The Drive & Control Company

Rexroth
Bosch Group

Automation terminals of the Rexroth Inline product range

Application Description
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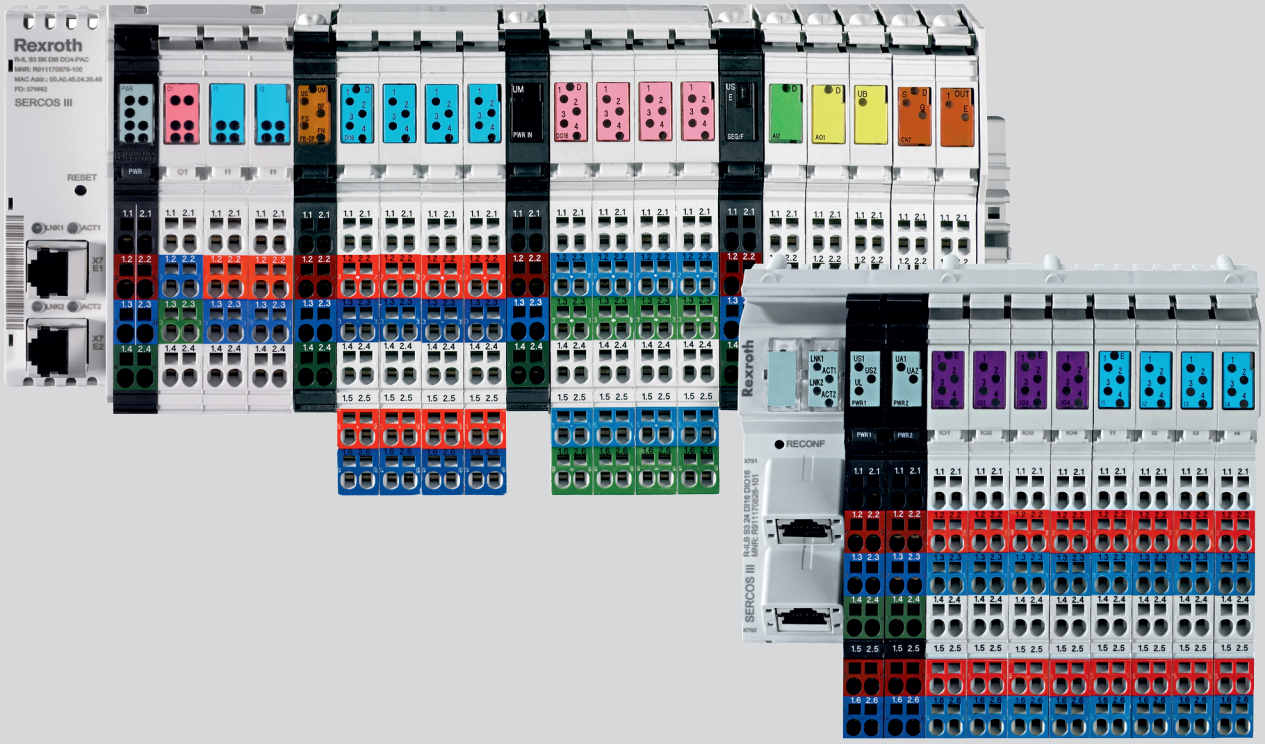
Edition 03



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1 Use of the safety instructions

1.1 Structure of the safety instructions

The safety instructions are structured as follows:

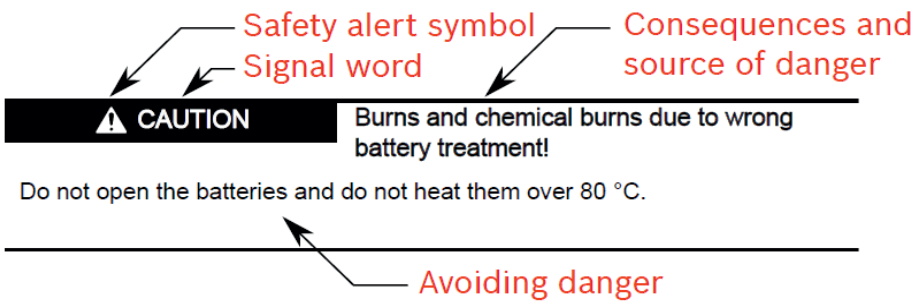


Fig. 1-1 Structure of the safety instructions

1.2 Explaining signal words and safety alert symbol

The safety instructions in this documentation contain specific signal words (danger, warning, caution, notice) and, if necessary, a safety alert symbol (according to ANSI Z535.6-2006).

The signal word is used to draw attention to the safety instruction and also provides information on the severity of the hazard.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words danger, warning and caution is used to alert the reader to personal injury hazards.

⚠ DANGER

In case of non-compliance with this safety instruction, death or serious injury **will** occur.

⚠ WARNING

In case of non-compliance with this safety instruction, death or serious injury **can** occur.

⚠ CAUTION

In case of non-compliance with this safety instruction, minor or moderate injury can occur.

NOTICE

In case of non-compliance with this safety instruction, material damage can occur.

Use of the safety instructions

1.3 Symbols used

Hints are represented as follows:

This is an information.

Tips are represented as follows:

This is a tip for the user.

1.4 Signal graphic explanation on the device

Prior to the installation and commissioning of the device, refer to the device documentation.

2 The Inline product range

The Inline product range consists of:

- Inline Modular IOs: modular, alignable terminals
- Inline Block IOs: compact remote input/output modules

This application description mainly describes the Inline Modular IOs, which are referred to as Inline terminals. For information regarding the Inline Block IOs, please refer to the module-specific data sheets.

2.1 Features

Inline Modular IO

- Side-by-side installation without tools, easy handling
- Open, flexible, and modular structure
- Combination of varying terminal widths to create a time-saving, compact, and cost-effective station structure
- 2-slot terminals:
  These terminals enable optimum adaptation to the desired configuration. They enable a flexible and compact station structure without unnecessary reserve installations.
- 8-slot terminals:
  These terminals provide a fast and effective station set-up for larger stations.
- Function block-oriented structure of the control box or control cabinet
  The modular structure makes it possible to assemble standard function blocks in advance. Parts of the system can be started up independently of another. This means that pretests can be carried out when the system is set up and the whole system can be adapted and extended.
- Automatic creation of potential groups, potential circuits, and data circuits
- Reduced need for complex parallel wiring
  Within a station, potential and data routing can be carried out without additional wiring.
- Support of all common bus systems

Inline Block IO

- Integrated bus interface for all common bus systems
- High channel density
- Compact 55 mm flat design
- Tool-free installation, easy handling
- Same look and feel as Inline Modular IO

2.2 Product description

Automation terminals with various functions are available within the Inline product range.

Automation terminals consist of an electronics base (Inline Modular IO) or an electronics module (Inline Block IO) and one or more connectors for I/O or power supply connection. The electronics can be replaced without having to remove a single wire from the connector.

Inline Modular IO versions

The product range offers terminals for all automation tasks:

- Bus couplers for integrating the Inline station into various bus systems, some with input and output function for digital signals
  The bus can be connected using copper or fiber optic technology.
- Terminals for feeding the supply voltages and segmenting the station (with and without fuse)
- Accessory terminals (potential distributor terminals, distance terminals)
- Input and output terminals for digital and analog signals
- Branch terminals for integrating further product groups (e.g., integration of a Fieldline Modular local bus in the Inline station) or for extending the local bus by several rows
- Terminals for open and closed-loop control, communication, and position detection
- Safety modules

Inline Block IO versions

- Input/output modules for digital and analog signals
- Bus interface is integrated in the module

Mounting location

Inline Modular IO terminals and Block IO modules meet IP20 degree of protection and are designed for use in closed housings. The compact design means that most of the Inline Modular IO terminals and all Block IO modules can be installed in standard terminal boxes.

Mounting

Inline Modular IO terminals and Block IO modules can be snapped onto DIN rails without tools. Potential and data jumpers are automatically created when the Inline Modular IO terminals are mounted side by side.

Bus connection

Inline Modular IO: the Inline station is integrated in the bus system using a bus coupler. Data routing allows the bus to be led through the Inline station.

Inline Block IO: the bus interface is integrated in the module. The bus is connected directly to the I/O module.

I/O connection

The Inline terminals and Block IO modules have connectors for 1, 2, 3 or 4-wire sensors or actuators. The wires are connected using spring-cage technology. For more detailed information, please refer to the individual chapters.

3 Important directions for use

3.1 Appropriate use

3.1.1 Introduction

Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Bosch Rexroth, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Rexroth products, make sure that all the pre-requisites for appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

Important directions for use

3.1.2 Areas of use and application

The Inline system of Rexroth is a modular and flexibly scalable input/output system in the degree of protection IP 20. It can be operated locally at the IndraControl L or peripherally via a fieldbus coupler.

The Rexroth Inline system may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines.

Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

Typical applications of the Rexroth Inline system are:

- Handling and assembly systems,
- Packaging and foodstuff machines,
- Printing and paper processing machines and
- Machine tools.

The Rexroth Inline system may only be operated under the assembly, installation and ambient conditions as described here (temperature, system of protection, humidity, EMC requirements, etc.) and in the position specified.

In residential areas as well as in business and commercial areas Class A devices may be used with the following note:

This is a Class A device. In a residential area, this device may cause radio interferences. In such a case, the user may be required to introduce suitable countermeasures at his own cost.

3.2 Inappropriate use

Using the Rexroth Inline system outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as "inappropriate use".

The Rexroth Inline system may not be used if

- they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extremely high maximum temperatures or if
- Bosch Rexroth has not specifically released them for that intended purpose. Please note the specifications outlined in the general Safety Guidelines!

4 Important information regarding the voltage areas

4.1 Voltage areas for Inline Modular IO and Inline Block IO

Inline Block IO modules are available for the protective extra-low voltage (PELV) area.

Inline Modular IO terminals are available for the PELV and low voltage areas. Depending on their use in a specific voltage area, the terminals are divided as follows:

Voltage area	Voltage used for Inline	Designation
PELV	24 V DC	Low-level signal terminals; Inline Block IO modules
Low voltage	230 V AC	Relay terminals

Fig. 4-1 Voltage areas and corresponding terminal designations for Inline

Observe the safety notes in the following chapters when working outside the PELV area.

Important information regarding the voltage areas

4.2 Intended use

Inline Block IO modules and Inline Modular IO terminals should only be used according to the instructions given in the terminal-specific data sheets and this application description. Bosch Rexroth accepts no liability if the terminals and modules are used for anything other than their designated use.

When used in the PELV area:

NOTICE **Disregarding this notice may result in malfunction**

Do not replace terminals while power is connected.

Before removing a terminal from or inserting a terminal in the station, disconnect power to the entire station.

Make sure the entire station is reassembled before switching the power back on.

When used in the low voltage area:

⚠ WARNING: **Dangerous contact voltage**

Do not replace terminals while power is connected.

Before removing a terminal from or inserting a terminal in the station, disconnect power to the entire station.

Make sure the entire station is reassembled before switching the power back on.

⚠ WARNING: **Dangerous contact voltage**

Please note that there are dangerous contact voltages when switching current circuits that do not meet the requirements of PELV.

When working on the terminals and wiring, always switch off the supply voltage and ensure it cannot be switched on again.

4.3 Notes for Inline Modular IO

4.3.1 Safety notes for use in the low voltage range

Only qualified personnel (electrically skilled persons or electrically instructed persons) may work on Inline terminals outside the PELV area.

The instructions given in the terminal-specific data sheets must be followed during installation and startup.

An **electrically skilled person** is someone who, because of their professional training, skills, experience, and their knowledge of relevant standards, can assess any required operations and recognize any possible dangers. (definitions according to DIN VDE 1000-10:1995)

An **electrically instructed person** is someone who has been instructed and, if necessary, trained by an electrically skilled person in their required tasks and the possible dangers caused by incorrect handling and who has also been informed of the necessary safety equipment and safety measures. (definitions according to DIN VDE 1000-10:1995)

4.3.2 Installation instructions and notes for low voltage terminals

⚠ WARNING: Dangerous contact voltage

Please note that there are dangerous contact voltages when switching current circuits that do not meet the requirements of PELV.

Connecting and disconnecting the terminals for the 230 V AC voltage area is only permitted when the power supply is disconnected!

When working on the terminals and wiring, always switch off the supply voltage and ensure it cannot be switched on again.

⚠ WARNING: Dangerous contact voltage in the event of ground faults

(if, for example, the residual current circuit breaker has not tripped or the star point is “exposed”)

Only operate Inline terminals for the 230 V AC area in grounded AC voltage networks.

4.3.2.1 Structure of an Inline station with a relay terminal

A relay terminal **must** be separated from the 24 V area of the Inline station by distance terminals.

The number of terminals is limited by the system limits of the bus system and the Inline system (see Chapter 12, “Inline Modular IO: technical data and ordering data”).

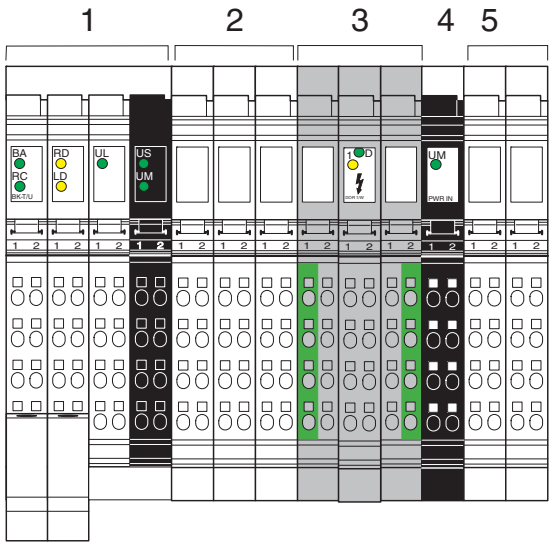


Fig. 4-2 Typical structure of an Inline station with 24 V voltage area and a relay terminal

1 Bus coupler
2 Various input/output terminals for the 24 V AC area
3 Relay terminal between distance terminals
4 Power terminal for the 24 V DC area
5 Various input/output terminals for the 24 V AC area

Important information regarding the voltage areas

4.3.3 Electronics base and connectors

Low-level signal terminals and relay terminals are located in the same type of housing, which is referred to as low-level signal housing. An external feature that distinguishes the bases and the corresponding connectors of low voltage terminals from the bases and connectors of low-level signal terminals is their color:

Area	Terminal	Connector	Other differences
Low-level signal (24 V DC)	Light gray	Light gray	Light color for function identification (e.g., light blue)
Relay terminals (low voltage; 230 V AC)	Dark gray	Dark gray	Dark color for function identification (e.g., dark blue) with white lightning bolt

Fig. 4-3 Base and connector colors for different voltage areas

4.3.4 Safety mechanisms to prevent mixing up terminals for different voltage areas

4.3.4.1 Protection against the insertion of 24 V connectors onto relay terminals

The low-level signal connectors can be inserted onto relay terminals. Because the relay outputs are electrically isolated, this connection error has no adverse effects.

4.3.4.2 Protection against the insertion of live 230 V AC connectors in the 24 V DC area

If the connectors for the input/output terminals are wired according to the installation instructions, they are disconnected from the power supply when removed.

The connectors for the relay terminals are closed in some places using filler plugs and therefore do not fit on the terminals of the 24 V area.

4.3.5 Response to the insertion of a relay terminal in the 24 V area

A relay terminal can be inserted in the 24 V DC area. This does not result in direct danger to people.

The module has no diagonal routing, so there is no direct danger from the terminal, even with a 230 V connector. This means that the shortest isolating distance is the distance from one connector to the next. This isolating distance is not permitted. Therefore, insert a distance terminal before and after the relay terminal (R-IB IL DOR LV-SET-PAC).

5 Inline product groups

The following chapters provide an overview of the Inline product groups. For specific information regarding the individual terminals/modules, please refer to the specific data sheets and the individual chapters in this application description.

The product range is continuously growing. For additional information, please visit www.boschrexroth.com/electrics.

5.1 Supported bus systems

Inline devices are available for the following bus systems:

Bus system	Inline Modular IO	Inline Block IO
PROFINET IO	Yes	No
INTERBUS	Yes	No
PROFIBUS DP	Yes	Yes
Modbus/TCP	Yes	No
Sercos III	Yes	Yes
DeviceNet™	Yes	Yes

Fig. 5-1 Bus systems supported by Inline

5.2 Inline Modular IO terminals

5.2.1 Scope of supply and transmission speed

Scope of supply

Inline terminals are mostly offered as complete items. This is indicated by the extension “**-PAC**” in the order code. The following are supplied as standard with a complete item:

- The electronics base
- All Inline connectors required
- All marking fields required

In the past, Inline terminals were available as stand-alone items without accessories. For a stand-alone item without accessories, the Inline connectors and marking fields have to be ordered separately.

Transmission speed in the local bus

It is possible to operate at a transmission speed of 500 kbps within an Inline station.

5.2.2 Example of an Inline station

Fig. 5-2 shows a typical Inline station. It contains just a few terminals from the extensive product range. The functions and special features of the individual product groups are described in the chapters below.

In addition, Fig. 5-2 shows how the main and segment circuits are structured. This structure can be created using power and/or segment terminals (see Chapter “Power, segment, and accessory terminals” on page 18).

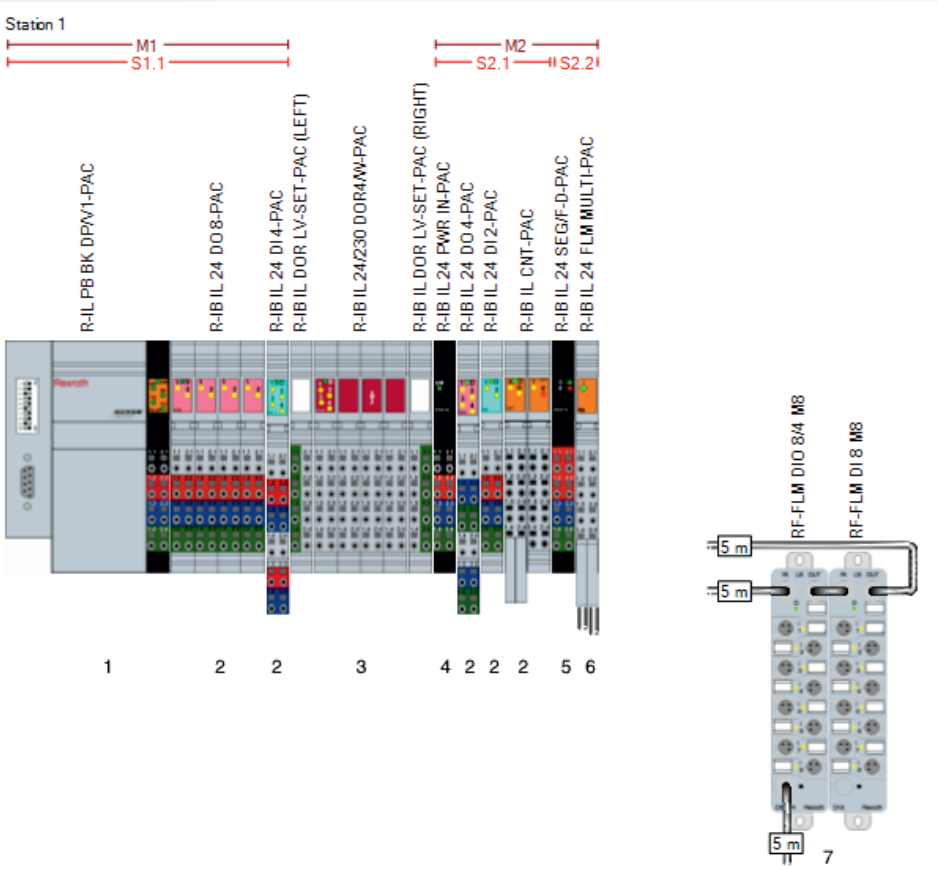


Fig. 5-2 Typical Inline station

1 Bus coupler (here: supply voltages are fed in)
2 Input/output terminals for the 24 V area
3 Relay terminal including distance terminals
4 Power terminal for the 24 V area
5 Segment terminal
6 Branch terminal (here: for connecting Fieldline Modular M8 devices)
7 Fieldline Modular M8 devices

M1, M2	Main circuit 1, 2
S1.1	Segment circuit 1 in main circuit 1
S2.1, S2.2	Segment circuit 1 and 2 in main circuit 2

5.2.3 Bus coupler

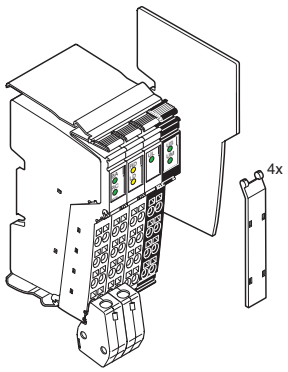


Fig. 5-3 Example: bus coupler for INTERBUS: R-IBS IL 24 BK-T/U-PAC

A bus coupler is required to connect an Inline station to your bus. Bus couplers are available for different bus systems (see Fig. 5-1).

The bus couplers are described in detail in a separate document.

Not all Inline terminals can be used with every bus coupler. The Inline Builder software is available as a configuration tool for Inline and Fieldline I/O stations.

Inline product groups

5.2.4 Power, segment, and accessory terminals

For more detailed information regarding the voltages used within an Inline station, please refer to Chapter “Circuits and provision of supply voltages” on page 45.

5.2.4.1 Overview of power and segment terminals

Power terminals and segment terminals are available to supply the station with I/O voltage. The segment terminals extend the power terminals. The segment terminals make it possible to create different segments within a main circuit. Different types can be used to meet your requirements:

Designation	Type	Supply/ provision	Fuse	Diagnostics (bus device)	Fuse-protected area
R-IB IL 24 PWR IN-PAC	Power terminal	U_M / U_S	No	No	None
R-IB IL 24 PWR IN/R-PAC R-IB IL 24 PWR IN/R/CN-PAC		U_{24V} (U_L/U_{ANA}) / U_M / U_S	No	No	None
R-IB IL 24 PWR IN/R/L-0.8A-PAC		U_{24V} (U_L/U_{ANA})	No	No	None
R-IB IL 24 SEG-PAC	Segment terminal	U_S	No	No	None
R-IB IL 24 SEG/F-PAC			Yes	No	Segment circuit
R-IB IL 24 SEG/F-D-PAC			Yes	Yes (500 kbps)	Segment circuit

Fig. 5-4 Overview of power and segment terminals

U_M	Main voltage
U_S	Segment voltage
U_{24V}	24 V supply, from which the voltages U_L and U_{ANA} are generated
U_L	Communications power (logic voltage)
U_{ANA}	Analog voltage

NOTICE **Consequential damage**

Protect the power supply externally, regardless of the power and/or segment terminal used.

5.2.4.2 Power terminals

A power terminal is used to supply the required voltages to the station-internal potential jumpers. Several power terminals can be used in one station. This means that different circuits can be electrically isolated.

All power terminals are used to supply the main voltage and/or the segment voltage.

In addition, a 24 V supply voltage is supplied at the R-IB IL 24 PWR IN/R-PAC terminal, from which the communications power U_L and analog voltage U_{ANA} are generated. The terminal is mainly designed to boost the communications power and the analog voltage if the maximum current carrying capacity of the potential jumpers for U_L/U_{ANA} or the maximum current carrying capacity of the bus coupler for U_L/U_{ANA} is reached.

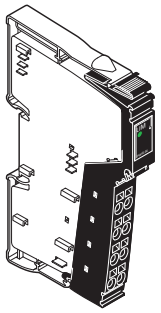


Fig. 5-1 Example of a power terminal: R-IB IL 24 PWR IN-PAC

Potential jumpers

The power terminal interrupts all potential jumpers for the voltages to be resupplied, and recreates them (see also Chapter “Electrical potential and data routing (Inline Modular IO)” on page 45).

Carrying capacity of the jumper contacts

The maximum current carrying capacity of the lateral jumper contacts is specified in Chapter “Current and voltage distribution” on page 54.

Electrical isolation

The power terminal is used to create electrically isolated I/O areas within a station.

Functional earth grounding (24 V DC)

24 V power terminals are connected to functional earth ground when they are snapped onto the grounded DIN rail via the FE spring on the bottom side of the terminal. The spring is connected to the FE potential jumper and to the terminal points for an FE connection.

If the previous terminal is a 24 V terminal, the power terminal is connected to the FE potential jumper of the station when it is connected to the previous terminal.

Required additional functional earth grounding (24 V DC)

A relay terminal interrupts the FE jumper, which is connected to FE via the additional functional earth grounding at the bus coupler. A 24 V DC power terminal that is placed after a relay terminal must therefore be reconnected to functional earth ground via the FE connection to ensure reliable functional earth grounding even if the FE spring is dirty or damaged. Connect the terminal points for the FE connection to a grounded PE terminal (see Chapter “Grounding concept” on page 69).

Additional documentation

For additional information regarding the function, properties and wiring of the individual terminals, please refer to the terminal-specific documentation.

5.2.4.3 Segment terminals

Segment terminals can be used to create partial circuits (segment circuit).

On segment terminals without fuse, the connection between the main circuit U_M and the segment circuit U_S must be established using a jumper or switch. Segment terminals with a fuse establish this connection automatically.

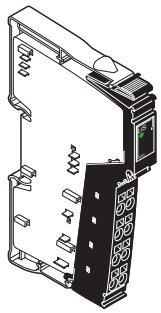


Fig. 5-2 Example of a segment terminal: R-IB IL 24 SEG-PAC

U_M The potential jumper for the main circuit U_M is not interrupted in the segment terminal. The potential for the segment circuit U_S is tapped from the potential jumper at the segment terminal.

U_S The segment terminal interrupts the segment circuit U_S in the potential jumper of the previous terminal.

For more detailed information regarding the supply voltages, please refer to Chapter “Circuits and provision of supply voltages” on page 45.

Carrying capacity of the jumper contacts The maximum current carrying capacity of the lateral jumper contacts is specified in Chapter “Current and voltage distribution” on page 54.

Functional earth grounding The connection to functional earth ground is established when the segment terminal is snapped onto the grounded DIN rail via the FE spring on the bottom side of the terminal. This spring is connected to the FE potential jumper and the terminal points for an FE connection.

When inserted into the previous terminal, the segment terminal is also connected to the FE potential jumper of the station.

Additional documentation

For additional information regarding the function, properties and wiring of the individual terminals, please refer to the terminal-specific documentation.

5.2.4.4 Supply and segmentation options

Fig. 5-5 provides an overview of the supply and segmentation options. For more detailed information, please refer to Chapter “Electrical potential and data routing (Inline Modular IO)” on page 45.

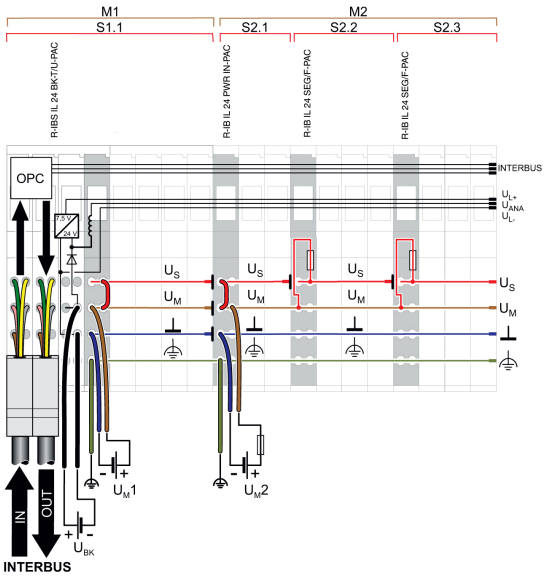


Fig. 5-5 Supply and segmentation options

5.2.4.5 Accessory terminals

Potential distributor terminals and distance terminals are available as accessory terminals.

Potential distributor terminals (for GND and 24 V) are intended for the economical return wiring of sensor and actuator cables when using Inline with 1-wire connection.

The distance terminal set creates the specified creepage distance when using relay terminals. Both distance terminals interrupt the potential jumpers for the main voltage, segment voltage, ground, and functional earth ground.

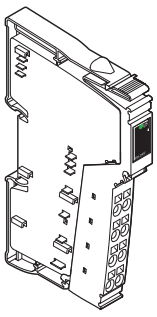


Fig. 5-6 Example of a potential distributor terminal: R-IB IL PD 24V-PAC

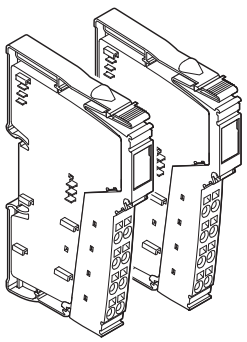


Fig. 5-7 Distance terminal set: R-IB IL DOR LV-SET-PAC

Additional documentation

For additional information regarding the function, properties and wiring of the individual terminals, please refer to the terminal-specific documentation.

5.2.5 Input/output terminals

Functions

Terminals with different functions are available for **low-level signals**. These include, for example, the terminals listed below. The text in brackets indicates the function according to the order code.

- Digital input and output terminals (DI, DO)
- Analog input and output terminals (AI, AO)
- Relay terminals (DOR)
- Temperature measurement terminals (TEMP)
- Communication terminals
  - Communication terminals with serial interface (RS232, RS485/422)
  - DALI terminals (DALI)
- Position detection terminals (INC-IN, SSI-IN)
- Terminals for open and closed-loop control
  - Function terminals (PWM, CNT)
  - Positioning terminals (SSI)

Relay terminals are available for the **low voltage level**.

These terminals are available in different sizes. This enables you to set up the station in a modular way so that it meets your requirements.

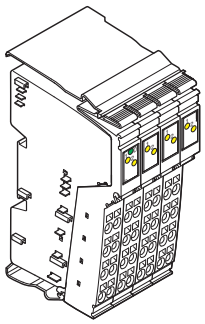


Fig. 5-8 Example of a digital input terminal: R-IB IL 24 DI 8-PAC

Protection

Overload protection of the system is provided centrally by a fuse in the power terminal or needs to be provided by the operator. The rating of the fuse connected upstream must be such that the maximum permissible load current is not exceeded. For the maximum permissible load current of an I/O terminal, please refer to the terminal-specific data sheet.

Carrying capacity of the jumper contacts

The maximum current carrying capacity of the lateral jumper contacts is specified in Chapter “Current and voltage distribution” on page 54.

Grounding (FE)

Connection to functional earth ground (24 V DC area) is established via the corresponding potential jumper when the terminal is inserted into the previous terminal.

Voltage areas

Input/output terminals are available for the 24 V DC voltage area.

Shielding

Inline shield connectors are available for connecting shielded cables.

Parameterization

Some terminals can be parameterized via process data or PCP. For detailed information, please refer to the terminal-specific data sheet.

Data formats

The measured values and corresponding output values of analog terminals and temperature measurement terminals can be represented in different data formats depending on the terminal used and its configuration. These formats are listed in the relevant terminal-specific data sheet.

Diagnostics The scope of the diagnostics depends on the terminal used and is specified in the corresponding terminal-specific data sheet.

Additional documentation

For additional information regarding the function, properties, wiring, and parameterization of the individual terminals, please refer to the terminal-specific documentation.

5.2.6 Safety modules

5.2.6.1 Safety-related segment circuit

The safety module can be used to create a safety-related segment circuit.

The structure of the safety-related segment circuit in the Inline system is such that actuators/controlled devices, which are connected to output terminals, can be switched separately via the bus system and can be switched off safely on a safety demand to the upstream safety module.

The safety-related segment circuit starts at a safety module and finishes at the last terminal before another power terminal is added or at the end of the station. Only Inline terminals that are specifically designed for the safety-related segment circuit may be used. They are listed in the “Safety-Related Segment Circuit” application description, MNR R911335486).

5.2.6.2 PROFIsafe

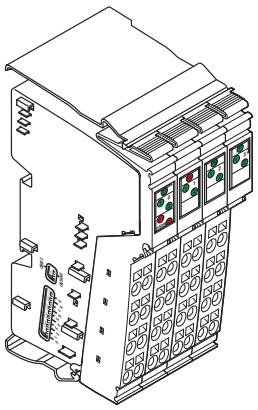


Fig. 5-9 Safety module: R-IB IL PSDI 8-PAC

In an Inline station, you can use safety modules in a bus system with a safe protocol (PROFIsafe). In this type of bus system, the safe data is transmitted between the safe controller and the safety modules via the bus using a safe protocol. This means that the same cable is used for both safety-related communication and standard communication.

PROFIsafe is a profile for PROFIBUS and PROFINET, certified according to IEC 61508.

Using PROFIsafe, safety functions with the following requirements can be met:

- Up to category 4 according to standard EN 954-1
- Up to SIL 3 according to standard IEC 61508

PROFIsafe therefore meets the highest safety requirements for the process and manufacturing industry.

Type	MNR
R-IB IL 24 PSDI 16-PAC	R911173314
R-IB IL 24 PSDI 8-PAC	R911172846
R-IB IL 24 PSDO 4/4-PAC	R911172849
R-IB IL 24 PSDO 8-PAC	R911172847
R-IB IL 24 PSDOR 4-PAC	R911172848

Fig. 5-10 Safety module for PROFIsafe

Additional documentation

For additional information regarding the function, properties, wiring, and parameterization of the individual modules, please refer to the terminal-specific documentation.

5.2.7 Branch terminals

5.2.7.1 Branch terminal for integrating a Fieldline Modular local bus in an Inline station

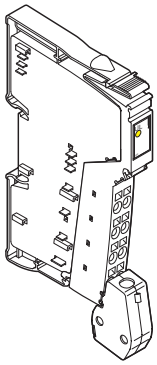


Fig. 5-11 Example of a branch terminal: R-IB IL 24 FLM-PAC

These branch terminals can be used to integrate sensors and actuators in close proximity to the station, which are connected to the Fieldline Modular M8 or M12 local bus with IP65/67 degree of protection, in your bus system.

The terminal converts the physical transmission method of the Inline local bus to the physical transmission method of the Fieldline Modular local bus.

For additional information, please refer to the terminal-specific data sheet and the Fieldline Modular documentation.

5.2.7.2 Local bus extension

An Inline station can be extended by one or more rows. To this end, you need a combination of an R-IB IL 24 FLM-PAC branch terminal and an R-IB IL 24 LSKIP-PAC local bus extension terminal.

The branch terminal is installed at the end of a row of an Inline station and the local bus extension terminal is installed at the beginning of the following row.

The data is transmitted between the two terminals via the RS-422 protocol.

For additional information, please refer to the terminal-specific data sheet and the Fieldline Modular documentation.

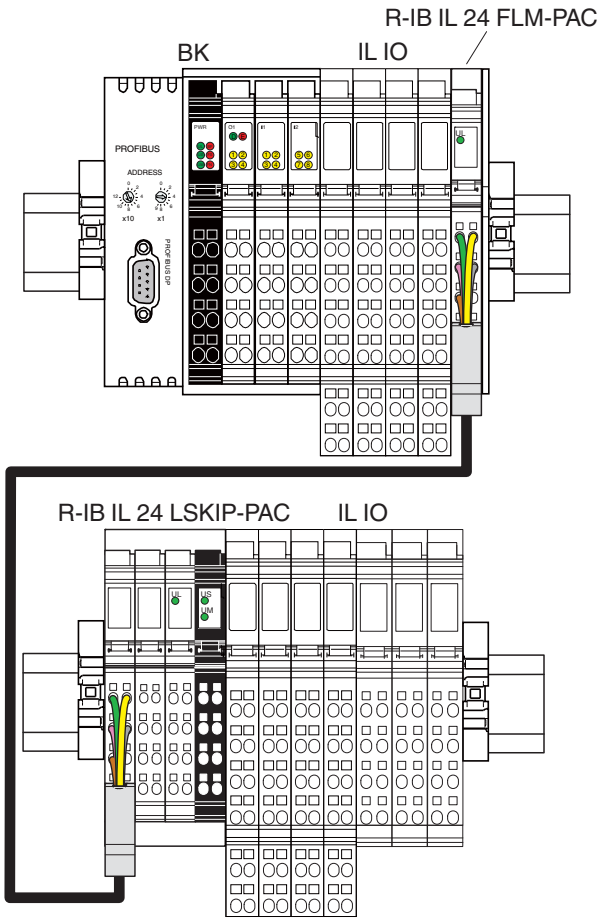


Fig. 5-12 Example: implementation of a local bus extension within an Inline station

BK	Bus coupler
IL IO	Any Inline terminals

Inline product groups

5.2.8 Example structure of an Inline Modular IO station

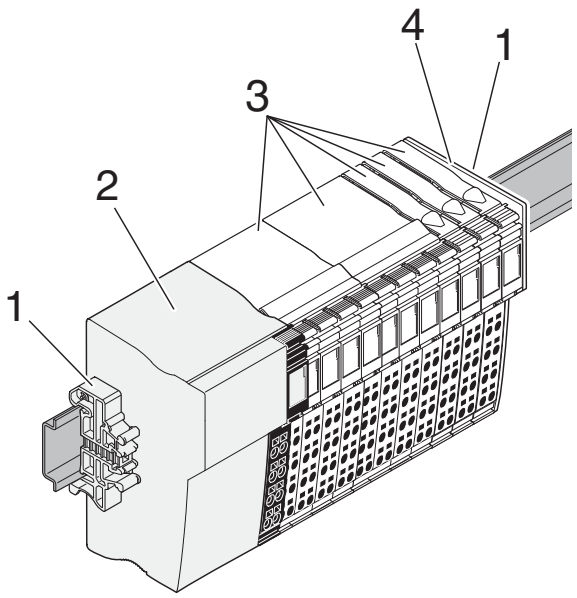


Fig. 5-13 Example station

Fig. 5-13 shows a typical Inline structure consisting of the following elements:

1 End bracket
2 Bus coupler (here: basic representation of a bus coupler with optional voltage supply)
3 Terminals for the 24 V DC area (e.g., input/output terminal)
4 End plate (end of the station)

5.3 Inline Block IO modules

Block IO modules are available for inputting and/or outputting digital and analog signals to various bus systems (see Fig. 5-1).

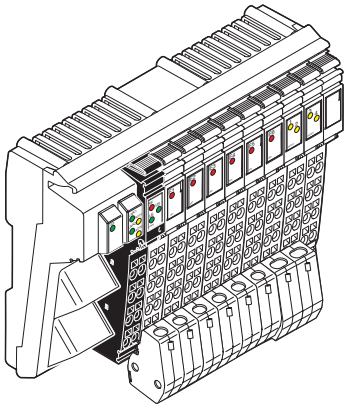


Fig. 5-14 Example: Inline Block IO module

Scope of supply The Inline Block IO modules are available as complete items. The following are supplied as standard with a complete item:

- The electronics base
- All Inline connectors required

Bus system Inline Block IO modules are available for Sercos, PROFIBUS, and DeviceNet™ (see Fig. 5-1).

Voltage supply All the required voltages are supplied at each individual Inline Block IO module.

Voltage areas Inline Block IO modules are available for the 24 V DC voltage area.

Functions Inline Block IO modules are available with various functions. These include, for example, the modules listed below. The text in brackets indicates the function according to the order code.

- Digital input and output modules (AI, AO)
- Analog input and output modules (AI, AO)
- Positioning modules (SSI)

Protection Overload protection of the system must be provided by the operator. The rating of the fuse connected upstream must be such that the maximum permissible load current is not exceeded. For the maximum permissible load current of an I/O module, please refer to the module-specific data sheet.

Grounding (FE) Each Inline Block IO module has an FE spring (metal clip) on its bottom side which establishes an electrical connection to the DIN rail. Use grounding terminals to connect the DIN rail to protective earth ground. The module is grounded when it is snapped onto the DIN rail.

To ensure reliable functional earth grounding of the module even when the DIN rail is dirty or the metal clip is damaged, Bosch Rexroth also recommends grounding the module via one of the FE terminal points of a power connector.

Shielding Shield connectors are available for connecting shielded cables.

Inline product groups

Parameterization Some modules can be parameterized via process data or PCP. For detailed information, please refer to the module-specific data sheet.

Data formats The measured values and the corresponding output values of analog modules can be represented in different data formats depending on the module used and its configuration. These formats are listed in the relevant module-specific data sheet.

Diagnostics The scope of the diagnostics depends on the module used and is specified in the relevant module-specific data sheet.

Additional documentation

For additional information regarding the function, properties, wiring, and parameterization of the individual modules, please refer to the module-specific documentation.

6 Structure and dimensions

6.1 Structure and dimensions of Inline Modular IO terminals

6.1.1 Basic structure

Regardless of the function and overall width, an Inline terminal consists of the electronics base and the snap-on connector (Inline connector).

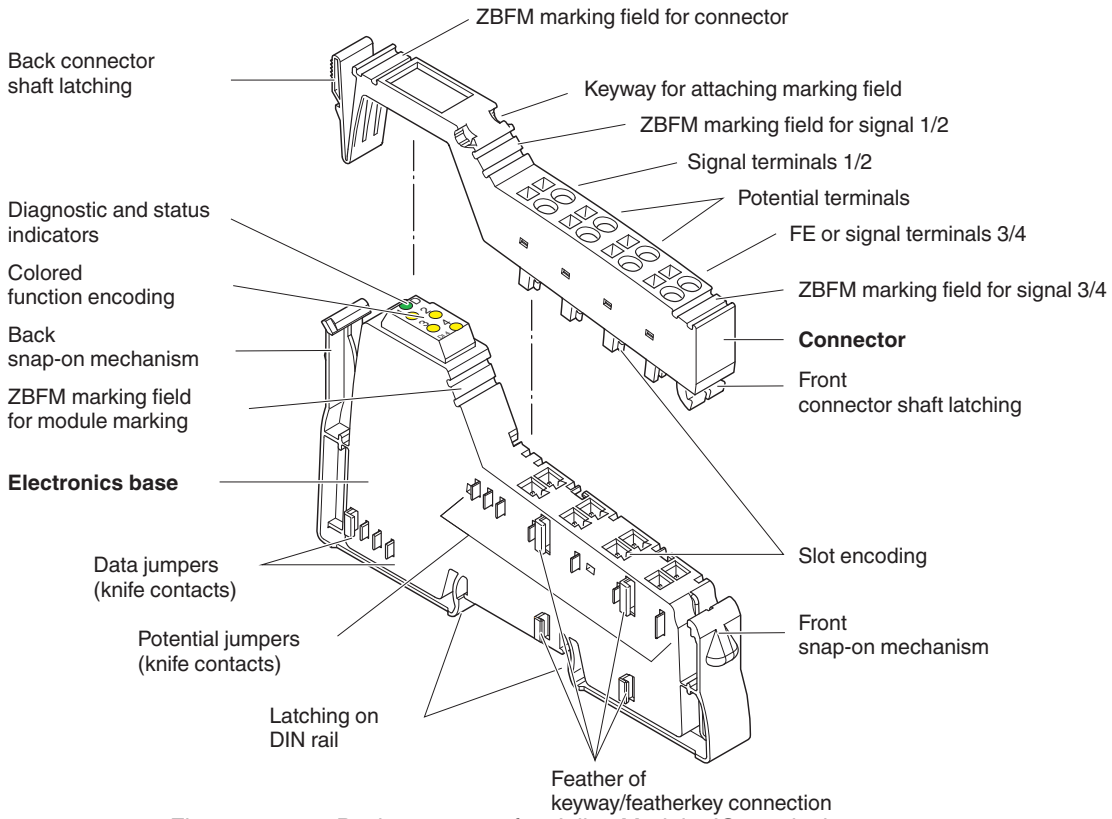


Fig. 6-1 Basic structure of an Inline Modular IO terminal

ZBFM: Zac marker sheets, flat
(see also Chapter “Function identification and marking” on page 31)

The components required for marking are listed in the Chapter “Ordering data” on page 102.

Structure and dimensions

6.1.2 Electronics base

The electronics base holds the entire electronics for an Inline terminal and the potential and data routing.

Potential and data routing

Potential and data routing are located in the base. As all terminals are snapped onto the DIN rail, the position of the interfaces between the terminals in relation to the DIN rail is the same for all terminals. The advantage of this is that terminals of different sizes can be integrated into the station.

The knife contacts are located on the left-hand side of the terminal (as shown in Fig. 6-1). They snap into the fork-type contacts of the next terminal on the left when the station is mounted.

The type of potential and data routing contacts that are available on a terminal depends on the function of the terminal and is shown in the circuit diagram of the relevant terminal-specific data sheet.

Snap-on mechanism/latching

Pressing the front and back snap-on mechanisms at the same time releases the latching, enabling the terminal to be removed by pulling it straight back from the DIN rail (see Chapter “Basic information about mounting” on page 66).

Keyway/featherkey connection

The featherkeys are on the left-hand side of the terminal (Fig. 6-1). They snap into the keyways of the next terminal on the left when the terminal is mounted on the DIN rail. The featherkeys are also referred to as locking clips and the keyways as guideways.

Base colors

The bases and the appropriate connectors for the different voltage areas are of different colors (see Chapter “Electronics base and connectors” on page 14).

6.1.3 Connectors

A connector that can be separated from the electronics base is used to connect the I/O and the supply voltages. For more detailed information regarding the Inline connectors, please refer to Chapter 7, “Inline connectors”.

6.1.4 Function identification and marking

Housing

The basic fields of application for Inline Modular IO terminals can be identified by their housing type or color.

Housing type	Housing color	Connector color	Field of application	
Low-level signal housing	Light gray	Light gray	Low-level signal (24 V DC)	All functions except for supply, safety, DALI
		Black	Low-level signal (24 V DC)	Supply, segmentation
	Yellow	Yellow	Low-level signal (24 V DC)	Safety
	Dark gray	Dark gray	Low-level signal (24 V DC)	DALI
			Low voltage (230 V AC)	Relay terminals

Fig. 6-2 Field of application and housing

Function identification

The area for the diagnostic and status indicators on the terminals is color-coded to enable visual identification of the functions (1 in Fig. 6-3).

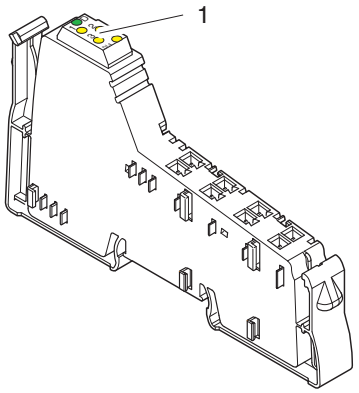


Fig. 6-3 Function identification

The following colors indicate the functions:

Color	Terminal function
Gray	Bus couplers, terminals with remote bus branch
24 V area	
Black	Supply/segmentation
Light blue, blue	Digital input
Pink, red	Digital output
Light green, green	Analog input, temperature measurement
Light yellow, yellow	Analog output
Orange	Open and closed-loop control, communication, position detection, programmable terminals
Relay terminals	
Dark red with lightning bolt	Digital output

Fig. 6-4 Color coding of terminal functions

Structure and dimensions

6.1.5 Housing dimensions

Today, small I/O stations are frequently installed in 80 mm standard control boxes. Inline terminals are designed so that they can be used in this type of control box.

The terminal housing dimensions are determined by the dimensions of the electronics base and the connectors.

The width of the terminal depends on the electronics base (housing) used.

When a connector is inserted, each terminal has a depth of 72 mm.

The height of the terminal depends on the connector used and is a maximum of 141 mm.

For the dimensions of the terminals, please refer to the terminal-specific data sheets.

6.1.5.1 Dimensions of the electronics base with possible connectors

BK IO housing
Example:
R-IL xx BK DI8 DO4 2TX-PAC

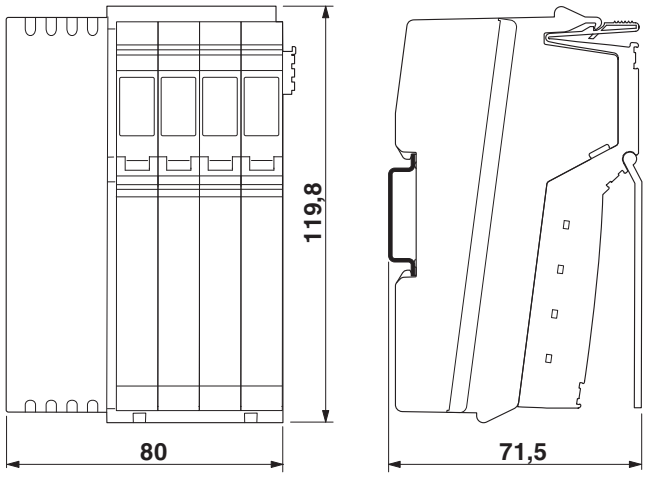


Fig. 6-5 Dimensions of BK IO housing (in mm)

Container housing
Example:
R-IL PB BK DP/V1-PAC

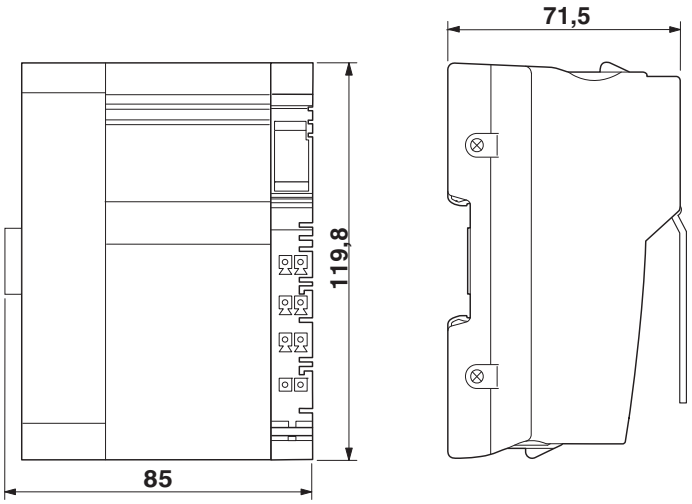


Fig. 6-6 Dimensions of the electronics base (container housing 1, in mm)

2-slot, 4-slot, 8-slot housings

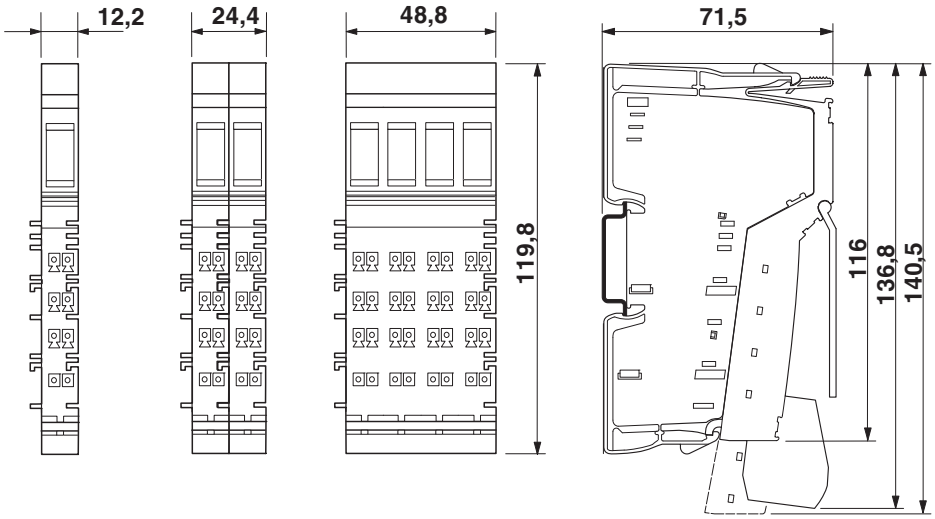


Fig. 6-7 *Dimensions of the electronics base with possible connectors (2-slot, 4-slot, 8-slot, in mm)*

Examples for 2-slot, 4-slot or 8-slot housing:

2-slot housing	**4-slot housing**	**8-slot housing**
R-IB IL 24 DO 2-2A-PAC	R-IB IL AO 1/SF-PAC	R-IB IL 24 DO 8-PAC
R-IB IL 24 DI 4-PAC	R-IB IL CNT-PAC	R-IB IL 24 DI 16-PAC

These bases take one, two, or four 12.2 mm wide connectors.

6.2 Structure and dimensions of Inline Block IO modules

6.2.1 Basic structure

Regardless of the function, an Inline Block IO module consist of the electronics module and the snap-on connectors (Inline connectors).

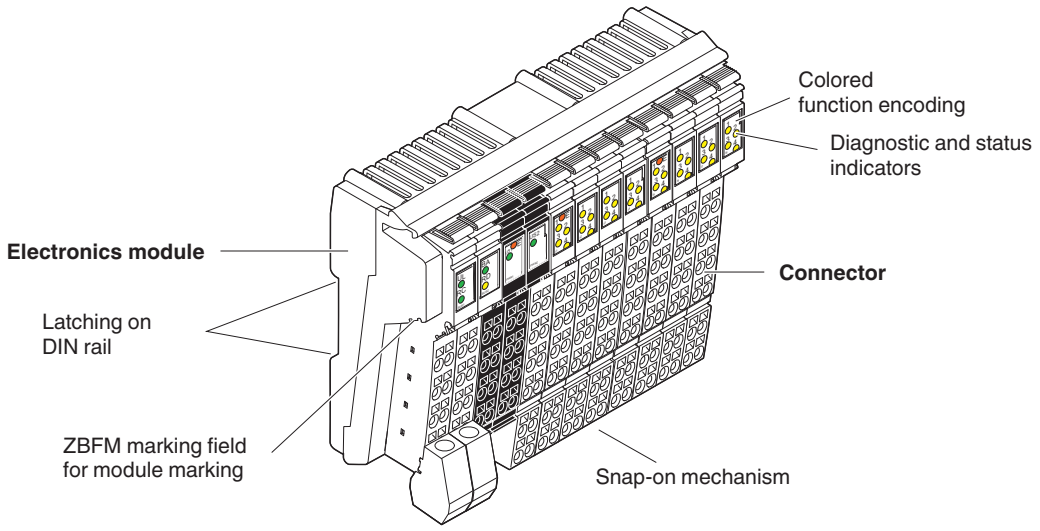


Fig. 6-8 Basic structure of an Inline Block IO module

ZBFM: Zac marker sheets, flat
(see also Chapter “Function identification and marking” on page 31)

The components required for marking are listed in “Ordering data” on page 102.

Electronics module

The electronics module holds the entire electronics for an Inline Block IO module.

Pressing the snap-on mechanism releases the latching, enabling the terminal to be removed by pulling it straight back from the DIN rail (see Chapter “Basic information about mounting” on page 66).

Connector

A connector that can be separated from the electronics module is used to connect the I/O and the supply voltages. For more detailed information regarding the Inline connectors, please refer to Chapter 7, “Inline connectors”.

6.2.2 Function identification and marking

Housing

Apart from their width, the Inline Block IO modules have the same appearance in terms of their housing type and housing color (light gray).

Function identification

The Inline Block IO modules are color-coded to enable visual identification of their functions (1 in Fig. 6-9).

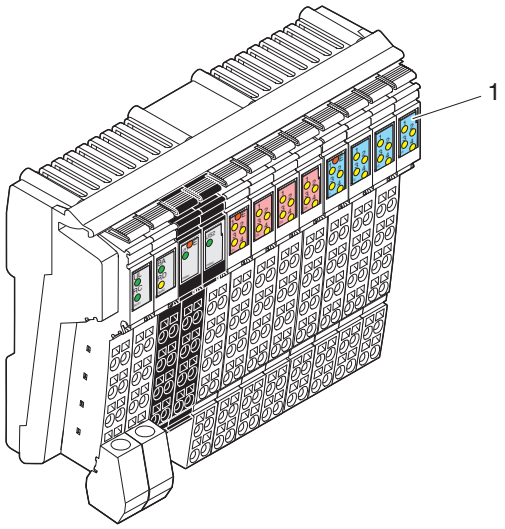


Fig. 6-9 Function identification

The following colors indicate the functions:

Color	Module function
Gray	Bus/supply
Light blue	Digital input
Pink	Digital output
Purple	Digital input or output
Green	Analog input
Yellow	Analog output

Fig. 6-10 Color coding of module functions

Structure and dimensions

6.2.3 Housing dimensions

Today, small I/O stations are frequently installed in 80 mm standard control boxes. Inline Block IO modules are designed so that they can be used in this type of control box. The terminal housing dimensions are determined by the dimensions of the electronics base and the connectors.

The width of the electronics modules depends on the function and is either 95 mm or 156 mm.

When a connector is inserted, each terminal has a depth of 55 mm.

The height of the terminal depends on the connector used and is a maximum of 141 mm.

For the dimensions of the modules, please refer to the corresponding module-specific data sheet.

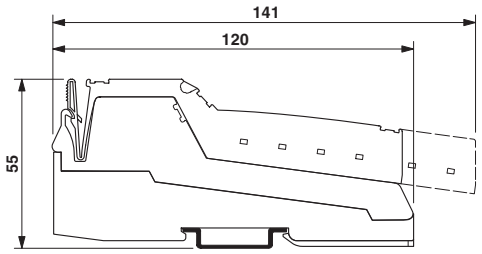


Fig. 6-11 Maximum dimensions (in mm)

7 Inline connectors

Inline connectors are inserted into Inline Modular IO terminals and Inline Block IO modules.

7.1 Basic structure and dimensions of the Inline connectors

Connector width The connectors have a width of two terminal points.

Connector colors To distinguish between the functions and voltage areas, the connectors have been assigned different colors:

Light gray	Connectors for low-level signal terminals (24 V DC, except for power/segment terminals)
Black	Connectors for power/segment terminals for low-level signals (24 V DC)
Dark gray	Connectors for relay terminals (not required for Inline Block IO modules)

Basic structure

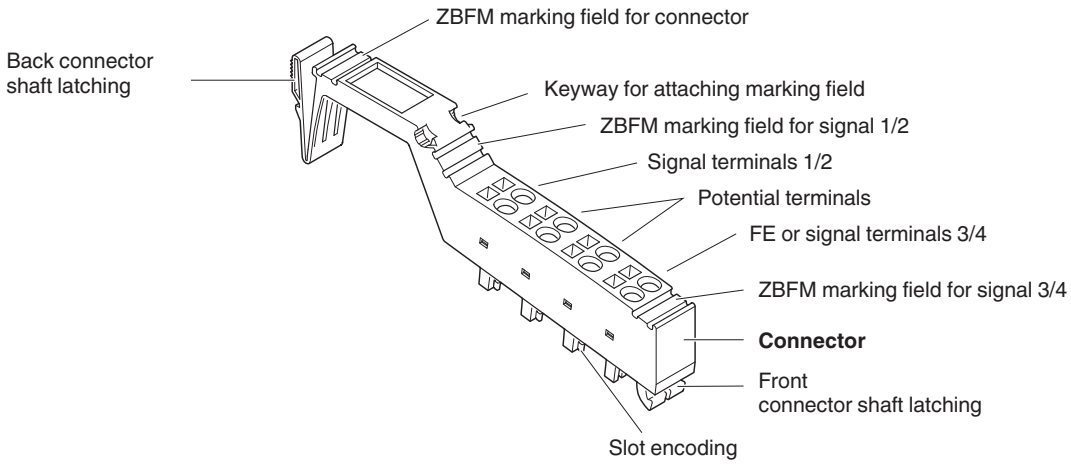


Fig. 7-1 Basic structure of an Inline connector

ZBFM: Zack marker sheets, flat
(see also Chapter “Function identification and marking” on page 31)

The components required for marking are listed in Chapter “Ordering data” on page 102.

Inline connectors

Dimensions

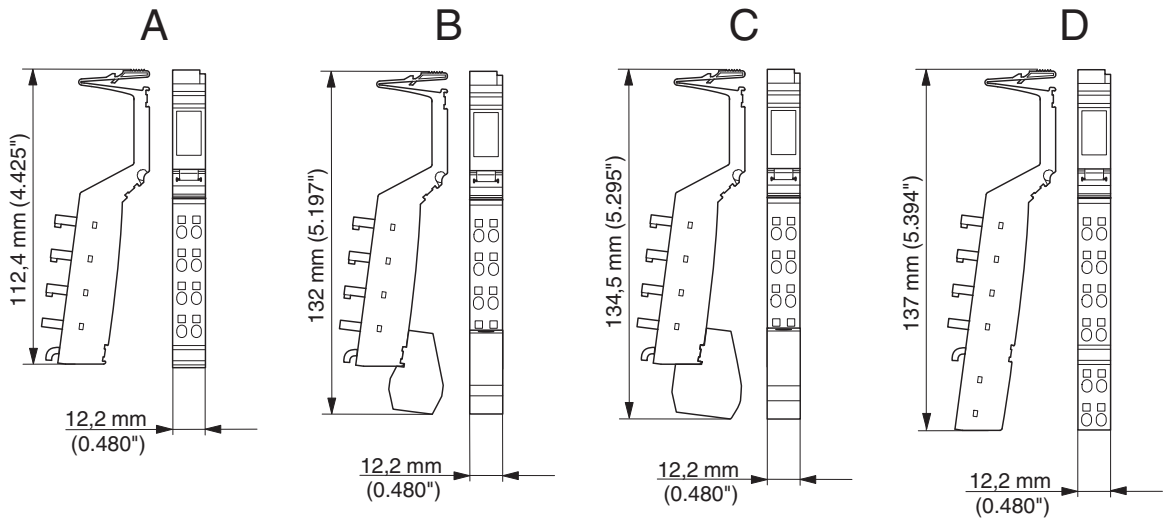


Fig. 7-2 Connector dimensions

Key:

A	Standard connector
B	Shield connector for connecting one cable
C	Shield connector for connecting two cables
D	Extended double signal connector

The depth of the connector is not relevant, since it does not influence the depth of the Inline Modular IO terminal or Inline Block IO module.

7.2 Connectors for the 24 V DC area

Connector versions

The following connector versions are available for the 24 V DC area:

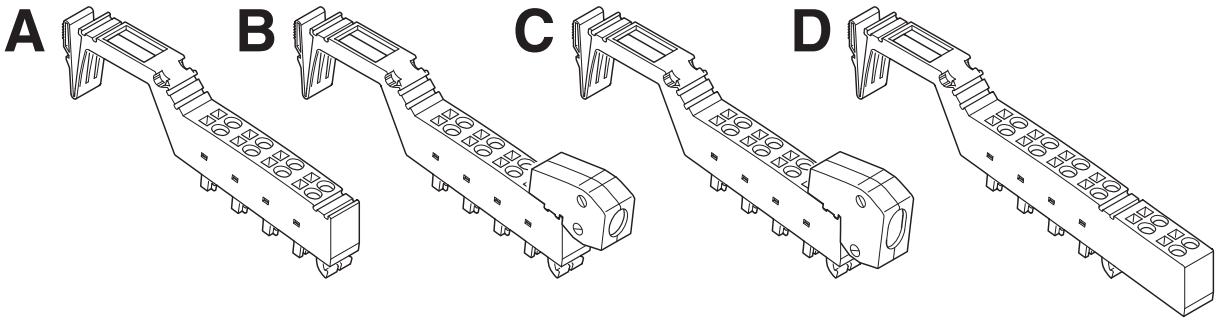


Fig. 7-3 Connector versions for Inline terminals

A Standard connector

The light gray standard connector is used for the connection of two signals in 4-wire technology or eight signals in 1-wire technology (e.g., digital input/output signals).

The black standard connector is used for feeding the supply voltage. Some of its adjacent contacts can be jumpered internally (see Fig. 7-5 on page 40).

B Shield connector for connecting one cable

C Shield connector for connecting two cables

The light gray connectors B and C are used for signals that are connected using shielded cables (e.g., analog input/output signals, high-frequency counter inputs, remote bus cable).

FE or shielding is connected via a shield connection clamp rather than via terminal points.

D Extended double signal connector

The light gray double signal connector is used for the connection of four signals in 3-wire technology (e.g., digital input/output signals).

The black double signal connector is used for feeding the supply voltage. Some of its adjacent contacts can be jumpered internally (see Fig. 7-5 on page 40).

Connector identification

All connectors are available with and without color print. The connectors with color print (indicated with CP in the order code) have terminal points that are color-coded according to their functions. The following colors indicate the signals of the terminal points:

Color	Signal at terminal point
Red	+
Blue	-
Green	Functional earth ground (FE)
Green/yellow	Functional earth ground FE; This printing may still be seen older connectors. Functional earth ground is marked in green on current connectors.

Fig. 7-4 Color coding of terminal points (24 V DC)

Inline connectors

Internal jumpering

Depending on their function, the connectors may have internal jumpers.

NOTICE **Disregarding this notice may result in malfunction**

To avoid malfunction, only snap an appropriate connector onto the terminal. The type of connector to be used is specified in every terminal-specific data sheet.

Only place **black** connectors on power or segment terminals.
With regard to potential routing, jumpered terminal points enable the potential to be routed through the jumpering in the connector and not through the printed-circuit board of the terminal. The full current carrying capacity is also ensured through this jumpering.

A **black** connector must **not** be placed on a terminal which is intended to be used in conjunction with a double signal connector. Inserting a black connector may result in a short circuit between two terminal points.

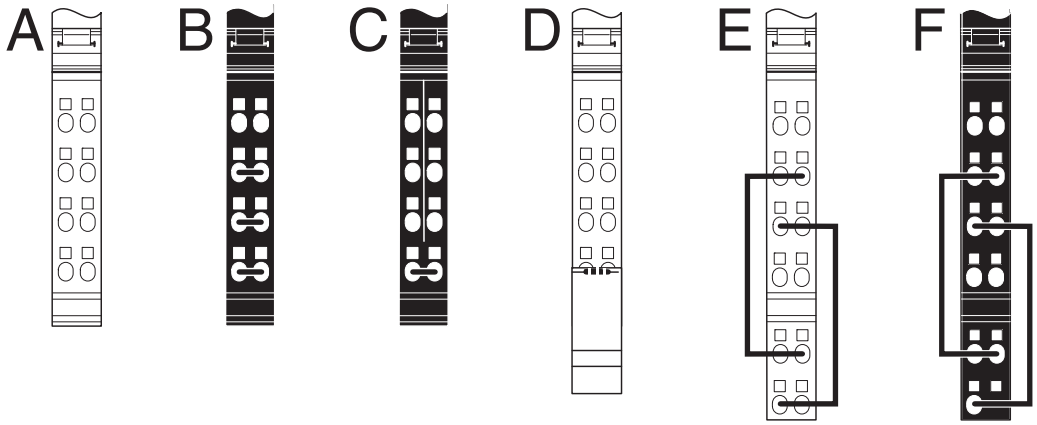


Fig. 7-5 Internal jumpering in connectors for the 24 V DC area

A	Light gray connector for connecting the I/O
B	Black connector for feeding the supply voltages **with** jumpering of the terminal points for voltage supply
C	Black connector for feeding the supply voltages **without** jumpering of the terminal points for voltage supply
D	Light gray shield connector for connecting shielded cables; the terminal points are jumpered via the shield connection
E	Light gray double signal connector for connecting the I/O
F	Black connector for feeding the supply voltages **with** jumpering of the terminal points for voltage supply

As shown in Fig. 7-5 as a dashed line, the shield connector is jumpered between terminal points 1.4 and 2.4 through the shield connection. For all other connectors, jumpering as illustrated above is carried out by **internally** connecting the terminal points **in the connector**.

7.3 Connectors for relay terminals (Inline Modular IO)

Connector versions

Dark gray standard connectors (see A in Fig. 7-5) are available for relay terminals.

Special features

The connectors for distance terminals used to isolate different voltage areas are coded with two colors.
The green marked side must point in the direction of the 24 V area and the gray marked side in the direction of the AC area.

Internal jumpering and special features of the terminal points

Depending on their function, the connectors may have internal jumpers. In addition, some terminal points are not used or even closed.

NOTICE **Disregarding this notice may result in malfunction**

To avoid malfunction, only snap an appropriate connector onto the terminal. The type of connector to be used is specified in every terminal-specific data sheet.

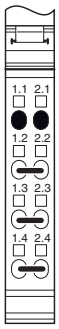


Fig. 7-6 Internal jumpering and special features of the connectors used for relay terminals (dark gray connectors)

● Terminal point closed

Inline connectors

7.4 Numbering and marking of terminal points

Marking/terminal point numbering

The numbering of terminal points is explained using the example of an 8-slot Inline Modular IO terminal.

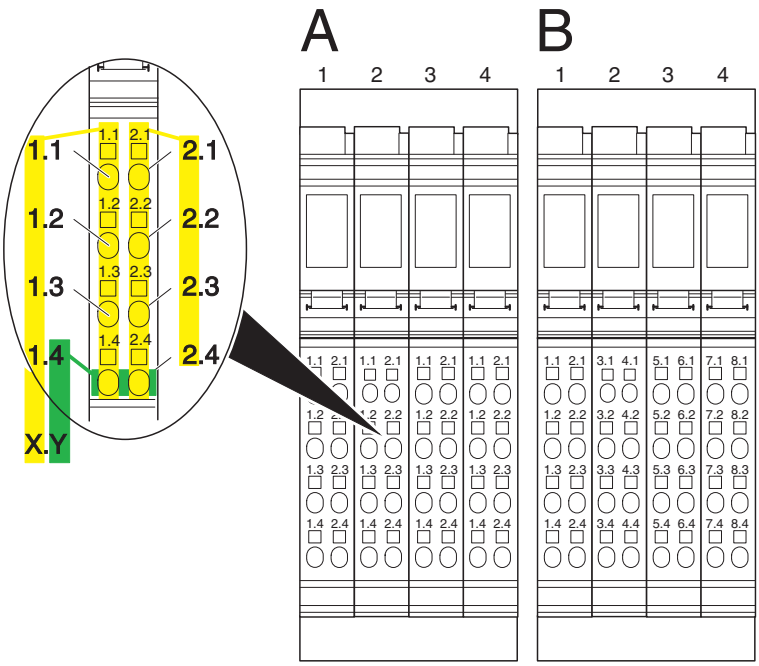


Fig. 7-7 Terminal point numbering

Slot/connector

The slots (connectors) on a base are numbered consecutively. The numbering is **not** indicated on the terminal, but shown above the terminals in Fig. 7-7.

Terminal point

Different connectors are available with different types of printing. In general, the numbering format X.Y is printed above the terminal point.

1 Terminal point numbering **by connector** (A in Fig. 7-7):
On these connectors:
X: number of the terminal point column on the connector
Y: number of the terminal point within the terminal point column

2 Terminal point numbering **by channel** (B in Fig. 7-7):
For terminals with 8, 16, or 32 inputs or outputs, connector sets are available in which the terminal point rows are numbered by terminal (1 ... 8) rather than by connector (1 and 2).
X: number of the terminal point column on the Inline terminal
Y: number of the terminal point within the terminal point column

Select the required connectors from the Bosch Rexroth catalog.

Additional marking

In addition to this connector printing, you can identify the slots, terminal points, and connections using zack marker strips and marking fields.

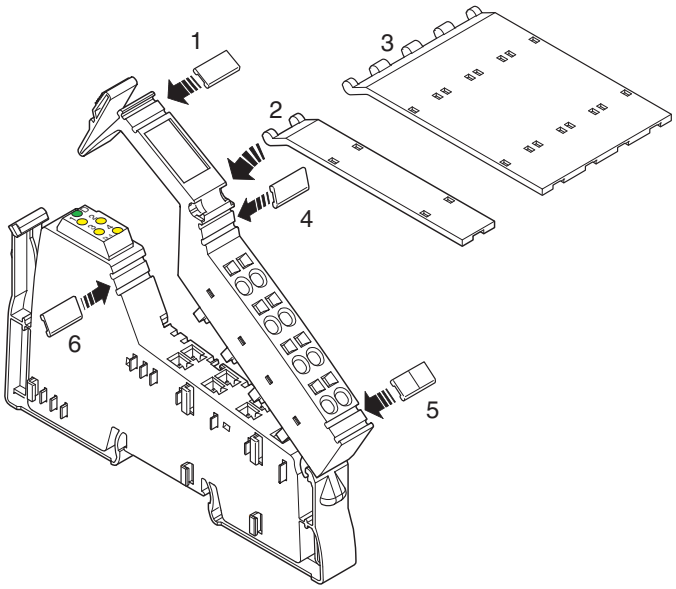


Fig. 7-8 Marking

Various options are available for marking the slots and terminal points:

1 Each connector can be marked individually using zack marker strips.

2 / 3 Another option is to use a marking field. Marking fields are available in two widths, either as a marking field covering one connector (2; R-IB IL FIELD 2) or as a marking field covering four connectors (3; R-IB IL FIELD 8). Using these fields, you can mark each channel individually with free text. On the upper part of the connector there is a keyway for attaching this marking field. The marking field can be tilted up and down. In each end position, a light latching ensures that the marking field remains in place.

4 / 5 Each signal can be marked individually using zack marker strips. On a double signal connector, the upper keyway (4) is intended for marking signals 1 and 2 and the lower keyway (5) for signals 3 and 4.

6 On the electronics base, each slot can be marked individually using zack marker strips. These marker strips are covered when a connector is inserted.

The markings applied to the connector and the electronics base enable you to clearly assign both the connector and the slot.

Insert strips for use with a laser printer are available for insertion in the R-IB IL FIELD 2 and R-IB IL FIELD 8 marking fields (see Chapter “Ordering data for accessories” on page 102).

Inline connectors

7.5 Terminal point keying

In order to avoid connectors being mixed up, the connection points between connectors and terminals can be keyed using the keying profile.

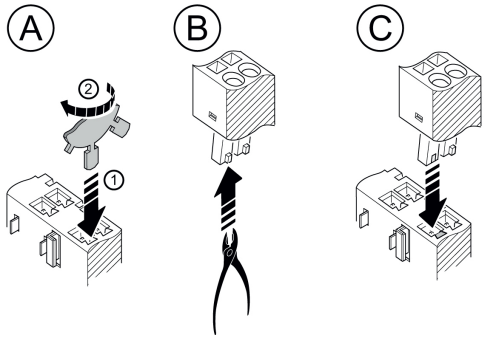


Fig. 7-9 Connector and terminal keying

A Insert a keying section of the keying profile in the corresponding keyway of the terminal point on the electronics housing.

Twist the keying profile to break off the keying section.

B Remove the keying tab from the corresponding slot keying on the connector.

C Insert the keyed connector in the corresponding slot.

8 Electrical potential and data routing (Inline Modular IO)

The Inline Builder software provides support when configuring an Inline station (see Chapter “Inline Builder - intelligent software tool for accelerated drive configuration” on page 113).

8.1 Circuits and provision of supply voltages

There are several circuits within an Inline station. These are automatically created when the terminals are mounted side by side. The voltages of the different circuits are supplied to the connected terminals via potential jumpers.

An example of the circuits within an Inline station is given in Chapter “Example of a circuit diagram” on page 49. The descriptions in the following chapters refer to this example.

Please refer to the terminal-specific data sheet for the circuit to which the I/O circuit of a specific terminal is to be connected.

Carrying capacity of the jumper contacts

Observe the maximum current carrying capacity of the lateral jumper contacts for each circuit. The current carrying capacities for all potential jumpers are given in the following sections and are summarized in Chapter “Current and voltage distribution” on page 54.

For the arrangement of the potential jumpers and information regarding the current and voltage distribution on the potential jumpers, please refer to Chapter “Electrical potential and data routing” on page 51.

The connection of the supply voltages is described in Chapter “Connecting the power supplies” on page 86.

For voltage connection, please observe the notes in the terminal-specific data sheets.

8.1.1 Bus coupler supply

For information regarding which supply voltage needs to be connected to the bus coupler, please refer to the documentation for your bus coupler.

The voltages for the logic circuit U_L and the supply of the terminals for analog signals U_{ANA} are always internally generated from the bus coupler supply.

Electrical potential and data routing (Inline Modular IO)

8.1.2 Logic circuit

The logic circuit with the communications power (logic voltage) U_L starts at the bus coupler or at a power terminal (R-IB IL 24 PWR IN/R-PAC) and is led through all the terminals of an Inline station.

Function The logic (e.g., protocol chips, microcontrollers) of the devices in a station is supplied with voltage from the logic circuit.

Voltage The voltage in the circuit is 7.5 V DC ± 5%.

Provision of U_L The communications power U_L is provided by the bus coupler or a corresponding power terminal from the connected supply voltage.

Current carrying capacity The **maximum** current carrying capacity is **2 A**. If this limit value is reached, the voltage must be boosted via a corresponding power terminal or a new station must be created using a bus coupler.

The current consumption from the logic circuit of each device is specified in every terminal-specific data sheet.

The communication power is not electrically isolated from the 24 V DC input voltage for the bus coupler.

This maximum current carrying capacity can be limited by certain bus couplers or corresponding power terminals. Please refer to the information in the terminal-specific data sheets.

8.1.3 Analog circuit

The analog circuit with the supply for the analog terminals (also referred to as analog voltage) U_{ANA} starts at the bus coupler or at a power terminal (R-IB IL 24 PWR IN/R-PAC) and is led through all terminals of an Inline station.

Function The I/O for analog signal terminals is supplied from the analog circuit.

Voltage The voltage in this circuit is 24 V DC (+20%, -15%).

Provision of U_{ANA} The analog voltage U_{ANA} is provided by the bus coupler or a corresponding power terminal from the connected supply voltage.

Current carrying capacity The **maximum** current carrying capacity is **0.5 A**. If this limit value is reached, the voltage must be boosted via a corresponding power terminal or a new station must be created using a bus coupler.

The current consumption from the analog circuit of each device that is supplied from U_{ANA} is specified in the corresponding data sheet.

8.1.4 Main circuit

The main circuit with the main voltage U_M starts at the bus coupler or a power terminal and is led through subsequent terminals until it reaches the next power terminal.

Please note the special features of Inline terminals with relay outputs. These terminals interrupt the potential jumpers U_M and U_S.

A new circuit starts at the next power terminal. This circuit is electrically isolated from the previous one, if electrically isolated power supply units are used.

Several power terminals can be used within one station.

Function

The segment voltage U_S can be tapped from the main voltage U_M using different segment terminals. Several independent segments can therefore be created within the main circuit. The main circuit provides the supply voltage for these segments.

Some terminals access the main circuit directly. For example, the encoder supply for positioning terminals is tapped from the main circuit, while the I/O is supplied from the segment circuit.

Voltage

The voltage in this circuit must not exceed 30 V DC.

Current carrying capacity

The **maximum** current carrying capacity for the main circuit is **8 A** (total current with the segment circuit).

The maximum current carrying capacity can be limited by certain terminals. Please refer to the information in the terminal-specific data sheets.

If the limit value of the potential jumpers U_M and U_S is reached (total current of U_S and U_M), a new power terminal must be inserted.

Provision of U_M

In the simplest case, the main voltage U_M can be supplied at the bus coupler.

The main voltage U_M can also be supplied via a power terminal. A power terminal **must** be used if:

1. A bus coupler is used to which the main voltage cannot be supplied.
2. The station is to be extended downstream of a relay terminal.
3. Electrical isolation between different I/O areas is to be created.
4. The maximum current carrying capacity of the potential jumpers U_M, U_S, and GND (total current of U_S and U_M) is reached.

Electrical potential and data routing (Inline Modular IO)

8.1.5 Segment circuit

The segment circuit with segment voltage U_S starts at the bus coupler or a power or segment terminal and is led through the subsequent terminals until it reaches the next power or segment terminal.

Please observe the special features of Inline terminals with relay output. These terminals interrupt the potential jumpers U_M and U_S.

You can use several segment terminals within a main circuit and therefore segment the main circuit.

Function

Apart from the analog terminals, almost all terminals in the Inline station are supplied from the segment circuit (e.g., digital input terminals, digital output terminals).

Some terminals access both the segment circuit and the main circuit. For example, the encoder supply for positioning terminals is tapped from the main circuit, while the I/O is supplied from the segment circuit.

The segment circuit can be switched off or fuse-protected using safety or segment terminals. It has the same reference ground as the main circuit. This means that different fuse-protected circuits can be created without external cross-wiring.

Voltage

The voltage in this circuit must not exceed 30 V DC.

Current carrying capacity

The **maximum** current carrying capacity for the segment circuit is **8 A** (total current with the main circuit).

The maximum current carrying capacity can be limited by certain terminals. Please refer to the information in the terminal-specific data sheets.

If the limit value of the potential jumpers U_M and U_S is reached (total current of U_S and U_M), a new power terminal must be inserted.

Provision of U_S

There are various ways of providing the segment voltage U_S:

1. The segment voltage can be supplied at the bus coupler or a power terminal.
2. The segment voltage can be tapped from the main voltage at the bus coupler or a power terminal using a jumper or a switch.
3. A segment terminal with fuse can be used for the segment circuit. In this terminal, the segment voltage is automatically tapped from the main voltage.
4. A segment terminal without fuse can be used and the segment voltage tapped from the main voltage using a jumper or switch.

8.1.6 Example of a circuit diagram

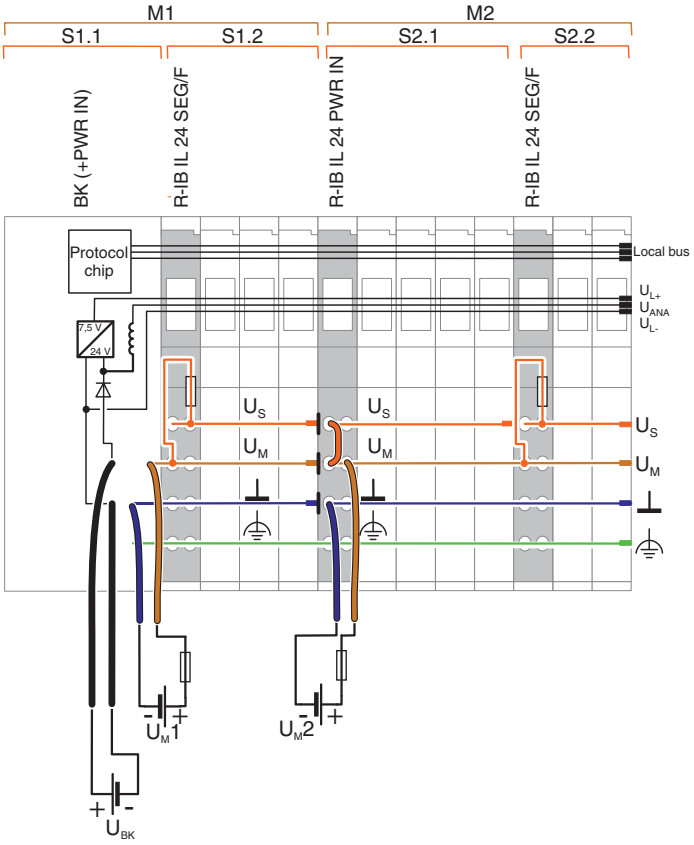


Fig. 8-1 Potential routing within an Inline station

The illustrated Inline station is a typical example. It shows the supply and provision of different voltages and their forwarding via potential jumpers. Further explanations can be found in the following chapters.

Mx	Main circuit (e.g., M1, M2)
Sx,y	Segment circuit y in main circuit x (e.g., S2.1, S2.2)
BK (PWR IN)	Bus coupler in conjunction with a power terminal, if required
U_{BK}	Bus coupler supply (supply for bus coupler, generates U_{ANA} and U_L)
U_M	Main supply (I/O supply in the main circuit)
U_S	Segment supply (I/O supply in the segment circuit)
U_{ANA}	I/O supply for analog terminals
U_L	Communications power
Local bus	Data jumpers for the local bus
⊥	Ground (GND for supply voltages U_M and U_S)
⏚	Noiseless ground (functional earth ground, FE)
I	Indicates the interruption of a potential jumper

Electrical potential and data routing (Inline Modular IO)

Main circuit M1/segment S1.1

The supply voltage for the bus coupler U_{BK} is supplied at the bus coupler (BK). In addition, the main supply U_{M1} is supplied at the bus coupler or a subsequent power terminal.

The communications power U_L and the supply voltage for the analog terminals U_{ANA} are generated from the bus coupler supply and are led through the entire station.

Electrical isolation between logic and I/O is provided through the separate supply of the bus coupler supply U_{BK} and the main supply U_{M1}.

If these voltages are not supplied separately (e.g., only the voltage U_{M1}, from which U_L and U_{ANA} are also generated), there is no electrical isolation between logic and I/O.

No terminals are used in segment S1.1.

Segment S1.2

In a segment terminal with fuse, the segment voltage U_S for segment S1.2 is automatically tapped from the main voltage U_{M1}. This segment circuit is protected by an internal fuse.

This segment terminal has been specifically used to create a fuse-protected segment circuit without the need for an additional external fuse. If this is not desired, the terminal does not have to be used. In this case, the connection between U_M and U_S on the bus coupler must be established using a jumper (as shown on the R-IB IL 24 PWR/IN-PAC terminal) or a switch.

Main circuit M2/segment S2.1

The supply voltage for the following terminals should be supplied separately. To this end, a new power terminal (e.g., R-IB IL 24 PWR/IN-PAC) is used to which the supply voltage U_{M2} is supplied.

Using a jumper, the segment voltage U_S for segment S2.1 is tapped from the main voltage U_{M2}.

Segment S2.2

The segment voltage U_S is provided at the R-IB IL 24 SEG-PAC segment terminal via a switch. Output terminals installed here can therefore be switched externally.

Examples of errors and their effects:

1. In this example structure, a short circuit in segment S1.2 would not affect the terminals in other segments. The fuse in the R-IB IL 24 SEG/F-PAC segment terminal means that only segment S1.2 is switched off.
2. If an error occurs in the system, the terminals in segment S2.2, for example, can be switched on or off without affecting the terminals in other segments.

8.2 Electrical potential and data routing

8.2.1 Arrangement of potential and data jumpers

An important feature of Inline is its station-internal potential routing system. The electric connection between the individual station devices is created automatically when the station is set up. When the individual station devices are connected next to one another, a power rail is created for the relevant circuit. This is created mechanically when contact is made between the knife and fork-type contacts of adjacent terminals.

This potential routing eliminates the need for additional external potential routing or cross-wiring.

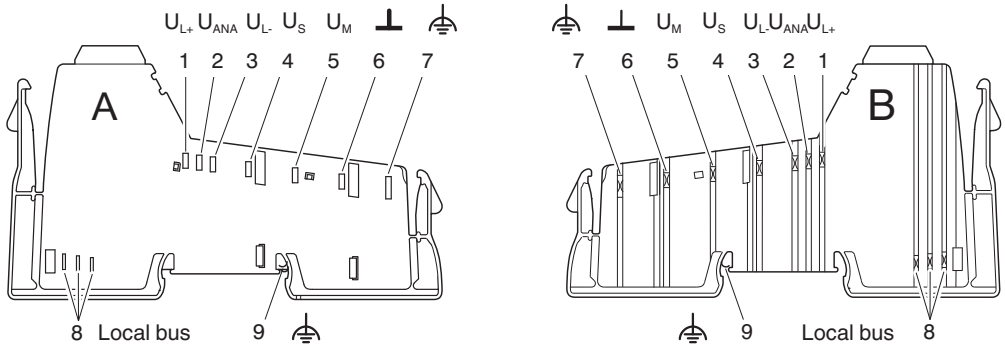


Fig. 8-2 Basic arrangement of potential and data jumpers

No.	Function		Meaning
			See Fig. 8-2 “Basic arrangement of potential and data jumpers” on page 51
Potential jumpers			
1	7.5 V DC	U_{L+}	Communications power for the bus interface
2	24 V DC	U_{ANA}	I/O supply for analog terminals
3	GNDL	U_{L-}	Ground of communications power and I/O supply for analog terminals
4	24 V DC	U_S	Segment circuit supply (protected against overload, if necessary)
5	24 V DC	U_M	Main circuit supply (protected against overload, if necessary)
6	GND	GND	Ground of segment and main supply
7	FE	FE	Functional earth ground
(9)	FE spring		FE contact to the DIN rail (for bus couplers, segment terminals, and power terminals for the PELV area)
Data jumpers			
8			Local bus

Fig. 8-3 Potential and data jumpers (24 V DC area)

Terminal inputs and outputs are supplied with voltage via the segment circuit.
The voltage for the segment circuit can be tapped from the main circuit. In addition, some terminals tap the voltage directly from the main circuit.
For more information regarding the circuits that are created via the potential jumpers U_L, U_{ANA}, $U_{M,}$ and U_S, please refer to page 45.

Depending on the terminal function, not all of the jumpers shown in Fig. 8-2 are provided for each terminal. Please refer to the circuit diagram of the corresponding terminal to see which jumpers are available and how they are internally connected. The circuit diagram is shown in the terminal-specific data sheet.

GND This potential jumper is ground for the main and segment circuit.

NOTICE **Overload**

Please note that the GND potential jumper carries the total current of the main and segment circuits. The total current of the main and segment circuits must not exceed the maximum current carrying capacity of the potential jumpers (8 A). The maximum current carrying capacity is determined not only by the potential jumpers, but also by the power/segment terminal used.

Calculate the current in the station. Refer to the data provided in the terminal-specific data sheets for your special application.

The Inline Builder software provides support when calculating the currents (see Chapter “Inline Builder - intelligent software tool for accelerated drive configuration” on page 113).

FE The FE potential jumper is connected to the grounded DIN rail via the FE spring at each bus coupler, 24 V power terminal, and segment terminal and is led through all subsequent 24 V terminals.

In addition, connect the FE connection to a grounding terminal at the bus coupler.

Please also observe the information provided in Chapter “Grounding concept” on page 69.

FE spring This spring creates the FE contact between the bus coupler, a 24 V DC power terminal or a segment terminal, and the grounded DIN rail.

Data routing The bus signal is also transmitted within the station using a connection that is created automatically when the station devices are snapped on.

Current carrying capacity

The maximum total current flowing through the potential jumpers is limited. The maximum current carrying capacity is specified in Chapter “Circuits and provision of supply voltages” on page 45 for each circuit.

Please also observe the information regarding the current carrying capacity of power and segment terminals provided in the terminal-specific data sheets.

NOTICE **Malfunctions**

If the current carrying capacity of the potential jumpers U_L or U_{ANA} is reached, the voltage must be boosted via a corresponding power terminal, or a new station must be created using a bus coupler.

If the current carrying capacity of the potential jumpers U_M, U_S, and GND is reached (total current of U_S and U_M), a new power terminal must be used.

The Inline Builder software provides support when calculating the currents (see Chapter “Inline Builder - intelligent software tool for accelerated drive configuration” on page 113).

Electrical potential and data routing (Inline Modular IO)

8.2.2 Current and voltage distribution

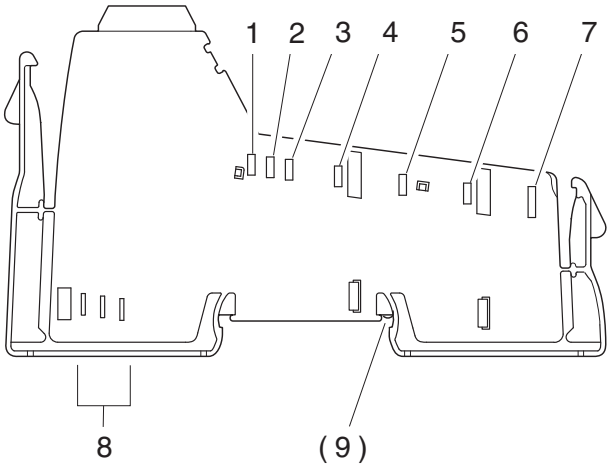


Fig. 8-4 Current and voltage distribution

No.	Function		Voltage to contact[1]		Current
			Minimum	Maximum	Maximum
Potential jumpers					
1	7.5 V DC	U_{L+}	7.0 V DC	7.87 V D	2 A
2	24 V DC	U_{ANA}	19.2 V DC	30 V DC	0.5 A
3	GNDL	U_{L-}	0 V DC	0 V DC	2.5 A
4	24 V DC	U_S	19.2 V DC	30 V DC	8 A
5	24 V DC	U_M	19.2 V DC	30 V DC	
6	GND	GND	0 V	0 V	8 A
7	FE	FE	Not defined	Not defined	Not defined
(9)	FE spring				
Data jumpers					
8 a	Bus signal				
8 b	Bus signal				
8 c	Clock				

Fig. 8-5 Current and voltage distribution in potential and data jumpers (24 V DC)

[1] Contact No. 3 is reference potential for the logic.
Contact No. 6 is reference potential for the I/O.
If there is no electrical isolation between logic and I/O, both have the same potential.

9 Diagnostic and status indicators

All Inline Block IO modules and Inline Modular IO terminals (hereinafter referred to as “devices”) are equipped with diagnostic and status LEDs for quick local error diagnostics. They enable the clear localization of system errors (bus errors) or I/O errors.

Diagnostics The diagnostic indicators (red, yellow or green) provide information on the state of the device and, in the event of an error, on the type and location of the error. A device is functioning correctly if all of the green LEDs are on.

Status The status indicators (yellow) display the status of the relevant input/output and the connected I/O device.

Extended diagnostics Some devices have extended diagnostics. A short circuit or overload of the sensor supply is indicated for each input. If a short circuit occurs at an output, each channel is diagnosed individually. Information regarding the supply voltage is also reported. Information regarding I/O errors is sent to the controller with precise details of the error type and is displayed using status indicators.

Refer to the device-specific data sheet for information regarding the diagnostic and status indicators available on a specific device.

9.1 Indicators on Inline Modular IO terminals

9.1.1 Indicators on bus couplers and terminals with remote bus branch

For the meaning of diagnostic and status indicators of bus couplers and terminals with remote bus branch, please refer to the corresponding documentation.

Diagnostic and status indicators

9.1.2 Indicators available on different terminals in the Inline system

Some indicators are available on various terminals (see the following chapters) and generally have the same meaning:

UM	Green LED	Main circuit supply
	ON:	Main circuit supply present
	OFF:	Main circuit supply not present

US	Green LED	Segment circuit supply
	ON:	Segment circuit supply present
	OFF:	Segment circuit supply not present

D	Green LED	Diagnostics
	ON:	Data transmission active within the station
	Flashing:	
	0.5 Hz: (slow)	Communications power present, data transmission not active within the station
	2 Hz: (medium)	Communications power present, I/O error present (e.g., fuse has blown, voltage not present)
	4 Hz: (fast)	Communications power present, error at the interface between previous and flashing terminal (the flashing terminal and all terminals located downstream of it cannot be addressed) (e.g., loose contact at the bus interface, terminal located upstream of the flashing module has failed, another terminal was snapped on during operation (not permitted))
	OFF:	Communications power not present

9.1.3 Indicators on power and segment terminals

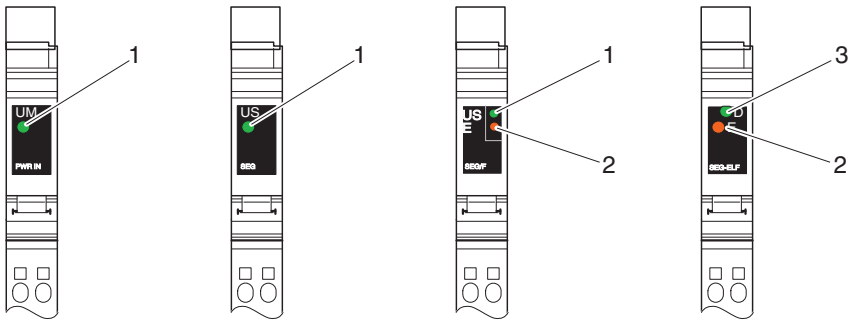


Fig. 9-1 Possible indicators on power and segment terminals

Diagnostics The following states can be read on power and segment terminals:

Power terminal		
UM (1)	Green LED	Supply voltage in the main circuit (for meaning see page 56)
Segment terminal		
US (1)	Green LED	Supply voltage in the segment circuit (for meaning see page 56)
Power terminal with fuse and diagnostics/ segment terminal with electronic fuse		
D (3)	Green LED	Diagnostics (for meaning see page 56)
Additionally, when using terminals with fuse		
E (2)	Red LED	Fuse status
	ON:	Fuse not present or blown
	OFF:	Fuse OK

On terminals with fuse, the green UM or US LED indicates that the main or segment voltage is present **on the line side** of the fuse, meaning that if the green LED is on, there is voltage **on the line side** of the fuse. If the red E LED is also on, the fuse has blown or is missing and no voltage is applied **after** the fuse.

If the red E LED is on and the green D LED is flashing at 2 Hz on terminals with fuse and diagnostics, there is no voltage present after the fuse.
Thus, a blown fuse is indicated by both diagnostic indicators (E and D).

Diagnostic and status indicators

9.1.4 Indicators on input/output terminals

In this chapter, input/output terminals are all terminals that acquire or output signals, i.e., all terminals except for bus couplers, power and segment terminals.

The LEDs of the input/output terminals are electrically located in the logic area.
This may mean that the LED of an output is on but the output cannot be controlled due to an error between the logic area and the digital output. The LED does not monitor the output state. In the event of an error, the actual output state may differ from the state indicated by the LED.

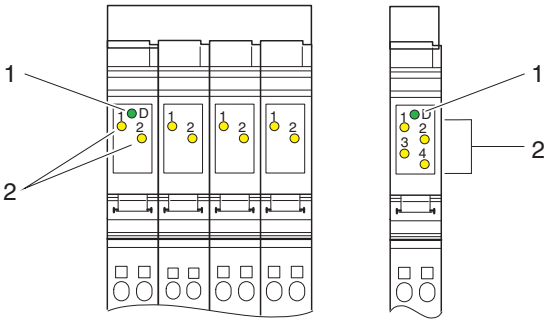


Fig. 9-2 Indicators on input/output terminals

Diagnostics The following states can be read on the input/output terminals:

D **(1)**	Green LED	Diagnostics (for meaning see page 56)

Status The status of the input or output can be read from the relevant yellow LED:

1, 2, 3, 4 (2)	Yellow LED	Status of the input/output
	ON:	Corresponding input/output set
	OFF:	Corresponding input/output not set
For terminals with extended diagnostics		
E1, E2, E3, E4	Yellow LED	The meaning depends on the terminal and is described in the terminal-specific data sheet. Examples: Short circuit/overload of the initiator supply Short circuit of an output Error message of diagnostic input
	ON:	An error has occurred
	OFF:	No error

Additional diagnostic and status indicators can be found on the terminals. They are described in the corresponding documentation.

Assignment between status LED and input/output

The figure shows the general principle of assigning a status LED to its input or output.

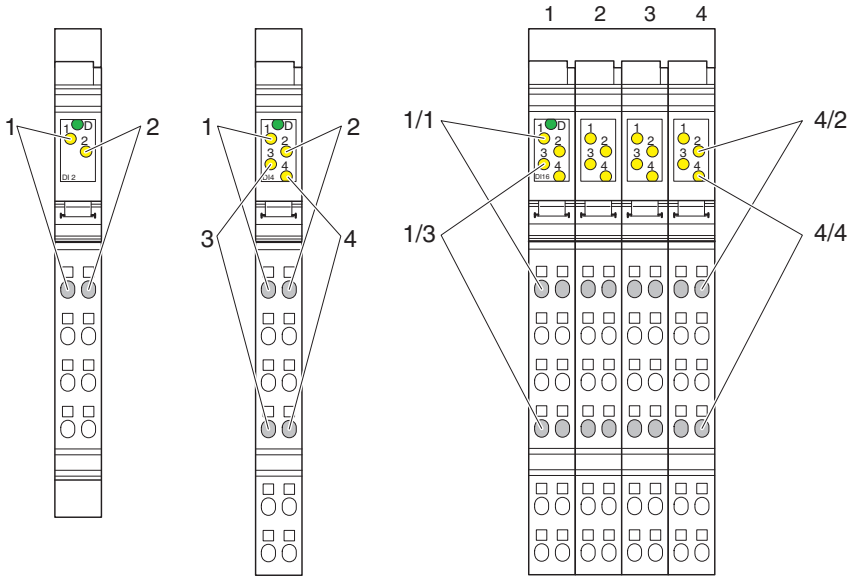


Fig. 9-3 Assignment between status LED and input/output

Please refer to Chapter “Function identification and marking” on page 31 for an explanation of the numbering.

With regard to 8-slot terminals, the LEDs of a slot belong to the terminal points of this slot. Every slot can be considered as a 2-slot terminal.

In the case of 2-slot terminals with four inputs or outputs (terminal in the middle of Fig. 9-3), the following LEDs are assigned to the following terminal points:

LED 1	Terminal point 1.1
LED 2	Terminal point 2.1
LED 3	Terminal point 1.4
LED 4	Terminal point 2.4

Looking at the 8-slot terminal in Fig. 9-3 and Fig. 9-4, the characters “4/2”, for example, refer to LED 2 on slot 4. The LED belongs to input 14 at terminal point 4.2.1 (slot 4, terminal point 2.1).

Diagnostic and status indicators

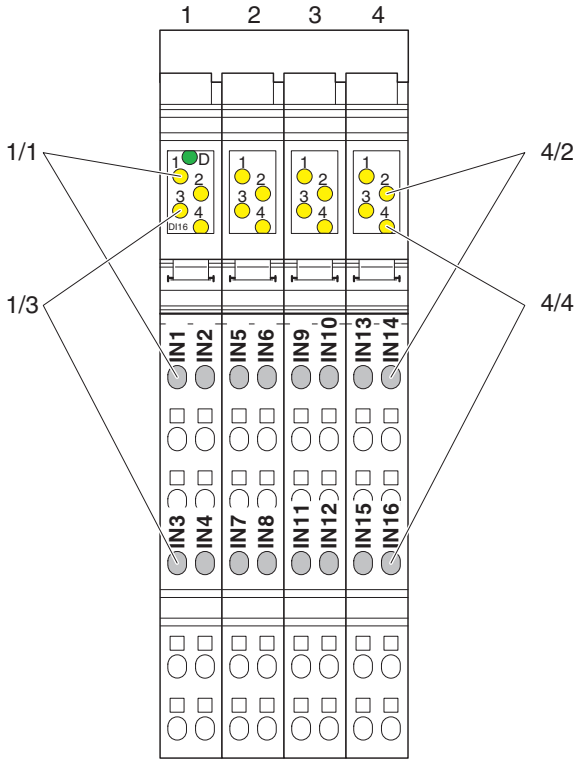


Fig. 9-4 *Assignment between status LED and input/output using the R-IB IL 24 DI 16-PAC terminal as an example*

The assignment is specified in the terminal-specific data sheet for each individual terminal.

9.1.5 Indicators on Inline Block IO modules

An Inline Block IO module can be divided according to its function areas: bus system, supply, and input/output. Local diagnostic and/or status indicators are assigned to each function area.

9.1.6 Indicators in the bus system function area (BUS)

For the meaning of the diagnostic and status indicators in the bus system function area (BUS in Fig. 9-5 on page 61) of the modules, please refer to the corresponding documentation.

9.1.7 Indicators in the supply function area (PWR)

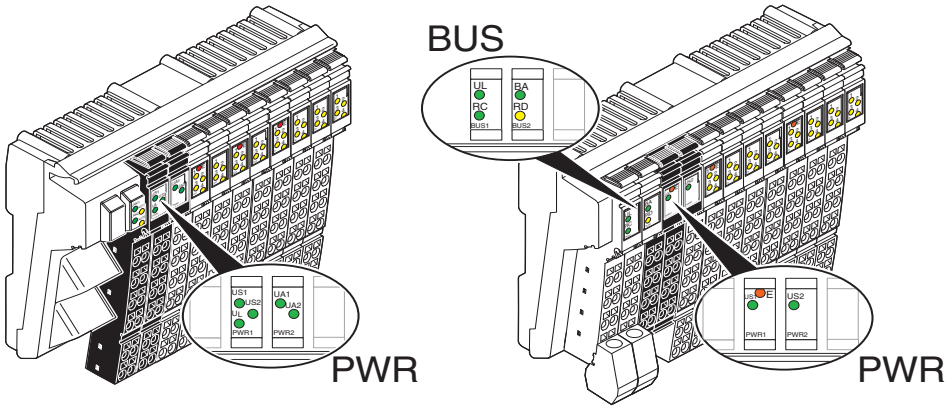


Fig. 9-5 Possible indicators in the supply function area

Diagnostics The following states can be read on the Inline Block IO modules:

E	Red LED	Sensor supply undervoltage
	ON:	Sensor voltage too low
US	Green LED	Sensor supply
	ON:	Sensor supply present
	OFF:	Sensor supply not present
US1/2	Green LED	Sensor supply 1/2 (for sensors, connector ... to connector ...)
	ON:	Sensor supply 1/2 present
	OFF:	Sensor supply 1/2 not present
UA	Green LED	Actuator supply
	ON:	Actuator supply present
	OFF:	Actuator supply not present
UA1/2	Green LED	Actuator supply 1/2 (for actuators, connector ... to connector ...)
	ON:	Actuator supply 1/2 present
	OFF:	Actuator supply 1/2 not present
UL	Green LED	24 V communications power
	ON:	24 V communications power present
	OFF:	24 V communications power not present

The UL LED may be located in the supply (PWR) or bus (BUS) function area.

Diagnostic and status indicators

9.1.8 Indicators in the input/output function area (IN, OUT, IN/OUT)

The LEDs of the input/output function area are electrically located in the logic area.
This may mean that the LED of an output is on but the output cannot be controlled due to an error between the logic area and the digital output. The LED does not monitor the output state. In the event of an error, the actual output state may differ from the state indicated by the LED.

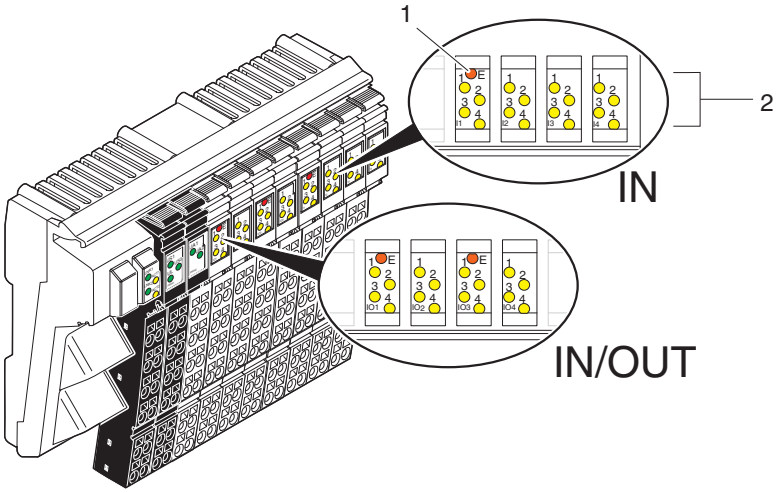


Fig. 9-6 Indicators on input/output terminals

Status The status of the input or output can be read from the relevant yellow LED:

1, 2, 3, 4 (2)	Yellow LED	Status of the input/output
	ON:	Corresponding input/output set
	OFF:	Corresponding input/output not set
For terminals with extended diagnostics		
E (1)	Red LED	The meaning depends on the module and is described in the module-specific data sheet. Examples: Short circuit/overload of a sensor supply Short circuit at at least one output in the group
	ON:	An error has occurred
	OFF:	No error

Assignment between status LED and input/output

The figure shows the general principle of assigning a status LED to its input or output.

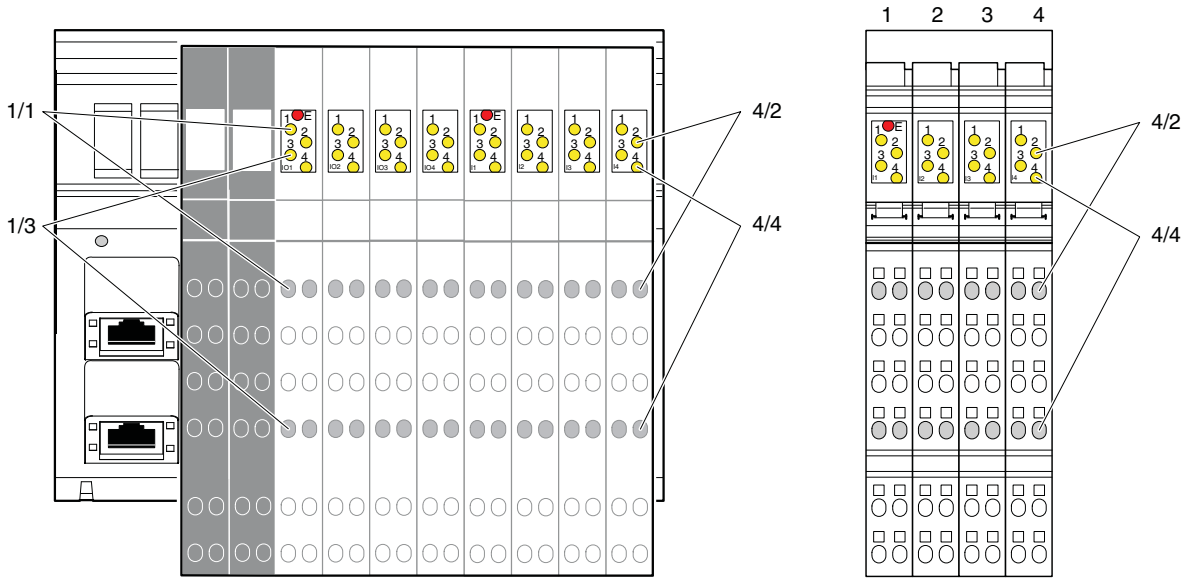


Fig. 9-7 Assignment between status LED and input/output

In the LED area, each slot is marked with the function (in Fig. 9-7, e.g., IO1, IO2, ...I3, I4).

The principle of assignment between the LED and terminal point is the same for all slots. For each slot with four inputs or outputs, the following LEDs are assigned to the following terminal points:

LED 1	Terminal point 1.1
LED 2	Terminal point 2.1
LED 3	Terminal point 1.4
LED 4	Terminal point 2.4

Looking at the module in Fig. 9-7, the characters “4/2”, for example, refer to LED 2 on slot I4. According to the data sheet, the LED belongs to input 30 at terminal point I4.2.1 (slot I4, terminal point 2.1).

The assignment is specified in the module-specific data sheet for each individual module.

Diagnostic and status indicators

10 Mounting and removing devices

10.1 Installation instructions

10.1.1 Unpacking

ESD regulations

NOTICE	**Electrostatic discharge**

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

Unpacking

All devices are supplied in an ESD bag.

Only qualified personnel may pack, unpack, mount, and remove a device while observing the ESD regulations.

10.1.2 Replacing a device

When replacing a device, please observe the following:

- In the PELV area:

NOTICE	**Disregarding this notice may result in malfunction**

Do not replace devices while power is connected!

Inline Modular IO:

Before removing a terminal from or inserting a terminal in the station, disconnect power to the entire station.

Make sure the entire station is reassembled before switching the power back on.

- In the low voltage area (**Inline Modular IO**):

⚠ **WARNING:**	**Dangerous contact voltage**

Do not replace devices while power is connected!

Before removing a terminal from or inserting a terminal in the station, disconnect power to the entire station.

Make sure the entire station is reassembled before switching the power back on.

10.2 Basic information about mounting

Mounting location

The modules and terminals of the Inline product group have IP20 degree of protection and can therefore be used in closed control cabinets or control boxes (terminal boxes) with IP54 degree of protection or higher.

DIN rail

All Inline Block IO modules and Inline Modular IO terminals are mounted on 35 mm standard DIN rails.

They are mounted perpendicular to the DIN rail. This ensures that they can be easily mounted and removed, even in confined spaces.

The distance between the DIN rail fasteners must not exceed 200 mm. This distance is necessary for the stability of the rail when mounting and removing devices.

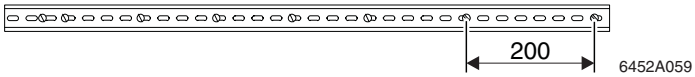


Fig. 10-1 Fixing the DIN rail (in mm)

Mounting position

In general, the mounting position of the Inline Block IO modules or Inline Modular IO terminals is not specified. However, please refer to the ambient temperatures and any other special requirements (such as derating) specified in the data sheets.

Analog terminals are a special case. The accuracy values specified in the data sheets for these devices refer to the documented mounting position (usually horizontal DIN rail; Fig. 10-2, A). The **typical tolerance values** for the relevant configurations are determined in this mounting position. Experience from previous testing indicates that the typical tolerances of analog terminals are slightly affected by the mounting position. In principle, you can select another mounting position.

To ensure sufficient mechanical fixing for the Inline station or the Inline Block IO module when mounted on a vertical DIN rail (Fig. 10-2, B), we recommend using the SUB-M01-ENDHALTER/AL end bracket (MNR R911171035). This prevents the station or module from slipping down, especially in the event of vibration.

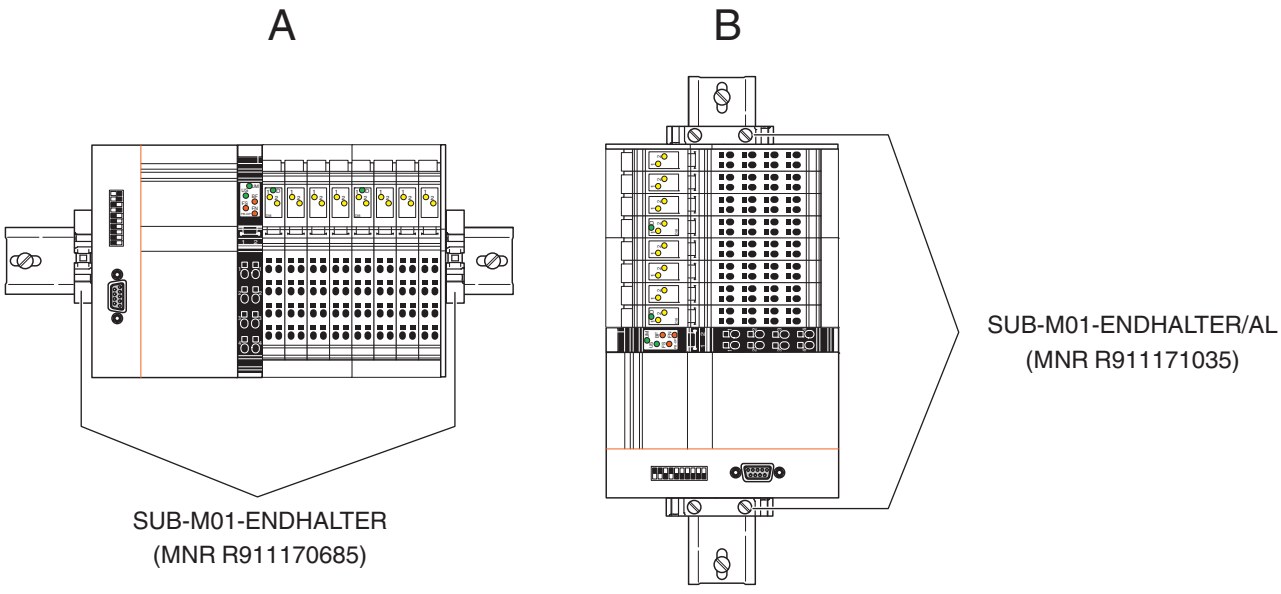


Fig. 10-2 Mounting positions for an Inline station

10.3 Mounting distances

The space required for cable routing depends on the number of cables to be installed and must be left free on the left and/or right-hand side.

In order to minimize the parallel installation of signal and power supply cables, the cable duct on the left can be used, for example, for the signal and bus cables and the cable duct on the right for the power supply cables. This ensures that the parallel installation of the cable types is kept to a minimum and limits interference on the signal cables.

For the distances of the upper and lower cable ducts or the cable routing to the devices, please refer to the following chapters.

10.3.1 Mounting distances for Inline Modular IO terminals

10.3.1.1 Mounting distances for terminals (except for bus couplers with fiber optic connections)

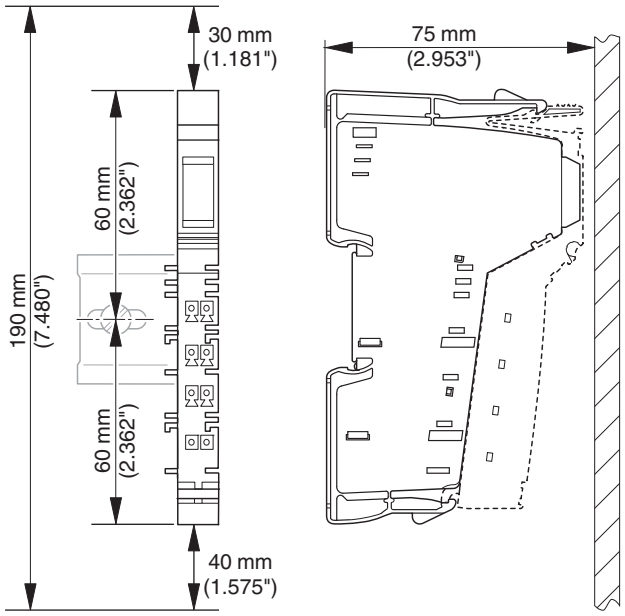


Fig. 10-3 Mounting distances for terminals

If the distances are smaller, the minimum bending radius of the cables, easy handling during installation, and a clear structure cannot be assured.

10.3.1.2 Mounting distances for bus couplers with fiber optic connections

When mounting terminals with fiber optic connections, the bending radii and therefore the required space depends on the fiber optics used. In addition, the selected connector influences the mounting distances.

The minimum bending radius for individual wires is 30 mm, and the minimum bending radius for a cable is either 50 mm or 65 mm depending on the cable used. Please observe the resulting mounting distances.

10.3.1.3 Mounting distances when mounting outside the terminal box

If the Inline stations are housed, e.g., in a control cabinet rather than in a terminal box, the DIN rail distances depend on the specified mounting distances and the special configuration of the individual Inline stations. The possible mounting distances are in shown in Fig. 10-4.

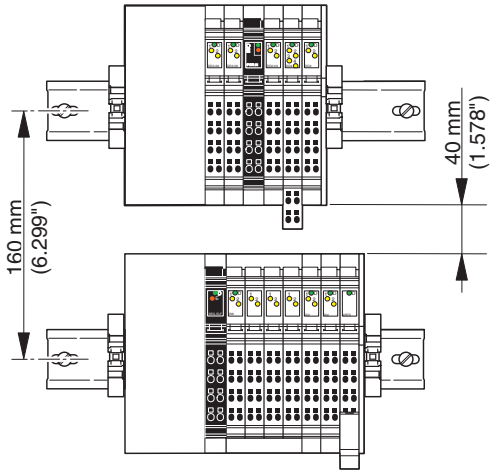


Fig. 10-4 Mounting distances when mounting outside the terminal box

10.3.2 Mounting distances for Inline Block IO modules

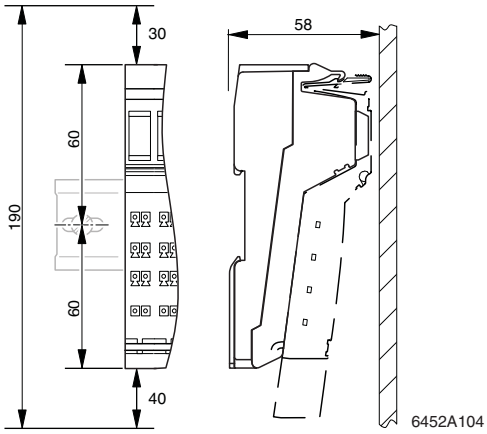


Fig. 10-5 Mounting distances

If the distances are smaller, the minimum bending radius of the cables, easy handling during installation, and a clear structure cannot be assured.

10.4 Grounding concept

Within an Inline station, a distinction is made between functional earth ground (FE) and protective earth ground (PE).

For Inline Block IO modules, only functional earth grounding is used.

Protective earth grounding (PE)

Protective earth grounding protects people and machines against hazardous voltages. To avoid these dangers, as far as possible, correct grounding, taking the local conditions into account, is vital.

Functional earth grounding (FE)

Functional earth grounding is used to improve noise immunity. All devices must be grounded so that any possible interference is shielded from data transmission paths and discharged to ground.

A conductor of 1.5 mm^2 must be used for grounding the spring-cage terminal blocks.

10.4.1 Functional earth ground (FE)

Functional earth ground is a low-impedance current path between circuits and ground. It is not designed as a safety measure but rather, for example, for the improvement of noise immunity.

Functional earth ground FE is only used to discharge interference. It does not provide shock protection for people.

Functional earth ground is used in the 24 V DC area (PELV).

To ensure reliable functional earth grounding, please observe the following points:

Inline Modular IO

For Inline Modular IO terminals, functional earth ground is led from the grounded bus coupler through the 24 V DC area of the station using the FE potential jumper.

1. The bus couplers, power terminals, and segment terminals have an FE spring (metal clip) on the bottom side of the electronics base. This spring establishes an electrical connection to the DIN rail. Use grounding terminals to connect the DIN rail to protective earth ground. The modules are then also grounded when snapped onto the DIN rail.
2. Bosch Rexroth recommends to additionally ground the Inline Modular IO coupler via the FE terminal of the corresponding connector to ensure reliable functional earth grounding even if the DIN rail is dirty or the metal clip is damaged (see terminal-specific data sheet).

The other Inline low-level signal terminals are automatically grounded via the potential jumper FE when they are connected next to one another.

Mounting and removing devices

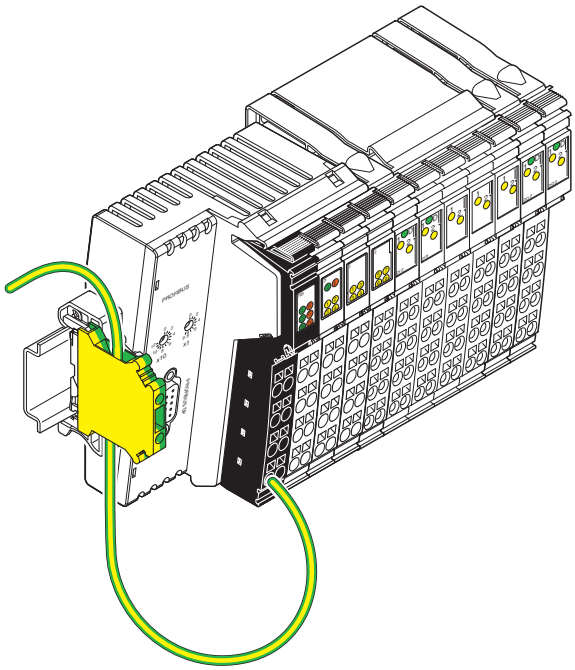


Fig. 10-6 Additional functional earth grounding of a bus coupler (example: R-IL PB BK DI8 DO4(/CN)-PAC)

Fig. 10-6 shows the additional grounding for a bus coupler using the R-IL PB BK DI8 DO4(/CN)-PAC bus coupler as an example. Connect the additional grounding to your device according to the terminal-specific documentation.

Inline Block IO

1. The modules have an FE spring (metal clip) on the bottom side of the electronics base. This spring establishes an electrical connection to the DIN rail. Use grounding terminals to connect the DIN rail to protective earth ground. The modules are then also grounded when snapped onto the DIN rail.
2. Bosch Rexroth recommends to additionally ground the Inline Block IO module via the FE terminal of the corresponding connector to ensure reliable functional earth grounding even if the DIN rail is dirty or the metal clip is damaged (see terminal-specific data sheet).

10.5 Shielding concept

Shielding is used to reduce the effects of interference on the system.

10.5.1 Inline shielding concept

In the Inline system, shielded cables are used with the following terminals:

- Remote bus cables
- Connecting cables
  - At terminals for analog signals (analog input, analog output, temperature measurement)
  - At terminals for open and closed-loop control
  - At communication terminals
  - At detection terminals

Observe the following points when shielding:

- Ensure a large surface connection of the shield underneath the clamp in the shield connection.
- Make sure there is good contact between the connector and base.
- Do not damage or squeeze the wires.
- When connecting the shielding, observe the specifications for connector wiring.

10.5.2 Shielding when connecting analog sensors and actuators

- Always connect analog sensors and actuators with shielded, twisted pair cables.
- Connect the shielding via the Inline connector with shield connection (see Chapter “Connecting shielded cables using an Inline shield connector” on page 82).

When connecting the cables, observe the information in the terminal-specific data sheets.

- As a rule, shielding must only be connected directly to the PE potential on one side. This is to prevent any occurrence of equipotential bonding currents via the shielding.
- If necessary, integrate the shielding concept for analog I/O cables in the system concept. For example, it is advisable to use a central FE shield connection at the control cabinet entry.

Mounting and removing devices

Example: integration of analog shielding in a concept with central equipotential bonding at the control cabinet entry

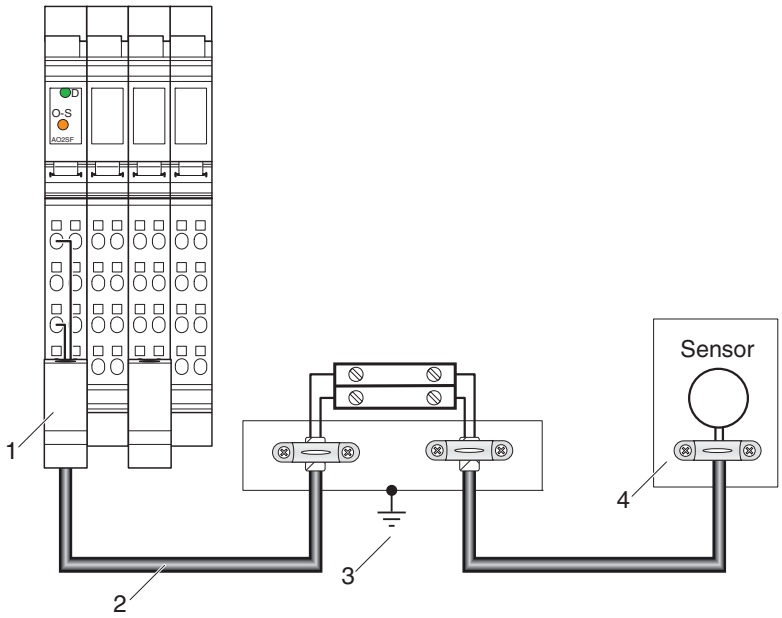


Fig. 10-7 Integration of analog shielding in a concept with central equipotential bonding at the control cabinet entry

1 Lead the analog cable into the Inline connector, making sure to maintain the cable insulation.

2 Use shielded twisted pair cables.

3 Connect the strain relief directly to PE potential.
Connect the shield for the entire analog transmission path to PE potential at only one point. In the example above, this point is the jumpering level.

4 Lead the sensor cable into the sensor, making sure to maintain the cable insulation.

NOTICE **Malfunctions possible**

When integrating the shielding of analog I/O cables in an equipotential bonding concept, make sure that the direct connection to the PE potential is only made at one point (e.g., at the central grounding point of the jumpering level).

10.6 Mounting/removal

10.6.1 Inline Modular IO: mounting/removal

Mounting side by side (Inline Modular IO)

An Inline station is set up by mounting the individual components side by side. No tools are required. Mounting the components side by side automatically creates potential and bus signal connections between the individual station components.

After a station has been set up, individual terminals can be exchanged by pulling them out or inserting them. Tools are not required.

End brackets (Inline Modular IO)

Mount end brackets on both sides of the Inline station. The end brackets ensure that the Inline station is correctly mounted. End brackets secure the Inline station on both sides and keep it from moving from side to side on the DIN rail. For the recommended end brackets, please refer to Chapter “Ordering data” on page 102.

When mounting on a horizontal DIN rail, the end brackets can be snapped onto the DIN rail at any point during station assembly.

When mounting on a vertical rail, attach the left end bracket at the beginning of the station assembly. This prevents the station from slipping on the DIN rail.

End plate (Inline Modular IO)

The mechanical end of an Inline station is the end plate. It has not electrical function, but protects the station against ESD pulses and the user against dangerous contact voltages. The end plate is supplied with the bus coupler and does not have to be ordered separately.

Sequence of the Inline terminals

Observe the correct sequence of the Inline terminals during mounting (see Chapter “Sequence of the Inline Modular IO terminals” on page 79).

Mounting and removing devices

10.6.1.1 Mounting/removing/replacing terminals

Mounting

When mounting a terminal, proceed as shown in Fig. 10-8 on page 75:

- Disconnect power to the station.
- First attach all the electronics bases required to set up the station perpendicular to the DIN rail (A).

Ensure that **all** featherkeys and keyways on adjacent terminals are securely interlocked (B).

The keyway/featherkey connection links adjacent terminals together and ensures that data and potential routing is created safely.

- First, insert the data jumpers for the bus interface in the guideways by snapping it onto the previous terminal (B1).

NOTICE **Malfunction if no contact is being made**

Press gently against the adjacent terminal on the left to make sure that the featherkey snaps into its keyway on the bus interface.

- Then insert the other potential jumpers into their guideways and snap the featherkeys into the corresponding keyways (B2).
- C1 shows a common error. Here, there is no proper contact of the bus interface. The featherkey is not in the keyway. The bus is not running or it is running with errors (“loose contact”).
- C2 shows secure contacting of the data jumpers and the interlocking keyway/featherkey connection.

- After snapping on all bases, insert the connectors into the corresponding bases.
  First, place the front connector shaft latching in the front snap-on mechanism (D1).
  Then press the top of the connector towards the base until it snaps into the back snap-on mechanism (D2).

The keyways of an electronics base do not continue in the connector. When snapping on an electronics base, there must be no connector on the left-hand side of the base. If a connector is present, it needs to be removed.

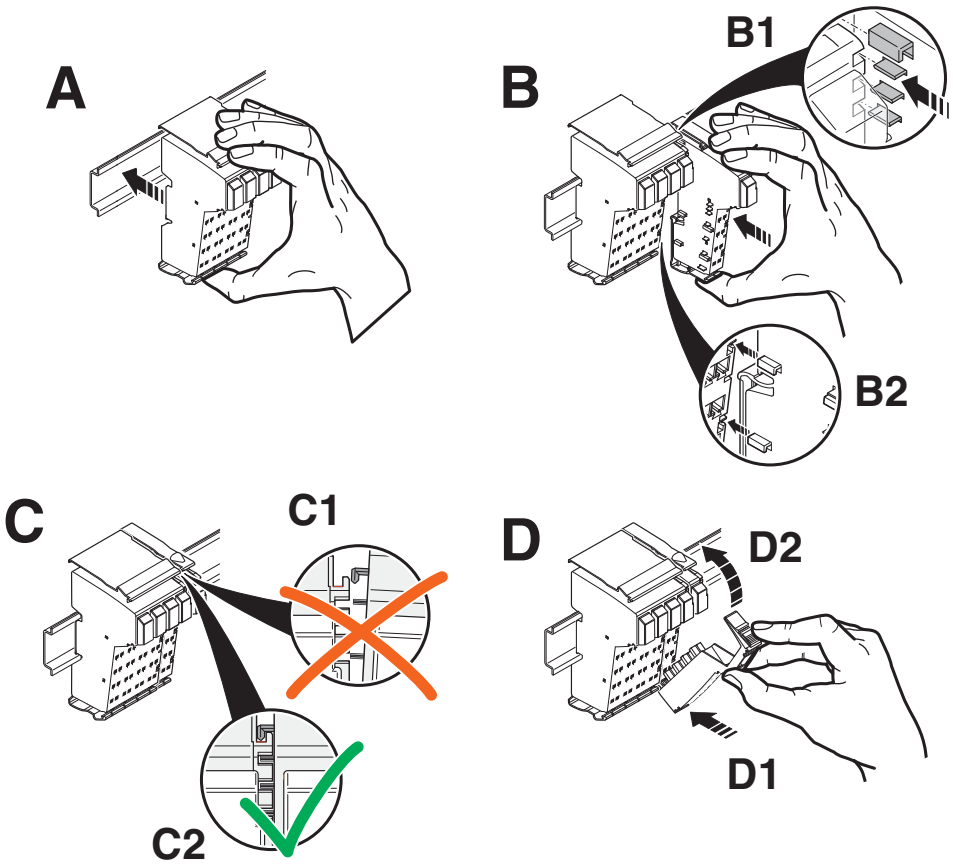


Fig. 10-8 Snapping on a terminal

Removal To remove a terminal, proceed as shown in Fig. 10-9 on page 76:

- Disconnect power to the station.
- If there is a marking field, which covers several connectors, it may have to be removed (A1).

If a terminal has several connectors, all connectors must be removed. The following describes how to remove a 2-slot terminal.

- Lever up the connector of the terminal to be removed by pressing on the back connector shaft latching (A2).

When using extended double signal connectors (long connectors), make sure that you do not bend them back too far, as you may break the front snap-on mechanism.

- Remove the connector (B).
- Remove the adjacent connectors of the neighboring terminals (C). This prevents the potential routing knife contacts and the featherkeys of the keyway/featherkey connections from being damaged. In addition, you have more space available for accessing the terminal.
- Press the snap-on mechanism (D1), and remove the electronics base from the DIN rail by pulling it straight back (D2). If you have not removed the connector on the adjacent terminal on the left, the connector now becomes loose in order to protect the potential routing knife contacts and the featherkeys of the keyway/featherkey connection.

Mounting and removing devices

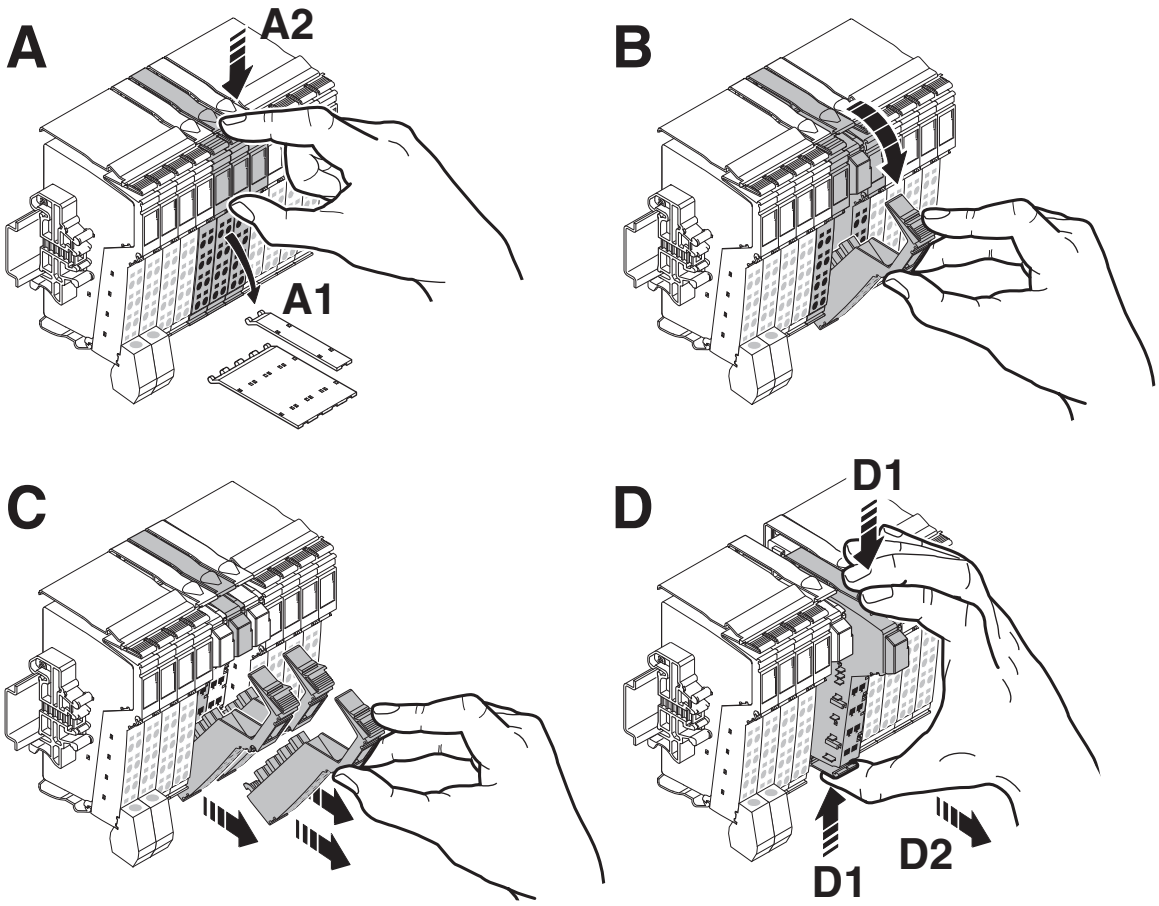


Fig. 10-9 Removing a terminal

Replacing a terminal

If you want to replace a terminal within an Inline station, follow the removal procedure described above. Do not snap the connector of the adjacent terminal on the left back on. Insert the base of the new terminal.

Ensure that **all** featherkeys and keyways on adjacent terminals are securely interlocked.

Then reinsert the connectors.

The top connector latching must audibly click into place.

10.6.1.2 Replacing a fuse

Die 24 V C power and segment terminals are also available in versions with a fuse. If a fuse is not present or faulty, you must insert or replace it.

⚠ WARNING: Observe the following notes when replacing a fuse for the protection of your health and your system.

1. Use the screwdriver carefully to avoid injury to yourself or other persons.
2. Lift the fuse out at the metal contact. Do not lift the fuse out at the glass body since there is a risk of breakage.
3. Carefully lift the fuse out at one side and remove it by hand. Make sure the fuse does not fall into your system.

To replace a fuse, proceed as shown in Fig. 10-10 on page 77:

- Lift the fuse lever (A).
- Insert the screwdriver behind a **metal contact** of the fuse (B).
- Carefully lift out the metal contact of the fuse (C).
- Remove the fuse by hand (D).
- Insert a new fuse (E).
- Push the fuse lever down again until it clicks into place (F).

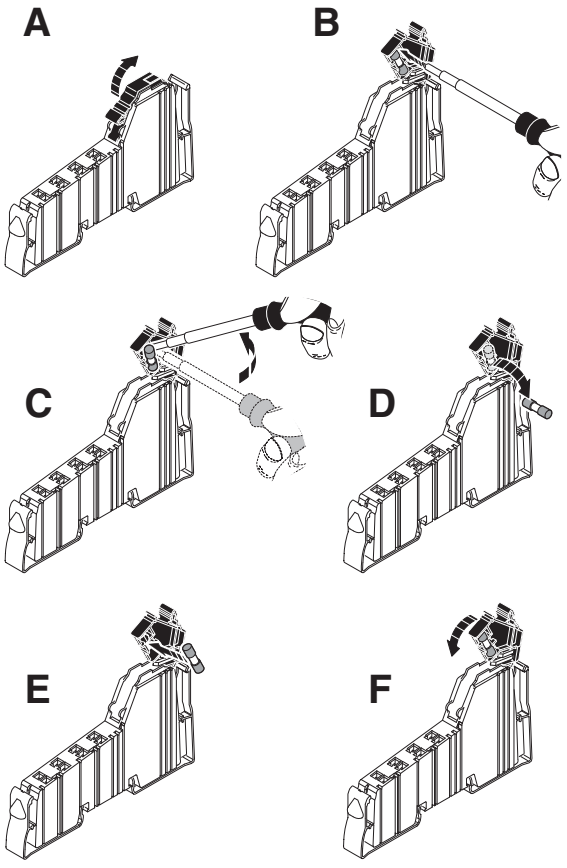


Fig. 10-10 Replacing a fuse

Mounting and removing devices

10.6.2 Inline Block IO: mounting/removal

Mounting

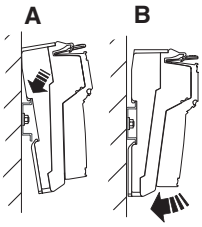


Fig. 10-11 Snapping on the base

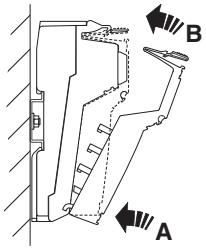


Fig. 10-12 Snapping on a connector

- Place the base onto the DIN rail from above (Fig. 10-11, A), then press it down (B).
- Insert the connectors into the base (Fig. 10-12).
  First, insert the front connector shaft latching (A).
  Then press the top of the connectors towards the base until it snaps into place (B).

Removal

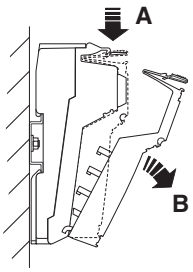


Fig. 10-13 Removing a connector

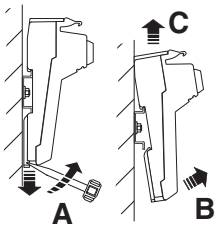


Fig. 10-14 Removing the base

- Disconnect power to the module.
- If there is a marking field, which covers several connectors, it may have to be removed.

Before removing the base, disconnect all the necessary connectors to provide access to the base latch.
When using extended double signal connectors (long connectors), make sure that you do not bend them back too far, as you may break the front snap-on mechanism.

- Lever up the connector to be removed by pressing on the back connector shaft latching (Fig. 10-13, A).
- Remove the connector (B).
- Insert a tool in the base latch and pull gently upwards (Fig. 10-14, A). Pull out the module from the DIN rail (B, C).

10.6.3 Sequence of the Inline Modular IO terminals

10.6.3.1 General sequence

The sequence of the terminals within an Inline station should depend on the current consumption of the I/O from the potential jumpers U_M and U_S.

As the voltage is resupplied to the potential jumpers U_M and U_S at every power terminal, the section (main circuit) between bus coupler and power terminal or between power terminal and power terminal must always be considered when calculating the current. If power terminals are not used, the entire station is a main circuit.

Within a main circuit, place the terminals according to their current consumption. Install the terminals with the highest current consumption first. This has the advantage that the high supply current does not flow through the entire main circuit and thus does not flow through all the terminals.

The following sequence is recommended:

	Function	Abbreviation in order code	Function identification	Remark
1	Digital output	DO, SDO	Pink, red, dark red	In descending sequence of current consumption
2	Digital input	DI, SDI	Light blue, blue, dark blue	In descending sequence of current consumption
3	Relay	DOR, SDOR	Dark red	
4	Special functions		Orange	In descending sequence of current consumption
	• Open and closed-loop control	PWM, CNT, SSI		
	• Communication	RS, DALI		
	• Detection	INC-IN, SSI-IN		
5	Analog output	AO	Yellow	In descending sequence of current consumption; see also 10.6.3.2
6	Analog input	AI, SGI, TEMP	Green	In descending sequence of current consumption; see also 10.6.3.2
		R-IB IL TEMP 2/UTH-PAC		As the last terminal

Fig. 10-15 Sequence of Inline terminals within a main circuit

Please also observe the following notes:

- Please refer to the terminal-specific data sheet for possible further restrictions regarding the position of a terminal.
- The current consumption values of the terminals are specified in every terminal-specific data sheet.

10.6.3.2 Positioning terminals for analog signals

High current flowing through potential jumpers U_M and U_S leads to a temperature rise in the potential jumpers and inside the terminal. This reduces the measuring accuracy and shortens the service life of the terminal.

To keep the current flowing through the potential jumpers of the analog terminals as low as possible, always place the analog terminals after all the other terminals at the end of the main circuit.

Within the analog terminals, position the R-IB IL TEMP 2/UTH-PAC terminal after **all** the other terminals to minimize the current flowing through **all** the potential jumpers for this terminal.

10.6.3.3 Example of a main circuit structure

Terminal		Type	Reason for selected position
1	R-IB IL 24 DO 16-PAC	Digital output terminal	DO, current higher than for 2; please observe the notice below the table
2	R-IB IL 24 DO 2-PAC	Digital output terminal	DO
3	R-IB IL 24 DI 16-PAC	Digital input terminal	DI, current higher than for 4
4	R-IB IL 24 DI 2-PAC	Digital input terminal	DI
5	R-IB IL CNT-PAC	Function terminal	
6	R-IB IL AO 2/SF-PAC	Analog output terminal	AO
7	R-IB IL TEMP 2/UTH-PAC	Analog input terminals	AI, after all other terminals

Fig. 10-16 Example: main circuit structure

NOTICE

In the event of a high level of simultaneity of the digital outputs and a maximum current load, insert a power terminal after the R-IB IL 24 DO 16-PAC terminal.

If the maximum load of the output is 0.2 A, an additional power terminal is not required. This configuration is shown in Fig. 10-17.

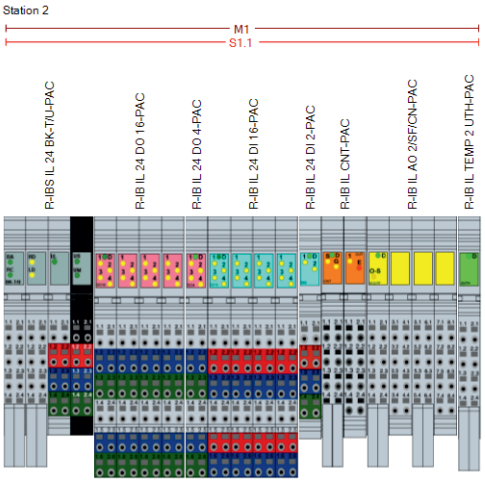


Fig. 10-17 Proposed solution

11 Connecting cables

11.1 Connecting cables using Inline connectors

With just a few exceptions, the cables for the I/O and supply voltages are connected via Inline connectors using the spring-cage connection method. In this way, it is possible to connect signals up to 250 V AC/DC and 8 A with a connection cross section of 0.2 mm^2 to 1.5 mm^2.

Please observe the permissible length for sensor/actuator cables (see Chapter “Cable connection method/cable cross section” on page 101 or terminal-specific data sheet).

Both shielded and unshielded cables are used in conjunction with Inline Modular IO terminals or Inline Block IO modules.

11.1.1 Connecting unshielded cables

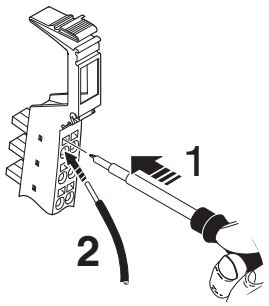


Fig. 11-1 Connecting unshielded cables

Wire the connectors according to your application.

For the connector pin assignment, please refer to the corresponding terminal-specific data sheet.

When wiring, proceed as follows:

- Strip 8 mm off the cable.

Inline wiring is normally done without ferrules. However, it is possible to use ferrules. If using ferrules, make sure they are properly crimped.

- Push a screwdriver into the actuation shaft of the appropriate terminal point (Fig. 11-1, 1), so that you can insert the conductor into the spring opening. Bosch Rexroth recommends using a screwdriver with blade dimensions of 0.6 mm x 3.5 mm x 100 mm.
- Insert the conductor (Fig. 11-1, 2). Remove the screwdriver from the opening. This clamps the conductor.

After installation, the wires and the terminal points should be marked (see also Chapter “Function identification and marking” on page 31).

11.1.2 Connecting shielded cables using an Inline shield connector

Shielded cables can be connected using the R-IB IL SCN-6 SHIELD and R-IB IL SCN 6-SHIELD-TWIN shield connectors. The R-IB IL SCN-6 SHIELD shield connector is designed to connect one shielded cable. Two shielded cables can be easily connected using the R-IB IL SCN 6-SHIELD-TWIN shield connector. When shield connectors are used to connect cables, the connection principle is generally the same (see Fig. 11-2 on page 83 and Fig. 11-3 on page 84).

Fig. 11-2 shows how to connect a shielded cable, using a remote bus cable as an example. In this example, the cables are twisted together in pairs.

Fig. 11-3 shows how to connect two shielded cables, using the wiring of the R-IB IL AI 2/SF-PAC terminal as an example. As two channels can be used here, the R-IB IL SCN 6-SHIELD-TWIN shield connector has been selected.

To connect the cables, proceed as shown in Fig. 11-2 and Fig. 11-3:

Stripping cables

- Strip the outer cable sheath to the desired length (a). (A)
  The desired length (a) depends on the connection position of the wires and whether the wires should have a large or small amount of space between the connection point and the shield connection.
- Shorten the braided shield to 15 mm. (A)
- Fold the braided shield back over the outer sheath. (B)
- Remove the protective foil.
- Strip 8 mm off the wires. (B).

Inline wiring is normally done without ferrules. However, it is possible to use ferrules. If using ferrules, make sure they are properly crimped.

When using twisted pair cables, keep the cable twisted until just before the terminal point.

Wiring connectors

- Push a screwdriver into the actuation shaft of the appropriate terminal point (Fig. 11-1 on page 81, 1) so that you can insert the wire into the spring opening.
  Bosch Rexroth recommends using a screwdriver with blade dimensions of 0.6 mm x 3.5 mm x 100 mm.
- Insert the wire (Fig. 11-1 on page 81, 2). Remove the screwdriver from the opening. This clamps the wire.

For the connector pin assignment, please refer to the corresponding terminal-specific data sheet.

Connecting the shield

Fig. 11-2 shows the shield connection of the R-IB IL SCN 6-SHIELD connector. The same equally applies to the R-IB IL SCN 6-SHIELD-TWIN connector shown in Fig. 11-3.

- Open the shield connection (C).
- Check the orientation of the shield connection clamp in the shield connection (see “Shield connection clamp” on page 85).
- Place the cable with the folded braided shield in the shield connection (D).
- Close the shield connection (E).
- Fasten the screws on the shield connection tightly with a screwdriver (F).

To ensure that the shield connection clamp remains in place when the shield connection is closed, you can first secure the shield connection clamp with screws and then close the shield connection.

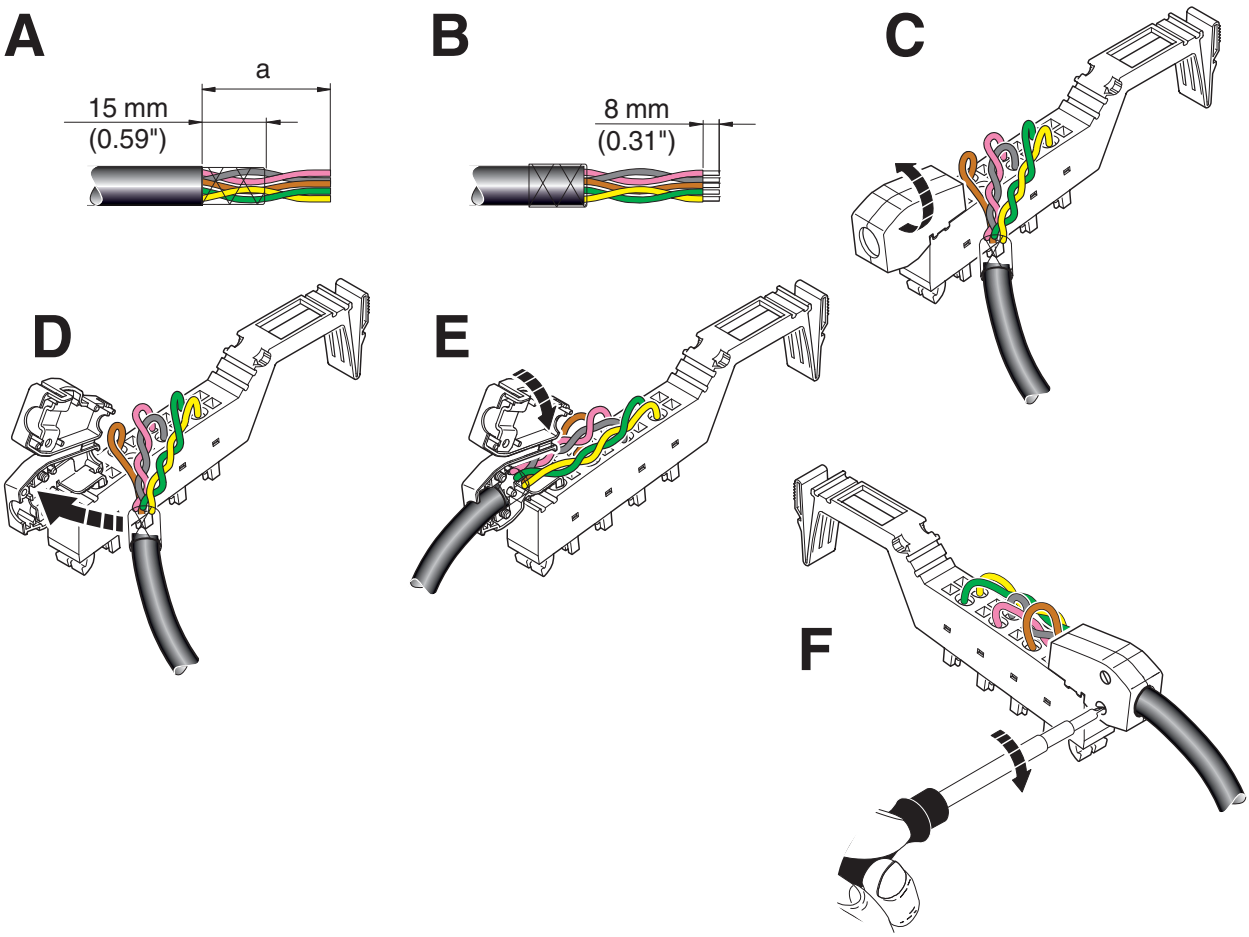


Fig. 11-2 Connecting a shielded cable using the R-IB IL SCN-6 SHIELD shield connector

Connecting cables

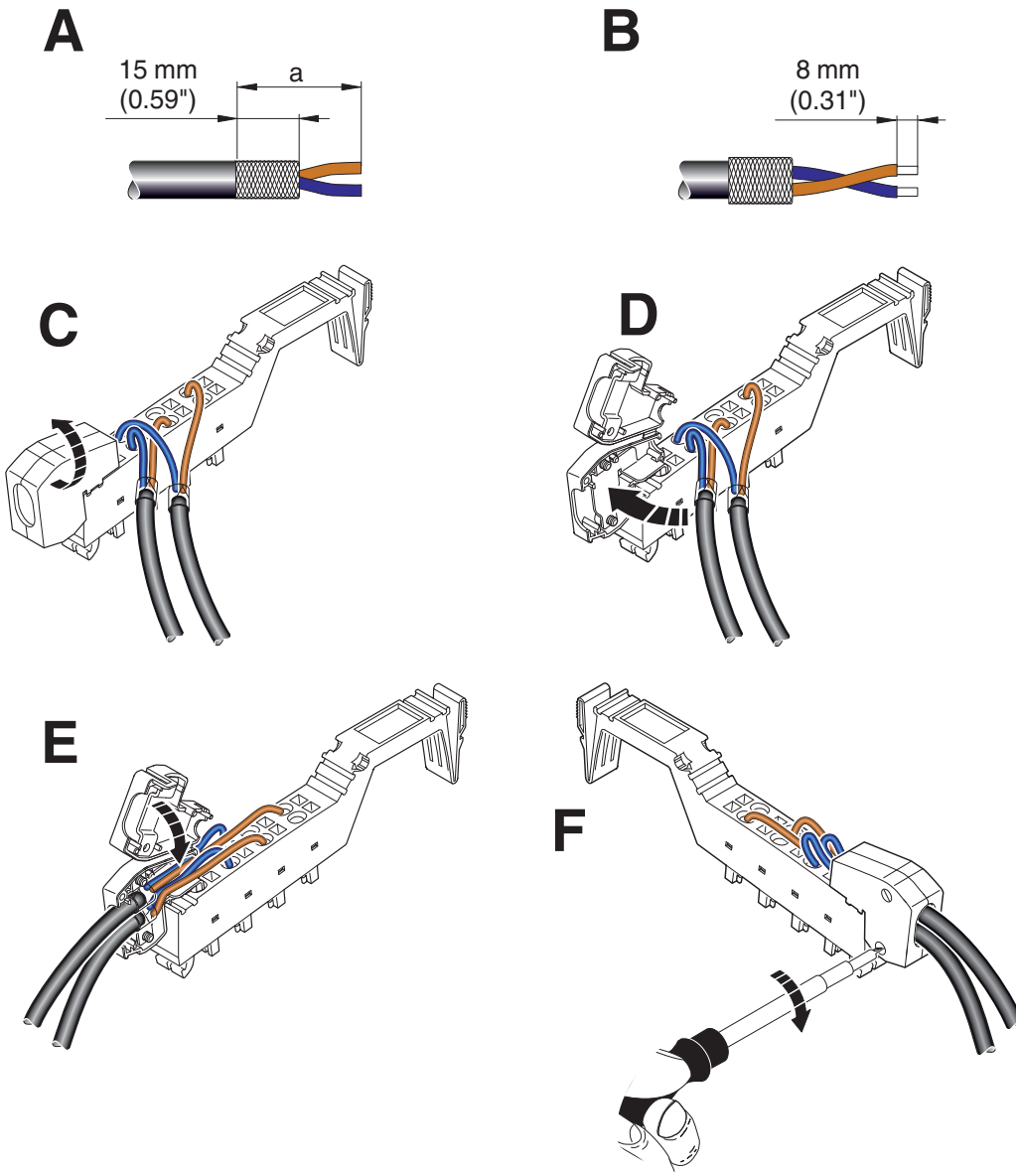


Fig. 11-3 Connecting two shielded cables using the R-IB IL SCN 6-SHIELD-TWIN shield connector

Shield connection clamp

The shield connection clamp (a in Fig. 11-4, B) in the shield connection can be used in different ways depending on the cable cross section. For thicker cables, (e.g., bus cable), the dip in the clamp must be turned away from the cable (Fig. 11-4, B). For thinner cables, the dip in the clamp must be turned towards the cable (Fig. 11-4, F).

If you need to change the orientation of the shield connection clamp, proceed as shown in Fig. 11-4:

- Open the shield connection housing.
- By default upon delivery, the shield connection is intended for connecting thicker cables (B).
- Remove the clamp (C), turn it to suit the cross section of the cable (D), and then reinsert the clamp (E).
- F shows the position of the clamp for a thin cable.

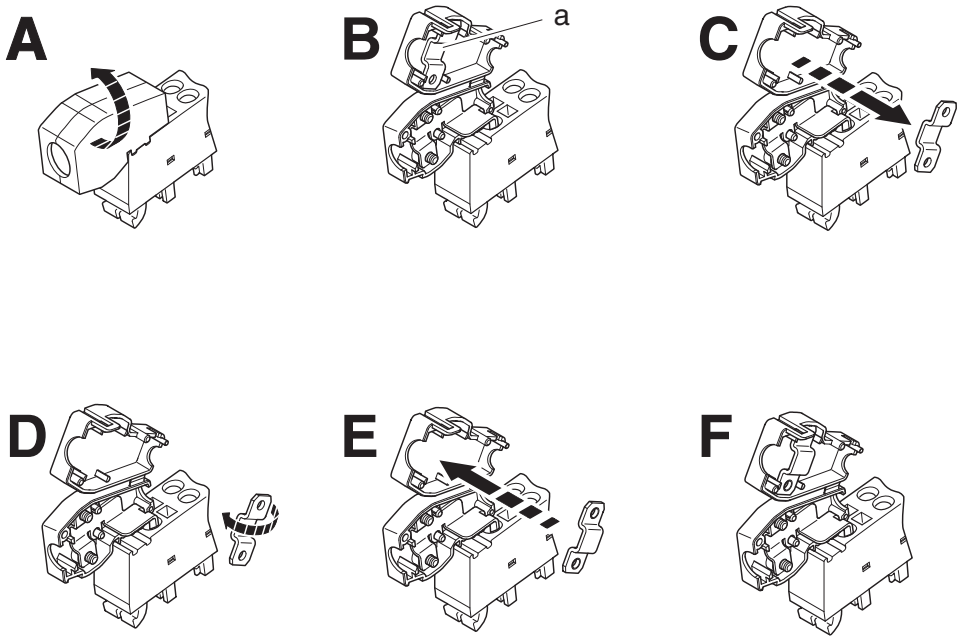


Fig. 11-4 Changing the orientation of the shield connection clamp

11.2 Connecting the power supplies

Inline Modular IO

To operate an Inline station, you must provide the supply voltage for the bus coupler, the logic of the terminals, and the sensors and actuators.

Connect the power supplies using unshielded cables as described in Chapter “Connecting unshielded cables” on page 81.

For the connector pin assignment of the supply voltage connections, please refer to the terminal-specific data sheets for bus couplers, power terminals, and segment terminals.

Inline Block IO

When using Inline Block IO modules, you must provide the supply voltage for the module, the sensors, and actuators. Depending on the module, connection can be made via an Inline or COMBICON connector.

The power supplies are connected using unshielded cables. For connection via an Inline connector, please refer to Chapter “Connecting unshielded cables” on page 81.

For the connector pin assignment of the supply voltage connections, please refer to the corresponding module-specific data sheet.

11.2.1 Inline Modular IO: supply options

Supply at the bus coupler

For detailed information, please refer to the documentation for your bus coupler.

Supply at power terminals

Depending on its type, the following supply voltages can be supplied to or provided for the power terminal:

- U_M and U_S (I/O supply voltage)
- U_{24V} (generation of U_L and U_{ANA}), U_M and U_S (communications power and I/O supply voltage).

Please also refer to the information provided in Chapter “Power, segment, and accessory terminals” on page 18.

Providing the segment voltage at segment terminals

The segment voltage U_S provided at the segment terminals is generated from the main circuit U_M.

Please also refer to the information provided in Chapter “Power, segment, and accessory terminals” on page 18.

Notes regarding the supply voltages

The bus coupler supplies the module electronics of the connected terminals with communications power (U_L), which is generated, for example, from the bus coupler supply voltage (U_{BK}). If the supply voltage U_{BK} is switched off, the bus will shut down.

The sensor and actuator supply voltage (U_M/U_S) should be installed and fuse-protected independently of the bus coupler supply (U_{BK}). In this way, the bus can continue to run, even if some I/O devices are switched off.

11.2.2 Power supply requirements

⚠ WARNING: Dangerous contact voltage

Only use power supply units that ensure safe isolation between the primary and secondary circuits according to EN 50178.

For additional power supply requirements, please refer to the documentation for your bus coupler and the power terminals.

Inline Modular IO: supply voltage requirements that differ from the system specifications

The specifications for Inline system supply voltages are described in “Technical data for Inline Modular IO” on page 97. However, some terminals have specific requirements. You should therefore always refer to the corresponding data sheet.

This chapter is intended to inform you about the various possible requirements within an Inline system.

	Inline (system requirements)
Nominal voltage	24 V DC
Ripple	±5%
Permissible voltage range (ripple included)	19.2 V DC ... 30.0 V DC
Documented in	“Technical data for Inline Modular IO” on page 97

Fig. 11-5 Requirements regarding the supply voltages

If you are using Inline in a system with other product groups, also observe the technical data for these product groups. Please refer to the corresponding documentation for this technical data.

Two options are available when using terminals, which have special requirements regarding the power supply:

1. Observe the specific parameters for the power supply in the entire system.
2. Observe the specific parameters in the main circuit where the terminals are located.

Connecting cables

11.3 Recommendation for feeding the supply voltages and re-setting the voltage with regard to Inline Modular

11.3.1 Supply at the bus head

In the Inline terminals, electrical isolation is implemented between the logic and the I/O. In order to maintain this electrical isolation, the voltages for supplying the logic and for supplying the I/O must be provided separately using two separate power supply units.

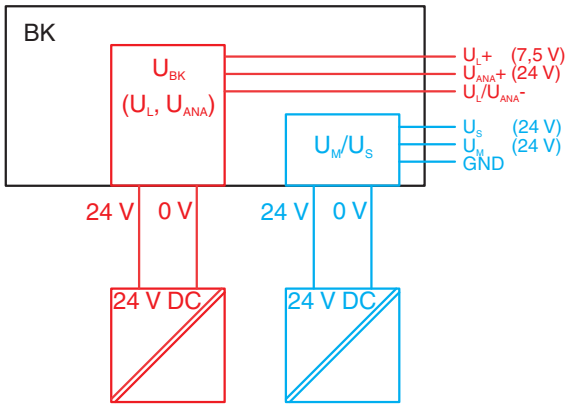


Fig. 11-6 Schematic example for feeding the supply voltages at the bus coupler (BK) using two separate power supply units

Depending on the device that forms the head of the Inline station, the voltage which is used to generate the communications power U_L and the voltage for the analog terminals U_{ANA} has different designations.

Device	**Designation of the voltage from which U_L and U_{ANA} are generated**
Bus coupler	U_{BK}
Inline controller	U_{ILC}
Field multiplexer	U_{MUX}
Other	U_{24V}

Fig. 11-7 Voltage designations

11.3.2 Supply at power and boost terminals

To ensure electrical isolation through the entire station, make sure that the power terminals and boost terminals are also supplied separately.

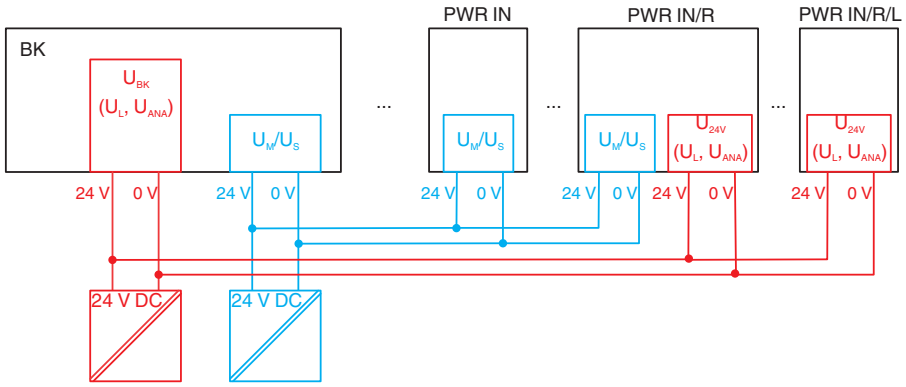


Fig. 11-8 Supply of the power terminals and boost terminals using two separate power supply units

Type	Supply of	
	U_M/U_S	U_{24V} (U_L, U_{ANA})
R-IB IL 24 PWR IN-PAC	X	–
R-IB IL 24 PWR IN/R-PAC	X	X
R-IB IL 24 PWR IN/R/L-0.8A-PAC	–	X

Fig. 11-9 Inline power and boost terminals

11.3.3 Supply when connecting sensors and actuators in 1-wire technology

If you are not supplying 1-wire technology sensors and actuators using the R-IB IL 24V-PAC or R-IB IL GND-PAC potential distributor terminals, these terminals must also be supplied from the power supply unit that was used to supply U_M/U_S.

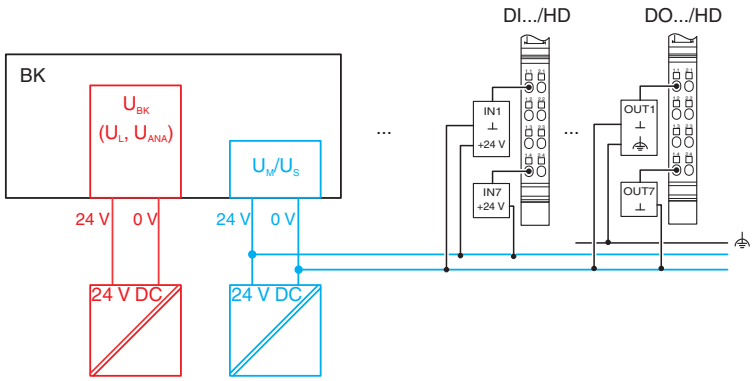


Fig. 11-10 Supply when connecting sensors and actuators in 1-wire technology

11.3.4 Testing the supply during startup

During startup, make sure that all GND connections of the supply connectors of an Inline station are connected to GND (0 V) of the relevant power supply unit by means of measurement. For this purpose, remove all power connectors from the relevant terminals and measure the connection.

When using power terminals, make sure that they are assigned to the correct power supply unit in order to maintain electrical isolation within the station.

11.3.5 Behavior during reset at the bus coupler

NOTICE **Malfunction**

If you want to perform a reset at the head of the Inline station by switching the supply voltage off and on again, disconnect power to all I/O devices connected.

Disregarding this notice may lead to unwanted feedback.

11.4 Connecting the bus

Using Inline Block IO, the bus cable for your system is connected directly to the module, whereas, in the case of Inline Modular IO, it is connected to a bus coupler. Fig. 11-11 lists the basic options for connecting the bus.

Fieldbus	Connection method (on the Inline Block IO module or Inline Modular IO bus coupler)	Available connection	
		Inline Modular IO	Inline Block IO
PROFINET IO	RJ45 socket	Yes	–
INTERBUS	Inline shield connector	Yes	–
PROFIBUS DP	9-pos. D-SUB socket	Yes	Yes
Modbus/TCP	RJ45 socket	Yes	–
Sercos II	FSMA socket	Yes	–
Sercos III	RJ45 socket	Yes	Yes
DeviceNet™	2 x 5-pos. TWIN-COMBICON connector	Yes	Yes

Fig. 11-11 Connection options for the different fieldbus systems

Key:

Yes	Connection method is available
Planned	Connection method is not available at present, but is planned
No	Connection method is not available at present
–	No devices are available at present for this bus system

Connect the fieldbus according to the documentation for your Inline Block IO module or Inline Modular IO bus coupler.

11.5 Connecting sensors and actuators

Sensors and actuators are connected using connectors. The relevant terminal-specific data sheet indicates which connector can be used for which terminal.

Connect the unshielded cables as described in Chapter “Connecting unshielded cables” on page 81.

Connect the shielded cables as described in Chapter “Connecting shielded cables using an Inline shield connector” on page 82.

11.5.1 Connection technology for sensors and actuators

The digital I/O terminals of the Inline product group normally permit the connection of sensors and actuators in 1, 2, 3 or 4-wire technology.

Because of the different connector versions, a single connector can support the following connection technologies:

- 8 sensors or actuators in 1-wire technology
- 2 sensors or actuators in 2, 3, or 4-wire technology
- 4 sensors or actuators in 2 or 3-wire technology
- 2 sensors or actuators in 2 or 3-wire technology with shield (for analog sensors or actuators)

When connecting analog devices, please refer to the terminal-specific data sheets, as the connection technology for analog devices differs from that for digital devices.

11.5.2 Connections used for digital input and output terminals

Different connection options are described below using the 24 V DC terminals as an example. A connection example is provided in every terminal-specific data sheet.

Connection	Representation in the figure	1-wire	2-wire	3-wire	4-wire
Sensor signal IN	IN	X	X	X	X
Sensor supply U_S/U_M	U_S (+24 V)	–	X	X	X
Ground GND	GND (⊥)	–	–	X	X
Grounding/FE shielding	FE (⏚)	–	–	–	X

Fig. 11-12 Overview of the connections used for digital input terminals

X Used
– Not used

Connection	Representation in the figure	1-wire	2-wire	3-wire	4-wire
Actuator signal OUT	OUT	X	X	X	X
Actuator supply U_S	U_S (+24 V)	–	–	–	X
Ground GND	GND (⊥)	–	X	X	X
Grounding/FE shielding	FE (⏚)	–	–	X	X

Fig. 11-13 Overview of the connections used for digital output terminals

X Used
– Not used

In the following diagrams, the supply voltage is referred to as U_S because this potential jumper is accessed in the majority of terminals. The terminal-specific data sheets specify whether the I/O is supplied from the main circuit U_M or the segment circuit U_S.

Connecting cables

11.5.3 Various connection technologies for sensors and actuators

1-wire technology

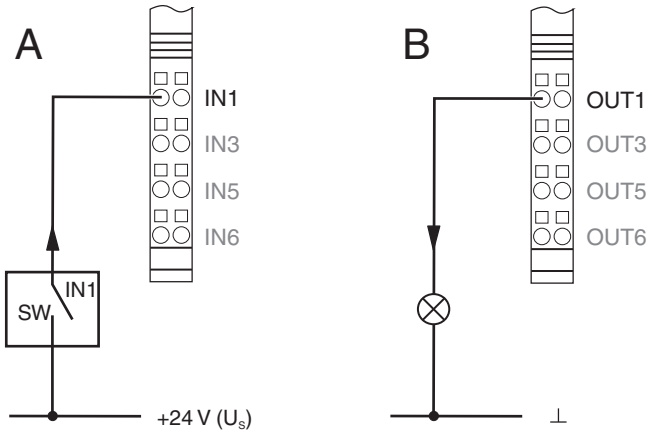


Fig. 11-14 1-wire connection for digital devices

Sensor

Fig. 11-15, A, schematically shows the acquisition of a sensor signal. The SW switch provides the input signal. The sensor signal is routed to terminal point IN1. The sensor is supplied by voltage U_S.

NOTICE **Malfunction due to potential shifts**

Supply the sensors and U_S of the Inline station from the same power supply. Make sure that there is at least one common GND as reference potential.

This will prevent potential shifts, which can have undesirable effects on the station's operation.

Actuator

Fig. 11-15, B, shows the connection of an actuator. The actuator is supplied with voltage by output OUT1. The load is switched directly via the output.

NOTICE **Malfunction due to potential shifts**

Make sure that GND of the actuators and GND of the supply voltage U_S, which supplies the actuators, have the same potential.

This will prevent potential shifts, which can have undesirable effects on the station's operation.

At the time of going to print, the R-IB IL 24 DI 32-PAC and R-IB IL 24 DO 32-PAC terminals are designed to connect sensors and actuators in 1-wire technology. For connection examples, please refer to the corresponding data sheets.

2-wire technology

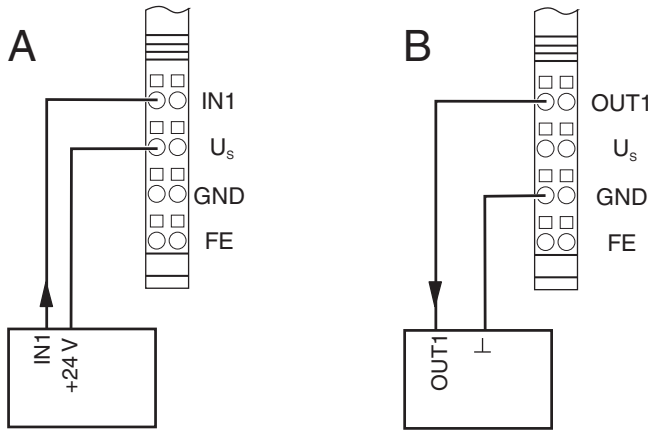


Fig. 11-15 2-wire connection for digital devices

Sensor Fig. 11-15, A, shows the connection of a 2-wire sensor. The sensor signal is routed to terminal point IN1. The sensor is supplied by voltage U_S.

Actuator Fig. 11-15, B, shows the connection of an actuator. The actuator is supplied with voltage by output OUT1. The load is switched directly via the output.

3-wire technology

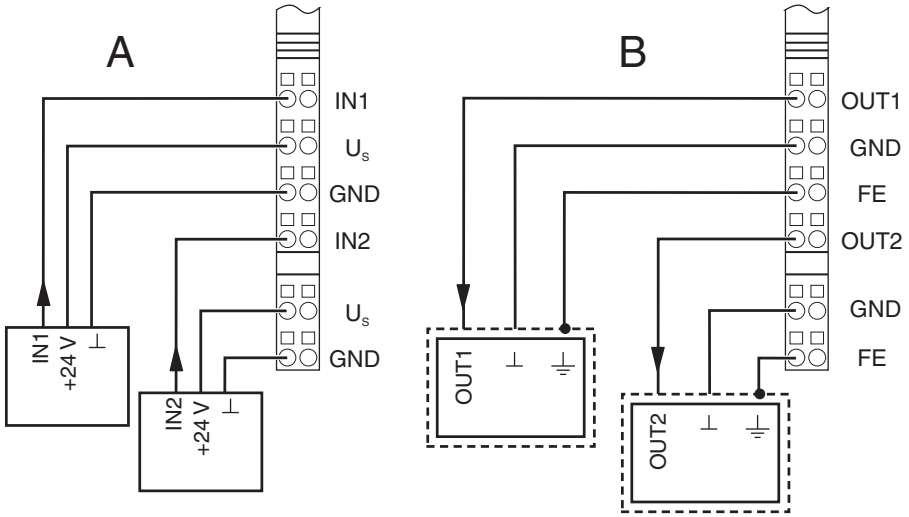


Fig. 11-16 3-wire connection for digital devices

Sensor Fig. 11-16, A, shows the connection of a 3-wire sensor. The sensor signal is routed to terminal point IN1 (IN2). The sensor is supplied with power via terminal points U_S and GND.

Actuator Fig. 11-16, B, shows the connection of a shielded actuator. The actuator is supplied by output OUT1 (OUT2). The load is switched directly via the output.

Connecting cables

4-wire technology

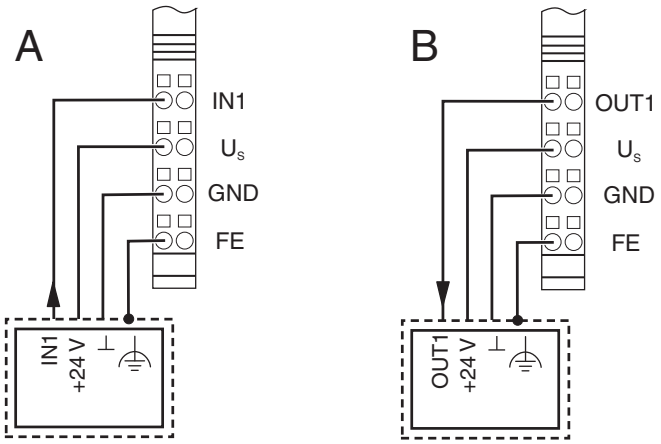


Fig. 11-17 4-wire connection for digital devices

Sensor Fig. 11-17, A, shows the connection of a shielded 3-wire sensor. The sensor signal is routed to terminal point IN1. The sensor is supplied with power via terminal points U_S and GND. The sensor is grounded via the FE terminal point.

Actuator Fig. 11-17, B, shows the connection of a shielded actuator. The provision of the supply voltage U_S means that even actuators that require a separate 24 V supply can be connected directly to the terminal.

12 Inline Modular IO: technical data and ordering data

For the system data of your bus system, please refer to the corresponding documentation.
If you are using Inline in a system with other product groups, also observe the technical data for these product groups. Please refer to the associated documentation for this technical data.

The following values are standard values for the preferred mounting position (horizontal DIN rail). For different values, please refer to the terminal-specific data sheets.

The technical data does not claim to be complete. Technical modifications reserved.

12.1 Technical data for Inline Modular IO

System data	
Number of devices in an Inline station	63 devices, maximum; see documentation for bus couplers
Maximum current consumption of Inline terminals	See terminal-specific data sheet

When configuring an Inline station, observe the power supply through the bus couplers, power terminals, and segment terminals, as well as the current consumption of each device. These are specified in every terminal-specific data sheet and may differ depending on the specific terminal. If the maximum current carrying capacity of a potential jumper is reached, use an additional power terminal or create a new station.

General data	

This table provides standard data. For different values, please refer to the terminal-specific data sheets.

Regulations	Developed according to EN 50178/IEC 62103, UL 508
Ambient temperature	
Ambient temperature (operation)	-25°C ... +55°C
Ambient temperature (storage/transport)	-25°C ... +85°C
Temperature cycles (speed of changing from positive to negative temperatures and vice versa)	0.5 K/min (non-condensing)
Permissible humidity (operation/storage/transport)	10% ... 95% (non-condensing) The humidity requirements have been verified in accordance with IEC 60068-2-30.
Permissible air pressure (operation/storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20

Inline Modular IO: technical data and ordering data

General data (continued)	
Protection class	IEC 61140
Protective extra-low voltage (PELV) (24 V DC ... 60 V DC, 24 V AC ... 35 V AC)	III
Extra-low and low voltage (>60 V DC, >35 V AC)	II (mounted in an adequate housing with at least IP54 degree of protection)
Air clearances and creepage distances	According to IEC 60644/IEC 60664A, DIN VDE 0110, and EN 50178/IEC 62103, DIN VDE 0160
Housing material	Plastic, PVC-free, PBT and others, self-extinguishing (V0)
Pollution degree according to EN 50178	2; condensation not permitted during operation
Overvoltage category	
Protective extra-low voltage (PELV) (24 V DC ... 60 V DC, 24 V AC ... 35 V AC)	II
Extra-low and low voltage (>60 V DC, >35 V AC)	III
Gases that may endanger functions according to DIN 40046-36, DIN 40046-37	
Sulfur dioxide (SO_2)	Concentration 10 ± 0.3 ppm Ambient conditions - Temperature: 25°C (±2°C) - Humidity: 75% (±5%) - Test duration: 10 days
Hydrogen sulfide (H_2S)	Concentration 1 ± 0.3 ppm Ambient conditions - Temperature: 25°C (±2°C) - Humidity: 75% (±5%) - Test duration: 4 days
Resistance of housing material to termites	Resistant
Resistance of housing material to fungal decay	Resistant

Mechanical requirements	
Vibration test Sinusoidal vibrations according to IEC 60068-2-6; EN 60068-2-6	5g load, 2 hours in each space direction (24 V DC, 120 V AC, 230 V AC areas)
Shock test according to IEC 60068-2-27; EN 60068-2-27	25g load for 11 ms, half sinusoidal wave, three shocks in each space direction and orientation
Broadband noise according to IEC 60068-2-64; EN 60068-2-64	0.78g load, 2.5 hours in each space direction

Conformance with EMC directive 2014/30/EU		

This table provides standard data. For different values, please refer to the terminal-specific data sheets.

Noise immunity test according to EN 61000-6-2		
Electrostatic discharge (ESD)	EN 61000-4-2/ IEC 61000-4-2	Criterion B 6 kV contact discharge 8 kV air discharge
Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	Criterion A Field strength: 10 V/m
Fast transients (burst)	EN 61000-4-4/ IEC 61000-4-4	Criterion B Remote bus: 2 kV Power supply: 2 kV I/O cables: 2 kV Criterion A All interfaces: 1 kV
Transient overvoltage (surge)	EN 61000-4-5/ IEC 61000-4-5	Criterion B Supply cables AC: 1.0 kV/2.0 kV (symmetrical/asymmetrical) DC supply cables: 0.5 kV/0.5 kV (symmetrical/asymmetrical) Signal cables: 1.0 kV/1.0 kV (symmetrical/asymmetrical)
Conducted interference	EN 61000-4-6 IEC 61000-4-6	Criterion A Test voltage 10 V
Noise emission test according to EN 61000-6-4		
Noise emission of housing	EN 55011	Class A

Data transfer in the local bus	
Protocol	IEC 61158
Transmission speed	500 kbps
Transmission	Inline data jumpers

24 V bus coupler supply (U_{BK})	
Nominal voltage	24 V DC
Ripple	±5%
Permissible voltage range	19.2 V DC ... 30.0 V DC, ripple included
Connection	Inline connector

The communications power (logic voltage) U_L (7.5 V) and the analog supply U_{ANA} (24 V) are generated from the bus coupler supply U_{BK}.

Inline Modular IO: technical data and ordering data

7.5 V bus logic supply (U_L; generated from U_{BK})	
Nominal voltage	7.5 V
Ripple	±5%
Load current	See terminal-specific data sheet
Maximum	2 A

Observe the specifications regarding the power supply (U_{BK}) in the terminal-specific data sheet for the terminal used.
These terminals can limit the maximum permissible load current.

Connection	Inline potential jumpers
Remark	The voltage is generated in the bus coupler from the 24 V supply voltage using a DC/DC converter. U_L is not electrically isolated from the 24 V bus coupler supply voltage. U_L is electrically isolated from the I/O voltages U_M and U_S. Communications power U_L is electronically short-circuit-proof.

Supply of terminals for analog signals (U_{ANA}; generated from U_{BK})	
Nominal voltage	24 V DC
Tolerance	-15% / +20%
Ripple	±5%
Permissible voltage range	19.2 V DC ... 30.0 V DC, ripple included
Maximum load current	500 mA
Connection	Inline potential jumpers
Remark	Decoupling of the 24 V input voltage by means of a diode. Smoothing via π-filter with base frequency of 9.8 kHz and attenuation of 40 dB/decade. U_{ANA} is not electrically isolated from the 24 V bus coupler supply voltage and the 7.5 V communications power.

Supply of terminals for digital signals (U_M, U_S) in the 24 V area	
Nominal voltage	24 V DC
Tolerance	-15% / +20%
Ripple	±5%
Permissible voltage range	19.2 V DC ... 30.0 V DC, ripple included
Load current at U_M (main supply)	See terminal-specific data sheet
Maximum	8 A
Load current at U_S (segment supply)	See terminal-specific data sheet
Maximum	8 A
Terminal-specific	6 A (e.g., R-IB IL 24 SEG/F-PAC) 4 A (e.g., R-IB IL 24 SEG/F-D-PAC)

Supply of terminals for digital signals (U_M, U_S) in the 24 V area (continued)	
Observe the specifications regarding the power supply (U_M/$U_{S)}$ in the terminal-specific data sheet for the terminal used. These terminals can limit the maximum permissible load current.	
Connection on corresponding terminals for supply	Inline connector
Connection within the Inline station	Inline potential jumpers

Voltage dips and interruptions of the I/O supply	
Intensity PS1	Interrupt time < 1 ms
Time interval between voltage dips	<1 s
Behavior	Evaluation criterion 1 A supply voltage dip of < 1 ms is not registered by the bus.
Intensity PS2	Interrupt time < 10 ms
Time interval between voltage dips	<1 s
Behavior	Evaluation criterion 3 Bus disconnection, all system outputs are reset.

Current and voltage distribution in data and potential jumpers

See Chapter “Current and voltage distribution” on page 54

Cable connection method/cable cross section	
Cable connection method	Spring-cage terminal blocks
Conductor cross section	
Typical (solid/stranded)	0.2 mm² ... 1.5 mm²; AWG 24 ... 16
For UL approvals (solid/stranded)	0.2 mm² ... 1.5 mm²; AWG 24 ... 16
Length of sensor/actuator cables	
For digital terminals	<30 m
For analog terminals	See Chapter “Maximum cable lengths for analog devices” on page 106

Electrically isolated areas

See terminal-specific data sheets

Air clearances and creepage distances (according to EN 50178, VDE 0109, VDE 0110)			
Isolating distance	**Clearance**	**Creepage distance**	**Rated surge voltage**
Technology for 24 V area			
Incoming bus / bus logic	0.3 mm	0.3 mm	0.5 kV
Outgoing bus / bus logic	0.3 mm	0.3 mm	0.5 kV
Incoming bus / outgoing bus	0.3 mm	0.3 mm	0.5 kV
Bus logic / I/O	0.3 mm	0.3 mm	0.5 kV
Relay outputs			
Main contact / N/O contact	See terminal-specific data sheet		
Relay contact / bus logic	See terminal-specific data sheet		

Inline Modular IO: technical data and ordering data

Test voltages	
Isolating distance	**Test voltage**
Technology for 24 V area (up to 60 V DC)	

For information regarding the test voltages between the bus and other potential areas, please refer to the documentation for the bus coupler.

7.5 V communications power, 24 V bus coupler supply / functional earth ground	500 V AC, 50 Hz, 1 min
7.5 V communications power, 24 V bus coupler supply / 24 V main supply, 24 V segment supply	500 V AC, 50 Hz, 1 min
24 V main supply, 24 V segment supply / functional earth ground	500 V AC, 50 Hz, 1 min
Relay outputs	
Main contact / N/O contact	1000 V AC, 50 Hz, 1 min
Relay contact / bus logic	2500 V AC, 50 Hz, 1 min

12.2 Ordering data

Ordering data for Inline terminals and corresponding connectors

For ordering data for Inline terminals and associated connectors, please refer to the online product catalog at www.boschrexroth.com/electrics.

Ordering data for accessories

Description	Type	MNR	Pcs./Pkt.
Keying profile	On request		
Zack marker strip for marking terminals	On request		
Marking field covering one connector	R-IB IL FIELD 2	R911289341	10
Marking field covering four connectors	R-IB IL FIELD 8	R911289342	10
Standard end bracket; snapped on without tools	SUB-M01 ENDHALTER	R911170685	2
End bracket for use in the event of vibrations or installation on vertical DIN rail; secured with screws	SUB-M01 ENDHALTER/AL	R911171035	2

Ordering data for documentation

For ordering data regarding the application descriptions for special Inline terminals, please refer to the online product catalog at www.boschrexroth.com/electrics.
Make sure you always use the latest documentation.
It can be downloaded at www.boschrexroth.com/electrics.

13 Appendix: Inline Modular IO: additional information

13.1 Tips for working with Inline

Safe grounding Please observe the grounding instructions provided in Chapter “Grounding concept” on page 69

Sequence of terminals Please observe the configuration instructions provided in Chapter “Sequence of the Inline Modular IO terminals” on page 79.

Appendix: Inline Modular IO: additional information

13.2 Configuration help for selecting the optimum analog input device for temperature measurement

13.2.1 Inline Modular IO

Criterion		R-IB IL TEMP 2 RTD-PAC R911170785	R-IB IL TEMP 4/8 RTD-PAC R911170428	R-IB IL TEMP 4/8 RTD/EF-PAC R911173029	R-IB IL TEMP 2 UTH-PAC R911170431
RTD	Resistance temperature detection (inputs for resistance temperature detectors, e.g., Pt100, Pt1000, Ni100, Ni1000)	Yes	Yes	Yes	No
	Number of 2-wire RTD sensors	2	8	8	–
	Number of 3-wire RTD sensors	2	8	8	–
	Number of 4-wire RTD sensors	1	-	8	–
TC	Thermocouple detection (thermocouple inputs, e.g., type B, C, E, J, K, E, R, S, T, U, W, HK)	–	–	–	Yes
	Number of 2-wire TC sensors	–	–	–	2
	Internal cold junction compensation for thermocouple detection	–	–	–	Yes
	Additional connection option for an external cold junction sensor (Pt1000, Ni1000)	–	–	–	Yes
Dynamic response	Dynamic response of measurement inputs	High	Very high	Low	High
	Measurements/second (typical for all channels)	30 … 50	4 … 165	0.3 … 0.5	30
Precision	Precision	High	Medium	Very high	Medium
	Typical tolerance of Pt100 or TC (at T_A = +25°C)	±0.26 K	±0.50 K	±0.09 K	0.6 K + tolerance of cold junction (TC type K)
	Maximum tolerance of Pt100 or TC (at T_A = +25°C)	±1.0 K	±2.13 K	±0.19 K	2.4 K + tolerance of cold junction (TC type K)

Table 13-1 Configuration help for selecting Inline Modular IO terminals for temperature measurement

13.2.2 Inline Block IO

Criterion		R-ILB IB AI4 AO2	R-ILB PB AI4 AO2
		R911170400	R911170401
RTD	Resistance temperature detection (inputs for resistance temperature detectors, e.g., Pt100, Pt1000, Ni100, Ni1000)	Yes	Yes
	Number of 2-wire RTD sensors	4	4
	Number of 3-wire RTD sensors	4	4
	Number of 4-wire RTD sensors	4	4
Dynamic response	Dynamic response of measuring inputs	Very high	Very high
	Measurements/second (typical for all channels)	43 ... 192	43 ... 192
Precision	Precision	High	Medium
	Typical tolerance Pt100 or TC (at T_A = +25°C)	±0.3 K	±0.5 K
	Maximum tolerance of Pt100 or TC (at T_A = +25°C)	±1.6 K	±1.9 K

Table 13-2 Configuration help for selecting Inline Block IO modules for temperature measurement

Appendix: Inline Modular IO: additional information

13.3 Maximum cable lengths for analog devices

Please also observe the information in the device-specific data sheet.

The following applies for the chapters below:

- The values for the maximum cable length are valid when complying with the installation instructions. They have been determined using the following reference data for the sensor and actuator cable:

Cable type	LiYCY (TP)	
	N x 2 x 0.5	Where: N = number of wire pairs 0.5 = conductor cross section A in mm^2
Inductance	0.67 mH/km (typical)	
Effective capacitance	120 nF/km	(between the wires)

- The values indicated in the tables also apply for versions of the specified terminal with comparable technical properties (e.g., /CN or non-PAC versions).
- Information with regard to greater lengths and other cable types is available on request.

13.3.1 Analog input and temperature measurement

Criterion	R-IB IL AI2/SF-PAC R911170784	R-IB IL AI8/SF-PAC R911308493	R-IB IL AI8/IS-PAC R911308494	R-IB IL AI2/SF-230-PAC R911170425	R-IB IL AI4/EF-PAC R911170426
Number of channels	2	8	8	2	4
Maximum cable length	250 m	250 m	250 m	250 m	250 m

Table 13-3 Maximum cable lengths: analog input

Criterion	R-IB IL TEMP 2 RTD-PAC R911170785	R-IB IL TEMP 4/8 RTD-PAC R911170428	R-IB IL TEMP 4/8 RTD-EF-PAC R911173029
Number of channels	2	8	8
Maximum cable length	250 m[1]	250 m[1]	250 m

Table 13-4 Maximum cable lengths: temperature measurement

[1] Please observe the specified tolerances for the selected connection technology (2, 3, or 4-wire) (see data sheet).

13.3.2 Analog output

Criterion	R-IB IL AO1/SF(/CN)-PAC R911170787 R911172575	R-IB IL AO 2/U/BP-PAC R911170786	R-IB IL AO 2/SF(/CN)-PAC R911170436 R911172576	R-IB IL AO 2/UI-PAC R911173634
Number of channels	1	2	2	2
Signals	0 V ... 10 V 0 mA ... 20 mA 4 mA ... 20 mA	-10 V ... +10 V 0 V ... 10 V	0 V ... 10 V 0 mA ... 20 mA 4 mA ... 20 mA	-10 V ... +10 V 0 V ... 10 V 0 mA ... 20 mA 4 mA ... 20 mA -20 mA ... +20 mA
Maximum cable length	250 m	500 m	250 m	250 m
Short-circuit withstand capability of analog voltage output	Yes, 1 minute	Yes, 1 minute	Yes, 1 minute	Yes, 1 minute
Short-circuit withstand capability of analog current output	Yes, permanent	Not present	Yes, permanent	Not present

Table 13-5 Maximum cable lengths and short-circuit withstand capability: analog output terminals

13.3.3 Analog input/output

Criterion	R-ILB S3 AI4 AO2
Channel number for input	4
Channel number for output	2
Signals	-10 V ... +10 V 0 V ... 10 V -5 V ... +5 V 0 V ... 5 V 0 mA ... 20 mA -20 mA ... +20 mA 4 mA ... 20 mA
Maximum cable length	250 m[1]
Short-circuit withstand capability of analog voltage output	Yes, permanent
Short-circuit withstand capability of analog current output	Yes, permanent

Table 13-6 Maximum cable lengths and short-circuit withstand capability: analog input/output

[1] Please observe the specified tolerances for the selected connection technology (2, 3, or 4-wire) (see data sheet).

Appendix: Inline Modular IO: additional information

13.4 Temperature response of terminals

Please note that derating or simultaneity limitations must be taken into consideration depending on the ambient temperature. Please refer to the corresponding notes in the terminal-specific data sheets. The terms used in the data sheets are explained in the following:

Power dissipation of the electronics (P_{EL})

The power dissipation of the electronics of a terminal is calculated according to the formula provided in the terminal-specific data sheet. The calculated value must not exceed the power dissipation of the housing.

Power dissipation of the housing (P_{HOU})

The power dissipation of the housing indicates the maximum power dissipation. The maximum power dissipation is specified in the terminal-specific data sheet.

In the permissible operating temperature range, the power dissipation of the housing can be dependent on or independent of the ambient temperature.

If the power dissipation of the housing depends on the ambient temperature, a permissible working point must be defined.

Permissible working point

Depending on the power dissipation of the housing and the power dissipation of the electronics at a certain current, the maximum temperature at which the terminal can be operated with this current can be calculated.

Examples

Examples for calculating these values can be found in the following chapter.

13.5 Calculation examples for power dissipation and working points

13.5.1 Constant power dissipation of the housing over the operating temperature range

In the following calculation, the R-IB IL 24 DO 8-PAC terminal is used as an example.

Formula to calculate the power dissipation of the electronics

This formula is terminal-specific and provided in every data sheet.

$$P_{EL} = 0.19\ W + \sum_{i=1}^{n} (0.10\ W + I_{Li}^2 \times 0.40\ \Omega)$$

Where:

P_{EL}	Total power dissipation of the electronics
i	Index
n	Number of set outputs n = 1 ... 8
I_{Li}	Load current of output i

If no output is set, the component with the sigma sign is omitted.

Example: Load currents of the outputs:

I_{L1} = 0.5 A; I_{L2} = 0.4 A; I_{L3} = 0.2 A; I_{L4} = 0.5 A; I_{L5} = 0.3 A; I_{L6} = 0.4 A

Outputs 7 and 8 are not used.

Power dissipation of the electronics

According to the formula, the electronics of this special configuration has the following power dissipation:

$$P_{EL} = 0.19\ W + [0.1\ W + (0.5\ A)^2 \times 0.4\ \Omega] + [0.1\ W + (0.4\ A)^2 \times 0.4\ \Omega] + [0.1\ W + (0.2\ A)^2 \times 0.4\ \Omega] + [0.1\ W + (0.5\ A)^2 \times 0.4\ \Omega] + [0.1\ W + (0.3\ A)^2 \times 0.4\ \Omega] + [0.1\ W + (0.4\ A)^2 \times 0.4\ \Omega]$$

$$P_{EL} = 0.19\ W + 0.200\ W + 0.164\ W + 0.116\ W + 0.200\ W + 0.136\ W + 0.164\ W$$

$$P_{EL} = 1.37\ W$$

Appendix: Inline Modular IO: additional information

Power dissipation of the housing

The value for the power dissipation of the housing is specified in every terminal-specific data sheet.

The power dissipation of the housing for the specified terminal is 2.7 W within the operating temperature range of -25°C ... +55°C. The calculated power dissipation for the electronics does not exceed the permissible upper limit.

Maximum load

Even with the maximum permissible load current (0.5 A per channel), the upper limit of 2.7 W is not exceeded within the permissible temperature range of -25°C ... +55°C.

$P_{EL} = 0.19\ W + 8 \times [0.1\ W + (0.5\ A)^2 \times 0.4\ \Omega]$

$P_{EL} = 1.79\ W$

13.5.2 Power dissipation of the housing within the operating temperature range depending on the ambient temperature

In the following calculation, the R-IB IL 24 DO 2-2A-PAC terminal is used as an example.

Formula to calculate the power dissipation of the electronics

This formula is terminal-specific and provided in every data sheet.

$$P_{EL} = 0.18\ W + \sum_{i=1}^{n} (0.20\ W + I_{Li}^{2} \times 0.10\ \Omega)$$

Where:

P_{EL}	Total power dissipation of the electronics
i	Index
n	Number of set outputs n = 1 to 2
I_{Li}	Load current of output i

If no output is set, the component with the sigma sign is omitted.

Example: Both outputs are enabled and operated at full load. The load currents of the outputs are $I_{L1} = I_{L2} = 2$ A.

Power dissipation of the electronics According to the formula, the electronics of this specific configuration has the following power dissipation:

$P_{EL} = 0.18\ W + 2 \times [0.20\ W + (2\ A)^2 \times 0.10\ \Omega)]$

$P_{EL} = 0.18\ W + 2 \times 0.6\ W$

$P_{EL} = 0.18\ W + 1.20\ W$

$P_{EL} = 1.38\ W$

Power dissipation of the housing The value for the power dissipation of the housing is specified in every terminal-specific data sheet.

The permissible power dissipation of the housing for the R-IB IL 24 DO 2-2A-PAC terminal depends on the temperature.

$P_{HOU} = 2.4\ W$	$-25°C < T_A \leq -5°C$
$P_{HOU} = 2.4\ W - [(T_A - (-5°C))/37.5°C/W]$	$-5°C < T_A \leq 55°C$

Where:

P_{HOU}	Power dissipation of the housing
T_A	Ambient temperature

At an ambient temperature of up to -5°C, you can load the housing with the maximum power dissipation.

Appendix: Inline Modular IO: additional information

Permissible working point

At an increased ambient temperature, you must calculate the permissible working point for the calculated power dissipation.

To do this, set $P_{EL} = P_{HOU}$.

$P_{EL} = 2.4\ W - [(T_A + 5°C)/37.5°C/W]$

After changing the formula, the maximum permissible ambient temperature, with this load, is calculated as:

$T_A = (2.4\ W - P_{EL}) \times 37.5°C/W - 5°C$

$P_{EL} = 1.38\ W$ (from the calculation for the power dissipation of the electronics)

$T_A = (2.4\ W - 1.38\ W) \times 37.5°C/W - 5°C$

$T_A = 1.02\ W \times 37.5°C/W - 5°C$

$T_A = 33.25°C$

With both outputs at full load, this terminal can be operated up to an ambient temperature of 33°C.

If you never operate the outputs simultaneously and if a set output consumes a current of 2 A, you can operate up to an ambient temperature of:

$P_{EL} = 0.18\ W + [0.20\ W + (2\ A)^2 \times 0.10\ \Omega)]$

$P_{EL} = 0.18\ W + 0.60\ W$

$P_{EL} = 0.78\ W$

$T_A = (2.4\ W - P_{EL}) \times 37.5°C/W - 5°C$

$P_{EL} = 0.78\ W$ (from the calculation for the power dissipation of the electronics)

$T_A = (2.4\ W - 0.78\ W) \times 37.5°C/W - 5°C$

$T_A = 1.62\ W \times 37.5°C/W - 5°C$

$T_A = 55.75°C$

$T_A = 55°C$ (maximum permissible ambient temperature)

As the maximum permissible ambient temperature is 55°C, you can operate under the conditions specified above in the entire permissible temperature range. This results in a simultaneity of 50% at 55°C as specified in the data sheet.

13.6 Software support

13.6.1 IndraWorks - universal framework for all engineering tasks

The IndraWorks engineering framework provides you with all the tools required for starting up your drives and controllers in a unified way.

Project management including the data management for device configurations, visualizations, and the PLC program enables both the transparent representation and data consistency.

Based on CODESYS V3, IndraWorks includes all editors according to the 3rd edition of the IEC 61131-3 for comfortable programming of your PLC application.

Intuitive wizards and a comprehensive online help gradually guide you through all engineering steps from device configuration via the generic application template up to the parameterization of technology functions.

Using the IndraWorks offline parameterization, you can set the configuration of all planned devices and use all parameters in the PLC application, without the need for connection to the real system.

A comprehensive range of tools for startup and service activities (e.g., multi-channel oscilloscope, logic analyzer and debugging functions of the PLC logic) offer various status messages and system diagnostics at the touch of a button.

13.6.2 Inline Builder - intelligent software tool for accelerated drive configuration

Using the Inline Builder software, only few data is required to configure the local I/O structure at the IndraControl L control platform and the distributed I/O stations.

For the required inputs and outputs, the tool automatically selects the most cost-effective configuration from the Inline portfolio, including the required power supply.

You will receive a technically correct configuration and need to export it to IndraWorks for direct use in your project.

NOTICE

Please be aware that the software is only meant to **support** you. The project engineer is responsible for the correctness of the configuration.

For more information on the software, visit:
http://www.boschrexroth.com/de/de/produkte/engineering/open-core-engineering/die-features-von-open-core-engineering/software-tools/software-tools-3

You can download the Inline Builder using this link:
http://www.boschrexroth.com/dcc/xMediaApplications/Download.cfc?method=downloadFile&file=%2Fsoftware%2FEA%2FInline%2FAllgemein%2FInlineBuilder%5F1%5F3%2Ezip

Appendix: Inline Modular IO: additional information

14 Appendix: Explanation of abbreviations and symbols

14.0.1 Explanation of abbreviations

Ground Ground, general symbol

FE Functional earth ground
Noiseless ground

This ground is free from external noise voltage, and is used to ground cable shields and to suppress noise and interference voltages.

Functional earth ground is a low-impedance path between electric circuits and ground. It is not designed as a safety measure but rather, for example, for the improvement of noise immunity (EN 61131).

This ground connection must be separated from parts with hazardous voltage by means of double or reinforced insulation (EN 60950).

PE Protective earth ground

This ground is used to ground devices. It also provides shock protection for people.

Protective earth ground is a low-impedance current path that minimizes the risk to the user in the event of an error (EN 61131).

GND 0 V ground; housing or chassis

In this application description the term ground refers to common voltage return lines. Ground is electrically isolated from FE and PE. If a jumper is placed between ground and FE or PE, this isolation is removed.

Various additions to GND (such as F-GND, BC-GND, etc.) indicate separate potentials.

U_{BC} Bus coupler supply

The voltage U_{BC} is used to supply the bus coupler power supply unit. In the power supply unit, the communications power U_L and the analog voltage U_{ANA} are generated from the voltage U_{BC}.

U_M Main supply (I/O supply in the main circuit)

The voltage U_M supplies all of the devices connected to the main circuit.

The voltage U_M is supplied using a bus coupler or a power terminal and is led through the potential jumper to the next power terminal. (Exception: terminal with a relay output interrupts the potential jumper)

U_S Segment supply (I/O supply in the segment circuit)

The voltage U_S supplies all of the devices connected to the segment circuit.

The voltage U_S is supplied using a bus coupler or a power terminal or is tapped from the main voltage U_M on the bus coupler, a power terminal or a segment terminal and is led through the potential jumper to the next supply terminal. (Exception: terminal with a relay output interrupts the potential jumper)

Appendix: Explanation of abbreviations and symbols

U_{ANA} I/O supply for analog terminals

The voltage U_{ANA} is used to supply all the terminals for analog signals.

It is generated in the bus coupler or in a special power terminal and is led through the Inline station by means of potential routing.

U_L Communications power

The voltage U_L is used to supply all the devices with communications power (supply of the module electronics).

It is generated in the bus coupler or in a special power terminal and is led through the Inline station by means of potential routing.

P_{EL} Power dissipation of the electronics

P_{HOU} Power dissipation of the housing

14.0.2 Representations used in circuit diagrams

Local bus (INTERBUS) This designation represents the data jumpers for the local bus (two jumpers) (sometimes still called INTERBUS).

U_L This designation represents the following potential jumpers:

- Communications power (U_{L+})
- Communications power ground (U_{L-})
- Supply voltage for analog terminals (U_{ANA})

U_{ANA} Supply voltage for analog terminals

U_S +24 V DC segment voltage

U_M +24 V DC main voltage

14.0.3 Frequently used symbols

Earth, ground, and equipotentials

Ground, general symbol

Noiseless ground, functional earth ground (FE)

Protective earth ground (PE)

Ground, housing (GND)

Ground
In circuit diagrams: Different markings indicate the electrical isolations.

Shield
In circuit diagrams: Different markings indicate the electrical isolations.

Inputs, outputs, and other connections

Analog input

Analog output

Digital input

Digital output

Potential or data jumper with jumper contacts on the side

Terminal point

Cable(s); x indicates the number of cables

Ideal Circuits

Ideal current source

Ideal voltage source

Resistors, capacitors, and inductors

Resistor, general symbol

Capacitor, general symbol

Appendix: Explanation of abbreviations and symbols

Semiconductors

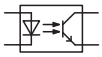
Semiconductor diode, general symbol

LED, general symbol
In circuit diagram: Diagnostic and status indicators on the terminals

PNP transistor

Miscellaneous

Protocol chip
(Bus logic including voltage conditioning)



Optocoupler

Converter, general symbol

Analog/digital converter

Digital/analog converter

Coupler with electrical isolation
Power supply unit with electrical isolation, general symbol

Coupling network

Amplifier

Electrically isolated area

Fuse

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16 Disposal

16.1 General information

Dispose the products according to the respective valid national standard.

16.2 Return

For disposal, our products can be returned free of charge. However, the products must be free of remains like oil and grease or other impurities.

Furthermore, the products returned for disposal must not contain any undue foreign substances or components.

Send the products free of charge to the following address:

Bosch Rexroth AG
Electric Drives and Controls
Bürgermeister-Dr.-Nebel-Straße 2
D-97816 Lohr am Main, Germany

16.3 Packaging

The packaging material consists of cardboard, plastics, wood or styrofoam. Packaging material can be recycled anywhere.

For ecological reasons, please do not return empty packages.

16.4 Batteries and accumulators

Batteries and accumulators can be labelled with this symbol.

The symbol indicating "separate collection" for all batteries and accumulators is the crossed-out wheeled bin.

The end user within the EU is legally obligated to return used batteries. Outside the validity of the EU Directive 2006/66/EC keep the stipulated directives.

Used batteries can contain hazardous substances, which can harm the environment or the health of the individual when they are stored incorrectly or disposed of.

After use, the batteries or accumulators contained in Rexroth products have to be disposed of according to the country-specific collection system.

Disposal

17 Service and support

Our worldwide service network provides an optimized and efficient support. Our experts offer you advice and assistance should you have any queries.
You can contact us **24/7**.

Service Germany

Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drive and controls.

Contact the **Service Hotline** and **Service Helpdesk** under:

Phone:	**+49 9352 40 5060**
Fax:	**+49 9352 18 4941**
E-mail:	service.svc@boschrexroth.de
Internet:	http://www.boschrexroth.com

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide

Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances
- Type plate specifications of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your e-mail address)

Service and support

Notes

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