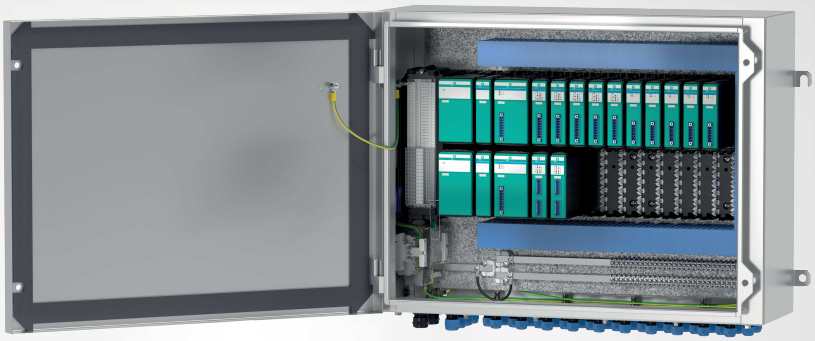
FB remote I/O

Hardware

Manual



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1 Introduction

1.1 Content of this Document

This document contains information required to use the finished device or system in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal

Note

This document does not replace the instruction manuals for the components in use.

The safety information for the components in use determines the specific safety instructions that apply to the system. The instruction manuals for the components in use must have been read and understood.

Note

For complete information about the components in use, refer to the instruction manuals and additional documentation available online at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This hardware manual
- Software manual for the gateways/com units in use
- Instruction manuals for the components in use
- Datasheets for the components in use

In addition, the documentation may comprise the following parts, if applicable:

- EC-type-examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Other documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Ensure that you are familiar with the system and its components before use. Read the documentation carefully.

1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols

Note

This symbol brings important information to your attention.

Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

2 Product Specifications

2.1 Prerequisites for Operating the FB Remote I/O Unit

Note

Requirements for equipment protection level Gb

Components of the FB remote I/O system may be installed and operated in Zone 1 only if they are installed in a certified surrounding enclosure that complies with equipment protection level Gb.

Note

Certification required

Before commissioning, the components of the FB remote I/O must be certified by a notified body together with the surrounding enclosure. Enclosures from Pepperl+Fuchs are supplied fully certified and with complete documentation so that they can be easily installed straight away.

2.2 Introduction

Remote I/O systems, consisting of I/O modules, gateways, com units, bus termination modules, power supplies, and a backplane, form the interface for signals to be transmitted from the explosion-hazardous area (Ex area), to the safe area (non-hazardous area). With appropriate surrounding enclosures, remote I/O systems can be installed in Gas-Ex areas of Zone 1. Using remote I/O systems, a wide range of digital and analog sensors and actuators can be connected to process control systems over a fieldbus. Specific measures need to be taken to disconnect I/O modules with Ex-e front connectors during ongoing operation. To do so, observe the safety notices in this manual. The gateway/com unit is the interface between the I/O modules on the backplane and the process control system. Power supplies are used to power the I/O modules and the com units/gateways.

All components of the FB remote I/O system with Ex-q protection meet the FB concept. This simplifies the evaluation of modules from an explosion protection point of view.

This manual sets out how to work with the hardware. Refer to the software manual for the gateway/com unit and the I/O modules for information on the configuration of the gateway/com unit and the I/O modules.

2.3 System Components

System overview

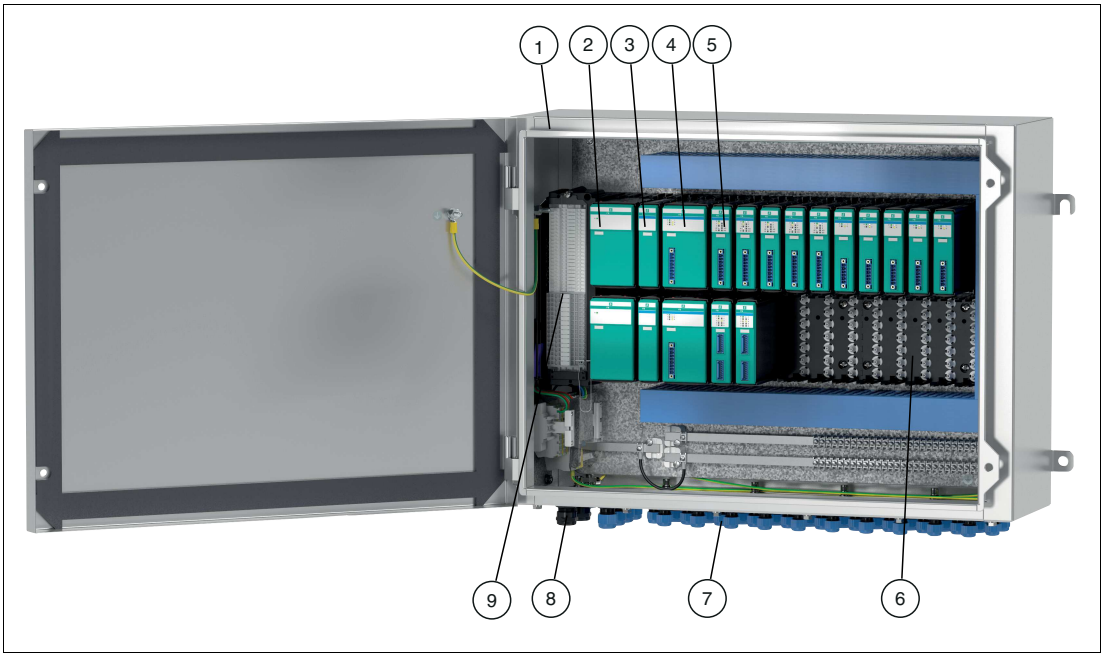

Figure 2.1 FB remote I/O system components

1 Field Unit (Surrounding Enclosure)
2 Power supply
3 Bus termination module
4 Gateway/Com unit
5 I/O module
6 Backplane
7 Cable gland for field lines
8 Cable gland for power supply and bus cables
9 Ex-e-terminals and IP30 cover

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2.4 Field Units (Surrounding Enclosures)

Field units serve to protect all electronic components against environmental influences and are an integral part of explosion protection. The enclosures are made of glass fiber reinforced polyester or stainless steel and are available in various versions. The surrounding enclosures contain backplanes for the connection of modules. The modular concept allows multiple surrounding enclosures to be flanged together to create the required expansion level. Each surrounding enclosure contains Ex-e terminals for power and communication lines. For safety, these are individually equipped with protective covers (IP30) and touch protection.

The surrounding enclosures are equipped with a rating plate listing all safety-relevant information, e.g., type of ignition protection, temperature class, permissible ambient temperature and permissible power.

Plastic enclosure

Figure 2.2 Field unit with plastic enclosure partially without cover and modules

Glass fiber reinforced polyester offers a high level of mechanical protection for both onshore and offshore plants.

Stainless steel enclosure

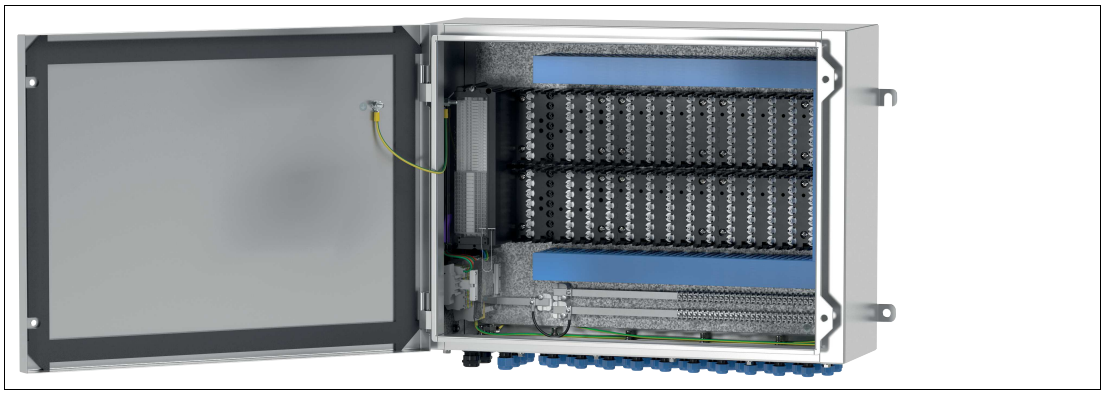

Figure 2.3 Field unit with stainless steel enclosure without modules

The stainless steel enclosure ensures a high level of corrosion resistance for onshore and offshore plants.

Modular plastic and stainless steel enclosures are available in various sizes and designs, and custom solutions are also available. Depending on the version, the device units comprise base, redundancy, and expansion backplanes installed in the corresponding surrounding enclosures.

Order designation	Type			Max. number of slots	Material	
	Field unit	Redundant field unit	Extension unit		Stainless steel	Polyester
FB9210-T6*-*-***-**-*-Y*	X			10	X	
FB9211-T6*-*-***-**-*-Y*R		X		10	X	
FB9220-T6*-*-***-**-*-Y	X			20	X	
FB9221-T6*-*-***-**-*-Y*R		X		20	X	
FB9224-T6*-*-***-**-*-Y*	X			24	X	
FB9240-T7-*-***-**-*-Y*	X			40	X	
FB9241-T7*-*-***-**-*-Y*R		X		40	X	
FB9241-T8*-*-***-**-*-Y*R		X		40	X	
FB9248-T7-*-***-**-*-Y*	X			48	X	
FB9248-T8-*-***-**-*-Y*	X			48	X	
FB9261-TX-*-***-**-*-Y*R		X		60	X	
FB9260-TX-*-***-**-*-Y*	X			72	X	
FB9221-PF0-A-0A0-00-0		X		20		X
FB9224-PF0-A-0A0-00-0	X			24		X
FB92MU-PF0-A-0A0-00-0			X	20		X
FB92EU-PF0-A-0A0-00-0			X	24		X

We also offer custom solutions for our customers. Experienced project engineers from our Solution Engineering Center (SEC) will assist you with designing your ideal FB remote I/O. More information can be found at www.pepperl-fuchs.com.

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2.5 Backplanes

2.5.1 Function

The modules are plugged into the backplane, which in turn is installed in a plastic or stainless steel enclosure. The backplane supplies the modules with energy and provides internal wiring.

Any I/O module can be inserted into any I/O slot, enabling a mixture of I/O functions in one field unit. Power supplies, com units/gateways, and bus termination modules are installed in their reserved slots. These are mechanically coded to avoid confusion.

Warning!

Risk of death as a result of using a damaged or tampered backplane.

Using a defective or tampered backplane means that explosion protection can no longer be guaranteed.

- Do not use a damaged backplane.
- The backplane must not be tampered with.
- In the event of a fault, the backplane must always be replaced with an original backplane from Pepperl+Fuchs.

Overview of backplanes

Order designation	Info
FB9262BP10220.2	• Universal backplane • 10 slots • Redundant: com unit and power supply
FB9262BP20220.2	• Universal backplane • 20 slots • Redundant: com unit and power supply
FB9262BP24110.2	• Base backplane • 24 slots
FB9262BP24200.2	• Extension backplane • 24 slots

Backplane combination options

Type FB9262BP* backplanes can be used together as base and extension backplanes in the following combinations:

		Extension			
		FB9262BP10220.2	FB9262BP20220.2	FB9262BP24110.2	FB9262BP24200.2
Base	FB9262BP10220.2	–	–	–	–
	FB9262BP20220.2	X	X	–	–
	FB9262BP24110.2	–	–	–	X

2.5.2 Design and Dimensions

Universal backplane

The following backplanes can be operated as basic backplane and extension backplane. The function is determined by setting plug-in jumpers.

FB9262BP10220.*

- Redundant configuration with slots for 2 com units/gateway, 2 bus termination modules, 2 power supplies
- Slots for max. 10 narrow or 5 wide I/O modules
- FB9262BP10220.2 for PROFIBUS DP, MODBUS RTU, MODBUS TCP, PROFINET
- FB9262BP10220.1 (former version) for PROFIBUS DP, MODBUS RTU, MODBUS TCP

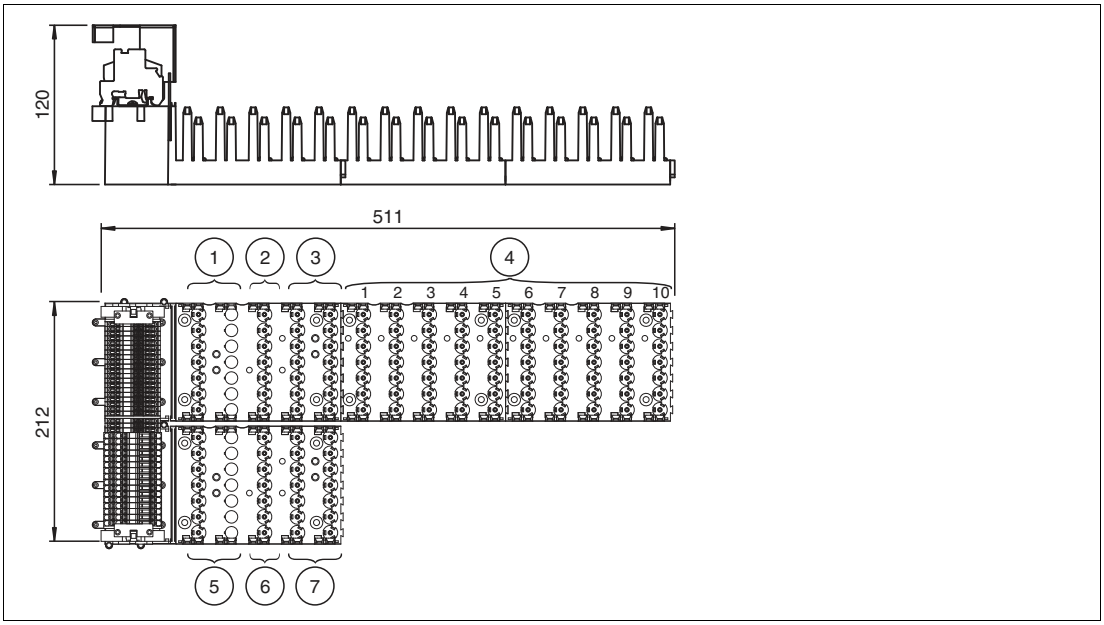


Figure 2.4 FB9262BP10220.* dimensions

1 Power supply

2 Bus termination module when used as a base backplane
Empty slot when used as an extension backplane

3 Gateway when used as a base backplane
Empty slot when used as an extension backplane

4 Slots for 10 narrow or 5 wide I/O modules

5 Redundant power supply

6 Bus termination module for redundant gateway, when used as base backplane
Empty slot when used as extension backplane

7 Redundant com unit when used as a base backplane
Empty slot when used as an extension backplane

FB9262BP20220.*

- Redundant configuration with slots for 2 gateways/com units, 2 bus termination modules, 2 power supplies
- Slots for max. 20 narrow or 10 wide I/O modules
- FB9262BP20220.2 for PROFIBUS DP, MODBUS RTU, MODBUS TCP, PROFINET
- FB9262BP20220.1 (former version) for PROFIBUS DP, MODBUS RTU, MODBUS TCP

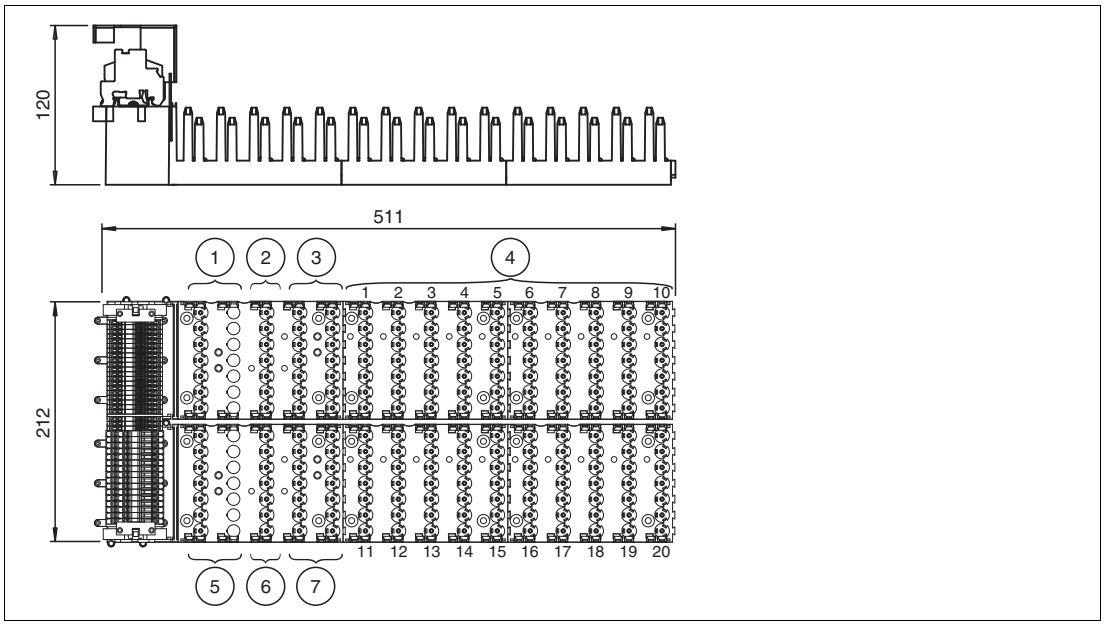


Figure 2.5 FB9262BP20220.* dimensions

1 Power supply

2 Bus termination module when used as a base backplane
Empty slot when used as an extension backplane

3 Com unit when used as a base backplane
Empty slot when used as an extension backplane

4 Slots for 20 narrow or 10 wide I/O modules

5 Redundant power supply

6 Bus termination module for redundant gateway/redundant com unit when used as a base backplane
Empty slot when used as an extension backplane

7 Redundant com unit when used as a base backplane
Empty slot when used as an extension backplane

Base and extension backplane

The following backplanes are available in non-redundant design. The base backplane can be expanded with the extension backplane. Connect both backplanes using the cordset.

FB9262BP24110.*

- Base backplane
- Non-redundant configuration with slots for 1 com unit, bus termination modules (see chapter 2.6) and 1 power supply
- Slots for max. 24 narrow or 12 wide I/O modules
- FB9262BP24110.2 for PROFIBUS DP, MODBUS RTU, MODBUS TCP, PROFINET
- FB9262BP24110.1 (former version) for PROFIBUS DP, MODBUS RTU, MODBUS TCP

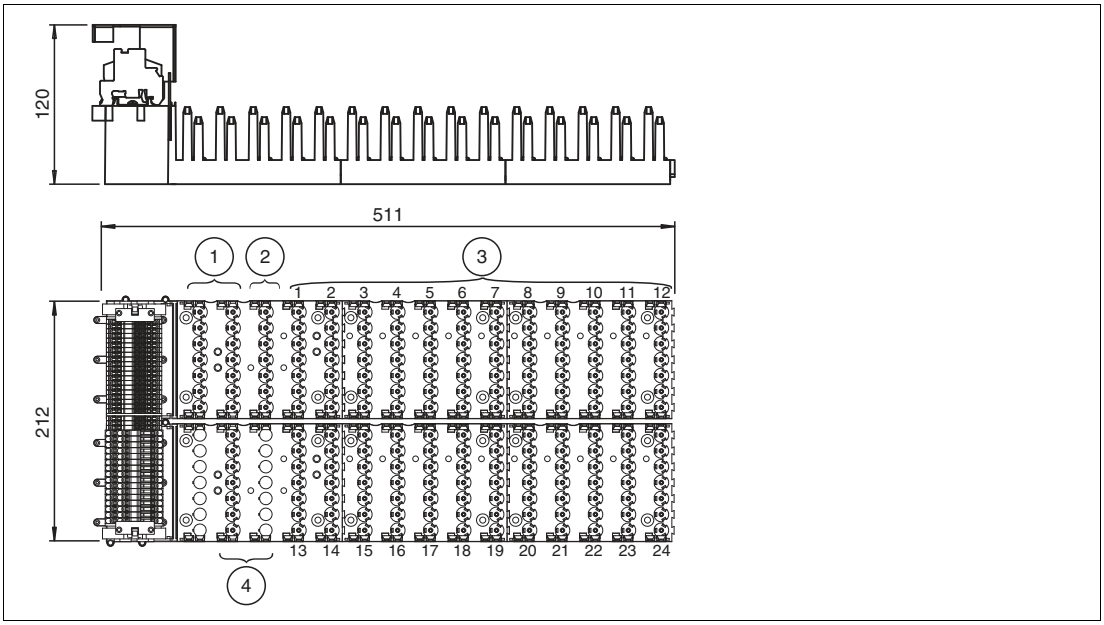


Figure 2.6 FB9262BP24110.* dimensions

1 Gateway

2 Bus termination module

3 Slots for 24 narrow or 12 wide I/O modules

4 Power supply

FB9262BP24200.*

- Extension backplane
- Expansion unit for base backplane for 2 power supplies and termination modules (see chapter 2.6)
- Slots for max. 24 narrow or 12 wide I/O modules
- FB9262BP24200.2 for PROFIBUS DP, MODBUS RTU, MODBUS TCP, PROFINET
- FB9262BP24200.1 (former version) for PROFIBUS DP, MODBUS RTU, MODBUS TCP

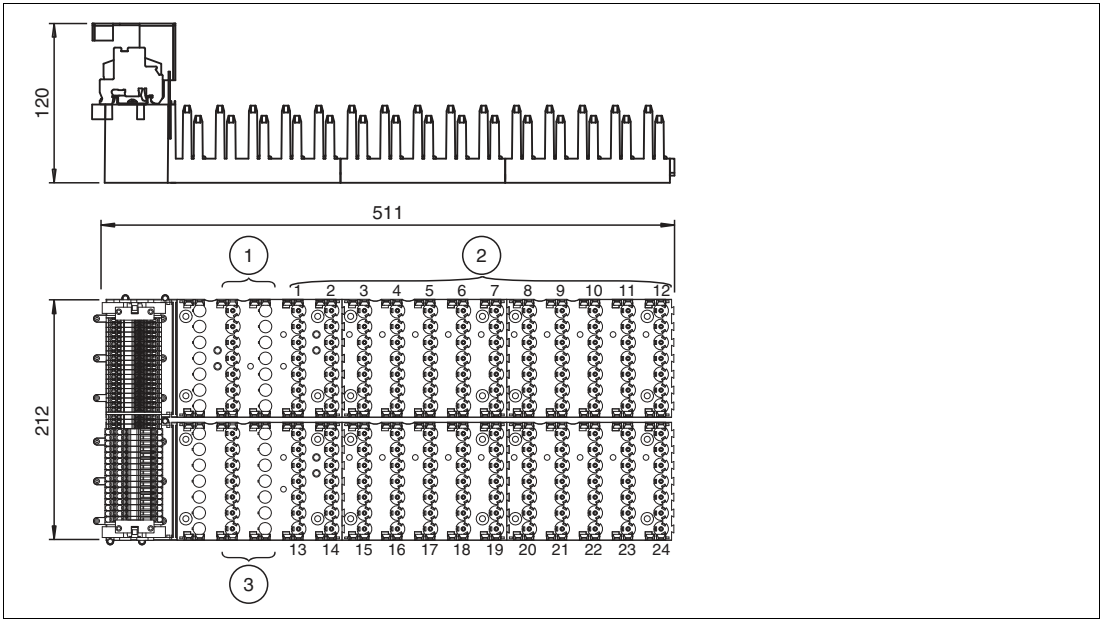


Figure 2.7 FB9262BP24200.* dimensions

1 Power supply

2 Slots for 24 narrow or 12 wide I/O modules

3 Redundant power supply

2.5.3 Backplane and Module Compatibility

In principle, FB backplanes are compatible with all FB modules. Narrow I/O modules occupy one slot, while wide I/O modules occupy two slots. However, please be aware of the following restrictions.

Warning!

Use the **FB9262BP*** backplane with the following power supplies only:

FB9206D

FB9215B2

FB9206D3

2.6 I/O Modules, Com Units, Bus Termination Modules, Power Supplies

2.6.1 Layout

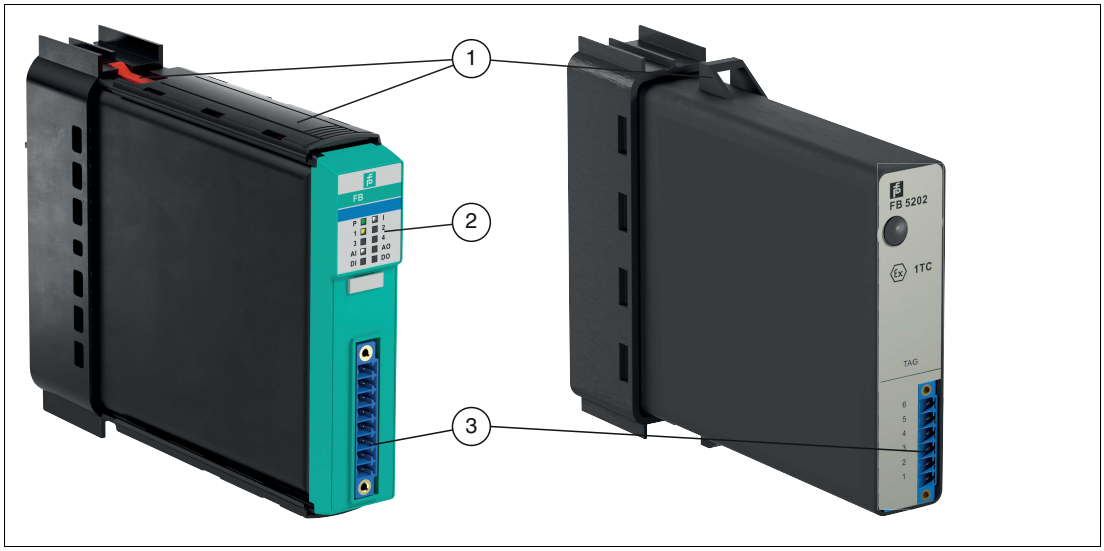


Figure 2.8 Layout shown through the example of an I/O module

Position	Module	Description
1	Ex-q modules (left)	The integrated removal device allows you to quickly install and safely replace modules during ongoing operation if the module has intrinsically safe front connections or no front connections.
	Ex-d modules (right)	The module is removed by means of a removal tool. See chapter "FB Removal Tool for Ex-d Modules".
2	Ex-q modules (left)	The status of each channel is displayed using an LED. This gives your technician clear information about the status of the field device directly on the device itself. For more information about the status LEDs, please refer to the respective datasheets for the modules.
3	Both modules	The sockets on the discharge side of the module offer 1, 2, 4 and 8 channels to connect Ex field devices. Using the single-channel modules for controlling valves, including feedback, two additional binary input signals can be transmitted from the field. The portfolio is supplemented with 2-channel modules with shutdown input for emergency shutdown. When modules are replaced, the new module automatically adopts the settings of its predecessor. This prevents errors when replacing modules.
	Ex-q modules (left)	The 4-channel universal module processes analog inputs and outputs depending on the setting. Each of the four channels can be configured independently of the others.

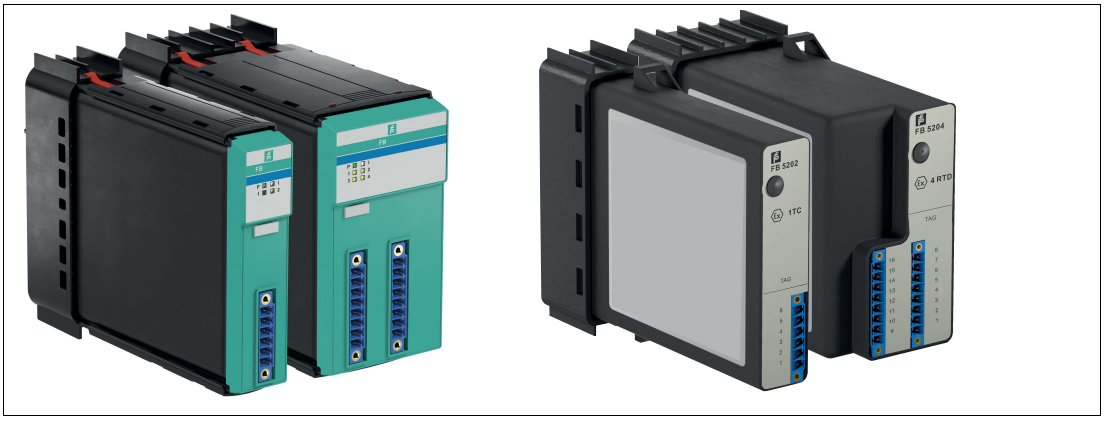
Note

All new I/O modules (Ex q) are fully compatible with the existing FB remote I/O and are therefore ideally suited for a plant expansion. The backwards compatibility offers you the opportunity to combine old modules (Ex d) and new modules (Ex q) on one backplane.

The IECEx certification only applies when Ex-q modules are used exclusively. The addition of an Ex-d module nullifies the IECEx certification. The ATEX certification remains in place.

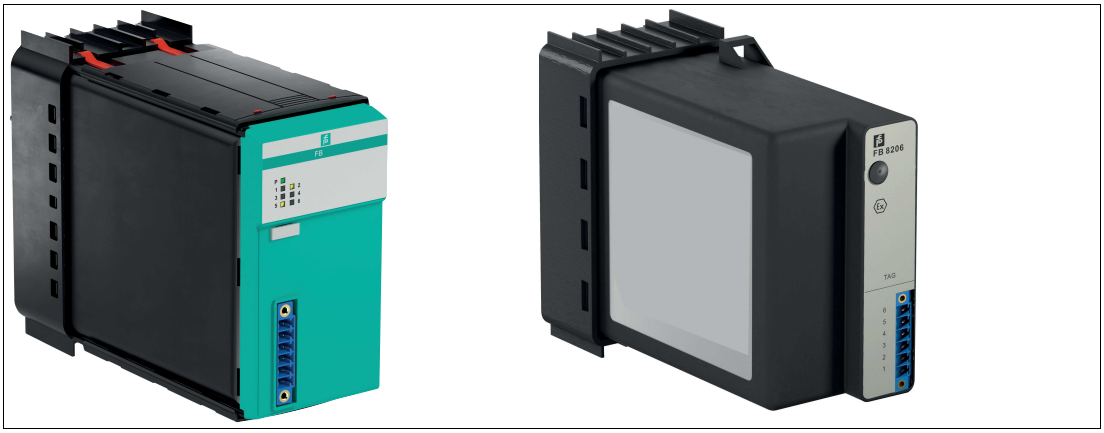
2.6.2 Function

I/O modules



I/O modules are used to modify signals between field devices in explosion-hazardous areas and controllers or control systems in the safe area. The slots for the I/O modules on the backplane are equal, so you can use I/O modules with different functions next to each other. The various I/O modules can be plugged in.

Com unit



Com units form the interface between the I/O modules and the process control system. The com unit converts the protocol of the bus integrated in the backplane to the protocol of the higher-level bus system.

Another com unit variant is the gateway. This is described in more detail below.

Gateway

Warning!

Explosion hazard in Zone 1

When pulling out an M12 connector in Zone 1, a spark may form that ignites an explosive mixture.

- Do not pull out M12 connectors in potentially explosive atmospheres.
- Use only original Pepperl+Fuchs cables.
- Connect the shield of each Ethernet cable leaving the control cabinet to the potential equalization (PE). Observe the installation instructions according to IEC/EN 60079-14. Make sure that the distance between the connection to PE and the M12 connection is as short as possible.

Warning!

Wrong terminal assignment or wrong position of the plug-in jumper

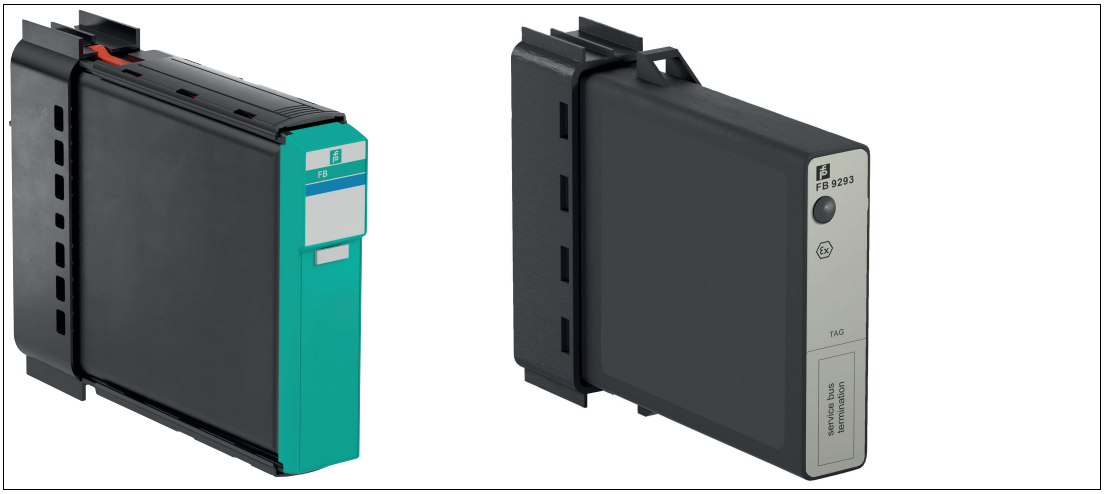
Wrong assignment of the terminals or incorrect positioning of the plug-in jumper on the backplane can cause damage to the Ex-q gateway. In both cases, please observe the information in the data sheet of the respective backplane.

- Ensure that the terminals for the Ex-q gateway are correctly assigned.
- Take special care to ensure that the plug-in jumper for the power supply of the gateway is correctly positioned.

The gateway (Ex-q) can be operated directly via the touch screen on the front. In addition, the device status is displayed using the four LEDs below the touch screen.

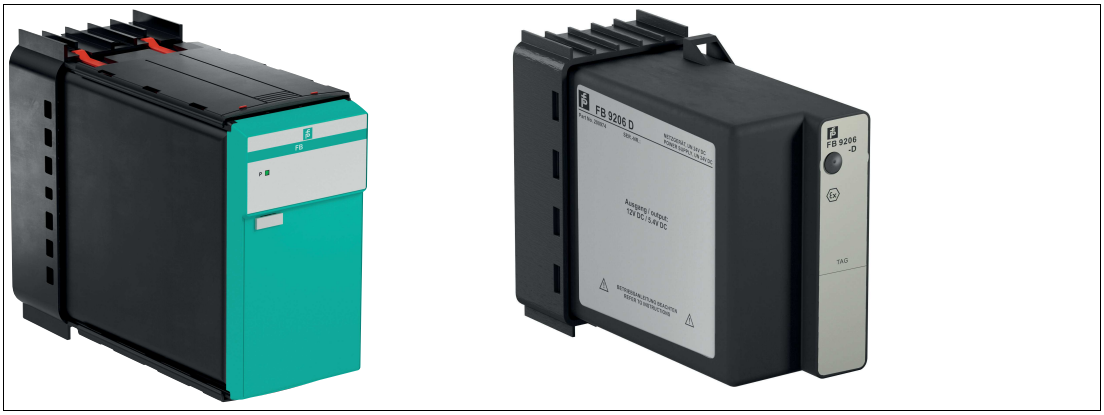
The two Ethernet interfaces on the front connect the device to the Ethernet network.

Bus termination modules



Bus termination modules prevent the reflection of signals at the end of the bus line. A bus termination module is required in each final unit of a bus line.

Power supplies



The power supplies provide power to all components of the FB remote I/O. The slots for power supplies are mechanically coded on the backplane and marked accordingly.

Place-holder module

Placeholder modules keep non-wired field circuits in position.

This modules have no electrical connection.

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2.6.3 Design and Dimensions of the Modules

The FB remote I/O system is designed in such a way that each I/O module can be connected to the I/O slot it requires on the backplane. The slots on the backplane are limited. Depending on the size, for example, a base backplane can accommodate max. 24 narrow or 12 wide I/O modules.

Power supplies, com units and bus termination modules are assigned to fixed slots. To avoid confusion, these are mechanically coded. Com units and power supply units are always wide modules. Bus termination modules are narrow modules.

Both the I/O modules and the gateways and power supplies are equipped with LEDs on the front that display the device status.

The I/O modules have connections on the front to which the relevant field devices are connected. On the back of the I/O modules there is a coding pin that prevents an I/O module from being accidentally inserted into a slot that is intended for a com unit or a power supply.

Warning!

Explosion hazard as a result of removing coding pins!

Removing the coding pins means explosion protection can no longer be guaranteed.

Never remove the coding pins from the module.

Narrow modules

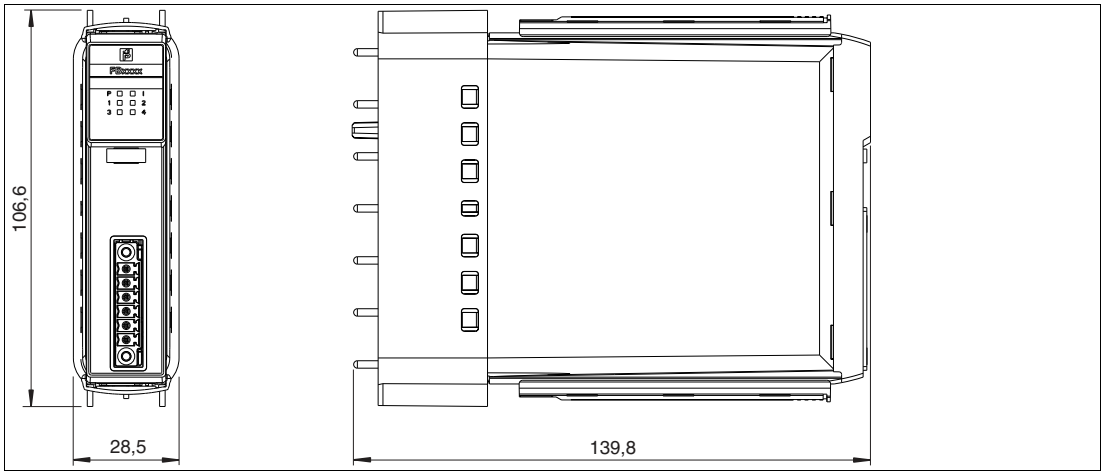


Figure 2.9 Narrow module dimensions

Wide modules

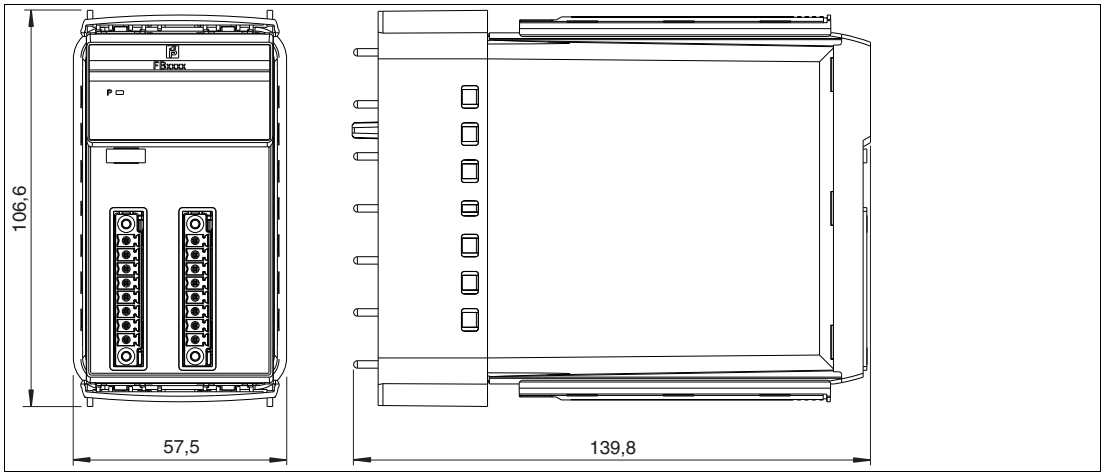


Figure 2.10 Wide module dimensions

2.7 Accessories

2.7.1 Field Wiring

The following accessories are available for field wiring.

Terminal blocks

Terminal blocks are wired to the field devices, attached to the front sockets of the I/O modules, and tightened using the side screws. Terminal blocks can come in the form of screw terminals, front screw terminals, or spring terminals. Use blue terminal blocks for intrinsically safe circuits. Use black terminal blocks for non-intrinsically safe circuits that comply with type of protection Ex e.

Danger!

Danger to life due to defective installation.

Incorrect installation of terminals can endanger the function and the electrical safety of the device.

- Crimp the stranded conductors with wire end ferrules before connecting them. Observe the requirements for wire end ferrules according to DIN 46228-1 and DIN 46228-4.
- Use only one conductor per terminal.
- Observe the requirements for stripping conductor insulation for Ex e protection according to IEC/EN 60028.
- Observe the tightening torque for the screws on the terminal.

- **Screw terminals**
  - Blue: LB9107A, LB9113A, LB9124A, LB9125A
- **Front screw terminals**
  - Blue: LB9117A, LB9118A, LB9119A, LB9127A
- **Spring terminals**
  - Blue: LB9107P, LB9115A, LB9116A, LB9126A, (LB9130A)
  - Black: LB9109.E.6.1, LB9109.E.8.1, LB9109.E.8.2

Screw terminals

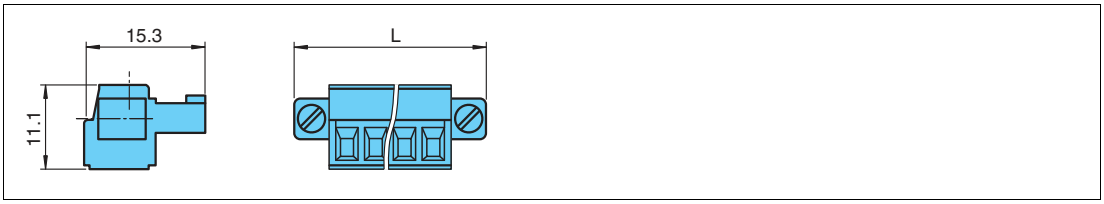


Figure 2.11 Screw terminal dimensions
L = 33.3 mm for 6-pin terminals and 40.9 mm for 8-pin terminals

Front screw terminals

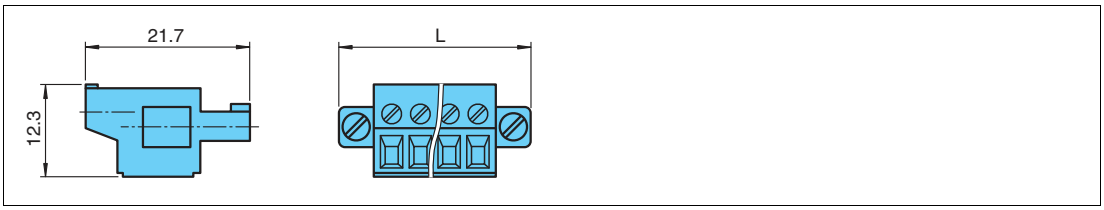


Figure 2.12 Front screw terminal dimensions
L = 33.3 mm for 6-pin terminals and 40.9 mm for 8-pin terminals

Spring terminals

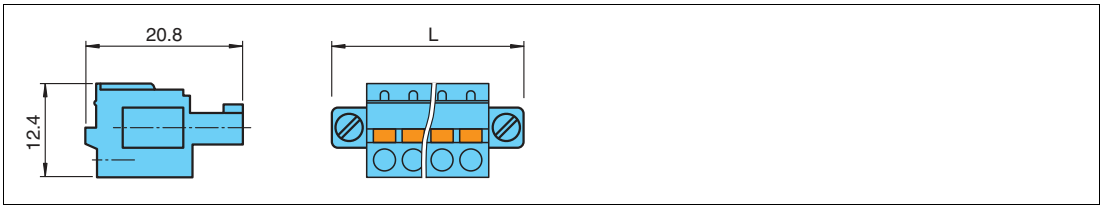


Figure 2.13 Spring terminal dimensions
L = 33.3 mm for 6-pin terminals and 40.9 mm for 8-pin terminals

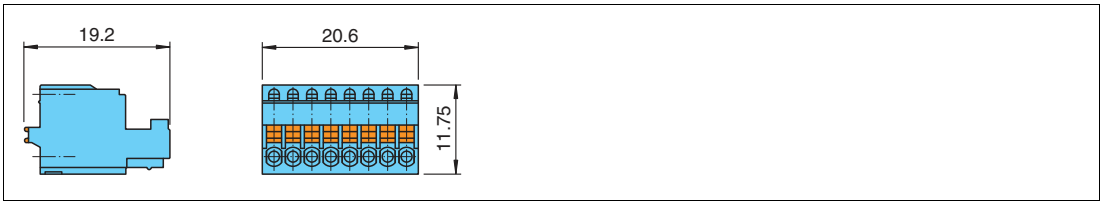


Figure 2.14 Spring terminal dimensions
8-pole terminal

Note

The LB9130A spring terminal for the FB1209 I/O module is only inserted and not screwed in.

Protective covers

Protective covers (IP30) are used to protect the wiring to the terminal blocks, so that no bare, conductive parts are exposed. Use black protective covers for non-intrinsically safe circuits that comply with type of protection Ex e.

- **Protective covers**
  - Black: LB9107.E.6, LB9107.E.8

Protective covers for Ex e modules

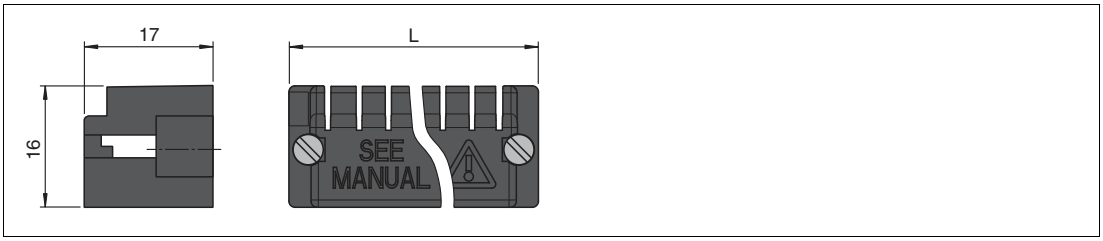


Figure 2.15 Dimensions of protective covers for Ex e modules
L = 33.4 mm for protective covers for 6-pin terminals and 40.8 mm for protective covers for 8-pin terminals

Cold junctions

Cold junctions have a prewired Pt100 thermocouple on terminal openings 1 and 2 for numerically correcting the thermoelectric voltage. Cold junctions are available exclusively in blue. Use blue cold junctions for intrinsically safe circuits.

- **Cold junctions**
  - Blue: LB9112A
- **Cold junctions with a protective cover**
  - Blue: LB9111A

Cold junction

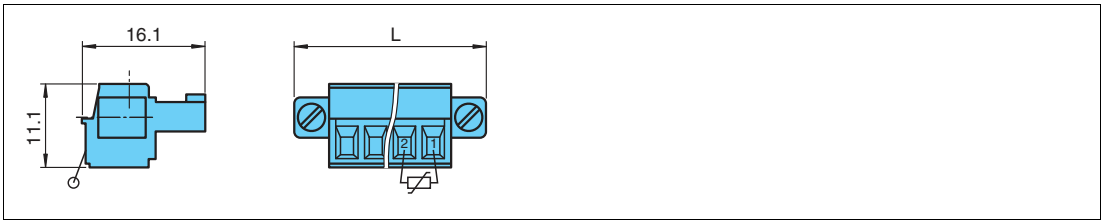


Figure 2.16 Cold junction dimensions
L = 33.3 mm for 6-pin terminals

Cold junction with a protective cover

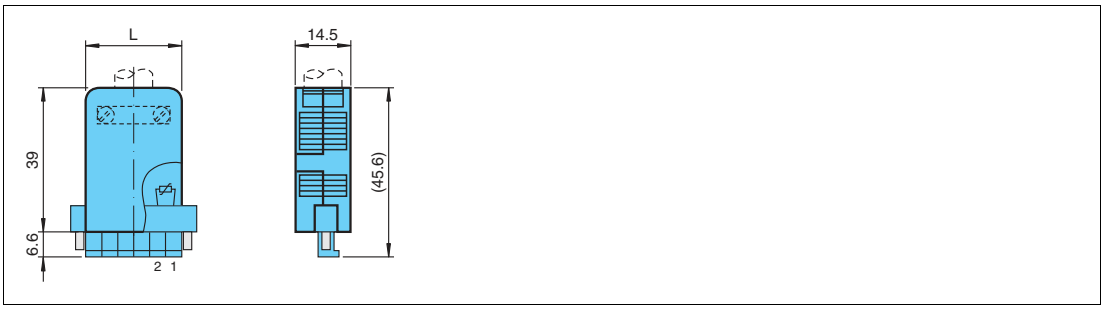


Figure 2.17 Dimensions of a cold junction with a protective cover
L = 33.3 mm for 6-pin terminals

Coding pins

Coding pins provide a unique assignment between I/O modules and terminal blocks or the associated field devices. To do this, the coding pins are pushed into the grooves provided in the front sockets of the I/O modules. This prevents terminal blocks from being accidentally plugged into another I/O module.

Warning!

Risk of confusing device connections.

When coding the front sockets of the I/O modules, ensure that the codes are mutually exclusive. Otherwise there is the danger of incorrect mapping between devices and circuits in explosion-hazardous areas.

KF-CP

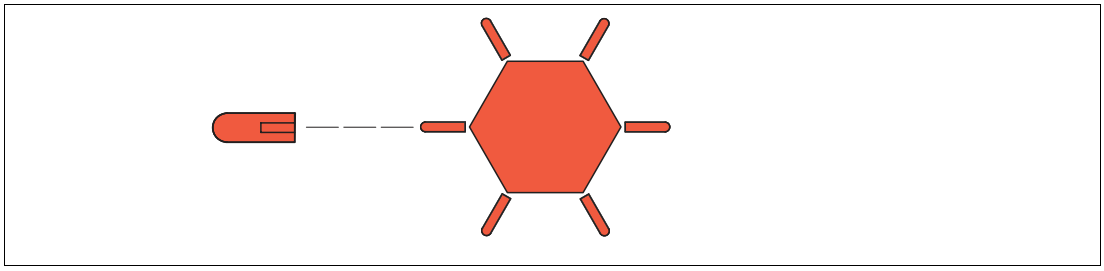


Figure 2.18 KF-CP coding pins

Note

The KF-CP coding pins are not suitable for the FB1209B3 module. Use suitable coding pins from Phoenix for this module.

Watchdog plugs

The watchdog plug is used with digital outputs with a feedback input (FB2201E* ... FB2213E*, FB6216E*). The watchdog plug sends the output signal from the I/O module back to its input channel, making it possible to check the function of the I/O module, as well as the communication between the process control system and the I/O module.

LB9180

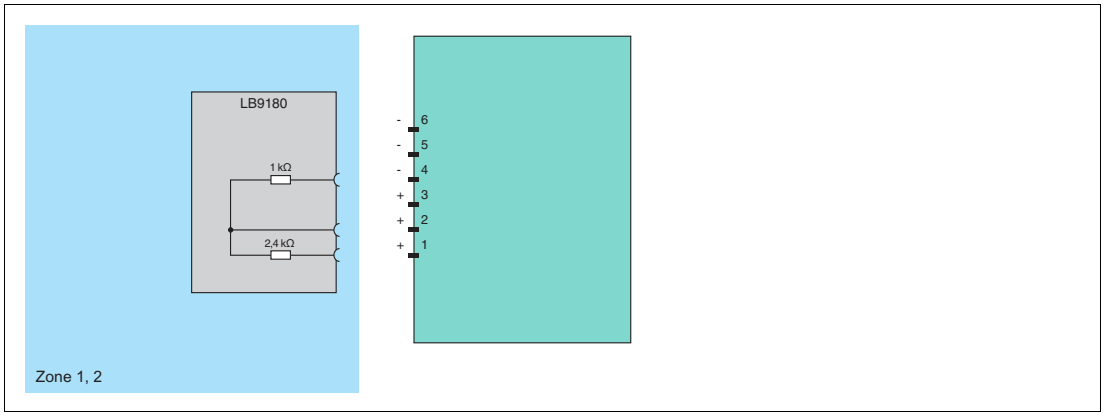


Figure 2.19 Block diagram for the LB9180

Resistor network

Most I/O modules have a line fault detection function that can recognize a lead breakage or a short circuit.

If binary I/O modules are used, for example with a mechanical contact, an additional resistor network must be installed to ensure that the line fault detection function can work correctly. Using the additional resistor network, the electronics can distinguish between a closed switch and a short circuit.

To do this, the resistor network must be positioned directly on the field device.

F-NR2-Ex1

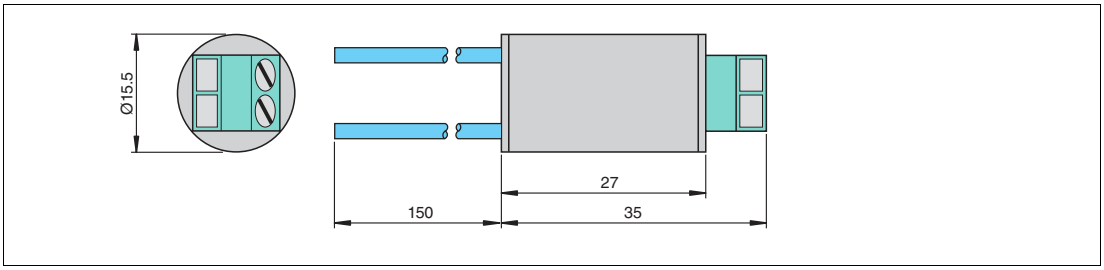


Figure 2.20 Dimensions of the F-NR2-Ex1 resistor network

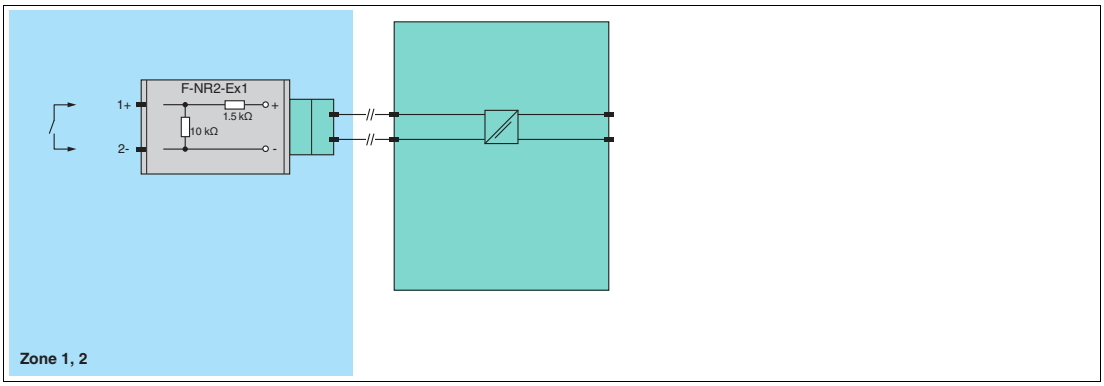


Figure 2.21 Block diagram of the F-NR2-Ex1 resistor network

2.7.2 Cordsets

Warning!

Explosion hazard through use of incorrect cordset.

The use of incorrect cables in a potentially explosive atmosphere can create sparks that can ignite the surrounding atmosphere.

Cordset between com units

If two com units are used in a redundant system, they must be connected using a cordset via the front socket to enable internal data exchange.

Com unit FB8211* has 2 front sockets. The socket with contacts 1 to 8 is used to connect the com unit cordset.

Com unit FB8210* is not designed for redundancy mode and therefore has no front socket.

Overview of cordsets (redundancy link)

Order designation	Slot	Redundancy link for com unit		Length
		FB8205, FB8206, FB8207, FB8209	FB8211	
FB9283-0400	6-pin	X	–	0.40 m
FB9283-0680	6-pin	X	–	0.68 m
FB9283-3000	6-pin	X	–	3 m
FB9283-0185	6-pin	X	–	0.185 m
FB9284-0185	8-pin	–	X	0.185 m

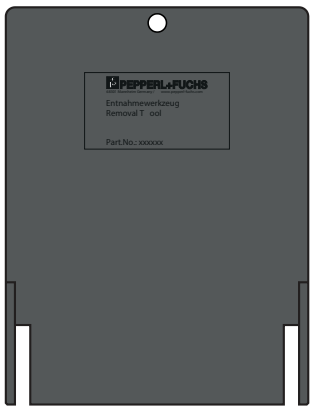
Cordset between backplanes

The following table shows an overview of possible cordsets. Cordsets establish a local connection between a base backplane and an extension backplane. If a base backplane is extended with an extension backplane with additional I/O modules and power supplies, the backplane cordset ensures data exchange between the com units on the base backplane and the I/O modules on the extension backplane.

Overview of cordsets between backplanes

Order designation	Base unit [Slots]	Extension unit [Slots]	Redundancy unit	Length
FB9271-074	24	–	X	0.74 m
FB9271-300	24	–	X	3 m
FB9273-300	–	24	X	3 m
FB9274-063	20	10, 20	–	0.63 m
FB9274-072	20	10, 20	–	0.72 m
FB9274-120	20	10, 20	–	1.20 m
FB9274-300	20	10, 20	–	3 m
FB9275-300	24	24	–	3 m

2.7.3 FB Removal Tool for Ex-d Modules



The removal tool allows for quick installation and safe module exchange during operation. That way, the module can be replaced without a hot work permit via the two-stage removal process. Excluded are devices with front connections in type of protection Ex e (e.g. FBx3xx or FB822* / FB823*), see chapter 3.5.
Use the removal tool with item number 536627 for wide modules and the removal tool with item number 536628 for narrow modules.
Ensure that the extraction tool is not used for Ex-q certified devices!

3 Installation

3.1 Field Unit (Surrounding Enclosure)

Danger!

Danger to life due to defective work

Errors during installation can cause life-threatening injuries and significant property damage.

- Ensure the installation is performed only by sufficiently trained and qualified personnel. Trained and qualified personnel have relevant experience in this area. They know and understand the rules and standards for the components and systems.
- Before you begin installation, make sure that the atmosphere is not potentially explosive.

Plastic enclosure
The plastic enclosure is mounted on through holes that are exposed when you remove the lid.

Metal enclosure
The metal enclosure is installed using an external mounting bracket attached to the enclosure.

A detailed description of the mounting instructions for the enclosure can be found on our website www.pepperl-fuchs.com.

Please also note the following information:

Danger!

Incorrect assembly poses an explosion hazard.

Operating the components of the FB remote I/O system without a certified enclosure can cause sparks. This may ignite the surrounding potentially explosive atmosphere.

In Zone 1 you must operate FB remote I/O system components in a certified enclosure that meets the device protection level Gb.

Note

Certification required

The components of the FB remote I/O system, together with the enclosure, must be certified by a recognized certification authority before commissioning. Enclosures with integrated FB remote I/O moduls from Pepperl+Fuchs are supplied fully certified and with complete documentation so that they can be easily installed straight away.

3.2 Backplanes

Warning!

Explosion hazard due to thermal ignition and violation of protection type.

Make sure that the maximum ambient temperature for the components used is not exceeded. Details of ambient temperature can be found in the relevant datasheets. Note that the temperature rises with an increasing number of active modules in the field unit. If necessary, take measures to reduce the temperature.

Mounting the Backplane

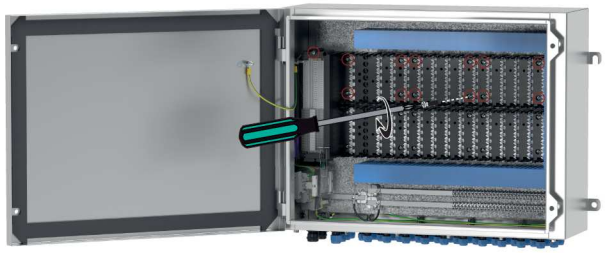


Figure 3.1 Screwing on the backplane

Fit the backplanes horizontally. Use the designated attachment points.

3.3 Connections for FB9262BP*

The power supply and the bus cables are wired using the Ex e terminal strip (1), which is located on the left side of the backplane. In addition, the Ex-e terminal strip forms the connection between the base backplane and the extension backplane. The terminal block is provided with a protective cover. This is used to protect the wiring against unintentional contact with other conductive elements and must be mounted before the system is commissioned. Observe the respective approval for explosion protection.

Figure 3.2 Ex-e terminal block

Danger!

Explosion hazard due to unapproved accessories

Accessories that do not meet the requirements for use in hazardous areas can cause explosive mixtures to ignite.

Only use accessories and devices that are approved for use in the respective environment.

Shutdown input

The safety function is realized via a separate shutdown input and is independent of the bus communication. The separate shutdown input deactivates the outputs with a single action. In order to avoid unnecessary diagnostic messages, the output circuit is interrupted rather than simply switching off the module power supply. Modules with shutdown input can be combined on the same backplane as modules without shutdown input. Modules without shutdown input are always controlled via the bus. Modules with shutdown input are only controlled via the bus when the shutdown input is closed. If the shutdown input is open, the modules are switched to a safe state.

The safe state is defined as: de-energized field circuit.

Danger!

Explosion hazard due to the use of non-suitable devices

Devices that do not meet the requirements for use in explosion-hazardous areas can cause explosive mixtures to ignite.

Only use volt-free contacts approved for use in the respective environment. For installation in Zone 1, for example, use a volt-free contact designed with Ex e protection.
The shutdown input is a circuit supplied by the backplane with safety extra-low protective voltage (SELV) and must therefore also be isolated from other circuits.

- To use the bus-independent output disconnection of the I/O modules, replace the corresponding plug-in jumper with an external, volt-free contact.
- To use the bus-independent output shutdown of I/O modules in slots 11 to 20 (not for FB9261BP10220.X), replace plug-in jumper 17/18 with an external volt-free contact.

Power connection (230 V)

The power supply may originate from a central power supply. We recommend that you install a power filter. Then connect the power supply to the appropriate terminals of the basic and extension backplanes.

Note

The power supplies must be supplied with power meeting the requirements specified in the datasheet, such as the overvoltage category.

Power connection (24 V)

If you are using a DC voltage, make sure that the cross sections of the cables are large enough to keep voltage drops on the supply lines to a minimum.

Note

The power supplies must be supplied with power of type SELV/PELV meeting the ranges specified in the datasheet.

Note

FB9206*: supplied DC voltage U_n = 24 V (18 - 32 V) must be of type SELV/PELV and not exceed a U_{max} (common mode) of 60 V.

3.4 Maximum Number of I/O Modules

Danger!

Explosion hazard through power overload or power dissipation overload

A too high power consumption of the power supply units can lead to an overload of the power supply units, which endangers the proper operation of the power supply units under the aspect of explosion protection.

A too high power dissipation inside the enclosure can cause the maximum permissible surface temperature of the enclosure to be exceeded.

For these two reasons, perform a calculation of the power consumption and power loss of the individual I/O modules and gateways/com units with regard to your application, as described in this chapter.
Additionally, note that only one power supply unit per backplane can be used for power calculation. If another power supply unit is installed on the backplane, it only serves as a redundancy function, not to increase the power. This is also an aspect of explosion protection.

FB6210* - 6215*

I/O modules of type FB621* have separate auxiliary power connectors for electronics and field circuits. The field circuits are supplied with auxiliary energy via booster terminals, the electronics are supplied via the backplane connectors from the system power supplies FB9206*(DC) and FB9215*(AC). With the advantage that the system power supplies will only be exposed to the low power requirements of the electronics part. In the case of a DC power supply, the booster terminals are connected directly to the power supply unit that feeds the backplane. In the case of AC supply, the booster terminals are connected to the output of the additionally required power supply unit type FB9205*. However, the total power loss of FB621* modules must be taken into account when considering the heat of the surrounding enclosure.

3.4.1 Power consumption of the I/O modules

Please refer to the corresponding data sheets for the power consumption of the I/O modules and gateways/com units. Add these values according to the positioning of the modules on the backplane and compare the sum value with the maximum output power of the power supply on the backplane. The power output of the power supply unit (data sheet specification) must not be exceeded in the process and only one power supply unit is permitted for power consideration.

Some I/O modules of the type FB621* have a booster connection for additional auxiliary power. Therefore, these modules are only considered with a relatively small value in this power consideration, which can also be taken from the data sheet.

3.4.2 Power dissipation of the I/O modules

The power dissipation of the individual I/O modules, the gateway/com unit and the power supply unit can be found in the corresponding data sheets. For the power supply unit there is a calculation formula.

If no value is specified for the power dissipation for an I/O module or a ComUnit, you can also use the value for the power consumption. Add these values and compare the sum value with the maximum permissible power dissipation of the enclosure.

If further consumers (no remote IO) are installed in the cabinet, their power dissipation must also be included in the summation.

3.5 Inserting and Removing Modules

The connector pins on the modules and the female connectors on the backplane form a flameproof enclosure when plugged together.

Danger!

Explosion hazard when connecting or disconnecting the field connections on the module.

I/O modules with Ex-e front ports require additional measures to be disconnected during operation.

Do not connect or disconnect the module while the circuit is live and while it cannot be guaranteed that the surroundings do not present an explosion hazard.

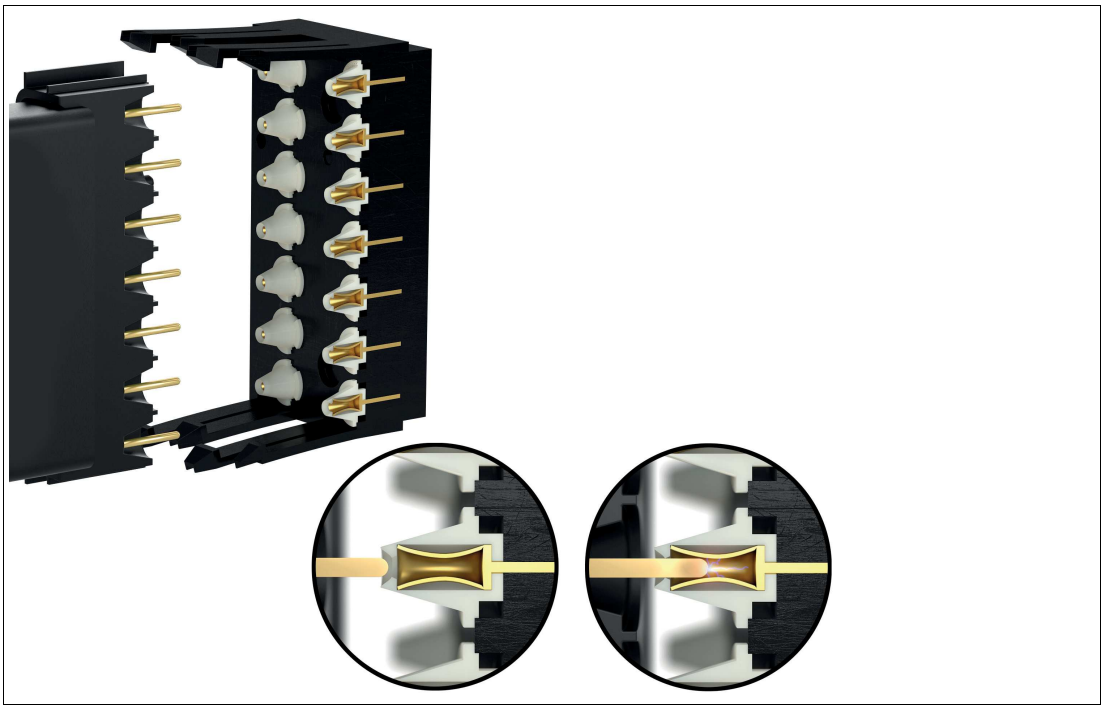


Figure 3.3 Flameproof enclosure

Danger!

Explosion hazard from damaged connector pins

Bent or damaged pins on modules can generate a spark, which can cause explosive mixtures to ignite.

- Never use modules with bent or damaged connector pins.
- If the connector pins are bent or damaged, replace the module with an intact original module.
- You are not permitted to repair modules with bent connector pins yourself.

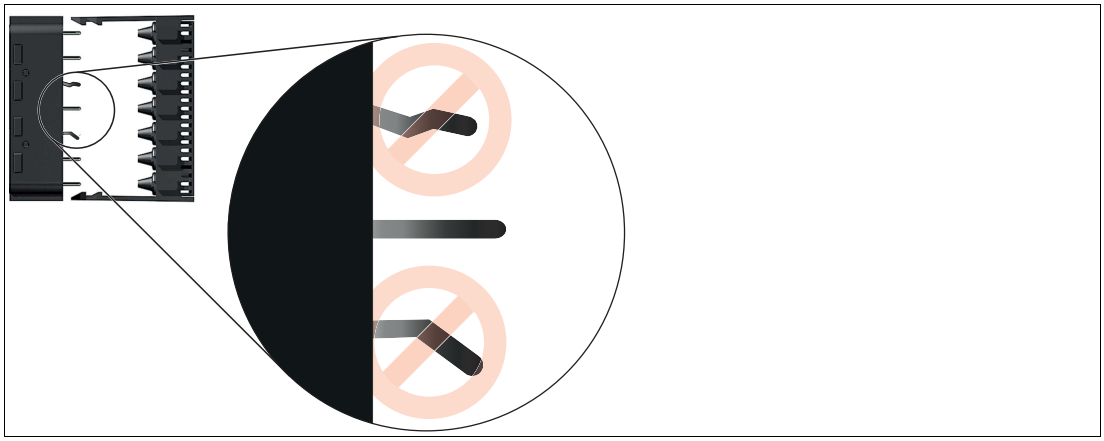


Figure 3.4 Bent connector pins

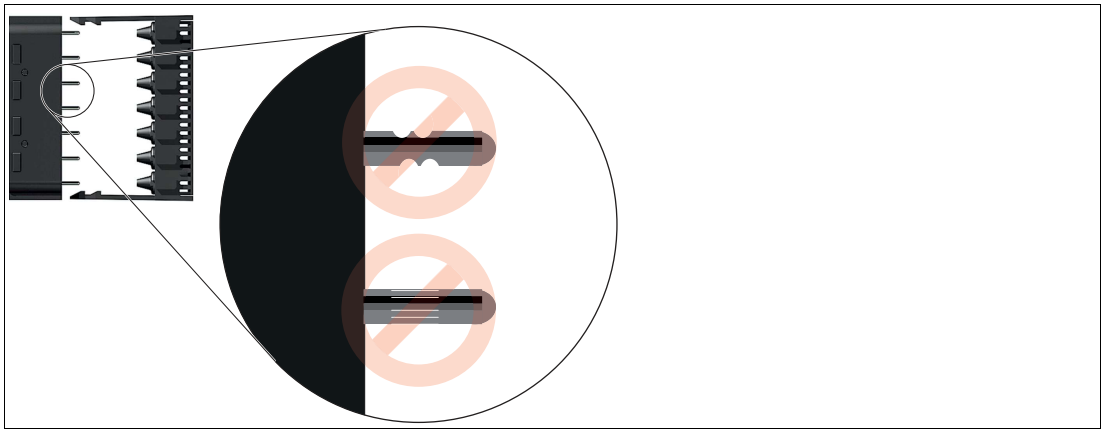


Figure 3.5 Damaged pins with nicks or scratches

Fixed slots are reserved on the backplane for gateways/com units, bus termination modules, and power supplies. Gateways/com units are equipped with mechanical coding pins on the underside of the enclosure to prevent these modules from being accidentally plugged into the slot of an I/O module.

Slots for I/O modules have equal status, meaning functions can be arranged side by side as required. I/O modules with intrinsically safe circuits and I/O modules with non-intrinsically safe circuits can also be arranged side by side.

Note

Please note that a clearance of 50 mm must always be maintained between intrinsically safe and non-intrinsically safe circuits.

Unused slots can be left empty or fitted with place-holder module FB9299B.

Inserting modules

Note

If you use redundant com units, establish a front connection between the primary com unit and the redundant com unit before you insert the redundant com unit into the backplane. This ensures that communication between the com units begins immediately after the power supply is established.

You can insert Ex d and Ex-q modules into one backplane. Also note the reference to IECEX certification from Chapter 2.6.

1. Write down the module types used or other identification codes using labeling strips, which you can stick between the female connectors of the backplane. The labeling strips should be no thicker than normal paper so that the modules engage properly at all times.

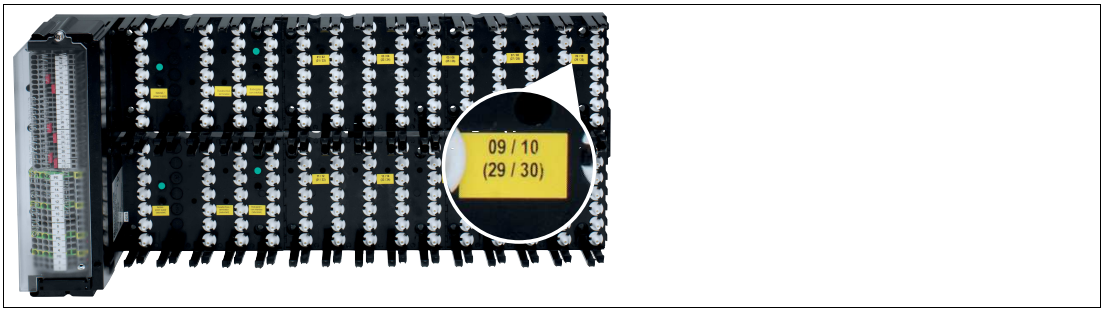


Figure 3.6 An example of backplane labeling

2. Arrange the modules on the backplane from left to right.
3. Push the module into the slot until you hear and feel both rear catches snap into place. The module must engage twice.

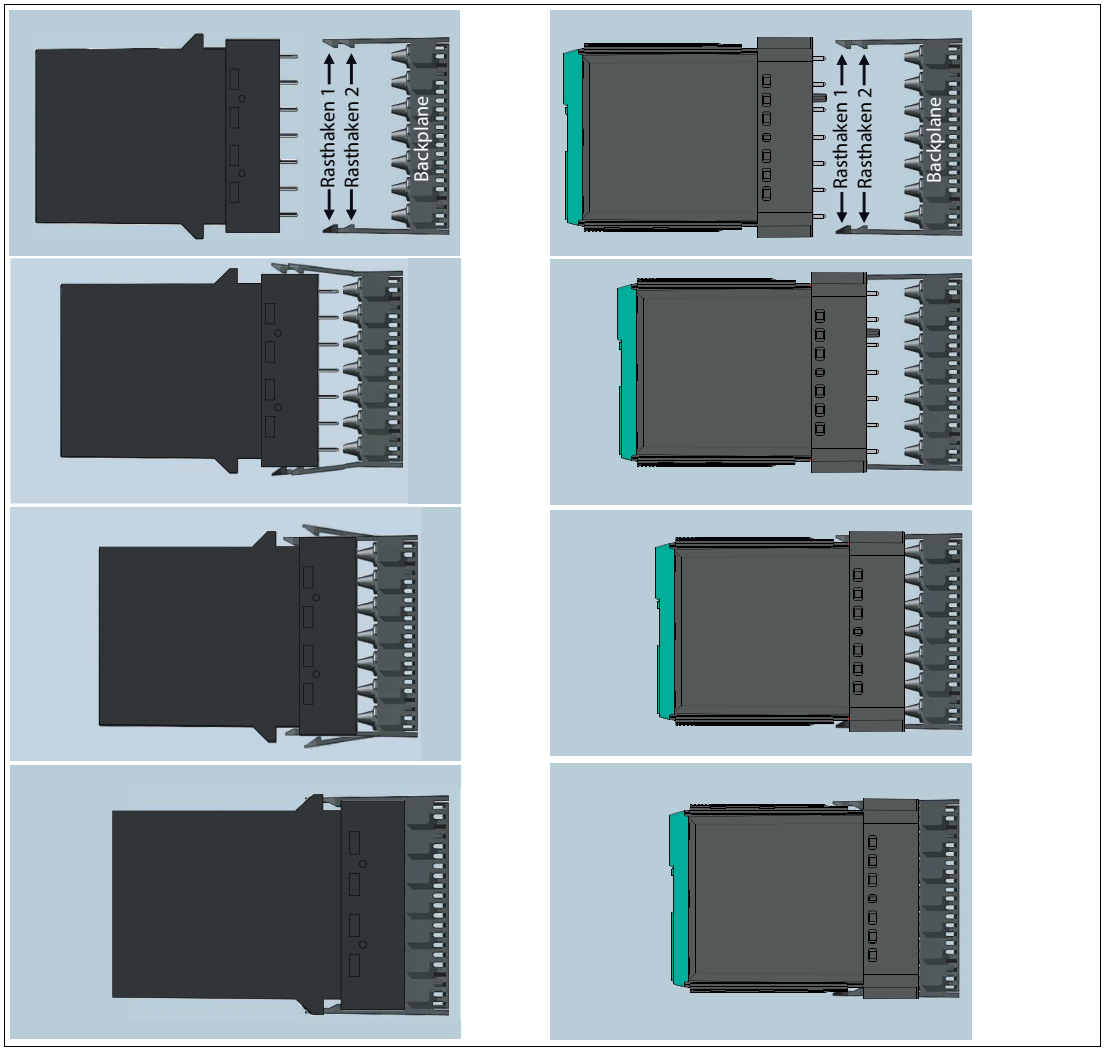


Figure 3.7 Insert module, left column with Ex-d modules and right column with Ex-q modules

↳ The I/O module is now mounted to the backplane.

Note

All modules with Ex-e front connections must be treated in a particular way. Refer to the relevant device approvals.

Removing Ex-d modules

Warning!

Explosion hazard due to damaged modules

Forcibly removing modules or using unsuitable tools can damage the module or the backplane, meaning that explosion protection can no longer be guaranteed.

Only remove modules using an original removal tool. The removal tool forces a two-stage removal process that contains any potential ignition spark within the pressure-resistant terminal area.

Danger!

Explosion hazard when removing field connections on the module.

I/O modules with Ex-e front ports require additional measures to be disconnected during operation.

Do not connect or disconnect the I/O module with Ex-e front connections while the circuit is live and while it cannot be guaranteed that the surroundings do not present an explosion hazard.

1. Disconnect the cordset from the front socket on the module.

Note

I/O modules with intrinsically safe front connectors or modules without front connectors (e.g., power supply, bus termination module) can be removed while operation is ongoing.

2. To release the first catch, position the FB removal tool on the right side of the module. Slide the FB removal tool towards the backplane up to the stop.

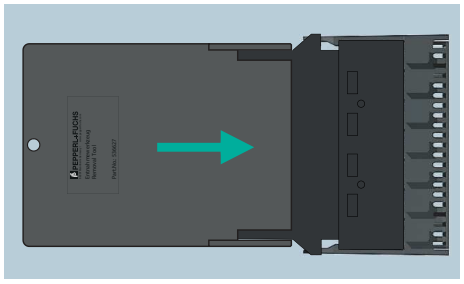


Figure 3.8 Inserting the FB removal tool

3. Pull out the module a few millimeters together with the FB removal tool until you begin to feel resistance from the second rear catch.

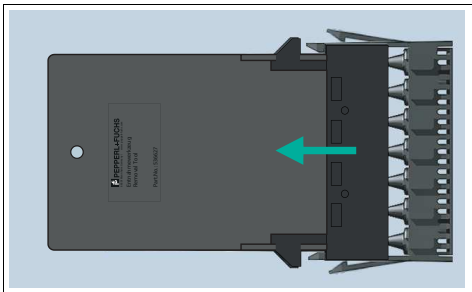


Figure 3.9 FB removal tool releases the first rear catch

2021-09

↳ The first rear catch is released and the module no longer has electrical contact with the backplane.

4. Turn the FB removal tool over and place it on the left side of the module. Slide the FB removal tool towards the backplane until the second catch is released.

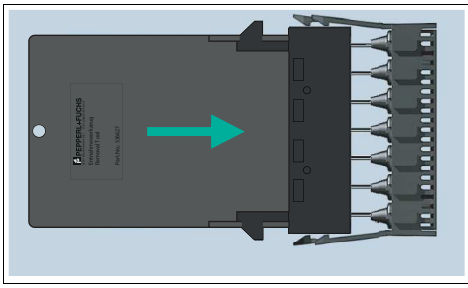


Figure 3.10 FB removal tool releases the second rear catch

5. Pull the module together with the FB removal tool out of the backplane.

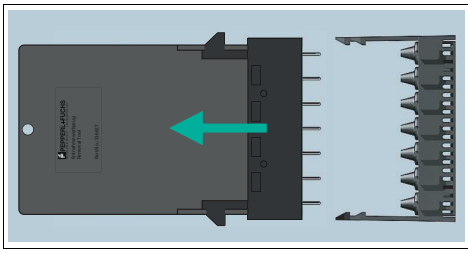


Figure 3.11 Pull out the module together with the front socket removal tool

↳ The second rear catch is released and the module is removed from the module slot.

6. If applicable, adjust the information on the labeling strips of the backplane.

Removing Ex-q modules

Warning!

Explosion hazard due to damaged modules

Forcibly removing modules or using unsuitable tools can damage the module or the backplane, meaning that explosion protection can no longer be guaranteed.

Only remove modules using the built-in removal device. The built-in removal device forces a two-stage removal process that contains any potential ignition spark within the pressure-resistant terminal area.

The pull and plug concept with a built-in removal lever on every module enables quick installation and permits safe module replacement during operation. In this way, the exchange can take place using the built-in removal lever and the two-step removal procedure.

Danger!

Explosion hazard when removing field connections on the module.

I/O modules with Ex-e front ports require additional measures to be disconnected during operation.

Do not connect or disconnect the I/O module with Ex-e front connections while the circuit is live and while it cannot be guaranteed that the surroundings do not present an explosion hazard.

1. Disconnect the cordset from the front socket on the module.

Note

I/O modules with intrinsically safe front connectors or modules without front connectors (e.g., power supply, bus termination module) can be removed while operation is ongoing.

2. Remove the first rear catch on the backplane. To do this, press the integrated removal levers on the top and bottom of the module using your thumb and index finger.

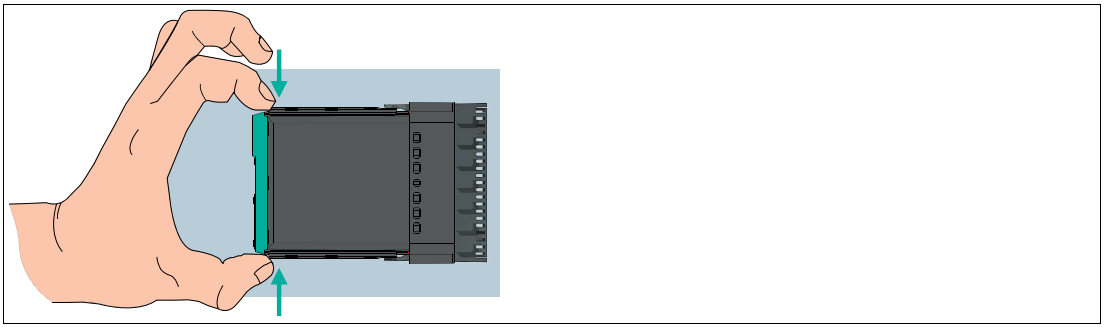


Figure 3.12 Integrated removal device

3. Pressing down with your thumb and index finger, push the removal lever as far as it will go toward the backplane. Use your thumb and index finger to grip the released module enclosure and pull the module out by a few millimeters until you feel resistance from the second rear catch.

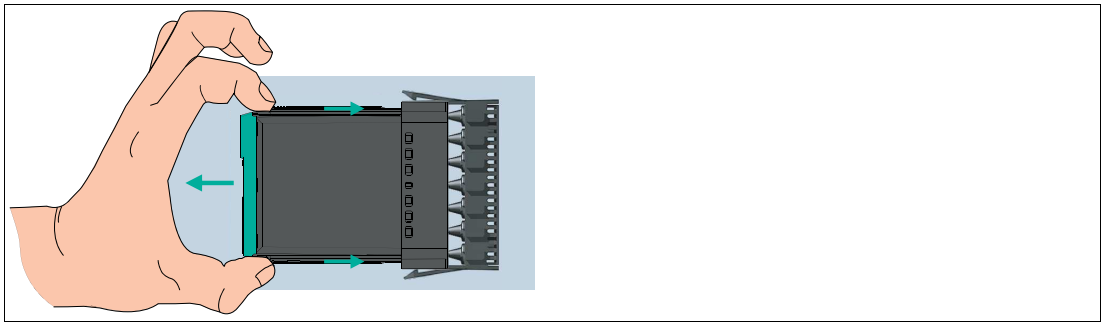


Figure 3.13 First rear catch

↳ The first rear catch is released and the module no longer has electrical contact with the backplane.

4. Release both removal levers. These automatically return to their original position.

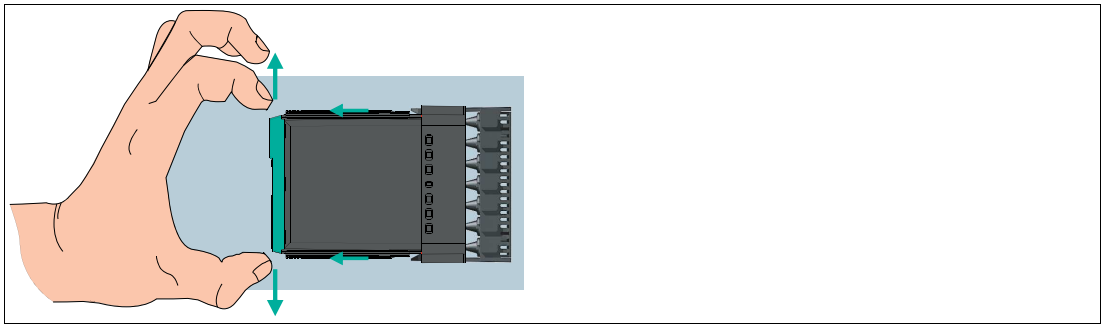


Figure 3.14 Integrated removal device

5. Loosen the second rear catch on the backplane. To do this, press the integrated removal levers on the top and bottom of the module using your thumb and index finger. Pull the module out of the backplane by the two module removal levers.

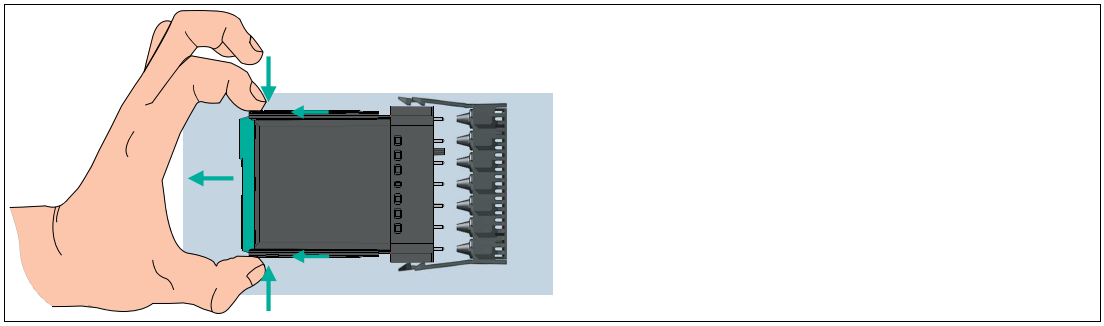


Figure 3.15 Second rear catch

↳ The second rear catch is released and the module is removed from the module slot.

6. If applicable, adjust the information on the labeling strips of the backplane.

3.6 Field Wiring

I/O modules are wired differently depending on the type.

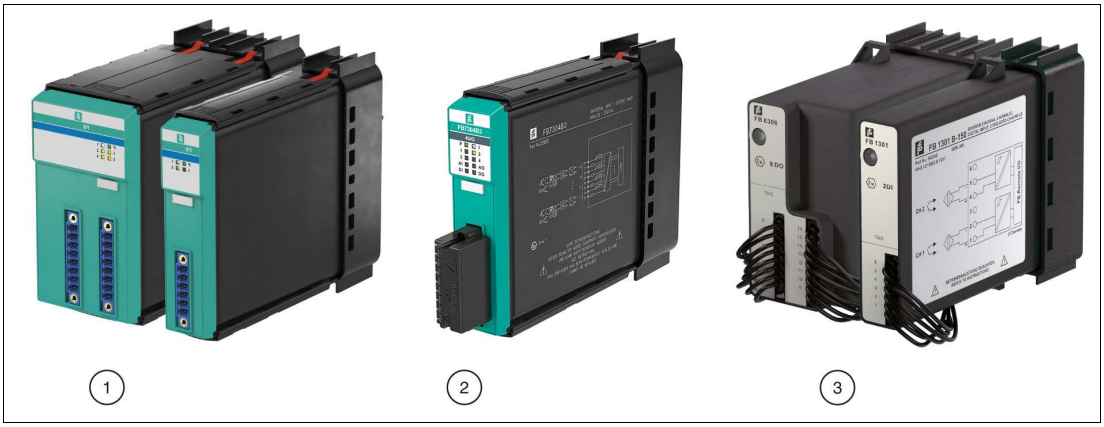


Figure 3.16 Overview of I/O module connections

Overview of connections

Position	Type	Designation	Description
1	Ex d, Ex q	Modules with intrinsically safe circuits and front sockets	Field connections can be made to the I/O modules using screw terminals, front screw terminals, or spring terminals.
2	Ex d, Ex q	Modules with non-intrinsically safe circuits and front sockets	Field connections can be made to the I/O modules using black spring terminals. The spring terminals must be covered with protective caps designed for Ex e type of protection.
3	Ex d	Modules with non-intrinsically safe circuits and cable tails	I/O modules with a cable tail must be connected to separately approved terminals that comply with type of protection Ex e. These terminals must be equipped with a IP30 cover.

Note

Use the terminal blocks and protective covers from the range of accessories.see chapter 2.7.1

Warning!

Explosion hazard caused by loose wire ends

A spark can be generated by bare, conductive parts such as loose wire ends, which can cause explosive mixtures to ignite.

- Stranded conductors must always be used with wire end ferrules. We recommend using wire end ferrules approved according to DIN 46228-4.
- If I/O-modules with intrinsically safe circuits and I/O modules with non-intrinsically safe circuits are placed directly next to one another, use wire end ferrules with plastic sleeves.

Please note the following requirements for wires, stranded conductors, and wire end ferrules.

- **Wires**
  - Insulation stripping: 9 mm
  - Core cross-section (conductor): 0.5 mm^2 ... 1.5 mm^2
  - External diameter (conductor + insulation): 2 mm ... 3 mm
- **Stranded conductors**
  - Insulation stripping: 9 mm
  - Core cross-section for wire end ferrules with plastic sleeve: 0.5 mm^2 according to IEC 60228 Class 5 and 6
  - Core cross-section for wire end ferrules without plastic sleeve: 0.5 mm ... 1.5 mm^2 according to IEC 60228 Class 5 and 6

Figure 3.17 Stranded conductor with wire end ferrule

Note

For the FB1209B3 module, conductors with a maximum core cross section of 0.5 mm² can be used.

Warning!

Explosion hazard due to unapproved measuring devices

Ensure that measuring devices also satisfy the requirements of their respective installation and ignition protection type.

Only use accessories and devices that are approved for use in the respective environment.

Warning!

Loss of intrinsic safety

Circuits with the Ex i type of protection that have been operated with non-intrinsically safe circuits must no longer be used as circuits with Ex i type of protection.

Use only Ex i-certified measuring instruments in conjunction with Ex i-certified I/O modules.

3.6.1 I/O Modules with Front Socket

Field connections can be made to the I/O modules using screw terminals, front screw terminals, or spring terminals. Use the terminal blocks and protective covers from the range of accessories. See chapter 2.7.1

Front screw terminals or spring terminals are ideal for performing extensions at a later point or for changing individual field connections, as the plug can remain in the front socket of the I/O modules during wiring. These spring terminals also offer a test plug socket for measuring individual circuits.

Installing field wiring for intrinsically safe circuits

Danger!

Explosion hazard due to improperly wired front connectors

Improperly wired front connections can lead to dangerous confusions of intrinsically safe and non-intrinsically safe circuits, causing explosive mixtures to ignite.

Always make sure that the front connectors are correctly wired.

1. The I/O modules are wired differently depending on the type. Wire the terminal blocks to the field devices in accordance with the information in the datasheets for the I/O modules used.
2. Note the permissible core cross section of the conductor. We recommend that you do not exceed a conductor cross section of 0.75 mm^2.
3. If you are using stranded conductors, crimp the stranded conductors with wire end ferrules.
4. Make sure that the insulation on the conductors extends all the way to the terminal.
5. Only use blue terminal blocks/protective covers for intrinsically safe circuits.
6. Make sure that the separation distances to non-intrinsically safe circuits are observed.
7. Unused cables and connection lines must be either connected to terminals, securely fixed and isolated, or grounded.
8. If necessary, you can code the front sockets of the I/O modules and terminals so that the terminals and the associated field devices can be assigned to exactly one front socket.see chapter 3.7.
9. Plug the terminals into the front sockets of the corresponding I/O modules and screw the terminals using the screws on the side of the socket (does not apply to the FB1209* module).
10. Label the connection lines.

Installing field wiring for non-intrinsically safe circuits

Danger!

Explosion hazard when removing the protective caps

If intrinsically safe and non-intrinsically safe circuits are present, removing the protective cap in a potentially explosive atmosphere can create sparks that can ignite the surrounding atmosphere.

- Only remove the cover when not located in a potentially explosive atmosphere.
- Only remove the cover if the non-intrinsically safe circuits are de-energized (no voltage or current). Remove the I/O module or switch off the circuit using the multifunction terminal.
- Cover all the unused terminal ports.
- If the field wiring is changed and lines for which lugs have already been broken off from the protective cover are removed, you must replace the protective cover with a new one.

Non-intrinsically safe circuits must be covered with protective covers for Ex e modules.

1. The I/O modules are wired differently depending on the type. Wire the terminal blocks to the field devices in accordance with the information in the datasheets for the I/O modules used.
2. Note the permissible core cross section of the conductor. We recommend that you do not exceed a conductor cross section of 0.75 mm^2.
3. If you are using stranded conductors, crimp the stranded conductors with wire end ferrules.
4. Make sure that the insulation on the conductors extends all the way to the terminal.
5. Use only black type LB9109.E.6.1, LB9109.E.8.1, and LB9109.E.8.2 terminal blocks and protective covers for type LB9107.E.6 and LB9107.E.8 Ex e modules.

Figure 3.18 Spring terminal with protective cover for Ex e modules

6. Make sure that the separation distances to intrinsically safe circuits are observed.
7. Unused cables and connection lines must be either connected to terminals, securely fixed and isolated, or grounded.
8. If necessary, code the front sockets of the I/O modules and terminals so that the terminals and the associated field devices can be assigned to exactly one front socket.
9. Plug the terminals into the front sockets of the corresponding I/O modules and screw the terminals into place using the side screws.
10. Break off the lugs of a protective cover for Ex e modules at the points where the field lines lead into the terminal openings. Unused terminal openings must remain covered by the lugs of the protective cover so that no bare, conductive parts are exposed.
11. Place the adapted protective cover for Ex e modules onto the terminal and screw the protective cover into place using the side screws.

Figure 3.19 Terminal with adapted protective cover for Ex e modules

12. Apply the warning marking “**Warning - non-intrinsically safe circuits protected by internal cover with degree of protection IP30!**” to a visible location on the surrounding enclosure.
13. Label the connection lines.

3.6.2 I/O Modules with Cable Tail

I/O modules with a cable tail must be connected to separately approved terminals that comply with type of protection Ex-e. These terminals must be equipped with a cover with degree of protection IP30. The cover ensures that no bare, conductive parts are exposed.

Figure 3.20 Field wiring of an I/O module with 2 cable tails

Installing field wiring for I/O modules with cable tail

Danger!

Explosion hazard by removing the cover

If intrinsically safe and non-intrinsically safe circuits are present, covers with degree of protection IP30 may be removed only when the non-intrinsically safe circuits are de-energized and currentless. This can be achieved by disconnecting the I/O module and activating the field circuits using a multifunction terminal (MFT-*).

- Only remove the cover when not located in a potentially explosive atmosphere.
- Only remove the cover if the non-intrinsically safe circuits are de-energized (no voltage or current).
- Remove the I/O module or switch off the circuit using the multifunction terminal.

The terminals for the field wiring must be equipped with a cover with degree of protection IP30.

1. Install the terminals on a separate DIN mounting rail. Arrange the terminals so that the length of the cable tails is sufficient.
2. If the I/O modules are equipped with color-coded connection cables, please refer to the respective data sheets for the color coding.
3. Make sure that the separation distances to intrinsically safe circuits are observed.
4. Make sure that the insulation on the conductors extends all the way to the terminal.
5. Follow the manufacturer's mounting instructions to install the terminals and the cover.
6. Unused cables and connection lines must be either connected to terminals, securely fixed and isolated, or grounded.
7. Apply the warning marking **Warning - non-intrinsically safe circuits protected by internal cover with degree of protection IP30!** to a visible location on the surrounding enclosure.

8. Label the connection lines.

Color coding for single-width I/O modules

Connection	Color
6	pink
5	gray
4	yellow
3	green
2	brown
1	white

Color coding for dual-width I/O modules

Left connection	Right connection	Color
8	16	red
7	15	blue
6	14	pink
5	13	gray
4	12	yellow
3	11	green
2	10	brown
1	9	white

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3.7 Coding

You can code the front sockets[1] and the terminals of the I/O modules so that the terminals and the connected field devices can be assigned to exactly one front socket.

Use coding pins KF-CP.

Coding connections

Caution!

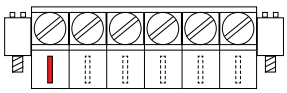
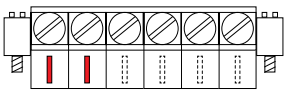
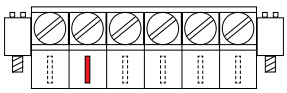
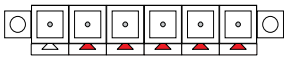
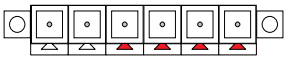
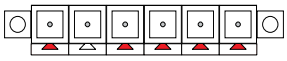
Danger of incorrect connections

If the coding is not unique, terminals can be accidentally mixed up.

Establish a clear coding so that every terminal fits exactly one front socket.

1. To code the front socket of an I/O module, insert one or more coding pins into the corresponding grooves on the front socket.
2. In order to code the terminal to match the front socket, cut off the plastic lugs from the terminal from those points where coding pins are located in the front socket.

   Note that the coding in example 1 and example 2 is not unique. The terminal from example 1 could be accidentally connected to the front socket in example 2. In contrast, the coding in example 1 and example 3 is unique.

	Example 1	Example 2	Example 3
Terminal			
Front socket			

3.8 Line Fault Detection

Most I/O modules have a line fault detection function that can recognize a lead breakage or a short circuit.

If digital I/O modules are used, for example with a mechanical contact, an additional resistor circuit must be installed to ensure that the line fault detection function can work correctly. Using the additional resistor circuit, the electronics can distinguish between a closed switch and a short circuit.

The line fault detection function of the analog I/O modules is based on a current measurement. An additional resistor circuit is not required.

Refer to the relevant datasheets for more information on line fault detection.

1. Not possible on FB1209*

3.9 Cold Junctions in Thermocouples

When measuring thermocouples, a thermoelectric voltage is generated at the material transition between the thermocouple and the copper connection point, which distorts the measurement result. The compensation is done by means of an internal or external cold junction. The temperature at the material transition is determined and the effect of the additional thermoelectric emf in the transmitter is compensated. The external reference junction is located remotely from the transmitter and is connected to the transmitter via copper connecting cables. The temperature of the material transition is either determined with a resistance temperature detector or kept at a constant temperature (typically 50°, 60°) by a thermostat. Both methods can be used with the thermocouple transmitters of the LB system (FB5102* and FB5105*) and can be set accordingly in the configuration tools.

In general, the material transition of an internal cold junction is located in the transmitter or directly at the terminals of the transmitter. The internal reference junction is implemented differently in the transmitters of the LB system. In the FB5102* by a separate plug connector attachment (LB9111A see also accessories) and in the FB5105* directly in the device without further accessories.

Cold junctions are available as accessories.

Figure 3.21 Cold junction for thermocouple measurements

1. Protective cover
2. Cold junction consisting of a terminal block and a Pt100 thermocouple on terminal openings 1 and 2

The LB9111A connector attachment can also be used as an external cold junction for FB5102* by using the connected Pt100 to determine the temperature at the material transition. However, the line resistance between transmitter and reference junction falsifies the measurement result due to the transfer in 2-wire technology. Therefore, the line resistance must be specified in the configuration tool for compensation. In the field, it is typically set beforehand to a total value of e.g. 20 ... 50 Ohm by connecting a potentiometer in series.

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3.10 Line Resistance in Resistance Thermometers

If you operate I/O modules FB5201* and FB5204* in a 2-wire configuration, the line resistance amounts to that of a resistor connected in series to the sensor and affects the measurement result. In order to avoid measurement errors, the line resistance must be measured and compensated for in this configuration. Two options are available here:

Short circuit the Pt100

1. Short circuit the Pt100 sensor.
2. In the configuration software, set the measuring input of the I/O module to resistance measurement.
   For more information, refer to the software manual for the com unit used.
3. Call up the measured value display for the I/O module and make a note of the measured value.
4. In the configuration software, set the measuring input of the I/O module to 2-wire measurement with Pt100 sensor.
5. Enter the measured resistance in the **Line resistance** field. The maximum permissible line resistance is 50 Ω.

Use a Calibrating Resistor

1. Use a calibrating terminal with an integrated calibrating resistor in the sensor supply line.
2. In the configuration software, set the measuring input of the I/O module to 2-wire measurement with Pt100 sensor.
   For more information, refer to the software manual for the com unit used.
3. In the configuration software, set the line resistance to 20 Ω.
4. Replace the Pt100 sensor at the measuring point with a 100-Ω measurement resistor.
5. To measure the resistance, call up the measured value display for the corresponding measuring point.
6. Set the displayed value to 0 °C using the calibration potentiometer.
7. Then reconnect the Pt100 sensor.

3.11 Strain Gauge Measurement

I/O modules FB4*01* and FB5202* can be interconnected for strain gauge measurements. Use analog output FB4*01* to create a constant current, and the measuring input for temperature input FB5202* to process the millivolt signal for the resulting bridge voltage.

A constant current of 20 mA is sufficient to power a 350-Ω bridge. A bridge voltage of 7 V is produced. With a bridge sensitivity of 2 mV/V, a voltage of 14 mV results at full load.

Configuring I/O Modules for Strain Gauge Measurement

1. Either set the FB4*01* analog output operating mode to **simulation** and select 20 mA as the simulation value, or set a fixed value of 20 mA via the fieldbus.
2. Set the FB5202* temperature input to a millivolt measurement **mV**.
3. Deactivate the cold junction of temperature input FB5202* by setting the thermostat temperature for the external cold junction to **0 °C**.

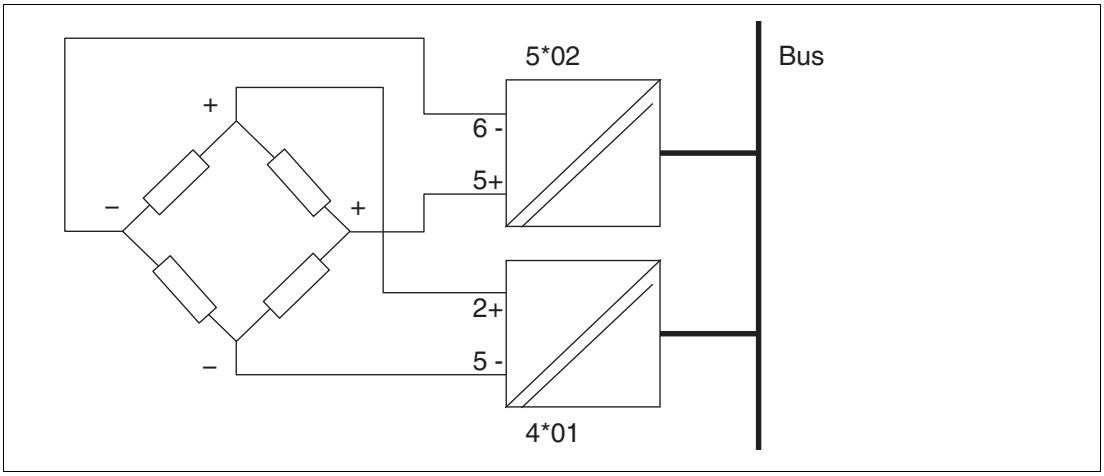

Figure 3.22 Example of a strain gauge bridge

3.12 Status Monitoring of the Output Shutdown

The I/O module FB1308 allows you to monitor the status of output shutdown.

Configuring I/O modules for status monitoring

Configure the I/O module as a passive voltage input. Disable the channel supply. See the manual "FB Remote I/O - Software".

Danger!

Explosion hazard due to incorrect connection

Improper installation and configuration of the device can cause sparks and other hazards in potentially explosive atmospheres, which can ignite the surrounding atmosphere.

- If you are using the I/O module for status monitoring, configure the module as a passive voltage input. Disable the channel supply.
- The circuit for output shutdown is a (non-intrinsically safe) SELV circuit. Disconnect this circuit from other circuits in accordance with the requirements of explosion protection and electrical safety.
- Keep the separation distances between the non-intrinsically safe circuit and the intrinsically safe circuits.

3.13 Redundancy in PROFIBUS Communication

3.13.1 Basic Principles

Redundancy is used when it is necessary to guarantee operation of a remote I/O unit despite one or more components having failed.

In order to build a redundant system, use the backplanes FB9262BP10220.* and FB9262BP20220.*. These backplanes provide space for redundant com units, redundant bus termination modules, and redundant power supplies.

To ensure that the primary com unit and the redundant com unit use the same data record, both com units must be connected to one another. To do so, connect the com unit via the front sockets using the com unit cordset. It is possible to tell which com unit is active by looking at the operating mode LED. If the operating mode LED is flashing, the com unit is active. If the operating mode LED is not lit, the com unit is passive. For more information about the status LEDs, refer to the datasheet for the relevant com unit in use.

As a general rule, a distinction is made between media redundancy and application redundancy. Com units can be set to media redundancy or application redundancy using the configuration software. For more information, refer to the software manual for the com unit used.

Note

Note that both com units in a redundant system must have the same firmware.

3.13.2 Media Redundancy

As an active switch, a voter converts two redundant PROFIBUS-DP lines into one PROFIBUS-DP line. The voter monitors the activities and the error status of the connected fieldbus lines and decides, depending on the error status, to transmit on one of the two redundant lines. The bus coupler, which then communicates with the master on the basis of this selection, is active and controls the I/O modules on the backplane. The other Bus Coupler is passive, but reads the data traffic on the backplane as well. If the voter now switches to the previously passive Bus Coupler, the latter automatically takes over control of the connected I/O modules on the backplane, and the other Bus Coupler becomes the passive Bus Coupler.

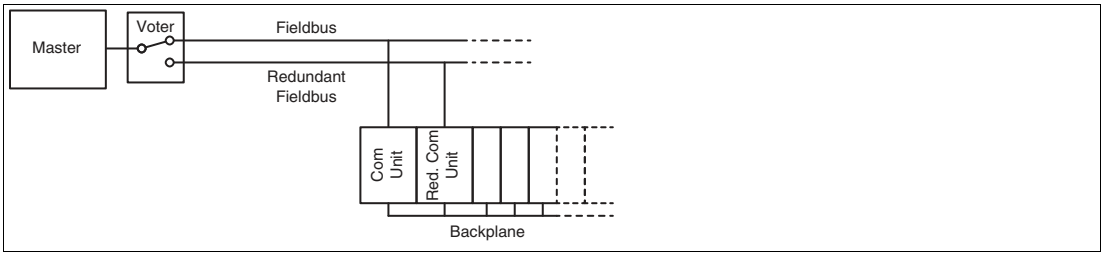

Figure 3.23 Line redundancy

If the master is also redundant, this is known as extended media redundancy.

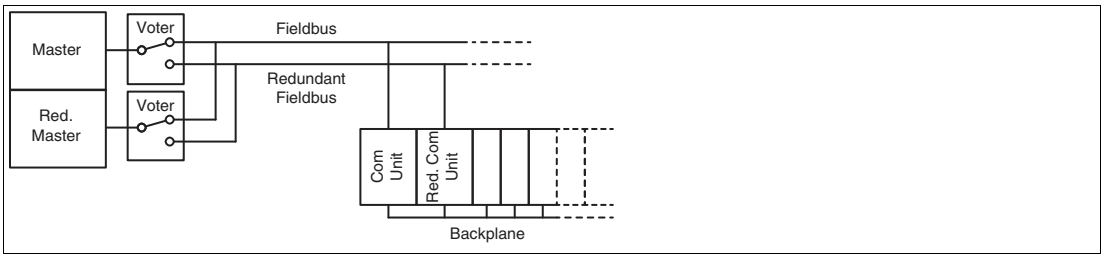

Figure 3.24 Extended media redundancy

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3.13.3 Application Redundancy

The application redundancy consists of two complete lines, each containing master, fieldbus and bus coupler. If one fieldbus line or Bus Coupler fails, the master switches over to the redundant fieldbus line. The Bus Coupler, which then communicates with the master on the basis of this selection, is active and controls the I/O modules on the backplane. The other Bus Coupler is passive, but reads the data traffic on the backplane as well. If the master now switches back to the line of the previous passive Bus Coupler, it automatically takes over control of the connected I/O modules on the backplane, and the other Bus Coupler becomes the passive Bus Coupler.

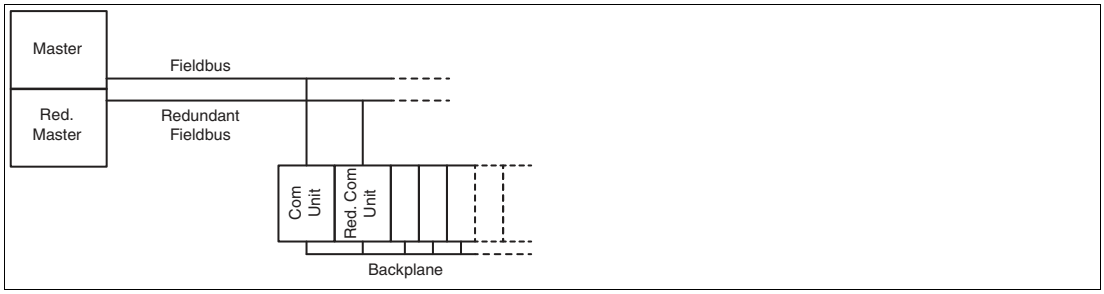

Figure 3.25 Application Redundancy

3.14 Potential Equalization and Shielding

Note

The following subchapters cannot provide the reader with a complete picture of all requirements in terms of grounding, shielding, and lightning protection. More information on this topic can be found in the technical literature and the applicable standards.

3.14.1 Sources of Noise

Electromagnetic fields can interfere with the communication path.

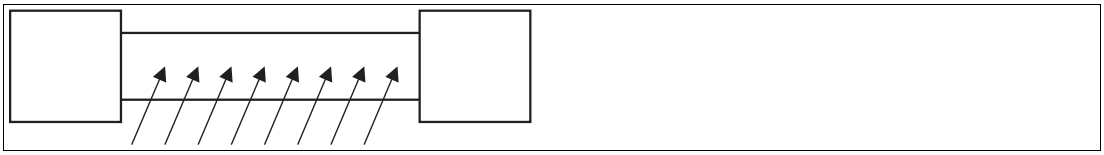

Figure 3.26 Interfering signals caused by induction in parallel conductors

Twisted-pair cables significantly reduce the influence of these interference fields, particularly when compared to cables with parallel cores. The direction of the recorded interference field in a twisted-pair cable reverses over short intervals. This means that the induced noise is practically canceled out, while in parallel cores the noise is active across the entire area.

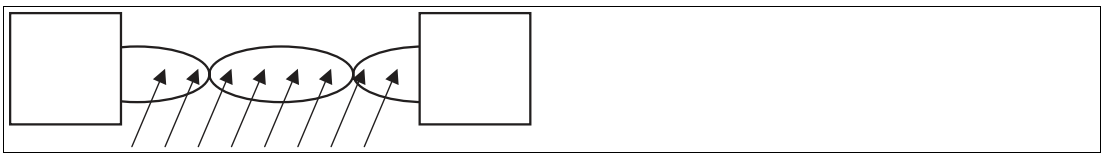

Figure 3.27 Reduced admission of interfering signals in twisted-pair cable

A shielding keeps interfering noise away from the communication path.

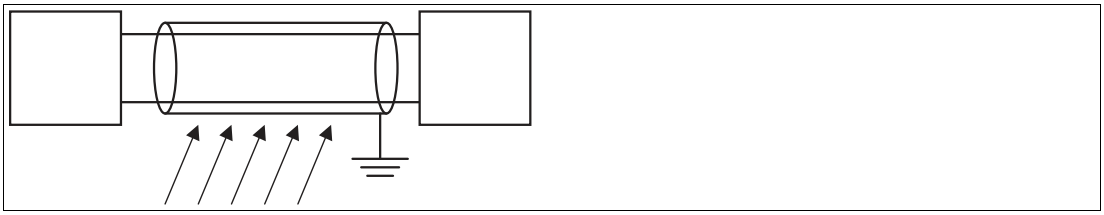

Figure 3.28 Shielding prevents the entry of interference fields

EMC filters are used in many devices to divert any noise to ground. High-frequency noise occurring in the same way on both lines is dissipated symmetrically through the capacitor impedances and does not appear as a differential signal.

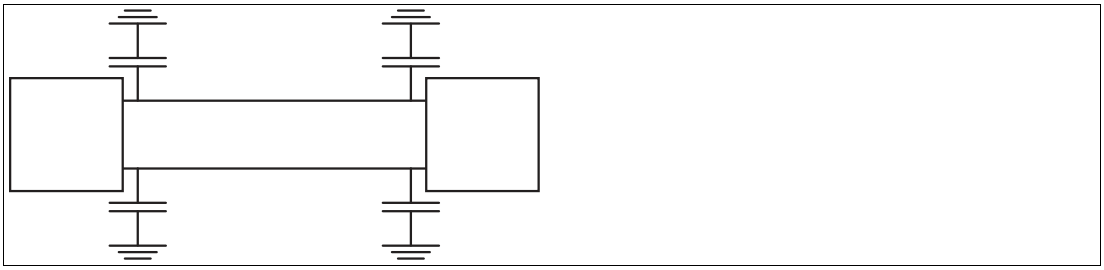

Figure 3.29 EMC filters in signal paths

3.14.2 Wiring

Danger!

Explosion hazard due to improper installation

Improperly installed wiring can cause explosive mixtures to ignite.

Observe the wiring specifications set out in IEC/EN 60079-14 for laying lines in an explosion-hazardous area.

Lay the signal lines such that they are separate from the power cables. Please note that AC voltages and current spikes can induce stray voltages in neighboring lines. Shielded cables should therefore be used for EMC-tested devices.

Field wiring

Digital inputs are normally controlled by NAMUR proximity switches with a low-impedance signal. In this case, noise has a far lower impact than in circuits containing open switches that do not have an additional resistor circuit. For this reason, do not connect digital inputs to exposed wiring.

The analog signals of resistive sensors or thermocouples are particularly susceptible to noise. Signal converters have built-in filters to reduce this noise. The filters can be switched on if fluctuations in the measuring signal cannot be reduced sufficiently by other means. For more information, refer to the software manual for the com unit used.

Eliminating noise

The following measures can improve power.

1. Install power filters in power lines.
   Please make sure that supply cables leading to power filters are laid separately from other cables to ensure that any filtered noise is not picked up again.
2. Fit surge protection filters in signal lines.
3. Change to galvanically isolated circuits.

3.14.3 Plant Ground

As of the FB9262BP*.2 backplane versions, the surrounding enclosure is connected to the equipotential bonding of the explosion-hazardous area (PB, plant ground).

Danger!

Explosion hazard due to faulty or missing grounding

Faulty or missing grounding can cause sparks. This may ignite the surrounding potentially explosive atmosphere.

- Make sure that external ground connections exist, are in good condition, and are not damaged or corroded.
- Make sure that all ground connections are tight and secured against mechanical stress.
- Disconnect an optional accompanying protective conductor (PE) from the equipotential bonding of the explosion-hazardous area (PB) or observe the installer regulations of IEC/EN 60079–14.

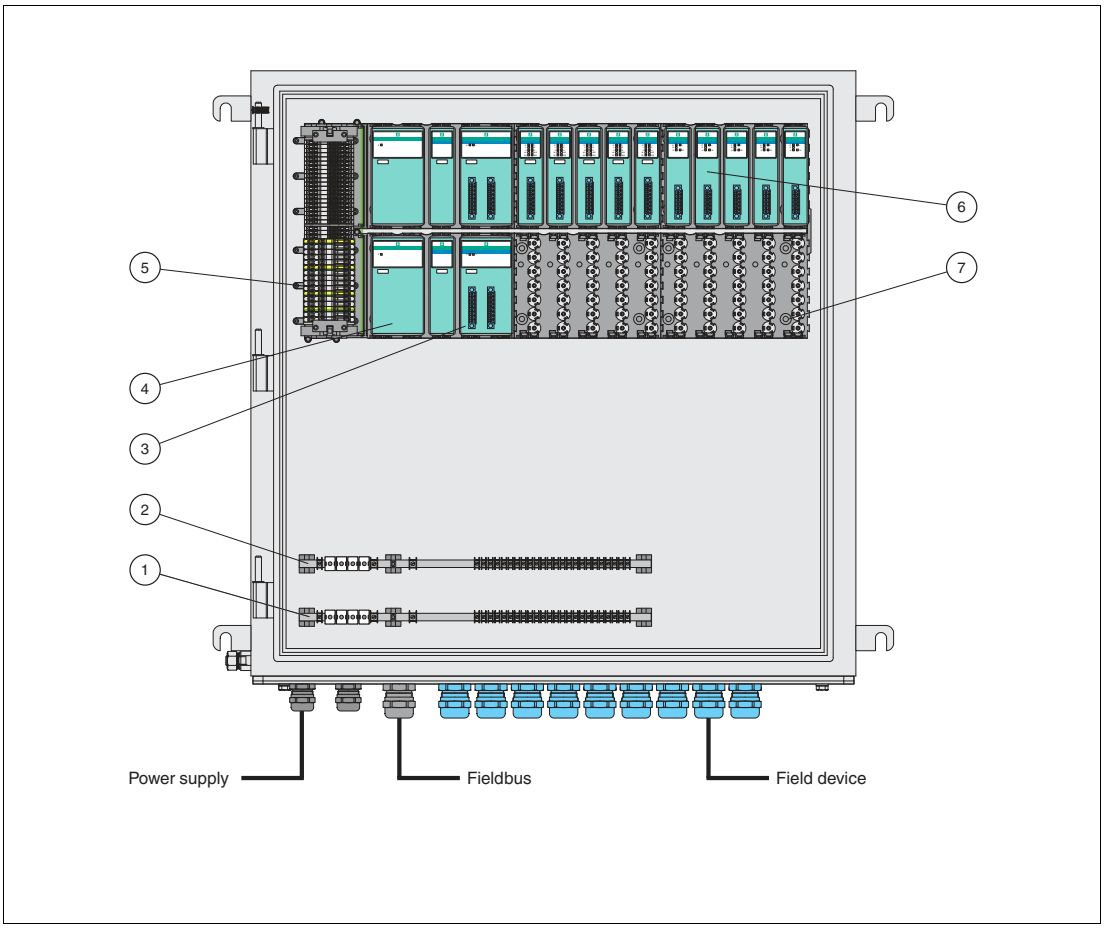

Figure 3.30 Surrounding enclosure earthing

1 Earthing rail for shields from the non-explosion hazardous area (optional)
2 Earthing rail for equipotential bonding (PB)
3 Com unit
4 Power supply
5 Ex e terminal strip
6 I/O module
7 Backplane

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Connecting the Surrounding Enclosure to the Equipotential Bonding of the Explosion-Hazardous Area

1. Connect the equipotential bonding of the explosion-hazardous area (PB) to the accordingly marked terminals of the Ex e terminal block of the backplane. The Ex e terminal block also has a marked connection for the protective conductor (PE). This conductor can be optionally routed into the switch cabinet.
2. A earthing rail can be installed in the surrounding enclosure. This bar is connected to the equipotential bonding of the explosion-hazardous area (PB).
   - Do not connect an optional protective conductor (PE) to this earthing rail.
   - Do not connect any shielded cables that are routed out of the safe area without adequate isolation (> 500 V AC/700 V DC) to this grounding bar.
3. For functional reasons, it may be necessary to connect the shielded cables from the non-explosion-hazardous area in the surrounding enclosure to a rail. In this case, isolate the earthing rail (> 500 V AC/700 V DC) from the earthing rail of the equipotential bonding (PB) of the explosion-hazardous area.

3.14.4 Shielding of Signal Cables or Bus Cables

Depending on the type of application, for EMC reasons it may be necessary to connect the shielding of signal cables or bus cables in the surrounding enclosure to the equipotential bonding of the explosion-hazardous area, see chapter 3.14.5

Danger!

Explosion hazard due to faulty or missing grounding

Faulty or missing grounding can cause sparks. This may ignite the surrounding potentially explosive atmosphere.

- Make sure that external ground connections exist, are in good condition, and are not damaged or corroded.
- Make sure that all ground connections are tight and secured against mechanical stress.
- Disconnect the protective conductor (PE) from the equipotential bonding of the explosion-hazardous area (PB) or observe the installation instructions according to **IEC/EN 60079–14**.

Shielding Signal Cables and Bus Cables

1. If the shield also needs to be grounded at both sides in the remote station in the non-explosion-hazardous area due to the conditions in the plant, route the equipotential bonding of the explosion-hazardous area to the remote station in accordance with the specifications in the installer regulations of IEC/EN 60079–14.
2. For single-sided grounding, adequately insulate the remote station located in the non-explosion-hazardous area (> 500 V AC/700 V DC).

3.14.5 Installation Conditions for Offshore Applications

Special installation conditions must be observed when using the FB remote I/O system in a metal surrounding enclosure in offshore applications. To reduce EMC interference

- that the power supply, the bus cable, and the field lines must be shielded and
- the cable entries with approved Ex e EMC cable glands must be replaced if necessary.

Refer to the information in the former chapters and in the following figure. See chapter 3.15 and see chapter 3.14. Pay special attention to the elementary safety considerations regarding the system earth.

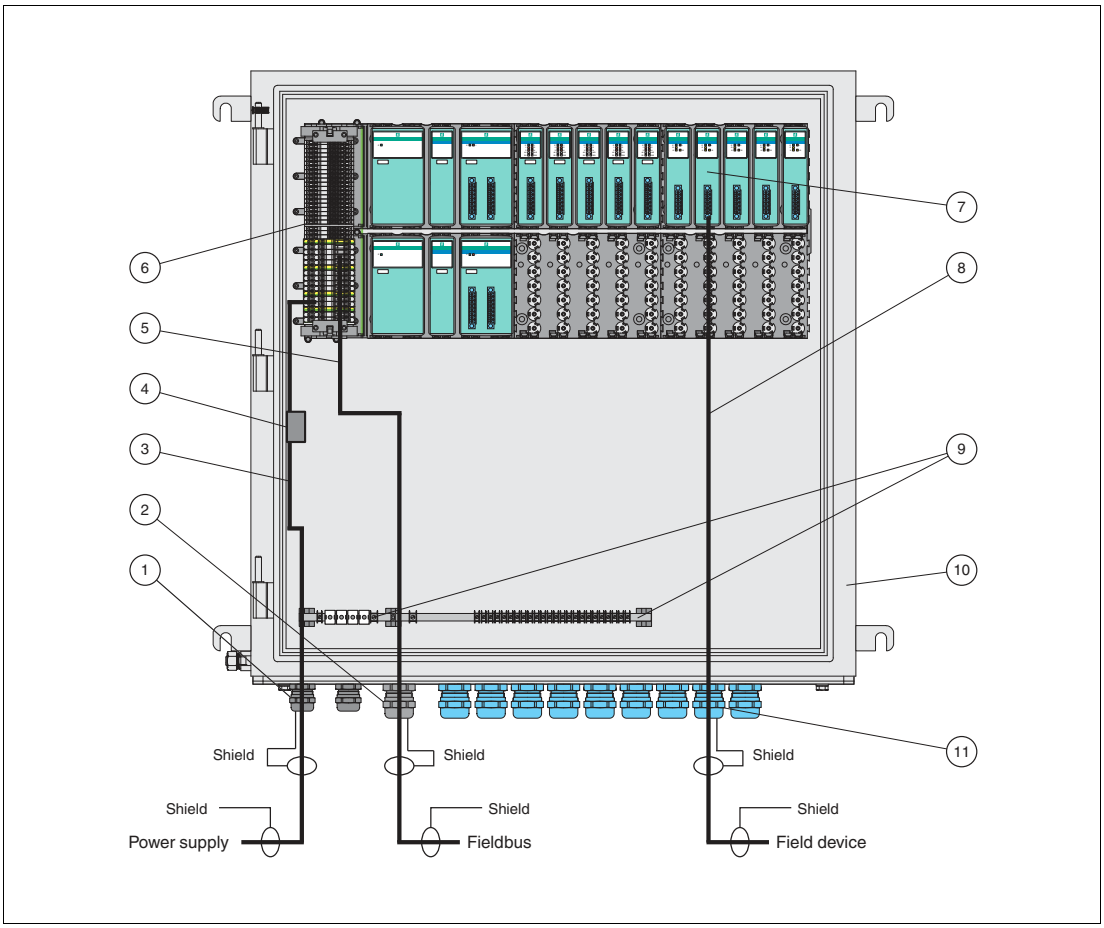

Figure 3.31 Shielding concept in the metal surrounding enclosure for offshore applications

1 Cable gland for power supply
2 Cable gland for bus cable
3 Power supply
4 EMC filter
5 Bus cable
6 Backplane
7 I/O module
8 Field line
9 Earthing rail
10 Field unit – metal surrounding enclosure
11 Cable gland for field lines

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Shielding the Bus Cables and Field Lines

1. Place the shield directly on the cable glands (1), (2), (11) in the surrounding enclosure. Also place the shield on the earthing rail (9) in the surrounding enclosure.
2. Route the field lines shield (8) to the I/O modules (7).
3. Route the bus cable shield (5) to the terminals on the backplane (6).

Shielding the Power Supply

1. Route the power supply (3) via an EMC filter (4).
2. Shield the power supply (3) between the EMC filter (4) and the cable gland (1). Connect the shield to the cable gland (1) or continue the shield up to the wall of the surrounding enclosure (10).
3. Route the power supply (3) between the EMC filter (4) and the terminals on the backplane (6) close to the wall of the surrounding enclosure (10).

Shielding and Sealing the Surrounding Enclosure

1. Use electrically conductive seals for the cover of the surrounding enclosure.
2. If necessary, also use an electrically conductive seal for the front panel or use copper foil to tape up the front plate
3. Ensure that the degree of protection is not compromised when the seal is replaced.

3.15 Fieldbus Connection

3.15.1 Fieldbus connection RS-485-Based Bus Systems

Danger!

Explosion hazard due to improper installation

Improperly installed fieldbuses can cause explosive mixtures to ignite.

Observe the wiring specifications set out in IEC/EN 60079-14 for laying lines in an explosion-hazardous area.

Danger!

Explosion hazard due to unapproved accessories

Accessories that do not meet the requirements for use in hazardous areas can cause explosive mixtures to ignite.

Only use accessories and devices that are approved for use in the respective environment.

Connection

The connections for the fieldbus and service bus are equipped with double terminals.

Connect the field bus to the appropriate terminals on the base backplane.

Cable length

Com units can be configured for various transfer rates. The required transfer rate and the bus system used dictate the maximum cable length.

For standard applications, the technical data for cable type A in accordance with DIN EN 61158 and DIN EN 61784 applies. The following table refers to standard applications.

Bus system	Transfer rate	Max. cable length
MODBUS	1.2 ... 9.6 kbit/s	1200 m
	19.2 kbit/s	1200 m
	38.4 kbit/s	1200 m
	115.2 kbit/s	1000 m
PROFIBUS DP	9.6 kbit/s	1200 m
	19.2 kbit/s	1200 m
	93.75 kbit/s	1200 m
	187.5 kbit/s	1000 m
	500 kbit/s	400 m
	1.5 Mbit/s	200 m
Service bus	9600 bit/s	1200 m

Bus system	Transfer rate	Max. cable length
FOUNDATION fieldbus H1	31.25 kbit/s	1900 m

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In accordance with DIN EN 61158 and DIN EN 61784, the following principles apply:

- Linear bus structure without branches, consisting of a cable with terminators
- Length of the spur to the node < 0.3 m
- Total length of all spurs < 6 m
- Data transfer via shielded twisted pair cable
- Terminator 100 ... 130 Ω
- Core cross section > 0.22 mm², approx. 60 pF/m
- Max. 32 active or passive nodes including repeaters
- Max. 3 repeaters between 2 nodes
- Max. cable length 1200 m, depending on the transfer rate
- The FOL7250* PROFIBUS fiber optic coupler and repeater enables the transfer of data at high speeds over long distances (1000 m at 1.5 Mbit/s).

Terminators

The RS-485 fieldbus must have exactly two terminators per segment, one at the start and one at the end. A segment usually starts at the master, while the last remote I/O unit is taken to be the end of the segment. A segment also ends or begins at a repeater or a fiber optic cable.

To install a terminator, use the following bus termination modules.

- Terminator for a service bus: FB9293*
- Terminator for a fieldbus: FB9294*
- Terminator for a service bus and a fieldbus: FB9295*

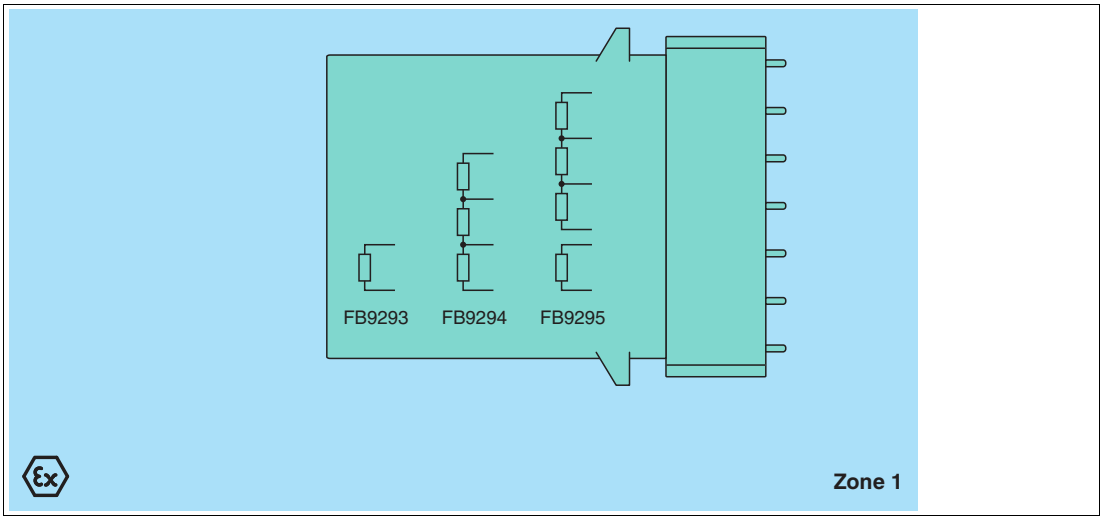

Figure 3.32 Block diagram for FB9293*, FB9294*, FB9295*

Example

A bus with 3 segments, 1 master, a fiber optic cable transfer path, 4 nodes, and 1 repeater has 6 terminators (T).

Master(**T**) — Node — (**T**)Fiber optic cable(**T**) — Node — (**T**)Repeater(**T**) — Node — (**T**)Node

3.15.2 Extending the Fieldbus

Warning!

Explosion hazard due to cable installation

Changes to the cable installation must only be carried out in the absence of a potentially explosive atmosphere or when equipment is de-energized.

In order to extend the fieldbus cable, the bus termination module may have to be removed. In this case, operation can only be maintained using a redundant system.

Warning!

Unused cable entries

Unsealed cable entries can cause conductive parts such as loose wire ends to generate sparks that could ignite an explosive mixture.

- Seal all unused openings in the enclosure prior to the start of commissioning with appropriate stopping plugs or sealing plugs in order to maintain the selected type of protection. See the relevant approval.

3.15.3 Fieldbus Connection Ethernet-Based Bus Systems with M12 Connections

The gateway is connected to the Ethernet network using the two Ethernet interfaces on the front. This occurs via M12 connectors according to IEC 61076-2-101:2012.

Three basic connection scenarios are shown below:

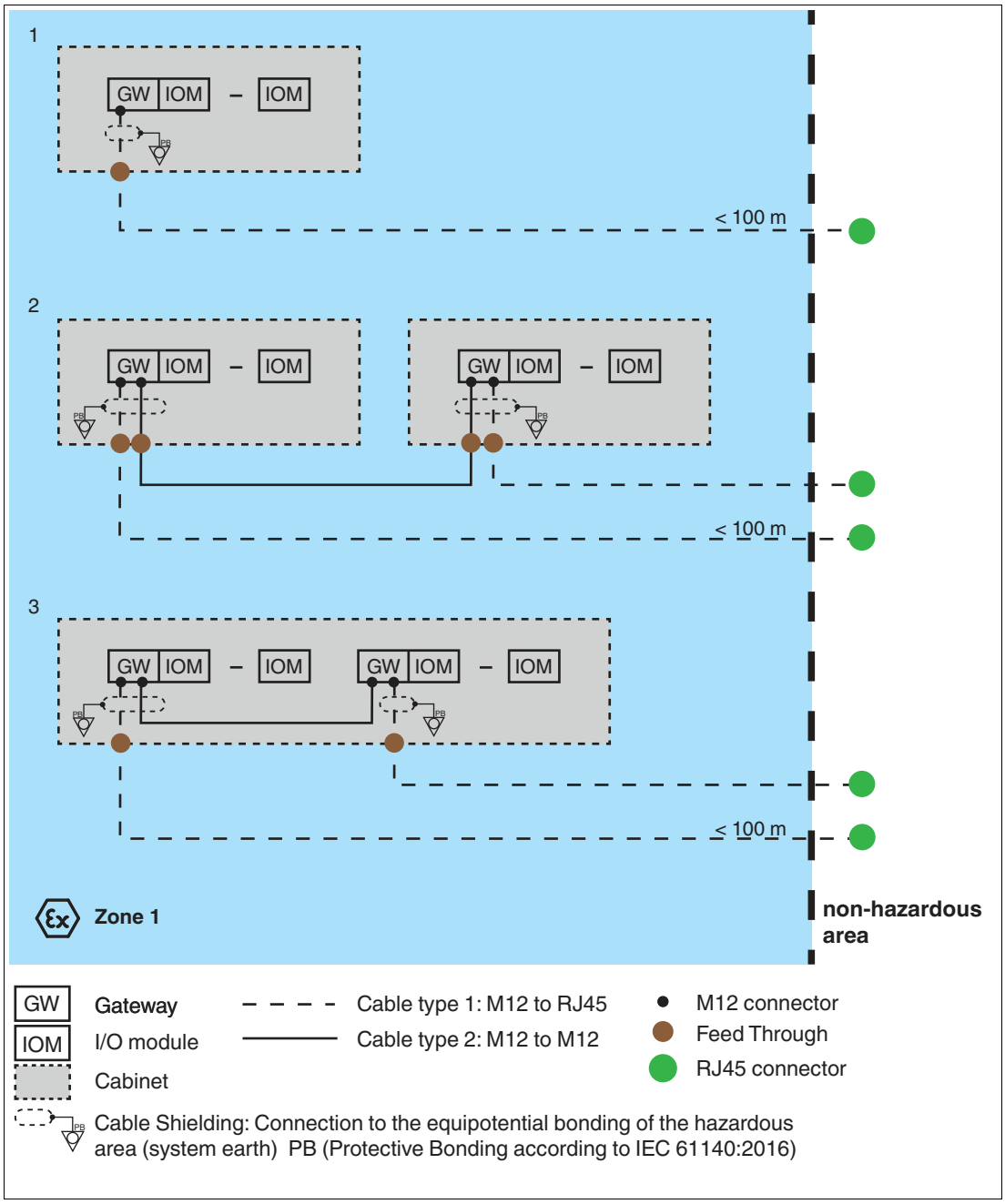

Figure 3.33 Connection Scenarios

3.15.3.1 Elementary Safety Considerations

Danger!

Explosion hazard due to faulty or missing grounding

Faulty or missing grounding can cause sparks. This may ignite the surrounding potentially explosive atmosphere.

- Make sure that external ground connections exist, are in good condition, and are not damaged or corroded.
- Make sure that all ground connections are tight and secured against mechanical stress.
- Disconnect the protective conductor (PE) from the equipotential bonding of the explosion-hazardous area (PB) or observe the installation instructions according to **IEC/EN 60079–14**.

Warning!

Risk of injury due to improper device connection

Faults when connecting the device can result in danger to people and machines.

- Use only original type **V1SD-F-*M-PUR-ABG*** cables from Pepperl+Fuchs.
- Never fabricate the M12 plug for the gateway. Always use the original plug supplied with the cable.
- For connections in the explosion-hazardous area, only the specified M12 connections on the gateway and cable may be used.
- No further jumpering is permitted in explosion-hazardous areas. A cable with an M12 plug must be connected either directly to another M12 connection in the explosion-hazardous area or directly to an RJ45 port in the non-hazardous area.
- The cable in the explosion-hazardous area may be plugged in and unplugged only if both sides of the connection (socket on the gateway and plug on the cable) are de-energized and it can be proven that the atmosphere is not potentially explosive.
- The shield of each ethernet cable in the surrounding enclosure must be connected to PB. Observe the installation specifications according to IEC/EN 60079–14.
- For functional reasons, the maximum cable length of 100 m must not be exceeded.
- When laying the cable through the switch cabinet, a cable gland of type CRST XX can be used as described in chapter 3.3.

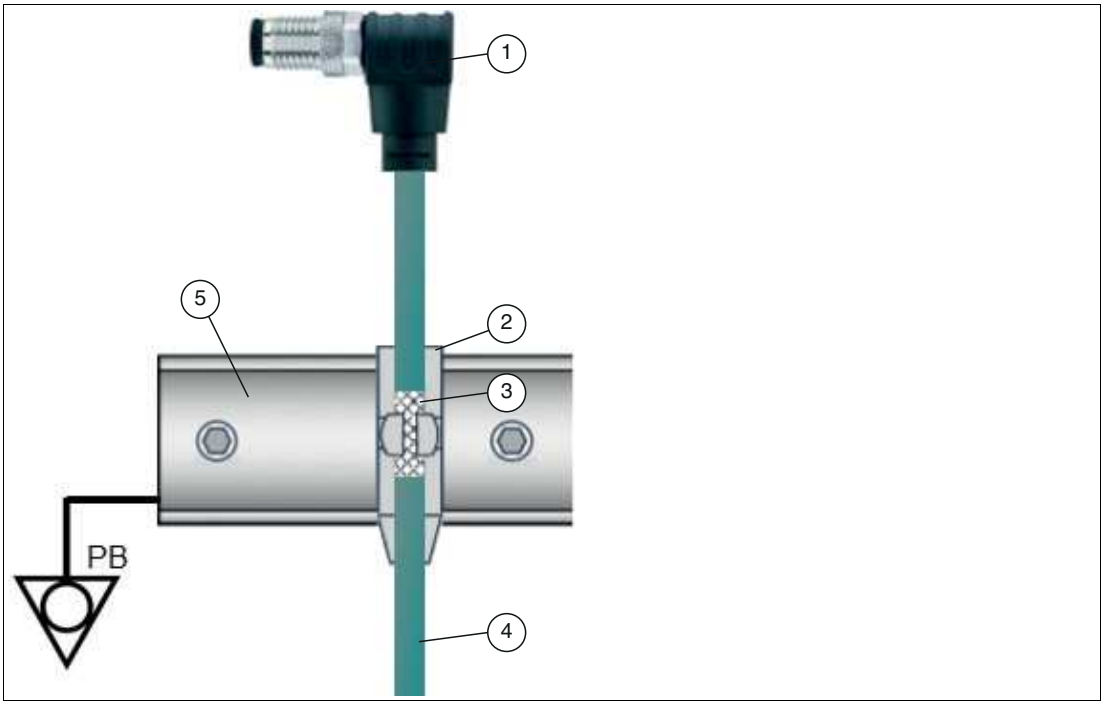

Figure 3.34 Equipotential bonding

1. M12 plug

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2. Ex e protective terminal
3. Exposed cable shield
4. Ethernet cable (specified type: V1SD-W-*M-PUR-ABG*
5. Earthing rail

Connecting the Surrounding Enclosure to the Equipotential Bonding of the Explosion-Hazardous Area

1. Observe the requirements specified in the previous chapters when connecting equipotential bonding. See chapter 3.14, in particular see chapter 3.14.3.
2. Connect the shield of the ethernet cable to the equipotential bonding of the explosion-hazardous area.

3.15.3.2 Overview of Ethernet Cordsets

Order designation	Plug first end	Plug second end	Length
V1SD-W-0,6M-PUR-ABG	M12	M12	0,6 m
V1SD-W-1M-PUR-ABG	M12	M12	1 m
V1SD-W-10M-PUR-ABG	M12	M12	10 m
V1SD-W-100M-PUR-ABG	M12	M12	100 m
V1SD-W-20M-PUR-ABG	M12	M12	20 m
V1SD-W-40M-PUR-ABG	M12	M12	40 m
V1SD-W-70M-PUR-ABG	M12	M12	70 m
V1SD-W-10M-PUR-ABG-V45-G	M12	RJ45	10 m
V1SD-W-100M-PUR-ABG-V45-G	M12	RJ45	100 m
V1SD-W-2M-PUR-ABG-V45-G	M12	RJ45	2 m
V1SD-W-20M-PUR-ABG-V45-G	M12	RJ45	20 m
V1SD-W-40M-PUR-ABG-V45-G	M12	RJ45	40 m
V1SD-W-5M-PUR-ABG-V45-G	M12	RJ45	5 m
V1SD-W-70M-PUR-ABG-V45-G	M12	RJ45	70 m

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3.15.3.3 Cable Gland with M12 Connections for Prefabricated Cables to Ethernet Gateways

This section describes how to seal a cable gland at a switch cabinet for a prefabricated cable in a Zone 1 explosion-hazardous area.

Product Data

Type	Torque lock nut [Nm]	Width across flats [mm]	Opening Ø [mm]	Cable area [mm]
C RS T 25	20	36	33	0+3.6 - 12

Fitting the seal for pre-fabricated cables

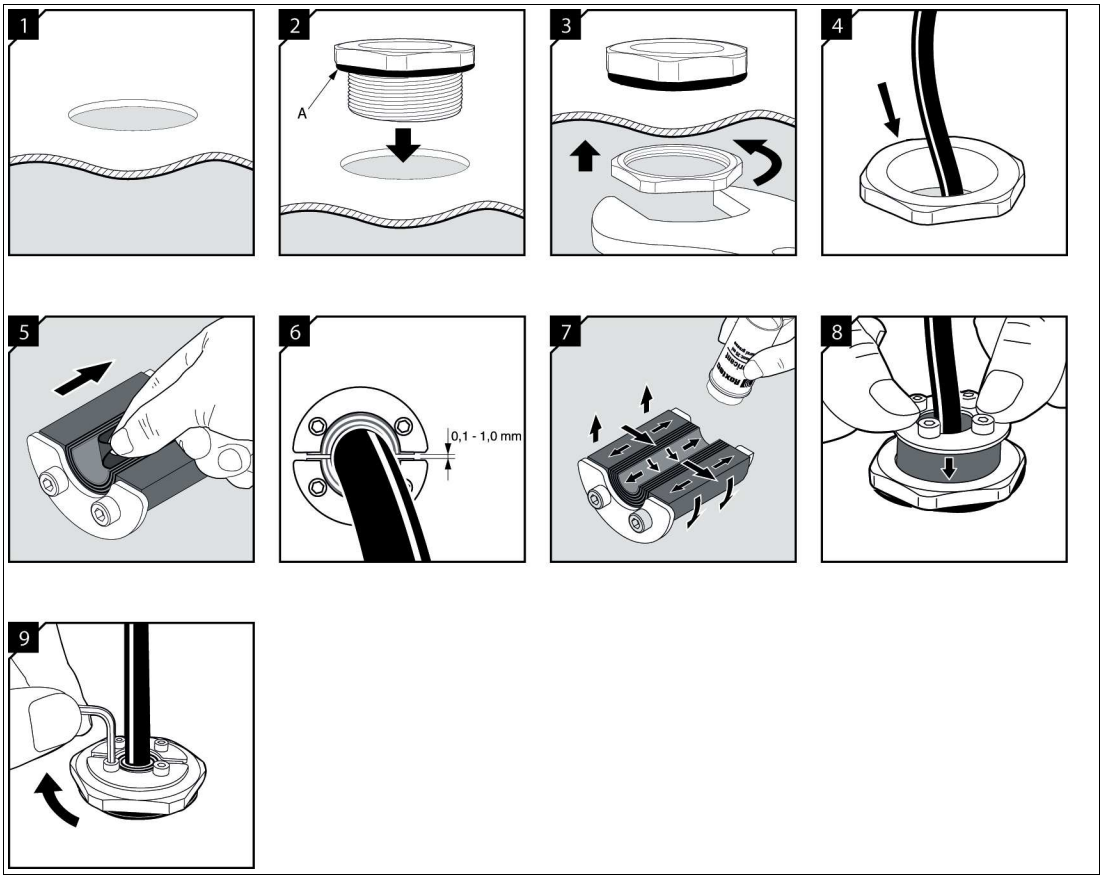

Figure 3.35 Fitting the seal

1. Make a hole for the screw sleeve in accordance with the "product data" table above.
2. Ensure that the rubber seal (A) is correctly attached to the screw sleeve. Insert the screw sleeve through the thru–hole.
3. Feed the union nut onto the screw sleeve from inside the enclosure and tighten the union nut to the specified torque according to the table above.
4. Run the cable through the screw sleeve.
5. Adjust the seal to the cable. Pull the layers off the halves until you achieve the gap shown in step 6 (0.1 - 1 mm). Ensure that the halves do not differ from each other by more than one layer.
6. Make sure you create a gap of 0.1 - 1 mm (A) between the two halves of the seal when you insert the cable between them.

7. Lubricate the inside and outside surfaces of the seal thoroughly but economically with a suitable lubricant.
8. Install the seal around the cable and insert it into the screw sleeve.

Note

Insert the cable far enough into the enclosure that you can easily access the connector.

9. Tighten the screws crosswise with the tightening torque specified in the table.

↳ The seal is compressed and seals the cable gland.

Tip

For optimum reliability, wait 24 hours or more after installation before exposing the cable to load or pressure.

Tightening torque for screws

Type	Recommended torque [Nm]	Allen wrench size [mm]
C RS T 25	1	2.5

Removing seal for pre-assembled cable

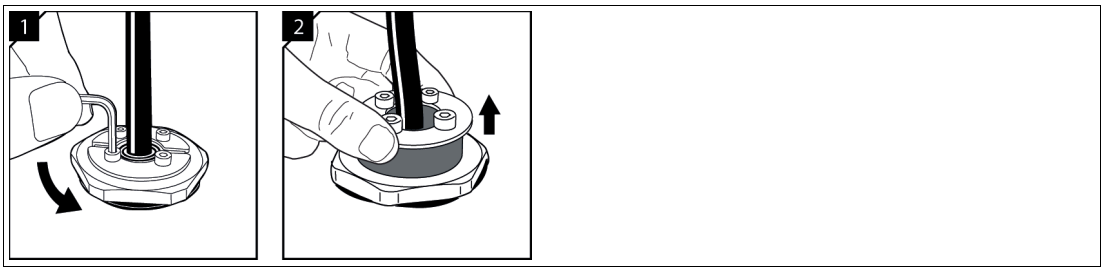

Figure 3.36 Removing the seal

1. Unscrew the bolts crosswise to release the compression.
2. Remove the seal from the screw sleeve.

3.16 System Expansion

Adding I/O modules

By adding an I/O-module, input or output data will be transferred to a slot that was previously empty. To do this, the configuration of the com unit must be adapted. Dependig on the com unit type, changes to the configuration of the com unit usually result in the function being interrupted due to a fieldbus restart.

To avoid this, you can activate Hot Configuration in Run (HCiR) in the com unit with PROFIBUS. If HCiR is active, a new configuration can be transferred to the com unit in the form of a passive data record. In this way, the master still has access to the old configuration in its existing form. As soon as the new configuration in the master matches the new configuration in the com unit, the new configuration in the com unit is activated and the old configuration is deleted. For more information, refer to the software manual for the com unit used.

4 Commissioning

4.1 Commissioning RS-485-Based Bus Systems

This chapter describes the commissioning of the RS-485-based bus system.

4.1.1 Electrical Testing of Connections

Make sure that the terminators have been properly fitted to the fieldbus and service bus. See chapter 3.15.1.

Danger!

Explosion hazard

When taking measurements in explosion-hazardous areas, there is an explosion hazard from sparks forming.

Use suitable measuring equipment or ensure there is no potentially explosive atmosphere.

Testing physical connection right to the end of the segment

Note

Perform the measurements from the control room.

1. Disconnect the bus connector from the master.
2. Deactivate the terminator on the bus connector (bus start).
3. Measure the voltage at the bus connector between A and B.

   ↳ A voltage of U = 220 Ω / (220 Ω + 2 * 390 Ω) * 5 V = 1.1 V must be present between A and B. This voltage is the result of the field-side terminator.
   If the 1.1 V voltage is not present, there is either no terminator connected at the end, the cable is faulty, or there is no terminating voltage at the FB remote I/O unit.
4. Measure the current at the bus connector between A and B.

   ↳ It must be possible to measure a current of I = 5 V / (2 * 390 Ω) ≈ 6.4 mA between A and B.
   If the current is significantly higher, by a factor of 2 or more, the bus is terminated using more than one terminator.
   If the current is I ≈ 0 mA, then either there is no terminator present, the cable is faulty, or there is no terminating voltage. In this case, there should be a resistance of 220 Ω between A and B.
   Should neither current nor resistance be present, the terminator is missing at the end of the bus or the cable is faulty.
5. Activate the terminator on the bus connector for the master.
6. Plug the bus connector back into the master.

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Testing physical connection

Note

Perform the measurements from the control room.

1. Disconnect the bus connector from the master.
2. Deactivate the terminator on the bus connector (bus start).
3. Measure the voltage between A and B on the bus connection of each FB remote I/O unit.

   ↳ A voltage of U = 1.1 V must be present between A and B on each FB remote I/O unit.
4. Activate the terminator on the bus connector for the master.
5. Plug the bus connector back into the master.

Note

Please refer to the current literature for more information.

4.1.2 Configuration of RS-485-based bus systems

Configuration of the entire FB remote I/O is conducted via the com unit. Communication with the com unit can be set up via either the fieldbus or the service bus.

Note

Com unit FB8207* can be configured via the service bus only.

For more information, refer to the software manual for the com unit used.

4.1.3 Startup Phase

Note

Do not start to operate all the FB remote I/O units simultaneously; instead, connect each remote I/O unit to the master one after the other.

Ensure that the master read cycle and the com unit watchdog are coordinated with one another. The duration for the transition to substitute values must be longer than the duration of a bus cycle.

For the purposes of fault analysis, we recommend using a bus monitor that is capable of passively monitoring data telegrams on the fieldbus.

4.2 Commissioning of Ethernet-Based Fieldbuses

A commissioning includes the integration of the FB-Remote-I/O-System into a communication network. For commissioning you need the IP address and the name of the gateway. After assigning the name via the configuration software, the gateway is addressable for a controller.

For further details refer to the software manual for the corresponding bus protocol.

5 Operation

During operation, you can access up-to-date measured values and diagnostic information for the I/O modules via the gateway/com unit. For more information, refer to the software manual for the gateway/com unit used.

In addition, you can read off basic information about supply and communication from the LEDs on the I/O modules and gateways/com units. For more information about the LEDs, refer to the data sheets for the I/O modules and gateways/com units used.

6 Troubleshooting

6.1 Troubleshooting of a RS-485-based bus system

This chapter describes troubleshooting for RS-485-based bus systems.

Danger!

Risk of explosion

When work is performed on the remote I/O unit in hazardous areas, there is a risk of explosion from spark formation.

Before starting any work on the remote I/O unit, familiarize yourself with the instruction manuals for the components and their relevant certificates.

Communication errors

Error	Remedy
Communication error on the fieldbus	• Check that the cables are connected. • Check that the transmitting and receiving lines are wired correctly and have not been swapped. • Check that the nodes are positioned in linear form and without branches. A star-shaped layout is not permitted. • Check that the terminator has been activated. The fieldbus must have exactly two terminators per segment, one at the beginning and one at the end. • In the configuration software, check that the selected address is the same as the remote FB remote I/O device address. • In the configuration software, check whether the master read cycle and the com unit watchdog are coordinated with one another.
Communication error on the service bus	• Check that the cables are connected. • Check that the nodes are positioned in linear form and without branches. A star-shaped layout is not permitted. • Check that the terminator has been activated. The service bus must have exactly two terminators per segment, one at the beginning and one at the end. • In the configuration software, check that the selected address is the same as the remote FB remote I/O device address. • Check that the correct interface is preset in the configuration software.
Communication error on the service bus after successfully establishing a connection	• Check that the service bus is galvanically isolated. • If you are using a laptop, operate the laptop using a battery. • Check the settings for the baud rate and transfer direction.
A new remote I/O unit will not work on a bus if other FB remote I/O devices are already operating on the bus	Check that the terminators are still on the beginning and end of the bus after expansion.
The software cannot locate a com unit when establishing the connection	Check that the com unit is plugged in correctly.
Communication to the extension backplane is not possible	• Check that the plug-in jumpers are set correctly. • Check that the base backplane and the extension backplane are wired correctly.

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Error	Remedy
Bus-independent deactivation of the I/O modules is not possible	Check that the plug-in jumpers are set correctly.
Multiple I/O modules fail simultaneously	• Check that the power supply is working properly. • Check that the base backplane and the extension backplane are wired correctly.

Redundancy faults

Error	Remedy
Continuous redundancy switchover	• Check that the correct type of redundancy is selected (**media redundancy** or **application redundancy**). • In the configuration software, check whether the master read cycle and the com unit watchdog are coordinated with one another. • Check whether the com units are connected via the front sockets using com unit cordset (see chapter 2.7.2). • Check that the process control system is set to the correct type of redundancy.
No redundancy switchover when a com unit is removed	• Check that redundancy has been configured at the com unit. • Check whether the com units are connected via the front sockets using com unit cordset (see chapter 2.7.2).
I/O modules are continuously changing the data	Check whether one of the com units has not been configured for redundancy mode. If this is the case, both com units actively try to access the I/O modules and interfere with one another.

Signal faults

Error	Remedy
Faulty signal	• Check whether the I/O module is in simulation mode or whether it is working with substitute values. • Check if there is a short circuit or lead breakage within the circuit. • Check that the field devices and sensors are working properly. • Check the communication path to the I/O module. • If necessary, replace the I/O module.
All signals for a unit are faulty	• Check that the power supply is working properly. • Check the bus connection. • Check the bus communication using a bus monitor.
The output module switches off	Communication with the com unit is interrupted. • Check that the I/O module is plugged into the backplane properly. • If necessary, switch off the status bits for analog outputs in the configuration software.
Input module sporadically delivers no measured values	Communication with the com unit is interrupted. Check that the I/O module is plugged into the backplane properly.
Measured values occasionally incorrect	• Check whether the measured value is being distorted by external influences. • Check that the shielding is intact.
I/O module reported to be faulty	• Check that the correct I/O module is plugged in. • Check that the green LED on the I/O module is lit and that the I/O module is correctly plugged in.

6.2 Troubleshooting of Ethernet-based fieldbuses

Check that the cable connections are intact and that all communication components including the gateway are correctly plugged in and supplied with sufficient power.

Check the communication status using the gateway LEDs. Please refer to the software manual of the corresponding bus protocol for the further procedure.

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