

SIPROTEC

Protection devices

7SA522, 7SA6

7SD5, 7SD610

7SJ61...7SJ64

7ST622, 7ST61, 7ST63

7UM61, 7UM62

7UT612, 7UT613, 7UT63

7VE61, 7VE63

7VK61

Input/Output unit

6MD63

Bay control unit

6MD663/6MD664

Communication module

PROFIBUS-DP

Communication profile

Revision 4.2

Edition: April 2005

C53000-L1840-B001-03

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Liability statement

We have checked the contents of this manual against the hardware and software described. Exclusions and deviations cannot be ruled out; we accept no liability for lack of total agreement.

The information in this manual is checked periodically, and necessary corrections will be included in future editions.

We appreciate any suggested improvements.

We reserve the right to make technical improvements without notice.

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Preface

Purpose of this manual

The manual describes the functions, bus specific parameters, DIGSI parameterization and the hardware interface of the PROFIBUS-DP slave of the SIPROTEC devices and is divided into the following topics:

- PROFIBUS Communication modules → Chapter 1;
- Parameters and properties → Chapter 2;
- Data type definitions → Chapter 3;
- PROFIBUS-DP - Parameterization in DIGSI → Chapter 4;
- Technical data → Chapter 5.

SIPROTEC4 System Manual

General details about the function, operation, assembly and commissioning of the SIPROTEC devices you find in the

- SIPROTEC4 System Manual, order no. E50417–H1176–C151.

Bus mapping documentation

The following additional manuals inform you about the data in the PROFIBUS-DP messages of the SIPROTEC devices:

Manual	Order number
PROFIBUS-DP - Bus mapping 7UM61	C53000-L1840-B005-03
PROFIBUS-DP - Bus mapping 7SJ61...7SJ64, 6MD63	C53000-L1840-B006-03
PROFIBUS-DP - Bus mapping 7SA522, 7SA6	C53000-L1840-B007-03
PROFIBUS-DP - Bus mapping 7UM62	C53000-L1840-B009-03
PROFIBUS-DP - Bus mapping 7UT612	C53000-L1840-B010-03
PROFIBUS-DP - Bus mapping 6MD663/6MD664	C53000-L1840-B011-03
PROFIBUS-DP - Bus mapping 7VK61	C53000-L1840-B013-03
PROFIBUS-DP - Bus mapping 7SD5, 7SD610	C53000-L1840-B014-03
PROFIBUS-DP - Bus mapping 7UT613, 7UT63	C53000-L1840-B015-03
PROFIBUS-DP - Bus mapping 7ST61, 7ST63	C53000-L1840-B016-03
PROFIBUS-DP - Bus mapping 7VE61, 7VE63	C53000-L1840-B017-03

You can download these manuals

from Internet <http://www.siprotec.com>

or please contact your Siemens representative.

PROFIBUS-DP specification

The PROFIBUS-DP specification and the structure of the PROFIBUS-DP messages are defined in the European Standard EN 50170:

- PROFIBUS Specification
Normative Parts of PROFIBUS-FMS, -DP, -PA
According to the European Standard
EN 50170, Volume 2
PROFIBUS Nutzerorganisation e.V.

Validity

This manual is valid for the SIPROTEC devices:

- 6MD63 (firmware version 4.40 or higher),
- 6MD663/6MD664 (firmware version 4.20 or higher),
- 7SA522, 7SA6 (firmware version 4.20 or higher),
- 7SD5, 7SD610 (firmware version 4.20 or higher),
- 7SJ61...7SJ64 (firmware version 4.40 or higher),
- 7ST61, 7ST63 (firmware version 4.00 or higher),
- 7ST622 (firmware version 4.00 or higher),
- 7UM61 (firmware version 4.10 or higher),
- 7UM62 (firmware version 4.00 or higher),
- 7UT612 (firmware version 4.00 or higher),
- 7UT613, 7UT63 (firmware version 4.00 or higher),
- 7VE61, 7VE63 (firmware version 4.00 or higher),
- 7VK61 (firmware version 4.00 or higher),

with PROFIBUS communication module up to HW revision 3 and

- PROFIBUS-DP firmware version 02.00.05,
- PROFIBUS-DP firmware version 03.00.03 or higher at use of
 - Transformer tap change commands/Transformer tap position indications (ref. to chap 3.7 and 3.8),
 - Event list via PROFIBUS-DP (Sequence of events, ref. to chap. 2.5),
- PROFIBUS-DP firmware version 03.01.03 or higher at use of
 - Time synchronization via PROFIBUS-DP with time intervals between time synchronization messages of less than 1 minute (ref. to chap. 4.4),
- PROFIBUS-DP firmware version 03.04.01 or higher at use of
 - PROFIBUS time synchronization messages with local time correction value (ref. to chap. 4.4.2),

with PROFIBUS communication module from HW revision 4 and

- PROFIBUS-DP firmware version 04.00.06 or higher at use of
 - Display of module specific information (ref. to chap. 1.2),
 - OLM V3 mode of the PROFIBUS-DP module (ref. to chap. 2.1.2),
- PROFIBUS-DP firmware version 04.01.01 or higher at use of
 - PROFIBUS time synchronization messages with local time correction value (ref. to chap. 4.4.2).

For device parameterization have to be used:

- DIGSI 4.21 considering the preconditions explained in chapter 4.1.3,
- DIGSI 4.30 or higher,
- DIGSI 4.40 or higher at use of
 - Transformer tap change commands/Transformer tap position indications (ref. to chap 3.7 and 3.8),
- PROFIBUS-DP standard mappings 3-1 to 3-n (n = device type dependent number of standard mappings).

Additional Support	For questions regarding SIPROTEC4 devices, please contact your Siemens representative.
Training courses	Individual course offerings may be found in our Training Catalog and questions can be directed to our Training Centre. Please contact your Siemens representative.
Target audience	Protection engineers, commissioning engineers, personnel concerned with adjustment, checking and service of selective protective equipment, automatic and control facilities and personnel of electrical facilities and power plants.



Warning!

Hazardous voltages are present in this electrical equipment during operation. Non-observance of the safety rules can result in severe personal injury or property damage.

Only qualified personnel shall work on and around this equipment after becoming thoroughly familiar with all warnings and safety notices of this and the associated manuals as well as with the applicable safety regulations.

The successful and safe operation of this device is dependent on proper transport and storage, proper handling, installation, operation, and maintenance by qualified personnel under observance of all warnings and hints contained in this and the associated manuals.

In particular the general erection and safety regulations (e.g. IEC, EN, DIN, VDE, or other national and international standards) regarding the correct use of high-voltage installations must be observed. Non-observance can result in death, personal injury or substantial property damage.

QUALIFIED PERSONNEL

For the purpose of this manual and product labels, a qualified person is one who is familiar with the installation, construction and operation of the equipment and the hazards involved. In addition, he has the following qualifications:

- Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- Is trained in the proper care and use of protective equipment in accordance with established safety practices.
- Is trained in rendering first aid.

Typographic and graphical conventions

The following text formats are used to identify concepts giving device information described by the text flow:

Parameter names, or identifiers for configuration or function parameters that appear in the device display or on the screen of a PC (with DIGSI) are shown in mono-script (same point size) bold text. This also applies to header bars for selection menus.

Parameter conditions, or possible settings of parameters that appear in the device display or on the screen of a PC (with DIGSI), are additionally shown in italic style. This also applies to selection items for selection menus.

„Annunciations“, or identifiers for information produced by the device or required by other devices or from the switchgear is shown in mono-script (same point size) and placed into quotation marks.

For diagrams in which the identifier type results from the representation itself, text conventions may differ from the above-mentioned.

Revision index

Listing of the changes between the editions of this manual:

Modified chapters / pages	Edition	Reasons of modification
	1.0	First edition, Doc.-No.: C53000-L1840-B001-03 Sept. 17 th , 2001
general Chap. 3.1.4 Chap. 3.3.3	2.0	<ul style="list-style-type: none"> Manual is also valid for 6MD63 an 7SJ61...7SJ64 devices New chapter "Interface selection and mapping selection in DIGSI 4.3 or higher" Description of Scaling indices 7 to 9 added Jan. 14 th , 2002
Chap. 2.7 - 2.9 Chap 1.1.3 Chap. 1.3.1 Chap. 1.2.2 Chap. 1.5 Chap. 3.2 Chap. 4.2 general Chap. 3.4.1	3.0	<ul style="list-style-type: none"> new data type definitions for "Transformer tap change command", "Transformer tap position indication" and "Message block for event list" new chapter "Event list settings" Note for setting of tagging "SysIntErr" added new chapter "Transformer tap change commands" new chapter "Event list via PROFIBUS-DP" Type TxTap can be routed to "Destination system interface" max. line length for redundant optical rings an baud rates ≥ 500 kB/s corrected Note to parameters "Retry limit" and "Slot time" added Manual is also valid for 7UM61 devices with firmware from V4.1 Time interval for time synchronization of SIPROTEC devices via PROFIBUS-DP has to be 1 minute Sept. 18 th , 2002
general Chap. 1.1.2 Chap. 3.4.1 Chap. 4.2	3.1	<ul style="list-style-type: none"> Manual is also valid for 7SD5, 7SD610 devices with firmware from V4.2, 7UT613, 7UT63 devices with firmware from V4.0 and 7VK61 devices with firmware from V4.0 Notes for fibre-optical settings, Network size: S3 at the OLM/G12 has to be set inversely to the value DP_OLM_NetworkSize Time intervals of less than 1 minute for time synchronization of SIPROTEC devices are available with PROFIBUS-DP communication module firmware from V03.01.03 Value for "Optical receiver sensitivity" added Feb. 28 th , 2003

Modified chapters / pages	Edition	Reasons of modification
general Chap. 1 Chap. 2.1.1 Chap. 2.1.2 Chap. 2.3.2 Chap. 4.4 Chap. 4.5 Chap. 5.2	4.0	<ul style="list-style-type: none"> • Manual is also valid for 7ST61, 7ST63 devices with firmware from V4.0 and 7VE61, 7VE63 devices with firmware from V4.0 • Chap. "PROFIBUS communication modules" added (new HW revision 4), <i>the following chapter numbers moved up</i> • Assignment of PNO identification numbers for modules form HW rev. 4; note to bus silent time after baud rate change added • Setting of OLM V3 compatible modes for fibre-optical modules from HW revision 4 • Example for routing of the OLM status indications in DIGSI added • Precondition for time synchronization: only one master station may send time messages in the PROFIBUS net • new Chap. "Using SFC14 and SFC15 in STEP7" • notes completed with OLM V3 mode and HW revisions and example for correct parameterization with "Number of OLM" in the DP master added Feb. 5th, 2004
general Chap. 1.2.1 Chap. 3.3 Chap. 4.4.2	4.1	<ul style="list-style-type: none"> • Page numbering in the manual now continuous, not chapter-related any more • Explanation of the display of the correction values from time synchronization messages added • Meaning of values 0 and 3 for DP, depending on the type, added • New value '2' for GlobalSection.DP_TimeSyncEnable Dec. 8th, 2004
Chap. 4.4.2	4.2	<ul style="list-style-type: none"> • New value '3' for GlobalSection.DP_TimeSyncEnable Apr. 14th, 2005

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PROFIBUS Communication modules

1

This chapter shows the hardware and software necessary for PROFIBUS-DP communication with SIPROTEC devices and describes the display of module-specific information at the device.

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1.1 Communication module types and hardware revisions

1.1.1 Communication module types

Two communication modules are available for the connection of PROFIBUS-DP to the SIPROTEC devices:

RS485 bus interface

PROFIBUS module with isolated RS485 interface.

This module also is called PSE module (Communication module **PROFIBUS slave electrical**) subsequently.

Fibre-optical bus interface

PROFIBUS module with fibre-optical interface.

An OLM (**O**ptical link **m**odule) for electrical to optical conversion of PROFIBUS signals is integrated on this communication module and two optical channels (each with Send and Receive) are utilizable.

It is possible to build up PROFIBUS nets in a redundant optical ring topology with that.

This module also is called PSO module (Communication module **PROFIBUS slave fibre-optical**) subsequently.

Technical data

The technical data of the above-mentioned PROFIBUS communication modules are summarized in chap. 5.

1.1.2 Hardware revisions

There exist two different hardware revisions for PROFIBUS communication modules:

- up to HW revision 3:
delivery up to the beginning of year 2004
- from HW revision 4:
replacement for modules up to HW revision 3, delivery from beginning of 2004

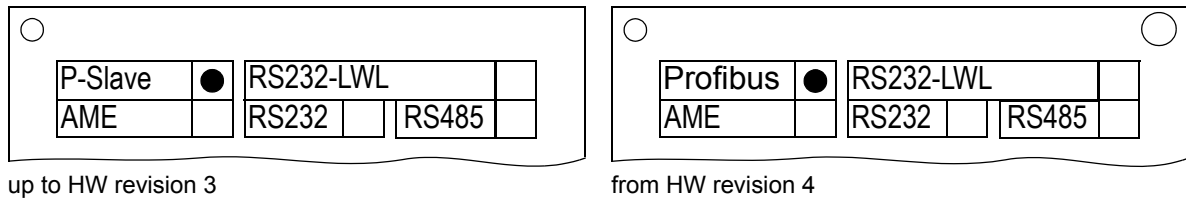
The communication modules from HW revision 4 are function compatible to the modules up to HW revision 3.

Please note the dependency of the PROFIBUS-DP firmware versions with the HW revisions described in chap. 1.1.3.

The hardware revision of the PROFIBUS communication modules is also recognizable in build-in condition at the rear of the SIPROTEC device at the labelling of the communication module mounting bracket:

- up to HW revision 3: identification "P-Slave"
- from HW revision 4: identification "Profibus"

PROFIBUS RS485 (PSE module)



PROFIBUS fibre-optical, double loop (PSO module)

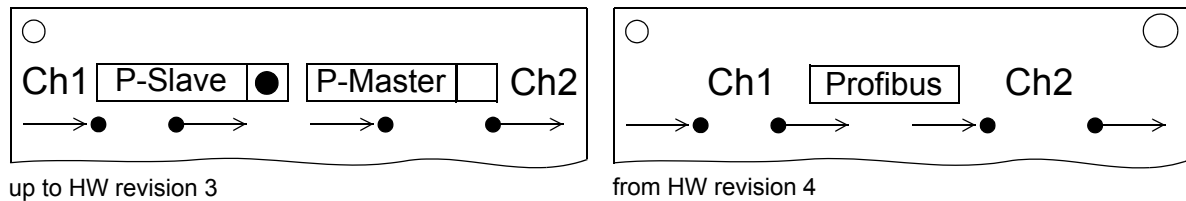


Figure 1-1 HW revisions of the communication modules, labelling of the mounting brackets

General details about the assembly of communication modules as well as the setting of the terminating resistors on the PSE modules you find in the SIPROTEC4 System Manual (ref. to page 3).

1.1.3 Compatibility of the communication module hardware with PROFIBUS-DP firmware versions and mapping files

Hardware and firmware

Please note the following listed compatibility between the hardware revisions of the communication modules and the PROFIBUS-DP firmware versions:

Hardware revision	Firmware version to be used
up to HW revision 3	up to PROFIBUS-DP firmware V03
from HW revision 4	from PROFIBUS-DP firmware V04

Table 1-1 Hardware revisions and firmware versions

The PROFIBUS-DP firmware for communication modules from HW revision 4 is:

- function compatible with firmware versions for modules up to HW revision 3 (i.e. contains all there contained functionalities),
- offers additional functionalities, e.g.:
 - display of module-specific information at the device (ref. to chap. 1.2),
 - OLM V3 compatibility mode with fibre-optical modules (ref to chap. 2.1.2).



Note:

If, during loading of the PROFIBUS-DP firmware on the communication module, a non-compatible hardware revision is recognized, then the firmware update is cancelled.

Please, in case of an abort of loading the PROFIBUS-DP communication firmware, check first the dependencies indicated in Table 1-1.

After attempting to load a PROFIBUS-DP firmware version on a non-compatible hardware revision, the SIPROTEC device remains in the loader mode (display = empty, LED 5 = ON, LED 6 flashing) and loading of a correct firmware version or an initial reset is expected.

If no firmware shall be loaded in this situation, then the device has to be switched off (after at least 3 sec.) switched on again.

The previous firmware configuration is then used furthermore.

Hardware and mapping files

There is no compatibility reduction between PROFIBUS-DP mapping files of the SIPROTEC devices and the hardware revision of the communication modules, i.e.:

- the known PROFIBUS-DP mapping files for SIPROTEC devices, offered in DIGSI and used so far, are used for parameterization furthermore,
- existing parameterizations can be used further, even if a communication module up to HW revision 3 is replaced by a communication module from HW revision 4 (considering the firmware compatibility in Table 1-1).

1.2 Display of module-specific information at the SIPROTEC device



Note:

The following prerequisites are necessary for using the functionality “Display of module-specific information at the SIPROTEC device”:

- PROFIBUS communication module from HW revision 4 with PROFIBUS-DP firmware from V04.00,
- SIPROTEC device firmware which supports this function, e.g.:
 - 7SJ61...7SJ64, 6MD63 device firmware from V4.50,
 - 6MD663/6MD664 device firmware from V4.50,
 - 7SA522, 7SA6 device firmware from V4.50.

Changing parameters for the PROFIBUS-DP slave of the SIPROTEC device is exclusively possible using the DIGSI parameterization system.

If the display of module-specific information is not supported by the firmware of the used SIPROTEC device then the below-mentioned menu items are not offered for selection.

If a PROFIBUS communication module up to HW revision 3 is used, then in a SIPROTEC device with above-mentioned firmware V4.50 the following text is displayed in case of selecting the menu item for display of module-specific information:

```
**** LIST EMPTY ****
```

The values in the display of module-specific information are actualized every 500 ms. It is therefore possible that short-time changes of information are not displayed.

The display of module-specific information is accessible with the following menu items or buttons:

- MENU
- Test/Diagnosis → 5
- Modulinfo → 5
- Port B → 1

The maximum number of displayed information, separated in five blocks, is shown in Figure 1-2.

Depending on the used communication module type and the selected mapping file (and the resultant functional range) the blocks 4 and 5 are not existing.

The data in the individual information blocks are explained in the following chap. 1.2.1 to 1.2.5.

PORT B	

PROFIBUS-DP	
Slave : 2	Block 1:
Status: DATA_EXCHG	Status and parameters of the PROFIBUS-DP slave.
PNO-Id: 80BChex	
Master: 1	
Baudr.: 1.5 MB/s	
SlvWDT: 70 ms	
TimeSy: C355F7A6hex	
DP_SW : V04.00.06	Block 2:
MapNo.: 3-1	PROFIBUS-DP firmware version as well as number and
MapRev: V01.00.05	version of the selected mapping file.
Module: PS02-GEN	Block 3:
HWCodex: 0Chex	Module hardware information and version number of
HWRev.: 04	the boot firmware.
BF-No.: 0310042351	
Ld_Jmp: V01.00.05	
OLMStA: OK	Block 4:
OLMStB: Error	OLM information
OLMLed: G Y R	Block 4 is only available for fibre-optical PROFIBUS
OLMCmp: V2, OLM/S4	modules.
OLMMod: Redundancy	
OLMNWS: Standard	
EvSize: 500	Block 5:
EvEntr: 0/0	Status of the "Event list via PROFIBUS-DP".
EvCtrl: 00h-00h T-R	Block 5 is only available if the selected mapping file sup-
***** END *****	ports an "Event list via PROFIBUS-DP" (ref to chap. 2.5).

Figure 1-2 Display of module-specific information at the device

1.2.1 Block 1: Status and parameters of the PROFIBUS-DP slave

Block 1 of the module-specific information shows parameterization data of the PROFIBUS-DP slave of the SIPROTEC device and the communication status with the PROFIBUS-DP master.



Note:

If no PROFIBUS-DP mapping file was selected during parameterization in DIGSI then all entries of Block 1 are marked with the sign '-':

```
Slave : -
Status: -
...
```

Slave Display of the slave address which was entered during parameterization in DIGSI for GlobalSection.DP_Addr (ref. to chap. 2.1.1).

Status Display of the communication status between the PROFIBUS-DP slave and the PROFIBUS-DP master.

The following status indications are signaled:

Status	Explanation
BAUD_SEARCH	no connection to the PROFIBUS-DP master (line faulty or the like)
BAUD_FOUND	the PROFIBUS-DP slave is connected to the bus but it is not addressed by the PROFIBUS-DP master (and it was never addressed since the last connection break)
PRM_OK	the PROFIBUS-DP slave is addressed by the PROFIBUS-DP master, the Set Prm message was received and is OK, the Chk Cfg message from the PROFIBUS-DP master is expected (this status often is not displayed because immediate transition to DATA_EXCHG)
PRM_REQ	the PROFIBUS-DP slave was addressed by the master before but is now no more addressed (parameter change at the master without connection break or PROFIBUS-DP master software is disabled but lower PROFIBUS layer is still active)
PRM_FAULT	error in Set Prm message (e.g. wrong PNO identification number)
CFG_FAULT	error in Chk Cfg message (different number of input/output bytes parameterized in the PROFIBUS-DP master compared with the number according to the selected mapping file in the SIPROTEC device)
CLEAR_DATA	PROFIBUS-DP master sends Global Control command CLEAR_DATA
DATA_EXCHG	PROFIBUS-DP master and slave are in DATA_EXCHANGE mode

Table 1-2 Communication status indications



Note:

The tagging "SysIntErr" (ref. to chap. 2.3.1) also indicates the status DATA_EXCHG (tagging is set) and can be evaluated in the SIPROTEC device.

PNO-Id Display of the PNO identification number which was entered during parameterization in DIGSI for `GlobalSection.DP_IdentNo` (ref. to chap. 2.1.1).

Master Address of the PROFIBUS-DP master which sent the Set Prm and Chk Cfg messages for the PROFIBUS-DP slave (and which is still in DATA_EXCHANGE mode with the PROFIBUS-DP slave).

If the PROFIBUS-DP slave is not in status DATA_EXCHG then the displayed address indicates the master which sent the Set Prm and Chk Cfg messages for the slave last. A 'l' (lower case character 'L') in the last column is added in this situation, e.g.:

Master: 100 1

If the PROFIBUS-DP slave has not received the Set Prm and Chk Cfg messages yet, then this is shown with:

Master: -

Baudr. Display of the baud rate determined by automatic baud rate recognition.

If a communication break occurs during the data exchange between the PROFIBUS-DP master and slave then the baud rate recognized last is shown furthermore. A 'l' (lower case character 'L') in the last column is added in this situation, e.g.:

Baudr.: 1.5 MB/s 1

If (after switching on the device) no baud rate was recognized yet, then this is shown with:

Baudr.: -

SlvWDT Watchdog time in milliseconds which was submitted by the PROFIBUS-DP master with the Set Prm message to the PROFIBUS-DP slave for response monitoring.

If response monitoring is deactivated for this slave in the PROFIBUS-DP master then this is indicated with:

SlvWDT: OFF



Note:

Response monitoring has to be activated for the slave in the PROFIBUS-DP master if the tagging "SysIntErr" (ref. to chap. 2.3.1) shall be evaluated in the SIPROTEC device in case of communication break.

If the PROFIBUS-DP slave is not in status DATA_EXCHG then the last received watchdog time is displayed.

A 'l' (lower case character 'L') in the last column is added in this situation, e.g.:

SlvWDT: 70 ms 1

If the PROFIBUS-DP slave has not received the Set Prm and Chk Cfg messages yet, then this is shown with:

SlvWDT: -

TimeSy

Reception of time synchronization messages via PROFIBUS (ref. to chap. 4.4).

The received value in seconds since 01-01-1900, 00:00 hours is displayed in hexadecimal representation, e.g.:

TimeSy: C355F7A6hex

This value has to be unequal 00000000hex and has to be changed about every minute if time synchronization messages are received via PROFIBUS.

If the reception of time synchronization messages is deactivated in DIGSI with the parameter `GlobalSection.DP_TimeSyncEnable` (ref. to chap. 2.1.1) then this is indicated with:

TimeSy: OFF

In case of a communication break the seconds value received last is shown furthermore for one minute.

If no time synchronization message was received for a time interval of more than one minute then it is shown in the display with:

TimeSy: Diff. >1min

With PROFIBUS-DP firmware V04.01.01 or higher also local time correction values can be evaluated.

These correction values are contained e.g. in time synchronization messages of SIMATIC PLC S7 CPU 412-2DP...CPU 416-2DP, CPU 414-3DP, CPU 416-3DP (from firmware version 3.0 respectively) or of the Communication Processor Module CP 443-5 Extended (from firmware version 6.0).

The parameter `GlobalSection.DP_TimeSyncEnable` has to be set to the values described in chap. 4.4.2 for this.

If the PROFIBUS-DP slave of the SIPROTEC device receives time synchronization messages with a local time correction value then this is signaled with the additional display of these correction value, e.g.:

TimeSy: C355F7A6+04

The first value (in hexadecimal representation) shows the seconds since 01-01-1900, 00:00 hours, the second value (in decimal representation) shows the signed correction value in number of $\frac{1}{2}$ hours.

In the example given above the correction value is plus two hours.

1.2.2 Block 2: Firmware versions and mapping file

Block 2 of the module-specific information shows the PROFIBUS-DP firmware version as well as the number and version of the selected mapping file.



Note:

If no PROFIBUS-DP mapping file was selected during parameterization in DIGSI then all entries of Block 2 are marked with the text 'not loaded':

MapNo.: not loaded
MapRev: not loaded

DP_SW

PROFIBUS-DP firmware version loaded on the communication module.

- MapNo.** Number of the selected standard mapping.
 The mapping file determines the data size which is available via PROFIBUS-DP for the SIPROTEC device.
 Depending on the device type, several standard mappings are offered for parameterization in DIGSI (ref. to page 3, "Bus mapping documentation" for the individual SIPROTEC devices).
- MapRev.** Version of the selected standard mapping with the number MapNo. (see above).

1.2.3 Block 3: Module hardware information and boot firmware version

Block 3 of the module-specific information contains hardware information for the built-in communication module.

Module Hardware type of the communication module built-in in the SIPROTEC device:

Module	Explanation	Note
PSE_GEN	PROFIBUS module RS485	OK
PSO2_GEN	PROFIBUS module fibre-optical, double loop (with two fibre-optical channels)	OK
PSO1_GEN	PROFIBUS module fibre-optical, single loop (with one fibre-optical channel)	not for PROFIBUS-DP, please replace
AME_GEN	Asynchronous module RS485	not for PROFIBUS-DP, please replace
AMO-GEN	Asynchronous module fibre-optical	not for PROFIBUS-DP, please replace

Table 1-3 Communication module hardware types

- HWCode** A hardware designation, coded on the module, in hexadecimal representation.
- HWRev.** Hardware revision of the communication module.
- BF-No.** Serial number (production number) of the communication module.
- Ld_Jmp** Version of the separate boot firmware part for start-up and with loader functions.

1.2.4 Block 4: OLM information

Block 4 with OLM information is only available for fibre-optical PROFIBUS modules.



Note:

All Optical Link Modules in the interconnected devices has to be configured identical (ref. to chap 2.1.2, "Configuration of the fibre-optical interface").

OLMStA
OLMStB

Line status to the respective PROFIBUS-DP stations connected via optical channel A (Ch1) and optical channel B (Ch2).

The interpretation of this status for communication modules from HW revision 4 depends on the selected operating mode of the Optical Link Module (ref. to chap. 2.1.2).

OLM V2 mode or OLM V3 mode without optical fibre link monitoring:

OK	valid PROFIBUS messages are received via the optical channel
ERROR	no valid PROFIBUS messages are received via the optical channel (break in a fibre line or receive and transmit fibre line interchanged or no active PROFIBUS station on the bus)

OLM V3 mode with optical fibre link monitoring

(Line/Star topology with optical fibre link monitoring or redundant optical ring):

OK	the fibre-optical line to the partner station is OK
ERROR	a break in the fibre line to the partner station is detected (line break or receive and transmit fibre line interchanged) or the baud rate was not recognized yet because no active PROFIBUS station is connected to the bus



Note:

- The status of the optical channels is also indicated with the optional routable taggings "Line-break Channel A" and "Line-break Channel B" and can be evaluated in the SIPROTEC device (ref. to chap. 2.3.2).
- Additionally, the tagging "SysIntErr" should be used (ref. to chap. 2.3.1).

OLMLed

Display of the LED indicators for System and the individual Channels how it is also available at the OLM devices SINEC L2 OLM/S4 and SIMATIC NET PROFIBUS OLM/G12.

Through this, further fault diagnoses with the LED indicators and with the following listed manuals of the OLM devices are possible.

Manual	Order number
SINEC L2 Optical Link Module OLM/S4	6ZB5530-1AF01-0BA0
SIMATIC NET PROFIBUS OLM/G12	6ZB5530-3AD00-0BA0

The status of the LED indicators is displayed with characters:

- G = green
- R = red
- Y = yellow
- - = LED is off

Assignment of the order of the three characters to the LED indicators:

- 1st character: System LED
- 2nd character: LED opt. channel A (Ch1 at the PROFIBUS communication module)
- 3rd character: LED opt. channel B (Ch2 at the PROFIBUS communication module)

As an example, the following display

OLMLed: G Y R

is to interpret as:

- System LED = green
- LED channel A = yellow
- LED channel B = red

The two LED indicators additional at the OLM devices OLM/S4 and OLM/G12 to the indication of the status of the RS485 channels are not shown.

OLMCmp

OLM compatibility mode which is parameterized for the fibre-optical communication module (ref. to chap. 2.1.2).

Display for OLM V2 mode:

OLMCmp: V2, OLM/S4

Display for OLM V3 mode:

OLMCmp: V3, OLM/G12

OLMMod	<p>OLM operating mode which is parameterized for the fibre-optical communication module (ref. to chap. 2.1.2).</p> <p>Redundant optical ring:</p> <p style="padding-left: 20px;">OLMMod: Redundancy</p> <p>Line or Star topology with optical fibre link monitoring</p> <p style="padding-left: 20px;">OLMMod: L/S w Supv.</p> <p>Line or Star topology without optical fibre link monitoring</p> <p style="padding-left: 20px;">OLMMod: Line/Star</p>
OLMNWS	<p>Optical network size which is parameterized for the fibre-optical communication module (ref. to chap. 2.1.2).</p> <p>This parameter only is relevant if OLM V2 mode is selected:</p> <p style="padding-left: 20px;">OLMNWS: Standard</p> <p>or</p> <p style="padding-left: 20px;">OLMNWS: Extended</p> <p>In OLM V3 mode it is always displayed:</p> <p style="padding-left: 20px;">OLMNWS: -</p>

1.2.5 Block 5: Status of the event list via PROFIBUS-DP

Block 5 is only available if the selected mapping file supports an event list via PROFIBUS-DP (ref. to chap. 2.5) and contains information about the status of transmission of indications using the event list mechanism.

EvSize Number of the parameterized (at most possible) entries in the event list on the PROFIBUS communication module (see `GlobalSection.DP_EvtLst_ListSize`).

EvEntr Number of entries which are stored in the event list and number of entries which are offered to the master in the message blocks of the PROFIBUS-DP telegram, e.g.:

EvEntr: 12/3

Twelve entries are currently contained in the event recorder and additionally three entries are currently offered to the PROFIBUS-DP master in the message blocks of the PROFIBUS-DP telegram.

The receipt of the evaluation of these three entries in the message blocks is expected from the PROFIBUS-DP master.

A buffer overflow is also shown in this line for the duration of signaling of this indication to the PROFIBUS-DP master, e.g. (with EvSize equal 100):

EvEntr: 100/3, 0vfl.

EvCtrl Current contents of the handshake bytes "Control_I" (sent to the PROFIBUS-DP master, ref. to chap. 2.5.2.1) and "Control_O" (received last from the PROFIBUS-DP master, ref. to chap. 2.5.2.2).

The display

EvCtrl: 40h-30h T-R

means e.g., that message blocks are offered to the master with message block number 4 but no receipt was received for this because the last received message block number is 3.

The text T-R indicates the data direction for the two values of the handshake bytes from view of the SIPROTEC device (T = Tx, to the master; R = Rx, from master).

Parameters and properties

This chapter describes the properties and functions of the PROFIBUS-DP slave and the bus specific parameters which have to be defined during parameterization of the SIPROTEC devices for PROFIBUS-DP communication.

2.1	Bus specific parameters	26
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2.4	Annunciations to the PROFIBUS-DP master	37
2.5	Event list via PROFIBUS-DP (Sequence of events recorder)	38

2.1 Bus specific parameters

The following settings for the serial communication between the PROFIBUS-DP master and the PROFIBUS-DP slave have to be defined during parameterization of the SIPROTEC device.

Names written in MonoScriptText are the associated designations of the bus specific parameters in the DIGSI parameterization software (ref. to chap. 4.1).

2.1.1 PROFIBUS-DP settings

Slave address GlobalSection.DP_Addr

Permissible PROFIBUS slave addresses for the SIPROTEC devices are in the range between 1 and 126.

PNO identification number GlobalSection.DP_IdentNo

Depending on the chosen connection of the PROFIBUS net to the SIPROTEC device (ref. to chap. 1.1 and 5) the PNO identification number of the communication module has to be selected:

Communication module	PNO identification number	Connection	Device name	DDB file / GSD file
PSE, up to HW-Rev. 3	0x80A1	Isolated RS485 interface	"SIPROTEC4 - DP Modul"	"siem80a1.gsd"
PSE, from HW-Rev. 4			"SIPROTEC4 - DP Modul_HWR4"	"si1_80a1.gsd"
PSO, up to HW-Rev. 3	0x80BC	Fibre-optical interface	"SIPROTEC4 - DP Fibre"	"siem80bc.gsd"
PSO, from HW-Rev. 4			"SIPROTEC4 - DP Fibre_HWR4"	"si1_80bc.gsd"

Table 2-1 PROFIBUS communication modules for SIPROTEC devices: PNO identification numbers, device names and DDB files/GSD files



Note:

You can continue to work also with the GSD file of the modules up to HW revision 3 if a PROFIBUS communication module up to HW revision 3 is replaced with a PROFIBUS communication module from HW revision 4 (ref. to chap. 1.1) in an existing installation
 A changing of the PROFIBUS-DP master parameterization is not needed.

The DDB file/GSD file (corresponding to the PNO identification number) is necessary for parameterization of the des PROFIBUS-DP master and describes the technical characteristics of the PROFIBUS-DP slave device.

After importing the DDB file/GSD file in the parameterization system of the PROFIBUS-DP master the SIPROTEC modules with their device names are inserted in the slave family

“Other field controller - SIPROTEC”.

**Note:**

The DDB files/GSD files of the PROFIBUS-DP communication modules of the SIPROTEC devices are enclosed within the parameterization system DIGSI:

DDB files/GSD files in the directory:

- "...SIEMENS\DIGSI4\MANAGER\S7DATA\GSD" or
- "...SIEMENS\STEP7\S7DATA\GSD" at installation of DIGSI and STEP7.

Associated Bitmap files:

- "...SIEMENS\DIGSI4\MANAGER\S7DATA\NSBMP" or
- "...SIEMENS\STEP7\S7DATA\NSBMP" at installation of DIGSI and STEP7.

Baud rate

The PROFIBUS-DP slave of the SIPROTEC devices supports automatic baud rate recognition. There are no settings necessary concerning the baud rate during the parameterization of the SIPROTEC devices.

The baud rate is provided by the PROFIBUS-DP master.

The following baud rates are supported by the PROFIBUS communication modules:

Connection	Supported baud rates
Isolated RS485 interface (PSE module)	9.6; 19.2; 93.75; 187.5; 500; 1500; 3000; 6000 kB/s
Fibre-optical interface (PSO module)	9.6; 19.2; 93.75; 187.5; 500; 1500 kB/s

Table 2-2 PROFIBUS communication moduls for SIPROTEC devices:
Supported baud rates

**Note:**

After baud rate change at the PROFIBUS-DP master a silent time of at least 2 seconds is necessary on the bus so that the PROFIBUS-DP slave of the SIPROTEC device can recognize the baud rate change and start the automatic baud rate recognition again (short-time break of the bus connection at the PROFIBUS-DP master or the like).

Time synchronization

`GlobalSection.DP_TimeSyncEnable`

If the time stamp mechanism of PROFIBUS System Management Service is used for time synchronization of the SIPROTEC devices then the evaluation of time synchronization messages from PROFIBUS has to be enabled on the communication module.

Ref. to chap. 4.4 for further information about parameter settings of time synchronization via PROFIBUS.

Status bit for metered measurands

`GlobalSection.DP_CountersWithStatus`

Counters (metered measurands) are transferred via PROFIBUS-DP as unsigned long values.

The meaning of the status bit (most significant bit of the unsigned long value) can be defined with this paramter (ref. to chap. 3.6).

2.1.2 Configuration of the fibre-optical interface

The following settings for "Operating mode / Monitor mode", "Redundancy function" und "Network size" are only necessary at connection of PROFIBUS-DP via fibre-optical interface (PSO module).



Attention!

- Fibre-optical communication modules up to HW revision 3 are compatible with OLM V2 (SINEC L2) devices (e.g. OLM/S3 and OLM/S4).

Fibre-optical communication modules from HW revision 4 offer *in addition* the OLM V3 settings of the SIMATIC NET devices OLM/G11 and OLM/G12.

For this reason, the value of the three parameters, described in this chapter, has to be selected depending on the hardware revision of the used communication modules (ref. to chap. 1.1).

If fibre-optical communication moduls up to HW revision 3 and from HW revision 4 are used together at the same PROFIBUS segment then all optical devices (including external OLMs) have to be switched in the OLM V2 mode.

- After device reset or device start-up the optical channels of the communication modules from HW revision 4 are switched to the optical net first after completion of the parameter setting of the module (device-dependently approx. 15 seconds after device start-up).
- The **OLM configuration settings have to be identical** for all Optical Link Modules (OLM/S4, OLM/G12) and all fibre-optical PROFIBUS-DP communication modules of the SIPROTEC devices which are interconnected.

Please ref. to chap. 5.2 for additional notes regarding the connection of PROFIBUS-DP to SIPROTEC devices with fibre-optical interface.

- The help texts in the mapping files delivered so far for communication modules up to HW revision 3 exclusively refer to setting for OLM V2 mode.

These mapping files can also be used for PROFIBUS-DP parameterization with communication modules from HW revision 4.

The possibilities of the settings for OLM V3 mode listed below are valid despite of the reductions in the help texts of the mapping files for OLM V2 mode.

The following OLM parameters are the default settings after selection of a mapping file (independent of the HW revision of the used PROFIBUS communication module):

- "Operating mode / Monitor mode" = 0
- "Redundancy function" = 1
- "Network size" = 0

i.e.: **OLM V2 mode and redundant optical ring topology.**

**Operation mode /
Monitor mode**

GlobalSection.DP_OLM_MonitorMode

Devices with communication module up to HW revision 3

Oper. mode	Meaning
0	Mode 0 / Transmit echo: (default setting) The fibre-optical line is constantly checked for breaks in the line-connection. An indication in the case of a line-break can be evaluated in the SIPROTEC device (ref. to chap. 2.3). For "Redundancy function" = 1, "Operating mode" always has to be set to 0.
1	Mode 1: Select Mode 1 if PROFIBUS devices are connected to the bus which do not transmit, expect or accept an echo for line-break supervision (no fibre-optical cable monitoring, ring topologies are not possible in Mode 1).

The parameter corresponds to DIL switch S1 at the OLM/S4 or OLM/G12 (in compatibility mode).

Devices with communication module from HW revision 4

Oper. mode	Meaning
0	OLM V2 compatible, Mode 0 / Transmit echo: (default setting) The fibre-optical line is constantly checked for breaks in the line-connection. An indication in the case of a line-break can be evaluated in the SIPROTEC device (ref. to chap. 2.3). For "Redundancy function" = 1, "Operating mode" always has to be set to 0.
1	OLM V2 compatible, Mode 1: Select Mode 1 if PROFIBUS devices are connected to the bus which do not transmit, expect or accept an echo for line-break supervision.
10	OLM V3 compatible: Mode depends on parameter "Redundancy function" "Redundancy function" = 0 Line or Star topology with optical fibre link monitoring "Redundancy function" = 1 Redundant optical ring An indication in the case of a line-break can be evaluated in the SIPROTEC device (ref. to chap. 2.3).
11	OLM V3 Modus: Mode depends on parameter "Redundancy function" "Redundancy function" = 0 Line or Star topology without optical fibre link monitoring "Redundancy function" = 1 Redundant optical ring

The parameter corresponds for Operating modes 0 and 1 to DIL switch S1 at the OLM/S4 or OLM/G12 (in compatibility mode).

The parameter corresponds for Operating modes 10 and 11 to settings of DIL switches S1 to S4 at the OLM/G12.

**Note:**

Both optical channels are always adjusted identically in the OLM V3 mode at the SIPROTEC communication module unlike the possible settings at the SIMATIC NET OLM/G12 for operating mode "Line" (i.e. both channels with or both channels without line-break monitoring).

Redundancy function

GlobalSection.DP_OLM_Redundancy

Devices with communication module up to HW revision 3

Enable the Redundancy function (DP_OLM_Redundancy = 1) if a redundant fibre-optical network configuration is used (Redundant optical ring or Line redundancy with transmitter-to-receiver links).

The parameter corresponds to DIL switch S2 at the OLM/S4 or OLM/G12 (in compatibility mode).

Devices with communication module from HW revision 4

Set "Redundancy function" together with parameter "Operating mode" (see above).

Network size

GlobalSection.DP_OLM_NetworkSize



Note:

The value of "Network size" is only relevant if a communication module up to HW revision 3 or a communication module from HW revision 4 configured for OLM V2 compatible mode (see above) is used.

"Network size" is not evaluated if OLM V3 compatible mode is configured.

Depending on the number of moduls (Optical Link Moduls or fibre-optical SIPROTEC communication moduls) in the PROFIBUS net, the used baud rate and the cable length either network size "Standard" (DP_OLM_NetworkSize = 0) or "Extended" (DP_OLM_NetworkSize = 1) is to be selected.

Line and star topology

Always select "Standard" setting.

Ring topology

Calculate settings using Table 2-3:

Baud rate	"Standard"	"Extended"
9.6 kB/s	$l + 30 n \leq 1800$	$1800 < l + 30 n \leq 4620$
19.2 kB/s	$l + 15 n \leq 900$	$900 < l + 15 n \leq 2310$
93.75 kB/s	$l + 3.2 n \leq 191$	$191 < l + 3.2 n \leq 491$
187.5 kB/s	$l + 1.6 n \leq 95$	$95 < l + 1.6 n \leq 245$
500 kB/s	$l + 0.6 n \leq 48$	$48 < l + 0.6 n \leq 92$
1500 kB/s	$l + 0.2 n \leq 22$	$22 < l + 0.2 n \leq 30$

Table 2-3 Configuration of fibre-optical connection - Selection of network size settings

n = Number of moduls (Optical Link Moduls or fibre-optical SIPROTEC communication moduls) in the ring

l = Total length of all fibre-optical subsections in km

The parameter corresponds to DIL switch S5 at the OLM/S4 and to DIL switch S3 at OLM/G12 (in compatibility mode).

The position of the DIL switch S3 at the OLM/G12 has to be set inversely to the value DP_OLM_NetworkSize, i.e. S3 = 1 for DP_OLM_NetworkSize = 0 and vice versa.

2.1.3 Event list settings

The following settings are only available if a mapping file is selected which supports an event list (Sequence of events recorder) via PROFIBUS-DP for the SIPROTEC device.

Further information regarding the properties and accessing the event list via PROFIBUS-DP can be found in chapter 2.5.

Number of entries in the event list

`GlobalSection.DP_EvtLst_ListSize`

This parameter determines the number of event list entries on the communication module (range: 10 to 1000).

If the event list already contains the set number of entries (as e.g. no retrieval by the PROFIBUS-DP master was carried out) when a new entry arises, then the "First in First out" principle applies, i.e. the oldest entry is replaced by the new entry and an overflow flag, which is transmitted to the PROFIBUS-DP master the next time entries are retrieved, is set.

The default setting value is 500.

2.1.4 PROFIBUS-DP Configuration data

Configuration data are needed in the PROFIBUS-DP master for parameterization of the SIPROTEC devices.

The DDB file/GSD file characterises the SIPROTEC communication module as a "slave with modular design", i.e. depending on the selected mapping, the number of input and output data is modified without changing the DDB file/GSD file.

The configuration data to the various devices are contained in the corresponding bus mapping documents (ref. to page 3).

2.2 Execution of switching operations via PROFIBUS-DP

2.2.1 Command output modes

The following types of commands are available in the SIPROTEC device:

Double commands Execution of double commands, output to the switching devices and checkback signals are processed through two outputs respectively two bits, which are defined by "01" = OFF and "10" = ON.

Single commands Execution of single commands, output to the switching devices and checkback signals are processed by one output respectively one bit, which is defined by "0" = OFF and "1" = ON.



Note:

In deviation to the above-written definition, **control of the single and double commands** in the SIPROTEC device via PROFIBUS-DP is processed identically via two bits of the PROFIBUS-DP output message.

A command output in the SIPROTEC device can be executed as continuous output or pulse output.

Commands with continuous output Commands in the operation mode continuous output are executed (controlled) if in the corresponding pair of bits a value changeover (a slope) is recognized via PROFIBUS-DP from "Quiescent status" or OFF to ON and they remain active until a new value changeover occurs from "Quiescent status" or ON to OFF via PROFIBUS-DP.

For the definition of the values for "Quiescent status", ON and OFF ref. to chap. 3.2 and 3.3.

Commands with pulse output An output of a control pulse to switch a switching device incl. monitoring of the programmed times is executed autonomously by the SIPROTEC device.
The switching operation (the pulse output via the allocated binary outputs of the SIPROTEC device) is executed if in the PROFIBUS-DP output message the value of the corresponding pair of bits is changed

- from "Quiescent status" or ON to OFF or from "Quiescent status" or OFF to ON controlling double commands,
- from "Quiescent status" to ON controlling single commands.



Note:

The switching direction OFF for single commands with pulse output is not permitted and is rejected in the SIPROTEC device.

2.2.2 Transformer tap change commands

A transformer tap change command is applied via two outputs viz. two bits, which are defined with "01" = LOWER and "10" = RAISE (ref. to chap. 3.7).

Feed-back information is obtained as transformer tap position indication (ref. to chap. 3.8)

The transformer tap change command is output when the relevant bit pair via PROFIBUS-DP changes its value (an edge) from: "Quiescent status" or RAISE to LOWER and "Quiescent status" or LOWER to RAISE (a definition of the "Quiescent status" value is given in chapter 3.7).

To execute a number of tap changes sequentially, the initiation via PROFIBUS-DP must be with impulses due to the fact that the command execution is edge triggered.

- "Quiescent status" → RAISE → "Quiescent status" for raising the tap
- "Quiescent status" → LOWER → "Quiescent status" for lowering the tap

The impulse length must be greater than the maximum bus-cycle time.

Information regarding the maximum bus-cycle time (also referred to as data cycle time) can be found under the bus parameter settings of the PROFIBUS-DP master parameterization system.

2.2.3 Behaviour under special operating conditions

- A change of the switching device status which was not initiated by the PROFIBUS-DP master (e.g. circuit breaker trip) is recognized by the PROFIBUS-DP master by a change of the value of the switching device status in the corresponding bit positions of the input message.

If the PROFIBUS-DP master wants to reclose the locally switched off switching device, then the current value (OFF) or "Quiescent status" must first be transmitted via PROFIBUS-DP and then the switching device can be reclosed by setting the must value (ON).

- A switching operation requested via PROFIBUS-DP, which cannot be executed (e.g. because the control authority is set to LOCAL or the corresponding interlock conditions in the bay are not fulfilled) is recognized by the PROFIBUS-DP master from a discrepancy between the checkback signal of the double command or the status of the single command in the PROFIBUS-DP input message and the requested switching status, or because the expected transformer tap change checkback indication is not received.

A checkback supervision time may be activated in the PROFIBUS-DP master.

Before starting a new switching attempt, first the current switching status as per the input message or "Quiescent status" has to be transmitted again in the output message via PROFIBUS-DP.

- The response in the event of disturbed communication is described in chap. 2.3.

2.3 Response in the event of disturbed communication to the PROFIBUS-DP master

2.3.1 Communication interruption



Attention!

The reaction to communication interruption described in this chapter is only possible in the SIPROTEC device, if the response monitoring of the PROFIBUS-DP slaves is activated in the PROFIBUS-DP master.

The following response is defined for the SIPROTEC devices:

After detecting the interrupted connection to the PROFIBUS-DP master

1. The tagging "SysIntErr" (Error System interface) in the SIPROTEC device is set to ON (registration in the operations event log, processing in CFC is possible).
2. The status of the outputs and switching devices remains the same as they were before the interruption of the communication.

After reestablishing the communication

1. The tagging "SysIntErr" (Error System interface) in the SIPROTEC device is set to OFF (registration in the operations event log, processing in CFC is possible).
2. The data from the messages which are now again received by the PROFIBUS-DP master are registered (if this is possible according to the control authority status).

If the switching device status of the SIPROTEC devices shall not be changed after reestablishing the communication between PROFIBUS-DP master and slave then "Quiescent status" (value "00") has to be transmitted in the output message's corresponding bit positions or the control authority has to be set to LOCAL.



Note:

The following conditions set the tagging "SysIntErr" (Error System interface) to ON:

1. The PROFIBUS-DP slave of the SIPROTEC device is not parameterized and configured by the PROFIBUS-DP master (no bus connection between master and slave, wrong PROFIBUS address, wrong PNO ident number, faulty configuration of the slave in the PROFIBUS-DP master or the like).
 2. The Response Monitoring time (Watchdog time) in the PROFIBUS-DP slave is expired (the PROFIBUS-DP slave is not more addressed by the PROFIBUS-DP master because of a break in the data traffic on the bus, e.g. a line-break).
 3. Reception of the "Clear Data" Global Control message from the PROFIBUS-DP master (e.g. if the PLC is switched to STOP mode).
The tagging "SysIntErr" is only set if in the output message to the SIPROTEC device at least one bit was set before reception of "Clear Data".
-

2.3.2 Signalling of line-breaks in a redundant fibre-optical ring

OLM status indications

If the SIPROTEC device is connected to the PROFIBUS network via a redundant optical ring topology then a (single) fibre-optical line-break does not lead to a communication interruption between the PROFIBUS-DP master and the PROFIBUS-DP slave.

This line-break however must be recognized and repaired because with this line-break the redundancy is not present any more.

Configured for redundant optical ring topology the OLM-IC on the fibre-optical PROFIBUS modules constantly checks for line-breaks to the two connected neighbor devices.

Two OLM status indications ("Line-break Channel A" and "Line-break Channel B") are available which can be routed using DIGSI to SIPROTEC objects (Internal single-point indications/Taggings) and then evaluated via CFC or LED indications in the SIPROTEC device or transmitted to the PROFIBUS-DP master.

Allocation in DIGSI

The two OLM status indications of the fibre-optical SIPROTEC communication module are offered additionally to the routing possibilities of the selected mapping if an (previously created user-defined) Internal single-point indication/Tagging is routed to "Source system interface" using the **DIGSI Configuration matrix** (ref. to chap. 4.2):

- "Line-break Channel A"

Byte offset = $FFFF_{\text{hex}}$ (65535), Bit mask = 1

- "Line-break Channel B"

Byte offset = $FFFF_{\text{hex}}$ (65535), Bit mask = 2

Routing example

Requirement:

The OLM status indications shall be transferred to the supervisory control system and a break in the fibre-optical line is to be indicated with a LED at the SIPROTEC device.

Solution:

1. Insert two user-defined taggings (Internal single-point indications) in the **DIGSI Configuration matrix** (ref. to Figure 2-1).
2. Name the inserted taggings, e.g. "OLMerr_A" und "OLMerr_B".
3. Routing of the inserted taggings in the column "Source system interface":

"OLMerr_A" at byte offset = 65535, Bit mask = 1

"OLMerr_B" at byte offset = 65535, Bit mask = 2

4. Routing of the taggings at free positions in the PROFIBUS-DP telegramm to the PROFIBUS-DP master in the column "Destination system interface" and to "Destination LED".

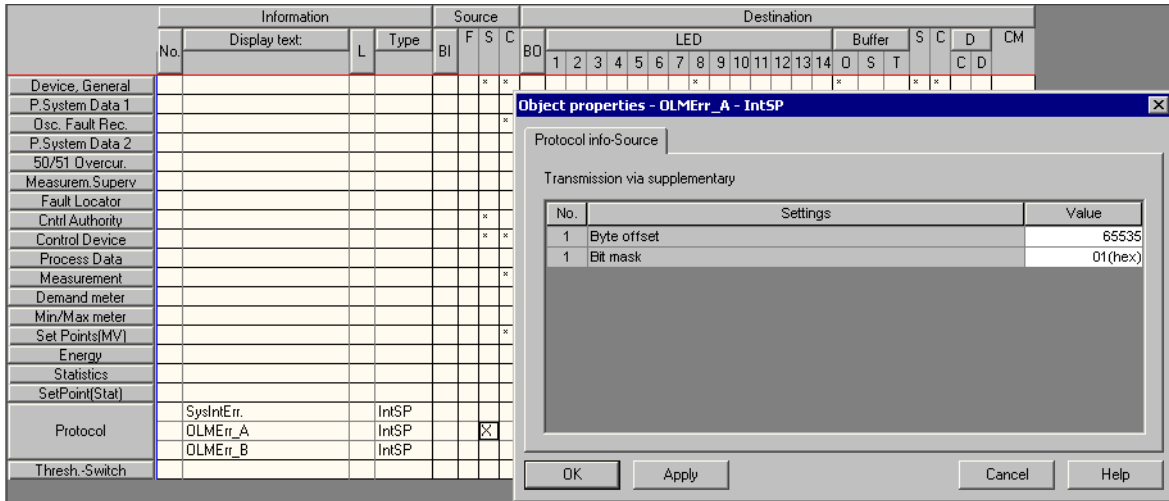


Figure 2-1 Routing of the OLM status indications in DIGSI



Note:

- The OLM status indications are ON if a line-break is detected.
- A delay of max. 5 sec. between the line-break and the signalling of the interruption can appear.
- The device recognizes the failure of a reception line.
A failure of the transmit line is signaled by the neighbor device.
- The “Byte offset” and “Bit mask” of the OLM status indications exist in DIGSI also at SIPROTEC devices with electrical PROFIBUS module, then do not have any meaning however.

External OLM

If a SIPROTEC device with an electrical PROFIBUS module is connected to a redundant optical ring topology using an external OLM (ref. to chap. 5.1) then a fibre-optical line-break is signaled via a potential-free contact at the OLM device.

The output of this contact can be connected to an input of the SIPROTEC device and used for evaluation of line-break indication.

SIPROTEC devices with surface-mounting case, two tier terminal top/bottom, are delivered only with electrical PROFIBUS connection, in principle.
For the connection of these devices to an optical ring an external OLM device is required.

2.4 Annunciations to the PROFIBUS-DP master



Note:

When analysing the annunciations of the SIPROTEC device in the PROFIBUS-DP master, it should be noted that due to the cycle period of the PROFIBUS-DP system or due to the cyclic processing time of a PLC, temporary changes of an annunciation's value (ON and OFF within one cycle) may eventually not be recognized.

This applies in the first place for protection annunciations.

Protection pickup

Protection annunciations which indicate the status "Protection pickup" are active only for the period of time of the protection pickup.

Protection TRIP

The parameter **Minimum Duration of TRIP Command** (parameter address = 210) allows setting of the minimum duration of the TRIP command.

This time setting applies to all protection functions which may cause a TRIP signal. After a protection TRIP, the corresponding protection annunciations transmit the value ON for the programmed minimum time duration.

2.5 Event list via PROFIBUS-DP (Sequence of events recorder)



Attention!

1. This function was especially developed for application of the bay control unit 6MD663/6MD664 in conjunction with a substation master S5-155H in a HV DC substation (high voltage DC transmission).
Other PROFIBUS-DP masters must be adapted if the function "Event list via PROFIBUS-DP" is to be used (refer to item 4).
 2. For the "Event list via PROFIBUS-DP" the following is required:
 - PROFIBUS-DP communication module firmware from V03.00.03,
 - a mapping file that supports "Event list via PROFIBUS-DP".
 3. Please check in the bus mapping documentation of the SIPROTEC device (ref. to page 3) that you are applying whether this device provides an "Event list via PROFIBUS-DP".
 4. To retrieve and evaluate the annunciations from the event list, the applied PROFIBUS-DP master must be programmed/set in accordance with the described handshake mechanism (ref. to chap. 2.5.3) and data type definition (ref. to chap. 3.9).
The required program sequences must be generated by the user.
 5. The "Event list via PROFIBUS-DP" is not identical to the operational event log in the SIPROTEC device, but is separately maintained on the communication module.
-

2.5.1 Properties of the event list

The PROFIBUS-DP communication module has an event list with entries of the type "Message block" (ref. to chap 3.9).

The size of the event list is set with the parameter **Number of entries on the event list** (ref. to chap. 2.1.3).

Characteristic

- The event list is a ring buffer.
- In the case of buffer overflow, the oldest entry is replaced by the current entry. The PROFIBUS-DP master is informed about the buffer overflow with a bit in the handshake byte "Control_I" (ref. to Figure 2-3).
- **Only** events of the type **single-point indication** and **double-point indication** are accepted in the event list.
- **Only those annunciations of the SIPROTEC device, that are in the "Cyclical range" (ref. to Figure 2-2, "Range 1") of the PROFIBUS-DP telegram in input direction are entered in the event list following a change.**
- Changes of the value of an object (ON/COMING and OFF/GOING as well as Intermediate position of double-point indications) are stored with a time stamp in the event list.
- Entries in the event list are not made for:
 - status changes,
 - command sequence states (CO+/CO-, FB+/FB- or similar).
- Following initial or reboot of the device, the event list is empty. Annunciations that were not retrieved are lost during initial or reboot of the device.
- In the event of failure of the communication, the event list is not erased. Entries are still saved following alarm state changes and can be transmitted to the PROFIBUS-DP master once the communication link is re-established (buffer overflow is indicated if necessary).
- The entries in the event list are transmitted to the PROFIBUS-DP master in the message blocks of the PROFIBUS-DP telegram (ref. to Figure 2-2) and must be acknowledged by the master (ref. to chap. 2.5.3).

2.5.2 Structure of a PROFIBUS-DP telegram with event list

In the following chapters 2.5.2.1 and 2.5.2.2, a typical construction of a PROFIBUS-DP telegram with message blocks and handshake bytes for the retrieval of an "Event list via PROFIBUS-DP" for a SIPROTEC device is shown and described.

The specific scope of the PROFIBUS-DP telegram for the particular SIPROTEC device should be checked in the corresponding bus mapping documentation. (ref. to page 3).



Note:

Also with "Event list via PROFIBUS-DP" the PROFIBUS-DP communication is with cyclic data exchange between the PROFIBUS-DP master and the PROFIBUS-DP slaves of the SIPROTEC devices (no PROFIBUS-DP V1 or a-cyclic data exchange).

2.5.2.1 Telegram in input direction

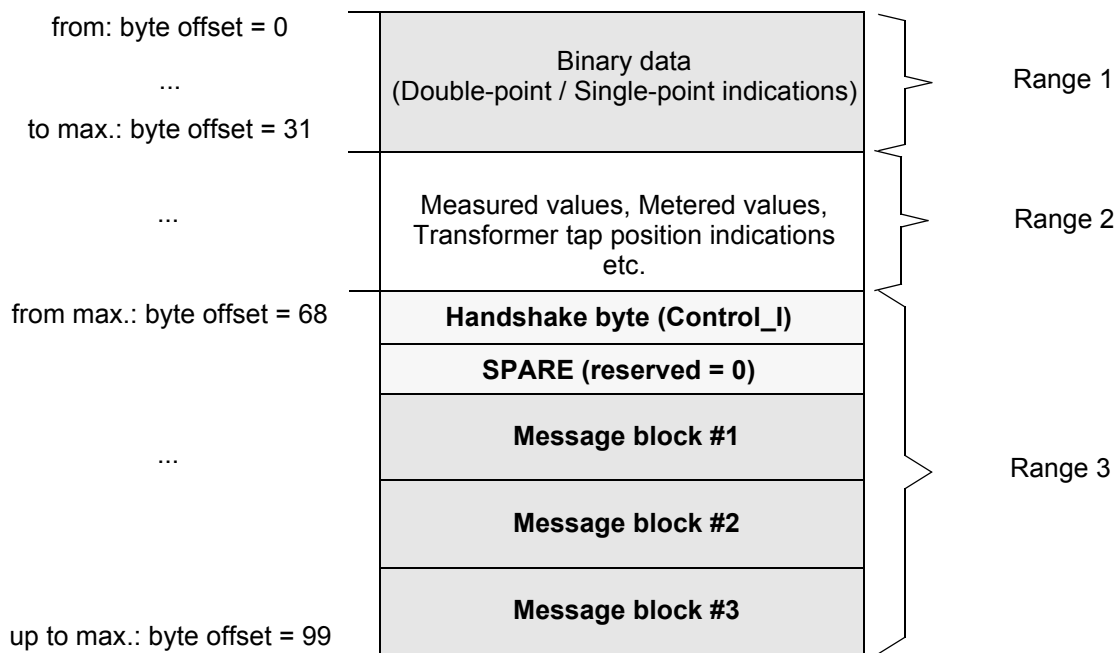


Figure 2-2 Event list: Input telegram with message blocks and handshake byte

Range 1

All single-point and double-point indications that are also indicated in the event list are part of Range 1 and are transmitted via the event list as well as the cyclic telegram image.

Thereby an immediate response to a change of these single-point and double-point indications is possible and these annunciations are also available for logging and record keeping purposes in the event list with a time stamp.

Range 2

This range of the input telegram contains measured values, metered values etc.

The information contained in this range is not part of the event list.

Single-point and double-point indications that are to be transmitted only within the cyclic telegram image can also be allocated in this range, depending on the mapping file that is available.

Range 3

Handshake byte and message blocks for retrieval of the event list

In Figure 2-3 the meaning of the individual bits of the handshake byte "Control_I" are represented.

Handshake mechanisms are referred to in chapter 2.5.3.

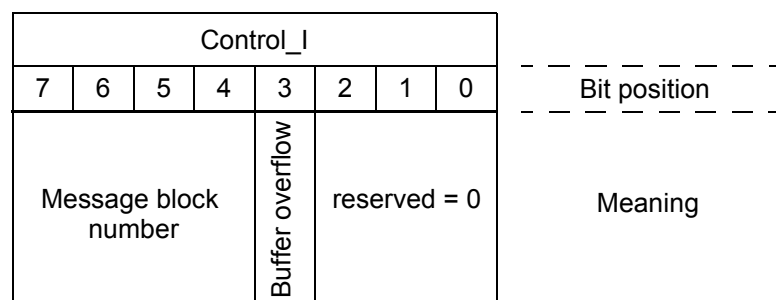


Figure 2-3 Handshake byte "Control_I" (input direction)

Message block number

- With each transmission of the message blocks (entries from the event list, max. 3 entries per telegram), the message block number is increased sequentially by 1, starting with 1 (0001_{bin}) up to 15 (1111_{bin}), and thereafter starting with 1 again.
- The message block number only has the (initial) value 0 if, following the initial or reboot of the SIPROTEC device no entries are available in the event list yet. After transmission of the first entry in the event list and the associated increment of the message block number, this number never assumes the value 0 again (unless another initial or reboot takes place).
- If the telegram contains none or less than 3 entries in the event list, then the unused message blocks are completely filled up with zeros.
- If no annunciation changes were transmitted in the event list during a number of bus cycles then the message block number remains unchanged in its value during this time.
The same last transmitted message block number is transferred repeatedly until new entries in the event list also effect changes to the message blocks that are transferred, thereby incrementing the message block number.

At the same time, the value of the message block number provides the acknowledgement that the message block entries were received by the PROFIBUS-DP master via the handshake byte in the output telegram (ref. to chap. 2.5.2.2)

Buffer overflow

A set bit indicates an overflow of the event list buffer.

The buffer overflow bit is reset following acknowledgement of the current transmitted message blocks if no new buffer overflow occurred in the meantime.

2.5.2.2 Telegram in output direction

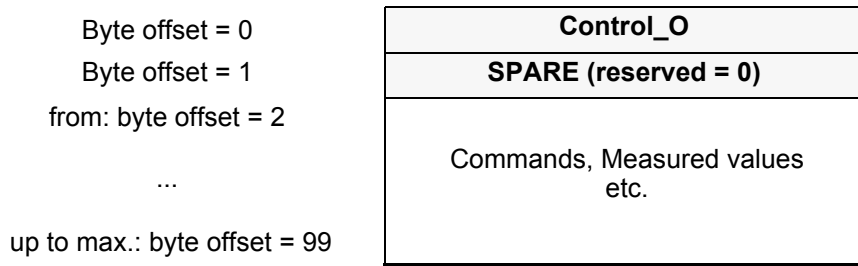


Figure 2-4 Event list: Output telegram with handshake byte

The individual bits of the handshake bytes "Control_O" have the meaning indicated in Figure 2-5.

Handshake mechanisms are referred to in chapter 2.5.3.

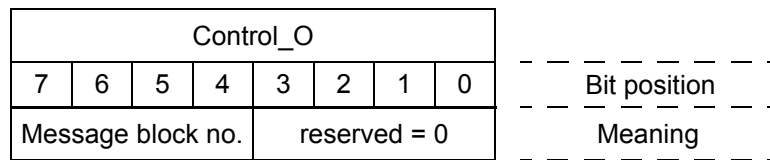


Figure 2-5 Handshake byte "Control_O" (output direction)

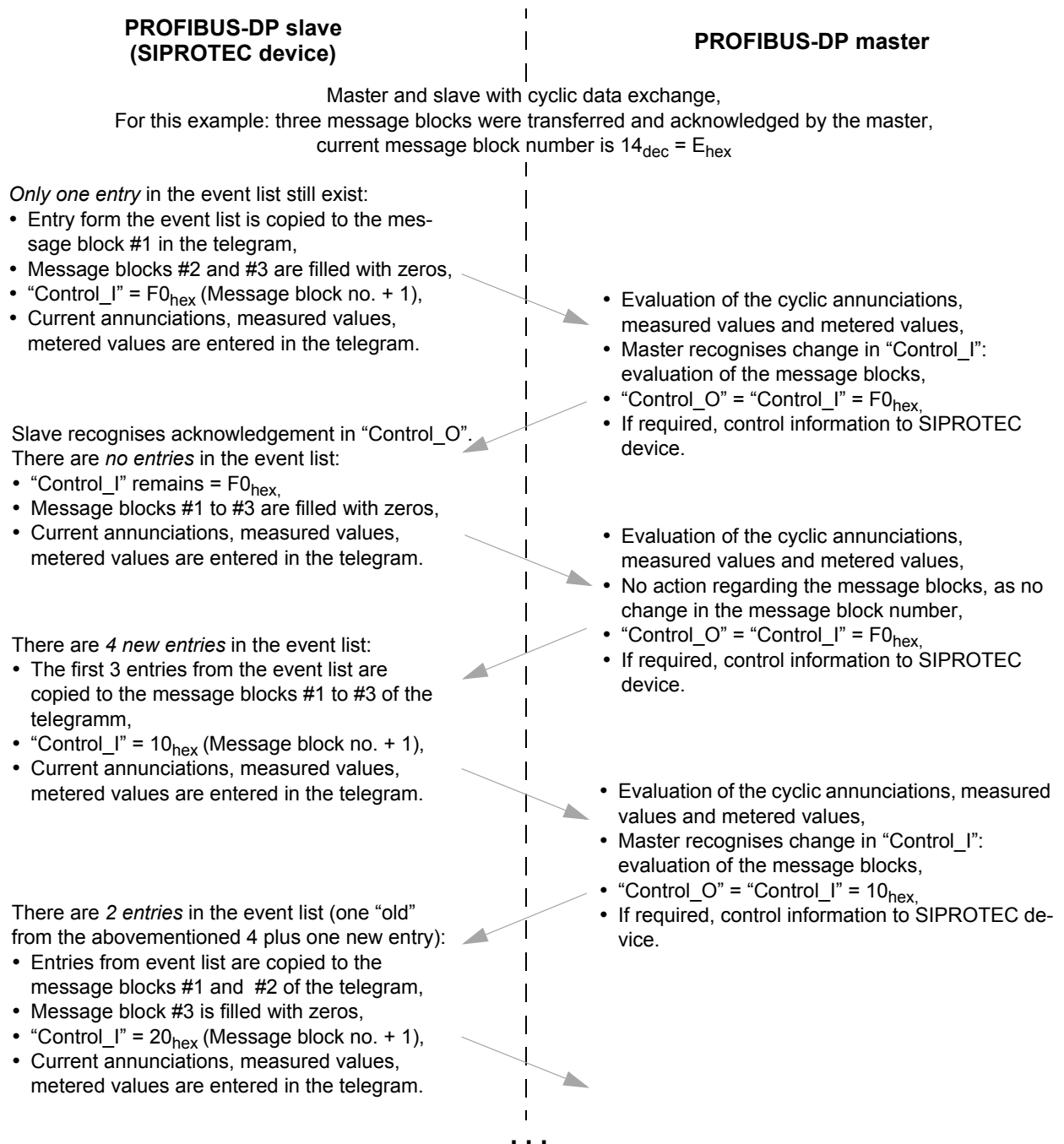
Message block number

Acknowledgement of receipt and evaluation of the message blocks in the telegram.

The PROFIBUS-DP master copies the message block number from the handshake byte "Control_I" of the input telegram to the handshake byte "Control_O" of the output telegram, following evaluation of the message blocks.

The PROFIBUS-DP slave repeats an message block until the message block number of the "Control_I" byte is mirrored back correctly by the master in the "Control_O" byte.

2.5.3 Handshake mechanism



Note:

A number of PROFIBUS-DP bus cycles may occur between a new telegram from the PROFIBUS-DP slave and the evaluation of its data (message blocks, setting of the control bytes) by the PROFIBUS-DP master (as well as the other way around), i.e. the arrows do not mark one bus cycle, but the direction of the superseding telegram exchange.

Data type definitions

This chapter describes the data types which are used for variables in the PROFIBUS-DP messages.



Note:

Depending on the SIPROTEC device not all of the indicated data types are used.

Please refer to the related bus mapping documentation (see page 3) for details about the data in the PROFIBUS-DP messages of the respective SIPROTEC device.

3.1	Single-point indication (SP, Input)	46
3.2	Single command (SC, Output)	47
3.3	Double-point indication (DP, Input) / Double command (DC, Output)	48
3.4	Measured value (signed integer)	49
3.5	Measured value (float)	50
3.6	Metered measurand (unsigned long)	51
3.7	Transformer tap change command (TC)	52
3.8	Transformer tap position indication (TM)	53
3.9	Message block for event list via PROFIBUS-DP	54

3.1 Single-point indication (SP, Input)

Number of byte-values $\frac{1}{8}$ (1 bit)

Range of values 0 - OFF
 1 - ON

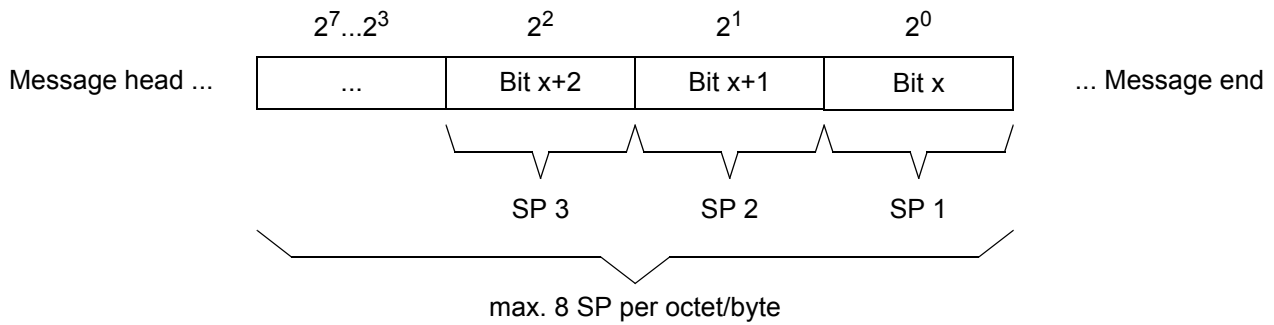


Figure 3-1 Data type: Single-point indication

3.2 Single command (SC, Output)

Number of byte-values	$1/4$ (2 bits)
Range of values	0 (bit 1 = 0 and bit 0 = 0) - Quiescent status 1 (bit 1 = 0 and bit 0 = 1) - OFF 2 (bit 1 = 1 and bit 0 = 0) - ON 3 (bit 1 = 1 and bit 0 = 1) - not permissible



Note:

- Single commands of the SIPROTEC device are controlled via PROFIBUS-DP by two bits (equivalent to double commands, ref. to chap. 2.2.1).
- The switching direction OFF for single commands with pulse output is not permitted and is rejected in the SIPROTEC device.

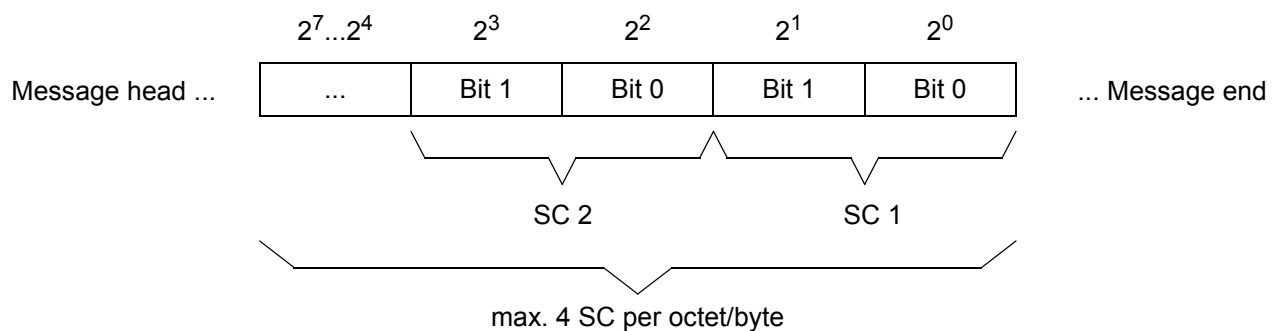


Figure 3-2 Data type: Single command

3.3 Double-point indication (DP, Input) / Double command (DC, Output)

Number of byte-values	$1/4$ (2 bits)
Range of values	0 (bit 1 = 0 and bit 0 = 0) - "Not applicable" / Intermediate position for DP, Quiescent status for DC 1 (bit 1 = 0 and bit 0 = 1) - OFF 2 (bit 1 = 1 and bit 0 = 0) - ON 3 (bit 1 = 1 and bit 0 = 1) - Intermediate position for DP, not permissible for DC



Note:

- Depending on the type, selected in DIGSI, the values 0 and 3 for double-point indications have the following meaning:
 - Type DP: 0 = "Not applicable", 3 = Intermediate position "00" or "11",
 - Type DP_I: 0 = "Not applicable" or Interm. position "00", 3 = Interm. position "11".
- "Not applicable": Double-point indication is not configured (not assigned to a binary input).

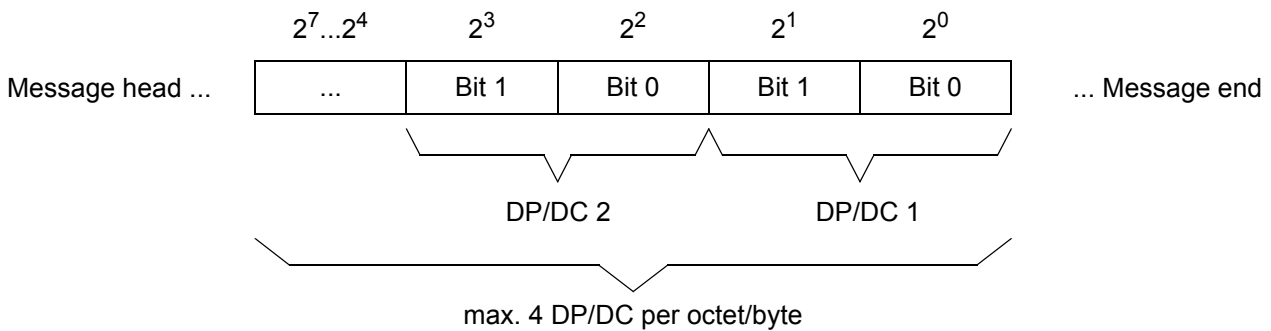


Figure 3-3 Data type: Double-point indication / Double command



Attention!

The data type double command in this chapter presupposes that the associated checkback indication is parameterized as a double-point indication.

A double command with a single-point indication as checkback indication or without checkback indication is controlled via PROFIBUS-DP like a single command (ref. to chap. 3.2), because the treatment of a double command via PROFIBUS-DP depends on the type of the associated checkback indication.

3.4 Measured value (signed integer)

Number of byte-values	2
Range of values	-32768 to +32767 (-32768 = 8000 _{hex} = "Overflow" or "Invalid")

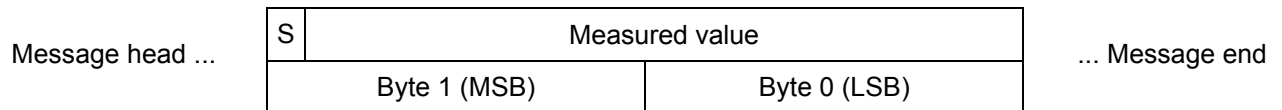


Figure 3-4 Data type: Measured value (signed integer)

Status bit (S)

- Sign bit, active if negative measured value

Negative measured values are transmitted in the two's complement, i.e.:

-1 = FFFF_{hex}, -2 = FFFE_{hex}, ..., -32767 = 8001_{hex}

- Status bit = 1 and measured value = 0
(i.e. transmission of the value 8000_{hex} = -32768):
Measured value overflow or invalid measured value.



Note:

The value -32768 for signalling of "Overflow" or "Invalid" is only used for measured values in input direction.

If an evaluation of the status of a measured value in output direction is required in the SIPROTEC device then a separate position in the PROFIBUS-DP message is to be used for this.

3.5 Measured value (float)

Number of byte-values	4
Range of values	+/- 1,7 * 10 ³⁸



Note:

Measured values in float format are only available for Transrapid protection devices (7ST622).

All other SIPROTEC devices use measured values in signed integer format for transmission (ref. to chap. 3.4).

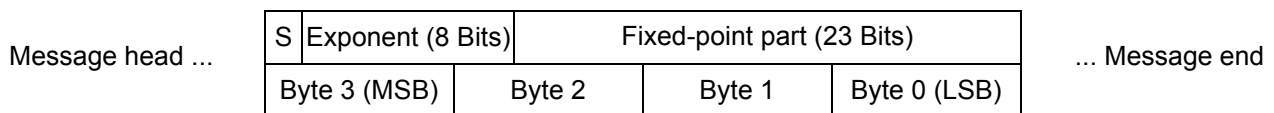


Figure 3-5 Data type: Measured value (float)

Sign bit (S) The sign bit is set for negative measured values.

Measured value The value of the measured value results as follows:

0 < exponent < 255:	value = (-1) ^{<sign>} * 2 ^{<exponent> - 127} * 1.<fixed-point part>
exponent = 0:	value = 0
exponent = 255, fixed-point part ≠ 0:	invalid

3.6 Metered measurand (unsigned long)

Number of byte-values	4
Range of values	0 to +4294967295

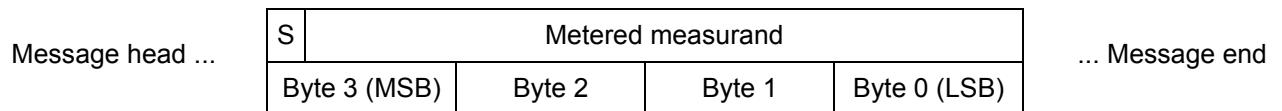


Figure 3-6 Data type: Metered measurand (unsigned long)

Status bit (S)

The status bit is set for invalid metered measurands in case of:

- corruption of the metered measurand after device reset/device start-up (the status bit is deleted after two update cycles of the metered measurand after device reset/device start-up),
- the external error bit of a pulse counter (metered measurand with a pulsed binary input as source) is set.



Note:

- The overflow of the metered measurands is $7FFFFFFF_{\text{hex}} + 1$ and the counter then starts at 0 again.
- The transmission of a status bit for metered measurands can be disabled in application cases the metered measurand's status bit is not required or if it could lead to miscalculations in the PROFIBUS-DP master (ref. to chap. 2.1, Parameter `GlobalSection.DP_CountersWithStatus`). The status bit is always 0 if it is disabled.

3.7 Transformer tap change command (TC)

Number of byte-values	$1/4$ (2 bits)
Range of values	0 (bit 1 = 0 and bit 0 = 0) - Quiescent status 1 (bit 1 = 0 and bit 0 = 1) - LOWER 2 (bit 1 = 1 and bit 0 = 0) - RAISE 3 (bit 1 = 1 and bit 0 = 1) - not permissible

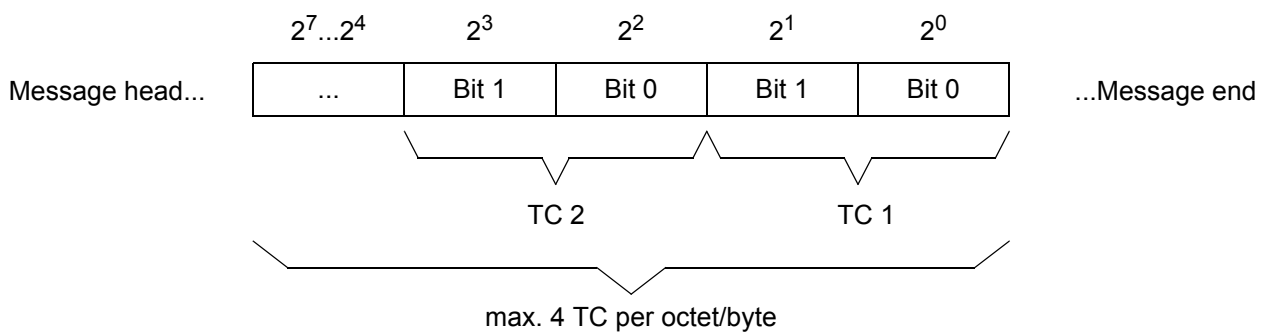


Figure 3-7 Data type: Transformer tap change command

Notes for the execution of transformer tap change commands via PROFIBUS-DP may be found in chapter 2.2.2.

3.8 Transformer tap position indication (TM)

Number of byte-values	1
Range of values	1 to 62 (63 = 3F _{hex} = invalid transformer tap change value via binary inputs)

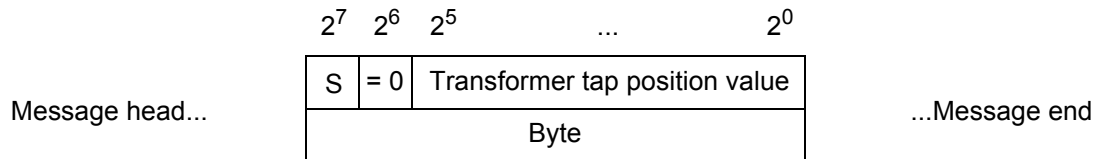


Figure 3-8 Data type: Transformer tap position indication

Status bit (S) In the event of a set status bit the transformer tap position indication is invalid, as no relevant binary inputs are allocated in DIGSI.
In conjunction a transformer tap position value of 0 is transmitted.

3.9 Message block for event list via PROFIBUS-DP

Number of byte-values 10

The complex data type "Message block" defines an entry in the event list via PROFIBUS-DP and contains an identification for the annunciation in the event list including the associated time stamp information.

Further information regarding the properties as well as the retrieval methods of the event list via PROFIBUS-DP can be found in chapter 2.5.

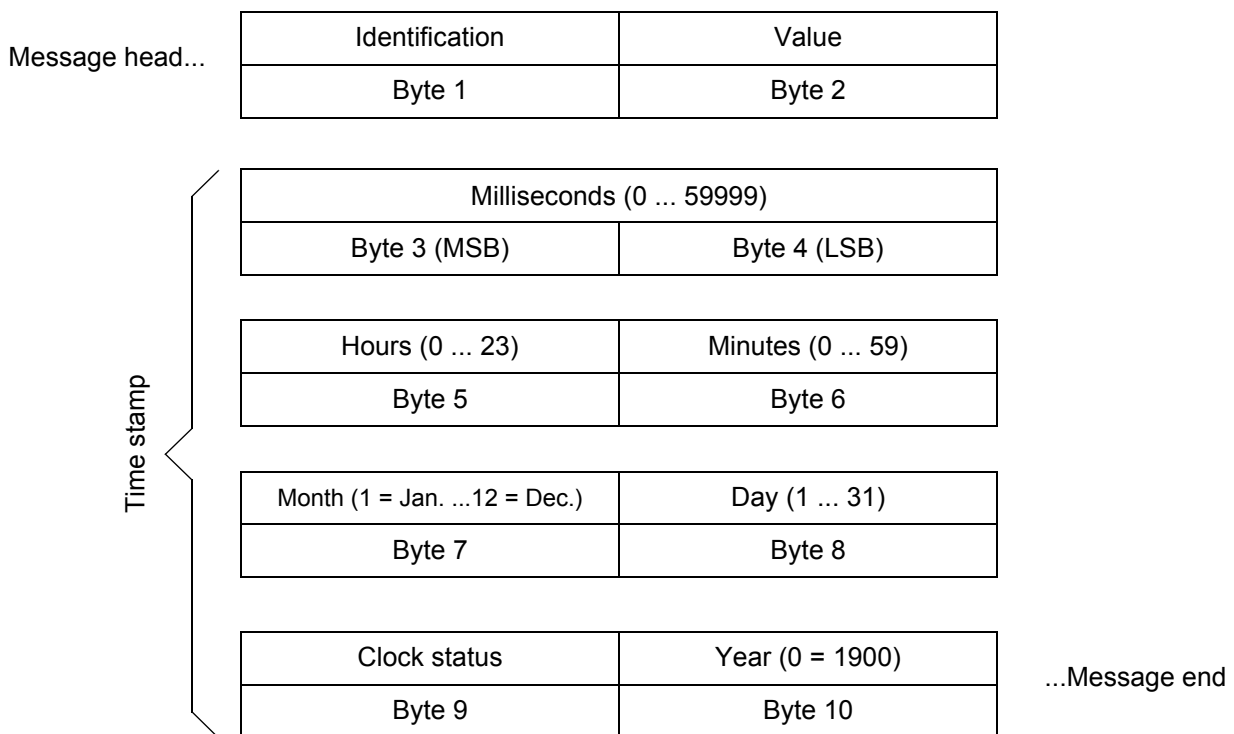


Figure 3-9 Data type: Message block for event list via PROFIBUS-DP

Byte 1: Identification

The identification byte identifies a single-point/double-point indication by means of the set position "Byte offset" and "Bit mask" (ref. to chap. 4.2 "Customization of the allocations") for the cyclic data exchange.

Instead of the "Bit mask" the bit position (0 to 7) is set in the identification byte, in the event of double-point alarms the least significant bit position in the byte.

For this purpose, the lower 3 bits of the identification byte define the bit position (0 to 7) and the remaining higher order bits define the byte offset (0 to max. 31).

**Note:**

Only information (single-point/double-point indications) located in the first 32 bytes of the PROFIBUS-DP telegram can be identified.

Identification byte								
7	6	5	4	3	2	1	0	
Byte offset				Bit position				Meaning

Bild 3-10 Byte "Identification" in the data type message block

Example

A single-point indication is set in DIGSI with:

Byte offset = 5

Bit mask = 08 (hex) → corresponds to 00001000_{bin} (bit position 3)

The identification byte in the message block for this single-point indication has the value

00101011_{bin} = 2B_{hex}.

Byte 2: Value

The value byte in the message block contains the value of a single-point/double-point indication after a change has been registered, as well as an identification as to whether it is a single-point or double-point alarm.

Value byte								
7	6	5	4	3	2	1	0	
reserved = 0		Indication type		reserved = 0		Value		Meaning

Bild 3-11 Byte "Value" in the data type message block

Value (bits 0 and 1)

- Single-point indication

00_{bin} = OFF, 01_{bin} = ON

- Double-point indication

00_{bin} = Intermediate position, 01_{bin} = OFF,

10_{bin} = ON, 11_{bin} = Intermediate position

Indication type (bits 4 and 5)

$01_{\text{bin}} = 1_{\text{hex}}$ for single-point indications

$10_{\text{bin}} = 2_{\text{hex}}$ for double-point indications

The bits designated as "reserved = 0" are at present always transmitted with the value = 0. These bit positions are not to be evaluated by the PROFIBUS-DP master, as in future, further information is envisaged to be transmitted therein.

Example

A change from ON to OFF of the indicated single-point indication used in the example for the identification byte (see above) is transmitted with the value byte $00010000_{\text{bin}} = 10_{\text{hex}}$.

**Bytes 3 to 10:
Time stamp**

The absolute time stamp is transmitted with the data indicated in Figure 3-9 (milliseconds up to year) for the point in time at which the alarm changed state.

Meaning of the clock status:

- Logic OR-combination of the real time status bits:

$10_{\text{hex}} \rightarrow$ set: daylight saving summer time

$20_{\text{hex}} \rightarrow$ set: real time clock error

$40_{\text{hex}} \rightarrow$ set: real time clock not valid

PROFIBUS-DP - Parameterization in DIGSI

This chapter describes the parameterization of PROFIBUS-DP as the system interface of a SIPROTEC device using parameterization system DIGSI.

For device parameterization have to be used:

- DIGSI 4.21 considering the preconditions explained in chapter 4.1.3,
- DIGSI 4.3 or higher,
- DIGSI 4.4 at use of Transformer tap change commands/Transformer tap position indications (ref. to chap 3.7 and 3.8).

4.1	Interface selection and mapping files	58
4.2	Customization of the allocations	66
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4.4	Time synchronization	75
4.5	Using SFC14 and SFC15 in STEP7	79

4.1 Interface selection and mapping files

Precondition

The parameterization of PROFIBUS-DP for a SIPROTEC device requires:

- selection of PROFIBUS-DP as system interface,
- selection of a mapping file which fixes the allocation of the data objects of the SIPROTEC device to the positions in the PROFIBUS-DP messages.

Bus specific parameters have to be defined simultaneously when selecting a mapping file (ref. to chap. 2.1).

4.1.1 Standard mappings 3-1 to 3-n

A number of standard mappings (standard mapping 3-1 to standard mapping 3-n, n = device type dependent number of standard mappings) are available for every SIPROTEC device type.

These mappings are different in the data size available via PROFIBUS-DP and offer a standard pre-allocation of SIPROTEC data objects to positions in the PROFIBUS-DP message.

Adaption of the allocation

In adaptation to the concrete installation environment the standard allocation can be changed (ref. to chap. 4.2):

- removing of data objects from the PROFIBUS-DP message,
- routing of data objects to free message positions,
- scaling of measured values according to the operating values of the primary equipment.



Note:

The size of the PROFIBUS-DP messages (number of commands, annunciations, measured values, metered measurands) in output or input direction is exclusively fixed by the selection of a standard mapping.

The data in the PROFIBUS-DP messages are defined in the bus mapping documentations of the individual SIPROTEC devices (ref. to page 3).

4.1.2 Compatibility with standard mappings of previous versions

Standard mappings 1 to n The standard mappings 1 to standard mapping n (n = device type dependent number of standard mappings) enclosed to DIGSI 4.1 for SIPROTEC devices 7SJ61...7SJ64 and 6MD63 should not be used for new device parameterizations.

A customization of allocations and scalings is not possible with these mappings and the same functional limitations as shown below for standard mappings 2-1 to 2-n are valid.

Standard mappings 2-1 to 2-n Compared with standard mappings 3-1 to 3-n the following functionalities are not available at use of standard mappings 2-1 to 2-n (n = device type dependent number of standard mappings):

- time synchronization,
- parameterization of the fibre-optical modules (PSO modules) for line or star topology (redundant optical ring topology only),
- signalling of (single) line-breaks in a redundant optical ring topology.

4.1.3 Interface selection and mapping selection in DIGSI 4.21



Attention!

The parameterization of PROFIBUS-DP with the functionalities described in this manual using standard mapping 3-1 to 3-n (n = device type dependent number of standard mappings) and DIGSI 4.21 requires the following preconditions:

- Update of the Parameter generating DLL for communication modules ("PG.DLL") in the DIGSI directory on the PC to version V02.04.01 or higher.

The update is required because of the extended functionalities of the standard mappings 3-1 to 3-n.

If no update of the Parameter generating DLL is carried out then an error occurs during the translation process of the mapping file when closing the dialog window

Properties - SIPROTEC 4 device (ref. to Figure 4-1).

You can download the Parameter generating DLL V02.04.01 as

DIGSI 4.21 ServicePack 3

from Internet <http://www.digsi.de>

or please contact your Siemens representative.

When entering the device MLFB (order number) to create a new SIPROTEC device in the **DIGSI 4 Manager** for parameterization, you are asked automatically for the selection of PROFIBUS-DP as system interface if the SIPROTEC device has a PROFIBUS-DP communication module at delivery.

Changing the system interface to PROFIBUS-DP for already existing devices in DIGSI is also possible.

Protocol assignment for system interface

Select the SIPROTEC device in your project in the **DIGSI 4 Manager** and use the menu item **Edit - Object properties...** to open the **Properties - SIPROTEC 4 device** dialog window (ref. to Figure 4-1).

In the property sheet **Communications Modules** the entry “additional protocols, see MLFB Ext. L” has to be selected for “1. SYSTEM-Port”.

By pressing the button “L: ...” the dialog window **Additional information** is opened which is used to enter the type of the communication module.

Please select in the dialog window **Additional information**:

- “Protocol” or “none” (depending on the SIPROTEC device type) for “1. SYSTEM-Port” and
- “Profibus DP Slave, RS485” or “Profibus DP Slave Fiber double loop ST” (depending on the hardware composition of the SIPROTEC device) for “2. SYSTEM-Port”.

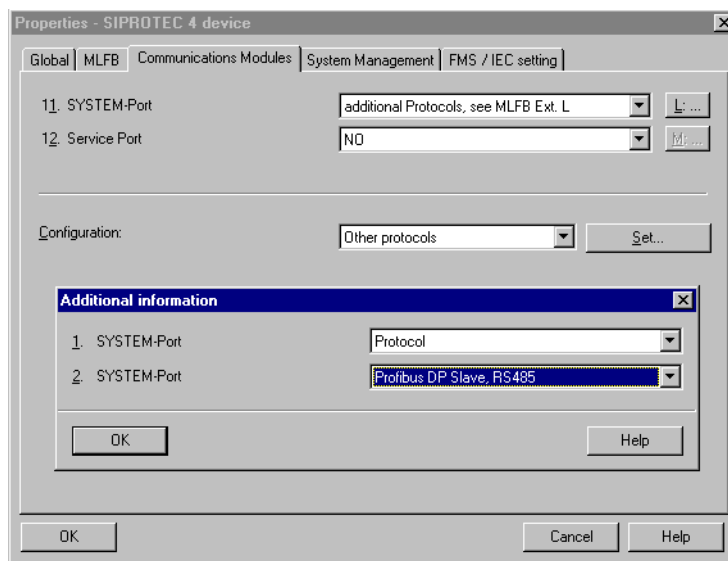


Figure 4-1 DIGSI 4.21: PROFIBUS-DP protocol assignment

Mapping file

The mapping file selection is available in the dialog window **Other protocols** which is opened by pressing the button “Set ...” in the property sheet **Communications Modules** (ref. to Figure 4-1).

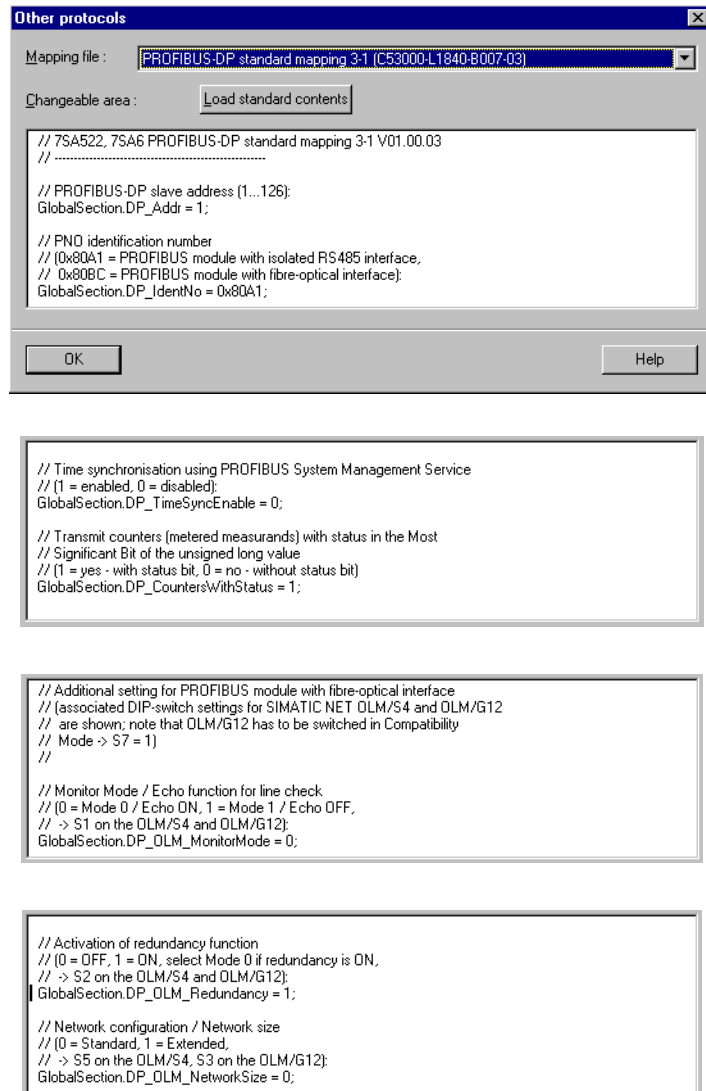


Figure 4-2 DIGSI 4.21: Mapping file selection and bus specific parameters

The list box “Mapping file:” includes all available PROFIBUS-DP mapping files for the respective SIPROTEC device type with their name and a reference to the associated bus mapping documentation (order numbers, ref. to page 3).

In the edit area “Changeable area:” bus specific parameters can be changed. Please refer to chap. 2.1 for a description of these parameters.

The button “Load standard contents” restores the default values of the bus specific parameters.



Note:

Please, edit only the numbers in the rows which do not start with “//” and note the semicolons at the end of the line.

Editing anything else in the “Changeable area:” may cause an error when closing the **Properties - SIPROTEC 4** device dialog window.



Attention!

If after change of a measured value's scaling (ref. to chap. 4.3) a bus specific parameter is changed then all scalings are reset to their defaults according to the bus mapping documents (ref. to page 3) again.

4.1.4 Interface selection and mapping selection in DIGSI 4.3 or higher

When entering the device MLFB (order number) to create a new SIPROTEC device in the **DIGSI 4 Manager** for parameterization, you are asked automatically for the selection of PROFIBUS-DP as system interface if the SIPROTEC device has a PROFIBUS-DP communication module at delivery.

Changing the system interface to PROFIBUS-DP for already existing devices in DIGSI is also possible.

Protocol assignment for system interface

Select the SIPROTEC device in your project in the **DIGSI 4 Manager** and use the menu item **Edit - Object properties...** to open the **Properties - SIPROTEC 4 device** dialog window (ref. to Figure 4-3).

In the property sheet **Communications Modules** the entry "additional protocols, see MLFB Ext. L" has to be selected for "11. SYSTEM-Port".

By pressing the button "L: ..." the dialog window **Additional information** is opened which is used to enter the type of the communication module.

Please select in the dialog window **Additional information**:

- "Protocol" or "none" (depending on the SIPROTEC device type) for "1. SYSTEM-Port" and
- "Profibus DP Slave, RS485" or "Profibus DP Slave Fiber double loop ST" (depending on the hardware composition of the SIPROTEC device) for "2. SYSTEM-Port".

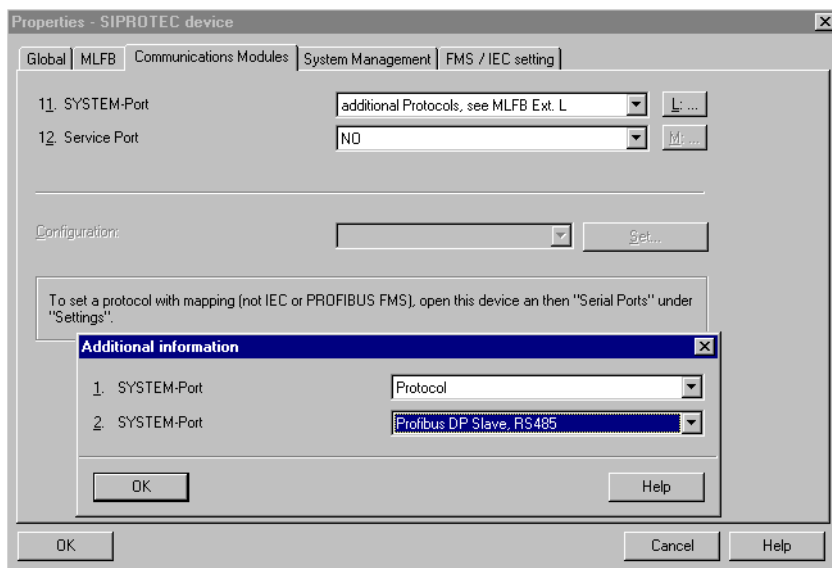


Figure 4-3 DIGSI 4.3: PROFIBUS-DP protocol assignment

Mapping file

To select a mapping file, please open the SIPROTEC device in DIGSI.

The dialog window **Interface Settings** (in DIGSI via **Settings - Serial Ports**) offers in the property sheet **Supplementary protocols at device** the following dialog elements:

- display of the chosen communication module (ref. to page 4-63, “Protocol assignment for system interface”),
- the list box “Mapping file:” which includes all available PROFIBUS-DP mapping files for the respective SIPROTEC device with their name and a reference to the associated bus mapping documentation (order numbers, ref. to page 3),
- the edit area “Module-specific settings:” to change the bus specific parameters (ref. to chap. 2.1 for a description of these parameters).

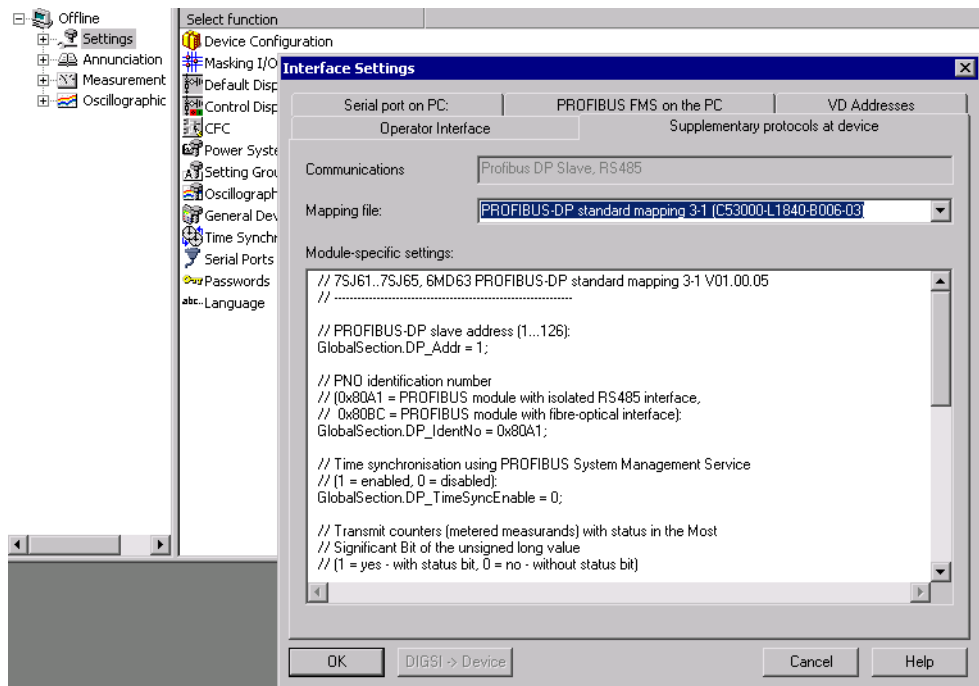


Figure 4-4 DIGSI 4.3: Mapping file selection and bus specific parameters

**List box
"Mapping file"**

If no mapping file is currently assigned to the SIPROTEC device then the following entries are available in the list box "Mapping file":

Selection	Meaning
<none>	No mapping file is assigned to the device.
PROFIBUS-DP standard mapping 3-1 ... PROFIBUS-DP standard mapping 3-n	Selection of a mapping file 3-1 to 3-n (n = device type dependent number of standard mappings).

The following entries can be selected at an already existing mapping file assignment:

Selection	Meaning
<none>	No mapping file is assigned to the device.
<see module-specific settings>	This selection indicates the currently to the device assigned mapping file with the changes of bus specific parameters already carried out in the edit area "Module-specific settings". Number and version of the mapping file have to be taken from the first line in the edit area "Module-specific settings".
PROFIBUS-DP standard mapping 3-1 ... PROFIBUS-DP standard mapping 3-n	(New) Selection of a mapping file 3-1 to 3-n (n = device type dependent number of standard mappings). All bus specific parameters are reset to default values.

If the mapping file assignment was changed for a SIPROTEC device, then this is in general connected with a change of the routing of the SIPROTEC objects to the system interface.

Please, check after choice of a new mapping file the allocations to "Destination system interface" or "Source system interface" in the **DIGSI configuration matrix**.

**Edit area
"Module-specific settings"**

Please, edit only the numbers in the rows which do not start with "/" and note the semicolons at the end of the line.

Editing anything else in the "Module-specific settings" may cause an error when closing the **Interface Settings** device dialog window.

4.2 Customization of the allocations

The identification whether an information is routed on system interface (PROFIBUS-DP) is shown in the columns "Source system interface" and "Destination system interface" in the **DIGSI Configuration matrix**.

A cross ('X') in this column indicates the associated information as "routed on system interface".

Information	No.	Display text:	Long text:	Type	Source			Destination											
					Bl	F	S	C	BO	LE	Buf	S	C	B	CM				
Measurment Superv																			
Control Authority							*												
Control Device	52Breaker	52 Breaker	52 Breaker	CF_D12		X							X	X	X	X			
	52Breaker	52 Breaker	52 Breaker	DP									X	X	X	X			
	Disc.Swit.	Disconnect Switch	Disconnect Switch	CF_D2		X							X	X	X	X			
	Disc.Swit.	Disconnect Switch	Disconnect Switch	DP									X	X	X	X			
	GndSwit.	Ground Switch	Ground Switch	CF_D2		X							X	X	X	X			
	GndSwit.	Ground Switch	Ground Switch	DP									X	X	X	X			
	52 Open	Interlocking: 52 Open	Interlocking: 52 Open	IntSP			X												
	52 Close	Interlocking: 52 Close	Interlocking: 52 Close	IntSP			X												
	Disc. Open	Interlocking: Disconnect switch Open	Interlocking: Disconnect switch Open	IntSP			X												
	Disc. Close	Interlocking: Disconnect switch Close	Interlocking: Disconnect switch Close	IntSP			X												
	GndSw Open	Interlocking: Ground switch Open	Interlocking: Ground switch Open	IntSP			X												
	GndSw Cl.	Interlocking: Ground switch Close	Interlocking: Ground switch Close	IntSP			X												
	UnlockDT	Unlock data transmission via BI	Unlock data transmission via BI	IntSP			X												
	Q2 Op/Cl	Q2 Open/Close	Q2 Open/Close	CF_D2		X								X					
	Q2 Op/Cl	Q2 Open/Close	Q2 Open/Close	DP										X					
Q9 Op/Cl	Q9 Open/Close	Q9 Open/Close	CF_D2		X														
Q9 Op/Cl	Q9 Open/Close	Q9 Open/Close	DP										X						
Fan ON/OFF	Fan ON/OFF	Fan ON/OFF	CF_D2																
Fan ON/OFF	Fan ON/OFF	Fan ON/OFF	DP																

Figure 4-5 DIGSI Configuration matrix with columns for system interface routing

Source system interface

The SIPROTEC object can be controlled via PROFIBUS-DP. This is possible for the following information types:

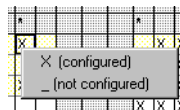
- IntSP Internal single-point indication (tagging)
- IntDP Internal double-point indication (tagging)
- SC/DC Single control/Double control without feedback from process
- SF/DF Single control/Double control with feedback from process

Destination system interface

The value of the SIPROTEC object is transmitted to the PROFIBUS-DP master. This is possible for the following information types:

- SP Single-point indication
- DP Double-point indication
- Out Output annunciation
- IntSP Internal single-point indication (tagging)
- IntDP Internal double-point indication (tagging)
- MV Measured value
- MVMV Power meter (metered measurand, source is a measured value)
- PMV Pulse (metered measurand, source is a pulsed binary input)
- TxTap Transformer tap position indication

To add or remove an information to "Source system interface" or "Destination system interface" set/reset the cross ('X') in the associated column of the **DIGSI Configuration matrix** (pop-up menu when pressing the right mouse button).



Note:

- The max. number of routable objects of an information type varies according to the chosen mapping file.
If e.g. a measured value not routed in the mapping file per default shall be transferred via PROFIBUS-DP, then first a measured value already routed has to be removed from system interface so that the position gets available in the PROFIBUS-DP message.
- An error message is shown if all routing possibilities of an information type are occupied and if it is nevertheless tried to route an information of this type.

Adding an allocation

Adding an allocation requires (in addition to the identification in the system interface column of the **DIGSI Configuration matrix**) the selection of the position of the information in the PROFIBUS-DP message as well as the definition of scaling values for measured values (scaling of measured values ref. to chap. 4.3).

Therefore after adding the allocation, the **Object properties** dialog window which is used to define the message position of the information is opened automatically (property sheet **Protocol info source** or **Protocol info destination**).

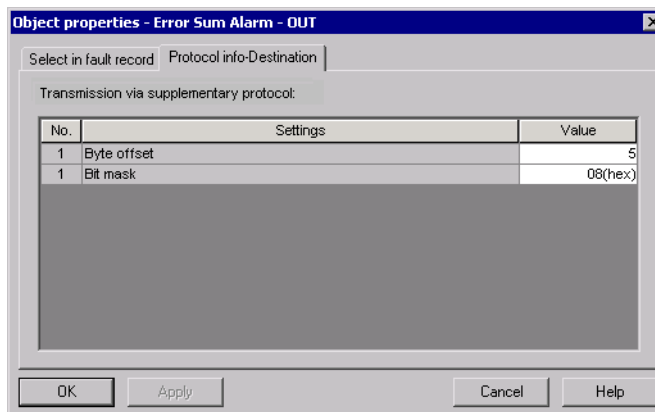


Figure 4-6 Definition of the position of an information in the PROFIBUS-DP message

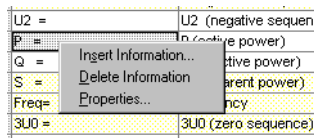


Attention!

- The information type of double commands for routing as "Source system interface" depends on the information type of the associated checkback indication. Only double commands with a double-point indication as checkback indication can be routed to the positions in the PROFIBUS-DP message which are reserved for double commands according to the bus mapping. Double commands with a single-point indication as checkback indication or without checkback indication are treated via PROFIBUS-DP like single commands and must be routed to the positions reserved for single commands.
- Commands without checkback indication can not be routed to "Destination system interface". Reading the state of these command types is not possible via PROFIBUS-DP.

Change of an existing allocation

If an information already routed on system interface shall get another (empty) position in the PROFIBUS-DP message, then the **Object properties** dialog window (ref. to Figure 4-6) has to be selected (**Properties ...** in the pop-up menu when pressing the right mouse button in one of the columns "Display text", "Long text" or "Type" of the **DIGSI Configuration matrix** in the row which is associated to the information).



Depending on the information type the following parameters are to select in the property sheet **Protocol info source** or **Protocol info destination** of the **Object properties** dialog window:

Parameter	Comments	Info types for Protocol info source	Info types for Protocol info destination
Byte offset	The offset indicates the byte in the PROFIBUS-DP message in which the bit value is placed.	IntSP, IntDP, SC/DC, SF/DF	SP, DP, Out, IntSP, IntDP
	The offset indicates the byte position in the PROFIBUS-DP message.	-	TxTap
	The offset indicates the beginning of the most significant byte in the message.	-	MV, MVMV, PMV
Bit mask	In the bit mask value all bit positions are set to 1 which are associated to the information. Representation of the bit mask as <ul style="list-style-type: none"> • decimal number in DIGSI 4.21, • hexadecimal number from DIGSI 4.3. 	IntSP, IntDP, SC/DC, SF/DF	SP, DP, Out, IntSP, IntDP

Example

The information "Error sum alarm" (ref. to Figure 4-6) is transferred after routing to "Destination system interface" (i.e. PROFIBUS-DP input message) at byte offset 5 (i.e. in the 6th byte), bit position 2^3 (Bit mask = $8_{\text{dec}} = 00001000_{\text{bin}}$).

**Note:**

Only the positions in the PROFIBUS-DP message (byte offset, bit mask) are offered to the selection on which the information type still can be routed according to the mapping file and the current occupancy.

Behavior at not routed positions in the PROFIBUS-DP message:

- In input direction the PROFIBUS-DP master always reads the value 0 from these positions.
- A write command to not routed positions in the output message is ignored by the SIPROTEC device.

Binary incoming annunciations

Binary incoming annunciations (marked with the sign '>' in the name, e.g. ">BLOCK 81-1") cannot be routed directly as "Source system interface".

A control of these objects via PROFIBUS-DP as a substitute for using binary inputs is however often meaningful.

To do this, taggings (information type: IntSP) routed to "Source system interface" as well as "Destination CFC" are used.

The binary incoming annunciation which is routed as "Source CFC" is connected via a CONNECT module in CFC to the tagging.

Example

Control of object ">BLOCK 81-1" using a user-defined tagging "DP 81-1 bl" via PROFIBUS-DP:

- In the **DIGSI Configuration matrix** set the source for ">BLOCK 81-1" to CFC output.
- Create a user-defined tagging using the **Information catalog**, rename this object in "DP 81-1 bl", release it as "Destination CFC" and route it to an empty position in the PROFIBUS-DP output message as "Source system interface".
- Open a **CFC working page** (e.g. "Device, Systemlogic" in run sequence PLC1).
- Insert a CONNECT module and check the run sequence of this module (PLC1_BE, MW_BE, ...) according to the selected **CFC working page**.
- Connect the input ("BO X") of the CONNECT module with the operand "DP 81-1 bl".
- Connect the output ("Y BO") of the CONNECT module with the operand ">BLOCK 81-1".
- Save and translate the **CFC working page**.

The object ">BLOCK 81-1" (and with that the associated protective function) can be influenced by changing the value of the "DP 81-1 bl" via PROFIBUS-DP now.

4.3 Scaling of measured values

Measured values are transferred via PROFIBUS-DP between the SIPROTEC device and the PROFIBUS-DP master as integer values (two bytes, ref. to chap. 3.4) but they are in general available in the SIPROTEC device in floating-point format as a percentage referred to the parameterized nominal values of the primary equipment.

4.3.1 Measurement conversion

Before transmission of a measured value via PROFIBUS-DP a measurement conversion (scaling) must be carried out in the SIPROTEC device.

Scaling	Scaling of a measured value to the format for the transmission via PROFIBUS-DP means the definition of: <ul style="list-style-type: none"> • Type, • Scaling factor, • Zero offset.
Type	Decision, whether the measured value is transmitted as percentage value, primary value or secondary value via PROFIBUS-DP. Depending on the measured value not all of these three possibilities are available, e.g. no secondary values for power values.
Scaling factor	The measured value in the SIPROTEC device (floating-point format) is multiplied by the scaling factor before transformation to an integer value (for PROFIBUS-DP). It is possible to transfer fractional digits by multiplication by a multiple of 10 in the integer value with that.
Zero offset	The Zero offset is added to the result of the multiplication of the measured value in the SIPROTEC device (floating-point format) by the scaling factor.
Formula	The measured value in integer format for transmission via PROFIBUS-DP is calculated summarizing according to the following formula: $\text{Measured value}_{\text{Integer}} = \text{Measured value}_{\text{Float}} * \text{Scaling factor} + \text{Zero offset}$ in which "Measured value _{Float} " is a percentage value or, if necessary, changed into primary value or secondary value before (according to the definition of Type).

4.3.2 Number representation depending on the parameterization

For specification of the scaling of a measured value it must be known in which number format (number of the relevant fractional digits) the measured value is available in the SIPROTEC device and to which unit it refers.

Percentage value

A scaling factor of 100 is recommended for percentage values.

With that the "Measured value_{Integer}" in the PROFIBUS-DP message has to be interpreted as:

+/- 32767 corresponds to +/- 327.67 %

Secondary value

The transmission of a measured value as secondary value is meaningful only in few cases (e.g. transducer measured values in mA).

The number of significant fractional digits depends on the installations and transducers data.

Primary value

The number of relevant fractional digits and the respective unit for primary values depends tightly on the parameterized nominal values of the primary equipment (DIGSI: **Power system data 1** and **Power system data 2**).



Note:

The following parameter numbers apply to the devices 7SJ61...7SJ64 and are partly divergently for other device types.

Voltages: V_a , V_b , V_c , V_{a-b} , V_{b-c} , V_{c-a} , $3V_0$, V_1 , V_2

Parameter: 1101 Nominal operation voltage of primary equipment

Parameter area	Number representation / unit
1.00 ... 10.00 kV	0.00 ... 99.99 kV
10.01 ... 100.00 kV	0.0 ... 999.9 kV
100.01 ... 1000.00 kV	0 ... 9999 kV
greater than 1 MV	0 ... 99.99 MV

Displacement voltages: V_N

Parameter: 0202 Voltage transducer - Primary voltage

0206 Ratio factor V_{ph}/V_{Δ}

Product of parameters 0202 and 0206	Number representation / unit
100.00 ... 1000.00 V	0 ... 9999 V
1.01 ... 10.00 kV	0.00 ... 99.99 kV
10.01 ... 100.00 kV	0.0 ... 999.9 kV
100.01 ... 1000.00 kV	0 ... 9999 kV
greater than 1 MV	0.00 ... 99.99 MV

Currents: I_a , I_b , I_c , $3I_0$, I_1 , I_2

Parameter: 1102 Nominal operating current of primary equipment

Parameter area	Number representation / unit
10.00 ... 100.00 A	0.0 ... 999.9 A
100.01 ... 1000.00 A	0 ... 9999 A
1.01 ... 10.00 kA	0.00 ... 99.99 kA

Ground currents: I_N , I_{Ns}

Parameter:

- (V4.2) 0204 Current transducer - Rated primary current
- 0207 Ratio factor I_N / I_{ph} or (dependent on the device type)
- 0208 Ration factor I_{Ns} / I_{ph}
- (V4.3) 0217 Rated primary current of I_N Current transducer

Product of parameters 0204 and 0207 / 0204 and 0208 or parameter 0217	Number representation / unit
0.00 ... 1.00 A	0 ... 9999 mA
1.01 ... 10.00 A	0.00 ... 99.99 A
10.01 ... 100.00 A	0.0 ... 999.9 A
100.01 ... 1000.00 A	0 ... 9999 A
1.01 kA ... 10.00 kA	0.00 ... 99.99 kA
greater than 10 kA	0.0 ... 999.9 kA

Power: P, Q, S

- Parameter: 1101 Nominal operation voltage of primary equipment
- 1102 Nominal operating current of primary equipment

Product of parameter 1101 and 1102 multiplied by $\sqrt{3}$	Number representation / unit
10.00 ... 100.00 kW (kVAR)	0.0 ... 999.9 kW (kVAR)
100.01 ... 1000.00 kW (kVAR)	0 ... 9999 kW (kVAR)
1.01 ... 10.00 MW (MVAR)	0.00 ... 99.99 MW (MVAR)
10.01 ... 100.00 MW (MVAR)	0.0 ... 999.9 MW (MVAR)
100.01 ... 1000.00 MW (MVAR)	0 ... 9999 MW (MVAR)
1.01 ... 10.00 GW (GVAR)	0.00 ... 99.99 GW (GVAR)
greater than 10 GW (GVAR)	0.0 ... 999.9 GW (GVAR)

Example

Definition of the scaling for a power measurement value

In the parameter set is configured:

Nominal operation voltage of primary equipment = 12.00 kV

Nominal operating current of primary equipment = 100 A

It follows:

$$V_{nom} * I_{nom} * \sqrt{3} = 2078.46 \text{ kW} = 2.078 \text{ MW}$$

In the SIPROTEC device the power measurement value is available with the following number representation and unit (see table above), i.e. two relevant fractional digits:

0.00 ... 99.99 MW

According to this a scaling factor of 100 is meaningful for transmission of the information as an integer value.

If the scaling factor is less than 100 then relevant fractional digits are lost.

A scaling factor of greater than 100 does not give more precision because there are only two relevant fractional digits.

With that the "Measured value_{Integer}" in the PROFIBUS-DP message has to be interpreted as:

+/- 32768 corresponds to +/- 327.68 MW

4.3.3 Parameterization in DIGSI

The **Object properties** dialog window (ref. to chap. 4.2) contains for measured values - beside the property sheet **Protocol info-Source** or **Protocol info-Destination** - an additional property sheet titled **Measured value-Destination**.

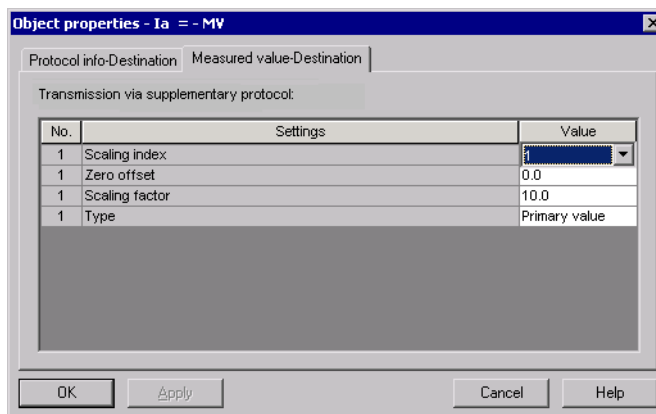


Figure 4-7 Scaling settings of a measured value

The scaling values assigned to the measured values per default are described in the bus mapping documents of the SIPROTEC device types (ref. to page 3).

The scaling - and with that customization to the installation-specific operating values - can be changed by selection of one Scaling index in the **Object properties** dialog window of the measured value.

Scaling index

A predefined scaling possibility (settings of Type, Scaling factor and Zero offset) is summarized using a Scaling index.

Scaling index	Type	Scaling factor	Zero offset
0	Primary value	1.0	0.0
1	Primary value	10.0	0.0
2	Primary value	100.0	0.0
3	Primary value	1000.0	0.0
4	Primary value	10000.0	0.0
5	Secondary value	1000.0	0.0
6	Percentage value	100.0	0.0
7	Secondary value	1.0	0.0
8	Secondary value	10.0	0.0
9	Secondary value	100.0	0.0



Note:

The Scaling indices 7 to 9 are not available for every SIPROTEC device.

4.4 Time synchronization

The PROFIBUS-DP slave of the SIPROTEC devices can use time synchronization messages via PROFIBUS System Management Service for time synchronization.

Preconditions:

- the PROFIBUS-DP master must be able to send time synchronization messages and must have a corresponding parameterization,
- only one master station may send time messages in the PROFIBUS net,
- the evaluation of time synchronization messages in the PROFIBUS-DP slave is enabled,
- **PROFIBUS** has to be selected for "Source of time synchronization" in the SIPROTEC device.

4.4.1 PROFIBUS-DP master

The following PROFIBUS-DP masters can e.g. transmit time synchronization messages via PROFIBUS System Management Service:

- SIMATIC S7 CPU 412-2DP...CPU 416-2DP, CPU 414-3DP, CPU 416-3DP with firmware from V3.0 respectively,
- SIMATIC S7 400 PLC Series with Communication Processor Module CP 443-5 Extended V2.0 or higher (6GK7 443-5DX02-...),
- WinCC Version 5 with Service Pack 2 or higher, Communication Processor Card CP 5613 and WinCC Option Basic Process Control (BPC).

Parameterization

A PLC S7-400 system with Communication Processor Module CP 443-5 Extended and parameterization software STEP7 is used as an example for the parameterization of a master station:

1. The CPU has to be defined as master for time synchronization.

Select the following settings in **HW Config** of STEP7 in the dialog window **Properties CPU 4xx** (ref to Figure 4-8):

- Synchronization in the PLC: "As master"
 - Time Interval: "1 minute", "10 seconds"¹ or "1 second"¹
 - Correction Factor to compensate deviation of the master clock (if necessary).
2. The PROFIBUS-DP master (CP 443-5 Extended) has to be configured to relay the time synchronization messages to the PROFIBUS-DP slaves.

Select the following settings in **HW Config** of STEP7 in the dialog window **Properties CP 443-5 Ext** (ref. to Figure 4-9):

- Pass on time-of-day frames: "From station to LAN"

¹ Time intervals of less than 1 minutes are supported with PROFIBUS-DP communication module firmware version 03.01.03 or higher, see notes on page 4-76.



Note:

PROFIBUS-DP firmware version 02.00.05 and 03.00.03:

- The time interval for the cyclic time synchronization messages from the PROFIBUS-DP master which include the current date and time for time synchronization of the SIPROTEC devices must be in the range of 50.05 to 61.95 seconds.
- Therefore, as shown above, “1 minute” has to be select at the time master.

Additional with PROFIBUS-DP firmware version 03.01.03 or higher:

- The following time intervals between time synchronization messages are also possible:
 - 1...15 seconds, 17...20 seconds, 26...30 seconds

The selection of one of the above-mentioned time intervals of less than 1 minute in the time master does not change the precision of the time synchronization in the SIPROTEC device.

If several time intervals are available in the time master then “1 minute” should be used.

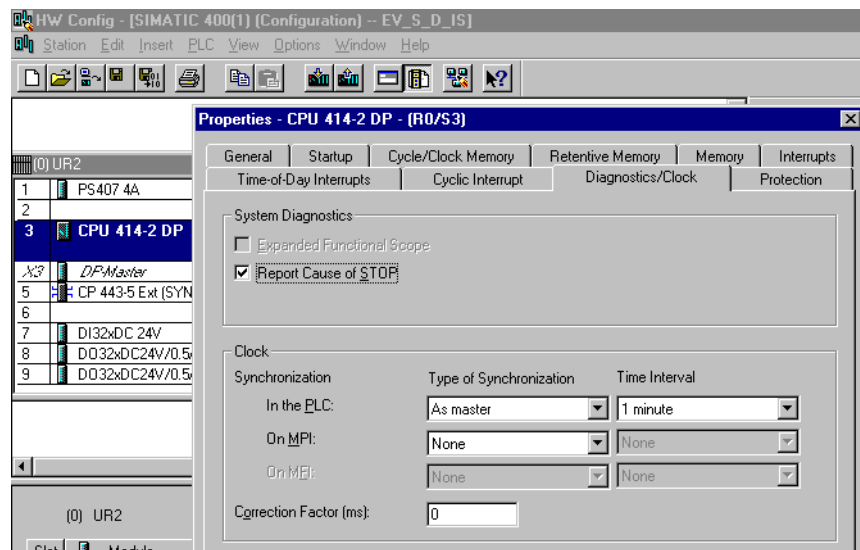


Figure 4-8 S7-400 PLC defined as master for time synchronization

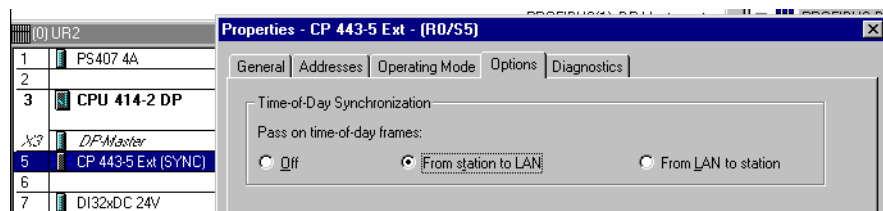


Figure 4-9 CP443-5 Extended - Time synchronization

4.4.2 Parameterization in DIGSI

Processing of time synchronization messages

The evaluation of time synchronization messages in the PROFIBUS-DP slaves of the SIPROTEC devices has to be enabled with the parameter `GlobalSection.DP_TimeSyncEnable` during the definition of bus specific parameters after selection of a bus mapping file (ref. to Figure 4-4)

Up to PROFIBUS-DP firmware V03.03.03 (for PROFIBUS modules up to HW revision 3) and V04.00.06 (for PROFIBUS modules from HW revision 4):

Value of DP_TimeSyncEnable	Meaning
0	PROFIBUS time synchronization messages are not evaluated.
1	PROFIBUS time synchronization messages are evaluated. Always the base time in the time synchronization message is used for time synchronization.

From PROFIBUS-DP firmware V03.04.01 (for PROFIBUS modules up to HW revision 3) and V04.01.01 (for PROFIBUS modules from HW revision 4):

Value of DP_TimeSyncEnable	Meaning
0	PROFIBUS time synchronization messages are not evaluated.
1	PROFIBUS time synchronization messages are evaluated. A PROFIBUS-DP master S7 CPU -2DP/-3DP (from V3.00): If the time synchronization messages contain a local time correction value (ref. to page 19, description to "TimeSy") then the base time plus the local time correction value is used for time synchronization.
2	Always the base time in the time synchronization message is used for time synchronization.

Additional from PROFIBUS-DP firmware V03.05.01 (for PROFIBUS modules up to HW revision 3) and V04.02.02 (for PROFIBUS modules from HW revision 4):

3	PROFIBUS time synchronization messages are evaluated. A PROFIBUS-DP master CP 443-5 Extended (from V6.00): If the time synchronization messages contain a local time correction value (ref. to page 19, description to "TimeSy") then the base time plus the local time correction value is used for time synchronization.
---	--



Note:

Please note, that depending on the used PROFIBUS-DP master unit (either SIMATIC S7 CPU -2DP/-3DP or CP 443-5 Extended) different settings for `GlobalSection.DP_TimeSyncEnable` are necessary in the SIPROTEC device for correct evaluation of the the local time correction value (see above).

Source of time synchronization

In the dialog window **Time Synchronization & Time Format** select **Profibus** as **Source of time synchronization** for the SIPROTEC device (ref. to Figure 4-10).

Monitoring

The SIPROTEC device continuously monitors the reception of time synchronization messages.

After expiry of the monitoring time **Fault indication after:** (ref. to Figure 4-10) without reception of an time synchronization message via PROFIBUS an error message "Clock SyncError" (Internal object no. = 68) is created.

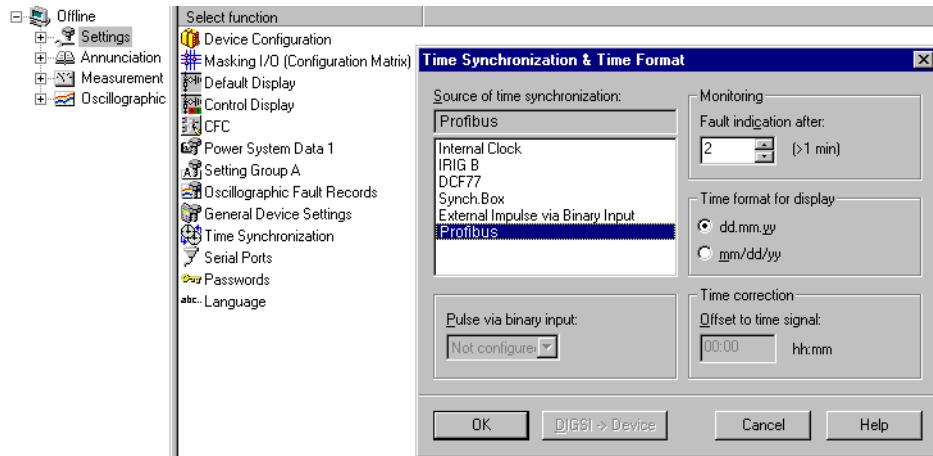


Figure 4-10 Source of time synchronization and Monitoring



Note:

DIGSI 4.21 does not offer **PROFIBUS** as **Source of time synchronization** yet if PROFIBUS-DP is selected as system interface.

Therefore this setting can only be changed using local control of the SIPROTEC device:

- MENU
- Settings → 4
- Setup/Extras → 10
- Clock Setup → 2
- Place the cursor in line "Source" and press ENTER button.
- Enter password for setting changes.
- Select **Profibus**, press ENTER button, wait for the completion of the settings check and confirm "Continue" after the settings check.

4.5 Using SFC14 and SFC15 in STEP7

Peripheral I/O access commands

The S7-CPU can read data from the connected PROFIBUS-DP devices or write data to these devices in the CPU program using peripheral access commands.

For reading a measured value (integer value, ref. to chap. 3.4) from a SIPROTEC device the following command can be used:

```
L PIW x
```

X determines the address of the measured value in the peripheral addressing range of the S7 CPU.

The above-named instruction has to be executed with the associated addresses e.g. five times in order to read five measured values.

After reading, every value has to be processed or to be copied in a data block for later processing in the S7 program:

```
L PIW x
T DB10.DBW y
...
```

SFC14, SFC15 and consistent data

Occasionally, the S7 system functions SFC14 (DPRD_DAT) and SFC15 (DPWR_DAT) shall be used for data transmission in the CPU program instead of peripheral I/O access commands.

These functions presuppose however that the data from and to the PROFIBUS-DP slave devices are configured as consistent blocks.

No consistent blocks are defined for configuration of the PROFIBUS-DP slaves of the SIPROTEC devices with the modules to be adjusted (e.g. Module: "Input 16 Bytes", ref. to chap. "Configuration data in the standard mapping" in the Bus mapping documentation of the respective SIPROTEC device) because:

- for transmission of data from and to the SIPROTEC device only data types with a data size of one, two or four bytes are used in general (ref. to chap. 3),
- access to word values (two bytes, e.g. measured values) and double-word values (four bytes, e.g. counters) is guaranteed as consistent automatically with associated peripheral access commands from the S7 CPU,
- access to data in consistent blocks is not possible with peripheral access commands.

Universal module

A "Universal module" is per default always offered in **HW Config** of STEP 7 at the parameterization of modular PROFIBUS-DP slaves.

With the "Universal module" it is possible to enter configuration data (including consistent blocks) independently of the module definitions in the GSD file.

The PROFIBUS-DP slave of the SIPROTEC devices accepts these configuration data within the number of input and output data bytes fixed in the standard mappings (including of consistent blocks up to a definite size, see below).

The SFC14 and SFC15 also can be used with that.



Note:

A consistent block for the PROFIBUS-DP slave of the SIPROTEC devices can contain maximum 16 byte values or 16 word values.

Parameterization - Specification of the data access

After selecting the standard mapping for the used SIPROTEC device, it is to define which data are to be read or written with peripheral access commands and which data with system functions SFC14/15.

The standard mapping determines the complete possible data size at this.

Example:

Standard mapping 3-2 of the devices 7SJ61...7SJ64, 6MD63 offers a data size of 48 bytes in input direction and 9 bytes in output direction (ref. to page 3, Bus mapping documentation of the above mentioned devices).

In input direction are transferred:

- Offset 0 to 15: single-point and double-point indications (one or two bits per value)
- Offset 16 to 35: measured values (integer values, 2 bytes)
- Offset 36 to 47: counters (unsigned long values, 4 bytes)

Possible definition in the S7 CPU program:

- write values in output direction with peripheral access commands,
- read single-point and double-point indications with peripheral access commands,
- read measured values and counters using SFC14 system function.

Parameterization - HW Config

The parameterization of the PROFIBUS net follows next, including the configuration of the connected SIPROTEC devices using the “Universal module” for definition of consistent data blocks.

Please note the maximum length of 16 word values of a consistent block for a PROFIBUS-DP slave of the SIPROTEC device.

If more data bytes shall be read with SFC14 then two (or more) consistent blocks are to define and the SFC is to call several times.

Continuation of the example:

Figure 4-11 shows the parameterization in **HW Config** using the “Universal module”.

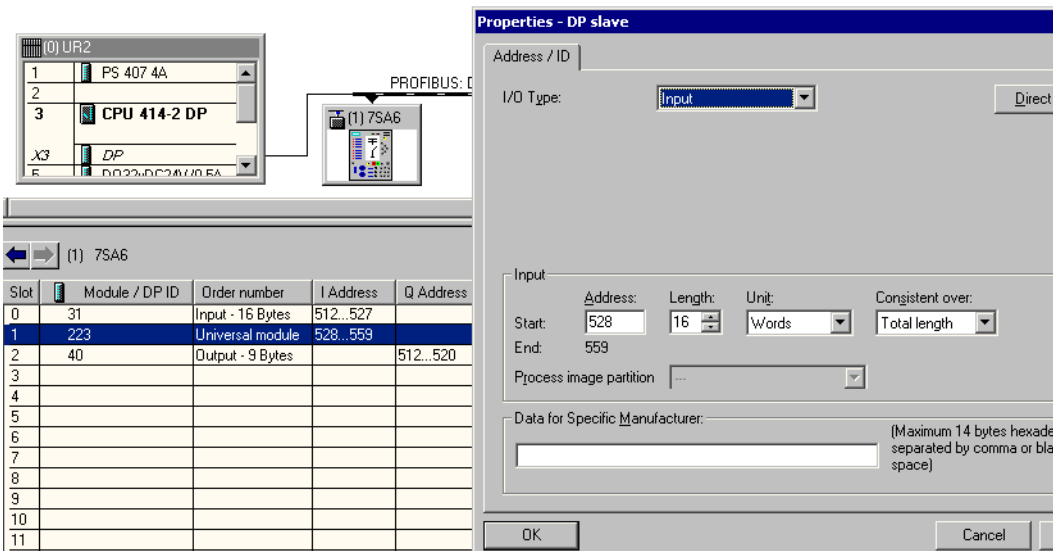


Figure 4-11 Consistent data block with “Universal module”



Note:

The evaluation of “Data for Specific Manufacturer” (ref. to Figure 4-11) is not supported by the PROFIBUS-DP slave of the SIPROTEC devices.
The associated edit box in the dialog window for parameterization with the “Universal module” has to be remain empty.

**Parameterization -
SFC call**

For storage of the data, which are to be read with SFC14 and to be written with SFC15, a data block has to be created.
Then the data exchange can be initiated by calling the system function in the S7 CPU program.

A description how to use SFC14 and SFC15 in a S7 CPU program you find among others in the following literature:

Weigmann, J.; Kilian, G.
Decentralization with PROFIBUS-DP/DPV1
Structure, configuration and use of PROFIBUS DP with SIMATIC S7
Siemens AG
Published by: Publicis Corporate Publishing Erlangen
2nd edition, 2003
ISBN: 3-89578-218-1

Continuation of the example:

A data block DB10 which contains an array of 16 word values was created.
The return-value of the function call is stored in MW100.
The start address of the module is $528_{\text{dez}} = 210_{\text{hex}}$ (ref. to Figure 4-11).

The following SFC14 function call is used to read the measured values and counters into data block DB10:

```
CALL SFC14
  LADDR    := W#16#210
  RET_VAL  := MW100
  RECORD   := P#DB10.DBX 0.0 WORD 16
```


Technical data

This chapter gives a summary about the technical data of the PROFIBUS-DP slave of the SIPROTEC device including the bus interface.

Two communication modules are available for the connection of PROFIBUS-DP to the SIPROTEC devices:

- PROFIBUS module with isolated RS485 interface (PSE module),
- PROFIBUS module with fibre-optical interface (PSO module).

5.1	Connection via the PSE module	84
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5.1 Connection via the PSE module

Connection	9-pole D-SUB outlet (ref. to Table 5-1)	
Protocol	semi-duplex	
Max. line length (depending on the transmission rate)	9.6 kB/s	1000 m
	19.2 kB/s	1000 m
	93.75 kB/s	1000 m
	187.5 kB/s	500 m
	500.0 kB/s	200 m
	1500.0 kB/s	200 m
	6000.0 kB/s	100 m
Insulation level	500 V _{AC}	
Bus termination	<p>On the PROFIBUS module: integrated, connectable terminating resistors</p> <ul style="list-style-type: none"> • 221 Ohm between RxD/TxD-P (B) and RxD/TxD-N (A) • 392 Ohm between RxD/TxD-P (B) and VCC1 as well as RxD/TxD-N (A) and GND1. <p>Input resistance not terminated ≥ 10 kOhm, then bus termination via bus plug with integrated terminating resistors</p>	
Level	<p>Transmitter:</p> <ul style="list-style-type: none"> • Low: $-5\text{ V} \leq V_{A-B} \leq -1.5\text{ V}$ • High: $+5\text{ V} \geq V_{A-B} \geq +1.5\text{ V}$ <p>Receiver:</p> <ul style="list-style-type: none"> • Low: $V_{A-B} \leq -0.2\text{ V}$ • High: $V_{A-B} \geq +0.2\text{ V}$ <p>Transmitter and receiver are surge-proof for voltages between A and GND1 as well as between B and GND1 in the range of $-7\text{ V} \dots +12\text{ V}$.</p>	
Cable	<p>Bus cable type A according to EN 50170, twisted and screened.</p> <p>SIMATIC NET PROFIBUS 6XV1 830</p>	
Plug	<p>SIMATIC bus connection plug for PROFIBUS 6GK1 500-0EA02 with axial cable output, resistor combination integrated and connectable by sliding switch.</p> <p>Dimensions (W x H x D) : 39 mm x 15 mm x 57 mm</p> <p>Depth incl. cable bending radius : approx. 120 mm</p> <p><i>Note:</i></p> <p>When angle plugs or plugs with non-axial output are used then the direction of the outgoing cable has to be coordinated with neighboring terminals and plugs.</p>	

Max. number of modules at the bus	<p>32</p> <p>For exclusive utilization of PSE modules at the bus. This value could be smaller depending on the used PROFIBUS-DP master and further modules at the bus. If more than 32 devices are needed, RS485 repeaters (e.g. 6ES7 972-0AA00-0XA0) have to be used.</p>
--	--

Bus connection

Pin	Signal	Meaning
1	Shield	Shield / Operational ground
2	-	-
3	RxD/TxD-P (B)	Reception data / Transmission data - positive
4	RTS/CNTR-P	Directions control (TTL level)
5	GND1	Data transmission level (ground towards VCC1)
6	VCC1	Supply voltage for terminating resistors (+5V DC, max. 100 mA)
7	-	-
8	RxD/TxD-N (A)	Reception data / Transmission data - negative
9	-	-

Table 5-1 Assignment of the bus connection at the device (D-SUB outlet)

OLM

Recommended OLM for external PROFIBUS - fibre-optic transformation:

SINEC L2 OLM V2

- OLM/S3 (6GK1 502-3AB10) with two RS485 and one fibre-optical channels,
- OLM/S4 (6GK1 502-4AB10) with two RS485 and two fibre-optical channels.

SIMATIC NET OLM V3

- OLM/G11 (6GK1 502-2CB10) with one RS485 and one fibre-optical channels,
- OLM/G12 (6GK1 502-3CB10) with one RS485 and two fibre-optical channels.

5.2 Connection via the PSO module

The following technical data are independent of the configured mode (OLM V2 or OLM V3, ref. to chap. 2.1.2) of the PSO module.

Connection	fibre-optical interface, Rx and Tx, 820 nm, BFOC/2.5 (ST plug)	
Protocol	semi-duplex	
Max. line length	<ul style="list-style-type: none"> • 2000 m / 1.25 miles for point-to-point connections and glass fibre 62.5/125 µm, • Redundant optical ring topology and glass fibre 62.5/125 µm: <ul style="list-style-type: none"> – 9.6 kB/s ... 187.5 kB/s → 2000 m – 500 kB/s → 1600 m – 1500 kB/s → 530 m • 2 m for plastic fibre 	
Baud rate	max. 1500.0 kB/s	
Max. number of modules in one optical ring (depending on the baud rate)	9.6 kB/s	140
	19.2 kB/s	129
	93.75 kB/s	81
	187.5 kB/s	55
	500.0 kB/s	41
	1500.0 kB/s	41
Optical receiver sensitivity	-24 dBm for glass fibre 62.5/125 µm	
Optical budget	min. 8 dB for glass fibre 62.5/125 µm	
Status for “no signal”	light OFF	



Attention!

Please note for optical communication modules up to HW revision 3 and for optical communication modules from HW revision 4 which work in the OLM V2 mode (ref. to chap. 2.1.2):

If the fibre-optical PROFIBUS modules of the SIPROTEC device operate together with the OLM/G12 of the OLM V3 family then the compatibility mode of the OLM/G12 has to be switched on (DIL switch S7 = 1).

The PROFIBUS interfaces of the fibre-optical modules of the SIPROTEC devices support the redundancy function implemented in OLM V2 family which differs to the implementation in the OLM V3 family.

With compatibility mode switched on, an OLM V3 behaves like an OLM V2.

An incorrect setting results in a faulty data transmission.



Note:

The PSO module is configured to communicate in a redundant optical ring (two fibre ring) in OLM V2 mode by default.

For an OLM/S4 or OLM/G12 (in compatibility mode) used within such a ring topology this corresponds to the following DIL switch settings:

OLM/S4

- S1 (Mode) = 0,
- S2 (Redundancy) = 1 and
- S5 (Opt. Power/Dist.) = 0

OLM/G12 (in compatibility mode, S7 = 1)

- S1 (Mode) = 0,
- S2 (Redundancy) = 1 and
- S3 (Distance) = 1

Please note for parameterization of a PROFIBUS-DP communication with redundant optical ring topology:

- every optical SIPROTEC communication module (PSO module) contains an OLM,
- the parameters “Retry limit” and “Slot time (t_{slot})” have to be set to correct values in the PROFIBUS-DP master.
 - Set “Retry limit” at least equal to 3.
 - You get the correct value for “Slot time” if you enter for “Number of OLM” in the Network settings in the parameterization system of the PROFIBUS-DP master the number of OLM/S4 or OLM/G12 devices plus the number of connected optical communication modules of the SIPROTEC devices.

Example

Redundant optical ring with nine SIPROTEC devices (with optical communication modules) and one OLM/G12 for the connection of the PROFIBUS-DP master.

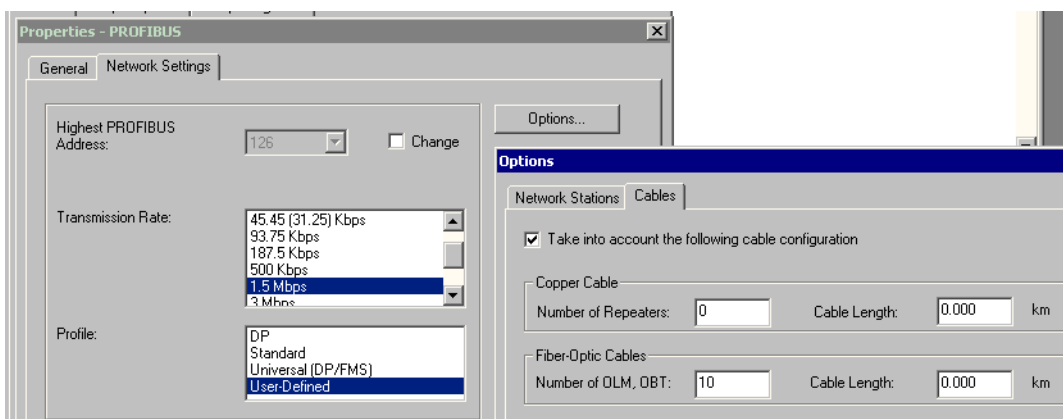


Bild 5-1 PROFIBUS parameterization - Number of OLM

Glossary

CFC	Continuous Function Chart
DC	Double command
DDB file / GSD file	<p>The DDB file contains the Device Data Base (technical characteristics) of the PROFIBUS-DP communication module (PROFIBUS-DP slave).</p> <p>This file is required for configuration of the PROFIBUS-DP master and is supplied together with DIGSI.</p>
DIGSI	Parameterization system / parameterization software for SIPROTEC devices
DP	Double-point indication
HW	Hardware
Input data / Input direction	Data from the PROFIBUS-DP slave to the PROFIBUS-DP master.
Octet	Term from EN 50170, one octet corresponds to 8 bits.
OLM	Optical Link Module
Output data / Output direction	Data from the PROFIBUS-DP master to the PROFIBUS-DP slave.
PLC	Programmable Logic Controller
PNO	PROFIBUS Nutzerorganisation / PROFIBUS International Organization (PI)
PROFIBUS-DP	PROFIBUS - Decentralized Peripherals
PSE	PROFIBUS interface module with (electrical) isolated RS485 interface for the SIPROTEC devices from Siemens.
PSO	PROFIBUS interface module with fibre-optical interface for the SIPROTEC devices from Siemens.
SC	Single command

SOE	Sequence of events (Event list / Event recorder via PROFIBUS DP)
SP	Single-point indication
TC	Transformer tap change command
TM	Transformer tap position indication / Transformer tap message

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