PSI-MOS-PROFIB/FO…

Fiber optic converter for PROFIBUS up to 12 Mbps

INTERFACE

Data sheet
101972_en_08

1 Description

PSI-MOS-PROFIB/FO… devices convert copper-based PROFIBUS DP interfaces to fiber optics. The devices can also be used in MPI networks (not in ring structures). A transparent protocol is used to convert all transmission speeds up to a maximum of 12 Mbps. The integrated optical diagnostics enable fiber optic paths to be monitored continuously during installation and even during operation. The floating switch contact is activated when the signal level on the fiber optic paths reaches a critical value. This early alarm generation enables critical system states to be diagnosed before they result in failure.

The main advantage of this system is the electrically isolated connection of devices, which prevents the negative effects of voltage equalization currents and electromagnetic interference on the data cables. This increases the overall availability of the system, and improves flexibility in terms of the design of the bus topology in a linear, star, tree or ring structure.

PSI-MOS-PROFIB/FO… **E termination devices** convert a PROFIBUS interface to a fiber optic cable. They are ideal for point-to-point connections.

PSI-MOS-PROFIB/FO… **T T-couplers** convert to two fiber optic cables. They can be used to create redundant bus topologies for increased system availability.

In addition, modular star distributors can be created from both device versions. In this case, the required devices are snapped onto DIN rail connectors, which ensure that the supply voltage and data signals are routed through.

Virtually any cascadable star and tree structures, which are only limited by the maximum permissible signal runtime of the relevant application, can be created using integrated bit retiming.

Devices with different transmission technologies (polymer, HCS, and glass fiber) can be freely combined within a star coupler.

PSI-MOS-PROFIB/FO 660 ... devices are networked using polymer fiber cable for distances up to 70 m and HCS fiber cable for up to 400 m. They are connected via F-SMA quick mounting connectors, which can be assembled locally within a few minutes. **PSI-MOS-PROFIB/FO 850 ...** devices are available for longer paths and can be used for distances up to 800 m using HCS fiber cable and B-FOC fast connection technology and up to 3300 m using multi-mode glass fiber cable.

If you have any technical problems, which you cannot resolve with the aid of this documentation, please contact us during the usual office hours at:

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Make sure you always use the latest documentation.
It can be downloaded at www.phoenixcontact.net/catalog.

This data sheet is valid for all products listed on the following page:

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2 Ordering data

Fiber optic converters

Description	Type	Order No.	Pcs./Pkt.
Termination device with one fiber optic interface			
Fiber optic converter with integrated optical diagnostics, alarm contact, for PROFIBUS up to 12 Mbps			
660 nm, for polymer/HCS fiber cable, F-SMA	PSI-MOS-PROFIB/FO 660 E	2708290	1
850 nm, for glass fiber cable, B-FOC (ST®)	PSI-MOS-PROFIB/FO 850 E	2708274	1
T-coupler with two fiber optic interfaces			
Fiber optic converter with integrated optical diagnostics, alarm contact, for PROFIBUS up to 12 Mbps			
660 nm, for polymer/HCS fiber cable, F-SMA	PSI-MOS-PROFIB/FO 660 T	2708287	1
850 nm, for glass fiber cable, B-FOC (ST®)	PSI-MOS-PROFIB/FO 850 T	2708261	1

Accessories

Description	Type	Order No.	Pcs./Pkt.
System power supply unit for supplying a modular star coupler topology	MINI-SYS-PS 100-240AC/24DC/1.5	2866983	1
Power supply unit for use in potentially explosive areas	MINI-PS-100-240AC/24DC/1.5/EX	2866653	1
End clamps	CLIPFIX 35	3022218	50
DIN rail connector, power supply and data (2 per device)	ME 17,5 TBUS1,5/5-ST-3,81GN	2709561	10
DIN rail connector, power supply only (2 per device)	ME 17,5 TBUS1,5/PP000-3,81BK	2890014	10
Small, angled PROFIBUS connector with screw connection	SUBCON-PLUS-PROFIB/SC2	2708232	1
Small, angled PROFIBUS connector with screw connection and additional PG connection	SUBCON-PLUS-PROFIB/PG/SC2	2708245	1
Polymer fiber connectors (4 connectors in the set)	PSM-SET-FSMA/4-KT	2799720	1
Polishing set for polymer fiber connectors (required to assemble polymer fiber connectors)	PSM-SET-FSMA-POLISH	2799348	1
Fiber optic polymer fiber cable for indoor installation	PSM-LWL-KDHEAVY	2744319	1
F-SMA HCS fiber connectors (4 connectors in the set)	PSM-SET-FSMA/4-HCS	2799487	1
B-FOC (ST®) HCS fiber connectors (4 connectors in the set)	PSM-SET-B-FOC/4-HCS	2708481	1
Tool set for HCS connectors (F-SMA) (required for HCS connector assembly)	PSM-HCS-KONFTOOL	2799526	1
Tool set for HCS connectors (B-FOC (ST®)) (required for HCS connector assembly)	PSM-HCS-KONFTOOL/B-FOC	2708465	1
Tool set for F-SMA and SCRJ connectors (polymer fiber)	PSM-POF-KONFTOOL	2744131	1
Fiber optic HCS cable for indoor installation	PSM-LWL-HCS RUGGED-200/230	2799885	1
Fiber optic HCS cable for outdoor installation	PSM-LWL-HCSO-200/230	2799445	1
Fiber optic glass fiber cable for indoor installation	PSM-LWL-GDM-RUGGED-50/125	2799322	1
Fiber optic glass fiber cable for outdoor installation	PSM-LWL-GDO-50/125	2799432	1
Measuring device for fiber optic power measurement	PSM-FO-POWERMETER	2799539	1

Other fiber optic converters in the PSI-MOS system

PSI-MOS-PROFIB/FO 1300… devices are networked for distances up to 25 km using multi-mode glass fiber cable and up to 45 km using single mode glass fiber cable.

Other fiber optic converters

Description	Type	Order No.	Pcs./Pkt.
Fiber optic converter with integrated optical diagnostics, alarm contact, for PROFIBUS up to 12 Mbps, 1300 nm, for glass fiber cable, SC duplex			
Termination device with one fiber optic interface	PSI-MOS-PROFIB/FO 1300 E	2708559	1
T-coupler with two fiber optic interfaces	PSI-MOS-PROFIB/FO 1300 T	2708892	1

3 Technical data

Interfaces		
Power supply	24 V DC (18 V DC ... 32 V DC)	
Nominal current consumption	130 mA, maximum	
Ready-to-operate indicator	"VCC" LED (green)	
Maximum star coupler expansion	10	
Serial RS-485 interface	PROFIBUS FMS/DP according to IEC 61158, 2-wire, also MPI	
Operating mode	Half duplex	
Data format/encoding	UART (11 bits, NRZ)	
Data direction changeover	Automatic control	
Transmission speed (automatic detection or set via DIP switches)	9.6/19.2/45.45/93.75/187.5/500/1500/3000/6000/12,000 kbps	
Transmission length	Depending on the transmission speed up to 1200 m, maximum	
Connection	9-pos. D-SUB female connector	
Output voltage/current (pin 6)	5 (±0.25) V DC, 50 mA	
Optical interface	According to technical guideline PNO No. 2.021	
Transmission protocol	Transparent protocol to RS-485 interface	
Connection method	**F-SMA**	**B-FOC (ST®)**
Wavelength	660 nm	850 nm
Minimum transmission power (fiber type)	-3.0 dBm (980/1000 µm) -15.4 dBm (200/230 µm)	-4.2 dBm (200/230 µm) -17.8 dBm (50/125 µm) -14.6 dBm (62.5/125 µm)
Receiver sensitivity		
Minimum	-30.0 dBm	-30.0 dBm (50/125 µm)
Maximum	-3.0 dBm (980/1000 µm)	-3.0 dBm (200/230 µm)
Minimum transmission length including 3 dB system reserve	70 m with F-P 980/1000; 230 dB/km 400 m with F-K 200/230; 10 dB/km with quick mounting connectors	800 m with F-K 200/230; 8 dB/km with quick mounting connectors 2600 m with F-G 50/125; 2.5 dB/km 3300 m with F-G 62.5/125; 3.0 dB/km
Minimum transmission length	1 m with F-K 200/230; 8.0 dB/km	

General data				
Bit distortion input	±35%, maximum			
Bit distortion output	< 6.25%			
Bit delay in redundancy mode (DIP 7 = ON)	11 bits			
Bit delay in standard mode (DIP 7 = OFF)	< 1 bit			
Electrical isolation	RS-485//power supply			
Test voltage	1.5 kV_{rms}, 50 Hz, 1 min.			
Alarm output	60 V DC/42 V AC, 1 A, maximum			
Status and diagnostic indicators	Power supply (VCC), transmit/receive data RS-485 PROFIBUS, fiber optic bar graph (FO SIGNAL), fiber optic error (FO ERR)			
Housing material	PA V0, green			
Ambient temperature				
Operation	-20°C ... +60°C			
Storage/transport	-40°C ... +85°C			
Humidity	30% ... 95%, no condensation			
Dimensions (W x H x D)	35 mm x 99 mm x 105 mm			
Degree of protection	IP20			
Weight	190 g, approximately			
MTBF according to Telcordia standard	**Termination devices (E)**	**Termination devices (E)**	**T-couplers (T)**	**T-couplers (T)**
	660 nm	**850 nm**	**660 nm**	**850 nm**
Ambient temperature 25°C	324 years	252 years	201 years	149 years
Ambient temperature 40°C	70 years	42 years	42 years	24 years

General data (continued)	
Chloroform test	Free from substances that would hinder coating with paint or varnish (according to VW/Audi/Seat specification)
Vibration resistance	5g according to IEC 60068-2-6, 2.5 h each in x, y, and z direction, criterion A
Shock resistance	15g according to IEC 60068-2-27 with 11 ms pulse length, criterion C
Free fall	1 m without packaging according to IEC 60950
Air and creepage distances	DIN EN 60664-1/VDE 0110-1, DIN EN 50178, DIN EN 60950

Tests/approvals	
CE	CE
PROFIBUS interoperability	Tested by independent PNO test laboratory (PN059-485-01)
ABB certification: Industrial IT Enabled This certification is a trademark of ABB.	Industrial IT enabled
UL/CUL 1604 Ex listed	**PROCESS CONTROL EQUIPMENT FOR HAZARDOUS LOCATIONS Class I, Zone 2, AEx nC IIC**
Conformity assessment according to Directive 94/9/EC	
Fiber optic interface as an associated item of equipment for zone 1 devices	II (2) GD [EX op is] IIC (PTB 06 ATEX 2042u)
Assembly and operation of the device in zone 2	II 3G Ex nAC IIC T4 X

Conformance with EMC Directive 2004/108/EC and Low Voltage Directive 2006/95/EC

Noise immunity test according to EN 61000-6-2[1]

Electrostatic discharge (ESD)	EN 61000-4-2	Criterion B[2]	
Air discharge			8 kV
Contact discharge			6 kV
Electromagnetic HF field	EN 61000-4-3	Criterion A[3]	
Amplitude modulation			10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion B[2]	
Signal			2 kV/5 kHz
Power supply			2 kV/5 kHz
Surge current load (surge)	EN 61000-4-5	Criterion B[2]	
Signal			1 kV/42 Ω
Power supply			0.5 kV/2 Ω
Conducted interference	EN 61000-4-6	Criterion A[3]	10 V

Noise emission test according to EN 61000-6-4

Noise emission of housing	EN 55011[4]	Class A[5]

[1] EN 61000 corresponds to IEC 61000

[2] Criterion B: Temporary adverse effects on the operating behavior, which the device corrects automatically.

[3] Criterion A: Normal operating behavior within the specified limits.

[4] EN 55011 corresponds to CISPR11

[5] Class A: Industrial application, without special installation measures.

Block diagram

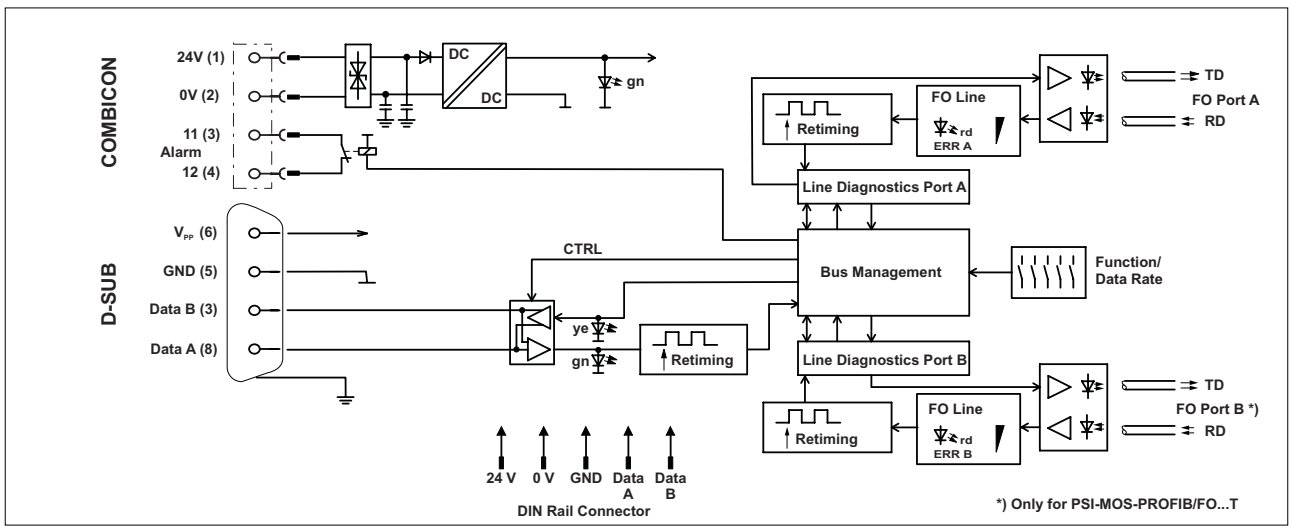


Figure 1 Block diagram

Housing dimensions

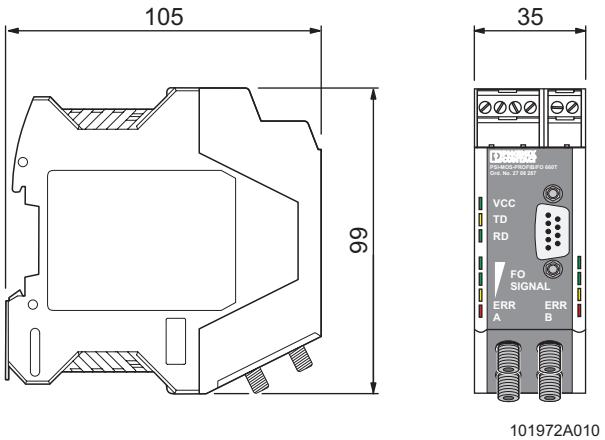


Figure 2 Housing dimensions (in mm)

4 Safety regulations and installation notes

4.1 Installation and operation

Follow the installation instructions.

NOTE: Installation, operation, and maintenance may only be carried out by qualified specialist personnel.

When installing and operating the device, the applicable safety directives (including national safety directives), accident prevention regulations, as well as general technical regulations, must be observed.

NOTE: The device must not be opened or modified apart from the configuration of the DIP switches.

NOTE: The switches that can be accessed may only be actuated when the power supply to the device is disconnected.

Do not repair the device yourself, replace it with an equivalent device. Repairs may only be carried out by the manufacturer.

NOTE: The IP20 degree of protection (IEC 60529/EN 60529) of the device is intended for use in a clean and dry environment. The device must not be subject to mechanical strain and/or thermal loads, which exceed the limits described.

For the safety data, please refer to the operating instructions and certificates (EC-type examination certificate, other approvals, if necessary).

4.2 Installation in zone 2

WARNING: Explosion hazard

The device is designed for installation in zone 2 potentially explosive areas.

Observe the specified conditions for use in potentially explosive areas.

WARNING: Explosion hazard

Install the device in suitable **housing with IP54 protection, minimum**, that meets the requirements of EN 60079-15.

Observe the requirements of EN 60079-14.

WARNING: Explosion hazard

Disconnect the block power supply **before**:

– Snapping it on or disconnecting it.
– Connecting or disconnecting cables.

WARNING: Explosion hazard

Only devices which are designed for operation in zone 2 potentially explosive areas and are suitable for the conditions at the installation location may be connected to the supply and signal circuits in zone 2.

WARNING: Explosion hazard

The device must be stopped and immediately removed from the Ex area if it is damaged or was subject to an impermissible load or stored incorrectly or if it malfunctions.

Installation in areas with a danger of dust explosions

WARNING: Explosion hazard

The device is **not** designed for installation in areas with a danger of dust explosions.

If dust is present, install the device in suitable, approved housing.

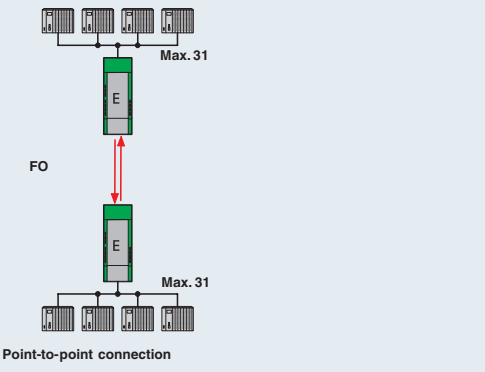
5 Supported network structures

The PSI-MOS-PROFIB/FO… system can be used to create network topologies that are ideally adapted to the relevant application. The structures are described briefly below.

5.1 Point-to-point connections

Two PSI-MOS-PROFIB/FO… E fiber optic termination devices can be used to easily convert a data link from copper cable to fiber optics.

Point-to-point connections can also be created redundantly using PSI-MOS-PROFIB/FO… T-couplers. This means that the failure of a fiber optic cable will not result in network failure. The devices automatically switch to the error-free fiber optic connection.

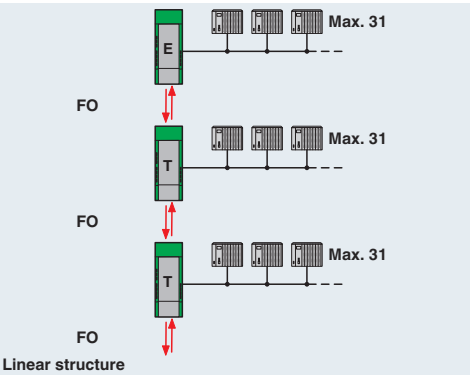


Point-to-point connection

5.2 Linear structures

PSI-MOS-PROFIB/FO… devices can be used to network several PROFIBUS devices to form a linear structure.

PSI-MOS-PROFIB/FO… E termination devices are used at the beginning and end of the fiber optic line. PSI-MOS-PROFIB/FO… T T-couplers with two fiber optic ports are used along the line.

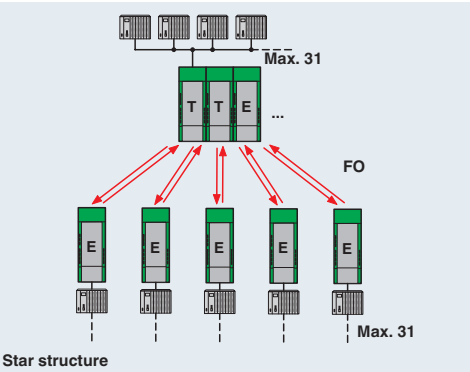


Linear structure

5.3 Star structures

PROFIBUS devices can also be networked in a star structure. Depending on the number of star lines required, several T-couplers or termination devices are connected to an active star coupler.

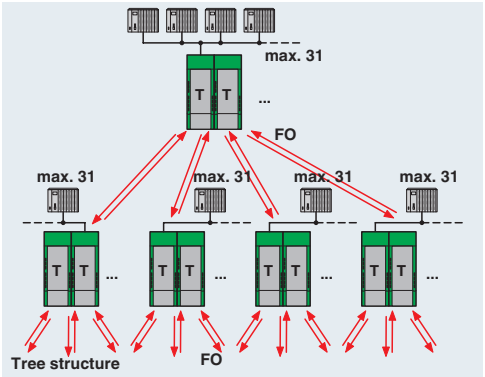
Up to ten PSI-MOS-PROFIB/FO… devices can be connected to each star coupler. Cross-wiring for RS-485 data and for the supply voltage is provided automatically by the DIN rail connector (installation accessory, see page 3).



Star structure

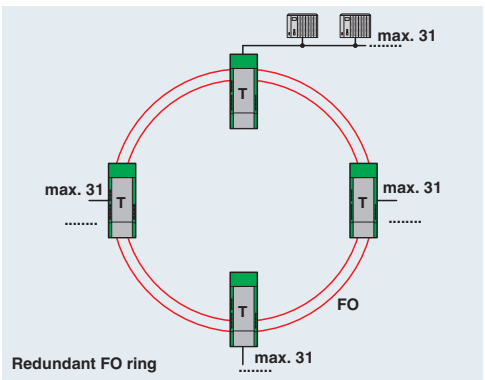
5.4 Tree structures

Linear and star structures can be cascaded to create complex tree structures. The number of devices that can be cascaded is only limited by the timing response (timeout) of the bus system used due to the bit retiming of the PSI-MOS-PROFIB/FO… fiber optic converter.



5.5 Redundant ring structures

If a system has increased requirements in terms of transmission reliability and availability, redundant ring structures can be created. If a fiber optic subsection fails in this topology (broken fiber), all the other devices can still be accessed. In MPI networks, redundant ring structures cannot be created.
In the redundant ring, mixed operation of PSI-MOS with fiber optic interfaces from other manufacturers is not permitted.



6 Function elements

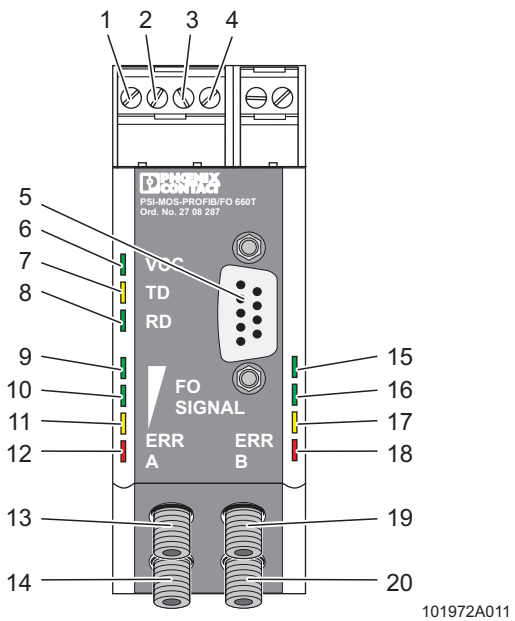


Figure 3 Function elements

1 24 V DC supply voltage connection
2 0 V DC supply voltage connection
3 Switch contact, connection 11
4 Switch contact, connection 12
5 9-pos. D-SUB: PROFIBUS interface
6 "VCC" LED
7 "TD" LED
8 "RD" LED
9 "FO SIGNAL" LED (port A)
10 "FO SIGNAL" LED (port A)
11 "FO SIGNAL" LED (port A)
12 "ERR" LED (port A)
13 Fiber optic transmitter (port A)
14 Fiber optic receiver (port A)
15 "FO SIGNAL" LED (port B)[1]
16 "FO SIGNAL" LED (port B)[1]
17 "FO SIGNAL" LED (port B)[1]
18 "ERR" LED (port B)[1]
19 Fiber optic transmitter (port B)[1]
20 Fiber optic receiver (port B)[1]

[1] Only for PSI-MOS-PROFIB/FO ... T

Diagnostic and status indicators

Des.	Color	Meaning	
VCC	Green Flashing at 1 Hz	Ready-to-operate – No valid transmission speed detected (autobaud setting)	
	Green ON	– Transmission speed detected or set	
TD	Yellow	Sending data at the PROFIBUS interface (9-pos. D-SUB)	
RD	Green	Receiving data at the PROFIBUS interface (9-pos. D-SUB)	
FO SIGNAL	Green	Receiving power at fiber optic port A/B (see Section 7)	Very good
	Green		Good
	Yellow		Critical
ERR	Red		Insufficient, broken fiber

7 Definition of fiber optic diagnostics

The quality of the path is determined using the incoming optical power P_{opt} and displayed using the LED bar graph. DIP switch 6 is used to switch the transmitters in the idle state (rest period between transmitting data) to steady light (INVERS), to enable continuous fiber optic diagnostics.

If DIP 6 is set to "ON" (NORM), the echo evaluation (DIP 5 = "OFF") is available as diagnostics. If the echo evaluation is also switched off, fiber optic diagnostics are not available.

LED bar graph	Receive status	Optical power P_{opt}
Green Green Yellow	Very good	P_{opt} is considerably greater than the system reserve
Green Yellow	Good	P_{opt} is still greater than the system reserve
Yellow	Critical	P_{opt} has reached the system reserve
Red	Error	P_{opt} has sapped the system reserve/broken fiber

As soon as the system reserve is reached, only the yellow LED remains lit. At the same time, the signaling relay drops and the switch contact opens. Data communication is still possible.

In "Redundant ring" mode, the affected fiber optic port is already switched off when the LED goes to yellow to prevent any risk of data corruption.

7.1 Idle setting

During the idle phase, fiber optic interfaces return to an idle setting defined by the manufacturer.

This idle setting may vary for different manufacturers and devices. As fiber optic interfaces can only be operated together if they have the same idle setting, this should be observed in mixed operation with third-party devices (see Section 8.4).

For PSI-MOS, the idle setting is specified as "Light on" (corresponds to "Logic 1").

NOTE: When connecting third-party devices, observe the receiver sensitivity and overrange of the fiber optic interfaces.

7.2 Basic method of operation

The PSI-MOS device has a maximum of four interfaces for the PROFIBUS signal: the electrical interface (D-SUB), the two fiber optic ports (port B only for T-couplers), and the DIN rail connector. All interfaces communicate with one another with equal rights. A signal available at one of the interfaces is also available at all other interfaces.

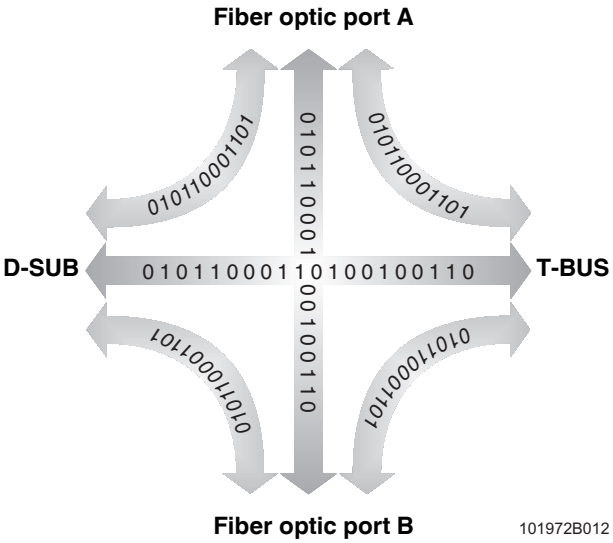


Figure 4 Communication between the interfaces

8 Configuration

Changes to the default settings are only required in the following cases:

– Operation with fixed transmission speed (default setting: automatic transmission speed detection)
– Operation in a redundant ring
– Operation of a PSI-MOS-PROFIB/FO… T T-coupler with only one fiber optic port (switch off fiber optic port B)
– Direct connection to fiber optic interfaces from other manufacturers
– Mixed operation of PSI-MOS with the old PSM-EG series. Usually, the different idle settings for the two series should be adjusted.
– Mixed operation of PSI-MOS with 8-pos. and 10-pos. DIP switches. Devices with 10-pos. DIP switches have been supplied since April 2006 and offer enhanced functions.

In all other cases, the devices can be operated using the default settings.

8.1 Setting the DIP switches

NOTE: Electrostatic discharge

The device contains components that can be damaged or destroyed by electrostatic discharge. When handling the device, observe the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and IEC 61340-5-1.

- For configuration, release the housing cover using a screwdriver (A in Figure 5).
- Then carefully pull the PCB out of the housing as far as possible (B).

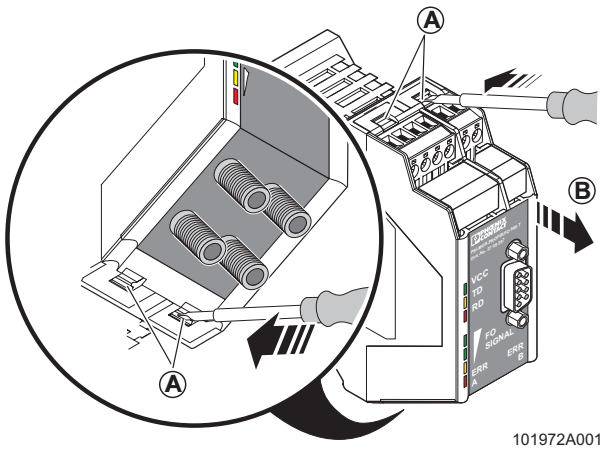


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Figure 5 Opening the housing

DIP switches 1 to 10 are then freely accessible.

- Configure the DIP switches according to the planned application.

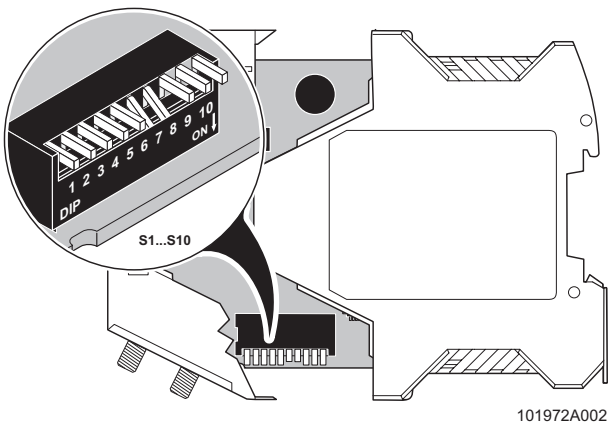

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Figure 6 Setting the DIP switches

The tables on page 12 provide an overview of the DIP switch functions. By default upon delivery, all DIP switches are in the "OFF" position.

NOTE: After changing the device settings, disconnect the power to the device so that the settings can be applied.

8.2 Setting the transmission speed (DIP 1 - 4)

PSI-MOS-PROFIB/FO… devices have automatic transmission speed detection. Ideally, the transmission speed should be set to a fixed value, as this considerably reduces the initialization time for the entire system.

The transmission speed is set using DIP switches 1 to 4:

NOTE: When automatic transmission speed detection is activated, the maximum PROFIBUS slot time (Tslot) must be 100 ms.

If the slot time is greater, the devices must be configured to the transmission speed used.

NOTE: When using transmission speeds greater than 1.5 Mbps, echo evaluation must be switched off (DIP 5 = "ON") if compatibility mode is selected (DIP 9 = "ON") and redundancy mode is switched off (DIP 7 = "OFF").

Transmission speed (kbps)	DIP switch			
	1	2	3	4
Auto	OFF	OFF	OFF	OFF
12000	OFF	OFF	OFF	ON
6000	OFF	OFF	ON	OFF
3000	OFF	OFF	ON	ON
1500	OFF	ON	OFF	OFF
500	OFF	ON	OFF	ON
187.5	OFF	ON	ON	OFF
93.75	OFF	ON	ON	ON
45.45	ON	OFF	OFF	OFF
19.2	ON	OFF	OFF	ON
9.6	ON	OFF	ON	OFF

DIP switch	ON	OFF
5	MIXED	–
6	NORM	INVERS
7[1]	REDUNDANCY	–
8[1]	END	NEXT
9	COMPATIBILITY	–
10	FIBER CONTROL	–

[1] No function for PSI-MOS-PROFIB/FO… E termination devices

8.3 Echo evaluation (DIP 5)

Echo evaluation is useful for the mixed operation of PSI-MOS and PSM-EG devices (older generation of Phoenix Contact fiber optic converters). Although PSM-EG devices offer echo evaluation, they do not offer the permanent diagnostics (FO signal) provided by PSI-MOS devices. The optical fibers are therefore monitored using echo evaluation. For additional information about the configuration of devices in mixed operation, please refer to "Mixed operation of PSI-MOS and PSM-EG" on page 14.

Echo evaluation (DIP 5 = "OFF") is used to detect broken fibers for the devices. During the idle phase (rest period between transmitting data), the fiber optics between directly connected devices are monitored for broken fibers.

In the event of a broken fiber, the affected optical fiber is switched off, the error LED is set (12 in Figure 3 on page 9), and the switching output is activated.

If the default setting for DIP 6 = "OFF" (INVERS) is used, echo evaluation is switched off because the built-in diagnostics (FO signal) permanently evaluates the received signal and therefore also detects a broken fiber.

In a redundant ring (DIP 7 = "ON"), echo evaluation is always available, regardless of DIP switches 5 and 6.

In the following cases, echo evaluation should always be switched off:

– When operating with data rates greater than 1.5 Mbps (e.g., 3 Mbps), because with long optical fibers a broken fiber could be detected due to the correspondingly long cable runtimes.
– For mixed operation of PSI-MOS with fiber optic interfaces from third-party suppliers (see also "Mixed operation of PSI-MOS and PSM-EG" on page 14).

8.4 Connection to fiber optic interfaces from third-party suppliers (DIP 5/6)

During the idle phase, fiber optic interfaces return to an idle setting defined by the manufacturer. This idle setting may vary for different manufacturers and devices. As fiber optic interfaces can only be operated together if they have the same idle setting, this should be set using the DIP switches.

For mixed operation of PSI-MOS with fiber optic interfaces from other manufacturers, proceed as follows.

- Deactivate echo evaluation.
  Set DIP 5 to "ON".
- Check the idle setting for the third-party interface:
  Logic 1 = Light off
  Logic 1 = Light on
- If necessary, adjust the idle setting of PSI-MOS using DIP 6.

DIP 6	Idle setting	Meaning
OFF = INVERS	Light on (Default setting)	Logic 1
ON = NORM	Light off	Logic 1

In the "OFF" position, the continuous measurement of received optical power is available and the receive quality is displayed using a 4-level bar graph (FO signal). In this case, echo evaluation is switched off automatically.

In the "ON" position, the continuous measurement of received optical power is not available and the 4-level bar graph is switched off. If echo evaluation is also switched off (DIP 5 = "ON"), broken fiber detection is not available either. In this combination, PSI-MOS devices have no fiber optic path diagnostics.

NOTE: In the redundant ring, mixed operation with fiber optic interfaces from other manufacturers is not permitted.

NOTE: If DIP 6 is set to "ON", fiber optic diagnostics are not available via the LED bar graph.

The LED bar graph can light up at high transmission speeds or flash at low transmission speeds. This display does **not** correspond to continuous evaluation of the optical power.

NOTE: When connecting third-party devices, observe the receiver sensitivity and overrange of the fiber optic interfaces.

8.5 Redundancy function (DIP 7/9)

NOTE: The redundancy function is only intended for use in the **redundant ring** network structure (see page 9).

- For path structures, (point-to-point, linear, star, etc.) switch off the redundancy function (DIP 7 = "OFF").

Activating the redundancy function ensures that the corresponding fiber optic port is switched off as soon as the receive quality reaches "System reserve reached" (LED bar graph on the device displays only the yellow LED), to prevent any risk of data corruption.

In the redundant ring, data communication continues via the second fiber optic port after the first fiber optic port is switched off.

For path structures, activating the redundancy function results in the affected fiber optic port being switched off in the event of a weak fiber optic signal (yellow LED) and thus causes the subsequent part of the network to fail.

To overcome the restrictions regarding the ring length and the maximum transmission speed of 1.5 Mbps, enhanced redundancy management has been implemented in PS-MOS devices. Enhanced redundancy management is only available for T-couplers as a redundant ring cannot be created using termination devices.

The new redundancy management solution is based on the parameterization of a non-existent device in STEP 7®. This means that there are no restrictions regarding the ring length, the number of devices (minimum of 3), and the maximum transmission speed.

To ensure compatibility with PSI-MOS devices that use the old redundancy management solution, an additional DIP switch (DIP 9 "COMPATIBILITY") has been added. PSI-MOS devices with the new redundancy management solution have a 10-pos. DIP switch range, which makes it easy to distinguish between them and PSI-MOS devices with the old redundancy management solution (8-pos. DIP switch range). For mixed operation of the two PSI-MOS series, set DIP 9 to "ON".

For mixed operation of PSI-MOS devices with 8-pos. and 10-pos. DIP switches in a redundant ring, make the following setting:

DIP	PSI-MOS 8-pos.	PSI-MOS 10-pos.
DIP 7	ON	ON
DIP 9	–	ON

Set the other switches according to your application.

8.6 Disabling the second fiber optic port (DIP 8)

If the second fiber optic port (B) is not used for PSI-MOS-PROFIB/FO ... T T-couplers, it must be disabled. Otherwise the red "ERR" LED will light up.

- Set DIP 8 to "ON" (END).

8.7 Activating enhanced ring management (DIP 7/9)

Enhanced ring management can only be used if PSI-MOS devices with 10-pos. DIP switches are used exclusively.

If DIP 9 is left set to "OFF" and DIP 7 is set to "ON", the following functions are available in the redundant ring:

– Increase maximum transmission speed from 1.5 Mbps to 12 Mbps
– No more restrictions regarding the maximum possible ring length
– No more restrictions regarding the maximum possible number of devices

8.8 Activating FIBER CONTROL function (DIP 10)

If in case of failure of **one** optical fiber, you wish to interrupt the transmission of the telegram between two PSI-MOS devices in **both** directions of the fiber optic link, activate the function FIBER CONTROL.

- Set DIP 10 to "ON" (FIBER CONTROL).

If a fiber break is detected, the PSI-MOS device switches its optical transmitter to steady light. Telegrams are now no longer transmitted on both fibers.

Once the received optical power is sufficient, the device automatically resends the received telegram.

Activate this function on all PSI-MOS devices that are connected directly to each other via fiber optic link.

8.9 Mixed operation of PSI-MOS and PSM-EG

Mixed operation of the old PSM-EG series with the new PSI-MOS series is generally possible. Please note the following settings and restrictions:

Device configuration

The DIP switch settings depend on the application requirements. Please note that the idle setting of all devices used in the entire system must be the same (can be set via DIP switches) and that on new generation PSI-MOS devices (with a 10-pos. DIP switch), DIP switch 9 must be set to "ON".

Diagnostics in mixed operation

In mixed operation, the function of diagnostic evaluation depends on the switch positions of the devices.

Usually PSM-EG devices are only mixed with PSI-MOS devices when exchanged or replaced. Therefore the following description is based on a given setting of the PSM-EG devices, with the PSI-MOS devices being adjusted to this setting.

If the idle setting is defined as "Light off" for PSM-EG (DIP 6 set to "OFF"), set DIP 6 to "ON" for PSI-MOS. The FO signal is thus no longer available to the PSI-MOS devices and diagnostics are limited to the detection of broken fibers. If the idle setting is defined as "Light on" for PSM-EG (DIP 6 set to "ON"), set DIP 6 to "OFF" for PSI-MOS.

If broken fiber detection is activated for PSM-EG (DIP 7 set to "ON"), set DIP 5 to "OFF" for PSI-MOS (mandatory in a redundant ring). If broken fiber detection is deactivated for PSM-EG (DIP 7 set to "OFF"), set DIP 5 to "ON" for PSI-MOS.

If broken fiber detection is deactivated and the idle setting is defined as "Light off", diagnostics are not available for the fiber optic path.

Overload/underload capability of fiber optic interfaces

In rare cases (usually in the case of very short fiber optic connections of just a few meters), an overload of the PSI-MOS devices may occur in mixed operation. This is due to the highly sensitive PSI-MOS receivers, which cover large ranges but can be overloaded on very short fiber optic paths (of just a few meters).

In the event of an overload, a patch cable with fiber optic joint can be used to increase the attenuation of the path, which will ensure error-free operation.

In mixed operation, observe the following ranges:

Fiber	Wavelength	Maximum range
Glass 50/125	850 nm	1600 m
Glass 62.5/125	850 nm	2200 m
HCS	Not permissible for PSM-EG	
POF	660 nm	70 m

Table 1 Switch combinations

DIP						FO diagnostics	Switch off for FO ports	Echo evaluation	Restrictions	Operating mode	Third-party connection/mixed operation
5	6	7	8	9	10						
X	OFF	OFF	X	OFF	OFF	Continuous	None	None	None	Linear/star/tree structure	Third-party coupler without echo function with "Light on" idle setting
OFF	OFF	OFF	X	ON	OFF	Continuous	None	Activated	Path length	Linear/star/tree structure	Third-party coupler with echo function and "Light on" idle setting
OFF	ON	OFF	X	X	OFF	None	None	Activated	Restriction of the path length depending on the transmission speed	Linear/star structure with "Light off" idle setting	–
ON	ON	OFF	X	X	OFF	None	None	None	None	Linear/star structure with "Light off" idle setting	Third-party coupler without echo with "Light off" idle setting
X	X	ON	OFF	OFF	OFF	Continuous	Yes, at low receiving power	Cannot be switched off[1]	None	Standard redundancy mode. Redundancy mode with fiber optic diagnostics, path monitoring, and enhanced redundancy management.	–
X	X	ON	OFF	ON	OFF	Continuous	Yes, at low receiving power		Ring length		For mixed operation with different generations of PSI-MOS devices
x	OFF	OFF	x	x	ON	Continuous	No disconnection in the event of broken fiber, telegrams are no longer transmitted	None	None	Linear/star/tree structure	–

[1] If DIP switch 7 (REDUNDANCY) is in the "ON" position and DIP switch 8 (END) is in the "OFF" position, the system switches automatically to "Light on" idle setting with echo evaluation.
However, if fiber optic port B is switched off by setting DIP switch 8 to "ON" (END), DIP switch 7 (REDUNDANCY) has no function.

(X = Any switch position)

9 Connection notes

WARNING: Only mount and remove devices when the power supply is disconnected.

WARNING: PSI-MOS-... devices are designed for SELV operation according to IEC 60950/EN 60950/VDE 0805.

- Install the device on a 35 mm DIN rail according to DIN EN 60715.

  To avoid contact resistance only use clean, corrosion-free DIN rails.
- End clamps can be mounted on both sides of the device to stop the devices from slipping on the DIN rail (for ordering data see page 3).

WARNING: Connect the DIN rail to protective earth ground using a grounding terminal block. The devices are grounded when they are snapped onto the DIN rail (installation according to PELV).

This ensures that the shielding is effective. Connect protective earth ground with low impedance.

9.1 Combined assembly with a system power supply unit (modular star coupler)

- Connect together the required number of DIN rail connectors for the connection station.

  Two DIN rail connectors are required for each device (see A in Figure 7).

  A maximum of ten devices are permitted in a connection station.
- Push the connected DIN rail connectors onto the DIN rail (B and C).
- Place the device onto the DIN rail from above. The upper holding keyway of the device must be hooked onto the top edge of the DIN rail (see Figure 8).

  Make sure that it is aligned correctly with the DIN rail connectors.
- Once the device has been snapped on properly, check that it is fixed securely on the DIN rail.

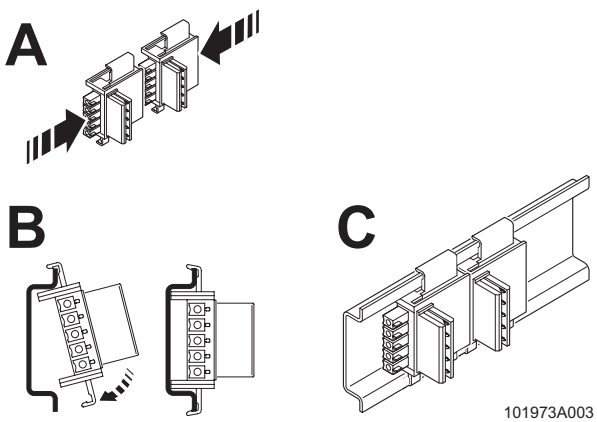


Figure 7 Combined assembly

9.2 Assembly as an individual device in the control cabinet (stand-alone)

- Place the device onto the DIN rail from above. The upper holding keyway of the device must be hooked onto the top edge of the DIN rail (see Figure 8).
- Push the device from the front towards the mounting surface.
- Once the device has been snapped on properly, check that it is fixed securely on the DIN rail.

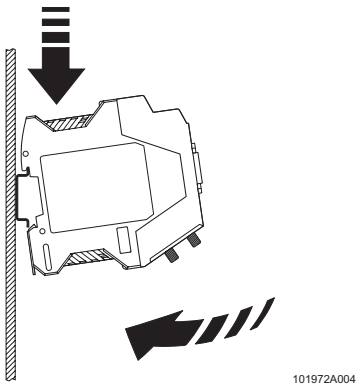


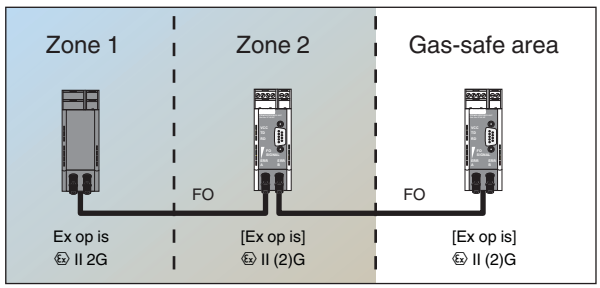
Figure 8 Assembly in the control cabinet

9.3 Assembly in potentially explosive areas

WARNING: Observe the safety notes on page 7.

– Areas with a danger of gas explosions

The devices are suitable for use in zone 2. Devices that are installed in zone 1 can be connected to the fiber optic interface. The fiber optic interface is an associated item of equipment with protection type "Ex op is".



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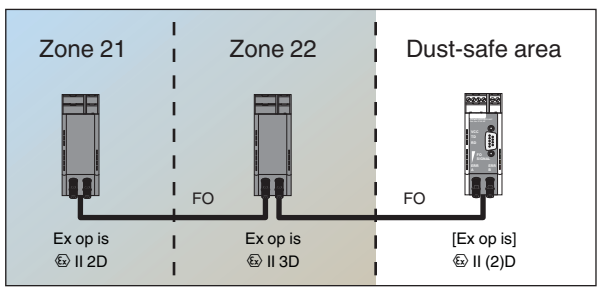
– Areas with a danger of dust explosions

The device is **not** designed for installation in areas with a danger of dust explosions.

If dust is present, install the device in suitable, approved housing.

When installed outside areas with a danger of dust explosions, devices installed in zone 22 or 21 can also be connected to the fiber optic interface.



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9.4 Removal

- Pull the locking latch down using a screwdriver, needle-nose pliers or similar.
- Pull the bottom edge of the module away from the mounting surface.
- Pull the module diagonally upwards away from the DIN rail.
- If removing a complete star distributor, remove the DIN rail connectors from the DIN rail as well.

10 Cabling notes

10.1 Connecting the supply voltage

WARNING: The device is operated with a +24 V DC SELV.

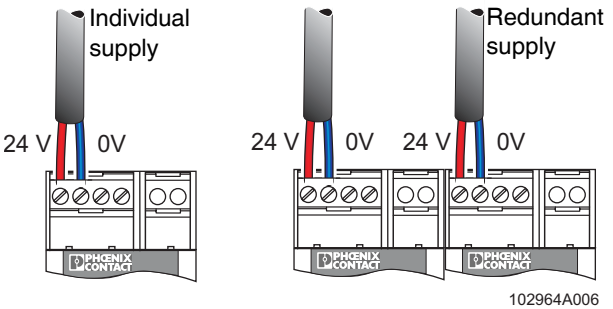


Figure 9 Individual/redundant supply

Operation as an individual device

Supply the supply voltage to the module via terminal blocks 1 (24 V) and 2 (0 V).

Operation in a star coupler topology

When the devices are operated in a star coupler topology, the supply voltage must only be supplied to the first device in the station. The remaining devices are supplied via the DIN rail connector. A redundant supply concept can be created by connecting a second power supply unit to another device in the topology.

Using the MINI POWER system power supply unit

As an alternative, the star coupler topology can also be supplied using the MINI-SYS-PS 100-240AC/ 24DC/1.5 (Order No. 2866983) or MINI-PS-100-240AC/24DC/1.5/EX (Order No. 2866653) system power supply unit. It is connected via two DIN rail connectors.

Usually the system power supply unit is mounted as the first device in a topology. A second power supply unit can be used to create a redundant supply concept.

10.2 Connecting the data cables

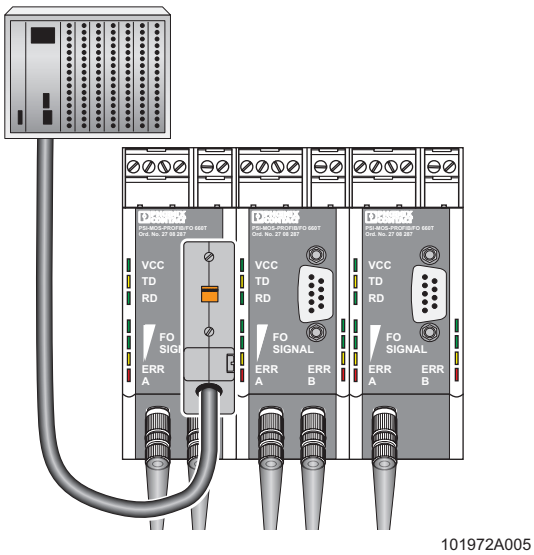


Figure 10 Connecting the data cables

- Use an approved connector (e.g., SUBCON-PLUS-PROFIB, see page 3) to connect the bus cable to the D-SUB connection on the PSI-MOS device.
- If the fiber optic converter is located at the start or end of an electrical PROFIBUS segment, activate termination in the connector.

NOTE: The maximum length of the RS-485 cables depends on the transmission speed. The values listed in the table must not be exceeded.

Transmission speed [kbps]	Range [m]
187.5	1000
500	400
1500	200
12000	100

Pin	Signal	Meaning
3	RxD/TxD-P	Receive/transmit data – positive B cable
5	DGND	Data transmission potential (reference potential to VP)
6	VP	5 V auxiliary voltage output (P5V); 50 mA, maximum
8	RxD/TxD-N	Receive/transmit data – negative A cable

10.3 Wiring the switch contact

PSI-MOS-PROFIB/FO… converters are equipped with a floating switch contact for error diagnostics (connection terminal blocks 3 and 4 in Figure 3 on page 9). This contact opens on the affected device if:

– The supply voltage fails
– An interrupt is detected on the fiber optic path
– The system reserve for the fiber optic path is not reached

The switch contact is an N/C contact and can be connected to a local digital input, e.g., on the PLC, to support error detection.

When using a device topology (modular star coupler), the individual contacts can be connected to separate input points or the individual contacts can be looped to generate a group message (Figure 11).

NOTE: The maximum load capacity of the relay contact is 60 V DC/42 V AC, 1 A.

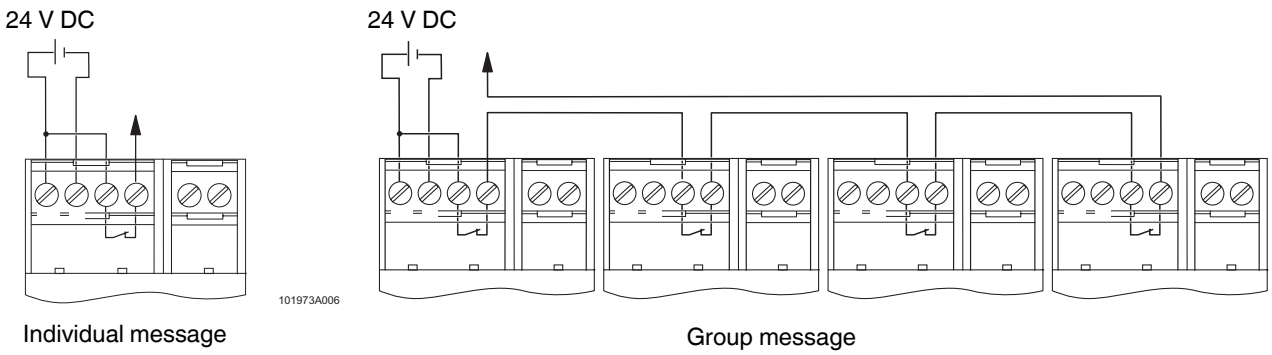


Figure 11 Individual and group message

10.4 Connecting the fiber optic cables

WARNING: Risk of eye injury

During operation, do not look directly into transmitter diodes or use visual aids to look into the glass fibers.
The infrared light is not visible.

NOTE: Dust protection caps should only be removed just before the connectors are connected. They prevent contamination of the transmit and receive elements.

The same applies for the protective caps on the connectors.

NOTE: The following fiber optic lengths must not be exceeded:

PSI-MOS-PROFIB/FO 660 ...

– 70 m with F-P 980/1000; 230 dB/km
– 400 m with F-K 200/230; 10 dB/km

PSI-MOS-PROFIB/FO 850 ...

– 800 m with F-K 200/230; 8 dB/km
– 2600 m with F-G 50/125; 2.5 dB/km
– 3300 m with F-G 62.5/125; 3.0 dB/km

NOTE: When using fiber optics, observe the fiber optic installation guidelines,
DB GB IBS SYS FOC ASSEMBLY
(Order No. 9393909).

F-SMA connection (PSI-MOS-PROFIB/FO 660 ...)

PSI-MOS-PROFIB/FO 660 ... devices use F-SMA connectors for the fiber optic connection. F-SMA is a standardized fiber optic connection.

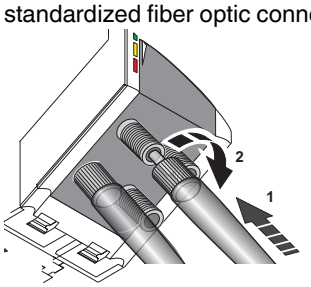


Figure 12 F-SMA connection

- The connectors are secured on the device by manually tightening the screw collar (see 2 in Figure 12).

B-FOC (ST®) connection (PSI-MOS-PROFIB/FO 850 ...)

Standardized B-FOC (ST®) connectors are used with PSI-MOS-PROFIB/FO 850 ... devices.

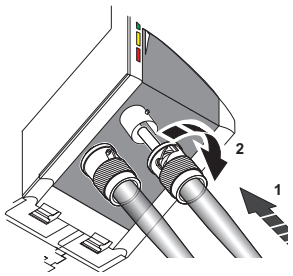


Figure 13 B-FOC connection

- Connect the fiber optic cable to the B-FOC (ST®) connector for the transmit and receive channel and push the connector clamp mechanism downwards.
- Secure the connection with a quarter turn to the right (see 2 in Figure 13).

Measuring and connecting devices

Due to the integrated optical diagnostics, there is no need to measure the path.

NOTE: Note the fiber optic cable signal direction when coupling two PSI-MOS devices:

Device 1 fiber connection "TD" (transmitter) to device 2 fiber connection "RD" (receiver) (Figure 14).

NOTE: Due to different operating wavelengths, PSI-MOS-PROFIB/FO 660 ..., PSI-MOS-PROFIB/FO 850 ..., and PSI-MOS-PROFIB/FO 1300… devices should not be connected directly with one another via fiber optic cables.

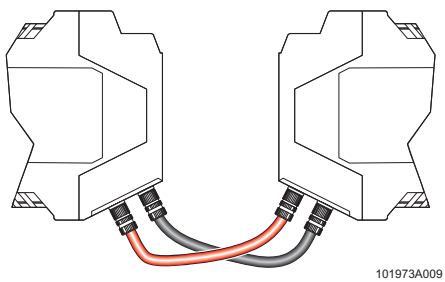


Figure 14 Crossed cables

11 Configuration rules

Data transmission cables and network components lead to signal delays. This means that the network parameters have to be adjusted using suitable configuration software (e.g., SIMATIC STEP 7®). In addition, specific maximum network expansion limits should be taken into consideration.

The following section provides support when calculating the necessary network parameters. These parameters depend on the type of network structure (linear, ring, etc.) as well as the PSI-MOS devices used.

The configuration of network parameters is described using a practical example with STEP 7® software.

The following data is required for configuration:

– Total number of PSI-MOS devices (referred to as "OLM" in STEP 7®)
– Total length of all fiber optic cables

To simplify configuration, two different sets of configuration instructions are provided below.

Section 11.1 on page 21 describes the **operation of PSI-MOS devices with a 10-pos. DIP switch**.

Section 11.2 on page 24 describes the **operation of PSI-MOS devices with an 8-pos. DIP switch** and **mixed operation for devices with 8 and 10-pos. DIP switches**.

11.1 Configuring the network parameters (PSI-MOS devices with 10-pos. DIP switch)

Operation in linear, star, and tree structures

In these network structures, use the following formula:

Tslot_Init = a + b x L + 2 x N

Where:

Tslot_Init =	Minimum slot time in bit periods
a, b =	Length parameter (see table)
L =	Network expansion in km
N =	Number of PSI-MOS devices

Transmission speed [kbps]	a		b
	DP	DP/FMS	
12000	811	811	120
6000	461	461	60
3000	261	261	30
1500	161	991	15
500	111	371	5
187.5	71	371	1.875
93.75	71	211	0.9375
45.45	411	411	0.4545
19.2	71	76	0.192
9.6	71	71	0.096

Operation in a redundant ring

In this network structure, use the following formula:

Tslot_Init = a + b x L + 44 x N

Where:

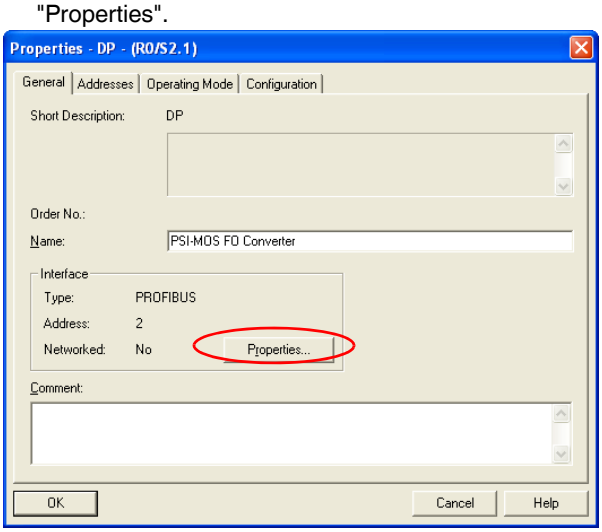
Tslot_Init =	Minimum slot time in bit periods
a, b =	Length parameter (see table)
L =	Network expansion in km
N =	Number of PSI-MOS devices

Transmission speed [kbps]	a		b
	DP	DP/FMS	
12000	1651	1651	240
6000	951	951	120
3000	551	551	60
1500	351	2011	30
500	251	771	10
187.5	171	771	3.75
93.75	171	451	1.875
45.45	851	851	0.909
19.2	171	181	0.384
9.6	171	171	0.192

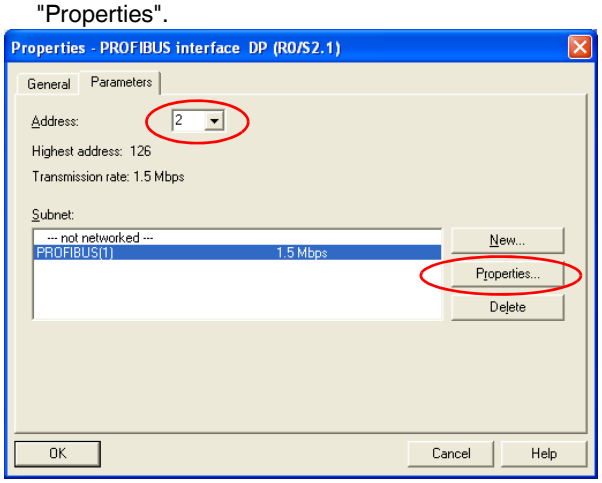
Example

A PROFIBUS DP network with 1.5 Mbps is created using fiber optics. Four PSI-MOS devices are used in a redundant ring. The total length of all fiber optic cables is 4 km. To configure the network parameters, proceed as follows:

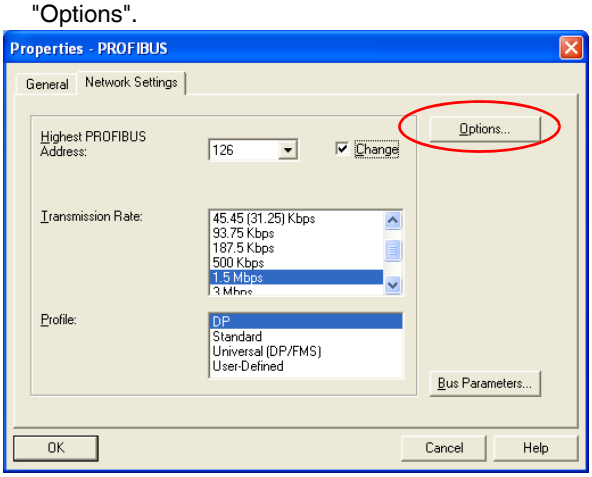
- Open the "Properties - DP" dialog box and click on "Properties".



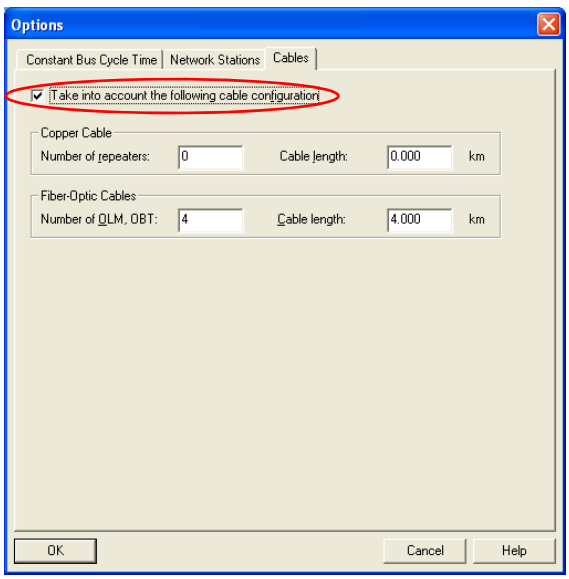
- Select the subnetwork to be configured and click on "Properties".



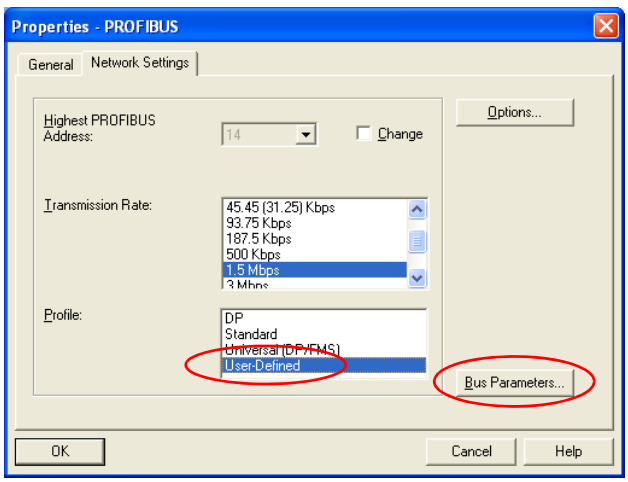
- Switch to the "Network Settings" tab, increase the highest PROFIBUS address (HSA) by 1 and click on "Options".



- Switch to the "Cables" tab and activate the "Take into account the following cable configuration" checkbox.
- Enter the total number of PSI-MOS (OLM) devices used and the total length of all fiber optic cables.
- Close all dialog boxes with "OK".



- Switch to the "Network Settings" tab and activate the "User-Defined" profile.
- Click on "Bus Parameters".



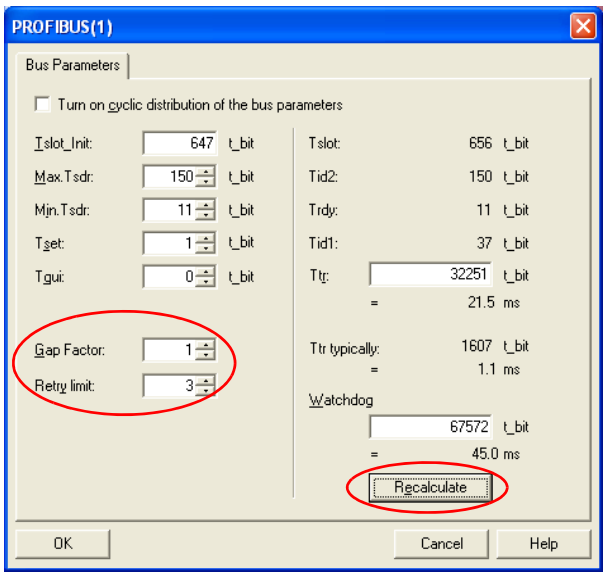
Calculation for this example

NOTE: The slot time calculation only takes into consideration the optical network and the electrical connection of bus devices over an RS-485 bus segment of 20 m, maximum.

Longer RS-485 bus segments must also be included in the calculation, by adding them to the fiber optic cable length.

Tslot_Init = a + b x L + 44 x N

Tslot_Init = 351 + 30 x 4 + 44 x 4 = 647



- Enter the calculated value in the input field and click on "Recalculate".
- Change the "Gap Factor" to "1" and increase the "Retry limit" parameter to "3".
- Confirm all dialog boxes with "OK" and load the parameterization to your control system.

Retry limit

In a redundant ring, when an error is detected (e.g., cable break for the optical fiber) PSI-MOS devices require a switch-over time during which correct data transmission is not possible.

In order to ensure error-free bridging for the application, we recommend setting the minimum retry limit in the PROFIBUS master to 3.

If the fiber optics are interrupted during active message transmission, this message is destroyed and can thus no longer be evaluated by the receiver. The PSI-MOS device detects the path fault that has occurred on the basis of missing telegrams.

Up to a total of two telegrams in succession can be destroyed or not transmitted at all before the redundant control system reliably detects the cable break and ensures stable message transmission again.

11.2 Configuring the network parameters (PSI-MOS devices with 8-pos. DIP switch)

NOTE: The following configuration instructions are also valid for the mixed operation of PSI-MOS devices with 8 and 10-pos. DIP switches.
In this case, set DIP switch 9 (COMPATIBILITY) to "ON".

Operation in linear, star, and tree structures

In these network structures, use the following formula:

Tslot_Init = a + b x L + 2 x N

Where:

Tslot_Init =	Minimum slot time in bit periods
a, b =	Length parameter (see table)
L =	Network expansion in km
N =	Number of PSI-MOS devices

Transmission speed [kbps]	a		b
	DP	DP/FMS	
12000	811	811	120
6000	461	461	60
3000	261	261	30
1500	161	991	15
500	111	371	5
187.5	71	371	1.875
93.75	71	211	0.9375
45.45	411	411	0.4545
19.2	71	76	0.192
9.6	71	71	0.096

Operation in a redundant ring

In this network structure, use the following formula:

Tslot_Init = a + b x L + 4 x N

Where:

Tslot_Init =	Minimum slot time in bit periods
a, b =	Length parameter (see table)
L =	Network expansion in km
N =	Number of PSI-MOS devices

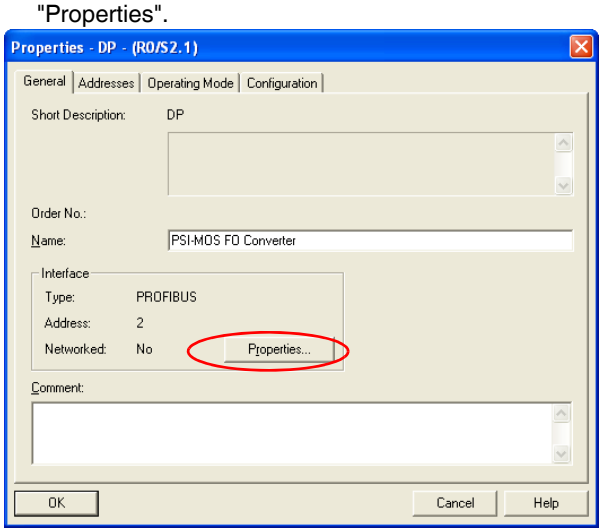
Transmission speed [kbps]	a		b
	DP	DP/FMS	
1500	311	1971	30
500	211	731	10
187.5	131	731	3.75
93.75	131	411	1.875
45.45	811	811	0.909
19.2	131	141	0.384
9.6	131	131	0.192

NOTE: For PSI-MOS devices with an 8-pos. DIP switch, the maximum transmission speed in a redundant ring is 1.5 Mbps.

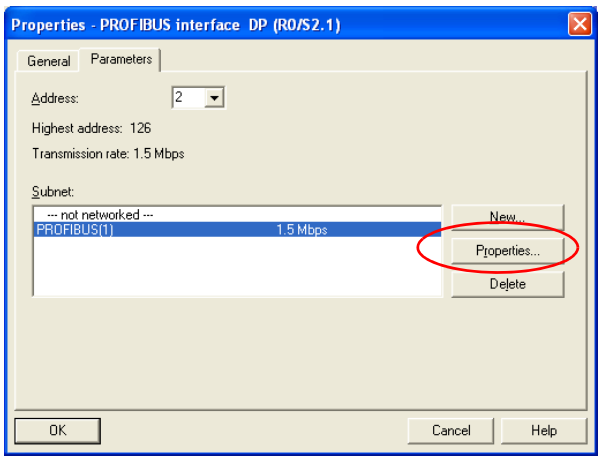
Example

A PROFIBUS DP network with 1.5 Mbps is created using fiber optics. Four PSI-MOS devices are used in a redundant ring. The total length of all fiber optic cables is 4 km. To configure the network parameters, proceed as follows:

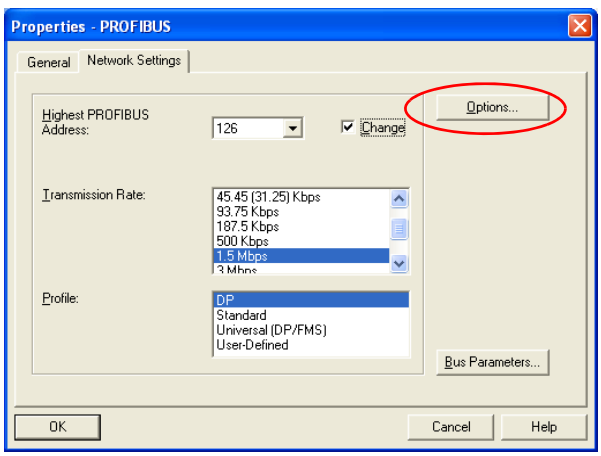
- Open the "Properties - DP" dialog box and click on "Properties".



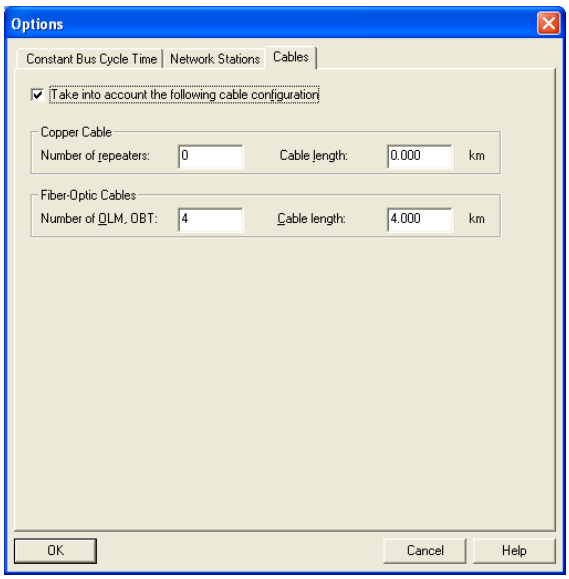
- Select the subnetwork to be configured and click on "Properties".



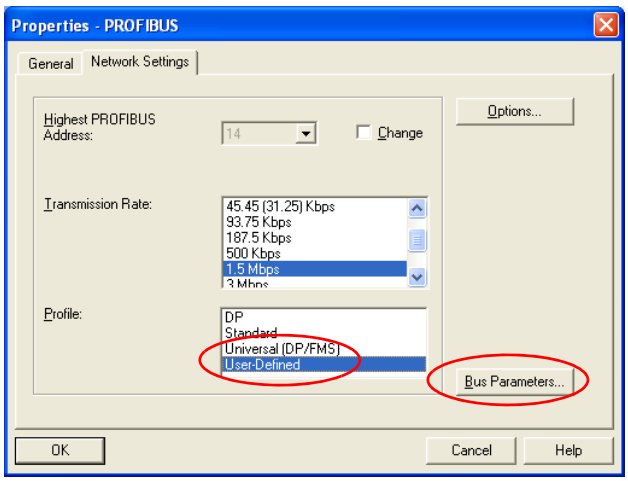
- Switch to the "Network Settings" tab and click on "Options".



- Switch to the "Cables" tab and activate the "Take into account the following cable configuration" checkbox.
- Enter the total number of PSI-MOS (OLM) devices used and the total length of all fiber optic cables.
- Close all dialog boxes with "OK".



- Switch to the "Network Settings" tab and activate the "User-Defined" profile.
- Click on "Bus Parameters".



Calculation for this example

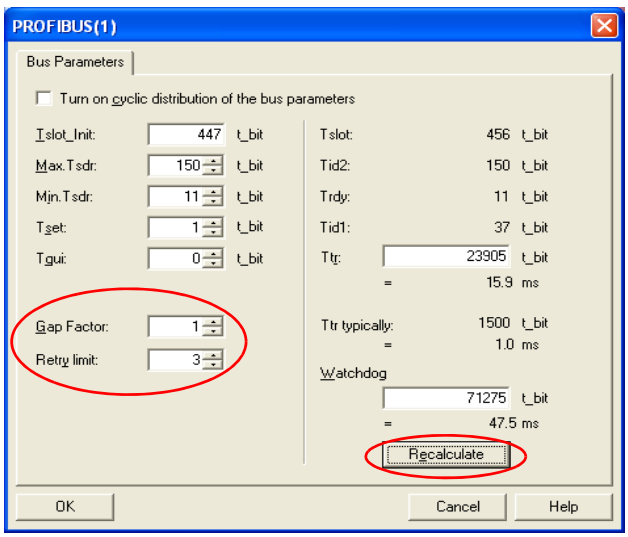
NOTE: The slot time calculation only takes into consideration the optical network and the electrical connection of bus devices over an RS-485 bus segment of 20 m, maximum.

Longer RS-485 bus segments must also be included in the calculation, by adding them to the fiber optic cable length.

NOTE: When automatic transmission speed detection is activated, the maximum PROFIBUS slot time (Tslot) must be 100 ms. If the slot time is greater, the devices must be configured to the transmission speed used.

Tslot_Init = a + b x L + 4 x N

Tslot_Init = 311 + 30 x 4 + 4 x 4 = 447



- Enter the calculated value in the input field and click on "Recalculate".
- Change the "Gap Factor" to "1" and increase the "Retry limit" parameter to "3".
- Confirm all dialog boxes with "OK" and load the parameterization to your control system.

Maximum ring lengths in kilometers for PSI-MOS devices with an 8-pos. DIP switch

For all PSI-MOS devices with an 8-pos. DIP switch, there must be at least three devices in the redundant ring.

For PSI-MOS devices with an 8-pos. DIP switch, please observe the ring lengths in the following table.

For PSI-MOS devices with a 10-pos. DIP switch, there are no restrictions in terms of ring length if DIP switch 9 (COMPATIBILITY) is set to "OFF".

If DIP switch 9 is set to "ON", the values for the total length (in km) specified in the table below apply.

Number of PSI-MOS	Transmission speed [kbps]						
	9.60	19.20	45.45	93.75	187.50	500	1500
2	Not permitted						
3	9.90	9.90	9.90	9.90	9.90	9.90	5.20
4	13.20	13.20	13.20	13.20	13.20	13.20	5.07
6	19.80	19.80	19.80	19.80	19.80	14.40	4.80
8	26.40	26.40	26.40	26.40	26.40	13.60	4.53
10	33.00	33.00	33.00	33.00	33.00	12.80	4.27
12	39.60	39.60	39.60	39.60	32.00	12.00	4.00
14	46.20	46.20	46.20	46.20	29.87	11.20	3.73
16	52.80	52.80	52.80	52.80	27.73	10.40	3.47
18	59.40	59.40	59.40	51.20	25.60	9.60	3.20
20	66.00	66.00	66.00	46.93	23.47	8.80	2.93
22	72.60	72.60	72.60	42.67	21.33	8.00	2.67
24	79.20	79.20	79.20	38.40	19.20	7.20	2.40
26	85.80	85.80	70.41	34.13	17.07	6.40	2.13
28	92.40	92.40	61.61	29.87	14.93	5.60	1.87
30	99.00	99.00	52.81	25.60	12.80	4.80	1.60
32	105.6	104.17	44.00	21.33	10.67	4.00	1.33

Example:

- Number of fiber optic converters in the ring: 6
- Transmission speed: 500 kbps
- Total length permitted according to table: **14.4 km**
- Installed total length of fiber optics: 9.98 km → OK
- Use of PSI-MOS devices with an 8-pos. DIP switch

Required slot time:

Tslot_Init = 211 + 9.98 x 10 L + 4 x 6 = **335 bits**

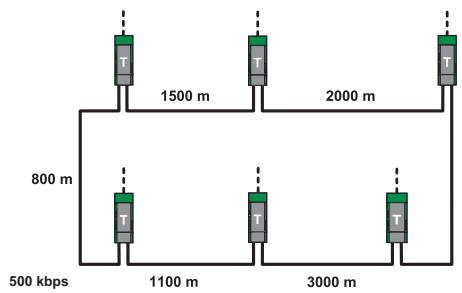


Figure 15 Example of a ring installation