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PSI-REP-PROFIBUS/12MB

Repeater for PROFIBUS systems up to 12 Mbps

INTERFACE

Data sheet
102986_en_03

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1 Description

The **PSI-REP-PROFIBUS/12MB** DIN rail-mountable modular PROFIBUS repeater is designed to meet the high requirements of high-performance PROFIBUS systems. The device is snapped onto standard DIN rails in the control cabinet and supplied with 24 V DC. The main areas of application are:

- Electrical isolation/bus segmentation
- Increasing system availability
- Increasing the range
- Increasing transmission speeds
- Extending the number of devices to $n \times 32$
- Implementing hybrid/network structures
- Modular PROFIBUS hubs

The following features of the repeater are particularly outstanding:

- Transmission speed of up to 12 Mbps
- Automatic transmit/receive changeover
- High-quality 4-way isolation
- Integrated surge protection with transient discharge to the DIN rail

- 24 V DC control cabinet supply voltage, with user-friendly connection via COMBICON plug-in screw terminal blocks
- Bit retiming
- Bit oversampling
- Modular station structure, even with PSI-MOS-... fiber optic converters

1.1 Bit retiming

PROFIBUS signals with a bit distortion of up to 35% can be reliably detected using the bit retiming function and are converted to their original bit form before being transferred to the next segment. This data processing function means that a virtually unlimited number of repeaters can be aligned without an impermissible level of bit distortion.

1.2 Bit oversampling

The bit oversampling function can be used to detect and filter malfunctions so that they are not transferred to the next segment.



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

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2 Ordering data




Repeater

Description	Type	Order No.	Pcs./Pkt.
Modular PROFIBUS repeater, for electrical isolation and increasing the range in PROFIBUS systems, 4-way isolation, DIN-rail mountable	PSI-REP-PROFIBUS/12MB	2708863	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
System power supply unit for supplying a modular star coupler topology, for 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 TBUS 1,5/ 5-ST-3,81 GN	2709561	10
PROFIBUS cable, Fast Connect type, up to 12 Mbps	PSM-CABLE-PROFIB/FC	2744652	1
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
PROFIBUS connector up to 12 Mbps, angled version, integrated termination resistor that can be connected externally, IDC terminal block connection	SUBCON-PLUS-PROFIB/FC 90	2313274	1
PROFIBUS connector up to 12 Mbps, angled version, integrated termination resistor that can be connected externally, with PG D-SUB female connector for a programming device, IDC terminal block connection	SUBCON-PLUS-PROFIB/PG/FC 90	2313287	1

3 Technical data

Interface													
Power supply	24 V DC ($\pm 20\%$ via COMBICON plug-in screw terminal block)												
Frequency	DC												
Nominal current consumption	90 mA (at 24 V DC)												
Ready-to-operate indicator	"VCC" LED (green)												
Star coupler configuration	10, maximum												
Serial RS-485 interface													
Transmission channels	2 (1/1), TD, RD												
Operating mode	Half duplex												
Data format/encoding	UART/NRZ (11 bits)												
Data direction changeover	Automatic, minimum station response time 2 bits												
Transmission speed (can be set via DIP switches)	<table border="1"> <thead> <tr> <th>Auto-baud</th> <th>9.6/19.2/45.45/93.75 kbps</th> <th>187.5 kbps</th> <th>500 kbps</th> <th>1500 kbps</th> <th>3000/6000/12,000 kbps</th> </tr> </thead> <tbody> <tr> <td></td> <td>1200 m</td> <td>1000 m</td> <td>400 m</td> <td>200 m</td> <td>100 m</td> </tr> </tbody> </table>	Auto-baud	9.6/19.2/45.45/93.75 kbps	187.5 kbps	500 kbps	1500 kbps	3000/6000/12,000 kbps		1200 m	1000 m	400 m	200 m	100 m
Auto-baud	9.6/19.2/45.45/93.75 kbps	187.5 kbps	500 kbps	1500 kbps	3000/6000/12,000 kbps								
	1200 m	1000 m	400 m	200 m	100 m								
Transmission length (depending on transmission speed and cable type)													
Transmission medium	2-wire twisted pair, shielded												
Connection	9-pos. D-SUB female connector												
Connection voltage/current	5 (± 0.25) V DC, 50 mA												
General data													
Bit distortion input	$\pm 35\%$, maximum												
Bit distortion output	$< 6.25\%$												
Bit delay	≤ 11 bits (FILTER MODE), 1 bit (DIRECT MODE)												
Electrical isolation	PROFIBUS (A) // PROFIBUS (B) // power supply // DIN rail connector												
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, port A (TD/RD) Transmission error, port A and port B (ERR A, ERR B)												
Housing material	PA V0, green												
Conductor cross-section	0.2 mm ² ... 2.5 mm ² (24 - 12 AWG), COMBICON connector												
Ambient temperature													
Operation	-20°C ... +60°C												
Storage/transport	-40°C ... +85°C												
Humidity	10% ... 95%, no condensation												
Dimensions (W x H x D)	35 mm x 99 mm x 105 mm												
Degree of protection	IP20												
Weight	200 g, approximately												
MTBF according to Telcordia standard													
Ambient temperature 25°C	1136 years												
Ambient temperature 40°C	238 years												
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 60068-2-32												
Air and creepage distances	DIN EN 50178, DIN EN 60950												
Tests/approvals													
CE													
UL/CUL 508	 US UL 508/C-UL 508												
Ex	 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 61000-6-2¹**

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/12 Ω
Power supply			0.5 kV/2 Ω
Conducted interference	EN 61000-4-6	Criterion A ³	10 V, 80% AM 1 kHz

Noise emission test according to EN 61000-6-4

Noise emission of housing	EN 55011 ⁴	Class A ⁵	
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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

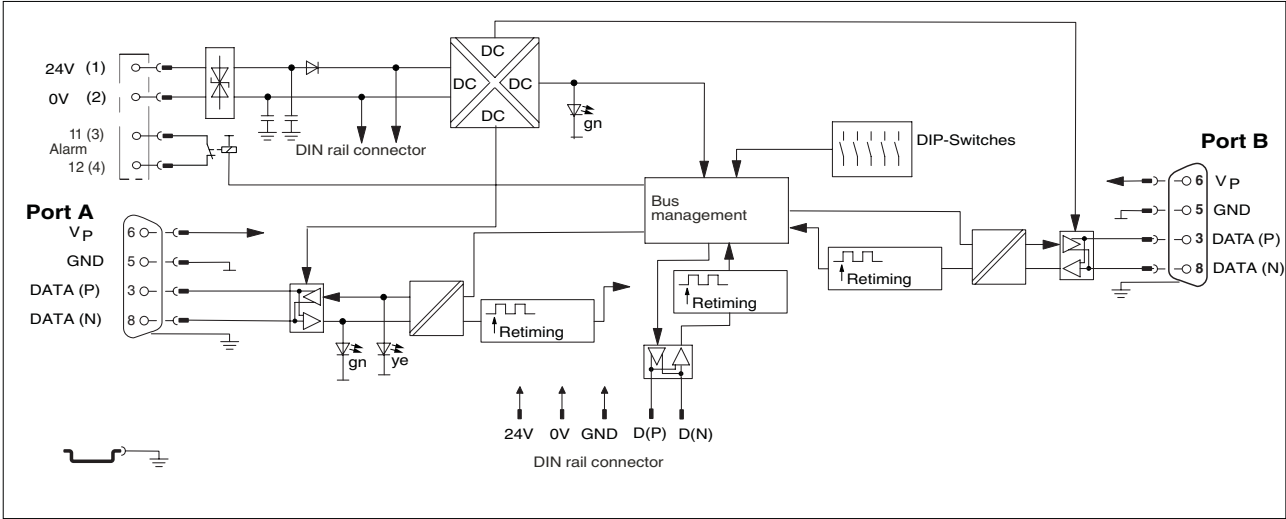
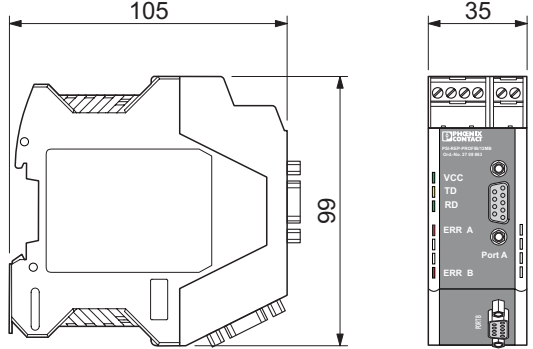


Figure 1 Block diagram

Housing dimensions



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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.



WARNING: The PSI-REP-PROFIBUS/12MB module is designed for SELV operation according to IEC 60950/EN 60950/VDE 0805.
The module may only be connected to devices, which meet the requirements of EN 60950.

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 Applications

The PSI-REP-PROFIBUS/12MB repeater can be used to create network topologies that are ideally adapted to the relevant application.

The limits set by the PROFIBUS standard, which specifies the electrical properties of PROFIBUS, are thus extended. This standard defines the following basic specifications:

- Maximum of 32 devices per potential segment
- Only (linear) bus structure permitted
- Maximum bus cable length of 1200 m
- Maximum branch line length of 5 m without termination resistor (depending on the transmission speed)
- Bus cable termination at the start and end of the bus cable

Example applications for repeaters

A segment can be created as an active branch, which can comprise the full bus cable length and a maximum of 31 devices.

Electrical isolation and bus segmentation using repeaters enables the permissible bus cable length to be multiplied and the number of devices to be extended to $n \times 32$, since the total number of devices of the PROFIBUS specification applies in each potential segment.

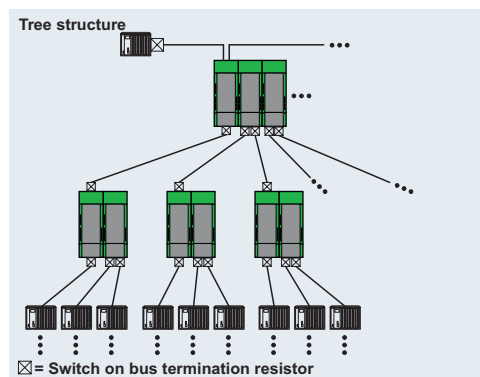
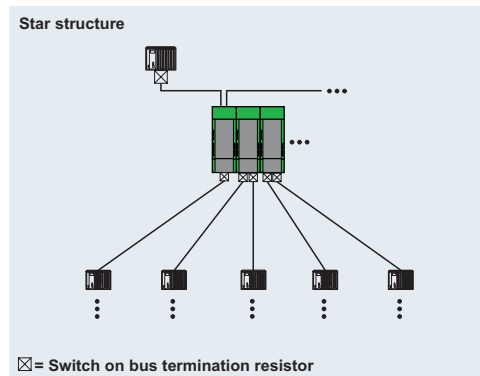
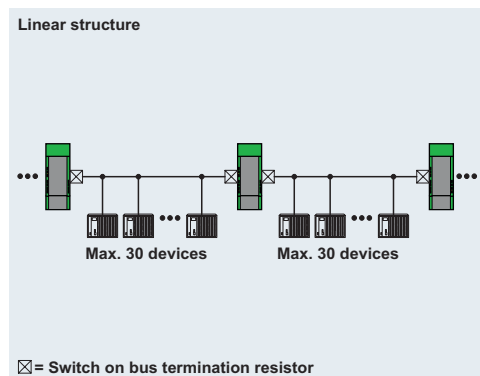
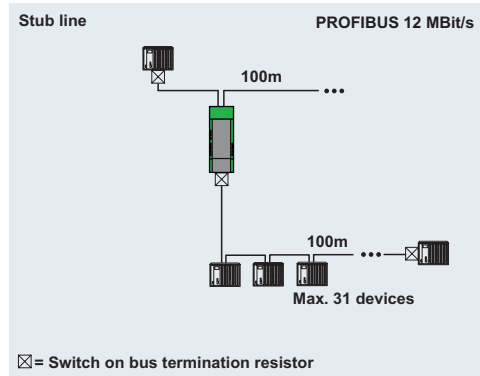
The repeater supports higher transmission speeds by subdividing into shorter segment lengths. For example, a 200 m long PROFIBUS system can only be operated at a transmission speed of 1.5 Mbps. The use of a repeater after 100 m means that 8 times the performance can be achieved, i.e., 12 Mbps.

Hybrid/network structures, star, and tree structures can be created using the PSI-REP-PROFIBUS/12MB modular repeater. A freely selectable installation concept, independent of the restrictive linear structure, is thus possible. The repeaters can be extended using PSI-MOS-PROFIB/FO... fiber optic converters for PROFIBUS systems.

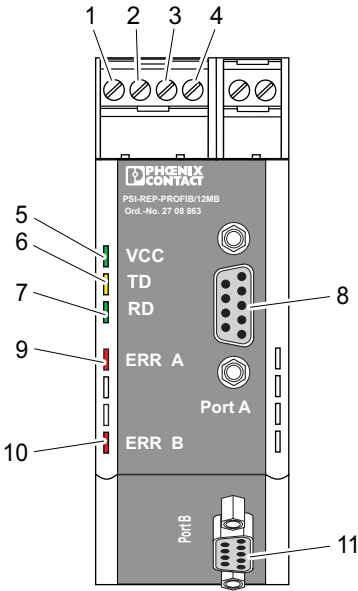
In addition, the repeaters can be combined and thus configured to form a modular PROFIBUS hub.



Please note that in each potential segment, the port of a repeater must be considered as a device.



6 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 "VCC" LED
- 6 "TD" LED
- 7 "RD" LED
- 8 9-pos. D-SUB: PROFIBUS interface (port A)
- 9 "ERR A" LED
- 10 "ERR B" LED
- 11 9-pos. D-SUB: PROFIBUS interface (port B)

Diagnostic and status indicators

Des.	Color	Meaning
VCC	Green	Ready-to-operate
TD	Yellow	Transmit data dynamic port A
RD	Green	Receive data dynamic port A
ERR A	Red	Transmission error port A
ERR B	Red	Transmission error port B

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Figure 3 Function elements

7 Setting the DIP switches

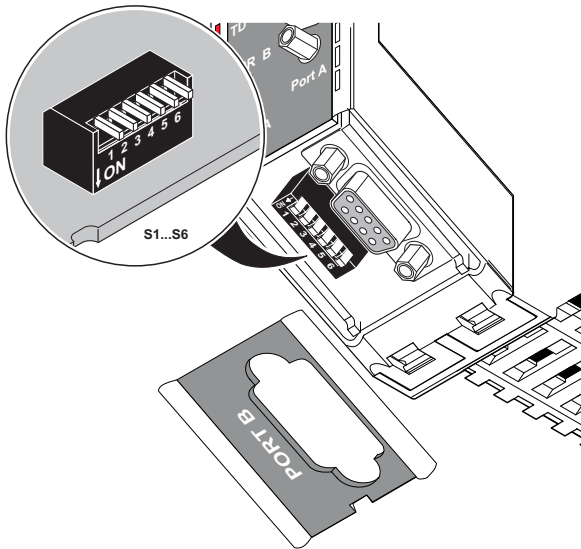


NOTE: Electrostatic discharge

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 EN 61340-5-2.

The DIP switches are located under the cap on the port B interface.

- Insert a small screwdriver into the slot on the bottom of the cap and lever it off.



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Figure 4 Setting the DIP switches

The tables in Section 7.1 and 7.2 provide an overview of the DIP switch functions. By default upon delivery, all DIP switches are in the "OFF" position.

7.1 Setting the transmission speed



NOTE: Set all connected PROFIBUS devices to the same data rate

- Set the transmission speed using DIP switches 1 to 4.

Transmission speed (kbps)	DIP switch			
	1	2	3	4
AUTO (default)	OFF	OFF	OFF	OFF
12,000	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

7.2 Setting the operating mode

DIP switch	ON	OFF
5	DIRECT	FILTER
6	N.C.	

In FILTER mode (DIP 5 = "OFF"), the repeater filters out damaged telegrams. This operating mode ensures maximum immunity to interference and prevents unnecessary network load due to damaged telegrams or resent telegrams.

The bit delay caused by the repeater is 11 bits, which must be taken into consideration in the cable configuration (see "Cable configuration" on page 10).

In DIRECT mode (DIP 5 = "ON"), the filter function is not available. The bit delay of 1 bit does not usually have to be taken into consideration in the cable configuration.

If several repeaters are connected to a star structure via the DIN rail connector, there is no additional bit delay when distributing the data signal via the DIN rail connector.

The corresponding bit delay must only be taken into consideration when the telegram is received at one of the D-SUB ports (A or B). The direction (master or slave) from which the telegram is received at the repeater is therefore not important.

8 Cable configuration

If the repeater is operated in DIRECT mode (DIP 5 = "ON"), the following cable configuration does not have to be taken into consideration. If the repeater is operating in FILTER mode as recommended, the bit delay of 11 bits must be taken into consideration in the cable configuration of the control system.

8.1 Configuration rules

Data transmission cables and network components lead to signal delays.

The following section provides support when calculating the necessary network parameters.

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 repeaters
- Total length of all copper cables

$$T_{slot_Init} = a + b \times L + 22 \times N$$

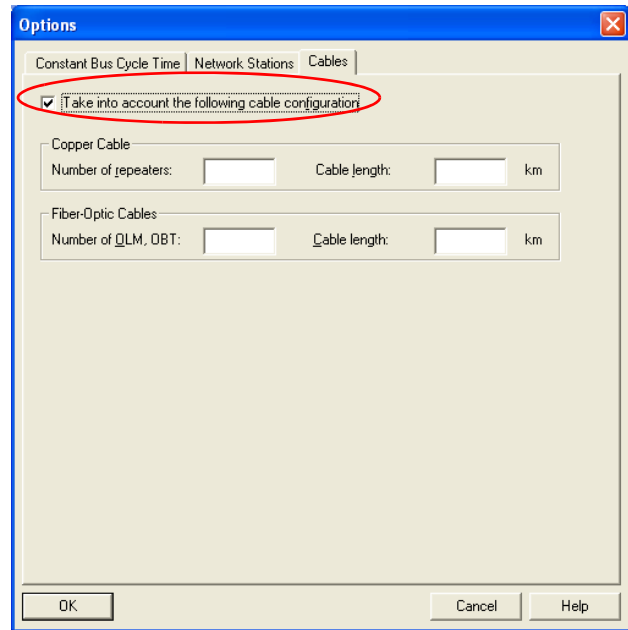
Where

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

Transmission speed [kbps]	a		b
	DP	DP/FMS	
12,000	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

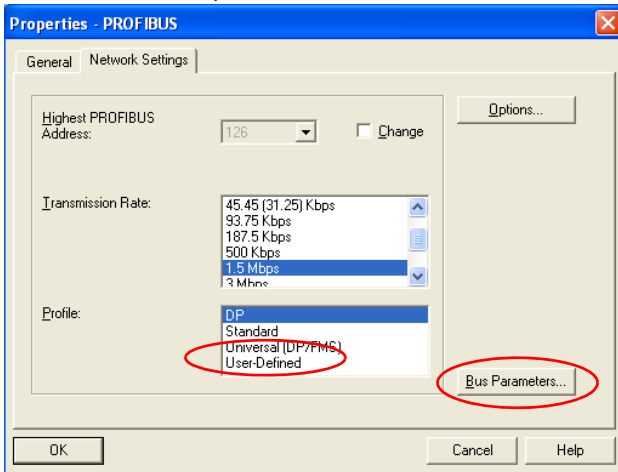
Configuring the network parameters in STEP 7

- 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.

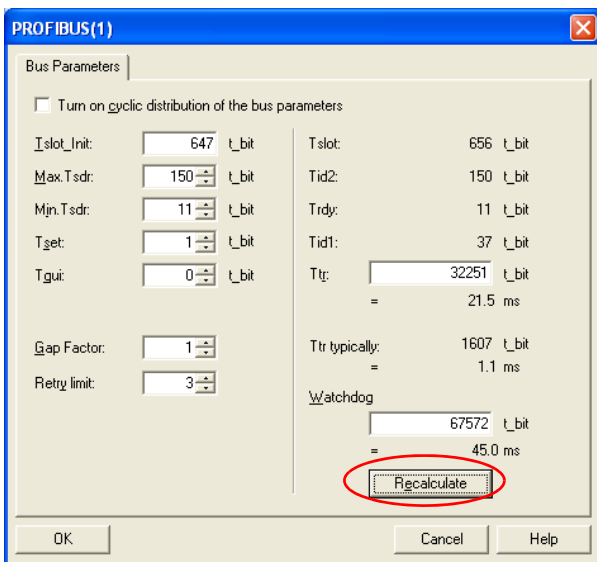


- In the "Cables" tab, activate the "Take into account the following cable configuration" checkbox.
- Enter the total number of repeaters used and the total length of all copper cables. If there are any fiber optic paths, they must be considered separately.
- Close all dialog boxes with "OK".

- Switch to the "Network Settings" tab and activate the "User-Defined" profile.



- Click on "Bus Parameters".



- Enter the calculated value in the "Tslot_Init" 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.

9 Connection notes



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



WARNING: The PSI-REP-PROFIBUS/12MB module is designed for SELV operation according to IEC 60950/EN 60950/VDE 0805.

The module may only be connected to devices, which meet the requirements of EN 60950.

- 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 2).



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 5).
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 6).
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.

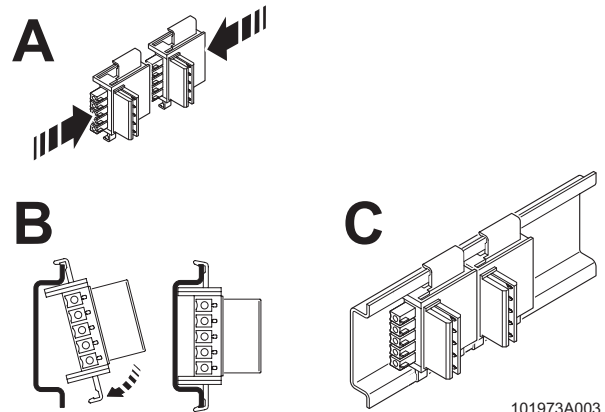
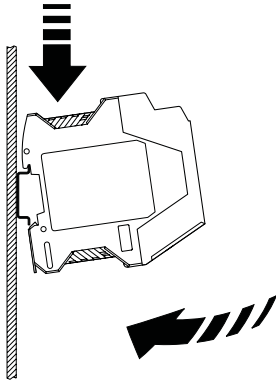


Figure 5 Combined assembly

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 6).
- 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.



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Figure 6 Assembly in the control cabinet

9.3 Assembly in potentially explosive areas



WARNING: Observe the safety notes on page 6.

- Areas with a danger of gas explosions
Only devices that are installed in zone 2 may be connected to the data interfaces (port A and B).
- Areas with a danger of dust explosions
If dust is present, install the device in suitable, approved housing.

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.

Operation as an individual device

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

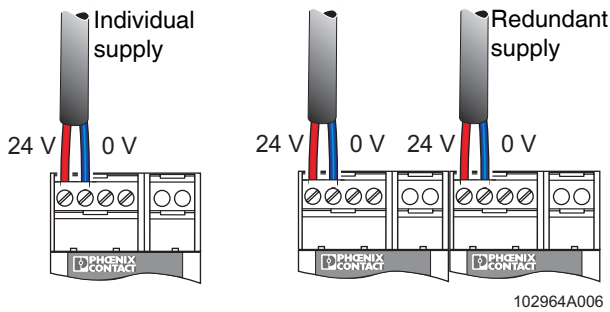


Figure 7 Individual/redundant supply

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

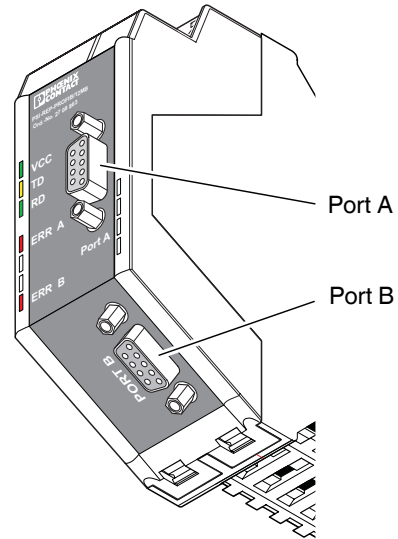


Figure 8 D-SUB connections for port A and port B



NOTE: Use shielded twisted pair data cables. Connect the cable shielding at both ends of the transmission path.

- Use a suitable connector (e.g., SUBCON-PLUS-PROFIB..., see page 2) to connect the bus cable to the D-SUB connection on the repeater.
- If the repeater is located at the start or end of an electrical PROFIBUS segment, activate termination in the connector.

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

10.3 Wiring the switch contact

PSI-REP-PROFIBUS/12MB repeaters are equipped with a floating switch contact for error diagnostics (connection terminal blocks 3 and 4 in Figure 3 on page 8). This contact opens on the relevant device in the event of a transmission error at port A or port B.

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 9).



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

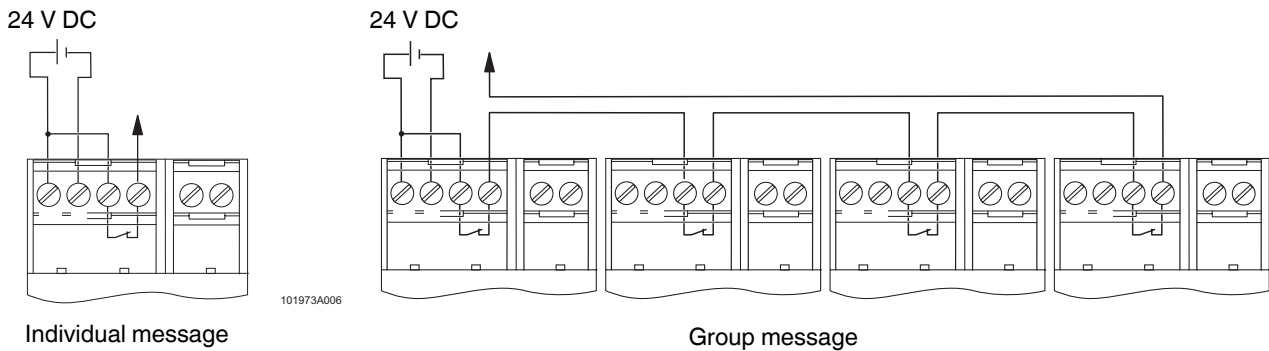


Figure 9 Individual and group message