the following:

- Process-image transfer time
- Operating system execution time
- User program execution time
- Processing time for S7 timers

Example

The user program in the C7 CPU has an execution time of 1.5 ms. Your user program uses four S7 timers.

In the parameter assignment of the C7 CPU, you have deactivated the C7 CPU self-test and, since the C7 CPU is a stand-alone unit, the cycle is not loaded with communication tasks.

Calculation

In the example, the scan cycle time is calculated from the following times:

- Process image transfer time
  - Process-image input table: approx. **0.2 ms**
  - Process-image output table: approx **0.15 ms**
- Operating system execution time
  - Cycle control: approx. **0.87 ms**
  - Rack monitoring: approx. **0.05 ms**
- User program execution time: approx. **1.5 ms**
- Processing time for S7 timers

  For four S7 timers, the single update takes

  4 x 7 us = 28 us = 0.03 ms. Adding the process-image transfer time, the operating system execution time and the user program execution time yields the time interval:

  0.2 ms + 0.15 ms + 0.87 ms + 0.05 ms + 1.5 ms = 2.77 ms. This time interval prolongs the execution time of the S7 timers:

$$Execution\ time\ of\ S7\ timers = \left(1 + \frac{2.77\ ms}{10\ ms}\right) \times 0.03\ ms\ =\ 0.04\ ms$$

The scan cycle time is the sum of the times listed:

Cycle time = 0.2 ms + 0.15 ms + 0.87 ms + 0.04 ms + 1.5 ms ≈ **2.8 ms.**

3.7.2 Calculation Example for the Response Time

Response Time

To recap, the response time is a total of :

- 2 x process input image transfer time +
- 2 x process output image transfer time +
- 2 x operating system execution time +
- 2 x program execution time +
- Processing time for S7 timers +
- Input and output delay times

Example

It is based on a C7 control system including I/O.

CPU Parameters

These are based on the data from the calculation example for the scan cycle time.

Calculation

The response time for the example is as follows:

- Process-image transfer time
  - Process input image (PII): approx. **0.85 ms**
  - Process output image (PIQ): approx. **0.6 ms**
- Operating system execution time
  - Cycle control: **0.87 ms**
  - Rack monitoring: approx. **0.1 ms**
  - CPU self-test: **0.5 ms**
- User program execution time: **2.6 ms**
- **1st subtotal:** As a time basis for calculating the
  - Execution time for the timers and the
  - Cycle load due to communication

  the sum of all the times listed below is valid:

2 x 0.8 ms	(Process input image transfer time)
+ 2 x 0.6 ms	(Process output image transfer time)
+ 2 x (0.87 ms+0.1 ms+0.5 ms)	(Operating system execution time)
+ 2 x 2.6 ms	(User program execution time)
≈ **11 ms**	

- Execution time for the S7 timers

  For 32 S7 timers, the single update takes 32 × 7 μs ≈ 0.22 ms.
  The execution time for the S7 timers is calculated as follows:

$$Execution\ time\ of\ S7\ timers = \left(1 + \frac{4.04\ ms}{10\ ms}\right) \times 0.03\ ms\ \approx\ 0.04\ ms$$

- Cycle load due to communication 20 %

  The time base is the 11 ms calculated above. 20% of this is **2.2 ms**.

- **2nd subtotal:** The response time **not including** the delay times of the inputs and outputs is calculated from the total of:

11 ms	(Result of the first subtotal)
+ 0.5 ms	(Execution time for S7 timers)
+ 2.2 ms	(Cycle load due to communication)
= **13.7 ms ≈ 14 ms**	

- Input and output delay times
  - The digital input SM321; DI 16 x 24 VDC has an input delay of max. **4.8 ms** per channel
  - The delay time of the digital output of the C7 can be neglected.
  - The analog input of the C7 has a resolution of 12 bits. The conversion time per channel is approximately 0.5 ms. All four channels are supposed to be active. Calibration measurement must be enabled. The cycle time is thus **2.5 ms**.
  - The analog output of the C7 has a conversion time of **0.8 ms** per channel. A settling time for the ohmic load of 0.1 ms must be added to this. This yields a response time for the analog output of **0.9 ms**.
- Response times with delay times of the inputs and outputs:
- **Case 1:** An output channel is enabled when a digital input signal is read in. The response time is:

  Response time = 4.8 ms + 5 ms = 9.8 ms ≈ **10 ms**

- **Case 2:** An analog value is read in and an analog value is output. The response time is:

  Response time = 2.5 ms + 5 ms + 0.9 ms = 3.9 ms ≈ **4 ms**

3.7.3 Hardware Interrupt Response Time

Hardware Interrupt Response Time

The hardware interrupt response time is the time that elapses between the first occurrence of a hardware interrupt signal and the calling of the first instruction in the hardware interrupt OB (OB40).

In general, higher-priority interrupts take precedence. That means the hardware interrupt response time is increased by the program execution time of the higher-priority hardware interrupt OBs and hardware interrupt OBs of the same priority which have not yet been processed.

Calculation

The hardware interrupt response time is calculated as follows:

Hardware interrupt response time = hardware interrupt response time of the C7 CPU + hardware interrupt response time of the signal module.

C7 CPU

The hardware interrupt response time of the C7 CPU is approx. 1.1 ms.

Signal Modules

The hardware interrupt response time of the signal modules is calculated as follows:

- Digital input modules

  Hardware interrupt response time = Internal interrupt preparation time + input delay

  The times are listed in the data sheet for the respective digital input module

- Analog input modules

  Hardware interrupt response time = Internal interrupt preparation time + conversion time

  The internal interrupt preparation time of the analog input modules can be neglected. Please refer to the data sheet of the respective analog input module for conversion times.

Interrupt Handling

Hardware interrupt processing begins when the hardware interrupt OB (OB40) is called. Higher-priority interrupts cause the hardware interrupt processing to be interrupted. Direct access to the I/O is made when the instruction is processed. When the hardware interrupt processing has finished, either cyclic program execution continues or further interrupt OBs of higher priority or the same priority are called up and executed.

Calculation Example

To recap, the hardware interrupt response time consists of:

- The hardware interrupt response time of the CPU
- The hardware interrupt response time of the signal module.

Example: In the example, the C7 I/O is to be used exclusively.

Calculation

For the example, the hardware interrupt response time is calculated from the following times:

- Hardware interrupt response time of the C7 CPU: approx. 1.1 ms
- Hardware interrupt response time of the module:
  - Internal interrupt preparation time: 0.2 ms
  - Input delay: 0.1 ms

The hardware interrupt response time is calculated from the sum of the times below:

Hardware interrupt response time = 1.1 ms + 0.2 ms + 0.1 ms = **approx. 1.4 ms**.

This hardware interrupt response time elapses from the time a signal is present at the digital input until the first instruction in OB40 is processed.

3.7.4 Diagnostic Interrupt Response Time

Diagnostic Interrupt Response Time

The diagnostic interrupt response time is the time that elapses between the first occurrence of a diagnostic interrupt signal and the calling of the first instruction in the diagnostic interrupt OB (OB82).

In general, higher-priority interrupts take precedence. That means the diagnostic interrupt response time is increased by the program execution time of the higher-priority interrupt OBs and interrupt OBs of the same priority which have not yet been processed.

Calculation

The diagnostic interrupt response time is calculated as follows:

Diagnostic interrupt response time = Diagnostic interrupt response time of the C7 CPU + diagnostic interrupt response time of the signal module.

For C7: 0.6 ms

C7 CPU

The diagnostic interrupt response time of the C7 CPU is approximately 1.3 ms.

Calculation Example

1.3ms + 0.6ms = 1.9ms ≈ **2 ms**

3.8 Bus Processing Times in the PROFIBUS-DP Network

Introduction

In a PROFIBUS-DP network, the response times are composed of several components:

- The response time of the DP master
- The bus processing time in the PROFIBUS-DP network
- The response time of the DP slave

Overview

This section describes the main information about the bus processing times in the PROFIBUS-DP network.

The description in this section refers to the operation of the C7-DP CPU as a master in the PROFIBUS-DP network.

The bus processing times are always dependent on the number of slaves, the transmission rate and the number of RS 485 repeaters.

You can use a programming device to display the bus processing time in your PROFIBUS-DP network (see *STEP 7* documentation). An example is used to show you how to estimate the bus processing time without a programming device.

To calculate the response time of the C7-DP CPU as a master, please read Sections 3.7 to 3.7.4.

To calculate the response times of a DP slave, please read the documentation for the corresponding DP slave.

3.8.1 Components of the Response Time with the C7-DP CPU as DP Master

Response Times within PROFIBUS DP

Figure 3-5 shows the components of the response time in a PROFIBUS-DP network. These times together produce the average response time which elapses between a change in state on an input and the associated change in state on an output:

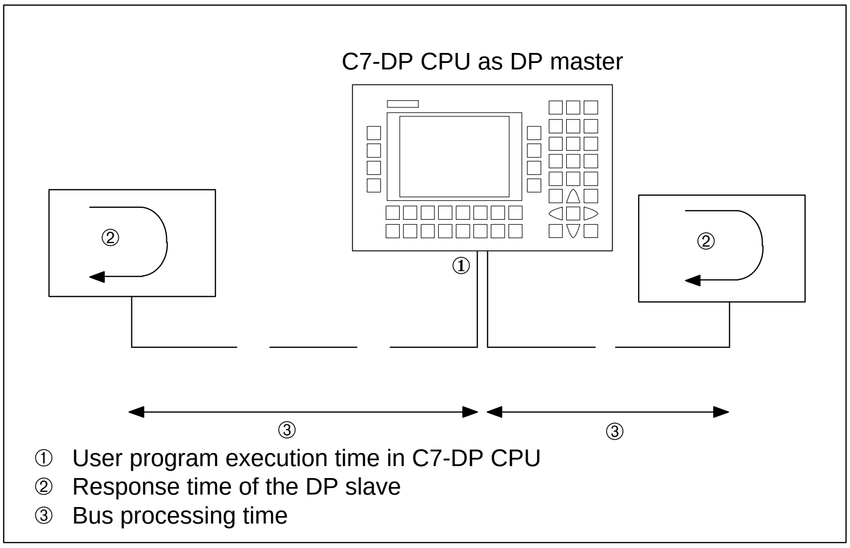


Figure 3-5 Response Times within the PROFIBUS-DP Network

Description

Table 3-20 shows where you can find a description of the various components of the response times.

Table 3-20 Components of the Response Time in the PROFIBUS-DP Network

No.	Component of Response Time	Description
①	User program execution time in the C7-DP CPU	See Sections 3.7 to 3.7.4
②	Response time of the DP slave	In the documentation for the DP slave
③	Bus processing time	In this section

3.8.2 Bus Processing Time t_{DP}

Definition

The bus processing time is the time taken by the DP master to address all the DP slaves assigned to it once only.

Calculation Using *STEP 7*

If you have configured your PROFIBUS-DP network using *STEP 7*, *STEP 7* will calculate the typical bus processing time to be expected. You can display the bus processing time of your configuration on the programming device (see *STEP 7* User Manual).

An overview of the bus processing time is provided in Figure 3-6. In this example, it is assumed that each DP slave has an average of 4 bytes of data.

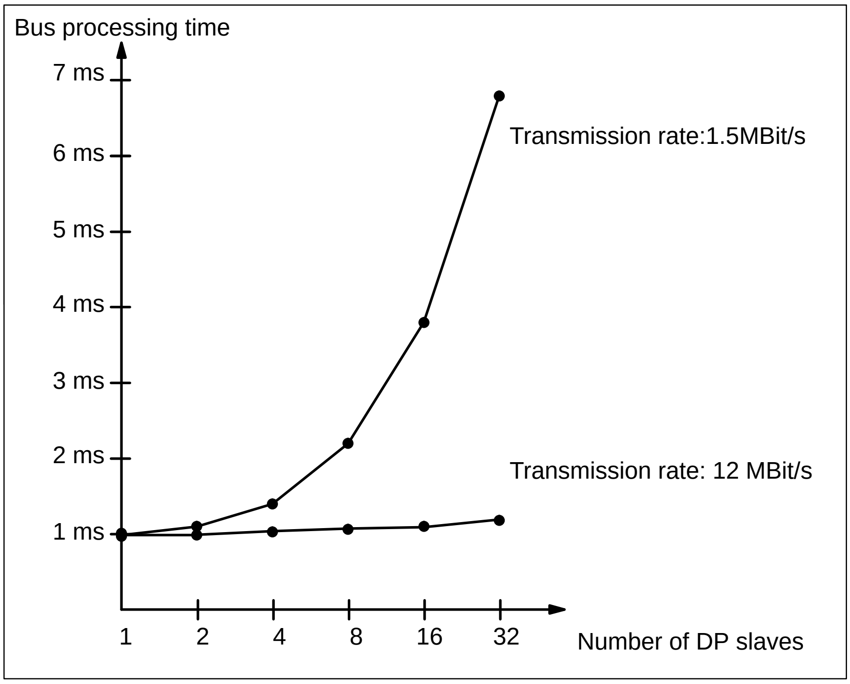


Figure 3-6 Overview of the Bus Processing Time on PROFIBUS-DP at 1.5 MBit/s and 12 MBit/s

Several DP Masters

If you operate a PROFIBUS-DP network with several masters, you must allow for the bus processing time for each master; that is,
Total bus processing time = Bus processing time × Number of masters

3.9 Test and Reference Data Functions of the C7 CPU

Overview

The C7 CPU offers the option of scanning the status of the C7 CPU and its associated signal modules by means of a series of test and reference data functions. This enables you to obtain information on the following:

- The current layout of the C7
- The current parameter assignment
- The current states
- The current sequences

in the C7 CPU and the associated signal modules.

You can also change process variables independently of the user program.

Description of the Test and Reference Data Functions

The test and reference data functions can only be executed using the STEP 7 software. The description of the test and reference data functions can be found in the appropriate chapters of the manual **/231/**.

List of Test and Reference Data Functions

Table 3-21 contains the reference data functions of the C7 CPU.

Table 3-21 Reference Data Functions of the C7 CPU

Reference Data Function	Application
User memory	Display of the current loading of the: • Constant memory (EEPROM), integrated into the C7 • Load memory of the C7 CPU (RAM) • Work memory of the C7 CPU (RAM)
Blocks	Display of all available blocks and the possible priority classes • SFCs (system functions) • SFBs (system function blocks) • OBs (organization blocks) • All blocks
Stacks	Read out the contents of • B stack (block stack) • I stack (interrupt stack) • L stack (local data stack)

Table 3-21 Reference Data Functions of the C7 CPU

Reference Data Function	Application
Communication	Display of • Number of links • Message frame length • Transmission rate via the MPI • Reserved OP links • Reserved programming device links • Free links
Time system	Display of following values • C7 time • C7 date • Time system • Correction factor • Cycle of the synchronization frames
Scan cycle times	Display of the scan cycle times of the user program • Monitoring time • Length of the longest cycle • Length of the shortest cycle • Length of the last cycle
Display diagnostic buffer	Display of the contents of the diagnostic buffer • Date and time of a diagnostic event • Number of the diagnostic event • Information describing the diagnostic event more exactly; for example, OB call for access errors
C7 CPU data	Display of the following C7 information • C7 type and version of the C7 CPU • Size of the work and load memories in the C7 CPU • Layout of the load memory • Number and area for the inputs, outputs, timers, counters and bit memory • Area for local data • C7 system behavior

List of Test Functions

Table 3-22 lists the test functions of the C7 CPU.

Table 3-22 Test Functions of the C7

Test Functions	User
Status variable	Observe selected process variables (inputs, outputs, bit memory, timers, counters, data) at a specified position in the user program: start of cycle, end of cycle, transition RUN → STOP.
Force variable	Assign a value (start of cycle, end of cycle, transition RUN → STOP) to selected process variables (inputs, outputs, bit memory, times, counters, data) at a specified position and thus control the user program directly.
Block status	Observe a block with regard to the program sequence to aid commissioning and fault finding. Block status offers the possibility of observing certain register contents during the execution of statements, for example, ACCUs, address register, status register, DB register.

3.10 Loading / Erasing the C7 CPU Flash Memory

Overview

During transmission of a user program to the C7 CPU, it is transferred only to the load memory and not automatically into the C7 CPU flash memory (ROM) as well.

The contents of a C7 CPU flash memory are not automatically reset during a memory reset of the C7 CPU**.**

You must explicitly initiate these actions using the functions of the programming device.

Load User Program into Flash Memory (ROM)

You must explicitly load the C7 flash memory using the STEP 7 function “Copy RAM to ROM”. You do this after you have copied the program and data into the RAM. In this way, the whole contents of the RAM are transferred to the flash memory (ROM).

Erase Flash Memory /ROM)

After the memory reset, the RAM is reinitialized with the contents of the flash memory. However, since you can only change the contents of the flash memory using the STEP 7 function “Copy RAM to ROM”, you must proceed as follows to erase the flash memory:

1. Go on-line in the Simatic Manager (AP-on). Select all SDBs, OBs, FCs, DBs, FBs and delete these using the menu command “Edit, Delete”.
2. Then select “MPI-2 (direct)” and execute the function “PLC, Copy RAM to ROM”.

The C7 CPU is then reset.

Addressing, Assigning Parameters and How the C7 I/O Works

4

Summary of Sections

4.1 Assigning Addresses to Signal Modules

Overview

The relationship between card slot and address assignment is described below. You require this information to determine the start addresses of the C7 modules used.

The C7 I/O and the customer-specific C7 modules always occupy the rack number 0.

C7-626 Slots

The logical slots 2 and 3 are reserved for the C7 CPU and the integrated IM360.

The I/O incorporated in the C7 occupies the logical slots 4 (digital I/O) and 5 (analog I/O and universal inputs).

Slots for Customer-Specific Module

The logical slots 6 to 11 can be occupied by a customer-specific module.

Free Address Assignment

With free address assignment, unlike slot-oriented addressing, you are free to assign the address of a module (SM/FM/CP). You define the start address of the module, and all other addresses of this module are based on this start address.

Free address assignment is only supported on S7-300 systems with the C7-626 DP.

Example

Example of a digital I/O module mounted in slot number 9 on rack 0:

- When slot-oriented adressing is used, *STEP 7* allocates the addresses starting from I20.0 and Q20.0 to the inputs and outputs.
- When free address assignment is used, you can allocate different addresses to the inputs and outputs, for example the input addresses starting with I10.0 and output addresses starting with Q6.0.

Advantage

Advantages of free address assignment:

- Optimum utilization of the address areas available, since , address “gaps” will not occur between the modules.
- When generating standard software, you can program addresses which are independent of the S7-300 configuration.

Addressing of DP Standard Slaves

In order to address DP standard slaves with a data consistency of 3 bytes and > 4 bytes, you must call up SFCs in the user program (see Appendix A and reference manual *System and Standard Functions*).

C7 Configuration

Figure 4-1 shows an example of a C7 configuration with a customer-specific module and the connection of additional S7-300 modules.

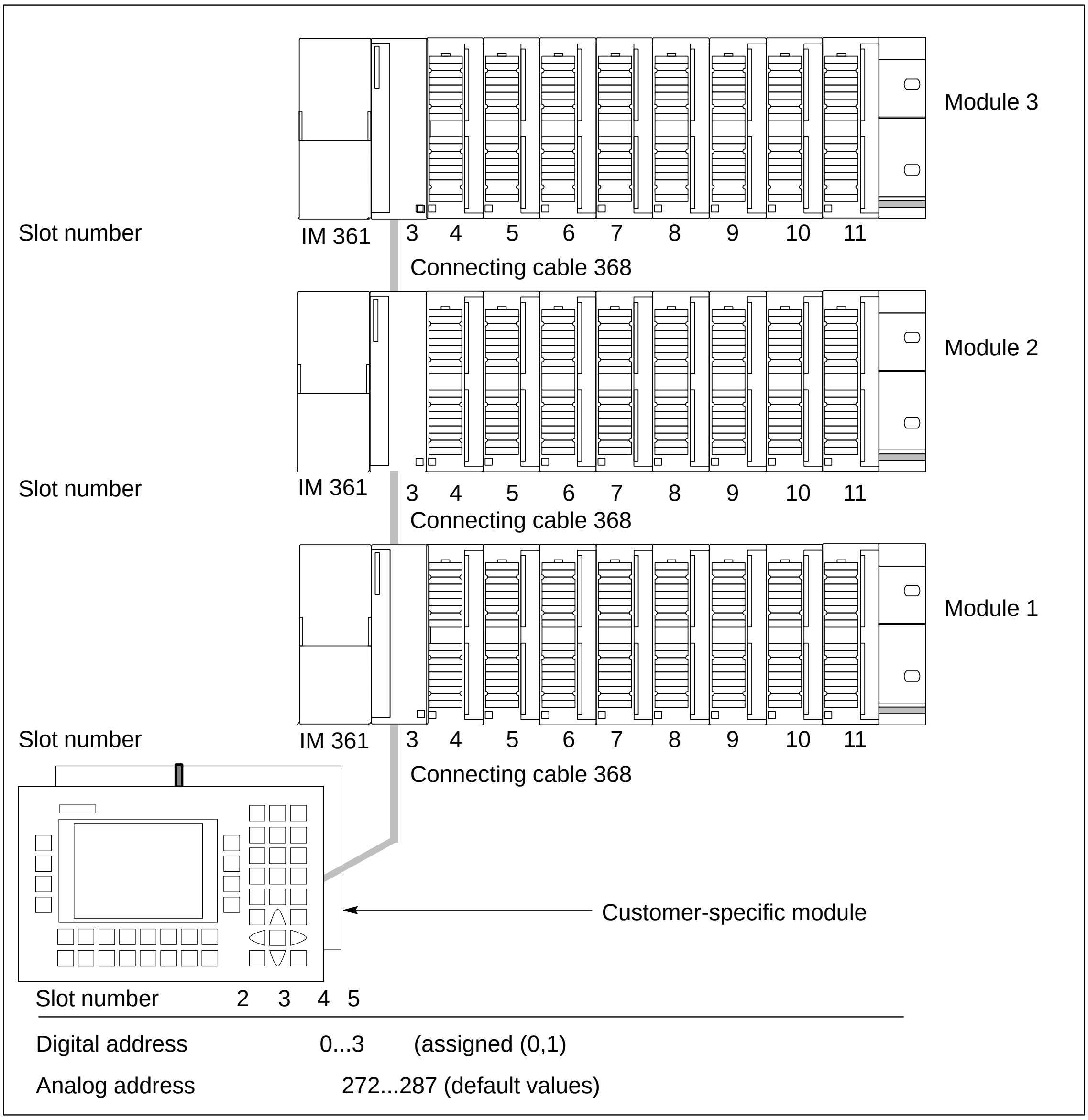


Figure 4-1 Example of Slots in C7

Additional S7-300 Racks

You can connect up to three S7-300 racks to a C7. The manual **/70/** describes how these are connected.

4.2 Addressing the C7 I/O

Overview

Figure 4-2 shows how the addresses of the individual channels of the digital I/O are laid out.

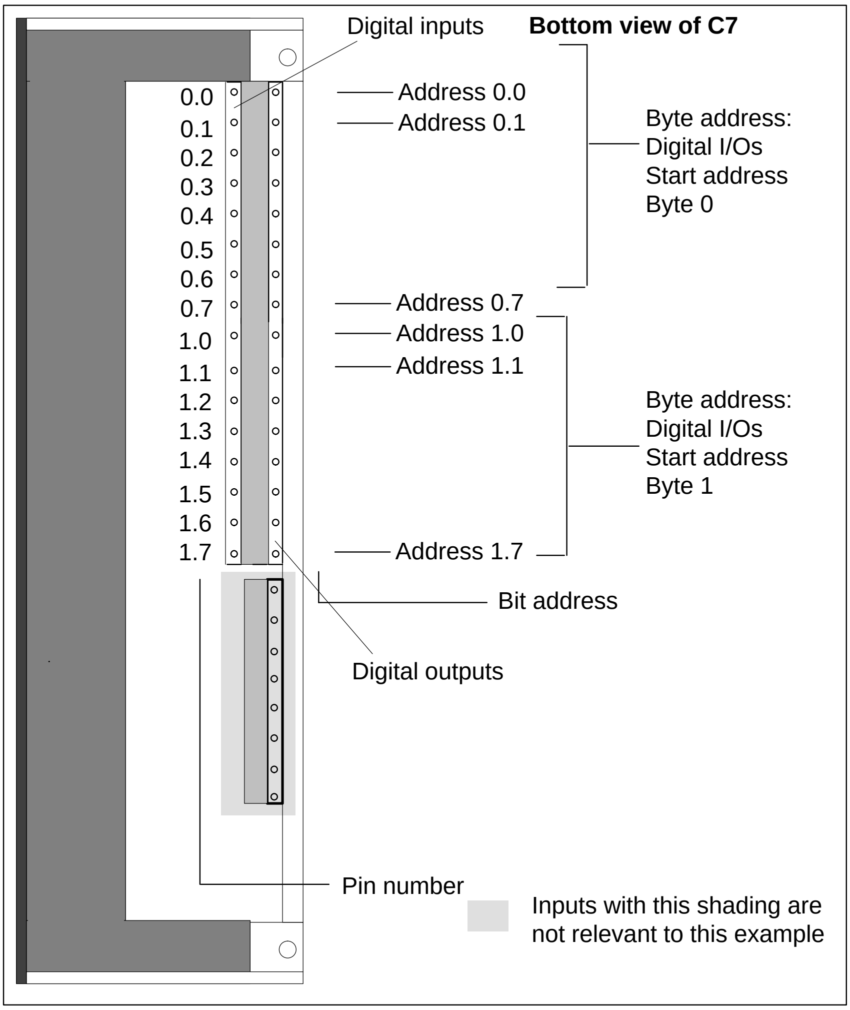


Figure 4-2 Digital I/O Addresses

4.3 Use and Function of C7 Analog I/Os

Overview

This section contains:

- Descriptions of the basic terminology for analog value processing.
- How to address and assign parameters to analog I/Os.
- How you allocate measuring ranges to analog input channels.
- The behavior of the individual analog input channels and the analog output channel.

4.3.1 Addressing the Analog I/Os

Analog Function Addresses

The address of an analog channel is always a word address.

An analog input/output has the same start address for the analog input and output channels.

Figure 4-3 shows which channel addresses result. You can see that for the analog I/O, the analog input channel and the analog output channel are addressed starting from the same address.

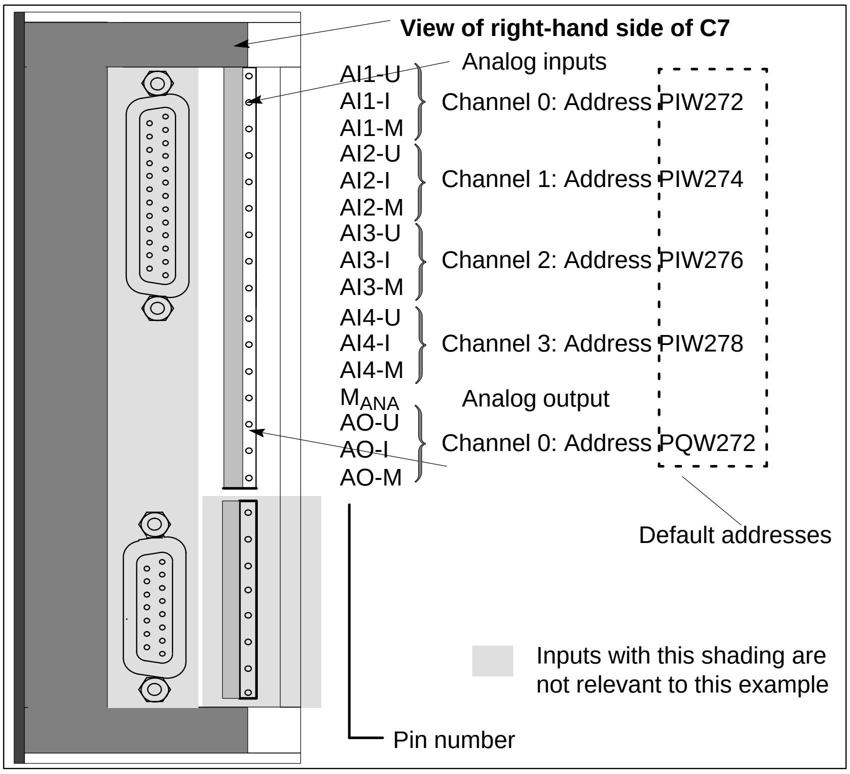


Figure 4-3 Analog I/O Addresses

4.3.2 Assigning Parameters to the Analog I/Os

Introduction

This chapter contains an overview of the analog I/O and their parameters.

Parameter Assignment

You set the parameters for the analog I/O using the STEP 7 function *Hardware Configuration*. A parameter block is generated that contains all the currently selected I/O parameters. After loading this parameter block, the parameters are not immediately transferred to the analog I/O. The C7 CPU then transfers the parameters to the respective analog I/O after every mode change from STOP to RUN.

Alternatively, you can also change some parameters in the user program with SFC55 to SFC57 (see reference manual **/235/**).

We subdivide the parameters for the two alternatives into:

- Static parameters and
- Dynamic parameters

The following table explains when the static and dynamic parameters are adopted.

Table 4-1 Time of Transfer of the Parameters from the C7 CPU to the Analog I/O

Parameter	Set with	Time of Parameter Transfer
Static	*Hardware Configuration*	STOP -> RUN
Dynamic	*Hardware Configuration*	STOP -> RUN
	SFC55 to SFC57	RUN

Assigning Parameters for Characteristics

The following parameter blocks permit the assignment of parameters in the STEP 7 function *Hardware Configuration* to define the following characteristics of the analog I/O:

- For inputs
  - Basic settings
  - Diagnostics
  - Measurement
  - Interrupt cycle
- For outputs
  - Basic settings
  - Diagnostics
  - Substitute values
  - Output range

Analog Input Parameters

Table 4-2 provides an overview of the analog input parameters.

Table 4-2 Analog Input Parameters

Parameter	Analog Output	
	Value Range	**Preset Value**
Basic settings • Enable diagnostic interrupt	 Yes/No	 No
Diagnostics • Enable – Configuration/parameter assignment error – Wire break (only 4...20 mA) – Measuring range undershoot – Measuring range overshoot • Wire break check (only for measuring range 4...20 mA)	 Yes/No Yes/No	 No No
Measurement • Type of measurement • Measuring range	 Deactivated Voltage Current ± 10 V ± 20 mA 4..20 mA	 Voltage ± 10 V
Interrupt cycle • Interrupt • Interrupt time	 Yes/No Unsolicited, 3 ms, 3.5 ms, 4 ms, 4.5 ms....16 ms	 No 16 ms

4

Interrupt Cycle

If parameters are assigned to this mode of analog inputs, then:

- A measurement cycle will be processed (Channel 1, 2, 3, 4)
- The measured value of each measured channel will be made available to the user program for collection
- After expiry of the interrupt time in the C7 CPU, a hardware interrupt will be triggered and a new measurement cycle initiated.

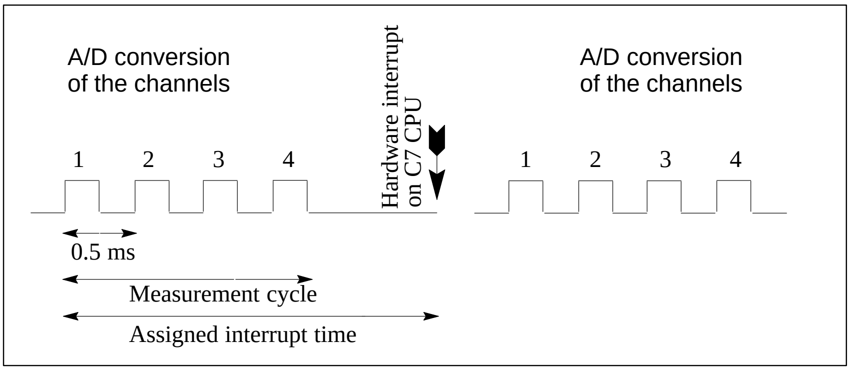


Figure 4-4 Sequence of the Measurement of all Four Channels with an Assigned Measurement Cycle

If individual measurement channels are deactivated, then the measurement cycle will be correspondingly shorter.

Parameter Characteristics of Analog Inputs

Table 4-3 shows which parameters

- Are static or dynamic
- Can be set for all analog inputs or for each individual channel.

Table 4-3 Parameter Characteristics of Analog Inputs

Parameter	Static/Dynamic	Effective Range
Enable diagnostic interrupt	Static	Analog inputs/ Analog output/ Universal inputs
Enable diagnostics	Static	Channel
Wire break check	Static	Channel
Type of measurement	Dynamic	Channel
Measuring range	Dynamic	Channel
Interrupt cycle	Dynamic	Analog inputs

Analog Output Parameters

Table 4-4 provides an overview of the analog output parameters.

Table 4-4 Analog Output Parameters

Parameter	Analog Output	
	Value Range	Preset Value
Basic settings • Enable diagnostic interrupt	 Yes/No	 No
Diagnostics • Enable – Configuration/parameter error – Substitute value switched on	 Yes/No	 No
Substitute value • Retain last value • Value	 Yes/No 9400_H...$6C00_H$	 No 0
Output range • Type of output • Output range	 Deactivated Voltage Current ± 10 V ± 20 mA 4..20 mA	 Voltage ± 10 V

4

Parameter Characteristics of Analog Outputs

Table 4-5 shows which parameters

- Are static or dynamic
- Can be set.

Table 4-5 Parameter Characteristics of Analog Outputs

Parameter	Static/Dynamic	Effective Range
Enable diagnostic interrupt	Static	Analog inputs / Analog output/ Universal inputs
Enable diagnostics	Static	Output
Substitute value • Retain last value • Value	 Dynamic Dynamic	 Output Output
Type of output	Dynamic	Output
Output range	Dynamic	Output

4.3.3 Representation of Analog Values

Overview

The representation of analog values, or an analog value in binary form, is the same for all C7 analog inputs and analog outputs.

This section describes the analog values for **all** measuring ranges or output ranges that can be used with the C7 analog I/O.

Representation of Analog Values

The digitized analog value is the same for input and output values of the same nominal range.

The representation of analog values is performed as a two's complement.

Table 4-6 illustrates the representation of the analog I/O:

Table 4-6 Representation of Analog Values

Resolution	**Analog Value**															
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Weighting of the bits	VZ	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Sign Conventions

The sign of the analog value is always contained in bit number 15:

- "0" → +
- "1" → –

12 Bit Resolution

The resolution is 12 bit. The analog value is entered into the ACCU left justified. The unoccupied low significance positions are written with "**0**".

Table 4-7 contains an example of a bit pattern showing how the unoccupied positions for 12 bit resolution are filled with **"**0**"**.

Table 4-7 Bit Pattern of a 12 bit Analog Value (Example)

Resolution	**Analog Value**															
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
12 bit analog value (including sign)	0	1	0	0	0	1	1	0	0	1	1	1	**0**	**0**	**0**	**0**

4.3.4 Representation of Analog Values for the Measuring Ranges of the Analog Inputs

Overview

The tables in this chapter contain the digitized analog values for the measuring ranges of the analog inputs.

In Table 4-8, you will find the representation of the binary analog values and the associated decimal or hexadecimal representation of the units of the analog values.

How the Measured Value Tables Should be Read

Table 4-9 contains the digitized analog values for the various measuring ranges.

Since the binary representation of the analog values is always the same, the tables contain only the comparison of the measuring ranges to the units.

These tables are therefore clearer and easier to read. The corresponding binary representation of the measured values can be referred to in Table 4-8.

Measured Value Resolution

The bits identified with “x” are not relevant to a resolution of 12 bits.

Table 4-8 Possible Resolutions of Analog Values

Resolution in Bit (including Sign)	Units		Analog Value	
	Decimal	Hexadecimal	High Byte	Low Byte
12	8	8_H	S 0 0 0 0 0 0 0	0 0 0 1 x x x x

Voltage / Current Measuring Ranges

Table 4-9 contains the representation of the digitized voltage measuring ranges for ± 10 V and the digitized current measuring ranges ± 20 mA, 4...20 mA.

Table 4-9 Representation of the Digitized Measured Value of the Analog Inputs (Voltage / Current Measuring Ranges)

Measuring Range ± 10 V	Measuring Range ± 20 mA	Measuring Range 4..20 mA	Units		Range
			Decimal	Hexadecimal	
≥ 11.759	≥ 23.516	≥ 22.815	32767	$7FFF_H$	Overflow
11.7589	23.515	22.810	32511	$7EFF_H$	Upper range
:	:	:	:	:	
10.0004	20.0007	20.005	27649	$6C01_H$	
10	20.000	20.000	27648	$6C00_H$	Nominal range
7.500	14.998	16.000	20736	5100_H	
:	:	:	:	:	
–7.50	–14.998	4.000	0	0_H	
		3.995	–1	$FFFF_H$	
		1.1852	–4864	ED00	
–10.00	–20.000		–27648	9400_H	
–10.0004	–20.0007		–27649	$93FF_H$	Lower range
:	:		:	:	
–11.759	–23.516		–32512	8100_H	
≤ –11.76	≤ –23.517	≤ 1.1845	–32768	8000_H	Underflow

4.3.5 Representation of Analog Values for the Output Range of the Analog Outputs

Table for Output Ranges

Table 4-10 contains the analog output ranges of the analog output.

Voltage / Current Output Ranges

Table 4-10 contains the representation of the voltage output range ± 10 V and the current output ranges ± 20 mA, 4...20 mA.

Table 4-10 Representation of the Analog Output Range of the Analog Outputs (Voltage / Current Output Ranges)

Output Range ± 10 V	Output Range 4 ..20 mA	Output Range ± 20 mA	Units		Range
			Decimal	Hexadecimal	
0	0	0	≥ 32512	≥ 7F00$_H$	Overflow
11.7589	22.81	23.515	32511	7EFF$_H$	Upper range
:	:	:	:	:	
10.0004	20.005	20.0007	27649	6C01$_H$	
10.0000	20.000	20.000	27648	6C00$_H$	Nominal range
:	:	:	:	:	
0	4.000	0	0	0$_H$	
0	3.9995		:	:	
:	0	:	– 6912	E500$_H$	
	0		– 6913	E4FF$_H$	
			:	:	
–10.0000		– 20.000	– 27648	9400$_H$	
10.0004			– 27649	93FF$_H$	Lower range
		:	:	:	
–11.7589		23.515	– 32512	8100$_H$	
0		0	≤ – 32513	≤ 80FF$_H$	Underflow

4.3.6 Conversion and Scan Cycle Time of the Analog I/Os

Introduction

This section contains the definitions and relationships between conversion time and scan cycle time for the analog inputs.

Conversion Time

The conversion time consists of the basic conversion time and an additional conversion time necessary for the input calibration.

Scan Cycle Time

The analog-digital conversion and the transfer of the digitized measured value to the C7 CPU is performed sequentially; that is, the analog input channels are converted one after the other. The scan cycle time, that is, the elapsed time before an analog input value is converted again, is the sum of all conversion times (0.5ms/channel) of all activated analog input channels plus one calibration measurement. Unused analog input channels should be deactivated in *Hardware Configuration* in order to reduce the scan cycle time.

Figure 4-5 gives you an overview of how the scan cycle time for a 4-channel analog input is composed.

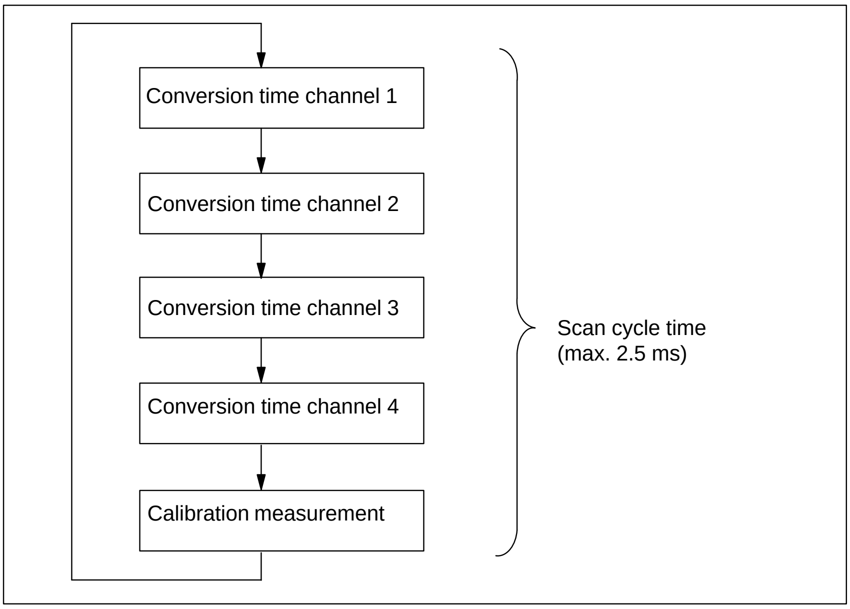


Figure 4-5 Scan Cycle time of an Analog Input

Interrupt Cycle

If the interrupt cycle mode has been assigned parameters, the new measuring cycle is not started unless the timed interrupt is initiated (see Section 4.3.2).

4.3.7 Conversion, Scan Cycle, Settling and Response Times of the Analog Outputs

Introduction

This section contains the definitions and relationships between relevant times for the analog output.

Conversion Time

The conversion time includes the acceptance of the analog output values from the internal memory and the digital-analog conversion.

Scan Cycle Time

The scan cycle time; that is, the elapsed time before an analog output value is converted the next time is equal to the time for the conversion of the one analog output.

Settling Time

The settling time (t_2 to t_3); that is, the elapsed time between the creation of the converted value and the attainment of the specific value at the analog output, is load-dependent. A distinction must be made between resistive, capacitive and inductive load.

Response Time

The response time, that is the interval between providing the digital output value and attaining the specified value at the analog output, is between 100 µs and 2 ms.

4.3.8 Behavior of the Analog I/Os

Overview

This section decribes:

- The relationship of the analog input and output values to the supply voltages of the analog I/O and the operating modes of the C7.
- The behavior of the analog I/O in relation to the position of the analog values in the respective value range.
- The influence of errors on the analog I/O.

Influence of the Supply Voltage and the Operating Mode

The input and output values of the analog I/O are dependent upon the supply voltage of the analog I/O and the operating mode of the C7.

The triggering of a diagnostic interrupt is dependent upon the parameter assignment.

Table 4-11 gives an impression of these inter-relationships.

Table 4-11 Dependencies Between Analog Input and Output Values upon the Operating State of the C7 and upon the Supply Voltage L+

Operating State of C7		Input Value of the Analog Input	Output Value of the Analog Output
POWER ON	RUN	Process value	C7 value
	STOP	Process value	Substitute value or retain last value (configurable)
POWER OFF	STOP	–	0 signal

Influence of the Value Range on the Input

The behavior of the analog input is dependent upon the area of the value range in which the input value lies. Table 4-12 illustrates these dependencies for the analog input values.

Table 4-12 Behavior of the Analog Input in Relation to the Position of the Analog Input Value in the Value Range

Process Value lies in	Input Value	Diagnostics	Interrupt
Nominal range	Process value	–	–
Upper range/lower range	Process value	–	–
Overflow/underflow	$7FFF_H$	Message[1]	Diagnostic interrupt[1]

[1] According to parameter assignment

Influence of the Value Range for the Output

The behavior of the analog output is dependent upon the position of the output value within the value range. Table 4-13 illustrates this dependency for the analog output values.

Table 4-13 Behavior of the Analog Input in Relation to the Position of the Analog Input Value in the Value Range

Output Value lies in	Output Value	Diagnostics	Interrupt
Nominal range	C7 value	–	–
Upper range/lower range	C7 value	–	–
Overflow/underflow	0 signal	–	–

Influence of Errors

Errors lead to a diagnostic message and diagnostic interrupt if diagnostic parameters have been assigned (see Volume 2 of the manual, Section 4.3.1 and Chapter 5).

4.3.9 Time Interrupt / Interrupt Cycle

Interrupt Cycle

If the interrupt cycle mode is assigned parameters, the new measuring cycle is not started unless the time interrupt is initiated (see Section 4.3.2).

Assignable Events

Use the STEP 7 function *Hardware Configuration* for parameter assignment.

Hardware Interrupt OB

If a hardware interrupt is transferred from the I/O to the C7 CPU, the hardware interrupt OB (OB40) is called in the C7 CPU. The event which called OB40 is stored in the start-up information (declaration section) of OB40. You have to evaluate the additional information Z1 to Z3 in the start-up information.

Declaration Section of OB40

The entries in the declaration section of OB40 are listed in Table 4-19. The bytes relevant to the user are hatched in the table.

Table 4-14 Declaration Section of OB40

Byte	Meaning		Meaning	Byte
0	Class	Identifier	Event number	1
2	Priority class		Current OB number	3
4	Data identifiers Z2/3		Data identifier Z1	5
6	Additional information Z1			7
8	Additional information Z2			9
10	Additional information Z3			11
12	Time stamp of event			13
14				15
16				17
18				19

Additional Information Z1

Additional information Z1 contains the initial address of the C7 I/O module (bytes 6/7).

Address: 272 or 0110_H or address with assigned parameters.

Additional Information Z2

Bit 4 of byte 8 = 1 in the case of an end-of-cycle interrupt.

Additional Information Z3

Additional information Z3 is not used and assigned the value 0000H.

Evaluation in the User Program

The evaluation of hardware interrupts in the user program is described in the manual /**234**/.

4.4 Use and Function of the Universal Inputs

Overview

This section contains information on:

- Basic terminology for the function of the universal inputs
- How to use the universal inputs
- How to address and assign parameters to the universal inputs.

4.4.1 Addressing the Universal Inputs

Overview

You can select the following functions by assigning the appropriate parameters to the universal inputs:

- Digital input
- Interrupt input
- Counter
- Frequency counter
- Period time counter

Adresses in the C7-626 DP

All of the addresses referred to in the following sections are default addresses and can be assigned parameters.

Adresses in the C7-626

The addresses for the universal inputs are default addresses which cannot be changed. According to the application of the universal inputs, the results occupy different addresses.

For the address assignment, a distinction can be made between:

- Input range PIW280 ... PIB287 for count values or signal state of the digital inputs
- Output/control range PQW 274...PQB282 for counters.

Input Range

The four universal inputs of the input range (see Figure 4-6) have the following addresses and weightings:

Table 4-15 Input Address of the Universal Inputs

Address	Designation	
PIW280	**CI1**: Counter input	
PIW282	**CI2**: Counter input	
PIB284 PIB285	**CI3**: Counter input	Frequency/period time counter
PIB286	—	
PIB287: Bit 0	Current state of universal input 1	
Bit 1	Current state of universal input 2	
Bit 2	Current state of universal input 3	
Bit 3	Current state of universal input 4	
Bit 4 Bit 5 Bit 6	States of the counter inputs see Table 4-16	
Bit 7	—	

States of the Inputs

The state of the individual inputs is stored as a bit pattern in PIB287:

Table 4-16 State of the Inputs

Address PIB287	Status Display of the Universal Inputs
Bit 0	Bit = 1: universal input 1 set. Bit = 0: universal input 1 reset.
Bit 1	Bit = 1: universal input 2 set. Bit = 0: universal input 2 reset
Bit 2	Bit = 1: universal input 3 set. Bit = 0: universal input 3 reset.
Bit 3	Bit = 1: universal input 4 set. Bit = 0: universal input 4 reset.
Bit 4*)	Bit = 1: Counter1 counting Bit = 0: Counter1 stopped
Bit 5*)	Bit = 1: Counter2 counting Bit = 0: Counter2 stopped
Bit 6*)	Bit = 1: Counter3 counting Bit = 0: Counter3 stopped

*) Only relevant when universal input is assigned as counter input

Output Range

If the universal inputs are used as counters, then the behavior of the counters is controlled via the output range.

Table 4-17 Addresses and Weighting of the Output Range of the Counter Inputs

Address		Control of Counter 1..3	
PQW274		Start/comparison value counter 1*	
PQB276:	Bit 0	0 = Counter1 disabled	1 = Counter1 enabled
	Bit 1	0 = New start/comparison value not valid	
		1 = Set new start/comparison value	
PQW277		Start/comparison value counter 2*	
PQB279:	Bit 0	0 = Counter2 disabled	1 = Counter 2 enabled
	Bit 1	0 = New start/comparison value not valid	
		1 = Set new start/comparison value	
PQW280		Start/comparison value counter 3*	
PQB282:	Bit 0	0 = Counter3 disabled	1 = Counter 3 enabled
	Bit 1	0 = New start/comparison value not valid	
		1 = Set new start/comparison value	

*) Initial value for down counter, comparison value for up counter

4

Diagram with Universal Inputs

The pins are shown in the diagram.

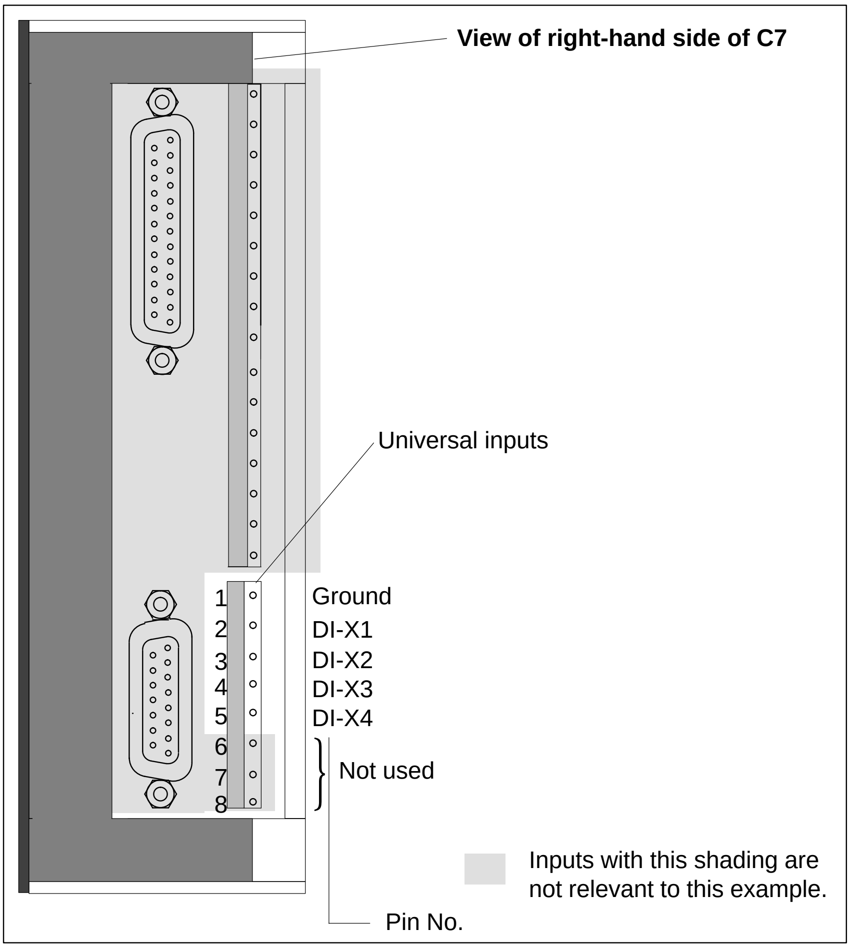


Figure 4-6 Pins of Universal Inputs

4.4.2 Assigning Parameters to the Universal Inputs

Parameter Block Universal Inputs

In parameter block “universal inputs” you set the parameters for:

- The interrupt inputs
- The counters
- The frequency meter/period time counter
- Digital input (always if interrupt or counter input = deactivated)

Parameter Assignment

You set the parameters for the universal inputs using the STEP 7 function *Hardware Configuration*. A parameter block is generated which contains all currently selected parameters of the universal inputs. After loading this parameter assignment, the C7 CPU then transfers the parameters to the appropriate universal inputs on every transition from STOP → RUN.

Interrupt Inputs

If the universal inputs are used as interrupt inputs, a hardware interrupt will be triggered at the C7 CPU for the assigned rising or falling edge at the input. The default is the rising edge.

Counter Inputs

The universal inputs 1...3 can be assigned as:

- Counter input
- Period time counter (input 3 only)
- Frequency meter (input 3 only)

The counter values are made available to the user program as 16 bit values and the frequency and period time counter as 24 bit values.

Table 4-18 lists the parameters for the above mentioned functions:

Table 4-18 Parameter Block of the Counter Inputs

Parameter	Explanation	Value Range	Default Setting
Counter input 1	Define the count direction	Up Down	Up
	Select counter edge to be used for counting	Rising Falling	Rising
	Counter can trigger a hardware interrupt after reaching the comparison value (when counting up) or zero transition (when counting down)	Yes No	No
Counter input 2	Define the counter direction	Up Down	Up
	Select counter edge to be used for counting	Rising Falling	Rising
	Counter can trigger a hardware interrupt after reaching the comparison value (when counting up) or zero transition (when counting down)	Yes No	No
Counter input 3	Activate the counter input and assignment of the counter type	Deactivated Counter Frequency counter Period time counter	Deactivated
	If counter activated then define the counter direction	Up Down	Up
	If counter activated then define the edge to be used for counting	Rising Falling	Rising
	If counter activated, then the counter can trigger a hardware interrupt after reaching the comparison value (when counting up) or a zero transition (when counting down)	Yes No	No
	If frequency counter selected, then select the gate time for the frequency counting	0.1 s 1 s 10 s	1s
	No further parameters for period time counter	–	–

Digital Inputs

If the universal inputs are deactivated in the parameter block (default setting), then the inputs react as digital inputs. However, no automatically updated process image will be made available to the user program for these inputs. The current state of the input can only be read by means of a direct I/O access. (See Table 4-15 or 4-16 for address).

4.4.3 Interrupt Inputs

Introduction

If universal inputs are used as interrupt inputs, then a hardware interrupt will be generated at every corresponding (assigned) edge at one of the inputs.

Assignable Events

The parameter assignment can be performed with the STEP 7 function *Hardware Configuration.*

Hardware Interrupt OB

If a hardware interrupt is sent from the I/O to the C7 CPU, then the hardware interrupt OB (OB40) will be called by the C7 CPU. The event that called the OB40 is stored in the start-up information (declaration section) of the OB40. You must evaluate the additional information Z1 to Z3 in the start-up information.

Declaration Section of OB40

The entries in the declaration section of OB40 can be found in Table 4-19. The bytes that are relevant to the user are hatched in the table.

Table 4-19 Declaration section of OB40

Byte	Meaning		Meaning	Byte
0	Class	Identifier	Event number	1
2	Priority class		Current OB number	3
4	Data identifier Z2/3		Data identifier Z1	5
6	Additional information Z1			7
8	Additional information Z2			9
10	Additional information Z3			11
12	Time stamp of event			13
14				15
16				17
18				19

Additional Information Z1

The start address of the C7 I/O module is contained in the additional information Z1 (bytes 6/7).
Address: 272 or 0110_H or address with assigned parameters.

Additional Information Z2

The serial number of the universal inputs that triggered the hardware interrupt can be found in byte 8 of the additional information Z2. Byte 9 is irrelevant.

You can find the additional information broken down into bits in Figure 4-7.

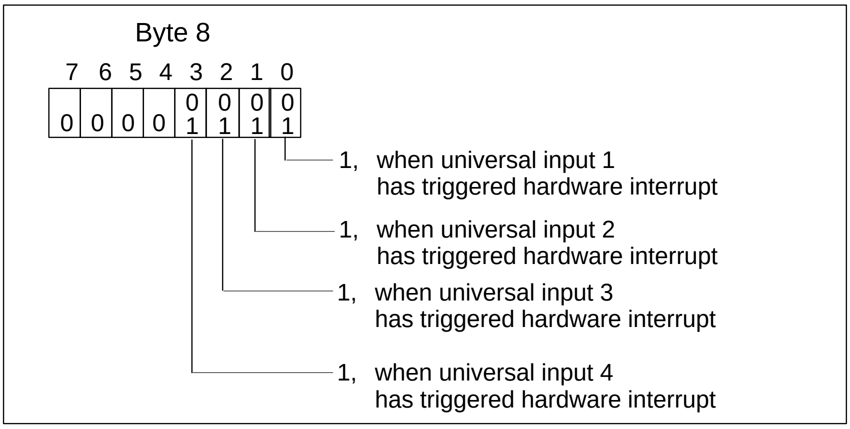


Figure 4-7 Additional Information Z2

Additional Information Z3

Additional information Z3 is not used and is set to 0110_H.

Evaluation in User Program

The evaluation of hardware interrupts in the user program is described in the manual **/120/**.

4.4.4 Counters

Counters

The counter calculates the value of the count from the count pulses (up or down).

You can assign parameters with the STEP 7 function *Hardware Configuration* for whether:

- Counter pulse is triggered by a rising or falling edge at the corresponding universal input
- Counting should be up or down

Actual Value of Counter

The counter calculates the actual value according to the following formula:

Actual value (up counter) = number of edges

or

Actual value (down counter) = start value ÷ number of edges

Counting Up

Counting up starts at zero or continues from the last counter value and until the selected comparison value is reached. The start value after resetting the counter is always zero. The comparison value is set by the user program.

Counting Down

Counting down starts from the selected start value back or continues from the last counter value until the value zero is reached. Start values are set by the user program.

Exceeding the Threshold Frequency

The universal input counter counts pulses up to a maximum frequency of 10 kHz.

A frequency filter is fitted to the inputs.

Warning

If the actual frequency exceeds the threshold frequency of 10 kHz, then the correct function of the universal inputs can no longer be guaranteed, since count pulses will be lost.

Stopping and Starting Counters

The universal counter inputs are controlled by the user program.

The control options you have in the user program to influence the counters are explained in Table 4-20. The addresses in this table can be freely addressed in the C7-626 DP.

Table 4-20 Controlling Counters with the User Program

Aim	Procedure
Start counter	• Enter a valid start value (if counting down) or a valid comparison value (PQW274, PQW277, PQW280). • Activate the new start/comparison value (Bit 1 of PQB276, PQB279, PQB282 rising edge ‘0‘→‘1‘) • Start the counter by selecting the start bit (Bit 0 of PQB276, PQB279, PQB282 falling edge ‘0‘→‘1‘
Stop counter	• Reset the start bits (Bit 0 of PQB276, PQB279,PQB282 falling edge ‘0‘→‘1‘)
Restart counter with counter initialization (reset)	• If necessary, enter a new start value or retain old start value (for counting down) or comparison value (for counting up) (PQW274, PQW277, PQW280). • Activate the new start/comparison value (Bit 1 of PQB276, PQB279, PQB282 rising edge ‘0‘→‘1‘). • Set the start bit (Bit 1 of PQB276, PQB279, PQB282 rising edge ‘0‘→‘1‘).
Restart counter without counter initialization (counter continues counting without a reset)	• No setting of the new start/comparison value • Start the counter by setting the start bit (Bit 0 of PQB276, PQB279, PQB282 rising edge ’0’→’1’).
Select new start/comparison value	• Enter new start/comparison value (PQW274, PQW277, PQW280). • Set value (Bit 1 of PQB276, PQB279, PQB282 rising edge ‘0‘→‘1‘. – New start/comparison value will be activated with the next rising edge at the counter input – If counting up running: new comparison value will be accepted – If counting down running: new start value will be accepted, current counter value will be corrected by the difference.

Table 4-20 Controlling Counters with the User Program

Aim	Procedure
Initialization of the counter (start of a new counting process) always occurs:	• At zero transition (counting down) or comparison value reached/exceeded (counting up) • After setting the enable bit in the data area (Bit 0 of PQB276, PQB279, PQB282 rising edge ‘0‘→‘1‘), if the bit “set new start/comparison value” is set simultaneously (Bit 1 of PQB276, PQB279, PQB282).
Generation of hardware interrupt and resetting of counter	• Prerequisite is that the hardware interrupt of the counter is set to “yes” • When counting direction is up, if counter value = comparison value • When counting direction is down, if counter value = zero

4.4.5 Counter Interrupts

Introduction

The universal inputs of counters can be assigned parameters for hardware interrupts. In this case, an up counter triggers a hardware interrupt when it reaches the comparison value, and a down counter when it passes through zero.

Assignable Events

The parameter assignment is performed with the STEP 7 function *Hardware Configuration.*

Hardware Interrupt OB

If a hardware interrupt from the counter is sent to the C7 CPU, then the hardware interrupt OB (OB40) to the C7 CPU will be called. The event that called the OB40 is stored in the start-up information (declaration section) of the OB40. You must evaluate the additional information Z1 to Z3 in the start-up information.

Declaration Section of OB40

The entries in the declaration section of OB40 can be found in Table 4-21: the bytes that are relevant to the user are hatched in the table.

Table 4-21 Declaration Section of OB40

Byte	Meaning		Meaning	Byte
0	Class	Identifier	Event number	1
2	Priority class		Current OB number	3
4	Data identifier Z2/3		Data identifier Z1	5
6	Additional information Z1			7
8	Additional information Z2			9
10	Additional information Z3			11
12	Time stamp of event			13
14				15
16				17
18				19

Additional Information Z1

The start address of the C7 I/O module is contained in the additional information Z1 (bytes 6/7).
Address: 272 or 0110_H or address with assigned parameters.

Additional Information Z2

The serial number of the universal inputs that triggered the hardware interrupt can be found in byte 8 of the additional information Z2. Byte 9 is irrelevant.

You can find the additional information Z2 broken down into bits in Figure 4-8.

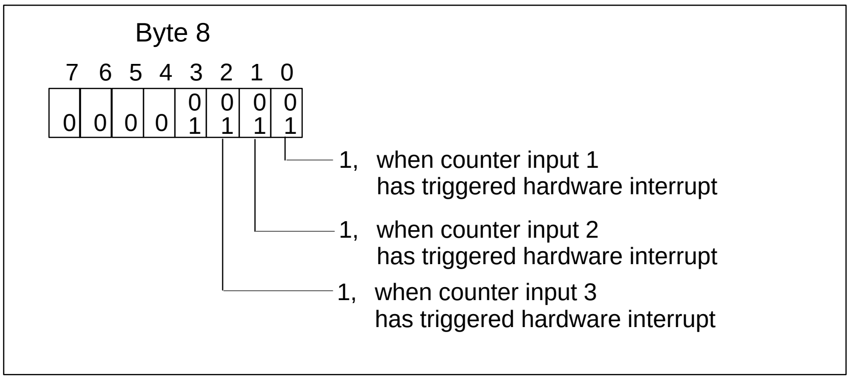


Figure 4-8 Layout of Additional Information Z2 in the Declaration Section of OB40

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Additional Information Z3

Additional information Z3 is not used and is set to 0110_H.

Evaluation in User Program

The evaluation of hardware interrupts in the user program is described in the manual /**280**/.

4.4.6 Frequency Counters

Overview

The universal input 3 (assigned as frequency meter) provides you with the possibility of continuously counting identical edges within a selected time period for a frequency $\leq$ 10 kHz.

Application

Calculation of high frequencies.

Frequency Calculation

The frequency meter calculates the frequency from the measured value and the measurement period.

The signal to be measured is to be connected to the universal input 3 (see Sections 4.4.1 and 4.4.2) of the C7. The frequency counter counts the rising edges of the signal to be measured within a time period that can be assigned using parameters.

From this, the user program can derive the actual frequency using the following formula:

$$\text{Frequency} = \frac{\text{Number of positive edges}}{\text{Measurement period}}$$

Measurement Period

The measurement period can be selected using the STEP 7 function *Hardware Configuration.* You can choose between the measurement periods 0.1 s, 1 s or 10 s. The measuring process is immediately restarted after the measurement period has elapsed, so that an updated frequency counter value is always available.

Example of Frequency Calculation

The measurement period is 1 s. During a measurement period, 6500 rising edges of the signal to be measured are counted. The value 6500 is made available to the user program.

$$\text{Frequency} = \frac{6500}{1\ \text{s}} = 6500\ \text{Hz}$$

Frequency During First Measurement Period

After starting up the C7, OB1 is processed and the universal input frequency meter is automatically started.

The first valid frequency is calculated after the first measurement period. Before the end of the first measurement period, the frequency counter value $FFFFFF_H$ is available in the C7 CPU.

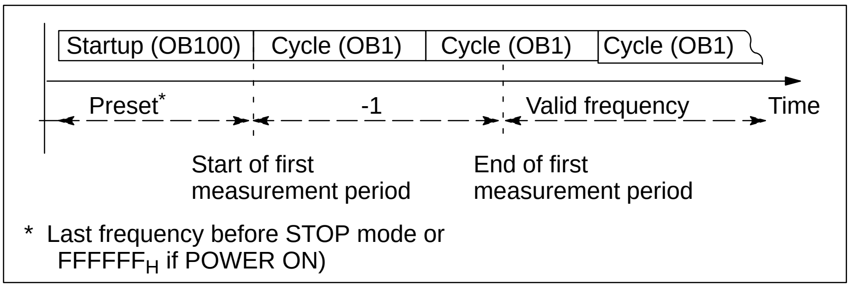

Figure 4-9 Frequency During First Measurement Period

Exceeding the Threshold Frequency

The universal input frequency meter is designed for a maximum frequency of 10 kHz.

A frequency filter is fitted to the input.

Warning

If the actual frequency exceeds the threshold frequency of 10 kHz, then the correct function of the universal inputs can no longer be guaranteed, since counter pulses will be lost.

Resolution of Measurement

With relatively constant frequencies, the resolution of the measurement is higher if you set a longer measurement period. Table 4-22 displays the resulution of the measurement according to the configured measurement period.

Table 4-22 Resolution of the Measurement

Measurement Period	Resolution	Example of Count Value During Measurement	Frequency (Calculated)
0,1 s	Frequency can be calculated in 10 Hz increments	900	9000 Hz
		901	9010 Hz
1 s	Frequency can be calculated in 1 Hz increments	900	900 Hz
		901	901 Hz
10 s	Frequency can be calculated in 0.1 Hz increments	900	90 Hz
		901	90.1 Hz

Disadvantage of Long Measurement Periods

The frequency meter calculates the frequency in longer intervals. This means that with long measurement periods, an updated frequency value is less often available. If the frequency continuously changes, then only average values are available.

Disadvantage of Short Frequency

Due to the principle of measurement, the measurement error increases with a reduction in the measured frequency.

4.4.7 Period Time Measurement

Overview

The universal input 3 can be assigned as a period time counter. This universal input reads pulses from a transducer. The transducer could, for example, be fitted to the barrel extruder of an injection moulding machine.

Application

Calculation of low frequencies and speeds.

Principle

The period time counter counts the number of increments (fixed time intervals) of t_{zi} = 0.5µs between two rising edges. The first period starts at the first transition from “0” to “1” (rising edge). It ends at the next rising edge. This is also the start of the next period.

From this, a period time can be calculated:

t_p = number of counted increments * 0.5µs

In addition, for every rising edge, a counter is started that increases its value by 1 every 0.5 µs until the next positive edge occurs.

The period time counter can be defined with a resolution of 0.5 µs.

Measuring Accuracy

To obtain a measuring accuracy of < 1%, the optimal measuring procedure should be selected depending on the frequency involved.

Recommendation for using period time/frequency counter:

Table 4-23 Period Time/Frequency Counter

Frequency	Measuring Procedure
< 10 Hz	Period time counting
10...100 Hz	Frequency counting Gate width: 10 s
100Hz...1 kHz	Frequency counting Gate width: 1 s
1...10 kHz	Frequency counting Gate width: 0.1 s

Explanation of Principle Based upon a Simple Transducer

Figure 4-10 illustrates a simple transducer. The transducer delivers “1” when the light passes through one of the slots in the disc. If the discs rotates, then the transducer delivers the signal shown in the diagram.

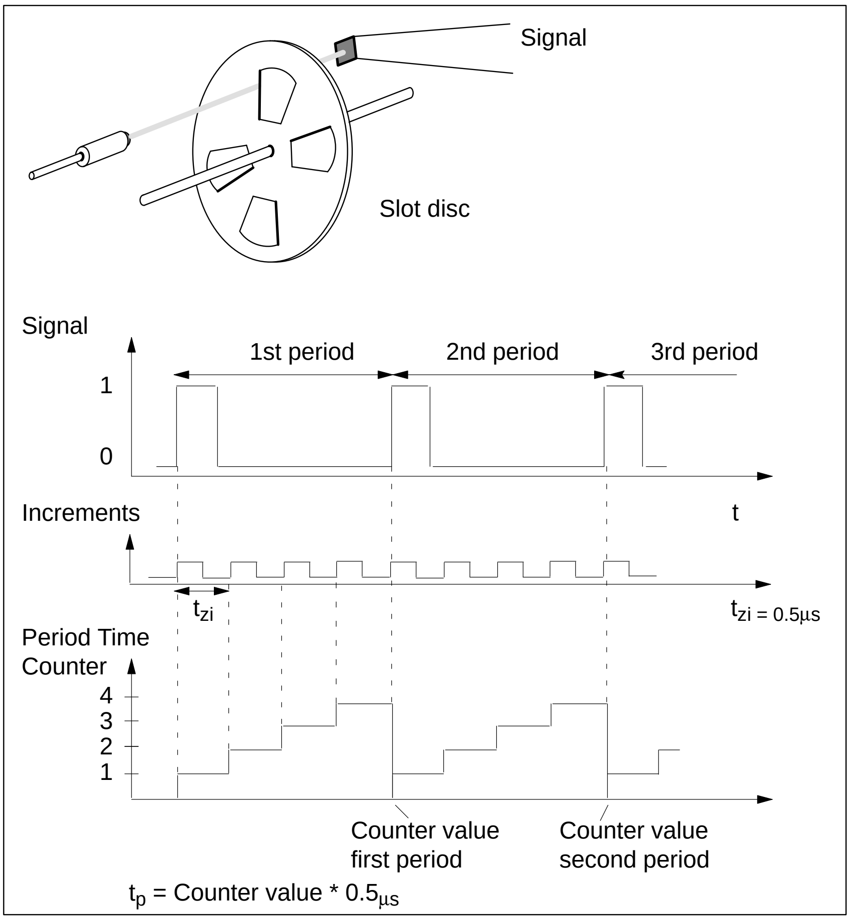

Figure 4-10 Simple Transducer, such as a Slot Disc on a Shaft

If you know the number of pulses that are delivered by the transducer for each revolution of the barrel extruder, then you can calculate the speed at which the barrel extruder is rotating. An example follows:

N = 16 pulses are generated per revolution of the barrel extruder (N is also known as the slot number of the transducer). The interval between 2 pulses is 50000 increments (fixed time interval). The rotational speed of the barrel extruder is calculated as follows:

$$v = \frac{1}{N \text{ x } ti} = \frac{1}{16 \text{ x } 50,000 \cdot \text{x } 0.5\,\mu s} = 2.5\frac{1}{s} = 150\frac{rev}{min}$$

Lower Threshold

The period time counter generates a 24-bit counter value. These 3 bytes can represent values up to FF FF FF_H (16777214 decimal). From this, the lower threshold frequency for N = 1 is (when taking into account the period time stated below (t_p = 8.39 s)):

$$fu = \frac{1}{tp} \; ; \qquad tp = 16777214 * 0.5\mu s = 8.39s$$

$$fu = 0.119Hz$$

And for N = 1, the lower threshold rotation speed

$$v = \frac{1}{N \text{ x } ti} = \frac{1}{1 \text{ x } 8.39s} = 0.119\frac{1}{s} = 7.14\frac{rev}{min}$$

Upper Threshold

The upper threshold frequency results from the condition that the universal inputs are designed for a maximum frequency of 10 kHz. The minimum period time of 0.1 ms follows. Therefore the upper threshold frequency is 10 kHz (corresponding to 600,000 rev/min).

If this frequency is exceeded, then the input values will be erroneous, since individual pulses will be suppressed by the input filter (of 10 kHz).

The relative measuring discrepancy gets smaller as the period time increases.

Thresholds

These thresholds are applicable for a transducer that generates one pulse per revolution. If you use transducers that generate several pulses per revolution, you must reconsider the threshold frequencies.

Counter Overflow

The counter value FF FF FF_H indicates a shortfall of the lower threshold. A diagnostic report will not be generated in this case.

Parameter Assignment

In order to use the universal input 3 as a period time counter, this must also be set as such (assigned parameters). This is performed with the STEP 7 function *Hardware Configuration*.

4.5 Data Set Description for Parameter Block of the C7 Analog I/Os and Universal Inputs

Overview

If a reassignment is to be performed during normal process operations, then the validity and inter-relationships between the individual parameters must be examined by the user program.

Incorrect value ranges of the parameters can result in incorrect behavior of the I/O. Table 4-24 lists the layout of the parameter data sets.

Table 4-24 Table with Data Set Descriptions Parameter Block

DS	Byte	Bit	Time Value	What Can Be Assigned Parameters	Meaning of the Respective Bit
0	00	0	0	Enable diagnostics AI1	0=No 1=Yes
		1	0	Enable diagnostics AI2	0=No 1=Yes
		2	0	Enable diagnostics AI3	0=No 1=Yes
		3	0	Enable diagnostics AI4	0=No 1=Yes
		4	0	Enable diagnostics AO1	0=No 1=Yes
		5..7	0	—	
	01	0	0	Enable diagn. wire break AI1	0=No 1=Yes (only if measurement range 4..20 mA)
		1	0	Enable diagn. wire break AI2	0=No 1=Yes (only if measurement range 4..20 mA)
		2	0	Enable diagn. wire break AI3	0=No 1=Yes (only if measurement range 4..20 mA)
		3	0	Enable diagn. wire break AI4	0=No 1=Yes (only if measurement range 4..20 mA)
		4..7	0	—	
	02	0..7	00_H	Reserved	
	03	0	0	Enable diagnostic interrupt for module	0=No 1=Yes
		1..7	0	–	
1	00	0..2	0	I1 Use	0=Disable (normal DI), 1=Interrupt DI, 2=CI
		3	0	Hardware interrupt	0=No, 1=Yes (always with interrupt DI) (selectable if use = 2)
		4	0	Edge	0=Rising edge, 1=Falling edge (only if not deactivated)
		5	0	Direction	0=Up, 1=Down (only if CI)
		6..7	0		
	01	0..2	0	I2 Use	0=Disable (normal DI), 1=Interrupt DI, 2=CI
		3	0	Hardware interrupt	0=No, 1=Yes (always with interrupt DI) (selectable if use = 2)
		4	0	Edge	0=Rising edge, 1=Falling edge (only if not deactivated)

Table 4-24 Table with Data Set Descriptions Parameter Block

DS	Byte	Bit	Time Value	What Can Be Assigned Parameters	Meaning of the Respective Bit
		5	0	Direction	0=Up, 1=Down (only if CI)
		6..7	0		
	02	0..2	0	I3 Use	0=Disable (normal DI), 1=Interrupt DI, 2=CI, 3=FC, 4=Period time counter
		3	0	Hardware interrupt	0=No, 1=Yes (always with interrupt DI) (selectable if use = 2)
		4	0	Edge	0=Rising edge, 1=Falling edge (only if use = 1 or = 2)
		5	0	Direction	0=Up, 1=Down (if use = 2)
		6..7	0	Gate time	0=0.1s, 1=s, 2=10s (if use = 3)
	03	0..2	0	I4 Use	0=Disable (normal DI), 1=Interrupt DI
		3	0	Hardware interrupt	0=No, (always when deactivated), 1=Yes (always with interrupt DI) (selectable if use = 2)
		4	0	Edge	0=Rising edge, 1=Falling. edge (only if not deactivated)
		5..7	00	—	
	04		0	Scan cycle time	0=16 ms, 1=continuous (approx. 2.5 ms), 6=3 ms, 7=3.5 ms, 8=4 ms..(0.5 ms increments).
	05	0..1	1	AI1 Measurement type	0=Deactivated, 1=Voltage=, 2=Current
		2	0	End-of-cycle interrupt*)	0=No, 1=Yes (only if Byte 4 <>1)
		3	0	—	
		4..7	9	Measuring range	0=Deactivated, 3=4..20 mA, 4=±20 mA (if measurement type=current) 9=±10 V (if measurement type=voltage)
	06	0..1	1	AI2 Measurement type	0=Deactivated, 1=Voltage, 2=Current
		2	0	End-of-cycle interrupt*)	0=No, 1=Yes (only if Byte 4 <>1)
		3	0	—	
		4..7	9	Measuring range	0=Deactivated, 3=4..20 mA, 4=±20 mA (if measurement type=current) 9=±10 V (if measurement type=voltage)
	07	0..1	1	AI3 Measurement type	0=Deactivated, 1=Voltage, 2=Current
		2	0	End-of-cycle interrupt*)	0=No, 1=Yes (only if Byte 4 <>1)
		3	0	—	
		4..7	9	Measuring range	0=Deactivated, 3=4..20 mA, 4=±20 mA (if measurement type=current) 9=±10 V (if measurement type=voltage)

Table 4-24 Table with Data Set Descriptions Parameter Block

DS	Byte	Bit	Time Value	What Can Be Assigned Parameters		Meaning of the Respective Bit
	08	0..1	1	AI4	Measurement type	0=Deactivated, 1=Voltage, 2=Current
		2	0		End-of-cycle interrupt*)	0=No, 1=Yes (only if Byte 4 <>1)
		3	0		—	
		4..7	9		Measurement range	0=Deactivated, 3=4..20 mA, 4=±20 mA (if measurement type=current) 9=±10 V (if measurement type=voltage)
	09	0..1	1	AO1	Output type	0=Deactivated, 1=Voltage, 2=Current
		2	0		Behavior on CPU STOP	0=Activate substitute value (word 10), 1=Retain last value
		3	0		—	
		4..7	9		Output range	0=Deactivated, 3=4..20 mA, 4=±20 mA (if measurement type=current) 9=±10 V (if measurement type=voltage)
	10		0000h	to AO1		Substitute value if byte 9 / bit 2 = 0
	11					

4.6 Examples for Programming the Analog I/Os and the Universal Inputs

Overview

The following examples for programming the analog I/O and the universal inputs of counters will help you to get familiar with the principles for programming the C7 I/O.

The three following examples are contained in this section:

- Block for scaling analog output values
- Block for scaling analog input values
- Block for programming the counters.

4.6.1 Block for Scaling Analog Output Values

Function of Block

The FC127 block is used to convert the setpoint to be specified in a memory double word as a floating point number to the corresponding hexadecimal pattern (=analog value) which must be output to a peripheral output word. For this purpose, a simple calculation using the rule of three is programmed.

1. First, the setpoint is related to the total range (RANGE_DEC) resulting from the difference (upper limit – lower limit).

   The result is a percentage of the absolute setpoint value. This is identical in the floating point number and in the hexadecimal representation.
2. Then the total range (RANGE_DEC), resulting from the difference (UL – LL) is calculated in hexadecimal representation, depending on whether the measuring range is unipolar or bipolar.
3. Now the percentage (PERCENT) calculated before is related to the total hexadecimal range (RANGE_HEX).

   The result is the absolute value to be output.
4. Finally, the lower limit (LL) is added to this value as offset.
5. The resulting bit pattern is output.

Summary of Formulae

PERCENT = (setpoint – lower limit) / (upper limit – lower limit)
RANGE_DEC = upper limit – lower limit
RANGE_HEX = UL – LL
Channel = PERCENT * RANGE_HEX + LL

FC127 Sequence of Statements

The FC127 function block contains the following statement lines:

```
FUNCTION FC 127: void

var_input
            lower limit: DWORD
            upper limit: DWORD
            setpoint: DWORD
end_var

var_temp
            LL : DWORD
            UL : DWORD
            RANGE_DEC : DWORD
            RANGE_HEX : DWORD
            PERCENT : DWORD
end_var

BEGIN

//***Case: unipolar or bipolar measuring range?***
L lower limit;              // lower limit negative?
L 0.0;                      // yes => bipolar measuring range
<R;
JC bipo;

L DW#16#0000_0000;          //unipolar range lower limit
T LL
JU comp;

bipo NOP 0
L W#16#9400;                // bipolar range lower limit
ITD;
T LL;

//***Calculating the range /hexadecimal)***
comp: NOP 0;

L W#16#6C00;                // upper limit for unipolar and bipolar
                            // range identical
ITD;
L LL;
–D;
T RANGE_HEX;                // buffer difference

//*** Relating setpoint to total measuring range***
L upper limit;              // compute range
L lower limit
–R;
T RANGE_DEC;
```

```
L setpoint;                 // relate setpoint to total
                            // range
L lower limit;
–R;
L RANGE_DEC;
/R;
T PERCENT;

//***Computing hex pattern to be output***
L RANGE_HEX;                // relate hex value to total range
DTR;
L PERCENT;
*R;
L LL;                       // add offset
DTR;
+R;
RND;                        // convert floating point number to
                            // 32-bit integer
T channel;                  // output result
```

Calling the FC127 in OB1

An example for calling the FC127 is given in the following:

Before calling the function block, the range limits and the setpoint must be reassigned to memory double words. This is necessary to enable using variable values. Normally, “upper limit” and “lower limit” are fixed values; the “setpoint” is variable.

This can be achieved by setting the “upper limit” and “lower limit” parameters in the declaration section of the FC127 to “REAL”. To enhance flexibility in a test environment, this variant has been omitted.

Sequence of Statements in OB1

```
ORGANIZATION_BLOCK OB1
var_temp
        start_info:array [0..19] of byte;
end_var;
BEGIN;

L–10.0;
T MD0;

L 10.0;
T MD4;

L 2.2;
T MD8;

CALL FC 127   (
                  lower limit:=MD0,
                  upper limit:=MD4,
                  setpoint:=MD8,
                  channel:=PQW272
              );

END_ORGANIZATION_BLOCK
```


4.6.2 Block for Scaling Analog Input Values

Function of Block

The FC126 block is used to convert the actual value entered as hexadecimal number in a peripheral input word into a corresponding floating point number (=analog value) to be output to a peripheral output word. For this purpose, a simple calculation using the rule of three is programmed.

1. First, the actual value is related to the total range (RANGE_HEX) resulting from the difference (UL – LL).

   The result is a percentage of the absolute actual value. This is identical in the floating point number and in the hexadecimal representation.

2. Then the total range (RANGE_DEC), resulting from the difference (UL – LL) is calculated in floating point number representation, depending on whether the measuring range is unipolar or bipolar.

3. Now the percentage (PERCENT) calculated before is related to the total floating point number range.

   The result is the absolute read-in value.

4. Finally, the lower limit (LL) is added to this value as offset.

5. The resulting floating point number is output.

Summary of Formulae

PERCENT=(channel – LL) / (UL – LL)
RANGE_HEX=UL – LL
actual value=PERCENT*(upper limit – lower limit) + lower limit

FC126 Sequence of Statements

The FC126 function block contains the following statement lines:

```
FUNCTION FC 126: void

var_input
            lower limit: DWORD
            upper limit: DWORD
            channel: DWORD
end_var

var_output
            actual value : DWORD
end_var

var_temp
            LL:DWORD;
            RANGE_HEX:DWORD;
            PERCENT:DWORD;
end_var

BEGIN

//***Case: unipolar or bipolar measuring range?***
L lower limit;                // lower limit negative?
L 0.0;                        // yes=> bipolar measuring range
<R;
JC bipo;

L DW#16#000_00000;            // unipolar range lower limit
T LL
JU comp;
bipo: NOP 0;

L W#16#9400;                  // bipolar range lower limit
ITD;
T LL;

//***Computing the range (hexadecimal)***
comp:NOP 0;

L W#16#6C00;                  // upper limit for unipolar and bipolar
                              // range identical
ITD;
L LL;
–D;
T RANGE_HEX;                  // buffer difference
```

```
//*** Relating actual value to total measuring range***
L channel;                      // relate input value to total
                                // range
ITD;
L LL;
–D;
DTR;
L RANGE_HEX;
DTR;
/R;
T PERCENT;

//***Computing floating point number***
L upper limit;                  // calculate floating point number range
L lower limit;
–R;
L PERCENT;
*R;
L lower limit;
+R;
T actual value;

END_FUNCTION
```


Calling the FC126 in OB1

An example for calling the FC126 is given in the following:

Before calling the function block, the range limits must be reassigned to memory double words. This is necessary to enable using variable values. Normally, “upper limit” and “lower limit” are fixed values.

This can be achieved by setting the “upper limit” and “lower limit” parameters in the declaration section of the FC126 to “REAL”. To enhance flexibility in a test environment, this variant has been omitted.

Sequence of Statements in OB1

```
ORGANIZATION_BLOCK OB1
var_temp
            start_info:array [0..19] of byte;
end_var;
BEGIN;

L10.0;
T MD4;

L –10.0;
T MD0;

CALL FC 126   (
                        lower limit:=MD0,
                        upper limit:=MD4,
                        channel:=PIW272
                        actual value:=MD8
              );
END_ORGANIZATION_BLOCK
```

4.6.3 Example for Programming Counters

Function of Block

The program is intended to implement a simple function which shows the principle of addressing the counter inputs with the STEP 7 program.

The counters are implemented to count up until the comparison value is reached. They are reset when the comparison value is reached and counting is restarted, beginning with zero. Due to the immediate reset, the specified comparison value can never be read out.

In the following program example, the universal inputs are assigned parameters as follows:

UI1	counter C1
UI2	counter C2
UI3	counter C3
UI4	standard digital input; not used in the example

The three counters are assigned parameters as follows:

interrupt:	yes
counting direction:	up
edge:	rising

Execution of block:

1. First, all three counters are stopped during startup.

   This is necessary so that the counter will start counting from zero after a complete restart. If this is not required, that is, if the counter must continue after a restart with its “old” value, the counters must not be stopped.

2. After a waiting time of about 10 ms, a comparison value is written for each counter.

   This waiting time is required so that the STOP command for the counters can become effective on the C7 module. In the complete restart OB (OB100), the times are not critical since the cycles are not monitored.

3. Immediately after the comparison value has been written, the comparison values are declared valid and the counters are started.

4. **OB1**
   The counter values can be read cyclically in OB1. The counter status bits are evaluated to ensure that the counters are active. OB1 is ended if not all counters are activated.

   If all counters are active, the read counter values are reassigned. This is an optional feature which can be useful for specific applications. If the same value must always be used within an OB1 cycle, reassignment is recommended (for example in the case of high counting frequency and relatively long cycles > more than one access in OB1 might supply different values).

5. **OB40**
   This block is used for interrupt evaluation. A jump is executed by evaluating the information of the interrupt vector register from the start-up information of OB40 (LB 8). A memory byte is incremented as a function of the counter which has triggered the interrupt. OB40 is programmed to recognize even several quasi-parallel interrupts.

6. **OB35**
   OB35 is used to generate the counter pulses. The following wiring is required to execute the example:

Connect	digital output 1.2	with	DI–X1
Connect	digital output 1.3	with	DI–X2
Connect	digital output 1.4	with	DI–X3

   In OB35, the output bits of the C7 digital outputs are toggled, and the effect is a period time of 200 ms at each output, correponding to a frequency of 5 Hz. This value results from the 100 ms default interrupt time of OB35. This means that each output is set to logic ”1” for 100 ms and then, also for 100 ms, reset to logic ”0”.

Programming Device On-Line Function

With the *Monitor/Modify Variable* function of STEP 7, the following can be monitored:

PIW280	current counter value C1
MW20	counter image C1
PIW282	current counter value C2
MW22	counter image C2
PIW284	current counter value C3
MW24	counter image C3
MB40	number of interrupts triggered by C1
MB41	number of interrupts triggered by C2
MB42	number of interrupts triggered by C3
PIB287	status of interrupts

OB100 Statement Sequence

The OB100 complete restart block contains the following statements:

```
ORGANIZATION_BLOCK OB100
var_temp
                start_info : array(0..19) of byte;
end_var
BEGIN

//***Resetting the counters***
L 0;            // explicitly stopping all counters
T PQB276;       // C1
T PQB279;       // C2
T PQB282;       // C3

CALL SFC 47     (
                      WT:=10000 // wait so that STOP becomes effective
                 );
```

```
//***Setting comparison values***
L 10;           // set comparison value C1
T PQW274;
L 20;           // set comparison value C2
T PQW277;
L 40;           // set comparison value C3
T PQW280;

//***Declaring comparison values valid and starting counter***
L 3;            // declare comparison value valid and start
T PQB276;       // C1
T PQB279;       // C2
T PQB282;       // C3

END_ORGANIZATION_BLOCK
```

OB1 Statement Sequence

OB1 contains the following statements:

```
ORGANIZATION_BLOCK OB1
var_temp
                start_info : array(0..19] of byte;
                status : BYTE;
end_var
BEGIN

//***Evaluation if all counters are active***
L PIB287;       // scan status bits
T status;

A L20.4;        // C1 signalled active
A L20.5;        // C2 signalled active
A L20.6;        // C3 signalled active
JC run;
BEU;

//***Determining counter image (optional)***
run: NOP 0;
L PIW280;       // C1
T MW20;
L PIW282;       // C2
T MW22;
L PIW284;       // C3
T MW24;

END_ORGANIZATION_BLOCK
```

OB35 Statement Sequence

OB35 contains the following statements:

```
ORGANIZATION_BLOCK OB35
var_temp
          start_info : array(0..19) of byte;
end_var
BEGIN

AN Q1.2;  // assigned to C1
=Q1.2;

AN Q1.3;  // assigned to C2
=Q1.3;

AN Q1.4;  // assigned to C3
=Q1.4;

L QW0;    // transfer QW0 immediately
T PQW0;

END_ORGANIZATION_BLOCK
```


OB40 Statement Sequence

OB40 contains the following statements:

```
ORGANIZATION_BLOCK OB40
var_temp
          start_info : array[0..19] of byte;
end_var
BEGIN

//***Determining which input has triggered interrupt***

AN L8.0;  // interrupt from C1?
JC c2;

L MB40;   // counts number of interrupts from C1 (up to 255)
INC 1;
T MB40;

c2:NOP 0;
AN L8.1;  // interrupt from C2?
JC c3;

L MB41;   // counts number of interrupts from C2 (up to 255)
INC 1;
T MB41;

c3:NOP 0;
AN L8.2;  // interrupt from C3?
BEB;

L MB42;   // counts number of interrupts from C3 (up to 255)
INC 1;
T MB42;

END_ORGANIZATION_BLOCK
```

I/O Diagnostics

5

Overview

In this section, you will learn which diagnostic messages you can select and the layout of the diagnostic buffer.

The diagnostics of the C7 analog I/O are described.

This chapter contains a statement of how you can correct the reported errors for the most important diagnostic messages of the C7 analog I/O with universal inputs.

The term “module” refers here to a unit consisting of the C7 analog I/O and the universal inputs.

Summary of Sections

5.1 Diagnostic Messages

Overview

The C7 CPU has a diagnostic buffer in which detailed information is provided for all diagnostic events in the order of their occurrence. The contents of the diagnostic buffer are preserved even after a complete reset of the C7 CPU. The diagnostic entries in the diagnostic buffer can be read and interpreted by the user program.

Advantages

Errors in the system can be evaluated after a long time delay using the diagnostic buffer in order be able to identify the cause of, for example, a STOP, or to trace and sort the occurrence of individual diagnostic events.

Diagnostic Events

Diagnostic events are, for example:

- Errors in an **I/O** (module)
- System errors in the C7 CPU
- Change of operating modes (for example, from RUN to STOP)
- Program errors in the CPU program

C7 CPU I/O Diagnostics

The I/O diagnostics are divided into two groups:

- Standard diagnostics (general malfunction of the C7 analog I/O module and universal inputs)
- Module-specific diagnostics

The standard diagnostics are always entered in the diagnostic buffer of the C7 CPU after the occurrence of a diagnostic interrupt. The precondition is an assigned module diagnostic.

The module-specific diagnostics provide detailed information regarding the type and possible cause of the error. This information can be called up by the user program by means of special system calls. The precondition is the assignment of a diagnostic enable (default setting is always “no” in this case).

Assign I/O Diagnostic Parameters

You can select whether the analog I/O diagnostic messages should be generated using STEP 7.

Using the STEP 7 application *Hardware Configuration*, you can also assign parameters to the diagnostic behavior of the analog I/O; that is, you select whether the analog I/O diagnostic messages should be sent to the C7 CPU on request. Furthermore, you can assign parameters to define whether the module should trigger a diagnostic interrupt in the C7 CPU after the occurrence of an error.

Diagnostic Information (I/O)

In the diagnostic information, a distinction can be made between permanent and temporary diagnostic errors.

- Permanent diagnostic errors cannot be influenced by the user program and can only be removed by resetting the C7 CPU (complete erase + restart) or equipment exchange (after a fault).
- Temporary diagnostic errors disappear automatically after a renewed measurement (ADC error, overrange or underrange error), can be removed by the user program (perhaps by parameter assignment during the process operations via SFC55) or by means of a manual entry at the connectors (correction of the wiring).

Read Diagnostic Messages

Diagnostic messages will be entered into the diagnostic buffer only if the diagnostic interrupt OB (OB82) occurs. The precondition is that the parameter “diagnostic interrupt enable = yes” was assigned. Then you can read out the detailed diagnostic messages in addition to the standard diagnostic information using STEP 7 (see manual **/231/**). No entry is made in the diagnostic buffer of the C7 CPU in the other cases. The diagnostic message cannot therefore be read out.

5.2 Diagnostic Data of the C7 Analog I/Os and Universal Inputs

Overview

This section describes the C7 analog I/O and universal inputs with regard to their module-specific diagnostic messages.

Analog Input Diagnostics

Table 5-1 provides an overview of the channel-specific diagnostic messages of the analog input.

The diagnostic information is allocated to the individual channels.

Table 5-1 Diagnostic Message of the Analog Input

Diagnostic Message	Analog Input
Parameter assignment error	Yes
Synchronization error	No
P short circuit	No
M short circuit	No
Wire break (only for 4..20 mA by software)	Yes
Reference channel error	No
Underrange (underflow)	Yes
Overrange (overflow)	Yes

Analog Output Diagnostics

Only one collective error exists for the analog output.
Possible causes of the collective error could be:

- Parameter error
- Substitute value is connected

Layout of Diagnostic Area of the Module

The diagnostic area consists of:

- Data set 0: the standard diagnostic bytes (0...3)
- Data set 1: the channel specific diagnostic bytes (for enabled diagnostics).
  - Bytes 4..7 and bytes 8..11 - channel and individual information – analog input (AI) diagnostics
  - Bytes 12..15 - channel information – analog output (AO) diagnostics

Table 5-2 illustrates the layout of the diagnostic area and the meaning of the individual entries.

Table 5-2 Layout of the Diagnostic Area

Byte	Bit	Meaning	Explanation	Value Range
00	0	Module fault	1 = error occurrence, 0 = everything OK	0 | 1
	1	Internal error	1 = watchdog, EPROM, ADC error	0 | 1
	2	External error	1 = error at AI or AO	0 | 1
	3	Channel error	1 = with byte 0/bit 2 and channel-specific diagnostic byte bytes 4 ...7	0 | 1
	4	External auxiliary voltage absent	—	0
	5	Front plug absent	—	0
	6	Module not assigned parameters	Base condition (standard parameters set) byte 0/bit 0=0 ****)	0 | 1
	7	Incorrect parameters	1 with bit 0 of byte 8,9,10,11 or 15 (standard parameters for channel set)	0 | 1
01	0	Module class	SM type class	0x51
02	0	—	—	0
	1	—	—	0
	2	—		0
	3	Watchdog activated	with bit 1 of byte 0 *) **) ***)	0 | 1
	4	—	—	
	5	—	—	
	6	—	—	
	7	—	—	
03	0	—	—	0
	1		—	0
	2	EEPROM error	—	0 | 1
	3		—	0
	4	ADC error	with bit 1 of byte 0	0 | 1
	5		—	0
	6	Hardware interrupt lost	—	0 | 1
	7		—	0
Channel-Specific Diagnostic Entries				
04	0..7	Channel type AI of the following channel-specific diagnostic information		71_H
05	0..7	Number of analog input channels		04_H
06	0..7	Number of diagnostic bits per channel		08_H
07		Channel Vector Channel Group AI		
	0	Change in diagnostic entry AI1	0 = no, 1 = yes	0 | 1
	1	Change in diagnostic entry AI2	0 = no, 1 = yes	0 | 1
	2	Change in diagnostic entry AI3	0 = no, 1 = yes	0 | 1

Table 5-2 Layout of the Diagnostic Area

Byte	Bit	Meaning	Explanation	Value Range
	3	Change in diagnostic entry AI4	0 = no, 1 = yes	0 | 1
	4..7	—		0000
08		Channel-Specific Diagnostic Byte AI1		
	0	Parameter error in parameters for channel	0 = no, 1 = yes *)	0 | 1
	1..3	—		–
	4	Wire break in software	0 = no, 1 = yes (only for 4..20 mA)	0 | 1
	5	—		–
	6	Measurement underrange	0 = no, 1 = yes (underflow)	0 | 1
	7	Measurement overrange	0 = no, 1 = yes (overflow)	0 | 1
09		Channel-Specific Diagnostic Byte AI2		
	0	Parameter error in parameters for channel	0 = no, 1 = yes *)	0 | 1
	1..3	—		–
	4	Wire break in software	0 = no, 1 = yes (only for 4..20 mA)	0 | 1
	5	—		–
	6	Measurement underrange	0 = no, 1 = yes (underflow)	0 | 1
	7	Measurement overrange	0 = no, 1 = yes (overflow)	0 | 1
10		Channel-Specific Diagnostic Byte AI3		
	0	Parameter error in parameters for channel	0 = no, 1 = yes *)	0 | 1
	1..3	—		–
	4	Wire break in software	0 = no, 1 = yes (only for 4..20 mA)	0 | 1
	5	—		–
	6	Measurement underrange	0 = no, 1 = yes (underflow)	0 | 1
	7	Measurement overrange	0 = no, 1 = yes (overflow)	0 | 1
11		Channel-Specific Diagnostic Byte AI4		
	0	Parameter error in parameters for channel	0 = no, 1 = yes *)	0 | 1
	1..3	—		–
	4	Wire break in software	0 = no, 1 = yes (only for 4..20 mA)	0 | 1
	5	—		–
	6	Measurement underrange	0 = no, 1 = yes (underflow)	0 | 1
	7	Measurement overrange	0 = no, 1 = yes (overflow)	0 | 1
12	0..7	Channel type AO of the following channel-specific diagnostic information		73_H
13	0..7	Number of analog output channels		01_H
14	0..7	Number of diagnostic bits per channel		00_H
15		Channel Vector for Channel Group AO		

Table 5-2 Layout of the Diagnostic Area

Byte	Bit	Meaning	Explanation	Value Range
	0	Collective error in AO1	0 = no, 1 = yes *****)	0 | 1
	1..7			0000000

*) Analog inputs will be reset until the channel functions again. (Exception: parameter assignment for wire break check for setting <>4...20 mA) AI=7FFFH

**) Analog output will be reset until channel functions again AO=0 V 0 mA

***) Counters will be reset until channel functions again CI=FFFFH, FC/IC= FFFFFFH

****) No hardware interrupt, no diagnostic interrupt, no disturbance on the analogI/O bit 0 of byte 0 =0.

*****) A group error is set if a substitute value is assigned for the analog output and this value is used.

5.3 Constraints and Responses of the Diagnostic Evaluation

Overview

The diagnostic entries are interdependent. For example, the message for the error “wire break” can only become effective if the diagnostic entries “external error” and ”channel error” are set simultaneously.

Constraints for Error Entry

These interactions are illustrated in Table 5-3.

Table 5-3 Constrants and Interactions of the Error Entries

Byte0 / Bit 0 = 1 Module error			
	Byte0 / Bit 1 = 1 Internal error		
		Byte2 / Bit 3 = 1 Watchdog	(R)
		Byte3 / Bit 2 = 1 EEPROM error	(R)
		Byte3 / Bit 4 = 1 ADC error (M/R)	(R)
	Byte0 / Bit 2 = 1 External error		
		Byte0 / Bit 3 = 1 Channel error	
		Byte7 Evaluate channel vector if required	
		Wire break Byte 8, 9, 10, 11: Bit 4 = 1 channel-specific diagnostic bytes AI (E/P)	
		Underrange Byte 8, 9, 10, 11: Bit 6 = 1 channel-specific diagnostic bytes AI	(E/P/M)
		Overrange Byte 8, 9, 10, 11: Bit 7 = 1 channel-specific diagnostic bytes AI	(E/P/M)
	Byte 0 / Bit 7 = 1 Incorrect parameter		
		Byte 8, 9, 10, 11 / Bit 0 = 1 channel-specific diagnostic bytes AI	(P)
		Byte15 / Bit 0 = 1 Group error AO	(P)
Byte 0 / Bit 6 = 1 Module not assigned parameters			

Legend:

E = temporary, correction at connector
P = permanent, reset by use of correct parameter
R = permanent, remove by RESET (complete erasure and restart of C7 CPU) or exchange of equipment
M = temporary, disappears after new measurement

Reaction to Diagnostic Messages

The diagnostic messages listed in Table 5-4 refer to Table 5-3.

Table 5-4 lists the diagnostic messages and also possible reactions of the user.

Table 5-4 Diagnostic Messages and Possible Responses

Reason for the Diagnostic Message	Source of Error	Response of the Module	Possible Elimination
Module not assigned parameters	During the startup of the module, if no parameters were assigned to the C7 CPU. The “module error” bit is not set if no further error exists.	Report to C7 CPU that the module is working with default parameters (no channel-specific module diagnostics, no hardware and diagnostic interrupts).	Assign parameters to module
Module fault	Collective error (except no module parameters) of all set diagnostic bits	The error is set/reset with the subordinate diagnostic bits. If the diagnostic interrupt has been assigned, one will be generated.	See error under the grouping “module error” (Table 5-3)
Internal error	The error bit is set simultaneously with the error bits “Watchdog”, “EEPROM error”, or “ADC error”. In addition, the watchdog is activated with “EEPROM error”.		See error under the grouping “Internal error” (Table 5-3)
Watchdog	The watchdog error is identified after an internal reset of the module. The watchdog error can arise as the result of an EPROM or general module error.	With watchdog, the module adopts a safe state. 0 V is output, the measured values become $7FFF_h$ and the counter values become $FFFF_h/FFFFFF_h$.	The error cannot be corrected by the user. The module can only be restarted after a reset on the bus (restart C7 CPU).
EEPROM error	The error is identified after resetting the module during the reading of the calibration values for the compensation of the offset error of the analog I/O from the serial EEPROM.	The module adopts a safe state. 0 V is output, the measured values become $7FFF_h$ and the counter values become $FFFF_h/FFFFFF_h$.	The error cannot be corrected by the user. The module can only be restarted after a reset on the bus (restart C7 CPU) or the analog I/O must be recalibrated at the manufacturer’s factory (device exchange).
External error	The error bit is set when channel-specific errors of the analog inputs or outputs occur.	Refer to the grouping “External error” in Table 5-3.	Refer to the grouping “External error” in Table 5-3.
Channel error	A channel causes an error. The diagnosis of the error-causing channel is activated by the parameter assignment.	Refer to the grouping “External error” in Table 5-3.	Refer to the grouping “Channel” in Table 5-3.

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Table 5-4 Diagnostic Messages and Possible Responses

Reason for the Diagnostic Message	Source of Error	Response of the Module	Possible Elimination
Wire break	Precondition: The measurement range 0...20 mA has been set for the channel. If a wire break check has been assigned, then the error is identified by evaluation of the input current of the analog input channel (<1.6 mA).	An error counter will be incremented. If the error counter reaches a fixed value of 3, then the error ”wire break” is reported.	Check the connection of the appropriate measurement channel.
Overflow	The error is identified after the comparison of the measured value (including correction calculation). Measurement >=overflow range.	The bit is set and reset again when the measurement decreases.	Check the connection of the appropriate input channel or transducer.
Underflow	The error is identified after the comparison of the measured value (including correction calculation). Measurement >= neg. overflow range. That is <0 mA for 4...20 mA.	The bit is set and reset again when the measurement becomes valid.	Check the connection of the appropriate input channel or transducer.
Incorrect Parameter	The error is identified after checking the parameter after reading and processing the parameter area.	The measurement $7FFF_h$ is set in the incorrectly configured measurement channel and the corresponding diagnostic bit set or, for an output channel, 0 V /0 mA is output and the corresponding bit set. If the module had not been assigned a parameter and the parameter is corrected, then the bit “incorrect parameter” is reset and (if diagnostic interrupt = yes) a diagnostic interrupt reported to the C7 CPU.	Assign correct parameters.

Operating the C7 (General) 6

Summary of Sections

Note

The explanations in this chapter relate to the so-called "standard screens" which are supplied in a standard configuration with the configuration tool *ProTool*. The special screens are called up via the standard screens. The standard screens may be redesigned for a customized operator interface. However, the special screens are stored permanently in the C7 firmware and can therefore not be modified.

6.1 Screen Layout

Overview

One screen takes up the entire display. An example of a possible layout is shown below.

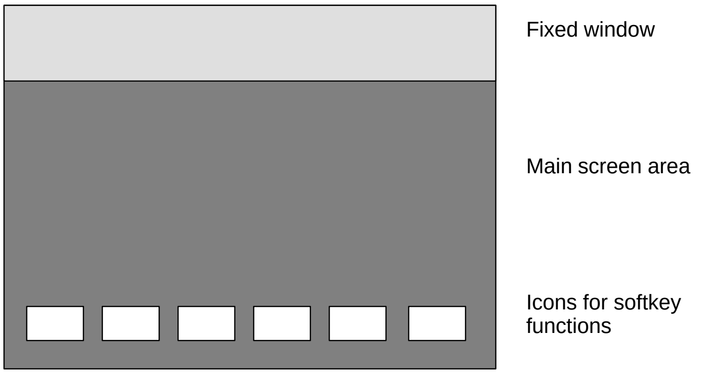


Figure 6-1 Screen Layout for the C7

Fixed Window

The fixed window provides the operator with a continuous stream of important process variables, regardless of which screen is open at the time.

Main Screen Area

The main screen area contains the actual contents of the currently opened screen.

Additional windows (for example, message windows, help windows and pop-up windows) are displayed over the main screen area and the fixed window.

Icons

Icons symbolize softkey functions related to specific screens.

6.2 Keyboard

Keyboard

The keyboard of the C7 consists of three functional blocks (see Figure 6-2):

- Function keys K1...K10
- Softkeys F1...F14
- System keys

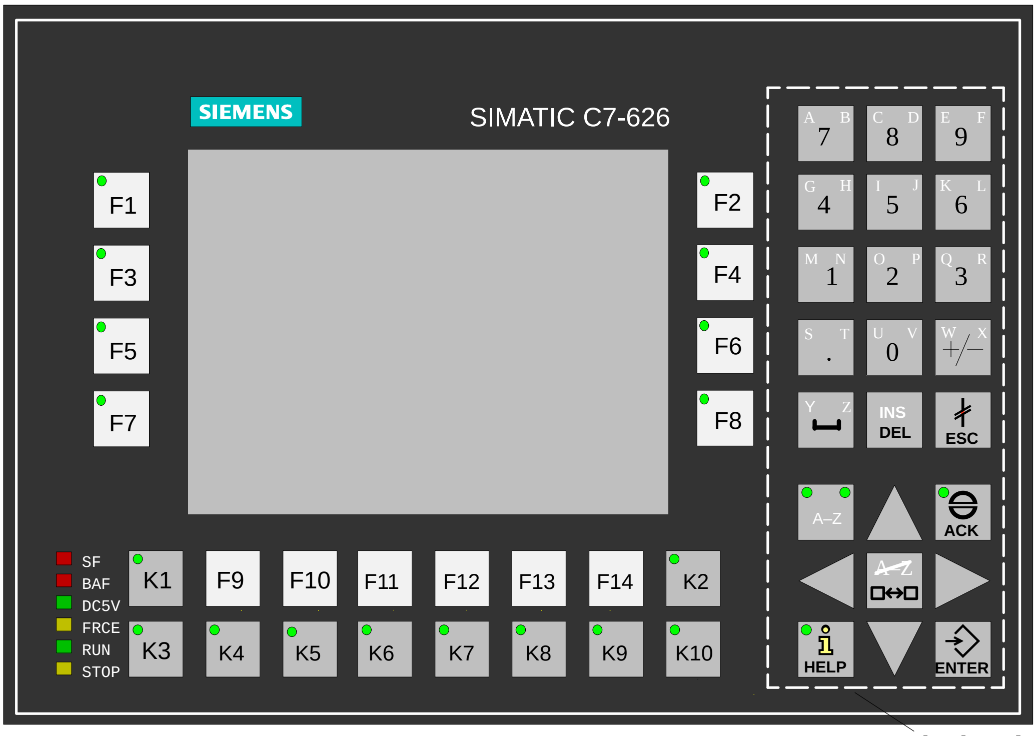


Figure 6-2 C7-626 or C7-626 DP with Keyboard and Display

Function Keys

The **function keys** K1...K10 always trigger the same actions on the C7 OP or C7 CPU, regardless of the picture currently displayed (global meaning on the C7 OP).

These actions can be, for example:

- Calling up a screen
- Displaying the current alarm messages
- Starting a printout of a screen (hardcopy)
- Displaying the time window

Softkeys

The softkeys F1...F14 have a specific (local) meaning according to the picture displayed.

The function of a softkey can vary from screen to screen. When a screen is open, a softkey's function is shown by an icon at the edge of the screen.

System Keys

With the system keys, you make entries on the C7 OP. The key block is marked with the system keys in Figure 6-2. The functionality of the individual keys is explained in Table 6-1.

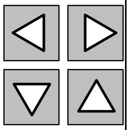
Key Functions

The control keys of the C7 OP have the following functions:

Table 6-1 Key Functions

Key	Function	Description
A–Z	**SHIFT key**	This key is used to switch the input keys from numeric to alphanumeric. The key is equipped with two LEDs which indicate the current status. No LED is on. • Numeric assignment of the input keys is active. • Alphanumeric assignment of the input keys becomes active when this key is pressed once. One of the two LEDs (left or right) is on. • Left or right alphanumeric assignment of the input keys is active. • Input key assignment alternates between the left and right alphanumeric assignment each time this key is pressed.
A–Z ◻↔◻		• Switches the active window • Switches from alphanumeric assignment of the input keys back to numeric assignment
INS DEL		• Activates edit mode • Deletes/inserts individual characters
ESC	**Cancel key (ESCAPE)**	This key cancels already started actions. Some examples are listed below. • Delete an already entered character for a value input • Delete a queued system message
ACK	**Acknowledge-ment key**	This key acknowledges the currently indicated alarm message or all messages of an acknowledgement group. The LED remains on as long as an unacknowledged alarm message is queued.

Table 6-1 Key Functions

Key	Function	Description
	**Info key (HELP)**	This key is used to open a window containing a help text for the selected object (for example, message, input field). The LED goes on when a help text is available for the selected object. The help window is closed by pressing any key.
	**ENTER key**	• Accepts and exit an entry • Opens the pop-up window for a symbolic entry
	**Cursor keys**	• Moves the cursor to the individual input fields in a screen • Move the cursor within an input field • Select an entry from the message buffer • Select a value from the pop-up window

---

Note

Pressing several keys at the same time may lead to incorrect entries.

6.3 Input / Output Fields

Overview

The screens on the C7 contain different types of input / output fields.

- Numeric fields (digital or analog)
- String fields
- Symbolic fields

Procedure

The basic procedure for entering values on the C7 OP is described below.

1. Using the cursor keys, position the cursor on the desired input field.
2. Enter the value. The method of entry varies depending on the type of field. See the following subsections for information on handling the individual fields.
3. Confirm the entry with the ENTER key.

Correcting / Canceling Entries

The following means of correction are available before the entry is applied.

- Using the INS/DEL key, insert / delete single characters where the cursor is positioned. Then use the ENTER key to confirm the correct value.
- Cancel the entry with the ESC key.

  The original value is then automatically rewritten in the field. Enter the correct value, and confirm with the ENTER key.

Edit Mode

An edit function is available which can be used to edit existing entries.

1. Position the cursor on the desired input field.
2. Activate edit mode by pressing the INS/DEL key.

   In contrast to input mode, the indicated value is retained.
3. Move the cursor to the appropriate position of the input field.

   Using the INS/DEL key, insert / delete characters where the cursor is positioned.
4. Confirm the entry with the ENTER key.

   The entry can be canceled with the ESC key. The old value is indicated again.

6.3.1 Numeric Fields

Input Mode

The shape of the cursor changes in input mode. Input starts at the right-hand edge of the input field. Digits are shifted to the left similar to a pocket calculator.

Entry

To make entries in a numeric field, proceed as follows:

Step		Key	Description
1	Enter decimal value	0 (U V) .. 9 (E F) +/– (W) , . (S T)	
	Enter hexadecimal value	7 (A B) .. 9 (F) 0 (U V) .. 9 (E F)	The characters A to F must be entered in alpha mode.
	Enter digital value	0 (U V) , 1 (M N)	
2	Confirm entry	ENTER	• The entered value becomes valid. • The entry becomes invalid if the entered value violates a configured limit value or an incorrect entry is made. The "old" value is retained.
	or		
	Cancel entry	ESC	The "old" value becomes valid again.

6

Correcting Entries

If you have made a mistake and have not yet confirmed the entry, proceed as follows:

IF ...	THEN ...
Wrong digit	◁ ▷ Position the cursor on the digit and overwrite. (The cursor remains on this position.)
One digit too many	INS DEL Delete the digit at the cursor position and consolidate the input from the left.
One digit too few	1. A–Z Switch to alpha mode. 2. INS DEL Insert a blank where the cursor is positioned and shift the entry to the left starting at the cursor position. 3. A–Z Switch back to numeric assignment of the input 4. Overwrite blank.

6.3.2 String Fields

Both numeric characters (digits) and alphanumeric characters (letters of the alphabet) can be entered in a string field. Strings may also contain blanks.

The cursor changes shape in input mode. The entry starts at the left edge of the input field. The cursor jumps one position to the right each time a character is entered.

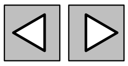
Entry

To make entries in a string field, proceed as follows:

Step		Key	Description
1	Enter digits	0 (U V) .. 9 (E F) +/– (W) , . (S T)	If necessary, switch back from alpha mode.
	Enter letters	A–Z 7 (A B) ... ␣ (Y Z)	Switch to alpha mode.
2	Confirm entry	ENTER	• The entered string becomes valid. • Switch back from alpha mode.
	or		
	Cancel entry	ESC	• The input cursor is deleted. • Switch back from alpha mode. • The “old” string becomes valid again.

Correcting Entries

If you have made a mistake and have not yet confirmed the entry, proceed as follows:

IF ...	THEN ...
Wrong character	 Position the cursor on the character and overwrite. (The cursor jumps one position to the right after the overwrite.)
One character too many	INS DEL — Delete the character at the cursor position and consolidate the input from the right.
One character too few	1. A–Z — Switch to alpha mode. 2. INS DEL — Insert a blank where the cursor is positioned and shifts the entry to the right starting at the cursor position. 3. Overwrite blank.

Example of a String Entry

You want to enter “valve 05”. Proceed as follows:

Key	Display
A–Z (● ○)	█
A–Z (○ ●) , U V	V █
A–Z (● ○) , E F	VA █
A–Z (○ ●) , M N	VAL █
S T	VALV █
A–Z (● ○) , I J	VALVE█
A–Z (○ ●) , K L	VALVE █
A–Z / □↔□ , ␣	VALVE █
0	VALVE 0█
5	VALVE 05█
ENTER	Confirm entry

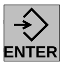
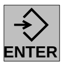
6

6.3.3 Symbolic Fields

Entries in symbolic fields are made with a pop-up window indicating the entries available for this field.

Entry

To make an entry in a symbolic field, proceed as follows:

Step		Key	Description
1	Open pop-up window		
2	Select entry	 	
3	Confirm entry		• The value belonging to the selected entry becomes valid. • The pop-up window is closed.
	or		
	Cancel entry		• The “old” value becomes valid again. • The pop-up window is closed.

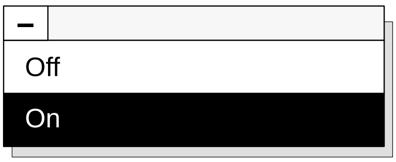
Example

You want to use a symbolic entry to turn on mixer 3.

The pop-up window appears.

Mixer 3 is marked “off”.

You select mixer 3 “on”.



The entry you selected is confirmed (that is, accepted).

6.4 Switching the Active Window

Overview

Several windows can be displayed at the same time on the C7.

To use them, you can switch between the individual windows.

Switches between the following windows are possible.

- Main screen
- Fixed screen
- Message line and message window

Selecting a Window

Use the middle cursor key to select the window in which you want to work or make entries.

Key	Description
	Each time you press this key the cursor jumps from one window to the next.

The window in which the cursor is located is the active window in which you can make entries or perform other operations.

Restrictions / Special Features

You cannot switch to windows which do not contain input fields.

Exceptions: Message line, message window and message page

For these exceptions, the cursor is positioned on the first message. You can then select the information text pertaining to the message.

Information Key

How to use the information key

- The first time the key is pressed

  The information text pertaining to the selected field or message is displayed.
- The second time the key is pressed

  The information text pertaining to the main screen is displayed.

Static and Dynamic Windows

The position of the displayed window is static on the C7.

When an alarm message window or a pop-up window is displayed, for example, an entry field hidden by the window cannot be used.

Generally, entries on the C7 cannot be made unless all windows are closed.

6.5 C7 System Settings

Overview

The functions described in this section can be used to configure the C7 to your requirements.

The following can be set:

- Operating modes of the C7
- Various message functions
- Date/time
- Language
- Brightness, contrast, blanking circuit
- Printer parameters

6.5.1 Standard Screen: System Settings

Overview

The following settings can be made in the *System Settings* standard screen.

- Operating modes: normal operation, on-line/off-line, transfer mode, MPI transfer
- Message indication: first (oldest) or last (latest) alarm message
- Switch message logging on/off
- Set current date and time
- Switch buffer overflow warning on/off
- Choice of up to 3 languages
- Blanking of the display
- Select backup/restore standard screen

Layout of the standard screen:

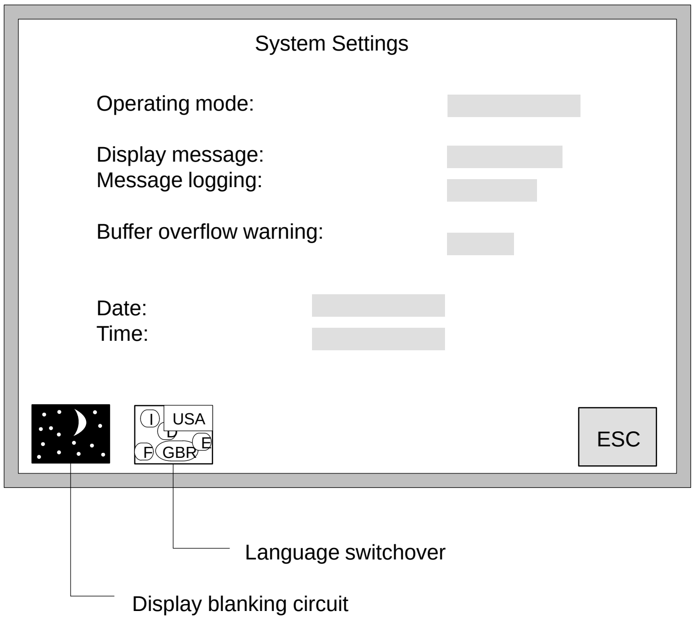


Figure 6-3 Standard Screen for System Settings

6.5.2 Standard Screen: Printer Settings

Overview

The type of printer and the transfer parameters can be specified on the C7 with the standard screen entitled *Printer Settings*.

The printer and the C7 must have the same transfer parameters.

The standard settings are listed below.

Transmission rate:	9600
Data bits:	8
Stop bits:	1
Parity:	None

Printer Screen

This standard screen can be used to set the following parameters:

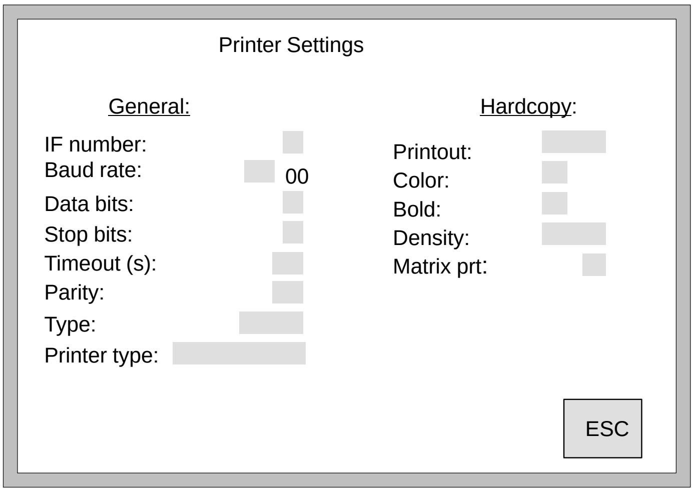


Figure 6-4 C7: Standard Screen for Printer Settings

6.5.3 Blanking Circuit

Lifespan of CCFL Tubes

The background illumination of the display uses a CCFL tube (**C**old **C**athode **F**luorescent **L**amp).

For technical reasons, the brightness of these CCFL tubes decreases with use.

The average lifespan is given as 20,000 hrs by the manufacturer of the display.

An automatic blanking circuit can be used to increase the useful life of CCFL tubes.

Blanking Circuit

This blanking circuit can be configured via ProTool.

If no key is pressed within a configured period of time, the display background illumination is switched off automatically.

Canceling the Blanking Circuit

The background illumination goes on again automatically when any key is pressed.

6.5.4 Contrast and Brightness Adjustment

The following can be adjusted at any time on the C7 during operation:

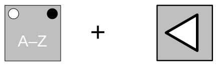
- Display contrast
- Brightness of the display background illumination

Press one of the key combinations shown below simultaneously:

Display Contrast

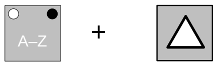
Higher

Lower



Brightness of the Display Background Illumination

Higher



Lower:

6.6 Setting / Changing the Operating Mode

Overview

The C7 OP recognizes the following operating modes.

- Normal operation, on-line/off-line
- Transfer mode

Normal Operation, On-Line

This is the standard operating mode for unrestricted manipulation and visualization of the processes.

The C7 OP and the C7 CPU exchange data with one another.

Normal Operation, Off-Line

Communication with the controller does not take place in this operating mode.

Process manipulation and visualization are not possible. Entries can still be made on the C7 OP.

Transfer Mode

Configuration data can be downloaded from the programming device/PC to the C7 OP in transfer mode.

Entries cannot be made on the C7 OP in this operating mode.

MPI Transfer

If MPI transfer is configured, configuration data can be transferred to the C7 OP via an MPI link.

Setting / Changing the Operating Mode

You can set or change the operating mode of the C7 OP either on the C7 OP or via a job from the C7 CPU.

The current operating mode is stored by the C7 OP and cannot be lost during a power failure. After the power is switched on, the C7 OP returns to the operating mode which was last set.

During Operation

Setting or changing the operating mode can be performed in the *System Settings* standard screen, for example.

During Startup

You can use key combinations during C7 OP startup to set the operating modes shown below.

Key Combination	Description
ESC + △	Transfer mode (serial transfer) You can exit transfer mode with ESC as long as no data transmission between the programming device/PC and the C7 OP is running.
ESC + A–Z □↔□	Alternate (toggle) between on-line and off-line operation.
ESC + ▷ + ▽	Reset C7 OP: Firmware and configuration are deleted; a serial transfer is then required via the V.24 interface.

6.7 Password Protection

Overview

The function keys, softkeys, and input fields can be protected with passwords (that is, only authorized persons can use these keys and fields).

Password, Password Level

A protected function cannot be used without first entering a password with a certain password level. This password level determines the access rights of the operator.

The required password level is specified during configuration and can be a number from 0 (lowest level) to 9 (highest level).

Super User

This super user has a level-9 password which is especially specified for this purpose during configuration. It permits all operator actions.

The super user password can be changed in the configuration.

Password Screen

A standard screen called *Password Processing* is available for entering passwords and assigning passwords/levels.

Password List

You can look at the passwords in a password list.

6.7.1 Logging In on the C7

There are two ways to log in on the C7.

- Using the standard screen
- Using a login window which is displayed automatically.

Login via Standard Screen

Proceed as follows:

1. Call up the standard screen *Password Processing*.

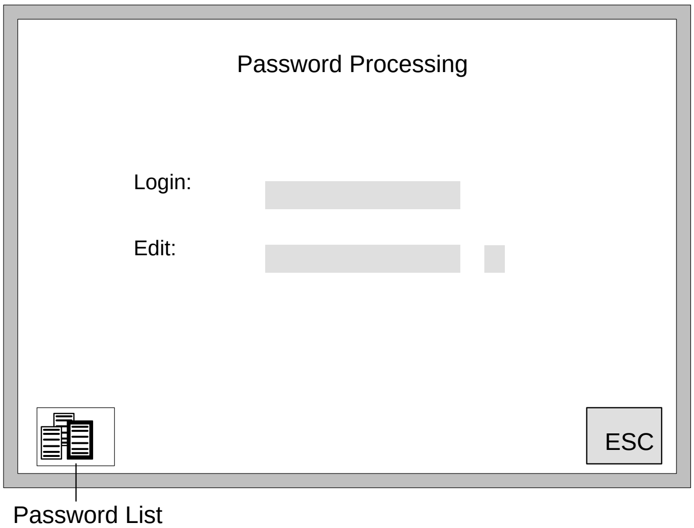


Figure 6-5 Standard Screen: Password Processing

2. Enter your personal password in the *Login:* field.

After you have entered a valid password and your entry has been accepted, the assigned password level is indicated.

You can now use all functions assigned to this level or a lower password level.

Login via Login Window

A login window appears automatically if you want to make an entry or use a function which requires a higher password level than the current one.

After you have entered a valid password, a jump is made back to the place at which you attempted to make an entry or use a function.

You can now repeat your entry.

6.7.2 Logging Out on the C7 (Logout)

Logout via Standard Screen

Call the standard screen *Password Processing.*

Enter any character string (in other words, an invalid password) in the *Login:* field.

After your entry has been accepted, you can only use functions with password level 0.

Automatic Logout

The operator is automatically logged out if no operator actions are performed on the C7 within a period of time specified during configuration.

6.7.3 Password Management

Password management includes the following activities.

- Assigning up to 50 different passwords
- Assigning a password level to each password
- Changing existing passwords and password levels
- Deleting passwords
- Viewing the passwords already assigned in a password list

Login

Enter a valid password in the password screen.

After the entry has been accepted, you can assign, change and delete passwords in the *Edit:* field.

Access Rights

You only have access rights to passwords whose level is equal to or less than the level under which you are logged in.

Define New Password

Proceed as follows.

1. Enter a non-existent password in the *Edit* field. You can use up to 8 characters.
2. Enter a password level (from 1 to 8).

After your entries have been accepted, the new password is stored in a memory of the C7 OP which is safe from power failure.

Change Password/ Password Level

Proceed as follows.

1. In the *Edit* field: Enter the password which you want to change or to which you want to assign a new password level.
2. Change password:
   Delete old password.
   Then enter new password.
   (You cannot change the password directly.)

   Change password level:
   Overwrite old password level with the new one.

Delete Password

Proceed as follows.

1. In the *Edit* field: Enter the password you want to delete.
   The C7 indicates the password level assigned to the password.
2. Overwrite the password level with zeros.
   After the entry is accepted, the password is deleted.

View Password List

The password list is called from the *Password Processing* standard screen with a softkey.

The passwords and their assigned level are displayed in a pop-up window.

Note

Only those passwords are displayed whose password level is less than or equal to the level in which you are currently logged in.

If there are so many passwords that they cannot all be displayed at the same time, you can scroll through the display with the cursor keys.

6.8 Hardware Test

The following function units can be tested with the C7 OP hardware test.

- Internal memory and memory module interface
- Serial interfaces
- Keyboard and display
- Internal function units
  (for example, watchdog or real-time clock)

Calling the Test Program

While turning on the power supply of the C7, press the

◁ ▽ ▷ cursor keys simultaneously, and keep them

pressed until the test menu is indicated.

Test Sequence

The test program provides a series of individual tests, each of which can be started with a function key (F9 to F14 and K1 to K10).

The test results appear on the display after an individual test is concluded.

OK : No errors

DEF : The tested function unit is defective.

Exiting the Test Program

The test program can only be exited by switching off the power supply of the C7.

Standard O/I Functions

7

Summary of Sections

7.1 Screens

Overview

Logically related process values are combined into screens. Graphic elements illustrate the relationships between these values. The individual screens provide a quick overview of a process or a system. In addition to showing what is happening in the process, screens can also be used to control the process by entering new process values.

7.1.1 The C7 in Action Using an Example

The C7 OP is to control and monitor a plant which mixes and bottles various fruit juices. Plant functions are divided roughly into the mixing and bottling stations.

Mixing Station

The ingredients for the juices are stored in three tanks. The ingredients are mixed in certain proportions depending on which fruit juice is to be produced.

Bottling Station

After the juice is mixed, a valve is opened, and the finished fruit juice flows into a filling tank and is then bottled. The bottles are transported on a conveyor belt. Before being filled, they are checked for glass breakage. After being filled, the bottles are sealed, labelled and palletized.

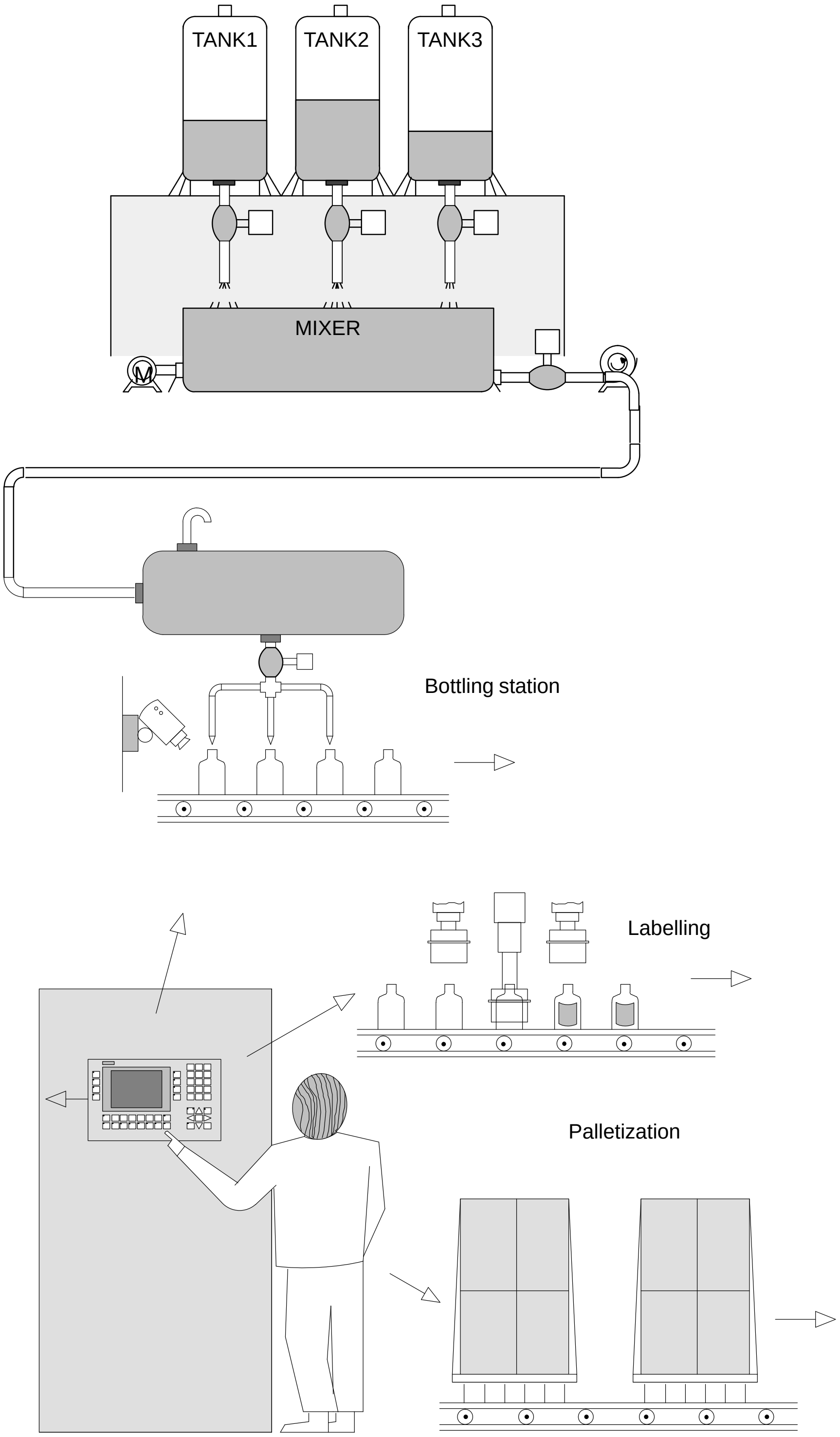


Figure 7-1 Mixing and Bottling Stations

7.1.2 Screen Elements

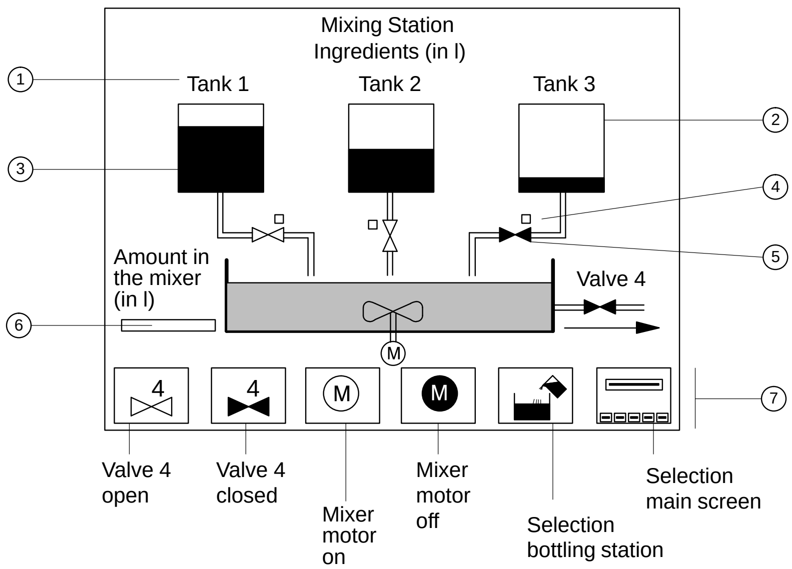
Screens on the C7 are made up of various screen elements. Some examples are listed below.

- Fixed texts
- Semigraphic characters
- Input fields for process values
- Output fields for process values
- Bars
- Curves
- Symbolic graphics

We will use the mixing station of the fruit juice plant to show you the various screen elements.

Screen Elements of the Sample Screen

The screen might look something like this:



1. Fixed text
2. Semigraphic (corresponding to tank)
3. Bar shows filling level of the tank graphically.
4. Symbolic input field to open and close the valve
5. Symbolic graphic shows the status of the valve (that is, open or closed)
6. Numeric output field
7. Icons for the softkey functions

Figure 7-2 Figure 7–2Sample Screen for a Mixing Station

7.1.3 Selecting a Screen

Overview

You can select a screen in the following ways:

- Via a function key (softkey)
- Via an appropriately configured input field
- Via a job from the controller

Via Function Key

You can open a certain screen by pressing a function key (or a softkey).

Via Input Field

A screen is opened after an entry has been executed in an input field configured for the selection of this screen.

Via Job from the Controller

When the state of the process/plant requires, the controller causes a screen to be selected on the C7.

7.1.4 Standard Screens

The C7 comes already equipped with standard screens. You can use these standard screens for your configuration, or adapt them to fit your application.

Main Screen

The standard screens are called from a main screen via softkeys.

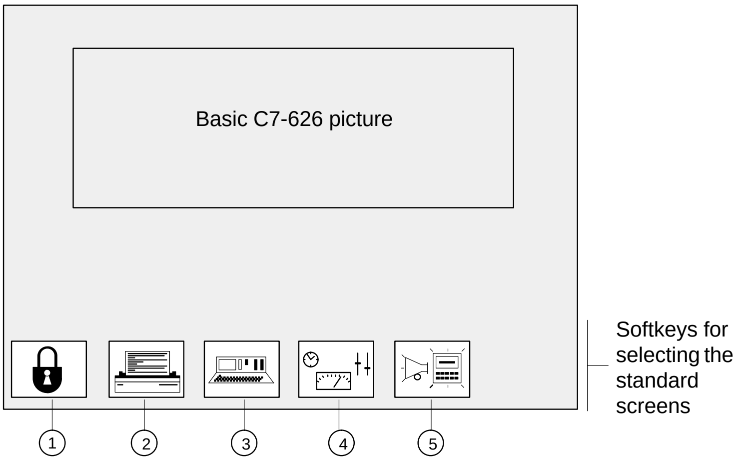


Figure 7-3 Basic Picture (Example)

① Password processing

② Printer settings

③ Status variable

④ System settings

⑤ Message processing

For detailed information on the function and use of the standard screens, see the relevant sections in this manual.

7.2 Messages

Overview

Messages inform the operator of certain occurrences by displaying a text.

There are three types of messages.

- **Event messages** indicate process states during normal operation of the system.
- **Alarm messages** indicate malfunctions/interruptions in the process.
- **System messages**

  In contrast to event and alarm messages which contain process-related information, system messages provide information on internal operating states/errors of the C7.

7.2.1 Event and Alarm Messages

Event and alarm messages provide information on normal or critical process states by indicating message texts. The message texts may also contain current measured values.

Below are two examples showing the differences between event and alarm messages.

Event Messages

The fruit juice plant has finished a mixing procedure. An event message informs the operator of this. The event message might look something like this:

```
Mixing procedure finished
Juice in the mixer: 5000 l
```

Alarm Messages

The operator would now like to start the bottling procedure but has forgotten to open the filling valve. The controller automatically stops the bottling procedure and outputs an alarm message. The alarm message might look something like this:

```
Bottling procedure terminated
Filling valve is closed !
```

Because of their urgency, alarm messages must be acknowledged to ensure that the operator has noticed the message.

Acknowledgement can also be performed by the controller.

7.2.2 General Features

Available Methods of Indication

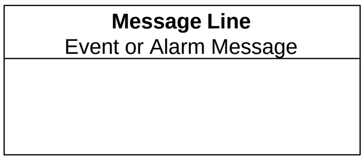
The C7 offers the following ways of indicating event and alarm messages.

Message Line, Message Window

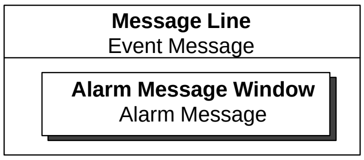
You can indicate a current event or alarm message in a message line or in a message window.

You can configure one of the following combinations:

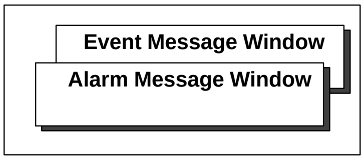
- Indicate an event or alarm message in the message line



- Indicate an event message in the message line and an alarm message in the message window



- Indicate an event/alarm message in the appropriate message window



Event Message Page, Alarm Message Page

The operator can look at all still queued event messages or alarm messages on the appropriate message page.

Message Buffer

The C7 OP stores all messages in a battery-buffered memory. The operator can look at these stored messages.

Indication Priorities

Each message is given a priority during configuration. This priority determines the importance of the message.

- When several messages are queued, the message with the highest priority is indicated first.
- When several, unacknowledged alarm messages are queued, either the **first** (that is, the oldest) or the **last** (that is, the latest) message is indicated.

  The operator can change the configured type of indication (*first/last*).
- When several event messages with the same priority are queued, the latest is indicated.

Message States

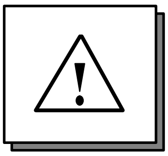
Message occurrences may assume the following states:

Arriving	Marks the occurrence of the message.
Departed	Cause of the message no longer exists.
Acknowledged	Only for alarm messages. The operator or the controller has recognized the message and confirmed it.

The C7 acquires these message states with the precise time and outputs them when a message page or the message buffer is indicated.

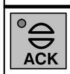
Message Indicator

At least one alarm message is still queued when this symbol appears on the C7 display.



Acknowledge Alarm Messages

Alarm messages must be acknowledged by either the operator or the controller.

Key	Description
	Confirm indicated alarm message

After acknowledgement, the next unacknowledged message (if one exists) is then displayed.

Acknowledgement Groups

You can combine messages into **acknowledgement groups**.

When the indicated message belongs to an acknowledgement group, its acknowledgement automatically acknowledges all other alarm messages of this acknowledgement group.

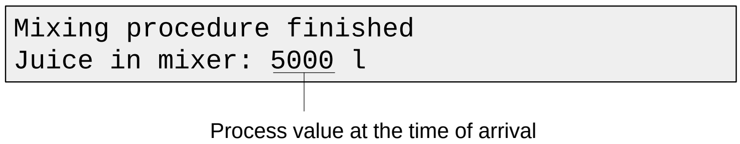
7.2.3 Current Messages

Message Line

The message line is always present regardless of which screen is selected.

Depending on your configuration, event messages and/or alarm messages are displayed in the message line.

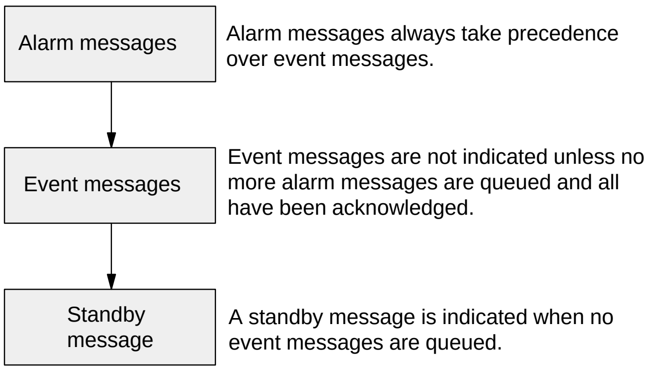
Example of an event message:



Flashing Alarm Messages

Alarm messages flash to distinguish them from event messages.

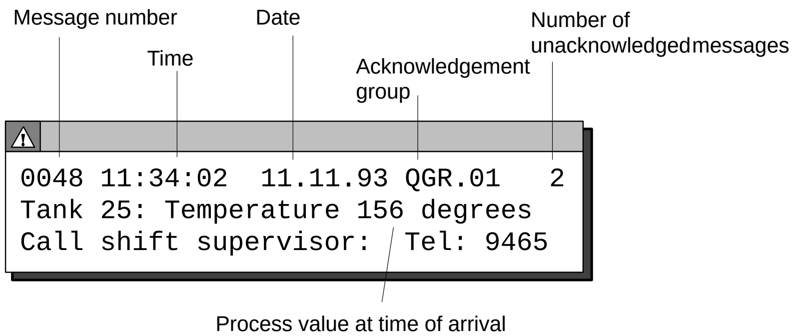
Indication Priorities



Message Window

In addition to the message text, messages in a message window contain other information (for example, message number and date/time of the arrival of a message).

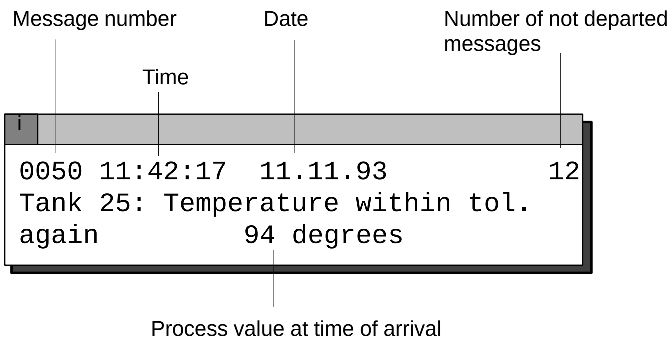
Example of an alarm message window:



Event Message Window

The event message window is not automatically displayed. It must be selected by the operator or the controller and then deselected again later.

A standby message is displayed when no current event message is queued.



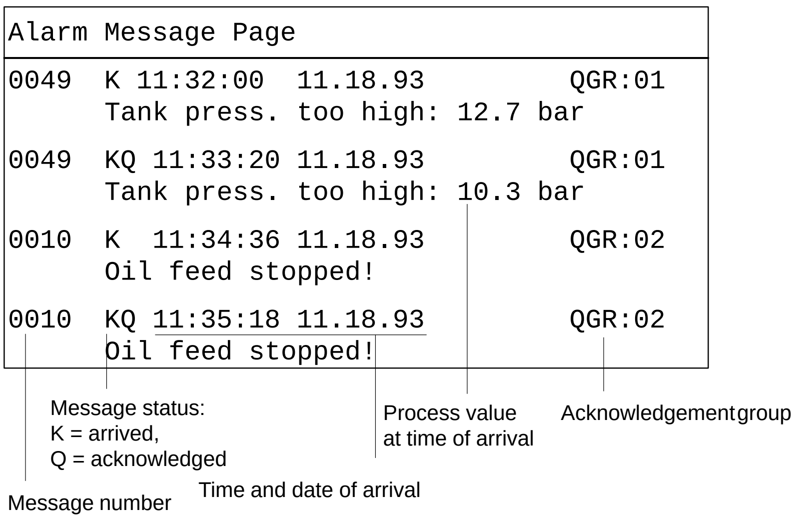
Alarm Message Page, Event Message Page

The message pages give the operator an overview of the still queued (that is, not yet departed) alarm or event messages.

The event message page or the alarm message page can be selected on the C7 or via the controller.

The individual message occurrences are sorted by **indication priority**, and alarm messages are listed by **first/last** setting.

Example of an alarm message page:



If all messages do not fit on the display at the same time, you can scroll the contents of the message page up/down with the ▽ , △ cursor keys.

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The message page contains the following information for each message occurrence.

- Message number
- Message status with date and time

  The C7 updates the message status display (for example, *K* for arriving, *Q* for acknowledged).
- Acknowledgement group to which an alarm message belongs
- Message text, with process values if applicable

  When a message contains process values, the C7 indicates these values as they were when the state occurred or stopped occurring (that is, time of arrival or time of departure).

  The C7 does not acquire current process values after the message has been acknowledged.

To Message Buffer and Back

You can switch back and forth between indication of the message page and the message buffer by repeatedly pressing the function key which you used to call the alarm message page/event message page.

Message Logging

All message occurrences are logged directly on a printer (if message logging is switched on and a printer is connected).

7.2.4 Stored Messages

The C7 stores all message occurrences in a battery-buffered memory.

This allows you to display the messages at a later date.

Alarm Message Buffer, Event Message Buffer

The stored message occurrences are indicated in the alarm message buffer or the event message buffer, depending on what type of message they are.

A buffer page can be selected on the C7 or via the controller.

All messages are indicated **in the order in which they occurred.** The latest message is shown at the top of the display.

Example of indicating the alarm message buffer:

```
Alarm Message Buffer
0010  KGQ11:38:04 11.18.93        QGR:02
      Oil feed stopped!
0010  KQ 11:35:18 11.18.93        QGR:02
      Oil feed stopped!
0049  KGQ11:34:09 11.18.93        QGR:01
      Tank press. too high: 9.3 bar
0049  KQ 11:33:20 11.18.93        QGR:01
      Tank press. too high: 10.3 bar
0049  K  11:32:00 11.18.93        QGR:01
      Tank press. too high: 12.7 bar
```

Message status:
K = arrived,
G = departed,
Q = acknowledged

Process value

Acknowledgement group

Time and date of arrival

Message number

If a message text contains process values, the C7 indicates these values as they were when the message occurrence arrived and departed.

Otherwise, the information is identical to that of the event message page or alarm message page.

Deleting the Buffer

The event message buffer/alarm message buffer can be deleted by operator input on the C7 or via the controller.

Exceptions:

- Queued messages
- Not yet acknowledged alarm messages

Buffer Overflow

The C7 stores message occurrences in a common memory area for event and alarm messages (the so-called message buffer).

If there is only a certain amount of memory space left in the message buffer (that is, remaining buffer space), the C7 can display a system message to that effect.

If there is no space left in the message buffer and new messages arrive, the C7 continues deleting message occurrences from the message buffer until a certain remaining buffer space is available again.

The oldest message occurrences are deleted in the following order.

1. Event messages which have already departed.
2. Alarm messages which have departed and have been acknowledged.
3. Event messages which are queued.
4. Alarm messages which are queued.

A forced printout of the deleted messages is made (if **overflow** was configured as on, and a printer is connected).

7.2.5 Standard Screen: Message Processing

Layout

Event and alarm messages can be processed with the standard screen *Message Processing*.

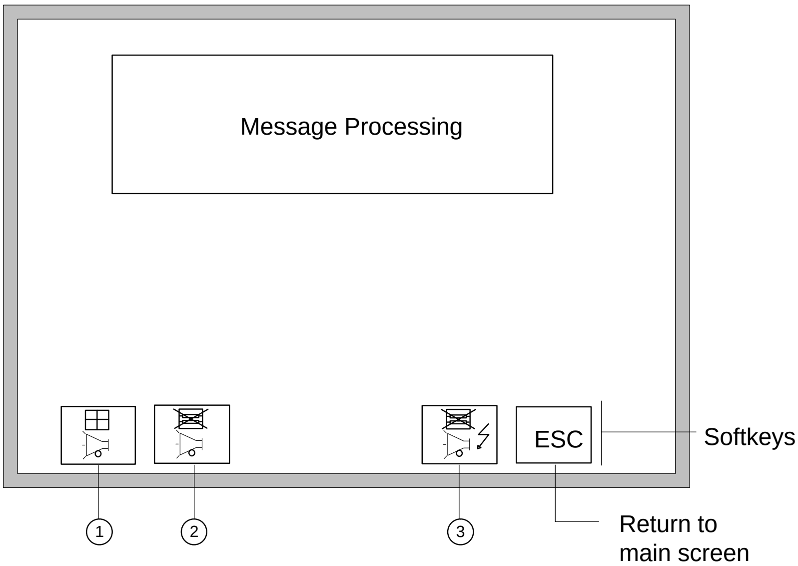


Figure 7-4 Standard Screen: Message Processing

Uses

The softkeys have the following meaning:

① Open event message window

② Delete event message buffer

③ Delete alarm message buffer

In addition, the following functions can be selected via function keys.

K1 Open event message page, alternate between indicating the event message page and the event message buffer

K2 Open alarm message page, alternate between indicating the alarm message page and the alarm message buffer

7.2.6 System Messages

Overview

System messages inform you of certain internal operating states of the C7 OP. The messages include everything from informational notes to serious and fatal error messages.

System messages can be caused by the following:

- Operator errors

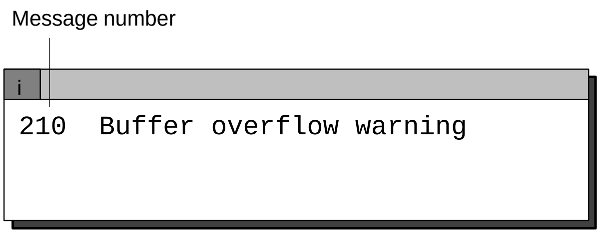
  (for example, illegal entries)
- System errors

  (for example, disturbed communication between C7 OP and C7 CPU)

System Message Window

As soon as a certain operating state/error occurs, the C7 OP automatically displays a window containing a system message.

Example of a system message window:



A system message consists of a message number and a message text. The message text can also contain internal system variables which help to localize the cause of the error message.

Some system messages expect a confirmation from or a decision by the operator. For example:

“`Delete error message buffer? 0 Yes / 1 No`”

By entering 0 (yes) or 1 (no), you determine what happens next.

Deselecting

The system message window can be closed by pressing the cancel key or by selecting another screen.

Error Causes and Remedies

The appendix of this manual contains a list of system messages including additional information on the cause of the message and any system variables indicated. In some cases, possible remedies are also shown.

7.3 Recipes

Overview

Our fruit juice plant was introduced in Section 7.1.1 of this manual. The finished product of our fruit juice plant is a bottle of fruit juice.

The finished product is determined by the various variables of the system.

You can combine the variables for one type of juice into a set of "processing instructions". This set of "instructions" is called a recipe. The individual variables are called recipe entries. Recipes are configured and cannot be changed on the C7.

Example of a Recipe

We will call our recipe "ORANGE".

Tank 1
Tank 2
Mixing time
Bottle size
Label
Bottles per case

One type of juice can be mixed in different concentrations to make orange "drink", orange "nectar" or "pure" orange juice, for example. The juice can then be bottled in different-sized containers. All this is performed with the same recipe but using different values for the individual entries. Related values for the entries (for example, for the orange drink) are combined into a data record.

Data Records

The data records for a recipe are put together on the C7 OP. An example of how they could appear is shown below.

	Data Records For		
"ORANGE" Recipe	Drink	Nectar	Juice
Tank 1	90	70	0
Tank 2	10	30	100
Mixing time	5	10	0
Bottle size	1	0.7	1
Label	4	2	1
Bottles per case	6	12	6

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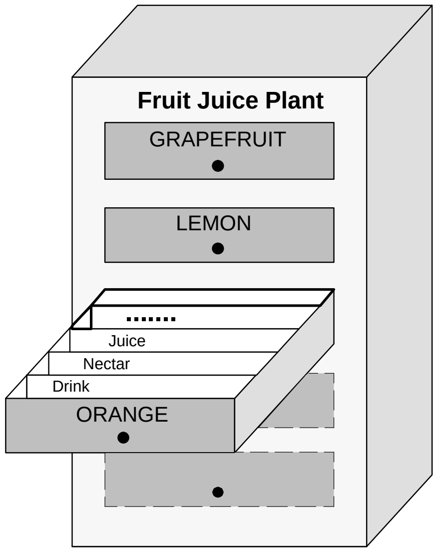
Analogy of a Filing Cabinet

A filing cabinet is a good way to illustrate how recipes function.

The filing cabinet is the plant or the process to be controlled. Each of the individual drawers represents the fixed structure of one recipe. Index cards in the drawer contain the data records for that recipe.



The operator uses the C7 OP to “handle the index cards”.

We will now show you how to do this in the following subsections.

7.3.1 Processing and Transferring Data Records

Up to now, you have learned that the recipe and its entries are configured and that you cannot change the recipes with the C7 OP later on.

Thus, handling of the recipes with the C7 OP is limited to the following operations on the data records:

- Store (set up)
- Load
- Delete
- Edit

The standard screen *Data Record Processing* is available for processing data records. A second standard screen called *Data Record Transmission* provides you with special transfer functions.

Data Record Processing Screen

Layout of the "Data Record Processing" standard screen:

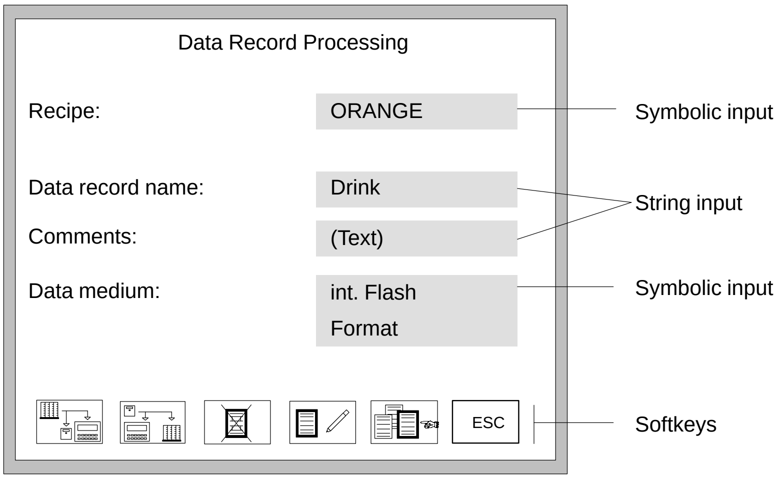


Figure 7-5 Standard Screen: Data Record Processing

The icons in the softkey bar have the following meaning:

Softkey	Description
SAVE	Copy the current values from the PLC to the C7 OP and store them as a data record on the required storage medium
LOAD	Load the selected data record from the selected storage medium in the C7 OP and transfer to the controller
DELETE	Delete the selected data record from the selected storage medium **Note:** If you want to delete all data records, it is easier to just reformat the FLASH memory or floppy disk
EDIT	Edit (change) the selected data record on the selected storage medium
SELECT	Select a data record from the selected recipe

Data Record Transmission Screen

You can transfer the current values back and forth between the C7 OP and the controller without storing the values on a data medium. This makes process startups easier, for example.

Transmission between the C7 OP and the data medium is also possible. The *Data Record Transmission* screen is available for these transmissions.

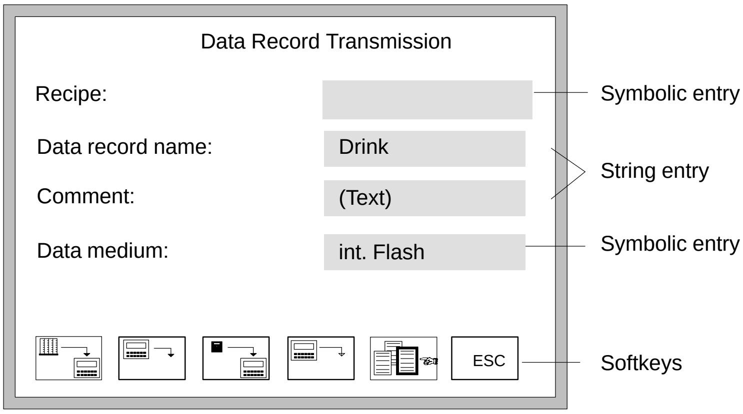
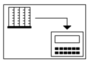
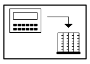
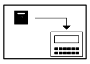
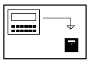
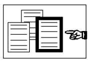


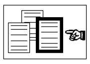
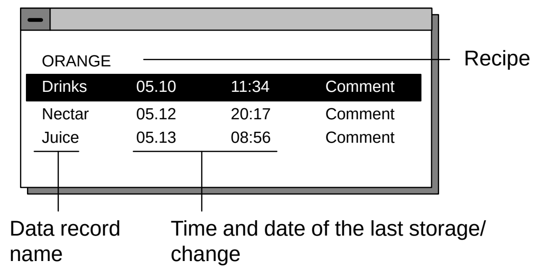
Figure 7-6 Standard Screen: Data Record Transmission

The icons in the softkey bar have the following meaning:

Softkey	Description
 SPS → C7 OP	Transfer the current values from the controller to the C7 OP (update values in the C7 OP)
 C7 OP → SPS	Transfer the current values from the C7 OP to the controller (transfer values to the controller)
 Data → C7 OP	Transfer a data record from the data medium to the C7 OP
 C7 OP → Data	Transfer a data record from the C7 OP to the data medium
 SELECT	Select a data record name

General Use

The following table shows you how to use the standard screens “Data Record Processing” and “Data Record Transmission”.

Step		Key/ Softkey	Description
1	Select recipe name		
2	Enter data record names or Select data record name		Observe the following conventions when assigning data record names: • Names may not contain more than 11 characters. After the eighth character is entered, a period is inserted automatically. • After the period, up to three characters can still be entered. • Special characters, blanks and commas may not be used. Activating the softkey causes a window to appear indicating all data records of the selected recipe.  Using the data record selection window: 1. △ , ▽ Select the desired data record with the cursor keys. 2. ENTER Accept selected data record, and close window.
3	Select data medium		Data records can be stored/archived on the internal FLASH.
4	With the softkey, select the function to be executed (for example, load, save, and edit).		

7.3.2 Setting Up and Editing Data Records

Only the recipe structure is specified during configuration of the C7 OP. No data records exist yet. These are generated/set up on the C7 OP.

Setting Up / Editing Data Records

The standard screen called *Data Record Processing* contains an edit function. You can use this function to accomplish the following:

- Set up new data records on a selected data medium
- Change the contents of data records stored on a data medium

To set up/edit data records, proceed as follows.

1. Select recipe.
2. Enter data record names.

   If you are setting up a new data record, enter a data record name which does not yet exist.
3. Select a data medium on which the data record is to be stored.

Note

The data medium must be formatted before data are stored on it for the first time.
The screen called *Data Record Processing* contains a format function which you can use to format flash disks and diskettes.

---

4. Select edit mode.

   The data record which you have selected is shown as a list in the edit window (that is, each line contains one recipe entry and value).

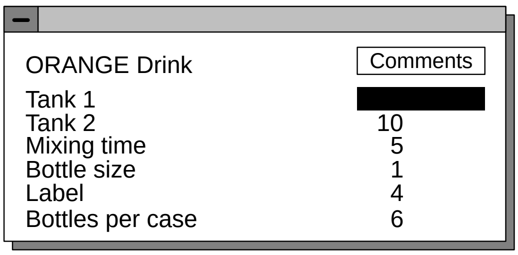


Figure 7-7 Data Record in the Edit Window

Using the edit window:

Step		Key	Description
1	Select the value to be changed	△ ▽	
2	Enter new value.		Only decimal numbers and strings are permissible.
3	Enter comment (optional)	△	Starting from the top input field, you can reach the comment field with the cursor key. **Note** Comments entered in the data record transmission screen are not included in the edit window.
4	Accept new values Or cancel entry	ENTER ESC	A safety prompt appears. 0 Yes: New values will be entered in the data record and the edit window closed. 1 No: Continue to use edit window. A safety prompt appears.

Accepting Values from the Controller

If you want your data records to contain the current values from the controller, perform the following steps in the *Data Record Processing* screen.

1. Select recipe to which a data record is to be assigned.
2. Enter data record name and comment (comment is optional).
3. Select a data medium on which you want the data record stored.
4. Store the data record.

   The current values from the controller will now be transferred to the C7 OP and stored as a data record on the data medium you have selected. The time at which the storage took place is also included.

Note

If the recipe does not yet contain a data record with the same name, the record is stored immediately.

Otherwise, you will be asked if you really want to store the record before it is overwritten.

---

5. To set up additional data records, repeat steps 1 to 4 for each data record.

Copying Data Records

Copying means that you use the current values in the C7 OP as your basis, and transfer these values to the data medium under different data record names.

You can then edit or adjust these data records later.

Proceed as described below in the *Data Record Transmission* screen.

1. Select recipe.
2. Enter data record name and comment (comment is optional).
3. Transfer data record from the C7 OP to the data medium.
4. Repeat steps 1 to 3 for each new data record.

7.3.3 Parameter Records

Definition

The parameter record is a combination of one data record each from various recipes with a common name.

The data records of a parameter record contain all values required to set a machine or plant. For example, you can use a parameter record to load the basic settings for machines which are identically equipped but produce different products.

Example

We will now expand our example of a fruit juice plant to include three identically equipped production lines. The recipes ORANGE, GRAPEFRUIT and LEMON are run parallel on these production lines. Each of the recipes contains a “drink” data record. These three data records make up the parameter record called “drink”.

At the beginning of a shift, for example, each of the three production lines must be set to produce a special drink. You can do this with just one load operation.

Processing

A parameter record is processed in the *Data Record Processing* screen in the same manner as a data record.

The following can be performed on a parameter record.

- Select
- Store (set up)
- Load
- Delete

Selection

Parameter Record must be selected as the recipe name in the *Recipe:* symbolic field.

Note

When “parameter record” is selected as the recipe, all data records of all recipes are indicated after the SELECT softkey is pressed in the data record selection window.
Parameter records (data records which exist more than once with the same name) are identified with an asterisk (*) preceding the name.

Selecting Message Level

You enter the message level by pressing ESC

Saving (Setting Up)

There are two ways to set up (that is, to save on a data medium) a parameter record in the *Data Record Processing* screen.

a) Save a data record for each recipe.

1. Select *Parameter Record* as the recipe.
2. Specify data record name and data medium.
3. Save parameter record as for a data record.

b) Store a data record individually for recipe selected.

1. Select recipe name.
2. Specify data record name and data medium.
3. Save data record.
4. Repeat steps 1 and 3 for each data record.

Loading

All data records with the selected name on the data medium are loaded to the C7 OP, and then to the controller.
Use the procedure described in Section 7.3.1.

Note

Depending on the scope of the recipes, it may require a relatively long period of time to transfer a parameter record to the controller. For this reason, a parameter record should only contain those recipes which are absolutely necessary.

Deleting

Complete parameter record:

Use procedure described in Section 7.3.1.
Select *Parameter Record* as the recipe name.

Part of a parameter record:

Delete the desired data record individually from the selected recipe.
Use procedure described in Section 7.3.1.

Editing

A parameter record cannot be edited.
Only the individual data records within the parameter record can be edited.
Use procedure described in Section 7.3.2.

7.4 Printing

Overview

The C7 OP can

- Log messages
- Force logins
- Make hardcopies of the contents of the current display
- Print a list of screens

Hardcopies and message logging can be performed at the same time. When a new print job is triggered while another print procedure is already running, the new print job is buffered.

Message Logging

You can switch message logging on and off on the C7 OP. All message occurrences for which logging is configured are printed out if message logging is active.

During message logging, you can print out messages at the same time. Messages arriving while the copies are being printed are stored in the buffer and printed later.

Configure Forced Logging

If forced logging has been configured, the messages deleted from the C7 OP are automatically output on a printer when the message buffer overflows.

Hardcopy

Trigger
The hardcopy is triggered by pressing a function key. The screen indicated on the display is then printed as characters (ASCII) or as pixel graphics. Windows currently opened in the screen (for example, message windows) are not included in the hardcopy.

Cancel
You can cancel an already started hardcopy by pressing the HARDCOPY key again. A system message is issued each time a hardcopy is cancelled.

The functions **Trigger** and **Cancel** a hardcopy are both displayed by a system message.

Printing Screen List

For logging purposes, you can configure a list containing up to 20 screens, which are printed automatically one after the other, one screen per page, after a print job has been initiated.

If a screen contains output fields for process values, the current values from the controller are printed for these fields.

Trigger
Printing is initiated by pressing a function key or via a job from the PLC.

Restrictions
Printing is performed in ASCII mode (in other words, graphic elements in the screens such as full-graphic screens, curves and bars are not printed). No hardcopies are possible during the printing procedure.

Printing Several Screen Lists

You can define and print several different screen lists by embedding this function several times – for example, by assigning it to several function keys – or by passing on PLC job 85 several times.

7.5 Status / Force with the C7

Overview

The C7 OP is equipped with the Status Variable and Force Variable functions. This permits you to use standard screens to indicate address values from the connected controller in a screen, and to change them in a second screen.

Controller addresses can be processed directly on the C7 OP during on-line operation. A programming device does not need to be connected to the controller.

Status Variable

You can use Status Variable to display the status of addresses of a SIMATIC S5 or S7.

Force Variable

You can control addresses of a SIMATIC S5 or S7 with Force Variable by modifying the variable values and transferring them back to the PLC.

Status Variable Standard Screen

The *Status Variable* standard screen is selected in the main screen with a softkey.

On the C7 OP, the display is split into two lines:

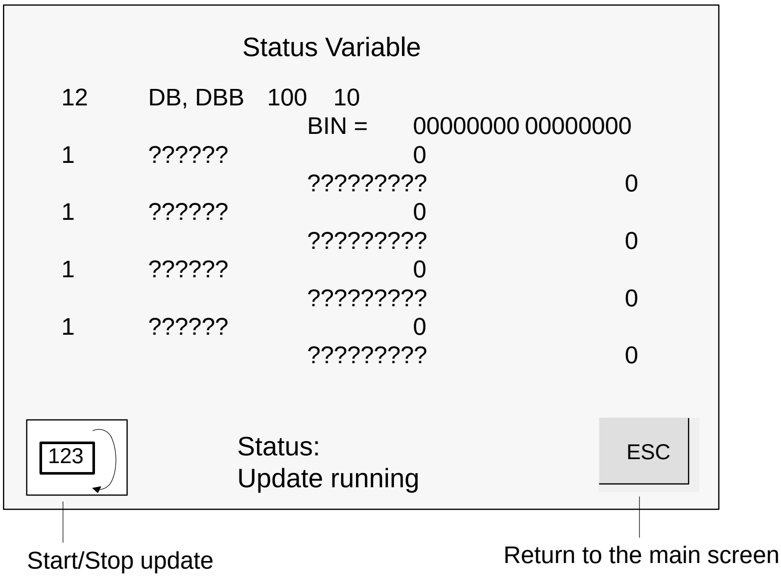


Figure 7-8 Status Variable Screen of C7 OP and SIMATIC S7

Addresses

Figure 7-9 shows an example of the layout of a line:

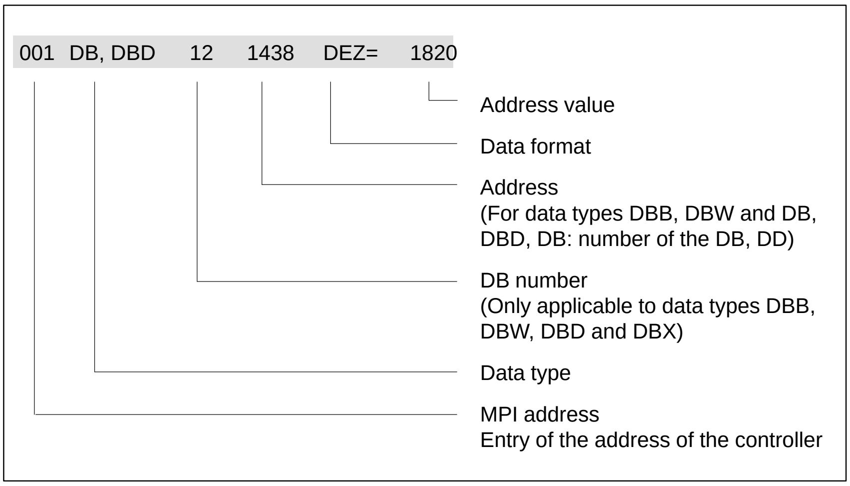


Figure 7-9 Example of the Controller Addresses

Operating Procedure for STATUS VAR

To view address values in the controller, proceed as follows.

Step		Key / Softkey	Description
1	Enter address		After the screen is selected, status processing is in status *Status stop* (indicated in the center of the bottom of the screen). 1. Enter data type for first address (symbolically via pop-up window). 2. Enter address (and DB number for data types DB, DW and DB, and DP). 3. Enter data format (symbolically via pop-up window). 4. Repeat entries for the 2nd to the nth addresses. **Note** A system message appears if you make a wrong entry (for example, data format does not agree with data type entered). The first entry from the pop-up window is then accepted by default in the field.
2	START update	123	When this softkey is pressed, status processing is switched to *Update running*. The values of the addresses are then shown in the last column. The values are updated cyclically.
3	STOP update	123	When this softkey is pressed again, status processing returns to *Status stop.*

Force Variable Standard Screen

In addition to the functions of Status Variable, values of addresses can be modified ($\hat{=}$ controlled) with Force Variable.

You have to configure the *Force Variable* standard screen in ProTool; you select it by means of a function key.

On the C7 OP, the display is split into two lines:

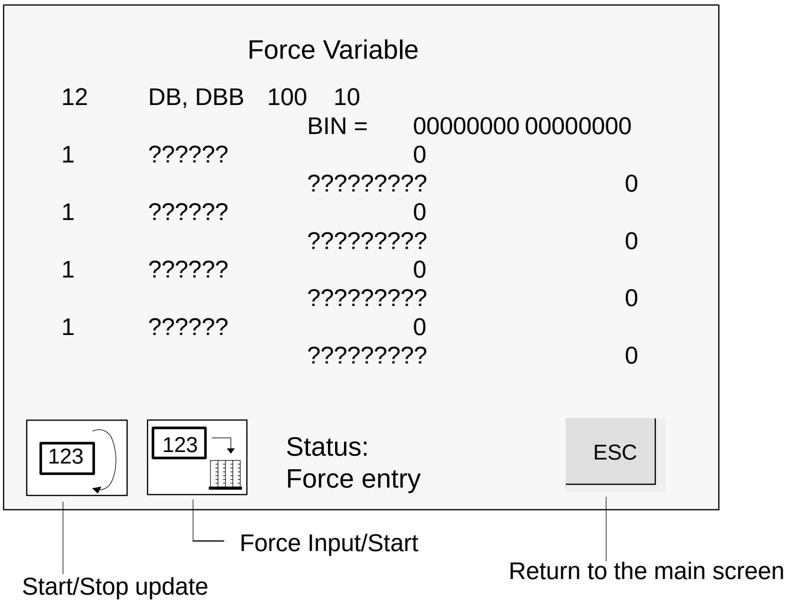


Figure 7-10 Force Variable Screen of C7 OP and SIMATIC S7

Operating Procedure for FORCE VAR

Procedure for controlling address values:

Step		Key / Softkey	Description
1	START update	123	Use this softkey to switch status processing to *Update running.*
2	Force ENTRY	123	Switch to *Force Entry.* Status processing is stopped. Entries can now be made.
3	Enter/ modify address value		When the value of an address is changed, a modification identifier appears in the last column of the line. 2 DB,DBW 17 24 DEC= 14 X Modification identifier
4	START force	123	The following occurs when the softkey is pressed again. • All address values marked with an modification identifier are transferred to the controller. • The modification identifiers are reset. • A return to status processing is made automatically (status *Update running).*
	Or Cancel entry	ESC	The modified values are not transferred to the controller when the Force Variable screen is exited, or
		123	A switch back to *Update running* status is made.

Data Areas for Communication between the C7 OP and the C7 CPU

8

Overview

This chapter provides you with information concerning configuration parameters that are necessary for communication between the C7 OP and the C7 CPU.

Communication occurs via two data areas:

- The user data area
  and/or
- The interface area.

The functions, construction and special features of the various user data areas and the interface areas are described in this chapter.

For those new to operator panels, we recommend the brochure *ProTool Made Easy - An Introduction* (62B5370-0CF01-0BA1).

Summary of Sections

8.1 Communication Parameters in a Configuration

Parameters

In the configuration software, the following parameters are to be set for communication via the MPI:

Note

The following parameters are already assigned generally applicable default values and need not be modified unless the C7 is used in connection with any other S7, C7 or OP units in a network.

Table 8-1

Parameter	Explanation
CPU type	Control CPU. The S7-300 is to be set for the C7 CPU. If further CPUs are connected, they must be set with S7-300 or S7-400.
CPU address	MPI address of the C7 CPU in the network configuration. The address has a default setting but can also be assigned by the user. It must be unique in a network.
Slot/subrack	Here you must set the slot and subrack. For the C7, the valid setting is: Slot 2 Subrack 0
C7 OP address	MPI address of the C7 OP in the network configuration. The address can be freely issued. It must be unique in the network configuration. The default value is address 2.
Interface	Here, you determine which interface of the C7 OP the C7 CPU is connected to.
Transmission rate	The data transmission rate between the C7 OP and the C7 CPU is fixed at 187.5 Kbps.

Configuration Tool

All settings can be made with ProTool and ProTool/Lite, under the menu **System → PLC...**.

C7 Feature

The first controller in the list **must** always be the C7 CPU since the C7 system function “DI/DO status display” always accesses the digital I/O of the first controller in the list.

8.2 Overview of User Data Areas

User Data Areas

User data areas are used to exchange data between the C7 CPU and the C7 OP. It is by means of these data areas that the C7 CPU and the C7 OP communicate.

The communication process consists of writing and reading information into and out of the data areas. Upon evaluation of the data, the C7 CPU and the C7 OP are triggered into the various actions.

The user data areas can reside in any required memory area in the C7 CPU.

Functionality

The following user data areas are possible:

- Event messages
- Alarm messages
- Recipes
- Control jobs
- System keyboard image
- Function keyboard image
- LED image
- Date and time
- Screen number area
- User version
- Trend request area
- Trend transfer area

8.3 Event and Alarm Messages

Message Triggering

Messages are triggered by setting a bit in one of the message areas in the C7 CPU. The position of the message area is defined by the configuration tool. The corresponding area is also to be established in the C7 CPU.

As soon as the bit in the event or alarm message area of the C7 CPU is set and transferred to the C7 OP, the message is recognized as having “arrived”.

Conversely, after resetting the same bit in the C7 CPU, the message is registered in the C7 OP as having ”departed”.

Message Areas

Table 8-2 represents the number of message areas for event and alarm messages and alarm acknowledgement areas, as well as the total length of all areas, for both the C7-626 and the C7-626 DP.

Table 8-2 Message Areas of the C7 OP

Device	Event message bit area		Alarm message area and alarm message acknowledgement area	
	Number	**Length** (words)	**Number of each type**	**Total length of each type** (words)
C7-626 / C7-626 DP	8	125	8	125

Message Bit and Message Number Assignment

A message can be configured for every bit in the configured message area. The bits are assigned to the message numbers in ascending sequence.

Example:

The following event message area is configured for the C7 CPU:

`DB 60        Address 42  Length 5` (in words)

Figure 8-1 shows the assignment of all 80 (5 x 16) message numbers to the individual bit numbers in the control event message area.

The assignment follows automatically in the C7 OP.

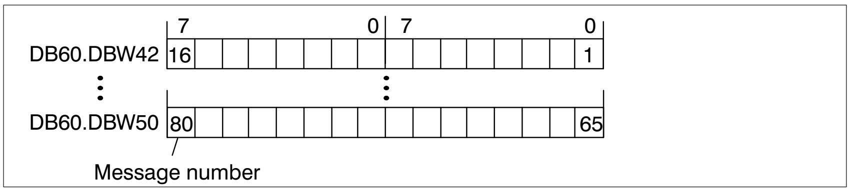


Figure 8-1 Assignment of Message Bit and Message Number

Acknowledgement

As alarm messages indicate faulty behavior of some sort, these must be acknowledged.
Acknowledgement follows either by

- Appropriate action on the C7 or
- By setting a bit in the acknowledgement area of the C7 CPU.

Acknowledgement Area

If the C7 CPU is to be informed about an acknowledgement of an alarm message at the C7 OP itself, or if the acknowledgement should be given by the C7 CPU, the corresponding acknowledgement areas are to be configured in the C7 CPU:

- **Acknowledgement area C7 OP → C7 CPU**:
  The controller is informed when an alarm message is acknowledged by an operation at the OP.
- **Acknowledgement area C7 CPU → C7 OP**:
  The alarm message is acknowledged via the C7 CPU.

These acknowledgement areas are to be allocated in the configuration; - when using ProTool, under “Area Pointers”.

Figure 8-2 shows schematically the individual alarm message and acknowledgement areas. The acknowledgement procedure is detailed in Table 8-3.

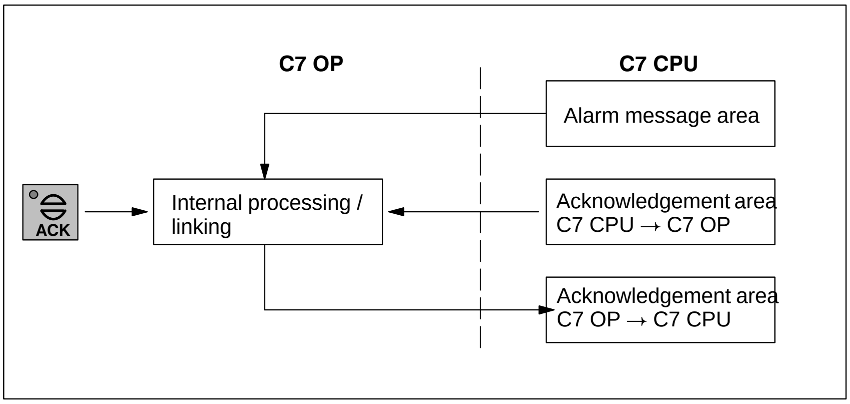


Figure 8-2 Alarm Message and Acknowledgement Areas

Table 8-3 Alarm Message Acknowledgement Procedure

Action	Reaction	Meaning
Set alarm message bit in C7 CPU	Appropriate acknowledge bit C7 OP → C7 CPU is reset	Alarm message has arrived and is unacknowledged
Set acknowledge bit in C7 CPU [1)] or Acknowledgement via a C7 OP operation.	Acknowledge bit C7 OP → C7 CPU is set	Alarm message has been acknowledged
Reset alarm message bit in C7 CPU		Alarm message has departed (independent of Acknowledgement condition)

1) If acknowledgement is initiated via the C7 CPU, the acknowledge bit C7 CPU → C7 OP must be reset using the user program by the time a renewed alarm message comes.

Assignment of Acknowledgement Bit to Message Number

Every alarm message has a message number. To this message number, the same bit of the alarm message area and the bit x of the acknowledgement area are assigned. This is also valid for more than one acknowledgement area, if the length of the previous acknowledgement area does not encompass the entire length of the alarm message area.

Figure 8-3 clarifies this situation.

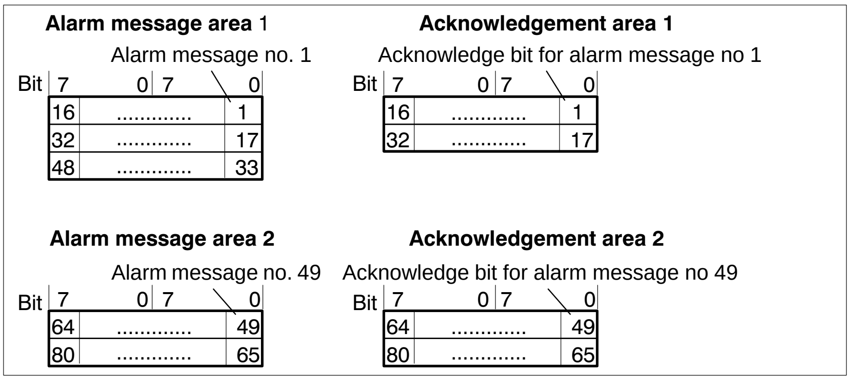


Figure 8-3 Assignment of Acknowledge Bit and Message Number

Acknowledgement Area C7 CPU → C7 OP

One of the bits set in the C7 CPU area causes the acknowledgement of the corresponding alarm message at the C7 OP.

The acknowledgement area C7 CPU → C7 OP

- Must be immediately connected to the relevant alarm message area
- Must have exactly the same polling time and
- Can have the same maximum length as the corresponding alarm message area.

Acknowledgement Area C7 OP → C7 CPU

If an alarm message is acknowledged at the C7 OP, the corresponding bit is set in the acknowledgement area C7 OP → C7 CPU. Thus the S7 can recognize that the alarm message has been acknowledged.

The acknowledgement area C7 OP → C7 CPU can have the same maximum length as the corresponding alarm message area.

Size of the Acknowledgement AreasC7 CPU → C7 OP and C7 OP → C7 CPU.

The acknowledgement areas may not be larger than the corresponding alarm message area. It can, however, be configured to be smaller, if it is not necessary to acknowledge every alarm message. Figure 8-4 clarifies this case.

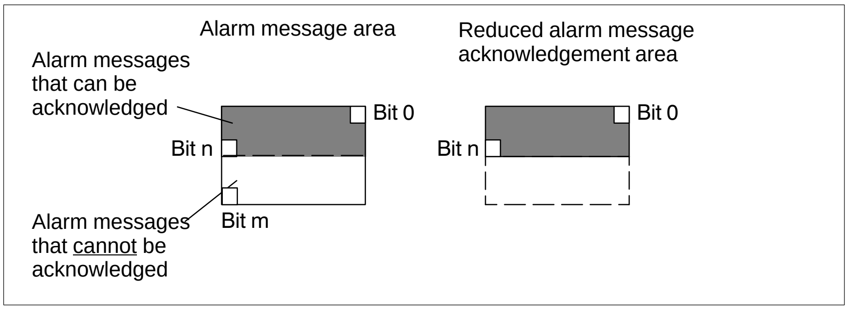


Figure 8-4 Reduced Acknowledgement Area

Note

Allocate important alarm messages whose acknowledgement is to be signalled to the C7 CPU in the alarm message area from bit 0 in ascending order.

8

8.4 Keyboard and LED Image

Application

Key actions on the C7 OP can be transferred to the C7 CPU and evaluated. In this way, an action (for instance switching on a motor) can be triggered in the C7 CPU.

The LEDs in the C7's function keys can be controlled. It is therefore possible to signal the user via a lit up LED, which key they should press, depending on the situation.

Prerequisite

In order to make use of this option, you must configure the appropriate data areas (so-called images) in the C7 CPU, and declare them as "area pointers" during the configuration.

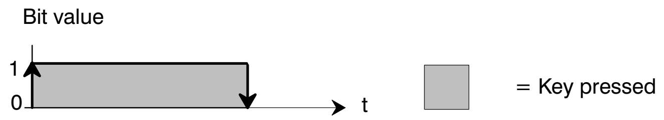
Transfer

The keyboard image is spontaneously transferred. That means the transfer always happens if a change is registered at the C7 OP. In this case, you do not need to configure a polling time. A maximum of two simultaneous key actions can be transferred at one time.

Value Assignment

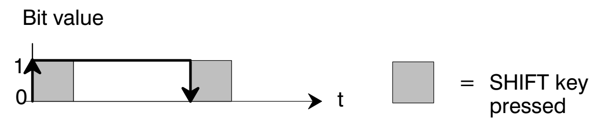
- **All keys (except SHIFT key)**

  As long as the corresponding key is pressed, the assigned bit in the keyboard image has the value 1, otherwise it has the value 0.



- **SHIFT key**

  When the SHIFT key is first pressed, the assigned bit in the keyboard image receives the value 1. This state remains also after letting the key go until the SHIFT key is pressed again.



8.4.1 System Keyboard Image

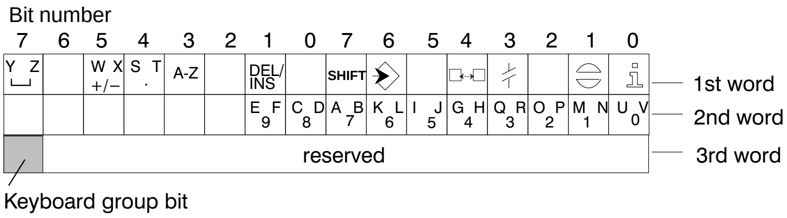
Layout

The system keyboard image is a data area with a fixed length of **two** data words.

Every key of the system keyboard is assigned exactly one bit in the system keyboard image, with the exception of the DIR key and the cursor keys.

The system keyboard image must also be declared as “area pointer, type: system keyboard” in the configuration. This image can be assigned **once** only and in **one** CPU.

Keyboard image:



Note

Unused bits may not be overwritten by the user program.

Keyboard Group Bit

The keyboard group bit serves as the control bit. It is set to the value 1 for each transfer of the keyboard image from C7 OP to C7 CPU. After evaluation of the data area by the user program, it should be reset.

By regular reading of the group bits, you can determine in the user program whether the image of the system keyboard has been newly transferred.

8

8.4.2 Function Keyboard Image

Data Areas

The image of the function keyboard can be categorized into separate data areas:

- Maximum number of data areas - 8
- Total length of all data areas (words) - 8

Key Assignment

The assignment of the individual keys to the data area bits is defined during the configuration of the function keys. The number within the image area is declared for every key.

The function keyboard image must also be declared in the configuration, under “area pointer, type: function keyboard”.

Keyboard Group Bit

The most significant bit in the last data word of **every** data area is the keyboard group bit. It serves as a control bit. This bit is set to 1 for every transfer of the keyboard image. After evaluation of the data area by the user program, the keyboard group bit should be reset.

You can determine whether a block is newly transferred by regularly reading the group bits using the user program.

8.4.3 LED Image

Data Areas

The LED image can be categorized into separate data areas.

- Maximum number of data areas: 8 (for example, 8 different data areas in various CPUs)
- Total length of all data areas (words): 16

LED Assignment

The assignment of the individual LEDs to the data area bits is defined during the configuration of the function keys. The bit number within the image area is declared for every LED.

The bit number (n) denotes the first of two consecutive bits, which can control four different LED states in total:

Bit n + 1	Bit n	LED Function
0	0	Off
0	1	Flashing at about 2 Hz
1	0	Flashing at about 0.5 Hz
1	1	Continually on

8.5 Screen Number Area

Application

The C7 OP stores information concerning the C7 OP’s called up screen in the screen area number.

It is thus possible to transfer information about the current display contents from the C7 OP to the C7 CPU, and from there, to trigger certain reactions, for example, calling up another screen.

Prerequisite

If the screen number area is to be used, it must be declared as an “area pointer” in the configuration. It can only be placed **once** and in **one** C7 CPU.

The screen number area is spontaneously transferred. That means the transfer always happens if a change is registered at the C7 OP. In this case, you do not need to configure a polling time.

Layout

The screen number area is a data area with a fixed length of two data words.

The layout of the screen number area for the C7 OP in the control memory is represented below.

	7 0 | 7 0
1st word	Current screen type
2nd word	Current screen number
3rd word	Reserved
4th word	Current input field number
5th word	Reserved

Entry	Assignment
Current screen type	1: Screen 3: Function screen 4: Fixed window 5: Alarm message window 6: Event message window
Current screen number	1 to 65535
Current input field number	1 to 65535

With function screens, the current screen number is assigned as follows:

Value	Meaning
1	Alarm message screen
2	Event message page
3	Alarm message buffer
4	Event message buffer

8.6 Trend Request and Transfer Areas

Trends

A trend is a graphic display of a value from the PLC. Depending on the configuration, a trend is triggered by a clock pulse or a bit.

Time-Triggered Trends

The C7 OP reads in the trend values upon a clock pulse set during configuration. Time-triggered trends are suitable for displaying continuous variations such as the operating temperature of a motor.

Bit-Triggered Trends

The C7 OP reads in either the trend value or the whole trend buffer as a result of a trigger bit being set. You set this in your configuration. Bit-triggered trends are normally used for displaying rapidly changing values. One example of using bit-triggered trends is injection pressure in the manufacture of plastic components.

When you are configuring, you have to create suitable areas in your configuration (by choosing *Area Pointers* from the menu) and on the C7 CPU to initiate bit-triggered trends. The C7 OP and the C7 CPU use these areas to communicate with each other.

The areas required are:
– trend request area
– trend transfer area1
– trend transfer area2 (required with switch buffer only)

The same bit is permanently assigned to every trend in these configured areas. In this way, every trend can be clearly identified in every area.

8

Switch Buffer

The switch buffer is a second buffer for the same trend that you can create in your configuration.

While the C7 OP is reading values from buffer 1, the C7 CPU writes to buffer 2. While the C7 OP is reading buffer 2, the C7 CPU writes to buffer 1. It prevents trend values from being overwritten by the C7 CPU while the trend is being read by the operator panel.

Partitioning Data Areas

The individual areas – trend request, trend transfer 1 and 2 – can be partitioned into separate data areas with a specified maximum number and length (Table 8-4).

Table 8-4 Partition of Data Areas

	Data Areas		
	Request	Transfer	
		1	2
Maximum number per type	8	8	8
Total length of all data areas (words)	8	8	8

Trend Request Area

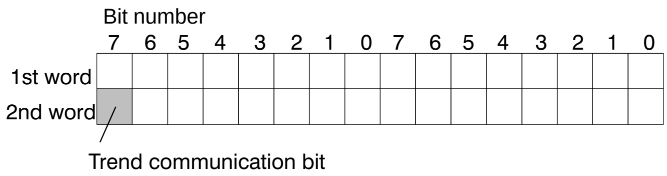
If a screen is opened on the C7 OP with one or more trends, the OP sets the corresponding bits in the trend request area. Once the screen has been deselected, the C7 OP resets the corresponding bits in the trend request area.

The trend request area can be used on the C7 CPU to evaluate which trend is currently being displayed on the C7 OP. Trends can be triggered even if the trend request area is not evaluated.

Trend Transfer Area1

This area is used to trigger trends. In the S7 program, set the bit assigned to the trend in the trend transfer area and the trend communication bit. The C7 OP detects the trigger and resets the trend bit and the communication bit. Depending on the configuration, it then reads out a single value or the whole buffer.

Trend transfer area(s)



Until the communication bit is reset, the trend transfer area cannot be modified by the S7 program.

Trend Transfer Area2

Trend transfer area2 is required for trends configured with a switch buffer. Its structure is exactly the same as that of trend transfer area1.

8.7 User Version

Usage

When the C7 OP starts up, a check can be made to determine whether the C7 OP is connected to the correct controller.

To perform the check, the C7 OP compares a value stored on the C7 CPU with the value that you configured. This insures compatibility of the configured data with the C7 CPU. If the data do not agree with each other, system message $653 is displayed on the C7 OP and the device is restarted.

For you to be able to use this function, you must set the following values when you configure your C7 OP:

- Value belonging to the configuration: (1 to 255) by choosing *System* → *Parameters* → *Miscellaneous*. If 0 is set, this check is not made.
- Data type and address of the value stored on the PLC by choosing *System* → *Area Pointers*, select *User Version* in the *Type:* field.

8.8 Interface Area

Overview

The interface area is only necessary for the C7 CPU if its functions are to be used or evaluated by the C7 CPU.

The interface area must be configured if you want to use the following functions:

- Send control jobs to the C7 OP
- Synchronize data and time between the C7 CPU and the C7 OP
- Evaluate coupling identifier
- Recipes (transfer of data records)
- Recognize C7 OP startup in C7 CPU program
- Evaluate C7 OP operation mode in C7 CPU program
- Evaluate C7 OP's ready bit in C7 CPU program

Layout of the Interface Area

Figure 8-5 shows the layout of the interface area. You can define the interface area in a data block or a memory area. The address of the interface area is to be declared in the configuration. This is necessary so that the OP knows where to put the data.

The interface area is to be determined once per CPU.

Interface area:

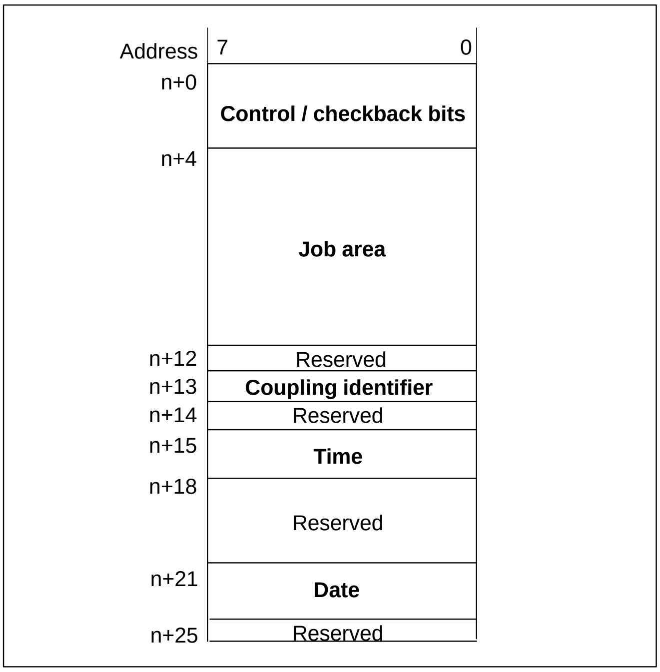


Figure 8-5 Layout of the Interface Area for the C7 CPU

8.8.1 Control and Checkback Bits

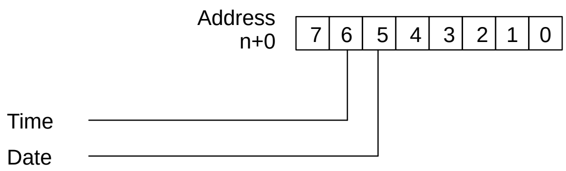
Introduction

Three bytes are available in the interface area for the control and checkback bits. Bytes n+0 and n+1 are used to coordinate between the C7 OP and the C7 CPU. Byte n+3 is required for the transfer of data records and indirect variables.

Bytes n+1 and n+2 are described below:

Description of byte n+0

The structure of byte n+0 is shown below. The diagram is followed by a description of the individual bits.



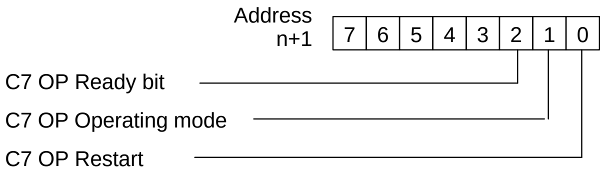
Bits 5–6 Date/time 1 = New

The transfer of the date and time from the C7 OP to the C7 CPU can be initiated by means of C7 CPU job 41. These bits are set by the C7 OP if a new date or a new time is transferred. The bits must be reset in the program after the date or time has been evaluated.

8

Description of byte n+1

The following diagram shows the layout of byte n+1. Afterwards follows the description of the individual bits.



Bit 0 C7 OP restart
1 = C7 OP has been started

Bit 0 is reset upon completion of the restart. You can reset the bit in the C7 CPU program and thus recognize when the C7 OP is being restarted.

Bit 1 C7 OP operating mode
1 = C7 OP in off-line mode
0 = C7 OP in normal mode

Bit 1 is set if the user switches the C7 OP to off-line. The bit has a value 0 in an on-line condition.

Bit 2 C7 OP ready bit
The C7 OP inverts the ready bit within the interval of 1 second. In the C7 CPU program, you can recognize whether a connection to the C7 OP exists.

Description of byte n+3

Byte n+3 serves to synchronize the transfer of data records and indirect variables. The meanings of the individual bits are described below. Exactly how the transfer works is described in Section 8.9.3.

Bit 0 1 = Data mailbox is disabled (is set only by the C7 OP)
0 = Data mailbox is enabled

Bit 1 1 = Data record/variable is errored

Bit 2 1 = Data record/variable is correct

Bit 3 1 = Data transfer terminated successfully

Bit 4 1 = Request data record/variable

Bit 5 1 = C7 OP should read the data mailbox

Bit 6 1 = Request data mailbox disable

8.8.2 Data Areas in the Interface Area

Overview

In this section, the layout and usage of the interface data areas is described.

The C7 CPU initiates an action to be carried out on the C7 OP by means of the job area. All other bytes are areas in which the C7 OP writes data. These areas can be evaluated by the C7 CPU program. The bytes are individually described below.

Job Area

Byte n+4 to n+11:
The C7 OP is passed on the control jobs via the job area. The actions on the C7 OP are initiated in this way.

The job area consists of four words. In the first word of the job area is the job number. In further words, the job parameters are to be entered (maximum 3).

Address	7 … 0 | 7 … 0
n+4	Job number
	Parameter 1
	Parameter 2
n+10	Parameter 3

If the first word of the job area is not equal to zero, the C7 OP evaluates the control job. After that, the C7 OP sets this data word to zero. For this reason, the parameters must first be entered in the job area and only then the job number.

The possible control jobs are listed with job numbers and parameters in Appendix C.2.

Coupling Identifier

Byte n+13:
The C7 OP enters the coupling identifier in byte 13.

Date and Time

Time = byte n+15 to n+17
Date = byte n+21 to n+24
The date and time can be transferred from the C7 OP to the C7 CPU via control job 41.

The following screens show the layout of the data area. All inputs are coded in Binary Coded Decimal (BCD).

Time:

Address	7 ... 0
n+15	Hours (0...23)
n+16	Minutes (0...59)
n+17	Seconds (0...59)

Date:

Address	7 ... 0
n+21	Weekday (1...7)
n+22	Day (1...31)
n+23	Month (1...12)
n+24	Year (0...99)

8.8.3 Example for Activating a Control Job

Control Job Procedure

Procedure for activating a control job:

1. You must configure the interface module (which contains the interface area) in the C7 CPU (example DB52).
2. You enter the interface module (52) into the “Area Pointers” dialog box during the configuration. The interface module is thus made known to the C7 OP.
3. The job is entered in the interface module via the C7 CPU program (see Figure 8-6).
4. The C7 OP reads the interface module and executes the job.

Program for Screen Selection

```
OPN DB    52           Call interface module.
L   screen no.         Enter first parameter (screen no.) into
T   DBW 6              job area of the interface module.
L   Input number.      Enter 2nd parameter into
T   DBW 8              job area of the interface module.
L   Field no.          Enter 3rd parameter (field no.) into
T   DBW 10             job area of the interface module.
L   51                 Enter the job no. into the job area of the
T   DBW4               interface module and activate the job.
```

Figure 8-6 Example for a C7 CPU Program

8.9 Recipes

Definition

A recipe is a group of variables for a fixed data structure. You set this structure in your configuration and assign data to it on the C7 OP. You cannot modify the structure on the C7 OP later.

Since the data structure can be assigned several times, we refer to data records. These data records are stored (created), loaded, deleted and modified on the C7 OP. The data are stored on the C7 OP, thus saving memory on the C7 CPU.

The use of recipes insures that, when a data record is transferred to the C7 CPU, several items of data are transferred to the C7 CPU **together** and in a **synchronized** fashion.

Transferring Data Records

Data records can be transferred from the C7 OP to the C7 CPU or from the C7 CPU to the C7 OP. You transfer data records from the C7 OP to the C7 CPU to set specific values on the C7 CPU – for example, to produce orange juice. It is similarly possible to fetch data from the C7 CPU and to store them on the C7 OP as a data record to save, say, a favorable assignment of values.

Note

With graphic displays, only the variables are used for transferring data records. To transfer a data record to the S7 from a data medium (flash), it must first be loaded to the variables.

Synchronization

To insure a coordinated procedure for transferring data records and to prevent any uncontrolled overwriting of data, bits are set in the control and checkback byte 3 of the interface area.

8.9.1 Transferring Data Records

Definition

Data records can be transferred by two different methods from the C7 OP to the PLC or from the PLC to the C7 OP. The two methods of transfer are ”direct” and ”indirect”.

Direct Transfer

When a data record is written, the variables in the data record are written directly to the defined addresses concerned. With direct reading, the variables are read into the C7 OP from the system memories of the C7 CPU.

With ProTool, the variables must have a direct link to the C7 CPU and the `write directly` attribute for direct transfer. Variables not having an assigned address on the C7 CPU are not transferred.

Indirect Transfer

All the variables in the data record are written to a clipboard – known as the data mailbox – on the C7 CPU. The data mailbox contains only the values of the variables; their addresses are not transferred.

When a data record is written, the variables are written to the clipboard. When a data record is read, the variables in the program have first to be written to the clipboard. The C7 OP then reads the variables out of the clipboard.

8.9.2 Addressing Recipes and Data Records, and the Required Data Areas

Addressing/Data Areas

Three *IDs* are available for identifying a recipe on the PLC. The IDs can be freely defined. We recommend that you enter the same value for the first ID as for the number of the recipe.

In ProTool, you enter the ID of the recipe in the *Parameters* dialog box against *IDs*. ProTool automatically enters the number of the recipe for the first ID. These IDs are written to the data mailbox when a data record is transferred between the C7 OP and the C7 CPU and can be evaluated by the PLC.

You create data records on the C7 OP under a symbolic name. The symbolic name is not transferred with a data record between the C7 OP and the C7 CPU. There is no ID for the data record on the C7 CPU.

Data mailbox:

The area for the *data mailbox* has to be reserved on the C7 CPU. Use the same specifications for it as were set in the configuration under ProTool for *Area Pointers*. The following figure shows the structure of the data mailbox.

1st word	Identification 1
2nd word	Identification 2
3rd word	Identification 3
4th word	Reserved
5th word	Length of data record in bytes
6th word	Data record value 1
	Data record value...
nth word	Data record value m

8.9.3 Synchronization During Transfer – Normal Case

Transferring Data Records

The control and checkback bits in the interface area synchronize data record transfer. A transfer is normally initiated by an operator input on the C7 OP.

Transfer C7 OP → C7 CPU (initiated on C7 OP)

The following description shows the procedure by which the C7 OP sets synchronizing bits and the manner in which the C7 CPU program has to react to them.

Table 8-5 Procedure for Transmission

Step	Explanation
1	Bit 0 is checked by the C7 OP. If bit 0 is set to 1 (= data mailbox disabled), the transfer is terminated with a system error message. If bit 0 is set to 0, the C7 OP sets the bit to 1.
2	The C7 OP enters the IDs in the data mailbox. With an indirectly transferred data record, the data record values are also written to the data mailbox. With a directly transferred data record, the values of the variables are written to the configured address.
3	The OP sets bit 3 to 1 (= data transfer terminated).
4	The data record or the variable can be evaluated in the C7 CPU program. You then have to acknowledge in the C7 CPU program whether the transfer was error-free or erroneous. Error-free: bit 2 is set to 1 Erroneous: bit 1 is set to 1
5	Reset bit 0 in the C7 CPU program.
6	The C7 OP resets the bits set in step 3 and step 4.

8.9.4 Synchronization During Transfer – Special Cases

Transfer C7 OP → C7 CPU (initiated by C7 CPU)

Make sure with this type of transfer that the current variables on the C7 OP are transferred. The values are not read directly from the data medium.

Table 8-6 Procedure for Transmission

Step	Explanation
1	In the control program, request the data mailbox lockout by setting bit 6 to 1.
2	If lockout is possible, the C7 OP sets bit 0 to 1 and simultaneously resets bit 6 to 0.
3	In the program, inform the C7 OP via the data mailbox which data record it should transfer. To do this, enter the IDs of the recipe in the data mailbox.
4	Set bit 4 to 1 (= request data via data mailbox) in the program.
5	The C7 OP reads the data mailbox.
6	The C7 OP resets bit 4 and transfers the data record or the variable as described for case 1 from step 2 onwards.

Transfer C7 CPU → C7 OP (initiated by C7 OP)

A direct transfer from the C7 CPU to the C7 OP is not coordinated. The values are read directly from the address. Variables not having an address are ignored. The following steps refer only to indirect transfer.

Step 1: Bit 0 is checked by the C7 OP. If bit 0 is set to 1 (= data mailbox disabled), the transfer is terminated with a system error message. If bit 0 is set to 0, the OP sets the bit to 1.

Step 2: The C7 OP enters the IDs in the data mailbox. The length of the data record is not specified by the C7 OP (length 0 is entered).

Step 3: The C7 OP sets bit 3 to 1 (= data transfer terminated).

Step 4: In the program, evaluate the IDs and enter the requested data in the data mailbox. Then acknowledge whether the IDs were error-free or erroneous by setting bit 1 or bit 2.
Error-free IDs: bit 2 is set to 1
Erroneous IDs: bit 1 is set to 1

Step 5: The C7 OP reads the data record from the data mailbox and then resets the following bits:
Bit 3, bit 2 or 1 (depending on acknowledgement), bit 0.

8

Transfer C7 CPU → C7 OP (initiated by C7 CPU)

Make sure with this direction of transfer that the values are written by the C7 CPU to the variables on the C7 OP. The values are not written directly to the data record on the data medium.

Step 1: In the program, request the data mailbox lockout by setting bit 6 to `1`.

Step 2: If lockout is possible, the C7 OP sets bit 0 to `1` and simultaneously resets bit 6 to `0`.

Step 3: In the program, enter the IDs and the data record in the data mailbox. Then set bit 5 to `1` (= C7 OP required to read data mailbox). The data record is determined by the IDs.

8.10 Writing Variables Indirectly

Principle

Indirect variables, which are assigned to input fields, can be configured for the C7 OP. The value is entered directly on the C7 OP by the operator. Following input on the C7 OP, the contents of these variables are transferred in a coordinated fashion to the data mailbox in the controller.

Coordination

The coordination of data transfer is similar to the coordination of the data record transfer of recipes (see Section 8.9.3).

Usage

Indirect variables can be used on screens as ”normal” variables, meaning variables with addresses.

8.11 Notes on Optimization

Decisive Factors

The construction of the user data area described in Section 8.3 and the configured polling times in the **area pointers** are significant factors for the **actual** reachable update times. The update time is the polling time plus the transfer time plus the processing time.

To reach an optimal update time, the following points should be observed during the configuration:

- Configure the individual data areas as large as necessary, but as small as possible.
- Define the data areas which belong together contiguously. The actual update time improves if you configure **one** large area as opposed to several small areas.
- The total performance is unnecessarily compromised if the polling times are too small. Set the polling time according to the changing speed of the process values. The change in temperature of an oven for example, is significantly more sluggish than the change of rotary speed in an electrical drive.

  The approximate value for the polling time is around 1 second.
- Avoid cyclic transfer of the user data area (Polling time 0). Instead, use the control jobs to allow event-controlled transfer of user data areas only if necessary.
- Place the variables of a message or a screen without gaps in one data area.
- In order that changes in the C7 CPU are recognized by the C7 OP, they must at least be impending during the actual polling time.

Screens

If, in the case of bit-triggered trends, the communication bit is set in the *trend transfer area*, the C7 OP updates all those trends every time whose bit is set in this area. Thereafter it resets the bit. If the bit is reset immediately in the program, the C7 OP is busy the whole time updating the trends. Operation of the C7 OP is then virtually no longer possible.

SFCs and SFBs in the C7 CPU

A

Summary of Sections

A.1 SFCs and SFBs

Overview

The C7 CPU provides you with various system functions, for example, for program processing and diagnostics. You call these system functions in your user program with the number of the SFC or SFB.

You will find detailed descriptions of all system functions in the reference manual **/235/**.

Real-Time Clock Function

For the clock functions, the CPU offers you the following system functions.

SFC	No.	Name	Description	Execution Time
SFC	0	SET_CLK	Setting the clock time If the clock to be set is a master clock, the clock time synchronization is triggered simultaneously. If the clock to be set is a slave clock, only the clock time is set.	120 µs
SFC	1	READ_CLK	Reading the clock time	190 µs
SFC	2	SET_RTM	Setting the run-time meter In the C7 CPU, you can set 1 run-time meter.	65 µs
SFC	3	CTRL_RTM	Starting and stopping the run-time meter	55 µs
SFC	4	READ_RTM	Reading the run-time meter	90 µs
SFC	64	TIME_TICK	Reading out the system time You can read out the system time in milliseconds.	45 µs

Block Functions

The following table contains system functions for copying and presetting array variables.

SFC	No.	Name	Description	Execution Time
SFC	20	BLKMOV	Copying variables of any type	90 µs + 2 µs/byte
SFC	21	FILL	Setting array default variables	90 µs + 3.2 µs/byte

Creating a Data Block

You create a data block using SFC22 “CREAT_DB”.

SFC	No.	Name	Description	Execution Time
SFC	22	CREAT_DB	Generate a data block of specified length in a specified area	110 µs+ 3.5 µs per DB in the specified area

Time-Of-Day Interrupt Functions

You can use the time-of-day interrupts for program processing controlled by the C7 CPU internal real-time clock.

SFC	No.	Name	Description	Execution Time
SFC	28	SET_TINT	Setting the times for a time-of-day interrupt	190 µs
SFC	29	CAN_TINT	Canceling the times for a time-of-day interrupt	50 µs
SFC	30	ACT_TINT	Activating a time-of-day interrupt	50 µs
SFC	31	QRY_TINT	Querying the status of a time-of-day interrupt	85 µs

Time-Delay Interrupts

Time-delay interrupts start the operating system at the end of a specified time.

SFC	No.	Name	Description	Execution Time
SFC	32	SRT_DINT	Start a time-delay interrupt	85 µs
SFC	33	CAN_DINT	Cancel a time-delay interrupt	50 µs
SFC	34	QRY_DINT	Query started time-delay interrupts	80 µs

Interrupt and Error/Fault Handling

The C7 CPU provides you with the following system functions for responding to interrupts and errors/faults:

SFC	No.	Name	Description	Execution Time
SFC	36	MSK_FLT	Masking sync faults	150 µs
SFC	37	DMSK_FLT	Enabling sync faults	160 µs
SFC	38	READ_ERR	Reading and erasing programming and access errors that have occurred or have been disabled	160 µs
SFC	39	DIS_IRT	Disabling the handling of new interrupts	215 µs
SFC	40	EN_IRT	Enabling the handling of new interrupts	305 µs
SFC	41	DIS_AIRT	Delaying the handling of interrupts	35 µs
SFC	42	EN_AIRT	Enabling the handling of interrupts	35 µs
SFC	43	RE_TRIGR	Re-triggering the watchdog monitoring	30 µs
SFC	44	REPL_VAL	Copying a substitute value into accumulator 1 of the level causing the error	45 µs

Status Changes

You can influence the CPU status with the following system functions:

SFC	No.	Name	Description	Execution Time
SFC	46	STP	Forcing the CPU into STOP mode	–
SFC	47	WAIT	Implementing waiting times	200 µs

Address Assignment

For allocating the free address of a module to the associated rack and slot, you can use the following SFCs.

SFC	No.	Name	Description	Execution Time
SFC	5	GADR_LGC	Determining the free address of channel x of the signal module in slot y	–
SFC	49	LGC_GADR	Converting a free address into the associated slot and rack number of a module	140 µs
SFC	50	RD_LGADR	Calculating all the predefined free addresses of a module	190 µs

Diagnostic Functions

You can use the following system functions to read and write diagnostic information:

SFC	No.	Name	Description	Execution Time
SFC	51	RDSYSST	Read the information out of the system status list	280 µs + 200 µs/data set
SFC	52	WR_USMSG	Write specific diagnostic information into the diagnostic buffer	110 µs

Module Initialization Functions

The C7 CPU places the following system functions at your disposal for writing and reading initial module parameters.

SFC	No.	Name	Description	Execution Time
SFC	55	WR_PARM	Writing dynamic parameters to a module	1.6 ms
SFC	56	WR_DPARM	Writing predefined parameters to a module	1.75 ms
SFC	57	PARM_MOD	Assigning parameters to a module	2.2 ms
SFC	58	WR_REC	Writing a module-specific data record	1.4 ms + 32 µs/byte
SFC	59	RD_REC	Reading a module-specific data record	0.49 ms

Functions for the DP Master

The C7-DP CPU provides the following system functions as DP master:

SFC	No.	Name	Description	Execution Time
SFC	13	DPNRM_DG	Read slave diagnostics coded according to DP standard	approx. 180 µs
SFC	14	DPRD_DAT	Read consistent user data from DP standard slaves with a DP standard identifier > 4 bytes	approx. 180 µs
SFC	15	DPRWR_DAT	Write consistent user data from DP standard slaves with a DP standard identifier > 4 bytes	approx. 180 µs

A.2 IEC Functions

DATE_AND_TIME

STEP 7 provides the following IEC functions for operations with the data formats DATE, TIME_OF_DAY and DATE_AND_TIME.

FC No.	Name	Description	Exection Time
3	D_TOD_DT	Combine the data formats DATE and TIME_OF_DAY (TOD) and convert to data format DATE_AND_TIME.	approx. 680 µs
6	DT_DATE	Extract the DATE data format from the DATE_AND_TIME data format.	approx. 230 µs
7	DT_DAY	Extract the day of the week from the data format DATE_AND_TIME.	approx. 230 µs
8	DT_TOD	Extract the TIME_OF_DAY data format from the DATE_AND_TIME data format.	approx. 200 µs

Time Formats

STEP 7 provides the following IEC functions for converting the time formats S5 Time and Time.

FC No.	Name	Description	Exection Time
33	S5TI_TIM	Convert S5 TIME data format to TIME data format	approx. 80 µs
40	TIM_S5TI	Convert TIME data format to S5 TIME data format	approx. 160 µs

Duration

STEP 7 provides the following IEC functions for operations with times.

FC No.	Name	Description	Execution Time
1	AD_DT_TM	Add a duration in the TIME format to a time in the DT format. The result is a new time in the DT format.	0.75 ms
35	SB_DT_TM	Subtract a duration in the TIME format from a time in the DT format. The result is a new time in the DT format.	0.75 ms
34	SB_DT_DT	Subtract two times in the DT format. The result is a duration in the TIME format.	0.7 ms

Compare DATE_AND_TIME

STEP 7 provides the following IEC functions for comparing the contents of variables in the DATE_AND_TIME data format.

FC No.	Name	Description	Execution Time
9	EQ_DT	Compare the contents of two variables in the DATE_AND_TIME format for equal to.	190 μs
12	GE_DT	Compare the contents of two variables in the DATE_AND_TIME format for greater than or equal to.	190 μs
14	GT_DT	Compare the contents of two variables in the DATE_AND_TIME format for greater than.	190 μs
18	LE_DT	Compare the contents of two variables in the DATE_AND_TIME format for less than or equal to.	190 μs
23	LT_DT	Compare the contents of two variables in the DATE_AND_TIME format for less than.	190 μs
28	NE_DT	Compare the contents of two variables in the DATE_AND_TIME format for not equal to.	190 μs

Compare STRING

STEP 7 provides the following IEC functions for comparing the contents of variables in the STRING data format.

FC No.	Name	Description	Execution Time
10	EQ_STRNG	Compare the contents of two variables in the STRING format for equal to.	150 μs + (n × 32)
13	GE_STRNG	Compare the contents of two variables in the STRING format for greater than or equal to.	150 μs + (n × 32)
15	GT_STRNG	Compare the contents of two variables in the STRING format for greater than.	140 μs + (n × 38)
19	LE_STRNG	Compare the contents of two variables in the STRING format for less than or equal to.	150 μs + (n × 32)
24	LT_STRNG	Compare the contents of two variables in the STRING format for less than.	140 μs + (n × 38)
29	NE_STRNG	Compare the contents of two variables in the STRING format for not equal to.	150 μs + (n × 32)

n = number of characters

STRING Variable Processing

STEP 7 provides the following IEC functions for operations with the contents of STRING variables.

FC No.	Name	Description	Execution Time
21	LEN	Read the length of a STRING variable.	90 μs
20	LEFT	Read the first L characters of a STRING variable.	150 μs + (L × 26)
32	RIGHT	Read the last L characters of a STRING variable.	150 μs + (L × 26)
26	MID	Read the middle L characters of a STRING variable (starting at the defined character).	150 μs + (L × 26)
2	CONCAT	Combine two STRING variables in one STRING variable.	180 μs + (n × 28)
17	INSERT	Insert a STRING variable into another STRING variable at a defined point.	250 μs + (n × 26)
4	DELETE	Delete L characters of a STRING variable.	300 μs + ((L + P) × 27)
31	REPLACE	Replace L characters of a STRING varaibale with a second STRING variable.	300 μs + ((L + P) × 27)
11	FIND	Find the position of the second STRING variable in the first STRING variable.	k × 50 μs

L, P = block parameters (if 1 + P = 0, then the execution time L + P = 254 μs
n = number of characters
k = number of characters in parameter IN1

Format Conversions with STRING

STEP 7 provides the following IEC functions for converting variables to and from the STRING format.

FC No.	Name	Description	Execution Time
16	I_STRNG	Convert a variable from INTEGER format to STRING format.	1.11 ms
5	DI_STRNG	Convert a variable from INTEGER (32-bit) format to STRING format.	1.5 ms
30	R_STRNG	Convert a variable from REAL format to STRING format.	1.72 ms
38	STRNG_I	Convert a variable from STRING format to INTEGER format.	0.5 ms
37	STRNG_DI	Convert a variable from STRING format to INTEGER (32-bit) format.	0.84 ms
39	STRNG_R	Convert a variable from STRING format to REAL format.	2.0 ms

Number Processing

STEP 7 provides the following IEC functions for selection functions.

FC No.	Name	Description	Execution Time
22	LIMIT	Limit a number to a defined limit value.	0.45 ms
25	MAX	Select the largest of three numeric variables.	0.43 ms
27	MIN	Select the smallest of three numeric variables.	0.43 ms
36	SEL	Select one of two variables.	0.32 ms

System Status List in the C7 CPU

B

Overview

The C7 CPU is able to provide you with certain information. The C7 CPU stores this information in the “system status list”.

This appendix contains the sublists of the system status list provided by the C7 CPU.

Definition

The system status list contains data describing the current status of a C7 CPU. You can use it at any time to gain an overview of the following:

- The current parameter assignment of the CPU and the signal modules which can be assigned parameters.
- The current statuses and sequences in the CPU and the signal modules which can be assigned parameters.

See the *STEP 7 Standard and System Functions* reference manual for a detailed description of the structure of the system status list and all possible entries.

Reading the System Status List

You can use SFC51 “RDSYSST” from the user program to read out the entries in the system status list (see the reference manual **/235/**).

Sublists

The system status list is divided into sublists. This makes it possible to target specific information in the system status list.

Structure of the Sublists

Each sublist contains:

- Header information of four data words
- A specific number of records containing the event information

Header Information

The header information of a sublist is four data words long. Figure B-1 shows the contents of the header information of a sublist.

SZL-ID (Sublist ID)
Index (Specification of an object type/object number)
Length of a record contained in the sublist
Number of records in the sublist

Figure B-1 Header Information of a Sublist of the System Status List

System Status List ID

Each sublist has an “System Status List ID” (SZL ID). In addition, it is possible to read only one excerpt from a sublist. The ID of this excerpt from the sublist is also contained in the SZL ID. Figure B-2 shows the structure of the SZL ID for the CPUs.

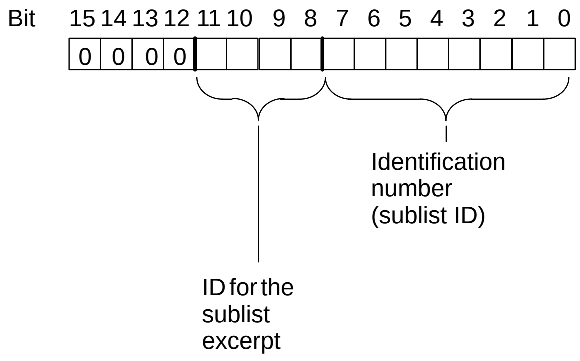


Figure B-2 Structure of the “System Status List ID” of the Sublist

ID for the Sublist Excerpt

You use the ID for the sublist excerpt to select the extent of the sublist to be output.

- **0_H**: The complete sublist is output
- **1_H to E_H**: A special sublist is output
- **F_H** Only header information is output

Index

You must assign an index if you want to read out only **one** specific record from the sublist.

Length of the Subsequent Records

This data word shows how much information (in bytes) a record of the sublist contains.

Number of Records

This data word shows how many records the transferred sublist contains.

Table of Sublists

Table B-1 below shows the individual sublists of the system status list with the entries relevant for the individual C7 CPUs.

Table B-1 Sublists of the System Status List of the C7 CPU

SZL_ID	Sublist	Index (= ID of the Individual Records of the Sublist)	Record Contents (Sublist Excerpt)
	C7 CPU identification	-	CPU type and version number
0011_H	All records of the sublist		
0111_H	One record of the sublist		
	C7 CPU features		
0012_H	All records of the sublist		
0112_H	Only those records of a group of features	0000_H	STEP 7 processing
		0100_H	Time system in the C7 CPU
		0300_H	STEP 7 instruction set
0013_H	**User memory areas**	01_H	Working memory
		02_H	Integrated load memory
		05_H	Size of back-up memory

Table B-1 Sublists of the System Status List of the C7 CPU

SZL_ID	Sublist	Index (= ID of the Individual Records of the Sublist)	Record Contents (Sublist Excerpt)
0014_H	**Operating system areas**	0001_H	Process image of the inputs (number in bytes)
		0002_H	Process image of the outputs (number in bytes)
		0003_H	Number of memory bits
		0004_H	Number of timers
		0005_H	Number of counters
		0006_H	Size of the I/O address area
		0007_H	Entire local data area of the C7 CPU (in bytes)
	Block types		
0015_H	All records of the sublist		
0115_H	One record depending on the index	0800_H	OBs (Number and size)
		$0A00_H$	DBs (Number and size)
		$0B00_H$	SDBs (Number and size)
		$0C00_H$	FCs (Number and size)
		$0E00_H$	FBs (Number and size)
	Loadable SDBs	SDB Number	-
0017_H			
0117_H			
	Rack information		
0018_H	All records of the sublist		
0118_H	One record depending on the index	0000_H	Rack 0
		0001_H	Rack 1
		0002_H	Rack 2
		0003_H	Rack 3
	Interrupt/error assignment via number of assigned OBs	-	-
0021_H	Records of all possible interrupts		
$0A21_H$	Records of all assigned interrupts		
	Interrupt status		
0222_H	Record for the specified interrupt	0001_H	Interrupt class of free cycle
		5050_H	Interrupt class of asynchronous interrupts
	Priority class		
0023_H	Records for all priority classes	0000_H	Priority of possible OBs
	Only sublist header information		

B

Table B-1 Sublists of the System Status List of the C7 CPU

SZL_ID	Sublist	Index (= ID of the Individual Records of the Sublist)	Record Contents (Sublist Excerpt)
	Operating statuses of the C7 CPU		
0024_H	Information on all stored operating status transitions		
0124_H	Information on the last executed operating status transition		
0424_H	Information on current operating status		
0524_H	Information on the operating status specified	5000_H	STOP status
		5010_H	STARTUP status
		5020_H	RUN status
0131_H	**Communication performance parameters** on the communications type specified	0001_H	Number of connections, transmission rates
		0002_H	Test and start-up parameters
		0003_H	Operator interface (parameters)
		0005_H	Diagnostic functions and diagnostic entries
		0007_H	Communications via global data (parameters)
		0008_H	Operator interface (time specifications)
0132_H	**Communications status information** on the communications type specified	0001_H	Number and type of connections
		0002_H	Number of test jobs set up
		0003_H	Number of current cyclic operator interface tasks
		0004_H	Protection levels of the C7 CPU
		0005_H	Diagnostic status data
		0007_H	Communications via global data
		0008_H	Scan cycle time, correction factor, run-time meter, date/time of day
		0009_H	Set transmission rate via the MPI
$0D91_H$	**Module status information** of all modules in the rack specified		Features/parameters of the module plugged in
		0000_H	Rack 0
		0001_H	Rack 1
		0002_H	Rack 2
		0003_H	Rack 3
	Diagnostic buffer	x	Event information
$00A0_H$	All entered event information		The information in each case depends on the event
$01A0_H$	The x latest information entries		
	Module diagnostics	Module rack and slot number	Module-dependent diagnostic information
$00B2_H$	Complete module-dependent record of the module diagnostic information		

Sublists for PROFIBUS-DP

The following sublists can be evaluated, in addition to those in Table B-1 by the C7-626 DP in its function as DP master.

Table B-2 Sublists of the System Status List of the C7-626 DP as DP Master

SZL_ID	Sublist	Index (= ID of the Individual Records of the Sublist)	Record Contents (Sublist Excerpt)
$0C91_H$	Module status information of a module	Module start address	Features/parameters of the module
	Status information of module rack or stations in DP network		
0092_H	Target status of racks in central configuration or of stations in a subnet	0000_H	Information of status of racks in central configuration
0292_H	Actual status of racks in central configuration or of stations in a subnet	Subnet ID	Information of status of stations in a subnet
	Module diagnostics		Module-dependent diagnostic information
$00B2_H$	Complete module-dependent record of the module diagnostic information	Module rack and slot number	
$00B3_H$	Complete module-dependent record of the module diagnostic information	Module start address	

B

C7 OP Functionality / Standard Screens / Control Jobs / System Messages

C

Summary of Sections

C.1 C7 OP Functionality

Table with List of Functions

The table below provides an overview of the functions of C7-626 and C7-626 DP with their different versions.

Table C-1 Functions of C7-626, C7-626 DP

Function		C7-626, C7-626 DP
Event messages	Number	2000
	Indication	In message line/message window
	View all queued events	On message page
	Length of message text (in characters)	2 x 35
	Lines per message	2
	Process values in message text	8
Alarm messages	Number	2000
	Indication	In message line/message window
	Indication type	1st value/last value (can be selected)
	View all queued alarms	On message page
	Length of message text (in characters)	2 x 35
	Lines per message	2
	Process values in message text	8
	Acknowledge individual alarm messages	Yes
	Acknowledge several alarm messages simultaneously	Yes, 16 acknowledgement groups
Message logging	Logged on a printer	Yes
Message buffer	Capacity	512 message occurrences
	Look at buffered event messages/ alarm messages	On buffer page
	Delete	Yes
	Buffer overflow warning	Yes
	Forced printout for buffer overflow	Yes
Message acquisition	Time of occurrence	Date/time
	Message status	Arriving, departing, acknowledged

Table C-1 Functions of C7-626, C7-626 DP, continued

Function		C7-626, C7-626 DP
Screens	Indicate	Yes
	Print (hardcopy)	Yes
	Static screen elements	Static full graphics Fixed text Semigraphic characters
	Input/output elements	Input fields Output fields Combined input/output fields Symbolic input (pop-up window) Symbolic output (graphics/text) Bars Curves
	Operator prompting	Icons for softkey functions
	Fixed window	Yes
Limit value monitoring	For inputs/outputs	Yes
Conversion functions	For inputs/outputs	Linear Square
Fonts	Loadable fonts per language	3
	Fonts not dependent on language (with semigraphic characters)	1
	Character sizes in pixels	8 x 8 to 64 x 64
Text attributes	Display	Flashing, inverse, underlined
	Printer	Bold, italics, underlined
Information texts	Lines/characters	7/35
	For messages	Yes
	For input fields	Yes
	For screens	Yes
Password protection	Number of passwords	50
	Password levels	9

C

Table C-1   Functions of C7-626, C7-626 DP, continued

Function		C7-626, C7-626 DP
Recipes	Number	255
	Data records per recipe	500
	Entries per data record	500
	Save data records (create)	C7 CPU/C7 OP → storage medium
	Load data records	Storage medium → C7 OP/C7 CPU
	Delete data records	In storage medium
	Change data records (edit)	In storage medium
	Transfer current values	C7 CPU → C7 OP C7 OP → C7 CPU
	Transfer data records	Data medium → C7 OP C7 OP → data medium
	Parameter records	Yes
Print functions	Hardcopy of the contents of the display Character mode (ASCII) Graphic mode	 Yes Yes
	Direct message logging	Yes
	Screen printout in character mode (ASCII)	Yes
Online language switchover	Number of languages	3
PG functions **(Status/force variable)**	For SIMATIC S7	Yes
Display	Setting for display brightness/ contrast	Yes
	Blanking circuit	Yes

C.2 Control Jobs and Their Parameters

Overview

Control jobs can be used to trigger functions from the user program in the C7 OP. Examples of these functions are as follows:

– Display screen
– Set date and time
– Modify general settings

A control job consists of four data words. The first data word contains the job number. Depending on the function, up to three parameters are transferred in data words 2 to 4. Figure C-1 shows the general structure of a control job.

Address	Most significant byte (MSB)	Least significant byte (LSB)
1st word	0	Job no.
2nd word	Parameter 1	
3rd word	Parameter 2	
4th word	Parameter 3	

Figure C-1 Structure of a Control Job

Note

Please refer to Section 8.8 for information on any provisions to be made in the interface area.

Listing

Table C-2 lists all the control jobs and their parameters which are possible with the C7 (No. = Job number of the control job):

Table C-2 Control Jobs with Parameters

No.	Function
1	**Select C7 operating mode** Parameters 1, 0: Off 1 On Parameters 2, 3
3	**Hardcopy** Parameters 1, 2, 3 -
12	**Enable/disable message log** Parameter 1 0: Off 1: On Parameters 2, 3 –
13	**Change language** Parameter 1 0: 1st language 1: 2nd language 2: 3rd language Parameters 2, 3 –
14	**Set time** **(BCD coded)** Parameter 1 [ ] [n+7] n+7: Hours (0..23) Parameter 2 [n+8] [n+9] n+9: Seconds (0..59) n+8: Minutes (0..59) Parameter 3 -

No.	Function
15	**Set date** **(BCD coded)** Parameter 1 [ ] [n+7] – Weekday 1: Sunday, 2: Monday, :, :, 7: Saturday Parameter 2 [n+8] [n+9] – n+9: Month (1..12); n+8: Day (1..31) Parameter 3 [n+10] [ ] – Year
21	**Display mode for alarm messages** Parameter 1 — 0: First value (oldest message) 1: Last value (newest message)
23	**Set password level** Parameter 1 — 1..9 (1 = lowest password level, 9 = highest password level) Parameters 2, 3 — -
24	**Password logout** (branching in message level) Parameters 1, 2, 3 — -
37	**Overflow warning for event messages on/off** Parameter 1 — 0: Off 1: On Parameters 2, 3 — -
38	**Overflow warning for alarm messages on/off** Parameter 1 — 0: Off 1: On Parameters 2, 3 — -
41	**Transfer date/time to C7 CPU** If this job is submitted too often, the C7 can get overloaded, as two transfers per job are necessary.
42	**Fetch LED area from C7 CPU** Parameter 1 — Block numbers 1-8 Parameters 2, 3 — -
43	**Fetch C7 CPU event message bit area** Parameter 1 — Block numbers 1-8 Parameters 2, 3 — -

C

No.	Function
44	**Fetch C7 CPU alarm message bit area** Parameter 1 — Block numbers 1-8 Parameters 2, 3 — -
45	**Fetch C7 CPU acknowledgement area** Parameter 1 — Block numbers 1-8 Parameters 2, 3 — -
47	**Fetch LED area from C7 CPU** Parameter 1 — LED image Area number (1...8) Parameter 2 — LED image word 0 Parameter 3 — LED image word 1 LED image / Area pointer → LED image word 0, LED image word 1 **Note:** The difference between this job and job 42 (fetch LED area from C7 CPU) is as follows: With job 47, the LED image is also transferred resulting in a faster control of the LEDs. The declared LED area may not be configured larger than 2DW!
49	**Delete event message buffer**
50	**Delete alarm message buffer**
51	**Screen selection** Parameter 1 — n+7: Screen number 1...255 Parameter 2 — – Parameter 3 — Field number 1...255 Output fields are not taken into account with the running number
69	**Transfer recipe data record to C7 OP** Parameter 1 — Key word 1 Parameter 2 — Key word 2 Parameter 3 — Key word 3
70	**Transfer recipe data record from C7 OP to C7 CPU** Parameter 1 — Key word 1 Parameter 2 — Key word 2 Parameter 3 — Key word 3
72	**Cursor positioning** in current process image or current recipe Parameter 1 — – Parameter 2 — Field number 1...255 Parameter 3 — –

C.3 System Messages

Overview

This section provides an overview of the most important system messages with their causes and the action required to remedy the errors.

Language

System messages are displayed in the language selected during the configuration. If there are no configuration data in the C7, messages will always be displayed in English.

Message Number

System messages on the C7 can be placed in different categories.

Information on the category to which a system message belongs is contained in the message number:

Message number

□□□ Message text

0 Driver error
1 Startup message
2 Warning
3 Note
4 Operating error
5 Other message
6 Configuration error
7 Internal error

Message Category

The message category gives you a rough idea of the cause of a system message.

A few important system messages are shown below together with their causes and the action that has to be taken. Self-explanatory system messages are not included.

Note

Messages are displayed in English until configuration data have been downloaded to the C7.

Messages

The following tables list the most important messages, their causes and possible action to take.

Message	Cause	Remedy
Please wait	Mode being changed	
Ready for transfer	Waiting for data from programming device/PC	
Data transfer	Data being transferred between programming device/PC and C7	
Firmware not compatible	Firmware cannot be used for current configuration	
EPROM memory failure	Memory submodule defective, internal hardware error	Return device for repair with details of error
RAM memory failure		
Flash memory failure	Memory submodule defective or transfer failure	Repeat download configuration or return device for repair

Message	Cause	Remedy
$ 005	Internal error	
$ 006	Error during data transfer in Download mode (message with two variables) Var. 1 Status display 0 Function introduction 1 Receive data 2 Send data 3 Send message block 4 Function end Var. 2 1 **Internal error** 3 Time-out error 5 Parity error 6 Framing error 7 Overrun error 8 Line interruption 9 Receive buffer overflow 10 Wrong control character 11 Logging error	Check connection, repeat download
$ 040	No response from controller – Cable defective or not plugged in	– Check physical connection
$ 041 $ 044	Temporary driver error	– Restart PC – Download configuration
$ 043	Error in data transfer. With this message, a variable is given as the cause of the error 0 Time-out error 1 Framing error (receive) 2 Overrun error 3 Parity error 4 No connection possible 5 Checksum error (receive) 6 Unexpected receipt of characters 7...11 Internal error (see Section C.3.1) 12 Receive data block too large 13 Memory area in C7 CPU does not exist	Repeat the data transfer. Check the physical connection or the configured interface parameters beforehand if necessary.

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Message	Cause	Remedy
$ 100	Invalid RAM contents	
$ 104	Download mode canceled by pressing a key	
$ 106	Serious error eliminated and key pressed	
$ 108	Mode change	
$ 110	Mode change	
$ 114	Controller cold restart	
$ 115	Establishment of logical link	
$ 117	Connection to controller OK again, following a fault	
$ 119	Automatic start of C7 (password list is not deleted)	
$ 125	Language changed by standard screen or control job	
$ 131	Mode change	
$ 133	Mode change	
$ 135	Mode change	
$ 136	No response from controller. Check program execution in controller or physical connection	
$ 138	Data block no. x not available in controller memory. Create % memory space.	

Message	Cause	Remedy
$ 200	Back-up battery voltage has fallen below minimum value or: wrong battery type inserted	Replace battery
$ 201	Error during clock chip write (hardware error)	Return device for repair
$ 202	Error reading date	Re-enter date (return C7 for repair)
$ 203	Error reading time	Re-enter time (return C7 for repair)
$ 204	Error reading day	Re-enter day (return C7 for repair)
$ 205	Printer not ready and internal storage of print jobs is no longer possible (capactity exceeded)	Ready printer or disable message log
$ 206	Printer not ready, print job will be stored temporarily	Ready printer
$ 207	Print job aborted	Check printer, cable and connector
$ 210	Internal error	Refer to remedy for internal errors
$ 212	Internal error	Refer to remedy for internal errors
$ 213	Off-line mode not possible at present	Try mode change again later
$ 214	The job number configured by the C7 CPU, or in a screen, is too large	Check user program and configured process screen
$ 217 $ 218	The addresses of two variables overlap	Modify configuration (variable)
$ 220 $ 221	Printer buffer overflow, messages have been lost	
$ 222	Event buffer full to remaining buffer space	Delete buffer or configure smaller remaining buffer space
$ 224	Event buffer full; buffer partially deleted and forced printout initiated	
$ 225	Alarm buffer full to remaining buffer space	Delete buffer or configure smaller remaining buffer space
$ 227	Alarm buffer full; buffer partially deleted and forced printout initiated	
$ 229	Keyboard connector faulty or loose (hardware fault)	Return device for repair

Message	Cause	Remedy
$ 250	Changeover to required OP mode not possible via job. This message may occur, for example, when trying to change over to loop-through mode during communications via FAP.	
$ 252	Recipe functions of the TD/OP cannot be carried out simultaneously. Two examples for situations where message 252 may be issued: – The selected function is already active (for example, in the background, used by the controller) – The operator tries to transfer or delete a data record after selecting it.	
$ 256	Insufficient memory space for executing the selected function. Select the function again. If the message is still output, ”simplify” the screen layout, that is, configure fewer screen elements/functions. Examples: – Shift the function causing the message to another screen – Do not use any curves in connection with this function	
$ 257	A data record was not stored in connection with the currently loaded recipe version. If the data records concerned are still to be used, the old version must be entered in the recipe configuration. The assignment of the values of a data record is defined in the recipe structure. If the structure was modified in a new configuration, an ”old” data set may be interpreted incorrectly.	
$ 259	A data record must be transferred to the controller within a specified period of time. This time was exceeded. Possible causes: – Reception of the data record was not acknowledged by the controller (user program) – The data record is very large. The data record is transferred completely despite the timeout.	
$ 260	The controller mode (for example, manual mode, automatic mode, STOP mode) does not correspond to the configuration.	
$ 261	A data set can no longer be used since the data are not consistent.	

Message	Cause	Remedy
$ 303	Controller did not invert life memory bit. Data have not been requested or are no longer valid	Check controller status
$ 304	Invalid job number or job parameters	Modify job on controller
$ 305	Data block number *x* missing	Create the data block that is missing
$ 306	Temporary driver error	
$ 307	Counter *x* not present on controller	Modify configuration (variable)
$ 308	Timer *x* not present on controller	Modify configuration (variable)
$ 309	Input *x* not present on controller	Modify configuration (variable)
$ 310	Output *x* not present on controller	Modify configuration (variable)
$ 311	Memory bit *x* not present on controller	Modify configuration (variable)
$ 312	Print job rejected because similar job now being executed	Wait until previous job terminated; initiate again
$ 313	Print job will be processed later because printer now busy	
$ 315	Information text has not been configured for highlighted object (that is message, setpoint)	
$ 316 $ 317	Current password level too low for required operator input	Log in at higher password level
$ 318	Login attempted with invalid password	
$ 319	You entered and tried to edit an existing password	
$ 320 $ 321		Enter password first, and then specify level
$ 322		Password must contain at least 3 characters
$ 323	In a buffer mask, you pressed [→] (message text), though an entry does not exist for the current message.	
$ 324	The screen number or entry number in your input does not exist.	
$ 335	Confirmation of alarm message inhibit	
$ 336 $ 337 $ 338	Printer cannot be addressed	Check printer and connection to C7
$ 339	Communication with controller resumed	
$ 340	You cannot operate the C7 with status function running on programming device	
$ 341	Internal error	

$ 342	This message indicates a data block error. Variables **x** and **y** are used to identify the cause of the error (variable **x**) and the number of the receive block (variable **y**). **Variable x:** 0 Wrong block length entered in receive block no. **y** 1 Wrong number entered in receive block no. **y** Correct the required block length or block number or send the correct data block.	
$ 385 $ 386	Recipe transfer in progress. During this time, the operator panel is not ready for operator inputs. Possible cause: The PLC has not reset the corresponding control/checkback bit which cancels the recipe inhibit state in the DB-TDOP.	

Message	Cause	Remedy
$ 400	Invalid key pressed	
$ 401	Entered value does not match display format	
$ 402	Operating error in STATUS VAR or FORCE VAR screen; (after pressing INS when 10th variable line already assigned).	
$ 403	Incorrect time input	
$ 404	Incorrect time input	
$ 406	Operating error in STATUS VAR or FORCE VAR screen	Abort updating (ESCAPE key)
$ 409	Lower limit for input ignored	Enter a value greater than or equal to *Var*
$ 410	Upper limit for input ignored	Enter a value smaller than or equal to *Var*
$ 411	Selection of special screens is not permissible in this case. If necessary, modify the configured interface parameters.	
$ 442	Thie message indicates a data block error. The **x** and **y** variables identify the cause of the error (x variable) and the number of the affected receive block (y variable). **Variable x**: 0 Invalid block size entered in receive block no. **y**. 1 Invalid block number entered in receive block no. **y**.	Either correct the block size or the block number or send the correct data block.

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Message	Cause	Remedy
$ 500 $ 501 $ 502 $ 503 $ 504	Download to C7 CPU not possible at present – C7 CPU overloaded – Standard FB not called for more than 1.5 s	– Check user program
$ 505	Data records cannot be transferred, either because the recipe disable bit is set in the C7 CPU or because a recipe is already being sent.	Send the data record again after the C7 CPU has enabled the recipe mailbox.
$ 506	Too many message blocks having the same block number in transit (overloading)	Error occurs when C7 CPU sends too many jobs within a certain time with “Fetch message bit area”
$ 507	A data record transfer has not been acknowledged by the C7 CPU (user program) within 10 seconds.	Speed up the DB check on the C7 CPU side.
$ 509	Firmware version different from standard FB version	Load new standard FB onto C7 CPU
$ 510	This message is output if: – The data block for the variable does not exist in the recipe, or – The recipe data contains errors.	Either set up the data block or change the configuration.
$ 511	The data record number in the control job or the function key is invalid.	
$ 512	This message indicates a PLC error. The variable which is transferred with the message identifies the number of a data block that is too short.	Correct the configuration if necessary.
$ 520	Too many returns stored	Go to message level (if necessary, by pressing ESCAPE key)
$ 522	Screen cannot be selected due to inadequate storage space. Results in cold restart with memory optimization	1. Delete unused fields from configuration 2. Configure smaller screen (with fewer fields) or partition screen
$ 526	Loop-through mode is set on C7	Change to Normal mode
$ 536	Disturbance on link between OP and disk drive.	Check the physical connection.
$ 538	Job and operator access data record simultaneously.	Repeat your input if it was not executed.
$ 539	The data records stored in RAM for recipe no. x contain errors; they have been deleted. Any data records stored in flash memory are still valid.	
$ 540	The maximum permissible number of data records in memory has already been reached.	
$ 541 to 550	The specified variable cannot be found in the controller.	Check the configuration.
§ 551	Controller address cannot be found.	

Message	Cause	Remedy
$ 600	Wrong parameter transferred by ProTool/Lite (overflow warning)	Set required value by means of standard screen or controller
$ 601	Wrong parameter transferred by ProTool/Lite (message log)	Set required value by means of standard screen or controller
$ 602	Wrong parameter transferred by ProTool/Lite (remaining buffer size)	Re-configure and repeat download of required value
$ 603	Recipe setpoint is only set up symbolically.	
$ 604	Message not configured for a set message bit	Configure messages and repeat download
$ 605	Process connection only configured symbolically.	
$ 606	Too many message variables are configured.	
$ 607	Configured data type does not exist.	
$ 608	Screen number does not exist.	
$ 609	Special object, control operator object for message text does not exist or is not allowed.	
$ 610	Control operator object for header or footer does not exist or is not allowed.	
$ 611	Special operator object for buffer printout does not exist.	
$ 613	Data block does not exist or is too short	Create DB or required length in controller
$ 614	The layout of the listing had not been configured when the print job was issued.	
$ 615	Line to be output is larger than the reserved print memory or the number of control sequences is too large	Check configuration for log
$ 616 $ 617		See Internal Errors
$ 618	Wrong value entered: Bit no. is actual control value.	
$ 619	ProTool/Lite error (data structure for presetting setpoint)	Re-load ProTool/Lite, repeat download of configuration
$ 620	Wrong parameter transferred by ProTool/Lite (function keyboard)	Repeat download of configuration
$ 621	Wrong parameter transferred by ProTool/Lite (message type)	Set required value by means of standard screen or controller
$ 622	Configured recipe does not fit in the C7 CPU recipe mailbox (more than 256 data words)	
$ 623		See Internal Errors
$ 624	No recipe entries available.	

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$ 625	Invalid recipe number in control job or function area.	
$ 626	No setpoints configured.	
$ 627	Internal error	See Internal Errors, Section C.3.1
$ 628	The recipe does not fit into the boxes.	
$ 629	LED image area too small	Enlarge LED image area according to configured bit offsets
$ 630	Keyboard image area too small	Enlarge image area according to configured bit offsets
$ 631	Message configuration **x** is incomplete or incorrect. **Variable x**: 1, 2 The triggered alarm message is not configured 3 The process connection is only set up symbolically 4 The actual value field is only set up symbolically 5, 6 The triggered event message is not configured 7 The symbolic actual value field is only set up symbolically 21...24 Field texts do not exist for the symbolic actual value 25 Field type not permitted 8...20 Internal error	Add to configuration and repeat download
$ 632	(Message with one variable) 1, 4 Information text not available 2 Information text identifier not available for messages 12 Process screen does not contain entries 3, 6, 7, 8, 11, 13 Internal errors	Add to configuration and repeat download

$ 634	(Message with one variable) 18 Screen title not configured 0 to 8, 34 Internal errors	Add to configuration and repeat download
$ 635	Configuration error in **x** **Variable x**: 1 The screen or recipe entry is only set up symbolically 3 The field is only set up symbolically 6 The message, entry or information text is not configured for the current language 7...9, 19, 28, 41...43 Internal errors 18 The screen or recipe title is not configured 20 The process connection is only set up symbolically 21 The information text is only set up symbolically 22 The symbolic field is only set up symbolically 23 Fewer than 2 field texts are configured for a symbolic field 24 The current field text is not configured for a symbolic field 25 Invalid data format for a symbolic field (only KF and KY are permitted) 26 Recipe setpoint configured with Char data format 33 Invalid data format for setpoint field 35 Data format for the scheduler is too short 36 Invalid data format for actual control value 44 For fixed cross-jump to menu: menu item does not exist 45 For fixed cross-jump to screen: entry or field number does not exist 46 Too many current control values on screen (maximum of 200 permitted) 48 Too many fields on process screen 50 Process connection for softkeys does not exist 51 Softkey number too high 53 Information text for softkey not configured or not in all languages 55 Softkey specified in entry does not exist	Add to or modify configuration and repeat download

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Message	Cause	Remedy
$ 636 $ 637	Initiated event messages (no. x) not configured	Add to configuration and repeat download
$ 638 $ 639	The actual value field for event message no. x is available in symbolic form only.	
$ 640 $ 641	Initiated alarm messages (no. x) not configured	Add to configuration and repeat download
$ 642 $ 643	The actual value field for alarm message no. x is available in symbolic form only.	
$ 645 $ 649	Internal errors	
$ 650	Area pointer for function you used not configured	Configured area pointer
$ 651	Internal error	
$ 653	Configured user version number does not agree with that stored in C7 CPU	Adjust user version number
$ 655	Controller acknowledgement area not physically beyond alarm message bit area (serious error, no startup)	Re-configure C7 CPU → C7 O/I acknowledgement areas and repeat download
$ 657	Configured controller driver not supported by version of device you are using (serious error)	Change protocol for version of device you are using and repeat download configuration
$ 659	Invalid variable in recipe no. x (BIN format).	
$ 660	Invalid destination configured for cross-jump in screen	Add to configuration and repeat download
$ 662	Invalid destination configured for cross-jump in screen	Add to configuration and repeat download

Message	Cause	Acton
$ 667	Incorrect configuration **x**. **Variable x:** 1 Data type does not correspond to DB 2 DB number greater than 15 3 DB length greater than 1024 4 DW is in data block header 5 Actual value is not in send block 6 Setpoint is not in receive block 7 Setpoint/actual value is not in receive block 8 Initial value is not in send block 9 Data type does not correspond to DB 10 DB number greater than 15 11 DB length greater than 1024 12 DW is not in data block header 13 Area located in wrong DB 14 Sum of data blocks too high	x = 1..8: Change configuration of process link and transfer again x = 9..13: Change configuration of area pointer and transfer again x = 14: Restrict configuration and transfer again
$ 670	Too many variables were requested simultaneously. Remedy: Configure – a longer basic clock, – fewer variables in the screen.	
$ 681	The link between OP and controller is disturbed. The interface parameters are possibly set incorrectly.	
$ 682	Configure fewer process links for the screen currently displayed.	

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Message	Cause	Remedy
$ 702	**Internal error** (actual value error)	
$ 703	**Internal error** (job faulty)	Limit configuration
$ 704	Flash memory full	
$ 705	**Internal error** (S7 error)	
$ 706	**Internal error** (unknown message acknowledged)	
$ 7xx	**Internal errors**	

C.3.1 Internal Errors

The field numbers from 700 onwards and some errors defined in previous sections are used to describe internal errors of the C7 control systems or the ProTool configuring tool.

Procedure

Please proceed step by step as described below if an internal error occurs:

- Set the C7 CPU to *STOP* mode. Switch off the C7 and then restart it.
- Set the C7 OP to transfer mode during startup. Transfer the configuration again and restart the C7.
- Should the error occur again, contact the Siemens regional office in your vicinity. Specify the error number including any variables coming up in the message.

Possible Causes

- **005** Error no.: #Var1, #Var2, #Var3, #Var4
- **6xx** Error in configuration file
- **701** Internal actual value errors
- **702** Invalid job (illegal job number or job parameter)
- **703** Flash full (restrict your configuration)
- **704** Controller error
- **705** Acknowledgement for unknown message
- **706** Recipe request already active
- **7xx** Internal errors

SIMATIC C7 and S7 Literature List

D

Supplementary Literature

/70/ S7-300 Programmable Controller
Hardware and Installation Manual

/71/ *S7-300/M7-300 Programmable Controllers,*
*Module Specification*s
Reference Manual

/72/ *S7-300 Programmable Controller, CPU 312/CPU 314*
Instruction List

/231/ User Manual: *Standard Software for S7 and M7,*
STEP 7

/233/ Ladder Logic (LAD) for S7-300 and S7-400, Programming
Manual

/235/ *System Software for S7-300 and S7-400, System and Standard Functions*
Reference Manual

/280/ *System Software for M7-300 and M7-400, Program Design*
Programming Manual

Siemens Worldwide

E

Overview

In this appendix you will find a list of:

- All cities in the Federal Republic of Germany with Siemens Sales Offices and
- All European and non-European Siemens Companies and Representatives

SIMATIC Contact in the Federal Republic of Germany

ZN Zweigniederlassung
(Regional Office)

ZN 52066 Aachen
AUT P 13, Hr. Georgens
Kurbrunnenstr. 22
☎ (02 41) 4 51-2 52
Fax (02 41) 4 51-3 98

ZN 86159 Augsburg
AUT S11, Hr. Hirth
Werner–von–Siemens Str. 6
☎ (08 21) 25 95-4 50
Fax (08 21) 25 95-4 08

ZN 95448 Bayreuth
AUT P/S 11, Fr. Hösl
Weiherstr. 25
☎ (09 21) 2 81-3 41
Fax (09 21) 2 81-4 44

ZN 10587 Berlin
AUT P 1, Hr. Liebner
Salzufer 6-8
☎ (0 30) 39 93-23 97
Fax (0 30) 39 93-23 02

ZN 33605 Bielefeld
AUT P 12, Fr. Schlüpmann
Schweriner Str. 1
☎ (05 21) 2 91-5 21
Fax (05 21) 2 91-5 90

ZN 38126 Braunschweig
AUT P 11, Hr. Pelka
Ackerstr. 20
☎ (05 31) 27 12-3 05
Fax (05 31) 27 12-4 16

ZN 28195 Bremen
AUT P 12, Fr. Ulbrich
Contrescarpe 72
☎ (04 21) 3 64-24 27
Fax (04 21) 3 64-28 42

ZN 09114 Chemnitz
AUT P 11, Fr. Aurich
Bornaer Str. 205
☎ (03 71) 4 75-35 10
Fax (03 71) 4 75-35 25

ZN 01189 Dresden
AUT 1, Hr. Lehmann
Karlsruher Str. 111
☎ (03 51) 40 22-2 77
Fax (03 51) 40 22-2 74

ZN 40219 Düsseldorf
AUT P 15, Hr. Becker
Lahnweg 10
☎ (02 11) 3 99-16 64
Fax (02 11) 3 99-18 48

ZN 99097 Erfurt
AUT P 22, Hr. Skudelny
Haarbergstr. 47
☎ (03 61) 4 25-23 51
Fax (03 61) 4 25-23 50

ZN 45128 Essen
AUT P 14, Hr. Klein
Kruppstr. 16
☎ (02 01) 8 16-24 28
Fax (02 01) 8 16-23 31

ZN 60329 Frankfurt
AUT P 25, Hr. W. Müller
Rödelheimer Landstr. 1-3
☎ (0 69) 7 97-34 18
Fax (0 69) 7 97-34 42

ZN 79104 Freiburg
AUT P, Hr. Thoma
Habsburgerstr. 132
☎ (07 61) 27 12-2 38
Fax (07 61) 27 12-4 46

ZN 20099 Hamburg
AUT 1, Hr. Rohde
Lindenplatz 2
☎ (0 40) 28 89-30 03
Fax (0 40) 28 89-32 09

ZN 30519 Laatzen (Hannover)
AUT P 10, Fr. Hoffmann
Hildesheimer Str. 7
☎ (05 11) 8 77–23 19
Fax (05 11) 8 77–27 39

ZN 74076 Heilbronn
AUT P/S, Hr. Gaul
Neckarsulmer Str. 59
☎ (0 71 31) 1 83-2 03
Fax (0 71 31) 1 83-3 20

ZN 76185 Karlsruhe
AUT 14 P, Hr. Boltz
Bannwaldallee 48
☎ (07 21) 9 92-24 13
Fax (07 21) 9 92-25 85

ZN 34117 Kassel
AUT P 13, Hr. Uhlig
Bürgermeister-Brunner-Str.15
☎ (05 61) 78 86-3 32
Fax (05 61) 78 86-4 48

ZN 87439 Kempten
AUT P, Hr. Fink
Lindauer Str. 112
☎ (08 31) 58 18-2 25
Fax (08 31) 58 18-2 40

ZN 24109 Kiel
AUT 1, Fr. Drews
Wittland 2-4
☎ (04 31) 58 60-3 26
Fax (04 31) 58 60-2 48

ZN 56068 Koblenz
AUT P 11, Hr. Ricke
Frankenstr. 21
☎ (02 61) 1 32-2 44
Fax (02 61) 1 32-2 55

ZN 50823 Köln
AUT P 14, Hr. Prescher
Franz-Geuer-Str. 10
☎ (02 21) 5 76-27 62
Fax (02 21) 5 76-27 95

ZN 78416 Konstanz
AUT P, Fr. Wiest
Fritz-Arnold-Str. 16
☎ (075 31) 988-2 02
Fax (075 31) 988-1 40

ZN 04105 Leipzig
AUT P 2, Fr. Kiesewetter
Springerstr. 15
☎ (03 41) 2 10-30 07
Fax (03 41) 2 10-30 63

ZN 39106 Magdeburg
AUT VG 33, Hr. Ganschinietz
Sieverstorstr. 32-33
☎ (03 91) 5 88-17 21
Fax (03 91) 5 88-17 22

ZN 68165 Mannheim
AUT 16 P, Hr. Sulzbacher
Dynamostr. 4
☎ (06 21) 4 56-28 43
Fax (06 21) 4 56-25 45

ZN 81679 München
AUT P 14, Hr. Schäfer
Richard-Strauss-Str. 76
☎ (0 89) 92 21-30 64
Fax (0 89) 92 21-43 99

ZN 48153 Münster
AUT S 13, Hr. Schlieckmann
Siemensstr. 55
☎ (02 51) 76 05-4 25
Fax (02 51) 76 05-3 36

ZN 90439 Nürnberg
AUT P 11, Hr. Glas
Von-der-Tann-Str. 30
☎ (09 11) 6 54-35 87
Fax (09 11) 6 54-73 84

ZN 49090 Osnabrück
AUT S 13, Hr. Pöhler
Eversburger Str. 32
☎ (05 41) 12 13-2 73
Fax (05 41) 12 13-3 50

ZN 93053 Regensburg
AUT P/S 12, Hr. Rewitzer
Hornstr. 10
☎ (09 41) 40 07-1 97
Fax (09 41) 40 07-2 36

ZN 18069 Rostock
AUT, Fr. Langhammer
Industriestr. 15
☎ (03 81) 78-21 71
Fax (03 81) 78-21 75

ZN 66111 Saarbrücken
AUT, Hr. Müller
Martin-Luther-Str. 25
☎ (06 81) 3 86-22 89
Fax (06 81) 3 86-21 11

ZN 57072 Siegen
AUT P 11, Hr. Patz
Sandstr. 42-48
☎ (02 71) 23 02-2 40
Fax (02 71) 23 02-2 38

ZN 70499 Stuttgart
AUT P 11, Hr. Müller
Weissacherstr. 11
☎ (07 11) 1 37-26 44
Fax (07 11) 1 37-29 46

ZN 54292 Trier
AUT VG 14 P, Hr. Baldauf
Löbstr. 15
☎ (06 51) 20 09-23
Fax (06 51) 20 09-24

ZN 89079 Ulm
AUT ZR, Hr. Birk
Nikolaus-Otto-Str. 4
☎ (07 31) 94 50-3 28
Fax (07 31) 94 50-3 34

ZN 97084 Würzburg
AUT PIS 13, Hr. Vogt
Andreas-Grieser-Str. 30
☎ (09 31) 61 01-4 59
Fax (09 31) 61 01-5 42

ZN 42103 Wuppertal
siehe ZN 45128 Essen
AUT P 14, Hr. Klein
Kruppstr. 16
☎ (02 01) 8 16-24 28
Fax (02 01) 8 16-23 31

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Siemens AG, AUT
Mr Jammernegg
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Fax 00 43 (3 16) 2 80 42 85

6040 Innsbruck/Neu-Rum
Siemens AG, AUT
Mr Mayr
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Glossary

A

ACCU (Accumulator)
Accumulators are registers in the → C7 CPU and serve as buffers for load and transfer operations, as well as for comparison, math and conversion operations.

Address
An address includes the address identifier and the physical memory location where the address is stored.

Alarm Message
It points out particularly critical operating states. An alarm message always requires an acknowledgement.

Alarm Time
Interval between the arrival and departure of an alarm message.

Analog I/O
The analog I/O converts analog process values (for example, temperature) into digital values that can be processed by the C7 CPU or converts digital values into analog manipulated variables.

Area Pointer
The area pointer is necessary for exchanging data between the operator panel section and the controller section of the C7. It includes information on the location and size of data areas in the controller.

Assigning Parameters
Assigning parameters means setting the operating characteristics of a module.

Authorization Input
External access point to superuser password level.

B

Back-Up Memory

The back-up memory backs up memory areas of the C7 without the need for a back-up battery. The memory backs up a programmable number of timers, counters, bit memory and data bytes, the → retentive timers, counters, bit memory and data bytes.

Bit Memory

A memory area in the → system memory of the CPU. This area can be accessed using write or read access (bit, byte, word, and double word). The bit memory area can be used to by the user to store interim results.

C

C7-620

The C7-620 control system integrates an S7-300 CPU, a COROS OP, the I/O and an IM 360 interface module in one single unit.

C7 CPU

The C7 CPU is a central processing unit of the C7 range, complete with processor, arithmetic unit, memory, operating system and interfaces for programming devices. The C7 CPU is independent of the → C7 OP. The C7 CPU has its own MPI address and is connected to the C7 OP via the MPI (multipoint interface).

C7 I/O

The C7 I/O (→ signal module) forms the interface between the process and the programmable controller. There are digital input and outputs as well as analog inputs and outputs. The integral universal inputs have special functions in the C7 (interrupt/counter inputs).

C7 OP

The C7 OP handles the OP functions of the C7 control system. It is independent of the → C7 CPU and continues to operate, for example, if the C7 CPU enters the STOP mode. The C7 OP has its own MPI address and is connected to the C7 CPU via this interface. It is via the MPI that the C7 OP is connected to a configuring computer (programming device/PC).

CP

→ Communications Processor

Communications Processor (CP)

Communication processors are intelligent modules with their own processor. They form an important group within the components of a programmable controller. A distinction can be made between various types of communications processors according to their tasks. For example, CPs for messages and logging, for point-to-point connection, for operator interfacing (COROS), for bus connections (SINEC), for diagnostics and mass storage applications.

Complete Restart

When a CPU starts up (for example, when the mode selector is moved from STOP to RUN or when power is turned on), before cyclic program processing starts (OB1), the organization block OB100 (complete restart) is processed first. In a complete restart, the process-image input table is read in and the STEP 7 user program processed starting with the first statement in OB1.

Compress

The programming device on-line function “Compress” is used to shift all valid blocks in the RAM of the C7 CPU evenly and without any gaps to the beginning of the user memory. All gaps caused by deleting or correcting of blocks are thus removed.

Configuration

The assignment of modules to racks/slots and addresses (for example, with signal modules).

Configuring

Defining plant-specific basic settings, messages and displays using the ProTool configuration software.

Configuration Memory

The configuration memory is a flash memory integrated in the C7 OP. It is used for storing the configuration data.

Control Job

Used for triggering a function in the C7. Handling control jobs is explained in Volume 2 of the manual, Section 8.8.3.

Counters (C)

Counters are an area in the → system memory of the → C7 CPU. The contents of these counters can be changed using STEP 7 instructions (for example, up counter, down counter).

Cyclic Interrupt

A cyclic interrupt is generated periodically by the C7 CPU according to a time grid which can be assigned parameters. It triggers execution of the relevant organization block.

D

Data Block (DB)

Data blocks are data areas in the user program which contain user data. There are shared data blocks which can be accessed by all logic blocks, and there are instance data blocks which are associated with a particular function block (FB) call.

Data, Static

Static data are data which are used only within a function block. These data are stored in an instance data block belonging to the function block. The data stored in the instance data block are retained until the next function block call.

Data, Temporary

Temporary data are local data of a block that are stored in the L stack during execution of the block and that are not retained after the execution.

Default Setting

The default setting comprises generally applicable basic settings which are used whenever no other values are specified.

Diagnostics

→ Diagnostic Functions, → System Diagnostics

Diagnostic Events

Diagnostic events include errors in a digital function in the C7, system faults in the C7 caused, for example, by programming errors or operating mode transitions.

Diagnostic Functions

Diagnostic functions comprise the complete scope of system diagnostics and the detection, evaluation and signalling of faults within the C7.

Diagnostic Interrupt

Modules with diagnostics capability signal system errors to the → C7 CPU by means of diagnostic interrupts.

Display

Representation of logically related process data for display and modification in the C7 either in groups or individually.

Display Duration

Interval between the arrival and departure of an event message.

Display Entry

Element of a display. It consists of the entry number, text and variables.

Display Function

Function that causes a change in the display contents, for example, display of message level or display of error message buffer.

Display Level

Processing level of the C7 at which displays can be monitored and operated.

E

Error Display

The error display is one of the possible responses of the operating system to a run-time error. The other possible responses are: → Error Response in the user program, STOP mode of the C7 CPU.

Error Response

Response to a run-time error. The operating system can react in the following ways: the C7 CPU changes to STOP mode; an organization block is called, in which the user can program a response; or an error is displayed.

Event Message

It draws the operator's attention to certain operating states in the machine or plant to which the C7 is connected.

F

FB

→ Function Block

FC

→ Function

Fields

Reserved areas in configured or fixed texts used to output or input values.

Flash EPROM

With regard to their characteristic to retain data in the case of a power failure, FEPROMs correspond to the electrically erasable EEPROMs, but can be erased much faster (FEPROM = Flash Erasable Programmable Read Only Memory).

The following data can be held in flash memory without being affected by a power failure:

- The → user program.
- The → parameters that determine the characteristics of the → C7 CPU and the I/O functionality of the C7.

Forced Printout

Automatic printout of fault and event messages that can be deleted in the event of a buffer overflow.

Function (FC)

According to the International Electrotechnical Commission's IEC 1131-3 standard, functions are → logic blocks that do not reference an → instance data block, meaning they do not have a "memory". A function allows you to pass parameters in the user program, which means they are suitable for programming complex functions that are required frequently, for example, calculations.

Function Block (FB)

According to the International Electrotechnical Commission's IEC 1131-3 standard, function blocks are → logic blocks that reference an → instance data block, meaning they have → static data. A function block allows you to pass parameters in the user program, which means they are suitable for programming complex functions that are required frequently, for example, control systems, operating mode selection.

H

Hardcopy

Output of the display contents to a connected printer.

Hardware Interrupt

A hardware interrupt is triggered by modules with interrupt capability as a result of a specific event in the process. The hardware interrupt is reported to the C7 CPU. The assigned → organization block is then processed according to the priority of this interrupt.

I

Incoming (Message)

Point in time at which the C7 triggers a message output.

Information Text

Supplementary, user-configurable information on messages, displays, display entries and selection fields.

Information Function

The information functions of STEP 7 permit the display of status information on the programming device via one or more C7 systems during the various startup phases and during operation of a programmable controller.

Instance Data Block

Each call of a function block in the STEP 7 user program is assigned a data block which is generated automatically. In the instance data block, the values of the input, output and in/out parameters, as well as the module local data are stored.

Interrupt

The → operating system of the C7 CPU recognizes 10 different priority classes which control the processing of the user program. These priority classes include interrupts, such as hardware interrupts. When an interrupt occurs, the relevant organization block is called automatically by the operating system in which the user can program the required reaction to the interrupt (for example, in a function block (FB)).

L

Load Memory

The load memory is part of the C7 CPU. It contains objects created by the programming device. It is available as an integrated memory.

Logic Block

In SIMATIC S7, a logic block is a block that contains part of the STEP 7 user program. The other type of block is a → data block which contains only data.

M

Memory Reset

During a memory reset of the → **C7 CPU**, the following memories are cleared:

- The → work memory
- The write/read area of the → load memory
- The → system memory
- The → back-up memory

The user program is reloaded from the flash memory.

The following memories are cleared in a memory reset of the → **C7 OP**.

- The → work memory
- The → configuration memory.

After this procedure, there is no longer any user configuration loaded.

Message Level

Operating level of the C7 at which any messages triggered in the system are displayed.

Message Logging

Printout of fault and event messages parallel to display output.

Module Parameters

Module parameters are values with which the behavior of the module can be set. A distinction can be made between static and dynamic module parameters.

MPI

→ Multipoint Interface

Multipoint Interface (MPI)

The multipoint interface is the programming device interface in SIMATIC S7. It allows a number of programmable modules, text display operator panels, and operator panels to be accessed from a central unit. The nodes on the MPI can communicate with each other. Each node is identified by an address (MPI address).

N

Nesting Level

A block can be called from another block by means of block calls. The nesting level is the number of simultaneously called → logic blocks.

Network

A network is a number of C7 systems and/or S7-300 systems and further terminals, such as programming devices linking together by connecting cables for the purpose of data communication.

Normal Operation

Operating mode of the C7; in this mode, messages are displayed and entries can be made in screens.

O

OB

→ Organization Block

OB Priority

The → operating system of the C7 differentiates between various priority classes, for example, cyclic program processing, hardware interrupt-controlled program processing. → Organization blocks (OBs) are assigned to each priority class, in which the S7 user can program a reaction. The OBs have different priorities, which allow them to be processed in the correct sequence when two occur at the same time and allow OBs with higher priority to interrupt those with lower priority.

Operating System of the C7 CPU

The operating system of the C7 CPU organizes all functions and processes of the C7 which are not linked to a special control task.

Organization Block (OB)

Organization blocks form the interface between the operating system of the C7 CPU and the user program. The sequence in which the user program is processed is specified in the organization blocks.

Output Field

Field for the display of an actual value.

P

Parameters

1. A parameter is a variable of a STEP 7 logic block
2. A variable for setting the behavior of a module (one or more per module)

Every configurable module has a basic parameter setting when it is supplied from the factory, but this can be changed using STEP 7.

There are two types of parameter: static and dynamic parameters (→ Parameters, Dynamic or → Parameters, Static)

Parameters, Dynamic

Dynamic parameters of modules, in contrast to static parameters, can be changed by the user program during operation by calling an SFC, for example, limit values of an analog signal input module.

Parameters, Static

Static parameters of modules, in contrast to dynamic parameters, cannot be changed by the user program, but only using STEP 7, for example, the input delay of a digital signal input module.

Password / Password Level

A password with a defined password level is required for accessing a protected function. The password level corresponds to the authorization level allocated to the operator. At the configuring stage, the necessary password level can be preset in the range from 0 (lowest level) to 9 (highest level).

PG

→ Programming Device

PLC

→ Programmable Logic Controllers

Process Image

The process image is a component part of the → system memory of the C7 CPU. At the beginning of the cyclic program, the signal states of the input modules are transferred to the process-image input table. At the end of the cyclic program, the process-image output table is transferred to the output modules as signal state.

Programmable Logic Controllers

Programmable logic controllers (PLCs) are electronic controllers whose function is stored in the control device as a program. The structure and the wiring of the device are therefore not dependent on the function of the controller. A programmable controller has the structure of a computer; it consists of a CPU with memory, I/O modules, and an internal bus system. The I/O and the programming language are set up according to the requirements of control engineering.

Programming Device A personal computer with a special compact design, suitable for industrial conditions. A programming device is completely equipped for programming the SIMATIC programmable logic controllers.

R

RAM The Random Access Memory or RAM is a read/write memory in which each memory location can be addressed individually and have its contents changed. RAM is used as a memory for data and programs.

Reference Data Reference data are used to check your C7 CPU program and include the cross reference list, the I/Q/M reference list, the program structure, the list of free addresses, and the list of missing symbols. The *STEP 7 User Manual* describes how these data can be displayed.

Retentivity Retentive data areas and retentive timers, counters and bit memory retain their contents in the case of a complete restart or power off.

S

Selection Field Field provided for assigning values to a parameter (values can be selected from a list of permissible values).

SFB → System Function Block

SFC → System Function

Signal Module Signal modules (C7 I/O) form the interface between the process and the C7. There are digital input and output modules and analog input and output modules.

Softkeys Keys with variable assignments (depending on the current display entry).

STARTUP The C7 CPU goes through the STARTUP mode during the transition from the STOP mode to the RUN mode.

Start-Up Test Checking the CPU status and the memory status each time the C7 is powered up.

STEP 7

Programming software for creating user programs for SIMATIC S7 programmable controllers.

STEP 7 Application

A STEP 7 application is a tool of → STEP 7, which is tailored to a specific task.

Substitute Value

Substitute values are values which are output to the process in the case of faulty signal output modules or which are used in the user program instead of a process variable in the case of faulty signal input modules. The substitute values can be specified in advance by the user (for example, maintain old value).

System Diagnostics

System diagnostics comprises the recognition, evaluation and signalling of errors which occur within the programmable controller. Examples of such errors include: program errors or module failures. System errors can be indicated via LEDs or via STEP 7.

System Function (SFC)

A system function is a → function integrated in the operating system of the CPU, which can be called in the STEP 7 user program when required.

System Function Block (SFB)

A system function block is a → function block integrated in the operating system of the C7 CPU, which can be called in the STEP 7 user program when required.

System Memory

The system memory is integrated in the CPU and executed in the form of RAM. The address areas (for example, timers, counters, bit memory) and data areas required internally by the → operating system (for example, backup for communication) are stored in the system memory.

System Message

It reports internal states in the C7 and in the controller.

T

Time-Delay Interrupt

The time-of-day interrupt belongs to one of the priority classes in the program execution of the C7 CPU. It is generated at a specific date (or day) and time (for example, 9:50 or every hour or every minute). A corresponding organization block is then executed.

Time-Of-Day Interrupt

The time-delay interrupt belongs to one of the priority classes in SIMATIC S7 program execution. It is generated when a timer has expired in the user program. A corresponding organization block is then executed.

Timers (T)

Timers are an area in the → system memory of the → C7 CPU. The contents of these timers is updated by the operating system asynchronously to the user program. You can use STEP 7 instructions to define the exact function of the timer (for example, on-delay timer) and start processing it (Start).

Tool

→ STEP 7 Application

Transfer Mode

Operating mode of the C7 OP used for transferring data from the programming device to the C7 OP.

Transmission Rate

Data transmission rate (bit/s).

Troubleshooting via OB

When the operating system recognizes a specific error (for example, STEP 7 access error), it calls the organization block (error OB) designated for this particular case, in which the behavior of the C7 CPU can be established.

U

User Memory

The user memory contains → logic blocks and → data blocks of the user program. The user memory is integrated in the C7 CPU as flash memory. In general, however, the user program is executed from the → work memory of the C7 CPU.

User Program

The user program contains all the statements and declarations and the data required for signal processing to control a plant or a process. The program is linked to a programmable module (for example, C7 CPU, FM) and can be structured in the form of smaller units (blocks).

W

Work Memory (RAM)

The work memory is a RAM in the → C7 which the processor accesses while executing the program.

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