

SIPROTEC

Multifunction Overcurrent
and Motor Protection Relay
7SJ602

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Specification and Mapping

Revision 1.0

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

We appreciate any suggested improvements.

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Preface

Purpose of this manual

The manual describes the functions, bus specific parameters, parameterization and the hardware interface of the PROFIBUS-DP slave of the SIPROTEC devices 7SJ602 and is divided into the following topics:

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

General details about the function, operation, assembly and commissioning of the SIPROTEC device 7SJ602 you find in the

- 7SJ602 Instruction Manual, order no. C53000–G1176–C125.

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:

- 7SJ602 (firmware version 3.50 or higher),
with PROFIBUS communication module from HW revision 4 and
- PROFIBUS-DP firmware version 04.00.06 or higher.

For device parameterization has to be used:

- DIGSI from version 4.50.

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!

During operation of electrical equipment, certain parts of these devices are under high voltage. Severe personal injury or significant equipment damage could result from improper behaviour.

Only qualified personnel should work on this equipment or in the vicinity of this equipment. These personnel must be familiar with all warnings and service procedures described in this manual, as well as with safety regulations.

Prerequisites to proper and safe operation of this product are proper transport, proper storage, setup, installation, operation, and maintenance of the product, as well as careful operation and servicing of the device within the scope of the warnings and instructions of this manual.

In particular, the general facility and safety regulations for work with high-voltage equipment (e.g. ANSI, IEC, EN, or other national or international regulations) must be observed. Noncompliance may result in death, injury or significant equipment damage.

QUALIFIED PERSONNEL

Within the meaning of safety precautions of this manual and the instructions, qualified personnel are those persons who are qualified to set up, install, place into service, and operate this device, and who possess the following qualifications:

- Training and instruction (or other qualification) for switching, grounding, and designating devices and systems.
- Training or instruction in accordance with safety standards for care and use of certain safety equipment.
- First aid training.

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.

„Announcements“, 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-L1876-B012-03 March 22 nd , 2004

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PROFIBUS-DP Communication modules

1

This chapter shows the hardware and software necessary for PROFIBUS-DP communication with the SIPROTEC device 7SJ602.

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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 device 7SJ602:

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

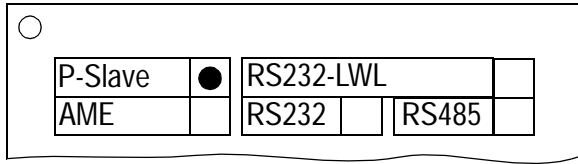
There exist two different hardware revisions for PROFIBUS communication modules:

- 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

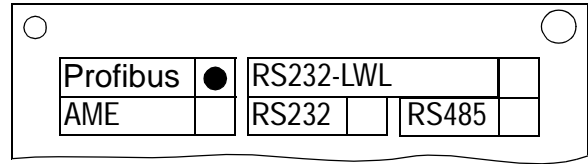
The hardware revision of the PROFIBUS communication modules is also recognizable in build-in condition at the rear of the SIPROTEC device at the labelling of the communication module mounting bracket:

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

PROFIBUS RS485 (PSE module)

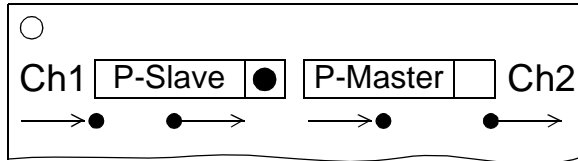


up to HW revision 3

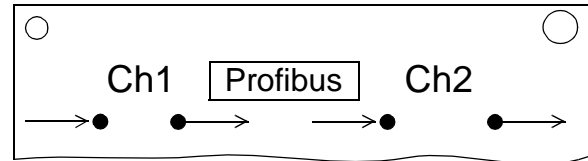


from HW revision 4

PROFIBUS fibre-optical, double loop (PSO module)



up to HW revision 3



from HW revision 4

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



Attention!

Exclusively PROFIBUS communication modules from HW revision 4 have to be used in the SIPROTEC device 7SJ602.

PROFIBUS communication modules from HW revision 4 require PROFIBUS-DP firmware version 04.00.06 or higher.

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.

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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 Parameter block 72 of the 7SJ602.

2.1.1 PROFIBUS-DP settings

Slave address TNR = 7250, "72DpSI Ad"

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

GSD file and PNO identification number

The DDB file/GSD file is necessary for parameterization of the des PROFIBUS-DP master and describes the technical characteristics of the PROFIBUS-DP slave device.



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.
-

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

"Additional field devices - General - SIPROTEC".

Depending on the chosen connection of the PROFIBUS net to the SIPROTEC device (ref. to chap. 5) one of the following GSD files has to be selected:

PNO identification number	Connection	Device name	DDB file / GSD file
0x80A1	isolated RS485 interface (PSE module)	"SIPROTEC4 - DP Modul_HWRev4"	"si1_80a1.gsd"
0x80BC	Fibre-optical interface (PSO module)	"SIPROTEC4 - DP Fibre_HWRev4"	"si1_80bc.gsd"

Table 2-1 DDB files/GSD files, device names and PNO identification number of the PROFIBUS communication module for SIPROTEC devices

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

TNR = 7251, "72DpTsEn"

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. 2.4 for further information about parameter settings of time synchronization via PROFIBUS.

2.1.2 Configuration of the fibre-optical interface

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

Every of this parameter corresponds to a DIL switch setting at the Optical Link Module OLM/S4 or OLM/G12 for external PROFIBUS to fibre-optical transformation (ref. to chap. 5.1).

Operating mode / Monitor mode

TNR = 7252, "72Dp0Mod"

Oper. mode	Meaning
"V2Mode0"	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. 2.2.2). For "Redundancy function" = 1, "Operating mode" always has to be set to 0.
"V2Mode1"	OLM V2 compatible, Mode 1: Select Mode 1 if PROFIBUS devices are conneted to the bus which do not transmit, expect or accept an echo for line-break supervision.
"V3Mode0"	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. 2.2.2).
"V3Mode1"	OLM V3 compatible: 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 OLM V2 Modes to DIL switch S1 at the OLM/S4 or OLM/G12 (in compatibility mode).

The parameter corresponds for OLM V3 Modes 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

TNR = 7253, "72Dp0Red"

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

Network size

TNR = 7254, "72Dp0Net"

*Note:*

The value of "Network size" is only relevant if a configuration with OLM V2 compatible mode (see above, "Operating mode") 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" (72Dp0Net = Std) or "Extended" (72Dp0Net = Ext) 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).

*Note:*

- The **settings for the configuration of the fibre-optical interface have to be identical** for all Optical Link Modules (OLM/S4 or 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 connecting SIPROTEC devices via optical communication modules to PROFIBUS-DP.

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

2.2.1 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 "OfProfi" (Operational fault of Port PROFIBUS) in the SIPROTEC device is set to ON.
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 "OfProfi" (Operational fault of Port PROFIBUS) in the SIPROTEC device is set to OFF.
2. The data from the messages which are now again received by the PROFIBUS-DP master are registered.

If the switching device status of the SIPROTEC devices and the status of protective functions 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.



Note:

The following conditions set the tagging "OfProfi" (Operational fault of Port PROFIBUS) 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 "OfProfi" is only set if in the output message to the SIPROTEC device at least one bit was set before reception of "Clear Data".
-

2.2.2 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 are offered:

- "OfOI mCA" (Operational fault of OLM Channel A)
- "OfOI mCB" (Operational fault of OLM Channel B).



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 OLM status indications exist also in 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.

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 REMOTE control is locked) is recognized by the PROFIBUS-DP master from a discrepancy between the checkback signal of the command in the PROFIBUS-DP input message and the requested switching status. 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.



Note:

It is recommended to use impulses for the initiation of commands or for manipulation of protective functions via PROFIBUS-DP:

- "Quiescent status" → ON → "Quiescent status" for the ON command
- "Quiescent status" → OFF → "Quiescent status" for the OFF command.

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.

2.3 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 = 1134) 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.

2.4 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,
- the evaluation of time synchronization messages in the PROFIBUS-DP slave is enabled.

2.4.1 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 2-1):

- Synchronization in the PLC: "As master"
- Time Interval: "1 minute"
- 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 2-2):

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



Note:

The following time intervals between time synchronization messages are possible:

1...15 seconds, 17...20 seconds, 26...30 seconds, 51...60 seconds

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

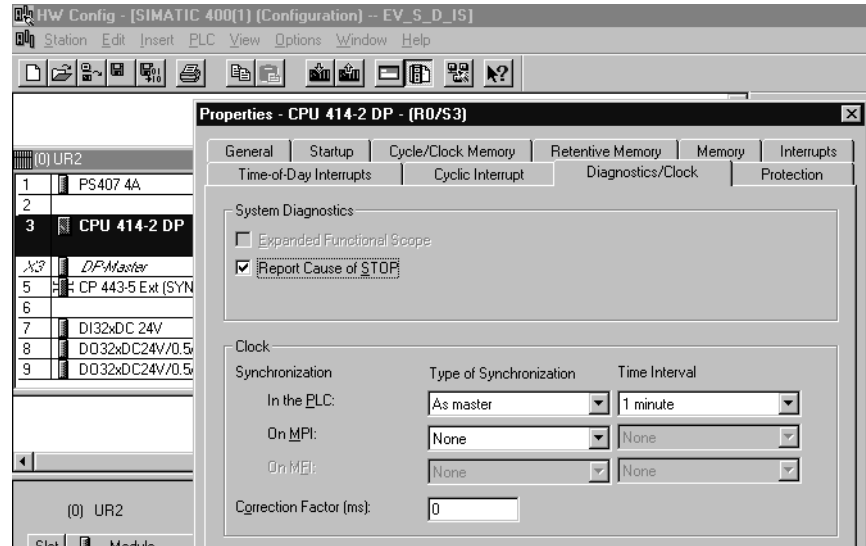


Figure 2-1 S7-400 PLC defined as master for time synchronization

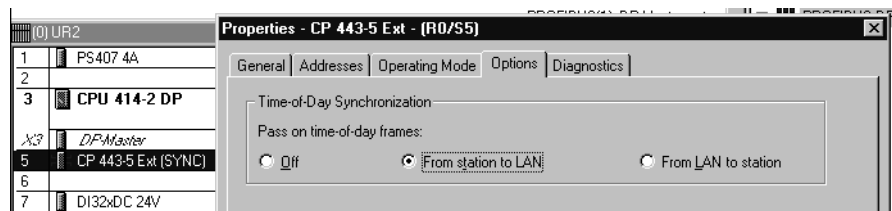


Figure 2-2 CP443-5 Extended - Time synchronization

2.4.2 Parameterization in the device

Processing of time synchronization messages

The evaluation of time synchronization messages in the PROFIBUS-DP slaves of the SIPROTEC devices has to be enabled during the definition of bus specific parameters (ref. to chap. 2.1.1)

Set the parameter $TNR = 7251$, "72DpTsEn" to 1.

Data type definitions

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

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3.3	Measured value (signed integer)	3-4
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3.1 Single-point indication (SP, Input)

Number of byte-values $1/8$ (1 bit)

Range of values
0 - OFF
1 - ON

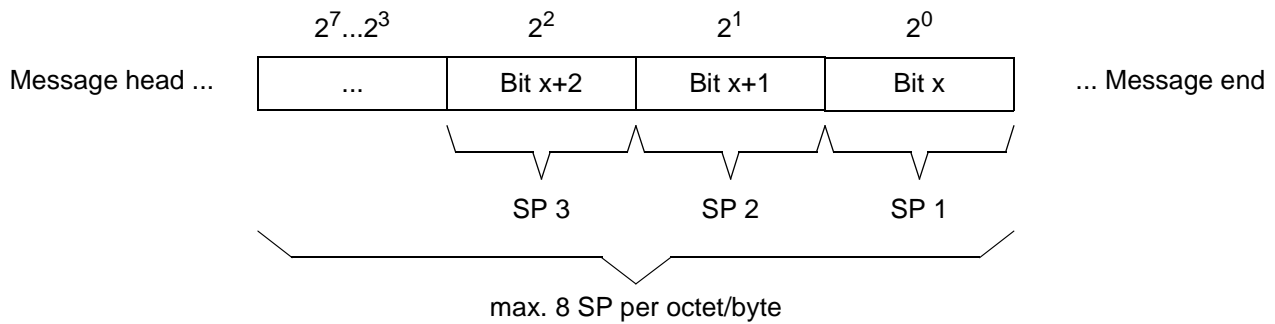


Figure 3-1 Data type: Single-point indication

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 (also ref. to chap. 2.2.3).

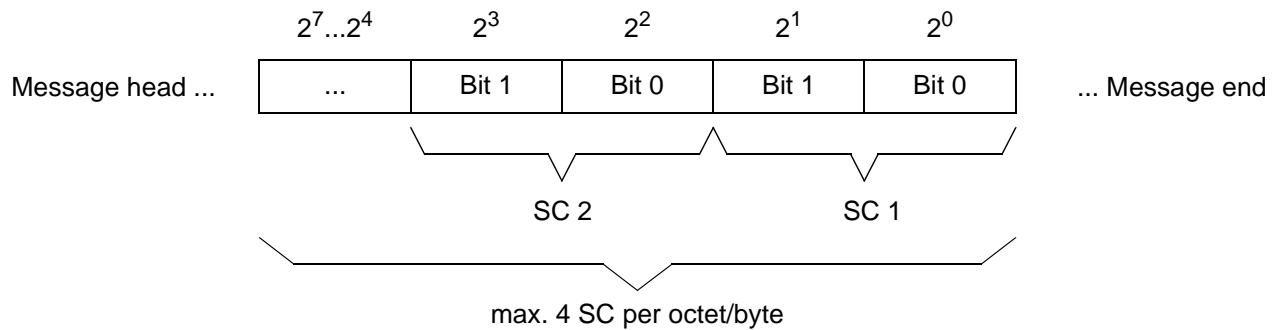


Figure 3-2 Data type: Single command

3.3 Measured value (signed integer)

Number of byte-values 2

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

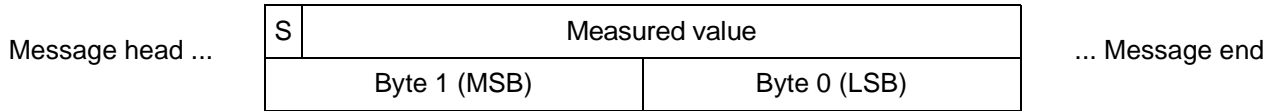


Figure 3-3 Data type: Measured value (signed integer)

- 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.

3.4 Metered measurand (unsigned long)

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

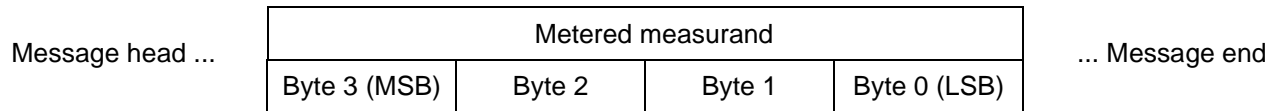


Figure 3-4 Data type: Metered measurand (unsigned long)



Note:

The overflow of the metered measurands is 2 000 000 000 (77359400_{hex}).

Data in the PROFIBUS-DP message

This chapter describes the data in the PROFIBUS-DP messages between the PROFIBUS-DP master and the SIPROTEC devices 7SJ602 and delivers notes for the configuration of 7SJ602 in the PROFIBUS-DP master.

4.1	Explanations	4-2
4.2	PROFIBUS-DP configuration data	4-3
4.3	Message in output direction	4-4
4.4	Message in input direction	4-7

4.1 Explanations

Chapter 4.3 and 4.4 define the data area of the PROFIBUS-DP messages for data transfer between the PROFIBUS-DP slave of the SIPROTEC devices 7SJ602 and the PROFIBUS-DP master.

The listed SIPROTEC objects in the PROFIBUS-DP messages' data area are sorted after byte offset, beginning with 0.

Variables with data type greater than or equal to 1 byte The offset defines the start of the most significant byte in the message, e.g.:

Offset	Designation	Comments	Scaling (32767 corresponds to...)	Internal object no.
30	IL1 =	Current in phase L1	ref. to Table 4-2	651

The measured value " I L1 =" is assigned to data byte 30 (most significant byte of the measured value) and data byte 31 (least significant byte of the measured value) in the PROFIBUS-DP message

Bit variables (SP/SC, DP/DC) The offset indicates the byte which contains the bit value and the position of bit 0 of the bit variable, e.g. (input message):

Offset	Designation	Comments	Internal object no.
1 / 7	DEV.Trp	1 = General trip of device	511

The single-point indication " DEV. Trp" is located in byte 1, bit position 2⁷.

4.2 PROFIBUS-DP configuration data

The 7SJ602 offers via PROFIBUS-DP a data size of:

- 5 bytes in output direction
- 46 bytes in input direction

This corresponds to the PROFIBUS-DP configuration data

1FH 1FH 1DH 24H

PROFIBUS-DP master

At the configuration of a PROFIBUS-DP slave of the SIPROTEC devices in the parameterization system of the PROFIBUS-DP masters are to select the following modules for the 7SJ602 and to allocate associated addresses in the I/O addressing range of the PROFIBUS-DP master:

Module	Order number	Input address	Output address
0	Input - 16 Bytes	Adr_Ix	
1	Input - 16 Bytes	Adr_Ix + 16	
2	Input - 14 Bytes	Adr_Ix + 32	
3	Output - 5 Bytes		Adr_Ox

Adr_Ix and Adr_Ox indicate arbitrary (as a rule even) addresses in the I/O addressing range of the PROFIBUS-DP master.

Adr_Ix (base address of the inputs) is identical with offset 0 of the PROFIBUS-DP message data of the SIPROTEC device in input direction (ref. to chap. 4.4).

Adr_Ox (base address of the outputs) is identical with offset 0 of the PROFIBUS-DP message data of the SIPROTEC device in output direction (ref. to chap. 4.3).



Note:

There is dependently on the PROFIBUS-DP master in addition possibly the demand to put the base address of the inputs on a value divisible by four so that accesses on the metered measurands (unsigned long values, ref. to chap. 4.4.2) can be correctly carried out in the PROFIBUS-DP master.

4.3 Message in output direction

The messages in PROFIBUS-DP output direction allow:

- command outputs through the output relays,
- manipulation of protective functions (blocking, ...).



Note:

Depending on the device composition there may be less than indicated PROFIBUS-DP message positions available in the SIPROTEC device.

4.3.1 Earth fault protection

Offset	Designation	Comments	FNo.
0 / 0	>UE bl (OFF)	>Block displacement voltage stage U_E >	1201
0 / 1	>UE bl (ON)		
0 / 2	<reserved>	not used	-
0 / 3			

4.3.2 Circuit breaker failure protection

Offset	Designation	Comments	FNo.
0 / 4	>BF blo (OFF)	>Block circuit breaker failure protection	1403
0 / 5	>BF blo (ON)		
0 / 6	>BF St (OFF)	>Initiate (start) circuit breaker failure protection from external	1431
0 / 7	>BF St (ON)		

4.3.3 Thermal overload protection

Offset	Designation	Comments	FNo.
1 / 0	>O/Lblk (OFF)	>Block thermal overload protection	1503
1 / 1	>O/Lblk (ON)		

4.3.4 Time overcurrent protection

Offset	Designation	Comments	FNo.
1 / 2	>O/Cpbk (OFF)	>Block overcurrent protection	1704
1 / 3	>O/Cpbk (ON)		
1 / 4	>O/Cebk (OFF)	>Block overcurrent protection earth	1714
1 / 5	>O/Cebk (ON)		
1 / 6	>C/O (OFF)	>C/O of overcurrent fault detec. level	1727
1 / 7	>C/O (ON)		

4.3.5 Automatic reclosure

Offset	Designation	Comments	FNo.
2 / 0	>AR St. (OFF)	>AR: Start external	2732
2 / 1	>AR St. (ON)		
2 / 2	>ARbISt (OFF)	>AR: External Blocking of Start	2733
2 / 3	>ARbISt (ON)		
2 / 4	>ARbICI (OFF)	>AR: External Blocking of reclosure	2734
2 / 5	>ARbICI (ON)		

4.3.6 Circuit breaker

Offset	Designation	Comments	FNo.
2 / 6	Q0 Ctr. (OFF)	Circuit breaker control	4642
2 / 7	Q0 Ctr. (ON)		

4.3.7 Restart lockout for motors

Offset	Designation	Comments	FNo.
3 / 0	>MSP bl (OFF)	>Block motor restart lock-out	4822
3 / 1	>MSP bl (ON)		
3 / 2	>MSP em (OFF)	>Emergency start information for motor restart lock-out	4823
3 / 3	>MSP em (ON)		

4.3.8 Unbalanced load protection

Offset	Designation	Comments	FNo.
3 / 4	>I2 blk (OFF)	>Block unbalanced load protection	5143
3 / 5	>I2 blk (ON)		

4.3.9 Start-up time monitoring for motors

Offset	Designation	Comments	FNo.
3 / 6	>SRT bk (OFF)	>Block starting time supervision	6801
3 / 7	>SRT bk (ON)		

4.3.10 Trip circuit supervision

Offset	Designation	Comments	FNo.
4 / 0	>SUP bk (OFF)	>Blocking trip circuit supervision	6851
4 / 1	>SUP bk (ON)		

Offset	Designation	Comments	FNo.
4 / 2	<reserved>	not used	-
4 / 3			
4 / 4	<reserved>	not used	-
4 / 5			
4 / 6	<reserved>	not used	-
4 / 7			

4.4 Message in input direction

The messages in PROFIBUS-DP input direction allow:

- polling of switching devices' status and binary inputs,
- transmission of annunciations, measurands and meter values to the PROFIBUS-DP master.

4.4.1 Annunciations



Note:

Depending on the device composition and the existing protection packages not all of the indicated protection annunciations (and corresponding PROFIBUS-DP message positions) may be available in the SIPROTEC device.

4.4.1.1 User defined annunciation

Offset	Designation	Comments	FNo.
0 / 0	>Annu.1	1 = >User defined annunciation 1 = ON	11
0 / 1	>Annu.2	1 = >User defined annunciation 2 = ON	12
0 / 2	>Annu.3	1 = >User defined annunciation 3 = ON	13
0 / 3	>Annu.4	1 = >User defined annunciation 4 = ON	14

4.4.1.2 Status annunciations

- Ref. to chap 2.2.2 for notes regarding the annunciations "OfOl mCA" and "OfOl mCB"

Offset	Designation	Comments	FNo.
0 / 4	operat.	1 = Any protection operative	52
0 / 5	Meas.Blk	1 = Logging and measuring functions blocked	61
0 / 6	FailΣI	1 = Failure: Current summation supervision	162
0 / 7	BatFail	1 = Battery failure; low battery	177
1 / 0	RemBlk	1 = Remote control is blocked	235
1 / 1	OfOl mCA	1 = Operational fault of OLM Channel A	237
1 / 2	OfOl mCB	1 = Operational fault of OLM Channel B	238
1 / 3	OfClkSy	1 = Operation fault of clock synchronization	239

Offset	Designation	Comments	FNo.
1 / 4	IL< al	1 = Undercurrent alarm IL<	284
1 / 5	Sys.Flt	1 = Fault in the power system	301
1 / 6	FT det	1 = General fault detection of device	501
1 / 7	DEV.Trp	1 = General trip of device	511
2 / 0	Data valid	1 = Data in the PROFIBUS-DP message are valid. (This indication is created by the PROFIBUS-DP slave; not available in the 7SJ602)	-

4.4.1.3 Circuit breaker

Offset	Designation	Comments	FNo.
2 / 1	>CBclo	1 = >Circuit breaker closed	1157

4.4.1.4 Earth fault protection

Offset	Designation	Comments	FNo.
2 / 2	EFDetOf	1 = Earth fault protection is switched off	1211
2 / 3	FD UE	1 = Pick-up (fault detection) of displacement voltage stage $U_{E>}$	1215
2 / 4	Trip UE	1 = Trip by displacement voltage stage $U_{E>}$	1217
2 / 5	<reserved>	= 0	-
2 / 6	<reserved>	= 0	-
2 / 7	<reserved>	= 0	-
3 / 0	<reserved>	= 0	-
3 / 1	EFfor	1 = Earth fault (non-earthed system) in forward direction	1276
3 / 2	EFrev	1 = Earth fault (non-earthed system) in reverse direction	1277
3 / 3	EFundef	1 = Earth fault (non-earthed system) direction undefined	1278

4.4.1.5 Circuit breaker failure protection

Offset	Designation	Comments	FNo.
3 / 4	BF off	1 = Circuit breaker failure protection is switched off	1451
3 / 5	BF bloc	1 = Circuit breaker failure protection is blocked	1452
3 / 6	BF Trip	1 = Trip by circuit breaker failure protection	1471

4.4.1.6 Thermal overload protection

Offset	Designation	Comments	FNo.
3 / 7	O/L off	1 = Thermal overload protection is switched off	1511
4 / 0	O/L blk	1 = Thermal overload protection is blocked	1512
4 / 1	O/L wrn	1 = Thermal overload protection: Thermal warning	1516
4 / 2	O/L Trp	1 = Thermal overload protection trip	1521

4.4.1.7 Time overcurrent protection

Offset	Designation	Comments	FNo.
4 / 3	O/Cpoff	1 = Overcurrent protection phase is switched off	1751
4 / 4	O/Ceoff	1 = Overcurrent protection earth is switched off	1756
4 / 5	O/Ceact	1 = Overcurrent protection earth is active	1758
4 / 6	O/C L1	1 = Overcurrent fault detection phase L1	1762
4 / 7	O/C L2	1 = Overcurrent fault detection phase L2	1763
5 / 0	O/C L3	1 = Overcurrent fault detection phase L3	1764
5 / 1	O/C E	1 = Overcurrent fault detection earth	1765
5 / 2	Trp l>>	1 = Overcurrent protection l>> phase trip	1805
5 / 3	Trip l>	1 = Overcurrent protection l> phase trip	1815
5 / 4	FD Ip	1 = Overcurrent fault detection Ip	1820
5 / 5	Trip Ip	1 = Overcurrent protection Ip phase trip	1825
5 / 6	Trp lE>>	1 = Overcurrent protection lE>> earth trip	1833
5 / 7	Trp lE>	1 = Overcurrent protection lE> earth trip	1836
6 / 0	Trp lEp	1 = Overcurrent protection lEp earth trip	1839
6 / 1	FD dyn	1 = Overcurrent protection: dynamic parameters active	1850

4.4.1.8 Automatic reclosure

Offset	Designation	Comments	FNo.
6 / 2	AR act.	1 = AR: Auto reclosure is active	2736
6 / 3	AR off	1 = AR: Auto reclose is switched off	2781
6 / 4	AR ClCm	1 = AR: Close command from auto reclose	2851
6 / 5	AR dTrp	1 = AR: Definitive trip	2863

4.4.1.9 Restart lockout for motors

Offset	Designation	Comments	FNo.
6 / 6	MSP off	1 = Motor restart lock-out is switched off	4824
6 / 7	MSP blk	1 = Motor restart lock-out is blocked	4825
7 / 0	MSP tri	1 = Trip by motor restart lock-out	4827

4.4.1.10 Unbalanced load protection

Offset	Designation	Comments	FNo.
7 / 1	I2 off	1 = Unbalanced load protection is switched off	5151
7 / 2	Trp I2	1 = neg. seq. I. (I2) prot.: Trip	5170

4.4.1.11 Start-up time monitoring for motors

Offset	Designation	Comments	FNo.
7 / 3	SRT off	1 = Starting time supervision off	6811
7 / 4	SRT Trp	1 = Trip by supervision of starting time	6821

4.4.1.12 Trip coil monitor

Offset	Designation	Comments	FNo.
7 / 5	CIR int	1 = Trip circuit interrupted	6865

Offset	Designation	Comments	FNo.
7 / 6	<reserved>	= 0	-
7 / 7	<reserved>	= 0	-

4.4.2 Metered measurands

Metered measurands are transferred via PROFIBUS-DP as primary values.

The data type of metered measurands is unsigned long (ref. to chap. 3.4).

Offset	Designation	Comments	Scaling (1 corresponds to ...)	FNo.
8	Wp pos =	Active energy Wp positiv	1 kWh	891
12	Wp neg =	Active energy Wp negativ	1 kWh	892
16	Wq pos =	Reactive energy Wq positiv	1 kVARh	921
20	Wq neg =	Reactive energy Wq negativ	1 kVARh	927

4.4.3 Measured values

Scaling

The scaling of the measured values (integer values, ref. to chap. 3.3) which are transferred as primary values depends on the nominal values of the primary equipment:

Adjustment range U_N / kV	Scaling UL1E, UE (32767 corresponds to ...)
0.10 ... 2.50	3276.7 V
2.51 ... 25.00	32767 V
25.01 ... 250.00	327.67 kV
250.01 ... 400	3276.7 kV

Table 4-1 Scaling of the voltages

Adjustment range I_N / A	Scaling IL1...IL3, IE (32767 corresponds to ...)
10 ... 1365	3276.7 A
1366 ... 13650	32767 A
13651 ... 50000	327.67 kA

Table 4-2 Scaling of the currents

Offset	Designation	Comments	Scaling (32767 corresponds to...)	FNo.
24	P =	Active power	3276.7 %	641
26	Q =	Reactive power	3276.7 %	642
28	S =	Apparent power	3276.7 %	645
30	IL1 =	Current in phase L1	s. Table 4-2	651
32	IL2 =	Current in phase L2	s. Table 4-2	652
34	IL3 =	Current in phase L3	s. Table 4-2	653
36	IE =	Earth current	s. Table 4-2	654
38	UL1E =	Voltage line to earth	s. Table 4-1	671
40	UE =	Displacement voltage	s. Table 4-1	677
42	<reserved>	= 0	-	-
44	CosPhi =	Power factor	32.767	901

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	5-2
5.2	Connection via the PSO module	5-4

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 neighbouring terminals and plugs.</p>	

Max. number of modules at the bus	<p>32</p> <p>For exclusive utilisation 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 moduls 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	



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 modul (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.

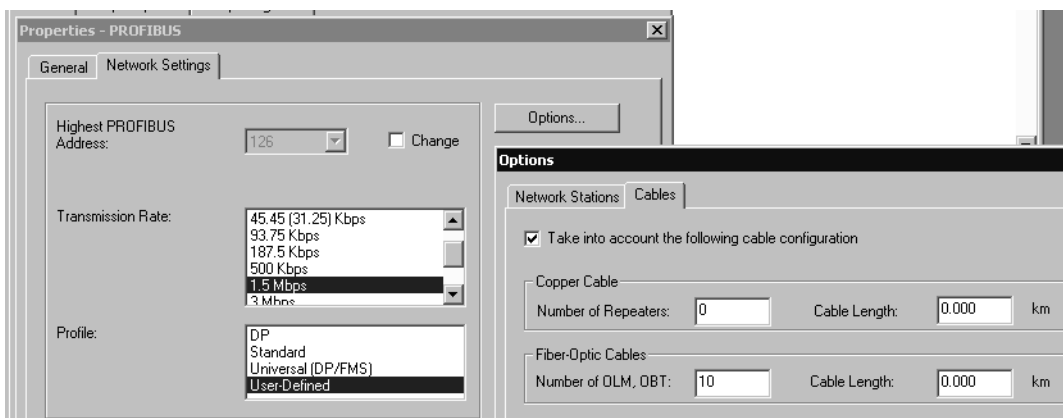


Bild 5-1 PROFIBUS parameterization - Number of OLM

Glossary

CFC	Continuous Function Chart
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
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
SP	Single-point indication

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Validity of the manualP-i

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D-13623 Berlin
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Corrections/Suggestions

Subject to technical alteration

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