SIEMENS

SIMATIC HMI

Communication

User’s Manual

6AV3991–1BC05–1AB0

Release 05/99

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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:

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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.

Technical data subject to change.

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Order No. 6AV3991–1BC05–1AB0

Preface

Purpose

The Communication User's Manual describes:

- the structure and function of the individual user data areas,
- the different types of connection between the operating unit and the PLC,
- the actions that need to be carried out in the PLC program.

That description applies both to operating units configured using ProTool and units configured using COM TEXT.

Conventions

The following conventions are used in this manual:

`VAR_23`	Text that is displayed on the screen is printed in Courier type face. Examples of this are commands, file names, entries in dialog boxes and system messages.
Tag	The names of dialog boxes and boxes and buttons in dialog boxes are printed in italics.
File → Edit	Menu items are shown linked by arrows. The full path to the menu item in question is always shown.
F1	The names of keys are printed in a different type face.

History of revisions

The table below shows the history of revisions to the Communication User's Manual.

Edition	Remarks
07/94	Original version
12/94	Errata corrected, SINEC L2-DP added
10/95	– New chapters on SIMATIC S7, SIMATIC 500/505 – Technical content reviewed – Manual reorganized
01/96	– Technical additions for ProTool and SIMATIC S7 – New chapter on Telemecanique TSX Adjust
05/96	Errata corrected
11/97	– Inclusion of operating units TD17, OP7/17, OP27/37, TP27/37 – Technical content of section on SIMATIC S5 connections reviewed
05/99	Errata corrected

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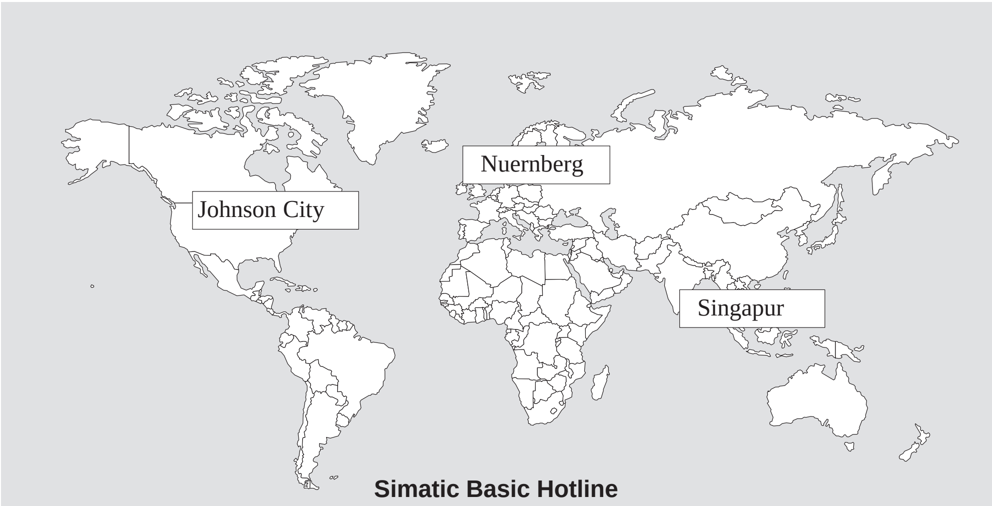

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Abbreviations

The meanings of the abbreviations used in the *Communication User's Manual* are as follows:

AM	Alarm message
ANSI	American National Standards Institute
AS511	Interface 511
ASCII	American Standard Code for Information Interchange
CBR	Coordination byte ”*receive*”
CBS	Coordination byte ”*send*”
CP	Communication processor
CPU	Central processing unit
DB	Data block (on PLC)
DHB	Data handling block
DW	Data word (on PLC)
DX	Extended data block (on PLC)
EM	Event message
EM	Equipment Manual
EPROM	Erasable (by UV light) programmable read-only memory
FAP	Free ASCII Protocol
FB	Function block
FW	Firmware
LED	Light-emitting diode
MPI	Multipoint interface (SIMATIC S7)
MW	Memory word (on PLC)
OB	Organization block
OP	Operator panel
PC	Personal computer
PLC	Programmable logic controller
PU	Programming unit
PPI	Point-to-point interface (SIMATIC S7)
RAM	Random-access memory (system memory)
RLO	Result of logical operation
SRAM	Static RAM (buffered)
TD	Text display
TP	Touch panel
UM	User's Manual

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Part I Introduction

1 Types of Connection

This chapter provides an overview of the possible types of connection between the operating units on the one hand and the various PLCs on the other.

The essential features of the different types of connection and the type of interface in each case are briefly described for each PLC.

For more detailed information on each type of connection including connection-specific guidance on configuration, please refer to the relevant chapters in sections II, III, IV and V of this manual.

1.1 Overview

Function of Operating Units

The operating unit is used to read, display, save and log messages and variables. The operating unit can also be used to intervene in the process.

The term *operating unit* is used in this manual to refer to units with the designation TD, OP or TP. With regard to operation of the units, a distinction is generally need to be made between *devices having a graphics display* and *devices having a text-based display*. Table 1-1 shows which units are devices having a text-based display and which are devices having a graphics display. Devices having a graphics display can display data graphically whereas devices having a text-based display can only display alphanumeric characters.

Table 1-1 Devices having a Graphics Display and Devices having a Text-Based Display

Devices having a Text-Based Display	Devices having a Graphics Display
TD17	OP25, OP35
OP3	OP27, OP37
OP5, OP15	TP27, TP37
OP7, OP17	
TD10, TD20, OP20 (with COM TEXT only)	

Data exchange

The prerequisite for the ability to perform control and monitoring functions is connection of the operating unit to a PLC. The exchange of data between the operating unit and the PLC is controlled by a connection-specific communication driver. Each type of connection requires its own communication driver.

PLC

The following are examples of PLCs:

- SIMATIC S5 and S7,
- SIMATIC 500/505,
- PC/AT-compatible computers,
- PLCs produced by other manufacturers.

Choice of connection type

Criteria for selecting the type of connection between the operating unit and the PLC include the following:

- the type of PLC,
- the CPU on the PLC,
- the type of operating unit,
- the number of operating units per PLC,
- the structure of an existing installation and, if applicable, the used bus system,
- the work and expense involved in any additional components required.

Implemented connection types

The following types of connection are supported at present:

- **SIMATIC S5**
  - AS511 connection
  - Connection using Free ASCII Protocol (FAP)
  - PROFIBUS-DP connection,
  - SINEC L1 connection,
  - PROFIBUS connection,
  - Parallel connection.
- **SIMATIC S7**
  - Point-to-point interface (PPI) connection,
  - Multipoint interface (MPI) connection,
  - PROFIBUS-DP connection,
- **SIMATIC 500/505**
  - NITP protocol
- **Other PLCs**

  For other PLCs there are what are referred to as NATIVE drivers. They are called NATIVE drivers because the PLC-specific addresses are specified directly in the operating unit configuration. The commissioning instructions are provided only in the Online Help.

  There are also block drivers. Operating units that are configured in ProTool support only the block driver for a “free serial connection” such as with a PC. Operating units that are configured using COM TEXT support the block drivers described in Section V.

1.2 Which Connection for Which Operating Unit?

Selection criteria

As not every type of connection is possible with every type of operating unit, tables 1-2, 1-3, 1-4 and 1-5 provide details of which type of connection can be used with which operating unit. The decisive factor in making the correct choice is the type of PLC and your existing network configuration. Tables 1-6, 1-7 and 1-8 show the possible connection for the various SIMATIC PLCs.

Table 1-2 Possible Types of Connection for Devices having a Text-Based Display – Part 1

PLC	Networks Supported (Protocol)	TD10 TD20	OP20	OP3	TD17
SIMATIC S5	AS511	x	x	–	x
	FAP	x	x	–	x
	SINEC L1	x	x	–	–
	PROFIBUS	1) 2)	1) 2)	–	–
	PROFIBUS-DP	1) 2)	1) 2)		x
	Parallel	1)	–	–	–
SIMATIC S7	MPI (S7 protocol)	–	–	x	x
	PPI (S7 protocol)	–	–	x	x
	PROFIBUS–DP (S7 protocol)	–	–	–	x
SIMATIC 500/505	NITP	–	–	–	x
Other PLCs (block driver)	SIMATIC 500/505	2)	2)	–	–
	Free serial	2)	2)	–	–
	Allen-Bradley (DF1)	3)	3)	–	–
	Mitsubishi (FX)	3)	3)	–	–
	Telemecanique TSX 17 Adjust	–	–	–	–
	Telemecanique TSX 7 Adjust	–	–	–	–
Other PLCs (NATIVE driver)	Allen-Bradley (DF1)	–	–	–	x
	Mitsubishi (FX)	–	–	–	x
	Modicon (MODBUS)	–	–	–	x
	Telemecanique TSX 17 Adjust	–	–	–	x
	Telemecanique TSX 7 Adjust	–	–	–	x
	Telemecanique Uni-Telway	–	–	–	x

1) Appropriate interface module required
2) Appropriate firmware memory module required
3) Upgrade driver (optional) required
x Possible
– Not possible

Table 1-3 Possible Types of Connection for Devices having a Text-Based Display – Part 2

PLC	Networks Supported (Protocol)	OP5/A1 OP15/A1 OP15/C1	OP5/A2 OP15/A2 OP15/C2	OP7/PP	OP17/PP
SIMATIC S5	AS511	x	–	x	x
	FAP	x	–	x	x
	SINEC L1	[2]	–	–	–
	PROFIBUS	–	–	–	–
	PROFIBUS-DP	–	x	–	–
	Parallel	–	–	–	–
SIMATIC S7	MPI (S7 protocol)	–	x	–	–
	PPI (S7 protocol)	–	x	–	–
	PROFIBUS-DP (S7 protocol)	–	x	–	–
SIMATIC 500/505	NITP	x	x	x	x
Other PLCs (block driver)	SIMATIC 500/505	x	x	–	–
	Free serial	x	x	–	–
	Allen-Bradley (DF1)	[1]	[1]	–	–
	Mitsubishi (FX)	[1]	[1]	–	–
	Telemecanique TSX 17 Adjust	–	[1]	–	–
	Telemecanique TSX 7 Adjust	[1]	[1]	–	–
Other PLCs (NATIVE driver)	Allen-Bradley (DF1)	x	x	x	x
	Mitsubishi (FX)	x	x	x	x
	Modicon (MODBUS)	x	x	x	x
	Telemecanique TSX 17 Adjust	x	x	x	x
	Telemecanique TSX 7 Adjust	x	x	x	x
	Telemecanique Uni-Telway	x	x	x	x

[1] Upgrade driver (optional) required
[2] Only with COM TEXT
x Possible
– Not possible

Table 1-4 Possible Types of Connection for Devices having a Text-Based Display – Part 3

PLC	Networks Supported (Protocol)	OP7/DP	OP17/DP	OP7/DP –12	OP17/DP –12
SIMATIC S5	AS511	–	–	x	x
	FAP	–	–	x	x
	SINEC L1	–	–	–	–
	PROFIBUS	–	–	–	–
	PROFIBUS-DP	x	x	x	x
	Parallel	–	–	–	–
SIMATIC S7	MPI (S7 protocol)	x	x	x	x
	PPI (S7 protocol)	x	x	x	x
	PROFIBUS-DP (S7 protocol)	x	x	x	x
SIMATIC 500/505	NITP	–	–	x	x
Other PLCs (block driver)	SIMATIC 500/505	–	–	–	–
	Free serial	–	–	–	–
	Allen-Bradley (DF1)	–	–	–	–
	Mitsubishi (FX)	–	–	–	–
	Telemecanique TSX 17 Adjust	–	–	–	–
	Telemecanique TSX 7 Adjust	–	–	–	–
Other PLCs (NATIVE driver)	Allen-Bradley (DF1)	–	–	x	x
	Mitsubishi (FX)	–	–	x	x
	Modicon (MODBUS)	–	–	x	x
	Telemecanique TSX 17 Adjust	–	–	x	x
	Telemecanique TSX 7 Adjust	–	–	x	x
	Telemecanique Uni-Telway	–	–	x	x

x Possible

– Not possible

Table 1-5 Possible Types of Connection for Devices having a Graphics Display

PLC	Protocol	OP25 OP35	OP27 OP37	TP27 TP37
SIMATIC S5	AS511	x	x	x
	FAP	x	x	x
	PROFIBUS-DP	x	x	x
SIMATIC S7	MPI (S7 protocol)	x	x	x
	PPI (S7 protocol)	x	x	x
	PROFIBUS-DP (S7 protocol)	x	x	x
SIMATIC 500/505	NITP	x	x	x
Other PLCs (block driver)	Free serial	x	x	x
Other PLCs (NATIVE driver)	Allen-Bradley (DF1)	x	x	x
	Mitsubishi (FX)	x	x	x
	Modicon (MODBUS)	x	x	x
	Telemecanique TSX 17 Adjust	x	x	x
	Telemecanique TSX 7 Adjust	x	x	x
	Telemecanique Uni-Telway	x	x	x

x Possible with standard software module or integral software
– Not possible

Table 1-6 Possible Connections for SIMATIC S5 PLCs

SIMATIC S5	AS511	FAP to SI2	FAP via CP	SINEC L1	PROFIBUS	PROFIBUS-DP	Parallel
S5-90U	x	–	–	–	–	–	x
S5-95U	x	–	CP 521 SI [1)]	–	x	x [1)]	x
S5-95U DP–Master	x	–	CP 521 SI [1)]	–	x	–	x
S5-100U (CPU 100/102)	x	–	–	–	–	–	x
S5-100U (CPU 103)	x	–	CP 521 SI [1)]	–	–	–	x
S5-115U (CPU 941-944)	x	x [2)]	CP 523	x	x	x	x
S5-115U (CPU 945)	–	x [3)]	–	–	–	x	–
S5-135U[4)]	x	x [5)]	CP 523	x	x	x	–
S5-155U	–	–	CP 523	x	x	x [6)]	–

[1)] Significant impairment of performance; not OP25/35, OP27/37, TP27/37
[2)] Only with CPU 943A/B, CPU 944A/B
[3)] Only with with special CPU interface module
[4)] CPU 928A Version -3UA12 or later only
[5)] Only with CPU 928B (with special CPU interface module)
[6)] CPU 946/947 Version -3UA22 or later only
x Possible without qualification
– Not possible

Table 1-7 Possible Connections for SIMATIC S7 PLCs

SIMATIC S7	**PPI**	**MPI**	**PROFIBUS-DP** [1)]
S7-200	x	–	–
S7-300	–	x	x
S7-400	–	x	x
S7-NC	–	x	x

1) All CPUs with the designation “–2DP”, CP or FM that support the S7 protocol
x Possible without qualification
– Not possible

Table 1-8 Possible Connections for SIMATIC 500/505 PLCs

SIMATIC 500/505
500 Series
505 Series

Table 1-9 shows the possible connections for other PLCs.

Table 1-9 Possible Connections for Other PLCs Using NATIVE Drivers

PLC	**CPU**
Allen-Bradley	SLC 500, PLC5
Mitsubishi	FX
Modicon	CPU 984 (not 984A, 984B, 984X), CPU984-785, CPU TSX
Telemecanique	TSX

1.3 SIMATIC S5 Connections

In the case of the SIMATIC S5 there is a number of types of connection which are briefly summarized below.

1.3.1 AS511 Connection

Interface

The operating unit is connected via the integral serial interface to interface SI1 on the CPU (figure 1-1).

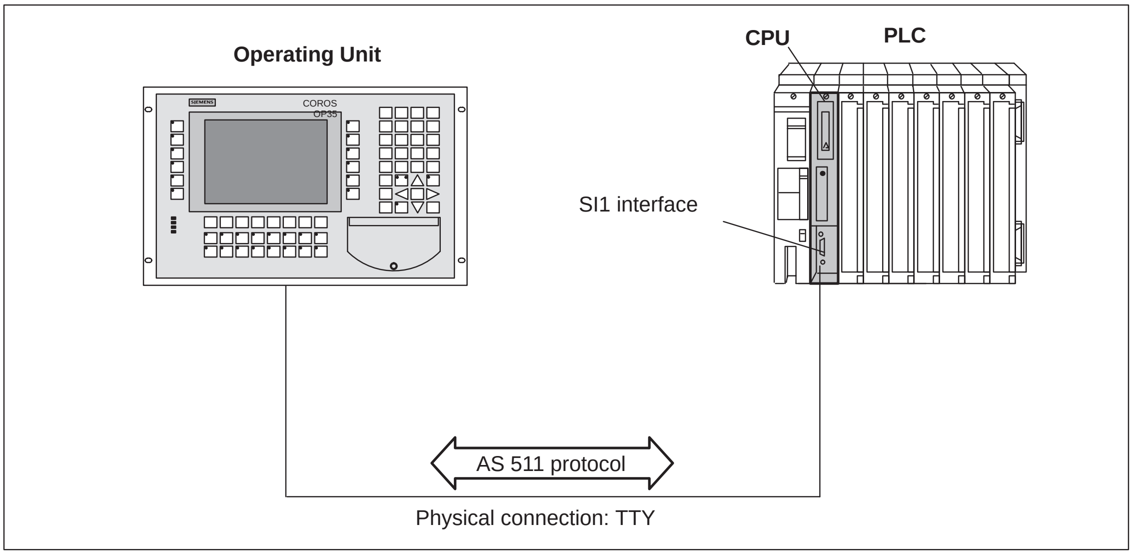


Figure 1-1 AS511 Connection

Features

- No additional modules are required.
- Possible with any PLC except CPU 945 and AG155U.

1.3.2 Free ASCII Protocol (FAP) Connection

Interface

The operating unit is connected via the integral serial interface to the PLC (figure 1-2). Connection is made to either

- interface SI2 on the CPU or
- the CP module on the PLC.

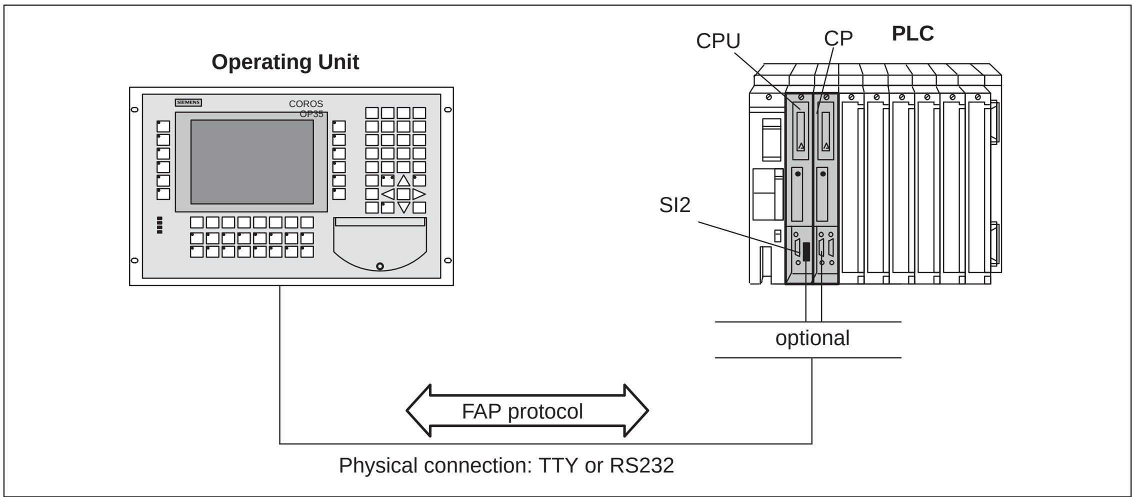


Figure 1-2 Connection using Free ASCII Protocol (FAP)

Features

- PU interface on PLC remains free.
- Connection via SI2.
- Connection via CP module:
  Multiple operating units can be connected to <u>one</u> PLC (CP 521 SI: up to 8, CP 523: up to 16).

1.3.3 PROFIBUS-DP Connection to SIMATIC S5

Interface

The operating unit is connected via the PROFIBUS-DP interface using a special PROFIBUS connector to the PROFIBUS-DP bus (figure 1-3). Connection via PROFIBUS-DP requires either a suitable type of unit or an interface module.

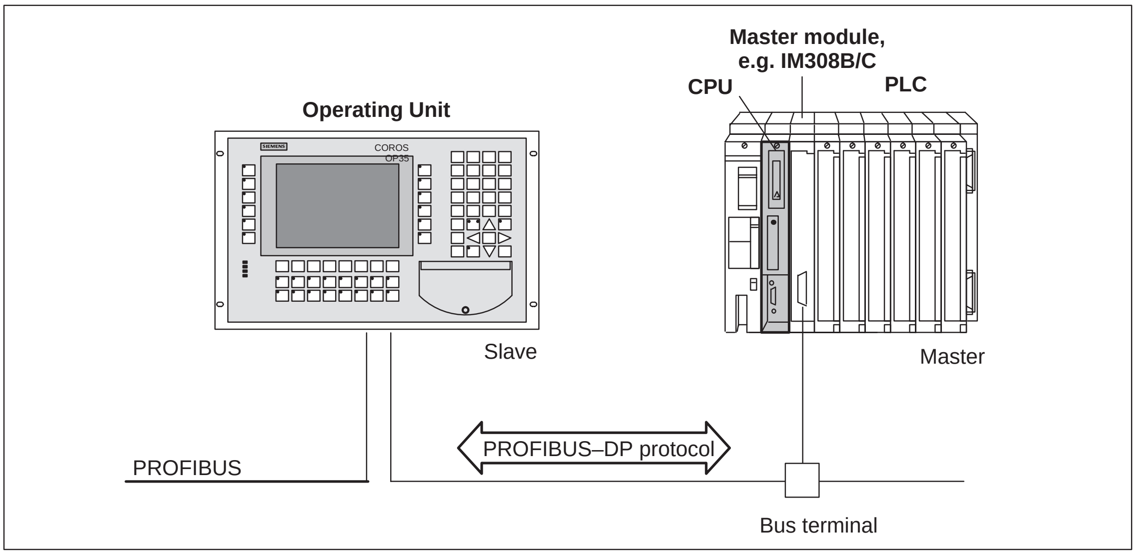


Figure 1-3 PROFIBUS-DP Connection

Features

- The PLC is the master.
- All operating units in the network are slaves.
- A network can have up to a maximum of 122 slaves.
- Rapid data transmission (up to 12 MBit/s).
- Multiple operating units can be connected to one PLC.

1.3.4 SINEC L1 Connection

Interface

Operating unit types TD10, TD20 and OP20 are connected via the integral serial interface and bus terminal BT777 to the SINEC L1 bus (figure 1-4).

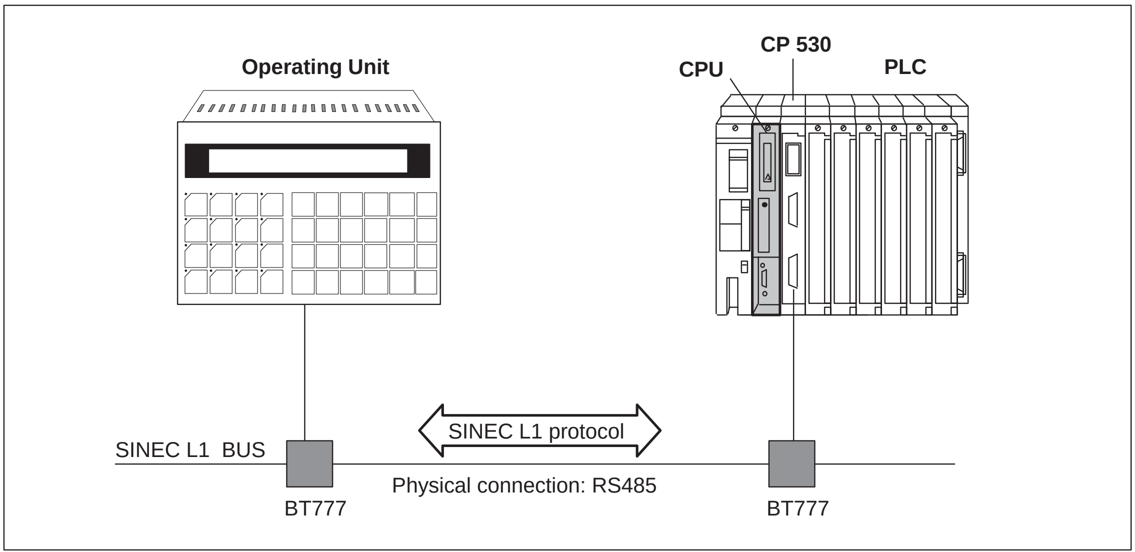


Figure 1-4 SINEC L1 Connection

Features

- PU interface on PLC remains free.
- Up to 4 operating units can be connected via a CP module to one PLC.

1.3.5 PROFIBUS Connection

Interface

Operating units types TD10, TD20 and OP20 are connected via the PROFIBUS interface module using a special PROFIBUS connector to the PROFIBUS (figure 1-5).

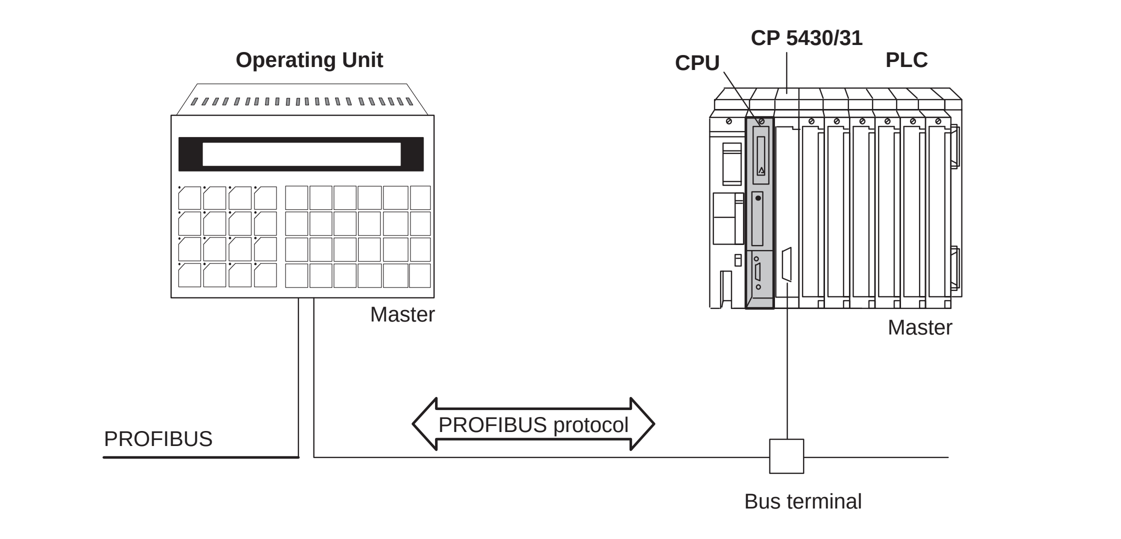


Figure 1-5 PROFIBUS Connection

Features

- Up to a maximum of 127 bus nodes can be connected.
- All bus nodes taking part in communication between the PLC and the operating unit are masters.
- A network can have up to a maximum of 32 masters.
- Rapid data transmission (up to 1,5 MBit/s).
- Multiple operating units can be connected to one PLC.
- Connection using ”free Layer 2 access”.

1.3.6 Parallel Connection

Interface

Text display unit types TD10 and TD20 are connected via the parallel interface module with digital inputs/outputs to the SIMATIC S5 (e.g. via digital I/O modules).

A schematic diagram of the connection is shown in figure 1-6.

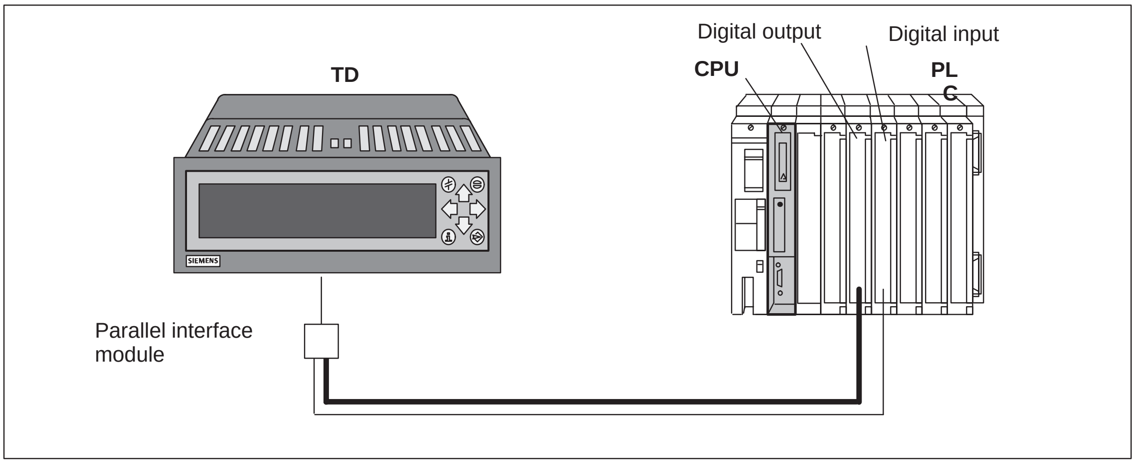


Figure 1-6 Parallel Connection

Features

Multiple TDs can be connected to <u>one</u> PLC.

- Connection via 16 digital outputs and 1 digital input.
- Restricted range of text display unit functions.

1.4 SIMATIC S7 Connections

In the case of the SIMATIC S7 there is a number of types of connection which are briefly summarized below.

1.4.1 MPI Connection

Interface

The operating unit is connected via the integral MPI interface on the CPU to the SIMATIC S7 (figure 1-7).

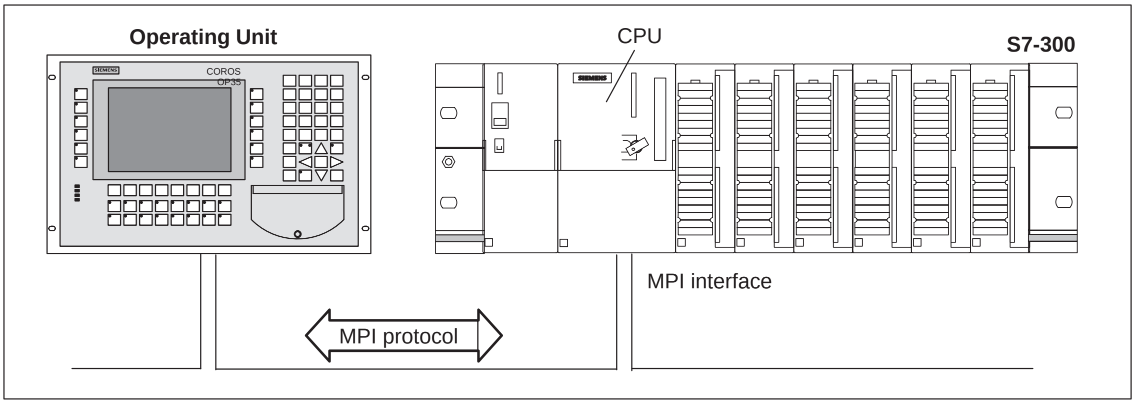


Figure 1-7 MPI Connection

Features

- Multiple PLCs can be connected to one operating unit.
- Operating unit is always the **master**..
- Baud rates up to 187.5 kBaud supported.
- Multiple operating units can be connected to <u>one</u> S7.
- Network can contain multiple operating units and multiple PLCs.
- Parallel operation of PU and operating unit possible.

1.4.2 PROFIBUS-DP Connection

Interface

The operating unit is connected via the integral PROFIBUS-DP interface on the CPU or a CP to the SIMATIC S7 (figure 1-8).

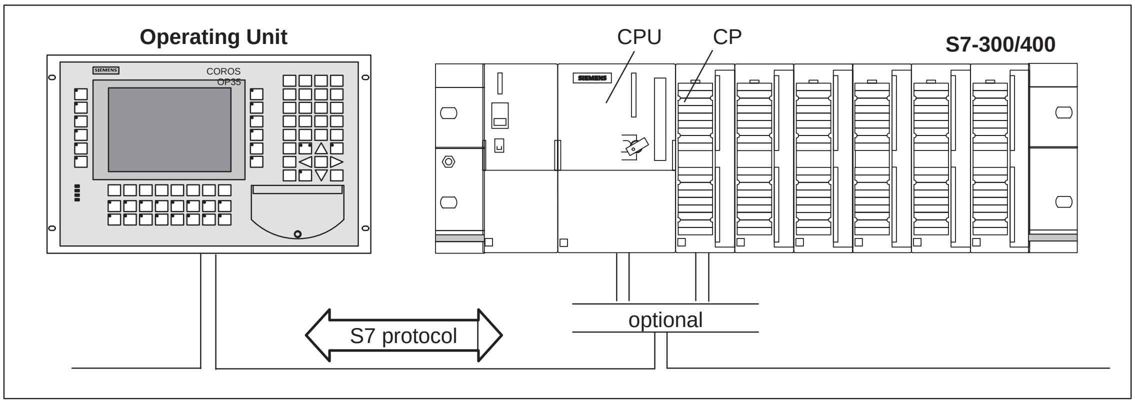


Figure 1-8 PROFIBUS-DP Connection

Features

- Multiple PLCs can be connected to one operating unit.
- Operating unit is always the **master**..
- Baud rates up to 1.5 MBaud supported.
- Use of DP direct keys with a response time of < 100 ms.
- Multiple operating units can be connected to <u>one</u> S7.
- Network can contain multiple operating units and multiple PLCs.

1.4.3 PPI Connection

The operating unit is connected via the integral PPI interface on the CPU (figure 1-9).

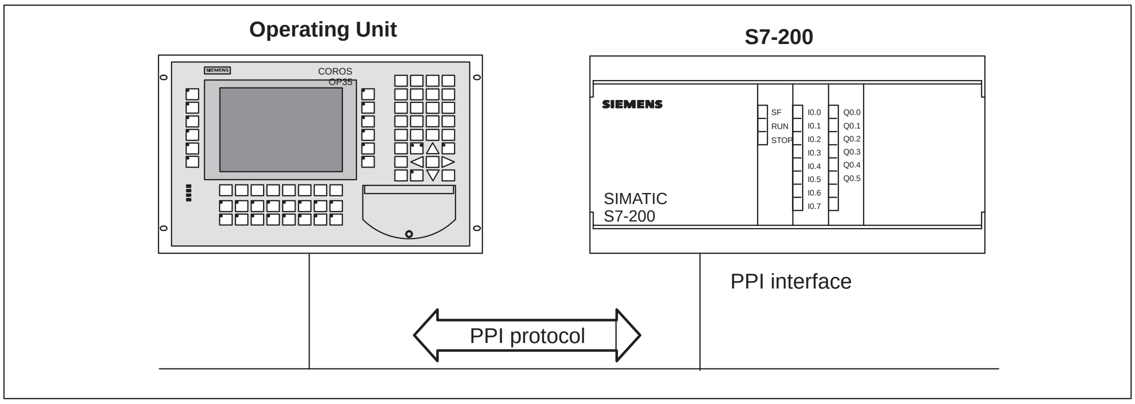


Figure 1-9 PPI Connection

Features

- Multiple PLCs can be connected to one operating unit.
- Operating units is always the **master**..
- Multiple operating units can be connected to <u>one</u> S7 but only connection can be used at any one time.

1.5 SIMATIC 500/505 Connections

Interface

The operating unit is connected via the programming interface of the CPU to the SIMATIC 500/505 (figure 1-10).

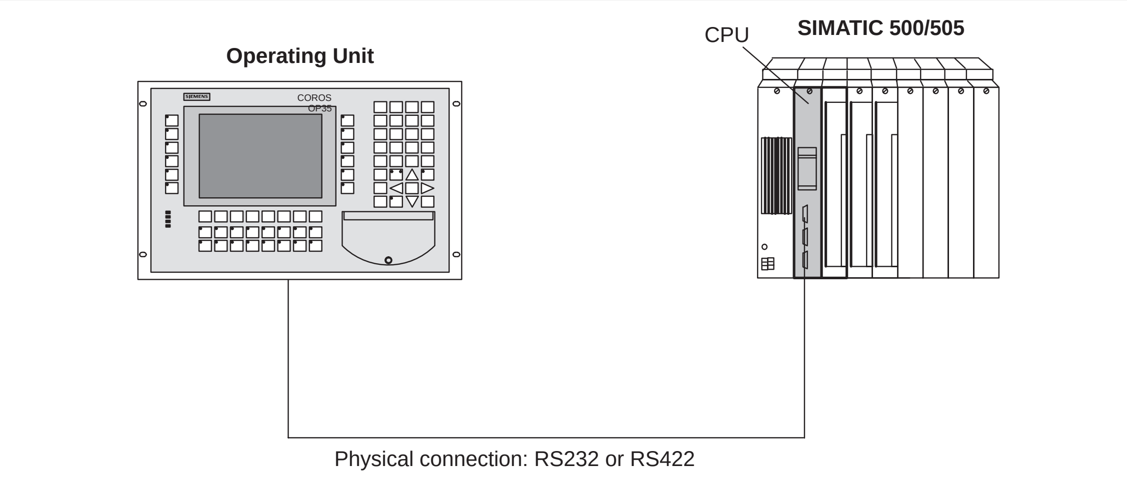


Figure 1-10 SIMATIC 500/505 Connection

Features

- No additional modules are required.
- 500/505 Series CPUs supported.

1.6 Data Block Connection

Basic principle

Connection of the operating units to other PLCs such as Free Serial Connection, Allen-Bradley, Mitsubishi or Telemecanique is established using the principle of the data block connection.

Interface

The operating unit is connected via the integral serial interface to the PLC in question.

Features

- Exchange of predefined data blocks between operating unit and PLC,
- PLCs divided into two classes:
  - **Class 1:**
    PLC does not support data block transmission,
  - **Class 2:**
    Integrated interface driver for data block transmission.

Part II SIMATIC S5 Connections

Communication Management for the SIMATIC S5 2

This chapter provides an overview of the blocks required for the various connections.

2.1 Overview

When connecting the operating unit to the SIMATIC S5 various blocks must be set up on the PLC for the purposes of communication. An overview of which blocks are required for which type of connection is provided by table 2-1.

Table 2-1 Blocks Required According to Type of Connection

Block	AS511	FAP via SI2	FAP via CP	PROFI-BUS-DP	SINEC L1	PROFI-BUS	Parallel
Standard function block	x	x	x	x	x	x	x
Interface area [1]	x	x	x	x	x	x	x
Assignment data block	-	x	x	x	x	x	-
Send and receive mailboxes[1]	-	x	x	x	x	x	-
Data handling blocks	-	-	-	x [2]	x	x	-

[1] When connecting multiple operating unitss to one SIMATIC S5, these blocks must be set up for each separate operating unit

[2] CP5430/31 only

Standard function block

The COROS standard function block is required for all types of connection. It co-ordinates data transfer between the operating unit and the PLC. However, different standard function blocks are required for the different PLCs and types of connection. The COROS standard function blocks must be ordered separately.

Interface area

The interface area is a data block that is required for all types of connection. It contains areas by means of which the operating unit and SIMATIC S5 synchronize their operations during data transfer.

Assignment data block

The assignment data block contains the parameters for all connected operating units, e.g. details of which interface area is to be used for which operating unit.

Send and receive mailboxes

The send and receive mailboxes are used as working areas for the function block.

Data handling blocks

The data handling blocks are additional standard function blocks required for the connection types SINEC L1, PROFIBUS and PROFIBUS-DP. They should be ordered together with the relevant connection.

2.2 Standard Function Block

Function

The functions of the standard function block (standard FB) include the following:

- Monitoring the connection with the operating unit,
- Co-ordinating data exchange between operating unit and SIMATIC S5,
- Transferring PLC jobs,
- Detecting errors

Standard function block files

The standard function block to be used depends on the PLC used and the type of connection chosen. Table 2-2 lists the file names according to the PLC being used. Those files are located on the disk labelled *COROS Standard Function Blocks* which must be ordered separately.

Table 2-2 Standard Function Block Files

PLC Type	File Name
S5-90U	S5TD**02**ST.S5D
S5-95U	S5TD**03**ST.S5D
S5-100U with CPU 100 or 102	S5TD**02**ST.S5D
S5-100U with CPU 103	S5TD**01**ST.S5D
S5-115U with CPU 941 to 944	S5TD**50**ST.S5D
S5-115U with CPU 945	S5TD**51**ST.S5D
S5-135U	S5TD**24**ST.S5D
S5-155U	S5TD**69**ST.S5D

Table 2-3 shows which standard FB should be used for which type of connection.

Table 2-3 Standard Function Block Names

Connection	FB No.	FB Name
AS511	FB51	TDOP:511
FAP to SI2	FB53	TDOP:FAP
FAP via CP521 SI	FB52	TDOP:521
FAP via CP523	FB52	TDOP:523
PROFIBUS-DP	FB58	TDOP:DP
SINEC L1	FB56	TDOP:L1
PROFIBUS	FB55	TDOP:L2
Parallel	FB54	TDOP:PAR

Note

- Make a copy of the original disk.
- Work with the original disk only.
- Keep the original disk in a safe place.
- The number of the standard function block can be altered in any way required.
- The standard FB can be run from either the RAM or the EPROM, according to choice.

2.3 Examples

Ready-made examples

The configuration software is supplied with some ready-made examples. Those examples contain both configuration files for the various operating units and program files for the CPU required. The function block is not included in the program files. You must copy it from the separately ordered disk.

Once you have loaded the configuration file onto the operating unit and transferred the program file to the PLC, the operating unit is ready for operation. The operating unit and the PLC are already communicating with one another. Detailed instructions for commissioning using the example files are included with the configuration software documentation.

The examples are designed for all types of connection. We recommend that you use the program files as the basis for programming the connection.

2.4 Optimization

Polling time and update time

The polling times specified in the configuration software for the *area pointers* and the polling times of the variables are key factors with regard to the update times actually achievable. The update time is the polling time plus transmission time plus processing time.

In order to achieve optimum update times, the following points should be observed during configuration:

- When setting up the individual data areas, make them as large as necessary but as small as possible.
- Define data areas that belong together as contiguous areas. The effective update time will be better if you create a single large area rather than several smaller areas.
- Setting the polling times that are too short unnecessarily impairs overall performance. Set the polling time to match the rate at which process variables change. The rate of change of temperature of a furnace, for example, is considerably slower than the acceleration curve of an electric motor.

  Guide figure for polling time: approx. 1 second.
- If necessary, dispense with cyclic transmission of user data areas (polling time = 0) in order to improve the update time. Instead, use PLC jobs to transfer the user data areas at random times.
- Store the variables for a message or a screen in a contiguous data area.
- In order that changes on the PLC are reliably detected by the operating unit, they must be present for the duration of the actual polling time at least.

Screens

In the case of screens, the update rate effectively achievable depends on:

- the number of data areas used,
- the type and volume of data to be displayed,
- the distribution of data within a particular data area.

In the interests of achieving rapid update times, the following points should be observed during configuration:

- Use only one data block for the variables of a particular screen.
- Store the items of data to be used as closely as possible to one another in the DB.
- Only configure short polling times for those entries that actually need to be updated at frequent intervals.
- Text-based displays only:
  For screens with large numbers of actual values and specified/actual values activate partial screen updating by means of a PLC job.

If, in the case of bit-triggered trends, the communication bit is set in the *trend transfer area*, the operating unit always updates all the trends whose bit is set in that area. Afterwards it resets the bit. If the S5 program immediately sets the bit again, the operating unit spends all its time updating the trends. It is then virtually impossible to operate the operating unit.

PLC jobs

If large numbers of PLC jobs are sent to the operating unit in quick succession, communication between the operating unit and the PLC can become overloaded as a result.

If the function block enters `0` in the first data word of the job mailbox it signifies that the operating unit has received the job. It then processes the job – for which it requires a certain amount of time. In the case of fast CPUs it is possible that the operating unit may not have completely processed the PLC job before the next is sent. Where necessary, you should build in a delay period.

Cyclic reading of DB address list

The DB address list only needs to be read every time the PLC is accessed if, for example, the user data areas are recreated during the commissioning phase. For subsequent operation, this operation should be deactivated for performance reasons.

2.5 Error Prevention

Editing data blocks

In the case of the SIMATIC S5 compressing the internal program memory of the PLC (PU function “Compress”, integrated FB COMPR) is not permissible if an operating unit is connected! The process of compression alters the absolute addresses of the blocks in the program memory. Since the operating unit only reads the address list at startup, it will not detect the changes to the addresses and will access the wrong memory areas.

If compression during normal operation can not be avoided, the operating unit must be switched off before compression takes place.

In areas subject to explosion hazard, always disconnect the operating unit from the power supply before disconnecting connectors.

PLC jobs

If the operating unit is started up while a PLC job is being executed (e.g. after a change of language), the relevant job mailbox may under certain circumstances not be enabled.

Inn order to prevent this, you should set Bit `28.0` in the interface area while the PLC is still in normal operation (operating unit is online).

When the operating unit is restarted, that bit is reset by the operating unit. In this case you should delete the job mailboxes in the interface area (enter `KY 8,0` in job status) and set Bit `28.0` again.

Interrupt processing

Below are a few notes on interrupt processing:

1. When programming process or timed-interrupt organization blocks, you should make sure that the scratch pad flags MB200 to MB255 (MB 100 to 127 on PLC 90U and PLC 100U) at the beginning of the interrupt organization block are saved and reloaded before quitting the interrupt organization block. This is only necessary if the data in the interrupt OB has been changed.

   On the S5-155U PLC the standard function blocks FB38 and FB39 should be used for saving and reloading.

2. When using the standard data handling blocks, you should make sure that the data handling blocks are not called twice. Interrupting the data handling blocks during the cycle and re-calling them at the interrupt level is not permissible.

   The user is responsible for these locking operations (disabling and enabling interrupts).

Operating unit is connected to CPU SI2

If communication via AS511 is performed on the CPU via both interfaces, the second interface has a lower priority. A possible configuration might be as follows: PU to SI1 and operating unit to SI2. In that case error messages indicating a communication fault may occur on the operating unit. In extreme cases, such characteristics may occur on the CPU928B .

Remedy:
Use FAP for communication.

Life bit monitoring is triggered with recipes

The life bit can not be set during transmission. When transferring large data records, therefore, the life bit monitoring may be triggered. In such cases, set the life bit monitoring setting in the interface area on the DW98 to a higher figure. We recommend that you set life bit monitoring to between 2000 and 4000 (data format KF).

AS511 Connection, Group 2

3

This chapter describes communication between the operating unit and SIMATIC S5 using the AS511 connection.

PLC groups

For communication via AS511 the PLCs are divided into two groups that differ in terms of their communication structure. The PLCs in Group 2 include the following:

- AG 95U
- AG 100U (CPU 103)
- AG 115U (except CPU 945)
- AG 135U

Connection

The operating unit is connected directly to the CPU. Preferably, you should use the CPU interface SI1 with the TTY physical characteristics. If available, you can also use the CPU interface SI2 with the TTY physical characteristics. In the case of the SI2 interface, however, performance limitations must be taken into account.

Details of which interface on the operating unit to use are given in the relevant equipment manual.

3.1 Communication Structure for Group 2 PLCs

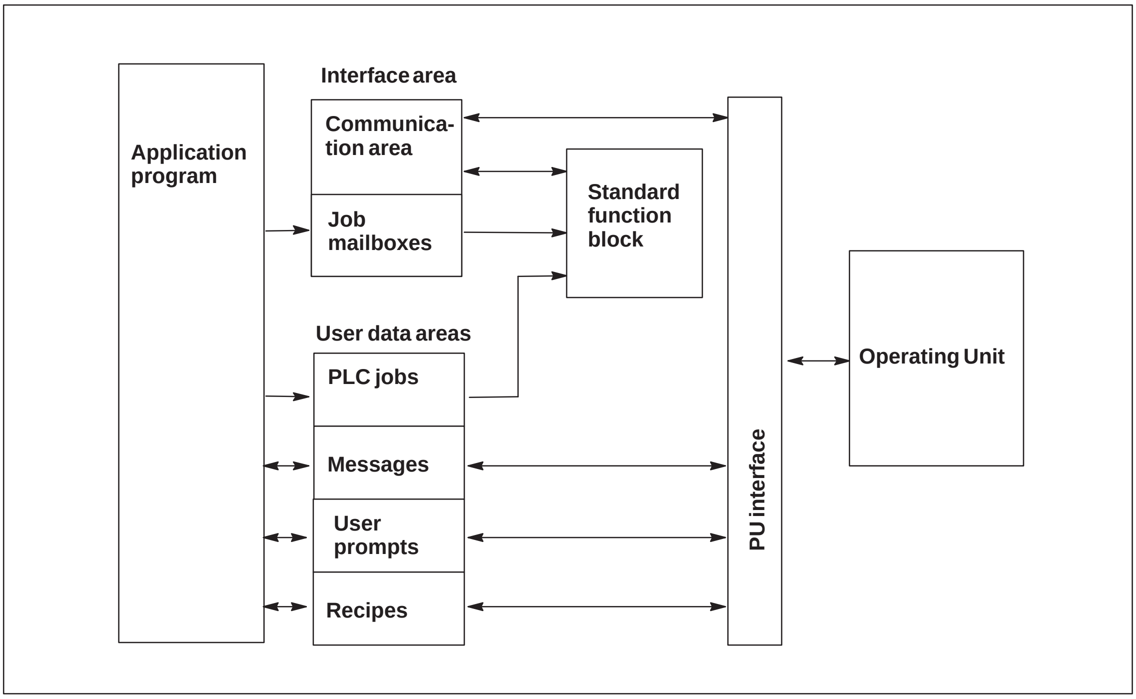


Figure 3-1 AS511 Communication Structure for Group 2 PLCs

Function of Standard FB

The arrows in figure 3-1 represent the flow of information between the components.

The operating unit and PLC communicate with one another via the CPU programming unit interface SI1/2. Communication is supported by the standard function block which should be integrated in the STEP5 application program. Its job includes monitoring the connection with the operating unit and co-ordinating data transfer.

Function of interface area

The interface area is required by the function block and it is therefore absolutely essential that it is set up.

General exchange of data between the PLC and the operating unit takes places by means of variables. The exchange of special data such as PLC jobs and watchdog is effected via the interface area. It contains data and pointers to data areas that are required, among other things, for synchronizing exchange of data between the PLC and the operating unit. A detailed description of the interface area is given in chapter 10.1, page 10-2.

User data areas

User data areas should only be set up if the associated function is to be used. User data area are required, for example, for the following purposes:

– initiating messages
– transferring function keys
– controlling LEDs
– for recipes

A detailed description of the user data areas is given in chapter 11.

3.2 Commissioning Procedure

Procedure

The basic steps for commissioning the AS511 connection for Group 2 are described below.

1. Set up the data block, e.g. `DB 51`, for the interface area using a length of `185 DW`. You do not have to specify any default values. The interface area may only be in the DB data area. DX extended data blocks are not permissible.

   If the data block is not present or too short, an error message is placed in AKKU 1 after the standard FB is invoked.

2. Copy standard FB 51 (file name: `TDOP:511`) from the disk labeled *COROS Standard Function Blocks* to your STEP5 program.

3. Load the data block number of the interface area into AKKU 1. Then invoke the standard FB unconditionally.

Example program:

`L KY 51,0`	51=Number of interface area
`:JU FB 51`	Communication with operating unit
`NAME :TDOP:511`	AS511 connection
`:T FW 100`	Save AKKU 1 to FW 100
`:JC=ERR`	Branch to error analysis Job status and error number are in FW 100.

   If an error occurs during processing of the function block, the logical operation result is set to the value ”1”. This allows you to branch to your own error analysis function using the command SPB.

   After the standard FB has been invoked, AKKU 1 contains the current job status and the number of any error that has occurred.

4. Now start up the standard FB using data word 64 in the interface area. In the interface area DW 64 is used to start up the standard FB.

   The startup organization block used (OB 20/21/22) must write the value 1 (KF format) to that data word in order to initiate FB startup and reset all other control bits.

   Example:
   OB 20/21/22
   ```
   :C DB 51
   :L KF 1
   :T DW 64
   ```

   In order to reset the operating unit and the standard FB, Bit 0 in this data word may also be set by the cyclic program. How this is done is described in chapter 10.2.1, page 10-6, under the heading ”Restarting”.

5. Check AKKU 1 to see if the standard FB has issued an error message.

   If an error occurs during processing of the function block, the logical operation result is set to the value 1. This allows you to branch to your own error analysis function using the command SPB.

   After the standard FB call, AKKU 1 contains the current job status and the number of any error that has occurred.

   The contents of AKKU 1 are illustrated in figure 3-2.

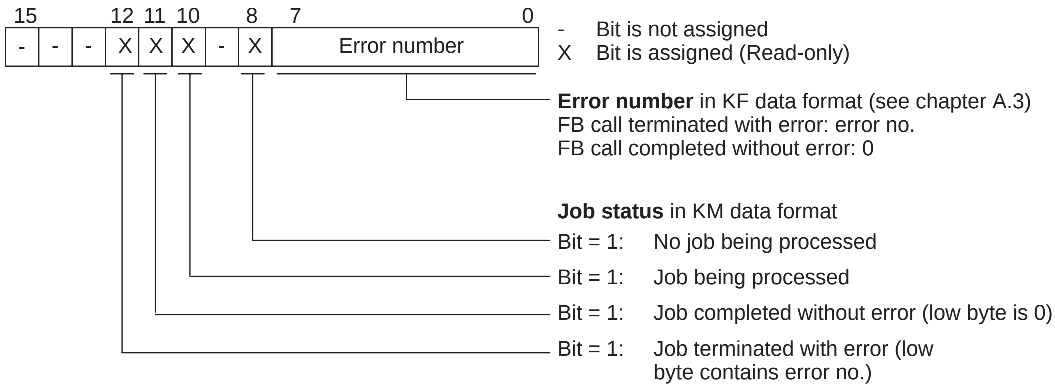


Figure 3-2 Contents of AKKU 1 after Invoking Standard FB

6. If you use user data areas, set them up now (see chapter 11).

Loop-through operation

In loop-through operation, a second operating unit or a PU/PC is connected to the second interface of the operating unit that is connected to the PLC.

Connection of a second operating unit is only permissible with the following units:
– OP15/A1
– OP15/C1
– OP25
– OP35

If a second operating unit is connected, the standard FB must be re-invoked within the same cycle as illustrated below.

Example program:

```
L KY 52,0              52=Number of 2nd interface area
     :JU FB 51
NAME :TDOP:511
     :T FW 100
     :JC=ERR
```

Limitations:

- The operating unit does not monitor the life bit. It can therefore not detect whether the PLC is in Stop mode, for example.
- The greater load on the interface between the operating unit and the PLC may impair performance.

Special features:

The following points should be observed when starting PU status functions (message on PU: `Status processing in progress`, e.g. for block status, ForceVar):

- system message $340 is displayed on the operating unit,
- the operating unit can no longer be operated,
- communication between the operating unit and the PLC is stopped. For that reason, analysis by the STEP5 program of error number 115, which comes from the standard FB, does not make sense in this case.

AS511 Connection, Group 1

4

This chapter describes communication between the operating unit and SIMATIC S5 using the AS511 connection.

PLC groups

For communication via AS511 the PLCs are divided into two groups that differ in terms of their communication structure. The PLCs in Group 1 include the following:

- AG 90U
- AG 100U (CPU 100, CPU 102)

Connection

The operating unit is connected directly to the CPU. Preferably, you should use the CPU interface SI1 with the TTY physical characteristics. If available, you can also use the CPU interface SI2 with the TTY physical characteristics. In the case of the SI2 interface, however, performance limitations must be taken into account.

Details of which interface on the operating unit to use are given in the relevant equipment manual.

4.1 Communication Structure for Group 1 PLCs

Description

Figure 4-1 shows the communication structure using the program and data blocks required on the PLC for communication between the PLC and the operating unit.

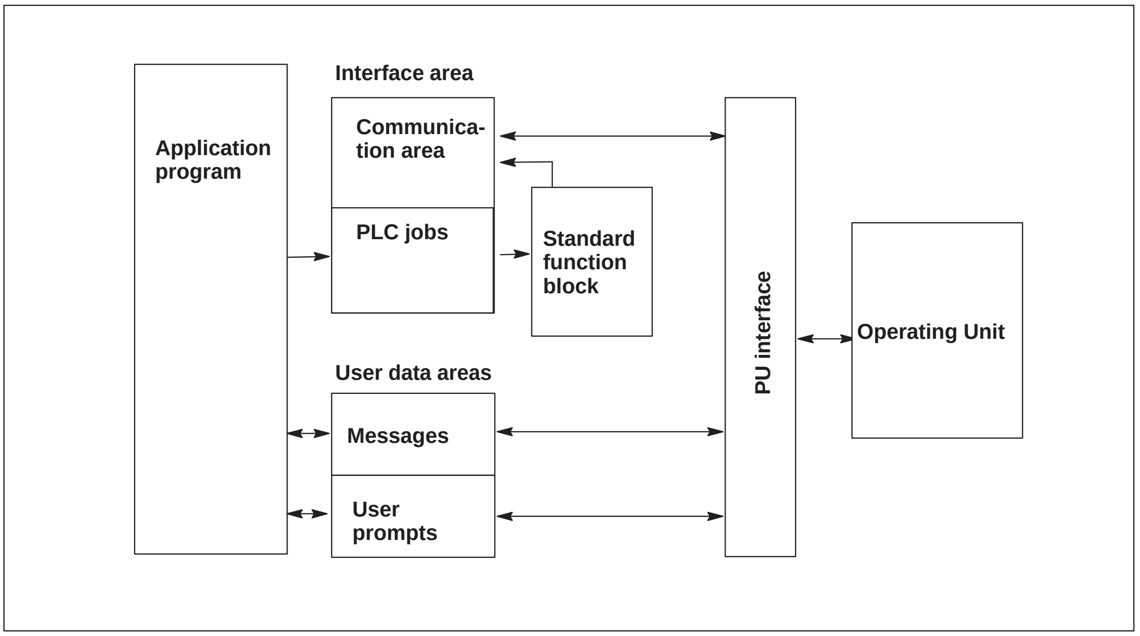


Figure 4-1 AS511 Communication Structure for Group 1 PLCs

Function of standard FB

The arrows in figure 4-1 represent the flow of information between the components.

The operating unit and PLC communicate with one another via the CPU programming interface SI. Communication is supported by the standard function block which should be integrated in the STEP5 application program. Its job includes monitoring the connection with the operating unit and co-ordinating data transfer.

Function of interface area

The interface area is required by the function block and it is therefore absolutely essential that it is set up.

General exchange of data between the PLC and the operating unit takes places by means of variables. The exchange of special data such as PLC jobs and watchdog is effected via the interface area. It contains data and pointers to data areas that are required, among other things, for synchronizing exchange of data between the PLC and the operating unit. A detailed description of the interface area is given in chapter 4.3, page 4-7.

User data areas

User data areas should only be set up if the associated function is to be used. User data area are required, for example, for the following purposes:
- initiating messages
- transferring function keys
- controlling LEDs

A detailed description of the user data areas is given in chapter 11.

Functional limitations

The following limitations apply to Group 1 PLCs when using the AS511 connection:

- recipes are not possible,
- PLC jobs are entered directly in the interface area.

4.2 Commissioning Procedure

Procedure

The basic steps for commissioning the AS511 connection for Group 1 are described below.

1. Set up the data block, e.g. `DB 51`, for the interface area using a length of `70 DW`. You do not have to specify any default values.
2. Copy standard FB 51 (file name: `TDOP:511`) from the disk labeled *COROS Standard Function Blocks* to your STEP5 program.
3. Open the data block. Then invoke the standard FB unconditionally.

Example program:

`A DB 51`	51=Number of interface area
`     :JU FB 51`	Communication with operating unit
`NAME :TDOP:511`	AS511 connection
`     :T FW 100`	Save AKKU 1 to FW 100
`     :JC=ERR`	Branch to error analysis Job status and error number are in FW 100.

4. Now start up the standard FB using data word 40 in the interface area.

   The startup organization block used (OB 21, 22) must write the value `1` (KF format) to that data word in order to initiate FB startup and reset all other control bits.

   Example:
   OB21/22
   ```
   :C DB 51
   :L KF 1
   :T DW 40
   ```

5. Check AKKU 1 to see if the standard FB has issued an error message.

   If an error occurs during processing of the function block, the logical operation result is set to the value `1`. This allows you to branch to your own error analysis function using the command SPB.

   After the standard FB call, AKKU 1 contains the current job status and the number of any error that has occurred.

   The contents of AKKU 1 are illustrated in figure 4-2.

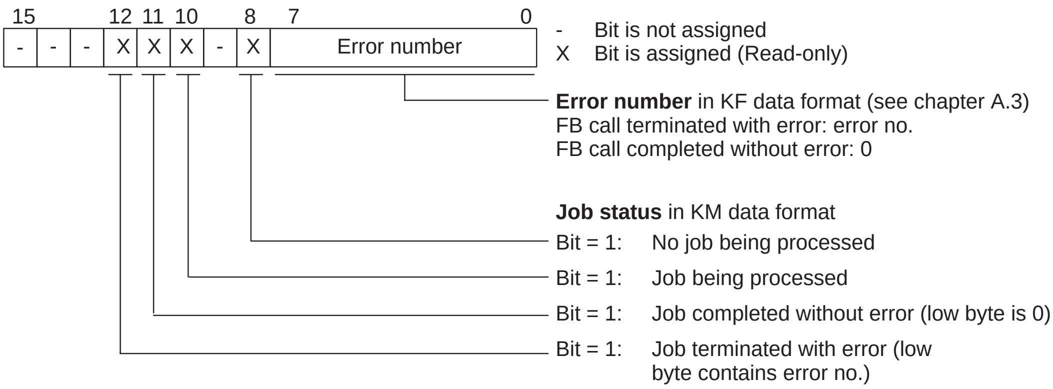


Figure 4-2 Contents of AKKU 1 after Invoking Standard FB

6. If you use user data areas, set them up now (see chapter 11).

Loop-through operation

In loop-through operation, a second operating unit or a PU/PC is connected to the second interface of the operating unit that is connected to the PLC.

Connection of a second operating unit is only permissible with the following units:
– OP15/A1
– OP15/C1
– OP25
– OP35

If a second operating unit is connected, the standard FB must be re-invoked within the same cycle as illustrated below.

Example program:

```
L KY 52,0           52=Number of 2nd interface area
     :JU FB 51
NAME :TDOP:511
     :T FW 102
     :JC=ERR
```

Limitations:

- The operating unit does not monitor the life bit. It can therefore not detect whether the PLC is in Stop mode, for example.
- The greater load on the interface between the operating unit and the PLC may impair performance.

Special features:

The following points should be observed when starting PU status functions (message on PU: `Status processing in progress`, e.g. for block status, ForceVar):

- system message $340 is displayed on the operating unit,
- the operating unit can no longer be operated,
- communication between the operating unit and the PLC is stopped. For that reason, analysis by the STEP5 program of error number 115, which comes from the standard FB, does not make sense in this case.

4.3 Layout and Description of Interface Area for Group 1 PLCs

Definition

Group 1 PLCs include the following: AG 90U, AG 100U (CPU 100, CPU 102).

Setting up the interface area

Set up the data block for the interface area using a length of 70 data words.If you do not use any of the data areas specified in the data block, you do not need to make any entries. The data areas required by the standard function block are present once the data block has been set up.

Table 4-1 Assignment of Interface Area for Group 1 PLCs

DW	DL	DR	Usage
0–9	Standard FB communication area This area must not be altered.		–
10–28	Reserved		–
29	Operating unit firmware version		The operating unit writes to DW 29 and 30.
30	254	DB number	
31	PLC ID	Connection ID	The standard FB writes to DW 31.
32	0	Job number	PLC job
33	Parameter 1		
34	Parameter 2		
35	Parameter 3		
36–38	Reserved		
39	Job status	Error number	
40	Not assigned	Startup of standard FB, operating mode	Control and acknowledgment bit 1
41	Synchronization of date, time, scheduler	Reserved	Control and acknowledgment bit 2
42	Not assigned	Hour (0...23)	Time (BCD format)
43	Minute (0 – 59)	Second (0 – 59)	
44	Not assigned		
45	Not assigned	Day of week (1...7)	Date (BCD format)
46	Day of month (1 – 31)	Month (1 – 12)	
47	Year (0 – 99)	Not assigned	

Table 4-1 Assignment of Interface Area for Group 1 PLCs, continued

DW	DL	DR	Usage
48–50	48 scheduler bits		To be specified by user in configuration.
51–57	Reserved		–
58	Life bit monitoring (Watchdog)		Default 200 (KF format)
59	Standard FB version number		The standard FB writes to DW 59.
60–68	Standard FB communication area This area must not be altered.		–

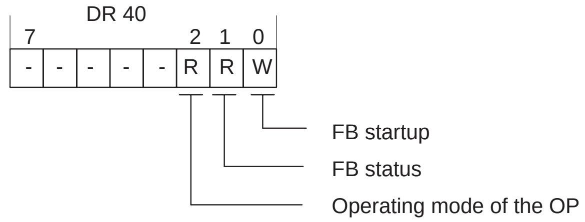
Note

The communication area and all areas not used by the connection concerned are reserved areas. Writing to reserved areas is illegal for the application program.

4.3.1 Startup of Standard Function Block and Operating Mode

Assignment of bits in DR 40

The standard FB is activated by means of Bit 0. Bit 1 shows the current status of the standard FB and Bit 2 the operating mode of the OP. Figure 10-1 shows the structure of control and acknowledgement bit 1.



- = Not assigned
R = Read only
W = Read and Write possible

Figure 4-3 Structure of Control and Acknowledgment Bit 1 (DR 64 in interface area)

Significance of bits

Bit 0 = 1	Activate FB startup
Bit 1 = 1	FB startup in progress
Bit 2 = 0	Operating unit is online
Bit 2 = 1	Operating unit is offline

Starting the standard FB

The standard function block has to be started by means of the rightmost byte of data word 40 in the interface area.

The startup organization block used (OB 21/22) must write the value `1` (KF format) to data word 40 in order to initiate FB startup and reset all other control bits.

Example: OB 21/22

```
:A DB 51        51 = DB number of interface area
:L KF 1
:T DW 40
```

In order to reset the operating unit and the standard FB, Bit 0 in this data word may also be set by the cyclic program.

Standard FB error message

Check AKKU 1 to see if the standard FB has issued an error message.

If an error occurs during processing of the function block, the logical operation result is set to the value `1`. This allows you to branch to your own error analysis function using the command JC.

After the standard FB call, AKKU 1 contains the current job status and the number of any error that has occurred.

The contents of AKKU 1 are illustrated in figure 10-2.

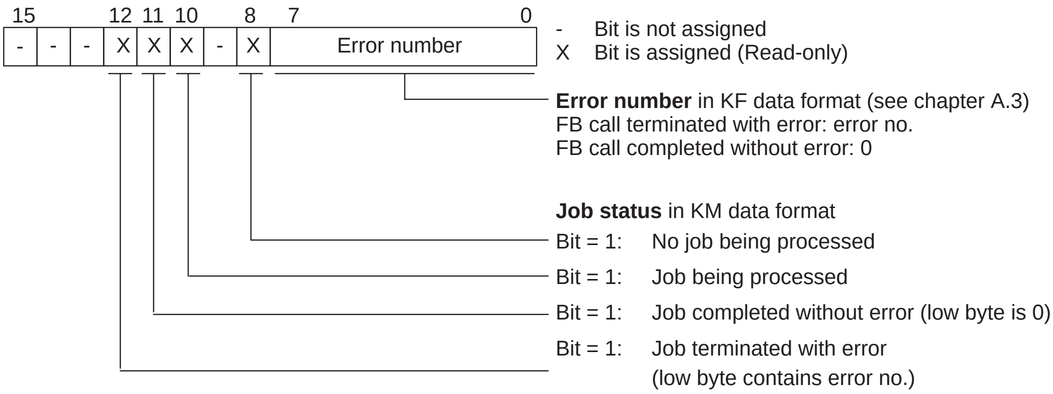


Figure 4-4 Contents of AKKU 1 after Invoking Standard FB

Operating mode bit

The operating unit overwrites Bit 2 in DW 40 for the operating mode during startup and sets it to 0.

If the operating unit is switched off-line by operator input on the operating unit, there is no guarantee that the operating unit will be able to set Bit 2 in DW 40 to 1. If the PLC sets the acknowledgment bit to 1, the PLC program can query whether the bit has been reset to 0, i.e. whether the operating unit is still off-line or is in communication contact with the PLC again.

4.3.2 Transferring Date and Time to PLC

Transferring date and time

DW 42–47
Transfer of date and time from the operating unit to the PLC can be initiated by PLC job 41. PLC job 41 writes the date and time to the interface area where they can be analysed by the STEP5 program. Figure 4-5 shows the layout of the data area in the interface area. All data is in BCD format.

DW	DL (15 ... 8)	DR (7 ... 0)	
42	Not assigned	Hour (0...23)	Time
43	Minute (0...59)	Second (0 – 59)	Time
44	Not assigned		Time
45	Not assigned	Day of week (1...7)	Date
46	Day of month (1...31)	Month (1 – 12)	Date
47	Year (0...99)	Not assigned	Date

Figure 4-5 Layout of data area for **Time** and **Date**

Synchronization of transfer

Control and acknowledgment bit 2 in the interface area (DW 41) synchronize the transfer of date and time. If the operating unit has transferred a new date or time to the PLC by means of the PLC job, it sets the bits shown in figure 4-6. After analysis of the date or time, the STEP5 program should reset the bits in order that the next transmission can be detected.

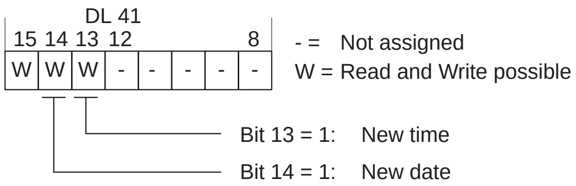


Figure 4-6 Synchronization Bits for Date and Time

Note

PLC job 41 must not be invoked cyclically or at intervals of less than 5 seconds or else communication with the operating unit will be overloaded. In such cases, error number 502 or 503 will appear on the operating unit.

4.3.3 Analyzing Scheduler Bits

Operating units usable

The use of schedulers is only possible with the OP15 and OP17. A scheduler is a periodically recurring (hourly, daily, weekly, annually) time at which a defined function is executed, e.g.

– printing out the message buffer

– printing out a screen

– selecting a screen.

When a scheduler time is reached on the OP, the corresponding bit is set in this area.

DW	15	Bit no.	0
48	16		1
49	32		17
50	48		33

Scheduler no.

Transferring scheduler times to the PLC (only if configured with COM TEXT)

Input fields for scheduler times linked to the process and therefore with a link to the PLC can be created in screen entries. If a scheduler time is altered by operator input on the OP, the new scheduler time is then transferred to the OP.

Scheduler type

Structure of process link:

Hourly

DL 15..							DL ..8	DR 7.. ..0
1	1	1	1	1	1	1	1	Minutes

Daily

DL 15.. ..8	DR 7.. ..0
Hours	Minutes

Weekly

	DL 15..							DL ..8	DR 7.. ..0
1st word	1	1	1	1	1	1	1	1	Day of week
2nd word	Hours								Minutes

Day of week: Sunday = 0
Monday = 1
:
:
Saturday = 6

Annually

	DL 15.. ..8	DR 7.. ..0
1st word	Month	Day
2nd word	Hours	Minutes

Note

The process link for the scheduler types ”weekly” and ”annually” must extend to a length of 2 data words. If not, system message $635 will be returned after the scheduler time is entered.

Synchronization of transfer

Control and acknowledgment bit 2 in the interface area (DW 41) synchronize the transfer of the scheduler bits.

If the OP has set a new scheduler bit in the interface area, it also sets the corresponding bit in control and acknowledgement bit 2 (see figure 4-7). You therefore only need to poll this bit in order to be able to detect a change in the scheduler bits.

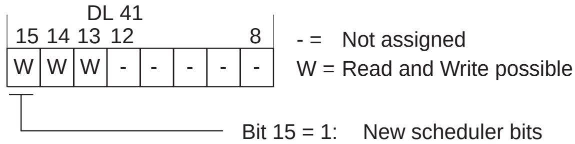


Figure 4-7 Synchronization Bits for Schedulers

4.3.4 Analyzable Areas of the Interface Area

Operating unit entries

The operating unit enters information in DW 29 and 30 that can be analysed by the application program. Writing to these data words is illegal for the application program.

Operating unit firmware version

DW 29:
The operating unit stores its firmware version number in DW 29. You can read that information with the STEP5 program.

Number of interface area

DW 30, DL:
Here, the operating unit enters the fixed value 254. At startup the standard function block checks whether code number 254 is entered in this data word. If it is not, the standard FB aborts processing and returns an error message.

DW 30, DR:
Here, the operating unit enters the number of the data block for the interface area configured in ProTool or COM TEXT.

Standard FB entries

The standard FB enters information in DW 31 and 59 that can be analysed by the application program. Writing to these data words is illegal for the application program.

PLC and connection ID

DW 31:
The standard function block enters the identification `0 2` for the PLC type in DL and the identification `1` for the connection type in DR. The structure of the data word is shown in figure 4-8.

DL		DR	
15 … 12	11 … 8	7 … 4	3 … 0
0	2	1	Not assigned

Figure 4-8 Assignment of DW 31 in Interface Area

Standard FB version number

DW 59
The standard function block enters its version number in this data word.

	15 ··· 8	7	6	5 … 0
DW 59	Version number (0 to 99) in KF format (fixed-point)	R	R	Not assigned

(Code letter from standard library no.)

	7	6
A	0	0
B	0	1
C	1	0
D	1	1

(R = Read only)

Life bit monitoring

DW 58
At regular intervals the operating unit inverts a bit in the interface area that is not accessible to the user. The standard FB counts how often it is invoked between two inversions of that bit. If the number of calls (cycles) exceeds a predefined figure, the standard FB passes error message 115 to AKKU 1.

You enter the maximum number of FB calls permitted without the error message being triggered in this data word. If the data word is overwritten with the value `0`, the standard FB enters the default figure of `200`.

If the application program cycle times are too short, error 115 can result even if the connection is good. In such cases, enter a higher figure for the maximum number of calls, e.g. `2000`.

4.3.5 Use of PLC Jobs

Description

PLC jobs can be used to initiate functions on the operating unit from the STEP5 program. Such functions include the following:

- Displaying screens
- Setting date and time
- Printing out the message buffer
- Altering general settings

A PLC job is identified by its job number. Depending on the PLC job in question, up to three parameters can then be specified. The PLC jobs possible are listed in appendix B together with their parameters.

PLC job structure

4 data words are defined in the interface area for a PLC job. The first data word contains the job number. Data words 2 to 4 are used to transfer up to three parameters depending on the function in question. The basic structure of a PLC job is shown in figure 4-9.

	DL	DR
DW 32	0	Job no.
DW 33	Parameter 1	
DW 34	Parameter 2	
DW 35	Parameter 3	

Figure 4-9 Structure of a PLC Job

Initiating a PLC job

Enter the PLC job directly in the interface area. The standard FB initiates transfer of the PLC job to the operating unit when the job number is entered in DW 32. For that reason, you must enter the parameters in DW 33 to DW 35 before entering the job number in DW 32.

Once the operating unit has received the PLC job, it is deleted. This means that the standard FB overwrites DW 32 with the value ”0”. Only then has the standard FB fully processed the PLC job thus allowing the job mailbox to be written to by the STEP5 program again. The operating unit issues no acknowledgement as to whether the PLC job has actually been executed or not.

Current PLC job status and error number

DW 39 shows the current status of the PLC job and any error number that has occurred.

After the standard FB has been invoked, this data word contains the same information as AKKU 1. Figure 4-10 shows the contents of AKKU 1. One exception to this is Bit 8 *No job being processed*. That bit is not set in the interface area.

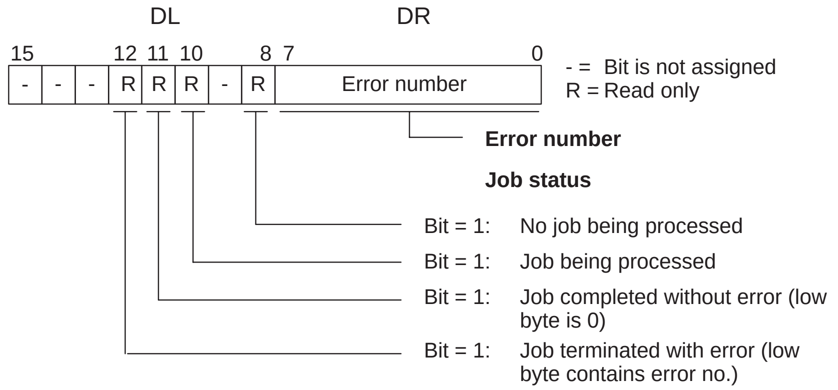


Figure 4-10 Job Status and Error Number for PLC Jobs

DL contains the job status. The bits are set by the standard FB. If the PLC job is completed without an error, the standard FB sets DR to the value 0. If the PLC job is terminated with an error, DR contains the error number. An explanation of the error numbers is given in appendix A.3.

FAP Connection

5

This chapter describes communication between the operating unit and the SIMATIC S5 using an FAP connection (FAP: Free ASCII Protocol).

5.1 Communication Structure

Connection

The operating unit is connected to the SIMATIC S5 either via

- the SI2 interface on the CPU or
- CP module (communication processor) on the PLC.

Multiple operating units can be simultaneously connected to one PLC via multiple CP modules. The communication structure and the differences between the to two methods of connection are described below.

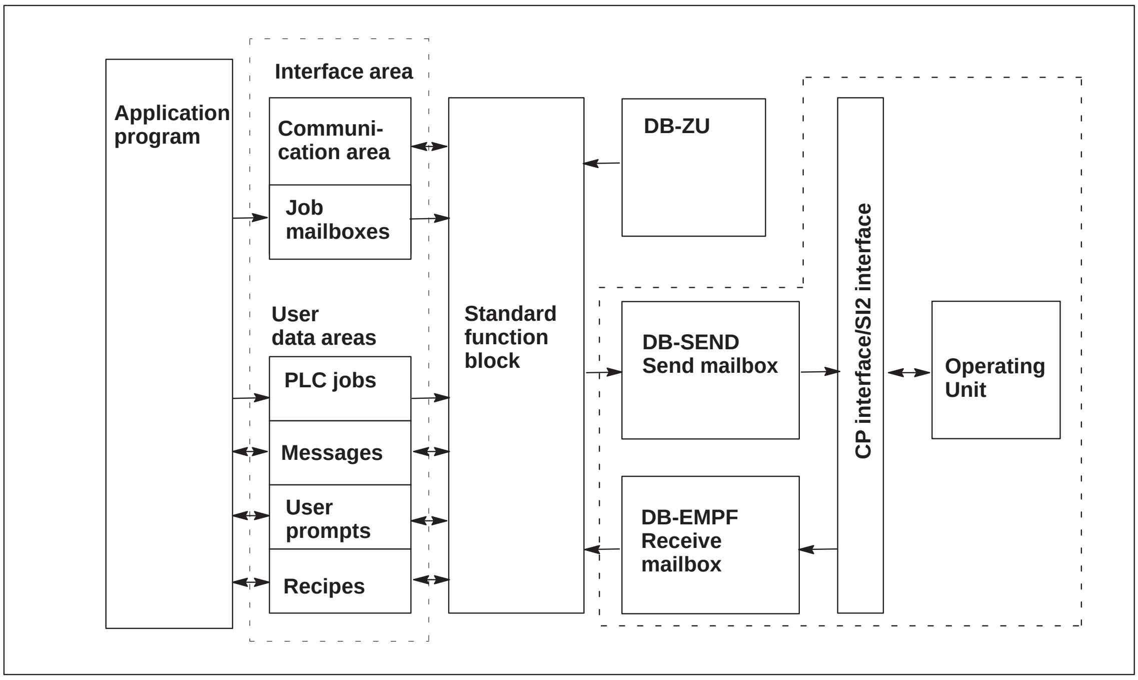


Figure 5-1 Communication Structure for FAP Connection

Description

The components enclosed in dotted lines in figure 5-1 have to be set up separately for each operating unit connected. The arrows represent the flow of information between the components.

Function of standard FB

The operating unit and PLC communicate with one another via the CP interface or the CPU programming interface SI2. Data transfer from the PLC to the operating unit takes place via a send mailbox and from operating unit to PLC via a receive mailbox. Those two data areas act as send and receive buffers for the standard function block.

The standard function block should be integrated in the STEP5 application program. Its job includes monitoring the connection with the operating unit and co-ordinating data transfer.

Function of interface area

The interface area is required by the function block and it is therefore absolutely essential that it is set up.

The interface area is a data block that is simultaneously an interface between the application program and the standard function block and the application program and the operating unit. It contains data and pointers to data areas that are required, among other things, for synchronizing exchange of data between the PLC and the operating unit. A detailed description of the interface area is given in chapter 10.1, page10-2.

Function of DB-ZU

The assignment data block DB-ZU contains the parameters of all configured operating units involved in communication with the PLC. A basic description of DB-ZU area is given in chapter 10.3. Table 5-1 shows the structure of a 16-data word area in DB-ZU as it should be assigned for FAP and one operating unit.

Table 5-1 Assignment of an Area in DB-ZU

DW	DL	DR	Usage
n+0	Reserved	DB number of interface area	To be specified by user
n+1	Reserved		–
n+2	Standard FB version number		–
n+3	Job status	Error number	To be analysed by user
n+4	CP address (CP523 and CP521SI only)		To be specified by user
n+5	Data type 0 = DB 1 = DX	DB/DX number	Pointer to receive mailbox; specified by user.
n+6	0	Start address (DW number)	
n+7	Data type 0 = DB 1 = DX	DB/DX number	Pointer to send mailbox; specified by user.
n+8	0	Start address (DW number)	
n+9	Not relevant to FAP		–
n+10			
n+11	Interface parameters.		To be specified by user
n+12			
n+13			
n+14	Reserved		–
n+15			

User data areas

User data areas should only be set up if the associated function is to be used. User data area are required, for example, for the following purposes:

- initiating messages
- transferring function keys
- controlling LEDs
- for recipes

A detailed description of the user data areas is given in chapter 11.

Send and receive mailboxes

The standard function block requires the send and receive mailboxes for internal communication. The two mailboxes have to be set up by the user at any memory location on the PLC. The addresses of the two mailboxes must be entered in the assignment block DB-ZU. The length of the mailboxes depends on the CPU being used (see table 5-2).

Table 5-2 Size of Send/Receive Mailbox According to CPU Used

CPU	Size of Send/Receive Mailbox in Words
All CPUs except CPU 945	50
CPU 945	128

5.2 Commissioning Procedure

Procedure

The basic steps for commissioning the FAP connection are described below.

1. Set up the data block, e.g. `DB 51`, for the interface area using a length of `185 DW`. You do not have to specify any default values.

   If the data block is not present or too short, an error message is placed in AKKU 1 after the standard FB is invoked.

2. Copy standard FB 52 (name `TDOP:521` or `TDOP:523`) or standard FB 53 (name `TDOP:FAP`) from the disk labeled *COROS Standard Function Blocks* to your STEP5 program.

   Table 5-3 shows which FB should be used for which configuration.

Table 5-3 Standard FBs to be Used for Different Configurations

Function Block	PLC	CPU	File
Standard FB for connection via SI2			
FB 53 (TDOP:FAP)	S5 115 U	CPU 943, 944	S5TD**50**ST.S5D
FB 53 (TDOP:FAP)	S5 115 U	CPU 945	S5TD**51**ST.S5D
FB 53 (TDOP:FAP)	S5 135 U	CPU 928-3UB11	S5TD**24**ST.S5D
Standard FB for connection via CP521			
FB 52 (TDOP:521)	S5 95 U		S5TD**03**ST.S5D
FB 52 (TDOP:521)	S5 100 U	CPU 103	S5TD**01**ST.S5D
Standard FB for connection via CP523			
FB 52 (TDOP:523)	S5 115 U	CPU 941, 942, 943, 944	S5TD**50**ST.S5D
FB 52 (TDOP:523)	S5 135 U	CPU 922 version 9 or later CPU 928-3UA12, CPU 928-3UB11	S5TD**24**ST.S5D
FB 52 (TDOP:523)	S5 155 U	CPU 946/947, 948	S5TD**69**ST.S5D

3. Set up DB-ZU, e.g. `DB 52`, with a minimum length of 16 words. The assignment data block DB-ZU contains the parameters of all configured operating units connected to the PLC.

   If more than one OP is connected to the same PLC using FAP (e. g. via CP 523), all of them can use the same DB-ZU. In such cases, 16 words must be reserved for each operating unit in DB-ZU.

4. Make the required entries in DB-ZU. Table 5-4 shows an example of the assignment for an operating unit connected to CPU 944. The connection is made via CP523. The offset n in DB-ZU corresponds to [(device number –1)*16].

   Specify the CP address in data word n+4. In data words n+5 to n+8, set up the pointers for the send and receive mailboxes. Enter the interface parameters in data words n+11 to n+13. The precise details of the entries required are given at the end of these step-by-step instructions.

   DB-ZU is only analysed during startup of the standard FB. That means that any changes to DB-ZU during normal operation will trigger a standard FB restart.

Table 5-4 Assignment of an Area in DB-ZU

DW	DL	DR	Usage
n+0	Reserved	51	To be specified by user
n+1	Reserved		–
n+2	Standard FB version number		–
n+3	Job status	Error number	To be analysed by user
n+4	0	128	To be specified by user
n+5	0	50	Pointer to receive mailbox; specified by user.
n+6	0	0	
n+7	0	50	Pointer to send mailbox; specified by user.
n+8	0	50	
n+9	Not relevant to FAP		–
n+10			
n+11	9600	0	To be specified by user
n+12	0	0	
n+13	1		
n+14	Reserved		–
n+15			

5. Set up send and receive mailboxes with a length of 50 words each (128 data words in the case of CPU 945). To do so, create the data block `DB 50` with a length of 100 words, for example.

A separate send and receive mailbox has to be created for each operating unit connected. The standard FB requires those mailboxes as message buffers. If the mailboxes are not present or too short, an error message is placed in AKKU 1 after the standard FB is invoked.

6. Load the number of DB-ZU and the device number of the operating unit into AKKU 1. In this example, this would be device number `1`.

   The device number is required is more than one operating unit is being operated using the same DB-ZU. The device number then determines the offset in DB-ZU. A maximum of 16 operating units can be operated using the same DB-ZU.

7. Next, invoke the standard FB unconditionally.

Example program:

`L KY 52,1`	52=Number of DB-ZU 1 = Device number
`:JU FB 52`	Communication with operating unit
`NAME :TDOP:523`	FAP Connection via CP523
`:T FW 100`	Save AKKU 1 to FW 100
`:JC=ERR`	Branch to error analysis Job status and error number are in FW 100.

If an error occurs during processing of the function block, the logical operation result is set to the value ”`1`”. This allows you to branch to your own error analysis function using the command JC.

After the standard FB has been invoked, AKKU 1 contains the current job status and the number of any error that has occurred.

8. Now start up the standard FB using data word 64 in the interface area. In the interface area DW 64 is used to start up the standard FB.

   The startup organization block used (OB 20/21/22) must write the value `1` (KF format) to that data word in order to initiate FB startup and reset all other control bits.

   Example:
   OB20/21/22
   ```
   :C DB 51
   :L KF 1
   :T DW 64
   ```

   In order to reset the operating unit and the standard FB, Bit 0 in this data word may also be set by the cyclic program. How this is done is described in chapter 10.2.1, page 10-6 under the heading ”Restarting”.

   With an FAP connection, there is no check-back signal to the operating unit if the standard FB restarts. This has no effect on communication.

9. Check AKKU 1 to see if the standard FB has issued an error message.

   If an error occurs during processing of the function block, the logical operation result is set to the value `1`. This allows you to branch to your own error analysis function using the command JC.

   After the standard FB call, AKKU 1 contains the current job status and the number of any error that has occurred.

   The contents of AKKU 1 are illustrated in figure 5-2.

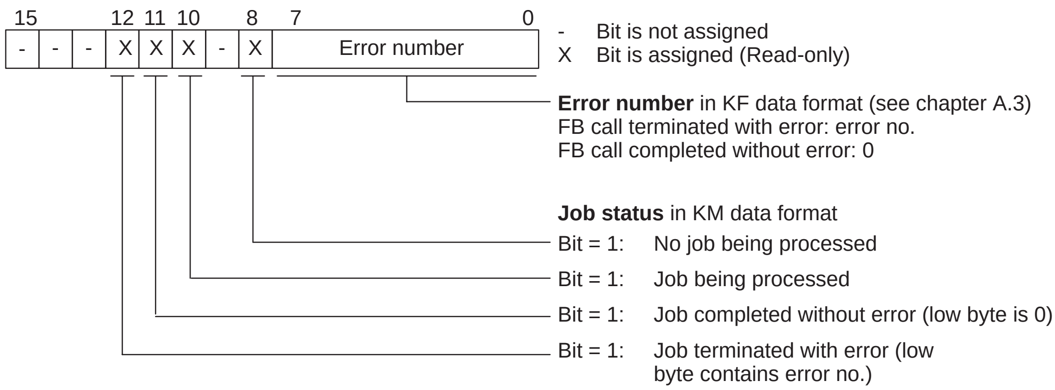


Figure 5-2 Contents of AKKU 1 after Invoking Standard FB

10. If you use user data areas, set them up now (see chapter 11).

5.3 Configuring CP Address and Interface Parameters

Connection-specific entries in DB-ZU

The interface with the PLC is configured by means of the assignment data block DB-ZU. This section describes on those entries specific to FAP. A general description of DB-ZU is given in chapter 10.3.

CP address

DWn+4
This data word must match the hardware setting for the CP module address.

for CP521SI:

DL	DR (start address)
0	64...120 (in increments of 8)

for CP523:

DL (address area)		DR (start address)
0	P area	≥ 128 (in increments of 8)
1	Q area	≥ 0 (in increments of 8)
2	IM3 area	≥ 0 (in increments of 8)
3	IM4 area	≥ 0 (in increments of 8)

If the CPU interface SI2 is used, data word n+4 is not relevant.

Note

Communication processors CP521 SI and CP523 use 8 addresses in the input/output area of the PLC.

No settings must be made which result in an overlap of the address areas of other modules. Address area overlaps are not checked by the standard function block!

Interface parameters for CP

DW n+(11 to 13):
The parameters set here must match those configured on the operating unit.

	DL	DR
DW n +11	Baud rate	Parity
DW n +12	0	TTY/V.24
DW n +13	Character delay time (in multiples of 10 ms)	

DL n +11	Baud rate
3	300
4	600
5	1200
6	2400
7	4800
8	9600

DR n +11	Parity
0	Even
1	Odd
4	No parity bit

DR n +12	Physical char.
0	TTY
1	V.24

The **character delay time** (DW n +13) should be set to 10 ms. This means that the value for DW n +13 = 1.

When configuring the operating unit, 120 ms and 8 data bits must be specified for the character delay time.

Interface parameters for CPU

If you connect the operating unit to the SI2 interface on the CPU, the following settings must be used:

- **CPU 943/944**: DW n + 11 and DW n + 12 are not relevant. They have a fixed setting specified on the CPU.
- In the case of **CPU 945** data words n + 11 and DW n + 12 must be specified in the configuration.

  Values to be specified:
  – Baud rate: 9600 or 19200
  – Parity: Even
  – Stop bits: 1
- In the case of **CPU 928 B** data words DW n+(5..8) for the send and receive mailboxes and data words DW n+(11..13) for the interface parameters are not relevant. All that is required is entry of the number of the interface area in data word n+0. Configuration of CPU 928B is described in chapter 5.4, page 5-11.

Cycle time for CP521 SI

For an FAP connection via the communication processor module CP521 SI, the period between successive standard FB calls must not be more than 80 ms. For that reason the cycle time of the S5 program must not exceed 80 ms.

If the cycle time of the PLC program is longer than 80 ms, the standard FB must not be invoked in OB1. Instead, it must be invoked in the timed organization block OB13. In such cases, save the scratchpad flags and then reload them afterwards. A cycle time of < 80 ms must be configured for OB13.

5.4 Configuring the SI2 Interface on CPU 928B

Configuration

The description which follows applies to 6ES5928-3UB11 version 6 or later. The following components must be configured:

- Extended data block DX2
- Static parameter record,
- Send mailbox and receive mailbox,
- Coordination bytes *Send* (CBS) and *Receive* (CBR).

The following information must be entered in the extended data block **DX2**:

- Type of connection: data transfer using the ”open driver”,
- Location of static parameter record,
- Location and length of send and receive mailboxes,
- Location of the two coordination bytes `Send` (CBS) and `Receive` (CBR).

Send and receive mailboxes must be located in separate data blocks and start at address 0. The pointers to the two mailboxes in DB-ZU are irrelevant.

The parameters for the bit transmission layer must be entered in the DB/DX with the **static parameter record** as follows:

- baud rate (bit/s),
- parity,
- bits per character,
- number of stop bits.

All other parameters in the static parameter record are predefined.

DX2 assignment

Figure 5-3 shows the values to be configured for extended data block DX2. Configuration starts at the absolute address DW 0.

All values are specified in hexadecimal format.

DW no.	Parameter	Explanation	
0	4D41	MA	
1	534B	SK	
2	5832	X2	
3	0030	Data transfer using ”open driver”	Connection type
4	44xx or 58xx	DB no. xx or DX no. xx	Pointer to static parameter record
5	xxxx	From DW no. xxxx	
6	0000	Reserved	
7	0000	Reserved	
8	44xx or 58xx	DB no. xx or DX no. xx	Pointer to send mailbox
9	xxxx	From DW no. xxxx	
10	xxxx	Length in words	
11	44xx or 58xx	DB no. xx or DX no. xx	Pointer to receive mailbox
12	xxxx	From DW no. xxxx	
13	xxxx	Length in words	
14	44aa	DB no. aa [1)]	Pointer to CBS/CBR
15	0064	DW no. 100	

1) The location of CBS/CBR is predefined. For aa, the number of the interface area must be entered. The DW number is 100_D (64_H).

Figure 5-3 Assignment of Extended Data Block DX2

Static parameter record

This contains the parameters for the bit transmission layer and the transmission-specific parameters.

Figure 5-4 shows the values stored for the static parameter record in the DB/DX. Configuration starts at the data word specified in DX2.

DW no.	Parameter	Explanation
n	0001	100 baud
	0002	150 baud
	0003	300 baud
	0004	600 baud
	0005	1200 baud
	0006	2400 baud
	0007	4800 baud
	0008	9600 baud
	0009	19200 baud
n + 1	0000	No parity
	0001	Odd parity
	0002	Even parity
n + 2	0006	6 bits per character
	0007	7 bits per character
	0008	8 bits per character
n + 3	0001	1 stop bit
	0002	1 stop bit
	0003	2 stop bits
n + 4	0000	No flow control
n + 5	0001	Mode 1
n + 6	0000	Reserved
n + 7	000X	Character delay time (x * 10 ms)
n + 8	0000	Reserved
n + 9	0000	Reserved
n + 10	0000	Reserved

Figure 5-4 Static Parameter Record

Note

The value 10 must be entered in data word n + 7 (character delay time = 100 ms)!

Adoption of operating system error numbers

The system program checks the second serial interface (SI2) of the CPU 928B every 100 ms for any communication errors that may have occurred. If an error has occurred, the system program invokes organization block OB 35.

For the purposes of analysis of the error messages, the following instructions must be programmed in OB 35:

OB35

`C`	`DB aaaa`	Number of interface area
`T`	`DD 101`	

The function block always generates error message 200 in the event of a communication error. The precise cause of the fault is stored in the interface area in data words DW 101 and DW 102.

5.5 Configuring the Operating Unit

Configuration parameters

Table 5-5 details the interface parameters that must be specified in the configuration. It also shows the default settings used by the configuration software. The parameters are entered

- in **ProTool** under *System → PLC*,
- in **COM TEXT** under *Configure→Basic Settings→TDOP Interfaces*.

Table 5-5 Configuring the Operating Unit

Parameter	Default setting in configuration software	Range of values
Interface	TTY	TTY; V.24
Baud rate	9.6 kBit/s	300 Bit/s 600 Bit/s 1.2 kBit/s 2.4 kBit/s 4.8 kBit/s 9.6 kBit/s 19.2 kBit/s
Parity	Even	Even; Odd; None
Data bits	8	7; 8
Stop bits	1	1; 2
Character delay time.[1)]	12 × 10 ms	(1...9999) × 10 ms

1) Max. permissible interval between two received characters. If no character is received at the operating unit in that time, a system message is returned.

The interface parameters specified for the operating unit must match those specified for the SIMATIC S5.

Note

For the OP7 and OP17 only 1 stop bit may be used.

6 PROFIBUS-DP Connection

This chapter describes communication between the operating unit and SIMATIC S5 using the PROFIBUS–DP connection.

6.1 Introduction

Definition

PROFIBUS-DP is a master-slave field bus with capacity for up to 122 slaves. A PROFIBUS-DP network is normally operated by one master. That master polls all slaves cyclically. The master is typically a PLC with an interface module compatible with the DP standard. Each operating unit is permanently assigned to a master PLC.

Connection of the PROFIBUS-DP slaves conforms to the PROFIBUS-DP standard DIN E 19245, Part 3.

Hardware requirements

In order to incorporate operating units in an existing PROFIBUS-DP network, the following hardware components are required:

- for the TD10, TD20 and OP20:
  PROFIBUS-DP interface module and firmware memory module,
- for the OP5 and OP15: model version OP5/A2, OP15/A2 or OP15/C2,
- for the OP7: model version OP7/DP or OP7/DP-12,
- for the OP17: model version OP17/DP or OP17/DP-12,
- for the OP25/35/27/37 and TP27/37: no additional components required,
- On the PLC:
  module compatible with DP standard, e.g. IM308C. Only one of these modules is required on the PLC.
- For every device (operating unit or PLC):
  PROFIBUS-DP bus connector or other component approved for the purpose (except FSK bus terminal; see configuration scheme in SIMATIC HMI Catalog ST80.1),
- For S5-155 U with CPU 946/947, equipment version 3UA22 or later is required.

Software requirements

In addition, the following software components are required for the PROFIBUS-DP connection:

- SIMATIC HMI standard function block version 3.2 or later (version 3.3 for DP window) for the PLC concerned,
- Configuration software ProTool or ProTool/Lite version 2 or later, or COM TEXT V3.10 or later,
- Specific configuration software for configuring the interface module in conformity with the DP-standard.

Additional bus masters

In special cases, a PROFIBUS-DP network can include an additional PLC with a master module compatible with the DP standard. The operating units can then be distributed between the two masters.

System limits

No more than 120 of the 122 slaves in a PROFIBUS-DP network may be an operating unit. Those figures are theoretical limits. The actual limits will be determined by the memory capacity and the performance capabilities of the PLC.

6.2 Communication Structure

Figure 6-1 shows the communication structure using the program and data blocks required on the PLC for communication between the PLC and multiple operating units.

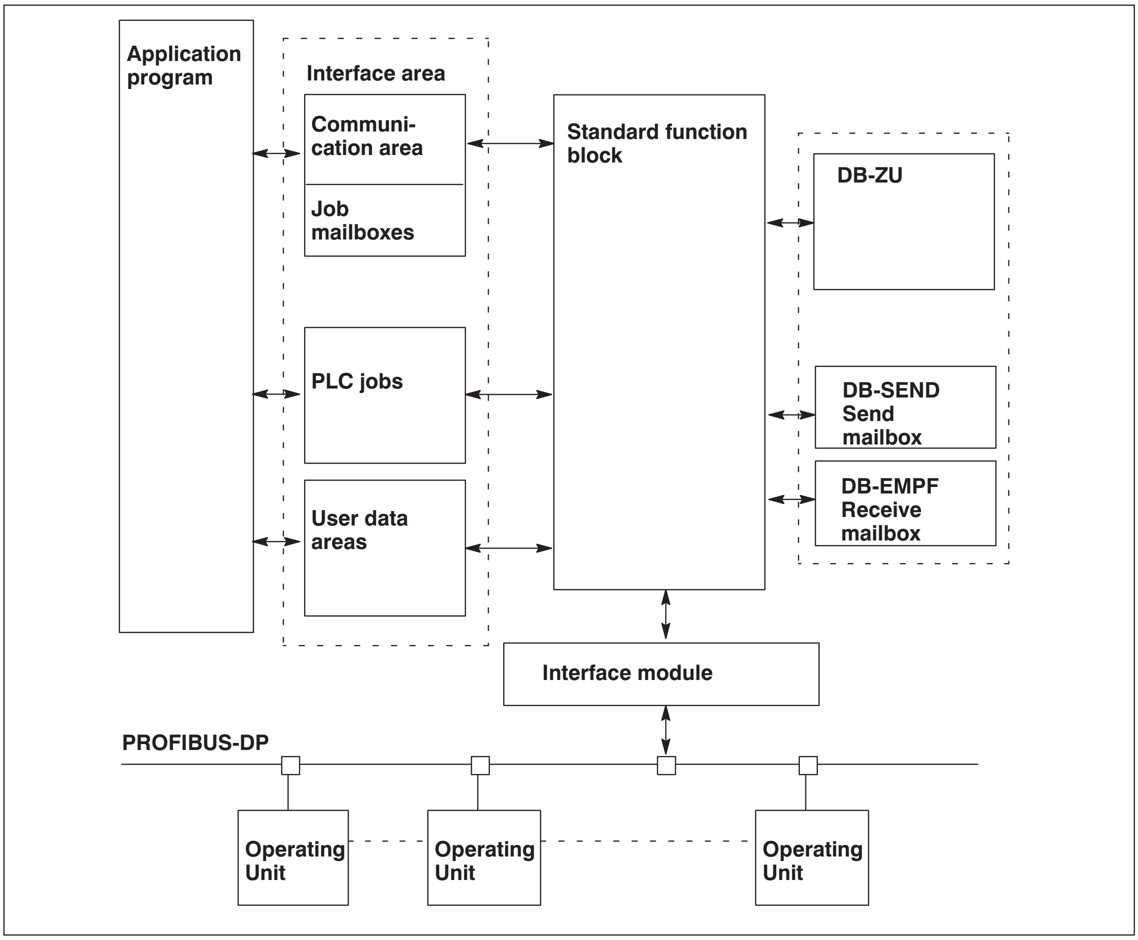


Figure 6-1 Communication Structure for PROFIBUS-DP Connection

Description

The components enclosed in dotted lines in figure 6-1 have to be set up separately for each operating unit connected. The arrows represent the flow of information between the components.

Function of standard FB

The operating unit and PLC communicate with one another via a PROFIBUS-DP master module. Data transfer from the PLC to the operating unit takes place via a send mailbox and from operating unit to PLC via a receive mailbox. Those two data areas act as send and receive buffers for the standard function block.

The standard function block should be integrated in the STEP5 application program. Its job includes monitoring the connection with the operating unit and co-ordinating data transfer.

Function of interface area

The interface area is a data block that is simultaneously an interface between the application program and the standard function block and the application program and the operating unit. It contains data and pointers to data areas that are required, among other things, for synchronizing exchange of data between the PLC and the operating unit. A detailed description of the interface area is given in chapter 10.1, page 10-2.

Function of DB-ZU

The assignment data block DB-ZU contains the parameters of all configured operating units involved in communication with the PLC. A basic description of DB-ZU is given in chapter 10.3, page 10-19. Table 6-1 shows the structure of a 16-data word area in DB-ZU as it should be assigned for PROFIBUS-DP and one operating unit.

Table 6-1 Assignment of an Area in DB-ZU

DW	DL	DR	Usage
n+0	Reserved	DB number of interface area	To be specified by user
n+1	Reserved		–
n+2	Standard FB version number		–
n+3	Job status	Error number	To be analyzed by user
n+4	Not relevant to PROFIBUS-DP		–
n+5	Data type 0 = DB 1 = DX	DB/DX number	Pointer to receive mailbox; specified by user.
n+6	0	Start address (DW number)	
n+7	Data type 0 = DB 1 = DX	DB/DX number	Pointer to send mailbox; specified by user.
n+8	0	Start address (DW number)	
n+9	Connection-specific entries that are dependent on the addressing method used.		To be specified by user
n+10			
n+11			
n+12	Not relevant to PROFIBUS-DP		–
n+13			
n+14	Reserved		–
n+15			

Connection specific entries in DB-ZU

The entries in DB-ZU are dependent on the addressing method used. The description of data words n+9 to n+11 below is subdivided into the headings ”Linear addressing/Page addressing” and ”Addressing via DP window”. For an explanation of the different methods of addressing, please refer to your PROFIBUS-DP manual.

With addressing via DP window, block sizes of over 32 bytes can be used. This improves the performance of the operating unit. At the same time it increases the response time on the decentralized peripheral system.

Note

DP window addressing is only possible with the IM308C version 3 or later.

Entries for linear addressing and page addressing

Figure 6-2 shows the structure of data words n+9 to n+11 in DB-ZU as required for linear addressing and page addressing. The data must match that specified in the interface module configuration.

	DL	DR
DW n +9	Addressing method	Peripheral start address
DW n +10	Page frame number	Block size
DW n +11	Reserved	

	Addressing method	**Permissible address area**
0	Linear P area	128...255
1	Linear Q area 1)	0...255
2	P page	192...254
3	Q page 1)	0...254

1) Only possible with S5-115U with CPU 945, S5-135U and S5-155U.

Figure 6-2 Structure of Data Words in DB-ZU for Linear Addressing and Page Addressing

The **block size** can be either 8, 16 or 32 bytes. Page addressing is not permitted with multi-processor operation. When using linear addressing, the **page frame number** is not analyzed.

The **peripheral start address** must be chosen so that the peripheral block of the specified size fits in the permissible address area.

Entries for addressing via DP window

Figure 6-3 shows the structure of data words n+9 to n+11 in DB-ZU as required for addressing via DP window. The data must match that specified in the interface module configuration.

	DL	DR
DW n +9	Addressing method	IM number
DW n +10	PROFIBUS address of the operating unit	Block size
DW n +11	DP window start address	

Figure 6-3 Structure of Data Words in DB-ZU for Addressing via DP Window

Entry in DB-ZU	Permissible Values
Addressing method	4
IM number	0, 16, 32, 48, ... , 240 (in increments of 16)
PROFIBUS address of the operating unit	1 ... 123
Block size	8, 16, 32, 64, 120
DP window start address	
For S5-115U	F800, FA00, FC00
For S5-135U, S5–155U	F800, FA00, FC00, FE00

Note

Operating unit types TD10, TD20 and OP20 do not support addressing via DP window.

Send and receive mailboxes

The standard function block requires the send and receive mailboxes for internal communication. The two mailboxes have to be set up by the user at any memory location on the PLC. The addresses of the two mailboxes must be entered in the assignment block DB-ZU. The length of the mailboxes depends on the block size used (see table 6-2).

Table 6-2 Size of Send/Receive Mailbox According to Block Size Used

Block Size in Bytes	Size of Send/Receive Mailbox in Words
8	41
16	41
32	41
64	41
120	60

User data areas

User data areas should only be set up if the associated function is to be used. User data area are required, for example, for the following purposes:

- initiating messages
- transferring function keys
- controlling LEDs
- for recipes

A detailed description of the user data areas is given in chapter 11.

6.3 Commissioning Procedure

Procedure

The basic steps for commissioning the PROFIBUS-DP connection are described below.

1. Set up the data block, e.g. `DB 51`, for the interface area using a length of `256 DW`. For addressing via DP window (IM308C only) the data block must have a length of `255 DW`. You do not have to specify any default values.

   If the data block is not present or too short, an error message is placed in AKKU 1 after the standard FB is invoked.

2. Copy standard FB 58 (file name: `TDOP:DP`) from the disk labeled *COROS Standard Function Blocks* to your STEP5 program. If you are using addressing via DP window you require version 3.3 or later of the function block.

3. Set up DB-ZU, e.g. `DB 52`, with a minimum length of 16 words. The assignment data block DB-ZU contains the parameters of all configured operating units connected to the PLC.

   If more than one operating unit is connected to the same PLC using PROFIBUS-DP, all of them can use the same DB-ZU. In such cases, 16 words must be reserved for each operating unit in DB-ZU.

4. Make the required entries in DB-ZU. Table 6-3 shows an example of the assignment for an operating unit. The offset n in DB-ZU corresponds to [(device number –1)*16].

   Specify the DB number of the interface area in data word n+0. In data words n+5 to n+8, set up the pointers for the send and receive mailboxes. Enter the connection-specific entries in data words n+9 to n+11.

   DB-ZU is only analyzed during startup of the standard FB. That means that any changes to DB-ZU during normal operation will trigger a standard FB restart.

Table 6-3 Example of DB-ZU Assignment

DW	DL	DR	Usage
0	Reserved	51	To be specified by user
1	Reserved		–
2	Standard FB version number		–
3	Job status	Error number	To be analyzed by user
4	Not relevant to PROFIBUS-DP		–
5	0	58	Pointer to receive mailbox; specified by user.
6	0	0	
7	0	58	Pointer to send mail-box; specified by user.
8	0	41	
9	0	128	Linear P area with start address 128
10		32	Block size
11	Reserved		–
12	Not relevant to PROFIBUS-DP		–
13			
14	Reserved		–
15			

5. Set up a send mailbox and a receive mailbox with a length of 41 words in each case for linear addressing or page addressing. To do so, create the data block `DB 58` with a length of 82 words, for example.

   For addressing via DP window (IM308C only) using a block size of 120 bytes, send and receive mailboxes with a length of 60 words in each case must be created. To do so, create the data block `DB 58` with a length of 120 words, for example.

   A separate send and receive mailbox has to be created for each operating unit connected. The standard FB requires those mailboxes as message buffers. If the mailboxes are not present or too short, an error message is placed in AKKU 1 after the standard FB is invoked.

6. Load the number of DB-ZU and the device number of the operating unit into AKKU 1. In this example, this would be device number `1`.

   The device number is required is more than one operating unit is being operated using the same DB-ZU. The device number then determines the offset in DB-ZU. A maximum of 16 operating units can be operated using the same DB-ZU.

7. Next, invoke the standard FB unconditionally.

Example program:

`L KY 52,1`	52=Number of DB-ZU 1 = Device number
`:JU FB 58`	Communication with operating unit
`NAME :TDOP:DP`	PROFIBUS-DP connection
`:T FW 100`	Save AKKU 1 to FW 100
`:JC=ERR`	Branch to error analysis Job status and error number are in FW 100.

If an error occurs during processing of the function block, the logical operation result is set to the value ”1”. This allows you to branch to your own error analysis function using the command JC.

After the standard FB has been invoked, AKKU 1 contains the current job status and the number of any error that has occurred.

8. Now start up the standard FB using data word 64 in the interface area. In the interface area DW 64 is used to start up the standard FB.

   The startup organization block used (OB 20/21/22) must write the value 1 (KF format) to that data word in order to initiate FB startup and reset all other control bits.

   Example:
   OB 20/21/22

```
:C DB 51
:L KF 1
:T DW 64
```

   In order to reset the operating unit and the standard FB, Bit 0 in this data word may also be set by the cyclic program. How this is done is described in chapter 10.2.1, page 10-6 under the heading ”Restarting”.

   With a PROFIBUS-DP connection, there is no check-back signal to the OP if the standard FB restarts. This has no effect on communication.

9. Check AKKU 1 to see if the standard FB has issued an error message.

   If an error occurs during processing of the function block, the logical operation result is set to the value ”1”. This allows you to branch to your own error analysis function using the command JC.

   After the standard FB call, AKKU 1 contains the current job status and the number of any error that has occurred.

   The contents of AKKU 1 are illustrated in figure 6-4.

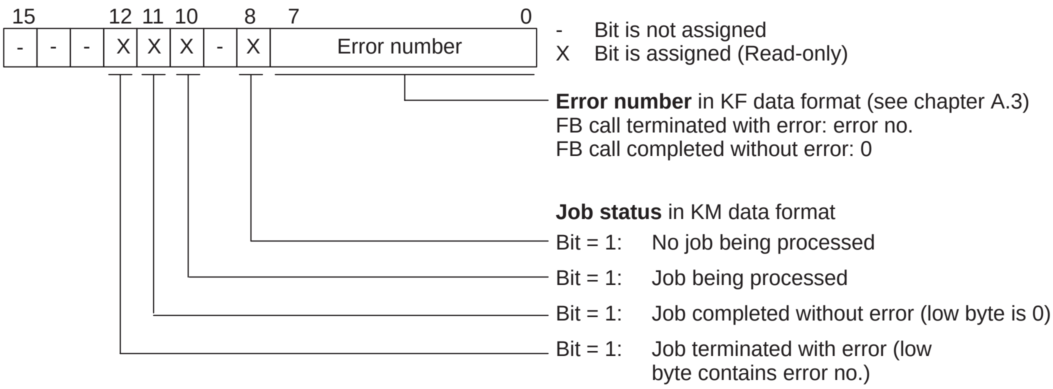


Figure 6-4 Contents of AKKU 1 after Invoking Standard FB

10. If you use user data areas, set them up now (see chapter 11).

6.4 Configuring the PROFIBUS-DP Network

Network configuration

The table below shows which parameters must be specified in the PROFIBUS-DP network for the interface module and the operating unit in order that the two can communicate with one another.

	To be specified when configuring		
Parameter	**Interface module**	**DB-ZU**	**Operating Unit**
Station number of operating unit (PROFIBUS node address)	x		x
Address size (block size)	x	x	
Peripheral address area	x	x	
Baud rate	x		x

In order to make optimum use of the available address space, the address size used can be specified individually for each operating unit.

Note

The bigger the block size chosen, the faster the data transmission rate. At the same time, however, it increases the response time on the decentralized peripheral system. For reasons of performance, the block size should always be as large as possible for graphics display units.

Use of acknowledgement delay for the operating unit

If you have activated acknowledgement delay for the operating unit and set up OB23, accumulator 1 must be set to zero, e.g. L KH0000, at the end of OB 23. This bypasses the acknowledgement delay which occurs when the operating unit is initialized (restart, power on) and the CPU remains in RUN mode.

Configuring the operating unit

Table 6-4 details the parameters that must be specified when configuring the operating unit. It also shows the default settings used by the configuration software. The parameters are entered

- in **ProTool** under *System* → *PLC*,
- in **COM TEXT** under *Configure* → *Basic Settings* → *TDOP Interfaces*.

Table 6-4 PROFIBUS-DP Parameters of the Operating Unit

Parameter	Default Setting in Configuration Software	Range of values
OP address	3	3 to 126
Baud rate	1.5 MBit/s	93.75 kBit/s 187.5 kBit/s 500 kBit/s 1.5 MBit/s 12 MBit/s

The data must match that specified in the configuration for the interface module, e.g. IM308C.

6.4.1 IM308B/C Interface Modules

COM PROFIBUS

In order to be able to configure the IM308B/C, the configuration package COM PROFIBUS is required. The SIMATIC HMI configuration tool is supplied with GSD files for operating unit slaves. Those GSD files can be found in the following locations:

- in **ProTool** in the directory `\PROTOOL\PLCPROG\GSD`,
- in **ProTool/Lite** in the directory `\PROLITE\PLCPROG\GSD`

The different operating units require different GSD files. Table 6-5 gives the details.

Table 6-5 GSD File Required According to Operating Unit

GSD File	Baud Rate Supported by Operating Unit	
	Less than 12 Mbaud	**Up to 12 Mbaud**
SI108020.GSD	OP20, TD10, TD20	–
SI058020.GSD	OP5	–
SI158020.GSD	OP15	–
SI078020.GSD	OP7/DP, OP17/DP	–
SI078040.GSD	–	OP7/DP–12, OP17/DP–12
SI178040.GSD	–	TD17
SI258020.GSD	OP25, OP35	–
SI278040.GSD	–	OP27, OP37, TP27, TP37

If you use the IM308B you do not require any device master files.

If the GSD files in the COM PROFIBUS directory are older than those supplied with ProTool or if the COM PROFIBUS does not yet support a newer operating unit, you should copy the files from ProTool to COM PROFIBUS. You should then restart COM PROFIBUS and then choose `Load Device Master Files`.

If you have already created a COM PROFIBUS configuration using an older file and now want to use the newer GSD files you need to create a new configuration.

Parameters

In order that the IM308B/C and operating unit can communicate with one another, the following parameters must be set in COM PROFIBUS:

- **Station type**: *COROS OP..* or *HMI..*
- **Station number**: 3...126

  The value entered here must match the OP address specified in the operating unit configuration.
- **Specified configuration**:

  The specified configuration is determined by selecting the block size. The block size is determined by the number of specified slots. This is done by specifying the address `055` in each slot used.

  The choice of possible block sizes is as follows: 8 bytes, 16 bytes, 32 bytes, 64 bytes, 120 bytes.
- **Address ID**:

  The address ID is allocated automatically by the specified configuration and must not be modified.
- **I and O address**:

  This field is left blank when addressing via DP window.

6.4.2 Connecting to AG 95U DP–Master

Communication peers

A maximum of two operating units can be connected to the AG 95U DP master. In ProTool, choose menu item *System* → *PLC* → *Edit*, select the protocol `SIMATIC S5 – L2-DP` and in the *Parameters* box set the *CPU Type* to `S5 95U`.

Performance is relatively low when two operating units are connected. For example, the update time for the operating unit is around 5 to 15 seconds if the PLC cycle time is longer than 150 ms.

Standard FB

The program file `S5TD03ST.S5D` contains FB 58 and the additional function block FB 0. FB58 should be invoked unconditionally by the S5 program whereas FB 0 is invoked by FB 58. FB 0 should only be copied to the program file.

Connection-specific entries in DB-ZU

In the case of the connection-specific entries in DB-ZU only addressing method 0 (linear P area) is permissible. Data word n+11 contains the number of the additional FB. This means that assignment of data words n+9 to n+11 in DB-ZU is as follows:

	DL	DR
DW n +9	0	Peripheral start address
DW n +10	Not relevant	Block size
DW n +11	0	No. of additional FB

Figure 6-5 Structure of Data Words in DB-ZU for Linear Addressing

The permissible data area is between 64 and 191. 8/16/32 input and output bytes are occupied in this area depending on the chosen block size. Since address 127 is at a different physical location than address 128, a block must not be created in such a way as to overlap areas. The start addresses for the various block sizes are thus as follows:

Block Size	Start Address
8	64 to 120, 128 to 184
16	64 to 112, 128 to 176
32	64 to 96, 128 to 160

Note

If the DP interface of the AG 95U DP master is configured by means of DB1, no scratchpad flags may be used for the DP status.

COM PROFIBUS

In order to be able to configure the AG 95U DP master, the configuration package COM PROFIBUS is required. The SIMATIC HMI configuration tool is supplied with GSD files for operating unit slaves. Those GSD files can be found in the following locations:

- in **ProTool** in the directory `\PROTOOL\PLCPROG\GSD`,
- in **ProTool/Lite** in the directory `\PROLITE\PLCPROG\GSD`
  The different operating units require different GSD files. Table 6-6 gives the details.

Table 6-6 GSD File Required According to Operating Unit

GSD File	Baud Rate Supported by Operating Unit	
	Less than 12 Mbaud	Up to 12 Mbaud
SI108020.GSD	OP20, TD10, TD20	–
SI058020.GSD	OP5	–
SI158020.GSD	OP15	–
SI078020.GSD	OP7/DP, OP17/DP	–
SI078040.GSD	–	OP7/DP–12, OP17/DP–12
SI178040.GSD	–	TD17
SI258020.GSD	OP25, OP35	–
SI278040.GSD	–	OP27, OP37, TP27, TP37

If the GSD files in the COM PROFIBUS directory are older than the GSD files supplied with ProTool or if the COM PROFIBUS does not yet support a newer operating unit, you should copy the files from ProTool to COM PROFIBUS. You should then restart COM PROFIBUS and then choose `Load Device Master Files`.

If you have already created a COM PROFIBUS configuration using an older file and now want to use the newer GSD files you need to create a new configuration.

Parameters

In order that the AG 95U DP master and operating unit can communicate with one another, the following parameters must be set in COM PROFIBUS:

- **Station type**: *COROS OP..* or *HMI..*
- **Station number**: 3...126

  The value entered here must match the OP address specified in the operating unit configuration.
- **Bus designation**: Profibus-DP
- **Bus profile**: Variable/S5-95U
- **Specified configuration**:
  The specified configuration is determined by selecting the block size. The block size is determined by the number of specified slots. This is done by specifying the address `055` in each slot used.

  The choice of possible block sizes is as follows: 8 bytes, 16 bytes, 32 bytes.
- **Address ID**:

  The address ID is allocated automatically by the specified configuration and must not be modified.
- **I and O address**:
  This field can only be assigned the P area; the permissible address range is 64–191.

Transfer of COM file

Transfer of the COM PROFIBUS configuration from the PU/PC to the PLC takes place via the DP interface of the CPU. The transmission may only be set to 19.2 kbaud.

1. Execute a full reset on the PLC.
2. Transfer the COM PROFIBUS configuration to the PLC.
3. Transfer the S5 program (excluding DB1).

6.4.3 Other SIMATIC S5 PROFIBUS-DP Master Modules

Requirement

The operating units can communicate via the PROFIBUS-DP with all master modules that support PROFIBUS-DP to DIN E 19245, Part 3.

Notes on configuring

For details of how to configure other PROFIBUS-DP master modules, please refer to the relevant module descriptions. When connecting the operating unit to a PROFIBUS-DP network you should take account of the following performance data:

- Configure the operating unit as a PROFIBUS-DP slave in accordance with DIN E 19245, Part 3.
- The address size (block size) of the I/O area must be set to 32 bytes for every operating unit.
- For the manufacturer ID of an operating unit slave that support as baud rate lower than 12 Mbaud, enter **8020**. For operating units that support a baud rate of 12 Mbaud, specify **8040** for the manufacturer ID.
- ”SYNC” and ”FREEZE” modes are not supported by the operating unit.
- User-configurable data is not possible.
- Slave response monitoring is possible but of no useful purpose for operating unit slaves. When the monitoring system is triggered a restart is executed on the operating unit.
- Select the operating unit baud rate from the following list of options only (regardless of any other possible settings offered by the configuration software):
  - 93.75 kBit/s,
  - 187.5 kBit/s,
  - 500 kBit/s,
  - 1.5 MBit/s,
  - 12 MBit/s.
- The ”Min. slave interval” should be set to 2 ms for all operating units except the OP15. For OP15 set an interval of 6 ms.
- Configure the operating unit peripheral address range as a combined I/O area with byte consistency (Address ID 55H).

There are no other consistency requirements.

CP 5430 TF and CP 5431 FMS

In order to be able to configure the communication processors CP 5430 TF (version 2 or later) and CP 5431 FMS (version 1 or later) the configuration interface PROFIBUS-NCM is required. The notes on configuration given on page 6-19 apply. At this point only the details of particular relevance to the CP 5430/5431 are explained.

For details of how to configure the communication processors using PROFIBUS NCM, please refer to the relevant module descriptions.

We recommend that you use the parameters listed below in table 6-7.

Table 6-7 Recommended Parameters for PROFIBUS-NCM

Parameter	Setting
Bus parameter data	Use ”calculated parameters”
DP operating mode	Non-synchronized
Response monitoring	”No” is the only meaningful setting for operating unit
Polling cycle time	At least 5 ms; as short as possible
Largest min. slave interval	5 ms

The only permissible addressing method is linear P area.

FB-SYNCHRON must be invoked by organization blocks OB 20, OB 21 and OB 22 as follows:

Example call for SIMATIC S5-115U:

```
     :JU FB 249      DHB SYNCHRON call
NAME :SYNCHRON
SSNR :KY 0,8         Interface no. (page frame no.)
BLGR :KY 0,5         Block size
PAFE :FY 255         DHB error message
```

SINEC L1 Connection 7

This chapter describes communication between the TD/OP and the SIMATIC S5 with a SINEC L1 connection.

7.1 Overview

Definition

The SINEC L1 bus is a master-slave bus with one master and up to 30 slaves.

Up to 4 TD/OP devices can be connected as SINEC L1 slaves to one SINEC L1 bus system. These TD/OP devices are addressed by one PLC (i.e. the L1 master).

The connection between the PLC and the SINEC L1 bus requires a CP 530 communications processor.

Interface

The TD/OP is connected to the SINEC L1 bus by means of a SINEC L1 BT 777 bus terminal. The connection is made either via

- the base interface of the TD/OP, or via
- the serial interface module of the TD/OP.

The serial interface module permits simultaneous use of a serial interface and the SINEC L1 bus connection.

Function

The serial connection of the SINEC L1 field bus is defined by the RS485 standard.

The SINEC L1 bus terminal is used to adapt the physical TTY characteristics of the TD/OP to the RS485 characteristics of the SINEC L1.

Required hardware

The SINEC L1 bus connection requires the following hardware:

- One or more TD/OP devices,
- One PLC
  – S5-115U (not for CPU 945),
  – S5-135U (CPU 928A only for Version -3UA12 or higher),
  – S5-155U (not for CPU 948),
- One CP 530 communications processor for the connection between the PLC and the SINEC L1 network,
- One interface module for the connection of the TD/OP to the field bus in case it is not directly connected via the base interface,
- One BT 777 bus terminal for each SINEC L1 user.

Required software

The SINEC L1 bus connection requires the following software:

- One FB-TDOP:L1 (FB 56) (function block for the PLC),
- One COM 530 package for configuring the CP 530 communications processor,
- Data handling blocks for the PLC (for S5-115U: integrated in the CPU; otherwise must be ordered separately).

Configuring the SINEC L1 network

The SINEC L1 bus is configured by the COM 530 software package. For further information refer to the corresponding manual.

The connection of each TD/OP device to the bus system requires that the slave address of each TD/OP which is configured with COM TEXT be entered in the polling list of the CP 530.

Note

Disconnect the voltage supply to the TD/OP before connecting or disconnecting the connection from the BT 777 to the TD/OP.

The bus can remain active during this procedure.

7.2 Communication Structure

Figure 7-1 shows the communication structure, as well as the program and data blocks which are required in the PLC for communication between it and several TD/OP devices.

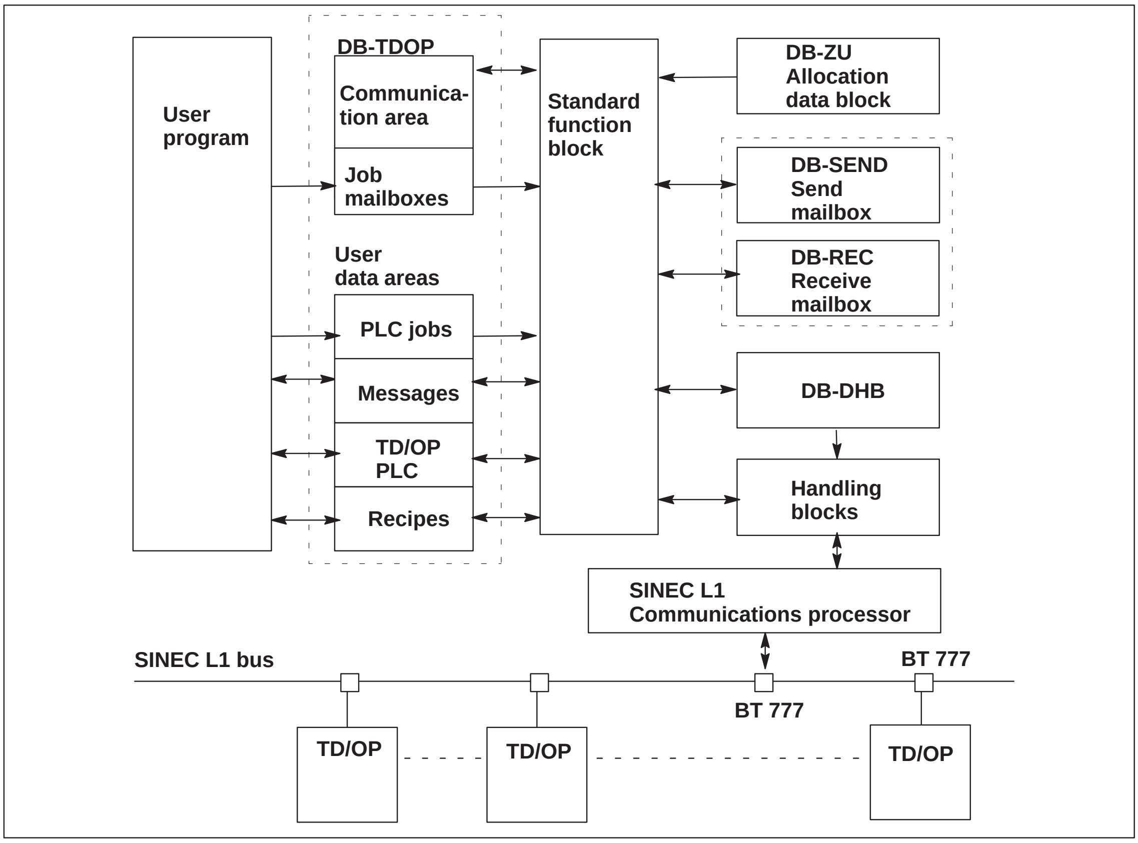


Figure 7-1 Communication structure of the SINEC L1 connection

Description

The components shown inside the broken lines in figure 7-1 must be set up separately for each TD/OP which is connected. The arrows represent the flow of information between the components.

Each bus user is connected to the SINEC L1 bus via a separate BT 777 bus terminal. These bus terminals convert the transferred signals to the physical RS485 characteristics of the SINEC L1 protocol.

Tasks of standard FB

The TD/OP and the PLC communicate with one another by means of a SINEC L1 communications processor. Data are transferred from the PLC to the TD/OP via a send mailbox and from the TD/OP to the PLC via a receive mailbox. These two data areas are used by the standard function block as send and receive buffers.

The standard function block must be embedded in the STEP5 user program. Its tasks include monitoring the connection to the TD/OP and coordinating data transfers. It is supported by data handling blocks, which it calls automatically.

Tasks of DB-TDOP

The interface area DB-TDOP serves as the interface both between the user program and the standard function block and between the user program and the TD/OP. It contains data and pointers to data areas, which are required amongst other things for synchronizing the data exchange between the PLC and the TD/OP.

A PLC job is stored by the user program in the user data area called ”PLC jobs”, together with its parameters. The job is initiated by entering a pointer to this data area in a free job mailbox in the DB-TDOP.

You must only set up user data areas if you are actually intending to use the associated functions.

Tasks of DB-ZU

The allocation data block DB-ZU contains a list of all the TD/OP devices which have been configured and which are participating in communication with the PLC, together with their PLC parameters.

Condition

The minimum configuration necessary to operate a TD/OP on the SINEC L1 bus is as follows:

- the standard function block FB 56 (TDOP:L1) of the program file on the PLC side,
- the interface area DB-TDOP,
- the allocation data block DB-ZU,
- data handling blocks.

These components are described below.

7.3 Setting up the Program and Data Areas

Interface area

Set up `DB 51`, for example, with a size of `228 DW`. This is the interface area DB-TDOP.

Standard function block

The standard FB is called by specifying an absolute address.

Example program:

```
L KY 52,1            52 = Number of DB-ZU
                     1 = TD/OP device number
    :JU FB 56        Communication with TD/OP
NAME:TDOP:L1         SINEC L1 connection
    :T FW 100        Store AKKU 1 in FW 100
    :JC= FEHL        Branch to error evaluation;
                     job status and error number contained in FW 100
```

The standard FB is started with data word DW 64 in the DB-TDOP. This data word must be set to the value `1` (KF format) in the relevant startup organization block (OB 20, 21, 22), in order for the FB to be started up and all the other control bits to be reset.

Example:

```
OB20/21/22
:C DB 51      51 = Number of DB-TDOP
:L KF 1
:T DW 64
```

Bit 0 of this data word can also be set in the cyclic program, in order to reset the TD/OP and the standard FB.

No acknowledgment is sent to the TD/OP via the SINEC L1 connection when the standard FB is restarted. This has no effect on communication.

Check AKKU 1 to see if the standard FB has output an error message.

If an error occurs while the function block is being processed, the result of the logic operation is set to the value `1`. This allows you to activate a separate error evaluation with the JC command.

After the standard FB call, AKKU 1 contains the current job status and the error number, if an error has occurred.

The contents of AKKU 1 are shown in figure 7-2.

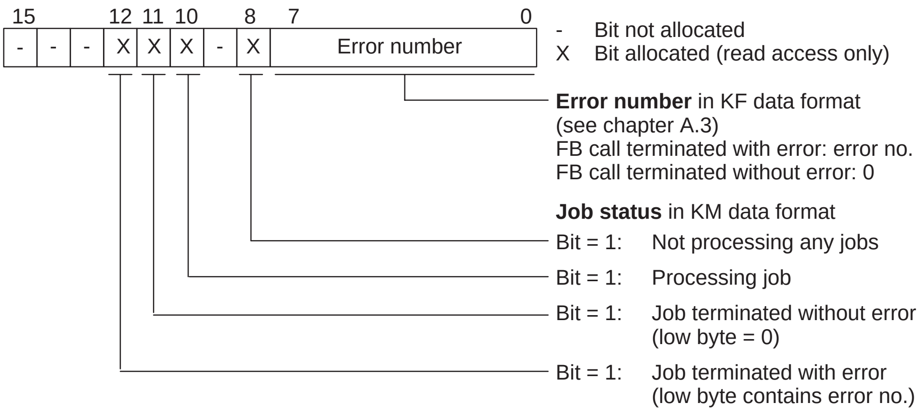


Figure 7-2 Contents of AKKU 1 after the standard FB call

Connection-specific entries in DB-ZU

The interface to the PLC is configured via the allocation data block DB-ZU. Only the SINEC L1-specific entries are written in this block. Please refer to chapter 10.3 for a general description of the DB-ZU.

The allocation data block DB-ZU must be set up with a size of at least 16 words.

DW n+4, DW n+11..13
These data words are reserved.

DW n+9, DW n+10: SINEC L1 parameters
These two data words contain:

- The page frame address of the communications processor
- The TD/OP slave number.

	DL	DR
DW n +9	Not allocated	CP page frame address
DW n +10	Not allocated	TD/OP slave number

The **CP page frame address** must be identical to the configured address (e.g. in COM 530).

The **TD/OP slave number** must be identical to the number configured in COM TEXT.

The following entries must be incorporated in the DB-ZU before the standard function block is started up:

– Pointer to the receive mailbox,
– Pointer to the send mailbox,
– Number of the DB-TDOP.

If other TD/OP devices are connected via the SINEC L1 in the same PLC, they can all use the same DB-ZU. In this case, 16 words must be reserved in the DB-ZU for each device.

Note

The DB-ZU is only evaluated when the standard FB is started up. The standard FB must be started up again after any changes to the DB-ZU.

Data handling blocks

All interface functions are handled via the function block FB-TDOP: L1. This block requires the following data handling blocks:

– DHB-SEND,
– DHB-RECEIVE,
– DHB-CONTROL,
– DHB SYNCHRON.

Note

The data handling blocks require the DB-DHB as a work area. This block must be set up permanently as DB 56 with a minimum size of 16 data words.

If DB 56 is set up with more than 16 data words, it is freely available to the user starting with data word DW 16.

Table 7-1 contains the function block numbers of the data handling blocks which are required for the different CPUs.

Table 7-1 Function block numbers

Function block	**PLC**		
	S5-115 U	**S5-135 U**	**S5-155 U**
FB-SEND	FB 244	FB 120	FB 120
FB-RECEIVE	FB 245	FB 121	FB 121
FB-CONTROL	FB 247	FB 123	FB 123
FB-SYNCHRON	FB 249	FB 125	FB 125

The data handling blocks are included in the EPROM of the CPU in the case of the 115 U PLC; they must be ordered separately for all the other PLCs.

Data handling block calls

Except for the FB-SYNCHRON, the data handling blocks are called automatically by the standard FB.

The FB-SYNCHRON must be called in the startup organization blocks OB 20, OB 21 and OB 22:

Example for SIMATIC S5-115 U:

```
     :JU  FB 249     DHB-SYNCHRON call
NAME:SYNCHRON
SSNR:    KY 0,8      Interface (page frame) no.
BLGR:    KY 0,5      Block size
PAFE:    FY 255      Error message of the DHB
```

Send mailbox, receive mailbox

One send mailbox and one receive mailbox with a fixed size of 34 data words each must be set up for every connected TD/OP. Pointers must be set up for the send mailbox and the receive mailbox in data words n+5 to n+8 of the DB-ZU.

7.4 Configuring the SINEC L1 Network

Table 7-2 lists the interface parameters which must be set for a configuration with COM TEXT. The preset values offered by COM TEXT are also shown.

You can set the parameters in *Configure* → *Basic Settings* → *TDOP Interfaces*.

Table 7-2 Interface parameters for the SINEC L1 connection

Parameter name	Preset value in COM TEXT	Range of values
Interface	TTY	TTY; V.24
Baud rate	187.5 kbit/s	9.6 kbit/s 19.2 kbit/s 93.75 kbit/s 187.5 kbit/s 500 kbit/s 1.5 Mbit/s
Parity	Even	Even; odd; none
Data bits	8	7; 8
Stop bits	1	1; 2
Slave no.[1)]	1	1 to 30

[1)] L1 bus address of TD/OP

The interface parameters specified for the TD/OP must be identical to the values configured for the SINEC L1 communications processor.

8 PROFIBUS Connection

This chapter describes communication between the TD/OP and the SIMATIC S5 with a SINEC L2 connection.

8.1 Overview

Definition

The SINEC L2 bus is a multi-master bus with a maximum of 127 stations. A maximum of 32 bus stations can have master capability. All bus stations interconnected by the TD/OP-PLC communication are bus masters.

A PLC can communicate with a maximum of 30 TD/OP devices. Each TD/OP device communicates with only one PLC.

The allocation of TD/OP devices to a PLC can be configured separately for each TD/OP.

TD/OP devices are connected to PLCs by means of the *Free Layer 2 Access protocol.* The Free Layer 2 Access protocol is compatible with PROFIBUS in accordance with DIN 19245 Part 1.

System limits

The following system limits must be observed when the TD/OP devices are networked via the SINEC L2 bus:

- Up to 32 masters (TD/OP or PLC) or other stations with a master capability can be connected in the network. Further SINEC L2 bus stations (slaves) are permissible but not included in TD/OP-PLC communication.
- Up to 30 TD/OP devices are allowed per PLC (if one bus master PLC is on the SINEC L2).

Required hardware

The SINEC L2 connection requires the following hardware:

- For TD10, TD20, OP20: One SINEC L2 interface module,
- For each PLC (except S5-95 L2): One CP communications processor with Free Layer 2 Access, e.g. CP5430, or
- One S5-95U-L2 PLC with Free Layer 2 Access (MLFB no. 6ES5 095-8MB**02** or higher),
- For each device (TD/OP or PLC): One SINEC L2 bus plug connector or other authorized component (except FBA bus terminal, see SINEC L2 catalog).

Required software

The SINEC L2 connection requires the following software:

- ”OPTIONS” memory module with SINEC L2 firmware,
- FB-TDOP:L2 function block for the relevant PLC,
- COM TEXT configuration package, V2.00 or higher,
- COM package for CP module.

8.2 Communication Structure

Figure 8-1 shows the communication structure, as well as the program and data blocks which are required in the PLC for the communication between it and several TD/OP devices.

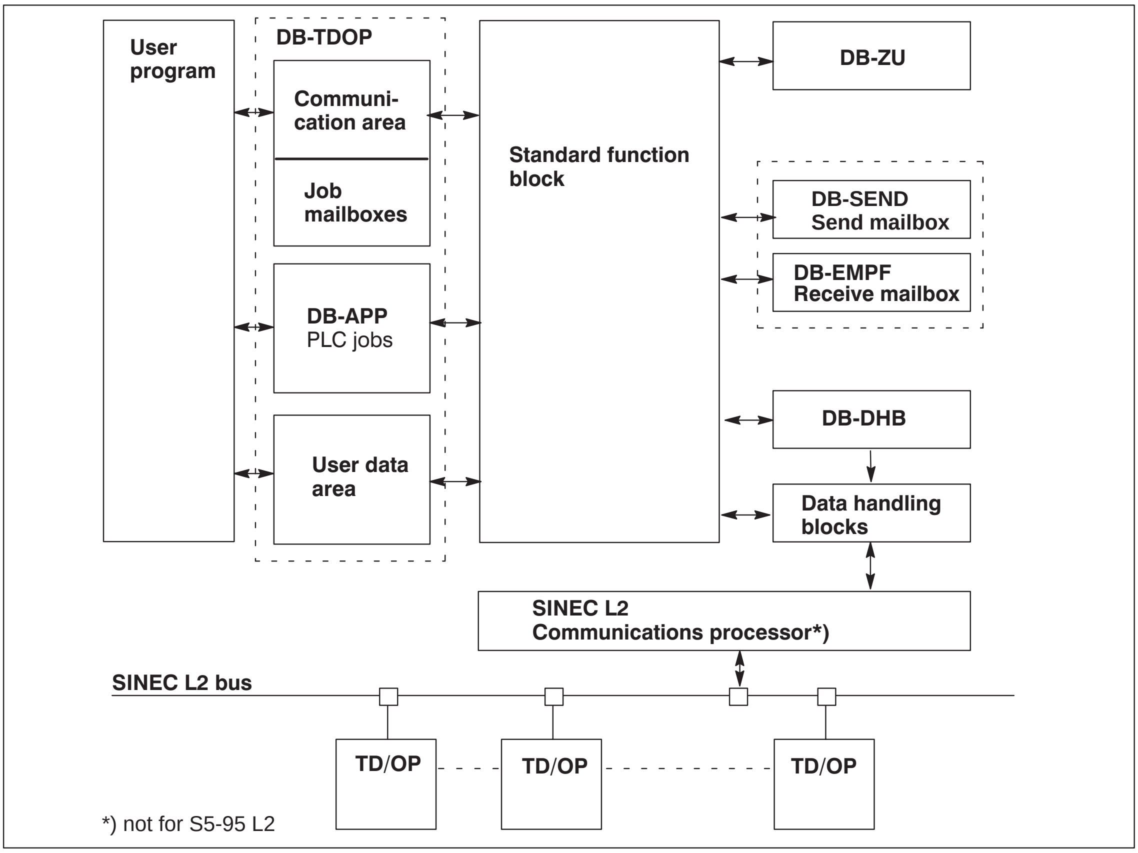


Figure 8-1 Communication structure of the SINEC L2 connection

Description

The components shown inside the broken lines in figure 8-1 must be set up separately for each TD/OP which is connected. The arrows represent the flow of information between the components.

Tasks of standard FB

The TD/OP and the PLC communicate with one another by means of a SINEC L2 CP. This communications processor is already integrated in the SIMATIC PLC S5-95 L2. Data are transferred from the PLC to the TD/OP via a send mailbox and from the TD/OP to the PLC via a receive mailbox. These two data areas are used by the standard function block as send and receive buffers.

The standard function block must be embedded in the STEP5 user program. Its tasks include monitoring the connection to the TD/OP and coordinating data transfers. It is supported by data handling blocks, which it calls automatically.

Tasks of DB-TDOP

The interface area DB-TDOP serves as the interface both between the user program and the standard function block and between the user program and the TD/OP. It contains data and pointers to data areas, which are required amongst other things for synchronizing the data exchange between the PLC and the TD/OP.

A PLC job is stored by the user program in the DB-APP, together with its parameters. The job is initiated by entering a pointer to this data area in a free job mailbox in the DB-TDOP.

You must only set up user data areas if you are actually intending to use the associated functions.

Tasks of DB-ZU

The allocation data block DB-ZU contains a list of all the TD/OP devices which have been configured and which are participating in communication with the PLC, together with their PLC parameters.

Condition

The minimum configuration necessary to operate a TD/OP on the SINEC L2 bus is as follows:

- the standard function block FB 55 (TDOP:L2) of the program file on the PLC side,
- the interface area DB-TDOP,
- the allocation data block DB-ZU,
- data handling blocks.

These components are described below.

8.3 Setting up the Program and Data Areas

Interface area

Set up `DB 51`, for example, with a size of `256 DW`. This is the interface area DB-TDOP.

Standard function block

The standard FB is called by specifying an absolute address.

Sample program:

```
L KY 52,1             52 = Number of DB-ZU
                      1 = TD/OP device number
    :JU  FB 55        Communication with TD/OP
NAME:TDOP:L2          SINEC L2 connection
    :T   FW 100       Store AKKU 1 in FW 100
    :JC= ERR          Branch to error evaluation;
                      job status and error number contained in FW 100
```

The standard FB is started with data word DW 64 in the DB-TDOP. This data word must be set to the value `1` (KF format) in the relevant startup organization block (OB 20, 21, 22) in order for the FB to be started up and all the other control bits to be reset.

Example:

```
OB20/21/22
:C DB 51     51 = Number of DB-TDOP
:L KF 1
:T DW 64
```

Bit 0 of this data word can also be set in the cyclic program, in order to reset the TD/OP and the standard FB.

No acknowledgment is sent to the TD/OP via the SINEC L2 connection when the standard FB is restarted. This has no effect on communication.

Check AKKU 1 to see if the standard FB has output an error message.

If an error occurs while the function block is being processed, the result of the logic operation is set to the value `1`. This allows you to activate a separate error evaluation with the JC command.

After the standard FB call, AKKU 1 contains the current job status and the error number, if an error has occurred.

The contents of AKKU 1 are shown in figure 8-2.

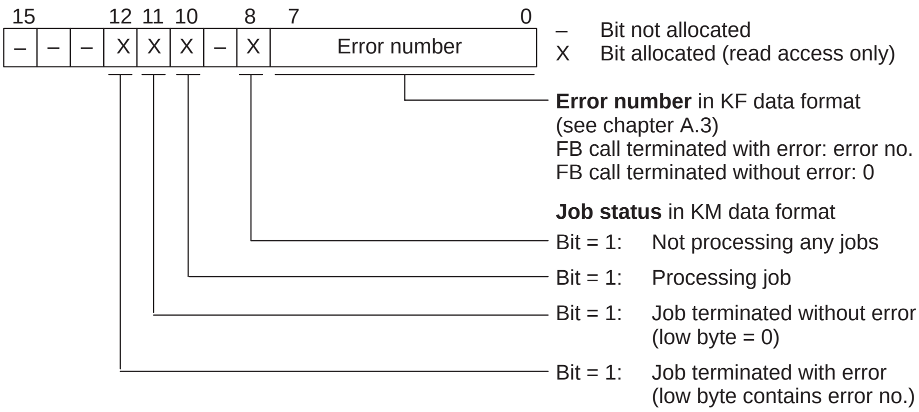


Figure 8-2 Contents of AKKU 1 after the standard FB call

Connection-specific entries in DB-ZU

The interface to the PLC is configured via the allocation data block DB-ZU. Only the SINEC L2-specific entries are written in this block. Please refer to chapter 10.3 for a general description of the DB-ZU.

The allocation data block DB-ZU must be set up with a size of at least 16 words.

Connection-specific entries are required in DW n+9 to DW n+11.

SIMATIC S5-95 L2

	DL	DR
DW n +9	L2 user address 1)	Reserved
DW n +10	TD/OP-SAP 1) 2)	PLC-SAP 2)
DW n +11	STBS 2)	STBS 2)

1) These entries must be identical to those configured in COM TEXT

2) These entries must be identical to those configured in DB1

Other PLCs

	DL	DR
DW n +9	L2 user address	Page frame address CP 5430 2)
DW n +10	TD/OP-SAP 1) 2)	SEND/REC-ANR 2)
DW n +11	Reserved	

1) These entries must be identical to those configured in COM TEXT

2) These entries must be identical to those configured in COM in the PLC CP or in COM NCM

Data handling blocks

All interface functions are handled via data handling blocks. The necessary function blocks are dependent on the PLC which is used.

SIMATIC S5-115 U, S5-135 U and S5-155 U

When the SINEC L2 bus is used to connect the TD/OP to the PLC, the data handling blocks control data communication between the standard function block and the CP module. Depending on the type of PLC, the data handling blocks have the following function block numbers.

Function block	**PLC**		
	S5-115 U	**S5-135 U**	**S5-155 U**
FB-SEND	FB 244	FB 120	FB 120
FB-RECEIVE	FB 245	FB 121	FB 121
FB-CONTROL	FB 247	FB 123	FB 123
FB-SYNCHRON	FB 249	FB 125	FB 125

The data handling blocks are included in the EPROM of the CPUs in the case of the PLC 115 U; otherwise they must be ordered separately.

Note

These data handling blocks require the DB-DHB as a work area. This block must be set up permanently as DB 55 with a minimum length of 16 data words. If DB 55 is set up with more than 16 data words, it is freely available to the user starting with DW 16.

Data handling block calls

Except for the FB-SYNCHRON, the data handling blocks are called automatically by the standard function block.

The FB-SYNCHRON must be called in the startup organization blocks OB 20, OB 21 and OB 22.

Example for SIMATIC S5-115U:

```
     :JU  FB 249     DHB-SYNCHRON call
NAME:SYNCHRON
SSNR:     KY 0,8     Interface (page frame) number
BLGR:     KY 0,5     Block size
PAFE:     FY 255     Error message of the DHB
```

SIMATIC S5-95 L2

The EPROM of SIMATIC S5-95 L2 contains the L2-SEND and L2-RECEIVE function blocks. These blocks are called by the FB-TDOP:L2. Synchronization by the user is not required.

Note

These function blocks require the DB-DHB as a work area. This block must be set up permanently as DB 55 with a minimum size of 16 data words.

If DB 55 is set up with more than 16 data words, it is freely available to the user starting with DW 16.

Error messages

The data handling blocks store any error messages in data words 101 and 102. Please refer to the SINEC L2 Manual for a detailed description of these errors.

Structure:

	DL	DR
DW 101	ANZW	
DW 102	Not used	PAFE

Send mailbox, receive mailbox

One send mailbox and one receive mailbox with a fixed size of 128 data words each must be set up for every connected TD/OP. Pointers must be set up for the send mailbox and the receive mailbox in data words n+5 to n+8 of the DB-ZU.

8.4 Configuring the SINEC L2 Network

Scope

The bus stations must be configured for the SINEC L2 bus connection. Configuration comprises:

- **Station-specific parameters**
  Example: Own station address, station type (active/passive), etc.
- **Bus parameters**
  Example: Transfer rate, protocol, etc.
- **Connection parameters**
  Connection channels and communication buffers are set up by these parameters.

SW tools

The SINEC L2-CP must be configured with the appropriate COM package for the PLC (except S5-95 L2).

The TD/OP is configured with the COM TEXT configuration software.

Preset values

The majority of the parameters are preset to standard values in both the CP COM package and COM TEXT. These preset values are identical for both the COM package and COM TEXT.

The necessary parameters for the TD/OP bus connection are listed in the following table. The table also indicates whether the parameter values configured in COM TEXT and the COM package must be identical.

The exact meanings of the bus parameters are described in the SINEC L2 Equipment Manual.

8.4.1 Configuring with COM TEXT

Tables 8-1 to 8-3 list the interface parameters which must be set for a configuration with COM TEXT. The preset values offered by COM TEXT are also shown. The following parameters must be set:

- Station-specific parameters (table 8-1),
- Bus parameters (table 8-2),
- Connection parameters (table 8-3).

You can set the parameters in *Configure* → *Basic Settings* → *TDOP Interfaces*.

Table 8-1 Station-specific parameters

Parameter name	Preset value in COM TEXT	Range of values
L2 user address	1	1 to 31
Baud rate[1)]	187.5 kbit/s	9.6 kbit/s 19.2 kbit/s 93.75 kbit/s 187.5 kbit/s 500 kbit/s 1.5 Mbit/s

1) The baud rate configured with COM TEXT must be identical to the value specified for the communications processor

Table 8-2 Bus parameters

Parameter name	Preset value in COM TEXT	Range of values
Retry counter	1	1 (fixed)
Slot time	400	35 to 65535 bit times[1)] (but not less than 2 msec)
Setup time	80	0 to 1024 bit times[1)]
Minimum station delay	80	0 to 255 bit times[1)]
Maximum station delay	400	0 to 1024 bit times[1)]
Target rotation time	3000	0 to 1048576 bit times[1)]
GAP updating factor	20	1 to 100
HSA	31	2 to 126
Default SAP [2)]	60	0 to 63

1) The times are entered as ”bit times”. A bit time unit is the time needed to send one bit (reciprocal value of the data transfer rate); see SINEC L2 Equipment Manual

2) SAP: Service Access Point

All the values configured with COM TEXT (exception: default SAP) must be identical to the values configured for the communications processor.

Note

The bus parameters are already preset with realistic values. Changing the preset values to implausible values can impair the functionality of the bus system.

Table 8-3 Connection parameters

Parameter name	Meaning	Range of values
Remote parameter (PLC) – Address	L2 station address of the PLC to which the TD/OP is allocated	1 to 126 (the PLC address must be different from the TD/OP station address)
– SAP	PLC-SAP: Communication with this TD/OP takes place via this address extension of the PLC	0 to 63
Local parameters (TD/OP) – SAP	TD/OP-SAP: Communication with the allocated PLC takes place via this address extension of the TD/OP	0 to 63 (SAP must be different from the default SAP)

The values configured with COM TEXT do not necessarily need to be identical to the values configured for the communications processor.

The following configured parameters must also be entered in the DB-ZU data block:

- Station address of the TD/OP device (DL n+9)
- SAP of the TD/OP device (DL n+10)

The following parameters must also be configured for the allocated PLC:

- L2 address of the PLC
- PLC-SAP

8.4.2 Configuring the Communications Processor

Configuring the communications processor (CP), e.g. CP 5430, in the SIMATIC S5 is described in the SINEC L2 Equipment Manual.

A *Free Layer 2 Access* must be configured for each TD/OP allocated to the PLC. The following connection parameters must be configured in the PLC CP:

- **Type** FREE
- **PRIO** H
- **SEND/REC-ANR** Freely configurable (must be identical to DR n+10 in the DB-ZU entry for this TD/OP)
- **SAP** The Service Access Point is freely configurable (must be identical to the PLC-SAP parameter in the *Connection Parameters* mask of COM TEXT).

8.4.3 Configuring the SIMATIC S5-95 L2

Configuring the SINEC L2 interface of the SIMATIC S5-95 L2 is described in the Equipment Manual.

A Free Layer 2 Access must be configured for each TD/OP assigned to the PLC. This is achieved by editing the DB 1 data block in the PLC.

A service access point (SAP) must be set up for each TD/OP connection in the send and receive directions. A ”status byte send” (STBS) and a ”status byte receive” (STBR) must be defined for each sending SAP.

The numbers of these status bytes must be entered in the DB-ZU.

Example for DB1:

```
  0:  KS =’DB1 OBA: AI 0 ; OBI:    ’;
 12:  KS =’   ; OBC: CAP N     CBP ’;
 24:  KS =’N       ; SL2: TLN 2    S’;
 36:  KS =’TA AKT BDR 187.5  HSA 10’;
 48:  KS =’  TRT 5120    SET 80  ST’;
 60:  KS =’ 440  SDT 1 80  SDT 2 40’;
 72:  KS =’0  STBS 34 FY196  STBR 3’;
 84:  KS =’4 FY198   STB 200 FY192 ’;
 96:  KS =’ FMAE Y ;   ERT: ERR MW1’;
108:  KS =’94 ;   END  ’;
114:
```

9 Parallel Connection

This chapter describes communication between the TD and the SIMATIC S5 with a parallel connection.

9.1 Overview

The TD10 and TD20 text displays can be connected to PLCs in the SIMATIC S5 series with a parallel interface module.

The connection between the TD device and the PLC is made via 16 digital inputs and one digital output on the parallel interface module. Since it is not possible to transfer data from the TD to the PLC, the TD's functionality is restricted as a result of the parallel connection.

It is possible to connect several TDs to the same PLC at once.

Figure 9-1 shows the standard configuration.

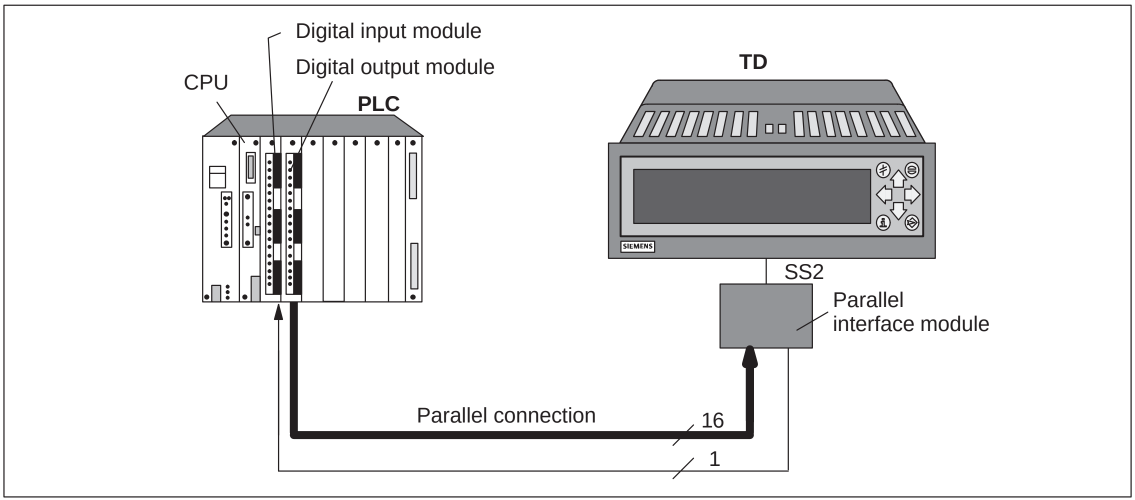


Figure 9-1 Parallel connection: standard configuration

PLC groups

When a parallel connection is used, PLCs are subdivided into two groups with different communication structures. These groups are as follows:

- **Group 1**:
  PLC 90U
  PLC 100U (CPU 100, CPU 102)
- **Group 2**:
  PLC 95U
  PLC 100U (CPU 103)
  PLC 115U

Interface

The TD device with the parallel module is connected to a PLC equipped with 16 digital outputs and one digital input (e.g. via a digital I/O module).

Communication

Communication (i.e. data transfer) takes place in only one direction, namely from the PLC to the TD device. Only the strobe signal from the TD device is transferred to the PLC via a line.

Function

The parallel connection between the PLC and the TD device can be used for:

- 999 event messages with/without variables
- 999 alarm messages with/without variables
- Jobs

Minimum system

The connection can also be configured so that not all 16 data lines from the PLC to the TD are used. In this case, the following constraints apply:

- Fewer than 999 messages can be configured
- Only jobs without parameters
- Only messages without variables

Note

You will require the information contained in chapter 9.4 (Structure of the Output Value to the TD) if you want to configure a minimum system.

The number of data lines to be used must be programmed in COM TEXT.

Required hardware and software

The parallel connection requires the following hardware:

- 1 TD10 or TD20,
- 1 parallel module,
- 1 PLC with 16 digital outputs and one digital input.

  The digital I/O module which is used must have a switching frequency of at least 100 Hz.

  The following PLCs can be used:

  – PLC 90U
  – PLC 95U
  – PLC 100U
  – PLC 115U (CPU 941 to CPU 944)
  – PLC 115U (CPU 941B to CPU 944B)
- Programming unit,
- Function block FB-TDOP:PAR for the particular PLC.

Restrictions

Since data can only be transferred from the PLC to the TD when a parallel connection is used, functions requiring a data request from the TD or a data transfer from the TD to the PLC cannot be utilized.
Examples:

- Variables on process screens or in the production report
- Transfer of an alarm acknowledgment to the PLC
- Transfer of a keyboard assignment to the PLC

The number of variable words is restricted to 5 per message when group 1 PLCs are used.

9.2 Communication Structure

Figures 9-2 and 9-3 show the principal procedures involved in transferring jobs or messages from the PLC to the TD for the various PLC groups.

Group 1 PLCs

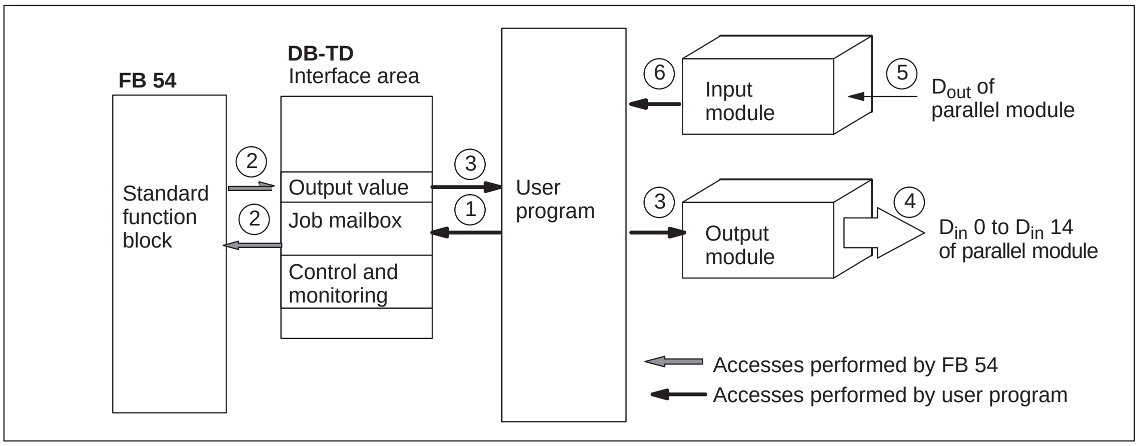


Figure 9-2 Job and message processing for group 1 PLCs

① The user enters the job or message data in the free job mailbox of the DB-TD.

② The standard function block (FB 54) reads the data in the job mailbox byte by byte, converts it to an output word and makes it available as an output value.

③ The output value is sent by the user to the output module.

④ The output module forwards the output value to the TD.

⑤ The TD interprets the received data and acknowledges the reception at the D_{out} output with a strobe signal.

⑥ The user uses an input module to read the TD strobe signal, and forwards it following the next call as a result of a logical operation to the standard function block.

Group 2 PLCs

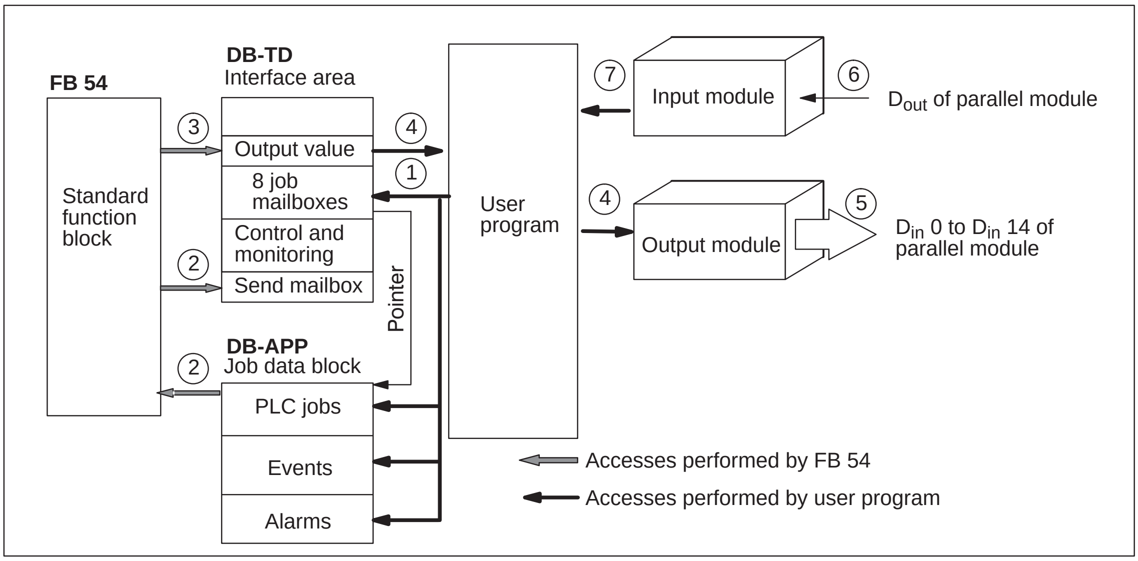


Figure 9-3 Job and message processing for group 2 PLCs

① The user makes the following entries:
– Jobs and messages in the DB-APP job data block
– A pointer to a job or message in a free job mailbox of the DB-TD

② FB 54 copies the job/message data from the job data area to a send mailbox of the DB-TD.

③ FB 54 reads the data in the send mailbox byte by byte, converts it to an output word and makes it available as an output value.

④ The output value is sent by the user to the output module.

⑤ The output module forwards the output value to the TD.

⑥ The TD interprets the received data and acknowledges its reception at the D_{out} output with a strobe signal.

9.3 Setting up the Program and Data Areas

Required program and data areas

You need the following program and data areas in the PLC to operate a TD via the parallel module interface:

– Standard function block FB 54 (TDOP:PAR),
– Interface area DB-TD,
– Job data area DB-APP
  (group 2 PLCs only).

9.3.1 Standard Function Block

File name

The standard function block FB 54 (TDOP:PAR) is stored on the floppy disk labeled *COROS Standard Function Blocks* in a file called

S5TDnnST.S5D

PLC-specific number (see chapter 2.2)

Call

FB 54 is called during the cyclic user program. It does not have block parameters.

Example program (group 1 PLCs)

```
     :A   I  0.5       ①
     :C   DB 54        ②
     :JU  FB54         ③
 NAME:TDOP:PAR
     :T   FW 100       ④
     :C   DB 54       ┐
     :L   DR 28       │
     :T   QB n        ├ ⑤
     :L   DL 28       │
     :T   QB n+1      ┘
     :JC= ERR          ⑥
```

Example program (group 2 PLCs)

```
     :A   I  0.5       ①
     :L   KY 54,0      ②
     :JU  FB54         ③
 NAME:TDOP:PAR
     :T   FW 100       ④
     :C   DB 54       ┐
     :L   DR 28       │
     :T   QB n        ├ ⑤
     :L   DL 28       │
     :T   QB n+1      ┘
     :JC= ERR          ⑥
```

Meaning of call

① Scan strobe bit D_{out} of TD for signal status “1” (provide result of logical operation ”RLO”).

Group 1 PLCs ② Open interface area DB-TD.

Group 2 PLCs ② Load number of DB-TD in DL of AKKU 1.

③ Call FB 54.

Before returning to the user program, FB 54 transfers the status and the error number of the current job (see chapter A.3) to accumulator 1. In addition, the RLO logical result is set to “1” if an error is detected.

④ Store (FW 100) job status and error number so that this information will be available for later evaluation.

⑤ Load two bytes of output word consecutively and transfer to output module.
(QB*n* = data bits D_{in}00 to D_{in}07
QB*n+1* = data bits D_{in}08 to D_{in}15).

The output values must also be transferred to the output word if an error occurs.

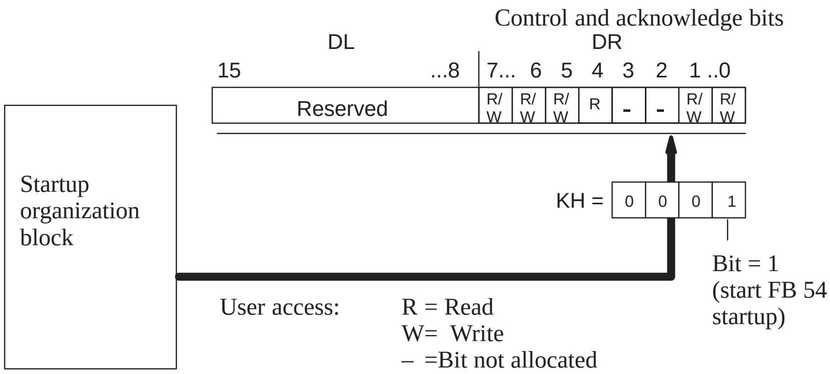
⑥ Branch to error routine if RLO = 1.

Startup of standard FB

An instruction which sets the startup bit in the interface area DB-TD must be programmed in the startup organization block.

The startup bit is located among the control and acknowledge bits of the DB-TD.

- Group 1 PLCs: DW 40, bit 0
- Group 2 PLCs: DW 64, bit 0



Resetting standard FB

The standard function block can also be reset by setting the startup bit in the cyclic program for **one program cycle**.

Function block FB-TDOP:PAR resets the startup bit again.

Example

Edge-triggered reset for group 2 PLCs

```
     :A    I    4.0     Edge evaluation reset input
     :AN   F    4.0     Edge flag
     :=    F    4.1     Reset pulse flag
     :A    I    4.0
     :=    F    4.0     Update edge flag
     :AN   F    4.1     Reset input activated?
     :JC= CONT          If not, then continue
     :L    KH   0001    Set reset bit
     :C    DB   DB-TD   Open DB-TD
     :T    DW   X       Transfer reset control bit
CONT:..   ..   ..
```

X = 40 for group 1 PLCs
60 for group 2 PLCs

Detecting wiring faults and open circuits

During the startup procedure and after a data transfer has been completed, function block FB 54 sets all the outputs which are used to 1.

The TD checks all the lines which are used during the startup to ensure that they have this level. If a fault is detected on a line, system message **$514** ”Line no. xx defective” is output (xx = 0 to 15). The TD then initiates a restart.

Note

In a minimum system with a reduced number of data lines, it is necessary to configure any lines which are not used in COM TEXT. They will otherwise be reported as defective when the check for open circuits is performed.

Job status and error number of current job

FB 54 stores the job/message status and an error (if one has occurred) in a word in the job mailbox of the DB-TD which is currently being processed.

The word contains the same information as accumulator 1 immediately after FB 54 is called.

Location of word in DB-TD

Group 1 PLCs: DB 39
Group 2 PLCs: DB m+4 in the current job mailbox

Structure and allocation

FB 54 enters an error number here if the job is terminated with an error. DR contains the value 0 if no errors occurred during processing. Please refer to chapter A.3 for a list of possible errors and remedies.

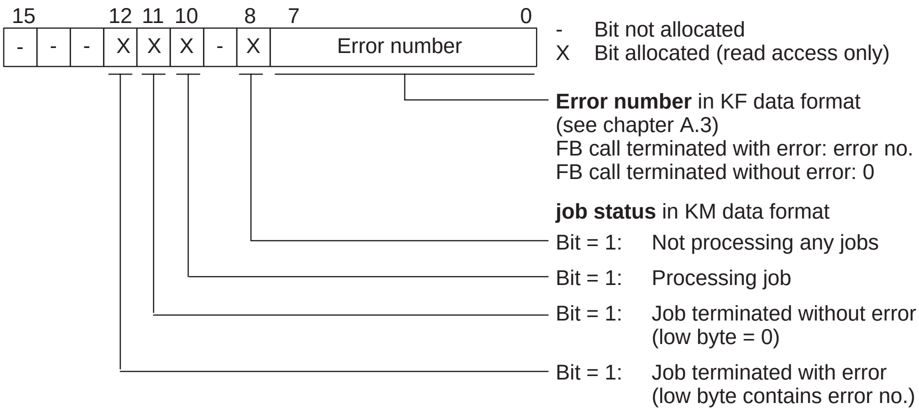


Figure 9-4 Contents of AKKU 1 after the standard FB call

9.3.2 Interface Area

The minimum size which must be set up for the interface area DB-TD is dependent on the PLC that is used:

– Group 1 PLCs: 60 data words,
– Group 2 PLCs: 134 data words.

If the DB-TD does not exist, or if it is too short, an error message will be output in the DR of AKKU 1 after the standard FB call.

DB-TD (group 1 PLCs)

DW no.	DL (15 … 8)	DR (7 … 0)	
0 … 27	Communication area Do **not** modify this area!		
28	16-bit output value of FB-TDOP:PAR		
29	Reserved		
30	Reserved	Reserved	
31	PLC identifier	Connection	
32	Job header		User job (message or PLC job)
33 … 38	Job data		User job (message or PLC job)
39	Job status, error number of PLC job		User job (message or PLC job)
40	Control and acknowledge bits		
41 … 57	Reserved		
58	Life bit monitoring (watchdog)		
59	Version number of standard FB		

Figure 9-5 Structure of the interface area for group 1 PLCs

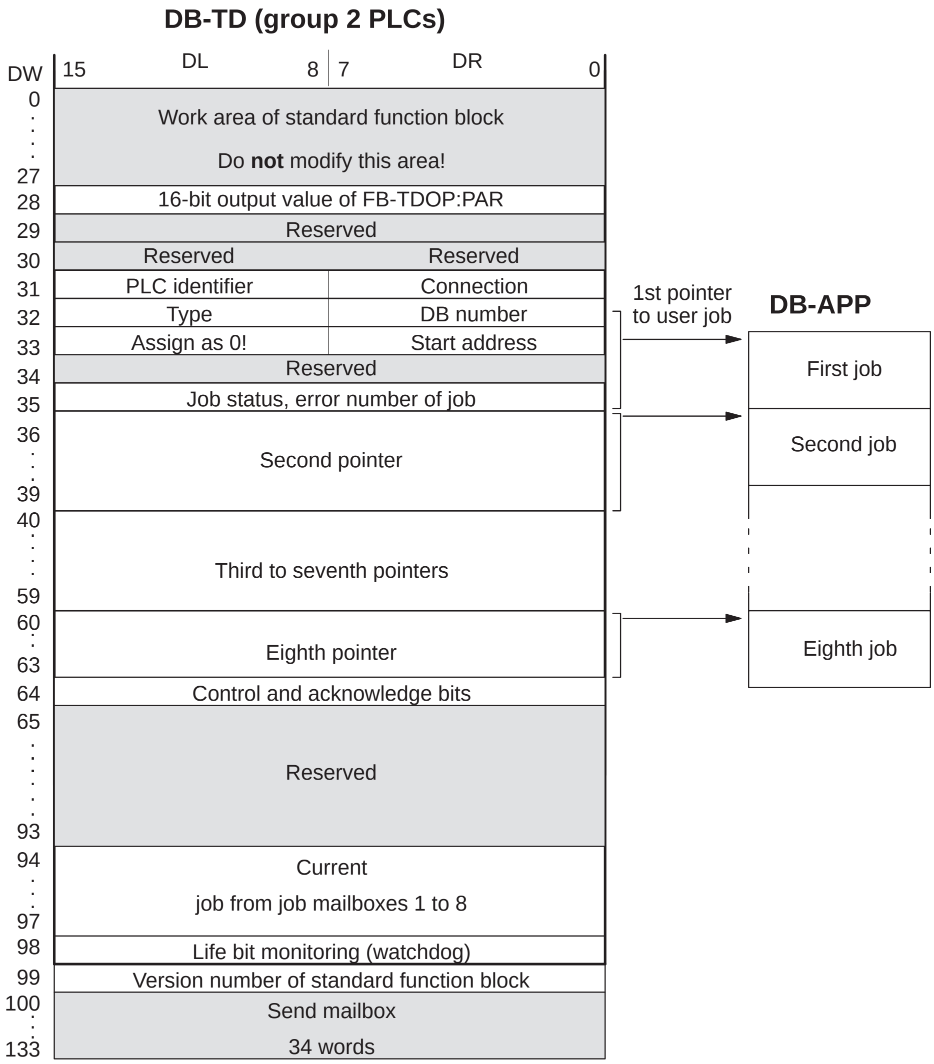


Figure 9-6 Structure of the interface area for group 2 PLCs

Control and acknowledge bits

DW 40 for group 1 PLCs,
DW 64 for group 2 PLCs:
Control and acknowledge bits are available in the DB-TD for the following functions:

– Starting and monitoring the startup of the function block
– Monitoring the acknowledgment signal status of the TD
– Configuring the parity check for transferring jobs/messages to the TD

Structure and allocation

DL	Control and acknowledge bits DR							
15 ...8	7	6	5	4	3	2	1	0
Reserved	RW	RW	RW	R	–	–	R	RW

User access: R = Read
W = write
– = Bit not allocated

DR: Control and acknowledge bits (KM data format)

Bit no.	Bit value	Meaning
7	1 0	Switch on parity evaluation Switch off parity evaluation
6	1 0	Odd parity Even parity
5	x	New value of TD acknowledgment signal status
4	x	Old value of TD acknowledgment signal status
1	0 1	Startup of FB 54 has not started. FB 54 is in startup phase.
0	1	Setting this bit to “1” triggers a startup of FB 54. This bit must be set by the startup organization block.

PLC identifier and connection identifier

DW 31:
FB 54 stores a PLC-specific identifier and a connection-specific identifier in this data word of the DB-TD.

Structure and allocation

PLC identifier DL | | Connection identifier DR |

15 … 12	11 … 8	7 … 4	3 … 0
R	R	R	–

User access: R =Read
– = Bit not allocated

DL: PLC identifier (BCD-coded)

Value	PLC	CPU	File
0 1	PLC 100U	CPU103	S5TD**01**ST.S5D
0 2	PLC 90U PLC 100U	CPU 100, CPU 102	S5TD**02**ST.S5D
0 3	PLC 95U		S5TD**03**ST.S5D
5 0	PLC 115U	CPU 941, 942, 943, 944	S5TD**50**ST.S5D

The PLC identifier is identical to the two digits in the file name

DR:
Connection identifier
(BCD-coded)

Bit	Connection
1	AS 511 connection
2	Parallel connection
3	Free ASCII protocol (PU-Interface)
4	Free ASCII protocol (CP 521 SI)
5	Free ASCII protocol (CP 523)
6	L1 connection
7	L2 connection

Version number of FB 54

DW 59 for group 1 PLCs,
DW 99 for group 2 PLCs:
The version number of FB 54 is stored in this data word of the DB-TD.

Structure of version number in DB-TD

Release status DL		Identification letter DR	
15	8	7 6	5 ..0
R		R	0

User access: R = Read

- **DL: Release status of FB 54**
  Value: 0 to 99
- **DR: Identification letter**
  The identification letter (A to D) of the library number is stored in bits 6 and 7.

Value	Identification letter
00	A
01	B
10	C
11	D

9.3.3 Job Data Area (group 2 PLCs only)

You should only set up the job data area DB-APP for group 2 PLCs. It contains the job and message data which must be transferred to the TD. The size of the job data area depends on the number of jobs and messages which are entered. The number of the data block DB-APP which is used must not be the same as that of the DB-TD.

9.4 Messages and PLC Jobs

The configuration options and the procedures for triggering and transferring messages and PLC jobs are described below.

9.4.1 Configuration Options

Messages

Up to 999 event messages and 999 alarm messages, each with or without variables, can be configured for the TD.

During the configuration procedure in COM TEXT, each message is assigned a unique message number (1 to 999), via which it can be triggered by the PLC.

Note

Event number 0 is a configurable standby message (variables are not permitted). During the startup of the TD, the configured message text is output instead of the fixed firmware standby message.

PLC jobs

PLC jobs are used to trigger certain permanently specified functions via a user program.
Examples:

– Switch operating mode of TD
– Select special screens
– Set date/time

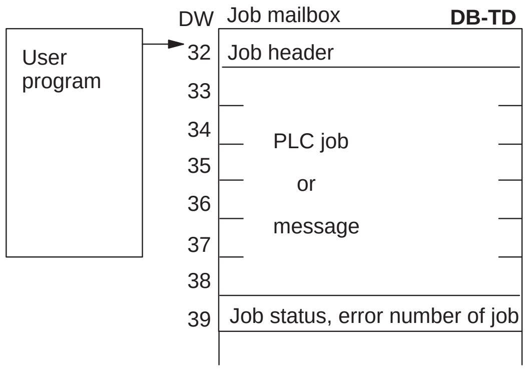
Please refer to appendix B for a list of permissible PLC jobs.

9.4.2 Triggering Messages and PLC Jobs

Group 1 PLCs

Data areas DW 32 to DW 39 of the DB-TD are made available for the job entry (PLC job or message). The job or message data are entered by the user in the job mailbox in order to trigger a job or a message.

- A PLC job consists of up to 4 words (job header and up to three parameters).
- A message consists of up to 7 words (message header and any message variables).



After the TD has accepted the job or the message and transferred all the job parameters or message variables, FB 54 overwrites the first data word in the job mailbox with the value 0.

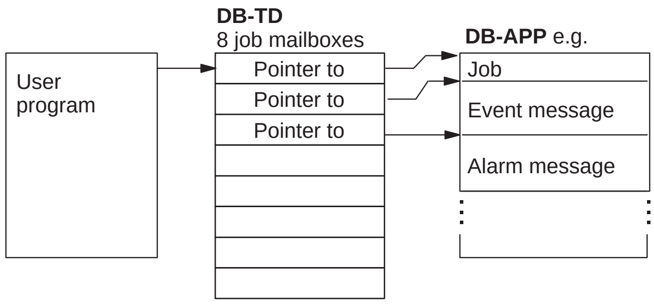
A new job (or message) must not be entered until the first data word in the job mailbox has the value 0.

Group 2 PLCs

Data areas DW 32 to DW 63 of the DB-TD are divided into 8 job mailboxes with equal access rights, each with a size of four words. The user program triggers a job or a message by entering a pointer in any free job mailbox.

Pointer to job

The pointer indicates the first data word in the DB-APP (job data area with job/message data). Using pointers in the job mailboxes of the DB-TD allows the jobs/messages to be entered in the DB-APP without gaps.



After the TD has accepted the job or the message and transferred all the job parameters or message variables, FB 54 deletes the pointer from the job mailbox. This causes the first data word in the mailbox to be overwritten with the value 0.

A new job (pointer to a job or message) must not be entered until the first data word in the mailbox has the value 0 (see Structure of a Job Mailbox, DW n+1).

Structure of a job mailbox for group 2 PLCs

Each of the eight job mailboxes has the following structure:

	DL 15... ..8	DR 7.. ..0
DW n+0	KH=00	DB number
DW n+1	Assign as 0!	Start address
DW n+2	Reserved	
DW n+3	Job status, error number of job	

DB number

Number of the DB-APP (the job/message data are located in DB-APP). Permissible values: 10 to 255

Start address

Number of the first data word of a job/message in the DB-APP. Permissible values: 0 to 255

Job status, error number

The job status and the error number of the current job are described in chapter 10.2.5.

9.4.3 Structure of Event and Alarm Messages

Figure 9-7 shows the basic structure of event and alarm messages.

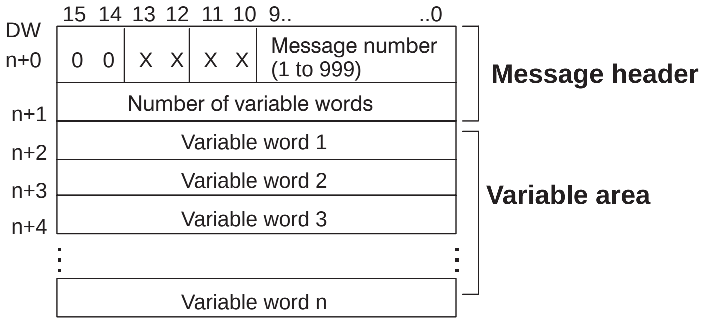


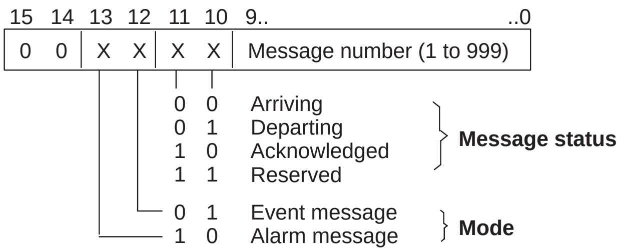
Figure 9-7 Message structure

Message header

With group 2 PLCs, the pointer in the job mailbox of the DB-TD indicates the job header.

You must enter the following information here:

- Message number (1 to 999)
- Message status
- ”Event” or ”alarm” mode



- Number of variable words (DW n+1)

  – Group 1 PLCs: 0 to 5
  – Group 2 PLCs: 0 to 31

  If the message does not contain variables, specify the value 0 as the number of variables. The variable area is then not transferred to the TD.

  The variables can only be updated by transferring the message again (“arriving” status, with new variable values).

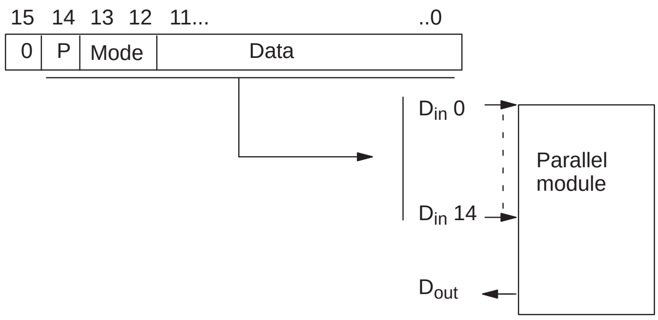
Variable area

The variable area is only required if messages are configured with variables.

Variable word 1 to variable word n: Specify the values of the variables in the PLC here.

9.4.4 Structure of the Output Value to the TD

PLC jobs and messages are transferred to the TD word by word (output value of DW 28 in DB-TD).



Assignment of digital inputs

Bits 0 to 14 of the output value are assigned to digital inputs D_{in} 0 to D_{in} 14 of the parallel module.

Parity

The parity bit is used to check the validity of the transferred data.

Proceed as follows if you need to evaluate the parity bit:

- Switch on the parity evaluation in **the control and acknowledge bits** of the DB-TD, and set the parity to even/odd.
- Configure the parity evaluation in COM TEXT (parity: even/odd) so that the TD performs a parity check.

Mode

Bits 12 and 13 are used to transfer the type of job to the TD.

Bit		
13	**12**	**Meaning**
0	0	Reserved
0	1	Event message
1	0	Alarm message

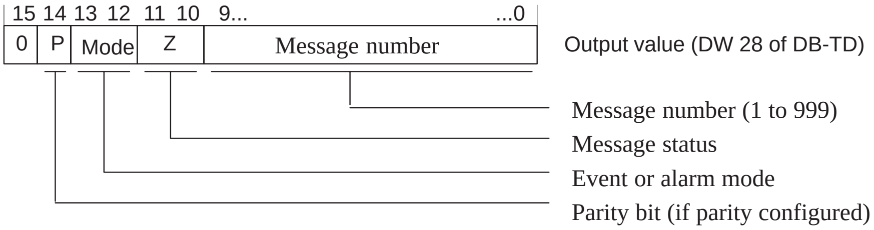
Data

Bits 0 to 11 are used to transfer the job/message data to the TD.

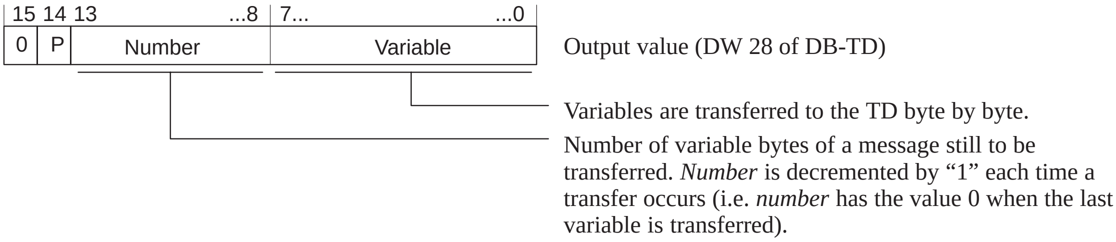
9.4.5 Transferring Messages

Transferring message header

When messages are transferred, the message header is transferred first byte by byte, followed by the message variables (if configured).



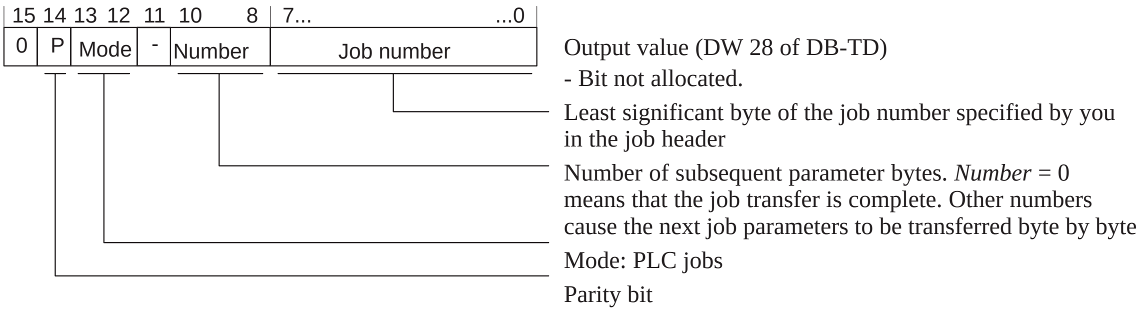
Transferring variables



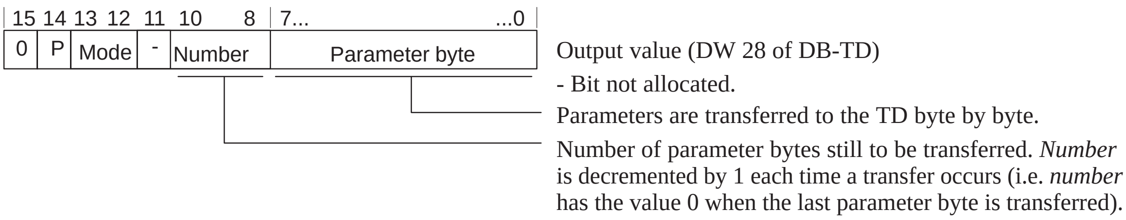
9.4.6 Transferring PLC Jobs

Transferring job header

When PLC jobs are transferred, the job header is transferred first, followed by the job parameters (if any).



Transferring job parameters



9.5 Configuring with COM TEXT

Table 9-1 lists the interface parameters which must be set for a configuration with COM TEXT. The preset values offered by COM TEXT are also shown.

You can set the parameters in *Configure* → *Basic Settings* → *TDOP Interfaces*.

Table 9-1 Interface parameters for the parallel connection

Parameter name	**Preset value in COM TEXT**	**Range of values**
Parity	None	Even; odd; none
Character delay time[1)]	50 × 10 ms	(1...500) × 10 ms
Lines 1...9 and 11...14	1[2)]	0; 1
Lines 10 and 15	1	Fixed setting

1) Maximum time allowed between two received characters. If a character is not received by the TD within this time, a system message is output.
2) 0 = line not required; 1 = line required.

The interface parameters specified for the TD must be identical to the values configured for the SIMATIC S5.

9.6 Connection of Several Text Displays to One PLC

Wiring of transfer line

Several devices can be operated in parallel when the parallel interface is used.

If only the transfer line of one device is wired, transfer errors may occur when rapid PLC cycles are used. Use sufficiently slow PLC cycles to prevent this.

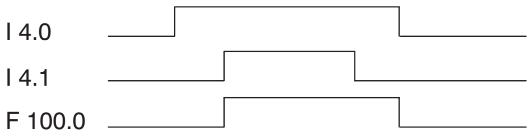
The transfer line of every device should be wired to ensure reliable data transfers.

Preparation

A link between all the transfer lines and one valid RLO must be established for the standard function block before FB 54 is called.

Example:

```
A   Ix.y    Transfer line, device 1
A   Ix.z    Transfer line, device 2
S   F100.0  Intermediate flag for RLO
AN  Ex.y    Transfer line, device 1
AN  Ex.z    Transfer line, device 2
R   F100.0  Intermediate flag for RLO
A   F100.0  Generate RLO from
            intermediate flag
```



I4.0: Transfer line for device 1
I4.1: Transfer line for device 2
F100.0: Group transfer line for all devices

9.7 Interrupt Processing

Saving scratch flags

When programming process or timed-interrupt organization blocks, make sure that any scratch flags you use:

- for group 1 PLCs: FY106 to FY127
- for group 2 PLCs: FY218 to FY255

are saved at the beginning of the interrupt block and reloaded again before the interrupt block is exited.

Communication Data Areas 10

This chapter describes in detail the data blocks that are required for communication. In doing so, it explains in detail the areas relevant to the user and how they are used.

10.1 The Interface Area

Function

The interface area is a data block that represents the interface between the application program and the standard FB. It contains data and pointers to data areas that are required for exchange of data between the PLC and the operating unit. A separate interface area has to be created for each operating unit connected.

Minimum length

The table below details the minimum data block length for the various types of connection.

Connection	Minimum Length in Data Words
AS511 (Group 1)	70
AS511 (Group 2)	185
FAP	185
SINEC L1	228
PROFIBUS	256
PROFIBUS-DP	169
PROFIBUS-DP with IM308C	256

Note

The data block for the interface area must be set up in the CPU RAM. DX extended data blocks are not permissible. The DB number must be greater than or equal to 10.

10.2 Structure and Description of the Interface Area

Types of connection

The description below applies to the following types of connection:

- AS511, Group 2 PLCs
  AG 95U, AG 100U (CPU 103), AG115U, AG 135U and AG 155U
- FAP
- PROFIBUS-DP
- SINEC L1
- PROFIBUS

Setting up the interface area

Set up the data block for the interface area with the required length for the type of connection you are using. If you do not use any of the data areas specified in the data block, you do not need to make any entries. The data areas required by the standard function block are present once the data block has been set up.

Table 10-1 Assignment of Interface Area for Group 2 PLCs

<table>
<tr><th>DW</th><th>DL</th><th>DR</th><th>Usage</th></tr>
<tr><td>0–9</td><td colspan="2">Standard FB communication area
This area must not be altered.</td><td>–</td></tr>
<tr><td>10</td><td>Data type</td><td>DB/DX number</td><td rowspan="3">Pointer to recipe mailbox; only text-based display units write to these data words.
For explanation refer to chapter 11.7.3.</td></tr>
<tr><td>11</td><td>0</td><td>Start address</td></tr>
<tr><td>12</td><td colspan="2">Length in words</td></tr>
<tr><td>13</td><td>Data type</td><td>DB/DX number</td><td rowspan="3">Pointer to successive recipe mailbox; only text-based display units write to these data words.
For explanation refer to chapter 11.7.3.</td></tr>
<tr><td>14</td><td>0</td><td>Start address</td></tr>
<tr><td>15</td><td colspan="2">Length in words</td></tr>
<tr><td>16</td><td>Data type</td><td>DB/DX number</td><td rowspan="3">Pointer to recipe number mailbox; only text-based display units write to these data words.
For explanation refer to chapter 11.7.3.</td></tr>
<tr><td>17</td><td>0</td><td>Start address</td></tr>
<tr><td>18</td><td colspan="2">Length in words</td></tr>
<tr><td>19–28</td><td colspan="2">Reserved</td><td>–</td></tr>
</table>

Table 10-1 Assignment of Interface Area for Group 2 PLCs, continued

DW	DL	DR	Usage
29	Operating unit firmware version		The operating unit writes to DW 29 and 30.
30	254	DB number	
31	PLC ID	Connection ID	The standard FB writes to DW 31.
32	Data type	DB/DX number	1st job mailbox
33	0	Start address	
34	Reserved		
35	Job status	Error number	
36–39	2nd job mailbox		As DW 32–35
40–43	3rd job mailbox		As DW 32–35
44–47	4th job mailbox		As DW 32–35
48–51	5th job mailbox		As DW 32–35
52–55	6th job mailbox		As DW 32–35
56–59	7th job mailbox		As DW 32–35
60–63	8th job mailbox		As DW 32–35
64	Synchronization of data transfer (see chapter 11.7.4)	Startup of standard FB, operating mode	Control and acknowledgment bit 1
65	Synchronization of date, time, scheduler	Reserved	Control and acknowledgment bit 2
66	Not assigned	Hour (0...23)	Time (BCD format)
67	Minute (0 – 59)	Second (0 – 59)	
68	Not assigned		
69	Not assigned	Day of week (1...7)	Date (BCD format)
70	Day of month (1 – 31)	Month (1 – 12)	
71	Year (0 – 99)	Not assigned	
72–74	48 scheduler bits		To be specified by user in configuration.
75–93	Reserved		–
94	0	Job number	Copy of last PLC job processed
95	Parameter 1		
96	Parameter 2		
97	Parameter 3		

Table 10-1 Assignment of Interface Area for Group 2 PLCs, continued

DW	DL	DR	Usage
98	Life bit monitoring (Watchdog)		Default 200 (KF format)
99	Standard FB version number		The standard FB writes to DW 99.
100	Reserved		–
101 – 102	Data handling block error messages (PROFIBUS only)		To be analyzed by user
103 – 255	Reserved (Length according to connection type)		–

If a pointer to a data area is specified in the interface area, different data types are permissible for that data area. Table 10-2 lists the permissible data types.

Table 10-2 Permissible Data Types

Data Type		DB/DX Number
0	DB-type data block	10 to 255
1	DX-type extended data block[1)]	10 to 255
2	Flag area	Not analyzed

1) Only possible with S5-115U with CPU 945, S5-135U and S5-155U.

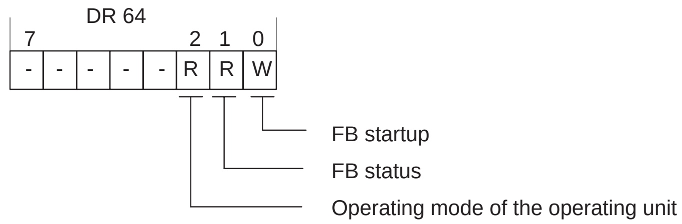
Note

The communication area and all areas not used by the connection concerned are reserved areas. Writing to reserved areas is illegal for the application program.

10.2.1 Startup of Standard Function Block and Operating Mode

Assignment of bits in DR 64

The standard FB is activated by means of Bit 0. Bit 1 shows the current status of the standard FB and Bit 2 the operating mode of the operating unit. Figure 10-1 shows the structure of control and acknowledgement bit 1.



- = Not assigned
R = Read only
W = Read and Write possible

Figure 10-1 Structure of Control and Acknowledgment Bit 1 (DR 64 in interface area)

Significance of bits

Bit 0 = 1 Activate FB startup

Bit 1 = 1 FB startup in progress

Bit 2 = 0 Operating unit is online
Bit 2 = 1 Operating unit is offline

Starting the standard FB

The standard function block has to be started by means of the rightmost byte of data word 64 in the interface area.

The startup organization block used (OB 20/21/22) must write the value `1` (KF format) to data word 64 in order to initiate FB startup and reset all other control bits.

Example: OB 20/21/22

```
:C DB 51        51 = DB number of interface area
:L KF 1
:T FW 64
```

In order to reset the operating unit and the standard FB, Bit 0 in this data word may also be set by the cyclic program.

Standard FB error message

Check AKKU 1 to see if the standard FB has issued an error message.

If an error occurs during processing of the function block, the logical operation result is set to the value `1`. This allows you to branch to your own error analysis function using the command JC.

After the standard FB call, AKKU 1 contains the current job status and the number of any error that has occurred.

The contents of AKKU 1 are illustrated in figure 10-2.

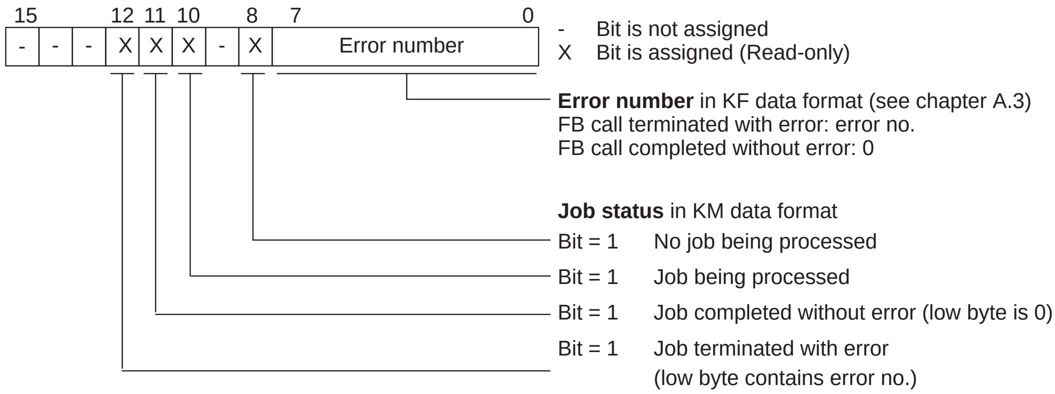


Figure 10-2 Contents of AKKU 1 after Invoking Standard FB

Restarting

If the PLC restart (automatic or manual) is to be used, Bit 0 ”`Initiate FB startup`” in DW 64 of the interface area must not be set directly by organization block OB21 or OB22. Set the bit indirectly by means of a flag so that communication with the operating unit can be reliably resumed.

Example program:

Block	Program Code	Explanation
OB 21/22	`:AN F 99.0` `:S F 99.0`	

OB 1	`:A F 99.0`
	`:JC PB 51`
	`:JU FB xx`
		
		Standard FB call

PB 51	`:R F 99.0`
	`:C DB 51`
	`:L KF 0001`
	`:T DW 64`
	`:BE`
		
		Interface area call

Restart not possible with AG 115U.

Operating mode bit

The operating unit overwrites Bit 2 in DW 64 for the operating mode during startup and sets it to 0.

If the operating unit is switched off-line by operator input on the operating unit, there is no guarantee that the operating unit will be able to set Bit 2 in DW 64 to 1. If the PLC sets the acknowledgment bit to 1, the PLC program can query whether the bit has been reset to 0, i.e. whether the operating unit is still off-line or is in communication contact with the PLC again.

10.2.2 Transferring Date and Time to PLC

Transferring date and time

DW 66-71
Transfer of date and time from the operating unit to the PLC can be initiated by PLC job 41. PLC job 41 writes the date and time to the interface area where they can be analyzed by the STEP5 program. Figure 10-3 shows the layout of the data area in the interface area. All data is in BCD format.

DW	DL 15 … 8	DR 7 … 0	
66	Not assigned	Hour (0...23)	Time
67	Minute (0...59)	Second (0 – 59)	Time
68	Not assigned		Time
69	Not assigned	Day of week (1...7)	Date
70	Day of month (1...31)	Month (1 – 12)	Date
71	Year (0...99)	Not assigned	Date

Figure 10-3 Layout of Data Area for **Time** and **Date**

Synchronization of transfer

Control and acknowledgment bit 2 in the interface area (DW 65) synchronize the transfer of date and time. If the operating unit has transferred a new date or time to the PLC by means of the PLC job, it sets the bits shown in figure 10-4. After analysis of the date or time, the STEP5 program should reset the bits in order that the next transmission can be detected.

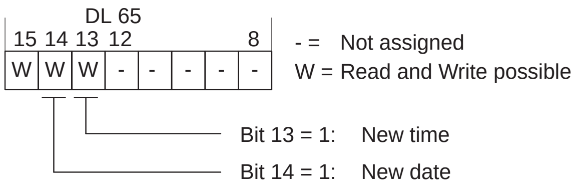


Figure 10-4 Synchronization Bits for Date and Time

Note

PLC job 41 must not be invoked cyclically or at intervals of less than 5 seconds or else communication with the operating unit will be overloaded. In such cases, error number 502 or 503 will appear on the operating unit.

10.2.3 Analysing Scheduler Bits

Operating units usable

The use of schedulers is only possible with the OP15 and OP17. A scheduler is a periodically recurring (hourly, daily, weekly, annually) time at which a defined function is executed, e.g.

– printing out the message buffer

– printing out a screen

– selecting a screen.

When a scheduler time is reached on the OP, the corresponding bit is set in this area.

DW	15	Bit no.	0
72	16		1
73	32		17
74	48		33

Scheduler no.

Transferring scheduler times to the PLC (only if configured with COM TEXT only)

Input fields for scheduler times linked to the process and therefore with a link to the PLC can be created in screen entries. If a scheduler time is altered by operator input on the OP, the new scheduler time is then transferred to the PLC.

Scheduler type

Structure of process link:

Hourly

	DL 15..							DL ..8	DR 7.. ..0
	1	1	1	1	1	1	1	1	Minutes

Daily

	DL 15 ..8	DR 7.. ..0
	Hours	Minutes

Weekly

	DL 15..							DL ..8	DR 7.. ..0
1st word	1	1	1	1	1	1	1	1	Day of week
2nd word	Hours								Minutes

Day of week Sunday = 0
Monday = 1
:
:
Saturday = 6

Annually

	DL 15.. ..8	DR 7.. ..0
1st word	Month	Day of month
2nd word	Hours	Minutes

Note

The process link for the scheduler types ”weekly” and ”annually” must extend to a length of 2 data words. If not, system message $635 will be returned after the scheduler time is entered.

Synchronization of transfer

Control and acknowledgment bit 2 in the interface area (DW 65) synchronize the transfer of the scheduler bits.

If the OP has set a new scheduler bit in the interface area, it also sets the corresponding bit in control and acknowledgement bit 2 (see figure 10-5). You therefore only need to poll this bit in order to be able to detect a change in the scheduler bits.

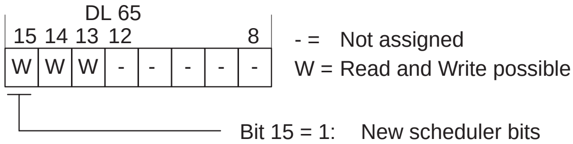


Figure 10-5 Synchronization Bits for Schedulers

10.2.4 Analyzable Areas of the Interface Area

Operating unit entries

The operating unit enters information in DW 29 and 30 that can be analyzed by the application program. Writing to these data words is illegal for the application program.

Operating unit firmware version

DW 29:
The operating unit stores its firmware version number in DW 29. You can read that information with the STEP5 program.

Number of interface area

DW 30, DL:
Here, the operating unit enters the fixed value 254. At startup the standard function block checks whether code number 254 is entered in this data word. If it is not, the standard FB aborts processing and returns an error message.

DW 30, DR:
Here, the operating unit enters the number of the data block for the interface area configured in ProTool or COM TEXT.

Standard FB entries

The standard FB enters information in DW 31 and 99 that can be analyzed by the application program. Writing to these data words is illegal for the application program.

PLC and connection ID

DW 31:
The standard function block enters an ID for the PLC type and for the connection type in the interface area. The structure of the data word is shown in figure 10-6. Details of the assignment are shown in tables 10-3 and 10-4. The PLC ID shown in table 10-4 matches the file name for the standard function block.

Example:
PLC ID = **69**
File name for standard function block = S5TD**69**ST.S5D

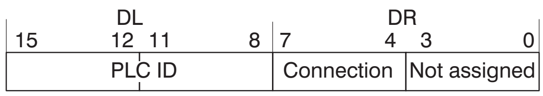


Figure 10-6 Assignment of DW 31 in Interface Area

Table 10-3 Connection ID

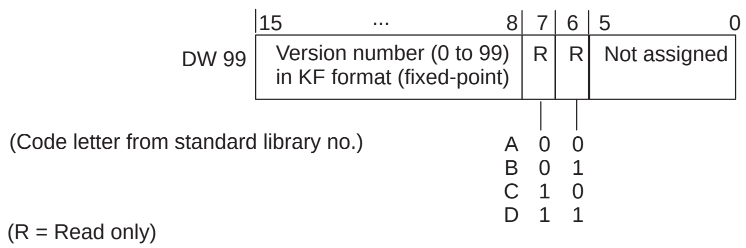
Value	Connection
1	AS511 (via CPU interface SI1)
2	Parallel
3	FAP (via CPU interface SI2)
4	FAP (via CP 521 SI)
5	FAP (via CP 523)
6	SINEC L1 (via CP 530)
7	PROFIBUS
9	PROFIBUS-DP

Table 10-4 PLC ID

PLC ID (BCD format)		PLC	CPU
Bit 12–15	Bit 8–11		
0	2	AG 90 U	
		AG 100 U	CPU 100, CPU 102
0	3	AG 95 U	≥ 6ES5 095-8MB02 with PROFIBUS
0	1	AG 100 U	CPU 103
5	0	AG 115 U	CPU 941 – 944
5	1	AG 115 U	CPU 945
2	4	AG 135 U	CPU 922 ≥ 9, 928-3UA12, 928B
6	9	AG 155 U	CPU 946/947, 948

Standard FB version number

DW 99
The standard function block enters its version number in this data word.



Data handling block error messages

DW 101, 102:
In the case of a PROFIBUS connection via CP5430/31 the data handling blocks store any error messages in these data words. A detailed description of the errors is given in the SINEC manual.

Layout:

	DL	DR
DW 101	ANZW	
DW 102	Not assigned	PAFE

Life bit monitoring

DW 98
At regular intervals the operating unit inverts a bit in the interface area that is not accessible to the user. The standard FB counts how often it is invoked between two inversions of that bit. If the number of calls (cycles) exceeds a predefined figure, the standard FB passes error message 115 to AKKU 1.

You enter the maximum number of FB calls permitted without the error message being triggered in this data word. If the data word is overwritten with the value `0`, the standard FB enters the default figure of `200`.

If the application program cycle times are too short, error 115 can result even if the connection is good. In such cases, enter a higher figure for the maximum number of calls, e.g. `2000`.

10.2.5 Use of PLC Jobs

Description

PLC jobs can be used to initiate functions on the operating unit from the STEP5 program. Such functions include the following:

– displaying screens
– setting date and time
– printing out the message buffer
– altering general settings

A PLC job is identified by its job number. Depending on the PLC job in question, up to three parameters can then be specified. The PLC jobs possible are listed in appendix B together with their parameters.

PLC job structure

A PLC job always consists of 4 data words. The first data word contains the job number. Data words 2 to 4 are used to transfer up to three parameters depending on the function in question. The basic structure of a PLC job is shown in figure 10-7. The 4 data words for the PLC job can be stored at any location on the PLC.

	DL	DR
1st word	0	Job no.
2nd word	Parameter 1	
3rd word	Parameter 2	
4th word	Parameter 3	

Figure 10-7 Structure of a PLC Job

Job mailboxes in the interface area

A job mailbox in the interface area contains a pointer to the address at which the actual PLC job is located. When you want to initiate a PLC job, you enter the pointer in the job mailbox.

The interface area contains 8 job mailboxes in all. This means that multiple PLC jobs can be initiated in succession. The order in which the PLC jobs are processed by the operating unit does not, however, have to be the same as the order in which they are placed in the interface area.

Initiating a PLC job

When you enter a pointer to a PLC job in the interface area, the standard FB initiates transfer to the operating unit.

You should first enter the actual data for the PLC job in the relevant memory area, e.g. a data block. Then enter the pointer to the memory area in the job mailbox. When doing so, first enter data in DW 33 and then in DW32.

Once the operating unit has received the PLC job, the pointer is deleted from the job mailbox. This means that the standard FB overwrites the first data word with the value ”0”. Only then has the standard FB fully processed the PLC job thus allowing the job mailbox to be written to by the STEP5 program again. The operating unit does not issue any acknowledgment that the PLC job is being processed or has in fact been executed.

Example of PLC job

Below is an example based on PLC job 51, “Select Screen”.Screen number 5 is to be activated on an OP17 and the cursor is positioned on screen entry 0 in the second field. Figure 10-8 shows a schematic representation of the assignment of the first job mailbox. The actual PLC job is located in data block 100 from DW 4 onwards. Table 10-5 lists the associated STEP5 program.

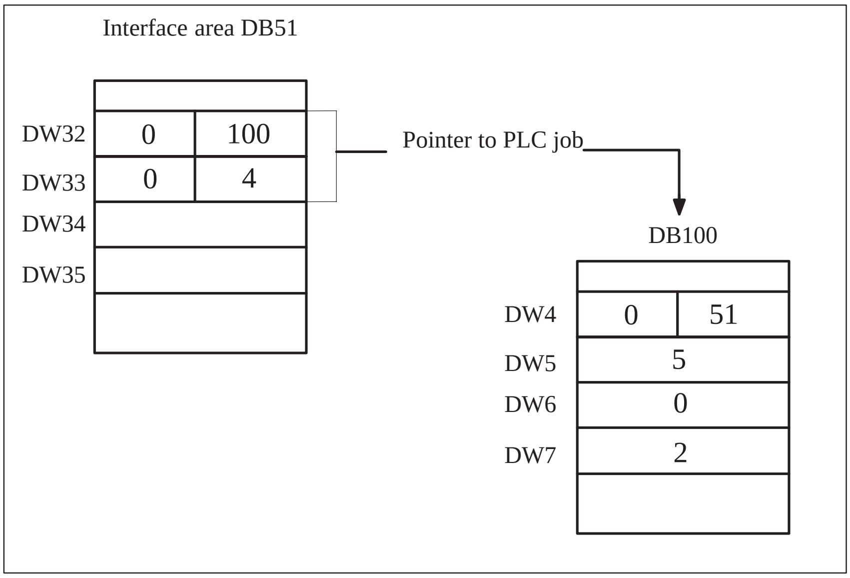


Figure 10-8 Assignment of 1st Job Mailbox, DW 32 to DW 35

Table 10-5 Example Program for PLC Job

Block	Program Code	Explanation
OB 1	`:A F1.0` `:JC FB 41`	Activate PLC job, set flag once only
FB 41	`:C DB 51` `:L DW 32`	
	`:L KF +0` `:><F`	Only enter job if the job mailbox is empty
	`:BEB`	
	`:L KY 0,4` `:T DW 33`	PLC job starts at DW 4
	`:L KY 0,100` `:T DW 32`	PLC job is in DB 100
	`:R F1.0`	
DB 100	`DW 4 KY 0,51`	Job number 51 for screen selection
	`DW 5 KY 0,5`	Parameter 1: Screen number 5
	`DW 6 KY 0,0`	Parameter 2: Screen entry 0
	`DW 7 KY 0,2`	Parameter 3: Field number 2

Current PLC job status and error number

The fifth data word in the job mailbox shows the current status of the PLC job and any error number that has occurred.

After the standard FB has been invoked, this data word contains the same information as Accumulator 1. Figure 10-9 shows the contents of accumulator 1. One exception to this is Bit 8 *No job being processed*. That bit is not set in the interface area.

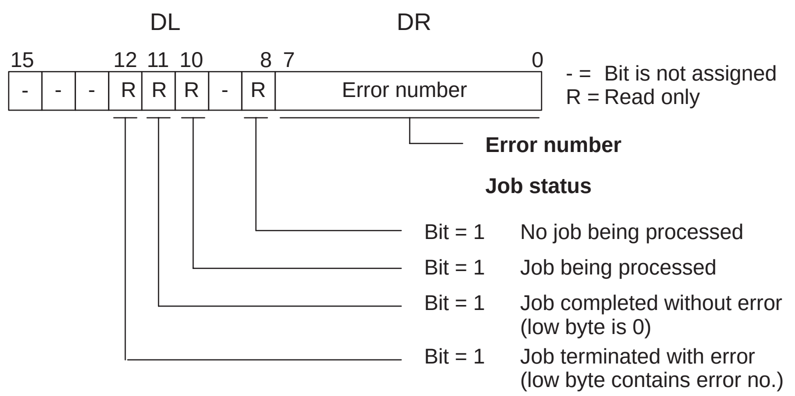


Figure 10-9 Job Status and Error Number for PLC Jobs

DL contains the job status. The bits are set by the standard FB. If the PLC job is completed without an error, the standard FB sets DR to the value `0`. If the PLC job is terminated with an error, DR contains the error number. An explanation of the error numbers is given in appendix A.3.

Copy of last PLC job

DW 94-97:
A copy of the PLC job last processed (job no. and parameters) is stored in these 4 data words.

10.3 Assignment Data Block DB-ZU

Function

If the PLC and operating unit are connected via FAP, SINEC L1, PROFIBUS or PROFIBUS-DP, an assignment DB must be set up. This contains a list of all configured operating units connected to the PLC.

An area of 16 data words is required for every operating unit connected, as follows:

DW 0 : DW 15	Area for operating unit 1
DW 16 : DW 31:	Area for operating unit 2
DW (x-1)×16 : DW x×16 – 1	Area for operating unit x
DW 240 : DW 255	Area for operating unit 16

If there are more than 16 operating units, DB-ZU must be distributed across several data blocks (maximum length 256 DW in each case).

When the standard FB is invoked, the assignment DB and the device number of the operating unit are transferred as parameters. The device number is the area in the assignment DB in which the entries for the operating unit are located.

Example:
The entries for the operating unit are located at DW 32 to DW 47. i.e. in Area 3. The assignment DB is DB 52. The call for the standard FB 58 in the case of PROFIBUS-DP is thus as follows:

```
:L KY 52,3
:JU FB 58
```

Note

- The assignment data block DB-ZU must be set up in the CPU RAM. DX extended data blocks are not permissible.
- The DB number must be greater than or equal to 10.
- DB-ZU is only analyzed during startup of the standard FB. If subsequent alterations are made, the standard FB must be restarted.
- In the case of simultaneous use of multiple standard FBs on one PLC (for different connections) a common DB-ZU can be used.

What the entry for an operating unit looks like in detail is shown in table 10-6. The entries shown are required for every operating unit connected.

Connection-specific entries should be entered in DW n+4 and DW n+9 to DW n+13 by the user. Which data words are relevant to which type of connection is shown in table 10-7.

Table 10-6 Assignment of an Area in DB-ZU

DW	DL	DR	Usage
n+0	Reserved	DB number of interface area	To be specified by user
n+1	Reserved		–
n+2	Standard FB version number		–
n+3	Job status	Error number	To be analyzed by user
n+4	Connection-specific entry		To be specified by user
n+5	Data type 0 = DB 1 = DX	DB/DX number	Pointer to receive mailbox; specified by user.
n+6	0	Start address (DW number)	
n+7	Data type 0 = DB 1 = DX	DB/DX number	Pointer to send mailbox; specified by user.
n+8	0	Start address (DW number)	
n+9	Connection-specific entries		To be specified by user
n+10			
n+11			
n+12			
n+13			
n+14	Reserved		–
n+15			

n = (Device number –1) * 16

Table 10-7 Assignment of Connection-Specific Entries

<table>
<tr><th>DW</th><th>For FAP</th><th>For PROFIBUS-DP</th><th>For PROFIBUS</th><th>For SINEC L1</th></tr>
<tr><td>n+4</td><td>CP address</td><td>Not relevant</td><td>Not relevant</td><td>Not relevant</td></tr>
<tr><td>n+9</td><td rowspan="2">Not relevant</td><td rowspan="3">Addressing method</td><td rowspan="3">PROFIBUS parameters</td><td rowspan="2">L1 parameters</td></tr>
<tr><td>n+10</td></tr>
<tr><td>n+11</td><td rowspan="3">Interface parameters</td><td rowspan="3">Not relevant</td></tr>
<tr><td>n+12</td><td rowspan="2">Not relevant</td><td rowspan="2">Not relevant</td></tr>
<tr><td>n+13</td></tr>
</table>

DW n + 0

DB no. of interface area:
In this byte the user should enter the number of the data block that is acting as the interface area.

The standard FB checks that the number specified here matches the number specified in the configuration. If it does not, the standard FB terminates and returns an error message.

DW n+2

Standard FB version number:
The standard function block enters its version number in this data word of the assignment data block.

	15 ... 8	7	6	5 ... 0
DW 59 (99)	Version number (0 to 99) in KF format (fixed-point)	R	R	Not assigned

(Code letter from standard library no.)

A	0	0
B	0	1
C	1	0
D	1	1

(R = Read only)

DW n+3

Current PLC job status and error number:

DL: The function block enters the job status in this byte.

DR: The standard FB enters the number of any error that has occurred on the current application in this byte.

This data word contains the same information as the accumulator immediately after the standard FB has been invoked. For more information on error handling in the standard function block, refer to appendix A.3 at the end of this manual.

DW n+5 and n+6, DW n+7 and n+8

Pointer to send and receive mailboxes:
These data words contain pointers to the send and receive mailboxes. The mailboxes themselves can be stored at any location on the PLC. These mailboxes can not be used by the user. They are intended for internal communication only. The length of each mailbox depends on the type of connection.

Connection Type	Data Words for Send and Receive Mailboxes
FAP – All CPUs except CPU 945 – CPU 945	 50 128
SINEC L1	34
PROFIBUS	128
PROFIBUS-DP	41
PROFIBUS-DP with IM308C	41–120[1)]

1) Dependent on block size used

The permissible data types for the pointers are listed in table 10-8.

Table 10-8 Permissible Data Types

Data Type		DB/DX Number
0	DB-type data block	10 to 255
1	DX-type extended data block[2)]	10 to 255

2) Only possible with S5-115U with CPU 945, S5-135U and S5-155U.

Example:
Send and receive mailboxes have been set up in DB 58 with a combined length of 100 words. Data words DW 5 to DW 8 are then assigned as follows:

Receive mailbox (DW 0..49)		
DW 5:	`KY 0,58`	(Data type: 0; DB no.: 58)
DW 6:	`KY 0,0`	(Start address: 0)
Send mailbox (DW 50..99)		
DW 7:	`KY 0,58`	(Data type: 0; DB no.: 58)
DW 8:	`KY 0,50`	(Start address: 50)

Note

- Send and receive mailboxes must not overlap. An overlap will not be recognized by the standard FB and may result in malfunctions!
- The addresses of the two mailboxes are only read when the standard FB is started up and must therefore not be altered during normal operation.

11 User Data Areas for the SIMATIC S5

User data areas are used for the purposes of data exchange between the PLC and the operating unit.

These data areas are written to and read by the operating unit and the application program in alternation during the process of communication. By analysing the data stored there, the PLC and operating unit reciprocally initiate predefined actions.

This chapter describes the function, layout and special features of the various user data areas.

11.1 Overview

Definition

User data areas can be located in any memory area on the PLC. User data areas include messages, recipes and trends, for example.

Range of functions

Which user data areas are possible depends on the operating unit used and the configuration software. Table 11-1 summarizes the range of functions available on the individual operating units.

Table 11-1 User Data Areas Usable According to Type of Operating Unit

User data area	TD10	TD20	TD17	OP5	OP7	OP15 OP17 OP20	OP25 OP35	OP27 OP37	TP27 TP37
Event messages	x	x	x	x	x	x	x	x	x
Alarm messages	–	x	–	x	x	x	x	x	x
PLC jobs	x	x	x	x	x	x	x	x	x
Recipes	–	–	–	x	x	x	x	x	x
System keyboard assignment	–	x	x	x	x	x	x	x	–
Function keyboard assignment	–	–	–	x	x	x	x	x	–
LED assignment	–	–	–	–	x	x	x	x	–
Scheduler	–	–	–	–	–	x	–	–	–
Date and time	x	x	x	x	x	x	x	x	x
Screen number	–	x	–	x	x	x	x	x	x
User version	x	x	x	x	x	x	x	x	x
Trend request area	–	–	–	–	–	–	x	x	x
Trend transfer area	–	–	–	–	–	–	x	x	x

11.2 Event and Alarm Messages

Definition

Messages consist of a fixed text component and/or variables. The text and variables are user-definable.

Messages are subdivided into event messages and alarm messages. The programmer defines what is an event message and what is an alarm message.

Event messages

An event message indicates a status, e.g.

- `Motor switched on`
- `PLC in manual mode`

Alarm messages

An alarm message indicates a fault, e.g.

- `Valve not opening`
- `Motor temperature too high`

Acknowledgment

Since alarm messages indicate abnormal operating statuses, they have to be acknowledged. They can be acknowledged either by

- operator input on the operating unit
- setting a bit in the PLC acknowledgement area.

Message initiation

A message is initiated by setting a bit in one of the message areas on the PLC. The location of the message areas is defined by means of the configuration software. The corresponding area must also be set up on the PLC.

As soon as the bit in the PLC event/alarm message area has been set and that area has been transferred to the operating unit, the operating unit detects that the relevant message has ”arrived”.

Conversely, when the same bit is reset on the PLC by the operating unit the message is registered as having ”departed”.

Message areas

Table 11-2 shows the number of message areas for event and alarm messages, the number of alarm message acknowledgement areas (PLC → operating unit and operating unit → PLC) and the overall length of all areas for each of the various operating unit models.

Table 11-2 Operating Unit Message Areas

Unit	Event message area		Alarm messages area/ Alarm message acknowledgement area	
	Number	**Length** (words)	**Number per type**	**Overall length per type** (words)
TD10	4	64	–	–
TD20	4	64	4	64
TD17	4	63	–	–
OP5	4	32	4	32
OP7	4	32	4	32
OP15	4	63	4	63
OP17	4	63	4	63
OP20	4	64	4	64
OP25, OP35	8	125	8	125
OP27, OP37	8	125	8	125
TP27, TP37	8	125	8	125

Assignment of message bit and message number

A message can be configured for every bit in the message area configured. The bits are assigned to the message numbers in ascending order.

Example:

Let us assume that the following event message area has been configured for the SIMATIC S5 PLC:

`DB 60        Address 43  Length 5` (in words)

Figure 11-1 shows the assignment of all 80 (5 ×x 16) message numbers to the individual bit numbers in the PLC event message area.

That assignment is performed automatically on the operating unit.

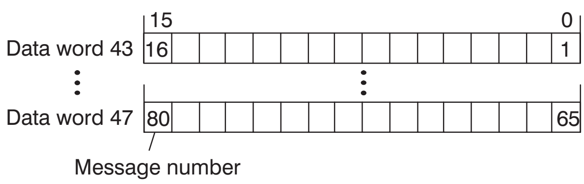


Figure 11-1 Assignment of Message Bit and Message Number

Acknowledgement areas

If the PLC is to be informed of acknowledgement of an alarm message on the operating unit or if the acknowledgement is to be issued by the PLC itself, the appropriate acknowledgement areas must be set up on the PLC as follows:

- **Acknowledgement area operating unit →PLC**:
  This area is used to inform the PLC when an alarm message has been acknowledged by operator input on the operating unit.
- **Acknowledgement area PLC → operating unit**:
  This area is used to acknowledge an alarm message by the PLC.

These acknowledgement areas must also be specified in the configuration under *Area Pointers*.

Figure 11-2 shows a schematic diagram of the of the individual alarm message and acknowledgement areas. The acknowledgement sequences are shown in figures 11-4 and 11-5.

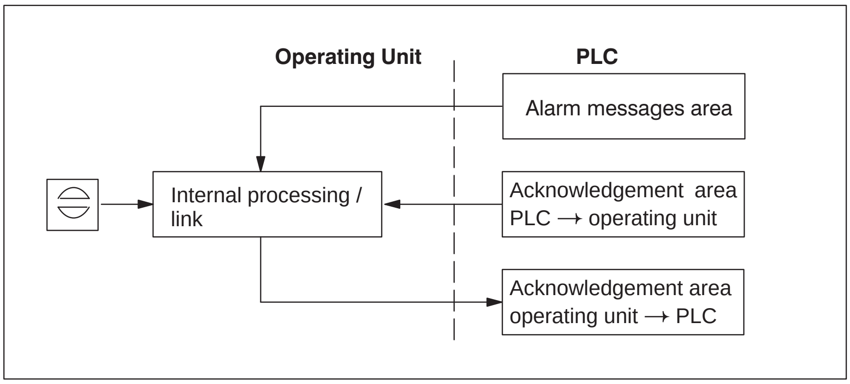


Figure 11-2 Alarm Message and Acknowledgement Areas

Assignment of acknowledgment bit to message number

Each alarm message has a message number. That message number is assigned the same bit number in the alarm messages area as the bit number it is assigned in the acknowledgement area. Under normal circumstances, the acknowledgement area is the same length as the associated alarm messages area.

If the length of an acknowledgement area is not equal to the overall length of the associated alarm messages area and there are succeeding alarm messages and acknowledgement areas, the following assignment applies:

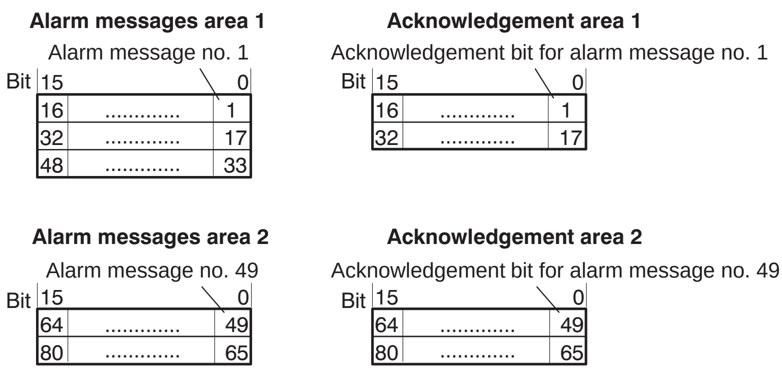


Figure 11-3 Assignment of Acknowledgement Bit and Message Number

Acknowledgement area PLC → operating unit

A bit set by the PLC in this area effects acknowledgment of the corresponding alarm message on the operating unit. Reset the bit when you reset the bit in the alarm messages area. Figure 11-4 shows the signal diagram.
The acknowledgement area PLC → operating unit

- must follow on immediately from the associated alarm messages area,
- must have precisely the same polling time and
- may not be any longer than the associated alarm messages area.

If the physical location of acknowledgement area PLC → operating unit does not follow on from the alarm messages area, system message $655 is issued when the operating unit starts up.

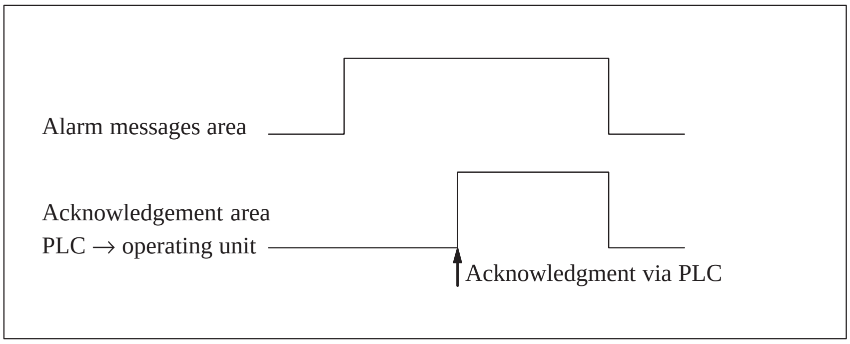


Figure 11-4 Signal Diagram for Acknowledgement Area PLC → Operating Unit

Acknowledgment area Operating unit → PLC

If a bit in the alarm messages area is set, the operating unit resets the corresponding bit in the acknowledgement area. If the alarm message is acknowledged on the operating unit, the bit in the acknowledgement area is set. In this way, the PLC can detect that the alarm message has been acknowledged. Figure 11-5 shows the signal diagram.

The acknowledgement area operating unit → PLC must be no longer than the associated alarm messages area.

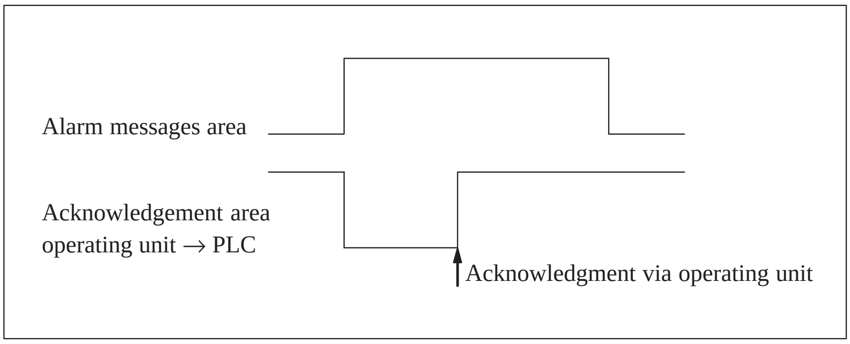


Figure 11-5 Signal Diagram for Acknowledgement Area Operating Unit → PLC

Size of acknowledgement areas

The acknowledgement areas PLC → operating unit and operating unit → PLC must not be any longer than the associated alarm messages areas. They can, however, be smaller if acknowledgement by the PLC is not required for all alarm messages. Figure 11-6 illustrates such a case.

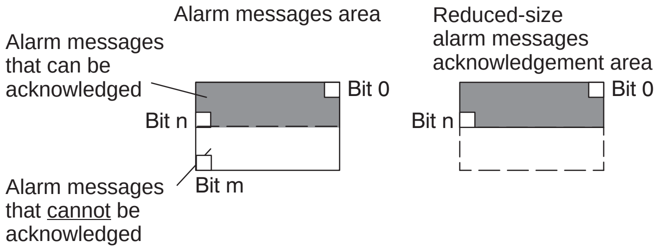


Figure 11-6 Reduced-size Acknowledgement Area

Note

Place important alarm messages in the alarm messages area starting at Bit 0 in ascending order.

The two associated bits in the alarm messages area and acknowledgement area must not be set simultaneously.

11.3 Keyboard and LED Assignment Areas

Usage

Key strokes on the operating unit can be transmitted to the PLC and analyzed there. In that way, an action such as ”switch on motor” can be initiated on the PLC.

The operating units have LEDs on the function keys. Those LEDs can be controlled from the PLC. This means, for example, that in specific situations, it is possible to indicate to the operator by switching on an LED which key should be pressed.

Note re. touch panels

Touch panels have no keyboard and no LEDs which are assigned to keys. For that reason, you do not need to set any area pointers in ProTool for the keyboard and LED assignment.

Requirement

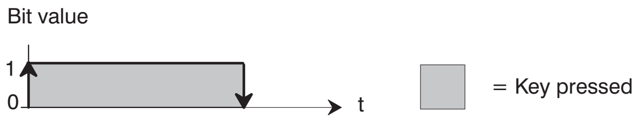
In order to be able to analyze key strokes and control the LEDs, associated data areas (also referred to as assignment areas) have to be set up on the PLC and specified in the configuration as *area pointers*.

Transfer

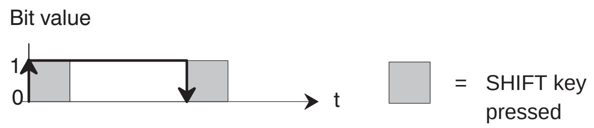
The keyboard assignment areas are transferred automatically to the PLC whenever a key is pressed on the operating unit. Configuration of a polling time is therefore not necessary. A maximum of two simultaneously pressed keys are transmitted at once.

Value assignment

- **All keys (except SHIFT key)**
  As long as the key remains pressed, the assigned bit in the keyboard assignment area has the value 1; otherwise its value is 0.



- **SHIFT key** (devices having a text-based display only)
  The first time the SHIFT key is pressed, the assigned bit in the keyboard assignment area takes on the value 1. This condition remains the same even when the key is released and stays that way until the SHIFT key is pressed again.



Note

If the operating unit is switched off or disconnected from the PLC while the key is depressed the corresponding bit in the keyboard assignment area remains set.

11.3.1 System Keyboard Assignment Area

Layout

The system keyboard assignment area is a data area with a fixed length. The precise length depends on the operating unit. Table 11-3 gives the details.

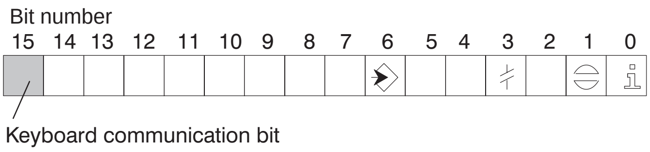
Table 11-3 Length of System Keyboard Assignment Area

Operating unit	Length in words
TD20	1
OP20, OP5, OP15, OP7, OP17	2
OP25, OP35, OP27, OP37	3

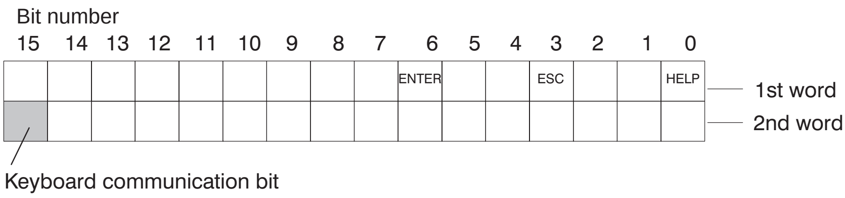
Each key on the system keyboard is assigned a specific bit in the system keyboard assignment area. Exception: DIR key on OP5/15 and cursor keys.

The system keyboard assignment area must also be specified in the configuration under *Area Pointers, Type: System Keyboard*. This assignment area can only be created on <u>one</u> PLC and only <u>once</u> on that PLC.

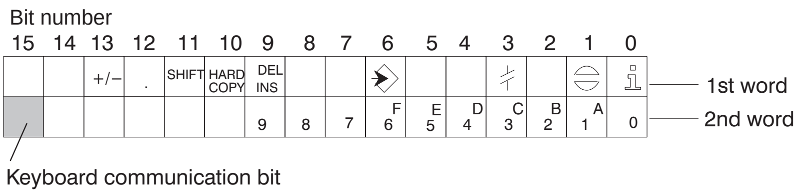
Keyboard assignment for TD20:



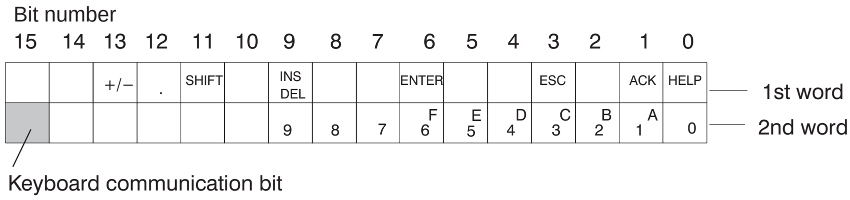
Keyboard assignment for TD17:



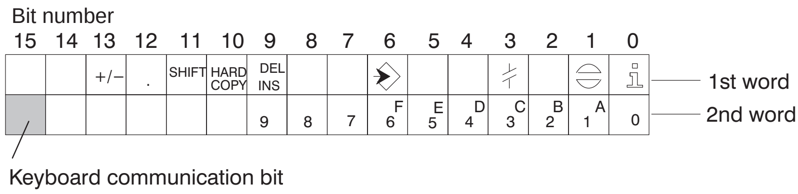
Keyboard assignment for OP5 and OP15:



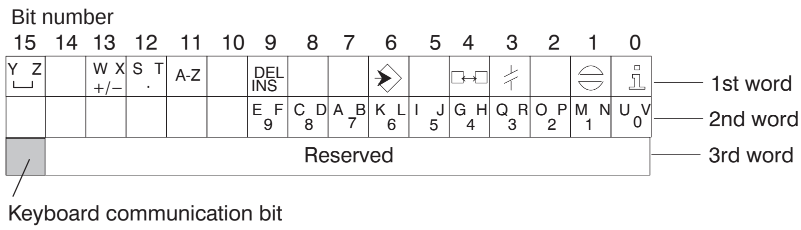
Keyboard assignment for OP7 and OP17:



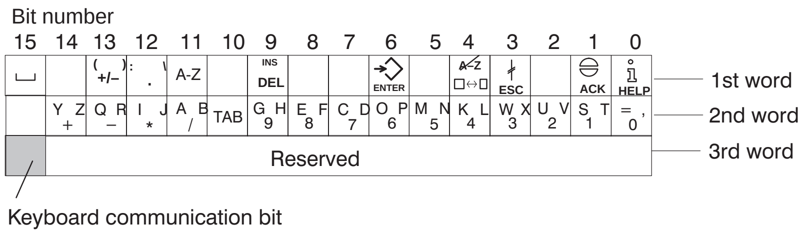
Keyboard assignment for OP20:



Keyboard assignment for OP25 and OP27:



Keyboard assignment for OP35 and OP37:



Note

Unused bits must not be overwritten by the application program.

Keyboard communication bit

The keyboard communication bit acts as a check bit. Every time the keyboard assignment area is transferred from the operating unit to the PLC it is set to the value 1 and should be reset by the application program after analysis of the data area.

By regular reading of the communication bit, the application program can ascertain whether the system keyboard assignment area has been transferred again.

11.3.2 Function Keyboard Assignment Area

Data areas

Operator panels have a function keyboard which can be assigned an area in the PLC memory. The function keyboard assignment area can be divided into separate data areas whose number and length depends on the OP concerned.

Data areas	OP5/15/20 OP7/17	OP25/35 OP27/37
Max. number	4	8
Overall length of all data areas (words)	4	8

Key assignment

The assignment of the individual keys to the bits in the data areas is specified when the function keys are configured. This involves specifying a number within the assignment area for each key.

The function keyboard assignment area must also be specified in the configuration under *Area Pointers, Type: Function Keyboard*.

Keyboard communication bit

Bit 15 in the last data word of **each** data area is the keyboard communication bit. It acts as a check bit. Each time the keyboard assignment is transferred from the OP to the PLC, the keyboard communication bit is set to the value `1`. Following analysis of the data area by the application program, the keyboard communication bit should be reset.

By regular reading of the communication bit, the application program can ascertain whether a block has been transferred again.

11.3.3 LED Assignment Area

Data areas

The LED assignment area can be divided into separate data areas as shown in the table below.

Data areas	OP7/15/1720	OP25/35 OP27/37
Max. number	4	8
Overall length of all data areas (words)	8	16

The LED assignment area must also be specified in the configuration under *Area Pointers, Type: LED Assignment*.

LED assignment

The assignment of the individual LEDs to the bits in the data areas is specified when the function keys are configured. This involves specifying a bit number within the assignment area for each LED.

The bit number (n) identifies the first of two consecutive bits that control a total of four different LED statuses (see table 11-4):

Table 11-4 LED Flashing Frequency for all OPs except OP17

Bit n + 1	Bit n	LED Function
0	0	Off
0	1	Flashes at approx. 2 Hz
1	0	Flashes at approx. 0.5 Hz
1	1	Permanently lit

On the OP17, the K keys have two-color LEDs (red/green). The resulting LED functions are detailed in table 11-5.

Table 11-5 LED Colors for OP17

Bit n + 1	Bit n	LED Function
0	0	Off
0	1	Flashes red
1	0	Permanently red
1	1	Permanently green

11.4 Screen Number Area

Usage

The operating units store information in the screen number area about the screen activated on the operating unit.

This enables information about the current display contents of the operating unit to be transmitted to the PLC and from there, in turn, to initiate specific responses such as the activation of another screen.

Requirement

If the screen number area is to be used, it must be specified in the configuration as an *Area Pointer*. It can only be created on <u>one</u> PLC and only <u>once</u> on that PLC.

The screen number area is transferred automatically to the PLC whenever a change is registered on the operating unit. Configuration of a polling time is therefore not necessary.

Layout

The screen number area is a data area with a fixed length. The precise length depends on the operating unit. Table 11-6 gives the details.

Table 11-6 Length of Screen Number Area

Operating unit	Length in words
TD20	2
OP20, OP5, OP15, OP7, OP17	2
OP25, OP35, OP27, OP37, TP27, TP37	5

The layout of the screen number area in the PLC memory for the various operating units is detailed below.

TD20, OP20, OP5/15, OP7/17:

	15 8	7 0
1st word	Current screen type	Current screen number
2nd word	**Current entry number**	**Current input field no.**

Entry	Assignment
Current screen type	1: Screen 2: Recipe 3: Function screen
Current screen/recipe number	1 to 99
Current entry number	1 to 99
Current input field number	0 to 32, (0: Entry number)

At message level, the menu level and when displaying a directory, all bytes in the screen number area have the value FF_H.

For **function screens**, the screen number area is assigned as follows:

	15 … 8	7 … 0
1st word	3	Function screen number
2nd word	FF_H	Current input field no.

OP25/35, OP27/37, TP27/37:

	15 … 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 4: Fixed window 5: Alarm message window 6: Event message window
Current screen number	1 to 65535
Current input field number	1 to 65535

For function screens the current screen number is assigned as follows:

Value	Explanation
1	Alarm message screen
2	Event message screen
3	Alarm buffer
4	Event buffer

11.5 Trend Request and Transfer Areas

Trends

A trend is the graphical representation of a value from the PLC. Reading of the value can be time-triggered or bit-triggered, depending on the configuration.

Time-triggered trends

The operating unit reads the trend values cyclically at time intervals specified in the configuration. Time-triggered trends are suitable for continuous progressions such as the operating temperature of a motor.

Bit-triggered trends

The operating unit reads either a single trend value or the complete trend buffer as a result of a trigger bit being set. This is specified in the configuration. Bit-triggered trends are normally used to display values that area subject to rapid variation. An example of this is the injection pressure for plastic mouldings.

In order to be able to activate bit-triggered trends, corresponding data areas have to be specified in the configuration (under *Area Pointers*)) and set up on the PLC. The operating unit and the PLC communicate with one another by means of those areas.

The areas required are the following:
– Trend request area
– Trend transfer area 1
– Trend transfer area 2 (required with switch buffer only)

In those configured areas, each trend is permanently assigned the same bit. This means that each trend is uniquely identifiably in all areas.

Switch buffer

The switch buffer is a second buffer for the same trend that can be set up in the configuration.

While the operating unit is reading the values from buffer 1, the PLC writes data to buffer 2. If the operating unit is reading buffer 2, the PLC writes to buffer 1. This prevents the PLC overwriting the trend data while it is being read by the operating unit.

Division of data areas

The individual areas – i.e. the trend request area and trend transfer areas 1 and 2 – can be divided into separate data areas with a predefined maximum number and length (table 11-7).

Table 11-7 Division of Data Areas

	Data areas		
	Request	Transfer	
		1	2
Max. number per type	8	8	8
Overall length of all data areas (words)	8	8	8

Trend request area

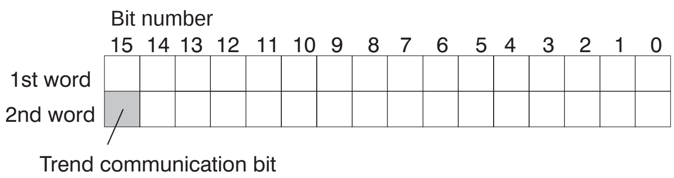
If a screen with one or more trends is opened on the operating unit, the operating unit sets the corresponding bits in the trend request area. After deselection of the screen, the operating unit resets the corresponding bits in the trend request area.

The trend request area can be used by the PLC to ascertain which trend is currently being displayed on the operating unit. Trends can also be triggered without analysis of the trend request area.

Trend transfer area 1

This area is used for the purpose of triggering trends. In the S5 program, set the bit assigned to the trend in the trend transfer area and the trend communication bit. The operating unit detects the trigger and resets the trend bit and the trend communication bit. It then reads a single value or the whole puffer, depending on the configuration.

Example of a trend transfer area with a length of 2 data words



Until the trend communication bit has been reset, the trend transfer area can not be altered by the S5 program.

Trend transfer area 2

Trend transfer area 2 is required for trends that are configured with a switch buffer. Its layout is precisely the same as that of trend transfer area 1.

11.6 User Version

Usage

When the operating unit is started up, a check can be carried out as to whether the operating unit is connected to the correct PLC/the correct CP module. This important in cases where multiple operating units are in use.

To perform the check, the operating unit compares a value stored on the PLC with the value specified in the configuration. This ensures compatibility of the configuration data with the S5 program. If the values do not match, system message $653 is displayed on the operating unit and the unit is restarted.

In order to be able to use this function, the following values must be specified in the operating unit configuration:

- Details of configuration version; value between 1 and 255.
  - **COM TEXT**:
    General parameters
  - **ProTool**:
    System → *Settings*
- Data type and address of the version value stored on the PLC:
  - **COM TEXT**:
    Area pointer lists, *User Version Area* field
  - **ProTool**:
    System → *Area Pointers*,
    Select *User Version* in the *Type:* box.

11.7 Recipes

Definition

A recipe is a combination of variables forming a fixed data structure. That structure is defined in the configuration and supplied with data on the operating unit. The structure can not subsequently be modified from the operating unit.

As the data structure can be assigned new data many times over, the data is referred to as a data record. Those data records are stored (created), loaded, deleted and edited on the operating unit. The data is stored on the operating unit, thus saving memory space on the PLC.

Using a recipe ensures that by transferring a data record to the PLC, multiple items of data are received **simultaneously** and **in synchronized fashion** by the PLC.

Condition

The use of recipes is subject to the following hardware requirements:

- **Operating unit**
  with text-based display: OP5, OP7, OP15, OP17, OP20
  with graphics display: OP25, OP27, OP35, OP37
  with touch screen: TP27, TP37
- **PLC**
  Group 2: S5-95U, S5-100U with CPU103, S5-115U, S5-135U, S5-155U

Transfer of data records

Data records can be transferred from the operating unit to the PLC or from the PLC to the operating unit.

Data records are transferred from the operating unit to the PLC in order to set specific values on the PLC, e.g. for the production of orange juice.

In the same way, data can be read from the PLC and stored on the operating unit as a data record in order to save details of a successful combination of values, for example.

Note

With graphics displays, only the variables are used when transferring data records. In order to transfer a data record from a data medium (such as Flash memory of floppy disk) to the S5, that record must first be written to the variables.

Synchronization

A basic feature of recipes is that the data is transferred in synchronized fashion and uncontrolled overwriting of data is prevented. In order to ensure coordinated transfer of data records, bits are set in control and acknowledgment bits 1 in the interface area.

11.7.1 Transfer of Data Records

Definition

Data records can be transferred from the operating unit to the PLC or from the PLC to the operating unit in two different ways. The two methods of transfer are ”direct” and ”indirect”. The transfer method setting relates primarily to transfer in the direction operating unit → PLC.

In the case of text-based display units only ”indirect” transfer from the operating unit to the PLC is possible. In the case of graphics displays, transfer in the direction operating unit → PLC can be ”direct” or ”indirect”. ”Indirect” transfer from the PLC to the operating unit is not possible with the SIMATIC S5.

Selecting method of transfer

The choice of transfer method depends on the configuration software used (COM TEXT or ProTool) and the operating unit. Table 11-8 shows the features of a recipe according to the operating unit and the configuration software.

Table 11-8 Rrecipe Transfer According to Operating Unit and Configuration Software

Operating unit	Direction of transfer	Created in		
		ProTool	ProTool/Lite	COM TEXT
OP5, OP15	OP → PLC	Indirect	Indirect	Indirect
	PLC → OP	Direct	Direct	Direct
OP7, OP17	OP → PLC	Indirect	Indirect	Indirect
	PLC → OP	Direct	Direct	Direct
OP20	OP → PLC	—	—	Indirect
	PLC → OP	—	—	Direct
OP25, OP35	OP → PLC	Indirect/direct	—	—
	PLC → OP	Direct	—	—
OP27, OP37	OP → PLC	Indirect/direct	—	—
	PLC → OP	Direct	—	—
TP27, TP37	TP → PLC	Indirect/direct	—	—
	PLC → TP	Direct	—	—

Direct transfer

When a data record is written, the variables of the data record are written directly to the address defined in each case. When a data record is read directly, the variables are read from the PLC system memory onto the operating unit.

In ProTool, variables which are to be transferred directly must have a link to the PLC as well as the attribute `Write directly`. Variables to which no address on the PLC is assigned are not transferred.

Indirect transfer

All variables of the data record are written to a temporary storage area on the PLC. In the case of operating units with text-based display, that temporary storage area is the recipe mailbox, in the case of operating units with graphics display, the data mailbox. The recipe mailbox contains the values of the variables and their addresses. The data mailbox contains only the values of the variables, the addresses are not transferred.

For ”indirect” transfer, the data record must be no longer than 98 data words.

11.7.2 Addressing Recipes and Data Records

The addressing of recipes and data records differs between operating units with text-based display and operating units with graphics display.

Devices having a text-based display

In the process of configuration, the recipe is given a name and a number. Both the recipe name and the recipe number are displayed on the operating unit.

The data records that you create on the operating unit are also given a name and a number.

The recipe number and data record number are transferred to the PLC along with the data when data record transfer in the direction operating unit → PLC is initiated.

Devices having a graphics display

In the process of configuration, the recipe is automatically given a name and a number. The recipe name and number are only relevant to the configuration and are <u>not</u> visible on the operating unit.

In ProTool, you enter the recipe identification in the *Parameters* dialog box under *Identifications*. When a data record is transferred from the operating unit to the PLC, the identification is written to the data mailbox and must be analyzed by the PLC.

Recommendation:
Use the recipe number for the first identification.

The data records that you create on the operating unit are given a symbolic name. That symbolic name is not transferred with the data record when it is transferred between the operating unit and PLC. The data record itself has no identification on the PLC apart from the recipe ID.

11.7.3 Data Areas for Transfer of Data Records

The data areas on the PLC that are required for transfer of data records differ between operating units with text-based display and operating units with graphics display.

Devices having a text-based display

When connecting a text-based display unit, you must set up areas on the PLC for recipe mailbox, successive recipe mailbox and recipe number mailbox. When doing so, use the same details specified in the configuration under *Area Pointers*.

As well as the data, the recipe mailbox and successive recipe mailbox also contain the addresses of the variables.

In the case of Group 2 PLCs, the interface area contains data words for the pointers to the recipe number mailbox, recipe mailbox and successive recipe mailbox. The operating unit enters the pointer specified in the configuration in this data word.

Recipe number mailbox:

You must set up an area on the PLC for the recipe number and data record number.

Layout of recipe number mailbox:

DL	DR
Recipe number	Data record number

Recipe mailbox:

The recipe mailbox is a data area with a maximum length of 256 data words.

The values entered must be distributed by the S5 program to the relevant memory areas. Use FB 42 to distribute the data to the relevant addresses.

	DL	DR	
1st word	Recipe number	Data record number	
2nd word	Overall length of recipe in words		
3rd word	Type, value 1	DB/DX no., value 1	Pointer to value 1
4th word	Start address, value 1		
5th word	Length in words, value 1		
6th word	Data, value 1		
:			
:	Pointer to value 2		
:	Data, value 2		
:	:		

Successive recipe mailbox:

The successive recipe mailbox is only necessary if the recipe mailbox can not be created with a sufficient size to accept the largest occurring data record. The maximum length is 256 data words.

	DL DR
1st word	Pointer to value 1
3rd word 4th word	Data, value 1
:	Pointer to value 2
:	Data, value 2 :

Devices having a graphics display

When connecting a graphics display unit, you must set an area on the PLC for the *data mailbox*. When doing so, use the same details specified in the ProTool configuration under *Area Pointers*.

The data mailbox does not contain any addresses in addition to the data.

Data mailbox:

The data mailbox is a data area with a maximum length of 256 data words.

It acts as an intermediate storage area for transfer of data records from the operating unit to the PLC. The values entered must be distributed by the S5 program to the relevant memory areas.

The identifications 1, 2, 3 (recipe number) configured in ProTool are also transferred to the data mailbox and must be analyzed by the PLC.

1st word	ID 1
2nd word	ID 2
3rd word	ID 3
4th word	Reserved
5th word	Length of data record in words
6th word	Data record value 1
	Data record value ...
nth word	Data record value m

11.7.4 Synchronization during Transfer

Control and acknowledgment bit 1

The transfer of data records is coordinated by Bits 11-15 of control and acknowledgment bits 1 in DW 64 of the interface area
(see chapter 10.1).

The relevant control and acknowledgment bits in DL 64 are the following:

Bit 11 = 1: Mailbox is locked

Bit 12 = 1: Data record contains errors

Bit 13 = 1: Data record contains no errors

Bit 14 = 1: Data transmission completed

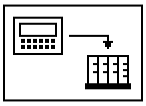
Bit 15 = 1: Data transmission in progress

Transfer sequence from operating unit → PLC

The sequence of transfer from the operating unit to the PLC is detailed below.

1. Before transfer starts, the operating unit checks Bit 11. If Bit 11 is set to `1`, transmission is cancelled and a system error returned. If Bit 11 is set to `0`, the operating unit sets it to `1`.
2. The operating unit sets bit 15 to `1` while transfer is in progress.
3. The operating unit sets bit 14 to `1` when transfer is completed.
4. Have the S5 program read Bit 14. If it is set, distribute the data to the relevant addresses as necessary. Then set Bit 12 or Bit 13 to `1`.
5. Unlock the mailbox again by resetting Bit 11.

The transfer sequence described above is programmed in the recipe FB (FB42:Recipe) as an example for text-based displays. That function block is located on the disk labelled *COROS Standard Function Blocks* which must be ordered separately. FB42 can not be used for graphics display units.

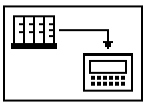


If the project for a graphics display unit incorporates the standard configuration, the transfer sequence described above corresponds to the use of the key illustrated on the left on the standard screen Z_RECORD_2.

Transfer sequence from PLC → operating unit

Transfer of a data record from the PLC to the operating unit is effected by reading directly from the memory areas configured for the recipe variables. Data transfer is not synchronized with the PLC.

In the case of text-based displays, the recipe number in the recipe number mailbox must match the recipe number requested on the operating unit.



If the project for a graphics display unit incorporates the standard configuration, the transfer sequence described above corresponds to the use of the key illustrated on the left on the standard screen Z_RECORD_2.

Example program for synchronization of transfer

Now have the PLC program set Bit 13 in DW 64 of the interface area to 1 for ”Transfer without errors”. Then reset Bit 11 in DW64 in order to unlock the data mailbox again. The program code for this sequence of operations might be as follows:

```
C DB 51
L DL 64
T FB 200
AN F 200.7
A F 200.6
S F 200.5
R F 200.3
L FB 200
T DL 64
BE
```

Transfer by way of PLC job with devices having a graphics display

We recommend that data record transfer is initiated by operator input on the operating unit. To do so, use standard screen `Z_Record_1`. When transferring data records by means of a PLC job (job nos. 69 and 70) the data record number can not be specified. Only the values of the current variables are transferred.

Job no. 70 corresponds to the function *Data record: OP → PLC*, and job no. 69 to function *Data record: PLC → OP*.

Transfer by way of PLC job with devices having a text-based display

In the case of text-based displays, PLC job no. 70 can be used to transfer a data record from the operating unit to the PLC. PLC job 69 initiates transfer from the PLC to the operating unit.

Example

Below is an example of the use of PLC job no. 70 on an OP7 or OP27 connected to a SIMATIC S5. The example illustrates the steps to be carried out on the OP7/OP27 and the PLC.

Step	Configuration for	
	OP7	**OP27**
1	Configure the tags for the recipe.	
2	Configure the recipe, i.e. define the text items and the tags.	
3	Configure a screen for editing and transferring the recipe. For that purpose you should define two function keys. The one function key should be assigned the function *Recipe Directory*, parameter 2 (Edit). The other should be assigned the function *Recipe Directory*, parameter 7 (Transfer).	
4	Configure the area pointers Interface Area, Recipe Number Mailbox and Recipe Mailbox.	Configure the two area pointers Interface Area and Data Mailbox.

Step	SIMATIC S5 PLC for	
	OP7	**OP27**
1	Reset bit 11 in data word 64 of the interface area.	
2	In the data area for the PLC job (size: 4 data words) enter job number `70` in data word 1.	
3	In data word 2 of the area enter the recipe number of the recipe that is to be transferred.	In data word 2 of the area enter the ID 1 of the recipe that is to be transferred.
4	In data word 3 of the area enter the data record number of the recipe that is to be transferred.	In data word 3 of the area enter the ID 2 of the recipe that is to be transferred.
5	Data word 4 of the area is not relevant.	In data word 4 of the area enter the ID 3 of the recipe that is to be transferred.
6	Write the start address of the area for the PLC job to data word 33 of the interface area.	
7	Write the data type (DL) and the DB number (DR) to data word 32 of the interface area. That initiates the PLC job.	
8	Data word 32 of the interface area is reset by the standard function block, the job has now been completed.	
9	The OP sets bit 11 and bit 14 bin data word 64 of the interface area.	
10	The PLC now has to confirm transfer by setting bit 13 and resetting bit 11 in data word 64 of the interface area. If that happens, the OP7 resets bit 14 in data word 64.	

The transfer is now complete. To transfer another data record, repeat Steps 2 to 10.

11.8 Writing Variables Indirectly

Basic principle

Indirect variables that are assigned to input fields can be configured for all graphics display units and text-based display units OP7/17 and TD17. The value is entered directly on the operating unit by the operator. After entry of the values on the operating unit, the contents of those variables are transferred in co-ordinated fashion to the data mailbox on the PLC.

Co-ordination

Co-ordination of data transfer is the similar to the co-ordination of data record transfer for recipes (see chapter 11.7.4).

Usage

Indirect variables can be used in screens in the same way as ”normal” variables, i.e. variables with addresses.

Part III SIMATIC S7 Connections

SIMATIC S7 Connection

12

In this chapter

This chapter describes communication between the operating unit and the SIMATIC S7. Explanations are provided of the different network configurations into which the operating unit can be integrated.

General

With the SIMATIC S7 PLC, the operating units can be connected via different network configurations. The network configuration depends on the CPU being used. The following network configurations are possible:

PLC		Protocol profile
Settings in ProTool for	**Modules**	
SIMATIC S7-300/400	CPU, Communication-compatible FM FM353/354, SIMODRIVE MCU 172A	MPI, DP[1], Standard[1], Universal[1]
SIMATIC S7-200	CPU	PPI, MPI[1], DP[1], Standard[1], Universal[1]
SIMATIC S7-NC	FM-NC, SINUMERIK 840D/810D	MPI, DP, Standard, Universal

1) CPU with PROFIBUS-DP interface only

The following operating units can be connected to the SIMATIC S7:

with graphics displays:	OP25/35, OP27/37, TP27/37
with text-based displays:	TD17, OP3, OP5/15, OP7/17

The following description does not apply to the OP3.

Network configuration

Operating units communicate with the S7-300/400 by means of the S7 protocol. The connection can be established via the MPI or the PROFIBUS interface of the CPU. The simplest network configuration consists of one CPU and one operating unit. A more complex configuration might consist of a CPU and several operating units, for example. Figure 12-1 shows the various possible network configurations.

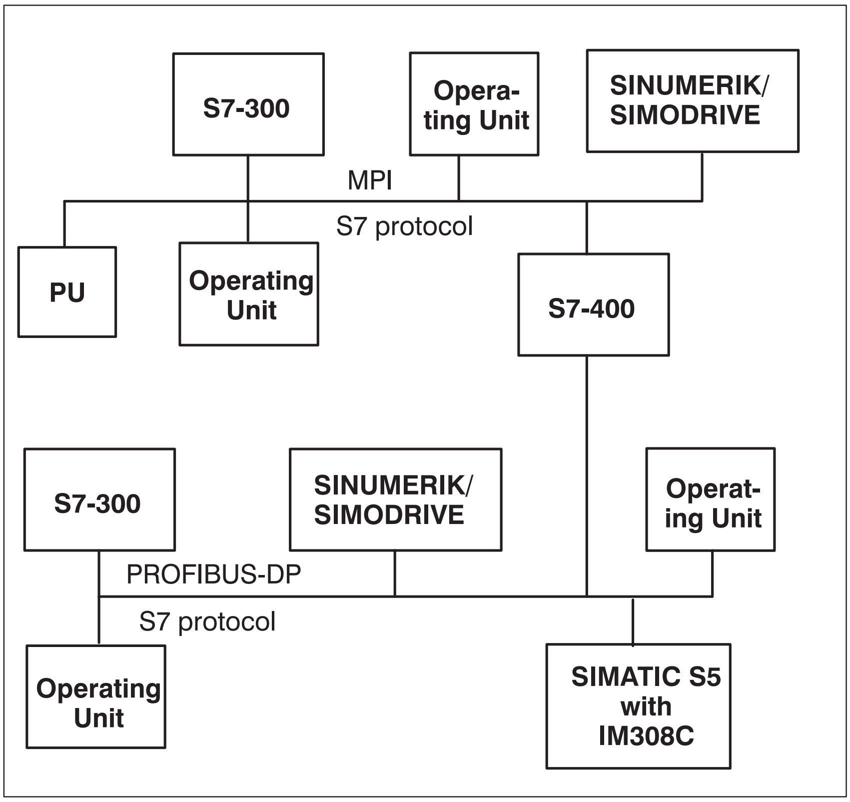


Figure 12-1 S7 network configurations

Communication between operating unit and S7

Communication between the operating unit and the SIMATIC S7 is fully supported by the operating system of the CPU. For that reason, no standard function blocks are required for communication.

The operating unit and the S7 communicate with one another by means of variables. The ProTool configuration software creates variables in the configuration that point to an address on the S7. The operating unit reads the value from the specified address and displays it. In the same way, the operator can enter a value on the operating unit which is then written to the PLC.

User data areas

As well as using variables, the operating unit and the S7 can communicate by means of user data areas. The user data areas are defined in the configuration and created in the S7 program. The user data areas you have to create depends on the objects used in ProTool. Those objects include messages, recipes and trends, for example. User data is are described in detail in chapter 14.

Permissible data types

The table below lists the data types that can be used in the configuration.

<table>
<tr><th>Address</th><th>Data type</th></tr>
<tr><th colspan="2">Permissible data types for S7-300/400</th></tr>
<tr><td>DB, M</td><td>CHAR
BYTE
INT
WORD
DINT
DWORD
REAL
BOOL
STRING*
TIMER
COUNTER</td></tr>
<tr><td>I, PI, Q, PQ</td><td>CHAR
BYTE
INT
WORD
DINT
DWORD
REAL
BOOL
STRING*</td></tr>
<tr><td>T</td><td>TIMER</td></tr>
<tr><td>C</td><td>COUNTER</td></tr>
<tr><th colspan="2">Permissible data types for S7-200</th></tr>
<tr><td>V</td><td rowspan="4">CHAR
BYTE
INT
WORD
DINT
DWORD
REAL
BOOL
STRING*</td></tr>
<tr><td>I</td></tr>
<tr><td>Q</td></tr>
<tr><td>M</td></tr>
<tr><td>T</td><td>TIMER</td></tr>
<tr><td>C</td><td>COUNTER</td></tr>
</table>

* If you are using ProTool integral with Step 7 and use tags of the type STRING, those tags are stored and updated by ProTool in the same way as in STEP 7.

  The following example illustrates the order of the bytes when specifying data type STRING[4] with the output value ’AB’:

  Byte 0: maximum length of string: 4
  Byte 1: actual length of string: 2
  Byte 2: ASCII value of ’A’
  Byte 3: ASCII value of ’B’
  Byte 4: –
  Byte 5: –

  If, however, ProTool is not integrated in STEP 7, byte 0 and byte 1 of a STRING tag are neither written to nor evaluated. This has to be taken into account when configuring the address in ProTool.

  If the above example were on the PLC in a data block from byte 100 to byte 105, the start address for that STRING tag would have to be configured as 102 in ProTool.

12.1 Connection to S7-200, S7-300 and S7-400 via MPI

Configuration

In the case of connection via the MPI, the operating unit is connected to the MPI interface of the S7. In this case, several operating units can be connected to an S7 and several S7 PLCs to an operating unit. As many as 32 nodes may communicate with each other in an MPI network configuration.

The SIMATIC S7-200 PLC should be configured in the network as a passive node. It is connected by means of the DP connector. The possible baud rate settings are 9.6 and 19.2 kBaud (ProTool Version 3.0 or later).

Figure 12-2 shows one possible network configuration. The numbers 1, 2, etc. are examples of addresses. The addresses of the S7 nodes are assigned using STEP7 hardware or network configuration.

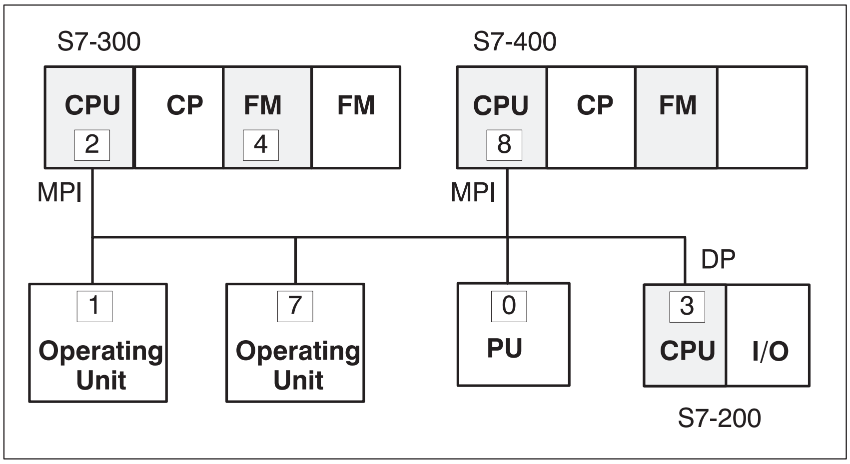


Figure 12-2 Connecting the Operating Unit to the SIMATIC S7

Communication peer

Every communication-compatible S7 module connected via the MPI port is a communication peer for the operating unit. Specifically, that involves the following:
– every CPU
– communication-compatible function modules (FMs) such as the FM356.

Modules that are communication-compatible are shown shaded in figure 12-2.

Maximum number of operating units connected

An operating unit can communicate with a maximum of 4 communication peers (e.g. CPU or FM) at the same time.

Similarly, there is a maximum number of connections to operating units defined for each communication-compatible module. For example, three operating units can be connected simultaneously to a CPU314 and 31 to a CPU414-1. For details of the maximum number of connections that a module may have at a time, refer to the documentation for the module concerned.

Configuring the operating unit

In order that the operating unit can communicate and exchange data with a CPU or an FM, the operating unit must be suitably configured. To do so, you must defined the address of the operating unit in the ProTool or ProTool/Lite configuration and specify the parameters for the connections with the communication peers.

To configure the operating unit, in ProTool or ProTool/Lite choose *System* → *PLC*. All the parameters required for the connection to a PLC are stored under a symbolic name such as `PLC_1`. Click the *Edit* or *New* button in order to enter the symbolic name and set up the S7. Click the *Parameters* button to configure the operating unit for connection to the S7. The dialog box shown in figure 12-3 appears.

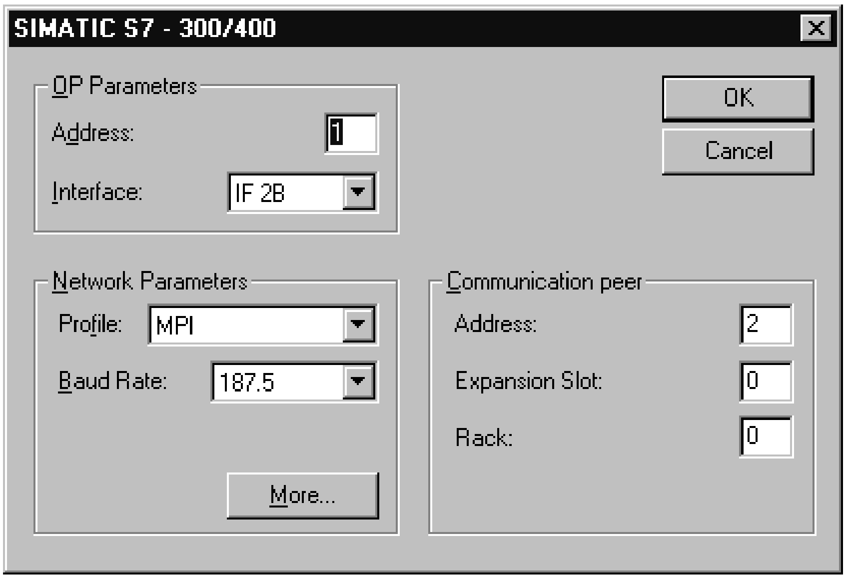


Figure 12-3 Dialog Box for Configuring the Operating Unit for Connection to the S7

Parameters

The parameters are subdivided into three groups.

– Under *OP Parameters* you enter the parameters for the operator panel in the network configuration. This is done once only. Any alteration to the OP parameters applies to all communication peers.

– Under *Network Parameters* you enter the parameters for the network to which the operating unit is linked. By clicking the *More* button, you can set the HSA and the number of masters in the network.

  If you installed ProTool integral with STEP 7 and have connected the operating unit to the network, the same network parameters will be used. Clicking the *More* button displays the global network parameters.

– Under *Peer Parameters*, enter the address details of the S7 module with which you want the operating unit to exchange data. A symbolic name has to be defined for every communication peer.

The various different parameters are explained below in table 12-1.

Table 12-1 Configuration Parameters

Group	Parameter	Explanation
OP parameters	Address	MPI address of the operating unit
	Interface	Interface on the operating unit via which the operating unit is connected to the MPI network.
Network parameters	Profile	The protocol profile used in the network configuration. You should enter *MPI* here.
	Baud rate	The baud rate at which communication takes place over the network.
Peer parameters	Address	MPI address of the S7 module (CPU, FM or CP) to which the **operating unit is connected.**.
	Expansion Slot	Number of the slot in which the S7 module with which the **operating unit exchanges data** is located.
	Rack	Number of the rack in which the S7 module with which the **operating unit exchanges data** is located.
More button	HSA	Highest station address; this must be identical throughout the whole network configuration.
	Master	Number of masters in the network. This information is only required for PROFIBUS networks and is necessary in order that the bus parameters can be calculated correctly.

12.1.1 S7-300 Addresses for MPI

MPI address

Every communication-compatible module in the S7-300 has a unique MPI address which may only only be assigned once within the network configuration. Only one CPU may be used in each rack. Figure 12-4 illustrates direct connection of the operating unit to the MPI interface of the CPU.

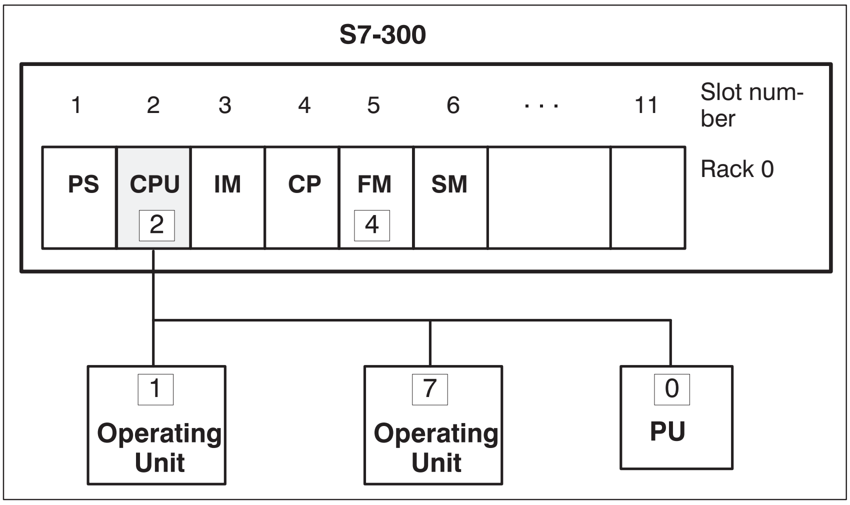


Figure 12-4 Network Configuration with S7-300 and Operating Unit – oneRrack

Peer address

When defining addresses, a distinction must be made between peers *with their own MPI address* and peers *without their own MPI address.*

– In the case of peers with their own MPI address, only the MPI address need be specified. Slot and rack details are not relevant.
– In the case of peers without their own MPI address, the MPI address, the slot number and the rack number must be specified.

Example: CPU address

In order that the operating unit can communicate with the CPU shown in figure 12-4, the following parameters must be specified for the *communication peer* S7-CPU in the configuration:

Example based on Figure 12-4		
	Own MPI Address	**No Own MPI Address**
Address	2	2
Slot number	0	2
Rack	0	0

The above values are are also the default values used in ProTool and ProTool/Lite.

FM address

The operating unit can only communicate with FM modules that have an MPI address. That covers all FMs that are connected to the K bus.

FMs that do not have an MPI address are connected to the P bus. That includes the FM350, for example. The data from those FMs can be visualized using the operating unit from the I/O bit pattern of the CPU.

Example based on Figure 12-4		
	Own MPI Address	**No Own MPI Address**
Address	4	2
Slot number	0	5
Rack	0	0

Number of racks

An S7-300 can consist of a maximum of 4 racks. The operating unit can communicate with any communication-compatible module in those racks. Figure 12-5 shows a configuration involving multiple racks and the allocation of addresses.

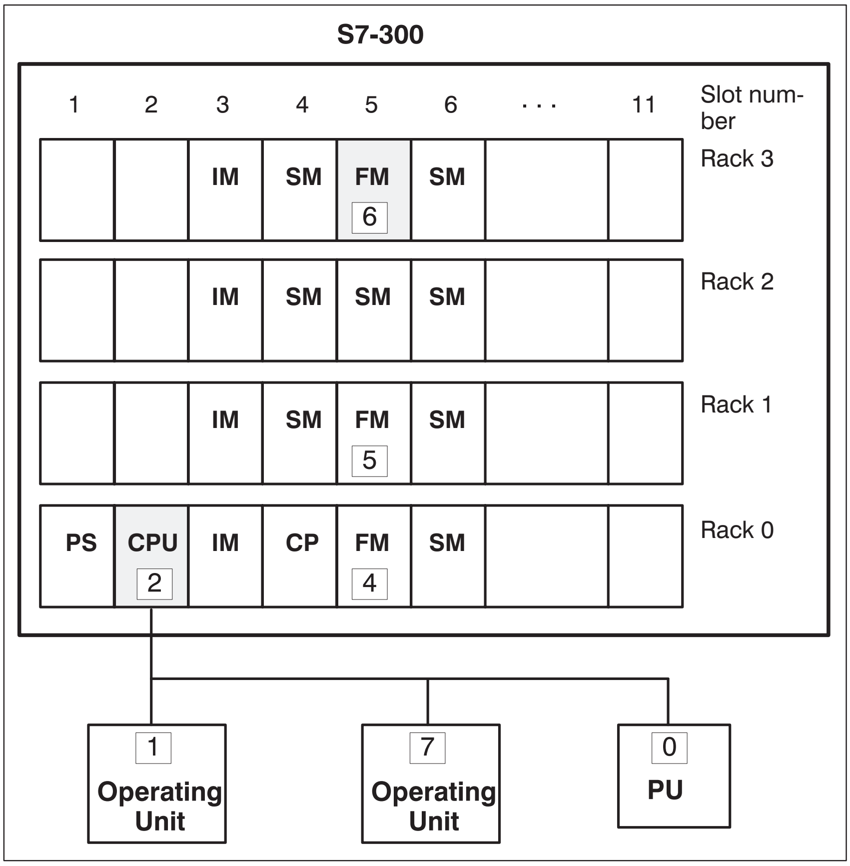


Figure 12-5 Network Configuration with S7-300 and Operating Unit – four Racks

Example: FM address

In order that the operating unit can communicate with the shaded FM shown in figure 12-5, the following parameters must be specified for the *communication peer* in the configuration:

Example based on Figure 12-5		
	Own MPI Address	**No Own MPI Address**
Address	6	2
Slot number	0	5
Rack	0	3

12.1.2 S7-400 Addresses for MPI

MPI address

Only modules that have an MPI connector also have an MPI address. The MPI address must be unique within the network configuration. Module that do not have an MPI connector are addressed indirectly by means of

– the MPI address of the module to which the operating unit is connected
– the slot and the rack in which the module with which the operating unit is to communicate is located.

Figure 12-6 shows a simple network configuration with one rack.

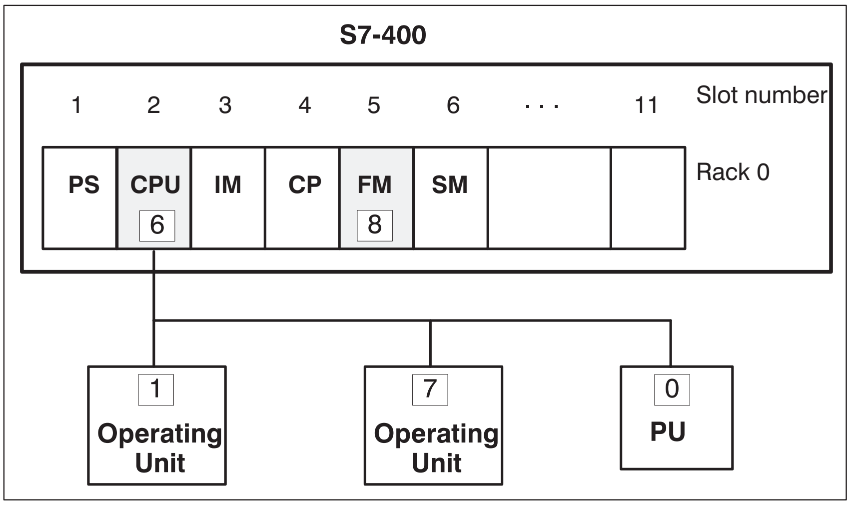


Figure 12-6 Network Configuration with S7-400 and Operating Unit – one Rack

Example: CPU address

In order that the operating unit can communicate with the shaded CPU shown in figure 12-6, the following parameters must be specified for the *communication peer* in the configuration:

Example based on Figure 12-6		
	Own MPI Address	**No Own MPI Address**
Address	6	6
Slot number	0	2
Rack	0	0

Example: FM address

In order that the operating unit can communicate with the shaded FM shown in figure 12-6, the following parameters must be specified for the *communication peer* in the configuration:

Example based on Figure 12-6		
	Own MPI Address	**No Own MPI Address**
Address	8	6
Slot number	0	5
Rack	0	0

Operating unit to FM

The operating unit can only communicate with FM modules that are connected to the K bus. Those include the FM453, for example.

12.2 Connection to S7-300 and S7-400 via PROFIBUS

Configuration

In a PROFIBUS network, an operating unit can be connected to any S7 modules that have an integral PROFIBUS or PROFIBUS-DP interface and support the S7 protocol. Several operating units can be connected to an S7 and several S7 PLCs to an operating unit.

Figure 12-7 shows one possible network configuration. The numbers 1, 2, etc. are examples of addresses. The addresses of the S7 nodes are assigned using STEP7 hardware or network configuration.

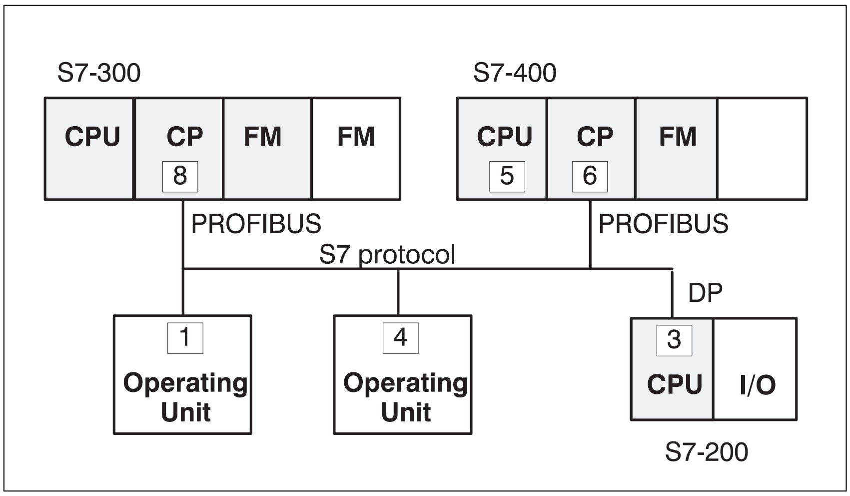


Figure 12-7 Connecting the Operating Unit to the SIMATIC S7 via PROFIBUS

Communication peers

As with the MPI interface, the operating unit can also exchange data via the PROFIBUS or PROFIBUS-DP with any communication-compatible S7 module. Specifically, that involves the following:

– any CPU that supports the S7 protocol, such as the CPU 413-2DP, CPU 414-2DP, CPU 315-2DP version 315-2AF01-0AB0 or later

– communication-compatible function modules (FMs)

– communication processors (CPs) such as the CP342-5DP.

The modules with which the operating unit can communicate and shown shaded in figure 12-7.

Configuring the operating unit

In order that the operating unit can communicate and exchange data with a CPU or an FM, the operating unit must be suitably configured. To do so, you must define the address of the operating unit in the ProTool or ProTool/Lite configuration and specify the parameters for the connections with the communication peers.

To configure the operating unit, in ProTool or ProTool/Lite choose *System* → *PLC*. All the parameters required for the connection to a PLC are stored under a symbolic name such as `PLC_1`. Click the *Edit* or *New* button in order to enter the symbolic name and set up the S7. Click the *Parameters* button to configure the operating unit for connection to the S7. The dialog box shown in figure 12-8 appears.

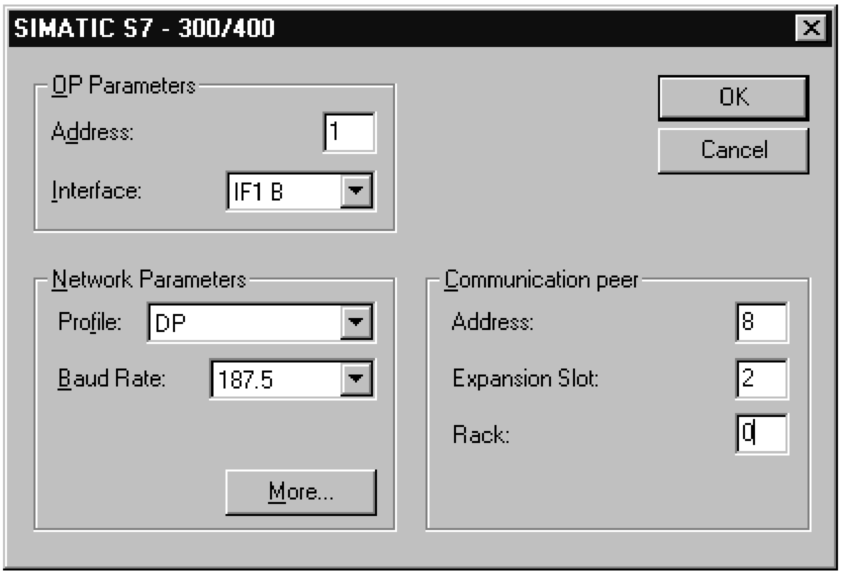


Figure 12-8 Dialog Box for Configuring the Operating Unit for Connection to the S7 via PROFIBUS

Parameters

The parameters are subdivided into three groups.

– Under *OP Parameters* you enter the parameters for the operating unit in the network configuration. This is done once only. Any alteration to the OP parameters applies to all communication peers.

– Under *Network Parameters* you enter the parameters for the network to which the operating unit is linked. By clicking the *More* button, you can set the HSA and the number of masters in the network.

  If you installed ProTool integral with STEP 7 and have connected the operating unit to the network, the same network parameters will be used. Clicking the *More* button displays the global network parameters.

– Under *Peer Parameters*, enter the address details of the S7 module with which you want the operating unit to exchange data. A symbolic name has to be defined for every communication peer.

The various different parameters are explained below in table 12-2.

Table 12-2 Configuration Parameters

Group	Parameter	Explanation
OP parameters	Address	PROFIBUS address of the operating unit.
	Interface	Interface on the operating unit via which the operating unit is connected to the PROFIBUS network.
Network parameters	Profile	The protocol profile used in the network configuration. Here you should enter *DP*, *Standard* or *Universal*. This setting must be identical throughout the whole network configuration.
	Baud rate	The baud rate at which communication takes place over the network.
Peer parameters	Address	PROFIBUS address of the S7 module (CPU, FM or CP) to which the **operating unit is connected.**.
	Expansion Slot	Number of the slot in which the S7 module with which the **operating unit exchanges data** is located.
	Rack	Number of the rack in which the S7 module with which the **operating unit exchanges data is located.**
More button	HSA	Highest station address; this must be identical throughout the whole network configuration.
	Master	Number of masters in the network. This information is only required for PROFIBUS networks and is necessary in order that the bus parameters can be calculated correctly.

Addressing with S7-300

A communication-compatible S7 module is addressed by means of the following parameters:

Address:	*PROFIBUS address of the CP.*
Slot number:	*Slot number of the S7 module*
Rack:	*The rack in which the S7 module is located*

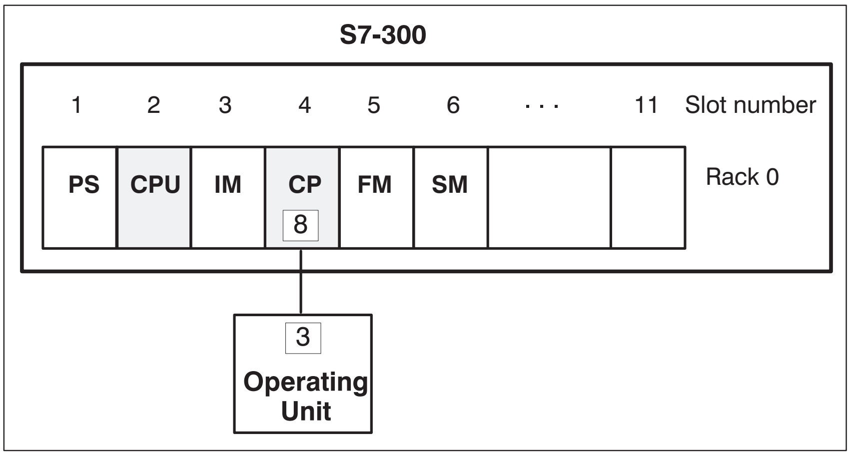


Figure 12-9 Network Configuration with S7-300 and Operating Unit – PROFIBUS-DP Profile

The CPU shown in figure 12-9 is addressed as follows:

Address:	8
Slot number:	2
Rack:	0

Addressing with S7-400

A communication-compatible S7 module is addressed by means of the following parameters:

Address:	*PROFIBUS address of the CP or the DP interface of the CPU*
Slot number:	*Slot number of the S7 module*
Rack:	*The rack in which the S7 module is located*

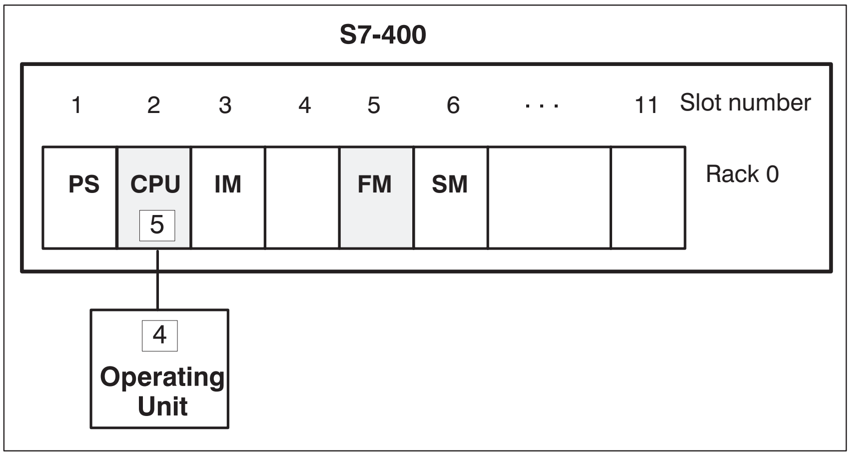


Figure 12-10 Network Configuration with S7-400 and Operating Unit – PROFIBUS-DP Profile

The CPU shown in figure 12-10 is addressed as follows:
Address: 5
Slot number: 0
Rack: 0

The FM is addressed as follows:
Address: 5
Slot number: 5
Rack: 0

12.3 Configuring DP Direct Keys for the Operating Unit

Usage

The F and K keys on operating units can also be used in a configuration as DP direct keys in addition to their normal usage. In the case of touch panels, the function *Direct Keys* must be associated with the button configured. When keys or buttons are configured as direct keys it means that whenever the key or button is pressed a bit in the CPU I/O area is set.

As far as the S7-CPU is concerned, DP direct keys are normal inputs and are therefore configured in precisely the same way as, say, an ET200 station. The cycle time of the DP bus is calculated as the sum of all configured inputs/outputs. This means that the response time of the DP direct keys can also be determined. For a typical DP configuration, the response time of the DP keys is < 100 ms.

Condition

The basic condition is that the operating unit is connected to the SIMATIC S7 PLCs via a PROFIBUS-DP link.

ProTool must have been installed integral with Step 7 and the operating unit must be incorporated in the PROFIBUS network. A detailed description of how this is done is given in the *ProTool User's Guide*.

Operating units usable

DP direct keys can be used with the following operating units:

Text-based displays:	OP7, OP17
Graphics displays:	OP25/35, OP27/37 (inc. CPI)
Touch panels:	TP27/37 (inc. CPI)

Configuration for STEP 7

The operating unit should be configured as an active node for general communication (reading and writing of variables) – for details see chapter 12.2. For the DP direct keys, the operating unit should also be configured as a slave in the PROFIBUS-DP network. Figure 12-11 shows the basic configuration based on an S7-400.

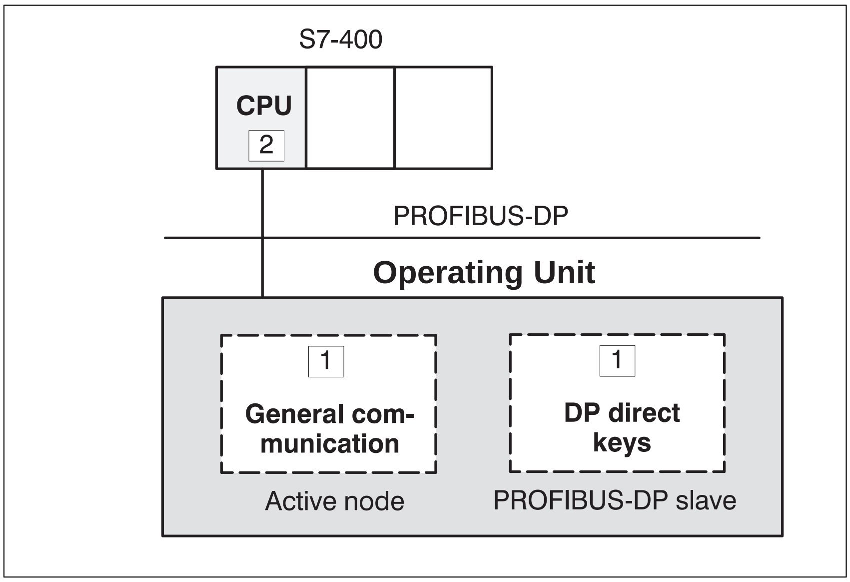


Figure 12-11 Configuration of Operating Unit using DP Direct Keys

Basic configuration procedure

The basic procedure for configuring the operating unit (as a master) for general communication with STEP 7 and for configuring the operating unit as a slave for the DP direct keys is described below.

1. Create a STEP 7 project and configure the hardware using a DP-compatible CPU, e.g. the CPU 413-2DP.
2. Copy a standard configuration for, say, the OP17 to your STEP 7 project. The standard configurations are located in the STEP 7 project `ProTool`. Double-click the operating unit to open the ProTool configuration software.
3. Choose *System* → *PLC* from the menu and click the *Edit* button followed by the *Parameters* button.
4. In the dialog box which then appears, select the network and the PLC to which you wish to connect the operating unit. The network parameters are automatically adopted. Figure 12-12 shows an example configuration.

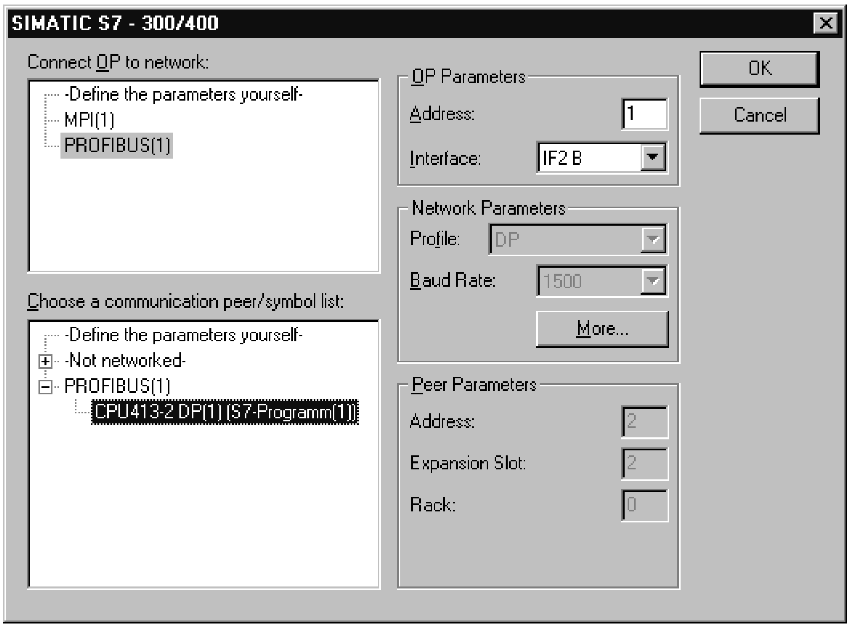


Figure 12-12 Example of Connecting the Operating Unit to the Network and CPU

By following steps 1 to 4, you have now configured the operating unit as an active node in the PROFIBUS-DP network. By carrying out step 5, you will then configure the operating unit as a PROFIBUS-DP slave in order to be able to use the DP direct keys. The same address is used to configure the operating unit as an active node and as a DP slave.

5. To configure the operating unit as a DP slave as well, now open the STEP 7 hardware configuration and in the hardware catalogue select, for example, the *OP17 DP KEY* from

   Previously configured stations
   SIMATIC OP

6. Attach the operating unit to the DP network as you would an ET200, for example. You are then shown a list of all operating units already configured in that network. In this example, you would then select the operating unit with the address 1.

   The same address is used for configuring the operating unit as a DP slave for the DP direct keys as when it is configured as an active node. In this example, that is address 1. Figure 12-13 shows the complete network configuration.

7. In the case of graphics displays, you can also configure CPI modules as well as the DP direct keys. The CPI modules are displayed if, for example, you select *OP37-DP KEYS* in the hardware catalogue.

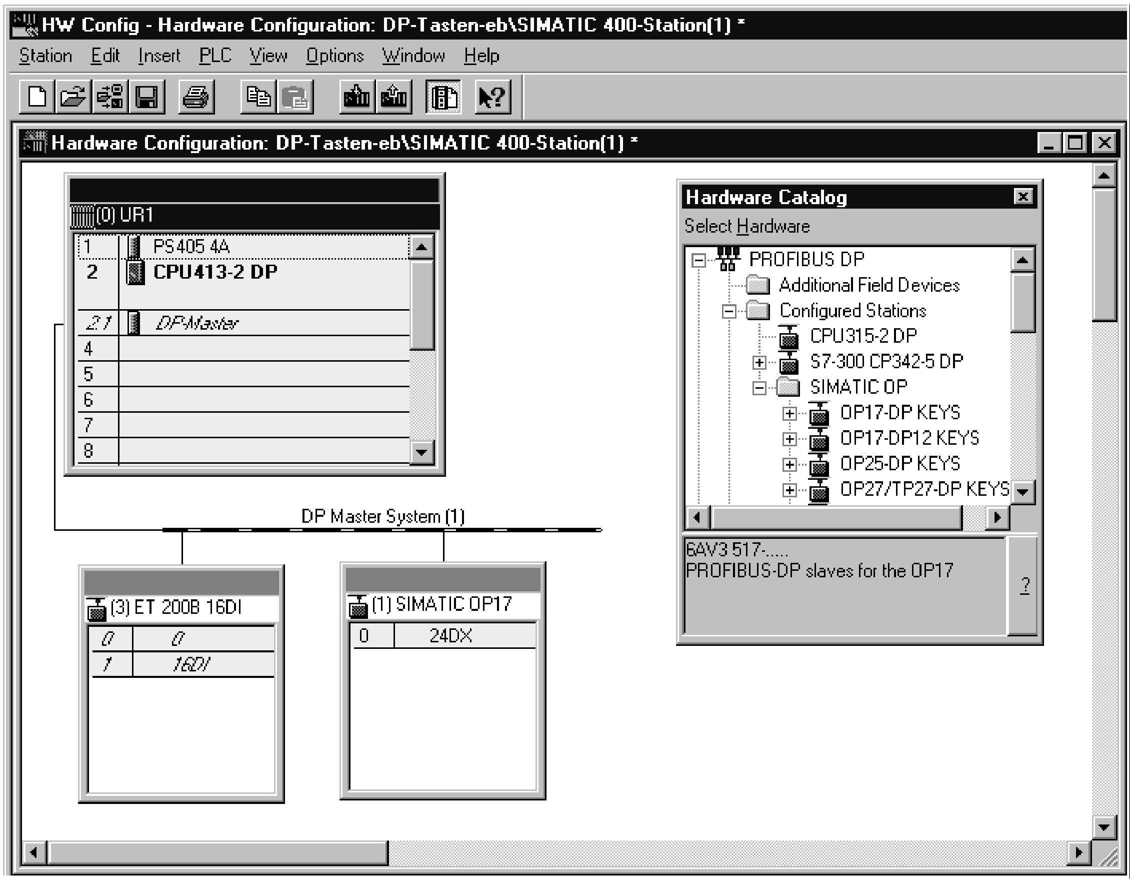


Figure 12-13 Example of Configuration of DP Direct Keys for OP17

Input/Output assignment

The keys or buttons on the operating unit are assigned to bytes in the DP input area while the LEDs are assigned to bytes in the DP output area. Table 12-3 shows the number of bytes used by the various models of operating unit. The precise assignment details are shown in the succeeding diagrams.

The touch panels do not have any permanently assigned keys. They only have user-configurable buttons. You can assign a button a bit in the DP input area by means of the function *Direct Keys*. The direction in which the bits are counted in the DP input area is from right to left. In contrast with operator panels, which have permanently assigned keys, the touch panel buttons can be assigned freely. A detailed description of this function is given in the *ProTool User's Guide*.

Table 12-3 Assignment of DP Inputs/Outputs

Operating unit	Inputs	Outputs
OP7	2 Bytes	2 Bytes
OP17	3 Bytes	3 Bytes
OP25, OP27	3 Bytes	3 Bytes
TP 27	3 Bytes	–
OP35, OP37	5 Bytes	5 Bytes
TP 37	5 Bytes	–
CPI module	2 Bytes per CPI module	2 Bytes per CPI module

CPI module

A CPI module can be plugged into the OP27/37 and TP27/37 as an option. External keys can be connected via the CPI module and then used on the DP bus in the same way as the keys or buttons on the operating unit. The bytes in the I/O area to which the first CPI module is assigned follow on directly from the permanently assigned area.

Assignment for OP35/37

7	6	5	4	3	2	1	0	Byte	7	6	5	4	3	2	1	0
F8	F7	F6	F5	F4	F3	F2	F1	n+0	F8	F7	F6	F5	F4	F3	F2	F1
F16	F15	F14	F13	F12	F11	F10	F9	n+1					F12	F11	F10	F9
□↔□	ALT	CTRL	SHIFT	F20	F19	F18	F17	n+2	A–Z	A–Z	ACK	INFO				
K8	K7	K6	K5	K4	K3	K2	K1	n+3	K8	K7	K6	K5	K4	K3	K2	K1
K16	K15	K14	K13	K12	K11	K10	K9	n+4	K16	K15	K14	K13	K12	K11	K10	K9

Keys **LEDs**

Assignment for OP25/27

Keys

Byte	7	6	5	4	3	2	1	0
n+0	F8	F7	F6	F5	F4	F3	F2	F1
n+1	K2	K1	F14	F13	F12	F11	F10	F9
n+2	K10	K9	K8	K7	K6	K5	K4	K3

LEDs

Byte	7	6	5	4	3	2	1	0
n+0	F8	F7	F6	F5	F4	F3	F2	F1
n+1	K2	K1			ACK	INFO	A–Z	A–Z
n+2	K10	K9	K8	K7	K6	K5	K4	K3

Assignment for OP17

Keys

Byte	7	6	5	4	3	2	1	0
n+0	K8	K7	K6	K5	K4	K3	K2	K1
n+1	K16	K15	K14	K13	K12	K11	K10	K9
n+2	F8	F7	F6	F5	F4	F3	F2	F1

LEDs

Byte	7	6	5	4	3	2	1	0
n+0	K8	K7	K6	K5	K4	K3	K2	K1
n+1	K16	K15	K14	K13	K12	K11	K10	K9
n+2								

Assignment for OP7

Keys

Byte	7	6	5	4	3	2	1	0
n+0					K4	K3	K2	K1
n+1					F4	F3	F2	F1

LEDs

Byte	7	6	5	4	3	2	1	0
n+0					K4	K3	K2	K1
n+1								

PROFIBUS screen number (TP only)

If PROFIBUS direct keys use the same bits for different functions on different screens, the S7 must distinguish between the various functions by means of the screen number. In such circumstances, the screen function *PROFIBUS Screen Number* can be used to overcome the delay in updating the screen number on the PLC following a change of screen.

The function *PROFIBUS Screen Number* allows you to set any bits in the DP input area in order to identify the screen and transfer them to the PLC at the same time as the direct key bits. This ensures unambiguous allocation of control bit to screen number at all times.

Depending on the allocation of the DP input area bits, you have access to a varying number of fast functions as follows:

	Total Number of Bits	Example of Possible Allocation	Number of Fast Functions
TP27	24	12 screens with 12 direct keys each	144
		4 screens with 20 direct keys each	80
TP37	40	20 screens with 20 direct keys each	400
		8 screens with 32 direct keys each	256

12.4 Connecting to S7 Positioning Modules

Compatible operating units

Operating units OP7/17 and TD17 support S7 positioning modules.

Addressing positioning modules

If the operating unit is connected to S7 positioning modules, those modules have to be configured in ProTool by choosing menu item *System* → *PLC*. Every intelligent module that communicates with the operating unit has to be set up as a separate PLC. If the operating unit is to communicate with the CPU and the positioning module, then two PLCs have to be created in ProTool.

SIMODRIVE MCU 172A compound units represent a special case. The compound unit should be set up in ProTool as a single PLC with a single address.

Configuring in ProTool

For function modules FM353 and FM354 as well as the SIMODRIVE MCU 172A you should set the PLC *SIMATIC S7 – 300/400*.

The two examples below describe address allocation for the FM and SIMODRIVE MCU 172 for connection via the MPI.

Peer address

The CPU and the FM represent two different peers as far as the operating unit is concerned which have to be created in ProTool as two separate PLCs. Each peer has a separate MPI address. Figure 12-14 shows a configuration with an FM.

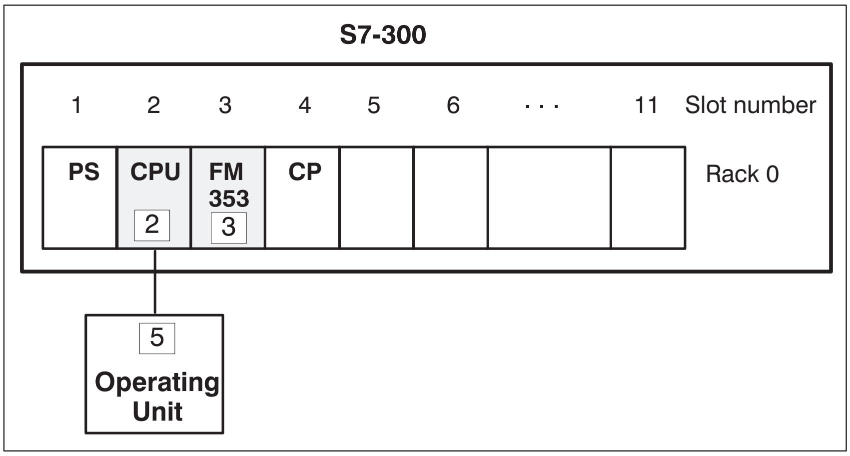


Figure 12-14 Network Configuration with S7-300 and Operating Unit – MPI Profile

	CPU	FM353
Address	2	3
Slot number	0	0
Rack	0	0

The SIMODRIVE MCU 172A compound unit contains one CPU and one FM positioning module. To connect the operating unit to the SIMODRIVE MCU 172A, only one PLC has to be configured in ProTool. Figure 12-15 shows a configuration with a SIMODRIVE MCU 172A.

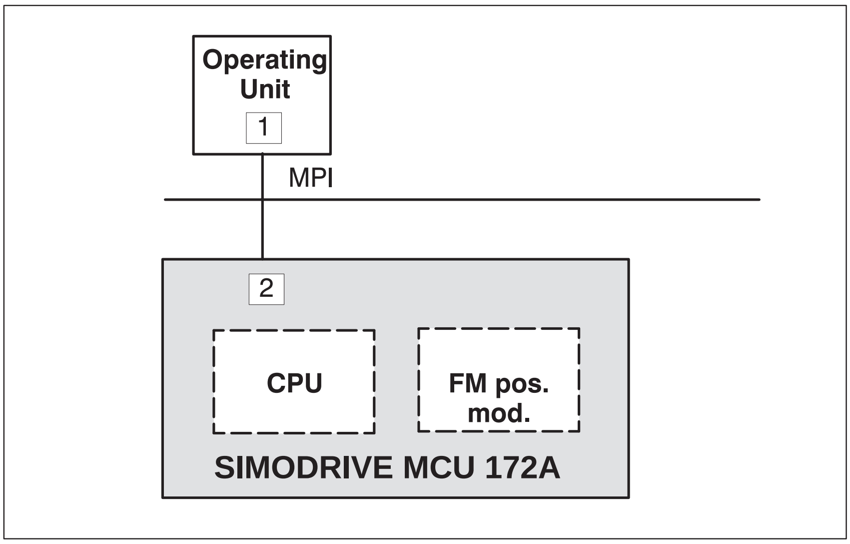


Figure 12-15 Network Configuration with SIMODRIVE MCU 172A and Operating Unit – MPI Profile

	SIMODRIVE MCU 172A
Address	2
Slot number	0
Rack	0

12.5 Connecting to S7 SINUMERIK Modules

Compatible operating units

Operating units OP7/17 and TD17 support S7 SINUMERIK modules.

Addressing SINUMERIK modules

If the operating unit is connected to S7 SINUMERIK modules, those modules have to be configured in ProTool by choosing menu item *System → PLC*. Every intelligent module that communicates with the operating unit has to be set up as a separate PLC. If the operating unit is to communicate with the CPU and the SINUMERIK module, then two PLCs have to be created in ProTool.

Configuring in ProTool

For FM-NC function modules and SINUMERIK 810D/840D compound units, the PLC *SIMATIC S7 – NC* should be entered because the NC has its own address.

The two examples below describe address allocation for the FM-NC and SINUMERIK 810D/840D for connection via MPI and PROFIBUS-DP.

Peer address for MPI

The CPU and the FM-NC represent two different peers as far as the operating unit is concerned which have to be created in ProTool as two separate PLCs. Each peer has a separate MPI address. Figure 12-16 shows a configuration for FM-NCs and the table below it the address details. Figure 12-17 shows the dialog box in ProTool for the FM-NC address details.

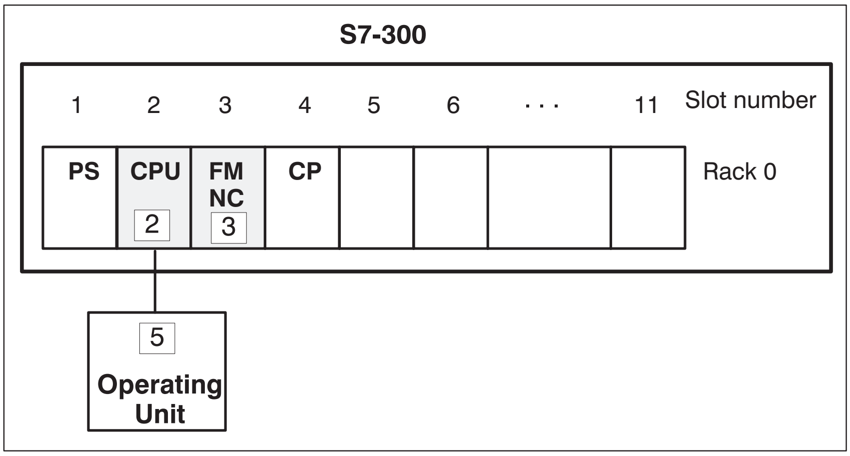


Figure 12-16 Network Configuration with S7-300 and Operating Unit – MPI Profile

	SIMATIC S7-300/400 CPU	SIMATIC S7-NC FM-NC
Address	2	3
Slot number	0	0
Rack	0	0

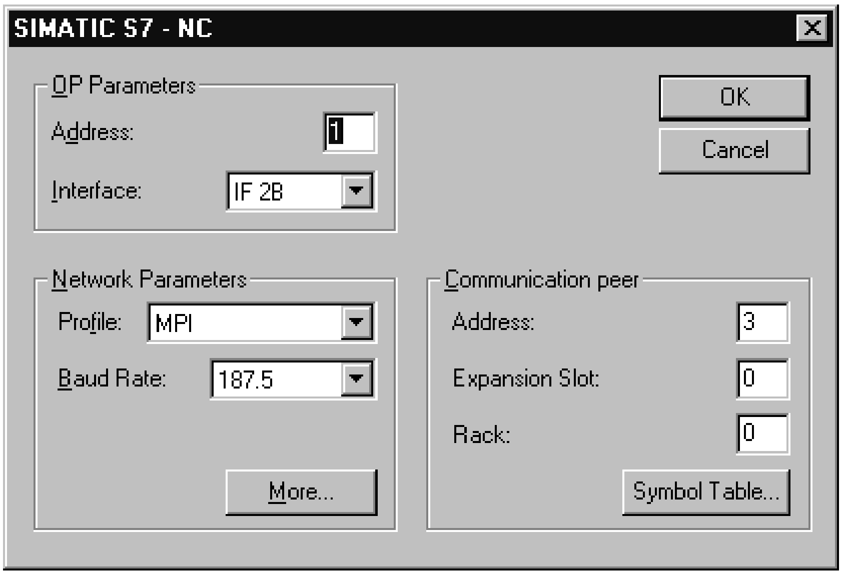


Figure 12-17 Configuring the FM-NC in ProTool – MPI Profile

The SINUMERIK 810D/840D compound units contain one CPU and one FM-NC. To connect the operating unit to the SINUMERIK 810D/840D, two PLCs have to be configured in ProTool with the addresses 2 and 3. Figure 12-18 shows a configuration with a SINUMERIK 810D.

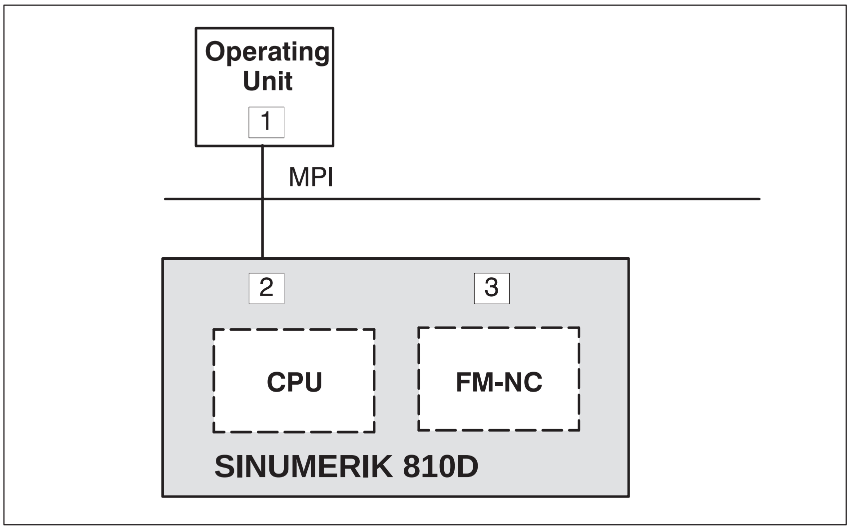


Figure 12-18 Network Configuration with SINUMERIK 810D and Operating Unit – MPI Profile

	SIMATIC S7-300/400 CPU	SIMATIC S7-NC FM-NC
Address	2	3
Slot number	0	0
Rack	0	0

Peer address for PROFIBUS-DP

The CPU and the FM-NC represent two different peers as far as the operating unit is concerned which have to be created in ProTool as two separate PLCs. Both peers are addressed via the DP address of the CP. Figure 12-19 shows a configuration for FM-NCs and the table below it the address details. Figure 12-20 shows the dialog box in ProTool for the FM-NC address details.

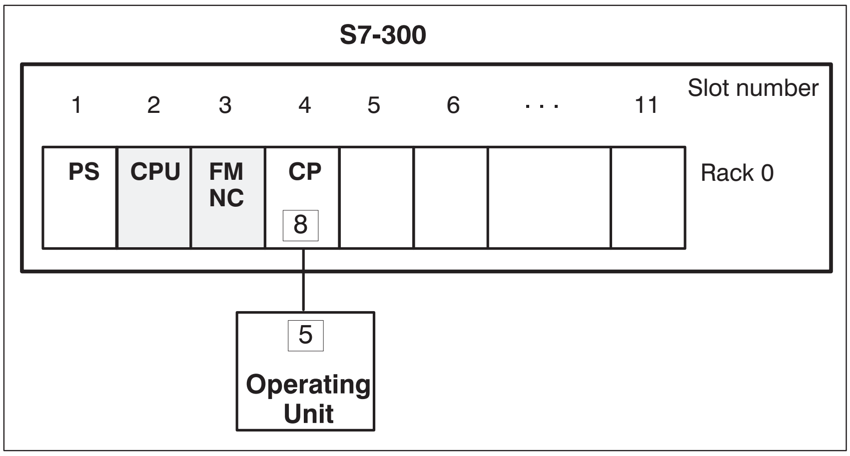


Figure 12-19 Network Configuration with S7-300 and Operating Unit – PROFIBUS-DP Profile

	SIMATIC S7-300/400 CPU	SIMATIC NC FM-NC
Address	8	8
Slot number	2	3
Rack	0	0

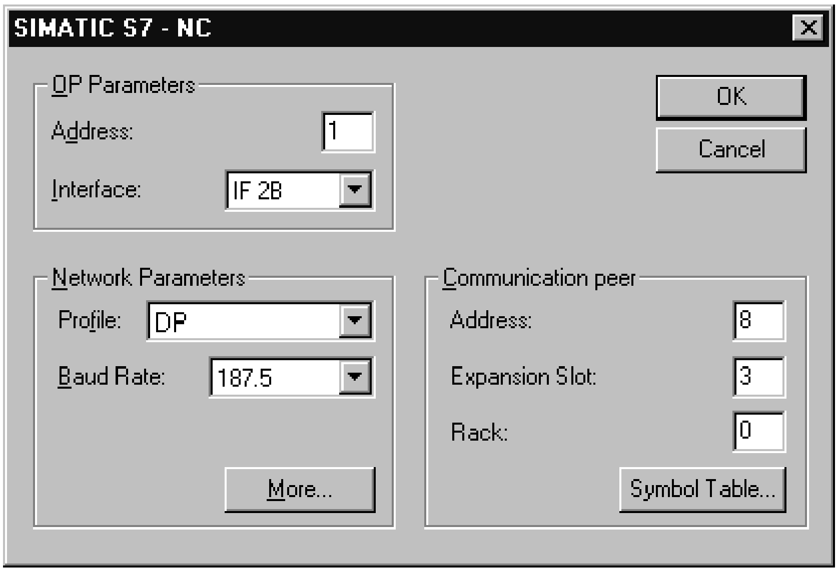


Figure 12-20 Configuring the FM-NC in ProTool – PROFIBUS-DP Profile

12.6 Connecting to an S7-200 via PPI

Principle

The PPI connection is a point-to-point connection in which the operating unit is the master and the S7-200 the slave. A maximum of two S7-200s can be connected to an operating unit.

Similarly, multiple operating units can be connected to one S7-200. In such cases, as far as the S7-200 is concerned, only one link is possible at any one time. The operating units only support multimaster function as of the ProTool versions listed in table 12-4.

Table 12-4 ProTool Versions which Support Multimaster Function

Unit	ProTool Version
TD17	Version 3 or later
OP7, OP17	Version 2.51 or later
OP25, OP35	Version 3 or later
OP27	Version 4 or later
OP37	Version 3 or later
TP27	Version 4 or later
TP37	Version 3 or later

Configuration

For connection to the S7-200, the operating unit is connected to the PPI interface of the S7-200. Figure 12-21 shows one possible network configuration. The numbers `2`, `4` and `1` are examples of addresses.

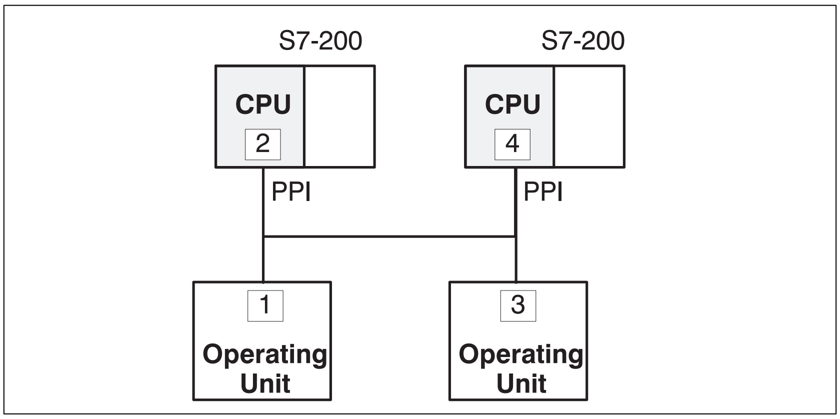


Figure 12-21 Connecting the Operating Unit to the SIMATIC S7-200

Configuring the operating unit

In order that the operating unit can communicate and exchange data with a CPU, the operating unit must be suitably configured. To do so, you must define the address of the operating unit in the ProTool or ProTool/Lite configuration and specify the parameters for the connections with the communication peers.

To configure the operating unit, in ProTool or ProTool/Lite choose *System → PLC*. All the parameters required for the connection to a PLC are stored under a symbolic name such as `PLC_1`. Click the *Edit* or *New* button in order to enter the symbolic name and set up the S7-200. Click the *Parameters* button to configure the operating unit for connection to the S7. The dialog box shown in figure 12-22 appears.

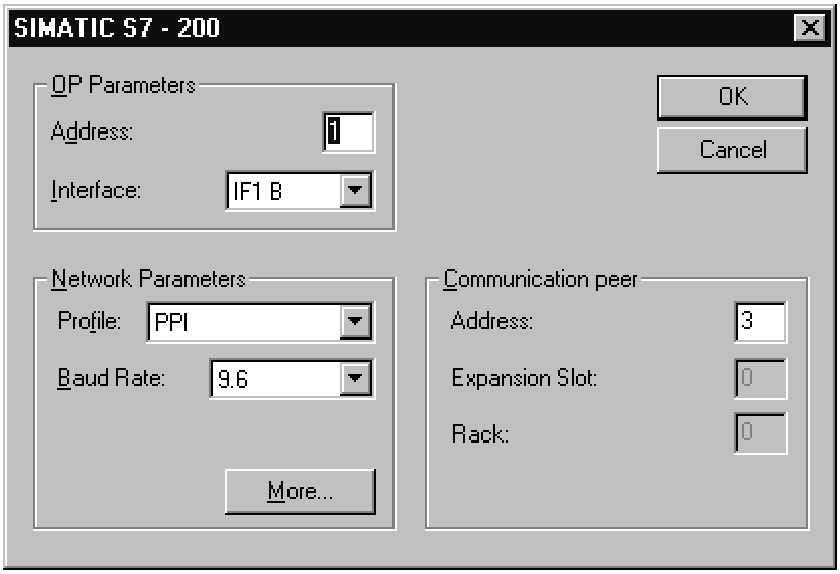


Figure 12-22 Dialog Box for Configuring the Operating Unit for Connection to the S7 via PPI

Parameters

The parameters are subdivided into three groups.

- Under *OP Parameters* you enter the parameters for the operating unit in the network configuration. This is done once only. Any alteration to the OP parameters applies to all communication peers.
- Under *Network Parameters* you enter the parameters for the network to which the operating unit is linked. By clicking the *More* button, you can set the HSA and the number of masters in the network.
- Under *Peer Parameters*, enter the address details of the S7 module with which you want the operating unit to exchange data. A symbolic name has to be defined for every communication peer.

The various different parameters are explained below in table 12-5.

Table 12-5 Configuration Parameters

Group	Parameter	Explanation
OP parameters	Address	PPI address of the operating unit
	Interface	Interface on the operating unit via which the operating unit is connected to the PPI network.
Network parameters	Profile	The protocol profile used in the network configuration. You should enter *PPI* here.
	Baud rate	The baud rate (9600 or 19200 Baud) at which communication takes place across the network.
Peer parameters	Address	The PPI address of the S7 module to which the **operating unit is connected**.
More button	HSA	Highest station address; this must be identical throughout the whole network configuration.
	Master	Number of masters in the network. This information is only required for PROFIBUS networks and is necessary in order that the bus parameters can be calculated correctly.

12.7 Notes on Optimization

Crucial Factors

The structure of the user data areas described in chapter 14 along with the polling times configured for the **area pointers** are crucial factors in the update times **actually achievable**. The update time is the polling time plus transmission time plus processing time.

In order to achieve optimum update times, the following points should be observed during configuration:

- When setting up the individual data areas, make them as large as necessary but as small as possible.
- Define data areas that belong together as contiguous areas. The effective update time will be better if you create a <u>single</u> large area rather than several smaller areas.
- Setting the polling times that are too short unnecessarily impairs overall performance. Set the polling time to match the rate at which process variables change. The rate of change of temperature of a furnace, for example, is considerably slower than the acceleration curve of an electric motor.

  Guide figure for polling time: approx. 1 second.
- If necessary, dispense with cyclic transmission of user data areas (polling time = 0) in order to improve the update time. Instead, use PLC jobs to transfer the user data areas at random times.
- Store the variables for a message or a screen in a contiguous data area.
- In order that changes on the PLC are reliably detected by the operating unit, they must be present for the duration of the actual polling time at least.

Screens

In the case of screens, the update rate effectively achievable depends on:

- the number of data areas used,
- the type and volume of data to be displayed,
- the distribution of data within a particular data area.

In the interests of achieving rapid update times, the following points should be observed during configuration:

- Use only one data block for the variables of a particular screen.
- Store the items of data to be used as closely as possible to one another in the DB.
- Only configure short polling times for those entries that actually need to be updated at frequent intervals.
- For devices having a text-based display only:
  For screens with large numbers of actual values and specified/actual values activate partial screen updating by means of a PLC job.

If, in the case of bit-triggered trends, the communication bit is set in the *trend transfer area*, the operating unit always updates all the trends whose bit is set in that area. Afterwards it resets the bit. If the S7 program immediately sets the bit again, the operating unit spends all its time updating the trends. It is then virtually impossible to operate the operating unit.

PLC jobs

If large numbers of PLC jobs are sent to the operating unit in quick succession, communication between the operating unit and the S7 can become overloaded as a result.

If the operating unit enters `0` in the first data word of the job mailbox it signifies that the operating unit has received the job. It then processes the job – for which it requires a certain amount of time. In the case of fast CPUs it is possible that the operating unit may not have completely processed the PLC job before the next is sent.

Interface Area for the SIMATIC S7 13

Function

The interface area is a data area that represents the interface between the application program and the operating unit. It contains data and pointers to data areas that are required for exchange of data between the SIMATIC S7 and the operating unit.

Condition

The interface area is only required for the SIMATIC S7 if the functions it contains are used or anlayzed by the S7. The interface area must be configured if the following functions are used:

– Sending of PLC jobs to the operating unit
– Synchronising of date and time between S7 and operating unit
– Analysis of connection ID
– Recipes (transfer of data records)
– Detection of operating unit startup by S7 program
– Analysis of operating unit mode by S7 program
– Analysis of operating unit life bit by S7 program
– Setting of scheduler (OP15 and OP17 only)

Layout of interface area

Figure 13-1 shows the layout of the interface area. You can create the interface area in a data block or a bit memory address area. You must also specify the address of the interface area in the configuration. This is necessary so that the operating unit knows where to find the data.

A separate interface area has to be created for each operating unit connected. If more than one CPU is connected to a particular operating unit, a separate interface area has to be set up for each CPU.

Interface Area:

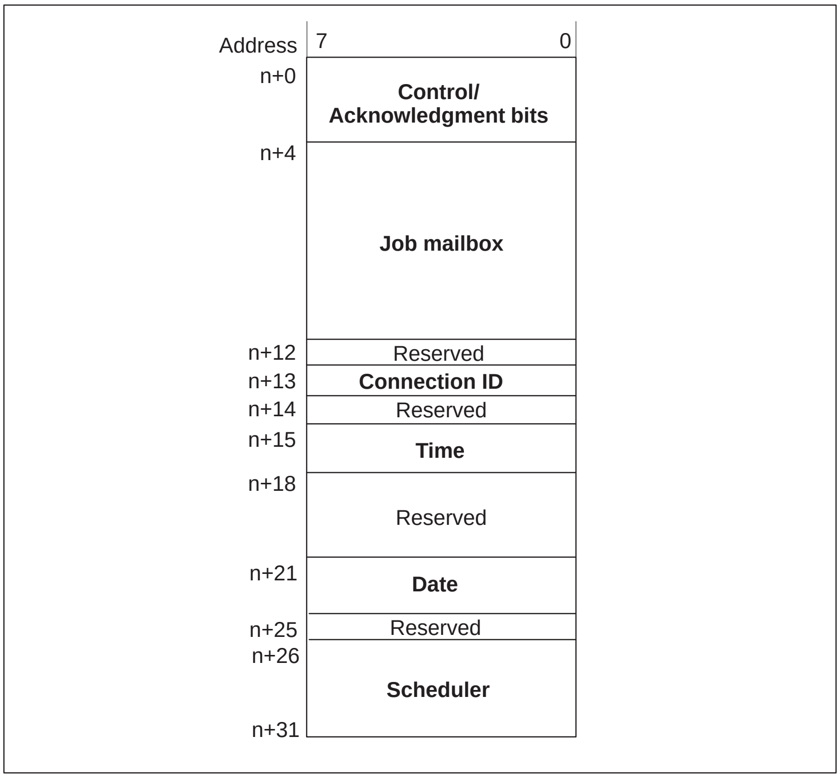


Figure 13-1 Layout of interface area for SIMATIC S7

Significance

The control and acknowledgment bits synchronize transmission of user data areas that are in the interface area or any other memory areas such as the data mailbox. The job mailbox, connection ID, date, time and scheduler are user data areas that are within the interface area.

13.1 Control and Acknowledgment Bits

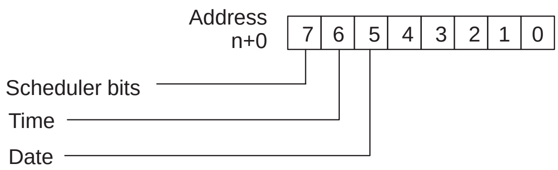
Introduction

There are three bytes provided in the interface area for the control and acknowledgement bits. Bytes n+0 and n+1 are used to co-ordinate the operating unit and the S7. Byte n+3 is required for transmission of data records and indirect variables.

Bytes n+0, n+1 and n+3 are described below. Chapter 14.7 also provides more detailed information about the use of the bits in conjunction with recipes.

Description of byte n+0

The diagram below shows the structure of byte n+0. The individual bits are described underneath the diagram.



Bits 5–6 Date and time: 1 = New

Transfer of date and time from the operating unit to the S7 can be initiated by PLC job 41. The date and time are then written to the interface area by the operating unit.

These bits are set by the operating unit if a new date or time has been transferred. After evaluation of the date or time, the bit must be reset by the S7 program.

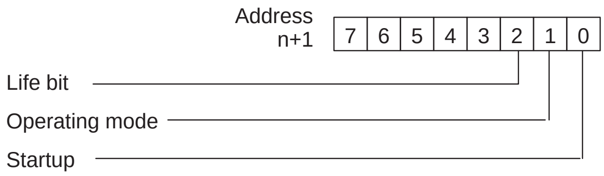
Bit 7 Scheduler bits: 1 = New

Scheduler bits are only possible in the case of the OP15 and OP17 units.

If the OP has set a new scheduler bit in the interface area, it also sets the corresponding control and acknowledgement bits. You only need to poll this bit in order to be able to detect a change in the scheduler bits. After evaluation, the bit must be reset by the S7 program.

Description of byte n+1

The diagram below shows the structure of byte n+1. The individual bits are described underneath the diagram.



Bit 0 Startup: 1 = Operating unit has started up

Bit 0 is set by the operating unit on completion of startup. The S7 program can reset the bit and thus detect if the operating unit is restarted.

Bit 1 Operating mode: 1 = Operating unit is off-line
0 = Operating unit in normal operation

The operating unit overwrites Bit 1 in Byte n+1 for the operating mode during startup and sets it to 0.

If the operating unit is switched off-line by operator input on the operating unit, there is no guarantee that the operating unit will be able to set Bit 1 in Byte n+1 to 1. If the PLC sets the acknowledgment bit to 1, the PLC program can query whether the bit has been reset to 0, i.e. whether the operating unit is still off-line or is in communication contact with the PLC again.

Bit 2 Life bit :
The life bit is inverted by the operating unit at one-second intervals. This enables the S7 program to detect whether the connection with the operating unit is still present.

Description of byte n+3

Byte n+3 is used for synchronization purposes when transferring data records and indirect variables. The significance of the individual bits is detailed below. The precise sequence of transmission is described in chapter 14.7.3.

Bit 0 1 = Data mailbox is locked (set by operating unit only)
0 = Data mailbox is unlocked

Bit 1 1 = Data record/variable contains errors

Bit 2 1 = Data record/variable contains no errors

Bit 3 1 = Data transmission completed

Bit 4 1 = Request data record/variable

Bit 5 1 = Operating unit must read data mailbox

Bit 6 1 = Request data mailbox lock

Bit 7 1 = Operating unit has read data mailbox
(transfer from S7 → operating unit)

13.2 Data Areas in the Interface Area

General

This section describes the layout and usage of the data areas that are located in the interface area.

The job mailbox is used by the S7 to initiate an action on the operating unit. All other bytes are areas to which the operating unit writes data. Those areas can be analyzed by the S7 program. The individual bytes are described below.

Job mailbox

Bytes n+4 to n+11:
The job mailbox can be used to send PLC jobs to the operating unit and thereby initiate actions on the operating unit.

The job mailbox always consists of four words. The first word of the job mailbox contains the job number. The parameters of the job must be entered in the succeeding words (maximum of 3).

Address	7 0	7 0
n+4		Job no.
		Parameter 1
		Parameter 2
n+10		Parameter 3

If the first word of the job mailboxes not equal to zero, the operating unit analyzes the PLC job. Afterwards, the operating unit sets this data word to zero again. For that reason, the parameters must be entered in the job mailbox first and only then the job number.

The PLC jobs possible are listed in the appendix B together with their job numbers and parameters.

Connection ID

Byte n+13:
The operating unit enters the connection ID in Byte 13. The ID numbers indicate the following:
0 Connection via MPI
1 Connection via PPI

Connection ID:

Address	7 0
n+13	Connection ID

Date and time

Time = Byte n+15 to n+17,
Date = Byte n+21 to n+24:
Transfer of date and time from the operating unit to the S7 can be initiated by PLC job 41. The date and time are written to the interface area.

The layout of the two data areas is illustrated below. All data is in BCD format.

Time:

Address	7 … 0
n+15	Hour (0...23)
n+16	Minute (0...59)
n+17	Second (0...59)

Date:

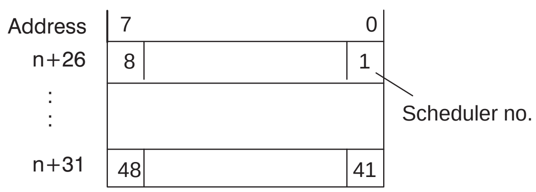
Address	7 … 0
n+21	Day of week (1...7)
n+22	Day of month (1...31)
n+23	Month (1...12)
n+24	Year (0...99)

Scheduler bits (OP15 and OP17 only)

Byte n+26 to n+31:
A scheduler is a periodically recurring (hourly, daily, weekly, annually) time at which a defined function is executed, e.g.

- Print message buffer or screen,
- Select screen.

When a scheduler time is reached on the OP, the corresponding bit is set in this area.



User Data Areas for the SIMATIC S7 14

User data areas are used for the purposes of data exchange between the S7 and the operating unit.

These data areas are written to and read by the operating unit and the application program in alternation during the process of communication. By analyzing the data stored there, the S7 and operating unit reciprocally initiate predefined actions.

This chapter describes the function, layout and special features of the various user data areas.

14.1 Overview

Definition

User data areas can be located in any memory area on the SIMATIC S7. User data areas include messages, recipes and trends, for example.

Range of functions

Which user data areas are possible depends on the operating unit used. Table 14-1 summarizes the range of functions available on the individual operating units.

Table 14-1 User Data Areas Usable According to Type of Operating Unit

User data area	TD17	OP3	OP5	OP7	OP15 OP17	OP25 OP35	OP27 OP37	TP27 TP37
Event messages	x	x	x	x	x	x	x	x
Alarm messages	–	–	x	x	x	x	x	x
PLC jobs	x	–	x	x	x	x	x	x
Recipes	–	x	x	x	x	x	x	x
System keyboard assignment	x	x	x	x	x	x	x	–
Function keyboard assignment	–	–	x	x	x	x	x	–
LED assignment	–	–	–	x	x	x	x	–
Scheduler	–	–	–	–	x	–	–	–
Date and time	x	x	x	x	x	x	x	x
Screen number	–	x	x	x	x	x	x	x
User version	x	x	x	x	x	x	x	x
Trend request area	–	–	–	–	–	x	x	x
Trend transfer area	–	–	–	–	–	x	x	x

14.2 Event and Alarm Messages

Definition

Messages consist of a fixed text component and/or variables. The text and variables are user-definable.

Messages are subdivided into event messages and alarm messages. The programmer defines what is an event message and what is an alarm message.

Event messages

An event message indicates a status, e.g.

- `Motor switched on`
- `PLC in manual mode`

Alarm messages

An alarm message indicates a fault, e.g.

- `Valve not opening`
- `Motor temperature too high`

Acknowledgments

Since alarm messages indicate abnormal operating statuses, they have to be acknowledged. They can be acknowledged either by

- operator input on the operating unit
- setting a bit in the S7 acknowledgement area.

Message initiation

A message is initiated by setting a bit in one of the S7 message areas. The location of the message areas is defined by means of the configuration tool. The corresponding area must also be set up on the S7.

As soon as the bit in the PLC event/alarm message area has been set and that area has been transferred to the operating unit, the operating unit detects that the relevant message has ”arrived”.

Conversely, when the same bit is reset on the PLC by the operating unit the message is registered as having ”departed”.

Message areas

Table 14-2 shows the number of message areas for event and alarm messages, the number of alarm message acknowledgement areas (PLC → operating unit and operating unit → PLC) and the overall length of all areas for each of the various operating unit models.

Table 14-2 Operating Unit Message Areas

Unit	Event message area		Alarm messages area/ Alarm message acknowledge-ment area	
	Number	**Length** (words)	**Number per type**	**Overall length per type** (words)
TD17	4	63	–	–
OP3	4	32	–	–
OP5	4	32	4	32
OP7	4	32	4	32
OP15	4	63	4	63
OP17	4	63	4	63
OP25, OP35	8	125	8	125
OP27, OP37	8	125	8	125
TP27, TP37	8	125	8	125

Assignment of message bit and message number

A message can be configured for every bit in the message area configured. The bits are assigned to the message numbers in ascending order.

Example:

Let us assume that the following event message area has been configured for the SIMATIC S7 PLC:

`DB 60        Address 42  Length 5` (in words)

Figure 14-1 shows the assignment of all 80 (5 x 16) message numbers to the individual bit numbers in the PLC event message area.

That assignment is performed automatically on the operating unit.

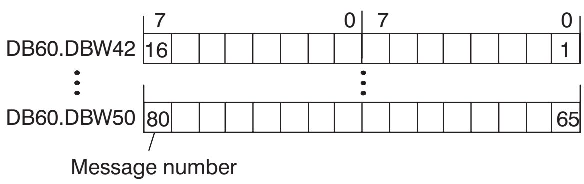


Figure 14-1 Assignment of Message Bit and Message Number

Acknowledgement areas

If the S7 is to be informed of acknowledgement of an alarm message on the operating unit or if the acknowledgement is to be issued by the S7 itself, the appropriate acknowledgement areas must be set up on the S7 as follows:

- **Acknowledgement area operating unit → S7**:
  This area is used to inform the PLC when an alarm message has been acknowledged by operator input on the operating unit.
- **Acknowledgement area S7 → operating unit**:
  This area is used for the PLC to acknowledge an alarm message.

These acknowledgement areas must also be specified in the configuration under *Area Pointers*.

Figure 14-2 shows a schematic diagram of the of the individual alarm message and acknowledgement areas. The acknowledgement sequences are shown in figures 14-4 and 14-5.

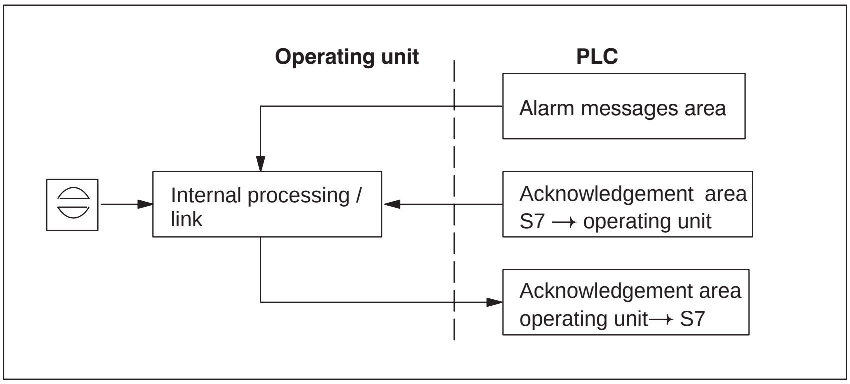


Figure 14-2 Alarm Message and Acknowledgement Areas

Assignment of acknowledgment bit to message number

Each alarm message has a message number. That message number is assigned the same bit number in the alarm messages area as the bit number it is assigned in the acknowledgement area. This also applies when using multiple acknowledgement areas if the length of the preceding acknowledgement area does not cover the overall length of the associated alarm messages area.

Figure 14-3 illustrates that assignment.

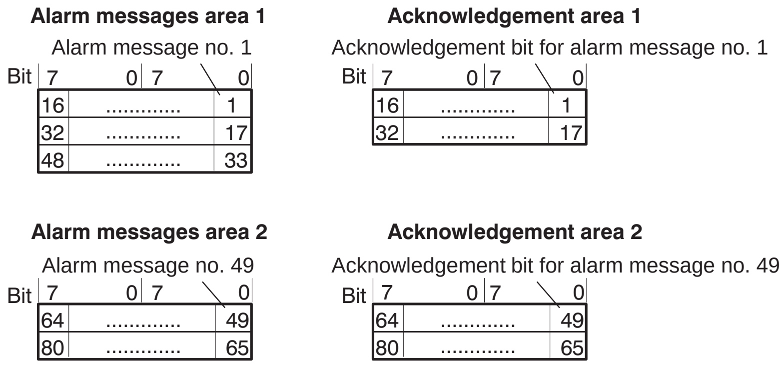


Figure 14-3 Assignment of Acknowledgement Bit and Message Number

Acknowledgement area S7 → operating unit

A bit set by the PLC in this area effects acknowledgment of the corresponding alarm message on the operating unit. Reset the bit when you reset the bit in the alarm messages area. Figure 14-4 shows the signal diagram.

The acknowledgement area S7 → operating unit

- must follow on immediately from the associated alarm messages area,
- must have precisely the same polling time and
- may not be any longer than the associated alarm messages area.

If the physical location of acknowledgement area S7 → operating unit does not follow on from the alarm messages area, system message $655 is issued when the operating unit starts up.

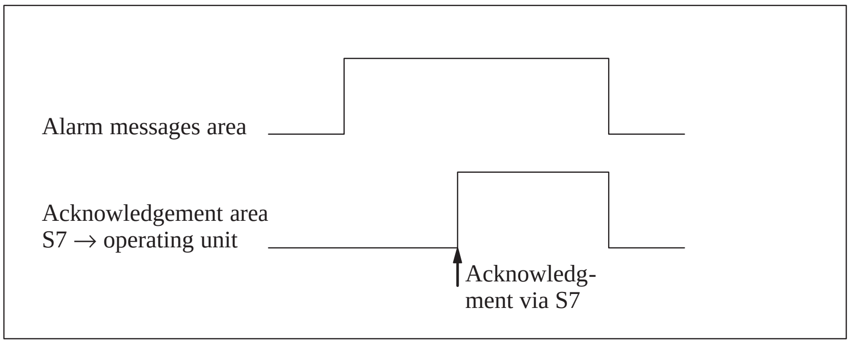


Figure 14-4 Signal Diagram for Acknowledgement Area S7 → Operating Unit

Acknowledgement area operating unit → S7

If a bit in the alarm messages area is set, the operating unit resets the corresponding bit in the acknowledgement area. If the alarm message is acknowledged on the operating unit, the bit in the acknowledgement area is set. In this way, the S7 can detect that the alarm message has been acknowledged. Figure 14-5 shows the signal diagram.

The acknowledgement area operating unit → S7 must be no longer than the associated alarm messages area.

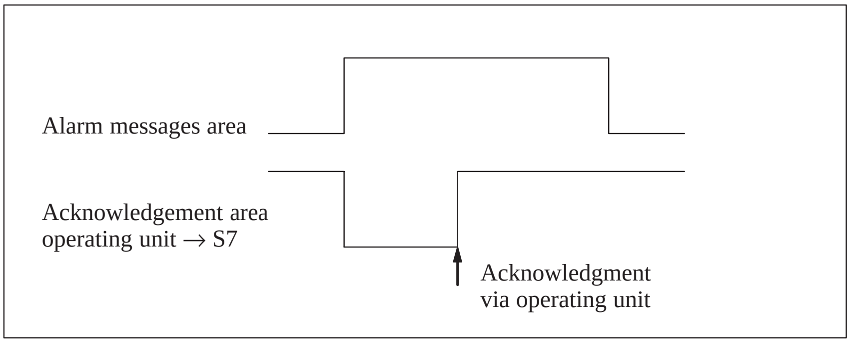


Figure 14-5 Signal Diagram for Acknowledgement Area Operating Unit → S7

Size of acknowledgement areas

The acknowledgement areas S7 → operating unit and operating unit → S7 must not be any longer than the associated alarm messages area. They can, however, be smaller if acknowledgement by the PLC is not required for all alarm messages. Figure 14-6 illustrates such a case.

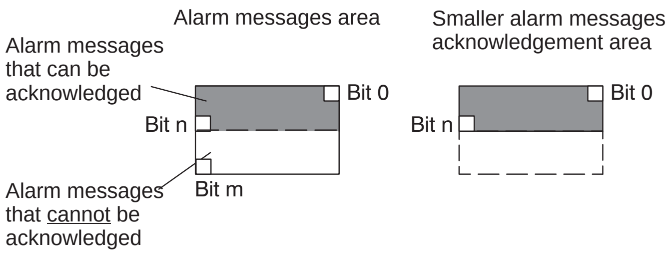


Figure 14-6 Reduced-size Acknowledgement Area

Note

Place important alarm messages in the alarm messages area starting at Bit 0 in ascending order.

The two associated bits in the alarm messages area and acknowledgement area must not be set simultaneously.

14.3 Keyboard and LED Assignment Areas

Usage

Key strokes on the operating unit can be transmitted to the S7 and analyzed there. In that way, an action such as ”switch on motor” can be initiated on the PLC.

The operator panels (OPs) have LEDs on the function keys. Those LEDs can be controlled from the S7. This means, for example, that in specific situations, it is possible to indicate to the operator by switching on an LED which key should be pressed.

Note re. touch panels

Touch panels have no keyboard and no LEDs which can be assigned to a memory area. For that reason, you do not need to set any area pointers in ProTool for the keyboard and LED assignment.

Condition

In order to be able to analyze key strokes and control the LEDs, associated data areas (also referred to as assignment areas) have to be set up on the S7 and specified in the configuration as *area pointers*.

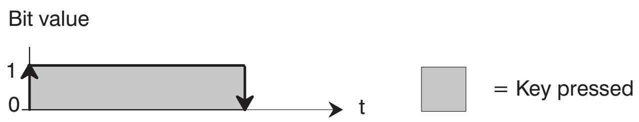
Transfer

The keyboard assignments are transferred automatically to the S7 whenever a change is registered on the operating unit. Configuration of a polling time is therefore not necessary. A maximum of two simultaneously pressed keys are transmitted at once.

Value assignment

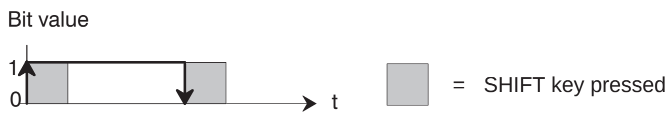
- **All keys (except SHIFT key)**

  As long as the key remains pressed, the assigned bit in the keyboard assignment area has the value 1; otherwise its value is 0.



- **SHIFT key** (text-based displays only)

  The first time the SHIFT key is pressed, the assigned bit in the keyboard assignment area takes on the value `1`. This condition remains the same even when the key is released and stays that way until the SHIFT key is pressed again.



Note

If the operating unit is switched off or disconnected from the S7 while the key is depressed the corresponding bit in the keyboard assignment area remains set.

14.3.1 System Keyboard Assignment Area

Layout

The system keyboard assignment area is a data area with a fixed length. The precise length depends on the operating unit. Table 14-3 gives the details.

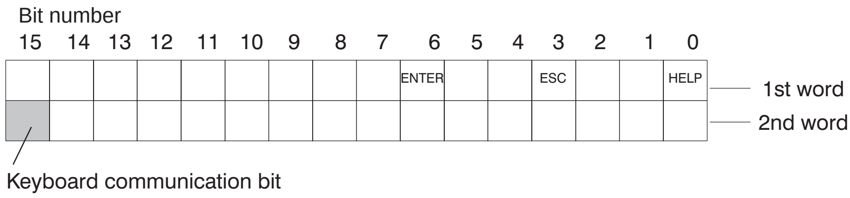
Table 14-3 Length of System Keyboard Assignment Area

Operating unit	Length (in words)
OP5, OP15, OP7, OP17	2
OP25, OP35, OP27, OP37	3

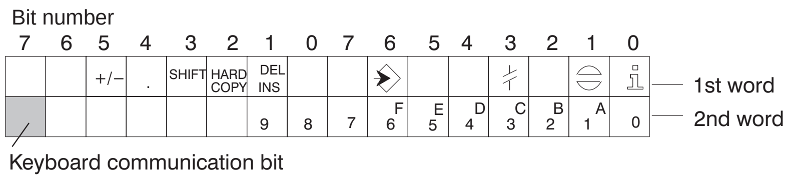
Each key on the system keyboard is assigned a specific bit in the system keyboard assignment area. Exception: DIR key on OP5/15 and cursor keys.

The system keyboard assignment area must also be specified in the configuration under *Area Pointers, Type: System Keyboard*. This assignment area can only be created on one CPU and only once on that CPU.

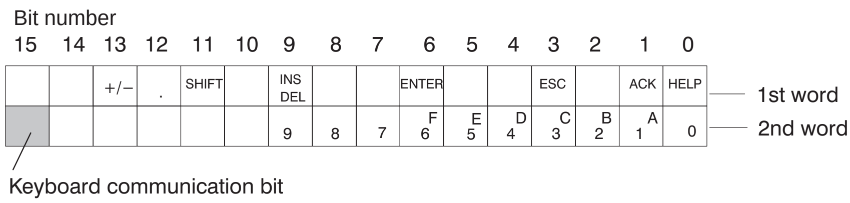
Keyboard assignment for TD17:



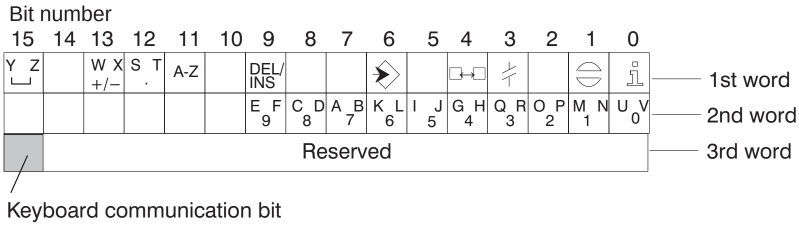
Keyboard assignment for OP5 and OP15:



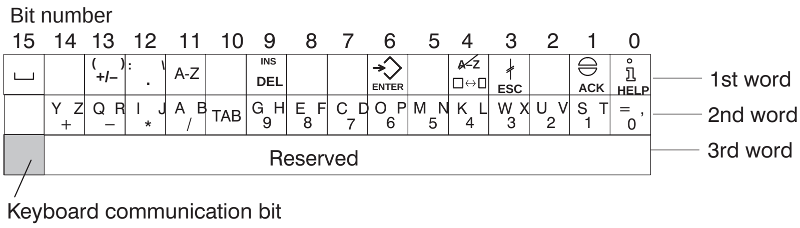
Keyboard assignment for OP7 and OP17:



Keyboard assignment for OP25 and OP27:



Keyboard assignment for OP35 and OP37:



Note

Unused bits must not be overwritten by the application program.

Keyboard communication bit

The keyboard communication bit acts as a check bit. Every time the keyboard assignment area is transferred from the operating unit to the PLC it is set to the value 1 and should be reset by the application program after analysis of the data area.

By regular reading of the communication bit, the application program can ascertain whether the system keyboard assignment area has been transferred again.

14.3.2 Function Keyboard Assignment Area

Data areas

Operator panels have a function keyboard which can be assigned an area in the PLC memory. The function keyboard assignment area can be divided into separate data areas whose number and length depends on the OP concerned.

Data areas	OP5/15/20 OP7/17	OP25/35 OP27/37
Max. number	4	8
Overall length of all data areas (words)	4	8

Key assignment

The assignment of the individual keys to the bits in the data areas is specified when the function keys are configured. This involves specifying a number within the assignment area for each key.

The function keyboard assignment area must also be specified in the configuration under *Area Pointers, Type: Function Keyboard*.

Keyboard communication bit

Bit 7 in the last data word of **each** data area is the keyboard communication bit. It acts as a check bit. Each time the keyboard assignment is transferred from the OP to the PLC, the keyboard communication bit is set to the value `1`. Following analysis of the data area by the application program, the keyboard communication bit should be reset.

By regular reading of the communication bit, the application program can ascertain whether a block has been transferred again.

14.3.3 LED Assignment Area

Data areas

The LED assignment area can be divided into separate data areas as shown in the table below.

Data areas	OP7/15/17	OP25/35 OP27/37
Max. number	4	8
Overall length of all data areas (words)	9	16

The LED assignment area must also be specified in the configuration under *Area Pointers, Type: LED Assignment*.

LED assignment

The assignment of the individual LEDs to the bits in the data areas is specified when the function keys are configured. This involves specifying a bit number within the assignment area for each LED.

The bit number (n) identifies the first of two consecutive bits that control a total of four different LED statuses (see table 14-4):

Table 14-4 LED Flashing Frequency for all OP except OP17

Bit n + 1	Bit n	LED Function
0	0	Off
0	1	Flashes at approx. 2 Hz
1	0	Flashes at approx. 0.5 Hz
1	1	Permanently lit

On the OP17, the K keys have two-color LEDs (red/green). The resulting LED functions are detailed in table 14-5.

Table 14-5 LED Colors for OP17

Bit n + 1	Bit n	LED Function
0	0	Off
0	1	Flashes red
1	0	Permanently red
1	1	Permanently green

14.4 Screen Number Area

Usage

The operating units store information in the screen number area about the screen activated on the operating unit.

This enables information about the current display contents of the operating unit to be transmitted to the PLC and from there, in turn, to initiate specific responses such as the activation of another screen.

Condition

If the screen number area is to be used, it must be specified in the configuration as an *Area Pointer*. It can only be created on one PLC and only once on that PLC.

The screen number area is transferred automatically to the PLC whenever a change is registered on the operating unit. Configuration of a polling time is therefore not necessary.

Layout

The screen number area is a data area with a fixed length. The precise length depends on the operating unit. Table 14-6 gives the details.

Table 14-6 Length of Screen Number Area

Operating unit	Length (in words)
OP5, OP15, OP7, OP17	2
OP25, OP35, OP27, OP37, TP27, TP37	5

The layout of the screen number area in the PLC memory for the various operating units is detailed below.

OP5/15, OP7/17:

	7 0	7 0
1st word	Current screen type	Current screen number
2nd word	**Current entry number**	**Current input field no.**

Entry	Assignment
Current screen type	1: Screen 2: Recipe 3: Function screen
Current screen/recipe number	1 to 99
Current entry number	1 to 99
Current input field number	0 to 8, 0: Entry number

At message level and when displaying a directory, all bytes in the screen number area have the value FF_H.

For **function screens**, the screen number area is assigned as follows:

	7 0	7 0
1st word	3	Function screen number
2nd word	FF_H	Current input field no.

OP25/35, OP27/37, TP27/37:

	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 4: Fixed window 5: Alarm message window 6: Event message window
Current screen number	1 to 65535
Current input field number	1 to 65535

For function screens the current screen number is assigned as follows:

Value	Meaning
1	Alarm message screen
2	Event message screen
3	Alarm buffer
4	Event buffer

14.5 Trend Request and Transfer Areas

Trends

A trend is the graphical representation of a value from the PLC. Reading of the value can be time-triggered or bit-triggered, depending on the configuration.

Time-triggered trends

The operating unit reads the trend values at time intervals specified in the configuration. Time-triggered trends are suitable for continuous progressions such as the operating temperature of a motor.

Bit-triggered trends

The operating unit reads either a single trend value or the complete trend buffer as a result of a trigger bit being set. This is specified in the configuration. Bit-triggered trends are normally used to display values that area subject to rapid variation. An example of this is the injection pressure for plastic mouldings.

In order to be able to activate bit-triggered trends, corresponding data areas have to be specified in the configuration (under *Area Pointers*)) and set up on the PLC. The operating unit and the PLC communicate with one another by means of those areas.

The areas required are the following:
- Trend request area
- Trend transfer area 1
- Trend transfer area 2 (required with switch buffer only)

In those configured areas, each trend is permanently assigned the same bit. This means that each trend is uniquely identifiably in all areas.

Switch buffer

The switch buffer is a second buffer for the same trend that can be set up in the configuration.

While the operating unit is reading the values from buffer 1, the PLC writes data to buffer 2. If the operating unit is reading buffer 2, the PLC writes to buffer 1. This prevents the PLC overwriting the trend data while it is being read by the operating unit.

Division of data areas

The individual areas – i.e. the trend request area and trend transfer areas 1 and 2 – can be divided into separate data areas with a predefined maximum number and length (table 14-7).

Table 14-7 Division of Data Areas

	Data areas		
	Request	Transfer	
		1	2
Max. number per type	8	8	8
Overall length of all data areas (words)	8	8	8

Trend request area

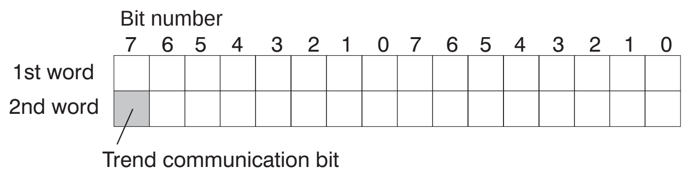
If a screen with one or more trends is opened on the operating unit, the operating unit sets the corresponding bits in the trend request area. After deselection of the screen, the operating unit resets the corresponding bits in the trend request area.

The trend request area can be used by the PLC to ascertain which trend is currently being displayed on the operating unit. Trends can also be triggered without analysis of the trend request area.

Trend transfer area 1

This area is used for the purpose of triggering trends. In the S7 program, set the bit assigned to the trend in the trend transfer area and the trend communication bit. The operating unit detects the trigger and resets the trend bit and the communication bit. It then reads a single value or the whole puffer, depending on the configuration.

Example of a trend transfer area with a length of 2 data words



Until the communication bit has been reset, the trend transfer area can not be altered by the S7 program.

Trend transfer area 2

Trend transfer area 2 is required for trends that are configured with a switch buffer. Its layout is precisely the same as that of trend transfer area 1.

14.6 User Version

Usage

When the operating unit is started up, a check can be carried out as to whether the operating unit is connected to the correct PLC. This important in cases where multiple operating units are in use.

To perform the check, the operating unit compares a value stored on the PLC with the value specified in the configuration. This ensures compatibility of the configuration data with the S5 program. If the values do not match, system message $653 is displayed on the operating unit and the unit is restarted.

In order to be able to use this function, the following values must be specified in the operating unit configuration:

- Details of configuration version; value between 1 and 255.
  - **ProTool**:
    System → *Settings*
- Data type and address of the version value stored on the PLC:
  - **ProTool**:
    System → *Area Pointers,*
    Select *User Version* in the *Type:* box.

14.7 Recipes

Definition

A recipe is a combination of variables forming a fixed data structure. That structure is defined in the configuration and supplied with data on the operating unit. The structure can not subsequently be modified from the operating unit.

As the data structure can be assigned new data many times over, the data is referred to as a data record. Those data records are stored (created), loaded, deleted and edited on the operating unit. The data is stored on the operating unit, thus saving memory space on the S7.

Using a recipe ensures that by transferring a data record to the S7, multiple items of data are received **simultaneously** and **in synchronized fashion** by the S7.

Condition

The use of recipes is subject to the following hardware requirements:

- **Operating units**
  with text-based display: OP5, OP7, OP15, OP17
  with graphics display: OP25, OP27, OP35, OP37
  with touch screen: TP27, TP37
- **SIMATIC S7**: S7-200, S7-300, S7-400

Transfer of data records

Data records can be transferred from the operating unit to the S7 or from the S7 to the operating unit. Data records are transferred from the operating unit to the S7 in order to set specific values on the S7, e.g. for the production of orange juice. In the same way, data can be read from the S7 and stored on the operating unit as a data record in order to save details of a successful combination of values, for example.

Note

With graphics displays, only the variables are used when transferring data records. In order to transfer a data record from a data medium (such as Flash memory of floppy disk) to the S7, that record must first be written to the variables (internal memory of the operating unit).

Synchronization

A basic feature of recipes is that the data is transferred in synchronized fashion and uncontrolled overwriting of data is prevented. In order to ensure coordinated transfer of data records, bits are set in the control and acknowledgment bit 2 section of the interface area.

14.7.1 Transferring Data Records

Definition

Data records can be transferred from the operating unit to the PLC or from the PLC to the operating unit in two different ways. The two methods of transfer are ”direct” and ”indirect”. The transfer method setting relates primarily to transfer in the direction operating unit → PLC.

In the case of text-based displays, only ”direct” transfer is possible. In the case of graphics displays, transfer in the direction operating unit → PLC can be ”direct” or ”indirect”. ”Indirect” transfer from the PLC to the operating unit is not possible with the SIMATIC S7.

Selecting method of transfer

Selection of the method of transfer depends on the operating unit being used. Table 14-8 shows the characteristics of a recipe according to operating unit.

Table 14-8 Transfer of Recipe According to Operating Unit

Operating unit	Direction of transfer	Created in	
		ProTool	ProTool/Lite
OP5, OP15	OP → S7	Direct	Direct
	S7 → OP	Direct	Direct
OP7, OP17	OP → S7	Direct	Direct
	S7 → OP	Direct	Direct
OP25, OP35	OP → S7	Indirect/direct	—
	S7 → OP	Indirect/direct	—
OP27, OP37	OP → S7	Indirect/direct	—
	S7 → OP	Indirect/direct	—
TP27, TP37	TP → S7	Indirect/direct	—
	S7 → TP	Indirect/direct	—

Direct transfer

When a data record is written, the variables of the data record are written directly to the address defined in each case. When a data record is read directly, the variables are read from the PLC system memory onto the operating unit.

In ProTool, variables which are to be transferred directly must have a link to the PLC as well as the attribute `Write directly`. Variables to which no address on the PLC is assigned are not transferred.

Indirect transfer

All variables of the data record are written to a temporary storage area on the PLC referred to as the data mailbox. The data mailbox contains only the values of the variables, the addresses are not transferred.

When a data record is written, the variables are written to the temporary storage area. When a data record is read, the variables in the PLC program must first be written to the temporary storage area. The operating unit then reads the variables from the temporary storage area.

For ”indirect” transfer, the data record must be no longer than 190 bytes.

14.7.2 Addressing Recipes and Data Records and the Data Areas Required

The addressing of recipes and data records differs according to whether the operating unit is a text-based display unit or a graphics display unit.

Devices having a text-based display

In the process of configuration, the recipe is given a name and a number. Both the recipe name and the recipe number are displayed on the operating unit.

The data records that you create on the operating unit are also given a name and a number.

The recipe number and data record number are transferred to the PLC along with the data when data record transfer in the direction operating unit → S7 is initiated. This requires creation of the data mailbox on the PLC. When doing so, use the same details specified in the configuration under *Area Pointers*. The data record values are written directly to the addresses on the PLC.

Data Mailbox:

1st word	Recipe number
2nd word	Reserved
3rd word	Reserved
4th word	Data record number
5th word	Reserved

Devices having a graphics display

There are three *Identifications* available for the purposes of identifying a recipe on the PLC. Those identifications are user-definable. We recommend that you use the the recipe number for the first identification.

In ProTool, you enter the recipe identification in the *Parameters* dialog box under *Identifications*. ProTool automatically enters the recipe number for the first identification. When a data record is transferred from the operating unit to the PLC, the identifications are written to the data mailbox and can be analyzed by the PLC.

You create data records on the operating unit under a symbolic name. That symbolic name is not transferred with the data record when it is transferred between the operating unit and PLC. There is no identification for the data record on the PLC.

Data Mailbox:

The area for the *data mailbox* has to be reserved on the PLC. When doing so, use the same details specified in the ProTool configuration under *Area Pointers*. The diagram below shows the layout 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

As of word 6, the data words are relevant only for indirect transmission.

14.7.3 Synchronization during Transfer – Normal Case

Transferring data records

The control and acknowledgment bits in the interface area synchronize the transfer of data records. Normally, transfer is initiated by operator input on the operating unit.

Bit 0	1 =	Data mailbox is locked (set by operating unit only)
	0 =	Data mailbox is unlocked
Bit 1	1 =	Data record/variable contains errors
Bit 2	1 =	Data record/variable contains no errors
Bit 3	1 =	Data transmission completed
Bit 4	1 =	Request data record/variable
Bit 5	1 =	Operating unit must read data mailbox
Bit 6	1 =	Request data mailbox lock
Bit 7	1 =	Operating unit has read data mailbox (transfer from S7 → operating unit)

Transfer from operating unit → S7 (initiated on operating unit)

The description which follows explains the sequence in which the operating unit sets the synchronization bits in the interface area and how the PLC program should respond to those settings.

Step 1: Bit 0 is checked by the operating unit. If bit 0 is set to 1 (= Data mailbox locked) transfer is cancelled and a system error message returned. If bit 0 is set to 0, the operating unit sets it to 1.

Step 2: The graphics display enters the identifications in the data mailbox. The text-based display enters the recipe number and data record number in the data mailbox.

If the data record is to be transferred indirectly, the data record values are also written to the data mailbox. If the data record is to be transferred directly, the data variable values are written to the configured address.

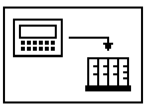
Step 3: The operating unit sets bit 3 to 1 (= Data transfer completed).

Step 4: The data record/variable can be analyzed by the S7 program. The S7 program then has to acknowledge whether the transferred data contained errors or not.

Data contains no errors:	Bit 2 is set to 1
Data contains errors:	Bit 1 is set to 1

Step 5: The S7 program must now reset Bit 0.

Step 6: The bits set in Steps 3 and 4 are reset by the operating unit.



If the project for a graphics display unit incorporates the standard configuration, the transfer sequence described above corresponds to the use of the key illustrated on the left on the standard screen Z_RECORD_2.

14.7.4 Synchronization during Transfer – Special Cases

Transfer from operating unit → S7 (initiated by S7)

Devices having a graphics display:
With this type of transfer, you should make sure that only the current variable values on the device having a graphics display are transferred. The values are not read directly from the data medium.

Devices having a text-based display:
This type of transfer is not possible with devices having a text–based display.

Step 1: Request the data mailbox lock in the S7 program by setting Bit 6 to `1`.

Step 2: If the data mailbox can not be locked, the operating unit sets Bit 0 to `1` and at the same time resets Bit 6 to `0`.

Step 3: In the S7 program, inform the operating unit via the data mailbox which data record it is to transfer. To do so, you enter the identifications of the recipe in the data mailbox in the case of graphics display and the recipe number and data record number in the case of text-based displays.

Step 4: In the S7 program, set Bit 4 to `1` (= Request data via data mailbox).

Step 5: The operating unit reads the data mailbox.

Step 6: The operating unit resets Bit 4 and transfers the data record/variable as described in chapter 14.7.3, Step 2 onwards.

Transfer from S7 → operating unit (initiated by operating unit)

Direct transfer from the S7 to the operating unit is always carried out without co-ordination. The values are read directly from the address. Variables without an address are ignored. The following steps relate only to indirect transfer.

Step 1: Bit 0 is checked by the operating unit. If bit 0 is set to `1` (= Data mailbox locked) transfer is cancelled and a system error message returned. If bit 0 is set to `0`, the operating unit sets it to `1`.

Step 2: The operating unit enters the identifications in the data mailbox. The length of the data record is not specified by the operating unit (length `0` is entered).

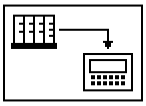
Step 3: The operating unit sets Bit 3 to `1` (= Data transfer completed).

Step 4: In the S7 program, you now analyze the identifications and enter the requested data in the data mailbox. You then acknowledge whether the identifications contain errors or not by setting Bit 1 or 2.

Identifications contain no errors: Bit 2 is set to `1`

Identifications contain errors: Bit 1 is set to `1`

Step 5: The operating unit 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.



If the project for a graphics display unit incorporates the standard configuration, the transfer sequence described above corresponds to the use of the key illustrated on the left on the standard screen Z_RECORD_2.

Transfer from S7 → operating unit (initiated by S7)

Devices having a graphics display:
With this direction of transfer, you should make sure that the values are written from the S7 to the variables on the operating unit. The values are not written directly to the data record on the data medium.

Devices having a text-based display:
This type of transfer is not possible with devices having a text–based display.

Step 1: Request the data mailbox lock in the S7 program by setting Bit 6 to `1`.

Step 2: If the data mailbox can not be locked, the operating unit sets Bit 0 to `1`and at the same time resets Bit 6 to `0`.

Step 3: In the S7 program, inform the operating unit via the data mailbox which data record it is to collect. To do so, you enter the identifications of the recipe in the data mailbox in the case of graphics display and the recipe number and data record number in the case of text-based displays.

Step 4: Set Bit 5 to `1` (= Operating unit must read data mailbox).

Step 5: When the operating unit has collected the data record, it sets Bit 7 to `1` (= Operating unit has read data mailbox). By setting Bit 7, the operating unit indicates that the reading operation has been completed.

Step 4: Set Bit 7 to `0`.

Transfer by way of PLC job with graphics displays

We recommend that data record transfer is initiated by operator input on the operating unit. To do so, use standard screen `Z_Record_1`. When transferring data records by means of a PLC job (job nos. 69 and 70) the data record number can not be specified. Only the values of the current variables are transferred.

Job no. 70 corresponds to the function *Data record: OP → PLC*, and job no. 69 to function *Data record: PLC → OP.*

Transfer by way of PLC job with text-based displays

In the case of text-based displays, PLC job no. 70 can be used to transfer a data record from the operating unit to the PLC. PLC job 69 initiates transfer from the PLC to the operating unit.

Example

Below is an example of the use of PLC job no. 70 on an OP7 connected to a SIMATIC S7-200. The example illustrates the steps to be carried out on the OP7 and the PLC.

OP7

1. Configure the tags for the recipe.
2. Configure the recipe, i.e. define the text items and the tags.
3. Configure a screen for editing and transferring the recipe. For that purpose you should define two function keys. The one function key should be assigned the function *Recipe Directory*, parameter `2` (Edit). The other should be assigned the function *Recipe Directory*, parameter `7` (Transfer).
4. Configure the two area pointers Interface Area and Data Mailbox.

Interface area on SIMATIC S7-200 PLC, e.g. VW 200

n+0	VB200	VB201
n+2	VB202	VB203
n+4	VB204	VB205
...	...	...
n+30	VB230	VB231

SIMATIC S7-200 PLC

1. Reset n+3 (VB203) in the interface area.
2. Write the recipe number of the recipe that is to be transferred to n+6 (VB206) of the interface area (= parameter 1 of the PLC job).
3. Write the data record number of the data record that is to be transferred to n+8 (VB208) of the interface area (= parameter 2 of the PLC job).
4. Initiate transfer by writing `70` to n+4 (VB204) of the interface area (= execute PLC job).
5. The OP7 then sets bits 0 and 3 of n+3 (V203.0 and V203.3) in the interface area.
6. The PLC now has to confirm transfer by setting bit 2 of n+3 (V203.2) in the interface area. If that happens, the OP7 resets bit 3 (V203.3) of n+3.

The transfer is now complete. To transfer another data record, repeat Steps 1 to 6.

14.8 Writing Variables Indirectly

Basic principle

Indirect variables which can be assigned to input fields can be configured for graphics displays. The value is entered directly on the operating unit by the operator. After entry of the value on the operating unit, the contents of those variables are transferred in co-ordinated fashion to the data mailbox on the PLC.

Co-ordination

Co-ordination of data transfer is the similar to the co-ordination of data record transfer for recipes (see chapter 14.7.3).

Usage

Indirect variables can used in screens in the same way as ”normal” variables, i.e. variables with addresses.

Part IV SIMATIC 500/505 Connections

SIMATIC 500/505 Connection, Version 3.1 or Later 15

This chapter describes communication between the operating unit and the SIMATIC 500/505. The version 3.1 driver is called a NATIVE driver because the PLC-specific addresses can be specified directly in the operating unit configuration.

General

In the case of the SIMATIC 500/505 Series, the connection is effected by means of the PLC’s own driver. This is a point-to-point connection.

The following operating units can be connected to the SIMATIC 500/505:

Devices having a text-based display	Devices having a graphics display	Touch Panels
TD17	OP25	TP27
OP7	OP27	TP37
OP17	OP35	
	OP37	

Configuration

The operating unit should be connected to the CPU programming interface (RS232 or RS422).

Parameters

The following parameters detailed below should be specified for connecting to a SIMATIC 500/505. In ProTool, all settings are entered under menu item *System* → *PLC*. Enter *SIMATIC 500/505 V3.1* as the protocol.

Interface

Here you should enter which interface on the operating unit the SIMATIC 500/505 is connected to.

Interface type

Here you can choose between RS232 and RS422.

Data bits

Here you should enter `7`.

Parity

Enter `Odd` here.

Stop bits

Here you should enter `1`.

Baud rate

Here you enter the transmission rate between operating unit and SIMATIC 500/505. Communication can take place at the following speeds: 19200, 9600, 4800, 2400, 1200, 600 or 300 baud.

User data areas

The operating unit and the SIMATIC 500/505 communicate via user data areas on the SIMATIC 500/505. Which user data areas need to be set up on the SIMATIC 500/505 depends on the configuration. Depending on what data is to be exchanged, the relevant user data areas should be set up. The data areas include messages, recipes and trends, for example. Those user data areas are described in chapter 17.

Known limitations

An RS422 connection with the SIMATIC 575-VME is not supported at present.

In the case of the SIMATIC 500 CPU 560-2120 and CPU 560-2820 access to the S-memory data types (special user data types) is not possible if the special function CPUs 565-2120 and 565-2820 are used.

15.1 Commissioning

Driver for SIMATIC 500/505

The driver for connecting to the SIMATIC 500/505 is supplied with the configuration software and installed automatically.

Standard cable

The following connecting cables are available for connecting the operating unit to the SIMATIC 500/505:

Table 15-1 Standard Cables

From \ To	SIMATIC 500/505			
	V.24 9-core	V.24 25-core	RS422 9-core[1)]	RS422 9-core[2)]
All operating units V.24, 15-core	6XV1 440-2K...	6XV1 440-2L...	–	–
All operating units RS422, 9-core	–	–	6XV1 440-2M...	6XV1 440-1M...

... = Length code
1) For SIMATIC 500/505 (PLC 535, PLC 545/CPU1101, PLC 565T)
2) For SIMATIC 505 (PLC 545/CPU1102, PLC 555)

Commissioning procedure

Connecting the operating unit to the SIMATIC 500/505 primarily involves making the physical connection to the operating unit. Special modules for the connection on the PLC are not required.

You should go through the check-list below.

1. The parameters set in the configuration under *System* → *PLC* must match those detailed on page 15-2 in the case of direct connection to the CPU interface.
2. If you use user data areas, set them up now (see chapter 17).
3. If you use user data areas for which the interface area is required, set it up now. A detailed description of the interface area is given in chapter 16.

15.2 Permissible Data Types

Data areas

Table 15-2 lists the *user data types* which can be used when configuring variables and area pointers. The basic condition is that those data areas have also been set up in TISOFT for the CPU.

Table 15-2 Permissible Data Areas for the Operating Unit

<table>
<tr><th>User Data Type</th><th>Addressed By</th><th>Format</th></tr>
<tr><td>Discrete Input</td><td>X</td><td>BIT</td></tr>
<tr><td>Discrete Output</td><td>Y</td><td>BIT</td></tr>
<tr><td>Control Relay</td><td>C</td><td>BIT</td></tr>
<tr><td>Variable Memory</td><td>V</td><td rowspan="5">BIT
+/– INT
INT
+/– DOUBLE
DOUBLE
REAL
ASCII</td></tr>
<tr><td>Word Input</td><td>WX</td></tr>
<tr><td>Word Output</td><td>WY</td></tr>
<tr><td>Constant Memory</td><td>K</td></tr>
<tr><td>Status Word Memory</td><td>STW</td></tr>
<tr><td>Timer/Counter Preset</td><td>TCP</td><td rowspan="2">+/– INT
INT</td></tr>
<tr><td>Timer/Counter Current</td><td>TCC</td></tr>
<tr><td>Analog Alarm</td><td></td><td></td></tr>
<tr><td>Process Loop</td><td></td><td></td></tr>
<tr><td>Special Function</td><td></td><td></td></tr>
</table>

Analog Alarm, Process Loop and Special Function are generic terms that stand for a collection of special user data types (see tables 15-3 to 15-5). If you select those collective terms in the dialog box, another selection list appears from which the precise user data type can be selected.

Table 15-3 Analog Alarm

User Data Type	Addressed By	Format
Analog Alarm/Alarm Acknowledge Flags	AACK	+/–INT, INT
Analog Alarm Deadband	AADB	+/–INT, INT, REAL
Most Significant Word of Analog Alarm C flags	ACFH	+/–INT, INT
Least Significant Word of Analog Alarm C flags	ACFL	+/–INT, INT
Analog Alarm Error	AERR	+/–INT, INT, REAL
Analog Alarm High Alarm Limit	AHA	+/–INT, INT, REAL
Analog Alarm High–High Alarm Limit	AHHA	+/–INT, INT, REAL
Analog Alarm Low Alarm Limit	ALA	+/–INT, INT, REAL
Analog Alarm Low–Low Alarm Limit	ALLA	+/–INT, INT, REAL
Analog Alarm Orange Deviation Alarm Limit	AODA	+/–INT, INT, REAL
Analog Alarm Process Variable	APV	+/–INT, INT, REAL
Analog Alarm Process Variable High Limit	APVH	REAL
Analog Alarm Process Variable Low Limit	APVL	REAL
Analog Alarm Rate of Change Alarm Limit	ARCA	REAL
Analog Alarm Setpoint	ASP	+/–INT, INT, REAL
Analog Alarm SP High Limit	ASPH	+/–INT, INT, REAL
Analog Alarm SP Low Limit	ASPL	+/–INT, INT, REAL
Analog Alarm Sample Rate	ATS	REAL
Analog Alarm Flags	AVF	+/–INT, INT
Analog Alarm Yellow Deviation Alarm Limit	AYDA	+/–INT, INT, REAL
Alarm Peak Elapsed Time	APET	+/–INT, INT

Table 15-4 Process Loop

User Data Type	Addressed By	Format
Loop Alarm/Alarm Acknowledge Flags	LACK	+/–INT, INT
Loop Alarm Deadband	LADB	+/–INT, INT, REAL
Most Significant Word of Loop C–flags	LCFH	+/–INT, INT
Least Significant Word of Loop C–flags	LCFL	+/–INT, INT
Loop Error	LERR	+/–INT, INT, REAL
Loop Alarm High Limit	LHA	+/–INT, INT, REAL
Loop Alarm High–High Limit	LHHA	+/–INT, INT, REAL
Loop Gain	LKC	REAL
Loop Derivative Gain Limiting Coefficient	LKD	REAL
Loop Low Alarm Limit	LLA	+/–INT, INT, REAL
Loop Low–Low Alarm Limit	LLLA	+/–INT, INT, REAL
Loop Output	LMN	+/–INT, INT, REAL
Loop Bias	LMX	+/–INT, INT, REAL
Loop Orange Deviation Limit	LODA	+/–INT, INT, REAL
Loop Process Variable	LPV	+/–INT, INT, REAL
Loop PV High Limit	LPVH	REAL
Loop PV Low Limit	LPVL	REAL
Loop Rate of Change Alarm Limit	LRCA	REAL
Loop Ramp/Soak Flags	LRSF	+/–INT, INT
Loop Ramp/Soak Step Number	LRSN	+/–INT, INT
Loop Setpoint	LSP	+/–INT, INT, REAL
Loop Setpoint High Point	LSPH	+/–INT, INT, REAL
Loop Setpoint Low Limit	LSPL	+/–INT, INT, REAL
Loop Rate	LTD	REAL
Loop Reset	LTI	REAL
Loop Sample Rate	LTS	REAL
Loop V–flags	LVF	+/–INT, INT
Loop Yellow Deviation Alarm Limit	LYDA	+/–INT, INT, REAL
Loop Peak Elapsed Time	LPET	+/–INT, INT

Table 15-5   Special Function

User Data Type	Addressed By	Format
SF Program Peak Elapsed Time	PPET	+/–INT, INT
SF Subroutine Peak Elapsed Time	SPET	+/–INT, INT

15.3 Notes on Optimization

Polling time and update time

The structure of the user data areas described in chapter 17 along with the polling times configured for the **area pointers** are crucial factors in the update times **actually achievable**. The update time is the polling time plus transmission time plus processing time.

In order to achieve optimum update times, the following points should be observed during configuration:

- When setting up the individual data areas, make them as large as necessary but as small as possible.
- Define data areas that belong together as contiguous areas. The effective update time will be better if you create a <u>single</u> large area rather than several smaller areas.
- Setting the polling times that are too short unnecessarily impairs overall performance. The same applies to the standard clock pulse. Set the polling time according to the rate of change of the process values. The rate of change of temperature of a furnace, for example, is considerably slower than the acceleration curve of an electric motor.

  Guide figure for polling time: approx. 1 second.
- If necessary, dispense with cyclic transmission of user data areas (polling time = 0) in order to improve the update time. Instead, use PLC jobs to transfer the user data areas at random times.
- Store the variables for a message or a screen in a contiguous data area.
- In order that changes on the PLC are reliably detected by the OP, they must be present for the duration of the actual polling time at least.
- Set the baud rate to the highest possible figure.

Screens

If, in the case of bit-triggered trends, the communication bit is set in the *trend transfer area*, the operating unit always updates all the trends whose bit is set in that area. Afterwards it resets the bit. If the PLC program immediately sets the bit again, the operating unit spends all its time updating the trends. It is then virtually impossible to operate the operating unit.

Interface Area for the SIMATIC 500/505 16

Function

The interface area is a data area that represents the interface between the application program and the operating unit. It contains data and pointers to data areas that are required for exchange of data between the SIMATIC 500/505 and the operating unit.

Condition

The interface area is only required for the SIMATIC 500/505 if the functions it contains are used or anlayzed by the SIMATIC 500/505. The interface area must be configured if the following functions are used:

– Sending of PLC jobs to the operating unit
– Synchronizing of date and time between SIMATIC 500/505 and operating unit
– Analysis of connection ID
– Recipes (transfer of data records)
– Detection of operating unit startup by PLC program
– Analysis of operating unit mode by PLC program
– Analysis of operating unit life bit by PLC program

Layout of interface area

Figure 16-1 shows the layout of the interface area. The interface area has to be set up in ProTool under menu item *System* → *Area Pointers* so that the operating unit knows where the data is located. When doing so, only the start address of the interface area has to be specified. In addition, the area must be available on the PLC.

Note

The structure of the interface area applies for all NATIVE drivers.

Interface area:

Address	1 … 16
n+0	**Control bits**
n+1	Reserved
n+2 … n+5	**Job mailbox**
n+6	**Acknowledgment bits**
n+7	Reserved
n+8	**Version number**
n+9 … n+11	**Time**
n+12 … n+14	**Date**
n+15 … n+25	Reserved

n = Address of configured *user data type*

Figure 16-1 Layout of Interface Area for SIMATIC 500/505

Significance

The control and acknowledgment bits synchronize transmission of user data areas that are in the interface area or any other memory areas such as the data mailbox. The job mailbox, connection ID, date, and time are user data areas that are within the interface area.

16.1 Control and Acknowledgment Bits

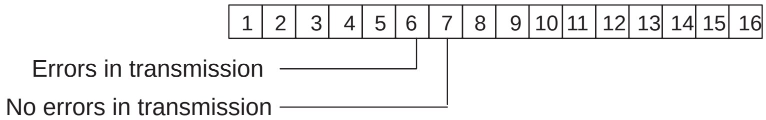
Introduction

There is one word each provided for the control and acknowledgement bits. Word n+0 contains the control bits. The control bits are written by the PLC and read by the operating unit. Word n+6 contains the acknowledgement bits. The acknowledgement bits are written by the operating unit and read by the PLC.

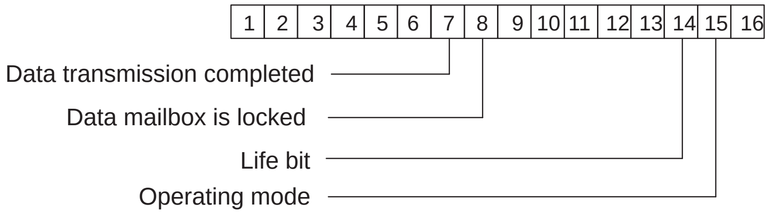
Detailed structure of control and acknowledgement bits

The diagrams below show the structure of the control and acknowledgement bits in detail. Following the diagrams is a description of how synchronization between the operating unit and the PLC is achieved by setting the bits. Synchronization during transfer of data records is described in chapter 17.7.

Control bits, word n+0



Acknowledgment bits, word n+6



Operating mode

Bit 15 in acknowledgment bits `1` = Operating unit is off-line
`0` = Operating unit in normal operation

The operating unit overwrites Bit 15 in the acknowledgment bits during start-up and sets it to 0.

If the operating unit is switched off-line by operator input on the operating unit, there is no guarantee that the operating unit will be able to set Bit 15 in the acknowledgement bits to 1. If the PLC sets acknowledgment bit 15 to 1, the PLC program can query whether the bit has been reset to 0, i.e. whether the operating unit is still off-line or is in communication contact with the PLC again.

Life bit

Bit 14 in acknowledgment bits

The life bit is inverted by the operating unit at one-second intervals. This enables the PLC program to detect whether the connection with the operating unit is still present.

Synchronization when transferring data records and indirect variables

Control bits:

Bit 6	1 =	Data record/variable contains errors
	0 =	Analysis not performed
Bit 7	1 =	Data record/variable contains no errors
	0 =	Analysis not performed

Acknowledgment bits:

Bit 7	1 =	Data transmission completed
	0 =	Analysis not performed
Bit 8	1 =	Data mailbox is locked
	0 =	Data mailbox is unlocked

16.2 Data Areas in the Interface Area

General

This section describes the layout and usage of the user data areas that are located in the interface area.

The job mailbox is used by the SIMATIC 500/505 to initiate an action on the operating unit. All other bytes are areas to which the operating unit writes data. Those areas can be analyzed by the SIMATIC 500/505 program. The individual data words are described below.

Job mailbox

Words n+2 to n+5:

The job mailbox can be used to send PLC jobs to the operating unit and thereby initiate actions on the operating unit.

The job mailbox consists of four words. The first word of the job mailbox contains the job number. The parameters of the job must be entered in the succeeding words (maximum of 3).

Job mailbox

Address	1 … 16
n+2	Job no.
	Parameter 1
	Parameter 2
n+5	Parameter 3

If the first word of the job mailboxes not equal to zero, the operating unit analyzes the PLC job. Afterwards, the operating unit sets this data word to zero again. For that reason, the parameters must be entered in the job mailbox first and only then the job number.

The PLC jobs possible are listed in the appendix B together with their job numbers and parameters.

Date and time

Time = **Words n+9 to n+11**
Date = **Words n+12 to n+14**

PLC job 41 can be used to initiate transfer of date and time from the operating unit to the SIMATIC 500/505. The date and time are written to the interface area.

Figure 16-2 shows the layout of the data area. All data is in BCD format.

	Left byte	Right byte	
Address	1 … 8	9 … 16	
n+9	Not assigned	Hour (0...23)	Time
n+10	Minute (0...59)	Second (0 – 59)	Time
n+11	Not assigned		Time
n+12	Not assigned	Day of week (1...7)	Date
n+13	Day of month (1...31)	Month (1 – 12)	Date
n+14	Year (0...99)	Not assigned	Date

Figure 16-2 Layout of Data Area for **Time** and **Date**

In order to detect when the date and time have been transferred, you should set the data words to `0` before dispatching the PLC job.

User Data Areas for the SIMATIC 500/505 — 17

User data areas are used for the purposes of exchanging data between the SIMATIC 500/505 and the operating unit.

These data areas are written to and read by the operating unit and the application program in alternation during the process of communication. By analyzing the data stored there, the SIMATIC 500/505 and operating unit reciprocally initiate predefined actions.

This chapter describes the function, layout and special features of the various user data areas.

Note

The description of the user data areas applies for all NATIVE drivers.

17.1 Overview

Definition

User data areas can be located in any memory area on the SIMATIC 500/505. User data areas include messages, recipes and trends, for example.

Range of functions

Which user data areas are possible depends on the operating unit used. Table 17-1 summarizes the range of functions available on the individual operating units.

Table 17-1 User Data Areas Usable According to Type of Operating Unit

User data area	TD17	OP7	OP17	OP25 OP35	OP27 OP37	TP27 TP37
Event messages	x	x	x	x	x	x
Alarm messages	–	x	x	x	x	x
PLC jobs	x	x	x	x	x	x
Recipes	–	x	x	x	x	x
System keyboard assignment	x	x	x	x	x	–
Function keyboard assignment	–	x	x	x	x	–
LED assignment	–	x	x	x	x	–
Scheduler	–	–	x	–	–	–
Date and time	x	x	x	x	x	x
Screen number	–	x	x	x	x	x
User version	x	x	x	x	x	x
Trend request area	–	–	–	x	x	x
Trend transfer area	–	–	–	x	x	x

17.2 Event and Alarm Messages

Definition

Messages consist of a fixed text component and/or variables. The text and variables are user-definable.

Messages are subdivided into event messages and alarm messages. The programmer defines what is an event message and what is an alarm message.

Event messages

An event message indicates a status, e.g.

- `Motor switched on`
- `PLC in manual mode`

Alarm messages

An alarm message indicates a fault, e.g.

- `Valve not opening`
- `Motor temperature too high`

Acknowledgment

Since alarm messages indicate abnormal operating statuses, they have to be acknowledged. They can be acknowledged either by

- operator input on the operating unit
- setting a bit in the PLC acknowledgement area.

Message initiation

A message is initiated by setting a bit in one of the message areas on the SIMATIC 500/505. The location of the message areas is defined by means of the configuration software. The relevant area must also be set up on the SIMATIC 500/505.

As soon as the bit in the PLC event/alarm message area has been set and that area has been transferred to the operating unit, the operating unit detects that the relevant message has ”arrived”.

Conversely, when the same bit is reset on the PLC by the operating unit the message is registered as having ”departed”.

Message areas

Table 17-2 shows the number of message areas for event and alarm messages, the number of alarm message acknowledgement areas (PLC → operating unit and operating unit → PLC) and the overall length of all areas for each of the various operating unit models.

Table 17-2 Operating Unit Message Areas

Unit	**Event message area**		**Alarm messages area/ Alarm message acknowledge-ment area**	
	Number	**Length** (words)	**Number per type**	**Overall length per type** (words)
TD17	4	63	–	–
OP7	4	32	4	32
OP17	4	63	4	63
OP25, OP35	8	125	8	125
OP27, OP37	8	125	8	125
TP27, TP37	8	125	8	125

Assignment of message bit and message number

A message can be configured for every bit in the message area configured. The bits are assigned to the message numbers in ascending order.

Example:

Let us assume that the following event message area has been configured for the SIMATIC 500/505 PLC:

`V 43` `Length 5` (in words)

Figure 17-1 shows the assignment of all 80 (5 x 16) message numbers to the individual bit numbers in the PLC event message area.

That assignment is performed automatically on the operating unit.

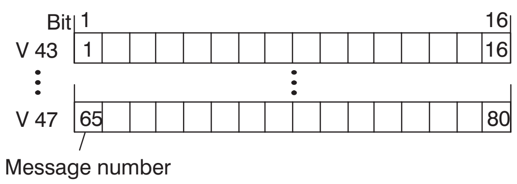


Figure 17-1 Assignment of Message Bit and Message Number

Acknowledgement areas

If the SIMATIC 500/505 is to be informed via an alarm message acknowledgement on the operating unit or if the SIMATIC 500/505 is to perform the acknowledgement itself, the relevant acknowledgement areas must be set up on the SIMATIC 500/505 as follows:

- **Acknowledgement area operating unit → SIMATIC 500/505**:
  This area is used to inform the PLC when an alarm message has been acknowledged by operator input on the operating unit.
- **Acknowledgement area SIMATIC 500/505 → operating unit**:
  This area is used by the PLC to acknowledge an alarm message.

These acknowledgement areas must also be specified in the configuration under *Area Pointers*.

Figure 17-2 shows a schematic diagram of the of the individual alarm message and acknowledgement areas. The acknowledgement sequences are shown in figures 17-4 and 17-5.

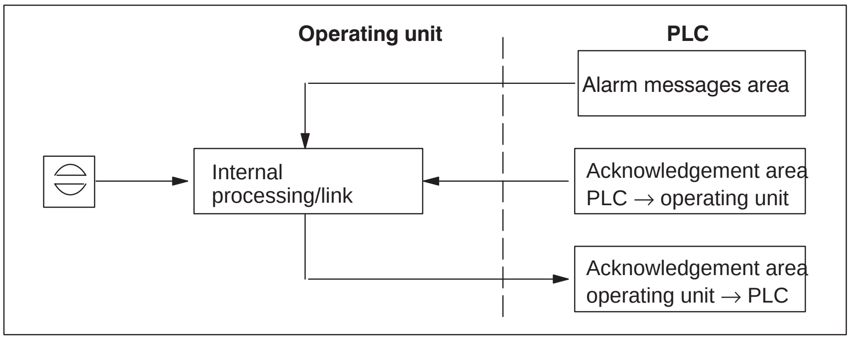


Figure 17-2 Alarm Message and Acknowledgement Areas

Assignment of acknowledgment bit to message number

Each alarm message has a message number. That message number is assigned the same bit number in the alarm messages area as the bit number it is assigned in the acknowledgement area. Under normal circumstances, the acknowledgement area is the same length as the associated alarm messages area.

If the length of an acknowledgement area is not equal to the overall length of the associated alarm messages area and there are succeeding alarm messages and acknowledgement areas, the following assignment applies:

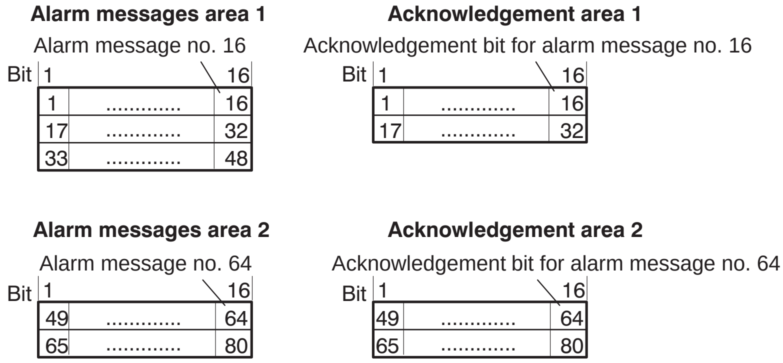


Figure 17-3 Assignment of Acknowledgement Bit and Message Number

Acknowledgement area PLC → operating unit

A bit set by the PLC in this area effects acknowledgment of the corresponding alarm message on the operating unit. Reset the bit when you reset the bit in the alarm messages area. Figure 17-4 shows the signal diagram.

The acknowledgement area PLC → operating unit

- must follow on immediately from the associated alarm messages area,
- must have precisely the same polling time and
- may not be any longer than the associated alarm messages area.

If the physical location of acknowledgement area PLC → operating unit does not follow on from the alarm messages area, system message $655 is issued when the operating unit starts up.

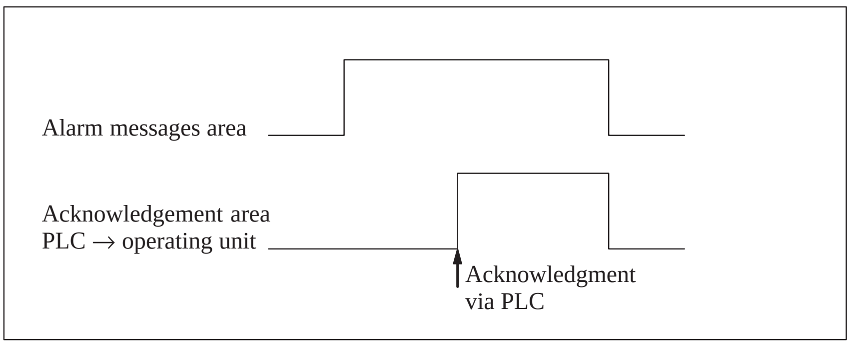


Figure 17-4 Signal Diagram for Acknowledgement Area PLC → Operating Unit

Acknowledgement area operating unit → PLC

If a bit in the alarm messages area is set, the operating unit resets the corresponding bit in the acknowledgement area. If the alarm message is acknowledged on the operating unit, the bit in the acknowledgement area is set. In this way, the PLC can detect that the alarm message has been acknowledged. Figure 17-5 shows the signal diagram.

The acknowledgement area operating unit → PLC must be no longer than the associated alarm messages area.

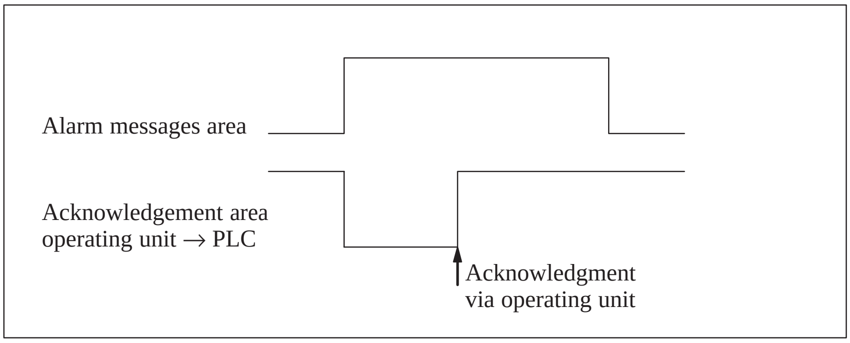


Figure 17-5 Signal Diagram for Acknowledgement Area Operating Unit → PLC

Size of acknowledgement areas

The acknowledgement areas PLC → operating unit and operating unit → PLC must not be any longer than the associated alarm messages areas. They can, however, be smaller if acknowledgement by the PLC is not required for all alarm messages. Figure 17-6 illustrates such a case.

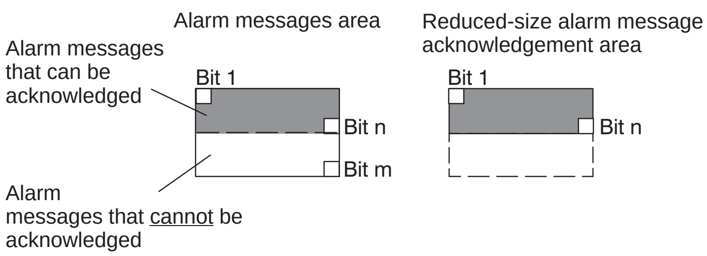


Figure 17-6 Reduced-size Acknowledgement Area

Note

Place important alarm messages in the alarm messages area starting at Bit 1 in ascending order.

The two associated bits in the alarm messages area and acknowledgement area must not be set simultaneously.

17.3 Keyboard and LED Assignment Areas

Usage

Key strokes on the operating unit can be transmitted to the PLC and analyzed there. In that way, an action such as ”switch on motor” can be initiated on the PLC.

The operator panels (OPs) have LEDs on the function keys. Those LEDs can be controlled from the PLC. This means, for example, that in specific situations, it is possible to indicate to the operator by switching on an LED which key should be pressed.

Note re. touch panels

Touch panels have no keyboard and no LEDs which can be assigned to a memory area. For that reason, you do not need to set any area pointers in ProTool for the keyboard and LED assignment.

Requirement

In order to be able to analyze key strokes and control the LEDs, associated data areas (also referred to as assignment areas) have to be set up on the PLC and specified in the configuration as *area pointers*.

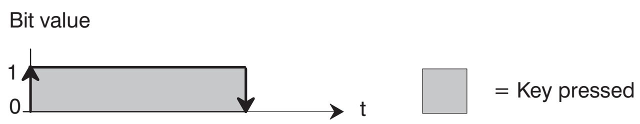
Transfer

The keyboard assignment areas are transferred automatically to the PLC whenever a key is pressed on the operating unit. Configuration of a polling time is therefore not necessary. A maximum of two simultaneously pressed keys are transmitted at once.

Value assignment

- **All keys (except SHIFT key)**

  As long as the key remains pressed, the assigned bit in the keyboard assignment area has the value 1; otherwise its value is 0.



Note

If the operating unit is switched off or disconnected from the PLC while the key is depressed the corresponding bit in the keyboard assignment area remains set.

17.3.1 System Keyboard Assignment Area

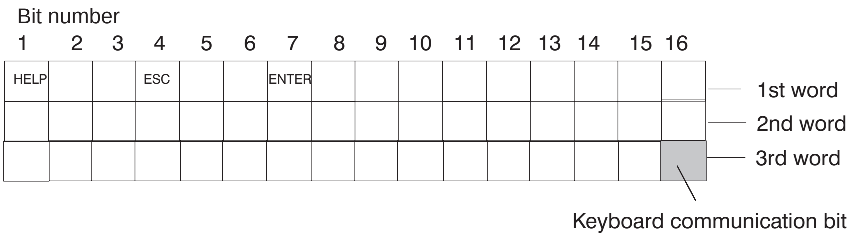
Layout

The system keyboard assignment area is a data area with the fixed length of 3 data words.

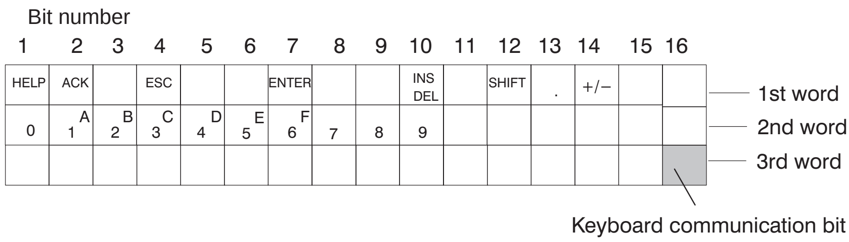
Each key on the system keyboard is assigned a specific bit in the system keyboard assignment area.

The system keyboard assignment area must also be specified in the configuration under *Area Pointers, Type: System Keyboard*. This assignment area can only be created on one PLC and only once on that PLC.

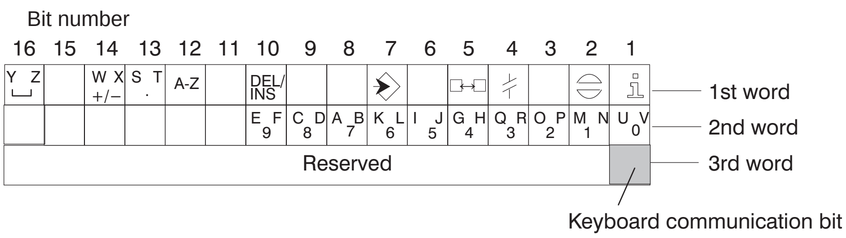
Keyboard assignment for TD17:



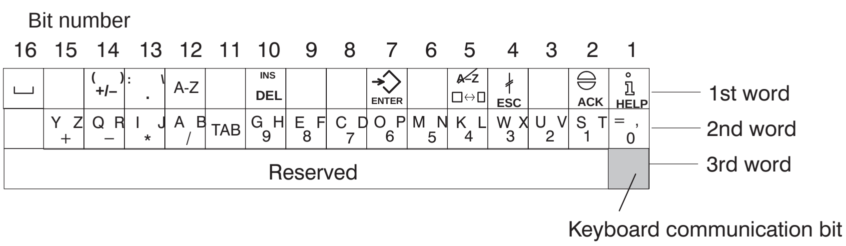
Keyboard assignment for OP7 and OP17:



Keyboard assignment for OP25 and OP27:



Keyboard assignment for OP35 and OP37:



Note

Unused bits must not be overwritten by the application program.

Keyboard communication bit

The keyboard communication bit acts as a check bit. Every time the keyboard assignment area is transferred from the operating unit to the PLC it is set to the value `1` and should be reset by the application program after analysis of the data area.

By regular reading of the communication bit, the application program can ascertain whether the system keyboard assignment area has been transferred again.

17.3.2 Function Keyboard Assignment Area

Data areas

Operator panels have a function keyboard which can be assigned an area in the PLC memory. The function keyboard assignment area can be divided into separate data areas whose number and length depends on the OP concerned.

Data areas	OP7/17	OP25/35 OP27/37
Max. number	4	8
Overall length of all data areas (words)	4	8

The function keyboard assignment area must also be specified in the configuration under *Area Pointers, Type: Function Keyboard*.

Key assignment

The assignment of the individual keys to the bits in the data areas is specified when the function keys are configured. This involves specifying a number within the assignment area for each key.

Keyboard communication bit

Bit 16 in the last data word of **each** data area is the keyboard communication bit. It acts as a check bit. Each time the keyboard assignment is transferred from the OP to the PLC, the keyboard communication bit is set to the value 1. Following analysis of the data area by the application program, the keyboard communication bit should be reset.

By regular reading of the communication bit, the application program can ascertain whether a block has been transferred again.

17.3.3 LED Assignment Area

Data areas

The LED assignment area can be divided into separate data areas as shown in the table below.

Data areas	OP7/17	OP25/35 OP27/37
Max. number	4	8
Overall length of all data areas (words)	9	16

The LED assignment area must also be specified in the configuration under *Area Pointers, Type: LED Assignment*.

LED assignment

The assignment of the individual LEDs to the bits in the data areas is specified when the function keys are configured. This involves specifying a bit number within the assignment area for each LED.

The bit number (n) identifies the first of two consecutive bits that control a total of four different LED statuses:

Table 17-3 LED Flashing Frequency for all OPs except OP17

Bit n + 1	Bit n	LED Function
0	0	Off
0	1	Flashes at approx. 0.5 Hz
1	0	Flashes at approx. 2 Hz
1	1	Permanently lit

On the OP17, the K keys have two-color LEDs (red/green). The resulting LED functions are detailed in table 17-4.

Table 17-4 LED Colors for OP17

Bit n + 1	Bit n	LED Function
0	0	Off
0	1	Permanently red
1	0	Flashes red
1	1	Permanently green

17.4 Screen Number Area

Usage

The operating units store information in the screen number area about the screen activated on the operating unit.

This enables information about the current display contents of the operating unit to be transmitted to the PLC and from there, in turn, to initiate specific responses such as the activation of another screen.

Requirement

If the screen number area is to be used, it must be specified in the configuration as an *Area Pointer*. It can only be created on one PLC and only once on that PLC.

The screen number area is transferred automatically to the PLC whenever a change is registered on the operating unit. Configuration of a polling time is therefore not necessary.

Layout

The screen number area is a data area with a fixed length. The precise length depends on the operating unit. Table 17-5 gives the details.

Table 17-5 Length of Screen Number Area

Operating unit	Length in words
OP7, OP17	2
OP25, OP35, OP27, OP37, TP27, TP37	5

The layout of the screen number area in the PLC memory for the various operating units is detailed below.

OP7/17:

	1 8	9 16
1st word	Current screen type	Current screen number
2nd word	**Current entry number**	**Current input field no.**

Entry	Assignment
Current screen type	1: Screen 2: Recipe 3: Function screen
Current screen/recipe number	1 to 99
Current entry number	1 to 99
Current input field number	0 to 8 Current entry number

At message level and when displaying a directory, all bytes in the screen number area have the value FF_H.

For **function screens**, the screen number area is assigned as follows:

	1 … 8	9 … 16
1st word	3	Function screen number
2nd word	FF_H	Current input field no.

OP25/35, OP27/37, TP27/37:

	1 … 16
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 4: Fixed window 5: Alarm message window 6: Event message window
Current screen number	1 to 65535
Current input field number	1 to 65535

For function screens the current screen number is assigned as follows:

Value	Explanation
1	Alarm message screen
2	Event message screen
3	Alarm buffer
4	Event buffer

17.5 Trend Request and Transfer Areas

Trends

A trend is the graphical representation of a value from the PLC. Reading of the value can be time-triggered or bit-triggered, depending on the configuration.

Time-triggered trends

The operating unit reads the trend values cyclically at time intervals specified in the configuration. Time-triggered trends are suitable for continuous progressions such as the operating temperature of a motor.

Bit-triggered trends

The operating unit reads either a single trend value or the complete trend buffer as a result of a trigger bit being set. This is specified in the configuration. Bit-triggered trends are normally used to display values that area subject to rapid variation. An example of this is the injection pressure for plastic mouldings.

In order to be able to activate bit-triggered trends, corresponding data areas have to be specified in the configuration (under *Area Pointers*) and set up on the PLC. The operating unit and the PLC communicate with one another by means of those areas.

The areas required are the following:
– Trend request area
– Trend transfer area 1
– Trend transfer area 2 (required with switch buffer only)

In those configured areas, each trend is permanently assigned the same bit. This means that each trend is uniquely identifiably in all areas.

Switch buffer

The switch buffer is a second buffer for the same trend that can be set up in the configuration.

While the operating unit is reading the values from buffer 1, the PLC writes data to buffer 2. If the operating unit is reading buffer 2, the PLC writes to buffer 1. This prevents the PLC overwriting the trend data while it is being read by the operating unit.

Division of data areas

The individual areas – i.e. the trend request area and trend transfer areas 1 and 2 – can be divided into separate data areas with a predefined maximum number and length (table 17-6).

Table 17-6 Division of Data Areas

	Data areas		
	Request	Transfer	
		1	2
Max. number per type	8	8	8
Overall length of all data areas (words)	8	8	8

Trend request area

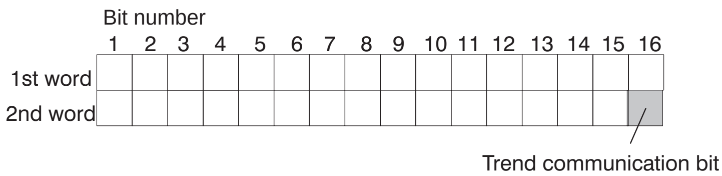
If a screen with one or more trends is opened on the operating unit, the operating unit sets the corresponding bits in the trend request area. After deselection of the screen, the operating unit resets the corresponding bits in the trend request area.

The trend request area can be used by the PLC to ascertain which trend is currently being displayed on the operating unit. Trends can also be triggered without analysis of the trend request area.

Trend transfer area 1

This area is used for the purpose of triggering trends. In the PLC program, set the bit assigned to the trend in the trend transfer area and the trend communication bit. The operating unit detects the trigger and resets the trend bit and the trend communication bit. It then reads a single value or the whole puffer, depending on the configuration.

Example of a trend transfer area with a length of 2 data words



Until the trend communication bit has been reset, the trend transfer area can not be altered by the PLC program.

Trend transfer area 2

Trend transfer area 2 is required for trends that are configured with a switch buffer. Its layout is precisely the same as that of trend transfer area 1.

17.6 User Version

Usage

When the operating unit is started up, a check can be carried out as to whether the operating unit is connected to the correct PLC. This important in cases where multiple operating units are in use.

To perform the check, the operating unit compares a value stored on the PLC with the value specified in the configuration. This ensures compatibility of the configuration data with the PLC program. If the values do not match, system message $653 is displayed on the operating unit and the unit is restarted.

In order to be able to use this function, the following values must be specified in the operating unit configuration:

- Details of configuration version; value between 1 and 255.
  - **ProTool**:
    System → *Settings*
- Data type and address of the version value stored on the PLC:
  - **ProTool**:
    System → *Area Pointers*,
    Select *User Version* in the *Type:* box.

17.7 Recipes

Definition

A recipe is a combination of variables forming a fixed data structure. That structure is defined in the configuration and supplied with data on the operating unit. The structure can not subsequently be modified from the operating unit.

As the data structure can be assigned new data many times over, the data is referred to as a data record. Those data records are stored (created), loaded, deleted and edited on the operating unit. The data is stored on the operating unit, thus saving memory space on the SIMATIC 500/505.

Using a recipe ensures that by transferring a data record to the PLC, multiple items of data are received **simultaneously** and **in synchronized fashion** by the PLC.

Condition

The use of recipes is subject to the following hardware requirements:

- **Operating unit**
  with text-based display: OP7, OP17
  with graphics display: OP25, OP27, OP35, OP37
  with touch screen: TP27, TP37
- **SIMATIC 500/505**

Transfer of data records

Data records can be transferred from the operating unit to the PLC or from the PLC to the operating unit. Data records are transferred from the operating unit to the PLC in order to set specific values on the PLC, e.g. for the production of orange juice. In the same way, data can be read from the PLC and stored on the operating unit as a data record in order to save details of a successful combination of values, for example.

Note

With graphics displays, only the variables are used when transferring data records. In order to transfer a data record from a data medium (such as Flash memory of floppy disk) to the PLC, that record must first be written to the variables.

Synchronization

A basic feature of recipes is that the data is transferred in synchronized fashion and uncontrolled overwriting of data is prevented. In order to ensure coordinated transfer of data records, bits are set in the control and acknowledgment area of the interface area.

Transferring data records

When a data record is written from the operating unit to the PLC, the data record values are always written directly to the specified addresses. When a data record is read from the PLC to the operating unit, the data record values are always read directly from the addresses and stored on the operating unit.

17.7.1 Addressing Recipes and Data Records and the Data Areas Required

The addressing of recipes and data records differs according to whether the operating unit is a text-based display unit or a graphics display unit.

Text-based displays

In the process of configuration, the recipe is given a name and a number. Both the recipe name and the recipe number are displayed on the operating unit.

The data records that you create on the operating unit are also given a name and a number.

The recipe number and data record number are transferred to the PLC along with the data when data record transfer in the direction operating unit → PLC is initiated. This requires creation of the data mailbox on the PLC. When doing so, use the same details specified in the configuration under *Area Pointers*. The data record values are written directly to the addresses on the PLC.

Data Mailbox:

1st word	Recipe number
2nd word	Reserved
3rd word	Reserved
4th word	Data record number
5th word	Reserved

Graphics displays

There are three *identifications* available for the purposes of identifying a recipe on the PLC. Those identifications are user-definable. We recommend that you use the the recipe number for the first identification.

In ProTool, you enter the recipe identification in the *Parameters* dialog box under *Identifications*. ProTool automatically enters the recipe number for the first identification. When a data record is transferred from the operating unit to the PLC, the identifications are written to the data mailbox and can be analyzed by the PLC.

You create data records on the operating unit under a symbolic name. That symbolic name is not transferred with the data record when it is transferred between the operating unit and PLC. There is no identification for the data record on the PLC.

Data Mailbox:

The area for the *data mailbox* has to be reserved on the PLC. When doing so, use the same details specified in the ProTool configuration under *Area Pointers*. The diagram below shows the layout of the data mailbox.

1st word	ID 1
2nd word	ID 2
3rd word	ID 3
4th word	Reserved
5th word	Length of data record in bytes

17.7.2 Synchronization during Transfer – Normal Case

Transfer of data records

The control and acknowledgment bits in the interface area synchronize the transfer of data records. Normally, transfer is initiated by operator input on the operating unit.

Control bits:

Bit 6 `1` = Data record/variable contains errors
`0` = Analysis not performed

Bit 7 `1` = Data record/variable contains no errors
`0` = Analysis not performed

Acknowledgment bits:

Bit 7 `1` = Data transmission completed
`0` = Analysis not performed

Bit 8 `1` = Data mailbox is locked
`0` = Data mailbox is unlocked

Transfer from operating unit → PLC (initiated on operating unit)

The description which follows explains the sequence in which the operating unit sets the synchronization bits in the interface area and how the PLC program should respond to those settings.

Step 1: Bit 8 of the acknowledgement bits is checked by the operating unit. If bit 8 is set to `1` (= Data mailbox locked) transfer is cancelled and a system error message returned. If Bit 8 is set to 0, the operating unit sets it to 1.

Step 2: The operating unit enters the identifications in the data mailbox. The variable values are written to the configured address.

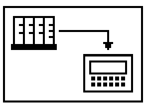
Step 3: The operating unit sets bit 7 of the acknowledgement bits to `1` (= Data transfer completed).

Step 4: The PLC program then has to acknowledge whether the transferred data contained errors or not.

Data contains no errors:	Bit 7 is set to `1`
Data contains errors:	Bit 6 is set to `1`

Step 5: The resets Bit 7 and 8 of the acknowledgment bits.

Step 6: The PLC program must reset Bit 6 and 7.



If the project for a graphics display unit incorporates the standard configuration, the transfer sequence described above corresponds to the use of the key illustrated on the left on the standard screen Z_RECORD_2.

17.7.3 Synchronization during Transfer – Special Cases

Transfer from PLC → operating unit

Direct transfer from the PLC to the operating unit is always carried out without synchronization.

Transfer by way of PLC job

We recommend that data record transfer is effected by operator input on the operating unit. To do so, use standard screen `Z_Record_1`. When transferring data records by means of a PLC job (job nos. 69 and 70) the data record number can not be specified. Only the values of the current variables are transferred.

Job no. 70 corresponds to the function *Data record: OP → PLC*, and job no. 69 to function *Data record: PLC → OP*.

Example

Below is an example of the use of PLC job no. 70 on an OP7 connected to a SIMATIC 500/505 . The example illustrates the steps to be carried out on the OP7 and the PLC.

OP7

1. Configure the tags for the recipe.
2. Configure the recipe, i.e. define the text items and the tags.
3. Configure a screen for editing and transferring the recipe. For that purpose you should define two function keys. The one function key should be assigned the function *Recipe Directory*, parameter `2` (Edit). The other should be assigned the function *Recipe Directory*, parameter `7` (Transfer).
4. Configure the two area pointers Interface Area and Data Mailbox.

Interface area on SIMATIC 500/505 PLC, e.g. V 200

n+0	VB200	VB201
n+2	VB202	VB203
n+4	VB204	VB205
...	...	...
n+50	VB250	VB251

SIMATIC 500/505 PLC

1. Enter the parameters for the PLC jobs *Recipe Number* and *Data Record Number* in n+3 (V203) and n+4 (V204) respectively.
2. Next, initiate transfer by writing `70` to n+2 (V202) of the interface area (= execute PLC job).
3. On completion of the transfer, the OP7 resets n+2.

The transfer is now complete. To transfer another data record, repeat the two steps above.

Part V Data Block Connections

Communication Management for Block Drivers

18

This chapter describes the communication structure, the functional principle and the hardware and software required to connect other PLCs to text displays and operator panels.

18.1 Overview

Supported connections

The TD/OP can also be connected to other PLCs. The following connections are supported, among others:

- SIMATIC 500/505,
- Free serial,
- Allen-Bradley,
- Mitsubishi,
- Telemecanique.

Dependencies

Connection of the TD/OP to other PLCs depends on the firmware version and the configuring tool. The following table shows the dependencies.

Operator Panel		ProTool		ProTool/Lite		COM TEXT
Type	Firmware version	up to V1.31	from V2.0	up to V1.01	from V2.0	
OP5	from V1.0	–	–	–	–	① to ④
	from V1.2	① to ④	① to ⑥	① to ④	① to ⑥	
OP15	from V2.1	–	–	–	–	① to ④
	from V2.20	① to ④	① to ⑤	① to ④	① to ⑤	
	from V2.22	① to ④	① to ⑥	① to ④	① to ⑥	
TD10, TD20, OP20	from V3.1	–	–	–	–	① to ④
OP25	from V1.01	① to ④	① to ④	–	–	–
OP35	all versions	① to ④	① to ④	–	–	–

Explanation of symbols:

① SIMATIC 500/505
② Free Serial Connection
③ Allen-Bradley
④ Mitsubishi
⑤ Telemecanique TSX7 Adjust
⑥ Telemecanique TSX17 Adjust

With OP5/15/25/35, the functionality is integrated into the OP. For TD10/TD20 and OP20, the ”Options” memory submodule is required.

The data block drivers are on a floppy disk, which is available as an option.

– For ProTool, the floppy disk is called ”Drivers”. The drivers are installed by means of Setup.
– For COM TEXT, the floppy disk is called ”Optional Connections”. The drivers are installed with an installation program located on the floppy disk.

Physical connection

Any interface which is designed for connecting a PLC can be used on the TD/OP. The table below provides an overview.

Device	Interface	Type			
		RS232	TTY	RS422	RS485[2]
TD10/20, OP20 – without SSM[1] – with SSM[1]	 SS1/IF1 Module interface	 x x	 x x	 – x	 – x
OP5/A1	IF1A	x	x	–	–
OP5/A2	IF1A IF1B	x –	– –	– x	– x
OP15/A1, OP15/C1	SS2A/IF2A SS2B/IF2B	x –	x –	– x	– x
OP15/C1, OP15/C2	SS2A/IF2A	x	x	–	–
OP25/35	IF1A IF1B	x –	x –	– x	– –

1) Interface module
2) Telemecanique TSX17 Adjust only

Standard cables are available for the majority of suitable PLCs.

In a few instances, you will have to make the cable yourself. In this case, please refer to the individual equipment manuals for details of the interface assignments.

Note

No liability will be assumed by Siemens AG for any malfunctions or damage caused by the use of ”own-manufactured” cables or of other non-Siemens cables.

Interface parameters

The interface parameters must be specified in the configuration of the TD/OP and in the PLC program. You must choose the same values for both the TD/OP and the PLC.

Note

The interface parameters cannot be altered during normal operation.

Data exchange

The TD/OP cannot access every single memory or peripheral area with these types of connection; it always exchanges predefined data blocks with the PLC. The user is responsible for the definition and distribution of these data blocks in the PLC.

Classes

”Other PLCs” are subdivided into classes 1 and 2:

- **Class 1**:
  These PLCs offer no special support for transferring the data blocks. You must provide suitable routines in your program for handling the serial interface. Typical example: PC-AT with MS-DOS operating system.
- **Class 2**:
  The operating systems of these PLCs contain interface drivers and connection protocols allowing the TD/OP direct access to certain memory areas. Example: SIMATIC 500/505.

18.1.1 Communication Structure

Figure 18-1 shows the communication structure, together with the components which are necessary for communication between class 1 or 2 PLCs and TD/OP devices.

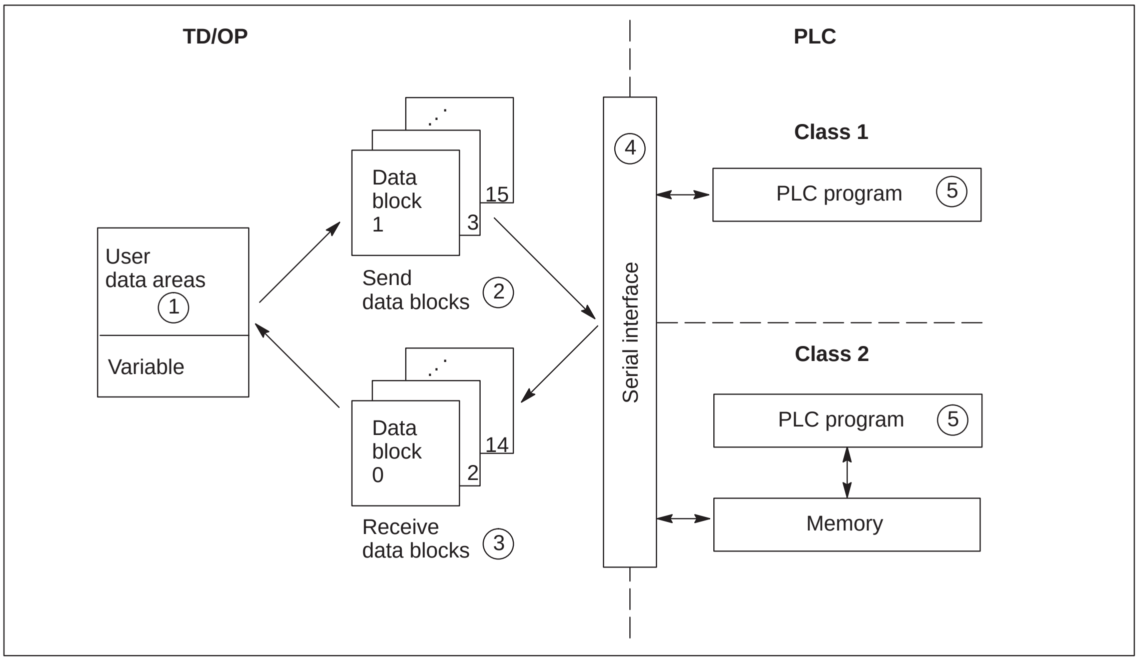


Figure 18-1 Communication structure for connecting other PLCs

Description of figure 18-1

Communication between the TD/OP and the PLC is effected by exchanging data blocks via the serial interface④. Data are transferred from the PLC to the TD/OP via receive data blocks③ and from the TD/OP to the PLC via send data blocks②. The task of the PLC program⑤ is todefine the data blocks which must be transferred to the TD/OP and to evaluate the received data blocks.

With class 2 PLCs, the drivers of the TD/OP and the PLC take care of sending and receiving the data blocks. In the case of class 1 PLCs, the PLC program is responsible for ensuring that the serial interface is controlled correctly.

Depending on the configuration and the purpose for which the TD/OP device is used, various user data areas① must be set up in the PLC in order to be able to use certain functions. The locations of the user data areas and the variables are specified in the configuration. The data blocks which are to be transferred to the TD/OP (receive data blocks) must be defined in the PLC program and the received data blocks (send data blocks) evaluated there.

18.1.2 Functional Principle

Class 1

The PLC must send back the corresponding receiving data block as soon as the TD/OP has transferred a send data block. This method is used for a *free serial* connection, for example.

Note

Do not use full duplex operation (i.e. the PLC must not send data until the TD/OP has completed the transfer of a data block).

Class 2

The TD/OP sends a send data block. The operating system of the PLC stores the received data in the memory. The TD/OP then uses the operating system of the PLC to read the corresponding receive data block. This method is used for a *SIMATIC 500/505* PLCs, for example.

Caution

The memory areas which are accessed by the send blocks must not be used elsewhere in the PLC program. The TD/OP overwrites them cyclically!

18.2 Communication via Data Blocks

18.2.1 Structure of the Data Blocks

Number of data blocks and data block number

The number of data blocks must be fixed by the user.
A number (0 to 15) identifies each data block. Data blocks with even numbers (0, 2...14) transfer data from the PLC to the TD/OP. Data blocks with odd numbers 1, 3...15) transfer data in the reverse direction.

The data blocks must be present in pairs: data blocks 0 and 1, data blocks 2 and 3, etc.

Data block for TD/OP →PLC (send block)	Corresponding data block for PLC → TD/OP (receive block)
1 3 : 15	0 2 : 14

Data block size

Each data block may have a size of up to 1024 words (= 2048 bytes). For performance reasons, however, we recommend not using more than 256 words per data block.

The size of a data block cannot be configured directly, but is dependent on the highest word address which is used.

The sum of all data blocks must not exceed the total amount of data shown below:

Device	Max. amount of data
TD10	2 kbyte
TD20, OP5/15/20/25/35	4 kbyte

Stucture of the data blocks

Each data block consists of a fixed data block header and an area available to the user.

Word no.	Entry
0	Data block number
1	Data block size in words
2 : 255 (1023)	Freely assignable

Since communication control requires data blocks 0 and 1, you may only use these two blocks as desired onwards of word number 9 (data block 0) and word number 19 (data block 1) respectively.

18.2.2 Data Block Exchange

Data block exchange

The data blocks must be present in pairs: data blocks 0 and 1, data blocks 2 and 3, etc. The send data block (odd number) is always transferred first, and then the receive data block (even number).

Cycle

The exchange of data blocks between the TD/OP and the PLC occurs in so-called cycles. A cycle always starts with the transfer of data block 1 to the PLC, which then sends data block 0 to the TD/OP.

The exchange of all other data blocks depends on the configured priority (0...9):

- **Priority = 0**:
  - if the TD/OP made a change in the block which must be sent.
  - if the TD/OP requires a data area or a process variable of a receive data block because of the configured polling time.

  The default priority 0 should be modified only if special optimizations are necessary.
- **Priority = 1**:
  - in every cycle.
- **Priority = 2..9**:
  - in every second to ninth cycle.

Note

Place data with a polling time in priority 0 data blocks in the configuration. The desired polling time cannot be guaranteed for other priorities due to the cyclic transfer mode.

18.2.3 Structure of Special Data Blocks 0 and 1

Function

Data blocks 0 and 1 contain information which is important for starting up and monitoring communication and for transferring PLC jobs.

This data block pair is always exchanged cyclically.

Structure of data block 0

Data block 0 for the transfer from the PLC to the TD/OP has the following structure:

Word no.	Entry
0	Data block number 0
1	Data block size in words
2	Control bits
3	Reserved
4	Reserved
5 : 8	Job mailbox
9 : 255 (1023)	Freely assignable

Structure of data block 1

Data block 1 for the transfer from the TD/OP to the PLC has the following structure:

Word no.	Entry
0	Data block number 1
1	Data block size in words
2	Acknowledge bits
3	Reserved
4	Identifier
5 : 7	Time
8 : 10	Date
11 : 13	Scheduler bits
14 : 18	Reserved
19 : 255 (1023)	Freely assignable

Note

Write accesses by the PLC program to reserved words are not allowed.

Entries in data blocks 0 and 1

Word no. 0

Data block number
Number of the data block (0 or 1).

Word no. 1

Data block size
Size of the data block in words (up to 1024).

Word no. 2

Control bits, acknowledge bits
The control bits in data block 0 (figure 18-2) and the acknowledge bits in data block 1 (figure 18-3) perform the following tasks:

- Starting up communication and life bit monitoring
- Controlling the transfer of the date and time
- Controlling the transfer of scheduler bits
- Controlling the transfer of data records
- Controlling the transfer of jobs

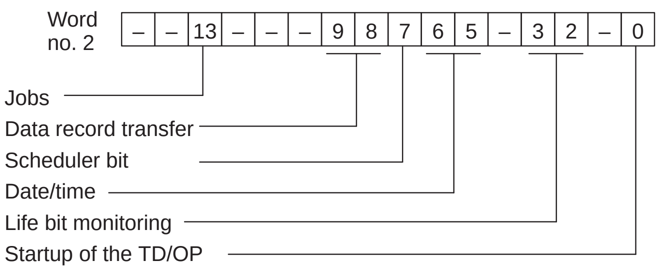


Figure 18-2 Control bits in data block 0

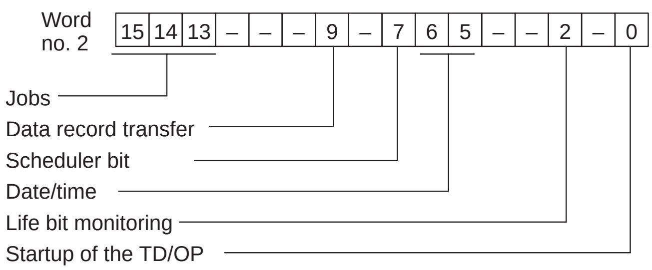


Figure 18-3 Acknowledge bits in data block 1

Word no. 4

Identifier (data block 1)
The TD/OP enters the version number of its firmware and an identifier for the configured type of connection in word no. 4 of data block 1.

The structure of data word no. 4 is shown in figure 18-4.

	Left byte	Right byte
Word no. 4	Version number	Connection identifier

Free serial	1
SIMATIC 500/505	2
⋮	⋮

Figure 18-4 Identifiers in data block 1

Word nos. 5...8

Job mailbox (data block 0)
A PLC job is triggered by entering it in the job mailbox in data block 0. The structure of the job mailbox is shown below.

	Left byte	Right byte
DW no. 5	0	Job number
6	Parameter 1	
7	Parameter 2	
8	Parameter 3	

The PLC jobs which are possible for each device are described in appendix B.

<u>Recommended procedure</u>:

1. User enters job in mailbox,
2. User sets control bit 13 (transfer job),
3. TD/OP sets acknowledge bit 13 (processing job),
4. TD/OP evaluates job,
5. TD/OP sets acknowledge bit 14 (job terminated with error) or 15 (job terminated without error),
6. User evaluates acknowledge bits,
7. User resets control bit 13,
8. TD/OP resets acknowledge bits.

A new job cannot be transferred until acknowledge bit 13 has been reset.

Word nos. 5...10

Date and time (data block 1)
You can use a job to trigger the transfer of the date and time from the TD/OP to the PLC. The information is stored (BCD-coded) in word nos. 5 to 10 of data block 1.

	Left byte	Right byte	
DW 5	Not used	Hours (0...23)	Time
6	Minutes (0...59)	Seconds (0...59)	Time
7	Not used		Time
8	Not used	Day of the week (1...7)	Date
9	Date (1...31)	Month (1...12)	Date
10	Year (0...99)	Not used	Date

The TD/OP sets acknowledge bits 5 (new time) and 6 (new date) in word no. 2 of data block 1 after the date/time has been transferred.

Recommended procedure:

1. TD/OP sets acknowledge bits 5 and 6 (after transfer of date/time).
2. User evaluates date and time.
3. User resets control bits 5 and 6.

Word nos. 11...13

Scheduler bits (data block 1)
When an scheduler time is reached on the operator panel, the corresponding bits are set in word nos. 11 to 13 of data block 1:

DW 11	Scheduler bit 16	...	Scheduler bit 1
12	Scheduler bit 32	...	Scheduler bit 17
13	Scheduler bit 48	...	Scheduler bit 33

After the time scheduler bits have been transferred, the OP sets acknowledge bit 7 in word 2 of data block 1; this bit remains set until control bit 7 is set in data block 0. More scheduler bits can then be transferred by the OP.

Recommended procedure:

1. OP sets acknowledge bit 7 (after transfer of time interrupt bits),
2. User evaluates scheduler bits,
3. User sets corresponding control bit 7,
4. OP resets acknowledge bit 7,
5. User resets control bit 7.

Startup of the TD/OP

DW 2, control and acknowledge bits 0:
A restart of the TD/OP can be triggered with control bit 0 in word no. 2 of data block 0.

Recommended procedure:

1. User sets control bit 0 (perform startup of TD/OP),
2. TD/OP resets acknowledge bit 0,
3. User resets control bit 0,
4. TD/OP initiates restart,
5. TD/OP sets acknowledge bit 0 (startup complete).

The TD/OP evaluates both the leading edge and the trailing edge of control bit 0.

Life bit monitoring

DW 2, control bits 2 and 3 and acknowledge bit 2:
A life bit monitoring function can be activated, to ensure that any interruptions in the connection to the PLC are detected immediately.

Note

If you disable life bit monitoring, detection of a connection malfunction of the TD/OP is not always guaranteed. An automatic restart of communication after the fault has been rectified is then not possible.

Recommended procedure:

1. User sets control bit 3 (i.e. perform life bit monitoring).
2. TD/OP inverts acknowledge bit 2 in every cycle.
3. User must copy the value of acknowledge bit 2 to control bit 2 in every cycle.

   or

1. User resets control bit 3. Life bit monitoring is not performed.

Life bit monitoring should always be enabled for normal applications.

Transfer of data records/ indirect input

DW 2, control bits 8 and 9 and acknowledge bit 9:
With operator panels OP5/15/20, data records can only be transferred directly. In the case of the OP25/35, data records can be transferred both directly and indirectly.

The transfer of data records is initiated by means of PLC jobs 69 and 70. If the device has a line display, it can also be initiated by activating function screens on the OP.

Recommended procedure:

1. After transfer of all the relevant data blocks in a record, OP sets acknowledge bit 9 (data transfer complete),
2. User sets control bit 8 (transfer of data records disabled),
3. User evaluates data mailbox/recipe number mailbox and copies contents of send data block to receive data block,
4. PLC program must then acknowledge transfer of data record: control bit 9 is set (data record transfer accepted),
5. OP resets acknowledge bit 9,
6. User resets control bit 9,
7. User evaluates values in data record,
8. User resets control bit 8 (transfer of data records enabled again).

The operator panel cannot transfer the next data record until this final step has taken place.

The TD/OP checks control bit 8 before another data record is transferred. If this bit is set, the transfer is canceled and a system message is output.

Indirect variables of the OP25/35 are transferred to the configured data mailbox according to the above procedure.

18.3 Drivers and Configuration Examples

Labeling of data media

There is one floppy disk for ProTool and one for COM TEXT, each containing drivers and configuration examples:

- ProTool: *Drivers*,
- COM TEXT: *Optional Connections* .

Note

- Make a backup copy of the original disk.
- Always work from the backup disk.
- Keep the original disk in a safe place.

Installing drivers in ProTool

The drivers must be installed in Windows.

- Select the program group called *COROS ProTool* and the program called *ProTool Setup*.
- Mark the *Optional PLC Drivers* option and unmark all other options.
- Follow the setup instructions on the screen to install the drivers.

Installing drivers in COM TEXT

- Insert your work disk with the name *Optional Connections* in the floppy disk drive.
- Change to this drive *a*: or *b*:
- Type *install* and press the Enter key. The installation program will then prompt you to choose the installation language:
  – **D**eutsch,
  – **E**nglish,
  – **F**rançais,
  – **I**taliano.

  The program guides you through the remainder of the installation procedure in a dialog.

18.4 Configuring

You must enter the following specifications while configuring with COM TEXT and ProTool if you are using a connection to other PLCs.

Select the PLC

ProTool: Menu item: *System → PLC*,

COM TEXT: Mask: *SYSTEM: CONNECTION TO*.

Set the interface parameters

ProTool: Menu item: *System → PLC → Edit → Parameters*,

COM TEXT: Mask: *CONFIGURE – BASIC SETTINGS – TDOP INTERFACES* and data block assignment with F1.

These parameters must be identical to the parameters set for the PLC. They are described in detail below.

- **Data block addresses** (class 2 PLCs only):
  The data block addresses are the start addresses of the data blocks in the memory of the PLC.
- **Priority**:
  You must specify the data block exchange priority for each pair of data blocks (except data blocks 0 and 1). Priority 0 is normally the only meaningful priority.
- **Pause** (multiple of 100 ms):
  After the transfer of a data block pair, the TD/OP waits the specified length of time before transferring the next data block pair. You can use this to artificially delay communication and thus reduce the load on the interface of the PLC.

  Remember, however, that this slows down the update speed.
- **Interface**:
  You must specify the interface of the TD/OP device to which the PLC is connected.
- **Baud rate**:
  The baud rate is the transfer rate for data exchanges between the TD/OP and the PLC.
- **Type**:
  This is the interface type (TTY or RS232).
- **Data bits, parity, stop bits**:
  These parameters define the number of data bits (7 or 8), the number of stop bits (1 or 2) and the parity (odd, even or none).
- **CPU type**:
  This is the PLC's CPU type.

- **Character delay time**:
  The character delay time is the time allowed between two received characters. If this time is exceeded, an error message is displayed on the TD/OP.
  A character delay time of 120 ms is set for the *free serial* protocol as default. It should not be altered. You are not able to alter it for other protocols.
- **Memory organization**:
  You can specify here whether the high byte or the low byte should be transferred first with the *free serial* protocol. You cannot change the value for other protocols.

Area pointers and variables

Area pointers

You should only define the area pointers which you actually need for the various user data areas in your configuration (see chapter 24).

- **ProTool**: Menu item *System → Area Pointers*,
- **COM TEXT**: Mask: *CONFIGURE – BASIC SETTINGS – AREA POINTER LISTS*.

Variables

- **ProTool**: Dialog box *Variable*,
- **COM TEXT**: Mask *CONFIGURE – DEFINITIONS – PROCESS LINKS*.

The location in one of the data blocks is specified for user data areas and variables. Be sure to fulfil the following requirements:

- Areas and variables read from the PLC (actual values) must be located in a receive data block (even numbers).
- Areas and variables transferred to the PLC (setpoints) must be located in a send data block (odd numbers).

User version

The user version can be checked when the TD/OP is started up, to ensure that if several devices are used they are each connected to the correct PLC.

A value stored in the PLC is compared with the configured value. If the two values are not identical, a system message is output on the TD/OP and the device is restarted.

If you want to be able to use this function, you must specify the following values when you configure the TD/OP:

- Value of the version stored in the PLC (1...255). This check is skipped if you specify 0:
  - **ProTool**: *System → Parameters → Miscellaneous*
  - **COM TEXT**: *General Parameters*
- Data type and address of the value stored in the PLC:
  - **ProTool**: *System → Area Pointers → User Version*
  - **COM TEXT**: *Area Pointer Lists*

18.4.1 Setpoints/Actual Values (Two-Way Transfer)

Field types and data areas

A data transfer occurs from the TD/OP to the PLC and back for the following field types and data areas:

- Setpoints/actual values
- Recipe setpoints
- Recipe number mailbox/data mailbox

You must place the appropriate process connections or area pointers in send data blocks during the configuration procedure. The same data area is then also assigned for this value in the corresponding receive data block.

Example

Area pointer for recipe number mailbox:

DB 3, DW 10, size: 1 word.
Word no. 10 is also assigned for the recipe number mailbox in the corresponding receive data block (DB 2).

18.4.2 Notes on Configuring

Polling time

The polling times which you specify during the configuration procedure determine how often a data area (e.g. the message bit area) is evaluated or how often the indication of a value (e.g. actual values in process screen entries) is updated.

If priority 0 has been configured for the corresponding data blocks (default), the data area is polled by the PLC if required (see chapter 18.2.2).

Priority

In addition to the polling time of a variable, you can specify another priority for each data block. In this case, the corresponding data pair is replaced irrespective of the update time it actually requires.

Advantage:
The variables on a screen can, for example, be updated before the screen itself is updated.

Disadvantage:
Unnecessary burden on data transfer. Priority 0 should therefore normally be set. The update rate of the data is then determined solely by the polling time.

Performance optimization

Remember the following to keep the interface load as low as possible.

- Data areas which must be evaluated continuously (e.g. message bit areas and LED assignment): place these areas in data block 0 as far as possible or, if this is not possible, transfer the areas together cyclically in another data block. The selected priority should then be approximately equal to the polling time required, depending on the total amount of data to be transferred and the interface parameters (particularly the baud rate).
- Process variables whose updating depends on the operating status (e.g. actual values of process screen entries): these values should not be transferred cyclically. Place the actual values of a process screen in one data block as far as possible and configure all of them with the same polling time. If technical considerations prevent the use of identical polling times, place the values which must be updated more frequently towards the ”front” (low word numbers) of the data block.
- You can use individual areas of the data blocks more than once. For example, the actual values of different process screens can access the same data block words (via different process connections). The user program must then determine the assignment to the correct memory areas on the basis of the screen number area.

Restrictions

The PU functions (`Status VAR` and `Control VAR`) cannot be used when other PLCs are connected.

19 Free Serial Connection

This chapter describes communication between the TD/OP and PLCs connected via the free serial interface.

Interface

The ”free serial” type of connection can be used to connect the TD/OP to any PLC or computer with a freely programmable serial interface, e.g. a PC-AT or a SIMATIC S5-CPU with an ”open driver”.

Note

The transfer procedure for this type of connection is described earlier in the Manual in conjunction with class 1 PLCs.

Standard cables

The following standard cables are available for connecting the TD/OP to a PC-AT:

To / From	PC-AT	
	RS232, 9-pin	RS232, 25-pin
TD/OP RS232, 15-pin	6XV1 440-2K...	6XV1 440-2L...

... = Length key

19.1 Configuring and Handling the Data Blocks

Handling the data blocks

You must program suitable routines in the PLC for handling the serial interface.

Configuring the data blocks

You cannot configure the size of a data block directly; the highest word address used determines the size of a block.

Interface parameter

The pause must not exceed 2 seconds.

Protocol

Only the data blocks described in chapter 18.2 are exchanged. The PLC can identify the end of a TD/OP send block either from the transferred length or from the character delay time which can be set at the end of the data block transfer. There are no further protocol security mechanisms.

19.2 Configuration Example

The floppy disk which is supplied contains an example of a connection to a PC-AT.

Required hardware and software

- AT-compatible PC
- MS-DOS Version 5.0 or higher
- 640 Kbyte RAM
- Approximately 200 Kbytes of free memory on the hard disk

Downloading the configuration

1. Start COM TEXT or ProTool.
2. Choose the example file which matches your equipment most closely (see table 19-1 and table 19-2). The ProTool example files and the example program are contained in the directory called *\SAMPLES\FREE_SER*.
3. Download the configuration data to the TD/OP.

Table 19-1 Example files available for ProTool

Device	File name and extension
OP25	XFSR_25.PDB
OP35	XFSR_35.PDB

Table 19-2 Example files available for COM TEXT

Device	File name[1)] and extension
TD10/220	XFSR220D.T10
TD10/240	XFSR240D.T10
TD20/240	XFSR240D.T20
OP5	XFSR420D.O05
OP15/A	XFSRAD.O15
OP15/B and /C (4x20)	XFSR420D.O15
OP15/B and /C (8x40)	XFSR840D.O15
OP20/220	XFSR220D.O20
OP20/240	XFSR240D.O20
OP397 (4x20)	XFSR420D.E97
OP397 (8x40)	XFSR840D.E97

1) The last letter of the file name specifies the language of the configuration example **D**eutsch, **E**nglish, **F**rançais, **I**taliano

Connecting the TD/OP to the PC

Connect the TD/OP to the PC-AT with a suitable standard cable.

Starting and using the example program

Change to the directory you specified for the example program (ProTool: *\SAMPLES\FREE_SER* or COM TEXT: *PLC\PROGRAMM*) during the installation procedure and start this program by entering:

`XFSR_PCD.BAT` (German) or
`XFSR_PCE.BAT` (English).

Available menu entries:

a **Example program**:
Execution of the following functions is cyclic:

- Triggering an event message
- Triggering an alarm message (not available with the TD10)
- Acknowledging this alarm message (not available with the TD10)
- Displaying the date and time of the TD/OP on the PC

With the OP5/OP15/OP20, you can also select Process Screen 1 using the menu.

e **Sending and receiving message automatically**:
The *ACKN_TEL* and *REQU_TEL* directories contain files which can be exchanged as data blocks. You can modify these files with an editor and use them to practice your own configuration.

i **Initialization**:
The program and the interface can be reinitialized.

Q **Quitting the program**:
The program is terminated.

Additional notes on the example program:

The *XFSR_PC.CFG* file contains the configuration of the interface, which can be modified using a text editor. The example program uses the COM1 interface as the standard interface. This interface has the following parameters:

- 9600 baud,
- 8 data bits,
- 1 stop bit,
- Even parity.

Microsoft C, V7.00, was used to generate the source code. The *XFSR_APP* directory contains this code. The *README.TXT* file in the*PC_D* directory contains additional notes.

Note

This program is merely designed to serve as an example of a possible connection. You can modify the configuration example according to your particular requirements and if necessary embed parts of the source code in your own applications.

SIMATIC 500/505

20

This chapter describes communication between the TD/OP and the SIMATIC 500 and 505 PLCs.

Interface

The use of a suitable driver permits connection of the TD/OP to PLCs belonging to the SIMATIC 500/505 systems.

Note

The transfer sequence for this connection is described earlier in the Manual in conjunction with class 2 PLCs.

Standard cables

Standard cables are available for connecting the TD/OP to a SIMATIC 500/505.

From \ To	SIMATIC 500/505			
	RS232 9-pin	RS232 25-pin	RS422 9-pin old[1)]	RS422 9-pin new[2)]
TD10, 20, OP5, 15, 20, OP25, 35, RS232, 15-pin	6XV1 440-2K...	6XV1 440-2L...	–	–
OP5-A2, OP15-A1/B/C1, OP25, 35 RS422, 9-pin	–	–	6XV1 440-2M...	6XV1 440-1M...
TD10, 20, OP20 with SSM, 25-pin	–	–	6XV1 440-2N...	–

SSM = Interface module
... = Length key
1) For SIMATIC 500/505 (PLC 525, PLC 535, PLC 545 – 1101, PLC 565T)
2) For SIMATIC 505 (PLC 545 – 1102, PLC 555)

20.1 Configuring and Handling the Data Blocks

Setting up the data blocks

Data blocks can only be created in the V memory in the case of the SIMATIC 500/505. During programming of the PLC, set up the V memory with sufficient space to hold all the data blocks which you require.

The permissible address range is between V1 and V1 048 575.

Handling

SIMATIC 500/505: A driver in the operating system of the PLC handles sending and receiving of data blocks. Your only responsibility is to be sure that the data blocks are written with the correct data (including the data block header) and that they are correctly evaluated.

Bit assignment

The method used by the SIMATIC 500/505 to count the bits of a data word is different from the method described in this documentation. The two methods of counting are shown below.

Method of counting in this documentation

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Method of counting in the SIMATIC 500/505

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Integer value range

Integer variables in the TD/OP devices are always preceded by a plus or minus sign on the display; their range of values extends from –32 768 to 32 767. However, if the SIMATIC 500/505 is used, integer variables are displayed without a plus or minus sign, i.e. the range of values is from 0 to 65 535.

Transfer rate

The maximum transfer rate is 9600 baud.

Optimization of the performance

The performance can be enhanced if the SIMATIC 500/505 PLC is operated with a fixed cycle time rather than a variable cycle time.

The greater the difference between the set cycle time and the actual cycle time, the faster the data exchange with the TD/OP.

20.2 Configuration Example

The floppy disk which is supplied contains an example of a connection to a SIMATIC 500/505.

Required hardware and software

- SIMATIC 500/505
- *TISOFT* programming package for the PLC
- Suitable connecting cable from the PC to the PLC

Downloading the configuration to the TD/OP

1. Start ProTool or COM TEXT.
2. Choose the example file which matches your equipment most closely (see table 20-1 and table 20-2). The ProTool example files and the example program are contained in the directory called *\SAMPLES\TI_505.120*.
3. Download the configuration data to the TD/OP.

Table 20-1 Example files available for ProTool

Device	File name and extension
OP25	XTI5_25.PDB
OP35	XTI5_35.PDB

Table 20-2 Example files available for COM TEXT

Device	File name[1)] and extension
TD10/220	XTI5220D.T10
TD10/240	XTI5240D.T10
TD20/240	XTI5240D.T20
OP5	XTI5420D.O05
OP15/A	XTI5AD.O15
OP15/B and /C (4x20)	XTI5420D.O15
OP15/B and /C (8x40)	XTI5840D.O15
OP20/220	XTI5220D.O20
OP20/240	XTI5240D.O20
OP397 (4x20)	XTI5420D.E97
OP397 (8x40)	XTI5840D.E97

1) The last letter of the file name specifies the language of the configuration example **D**eutsch, **E**nglish, **F**rançais, **I**taliano

Downloading the project to the PLC

Connect your PC to the PLC. Start the *TISOFT* programming package. Download the project called *XTI5* to the PLC from the directory you specified during the installation procedure. Continue as described in the applicable manuals.

Note

Only download the *LADDER* program.

Starting the program

Set your PLC to the *RUN* status.

Connecting the TD/OP to the CPU

Connect the TD/OP to the CPU of your PLC with a suitable standard cable. Execution of the following functions is cyclic:

- Triggering an event message
- Triggering an alarm message (not available with the TD10)
- Acknowledging this alarm message (not available with the TD10)

With the OP5/OP15/OP20, you can also select Screen 1 using the menu system.

Note

This program is merely designed as an example of a possible connection. You can modify the configuration example according to your particular requirements and if necessary embed parts of the program in your own applications.

The example files are configured for a connection via the RS232 interface. For a connection via the RS422 interface, the *Interface Type* parameter must be modified in ProTool or in COM TEXT and an RS422 connection must be set up.

Mitsubishi FX

21

This chapter describes communication between the TD/OP and PLCs belonging to Mitsubishi systems in the FX0 and FX Series.

Interface

The use of a suitable driver permits connection of the TD/OP to PLCs belonging to Mitsubishi systems in the FX0 and FX Series.

Standard cables

Standard cables are available for connecting the TD/OP to a Mitsubishi FX:

To / From	**MITSUBISHI** (RS422)	
	FX0 Mini DIN 8-way	FX Series Sub-D 25-way
TD10, TD20, OP5, OP15, OP20 RS232, 15-way	Adapter 6XV1 440-2UE32 Mitsubishi SC-07[1)]	Adapter 6XV1 440-2UE32 Mitsubishi SC-08[1)]
OP5-A2, OP15-A1/B/C1, OP25, OP35 RS422, 9-way	6XV1 440-2P...	6XV1 440-2R...
TD10, TD20, OP20 with SSM, 25-way	6XV1 440-2Q...	6XV1 440-2S...

SSM = Interface module
... = Length key
1) As the Mitsubishi PLCs communicate via RS 422 as standard, the Mitsubishi SC-07 or SC-08 programming cable with integrated RS422/RS232 adapter is required for the TD/OP connection via RS232
Caution: Limited cable length: approx. 3 m.

21.1 Configuring and Handling the Data Blocks

Setting up the data blocks

During programming of the PLC, divide the data register so that there is sufficient space to hold all the data blocks which you require.

Although data words 0 and 1 of each data block must be present, they are not exchanged between the TD/OP and the PLC. You may use these data words for other purposes.

The permissible address range is:

- between D0 and D31 for **FX0**
- between D0 and D511 for the **FX Series.**

Handling

Mitsubishi FX: A driver in the operating system of the PLC handles sending and receiving of data blocks. Your only responsibility is to be sure that the data blocks are written with the correct data and that they are correctly evaluated.

21.2 Configuration Example

The floppy disk which is supplied contains an example of a connection to the Mitsubishi FX.

This example can be used for the FX0 and FX Series.

Required hardware and software

- Mitsubishi FX0 or FX Series
- *MEDOC* programming package for the PLC
- Suitable connecting cable from the PC to the PLC

Downloading the configuration to the TD/OP

1. Start ProTool or COM TEXT.

2. Choose the example file which matches your equipment most closely (see table 21-1 and table 21-2). The ProTool example files and the example program are contained in the directory called *\SAMPLES\MITSU_FX.120*.

3. Download the configuration data to the TD/OP.

Table 21-1 Example files available for ProTool

Device	File name and extension	Configured interface type
OP25	XFXS_25.PDB	RS232
OP35	XFXS_35.PDB	RS232

Table 21-2 Example files available for COM TEXT

Device	File name1) and extension	Configured interface type
TD10/220	XFXS220D.T10	RS422 (module)
TD10/240	XFXS240D.T10	RS422 (module)
TD20/240	XFXS240D.T20	RS422 (module)
OP5	XFXS420D.O05	RS232
OP15/A	XFXSAD.O15	RS232
OP15/B and /C2 (4x20)	XFXS420D.O15	RS232
OP15/B and /C2 (8x40)	XFXS840D.O15	RS232
OP15/B and /C1 (4x20)	XFXSC12D.O15	RS422
OP15/B and /C1 (8x40)	XFXSC14D.O15	RS422
OP20/220	XFXS220D.O20	RS422 (module)
OP20/240	XFXS240D.O20	RS422 (module)
OP397 (4x20)	XFXS420D.E97	RS232
OP397 (8x40)	XFXS840D.E97	RS422

1) The last letter of the file name specifies the language of the example file: **D**eutsch, **E**nglish, **F**rançais, **I**taliano

Downloading the project to the PLC

Connect your PC to the PLC. Start the *MEDOC* programming package and download the XFXS project to the PLC from the directory you specified during the installation procedure. Continue as described in the applicable manuals.

Starting the program

Set your PLC to the *RUN* status.

Connecting the TD/OP to the CPU

Connect the TD/OP to the CPU of your PLC with a suitable standard cable. Execution of the following functions is cyclic:

- Triggering an event message
- Triggering an alarm message (not available with the TD10)
- Acknowledging this alarm message (not available with the TD10)

With the OP5/OP15/OP20, you can also select Screen 1 using the menu system.

Note

This program is merely designed as an example of a possible connection. You can modify the configuration example according to your particular requirements and if necessary embed parts of the program in your own applications.

The configuration examples are designed for the interface types specified in tables 21-1 and 21-2.

For connecting operator panels OP5, OP15A, OP25, and OP35 via RS422 or for connecting the TD10, TD20 and OP20 devices via the integrated V.24 interface, the *Interface Type* parameter must be modified in ProTool or in COM TEXT and a V.24 or RS422 connection must be set up.

Allen-Bradley 22

This chapter describes communication between the TD/OP and PLCs belonging to the Allen-Bradley SLC 500 and PLC-5 systems.

Interface

The use of a suitable driver permits connection of the TD/OP to PLCs belonging to the Allen-Bradley SLC 500 and PLC-5 systems. At the moment connections are only possible to CPUs with integrated V.24 (RS 232) or V.24 (RS 232)/RS 422 interfaces.

Standard cables

Standard cables are available for connecting the TD/OP to Allen-Bradley systems.

To / From	ALLEN-BRADLEY		
	SLC500 RS232, 9-pin	PLC-5 RS232, 25-pin	PLC-5 RS422, 25-pin
TD10, TD20, OP5, 15, 20, OP25, 35 RS232, 15-pin	6XV1 440-2K...	6XV1 440-2L...	–
OP5-A2, OP15-A1/B/C1, OP25, 35 RS422, 9-pin	–	–	6XV1 440-2V...
TD10, TD20, OP20 with SSM, 25-pin	–	–	6XV1 440-2W...

SSM = Interface module
... = Length key

Allen-Bradley offers a large number of communications adapters for integrating ”RS232 stations” for DH-485, DH and DH+ networks. These connections have not been system-tested by Siemens and are not approved.

22.1 Configuring and Handling the Data Blocks

Setting up the data blocks

Data blocks can only be set up in the data file. During programming of the PLC, the data file must be set up so that there is sufficient space to hold all the data blocks which you require.

The values shown in the table for the source address (SRC) and the destination address (DST) of the data blocks apply to the Allen-Bradley PLC.

PLC / Addresses	**SLC500**	**PLC-5**
Source address	9	0 to 254
Destination address	0 to 255	0 to 999

Handling

Allen-Bradley: A driver in the operating system of the PLC handles sending and receiving of data blocks. Your only responsibility is to be sure that the data blocks are written with the correct data and that they are correctly evaluated.

22.2 Configuration Example

The floppy disk which is supplied contains an example of a connection to Allen-Bradley equipment.

Required hardware and software

- Allen-Bradley, SLC 500 or PLC-5 Series
- APS or 6200 programming software for the PLC
- Suitable connecting cable from the PC to the PLC

Downloading the configuration to the TD/OP

1. Start ProTool or COM TEXT.
2. Choose the example file which matches your equipment most closely (see table 22-1 and table 22-2). The ProTool example files and the example program are contained in the directory called *\SAMPLES\ALBR_DF1.120*.
3. Download the configuration data to the TD/OP.

Table 22-1 Example files available for ProTool

Device	File name and extension
OP25	XDF1_25.PDB
OP35	XDF1_35.PDB

Table 22-2 Example files available for COM TEXT

Device	File name[1)] and extension
TD10/220	XDF1220D.T10
TD10/240	XDF1240D.T10
TD20/240	XDF1240D.T20
OP5	XDF1420D.O05
OP15/A	XDF1AD.O15
OP15/B and /C (4x20)	XDF1420D.O15
OP15/B and /C (8x40)	XDF1840D.O15
OP20/220	XDF1220D.O20
OP20/240	XDF1240D.O20
OP397 (4x20)	XDF1420D.E97
OP397 (8x40)	XDF1840D.E97

1) The last letter of the file name specifies the language of the example file **D**eutsch, **E**nglish, **F**rançais, **I**taliano

Downloading the project to the PLC

Connect your PC to the PLC. Start the programming package and download the project called *XDF1* to the PLC from the directory you specified during the installation procedure. Continue as described in the applicable manuals.

Note for PLC-5 users:

If the connection is via the RS232 interface, it is possible that the programming software may ”hang up” at the end of the program download phase. This is caused by the new channel configuration of the PLC-5, but it does not result in any limitations. You may then make the connection to the TD/OP and start the PLC-5.

Starting the program

Set your PLC to the *RUN* status.

Connecting the TD/OP to the CPU

Connect the TD/OP to the CPU of your PLC with a suitable standard cable. Execution of the following functions is cyclic:

- Triggering an event message
- Triggering an alarm message (not available with the TD10)
- Acknowledging this alarm message (not available with the TD10)

With the OP5/OP15/OP20, you can also select Screen 1 using the menu system.

Note

This program is merely designed as an example of a possible connection. You can modify the configuration example according to your particular requirements and if necessary embed parts of the program in your own applications.

<u>Connection to PLC-5</u>:
The example files are configured for a connection to a PLC-5 via the RS232 interface. For a connection via RS422, you must change the interface type in ProTool or in COM TEXT to *RS422* and set up an RS422 connection.

<u>Connection to SLC 500</u>:
For a connection to an SLC 500 via the RS232 interface, you must set *SLC 500* as the PLC/CPU type in ProTool or in COM TEXT.

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23 Telemecanique TSX Adjust

This chapter describes communication between the TD/OP and Telemecanique TSX PLCs with the adjust driver for the PU interface.

Interface

The TD/OP can be interfaced to Systeme Telemecanique TSX PLCs by means of a suitable driver.

Note

The transfer procedure for this connection is described in the preceding chapters under Class 2 PLCs.

Standard cables

The following cables are available for the interface to the Telemecanique TSX:

To / From	Telemecanique Adjust	
	Compact PLCs TSX 17 15-pin, RS 485	Modular PLC TSX 7 9-pin, TTY
OP5–A2, **OP15– A1/C1**[1)] 9-pin, RS 485	6XV1 440 1E...	
OP 5, OP15 15-pin, TTY		6XV1 440 1F...

... = Length code

1) RS485 possible only if the OP15 has the SS2B/IF2B 9-pin connector

23.1 Configuring and Handling Data Blocks

Creating data blocks

With Systeme Telemecanique TSX PLCs, data blocks are stored in the memory for *variable internal values*. When the PLC is programmed, the memory for *variable internal values* must be created in such a manner that it can accommodate all the data blocks required by the user.

The authorized address range for the

- TSX 17 is between W0 and W1023,
- TSX 7 is between W0 and a maximum of W360447, depending on the configuration.

Handling

With the Telemecanique TSX, a driver in the operating system of the PLC is responsible for sending and receiving data blocks. The user only has to make sure that the data blocks are written with the correct data (including data block head) and correctly evaluated.

Range of integer values

On the TD/OP and on the Telemecanique TSX, integer variables are always signed. The range of values extends from -32 768 to +32 767.

Baud rate

The baud rate is 9600 Bd.

23.2 Example Configuration

The floppy disksupplied to you contains an example for connecting the Telemecanique TSX.

Requirements

- Telemecanique TSX
- Program package for the PLC
- Suitable interconnecting cable between the PC and PLC.

Download the configuration to the TD/OP

1. Start ProTool.
2. Select the example file that suits your device (refer to table 23-1). The ProTool example files and the program examples arelocated in the directory called *\SAMPLES\TM_ADJ.120*.
3. Download the configuration data to the TD/OP.

Table 23-1 Example files available for ProTool

PLC	Device	Interface	File Name and Extension
TSX 17	OP5	RS485	17ADJ05.PDB
	OP15/A	RS485	17ADJ15A.PDB
	OP15/C	RS485	17ADJ15C.PDB
TSX 7	OP5	TTY	47ADJ05.PDB
	OP15/A	TTY	47ADJ15A.PDB
	OP15/C	TTY	47ADJ15C.PDB

Download the project to PLC

1. Connect you PC to the PLC.
2. Start the corresponding program package.
3. Download project *TSX1720.BIN* or *TSX47-20.BIN* from the directory you created during installation to the PLC. To do this, proceed in accordance with the instructions in the corresponding manuals.

Start program

Place your PLC in *RUN* mode.

Connect TD/OP to CPU

Using a suitable standard cable, connect the TD/OP to the CPU of your PLC. The following functions are executed periodically:

- Triggering an event message
- Triggering an alarm message (not available with the TD10)
- Acknowledging this alarm message (not available with the TD10)

Pressing ENTER takes you from message level to screen level and calls Screen 1.

Note

This program is merely an example of one possible connection. Modify the example configuration according to your specific requirements or, if necessary, integrate parts of the programs into your own applications.

24 User Data Areas for Block Drivers

User data areas are used for the data exchange between a PLC and TD/OPs.

The data areas are alternately read and written by a TD/OP and the PLC program during communication. By evaluating data stored there, the PLC and the TD/OP reciprocally initiate permanently defined actions.

This section describes the function, structure and special features of the different user data areas.

24.1 Overview

Definition

User data areas may be located in any memory area on the PLC. They include such objects as messages, recipes and trends.

Functions

The user data areas available to you depend on the TD/OP you are using and the configuration software. Table 24-1 provides an overview of the functions that can be used on the different TD/OPs.

Table 24-1 User Data Areas for the Different TD/OPs.

User Data Area	TD10	TD20	OP5	OP15 OP20	OP25 OP35
Event messages	x	x	x	x	x
Alarm messages	–	x	x	x	x
PLC jobs	x	x	x	x	x
Recipes	–	–	x	x	x
System keyboard assignment	–	x	x	x	x
Function keyboard assignment	–	–	x	x	x
LED assignment	–	–	–	x	x
Schedulers	–	–	–	x	–
Date and time	x	x	x	x	x
Screen number area	–	x	x	x	x
User version	x	x	x	x	x
Trend request area	–	–	–	–	x
Trend transfer areas	–	–	–	–	x

24.2 Event Messages and Alarm Messages

Definition

Messages consist of static text and/or variables. Text and variables can be freely configured.

Messages are basically organized into event messages and alarm messages. The configurer defines what constitutes an event message and what constitutes an alarm message.

Event message

An event message displays a status – for example,

- `Motor switched on`
- `PLC to manual mode`

Alarm message

An alarm message displays a malfunction – for example,

- `Valve will not open`
- `Motor temperature too high`

Acknowledgment

Since alarm messages display extraordinary operating states, they have to be acknowledged. You can acknowledge them either

- by means of an operator input on the TD/OP or
- by setting a bit in the acknowledgment area of the PLC.

Message initiation

Messages are initiated by setting a bit in any one of the PLC message areas. The positions of the message areas are defined by the configuration software. You also have to create the corresponding area on the PLC.

As soon as the bit is set in the event message area or the alarm message area of the PLC and this area is transferred to the TD/OP, the TD/OP detects the corresponding message as having ”arrived”.

Conversely, the message is registered as having ”departed” after the same bit has been reset on the PLC by the TD/OP.

Message areas

Table 24-2 shows the number of message areas for event messages and alarm messages, the number of alarm acknowledgment areas (PLC → TD/OP and TD/OP → PLC) and the overall length of all areas for the different TD/OPs.

Table 24-2 TD/OP Message Areas

Device	Event Message Area		Alarm Message Area and Alarm Acknowledgment Area	
	Number	**Length** (Words)	**Total per Type**	**Overall Length per Type** (Words)
TD10	4	64	–	–
TD20	4	64	4	64
OP5	4	63	4	63
OP15	4	63	4	63
OP20	4	64	4	64
OP25	8	125	8	125
OP35	8	125	8	125

Assignment of message bit and message number

A message can be configured for every bit in the configured message area. The bits are assigned to the message numbers in ascending order.

Acknowledgement areas

If you require the PLC to be informed about the acknowledgement of an alarm message on the TD/OP or the PLC to perform the acknowledgement, you have to create corresponding acknowledgment areas on the PLC:

- **Acknowledgement area TD/OP → PLC**:
  The PLC is informed via this area when an alarm message is acknowledged by means of an operator input on the TD/OP.
- **Acknowledgement area PLC → TD/OP**:
  An alarm message is acknowledged by the PLC using this area.

You also have to specify these acknowledgment areas in the configuration under *Area Pointers*.

Figure 24-1 illustrates the different alarm message and acknowledgement areas. The acknowledgment sequences are listed in table 24-3.

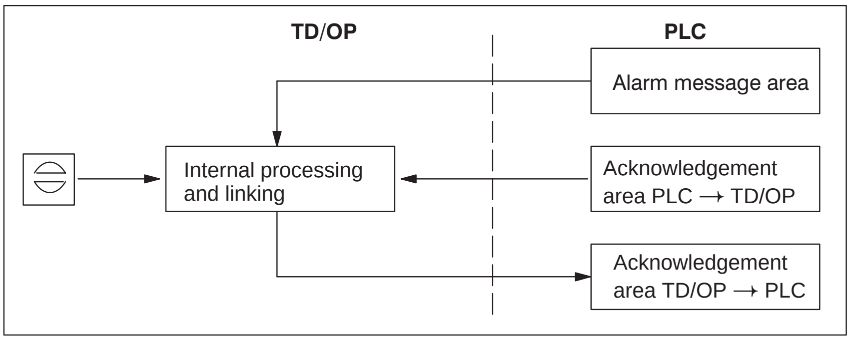


Figure 24-1 Alarm Message Areas and Acknowledgement Areas

Table 24-3 Sequences in Alarm Message Acknowledgement

Action	Reaction	Meaning
Set alarm message bit on the PLC	Corresponding acknowledgement bit TD/OP → PLC and PLC → TD/OP is reset	Alarm message has arrived and is not acknowledged
Set acknowledgement bit on PLC or acknowledgement by operator input on TD/OP	Acknowledgement bit TD/OP → PLC is set	Alarm message is acknowledged
Reset alarm message bit on PLC		Alarm message has departed (irrespective of acknowledgement status)

Assignment of acknowledgement bit to message number

Every alarm message has a message number. The same bit x of the alarm message area and the same bit x of the acknowledgement area are assigned to this message number. The acknowledgement area is normally as long as its related alarm message area.

If the length of an acknowledgement area does not take up the whole length of its related alarm message area and there are the following alarm message areas and acknowledgement areas, the assignment is as follows:

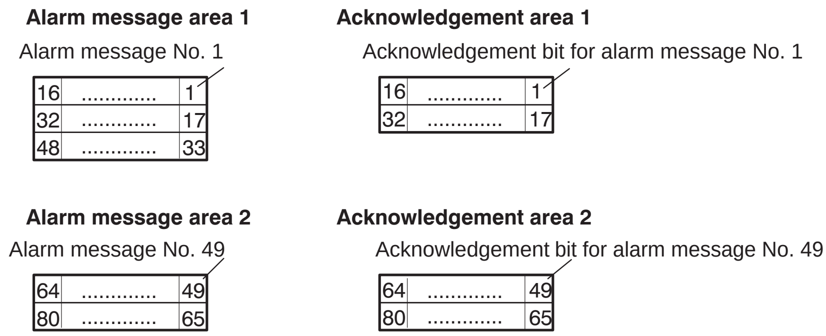


Figure 24-2 Acknowledgement Bit and Message Number Assignment

Acknowledgement area PLC → TD/OP

A bit set in this area by the PLC causes the corresponding alarm message to be acknowledged on the TD/OP.

Acknowledgement area PLC → TD/OP

- must directly follow the related alarm message area
- must have the same polling time and
- may have the same maximum length as the related alarm message area.

If acknowledgement area PLC → TD/OP does not physically follow the alarm message area, system message $655 is issued when the TD/OP starts up.

Acknowledgment area TD/OP → PLC

If an alarm message is acknowledged on the TD/OP, the related bit is set in acknowledgment area TD/OP → PLC. This enables the PLC to detect that the alarm message has been acknowledged.

Acknowledgment area TD/OP → PLC must not be longer than the related alarm message area.

Size of acknowledgment areas PLC → TD/OP and TD/OP → PLC

An acknowledgment area must not be larger than its related alarm message area. However, it may be created smaller if not all alarm messages are to be acknowledged by the PLC. Figure 24-3 illustrates this instance.

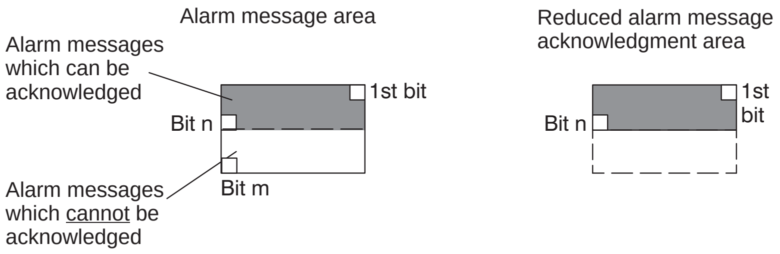


Figure 24-3 Reduced Acknowledgment Area

Note

Place important alarm messages in the alarm message area in ascending order, starting with bit 0.

24.3 Keyboard and LED Assignments

Usage

Key operations on the TD/OP can be transferred to the PLC, where they can be evaluated. This initiates an action, such as Turn on Motor, on the PLC.

The LEDs on the function keys of the OP can be driven by the PLC. This means that it is possible, by means of a lit LED, to indicate to the operator which key he should press in a given situation.

Condition

For you to be able to use this option, you have to create suitable data areas (also called assignments) on the PLC and to specify them in your configuration as *area pointers* .

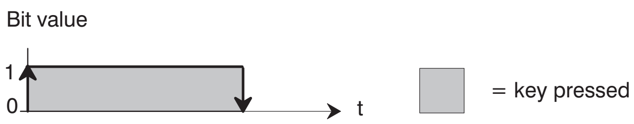
Transfer

Keyboard assignments are transferred spontaneously to the PLC, meaning a transfer is performed whenever a key is pressed on the TD/OP. There is therefore no need to configure a polling time. Up to two simultaneously pressed keys are transferred.

Assigning values

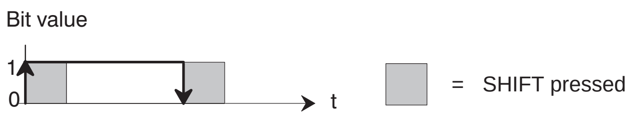
- **All keys (except SHIFT)**

  The value of the assigned bit in the keyboard assignment is 1 as long as the corresponding key is pressed; at other times its value is 0.



- **SHIFT** (not available with OP25/35)

  When you first press SHIFT, the assigned bit is given a value of `1` in the keyboard assignment. This state continues, even after you release the key, until SHIFT is pressed again.



Note

If the TD/OP is switched off while is a key is pressed or if it is isolated from the PLC, the corresponding bit remains set in the keyboard assignment.

24.3.1 System Keyboard Assignment

Structure

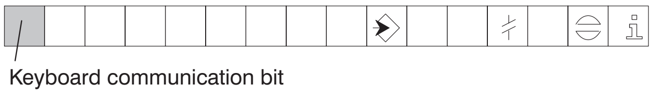
The system keyboard assignment is a data area with a fixed length of

- **one** data word (for TD20)
- **two** data words (for OP5/15/20)
- **three** data words (for OP25/35)

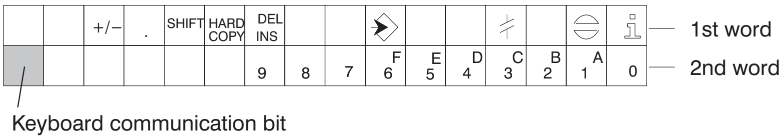
Precisely one bit in the system keyboard assignment is permanently assigned to every key on the system keyboard. Exceptions to this are the DIR key for the OP5/15 and arrow keys.

You must also specify the system keyboard assignment in your configuration under *Area Pointers*, *Type*: *System Keyboard*. This area can be created only on one PLC – and once only.

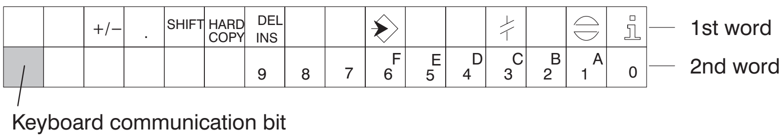
Keyboard assignment for TD20:



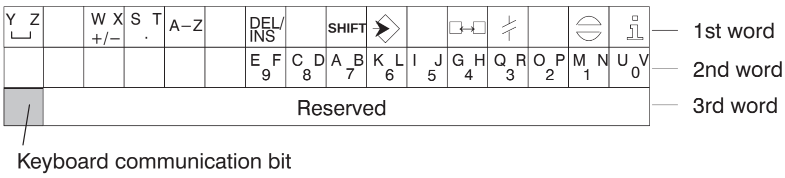
Keyboard assignment for OP5 and OP15:



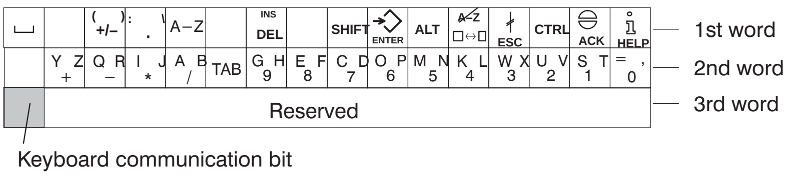
Keyboard assignment for OP20:



Keyboard assignment for OP25:



Keyboard assignment for OP35:



Note

Bits that are not used must not be overwritten by the user program.

System keyboard communication bit

The keyboard communication bit is used as a control bit. Every time the keyboard assignment is transferred to the PLC from the TD/OP, its value is set to 1 and should be reset by the PLC program following evaluation of the data area.

Regular reading of the communication bit makes it possible to determine in the PLC program whether the system keyboard assignment was transferred again.

24.3.2 Function Keyboard Assignment

Data areas

The function keyboard assignment can be partitioned into separate data areas, their number and length depending on the OP concerned.

Data Areas	OP5/15/20	OP25/35
Maximum number	4	8
Total length of all data areas (words)	4	8

You must also specify the function keyboard assignment in your configuration under *Area Pointers*, *Type*: *Function Keyboard*.

Key assignment

You set the assignment of the individual keys to bits in the data areas when you configure the function keys. When you configure, you specify a number within the assignment area for every key.

Function keyboard communication bit

Bit 15 in the final data word of **every** data area is the keyboard communication bit. It is used as a control bit. Every time the keyboard assignment is transferred to the PLC from the OP, the value of the keyboard communication bit is set to 1. The keyboard communication bit should be reset by the PLC program following evaluation of the data area.

Regular reading of the communiation bit makes it possible to determine in the PLC program whether a block has been transferred again.

24.3.3 LED Assignment

Data areas

The LED assignment can be partitioned into separate data areas, as shown in the following table.

Data Areas	OP15/20	OP25/35
Maximum number	4	8
Total length of all data areas (words)	9	16

You must also specify the LED keyboard assignment in your configuration under *Area Pointers, Type: LED Assignment*.

LED assignment

You set the assignment of the individual LEDs to bits in the data areas when you configure the function keys. When you configure, you specify a number within the assignment area for every LED.

Bit number (n) denotes the first of two serial bits, which drive a total of four different LED states :

Table 24-4 LED Flashing Frequency

Bit n + 1	Bit n	LED Function
0	0	Off
0	1	Flashing at approx. 2 Hz
1	0	Flashing at approx. 0.5 Hz
1	1	Permanently on

24.4 Screen Number Area

Usage

TD/OPs store information in the screen number area about the screen called on the OP.

In this way it is possible to transfer information about the current display contents of the TD/OP to the PLC and to initiate specific reactions on the PLC – for example, calling another screen.

Condition

If you wish to use the screen number area, you have to specify it in your configuration as the *Area Pointers*. It can be created only on one PLC – and once only.

The screen number area is transferred spontaneously to the PLC, meaning a transfer takes place whenever a modification is registered on the TD/OP.

There is therefore no need to configure a polling time.

Structure

The screen number area is a data area having a fixed length of

- 2 data words for TD20, OP5/15/20,
- 5 data words for OP25/35.

The structure of the screen number area in the PLC memory is shown below for the different TD/OPs.

TD20, OP5/15/20:

	Left byte	Right byte
1st word	Current screen type	Current screen number
2nd word	**Current entry number**	**Current input field number**

Entry	Assignment
Current screen type	1: Screen 2: Recipe 3: Function screen
Current screen/recipe number	1 to 99
Current entry number	1 to 99
Current input field number	0 to 8 0: Entry number

At message level, at menu level and during the display of a directory, FF_H is assigned to all the bytes of the screen number area.

With **function screens**, the screen number area is assigned as follows:

	Left byte	Right byte
1st word	3	Function screen number
2nd word	FF_H	Current input field number

OP25/35:

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 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

24.5 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 OP reads in the trend values cyclically 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 OP reads in either the trend value or the whole trend buffer as a result of trigger bit being set. You set it 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 PLC to initiate bit-triggered trends. The OP and the PLC 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.

Switch buffer

The switch buffer is a second buffer for the same trend that you can create in your configuration.

While the OP is reading values from buffer 1, the PLC writes to buffer 2. While the OP is reading buffer 2, the PLC writes to buffer 1. In this way, trend values cannot be overwritten by the PLC while the trend is being read by the OP.

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 24-5).

Table 24-5 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

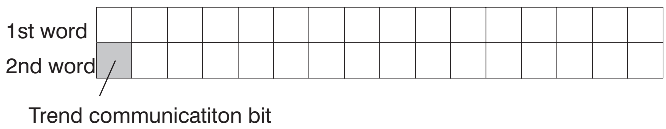
If a screen is opened on the OP with one or more trends, the OP sets the corresponding bits in the trend request area. Once the screen has been deselected, the OP resets the corresponding bits in the trend request area.

The trend request area can be used on the PLC to evaluate which trend is currently being displayed on the 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 PLC program, set the bit assigned to the trend in the trend transfer area and the trend communication bit. The OP detects the trigger and resets the trend bit and the trend indication bit. Depending on the configuration, it then reads out a single value or the whole buffer.

Example of a trend transfer area with a length of 2 data words



Until the communication bit is reset, the trend transfer area cannot be modified by the PLC 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.

24.6 User Version

Usage

When the TD/OP starts up, a check can be made to determine whether the TD/OP is connected to the correct PLC or the correct CP board. This is important when several TD/OPs are in use.

To perform the check, the TD/OP compares a value stored on the PLC with the value that you configured. This insures compatibility of the configured data with the PLC program. If the data do not agree with each other, system message $653 is displayed on the TD/OP and the device is re-started.

For you to be able to use this function, you must set the following values when you configure your TD/OP:

- Value belonging to the configuration: (1 to 255)
  If 0 is set, this check is not made:
  - **COM TEXT**:
    General Parameters
  - **ProTool**:
    System → Parameters → Miscellaneous
- Data type and address of the value stored on the PLC:
  - **COM TEXT**:
    Area Pointers Lists; field: *User-Version Area*
  - **ProTool**:
    System → Area Pointers ; choose *User Version* in the *Type:* field.

24.7 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 OP. You cannot modify the structure on the 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 OP. The data are stored on the OP, thus saving memory on the PLC.

The use of recipes insures that, when a data record is transferred to the PLC, several items of data are transferred to the PLC **together** and in a **synchronized** fashion.

Condition

The following hardware requirements apply to the use of recipes:

Operator Panels

with text–based display:	OP5, OP15, OP20,
with graphics display:	OP25, OP35

Transferring data records

Data records can be transferred from the OP to the PLC or from the PLC to the OP.

You transfer data records from the OP to the PLC to set specific values on the PLC – for example, to produce orange juice.

It is similarly possible to fetch data from the PLC and to store them on the OP as a data record to save, say, a favorable assignment of values.

Synchronization

A major feature with recipes is that data can be transferred in a synchronized fashion and any uncontrolled overwriting of data is inhibited. To insure a coordinated sequence for transferring data records, bits are set in control and response bits of data blocks 0 and 1.

24.7.1 Transferring Data Records

Definition

Data records can be transferred by two different methods from the OP to the PLC or from the PLC to the OP. The two methods of transfer are ”direct” and ”indirect”. The setting of the type of transfer refers mainly to the OP → PLC direction.

With text displays, only the ”indirect” type of transfer from the OP → PLC is possible. With graphic displays, you can choose between ”direct” and ”indirect” in the OP → PLC direction.

Choosing the type of transfer

Your choice of the type of transfer will depend on the configuration software you used (COM TEXT or ProTool) and your OP.

Table 24-6 shows the features of a recipe as a function of the OP and the configuration software.

Table 24-6 Recipe Transfer as a Function of OP and Configuration Software

OP	Direction of Transfer	Created with				
		ProTool		ProTool/Lite		COM TEXT
		Up to V1.31	From V2.0	Up to V1.01	From V2.0	
OP5, OP15	OP → PLC	—	Direct	—	Direct	Direct
	PLC → OP	—	Direct	—	Direct	Direct
OP20	OP → PLC	—	—	—	—	Direct
	PLC → OP	—	—	—	—	Direct
OP25, OP35	OP → PLC	Indirect/direct	Indirect/direct	—	—	—
	PLC → OP	Direct	Direct	—	—	—

Direct transfer

When a data record is written, the variables in the data record are written directly into the defined addresses concerned. With direct reading, the variables are read into the OP from the system memories of the PLC.

With ProTool, the variables must have a direct link to the PLC and the `write directly` attribute for direct transfer. Variables not having an assigned address on the PLC are not transferred.

Indirect transfer

All the variables in the data record are written to a Clipboard on the PLC. The Clipboard is the recipe mailbox for OPs with a graphics display. Only the values of the variables are located in the data mailbox; addresses are not transferred.

With indirect transfer, it is irrelevant whether the variables have addresses. It is up to the PLC program to decide how the values from the Clipboard have to be interpreted.

24.7.2 Addressing Recipes and Data Records

Recipes and data records are addressed differently for OPs having a text display from OPs having a graphics display.

Text display

When you configure with COM TEXT, the recipe is given a name and a number. Both the recipe name and the recipe number are visible on the OP.

The data records you create on the OP are similarly provided with a name and a number.

Recipe numbers, data record numbers and data record names are transferred with the data to the PLC when the transfer of a data record from the OP → PLC is initiated.

Graphics display

When you configure with ProTool, a recipe is automatically given a name and a number. The recipe name and the recipe number apply only to the configuration and are not visible on the OP.

In ProTool, you enter the ID of the recipe in the *Parameters* dialog box against *Identifications*. This ID is written to the data mailbox when a data record is transferred between the OP and the PLC and has to be evaluated by the PLC.

We recommend that you use the same value for the ID as was used for the recipe number.

The data records which you create on the OP are given a symbolic name. The symbolic name is not transferred when a data record is transferred between the OP and the PLC. There is no identification for the data record on the PLC.

24.7.3 Data Areas for Transferring Data Records

The data areas on the PLC for transferring data records are different for OPs having a text display from those having a graphics display.

Text display

When you connect an OP having a text display, you have to create an areas on the PLC for the recipe number mailbox. When you do this, use the same specifications as were set for *Area Pointers* in your configuration.

Recipe number mailbox:

You have to create an area for the recipe number and the data record number on the PLC.

Structure of recipe number mailbox:

Left byte	Right byte
Recipe number	Data record number

Graphics display

When using an OP having a graphics display, you have to create an area on the PLC for the *data mailbox*. Use the same specifications for it as were set in the configuration under ProTool for *area pointers*.

No addresses are contained in the data mailbox in addition to data.

Data mailbox:

The data mailbox is a data area having a maximum length of 256 data words.

It is used as a Clipboard when data records are transferred from the OP to the PLC. Entered values have to be distributed by the PLC program to the corresponding memory areas.

Identifications 1, 2, 3 (recipe number) configured in ProTool are similarly transferred to the data mailbox and have to be evaluated by the PLC.

Structure of data mailbox:

1st word	Identification 1
2nd word	Identification 2
3rd word	Identification 3
4th word	Reserved
5th word	Length of data record in words
6th word	Data record value 1
...	Data record value...
nth word	Data record value m

24.7.4 Synchronization while Sending a Data Record

Control and response bit 1

Data record transfer is coordinated by bits 8 and 9 of the control bits in data block 0 and by bit 9 of the response bits in data block 1.

The applicable control and response bits are:

Control bits

Bit 8 = 1: Data record transfer disabled

Bit 9 = 1: Data record transfer accepted

Response bits

Bit 9 = 1: Data record transfer terminated

Transfer sequence OP → PLC

The different steps of the transfer sequence from the OP to the PLC are listed below.

1. Prior to any transfer, the OP checks control bit 8. If bit 8 is set to `1`, transfer is terminated with a system error. If the bit is set to `0`, a data transfer takes place.
2. After the transfer, the OP sets response bit 9 to `1`.
3. Interrogate response bit 9 in your PLC program. If it is set, set control bit 8.
4. Evaluate the data mailbox/recipe number mailbox and copy the contents of the send data block to the receive data block.
5. Then set control bit 9.
6. The OP deletes response bit 9.
7. Then delete control bit 9.
8. When you have distributed the data to the corresponding addresses, enable the mailbox by resetting control bit 8.

Transfer by means of PLC job for text displays

With text displays, a data record can be transferred from the OP to the PLC by means of PLC job 70. PLC job 69 initiates a transfer from the PLC to the OP.

24.8 Writing Variables Indirectly

Principle

Indirect variables, which are assigned to input fields, can be configured for operator panels OP25 and OP35. The value is entered directly on the OP by the operator. Following input on the OP, the contents of these variables are transferred in a coordinated fashion to the data mailbox on the PLC.

Coordination

The coordination of data transfer is similar to the coordination of the data record transfer of recipes (refer to section 24.7.4).

Usage

Indirect variables can be used on screens as ”normal” variables, meaning variables with addresses.

24.9 Notes on Optimization

Major factors

The structure of the user data areas described in chapter 24 and the polling times configured under **area pointers** are major factors for the update times that can **actually** be achieved.

Please keep to the rules listed below:

- Make the individual data areas as small as possible and as large as necessary.
- Define contiguous data areas if they belong together. The actual update time improves if you create a single, large area instead of several smaller ones.
- Overall performance is degraded by polling times that are too short. Set the polling time according to the speed of variation of the process values. The temperature variation of a furnace, for example, is distinctly more inert than the variation in speed of an electric drive.

  Recommended value for polling time: approx. 1 second.
- A spontaneous transfer of data areas by means of a PLC job improves update times for cyclically processed data areas: polling time = 0.
- Place complete variables of a message or of a screen in a data area.

Polling time

If a polling time of 0 is specified for a data area, the data area is not transferred cyclically to the OP. To have this data area transferred, the corresponding PLC job (refer to appendix B) has to be used.

Actual polling time

The polling time actually achieved depends, among other things, on the total number of polled areas and the data required at the time.

So that modifications on the PLC can be properly detected by the TD/OP, they must be present at least 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 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 PLC program, the OP is busy the whole time updating the trends. Operation of the OP is then virtually no longer possible.

Part VI Appendix

System Messages

A

A.1 Operating Unit System Messages

Error messages at operatin unit startup

The following messages indicate a hardware failure on the memory module specified:

– EPROM memory failure,

– RAM memory failure,

– Flash memory failure

Message number

Operating unit system messages can be subdivided into various categories.

The information as to which category a system message belongs to is contained in the message number as indicated below.

Message number

□□□□ Message text

00	Driver error
01	Startup message
02	Warning
03	Information message
04	Operator error
05	Other message
06	Configuration error
07	Internal error
22	Message archive

The message category enables you to identify the general area in which the cause of the fault is to be found.

Below you will find a selection of system messages listed together with details of under what circumstances they occur and, where applicable, how the cause of the fault can be eliminated.

Self-explanatory system messages are not included.

Note

System messages are displayed in the language selected in the configuration. If the operating unit does not have access to any configuration data, the messages are displayed in English.

Message	Cause	Remedy
Please wait	Mode change in progress or recipe function started.	
Ready for transfer	Waiting for data from PU/PC	
Data transfer	Data transfer between PU/PC and operating unit in progress	
Firmware not compatible	The firmware can not be used for the current configuration	
EPROM memory failure	Memory module defective or internal hardware fault	Send unit for repair quoting details of error message
RAM memory failure		
Flash memory failure	Memory module defective or transmission error	Retransfer configuration or send operating unit for repair

Message	Cause	Remedy
005	*Internal error:* Error message returned if nothing configured for a system message	
006	Error during data transfer in download mode. Two tags are transferred with this message which contain information about the function in which the error has occurred (tag 1) and the cause of the error (tag 2). **Tag 1**: 0 Initialize function 1 Receive data 2 Send data 3 Send message block 4 Terminate function **Tag 2**: 1 Internal error 3 Timeout error 5 Parity error 6 Framing error 7 Overrun error 8 Break in line 9 Receive buffer overflow 10 Control character error when receiving 11 Logging error	Repeat data transfer after first checking the physical connection if necessary.
026...029	Storage medium not ready, contains errors or status undefinable.	Reset hardware, remove then refit Flash memory module or carry out hardware test.
030	Storage medium not intialized.	Switch to download mode.
032	Error accessing module, Flash may not be supported or initialized by incorrect operating unit.	Check whether module is properly inserted and compatible. If restoring: repeat backup with correct operating unit.
033	Internal Flash memory initialized; configuration data deleted, some recipe data preserved.	Retransfer configuration.
034	Inserted module initialized, all stored data deleted.	Retransfer configuration.
035	Size of selected recipe memory has been reduced.	The reduced-size recipe memory can not be used and all data records must be deleted. The recipe memory is only initialized when requested.
040	Driver error If FAP is set, the character delay time setting may be too short.	Check physical connection with PLC. Modify character delay time.
041	Fault in connection with PLC. Possible causes: – Fault on the transmission link, e.g. connecting cable defective – Incorrect interface parameters set on operating unit or on communication peer.	

Message	Cause	Remedy
043	Data transfer error. A tag indicating the cause of the fault is transferred with this message. **Tag**: 0 Timeout error 1 Framing error (receiving) 2 Overrun error 3 Parity error 4 No connection established 5 Checksum error (receiving) 6 Unexpected characters received 7...11 Internal error 12 Receive data block too large 13 Memory area not available on PLC	Repeat the data transfer. Before doing so, check the physical connection/configured interface parameters if necessary.
044	Fault in connection with PLC. Possible causes: – Fault on the transmission link, e.g. connecting cable defective – Incorrect interface parameters set on operating unit or on communication peer.	
045	No connection with PLC established.	Set different CPU under ”PLC –> Parameters”.
100	Restart due to RAM failure.	
101	Restart following termination of COM-UNI mode	
103	Startup following cancellation of COM-UNI mode	
104	Transfer cancelled by operator. Connection with operating unit is still open, the operating unit is waiting.	
105	Fault resulting in wait message has been eliminated.	
107	Restart following activation of COM-UNI mode	
108	Operating unit is in download mode.	
109	Restart after change of operating mode from offline to online.	
110, 113	Operating unit is in ”normal” mode.	
114	PLC has been restarted.	
115	Establishment of logical link with PLC in progress.	
117	Connection with PLC is OK again following a fault.	
119	Automatic restart.	
120	Restart after change of S5 protocol.	
124	Restart following selection of different language.	
129	SINEC L1 or SINEC L2 parameter has been changed.	
130, 132	Startup due to loop-through operation when online.	
134	Restart due to offline operation.	
136	PLC not responding.	Check program sequence on PLC. Check physical connection.
138	Data block not available on PLC.	Set up relevant memory area.

Message	Cause	Remedy
200	Battery power no longer sufficient for internal data buffer on operating unit. Battery on memory is discharged, data may no longer be readable.	Replace battery. **Note:** Replace the battery while the unit is switched on in order to prevent loss of data.
201	Hardware fault on timer module.	Send unit for repair.
202	Error reading date	Send unit for repair.
203	Error reading time	Send unit for repair.
204	Error reading day	Send unit for repair.
205	Printer not ready and internal storage of print jobs is no longer possible.	Make sure printer is ready or disable message logging.
206	Printer not ready. Print job placed in temporary storage.	Make sure printer is ready.
207	Buffer printout or print screen function cancelled.	Check printer, cable and connectors.
210	*Internal error* Operating unit co-ordination area not receivable during startup.	Press restart button.
212	*Internal error* Bit for changing operating mode has been inverted erroneously.	Restart operating unit.
213	Offline mode not possible at present.	Try change of operating mode again later.
214	The job number sent by the PLC or configured in a function field is too large.	Check PLC program and configured screen.
217, 218	Overlapping specified/actual values.	Check configuration of actual/specified values in the process link.
219	Hardware fault: relay or port could not be set.	Send unit for repair.
220	Print buffer overflow due to overload. Printout not possible.	Messages have been lost.
221	Print buffer overflow due to overload. Printout of overflow messages not possible.	Messages have been lost.
222	Warning: the event message buffer is full apart from the specified remaining buffer space.	Clear the buffer or configure a smaller figure for the remaining buffer space.
224	The event message buffer has overflowed.	If a printer is connected and buffer overflow has been configured, the overflow messages will automatically be printed out.
225	Warning: the alarm message buffer is full apart from the specified remaining buffer space.	Clear the buffer or configure a smaller figure for the remaining buffer space.
227	The alarm message buffer has overflowed.	If a printer is connected and buffer overflow has been configured, the overflow messages will automatically be printed out.
229	No keyboard connected (internal keyboard with ribbon cable).	
230	The minimum value is greater than the maximum value for tag limits.	Correct the limit settings.
231	The minimum value is equal to the maximum value for tag scales.	Correct the scale on the operating unit.
250	You can not switch to the desired operating mode.	Check parameters of PLC job.

Message	Cause	Remedy
251	Error transferring data record to PLC.	Check recipe configuration.
252	Function can not be executed as a function of the same group has not yet been completed (e.g.: setpoint entry is active, password list can not be opened).	Wait until preceding function has been completed (or terminate function) and then invoke desired function again.
253	Access to data medium is not possible.	1. Floppy drive not present, 2. Floppy is read only, 3. Disk is not formatted.
254	The disk must be formatted before a data record can be saved for the first time.	First format the disk.
255	Not enough space on disk for this data record.	Delete data records that are no longer required.
256	Not enough system memory available to execute the desired function.	Try activating function again. Check configuration. 1. Move function to a different screen 2. Simplify screen structure 3. Do not use trends on screen in conjunction with this function
257	Data record has been stored with a different version stamp than defined in the current configuration.	If the data records are to continue to be used, the old version number must be entered in the recipe configuration. **Caution**: The structure of the recipe determines the assignment of data to a data record.
258	A parameter record has been selected as a recipe. Parameter records can not be edited directly.	Only individual data records of a parameter record can be edited.
259	Transfer of a data record to the PLC is taking too long. **Example**: PLC is not acknowledging data record or very large data records are being transferred.	Check PLC program. In the case of large data records no modifications are necessary as the function is being processed correctly.
260	Operating mode of PLC does not match the configuration.	Change operating mode of PLC.
261	The data in this data record is no longer consistent and it can therefore no longer be used.	Edit data record and check that all entries are correct.
262	Password or query window already in use by another function.	Complete first function then execute desired function again.
263	Specified remaining buffer space for messages has been reached!	Configure smaller remaining buffer, delete event/alarm message buffers.
264	Message buffer overflow.	The overflow messages are printed out if so specified in the configuration.
265	The number of passwords issued has already reached 50. You can not enter any more passwords.	If you wish to issue additional passwords, you must first delete some of the existing ones.
266	The field configured in the PLC job does not exist.	Change the parameters of the PLC job and retransfer the configuration.
303	Fault in connection with PLC. **S5**: this error may occur when transferring large data records. In such cases the watchdog is activated.	Check PLC status. **S5**: set value in data word 98 to at least 2000.

Message	Cause	Remedy
304	Illegal S5 job number or job parameters in a function field.	
305	Data block number missing.	Set up data block or change configuration.
306	Incorrect CPU specified under ”PLC –> Parameters”.	Change configuration and retransfer.
307 ... 311	Tag not present on PLC	Check configuration of process link.
312	The printer is already processing a print job and can not accept this next job at present.	Wait until the printer is free again and repeat the print job.
313	Information message: print job completed.	
314	S7 diagnostics buffer not present.	The CPU has no diagnostics buffer (hardware problem).
315	No help text available.	
316	Active password level insufficient for menu item	Enter password with higher password level.
317	Input is password protected.	Enter password.
318	Incorrect password entered when attempting to log in.	
319	An existing password was entered when editing the password.	Enter a different password.
320	You have attempted to alter the level of or delete the supervisor password.	
321	You have attempted to alter the level of an invalid password.	First enter the password then specify the level.
322	The password entered is too short.	Password must be at least three characters long.
323	You have pressed <– Statistics or Message Text –> on a buffer screen but there is no entry for the current message.	—
324	The entry number specified does not exist on the selected screen.	—
325	The FM/NC (= MPI peer) has no alarm messages buffer.	A node does not have the required functional capability.
326	You have attempted to collect a recipe number other than the active recipe number from the PLC.	Select the appropriate recipe number.
327	There is no recipe number when a recipe is selected.	Configure missing recipe or select a different one.
328	Recipe number >99 when selecting a recipe.	
329	The same number has been entered for source and destination on the ”Data Record Processing and Transmission” screen.	Enter differing numbers.
330	Full details of source and destination not entered when initiating data record transfer function.	
331	The data record specified as the source does not exist.	
332	Data record number >99 when selecting a recipe screen.	
333	Data record number not present when selecting a recipe screen.	
335	Information message: alarm message will be suppressed.	
336	No process screens have been configured.	
337	No recipes have been configured.	

Message	Cause	Remedy
338	Operating unit can not establish a connection with the printer.	1. Printer is not switched on, 2. Printer is not ready, 3. Connecting lead between printer <—> operating unit is not connected or defective, 4. No interface module inserted.
339	Startup completed.	Communication with PLC has been resumed.
340	Status processing in progress on PU/PC. The operating unit can not be used while this is going on.	
341	*Internal error* With non-Siemens connections: data block error	
342	Network node has illegal address.	Max. addresses: S7-MPI: 32 PROFIBUS-DP: 128
343	You are attempting to edit a tag of a type that can not be edited in a recipe: currently applies to ARRAY tags only.	
350	PLC is performing initialization. You can not enter any setpoints during initialization. Scrolling of screens is possible.	This operating mode may be set by the PLC programmer.
351	PLC has completed initialization. You can resume entering setpoints once this message has appeared.	
352	You are attempting to select a screen that does not exist or has been disabled by the function Hide.	
353	The minimum value is greater than the maximum value for tag scales.	Minimum and maximum values are being confused by operating unit. To prevent this, enter correct minimum and maximum values.
354	You are attempting to enter a value in an input field when the current password level is insufficient for input.	Log on with a higher password level.
355	Entry of this tag has not been configured for the current PLC mode.	
356	A print function has been initiated on the operating unit. When attempting to print it has been ascertained that the printer is offline.	Switch the printer online. Check the connection between the operating unit and the printer. Has the printer been connected to the correct interface?
357	You are attempting to enter a setpoint that contains an illegal character.	Enter the value correctly.
358	The operating unit is currently executing a function which does not permit use of the operating unit while it is in progress.	Wait until the function has been completed. This message may appear in the case of recipe functions, for example.

Message	Cause	Remedy
359	The CPU is in STOP mode. System error message issued if S7 messages not available. The S7 CPU is in STOP mode. This may occur if – there is an internal fault on the CPU – the mode switch is operated – STEP 7 is set in the ”Mode” dialog box	Switch S7 CPU back to RUN mode.
360	The S7 CPU is in STOP mode due to an error in the S7 PLC program.	Correct the error in the S7 PLC program and switch to RUN mode.
361	The S7 CPU is defective.	
365	A multiplex index is outside the defined range.	
366	– The mode you require is already active. – The CPU key-operated switch is not set to RUN-P. – The command is not supported by the CPU.	
367	Set PLC parameters are incorrect.	
368	Communication error S7 module; error class and error number will be read out.	
369	The command cannot be executed in the S7 mode selected.	
370	Hard copy print-out has been cancelled manually.	
371	Print function disabled at present.	
372	The function started has been cancelled.	
383	Information message: transfer of data records completed.	
384	Data record required is not on data medium.	Check the data record selection parameters (recipe, data record name, data medium) or use the Select function to select the data record.
385	Information message: transfer of data records from operating unit to data medium or vice versa has been initiated.	One possible reason is that operation is no longer possible: The PLC has not reset the corresponding control and acknowledgment bit, which deactivates the recipe mailbox lock, in the interface area.
386	Information message: transfer of data records from operating unit to PLC or vice versa has been initiated.	
387	There is no data record relating to the selected recipe on the data medium.	
388	Activating selected function.	
389	De-activating selected function.	
391	No help text configured.	Check configuration.
392	– No alarm messages are queued on the NC. – Acknowledgement is not possible in the NC mode set.	
393	The password is incorrect or you cannot enter a password in the NC mode set.	
394	Acknowledgement is not possible on the NC set.	
395	– No part programs have been configured. – The PLC specified (FM or NC) is not ready.	

Message	Cause	Remedy
396	– The part program specified does not exist. – The PLC specified (FM or NC) is not ready; in the case of FM: no user data area has been created on the PLC.	
397	– The part program specified does not exist. – The record specified does not exist. – The PLC specified (FM or NC) is not ready.	
398	– The command cannot be executed in the MCU mode selected. – The command is not supported by the MCU version.	
399	– The PLC does not have a directory of tool corrections. – The tool correction specified does not exist.	
400	Illegal key pressed.	
401	Value entered could not be converted.	
402	Operator error on STATUS VAR or FORCE VAR screen.	Only 10 entries are permitted (after pressing INS if 10th line already used).
403	Incorrect time entered	
404	Incorrect date entered	
406	Operator error on STATUS VAR or FORCE VAR screen.	Values can only be changed after update operation has been cancelled (BREAK key).
407	You have attempted to delete the only data record for a recipe.	
409	Lower limit violated: you have attempted to enter a setpoint that is below the configured lower limit.	Enter a value that is greater than or equal to the specified value. No limit is indicated for data of the type DOUBLE.
410	Upper limit violated: you have attempted to enter a setpoint that is above the configured upper limit.	Enter a value that is less than or equal to the specified value. No limit is indicated for data of the type DOUBLE.
411	Illegal screen selection because incorrect PLC type specified (external driver)	Change configured interface parameter.
442	Data block error x DB no. y This message indicates a data block error. The tags **x** and **y** identify the cause of the fault (x)) and the number of the receive block concerned (y)). **Tag x**: 0 incorrect block length entered in receive block No. **y**. 1 incorrect block number entered in receive block No. **y** .	Correct the block length/block number as necessary or send the correct data block.
450	When entering a value, you have attempted to press a key that is not compatible with the defined input field.	
451	You have entered a setpoint that is below the configured lower limit.	Enter a value that is greater than or equal to the limit.
452	You have entered a setpoint that is above the configured upper limit.	Enter a value that is less than or equal to the limit.
453	Time not entered correctly.	Enter time correctly

Message	Cause	Remedy
454	Interface parameters incorrectly set. – When configuring the printer interface – By specifying an identification in PLC job Recipe which is not assigned to a recipe	Enter valid settings for interface parameters. The following settings are possible: – Baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200 – Data bits: 5, 6, 7, 8 – Stop bits: 1, 2 – Timeout: 1...600 Enter correct identifications in PLC job.
455	You have set graphics printing on the operating unit but the corresponding ESC sequence has not been configured.	Select a different printer or check printer configuration in ProTool.
456	You have entered an incorrect value, e.g. a tag with a user function that blocks certain input values.	Enter permissible value.
458	You have entered a value that is too great or too small for the tag type concerned, e.g. a value greater than 32767 for a tag of the type Integer.	Enter a value that is within the permissible range.
459	You are attempting to enter an illegal character (e.g. letter in a numerical value) The input is rejected and the existing entry retained.	Enter permissible value.
500...503	Scheduler, counter, date or time data can not be sent.	This error can occur if the PLC is temporarily overloaded or if the function block is not invoked for more than 1.5 s.
504	Free ASCII Protocol: operator input value could not be sent.	
505	The data record can not be sent as the recipe disable bit on the PLC is set or because transfer of a recipe is still in progress.	Try sending again later when the PLC has released the recipe mailbox.
506	Overload: too many message blocks with the same block number in transit.	This error occurs if the PLC sends too many jobs using 'collect message area' within a certain period of time.
507	Transfer of the data record was not acknowledged by the PLC within a certain period.	Checking of data records by the user at the PLC end must be carried out more quickly (< 10 s).
509	Firmware version is different from standard FB version.	Please contact the SIMATIC Hotline.
510	A process link with a non-existent data block has been configured in a recipe or the recipe data contains errors.	
511	You have used a PLC job to select a recipe or a request data record that does not exist.	
512	Configured data block length is too short. The tag transferred with the message identifies the number of the data block.	Change configuration and retransfer.
516	SINEC L2 protocol configured but no interface module inserted.	Change configuration and retransfer.
518	Interface module inserted and protocol configured do not match.	Change configuration and retransfer.
520	Excessive number of saved returns has meant that maximum nesting level has been exceeded.	Go to Message Level (by pressing ESC key if necessary).

Message	Cause	Remedy
521, 522	Screen can not be constructed or selected because there is not enough memory available. Message 522 triggers a restart with memory optimization.	You can optimize memory availability by 1. Removing unused fields from the configuration 2. Configuring the screen with fewer fields, or splitting it into more than one screen 3. Creating fewer recipe data records
523	No text found.	
524	Object class does not exist.	
525	Illegal operand.	
526	Loop-through operation is set on the operating unit.	Change mode from “Loop-through operation” to ”Normal operation”.
527	Access to recipe data is not possible at present.	
528	Recipe does not exist.	
529	File does not exist.	
530	Data record not present.	
531	Data record can not be loaded.	
532	Information message: data record memory is full.	
533	Floppy connection unclear.	
534	Information message: disk is full.	
535	Disk access error.	
536	Disk transfer error.	Check the physical connection.
537	Information message: disk is blank.	
538	Simultaneous accessing of data record by job and operator.	Repeat uncompleted accessing operation.
539	The data records in the RAM for recipe no. x contained errors and have been deleted.	If data records are stored in the Flash memory they will remain valid.
540	The maximum number of data records has already been created.	
541...550	Specified tag not available on PLC.	Change configuration and retransfer.
551	An MPI/PPI connection to the PLC cannot be established using the specified station address.	Check MPI station addresses and wiring.
552	Query: safety check as to whether the selected data record is to be deleted. The data record is only deleted if 0 is entered. If not the function is cancelled.	This query is also used when backing up or restoring configurations. In that case, it relates to deletion of all data records in the system memory.
553	Information message: selected data record has been deleted.	
554	Query: 1st safety check as to whether the data medium for storing data records is to be formatted. Any data records already on the disk will be deleted when the function is executed! The function is only executed if 0 is entered.	

Message	Cause	Remedy
555	Query: 2nd safety check as to whether the data medium for storing data records is to be formatted. Any data records already on the disk will be deleted when the function is executed! The function is only executed if 0 is entered.	
556	Information message: disk has been formatted.	
557	Query: if 0 is entered the data record will be adopted with the new values. If anything else is entered, you may continue editing.	
558	Query: if 0 is entered the edited data record is rejected. The data remains as it was before editing. If anything else is entered, you may continue editing.	
559	Query as to whether the event message buffer should be cleared.	
560	Query as to whether the alarm message buffer should be cleared.	
561	A global data record (rel. 3.0 or higher) is being edited and does not have all the entries defined in the current recipe.	The data record can only be saved if the marked entries are edited. If no entries are marked, only the version number has changed.
562, 563	Information as to which mode was set using the function ”First/Last Message”.	
564	Query: if 0 is entered the data record is created. If anything else is entered, the function is cancelled.	
565	On transferring a global data record, it is established that not all entries are present. You have the following options: 1: read the missing entries from the PLC 2: edit the missing entries 3: cancel the Download operation.	Only returned in the case of data records that are transferable from one recipe to another. (Rel. 3.0 or higher, plastic functions.)
566	Data record contains array that does not fit the current recipe structure.	The following question appears: `Save yes/no ?` If you elect to save, the array data is set to 0.
567, 568	In the event of forced deletion of the message buffer contents, pending event/alarm messages have to be deleted as well so that space can be reclaimed for new message events.	Check configuration. There are too many messages pending. ALARM_S: quantity structure exceeded. Display of pending messages no longer correct! If necessary, clear SRAM.
569	CPI no. x error y This message indicates a CPI error. The variables **x** and **y** indicate the cause of the fault (y) and the number of the CPI concerned (x). **Variable y**: 1 Voltage too low 2 Current too high 3 Temperature too high 2 Module not present (failed during operation)	

Message	Cause	Remedy
570	Tag contains errors: tag name from ProTool is used as parameter.	Check configuration. Frequently occurs with NC tags and when multiplexing.
571	S7 system diagnosis/ALARM_S returns error if OP logs on/off.	CPU operating system out of date.
572	Query: data record already exists on data medium.	If 0 is entered the data record will be overwritten with the new values.
600	Configuration error: overflow warning at basic setting 1	
601	Configuration error: message logging at basic setting 1	
602	Configuration of remaining buffer space incorrect.	Correct the remaining buffer space and retransfer configuration.
604	Message does not exist.	Configure message.
605	Process link is only configured symbolically.	Change configuration and retransfer.
606	Too many message tags configured.	
607	Data type configured does not exist.	
608	The process screen number does not exist.	Change configuration and retransfer.
609	Special object or operator object for message text does not exist or is not permissible.	
610	Operator object for header or footer does not exist or is not permissible.	If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.
611	Special operator object for buffer printout does not exist or is not permissible.	
613	Data block not available or too short.	Create data block of required length on the PLC.
614	No entry present for log (header and footer not present).	Configure log fully.
615	The line to be output is larger than the amount of print memory reserved for it or the number of control sequences is too great.	Check configuration as regards logging.
616	*Internal error* Incorrect data format in process link.	Correct the data format.
617	*Internal error* Incorrect word length in process link.	Correct the word length.
618	Configuration error in actual control value (bit number > 15).	Bit number for actual control tag must be < 15.
619	Error presetting setpoint (error in data structures).	Change configuration and retransfer.
620	Illegal keyboard ID: module number too high or number of keys does not match keyboard ID.	Enter configuration to match hardware.
621	Incorrect parameter transferred: message type	Set required value by way of standard screen or PLC.
622	Configured recipe does not fit in recipe mailbox on PLC (> 512 data words).	Reduce configured size of recipe and retransfer configuration.
623	*Internal error* Screen object for “Send Recipe“ is not a recipe type (fixed by COM TEXT).	If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.
624	No recipe entries found.	Set up area pointers and retransfer configuration.

Message	Cause	Remedy
625	Recipe number does not exist.	Reconfigure recipe.
626	No setpoints have been configured.	
627	*Internal error* Configured keyboard block number too high.	Correct the block number.
628	Recipe does not fit in mailboxes.	Increase configured size of recipe mailbox or succeeding recipe mailbox.
629	LED assignment area too small.	Increase size of LED assignment area according to bit numbers used.
630	Keyboard assignment area too small.	Increase size of keyboard assignment area according to bit numbers used.
631	Message configuration incomplete or incorrect. **Tag x**: 1, 2 Alarm message triggered not configured 3 Process link only created symbolically. 4 Actual-value field only created symbolically. 5, 6 Event message triggered not configured 7 Symbolic actual-value field only created symbolically. 8..20 Internal error 21..24 Field texts for symbolic actual value do not exist 25 Illegal field type	Complete configuration. If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.
632	Configuration error: **Tag x**: 1, 4 Help text does not exist 2 Help text ID for messages does not exist 3, 6..8, 11, 13 Internal error 5 Field only created symbolically. 9 Screen or recipe entry created symbolically only 12 Process screen or recipe does not contain any entries	Check the configuration. If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.
634	Configuration error: **Tag x**: 0..8, 34 Internal error 18 Screen or recipe title not configured	Screen or recipe title not configured If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.

Message	Cause	Remedy
635	Configuration error: **Tag x**: 1 Screen or recipe entry created symbolically only 3 Field only created symbolically. 6 Message, entry or information text not configured for current language 7...9, 19, 28, 41...43 Internal error 18 Screen or recipe title not configured 20 Process link only created symbolically. 21 Help text only created symbolically. 22 Symbolic field only created symbolically. 23 Fewer than 2 field texts configured for symbolic field 24 Current field type for symbolic field not configured 25 Illegal data format for symbolic field (only KF and KY permissible) 26 Recipe setpoint configured with data format KC 33 Illegal data format for setpoint field 35 Data format for scheduler too short 36 Illegal data format for actual control value 44 With a permanently programmed Return to menu: menu item not present 45 With permanently programmed Return to screen: entry or field number not present 46 Too many control actual values on screen (no more than 200 allowed) 48 Too many fields on process screen 50 Process link for soft keys does not exist 51 Soft key number too high 53 Help text for soft key not configured or not configured in all languages 55 Soft key specified in entry does not exist	Check the configuration. If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.
636	Event message is not configured	Configure event message (–> message number) fully.
637	Missing configuration for an event message	Configure event message (–> message number) fully.
638, 639	Actual value field for event message has only been created symbolically.	
640	Alarm message is not configured	Configure alarm message (–> message number).
641	Alarm message triggered is not configured	
642, 643	The actual value field for alarm message has only been created symbolically.	Reconfigure alarm message (–> message number).
645	*Internal error* PLC co-ordination area not receivable during startup.	Press key to restart. If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.
648	The driver number configured can not be interpreted.	
649	*Internal error* Driver number configured can not be interpreted.	If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.

Message	Cause	Remedy
650	Missing area pointer.	Configure an area pointer.
651	*Internal error* There is not at least one data record for every recipe.	If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.
652	Configuration is not compatible with S5	Change configuration and retransfer. If the fault is not corrected by performing a restart, please contact the SIMATIC Hotline.
653	The configured user version number does not match the version number stored on the PLC.	Change configuration and retransfer.
654	The PLC acknowledgement area has not been configured to follow on physically from the message area.	
655	PLC acknowledgement area does not physically follow on from the alarm messages area (–> no startup).	
656	Configured protocol is not possible.	Check protocol in configuration.
657	Configured PLC protocol is not possible.	Use current firmware version or configure different protocol.
658	Configured PLC protocol is not possible.	
659	Illegal process link in recipe, destination does not exist.	Change configuration and retransfer.
660	Invalid destination configured for return reference in menu.	Break key on operating unit; complete configuration and retransfer
661	On process screen: recipe setpoint or previous value configured in recipe: field is neither recipe setpoint or previous value.	Change field type or remove field and retransfer configuration
662	Invalid destination configured for return reference in screen.	Change configuration and retransfer.
663	Data record memory full (during startup)	
664	Standard data records for the configured recipes require more than 20 Kbytes. Unit switches to COM TEXT mode.	Configure fewer or smaller recipes.
665	Configuration of interfaces incorrect, printer/PLC interfaces have same physical characteristics.	Check interface parameters.
667	Configuration error: **Tag x**: 1 Data type is not DB 2 DB number is greater than 15 3 DB length is greater than 1024 4 DW is in data block header 5 Actual value not in send block 6 Setpoint not in receive block 7 Setpoint/actual value not in receive block 8 Initial value not in send block 9 Data type is not DB 10 DB number is greater than 15 11 DB length is greater than 1024 12 DW is in data block header 13 Area is in wrong DB 14 Sum of data blocks too great	x = 1..8: Change the configuration of the process link and retransfer. x = 9..13: Change configuration of area pointer and retransfer x = 14: Restrict configuration and retransfer.

Message	Cause	Remedy
668	Incorrect configuration. Meaning of tags: 1: Incompatible PLC types configured 2: No PLC configured 3: Incorrect baud rate configured	Change configuration and retransfer.
669	Too many actual values (> 512) have been configured for cyclic reading in a screen/tag.	
670	Too many tags requested simultaneously.	Lengthen standard clock pulse or configure fewer tags on screen.
671	Configuration of message tags incompatible. Differences between configuration and PLC.	Check S7 programs, check message server configuration, modify configuration and download again.
672	Message not configured.	
680	Selection of a recipe not defined in the project.	Select a valid recipe.
681	Overload caused by too many tags (setpoints/actual values). Fault in connection between the operating unit and PLC.	Check the interface parameters.
682	Incorrect interface parameters configured.	Configure fewer process links for the screen displayed.
683	Configuration error: upper limit = lower limit	Correct the limits and retransfer configuration.
684	Non-existent trend switch buffer requested.	Check PLC program/operating unit configuration. Only use trend request area 2 for trends with switch buffer.
685	Configuration error. Two tags that supply information about the faulty function (Tag 1) and the faulty parameter (Tag 2) are transferred together with this message. **Tag 1**: 535 Conversion, Linear 1 536 Conversion, Linear 2 537 Increment, tag 539 Increment current 545 Convert value **Tag 2:** This specifies the parameter of the function in which an error has arisen (e.g. Tag 2 = 3: parameter 3 of the Tag 1 function is faulty).	If you are dealing with a configuration error: delete the function and reconfigure. Or if the operating unit tries to determine the value of a tag while no PLC is connected: connect a PLC.
686	Too many tags.	
701	*Internal error* Incorrect assignment of “head –> res“ when receiving tag.	
702	Job can not be executed.	Change interface or configure area pointer.
703	Flash memory full.	Restrict the configuration.
704	Incorrect CPU specified under ”PLC –> Parameters”.	Change configuration and retransfer.
705	An acknowledged message can not be entered in the buffer because the corresponding message or a message in the same acknowledgement group is missing.	

Message	Cause	Remedy
706	Recipe request will not be processed as another request is already active.	
707	*Internal error* S7 message task error.	
708	*Internal error* Incorrect mailbox type	
709	*Internal error* Invalid mailbox type.	
710	*Internal error* Incorrect mode.	
711	*Internal error* Display status invalid.	
712	No submenu configured.	
713	*Internal error* No special operator object configured.	
714	*Internal error* Menu number invalid.	
715	*Internal error* Mailbox type of received message is incorrect.	
716	*Internal error* The setting for the maximum number of messages is too high (tag overflow).	
717	*Internal error* Incorrect message status when entering in statistics.	
718	*Internal error* Incorrect message status when entering in event message buffer.	
719	*Internal error* Incorrect message status when entering in alarm message buffer.	
720	*Internal error* Error reading messages from message buffer.	
721	*Internal error* Configuration message error	
722	*Internal error* Incorrect mailbox type received (OP15 –> OP5)	
723	*Internal error* OP5: more than 500 messages are specified in the area pointer lists.	Change area pointer list.
724	*Internal error* Mailbox type not implemented.	

Message	Cause	Remedy
725	*Internal error* Block number does not exist.	
726	*Internal error* Incorrect mailbox type	
727	*Internal error* Illegal screen type	
728	*Internal error* Return reference number incorrect	
729	*Internal error* Error in internal mailbox buffer management for direct message logging.	
731	*Internal error* Transfer parameter LEDSTATUS is incorrect in RIO function “Change LED Status“	
732	*Internal error* Key number can not be higher than 7/15/23 (8-key/16-key/24-key keyboard)	
733	*Internal error* Key number must be less than 4 as a maximum of 4 keys is possible.	
734	*Internal error* The module number must be 0.	
735	*Internal error* Illegal RIO function.	The following are permissible: Read, Write (LEDs, outputs) and Initialize.
736	*Internal error* Keyboard driver error.	
737	*Internal error* Too many keyboard assignment areas (mailboxes) being transferred to PLC.	
738	*Internal error* Mailbox type of received message is incorrect.	
739	*Internal error* Key acknowledgement received when message already acknowledged.	
740	*Internal error* Message status not permitted for first alarm/event message.	
741	*Internal error* Buffer type different from event or alarm message buffer.	
742	*Internal error* Message type different from event or alarm message buffer.	

Message	Cause	Remedy
743	*Internal error* Configuration message error	
744	*Internal error* Incorrect mailbox type received.	
746	*Internal error* Actual control value and process link are identical on a screen.	In COM TEXT: change address
747	*Internal error* Buffer type different from event or alarm message buffer.	
748	*Internal error* Message type different from event or alarm message buffer.	
749	*Internal error* Error in data structure of a buffer function screen.	
750	*Internal error* Error in data structure of the password function screen.	
751	*Internal error* Error in data structure of screen for setting time.	
752	*Internal error* Error in data structure of the Login screen.	
753	*Internal error* Error in data structure of other type of function screen.	In COM TEXT: IHV recipes affected
754	*Internal error* Error in data structure of ”Average Statistics” screen.	
758	*Internal error* Error group (task ID) does not exist.	
759	*Internal error* The message number for this error group does not exist.	
760	*Internal error* Communication: Mailbox type of received message is incorrect.	
761	*Internal error* Configuration error: message for which there is no text expected. 761 received instead.	Occurs if, for example, new firmware is being used with old COM TEXT version.
762	*Internal error* Configuration error	
763, 764	*Internal error* There are two tags: Tag 1: Message number, Tag 2: Number for error location	

Message	Cause	Remedy
765...770	*Internal error* With stop, TD10 – TD/OP20 different.	
771	*Internal error* Error during communication (→ messages).	
773	*Internal error* Error reading area pointer	
774	Error on reading from “Basic Settings→ General parameters“	
775	*Internal error* Data record memory full	
776	*Internal error* Too many schedulers in transit	
779	*Internal error* Internal error during MPI download; possibly due to buffer problems.	Reset and repeat MPI download.
780	*Internal error* Undefined error from communication with PLC.	
781	An ”Online Setter” function has been incorrectly defined in ProTool.	
783	*Internal error* Error in NC messages	
784	Communication fault in tag x.	Communication must be restarted.
785	*Internal error* Press key to restart. M = Module, # = Error number for more precise differentiation.	Restarting the operating unit may remedy the problem in the short term. Please contact the SIMATIC Hotline.
2280	Alarm or event message buffer is empty or the filter settings are such that no matching data could be found.	Check contents of message buffer on message buffer pages or change filter settings.
2281	Error during download to PC.	Error in PC program or connection lost.
2282... 2284	No disk inserted or disk drive faulty.	Insert disk or check disk drive using recipe function.
2285	Disk is write protected, no disk inserted or disk drive faulty.	Set disk write protection tab to Write Enable, insert disk or check disk drive using recipe function.

Procedure for "internal errors"

In the case of all system messages that relate to "internal errors", please follow the procedure outlined below.

a) Switch off the operating unit, set the PLC to STOP mode and then restart both units.

b) During startup, set the operating unit to download mode, downlaod the configuration again and then restart the operating unit and PLC again.

c) If the fault recurs, please contact your nearest Siemens representative. When doing so, please quote the number of the error that has occurred and any tags referred to in the message.

A.2 SIMATIC S5 Standard Function Blocks

General errors

Under normal circumstances, the standard function blocks can not cause the CPU to go into STOP mode. However, the function blocks can not detect whether the I/O peripheral addressed is actually present.

If STOP mode occurs with an addressing error or an acknowledgement error during startup of the PLC program, one of the following errors has occurred:

- Error in PLC peripheral allocation (in DB1 on S5-135U or S5-155U)
- Error in peripheral address allocation for CP 521 SI, CP 523 or IM308B (in DB-ZU)

Note

Occurrence of STOP mode can be prevented by programming the relevant PLC error OBs. However, this does not correct the configuration error.

A.3 Standard FB Error Numbers

Error analysis

If an error occurs during processing of the standard function block, the logical operation result **RLO** is set. This enables the user to branch to a user-specific error analysis routine using the conditional branch **SPB**.

Storage method

The standard function block stores errors that have occurred at various locations in the PLC memory as follows:

a in accumulator 1 **every time** the standard function block is invoked,

b in DW n+3 of data block DB-ZU (if present),

c in the interface area application mailbox if the error is attributable to an application.

The table below details the possible errors arranged in order of error number and according to storage method. The errors possible in the case of PROFIBUS and PROFIBUS-DP are identified by an asterisk (*) after the error number.

Storage Method Interface Area (c) DB-ZU (if present) (b) Accumulator 1 (a)				**Standard Function Block** **Possible Errors and Their Treatment**	
Error Number	**a**	**b**	**c**	**Description of Error**	**Cause/Remedy**
1*	•			DB-ZU: number invalid	The DB-ZU number transferred in accumulator 1 must be in the range 10 to 255. It may be that the accumulator high byte has been confused with the low byte.
2*	•			DB-ZU: does not exist.	DB-ZU must be set up with a minimum length of 16 words, depending on the number of OPs connected.
3*	•			DB-ZU: too short	The length of data block DB-ZU is based on the highest OP number issued, even if only one OP is connected.
4*	•			OP number: invalid	The OP number transferred in accumulator 1 must be in the range 1 to 16. It may be that the accumulator high byte has been confused with the low byte.
5*	•			No startup performed	Set startup bit (D64.0 in interface area) once
6	•			Incorrect CPU type	Check type and version number of CPU
7*	•	•		Interface area = DB-ZU	Specify a different number for the interface area
10*	•			Invalid PLC job number	The OP sends internal PLC jobs to the standard FB (e.g. date, time). If this error occurs it indicates that the OP has sent an invalid job number. The version number of the function block does not match the firmware version.
101*	•	•		Interface area: DB number invalid	An interface DB number in the range 10 to 255 must be transferred to the standard FB.

Error Number	a	b	c	Description of Error	Cause/Remedy
102*	•	•		Interface area: does not exist.	The data block for the interface area must be set up.
103*	•	•		Interface area: too short	The data block must be set up with the required minimum length.
105	•	•		Interface area: incorrect ID	The connected OP must enter a specific ID in DW 30 of the data block for the interface area. The data block number configured on the OP is a component of that ID. This error message occurs if the data block number configured on the OP does not match the DB number specified in the standard function block. It may temporarily occur immediately following startup if the OP has not yet stored the ID in the data block. In that particular case, the error should be ignored.
107*	•	•		DB-ZU number = Interface area no. = DB-HTB number	Rename one of the two data blocks DB-ZU and DB for interface area. (DB-HTB no. is fixed)
108*	•	•		DB-HTB does not exist.	DB-HTB must be present as DB 56 for the SINEC-L1 connection. DB-HTB must be present as DB 55 for the PROFIBUS connection.
109*	•	•		DB-HTB too short	The data block must have been set up with a length of 15 data words (DW 0 to DW 14).
115	•	•		Life bit monitoring has been triggered	The connected OP has not inverted its life bit. Reason: There is no connection with the OP or the standard FB is being invoked too many times within a cycle. Increase the setting in the DB for the interface area.
120*	•			STBS: number invalid	Valid flag numbers: 0...198
121*	•			STBR: number invalid	Valid flag numbers: 0...198
122*	•			STBS=STBR	Specify a different number for one of the status bytes.
150	•			CP 521 SI, CP 523 not ready	May occur during startup before the CP has adopted the configuration data.
151	•	•		CP 521 SI, CP 523, IM308B: address invalid	The address of the CP 521 SI, CP 523 or IM308B specified in DB-ZU is invalid.
152	•	•		CP 521 SI, CP 523: does not exist.	The communication processor CP 521 SI, CP 523 is not present on the PLC or the address set on the CP 521 SI, CP 523 does not match the one specified in the standard FB.
153*	•	•		Invalid block size	Valid block sizes: 8, 16, 32, 64, 120 or 240 bytes
154*	•	•		Incorrect IM number	Change IM number in DB-ZU
155*	•	•		Incorrect OP address	OP with address specified not present; change address of OP in DB-ZU.
156*	•	•		IM308C not communicating with OP	– IM308C not ready or defective. – Start address of DP window in DB-ZU does not match the COM PROFIBUS configuration of the IM308C.

Error Number	a	b	c	Description of Error	Cause/Remedy
157*	•	•		Incorrect DP window address	Start address of DP window in DB-ZU does not match the COM PROFIBUS configuration of the IM308C.
158*	•	•		Incorrect block length	Block length in DB-ZU does not match the COM PROFIBUS configuration of the IM308C.
160*	•	•		Receive mailbox type no. invalid	Valid types: 0=DB, 1=DX (DX only possible on S5-115U with CPU 945, S5-135U and S5-155U)
161*	•	•		Receive mailbox DB/DX no. invalid	The DB/DX no. must be in the range 10 to 255.
162*	•	•		Receive mailbox DB/DX offset invalid	The offset must be in the range 0 to 128 (for PROFIBUS-DP: 0 to 215)
163*	•	•		Send mailbox type invalid	Valid types: 0=DB, 1=DX (DX only possible on S5-115U with CPU 945, S5-135U and S5-155U)
164*	•	•		Send mailbox DB/DX no. invalid	The DB/DX no. must be in the range 10 to 255.
165*	•	•		Send mailbox DB/DX offset invalid	The offset must be in the range 0 to 128 (for PROFIBUS-DP: 0 to 215)
166	•	•		DX2 not present (SI2 of CPU 928B only)	Set up DX2
167	•	•		Coordination bytes CBS and CBR missing	The coordination bytes must be in the interface area (for SI2 of CPU 928B see **DX2 Configuration**).
168	•	•		ASCII driver missing	Startup may not have been carried out
169	•	•		ASCII driver not enabled	Startup may not have been carried out
170*	•	•		Acknowledgement of PLC job received when no PLC job is active.	Job status of an application has been overwritten by user.
171	•	•		Message ID unknown	The OP has either received an undefined job or an error has occurred in transmission.
172	•	•		Job number invalid	The OP has received a PLC job with an unknown job number.
180	•	•		Transmission error	Undefined status of coordination byte CBR.
181	•	•		Parity error	Compare parity settings of S5 and OP and set both to the same parity (parity for SI2 of CP944: even).
183	•	•		Input buffer full	The OP is transmitting too fast for the PLC cycle. Messages are being lost. Invoke the FB more often in each cycle or optimize configuration of OP.
184	•	•		Too many messages	See error no. 183
185	•	•		Message larger than receive mailbox	Message length is normally limited to 88 bytes by the OP; it may be that the character delay time between two messages has not been detected ==> transmission error.
186	•	•		Receive mailbox not present	Configured data area not present or startup not performed after making changes.

Error Number	a	b	c	Description of Error	Cause/Remedy
187	•	•		Message too long	See error no. 185
188	•	•		Break	There is a break in the connection. Cable defective or not connected.
189*	•	•	•	Receive mailbox DB/DX too short	Compare specified pointer for receive mailbox (offset + length) with actual data area.
190*	•	•		Transmission error	Undefined status of coordination byte CBS.
191*	•	•		Output buffer full	
192	•	•		Configuration error	Check data in DB-ZU relating to send/receive mailbox and character delay time.
193	•	•		Send mailbox not present	Configured data area not present or startup not performed after making changes.
194	•	•		Message too long	The character delay time between two messages has not been detected ==> transmission error.
199*	•	•	•	Send mailbox DB/DX too short	Compare specified pointer for send mailbox (offset + length) with actual data area.
200	•	•	•	System program communication error (SI2 of CPU 928B only)	Check static parameter record for SI2.
201*	•	•	•	DB-APP: number invalid	The pointer to a PLC job contains an invalid DB number. Only DB numbers in the range 10 to 255 are permissible.
202*	•	•	•	DB-APP: does not exist.	The pointer for a PLC job points to a non-existent DB-type data block. The data block must be set up.
203*	•	•	•	DB-APP: too short	The pointer for a PLC job points to a DB-type data block. The PLC job is partially or completely outside the DB. The start address of the pointer should be selected so that the the 4-word PLC job fits completely inside the DB.
206	•	•	•	DX-APP: number invalid	The pointer to a PLC job contains an invalid DX number. Only DB numbers in the range 10 to 255 are permissible.
207	•	•	•	DX-APP: does not exist.	The pointer for a PLC job points to a non-existent DX-type data block. The data block must be set up.
208	•	•	•	DX-APP: too short	The pointer for a PLC job points to a DX-type data block. The PLC job is either partially or completely outside the DX. The start address of the pointer should be selected so that the the 4-word PLC job fits completely inside the DX.
209*	•	•	•	TIMER-APP: Invalid address	A PLC job pointer points to a timer area. The permissible start addresses are CPU-dependent. Check the configuration of the OP.
210*	•	•	•	COUNTER-APP: Invalid address	A PLC job pointer points to a counter area. The permissible start addresses are CPU-dependent. Check the configuration of the OP.

Error Number	a	b	c	Description of Error	Cause/Remedy
211	•	•	•	M-APP: address invalid	A pointer to a PLC job points to the flag area. The PLC job must not be located in the scratchpad flag area (even partially). The permissible start addresses are in the range 0 to 192.
212*	•	•	•	S-APP: address invalid	The pointer to the PLC job points to the extended scratch-pad flag area. The permissible start addresses are CPU-dependent and are in the range 0 to 4088.
213*	•	•	•	EB-APP: address invalid	The permissible start addresses are in the range 0 to 126.
214*	•	•	•	AB-APP: address invalid	The permissible start addresses are in the range 0 to 126.
215*	•	•	•	OP is offline	The connection with the OP has been lost and no PLC jobs can be sent at present. This error may also occur temporarily immediately after startup. In that case, the error should be ignored.
216*	•	•	•	PROFIBUS-DP connection can not be established	– Peripheral address area in DB-ZU specified incorrectly – OP not connected (check BF LED on IM308B)
219	•		•	Invalid PLC job	Error only occurs with parallel connection. The job ID must be in the range $30_H$to 36_H.
220	•	•	•	Number of tags greater than 31	The number of tags in an alarm message or event message must not be more than 31.
221*	•	•	•	Pointer: incorrect type	In the application mailbox there is an incorrect data type as the pointer to a PLC job. Only data types 0 to 3 are permissible. In the case of PLC job pointers, only data types 0 to 7 are permissible.
222*	•	•	•	Pointer: type pointing to DX incorrect	The DX-type extended data blocks are only permitted on PLCs 115U with CPU 945, 135 U, 155 U.
223*	•	•	•	Pointer: type pointing to scratchpad flag invalid	The extended flag area is only permitted on PLCs 135 U and 155 U 1 (PAFE no. in DR102 of DB for the interface area).
246*	•	•	•	PAFE error	PAFE error in data handling blocks CONTROL, SEND or RECEIVE.
247*	•	•	•	SEND terminated with error	The send job has been terminated with an error. The indicator word (ANZW1) is available to the user in data word 101 in the data block for the interface area.
	•	•		STBS/STBR error	The send/receive job has been terminated with an error. (S5-95 L2 only)
248*	•	•	•	Link status 01h:	Interface error[1)]
249*	•	•	•	Link status 02h:	Device not available[1)]
250*	•	•	•	Link status 03h:	Service not activated[1)]
251*	•	•	•	Link status 10h:	Service on local SAP not activated[1)]
252*	•	•	•	Link status 11h:	No response from station[1)]
253*	•	•	•	Link status 12h:	Bus line disconnected[1)]

Error Number	**a**	**b**	**c**	**Description of Error**	**Cause/Remedy**
254*	•	•	•	Link status 15h:	Invalid parameter in header[1)]
255*	•	•	•	OP error	The connected OP has reported an error. The error number is stored in the application mailbox in DW m+3.

1) PROFIBUS bus error:

The meaning of the **link status** is explained in the PROFIBUS equipment manual. Only SDA services are used for the connection between the OP and the PLC.

PLC Jobs B

This section of the Appendix contains a list of all PLC jobs and their relevant parameters.

Description

PLC jobs can be used to initiate functions on the TD/OP from the PLC program for the purposes of

- displaying screens
- setting date and time
- altering general settings

A PLC job consists of 4 data words. The first data word contains the job number. Data words 2 to 4 are used to transfer up to three parameters depending on the function in question. The basic structure of a PLC job is shown in figure B-1.

Address	Left byte (LB)	Right byte (RB)
1st word	0	Job no.
2nd word	Parameter 1	
3rd word	Parameter 2	
4th word	Parameter 3	

Figure B-1 Structure of a PLC Job

Listing

All PLC jobs that are possible on the various operating units are listed below along with their parameters. The **No.** column shows the PLC job number. In general, PLC jobs can only be initiated **by the PLC** when the operating unit is in online mode.

No.	Function		TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
2	**Blank Screen**		●	●	–	–	–	–	–	●	●	●	●	●	●	●
	Parameter 1	0: Off 1: On														
	Parameter 2, 3	–														
3	**Print Screen**		●	●	–	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1, 2, 3	–														
4	**Activate Port**		–	–	–	–	–	–	–	●	●	●	●	●	●	●
	Parameter 1	Port number: 1..4 on OP20 1..8 for port 1..8: on OP25/35, OP27/37, TP27/37 1..8 for port 9..16: on OP35/OP37/TP37														
	Parameter 2	LB: Keyboard number: 1..4 on OP20 1 for port 1..8: on OP25/35, OP27/37, TP27/37 2 for port 9..16: on OP35, OP37, TP37 RB: 0														
	Parameter 3	0: Off 3: On														

No.	Function		TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
4	**Set Relay**		●	●	–	–	–	–	–	●	●	●	●	●	●	●
	Parameter 1	0														
	Parameter 2	LB: FF$_H$ RB: FF$_H$														
	Parameter 3	0: Off 3: On														
5	**Select Directory**															
	Parameter 1	1: Directory: screens, display	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		2: Directory: recipes, display	–	–	–	●	●	●	●	●	–	–	–	–	–	–
		4: Directory: print screens	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		5: Directory: print recipes	–	–	–	●	●	●	●	●	–	–	–	–	–	–
		7: Directory: recipes, data record transfer	–	–	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 2, 3	–														
7	**Print All Screens**		–	●	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1, 2, 3	–														
10	**Print recipe with all data records**		–	–	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1	Recipe number (1..99)														
	Parameter 2, 3	–														
11	**Select Function Screen**															
	The following screens integrated in the firmware can be selected by their (fixed) object numbers.															
	Parameter 1	LB: Cursor lock (0: Off, 1: On) RB: Function screen number	–	–	–	●	●	●	●	●	–	–	–	–	–	–
		Alarm message buffer														
		1 Buffer output	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		2 Output number of messages	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		3 Overflow warning on/off	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		4 Delete buffer yes/no	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		Event messages buffer														
		5 Buffer output	–	●	●	●	●	●	●	●	–	–	–	–	–	–
		6 Output number of messages	–	–	–	●	●	●	●	●	–	–	–	–	–	–
		7 Overflow warning on/off	–	–	–	●	●	●	●	●	–	–	–	–	–	–
		8 Delete buffer yes/no	–	●	●	●	●	●	●	●	–	–	–	–	–	–
		Alarm message statistics														
		15 Frequency and duration of fault per group	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		16 Frequency and duration of fault per message	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		17 Average fault times	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		18 Average acknowledgement time	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		19 Delete buffer yes/no	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		Event message statistics														
		20 Frequency and duration per group	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		21 Frequency and duration per message	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		22 Total number and duration	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		23 Delete buffer yes/no	–	●	–	–	–	–	–	●	–	–	–	–	–	–

No.	Function		TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
		PU functions														
		25 Status VAR	–	–	–	●	●	●	●	●	–	–	–	–	–	–
		26 Force VAR	–	–	–	●	●	●	●	●	–	–	–	–	–	–
		Special functions														
		30 Select language, brightness (contrast)	–	●	●	●	●	●	●	●	–	–	–	–	–	–
		31 Change operating mode	–	●	●	●	●	●	●	●	–	–	–	–	–	–
		Settings														
		35 Set time/date	●	●	–	●	●	●	●	●	–	–	–	–	–	–
		36 Internal interface (OP5/OP7: V.24; OP15/OP17: IF1)	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		37 Module interface (OP5/OP7: TTY; OP15/OP17: IF2)	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		38 Printer parameters	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		40 Message type	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		Message texts														
		45 Display alarm message texts	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		46 Display event message texts	●	●	–	●	●	●	●	●	–	–	–	–	–	–
		System messages														
		50 Output system message buffer	●	●	–	●	●	●	●	●	–	–	–	–	–	–
		Passwords														
		55 Login	–	●	–	●	●	●	●	●	–	–	–	–	–	–
		56 Password entry	–	●	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 2, 3	–														
12	**Enable/disable message logging**		●	●	–	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1	0: Off 1: On														
	Parameter 2, 3	–														
13	**Change Language**		●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1	0: 1st language 1: 2nd language 2: 3rd language														
	Parameter 2, 3	–														
14	**Set Time (BCD format)**		●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1	LB: – RB: Hours (0..23)														
	Parameter 2	LB: Minutes (0..59) RB: Seconds (0..59)														
	Parameter 3	–														
15	**Set Date (BCD format)**		●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1	LB: – RB: Day of week (1..7: Sunday...Saturday)														
	Parameter 2	LB: Day of month (1..31) RB: Month (1..12)														
	Parameter 3	LB: Year														

No.	Function		TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
16	**Internal Interface Parameters** (OP5/OP7: V.24; OP15/OP17/TD17: IF1)		●	●	●	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1	Value for parameter 2 **Baud rate** (FAP and printer only) 0: 300 baud 1: 600 baud 2: 1200 baud 3: 2400 baud 4: 4800 baud 5: 9600 baud 6: 19200 baud (FAP only) **Data bits** (FAP and printer only) 0: 7 data bits 1: 8 data bits **Stop bits** (FAP and printer only) 0: 1 stop bit 1: 2 stop bits **Parity** (FAP and printer only) 0: Even 1: Odd 2: None **Operating unit address** 1..30 (only on SINEC L1)														
	Parameter 2	Interface parameters to be set 0: Baud rate 1: Data bits 2: Stop bits 3: Parity 4: Operating unit address (SINEC L1 only)														
	Parameter 3	–														
17	**Module Interface Parameters** (OP5/OP7: TTY; OP15/OP17: IF2)		●	●	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1	Value for parameter 2 **Baud rate** (FAP only) 0: 300 baud 1: 600 baud 2: 1200 baud 3: 2400 baud 4: 4800 baud 5: 9600 baud 6: 19200 baud **Data bits** (FAP only) 0: 7 data bits 1: 8 data bits **Stop bits** (FAP only) 0: 1 stop bit 1: 2 stop bits **Parity** (FAP only) 0: Even 1: Odd 2: None														

No.	Function		TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
		Operating unit address 1..30 (SINEC L1) 1..31 (PROFIBUS) 3..122 (PROFIBUS–DP)														
		PLC address 1..126 (PROFIBUS only) **TD/OP-SAP** 0..63 (PROFIBUS only) **PLC SAP** 0..63 (PROFIBUS only)														
	Parameter 2	Interface parameters to be set 0: Baud rate 1: Data bits 2: Stop bits 3: Parity 4: Operating unit address (SINEC L1, PROFIBUS and PROFIBUS-DP only) 5: PLC address (PROFIBUS only) 6: TD/OP-SAP (PROFIBUS only) 7: PLC SAP (PROFIBUS only)														
	Parameter 3	–														
19	**Printer parameters**		●	●	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1	Value for parameter 2 **Number of characters per line** 0: 20 Characters/line 1: 40 Characters/line 2: 80 Characters/line **Number of lines per page** 0: 60 Lines/page 1: 61 Lines/page : 12: 72 Lines/page														
	Parameter 2	Printer parameters to be set 0: Number of characters per line 1: Number of lines per page														
	Parameter 3	–														
21	**Alarm message display mode**		–	●	–	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1	0: First (oldest message) 1: Last (most recent message)														
	Parameter 2, 3	–														
22	**Set display brightness**		●	●	–	–	–	–	–	●	–	–	–	–	–	–
	Parameter 1	0..9 (corresponds to 10%..100% intensity)														
	Parameter 2, 3	–														
	Set display contrast		–	–	●	●	●	●	●	–	–	–	–	–	–	–
	Parameter 1	0..15														
	Parameter 2, 3	–														

No.	Function	TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
23	**Set password level** Parameter 1 0..9 0 = Lowest password level 9 = Highest password level Parameter 2, 3 –	–	●	–	●	●	●	●	●	●	●	●	●	●	●
24	**Password logout** Parameter 1, 2, 3 –	–	●	–	●	●	●	●	●	●	●	●	●	●	●
29	**Print production report (only for configuration with COM TEXT)** Parameter 1, 2, 3 –	–	●	–	●	●	●	●	●	–	–	–	–	–	–
31	**Print alarm buffer** Parameter 1 0: Print chronologically 1: Print grouped Parameter 2, 3 –	–	●	–	●	●	●	●	●	–	–	–	–	–	–
32	**Print event buffer** Parameter 1 0: Print chronologically 1: Print grouped Parameter 2, 3 –	●	●	–	●	●	●	●	●	–	–	–	–	–	–
33	**Print alarm message statistics** Parameter 1, 2, 3 –	–	●	–	–	–	–	–	●	–	–	–	–	–	–
34	**Print event message statistics** Parameter 1, 2, 3 –	–	●	–	–	–	–	–	●	–	–	–	–	–	–
37	**Enable/disable overflow warning for event messages** Parameter 1 0: Off 1: On Parameter 2, 3 –	●	●	●	●	●	●	●	●	●	●	●	●	●	●
38	**Enable/disable overflow warning for alarm messages** Parameter 1 0: Off 1: On Parameter 2, 3 –	–	●	–	●	●	●	●	●	●	●	●	●	●	●
39	**Reset event message statistics** Parameter 1, 2, 3 –	–	●	–	–	–	–	–	●	–	–	–	–	–	–
40	**Reset alarm message statistics** Parameter 1, 2, 3 –	–	●	–	–	–	–	–	●	–	–	–	–	–	–
41	**Transfer date/time to PLC** There should be at least 5 seconds between two jobs or else the operating unit will be overloaded. Parameter 1, 2, 3 –	●	●	●	●	●	●	●	●	●	●	●	●	●	●

No.	Function	TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
42	**Get LED area from PLC** Parameter 1 Area pointer no.: 1..4 on OP15/OP17/OP20 1..8 on OP25/35, OP27/37 Parameter 2, 3 –	–	–	–	–	–	●	●	●	●	●	●	●	–	–
43	**Get event message area from PLC** Parameter 1 Area pointer no.: 1..4 on TD10/20, OP20, OP5/15, OP7/17, TD17 1..8 on OP25/35, OP27/37, TP27/37 Parameter 2, 3 –	●	●	●	●	●	●	●	●	●	●	●	●	●	●
44	**Get alarm message area and acknowledgement area from PLC** This PLC job gets both the alarm message area and the PLC → operating unit acknowledgement area from the PLC. If you have not set up an acknowledgement area, only the alarm message area is returned. Parameter 1 Area pointer no.: 1..4 on TD20, OP20, OP5/15, OP7/17 1..8 on OP25/35, OP27/37, TP27/37 Parameter 2, 3 –	–	●	–	●	●	●	●	●	●	●	●	●	●	●
47	**Transfer LED area directly to operating unit** Parameter 1 Area pointer no.: 1..4 on OP15/OP17/OP20 1..8 on OP25/35, OP27/37 Parameter 2 LED assignment: 1st word Parameter 3 LED assignment: 2nd word In contrast with PLC job **no. 42** (Get LED area from PLC) the LED assignment area is transferred directly with the PLC job in this case resulting in more rapid activation of the LED. The specified LED area must not be configured larger than 2 DW!	–	–	–	–	–	●	●	●	●	●	●	●	–	–

No.	Function			TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
48	**Select menu** (only for configuration with COM TEXT)																
	Parameter 1	Menu number in standard menu															
		1	Message level (including configuration with	●	●	–	●	●	●	●	●	–	–	–	–	–	–
			ProTool)	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		2	Main menu	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		3	Alarm messages	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		12	Print alarm messages	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		4	Event messages	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		14	Print event messages	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		5	Screens	–	–	–	●	–	●	–	●	–	–	–	–	–	–
		6	Recipes	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		7	Statistics functions	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		18	Alarm message statistics	–	●	–	–	–	–	–	●	–	–	–	–	–	–
		19	Event message statistics	–	–	–	●	–	●	–	●	–	–	–	–	–	–
		8	PU functions	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		9	Special functions	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		24	System messages	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		23	Message texts	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		22	Settings	–	●	–	●	–	●	–	●	–	–	–	–	–	–
		10	Password														
	Parameter 2	Menu item number															
		0:	First menu item														
		1..20	Other menu items														
	Parameter 3	–															
49	**Delete event buffer**			●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1, 2, 3	–															
50	**Delete alarm buffer**			–	●	–	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1, 2, 3	–															
51	**Select Screen**			–	●	–	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1	LB:	Cursor lock (0: Off, 1: On)	–	–	–	●	●	●	●	●	–	–	–	–	–	–
		RB:	Screen number	–	●	–	●	●	●	●	●	●	●	●	●	●	●
			1..99 on TD20, OP20, OP5/15, OP7/17														
			1..255 on OP25/35, OP27/37, TP27/37														
	Parameter 2	Entry number 0..99		–	●	–	●	●	●	●	●	–	–	–	–	–	–
		(0 = Cursor is positioned on first available entry)															
	Parameter 3	Field number:		–	●	–	●	●	●	●	●	●	●	●	●	–	–
			1..8 on TD20, OP20, OP5, OP7														
			1..32 on OP15, OP17														
			1..255 on OP25/35, OP27/37														
		Output fields are ignored for serial number purposes.															
		Note re. TD20, OP20,OP5/15, OP7/17:															
		The input fields of an entry are number consecutively:															
		0	Entry number field														
		1	First input field														
		:															
		n	Last input field														
		The numbering of the input fields starts from 1 again for each entry.															

No.	Function		TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
52	**Print screen**		–	●	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1	Screen number (1..99) in Byte format														
	Parameter 2, 3	–														
53	**Select recipe**		–	–	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1	LB: Cursor lock (0: Off, 1: On) RB: Recipe number 1..99														
	Parameter 2	Data record number 1..99														
	Parameter 3	LB: Entry number (0..99) (0 = Cursor is positioned on first available entry) RB: Field number (0/1) The input fields of an entry are number consecutively: 0 Entry number field 1 First input field : n Last input field The numbering of the input fields starts from 1 again for each entry. Output fields are ignored for serial number purposes.														
54	**Print recipe**		–	–	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1	Recipe number (1..99)														
	Parameter 2	Data record number (1..99)														
	Parameter 3	–														
69	**Transfer recipe data record from PLC to operating unit**		–	–	–	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1	Recipe number: 1..99 on OP20, OP5/15, OP7/17 Identification 1: on OP25/35, OP27/37, TP27/37														
	Parameter 2	Data record number 1..99 on OP20, OP5/15, OP7/17 Identification 2: on OP25/35, OP27/37, TP27/37														
	Parameter 3	0, 1 on OP20, OP5/15, OP7/17 0: Data record is not overwritten 1: Data record is overwritten Identification 3: on OP25/35, OP27/37, TP27/37														
70	**Transfer recipe data record from operating unit to PLC**		–	–	–	●	●	●	●	●	●	●	●	●	●	●
	Parameter 1	Recipe number: 1..99 on OP20, OP5/15, OP7/17 Identification 1: on OP25/35, OP27/37, TP27/37														
	Parameter 2	Data record number: 1..99 on OP20, OP5/15, OP7/17 Identification 2: on OP25/35, OP27/37, TP27/37														
	Parameter 3	– on OP20, OP5/15, OP7/17 Identification 3: on OP25/35, OP27/37, TP27/37														

No.	Function			TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
71	**Partial screen update**			–	●	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1	0: Off 1: On															
	Parameter 2, 3	–															
	This job may only be activated when no screen is selected!																
72	**Position cursor** on current screen or in current recipe			–	●	–	●	●	●	●	●	●	●	●	●	–	–
	Parameter 1	Entry number:	0..99	–	●	–	●	●	●	●	●	–	–	–	–	–	–
	Parameter 2	Field number: 1..8 1..32 1..255	 on TD20, OP20, OP5, OP7 on OP15, OP17 on OP25/35, OP27/37	–	●	–	●	●	●	●	●	●	●	●	●	–	–
	Parameter 3	Cursor lock	(0: Off, 1: On)	–	–	–	●	●	●	●	●	–	–	–	–	–	–
73	**Position cursor** on current function screen			–	–	●	●	●	●	●	●	–	–	–	–	–	–
	Parameter 1	Field number	(0..8)														
	Parameter 2	Cursor lock	(0: Off, 1: On)														
	Parameter 3	–															

No.	Function	TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
74	**Simulate keyboard**	–	●	●	●	●	●	●	●	–	–	–	–	–	–

Parameter 1 — LB: Keyboard number

1 TD20: system keyboard
  OP20: internal function keyboard
  OP5/15: internal function keyboard
  OP7/17: internal function keyboard
2 OP20: system keyboard
  OP5/15: system keyboard
  OP7/17: system keyboard
  TD17: system keyboard
3 OP20: external function keyboard (16 keys)
4 OP20: external function keyboard (24 keys)

RB: Password level
0: is analyzed
1: is not analyzed

Parameter 2 — LB: First Key Code

Parameter 3 — –

A summary of the key codes for the operating units is given in chapter B.2.

When performing keyboard simulation by PLC job, the transmission time from PLC to operating unit must be taken into account. The acknowledgement of an alarm message from the PLC by keyboard simulation can, under certain circumstances, bring about an undesirable result if

– the alarm message concerned has already been acknowledged by operator input on the operating unit,
– an new alarm message or a system message arrives before the PLC job is analyzed.

No.	Function	TD10	TD20	TD17	OP5	OP7	OP15	OP17	OP20	OP25	OP27	OP35	OP37	TP27	TP37
75	**Scroll event messages**	●	–	●	–	–	–	–	–	–	–	–	–	–	–

Parameter 1 — 0: Off
1: On

Parameter 2, 3 — –

B.1 PLC Jobs – Special Cases

Jobs with cursor lock

If any of the jobs 11, 51, 53, 72 or 73 is initiated with a value other than 0 specified for the parameter ”Cursor lock”, the selected input field can not be exited using the arrow keys or the ESC key. The cursor lock is not cancelled until

- the job is repeated specifying cursor lock = 0,
- another job that changes the display is executed.

If an attempt is made to exit the input field while the cursor lock is active the system message ”`$400 Illegal input`” is displayed.

The cursor lock is not possible on the graphic display units.

B.2 Key Codes

The key codes for the TD20, OP5, OP15 and OP20 are detailed below. These key codes are required, among other things, for PLC job no. 74 (Simulate keyboard).

Function keys

OP5:
F1...F6: 1...6

OP7:
F1...F4: 1...4
K1...K4 5...8

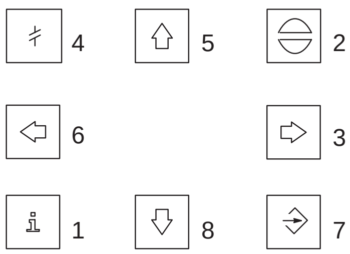
OP15:
F1...F16: 1...16

OP17:
F1...F8: 1...8
K1...K16: 9...24

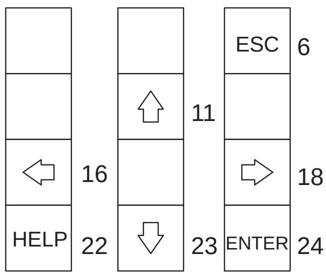
OP20:
F1...F24: 1...24

System keyboard

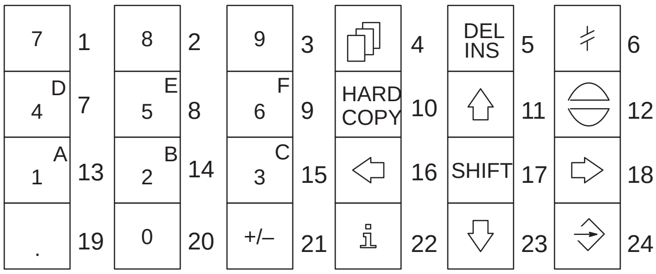
TD20:



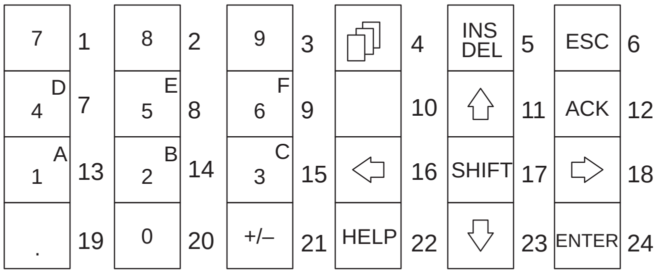
TD17:



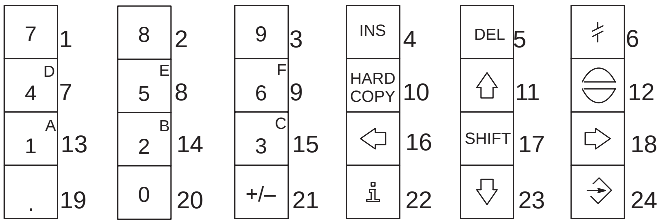
OP5 and OP15:



OP7 and OP17:



OP20:



Interface Modules

C

This part of the Appendix describes the different interface modules for the TD10, TD20 and OP20.

C.1 General

Concept

Different methods of implementation have been adopted for each device, in order to allow for the differences between the interfaces:

TD10, TD20 and OP20
There are several interface modules for these devices.

OP5/15 and OP15/17
There are several device versions of these operator panels.

OP25/35, OP27/37 and TP27/37
All the interfaces are integrated in these operator panels.

Interface modules

An interface module must be used in the TD10/20, OP20 if one of the following conditions applies:

- Operation of a printer on the TD10/20 or OP20
- Connection to the PLC via:
  - RS422 interface
  - Second serial interface (loop-through mode)
  - Parallel interface
  - SINEC L2 bus
  - SINEC L2-DP bus

Possible modules

- Serial interface module
- Parallel module
- SINEC L2 module
- SINEC L2-DP module

Hardware identifier

Each interface module has its own hardware identifier, which is read by the TD/OP during the device startup procedure and compared to the specifications in the configuration. If the hardware identifiers do not match, the device indicates an error message and stops.

Caution

The interface modules are only allowed to be inserted and withdrawn when the power supply to the TD/OP is switched off.

C.2 Serial Interface Module

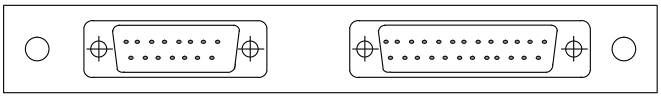
Models

The serial interface module is designed for three different transfer modes.

- V.24 (RS 232)
- X.27 (RS 422)
- TTY (20 mA)

Connection elements

The serial interface module is equipped with two sub-D sockets, some of whose signals are wired in parallel. For this reason, only one can be used at a time.



15-pin sub-D socket   25-pin sub-D socket

- **15-pin sub-D socket**

  Characteristics:

  – Sliding lock

  – TTY signal assignment same as programming unit interface on PLC

  – Additional V.24 signals

Pin-out of the 15-pin socket:

Pin	General	V.24	TTY
1	Shield		
2			RxD–
3		RxD	
4		TxD	
5		CTS	
6			TxD+
7			TxD–
8	Shield		
9			RxD+
10		RTS	
11			+JT
12	GND		
13			+JR
14	+5 V		
15	GND		

- **25-pin sub-D socket**

  Characteristics:

  – Screw-down lock

  – V.24 standard assignment

  – Additional TTY and X.27 signals

Pin-out of the 25-pin socket:

Pin	General	V.24	TTY	X.27
1	Shield			
2		TxD		
3		RxD		
4		RTS		
5		CTS		
6	n. c.			
7	GND			
8	n. c.			
9			RxD+	
10			+JR	
11			RxD–	
12	GND			
13	n. c.			
14				RxD+
15				RxD–
16				TxD+
17				TxD–
18			TxD+	
19	n. c.			
20	n. c.			
21			+JT	
22			TxD–	
23	GND			
24	n. c.			
25	n. c.			

Switch elements

The serial interface module is equipped with a quadruple DIL switch.

Setting as delivered and default setting:
All switches in *OFF* position.

Set all switches to OFF if the standard cables are used.

Exception: standard cable *6ES5 726-5* for connection to CPU 928B: all switches in *ON* position.

Figure C-1 shows the positions of the switch elements and the default setting.

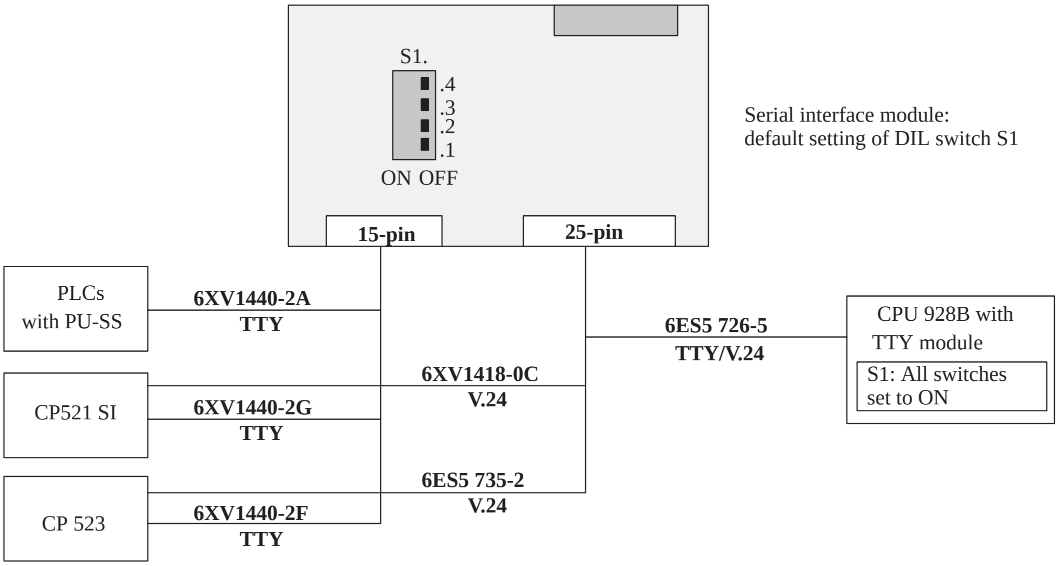
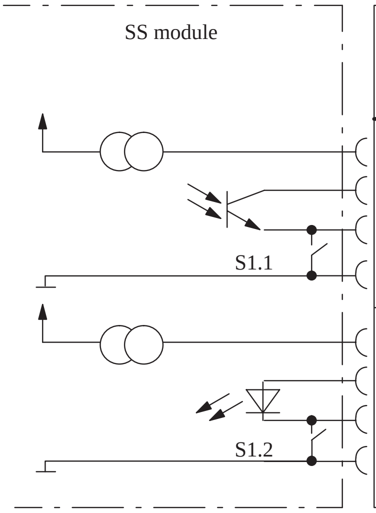


Figure C-1 Positions of the switch elements; default setting

Switches S1.1 and S1.2

Switches S1.1 and S1.2 are used for active/passive TTY operation (see figure C-2).



Sub-D socket 25-pin	Sub-D socket 15-pin	Signal assigment for DIL switch setting: Active	Signal assigment for DIL switch setting: Passive
21	11	TxD+	+JT
18	6	TxD–	TxD+
22	7		TxD–
23	15		GND
10	13	RxD+	+JR
9	9	RxD–	RxD+
11	2		RxD–
12	12		GND

Figure C-2 Active/passive TTY operation

Switches S1.3 and S1.4

Switches S1.3 and S1.4 are not evaluated.

Technical specifications

- Insulation voltage: 250 V (for TTY, passive)
- Current consumption:
  TTY max. 50 mA at 24 V
  V.24 max. 10 mA at 5 V
  X.27 max. 100 mA at 5 V

C.3 Parallel Module

Short description

The parallel module allows a TD to be connected to a PLC with digital inputs/output (e.g. digital I/O modules).

Seventeen 24 V digital inputs and one digital output are available.

The digital inputs and the digital output are electrically isolated from the TD by optical isolators.

Structure

Figure C-3 shows the structure of the parallel module.

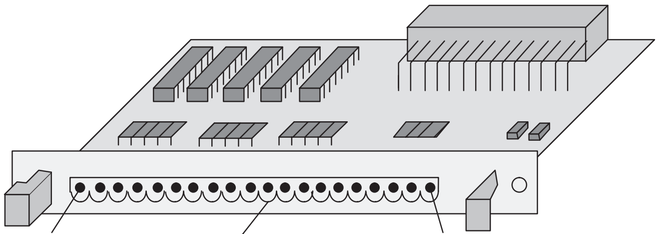


Figure C-3 Structure of the parallel module

Pin-out

The pin-out of the 20-pin plug connector on the parallel module is shown in the table below.

Pin	Name	Function
1	D_{in} 00	Digital input 0
2	D_{in} 01	Digital input 1
3	D_{in} 02	Digital input 2
4	D_{in} 03	Digital input 3
5	D_{in} 04	Digital input 4
6	D_{in} 05	Digital input 5
7	D_{in} 06	Digital input 6
8	D_{in} 07	Digital input 7
9	D_{in} 08	Digital input 8
10	D_{in} 09	Digital input 9
11	D_{in} 10	Digital input 10
12	D_{in} 11	Digital input 11
13	D_{in} 12	Digital input 12
14	D_{in} 13	Digital input 13
15	D_{in} 14	Digital input 14
16	D_{in} clk pls	Digital input 15 (clock pulse signal)
17	D_{in} Aux	Digital input 16 (not used)
18	D_{out} 01	Digital output (acknowledgment signal)
19	P 24 V	Input +24 V DC (18...30 V) for D_{out} 01
20	EGND	Ground ”GND” for D_{in}/D_{out}

Technical specifications

Digital inputs:
Current consumption at 24 V: 10 mA
Low level: –30 V to +5 V
High level: +13 V to +30 V

Digital output:
Low level: < 2 V
High level: +16 V to +30 V

C.4 SINEC L2 Interface Module

Short description

A TD/OP device is connected to the SINEC L2 bus (PROFIBUS) by the SINEC L2 module.

The SINEC L2 module is an “intelligent” module with its own processor which handles various protocol functions.

The L2 module is connected to the SINEC L2 or PROFIBUS bus system by a serial interface with RS485 characteristics. This interface is available on the 9-pin socket of the module.

The SINEC L2 interface module can be connected to all SIEMENS SINEC L2 bus components, such as RS485 bus terminals or SINEC L2 FO bus terminals.

Note

FBA bus terminals cannot be connected!

Structure and connection elements

Figure C-4 shows the structure and connection elements of the SINEC L2 interface module.

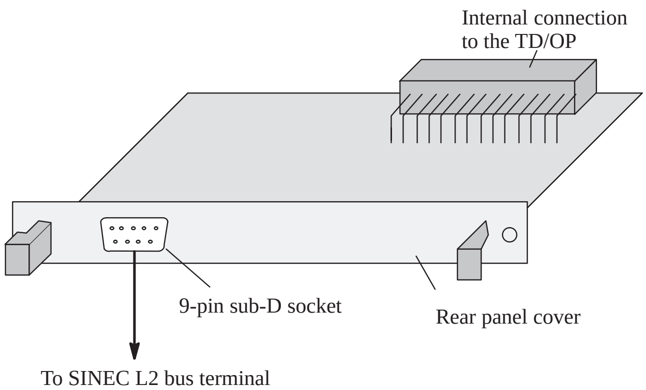
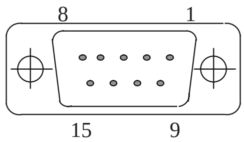


Figure C-4 Structure of the L2 interface module

Pin-out

9-pin, sub-D socket



Pin	Signal
1	Shield
2	Data B (redundant)
3	Data B
4	RTS-PU (identical to pin number 9)
5	Data ground and supply voltage ground
6	+5 V DC supply voltage
7	Data A (redundant)
8	Data A
9	RTS-PU (send enable output)

Technical specifications

Transfer rate:
9.60 kbit/s
19.20 kbit/s
93.75 kbit/s
187.50 kbit/s
500.00 kbit/s
1.50 mbit/s

Interface type:
RS485

Transfer cable:
Twisted, shielded two-wire line

C.5 SINEC L2-DP Interface Module

Short description

The SINEC L2-DP interface module is required to integrate the TD10/20 and OP20 in a SINEC L2-DP system.

The L2-DP module is connected to the SINEC L2-DP bus system by a serial interface with RS485 characteristics. This interface is available on the 9-pin socket of the module.

The L2-DP module can be connected to all SIEMENS SINEC L2 bus components, such as RS485 bus terminals or SINEC L2 FO bus terminals.

Note

FBA bus terminals cannot be connected!

Structure and connection elements

Figure C-5 shows the structure and connection elements of the SINEC L2-DP interface module.

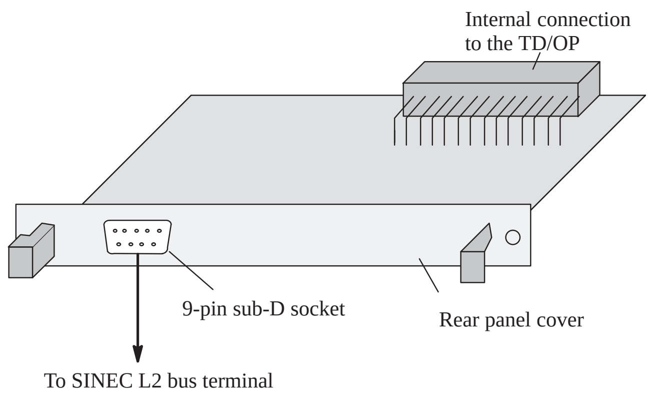
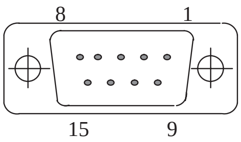


Figure C-5 Structure of the L2-DP interface module

Pin-out

9-pin, sub-D socket



Pin	Signal
1	Shield
2	Reserved
3	Data B
4	Reserved
5	Data ground and supply voltage ground
6	+5 V DC supply voltage for bus terminal
7	Reserved
8	Data A
9	Reserved

Technical specifications

Transfer rate:
9.60 kbit/s
19.20 kbit/s
93.75 kbit/s
187.50 kbit/s
500.00 kbit/s
1.50 mbit/s

Interface type:
RS485

Transfer cable:
Twisted, shielded, two-wire line

Technical Specifications of the Standard Function Blocks

D

This part of the Appendix contains the technical specifications of the standard function blocks for connections via AS511, FAP, SINEC L1, PROFIBUS and PROFIBUS-DP.

D.1 AS511 Connection

Table D-1 General specifications

PLC	S5-90 U, S5-100 U with CPU 100/102	S5-95 U	S5-100 U with CPU 103	S5-115 U	S5-135 U with CPU 922/928
Block number	FB51	FB51	FB51	FB51	FB51
File name	S5TD02ST.S5D	S5TD03ST.S5D	S5TD01ST.S5D	S5TD50ST.S5D	S5TD24ST.S5D
Block name	TDOP:511	TDOP:511	TDOP:511	TDOP:511	TDOP:511
Lib. no. E88530-B	3051-A-2	1051-A-2	1051-A-2	5051-A-2	2051-A-2
Call length (in words)	2	2	2	2	2
Block size (in words)	290	543	543	526	495
Nesting depth	0	0	0	0	0
Allocation in the DB-TDOP	DW 0...69	DW 0...184	DW 0...184	DW 0...184	DW 0...184
Allocation in the flag area	FW 100...126	FW 200...254	FW 200...254	FW 200...254	FW 200...254
Allocation in the system area	–	–	–	–	–

Table D-2 Processing times of FB51 (all times stated in milliseconds)

PLC	Basic load	Sending PLC message	Evaluating TD/OP message
S5-90 U	2.1 (2.0)	2.2	2.2
S5-95 U	4.0 (2.5)	3.7 to 5.1	2.2
S5-100 U			
– CPU 100	12.3 (12.1)	12.5	12.6
– CPU 102	2.5 (2.4)	2.6	2.6
– CPU 103	4.8 (3.0)	4.5 to 6.1	5.7
S5-115 U			
– CPU 941	32.7 (15.1)	22.5 to 38.2	36.8
– CPU 942	8.4 (4.3)	6.4 to 9.0	8.8
– CPU 943	3.6 (1.5)	2.8 to 4.5	4.1
– CPU 944	0.7 (0.4)	0.5 to 1.1	0.9
– CPU 941 B	3.2 (1.4)	2.4 to 3.8	3.6
– CPU 942 B	3.2 (1.4)	2.4 to 3.8	3.6
– CPU 943 B	2.7 (1.0)	1.9 to 3.3	3.1
– CPU 944 B	0.5 (0.4)	0.8	0.7
S5-135 U			
– CPU 922	7.5 (4.3)	5.8 to 8.1	7.8
– CPU 928	2.8 (1.2)	2.0 to 3.2	3.0
– CPU 928 B	0.7 (0.4)	0.4 to 0.8	0.7

Meanings of the processing times:

Basic load

- Time for processing the control and acknowledge bits
- Time for browsing through the application mailboxes and the job mailbox for new entries (the values in parentheses apply if a job is currently being processed)
- Time for evaluating the life bit

Sending PLC message

Time for processing a PLC job which must be sent. The time varies according to whether the program finds a pointer to a new job in the first application mailbox through which it browses or in a subsequent mailbox. The value does not provide any indication of when the job is actually located in the TD/OP or when it is executed there.

Evaluating TD/OP message

Time for entering the date, the time and the time interrupt bits in the interface DB.

D.2 Free ASCII Protocol (FAP)

D.2.1 FAP at Interface SI2

Table D-3 General specifications

PLC	S5-115 U with CPU 943B, CPU 944A/B	S5-135 U with CPU 928B
Block number	FB53	FB53
Block name	TDOP:FAP	TDOP:FAP
Lib. no. E88530–B	5053-A-2	2053-A-2
Call length (in words)	2	2
Block size (in words)	1569	1252
Nesting depth	0	0
Allocation in the – DB-TDOP – DB-ZU	 DW 0...184 DW 0...n*16	 DW 0...184 DW 0...n*16
Allocation in the flag area	FW 200...254	FW 200...254
Allocation in the system area	–	BS 60, BS 61

n = Number of connected TD/OP devices

Table D-4 Processing times of FB53 (all times stated in milliseconds)

PLC	Startup	Basic load	Transfer to TD/OP		Transfer to PLC
			1 pointer	4 pointers	
S5-115 U – CPU 944A – CPU 944B	 2.5 1.9	 1.6 0.9	 1.6 / 1.1 0.9 / 0.8	 2.6 / 1.1 1.6 / 0.8	 1.9 1.2
S5-135 U – CPU 928B	 2.2	 1.2	 1.3 / 1.0	 2.1 / 1.0	 1.6

D.2.2 FAP at CP Module

Table D-5 General specifications for CP 521 SI

PLC	S5-95 U with CP 521 SI	S5-100 U with CPU 103/CP 521 SI
Block number	FB52	FB52
Block name	TDOP:521	TDOP:521
Lib. no. E88530-B	0352-A-3	1052-A-3
Call length (in words)	2	2
Block size (in words)	2132	1812
Nesting depth	0	0
Allocation in the – DB-TDOP – DB-ZU	 DW 0...184 DW 0...n*16	 DW 0...184 DW 0...n*16
Allocation in the flag area	FW 200...254	FW 200...254
Allocation in the system area	–	–

n = Number of connected TD/OP devices

Table D-6 General specifications for CP 523

PLC	S5-115 U with CP 523	S5-135 U with CP 523	S5-155 U with CP 523
Block number	FB52	FB52	FB52
Block name	TDOP:523	TDOP:523	TDOP:523
Lib. no. E88530-B	5052-A-4	2052-A-3	6052-A-3
Call length (in words)	2	2	2
Block size (in words)	1707	1540	1626
Nesting depth	0	0	0
Allocation in the – DB-TDOP – DB-ZU	 DW 0...184 DW 0...n*16	 DW 0...184 DW 0...n*16	 DW 0...184 DW 0...n*16
Allocation in the flag area	FW 200...254	FW 200...254	FW 200...254
Allocation in the system area	–	BS 60, BS 61	–

n = Number of connected TD/OP devices

Table D-7 Processing times of FB52 (all times stated in milliseconds)

PLC	Startup	Basic load	Transfer to TD/OP		Transfer to PLC
			1 pointer	**4 pointers**	
S5-95 U	11	6	11 *)		11 *)
S5-100 U – CPU 103	 11	 6	 11 *)		 11 *)
S5-115 U – CPU 941 – CPU 941B – CPU 942 – CPU 942B – CPU 943 – CPU 943B – CPU 944 – CPU 944B	 33.5 3.7 9.5 3.7 5.2 3.2 2.1 1.7	 51.0 7.1 13.5 7.1 7.1 4.6 1.3 0.7	 80 / 56 12.8 / 7.0 21.7 / 15.3 12.8 / 7.0 12.8 / 7.0 10.7 / 5.2 2.0 / 1.5 1.4 / 1.2	 129 56 19.0 / 7.0 35.2 / 15.3 19.0 / 7.0 22.1 / 7.0 17.0 / 5.2 3.8 / 1.5 2.2 / 1.2	 126 19.5 34.2 19.5 22.8 19.2 3.8 1.8
S5-135 U – CPU 922 – CPU 928A – CPU 928B	 6.5 4.7 0.7	 12.8 5.8 0.9	 16.2 / 14.5 7.8 / 6.6 2.8 / 3.0	 26.5 / 14.5 13.6 / 6.6 4.6 / 3.0	 19.2 9.8 3.9
S5-155 U	0.9	1.3	1.9 / 1.5	3.2 / 1.5	3.1

*) These PLCs (with CPU 521 SI) only transfer 6 bytes to the TD/OP or read 6 bytes from it during each cycle (standard FB call).

Meanings of the processing times:

Basic load

- Time for processing the control and acknowledge bits
- Time for browsing through the application mailboxes for new entries
- Time for evaluating the life bit

Transfer to TD/OP

First FB call
- Time for evaluating the data request from the TD/OP
- Time for gathering together the requested data
  Second FB call
- Time for entering the requested data in the send mailbox
  The specified values apply to the first and second calls in the following configuration example:
- One pointer to one contiguous area of 15 data words
- Four pointers to four separate areas of 15 data words each
  The specified values apply to one contiguous area of 15 data words.

D.3 SINEC L1 Connection

Table D-8 General specifications

PLC	S5-115 U with CP 530	S5-135 U with CP 530	S5-155 U with CP 530
Block number	FB56	FB56	FB56
Block name	TDOP:L1	TDOP:L1	TDOP:L1
Lib. no. E88530-B	5056-A-1	2056-A-1	6056-A-1
Call length (in words)	2	2	2
Block size (in words)	1601	1431	1530
Nesting depth	0	0	0
Allocation in the – DB-TDOP – DB-ZU – DB-DHB (DB56)	 DW 0...227 DW 0...n*16 DW 0...14	 DW 0...227 DW 0...n*16 DW 0...14	 DW 0...227 DW 0...n*16 DW 0...14
Allocation in the flag area	FW 200...254	FW 200...254	FW 200...254
Allocation in the system area	–	BS 60, BS 61	–

n = Number of connected TD/OP devices

Table D-9 Processing times of FB56 (all times stated in milliseconds)

PLC	Basic load	Sending PLC message	Evaluating TD/OP message
S5-115 U – CPU 943 – CPU 944 – CPU 941 B – CPU 942 B – CPU 943 B – CPU 944 B	 9.0 4.5 9.5 9.5 9.0 3.0	 13.0 8.0 13.0 13.0 12.0 6.0	 17.5 13.5 18.5 18.5 17.5 9.0
S5-135 U – CPU 922 – CPU 928 – CPU 928 B	 11.0 4.0 1.5	 14.0 7.0 4.0	 19.0 10.0 5.5
S5-155 U	2.5	5.0	7.0

Meanings of the processing times:

Basic load

- Time for processing the control and acknowledge bits
- Time for browsing through the application mailboxes for new entries
- Time for evaluating the life bit
- Time for calling FB-CONTROL

Sending PLC message

Time needed for the FB-SEND to process a PLC send job. The value does not provide any indication of when the job is actually located in the TD/OP or when it is executed there.

Evaluating TD/OP message

- Time for calling FB-RECEIVE
- Time for evaluating the data request from the TD/OP and gathering together the requested data
- Time for calling FB-SEND

D.4 PROFIBUS and PROFIBUS–DP Connection

Table D-10 General specifications PROFIBUS

PLC	S5-95 L2	S5-115 U with CPU 941 A/B to CPU 944 A/B	S5-115 U with CPU 945	S5-135 U with CPU 922 CPU 928 A/B	S5-155 U with CPU 946/947
Block number	FB55	FB55	FB55	FB55	FB55
Block name	TDOP:L2	TDOP:L2	TDOP:L2	TDOP:L2	TDOP:L2
Lib. no. E88530-B	0355-A-1	5055-A-3	5155-A-1	2055-A-3	6055-A-3
Call length (in words)	2	2	2	2	2
Block size (in words)	1996	1682	1628	1512	1621
Nesting depth	1	1	1	1	1
Allocation in the – DB-TDOP – DB-ZU – DB-DHB (DB 55)	 DW 0...255 DW 0...(n×16)-1 DW 0...14	 DW 0...255 DW 0...(n×16)-1 DW 0...14	 DW 0...255 DW 0...(n×16)-1 DW 0...14	 DW 0...255 DW 0...(n×16)-1 DW 0...14	 DW 0...255 DW 0...(n×16)-1 DW 0...14
Allocation in the flag area	FW 200...254	FW 200...254	FW 200...254	FW 200...254	FW 200...254
Allocation in the system area	–	–	–	BS 60, BS 61	–

n = Number of connected TD/OP devices

Table D-11 Gemeral specifications PROFIBUS–DP

AG	**S5-115 U with CPU 941 A/B to CPU 944 A/B**	**S5-115 U with CPU 945**	**S5-135 U with CPU 922 CPU 928 A/B**	**S5-155 U with CPU 946/947**
Block number	FB58	FB58	FB58	FB58
Block name	TDOP:DP	TDOP:DP	TDOP:DP	TDOP:DP
Lib. no. E88530-B	5058-A-1	5158-A-1	2058-A-1	6055-A-1
Call length (in words)	2	2	2	2
Block size (in words)	1704	1802	1779	1793
Nesting depth	1	1	1	1
Allocation in the – DB-TDOP – DB-ZU – DB-DHB (DB 55)	 DW 0...168 DW 0...(n × 16) – 1 DW 0...14	 DW 0...168 DW 0...(n × 16) – 1 DW 0...14	 DW 0...168 DW 0...(n × 16) – 1 DW 0...14	 DW 0...168 DW 0...(n × 16) – 1 DW 0...14
Allocation in the flag area	FW 200...254	FW 200...254	FW 200...254	FW 200...254
Allocation in the system area	–	–	BS 60, BS 61	–

n = Number of connected TD/OP devices

Table D-12 Processing times PROFIBUS and PROFIBUS–DP

PLC	**CPU**	**Function**		
		Upload PLC → TD/OP (PLC job)	Download TD/OP → AG (TD/OP job) (approx. 20 Byte)	Basic load
PLC S5–115U	CPU 943 CPU 944 CPU 941 B CPU 942 B CPU 943 B CPU 944 B CPU 945 *)	13,0 8,0 13,0 13,0 12,0 6.0 –	17,5 13,5 18,5 18,5 17,5 9,0 –	9,0 4,5 9,5 9,5 9,0 3,0 –
PLC S5–135U	CPU 922 CPU 928 CPU 928 B	14,0 7,0 4,0	19,0 10,0 5,5	11,0 4,0 1,5
PLC S5–155U	CPU 946/947 CPU 948 *)	5,0 –	7,0 –	2,5 –

*) Values not yet available.

Meanings of the processing times:

Basic load

The function block must be called absolutely in the periodic program. At base load, the control and acknowledgement bits are processed; all eight application mailboxes of the DB–TD/OP interface data block are examined for possible entries and the life bit for the connection watchdog is evaluated. The function block requires the specified time for this activity.

Download TD/OP job

When data are uploaded from the PLC to the connected TD or OP, the TD or OP first sends a request for data. The function block evaluates this request for data (checks for validity, availability of data etc.), assembles the requested data and uploads them.

The processing time has been determined for one data area (1pointer) in the request for data. In this case 20 bytes of useful data will be uploaded.

Upload PLC job

When PLC jobs are uploaded, the function blocks are examined until an entry is found and the data area specified in the pointer is checked. The data to be transmitted are assembled with the coordination area in the send mailbox and transmitted. No TD/OP job is accepted by the function block in the same cycle.

Notes on the PROFIBUS and PROFIBUS–DP bus system

The response time of TDs and OPs on the PROFIBUS bus is determined by the scan time of the PLC. You can improve response times by means of a high–speed CPU û for example, CPU 944/S5–115U or CPU 928/S5–135U û or by distributing the TDs or OPs over several PLCs.

Use of CPUs 941 and 942 of the S5–115U series and CPU 922 of the S5–135U series is to be recommended therefore only for hardware configurations which are uncritical with respect to time, for few devices, or for small parameter configurations (few area pointers or, even better, transfers initiated by PLC jobs).

Interface Area Assignment

E

This appendix details the interface assignment for all plug-in connecting cables. They can also be ordered separately from Siemens.

Note

Siemens offers no guarantee for cables soldered by the user.

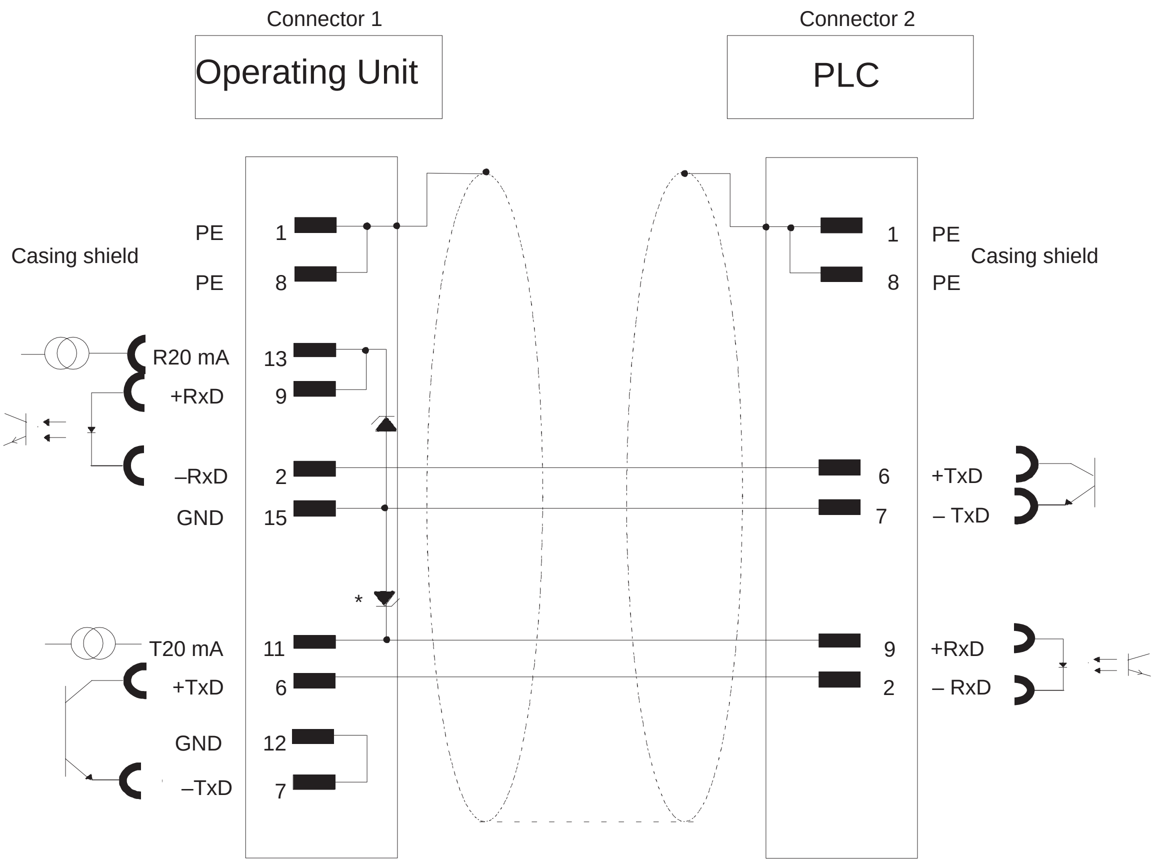
Plug-in Connecting Cable: Operating Unit <–> SIMATIC S5 (TTY)

PU Interface on CPUs

6XV1440 – 2A...

Connector 1: 15-pin Sub D male connector
Secured by slide
TTY, active

Connector 2: 15-pin Sub D male connector
Secured by slide
TTY, passive



* For TTY cables with special lengths > 10m, 2 Zener diodes (12 V) must be soldered in the 15-pin connector for the operating unit (TTY active):
BZX 55 C12 ser. no. 30095128

Shielding connected at both ends to casing with large contact area

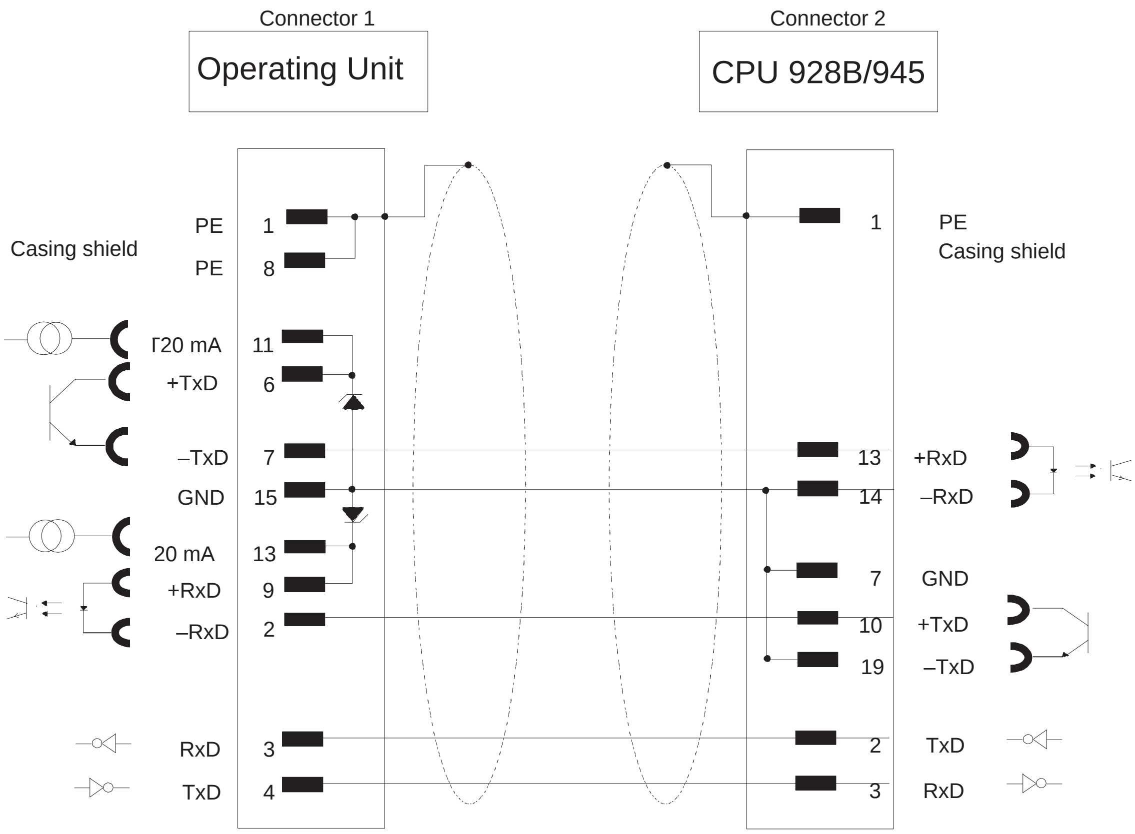
Cable: 5 x 0.14 mm^2; shielded; max. length 1000 m

Plug-in Connecting Cable: Operating Unit <–> CPU 928B/945 (TTY)

6 XV1440 – 2J...

Connector 1: 15-pin Sub D male connector
Secured by slide
V.24, TTY, active

Connector 2: 25-pin Sub D male connector
Secured by slide
V.24, TTY, passive



Cable: 5 x 0.14 mm²; shielded; max. length 1000 m
Shielding connected at both ends to casing with large contact area

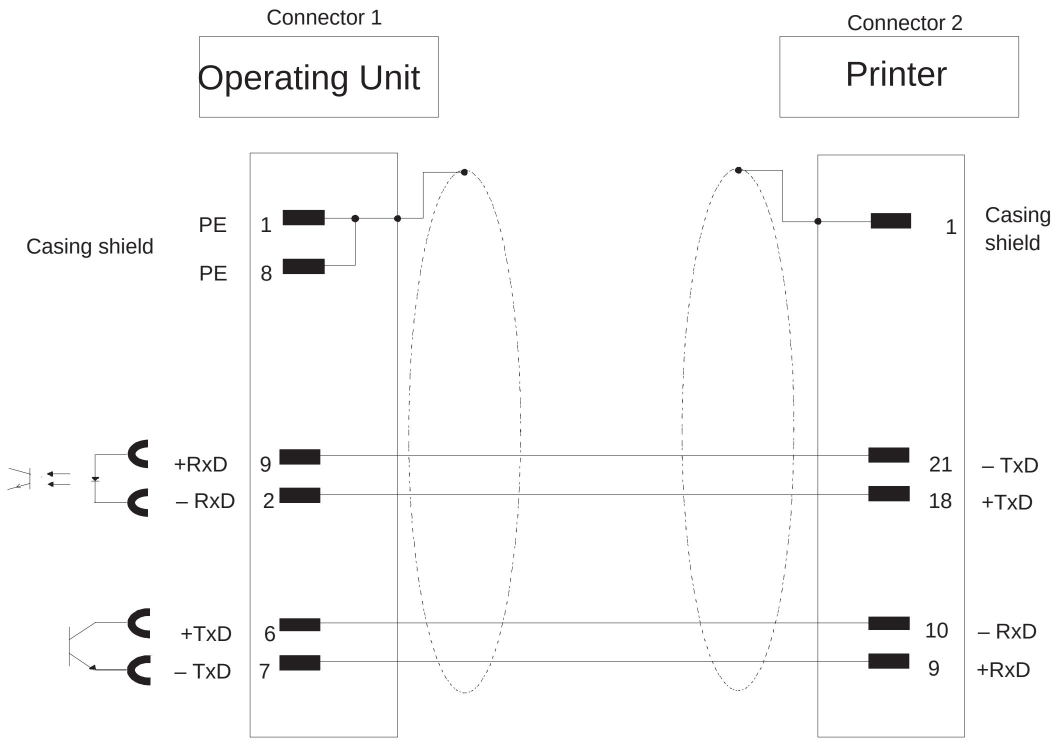
Plug-in Connecting Cable: Operating Unit <–> Printer (TTY)

6 XV1440 - 2B...

Printer: DR210–/211–/230–/231–N
DR215–/216–/235–/236–N

Connector 1: 15-pin Sub D male connector
Secured by slide
TTY, passive

Connector 2: 25-pin Sub D male connector
Secured by screws
TTY, active



Cable: 5 x 0.14 mm²; shielded; max. length 1000 m
Shielding connected at both ends to casing with large contact area

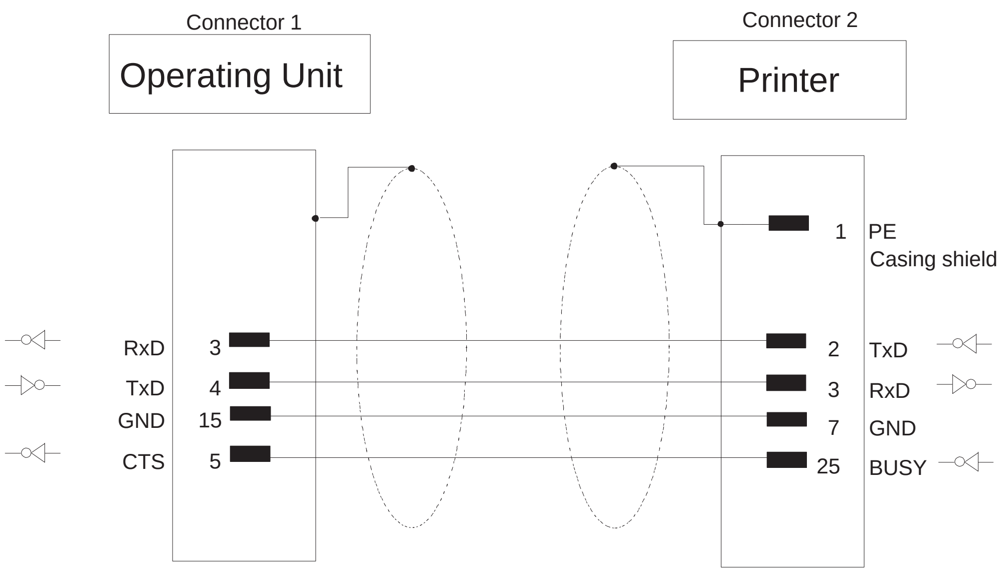
Plug-in Connecting Cable:
Operating Unit <–> Printer (V. 24)

6 XV1440 – 2C...

Printer: DR210–/211–/230–/231–N
DR215–/216–/235–/236–N

Connector 1: 15-pin Sub D male connector
Secured by slide
V.24

Connector 2: 25-pin Sub D male connector
Secured by screws
V.24



Cable: 5 x 0.14 mm²; shielded; max. length 15 m
Shielding connected at both ends to casing with large contact area

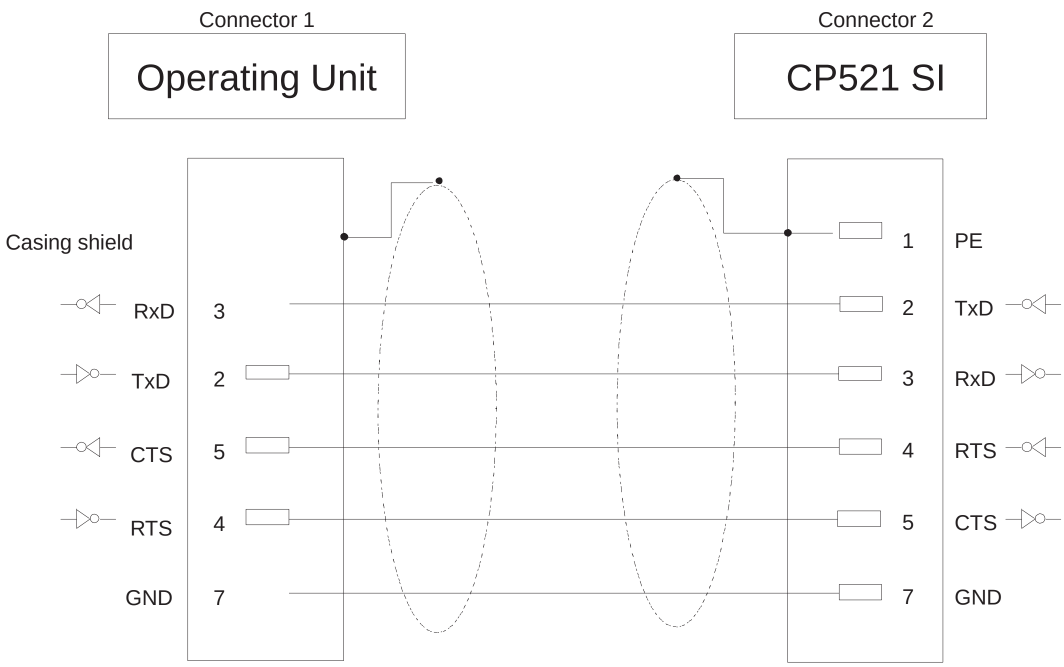
Plug-in Connecting Cable: Operating Unit <–> CP 521 SI (V.24)

6 XV1418 – OC...

Serial interface module or adapter 6XV1440–2DE32

Connector 1: 25-pin Sub D male connector
Secured by screws
V.24

Connector 2: 25-pin Sub D male connector
Secured by screws
V.24



Cable: 5 x 0.14 mm²; shielded; max. length 15 m

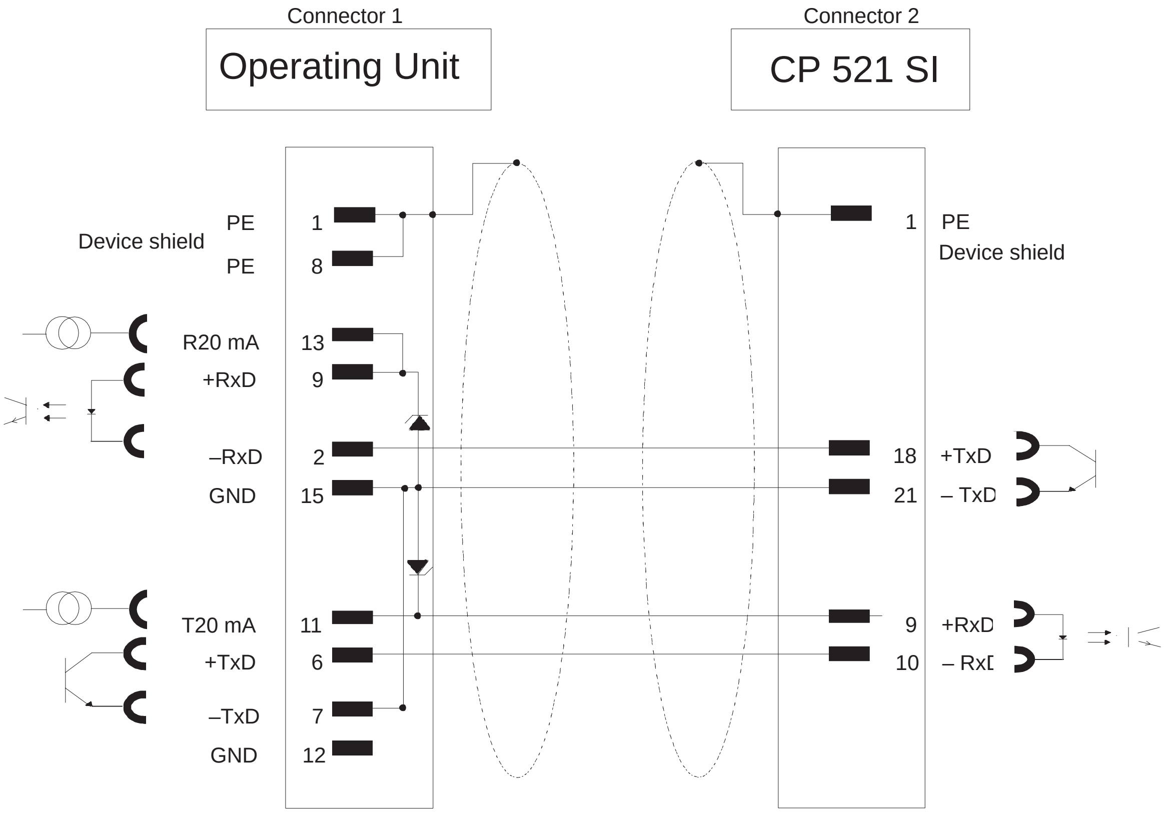
Shielding connected at both ends to casing with large contact area

Plug-in Connecting Cable: Operating Unit <–> CP 521 SI (TTY)

6 XV1440 – 2G...

Connector 1: 15-pin Sub D male connector
Secured by slide
TTY, active

Connector 2: 25-pin Sub D male connector
Secured by screws
TTY, passive



For TTY cables with special lengths > 10m, 2 Zener diodes (12 V) must be soldered in the 15-pin connector for the operating unit (TTY active):

BZX 55 C12 ser. no. 30095128

Shielding connected at both ends to casing with large contact area

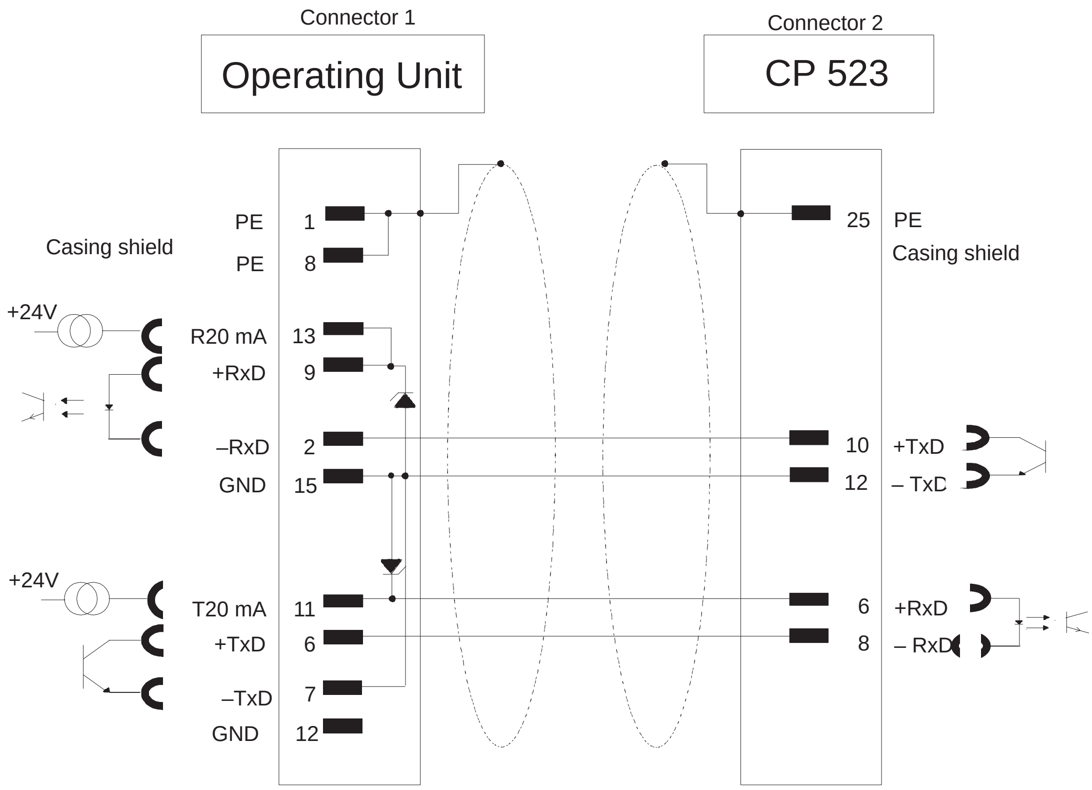
Cable: Liycy 5 x 0.14 mm^2; shielded; max. length 1000 m

Plug-in Connecting Cable: Operating Unit <–> CP 523 (TTY)

6 XV1440 – 2F...

Connector 1: 15-pin Sub D male connector
Secured by slide
TTY, active

Connector 2: 25-pin Sub D male connector
Secured by screws
TTY, passive



For TTY cables with special lengths > 10m, 2 Zener diodes (12 V) must be soldered in the 15-pin connector for the operating unit (TTY active):
BZX 55 C12 ser. no. 30095128

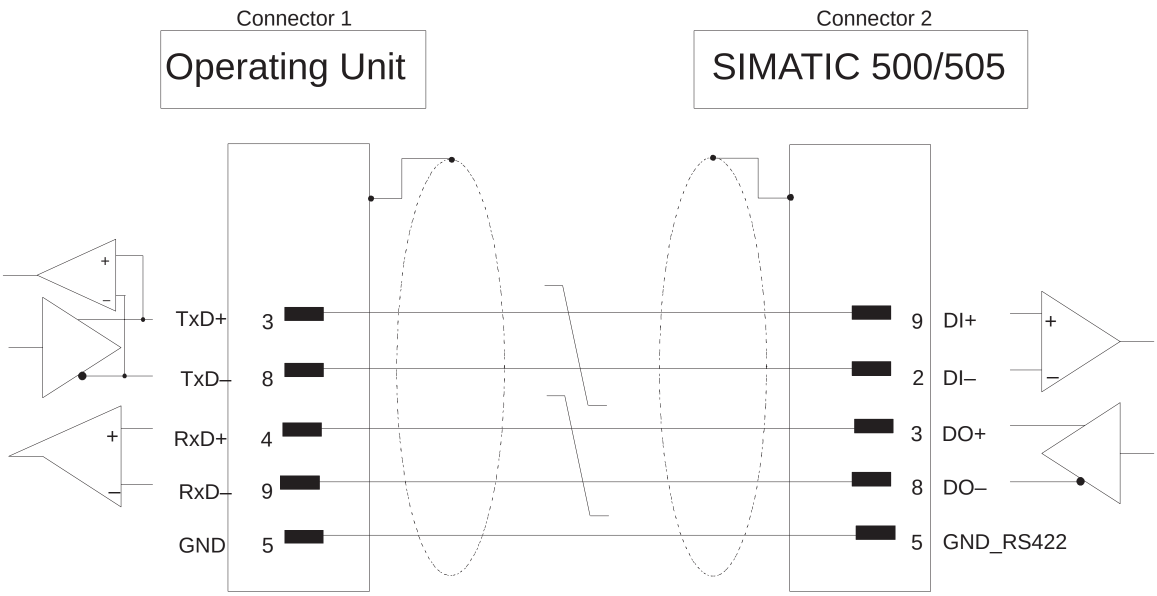
Shielding connected at both ends to casing with large contact area
Cable: 5 x 0.14 mm²; max. length 1000 m

Plug-in Connecting Cable: Operating Unit RS422 <–> SIMATIC 500/505 RS422

6 XV1440 – 1M... (PLC 545 / CPU 1102, 555)

Connector 1: 9-pin Sub D male connector
Secured by screws
Cable outlet at Pin 1
RS422

Connector 2: 9-pin Sub D male connector
Secured by screws
Cable outlet at Pin 1
RS422



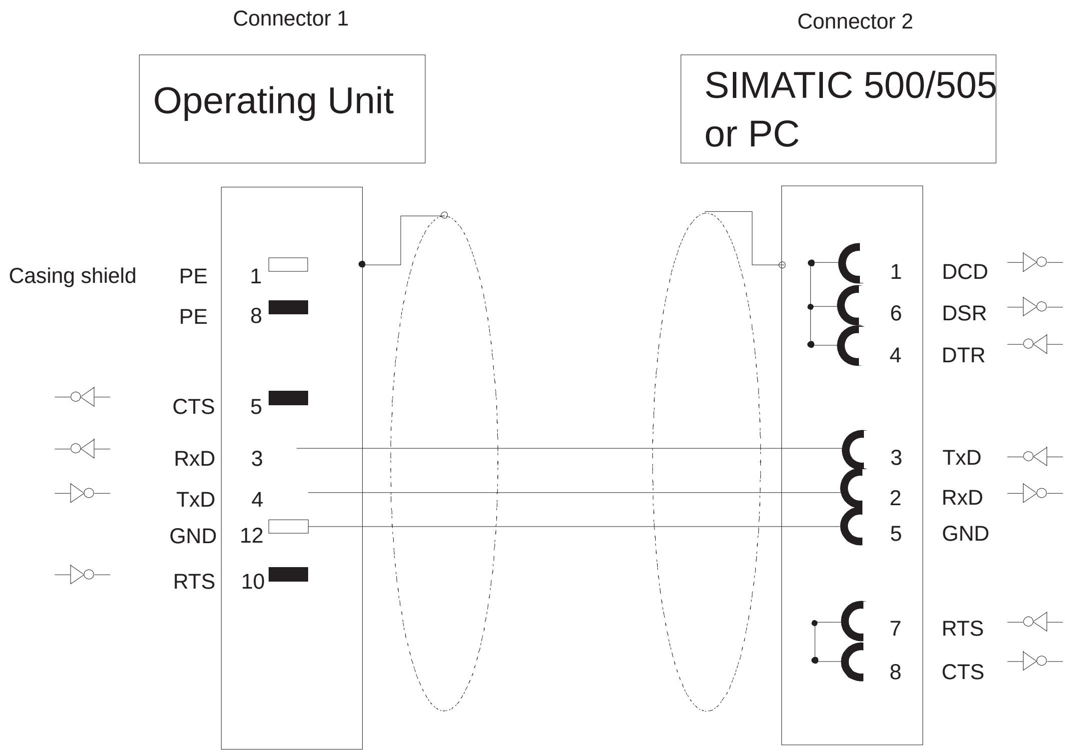
Shielding connected to casing with large contact area
Cable: 3 x 2 x 0.14 mm^2; shielded; max. length 300 m

Plug-in Connecting Cable:
Operating Unit <–> SIMATIC 500/505 or PC

6 XV1440 – 2K...

Connector 1: 15-pin Sub D male connector
Secured by slide
Cable outlet at Pin 1
Solid metal cover
V.24

Connector 2: 9-pin Sub D socket connector
Secured by screws
Cable outlet at Pin 1
V.24



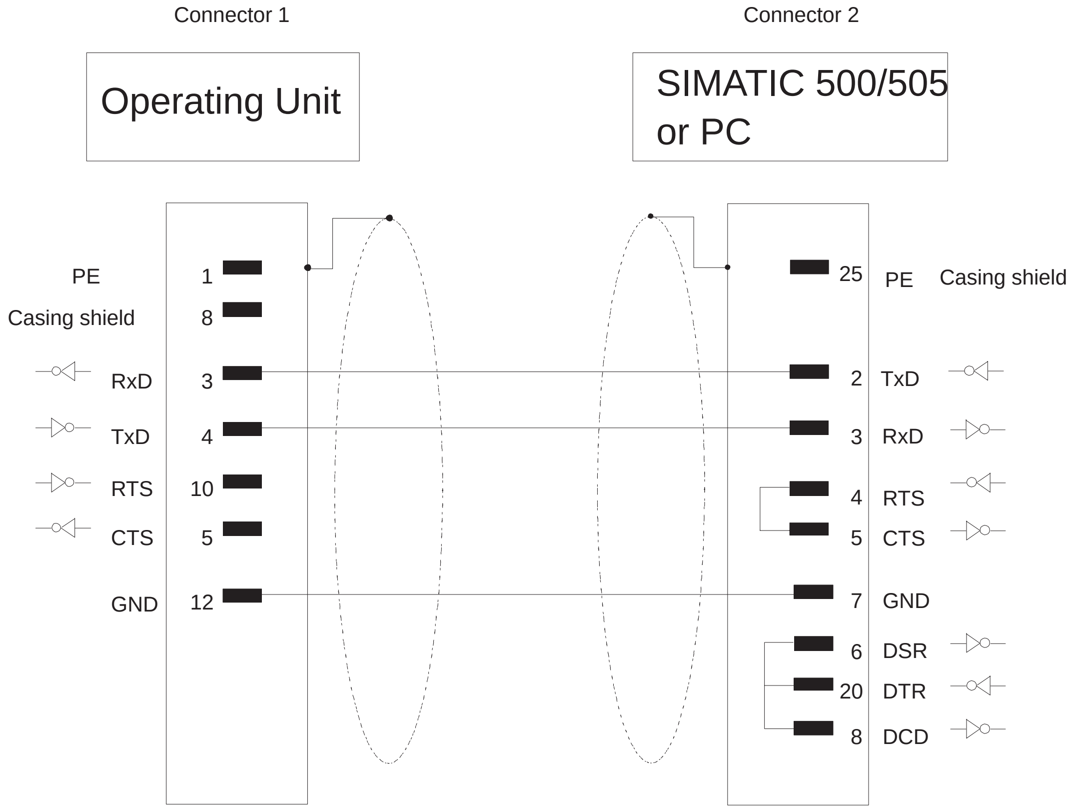
Shielding connected at both ends to casing with large contact area
Cable: 5 x 0.14 mm²; shielded; max. length 15 m

Plug-in Connecting Cable:
Operating Unit <–> SIMATIC 500/505 or PC

6 XV1440 – 2L...

Connector 1: 15-pin Sub D male connector
Secured by slide
Cable outlet at Pin 1
Solid metal cover
V.24

Connector 2: 25-pin Sub D male connector
Secured by screws
Cable outlet at Pin 1
V.24



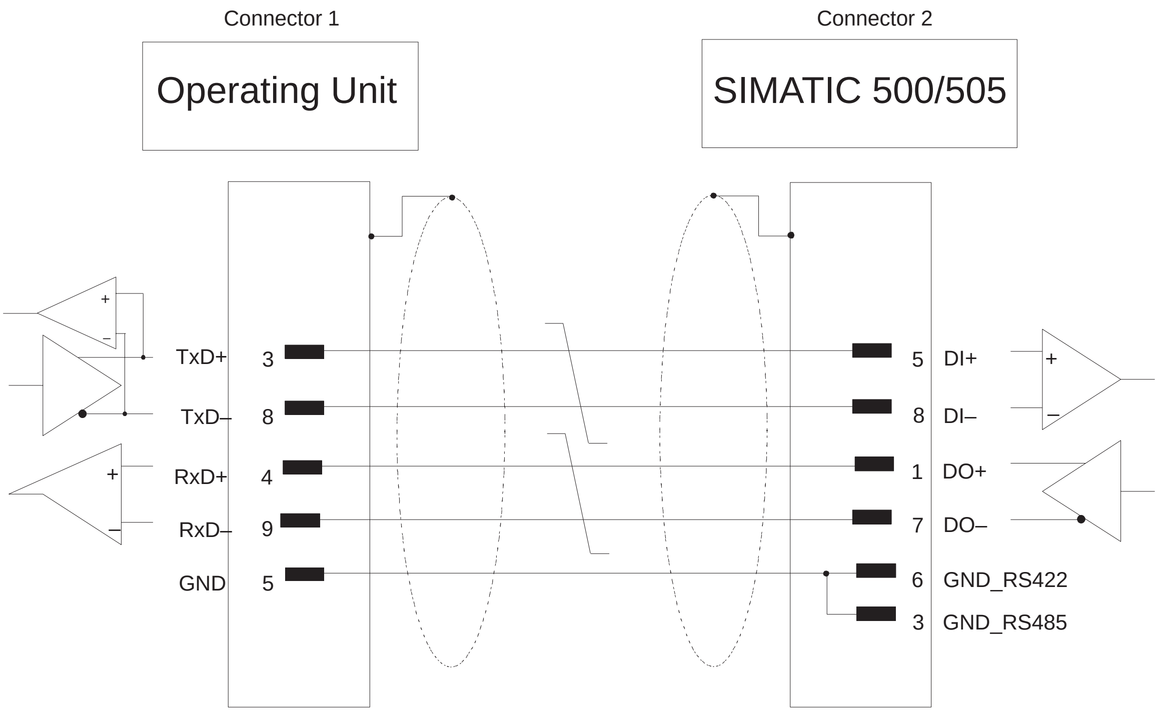
Shielding connected to casing with large contact area
Cable: 5 x 0.14 mm²; shielded; max. length 15 m

Plug-in Connecting Cable:
Operating Unit RS422 <–> SIMATIC 500/505 RS422

6 XV1440 – 2M... (PLC 525, 545 / CPU 1101, 565T)

Connector 1: 9-pin Sub D male connector
Secured by screws
Cable outlet at Pin 1
RS422

Connector 2: 9-pin Sub D male connector
Secured by screws
Cable outlet at Pin 1
RS422



Shielding connected to casing with large contact area
Cable: 3 x 2 x 0.14 mm^2; shielded; max. length 300 m

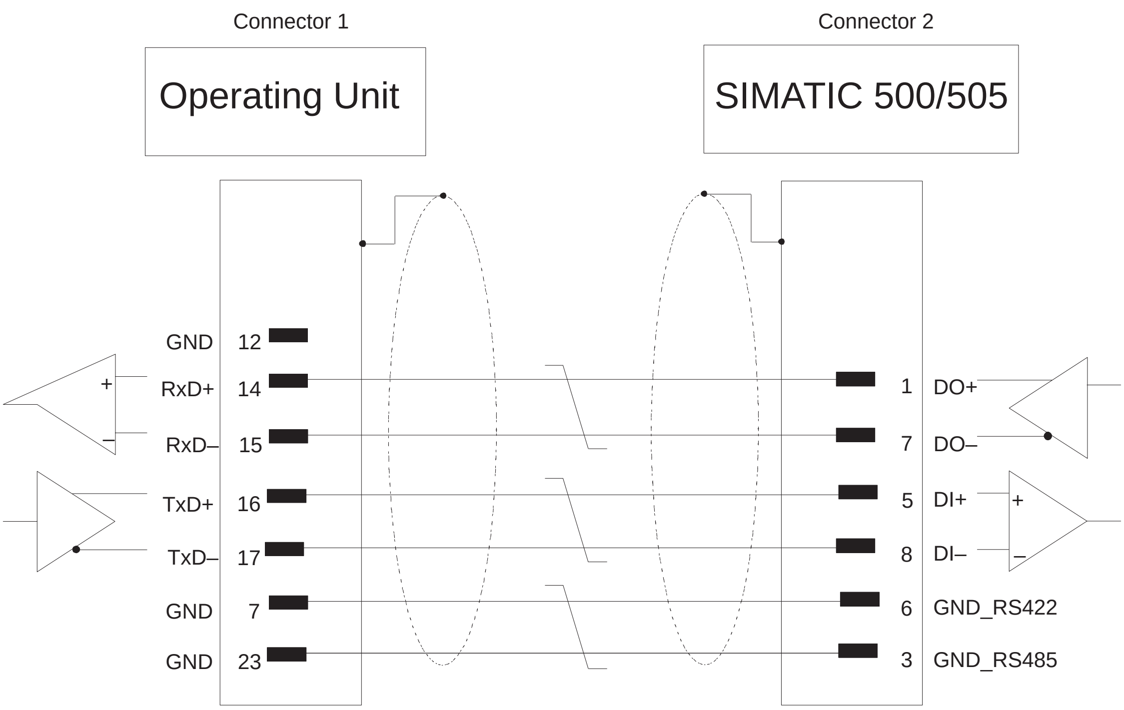
Plug-in Connecting Cable:
Operating Unit RS422 <–> SIMATIC 500/505 RS422

6 XV1440 – 2N...

For the following operating units only:
TD10, TD20, OP5, OP15, OP20, OP30

Connector 1: 25-pin Sub D male connector
Secured by screws
Cable outlet at Pin 1
Solid metal cover

Connector 2: 9-pin Sub D male connector
Secured by screws
Cable outlet at Pin 1



Shielding connected to casing with large contact area
Cable: 3 x 2 x 0.14 shielded; max. length 300 m

Plug-in Connecting Cable:
Adapter cable (TTY/V. 24)

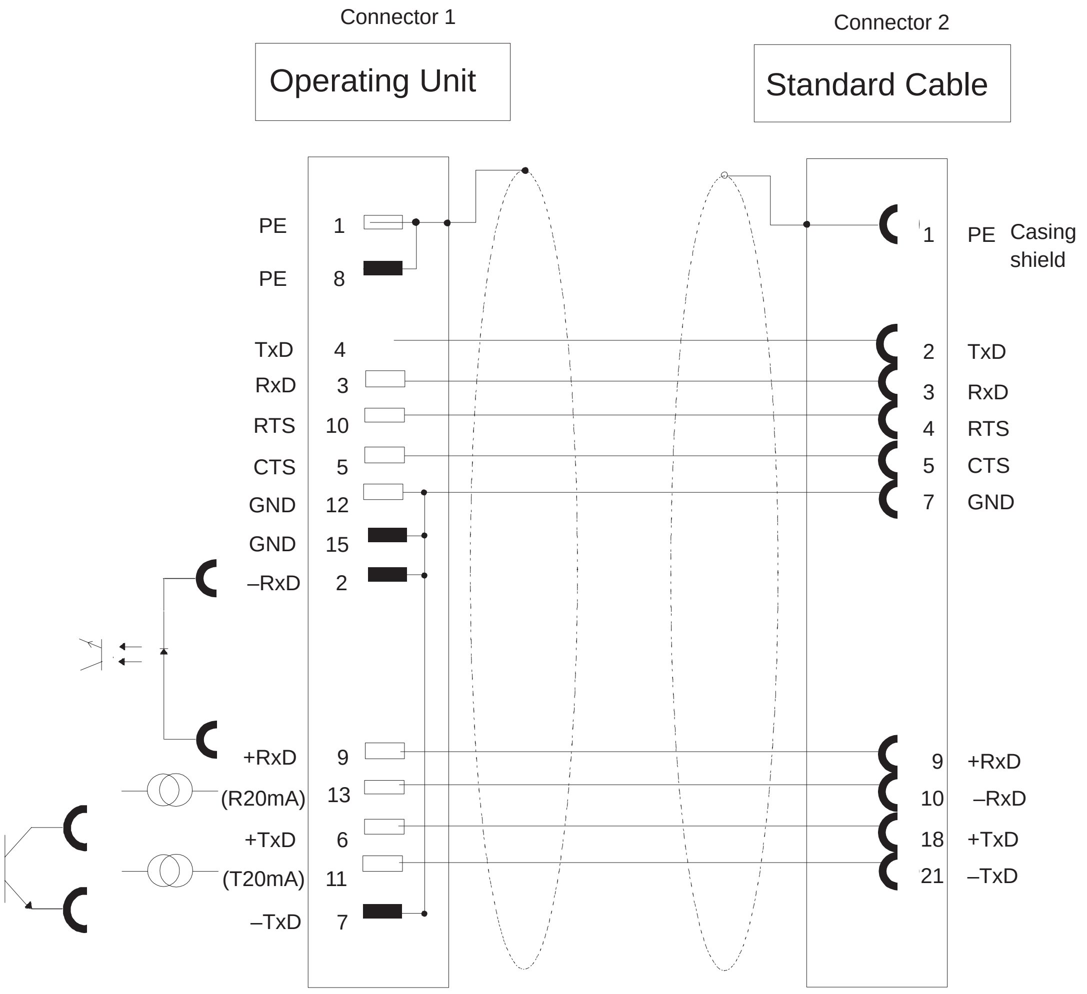
6 XV1440 – 2DE32

Adapter cable for connecting plug-in cable: 6ES5 735–2...
6XV1418–OC...

to integral interface on operating unit

Connector 1: 15-pin Sub D male connector
Secured by slide
V. 24, TTY, active

Connector 2: 25-pin Sub D socket connector
Bolt for screw fixing
V.24, TTY



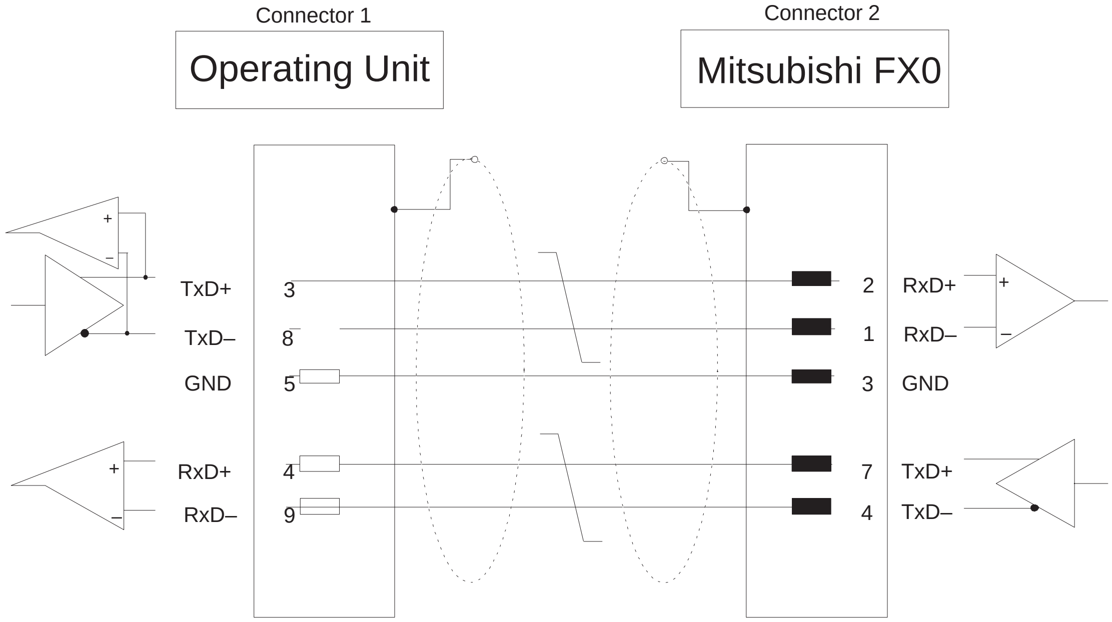
Cable: 9 x 0.14 mm²; shielded; max. length 0.3 m
Shielding connected at both ends to casing with large contact area

Plug-in Connecting Cable:
Operating Unit <–> Mitsubishi FX0

6 XV1440 – 2P

Connector 1: 9-pin Sub D male connector
Secured by screws
Cable feed-out to rear

Connector 2: 8-pin mini DIN socket
Secured by screws
Cable feed-out to rear



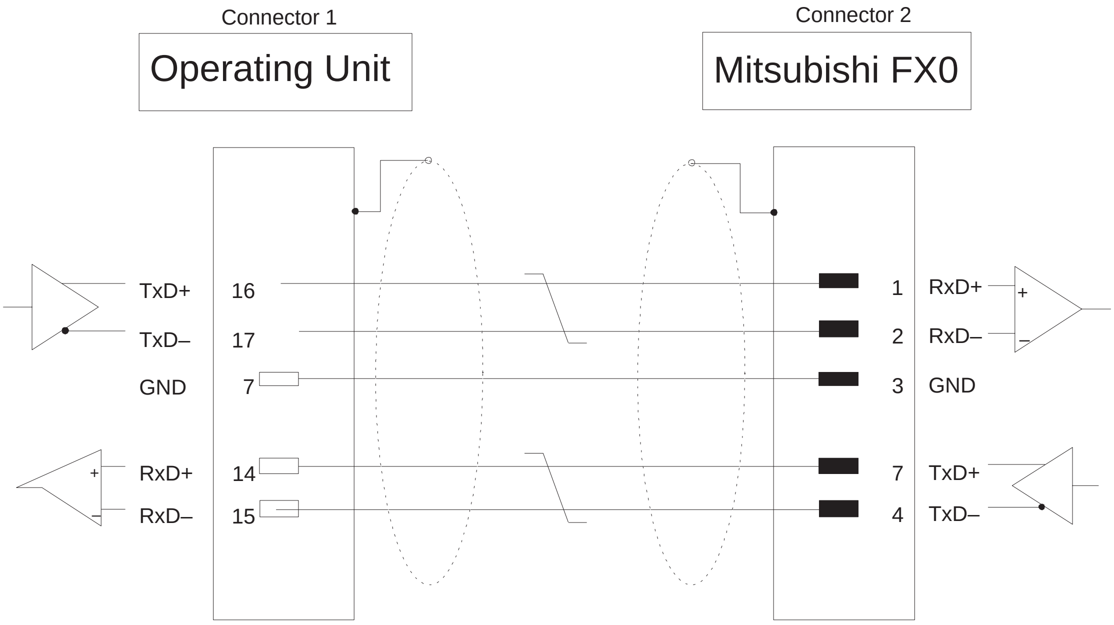
Cable: 3 x 2 x 0.14 mm²; shielded; max. length 500 m
Shielding connected at both ends to casing with large contact area

Plug-in Connecting Cable:
Operating Unit <–> Mitsubishi FX0

6 XV1440 – 2Q

Connector 1: 25-pin Sub D connector
Secured by screws
Cable feed-out to rear

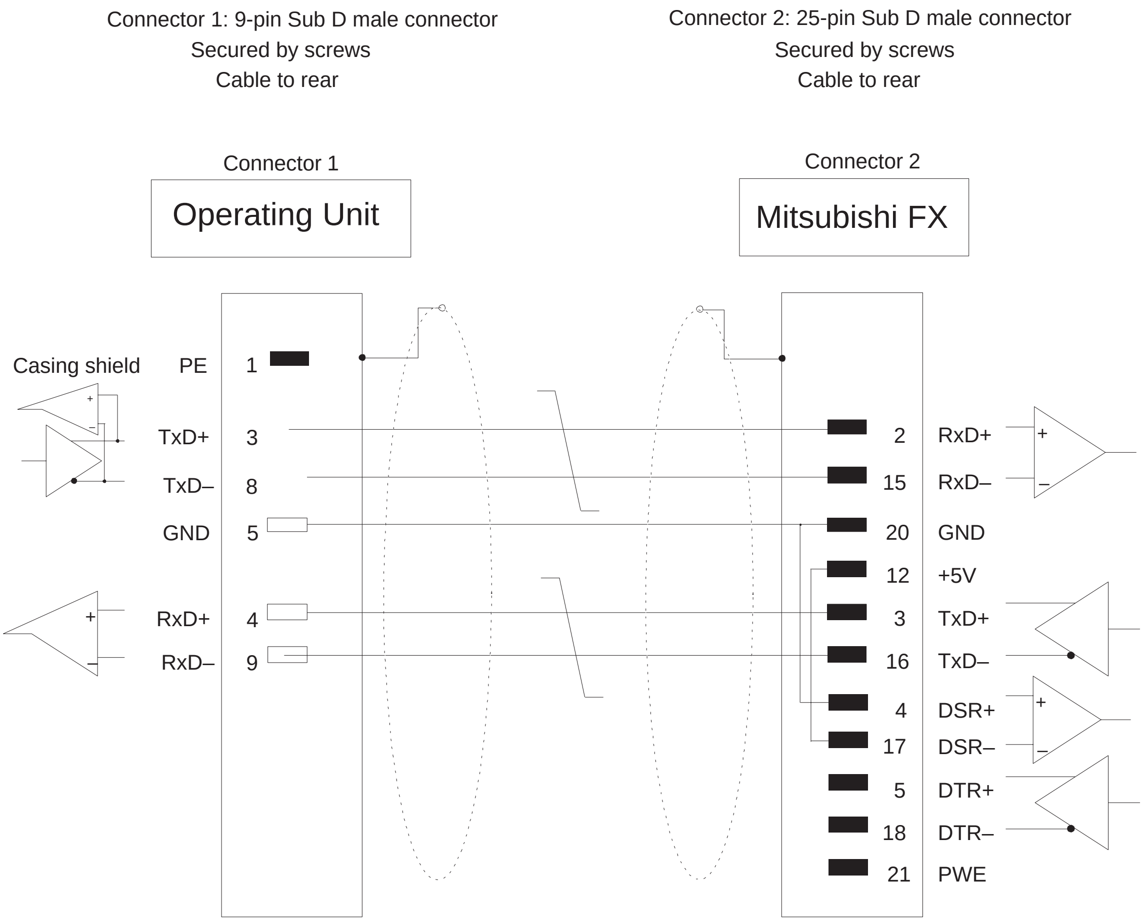
Connector 2: 8-pin mini DIN socket
Secured by screws
Cable feed-out to rear



Cable: 3 x 2 x 0.14 mm²; max. length 500 m
Shielding connected at both ends to casing with large contact area

Plug-in Connecting Cable: Operating Unit <–> Mitsubishi FX

6 XV1440 – 2R



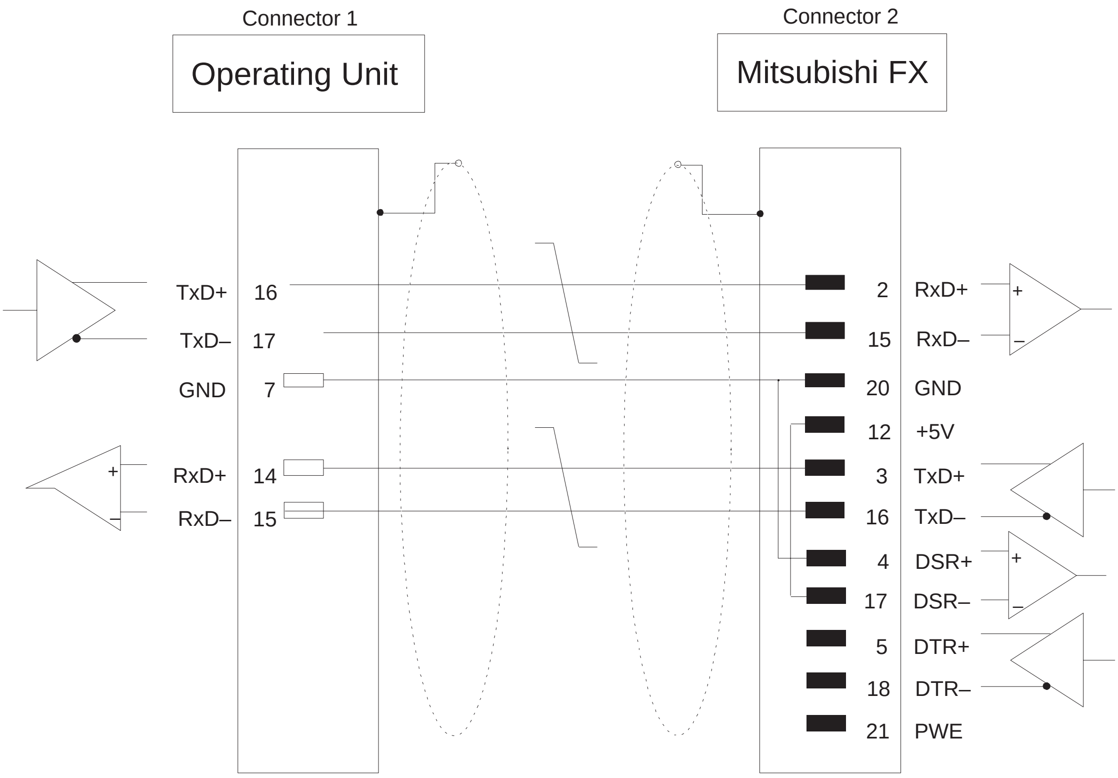
Cable: 3 x 2 x 0.14 mm²; max. length 500 m
Shielding connected at both ends to casing with large contact area

Plug-in Connecting Cable:
Operating Unit <–> Mitsubishi FX

6 XV1440 – 2S

Connector 1: 9-pin Sub D connector
Secured

Connector 2: 25-pin Sub D male connector
Secured by screws
Cable to rear



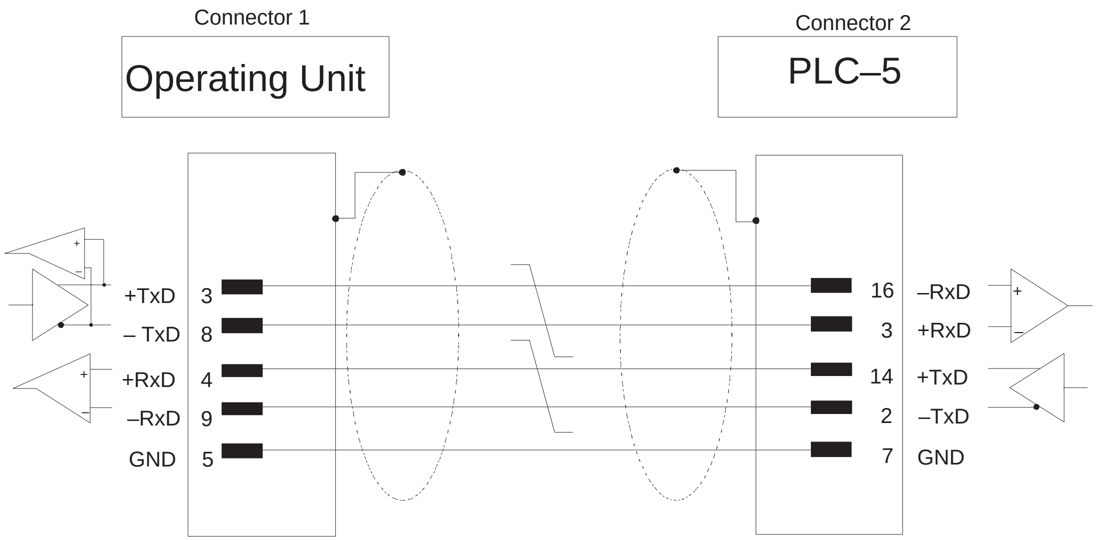
Cable: 3 x 2 x 0.14 mm²; max. length 500 m
Shielding connected at both ends to casing with large contact area

Plug-in Connecting Cable:
Operating Unit <–> Allen Bradley PLC–5/RS422

6 XV1440 – 2V...

Connector 1: 9-pin Sub D connector
Secured by screws
Cable feed-out to rear

Connector 2: 25-pin Sub D connector
Secured by screws
Cable feed-out to rear



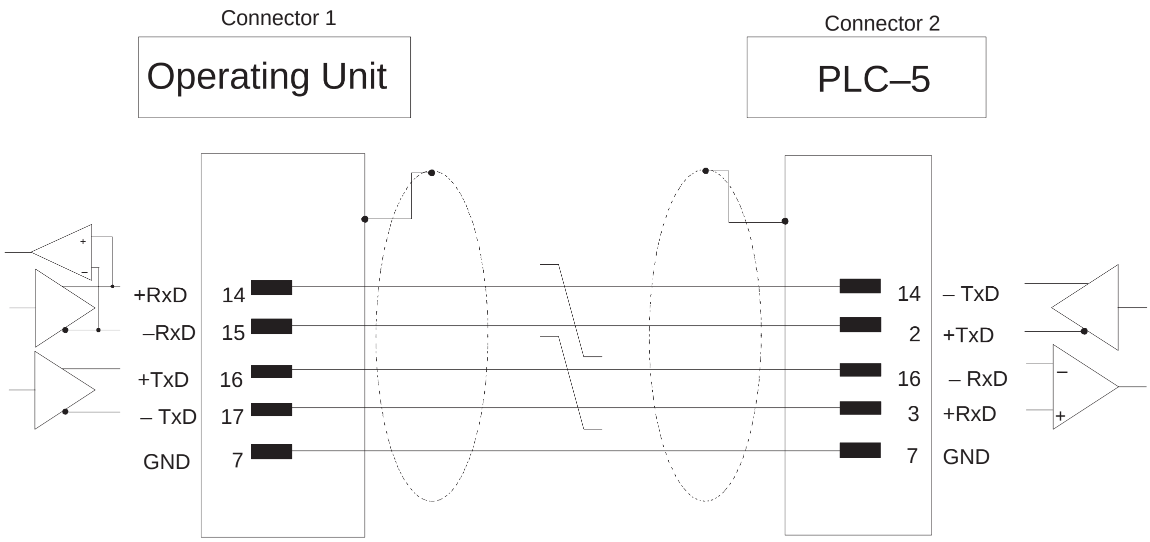
Cable 3 x 2 x 0.14 mm^2; shielding contacts joined; max. length 60 m
Shielding connected at both ends to casing with large contact area

Plug-in Connecting Cable: Operating Unit <–> Allen Bradley PLC–5/RS422

6 XV1440 – 2W...

Connector 1: 25-pin Sub D connector
Secured by screws
Cable feed-out to rear

Connector 2: 25-pin Sub D connector
Secured by screws
Cable feed-out to rear

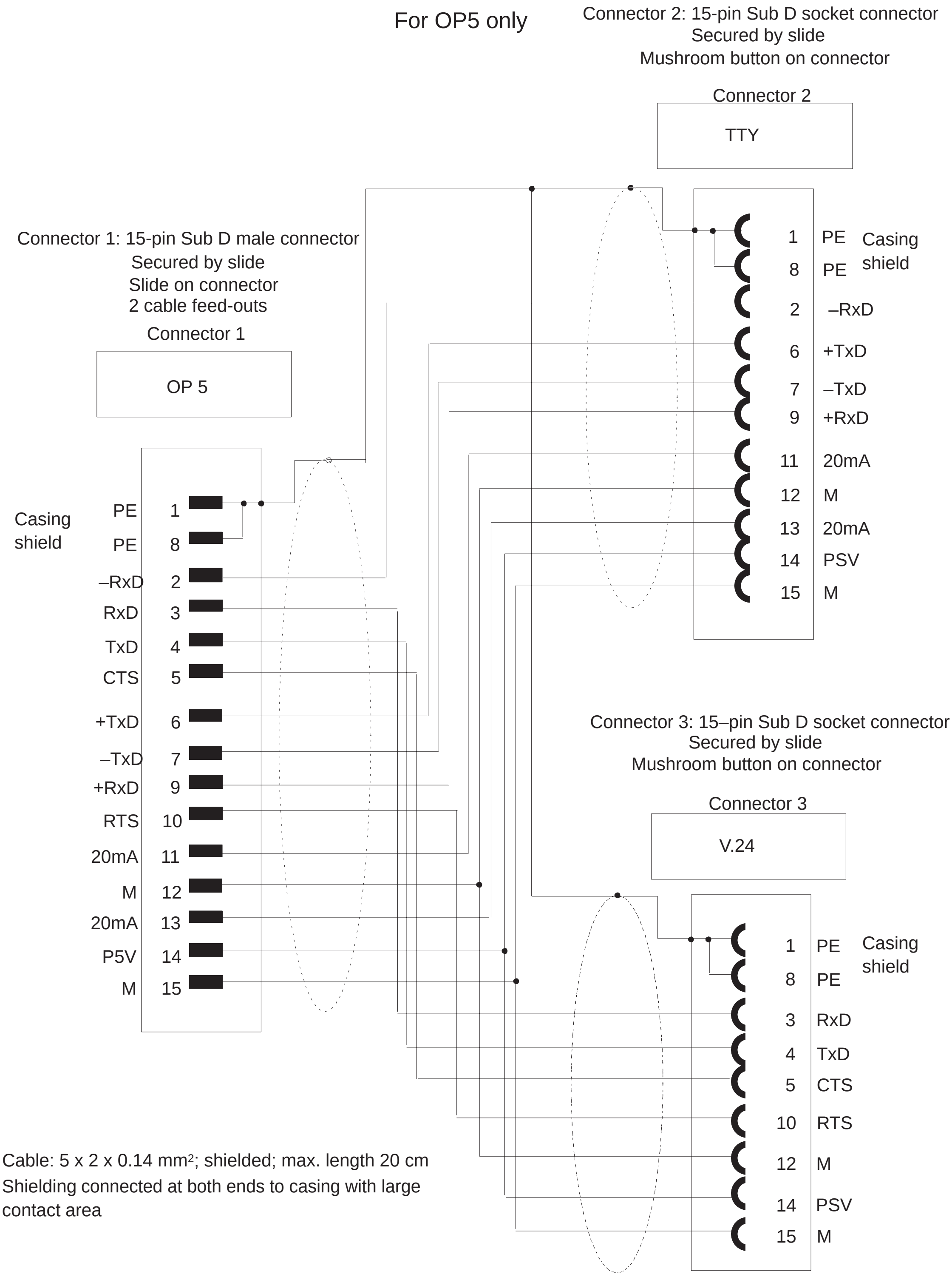


Cable 3 x 2 x 0.14 mm²; shielded; max. length 60 m
Shielding connected at both ends to casing with large contact area
Shielding contacts joined.

Plug-in Connecting Cable: Adapter cable (TTY/V. 24)

6 XV1440 – 2HE20

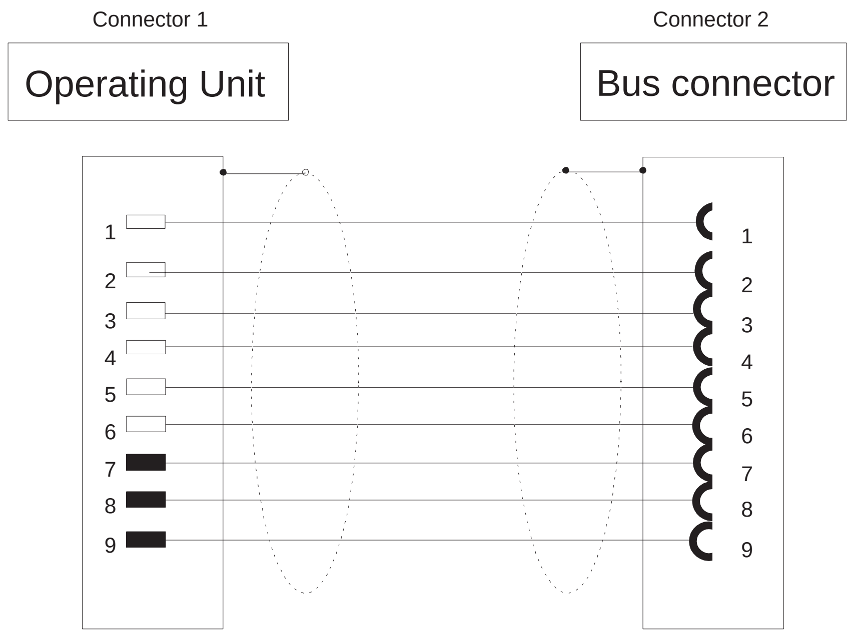
For OP5 only



Cable: 5 x 2 x 0.14 mm²; shielded; max. length 20 cm
Shielding connected at both ends to casing with large contact area

Adapter for PROFIBUS-DP extension

6 XV1440 – 2T...



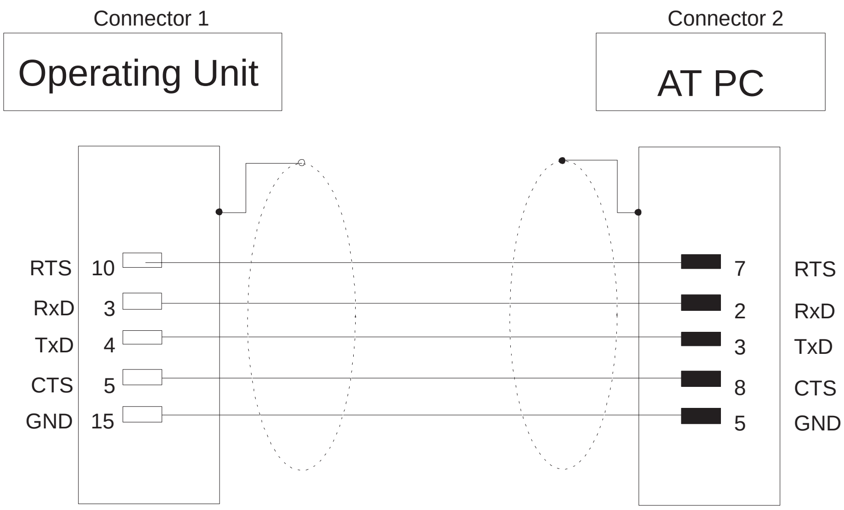
Cable: 9 x 0.14 mm2, shielded; length 5 cm
Shielding connected at both ends to casing with large contact area
Installation of multiple OP15s one under another (e.g. 3x6 = 18 units at intervals of 3 cm)
6XV1440–2TE10 can not be used.

Adapter for TD/OP to 9-pin (as PC)

6 XV1440 – 2UE 32

Connector 1: 15-pin Sub D male connector
Secured by slide
Cable outlet at Pin 1

Connector 2: 9-pin Sub D male connector
Bolt for screw fixing
Cable to rear



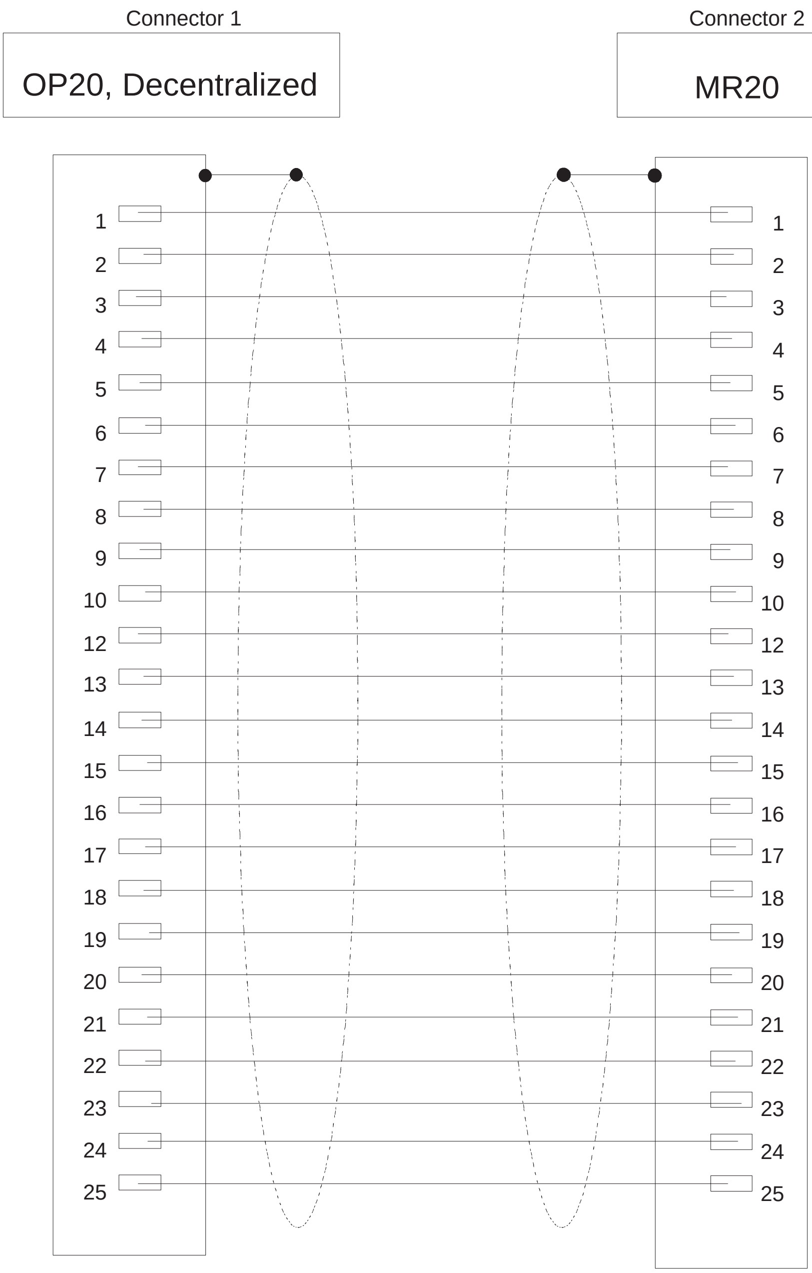
Cable: 5 x 0.14 mm^2; shielded; max. length 32 cm
Shielding connected at both ends to casing with large contact area

Plug-in Connecting Cable: OP20 <–> MR20

6 XV1440 – 2E...

Connector 1: 25-pin Sub D male connector
Secured by screws

Connector 2: 25-pin Sub D male connector
Secured by screws



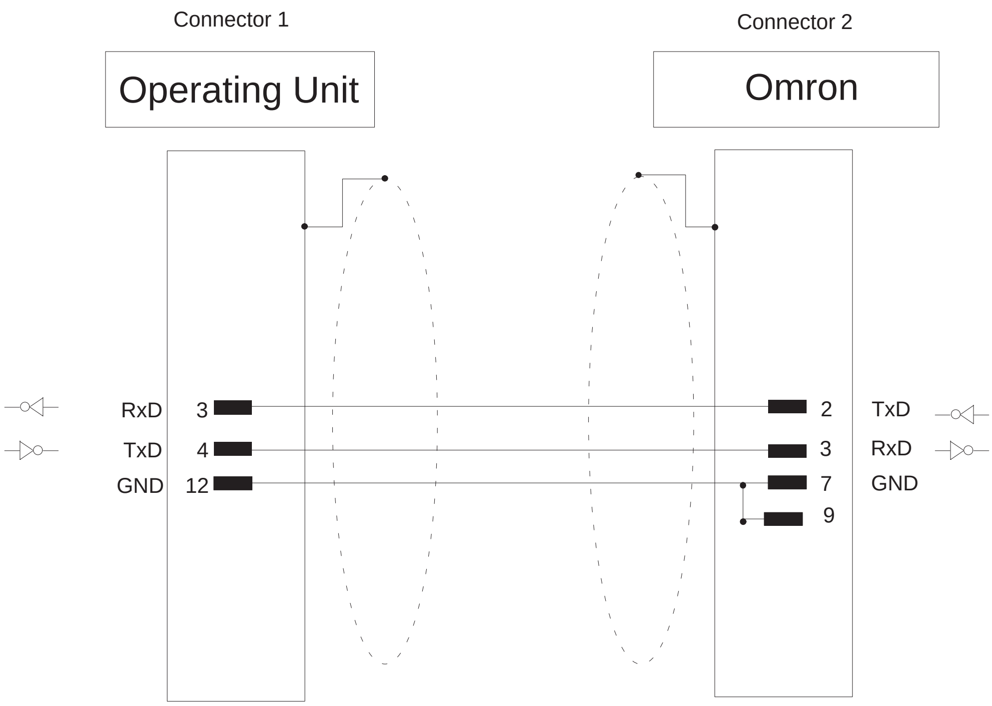
Cable 26 x 0.18 mm²; shielded; max. length 3.2 m
Shielding connected at both ends to casing with large contact area

Plug-in Connecting Cable: Operating Unit <–> Omron

6 XV1440 – 2X...

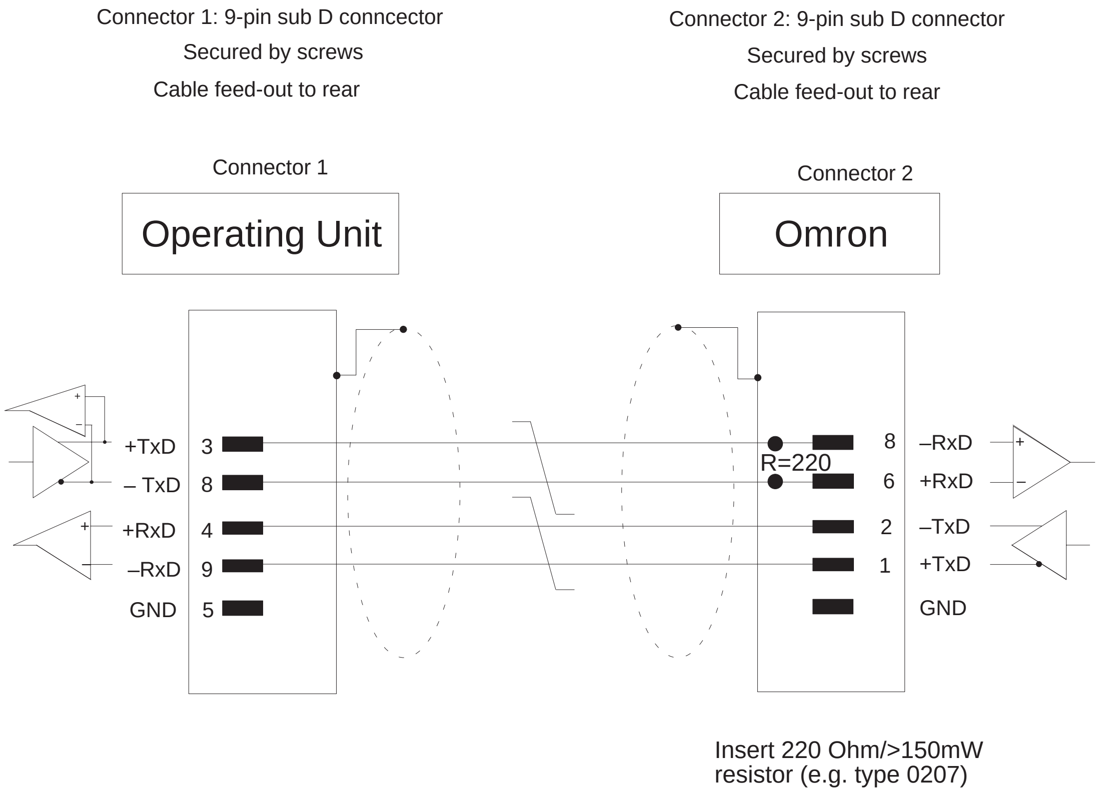
Connector 1: 15-pin sub D mail connector
Secured by slide
Cable outlet at Pin 1
Solid metal cover
V.24

Connecotr 2: 9-pin sub D male connector
Secured by screws
Cable outlet at Pin 1
Solid metal cover
V.24



Shielding connected to casing with large contact area
Cable: 5 x 0,14mm^2; shielded; max. length 15m

Plug-in Connecting Cable: Operating Unit <–> Omron



Cable: 3 x 2 x 0,14mm²; shielding contacts joined; max. length 500 m

SIMATIC HMI Documentation

F

Target groups

This manual is part of the SIMATIC HMI documentation. The documentation is aimed at the following target groups:

- Newcomers
- Users
- Configurers
- Programmers
- Commissioning engineers

How the documentation is organized

The SIMATIC HMI documentation consists of the following components:

- User's Guides / User's Manuals for:
  - Configuration software
  - Runtime software
  - Communication between PLCs and operating units
- Equipment Manuals for the following operating units:
  - MP (Multi Panel)
  - OP (Operator Panel)
  - TP (Touch Panel)
  - TD (Text Display)
  - PP (Push Button Panel)
- Online Help on the configuration software
- Start–up Guides
- First Steps

Overview of complete documentation

The following table provides an overview of the SIMATIC HMI documentation and shows you when you require the different documents.

Documentation	Target Group	Content
First Steps with ProTool Product Brief	Newcomers	This documentation guides you step by step through the configuration of • a screen with various objects • changing from one screen to another • a message. This documentation is available for: • OP3, OP5, OP7, OP15, OP17 • OP25, OP27, OP35, OP37, TP27, TP37 • Windows-based systems
ProTool Configuring Windows-based Systems User's Guide	Configurers	Provides information on working with the ProTool/Pro configuration software. It contains • information on installation • basic principles of configuration • a detailed description of configurable objects and functions. This documentation is valid for Windows-based systems.
ProTool Configuring Graphics Displays User's Guide	Configurers	Provides information on working with the ProTool configuration software. It contains • information on installation • basic principles of configuration • a detailed description of configurable objects and functions. This documentation is valid for graphic display operating units.
ProTool Configuring Text-based Displays User's Guide	Configurers	Provides information on working with the ProTool/Lite configuration software. It contains • information on installation • basic principles of configuration • a detailed description of configurable objects and functions. This documentation is valid for text-based display operating units.
ProTool Online Help	Configurers	Provides information on the configuration computer while working with ProTool. Online Help contains • context-sensitive help • detailed instructions and examples • detailed information • all the information from the user guide.
ProTool/Pro Runtime User's Guide	Commissioning engineers, Users	Provides information on working with ProTool/Pro Runtime software. It contains • installation of the ProTool/Pro Runtime visualization software • commissioning and running the software on Windows-based systems.
Copy Protection Start–up Guide	Commissioning engineers, Users	The ProTool/Pro Runtime visualization software is a copyright product. This manual contains information on the installation, repair and uninstallation of authorizations.

Documentation	Target Group	Content
Application Example Start–up Guide	Newcomers	ProTool is supplied with example configurations and the corresponding PLC programs. This documentation describes how you • load the examplesonto the operating unit and PLC • run the examples and • upgrade the connection to the PLC to suit your own specific application.
MP270 Equipment Manual	Commissioning engineers, Users	Describes the hardware and the general operation of Multi Panel MP270. It contains • installation and commissioning instructions • a description of the equipment • operating instructions • instructions for connecting the PLC, printer and programming computer, • maintenance instructions.
OP37/Pro Equipment Manual	Commissioning engineers, Users	Describes the hardware, installation and inclusion of upgrades and options for the OP37/Pro.
TP27, TP37 Equipment Manual OP27, OP37 Equipment Manual OP25, OP35, OP45 Equipment Manual OP7, OP17 Equipment Manual OP5, OP15 Equipment Manual TD17 Equipment Manual	Commissioning engineers, Users	Describes the hardware and general operation. It contains • installation and commissioning instructions • operating unit description • connecting the PLC, printer and programming computer • operating modes • operation • description of the standard screens supplied with the operating unit and how to use them • fitting options • maintenance and fitting of spare parts.
OP3 Equipment Manual	Commissioning engineers, Users, Programmers	Describes the hardware of the OP3, its general operation and the connection to the SIMATIC S7.
PP7, PP17 Equipment Manual	Commissioning engineers, Users	Describes the hardware, installation and commissioning of push-button panels PP7 and PP17.
Communication User’s Manual	Programmers	Provides information on connecting text-based and graphics displays to the following PLCs: • SIMATIC S5 • SIMATIC S7 • SIMATIC 500/505 • drivers for other PLCs This documentation describes the • configuration and parameters required for connecting the devices to the PLC and the network • user data areas used for exchanging data between operationg unit and PLC.

Documentation	Target Group	Content
Communication for Windows-based Systems User's Manual	Programmers	Provides information on connecting Windows-based systems to the following PLCs: • SIMATIC S5 • SIMATIC S7 • SIMATIC 505 • Allen Bradley PLC 5/SLC 500 This documentation describes the • configuration and parameters required for connecting devices to the PLC and the network • user data areas used for exchanging data between operating unit and PLC.
Other PLCs Online Help	Programmers	Provides information on connecting devices to PLCs, such as: • Mitsubishi • Allen Bradley • Telemecanique • Modicon • Omron • SIMATIC WinAC When the drives are installed, the relevant Online Help is installed at the same time.
ProAgent for OP User's Manual	Configurers	Provides the following information about the ProAgent optional package (process diagnosis) for OPs • configuring system-specific process diagnosis • detecting, locating the cause of and eliminating process errors, • customizing standard diagnostic screens supplied with the software.

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