Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth
Bosch Group

Automation Terminals Of The Rexroth Inline Product Range

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Application Description

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Notes

1 The Inline Product Range

The Inline product range consists of

- Inline Modular IOs: modular terminals and
- Inline Block IOs: compact remote I/O modules

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

1.1 Features

Inline Modular IO

- Modules can be easily installed side by side without tools.
- Open, flexible, modular structure
- Terminals of varying widths may be combined to create a time-saving, compact, and cost-effective station structure.
- 2-slot terminals:
  These terminals provide optimum adaptation to the desired configuration. They enable a flexible and compact station structure without unnecessary reserve installation space.
- 8-slot terminals:
  These terminals provide a fast and effective station structure for larger stations.
- Functional orientation of the switch 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 one another. This means that pretests can be carried out when the system is set up and the whole system can be adapted and expanded.
- Automatic creation of isolated groups, potential and data circuits
- The amount of costly parallel wiring is reduced
  Within a station, potential and data routing can be carried out without additional wiring.

Inline Block IO

- Integrated bus interface for all popular bus systems
- High channel density
- Compact and 55 mm flat design
- Modules can be easily installed without tools.
- Same look and feel as Inline Modular IO

1.2 Product Description

Within the Inline product range, automation terminals are available for I/O functions, special functions, control functions, and power-level terminals.

Automation terminals consist of an electronics base and one or more connectors for connecting the I/O devices or the power supply. The electronics base can be replaced without removing a single wire from the connector.

The Inline terminals are integrated into the bus system via a bus coupler (see "Bus Couplers" on page 22).

Versions Inline Modular IO

The Inline product range offers terminals for all automation tasks:

- Bus coupler for integrating the Inline station in various bus systems
- Terminals with remote bus branch for opening a remote bus branch
- Supply terminals for supplying the supply voltages and segmenting the station (with and without fuse)
- Input and output terminals for digital and analog signals
- Function terminals (e.g., counters, incremental encoders)
- Branch terminals to integrate branches
- Terminals with or without accessories
- Terminal for different transmission speeds (500 kbps, 2 Mbps)

Inline Block IO versions

- Input modules, output modules and input/output modules for digital and analog signals

Mounting location

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

Mounting

Inline 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 properly installed.

Bus connection

Inline Modular IO: The Inline station is connected to the bus via a bus coupler. The bus is controlled by the Inline station using data routing.

Inline Block IO: The bus interface is integrated in the module.

I/O connection

The Inline terminals and Block IO modules have connectors for 1-, 2-, 3-, and 4-wire sensors or actuators. The wires use spring-cage connections. For further information refer to the individual sections.

1.3 Standard Product Designations Used in This Application Description

Terminals are available with or without accessories and for various transmission speeds. Deviations are given in the Section "General" on page 21. Since the basic functions of the terminals are identical, only the designation of the standard product (without accessories, 500 kbps) is used in this document in order to make things simpler. In all cases, you can use the product with accessories rather than the standard product. In a system with a transmission speed of 2 Mbps, you would use the 2MBD version rather than the standard product.

For available product versions, please refer to the online product catalog at www.boschrexroth.com.

Example

R-IB IL 24 DI 2	Without accessories, 500 kbps
R-IB IL 24 DI 2-PAC	Including accessories
R-IB IL 24 DI 2-2MBD	Without accessories, 2 Mbps

The Inline Product Range

Notes:

2 Important Directions for Use

2.1 Appropriate Use

2.1.1 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

2.1.2 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 field bus 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.

2.2 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!

3 Safety Instructions for Electric Drives and Controls

3.1 Safety Instructions - General Information

3.1.1 Using the Safety Instructions and Passing them on to Others

Do not attempt to install or commission this device without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with the device. If you do not have the user documentation for the device, contact your responsible Bosch Rexroth sales representative. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the device.

If the device is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the device in the official language of the user's country.

WARNING

Improper use of these devices, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!

Observe the safety instructions!

3.1.2 How to Employ the Safety Instructions

Read these instructions before initial commissioning of the equipment in order to eliminate the risk of bodily harm and/or material damage. Follow these safety instructions at all times.

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before commissioning the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of this device.
- Only assign trained and qualified persons to work with electrical installations:
  - Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity. The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the product, as well as an understanding of all warnings and precautionary measures noted in these instructions.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and devices on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.

Safety Instructions for Electric Drives and Controls

- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The devices have been designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Only use safety-relevant applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded. Safety-relevant are all such applications which can cause danger to persons and material damage.
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.
- The machine and installation manufacturer must
  - make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components,
  - make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Commissioning of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only permitted if the national EMC regulations for the application are met.
- The instructions for installation in accordance with EMC requirements can be found in the section on EMC in the respective documentation (Project Planning Manuals of components and system).
  The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
- Technical data, connection and installation conditions are specified in the product documentation and must be followed at all times.

National regulations which the user must take into account

- European countries: according to European EN standards
- United States of America (USA):
  - National Electrical Code (NEC)
  - National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
  - regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
  - International Organization for Standardization (ISO)
  - International Electrotechnical Commission (IEC)

3.1.3 Explanation of Warning Symbols and Degrees of Hazard Seriousness

The safety instructions describe the following degrees of hazard seriousness. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions:

Warning symbol	**Signal word**	**Degree of hazard seriousness acc. to ANSI Z 535.4-2002**
	Danger	Death or severe bodily harm will occur.
	Warning	Death or severe bodily harm may occur.
	Caution	Minor or moderate bodily harm or material damage may occur.

Fig. 3-1 Hazard classification (according to ANSI Z 535)

Safety Instructions for Electric Drives and Controls

3.1.4 Hazards by Improper Use

DANGER

High electric voltage and high working current! Risk of death or severe bodily injury by electric shock!

Observe the safety instructions!

DANGER

Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!

Observe the safety instructions!

WARNING

High electric voltage because of incorrect connection! Risk of death or bodily injury by electric shock!

Observe the safety instructions!

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

Observe the safety instructions!

CAUTION

Hot surfaces on device housing! Danger of injury! Danger of burns!

Observe the safety instructions!

CAUTION

Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting or improper handling of pressurized lines!

Observe the safety instructions!

CAUTION

Risk of injury by improper handling of batteries!

Observe the safety instructions!

3.2 Instructions with Regard to Specific Dangers

3.2.1 Protection Against Contact with Electrical Parts and Housings

This section concerns devices and drive components with voltages of more than **50 volts**.

Contact with parts conducting voltages above 50 volts can cause personal danger and electric shock. When operating electrical equipment, it is unavoidable that some parts of the units conduct dangerous voltage.

DANGER

High electrical voltage! Danger to life, electric shock and severe bodily injury!

- Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain and repair this equipment.
- Follow general construction and safety regulations when working on electrical power installations.
- Before switching on the device, the equipment grounding conductor must have been permanently connected to all electrical equipment in accordance with the connection diagram.
- Do not operate electrical equipment at any time, even for brief measurements or tests, if the equipment grounding conductor is not permanently connected to the mounting points of the components provided for this purpose.
- Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit. Provide a safeguard to prevent reconnection.
- For electrical drive and filter components, observe the following:
  Wait **30 minutes** after switching off power to **allow capacitors to discharge** before beginning to work. Measure the electrical voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.
- Never touch the electrical connection points of a component while power is turned on.
- Install the covers and guards provided with the equipment properly before switching the device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.
- A residual-current-operated circuit-breaker or r.c.d. cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device according to the relevant standards.
- Secure built-in devices from direct touching of electrical parts by providing an external housing, for example a control cabinet.

For electrical drive and filter components with voltages of **more than 50 volts**, observe the following additional safety instructions.

DANGER

High housing voltage and high leakage current! Risk of death or bodily injury by electric shock!

- Before switching on, the housings of all electrical equipment and motors must be connected or grounded with the equipment grounding conductor to the grounding points. This is also applicable before short tests.
- The equipment grounding conductor of the electrical equipment and the devices must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.
- Over the total length, use copper wire of a cross section of a minimum of 10 mm² for this equipment grounding connection!
- Before commissioning, also in trial runs, always attach the equipment grounding conductor or connect to the ground wire. Otherwise, high voltages may occur at the housing causing electric

3.2.2 Protection Against Electric Shock by Protective Extra-Low Voltage

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

All connections and terminals with voltages between 5 and 50 volts at Rexroth products are PELV systems[1]. It is therefore allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections and terminals.

WARNING

High electric voltage by incorrect connection! Risk of death or bodily injury by electric shock!

If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g. the mains connection) are connected to Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV[1].

3.2.3 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

These errors can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily harm and/or material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

1) "Protective Extra-Low Voltage"

DANGER

Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

- For the above reasons, ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation.
  They have to be provided for by the user according to the specific conditions within the installation and a hazard and fault analysis. The safety regulations applicable for the installation have to be taken into consideration. Unintended machine motion or other malfunction is possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, bodily harm and/or material damage

- Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:
  - use safety fences
  - use safety guards
  - use protective coverings
  - install light curtains or light barriers
- Fences and coverings must be strong enough to resist maximum possible momentum.
- Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before commissioning. Do not operate the device if the emergency stop switch is not working.
- Isolate the drive power connection by means of an emergency stop circuit or use a safety related starting lockout to prevent unintentional start.
- Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone.
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example:
  - mechanically securing the vertical axes,
  - adding an external braking/arrester/clamping mechanism or
  - ensuring sufficient equilibration of the vertical axes.
- The standard equipment motor brake or an external brake controlled by the drive controller are **not sufficient to guarantee personal safety**!
- Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:
  - maintenance and repair work
  - cleaning of equipment
  - long periods of discontinued equipment use
- Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such devices cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial commissioning. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

3.2.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious personal danger to those with heart pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

- Persons with heart pacemakers and metal implants are not permitted to enter following areas:
  - Areas in which electrical equipment and parts are mounted, being operated or commissioned.
  - Areas in which parts of motors with permanent magnets are being stored, repaired or mounted.
- If it is necessary for somebody with a pacemaker to enter such an area, a doctor must be consulted prior to doing so. The noise immunity of present or future implanted heart pacemakers differs greatly so that no general rules can be given.
- Those with metal implants or metal pieces, as well as with hearing aids, must consult a doctor before they enter the areas described above. Otherwise health hazards may occur.

3.2.5 Protection Against Contact with Hot Parts

CAUTION

Hot surfaces at motor housings, on drive controllers or chokes! Danger of injury! Danger of burns!

- Do not touch surfaces of device housings and chokes in the proximity of heat sources! Danger of burns!
- Do not touch housing surfaces of motors! Danger of burns!
- According to the operating conditions, temperatures can be **higher than 60 °C**, 140 °F during or after operation.
- Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require **up to 140 minutes**! Roughly estimated, the time required for cooling down is five times the thermal time constant specified in the Technical Data.
- After switching drive controllers or chokes off, wait 15 minutes to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, the manufacturer of the end product, machine or installation, according to the respective safety regulations, has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: warnings, guards (shielding or barrier), technical documentation.

3.2.6 Protection During Handling and Mounting

In unfavorable conditions, handling and mounting certain parts and components in an improper way can cause injuries.

CAUTION

Risk of injury by improper handling! Bodily injury by bruising, shearing, cutting, hitting!

- Observe the general construction and safety regulations on handling and mounting.
- Use suitable devices for mounting and transport.
- Avoid jamming and bruising by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- If necessary, use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids because of the danger of skidding.

3.2.7 Battery Safety

Batteries consist of active chemicals enclosed in a solid housing. Therefore, improper handling can cause injury or material damage.

CAUTION

Risk of injury by improper handling!

- Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
- Do not recharge the batteries as this may cause leakage or explosion.
- Do not throw batteries into open flames.
- Do not dismantle batteries.
- When replacing the battery/batteries do not damage electrical parts installed in the devices.
- Only use the battery types specified by the manufacturer.

Environmental protection and disposal! The batteries contained in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separate from other waste. Observe the local regulations in the country of assembly.

Safety Instructions for Electric Drives and Controls

3.2.8 Protection Against Pressurized Systems

According to the information given in the Project Planning Manuals, motors cooled with liquid and compressed air, as well as drive controllers, can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricating agents. Improper handling of the connected supply systems, supply lines or connections can cause injuries or material damage.

CAUTION

Risk of injury by improper handling of pressurized lines!

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Observe the respective manufacturer's operating instructions.
- Before dismounting lines, relieve pressure and empty medium.
- Use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
- Immediately clean up any spilled liquids from the floor.

Environmental protection and disposal! The agents used to operate the product might not be economically friendly. Dispose of ecologically harmful agents separately from other waste. Observe the local regulations in the country of assembly.

4 Important Information on Voltage Areas

4.1 Inline Voltage Areas

Inline terminals are mainly available for the safety extralow voltage area. When using relay terminals, you work in the low-voltage area. The terminals are divided into two product groups according to their use in a specific voltage area and their function.

Voltage Area	Voltage Used for Inline	Product Group
SELV	24 V DC	Low-level signal terminals
Low voltage	230 V AC	Relay terminals

Figure 4-1 Voltage areas and corresponding terminal designations for Inline

Follow the safety instructions given in the following sections when working outside the SELV area.

4.2 Correct Usage

The Inline terminals should only be used within an Inline station according to the instructions given in the terminal-specific data sheets and in this application description.
Accepts no liability if the device is used for anything other than its designated use.

WARNING

Dangerous voltage

Please note that there are dangerous voltages when switching circuits that do meet SELV requirements.When working on the terminals and wiring, always switch off the supply voltage and ensure it cannot be switched on again.

DANGER

Do not replace terminals while the power is connected.

Before removing or mounting a terminal, disconnect power to the entire station. Make sure the entire station is reassembled before switching the power back on.

Important Information on Voltage Areas

4.3 Safety Instructions for the Low-Voltage Area

CAUTION

Only qualified personnel (qualified electricians or persons instructed in electrical engineering) may work on Inline terminals outside the SELV area.
The instructions given in the terminal-specific data sheets must be followed during installation and startup.

An **electrician** is a person who, because of their education, experience and instruction and their knowledge of relevant standards, can assess any required operations and recognize any possible dangers. (Definitions according to DIN VDE 1000-10:1995)

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

4.4 Installation Instructions and Notes for the Low-Voltage Area

CAUTION

Dangerous voltage

Please note that there are dangerous voltages when switching circuits that do meet SELV requirements.

Connecting and disconnecting connectors and terminals in the 230 V AC voltage area is only permitted if 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.

CAUTION

Use grounded AC voltage networks.

Inline terminals for the 230 V AC voltage area should only be operated in grounded AC voltage networks (AC networks).

4.5 Structure of an Area With a Relay Terminal

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

The number of terminals within a station is limited by the system restrictions of the bus system and the Inline system (see Chapter 11, "Technical Data and Ordering Data").

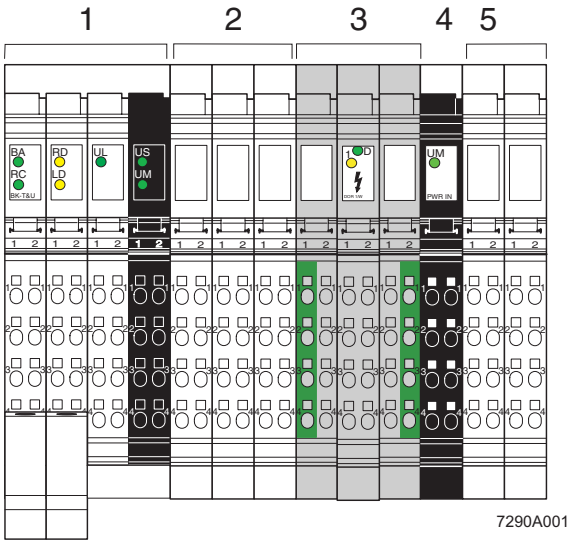


Figure 4-1 Typical structure of an Inline station with 24 V voltage area and a relay terminal

1 Bus couplers
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 DC area

4.6 Electronics Base and Connectors

Low-level signal terminals and relay terminals are located in the same type of housing, which is referred to as a low-level signal housing. An external characteristic that distinguishes the base and the appropriate connectors for the relay terminals from the base and connectors for the 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	Light color for function identification (e.g., light blue) with white lightning bolt

Figure 4-2 Color of base and connectors

4.7 Safety Mechanisms to Prevent Incorrect Connection of Connectors for Different Voltage Areas

4.7.1 Protection Against the Connection of Connectors of the 24-V-Level to Relay Terminals

The low-level signal connectors can be plugged into relay terminals. Because the relay outputs are floating, this connection error has no negative effects.

4.7.2 Protection Against the Connection of Live 230-V-AC- Connectors in the 24 V DC Area

In the low-voltage area, live connectors can be connectors for the relay terminals.

These connectors are closed using filler plugs at some places and, therefore, do not fit on the terminals of the 24-V-area.

4.8 Response to the Connection of a Relay Terminal in the 24-V-DC 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 (type: R-IB IL DOR LV-SET) before and after the relay terminal.

5 Inline Product Groups

The following sections give you an overview of the Inline product groups. For specific information on the individual terminals, please refer to the terminal-specific data sheets and the individual sections in this application description.

5.1 General

5.1.1 Different Transmission Speeds

Inline terminals are available for transmission speeds of 500 kbps and 2 Mbps. The order designation specifies the transmission speed.

Example:

500 kbps:	R-IB IL 24 DI 4
2 Mbps	R-IB IL 24 DI 4**-2MBD**

CAUTION

Please note that you can only work with one transmission speed within a bus system.

You can identify terminals by means of the function identification (see "Function Identification and Labeling" on page 36).

5.1.2 Products With or Without Accessories

Inline terminals are available with or without accessories. The order designation specifies the scope of supply.

Example:

Without accessories:	R-IB IL 24 DI 4
Including accessories:	R-IB IL 24 DI 4**-PAC**

In the case of PAC products, Inline connectors and labeling fields are included in the scope of supply.

Inline Product Groups

5.2 Bus Couplers and Terminals With Remote Bus Branch

5.2.1 Bus Couplers

A bus coupler is needed to connect an Inline station to a bus. The following bus couplers were available when this application description was ready for printing:

Bus Coupler	Bus System
R-IBS IL 24 BK-T/U R-IBS IL 24 BK-DSUB	INTERBUS
R-IL PB BK R-IL PB BK DP/V1 R-IL PB BK DI8 DO4	PROFIBUS-DP
R-IL DN BK	DeviceNET
R-IL CAN BK-TC	CANopen

Figure 5-1 Bus couplers for different bus systems

The product range is continuously growing. More information on the range can be found on the Internet at www.boschrexroth.com.

The different bus couplers are described in separate documents. Not every Inline terminal can be operated with every bus coupler. For an overview of the compatibility between Inline terminals and bus couplers for various bus systems, please see "DOC-CONTRL-ILIOLIST***-KB..-EN-P".

5.2.2 Terminal With Remote Bus Branch

If permitted by your bus system, this terminal can be used to create a remote bus branch from the Inline station. This enables further segmentation of the system so that, for example, star structures can be created. This terminal can be used to switch the connected remote bus branch on or off.

The remote bus branch modules do not count as Inline station modules.

Terminals with remote bus branch can only be placed **directly** behind a bus coupler or a terminal with remote bus branch.

This means that there must be **no INTERBUS devices** (no terminals with protocol chip/ID code) between the bus coupler and the terminal with remote bus branch.

Observe the restrictions of your bus system or bus coupler with regard to terminals with remote bus branch.

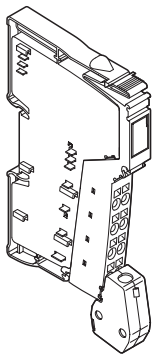


Figure 5-1 Terminal with remote bus branch: R-IBS IL 24 RB-T

5.3 Supply Terminals

Power terminals and segment terminals are available to supply the station with I/O voltage. The segment terminals complement 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 (INTERBUS Device)	Fused Area
R-IB IL 24 PWR IN	Power terminal	U_M/U_S	No	No	None
R-IB IL 24 PWR IN/R		U_{24V} (U_L/U_{ANA})/ U_M/U_S	No	No	None
R-IB IL 24 SEG/F	Segment terminal	U_S	Yes	No	Segment circuit
R-IB IL 24 SEG/F-D				Yes	

Figure 5-2 Overview of the supply terminals

CAUTION

Protect the power supply.

Protect the voltage supply externally, regardless of the supply terminal used.

CAUTION

Do not replace terminals while the power is connected.

Make sure power to the entire station is disconnected before removing a terminal. Make sure the entire station is reassembled before switching the power back on.

5.3.1 Power Terminal

A power terminal is used to supply the required voltages to the internal station potential jumpers. Several supply 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 segment voltage.

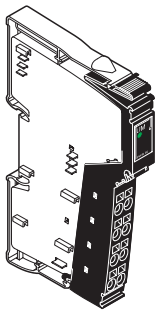


Figure 5-2 Example of a power terminal: R-IB IL 24 PWR IN

Potential jumpers

The power terminal interrupts all potential jumpers for the voltages to be reinjected, and recreates all potential jumpers (see also "Electrical Potential and Data Routing" on page 47).

Carrying capacity of the jumper contacts

The maximum load capacity of the jumper contacts on the side is indicated in "Current and Voltage Distribution" on page 58.

Electrical isolation

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

Functional earth ground connection

24 V terminals are connected to the functional earth ground when they are 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 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 snapped onto this terminal.

Inline Product Groups

5.3.2 Segment Terminal

Segment terminals can only be used in the 24 V DC area. Segment terminals are used to create partial circuits (segment circuits) within the main circuit.

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

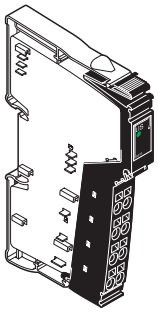


Figure 5-3 Example of a segment terminal: R-IB IL 24 SEG

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 further information on the supply voltages, please refer to "Circuits and Provision of Supply Voltages" on page 47.

Carrying capacity of the jumper contacts The maximum load capacity of the jumper contacts on the side is indicated in "Current and Voltage Distribution" on page 58.

Functional earth ground connection The terminal is connected to the functional earth ground when it 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 to the terminal points for an FE-connection.

When mounting a segment terminal onto the previous terminal, this segment terminal is connected to the potential jumper FE of the station.

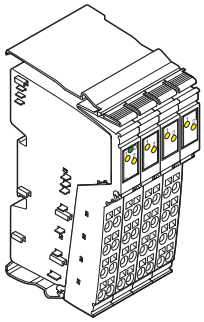
5.4 Input/Output Terminals

5.4.1 General Information on Terminals for Analog and Digital Signals

For low-level signals, terminals with different functions are available. This includes, for example, input/output terminals for analog and digital signals, counter terminals and positioning terminals.

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

Input/output terminals for digital signals and terminals with floating SPDT relay contacts are available for the low voltage level.



5520A015

Figure 5-4 Example of a digital input terminal: R-IB IL 24 DI 8

Protection

Overload protection of the system is centrally provided by a fuse in the power terminal or by an external fuse provided by the user. The rating of the preconnected fuse must be such that the maximum 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 load capacity of the jumper contacts on the side is indicated in "Current and Voltage Distribution" on page 58.

Grounding (FE)

Connection to functional earth ground (24 V DC area) is provided via the potential jumpers when the terminal is snapped onto the previous terminal.

Voltage area

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

Inline Product Groups

5.4.2 Terminals for Analog Signals

Shielding The connectors of analog terminals have a special shield connection to shield the cables.

Parameterization Terminals for analog signals are in a preset configuration upon delivery.

Some terminals may also be parameterized to other configurations using the output data words. Please refer to the terminal-specific data sheet to see if a specific analog terminal can be configured and how the output data words are assigned.

Data formats The measured values and the corresponding output values of terminals for analog signals can be represented in different data formats depending on the terminal used and on its configuration. These formats are listed in the terminal-specific data sheets.

Diagnostics in the input data word Analog input terminals have overrange detection in all measuring ranges.

Open circuit is indicated in the 4 mA - 20 mA range.

Open circuit is also reported when using terminals for connecting thermocouples and resistive temperature sensors.

Extended diagnostics Some data formats support extended diagnostics. To determine whether extended diagnostics are available for a specific terminal, please refer to the terminal-specific data sheet.

5.5 Function Terminals (Communication, Open and Closed-Loop Control)

Function terminals are available to meet the following requirements:

- Counting (R-IB IL CNT)
- Positioning (e.g., R-IB IL SSI, R-IB IL INC)
- Integrating V.24 devices
  (R-IB IL RS 232-PRO, R-IB IL RS 485/422-PRO)
- Pulse width modulation (R-IB IL PWM/2)
- Temperature controller (R-IB IL TEMPCON UTH, R-IB IL TEMPCON RTD)

Please refer to the corresponding data sheet or application description for information on these terminals.

5.6 Branch Terminal

A branch terminal is available for integrating a Fieldline modular local bus in an Inline station.

This terminal can be used to integrate sensors and actuators in close proximity to the station, which are connected to the Fieldline modular local bus with IP65/67 protection, in your bus system. Only use the branch terminal as the last terminal in an Inline station.

Please refer to the corresponding data sheet for information on this terminal.

5.7 Example Structure of an Inline Station

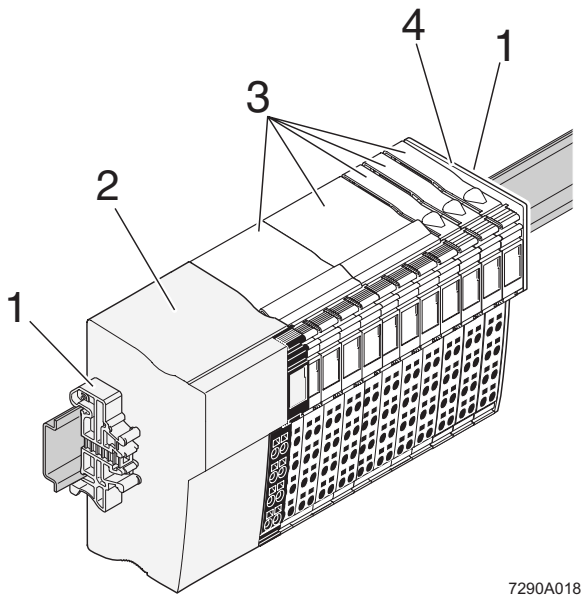


Figure 5-5 Example station with 24-V-DC-terminals

The example Inline station shown in Figure 5-5 consists of the following elements:

1 End clamp
2 Bus coupler (here, basic representation of a bus coupler with optional voltage supply)
3 24 V DC terminals (e.g., I/O terminal)
4 End plate (end of the station)

Notes

5.8 Inline Block IO Modules

Block IO modules are available for inputting and/or outputting digital and analog signals to various bus systems. Modules are available for the following bus systems: INTERBUS, PROFIBUS-DP, DeviceNET, and CANopen.

The product range is continuously growing. More information on the range can be found in the latest online product catalog at www.boschrexroth.com.

6 Structure and Dimensions of the Inline Terminals

6.1 Basic Structure of Terminals

Independent of function and design width, an Inline terminal consists of the electronics base and the snap-in-place connector.

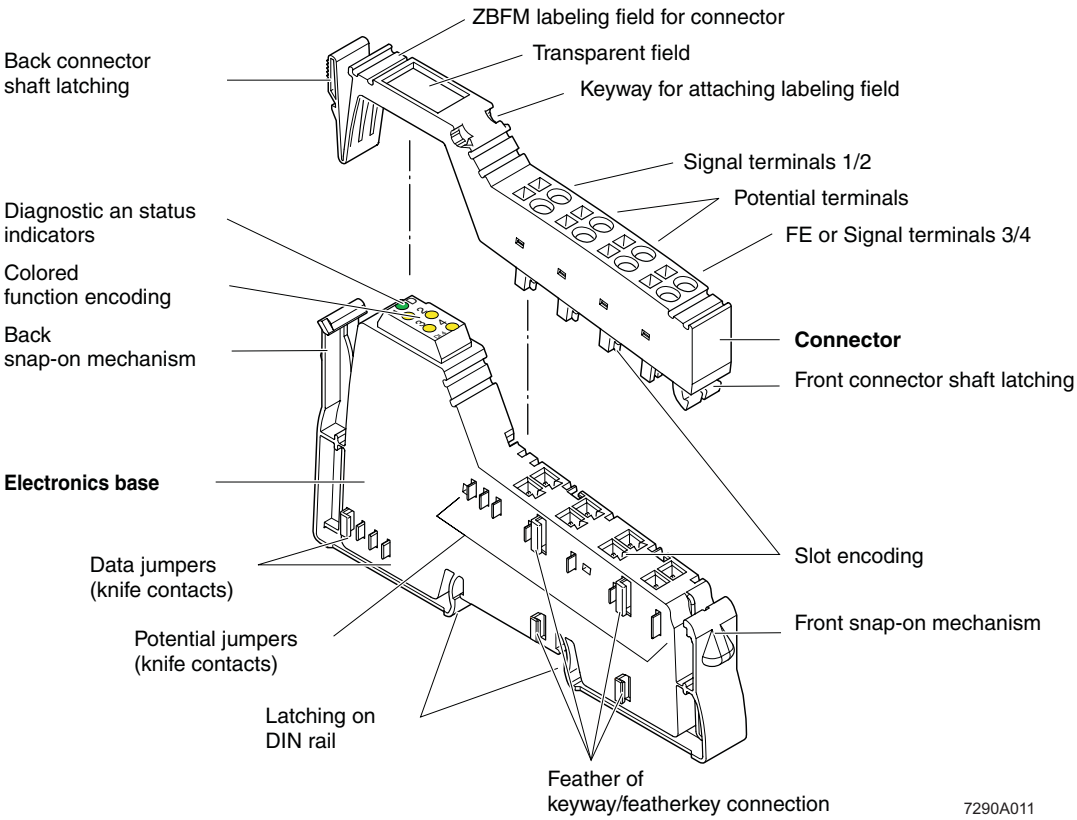


Figure 6-1 Basic Inline terminal structure

The components shown in Figure 6-1 are described in the following sections.

The components required for labeling are listed in "Ordering Data" on page 103.

6.2 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 with regard to the DIN rail is the same for all terminals (see also Figure 7-2 on page 55). 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 (shown in Figure 6-1). They snap into the featherkeys of the next terminal on the left when the station is mounted.

The type of routing contacts (i.e., potential or data) that are on each terminal depends on the function of the terminal and is shown in the circuit diagram of each terminal-specific data sheet.

Snap-on mechanism/ latching

Pressing the front and back snap-on mechanism at the same time releases the latching, enabling the terminal to be removed by pulling it straight back from the DIN rail (see "Mounting and Removing Inline Terminals" on page 68).

Keyway/featherkey connection

The featherkeys are on the left-hand side of the terminal (Figure 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 base and the appropriate connectors for the different voltage areas are of different colors (see "Electronics Base and Connectors" on page 19).

6.3 Connectors

The I/O or supply voltages are connected using a pluggable connector.

Connector width

Regardless of the width of the electronics base, the connectors have a width of two terminal points (connection points). This means that you must plug one connector on a 2-slot base, two connectors on a 4-slot base, and four connectors on an 8-slot base.

Connector colors

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

Light gray	Connectors for low-level signal (24 V DC) terminals (excluding supply terminals)
Black	Connectors for low-level signal supply terminals (24 V DC)
Dark gray	Connectors for relay terminals

Connector types (24 V DC) The following connector types are available for the 24 V DC area:

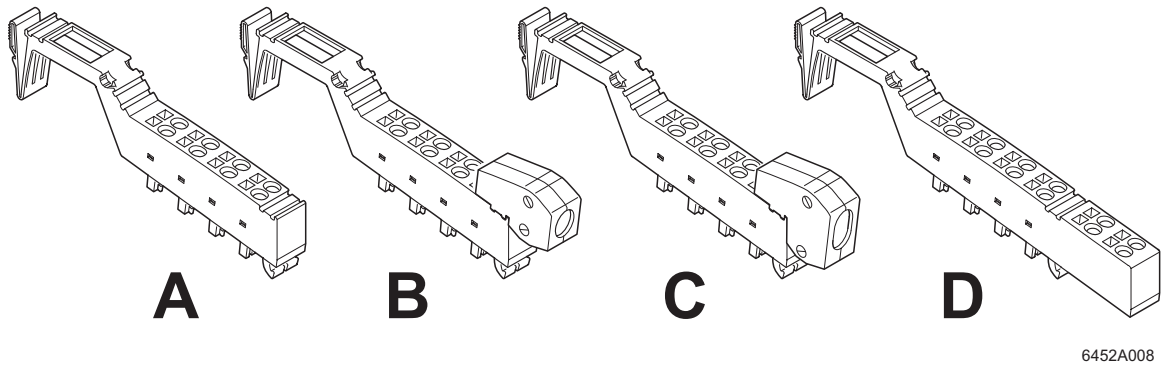


Figure 6-2 Connector types for Inline terminals

A Standard connector

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

The black standard connector is used for supply terminals. Some of the adjacent contacts are jumpered internally (see Figure 6-3 on page 35).

B Shield connector for connecting one cable

C Shield connector for connecting two cables

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

FE or shielding is connected by a shield connection clamp rather than by a terminal point.

D Extended double signal connector

This light gray connector is used for the connection of four signals in 3-wire technology (e.g., digital I/O signals).

Relay-module connector Dark gray standard connectors are available for the relay modules.

Structure and Dimensions of the Inline Terminals

Connector identification

All connectors are offered with and without color print. The connectors with color print (marked with CP in the order designation) have terminal points that are color-coded according to their functions.

The following colors indicate the signals of the terminal points:

Color	Terminal Point Signal
Red	+
Blue	-
Green	Functional earth ground (FE)
Green/yellow	Functional earth ground (FE); This marking may still be seen on older connectors. Functional earth ground is marked in green on modern connectors.

Figure 6-1 Terminal point color-coding (24 V DC)

The connectors for distance terminals are color-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.

Special features and internal jumpering

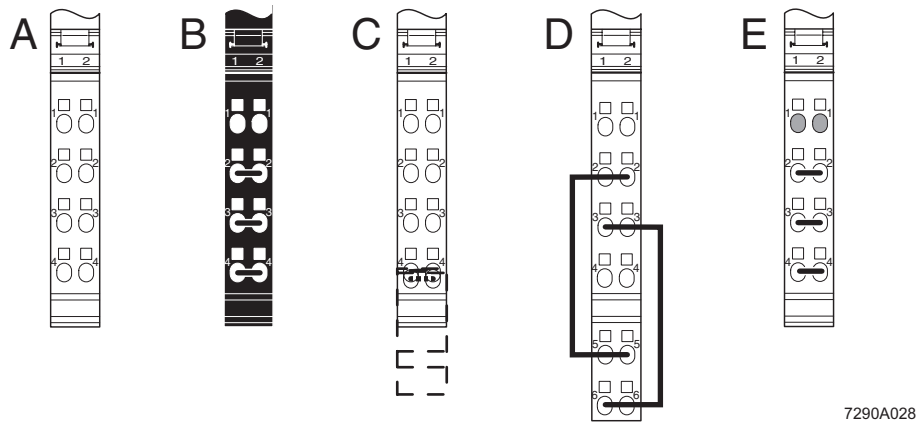


Figure 6-3 Internal jumpering within 24 V DC connectors

A Light gray connector for I/O connection

B Black connector for providing the supply voltages

C Light gray shield connector for the connection of shielded cables

D Light gray double signal connector for I/O connection

E Dark gray connector for relay terminals

○ Terminal point without metal contact

The shield connector is jumpered between terminal points 1.4 and 2.4 through the shield connection as seen in Figure 6-3. All other connectors are jumpered **internally** through the terminal point connections **in the connector**.

CAUTION

Only install the appropriate connectors.

To avoid a malfunction, only snap a connector on a terminal that is appropriate for this connector. Refer to the terminal-specific data sheet to select the correct connectors.

Only place **black** connectors on supply terminals.

When the terminal points are jumpered in the black connector, power is carried through the jumpering in the connector and not through the printed circuit board of the terminal. The complete current carrying capacity is ensured through this jumpering.

The **black** connector must **not** be placed on a terminal that is to be used for a double signal connector. Incorrect connection may lead to a short circuit between two signal terminal points.

Structure and Dimensions of the Inline Terminals

6.4 Function Identification and Labeling

Housing

The basic fields of application for terminals can be identified by their housing color.

Field of Application	Housing Type	Housing Color	Connector Color
Low-level signal terminals (24 V DC)	Low-level signal housing	Light gray	Light gray/black
Relay terminals	Low-level signal housing	Dark gray	Dark gray

Figure 6-2 Field of application and housing

Function identification

The terminals are color-coded to enable visual identification of the functions (1 in Figure 6-4).

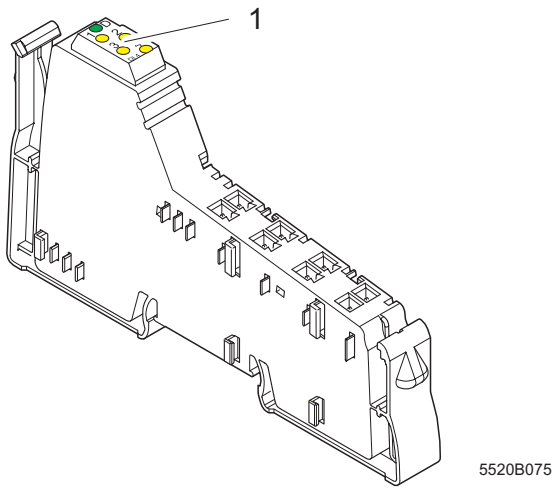


Figure 6-4 Function identification

The following colors indicate the functions:

Color	Terminal Function
24 V DC area	
Gray	Bus coupler
Black	Power terminal/segment terminal
Light blue	Digital input
Pink	Digital output
Green	Analog input
Yellow	Analog output
Orange	Function terminal/control terminal
Relay terminal	
Red with lightning bolt	Digital output

Figure 6-3 Terminal color-coding

Identification of transmission speed

Terminals with a transmission speed of 2 Mbps are identified by a white stripe at the level of the D LED.

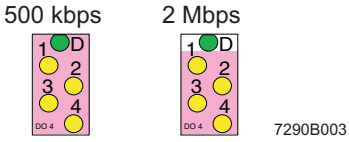


Figure 6-5 Identification of transmission speed

Connector identification

The color-coding of the terminal points is described on page 34.

Labeling/terminal numbering

Terminal point numbering is explained using the example of an 8-slot terminal.

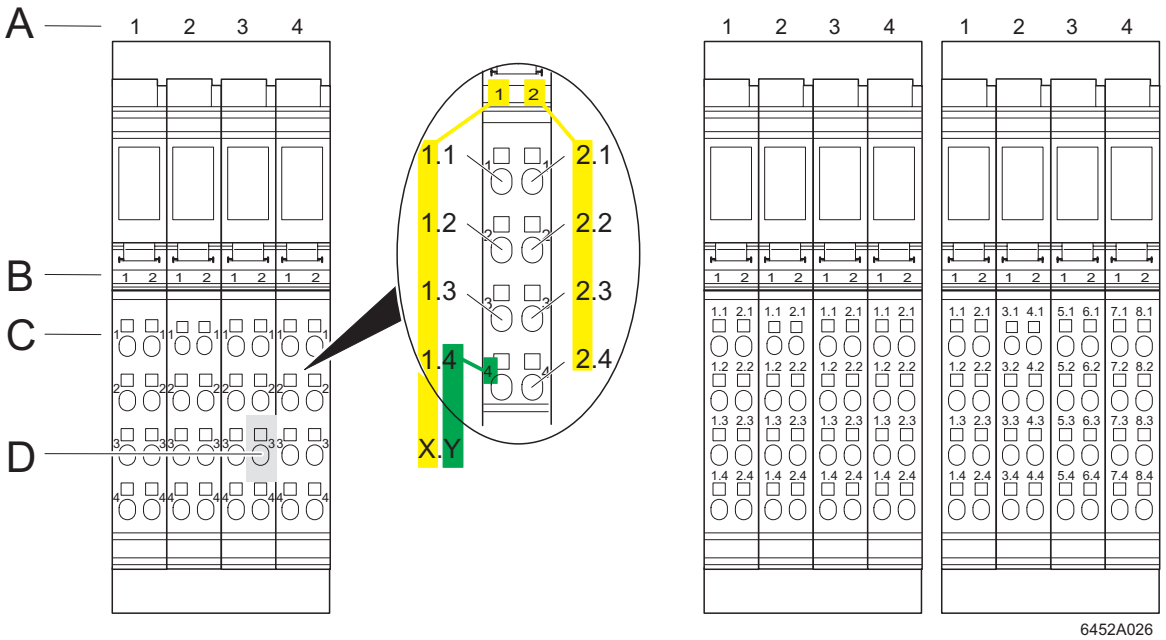


Figure 6-6 Terminal numbering

Slot/connector

The slots (connectors) on a base are numbered consecutively (A in Figure 6-6). This numbering is **not** shown on the terminal.

Structure and Dimensions of the Inline Terminals

Terminal point

Depending on your requirements you may order connectors with different terminal point labeling:

1 Connectors without labeling (diagram on the left-hand side in Figure 6-6):

The terminal points on these connectors are marked X.Y.

X is the number of the terminal point row on the connector. It is indicated above the terminal point row (B).

Y is the terminal point number in the terminal point row. It is directly indicated on the terminal point (C).

The precise designation for a point is thus specified by the slot and terminal point. The highlighted (gray) terminal point (D) would be numbered as follows: Slot 3 terminal point 2.3 (3.2.3).

2 Connector with printed terminal point numbering for each connector (middle diagram in Figure 6-6):

Here, the terminal points are numbered as described above. The numbers are printed above the terminal point.

3 Connector with printed terminal point numbering for each channel (diagram on the right-hand side in Figure 6-6):

For terminals with eight or sixteen inputs or outputs, connector sets are available, in which the terminal point rows are numbered by terminal (1 to 8) rather than by connector (1 and 2). The numbers are printed above the terminal point.

Use the information provided in the terminal-specific data sheet to select the connectors you require.

Additional labeling

In addition to this terminal designation, you can identify the slots, terminal points, and connections using labeling fields.

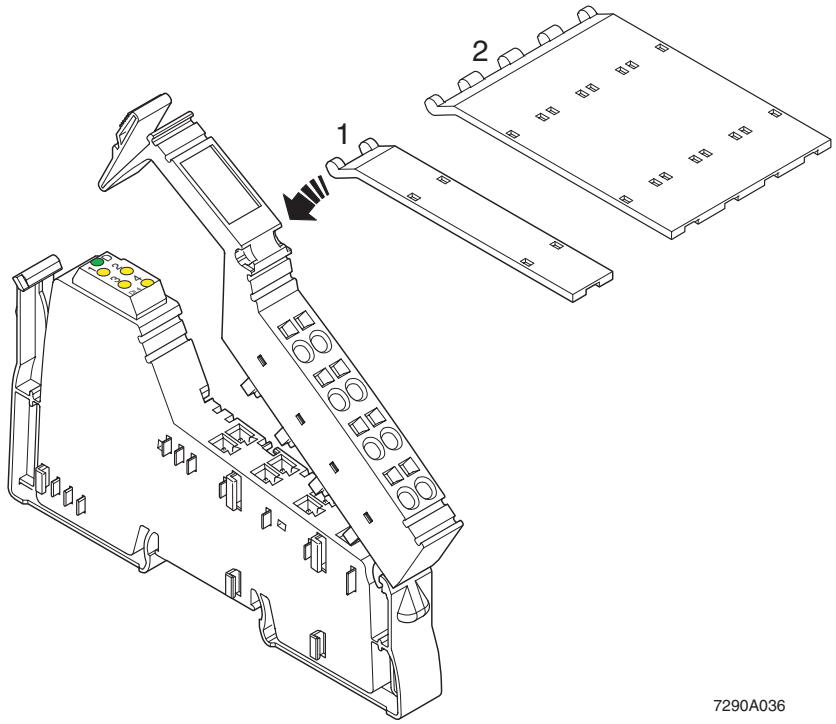


Figure 6-7 Labeling

Labeling fields are available in two widths, either as a labeling field covering one connector (1; R-IB IL FIELD 2) or as a labeling field covering four connectors (2; R-IB IL FIELD 8). You can label each channel individually with free text. On the upper part of the connector there is a keyway for attaching this labeling field. The labeling field can be tilted up and down. In each end position a light latching ensures that the labeling field remains in place.

Using the markers on the connector and on the electronics base, you can clearly assign both connector and 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 labeling fields (see "Ordering Data for Accessories" on page 103).

6.5 Housing Dimensions for Terminals

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 dimensions are determined by the dimensions of the electronics base and the dimensions of the connector.

The electronics base of the terminals is available in three standard design widths (12.2 mm, 24.4 mm and 48.8 mm. They take one (1), two (2) or four (4), 12.2 mm wide connectors.

When a connector is plugged in, each terminal has a depth of 71.5 mm.

The height of the terminal depends on the connector used. The connectors are available in three different versions.

6.5.1 Dimensions of the Electronics Base

2-slot housing, example: R-IB IL 24 DO 2 R-IB IL 24 DI 4

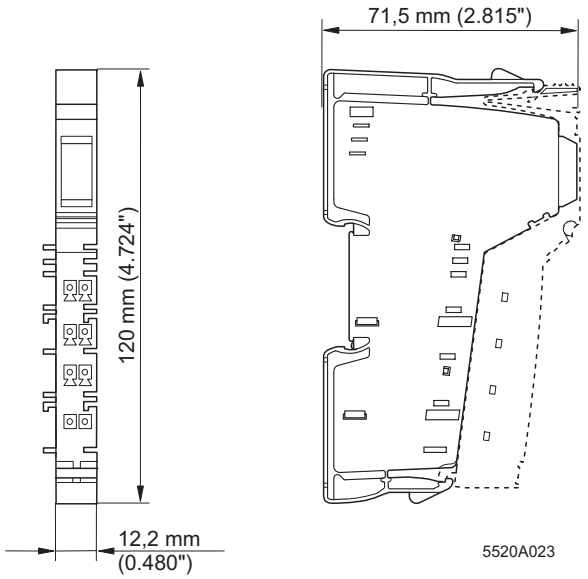


Figure 6-8 Dimensions of the electronics base (2-slot housing)

4-slot housing, example: R-IB IL AO 1/SF R-IB IL CNT

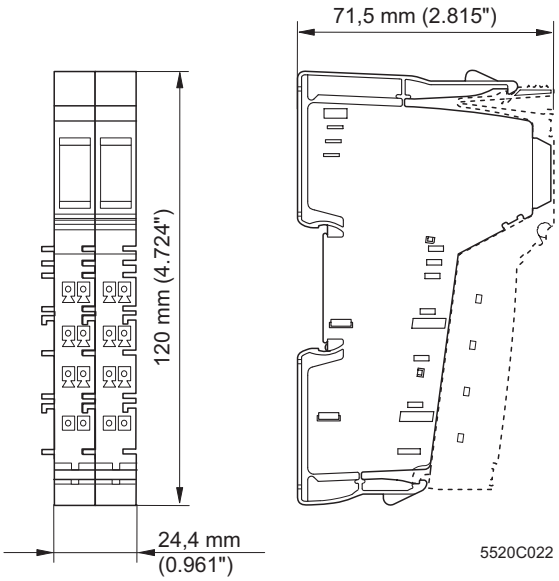


Figure 6-9 Dimensions of the electronics base (4-slot housing)

8-slot housing, example: R-IB IL 24 DO 8 R-IB IL 24 DI 16

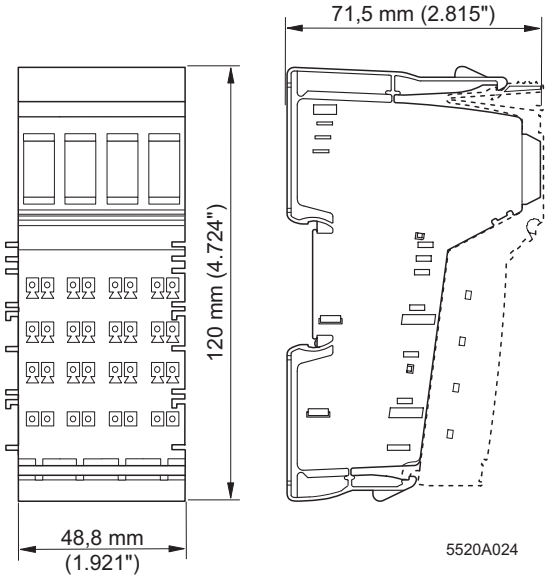


Figure 6-10 Dimensions of the electronics base (8-slot housing)

Structure and Dimensions of the Inline Terminals

Container housing 1, example: R-IBS IL 24 BK-DSUB R-IL PB BK

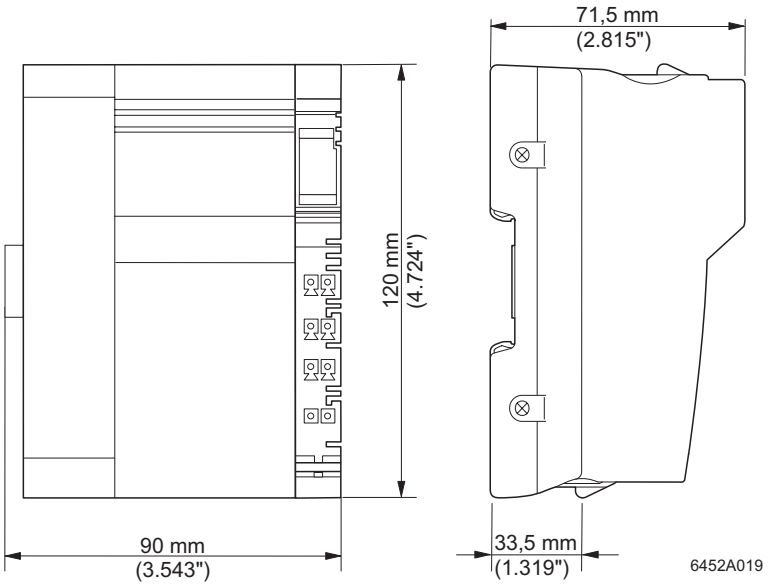


Figure 6-11 Dimensions of the electronics base (container housing 1)

6.5.2 Connector Dimensions

Connector

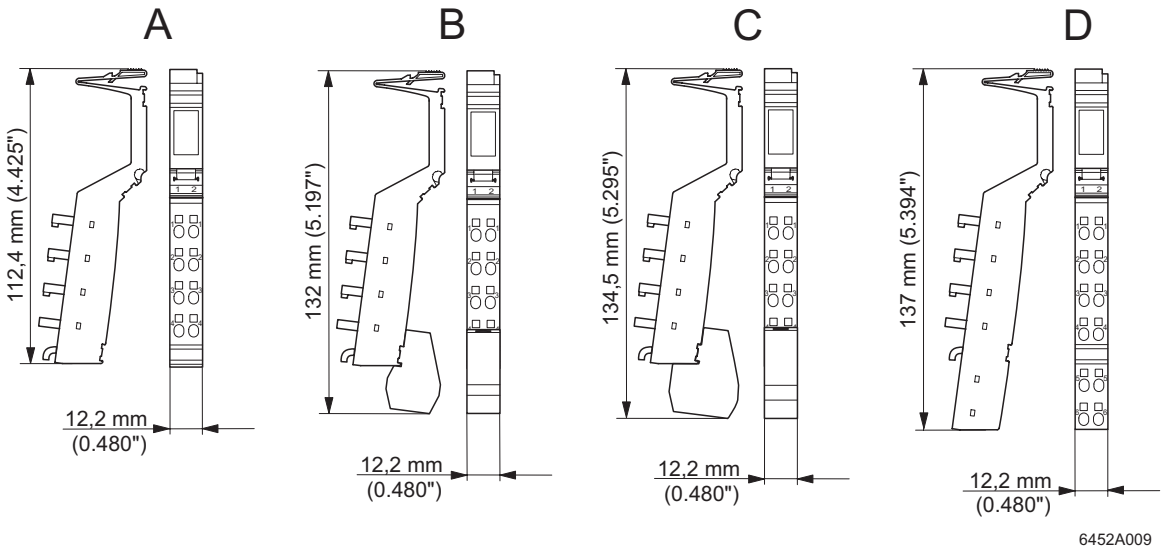


Figure 6-12 Connector dimensions

Key:

A Standard connector (dimensions also apply to connector for relay terminals)

B Shield connector for connecting one cable

C Shield connector for connecting two cables

D Extended double signal connector

The depth of the connector does not influence the overall depth of the terminal.

6.6 Mounting Distances

DIN rail Inline terminals are always mounted onto DIN rails.

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

6.6.1 Mounting Distances

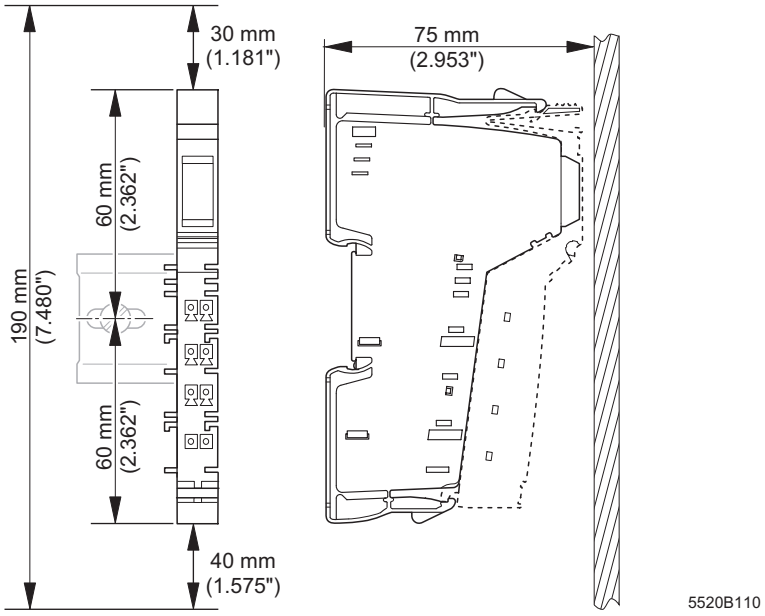


Figure 6-13 Mounting Distances

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

6.6.2 Mounting Distances for Mounting Outside a Terminal Box

If the Inline stations are housed in a control cabinet rather than a terminal box, for example, the DIN rail distances depend on the previously mentioned mounting distances.

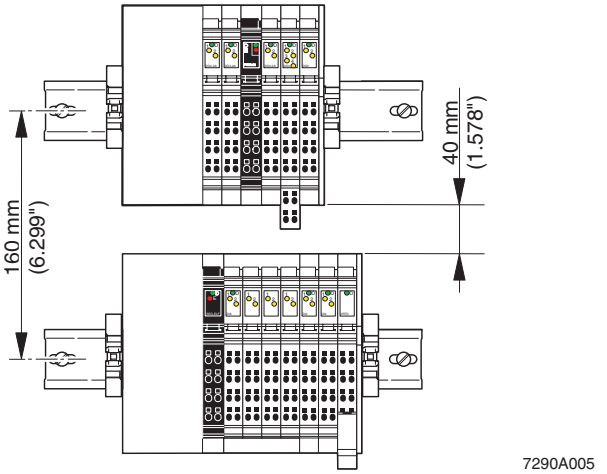


Figure 6-14 Mounting distances for mounting outside a terminal box

Notes

7 Electrical Potential and Data Routing

7.1 Circuits and Provision of Supply Voltages

There are several circuits within an Inline station. These are automatically created when the terminals are properly installed. 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 "Example of a Circuit Diagram" on page 52. The descriptions in the following sections refer to this example.

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

Carrying capacity of the jumper contacts

Observe the maximum current carrying capacity of the jumper contacts on the side for each circuit. The current carrying capacities for all potential jumpers are given in the following sections and are summarized in "Current and Voltage Distribution" on page 58.

The arrangement of the potential jumpers and information on current and voltage distribution on the potential jumpers can be found in "Electrical Potential and Data Routing" on page 55.

The connection of the supply voltages is described in "Connecting the Voltage Supply" on page 83.

For voltage connection, please refer to the notes given in the terminal-specific data sheets.

7.1.1 Supply of the Bus Coupler

Please refer to the documentation for your bus coupler to determine the correct voltage supply for the 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

7.1.2 Logic Circuit

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

Function The protocol chips for station devices are supplied with communications power from the logic circuit.

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

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

Current carrying capacity The current carrying capacity is 2 A maximum (see technical data of the bus coupler or power terminal). If this value is reached, the voltage must be reinjected via a power terminal or a new station must be created using a bus coupler.

The current consumption from the logic circuit of each device is given in the Inline device list and in every terminal-specific data sheet.

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

7.1.3 Analog Circuit

The analog circuit with the supply for the analog terminals (also known as analog voltage) U_{ANA} starts at the bus coupler or at a power terminal (R-IB IL 24 PWR IN/R) 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 from the bus coupler or a power terminal from the connected supply voltage.

Current carrying capacity The current carrying capacity is 0.5 A maximum (see technical data of the bus coupler or power terminal). If this value is reached, the voltage must be reinjected via a 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 given in the Inline device list and in every terminal-specific data sheet.

7.1.4 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 feature 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 thus 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 devices are supplied from the segment circuit.

Voltage

The voltage in this circuit should 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).

This current carrying capacity can be reduced 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 used.

Electrical Potential and Data Routing

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 that cannot supply the main voltage is used.
2. A new 24 V area is to be created 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.

7.1.5 Segment Circuit

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

Please note the special feature 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

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

The segment circuit also provides the auxiliary supply voltage for controlling power switches and contactors.

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 devices are supplied from the segment circuit.

The segment circuit can be switched off or fused using the safety or segment terminals. It has the same reference ground as the main circuit. This means that circuits with different fuses can be created within the station without external cross wiring.

Voltage

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

Current carrying capacity

If the segment terminal and the preconnected power terminal do not have any other limitations, the maximum current carrying capacity is 8 A (total current with the main circuit). 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 used.

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 power terminal with fuse can be used for the segment circuit. In this terminal, the segment voltage is automatically tapped from the main voltage.

Electrical Potential and Data Routing

7.1.6 Example of a Circuit Diagram

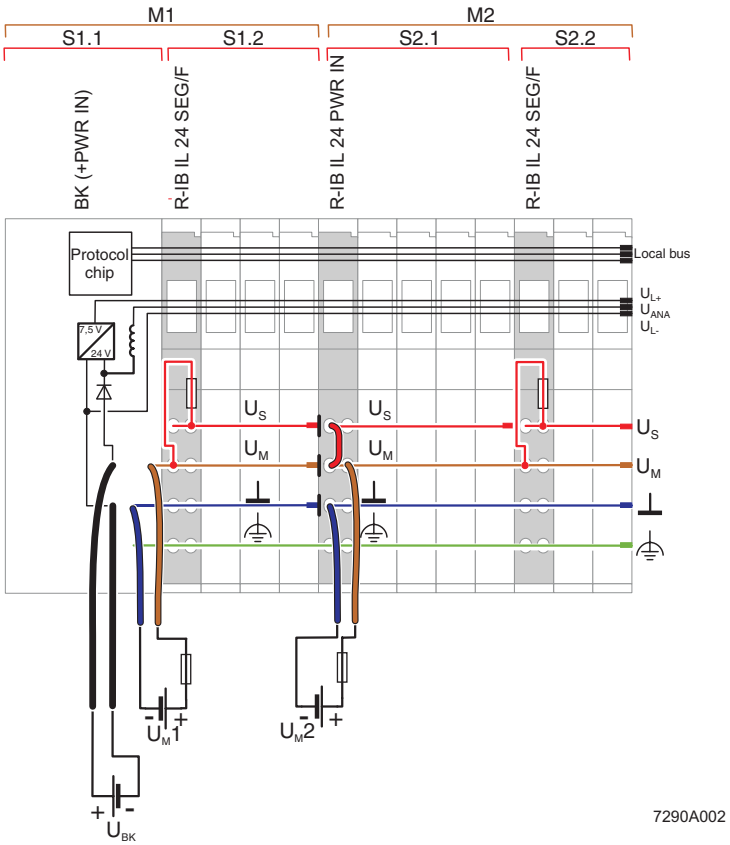


Figure 7-1 Potential routing within an Inline station

The illustrated Inline station is a typical example. It indicates the supply and provision of different voltages and their forwarding via potential jumpers. Explanations for this can be found in the following sections.

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

UBK Bus coupler supply (supply for bus coupler, generates U_{ANA} and U_L)

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

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

UANA I/O supply for analog terminals

UL Communications power

Local bus Data jumper for the local bus

Ground (GND for the supply voltages U_M and U_S)

Noiseless ground (functional earth ground, FE)

Protective earth ground

I Indicates the interruption of a potential jumper

Main circuit M1/segment S1.1

The supply voltage for the bus coupler U_{BK} is provided at the bus coupler (BK). In addition, the main voltage U_M1 is supplied at the bus coupler or a subsequent power terminal.

The supply voltage of the logic U_L and the supply voltage of 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 voltage U_M1.

If these voltages are not supplied separately (i.e., only the voltage U_M1, from which U_L and U_{ANA} are also generated, for example) 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 the internal fuse.

This segment terminal has been specifically used to create a protected segment circuit without the need for additional external fusing. If this is not necessary, 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 terminal) or a switch.

Electrical Potential and Data Routing

Main circuit M2/segment S2.1

The supply voltage for the power-level terminals and the subsequent terminals should be provided separately. For this, a new power terminal (e.g., R-IB IL 24 PRW/IN) is used, which provides the supply voltage U_M2.

Using a jumper, the segment voltage U_S for segment S2.1 is tapped from the main voltage U_M2 at this terminal.

Segment S2.2

Segment terminal R-IB IL 24 SEG provides the segment voltage U_S via a switch. Output terminals installed here can, therefore, be switched externally.

Errors and their effects

In this example structure, a short circuit in segment S1.2 or segment S2.2 would not affect the terminals in other segments. The fuse in segment terminal R-IB IL 24 SEG/F means that only segment S1.2 is switched off.

7.2 Electrical Potential and Data Routing

7.2.1 Arrangement of Potential Jumpers and Data Jumpers

An important feature of Inline is its internal potential routing system. The electric connection between the individual station devices is created automatically when the station is installed. When the individual station devices are connected, a power rail is created for the relevant circuit. Mechanically, this is created by interlocking knife and featherkey contacts from the adjacent terminals.

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

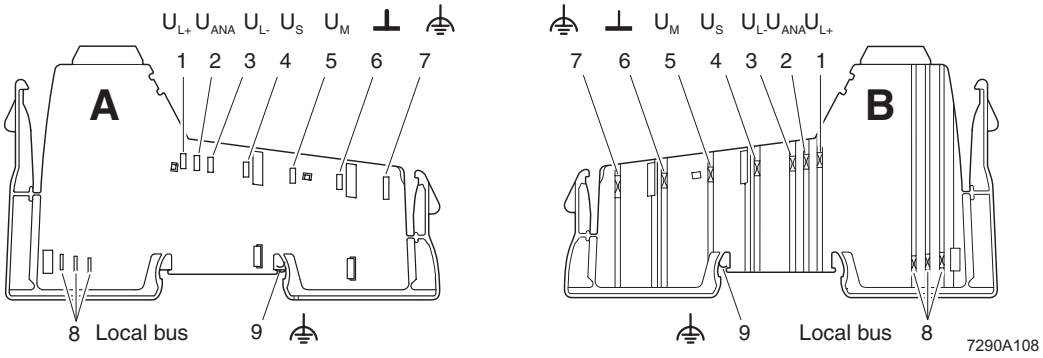


Figure 7-2 Arrangement of the potential and data jumpers

Electrical Potential and Data Routing

No.	Function		Meaning
			See Figure 7-2 "Arrangement of the potential and data jumpers" on page 55
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	Supply of the segment circuit (if necessary with overload protection)
5	24 V DC	U_M	Supply of the main circuit (if necessary with overload protection)
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 SELV area)
Data jumper			
8			Local bus

Figure 7-1 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 further information on circuits that are created via the potential jumpers U_L, U_{ANA}, U_M, and U_S, please refer to page 47.

Depending on the terminal function, not all of the jumpers listed in Figure 7-2 are present in a terminal. Please refer to the circuit diagram of the terminal to see which jumpers are provided for a terminal 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 circuits.

CAUTION

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 terminals used.

Refer to the data provided in the terminal-specific data sheet for your particular application.

FE The FE potential jumper must be connected via the corresponding connection at the bus coupler to a grounding terminal. In addition, the FE potential jumper is connected via the FE spring to the grounded DIN rail of every supply terminal and led through all of the terminals.

FE spring The 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 indicated for each circuit in "Circuits and Provision of Supply Voltages" on page 47.

Please refer to the information on the current carrying capacity of the power and segment terminals provided in the terminal-specific data sheets.

CAUTION

If the current carrying capacity of the potential jumpers U_L or U_{ANA} is reached, voltage must be reinjected via a 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.

Electrical Potential and Data Routing

7.2.2 Current and Voltage Distribution

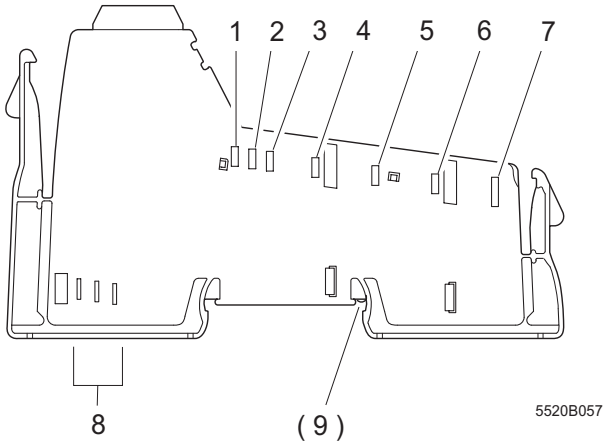


Figure 7-3 Current and voltage distribution

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 DC	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				

Figure 7-2 Current and voltage distribution in potential and data jumpers

[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.

8 Diagnostic and Status Indicators

All terminals are provided with diagnostic and status indicators 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 about the status of the terminal and, in the event of an error, provide information about the type and location of the error. A terminal is operating correctly if all its green LEDs are on.

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

Extended diagnostics Some Inline terminals 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 on the supply voltage is also reported. Information on I/O errors is sent to the control system with the precise identification of the error type and is displayed using status indicators.

Please refer to the terminal-specific data sheet for information about the diagnostic and status indicators on each terminal.

8.1 Indicators on Bus Couplers and Terminals With Remote Bus Branch

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

8.2 Indicators Available on Different Terminals in the Inline System

Some indicators can be found on various terminals and generally have the same meaning:

UM	Green LED	Supply in the main circuit
	ON:	Supply is present in the main circuit
	OFF:	Supply is not present in the main circuit

US	Green LED	Supply in the segment circuit
	ON:	Supply is present in the segment circuit
	OFF:	Supply is not present in the segment circuit

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

8.3 Indicators on Supply Terminals

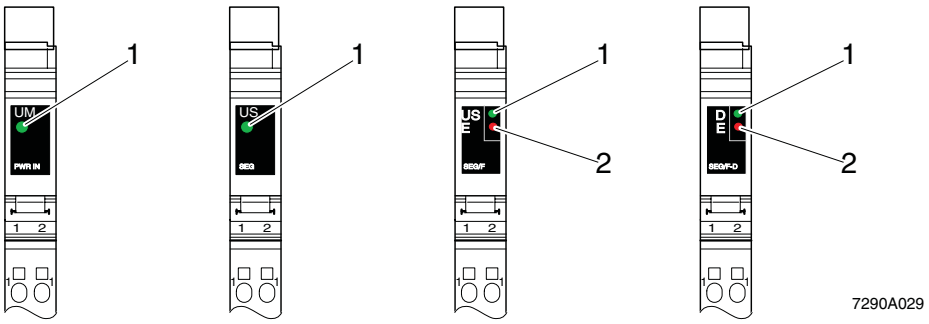


Figure 8-1 Possible indicators on supply terminals

Diagnostics The following states can be read on the supply terminals:

Power Terminal		
UM (1)	Green LED	Supply voltage in the main circuit (for meaning see page 60)
Segment Terminal		
US (1)	Green LED	Supply voltage in the segment circuit (for meaning see page 60)
Power Terminal With Fuse and Diagnostics/ Segment Terminal With Electronic Fuse		
D (3)	Green LED	Diagnostics (for meaning see page 60)
Also on Supply Terminals With Fuse		
E (2)	Red LED	Fuse status
	ON:	Fuse not present or blown
	OFF:	Fuse OK

On terminals with fuses, the green UM or US LED indicates that the main or segment voltage is present **at 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 fuses and diagnostics, there is no voltage after the fuse. Thus, a blown fuse is indicated by both diagnostic indicators. The red E LED is on and the green D LED flashes at 2 Hz.

8.4 Indicators on Input/Output Terminals and Function 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.

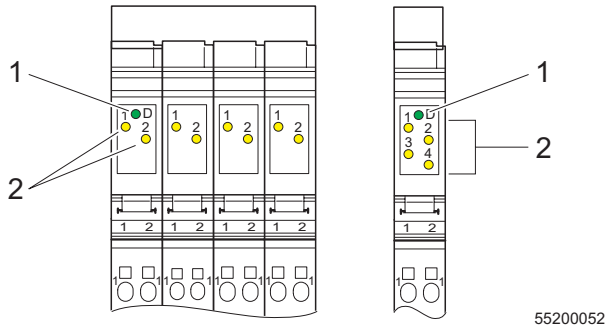


Figure 8-2 I/O terminal indicators

Diagnostics The following states can be read on the I/O terminals:

D **(1)**	Green LED	Diagnostics (for meaning see page 60)

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

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

Function terminals Diagnostic indicator D is located on all function terminals and has the same function as described on page 60.

Additional diagnostic indicators can be found on the function terminals. They are described in the corresponding documentation. The various status indicators for the function terminals are also described in the corresponding documentation.

Assignment Between Status LED and Input/Output

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

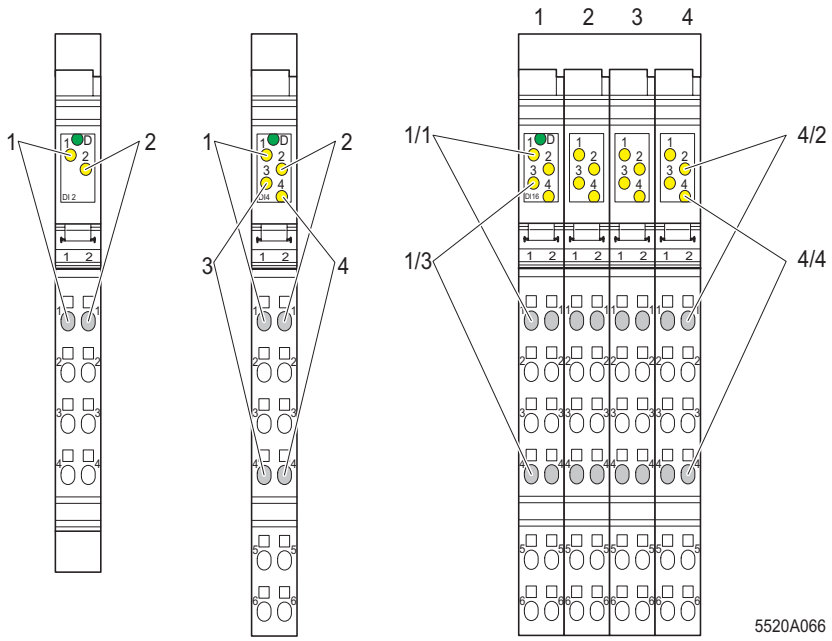


Figure 8-3 Assignment between status LED and input/output

Please refer to "Function Identification and Labeling" on page 36 for an explanation of the numbering.

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

For a 2-slot terminal with four inputs or outputs (example in the middle in Figure 8-3), the following LEDs belong 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

On the 8-slot terminal in Figure 8-3 and Figure 8-4, e.g., with 4/2, LED 2 on slot 4 is indicated. The LED belongs to input 14 on terminal point 4.2.1 (slot 4, terminal point 2.1).

Diagnostic and Status Indicators

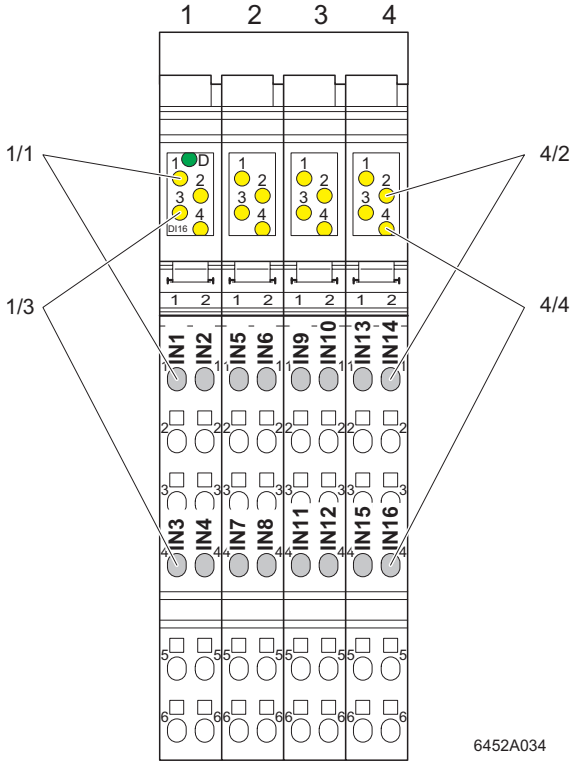


Figure 8-4 *Assignment between status LED and input/output using the example of an R-IB IL 24 DI 16 terminal*

For every terminal, the assignment is indicated in the terminal-specific data sheet.

9 Mounting/Removing InlineTerminals and Connecting Cables

9.1 Installation Instructions

9.1.1 Unpacking a Terminal

ESD Regulations

Electrostatic discharge

The terminal contains components that can be damaged or destroyed by electrostatic discharge. When handling the terminal, observe the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and EN 61340-5-2.

Unpacking the Terminal

The terminal is supplied in an ESD box.

Only qualified persons should pack, unpack, mount, and remove a terminal while observing the ESD regulations.

9.1.2 Replacing Terminals

WARNING

Do not replace terminals while the power is connected.

Before removing or mounting a terminal, disconnect power to the entire station. Make sure the entire station is reassembled before switching the power back on.

9.2 Sequence of the Inline Terminals

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

As the voltage at every power terminal is resupplied into the potential jumpers U_M and U_S, the section (main circuit) between a bus coupler and a power terminal or between a power terminal and a 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, install 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.

This results in the following sequence:

1. Digital output terminals
2. Digital input terminals
3. Function terminals
4. Analog terminals

Power-level terminals may be placed anywhere in the main circuit before function and analog terminals.

For the current consumption of the terminals, please refer to the terminal-specific data sheet.

9.2.1 Remote Bus Branch in an Inline Station

If you want to integrate a remote bus branch into an Inline station, note that the terminal with remote bus branch **must** be placed **directly** behind a bus terminal or a terminal with remote bus branch.

Please refer to the corresponding data sheets to see if any other special requirements should be noted.

9.2.2 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 the inside of the terminal. This decreases the measuring precision and shortens the life of the terminal.

Observe the following instructions to keep the current flowing through the potential jumpers of the analog terminals as low as possible:

CAUTION

Create a separate main circuit for each analog terminal.

If this is not possible in your application and if you are using analog terminals in a main circuit together with other terminals, place the analog terminals after all the other terminals at the end of the main circuit.

Creating a separate main circuit means that

- A main circuit is provided for all analog terminals or
- Several main circuits are only provided exclusively for analog terminals.

This also means that no terminals other than analog terminals should be in a main circuit for analog terminals.

Within the analog terminals, position the R-IB IL TEMP 2/UTH terminal behind **all** the other terminals to keep the current flowing through **all** potential jumpers as low as possible.

9.3 Mounting and Removing Inline Terminals

Mounting location

Terminals of the Inline product range have IP20 protection and are therefore suitable for use in closed control cabinets or control boxes (box for terminals) with IP54 or higher.

DIN rail

All Inline terminals are mounted on 35 mm standard DIN rails.

The modules are mounted perpendicular to the DIN rail. This ensures that they can be easily mounted and removed even within limited space.

Mounting side by side

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 the 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 plugging them in. Tools are not required.

End clamp

Mount end clamps on both sides of the Inline station. The end clamps ensure that the Inline station is correctly mounted. End clamps fix the Inline station on both sides and stop it moving from side to side on the DIN rail.

Bosch Rexroth recommends that SUB-M01 ENDHALTER
(MNR R911170685, pack of 2) are snapped on without tools.

End plate

The end plate terminates an Inline station. It has no electrical function. It protects the station against ESD pulses and the user against dangerous voltages. The end plate is supplied with the bus coupler and need not be ordered separately.

Mounting

When mounting a terminal, proceed as shown in Figure 9-1 on page 69:

- Disconnect the power to the station.
- First snap on the electronics base, which is required for mounting the station, perpendicular to the DIN rail (detail A).

When doing this 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 jumper for the bus interface in the guideways by snapping it into the previous terminal (detail B1). **Press gently against the previous terminal to make sure that the featherkey has snapped into its keyway on the bus interface.**
- Then insert the other potential jumpers into their guideways and snap the featherkeys into the corresponding keyways (detail B2).
- Detail C1 shows a common error. Here, the bus interface has not contacted properly. The featherkey is not in the keyway. The bus is not running or running with errors ("loose contact").
- Detail C2 shows secure contacting of the data jumpers and the interlocking keyway/featherkey connection.

- Once all the bases have been snapped on, plug the connectors into the appropriate bases.
  First, place the front connector shaft latching in the front snap-on mechanism (detail D1).
  Then pivot the top of the connector towards the base until it snaps into the back snap-on mechanism (detail D2).

The keyways of an electronics base do not continue when a connector has been installed on the base. 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 will have to be removed.

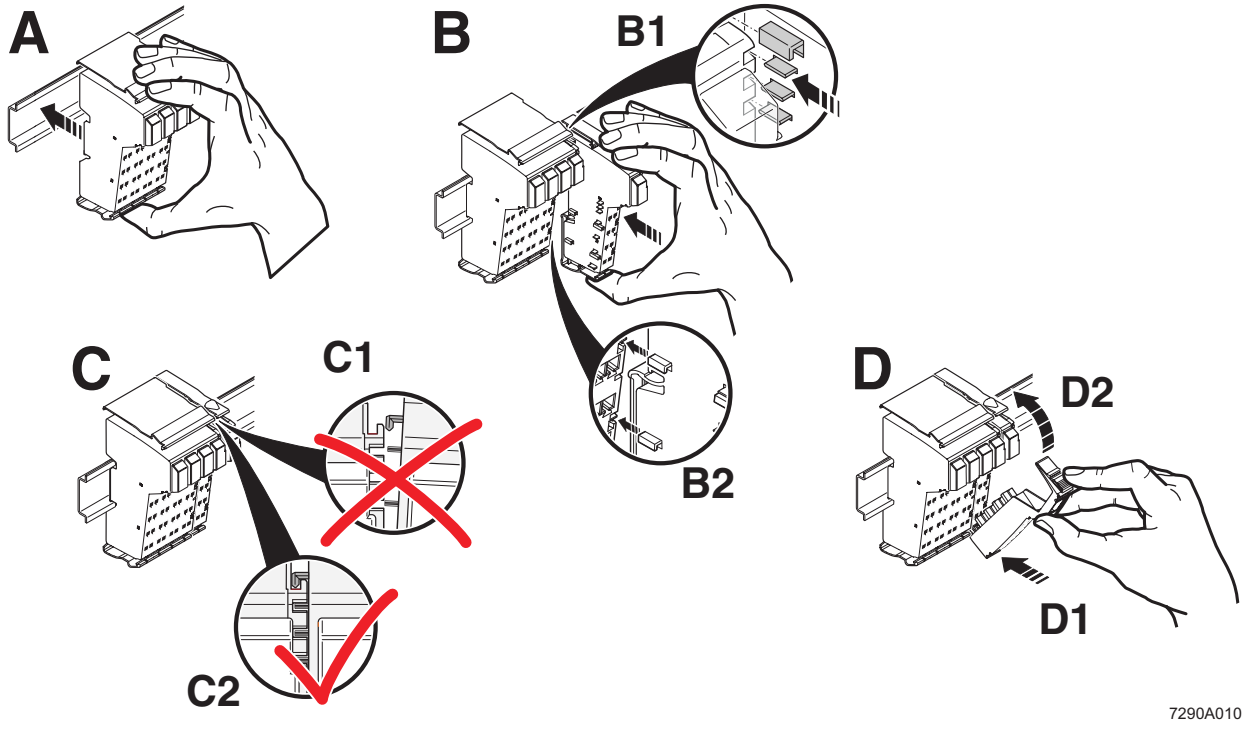


Figure 9-1 Mounting a terminal

Mounting/Removing InlineTerminals and Connecting Cables

Removal When removing a terminal, proceed as shown in Figure 9-2 on page 71:

- Disconnect the power to the station.
- If there is a labeling field, which covers several connectors, it may be necessary to remove it (detail A1).

If a terminal has several connectors, all connectors of the terminal must be removed. The following describes how a 2-slot terminal is removed.

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

Please ensure when using extended double signal connectors (long connectors) that you do not bend the connectors back too far, as you may break the front snap-on mechanism.

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

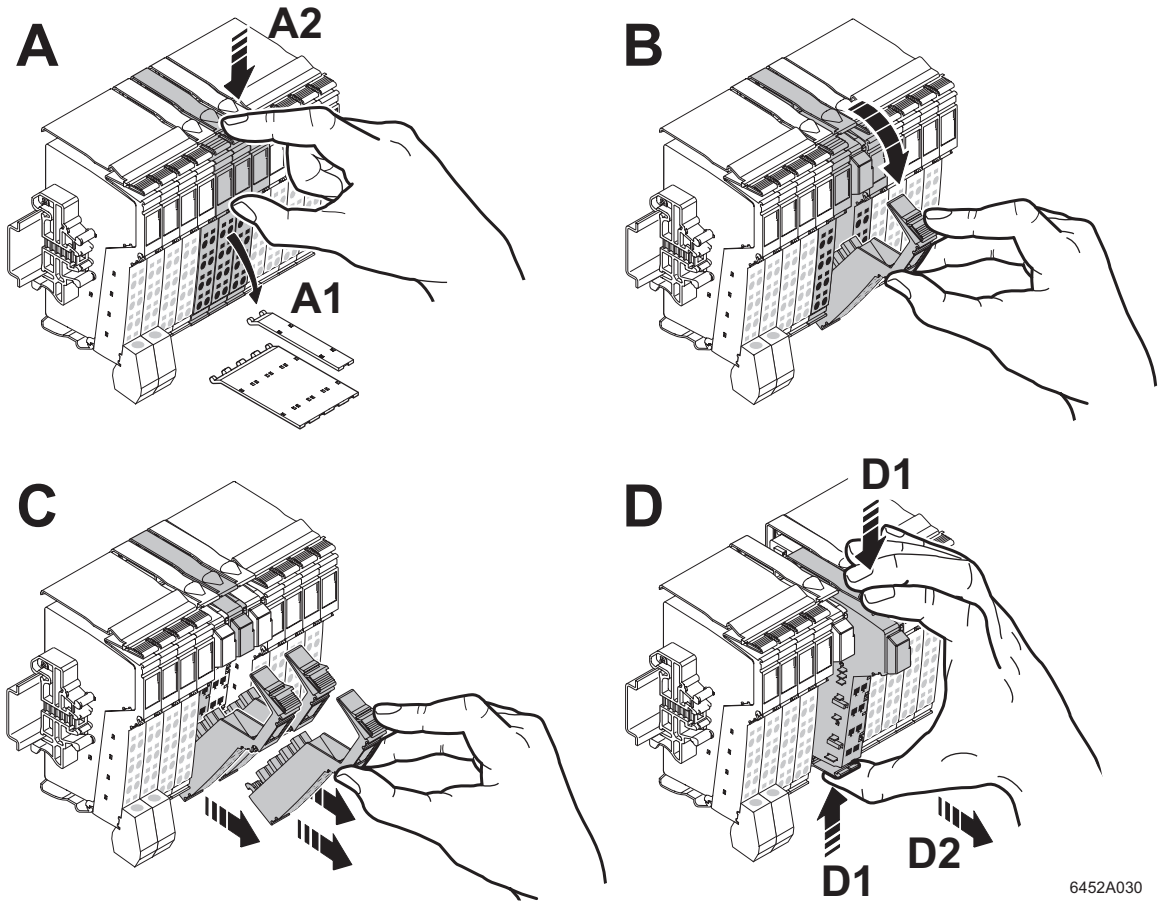


Figure 9-2 Removing a terminal

Replacing a terminal

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

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

9.4 Replacing a Fuse

The 24 V DC 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 part as this may break it.

Carefully lift the fuse out at one side and remove it by hand. Make sure the fuse does not fall into your system.

When replacing a fuse, proceed as shown in Figure 9-3 on page 73:

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

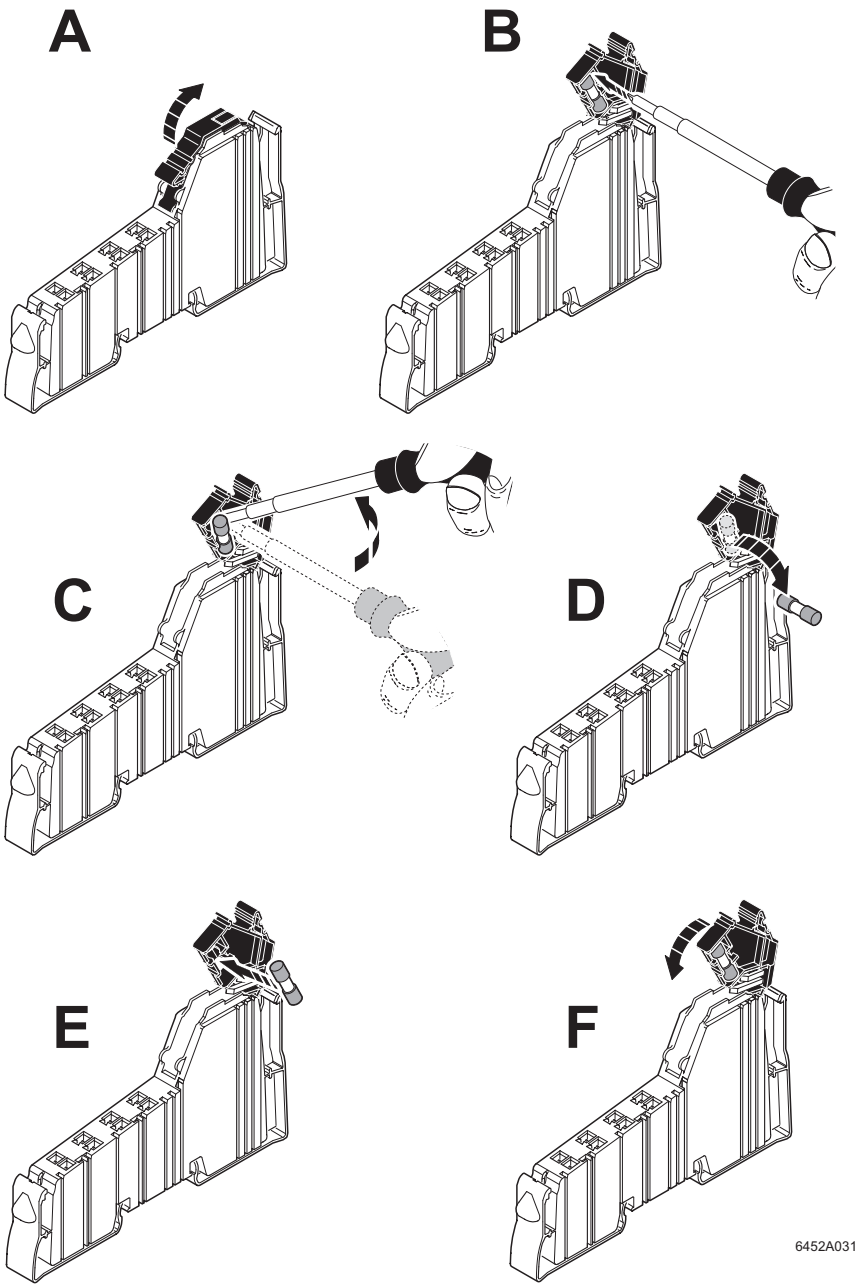


Figure 9-3 Replacing a fuse

9.5 Grounding Concept (Functional Earth Ground)

Only the functional earth ground is used within an Inline station.

Functional earth grounding (FE)

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

A wire of 1.5 mm^2 (16 AWG) must be used for grounding spring-cage terminals.

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

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

Functional earth ground is used within the 24 V DC area (SELV).

It is led from the grounded bus coupler or power terminal through the 24 V DC area of the station using the FE potential jumper.

To ensure reliable functional earth grounding of the station, you must observe various points.

1. Bus coupler, power terminals, and segment terminals have an FE spring (metal clip) on the bottom of the electronics base. This spring creates an electrical connection to the DIN rail. Use grounding terminals to connect the DIN rail to protective earth ground. The terminals are grounded when they are snapped onto the DIN rail.
2. It is also recommended that the bus coupler should be grounded using the FE-terminal point to ensure reliable functional earth grounding even if the DIN rail is dirty or the metal clip damaged (see terminal-specific data sheet).

The other Inline low-level signal terminals are automatically grounded via the FE potential jumper when they are mounted adjacent to other terminals.

The FE potential jumper is looped through the relay terminals.

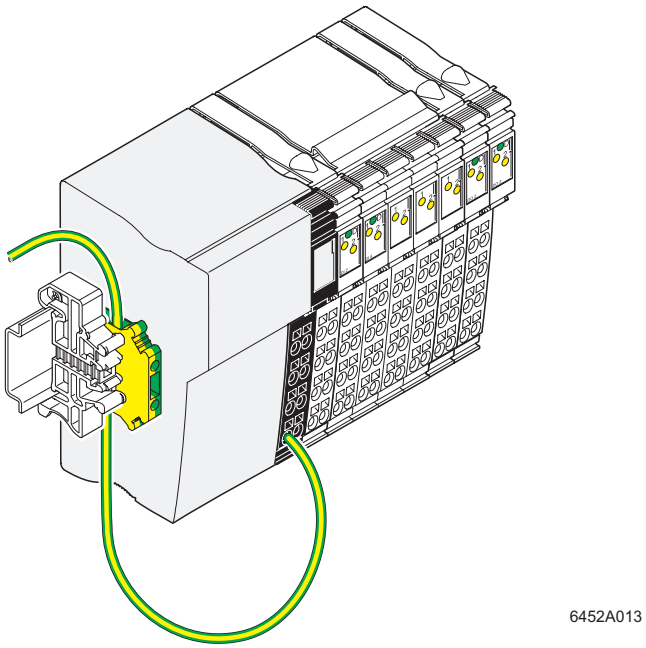


Figure 9-4 Diagram of the additional functional earth grounding of a bus coupler

Figure 9-4 shows the additional grounding of a standard bus coupler. The additional grounding of a special bus coupler is shown in the documentation for the bus coupler.

9.6 Shielding Concept

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

9.6.1 Inline Shielding Concept

In the Inline system, remote bus cables and the cables to connect terminals for analog signals are shielded.

Observe the following notes when installing shielding:

- Fasten the shielding so that as much of the braided shield as possible is held underneath the clamp of the shield connection.
- Make sure there is good contact between the connector and base.
- Do not damage or squeeze the wires. Do not strip more than 8 mm off the wires.

9.6.2 Shielding Analog Sensors and Actuators

- Always connect analog sensors and actuators with shielded, twisted pair cables.
- Connect the shielding via the shield connector. The method for connecting the shielding is described in "Connecting Shielded Cables Using a Shield Connector" on page 78.

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

9.7 Connecting Cables

Shielded and unshielded cables are used in an Inline station.

The I/O devices, supply voltages, and bus cables are connected using the spring-cage connection method. This means that signals up to 250 V AC/DC and 5 A can be connected with a conductor cross section of 0.2 mm^2 to 2.5 mm^2 (24 - 14 AWG).

Please note the sensor/actuator cable must be less than 30 m long.

9.7.1 Connecting Unshielded Cables

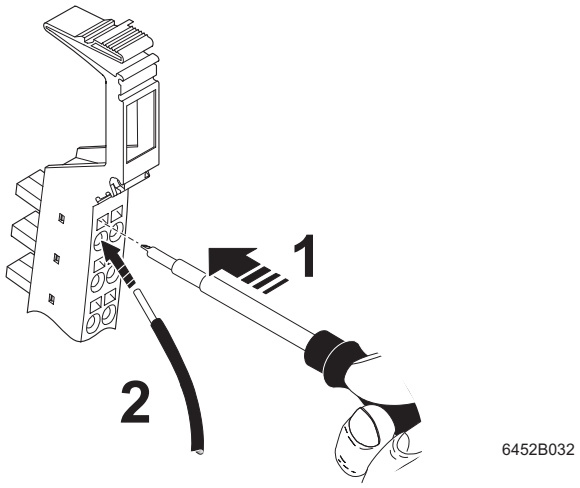


Figure 9-5 Connecting unshielded cables

Wire the connectors as required for your application.

For the connector pin assignment, please refer to the appropriate 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 slot above the appropriate terminal point (Figure 9-5, 1), so that you can plug the wire into the spring opening. Bosch Rexroth recommends using a screwdriver with a 0.6 mm x 3.5 mm x 100 mm blade.
- Insert the wire (Figure 9-5, detail 2). Remove the screwdriver from the opening. This clamps the wire.

After installation, you should always label the wires and the terminal points (see also "Function Identification and Labeling" on page 36).

9.7.2 Connecting Shielded Cables Using a Shield Connector

Shielded cables can be connected via 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 via the R-IB IL SCN 6-SHIELD-TWIN shield connector. In principle, cables are connected via the shield connector in the same way as shown in Figure 9-6 on page 80 and Figure 9-7 on page 81.

Figure 9-6 shows the connection of a shielded cable using a remote bus cable as an example. In this example, the cables are twisted pair cables.

Figure 9-7 shows the connection of two shielded cables, using the wiring of the R-IB IL AI 2/SF terminal as an example. As two channels can be used here, the R-IB IL SCN 6-SHIELD-TWIN shield connector is used.

When connecting the cables proceed as shown in Figure 9-6 and Figure 9-7:

Stripping cables

- Strip the outer cable sheath to the desired length (a). (Detail 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. (Detail A)
- Fold the braided shield back over the outer sheath. (Detail B)
- Remove the protective foil.
- Strip 8 mm off the wires. (Detail B)

Inline wiring is normally carried out 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 wire twisted until just before the terminal point.

Wiring the connectors

- Push a screwdriver into the slot above the appropriate terminal point (Figure 9-5 on page 77, 1), so that you can plug the wire into the spring opening.
  Bosch Rexroth recommends using a screwdriver with a 0.6 mm x 3.5 mm x 100 mm blade.
- Insert the wire (Figure 9-5 on page 77, detail 2). Remove the screwdriver from the opening. This clamps the wire.

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

Connecting the shield

Figure 9-6 shows the shield connection for the R-IB IL SCN 6-SHIELD connector. The procedure for the R-IB IL SCN 6-SHIELD-TWIN connector (shown in Figure 9-7) is the same.

- Open the shield connection (detail C).
- Check the position of the shield connection clamp in the shield connection (see also "Shield connection clamp" on page 82).
- Place the cable with the folded braided shield in the shield connection (detail D).
- Close the shield connection (detail E).
- Fasten the screws for the shield connection using a screwdriver. (Detail F)

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

Mounting/Removing InlineTerminals and Connecting Cables

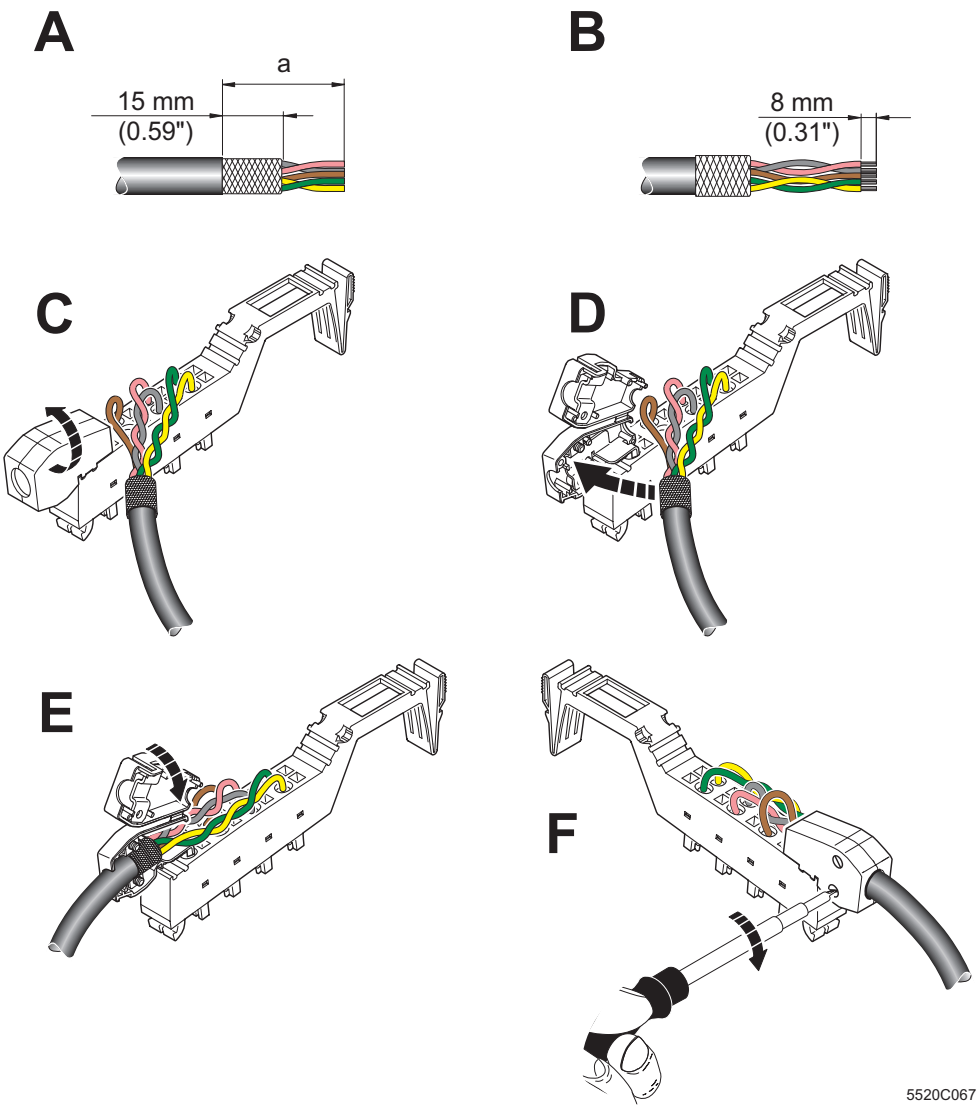


Figure 9-6 Connecting a shielded cable via the R-IB IL SCN-6 SHIELD shield connector

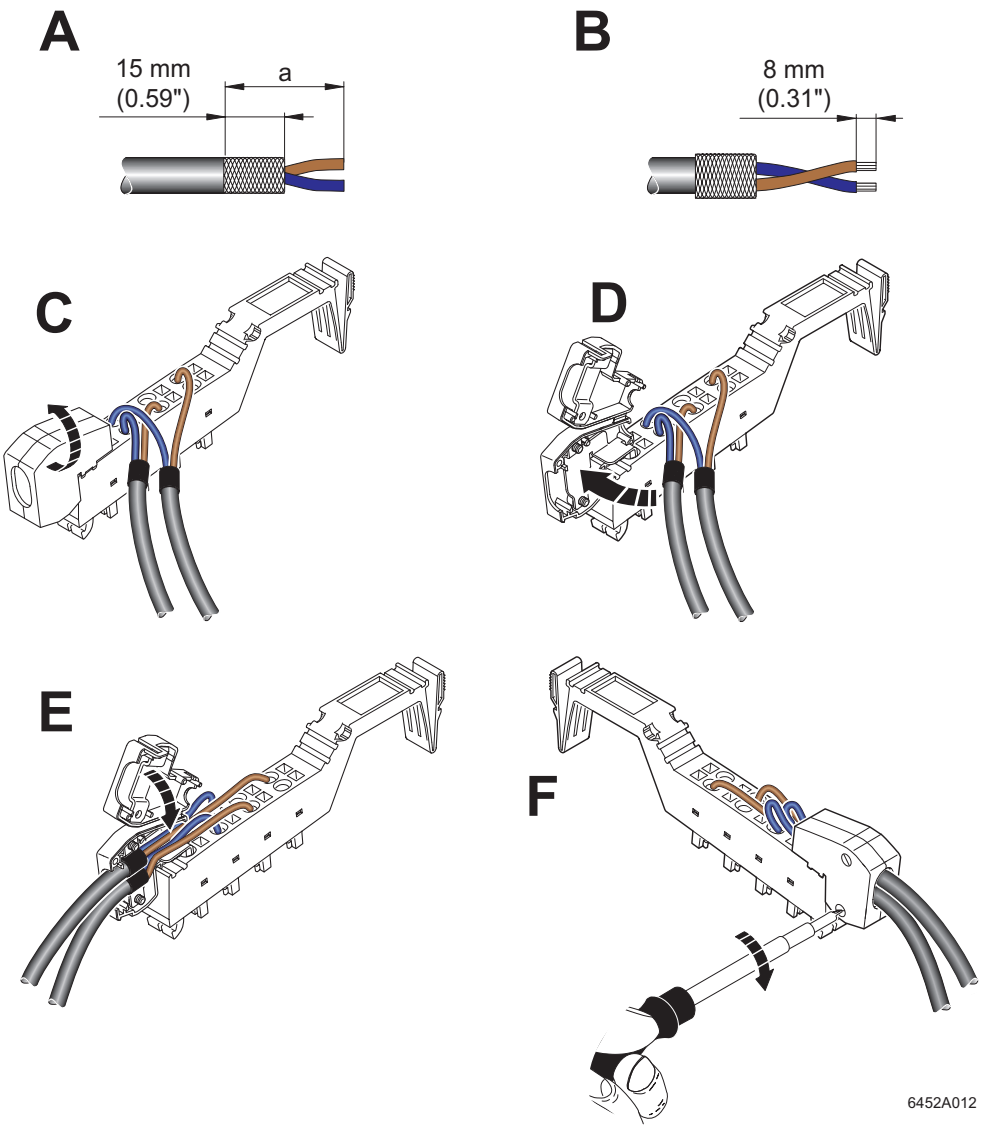


Figure 9-7 Connecting two shielded cables via the R-IB IL SCN 6-SHIELD-TWIN shield connector

Mounting/Removing InlineTerminals and Connecting Cables

Shield connection clamp

The shield connection clamp (a in Figure 9-8, detail B) in the shield connection can be used in various ways depending on the cross section of the cable. For thicker cables (e.g., bus cable), the dip in the clamp must be turned away from the cable (Figure 9-8, detail B). For thinner cables, the dip in the clamp must be turned towards the cable (Figure 9-8, detail F).

If you need to change the position of the shield connection clamp, proceed as shown in Figure 9-8:

- Open the shield connection housing (detail A).
- The shield connection is delivered with the clamp positioned for connecting thicker cables (detail B).
- Remove the clamp (detail C), turn it to suit the cross section of the cable (detail D), then reinsert the clamp (detail E).
- Detail F shows the position of the clamp for a thin cable.

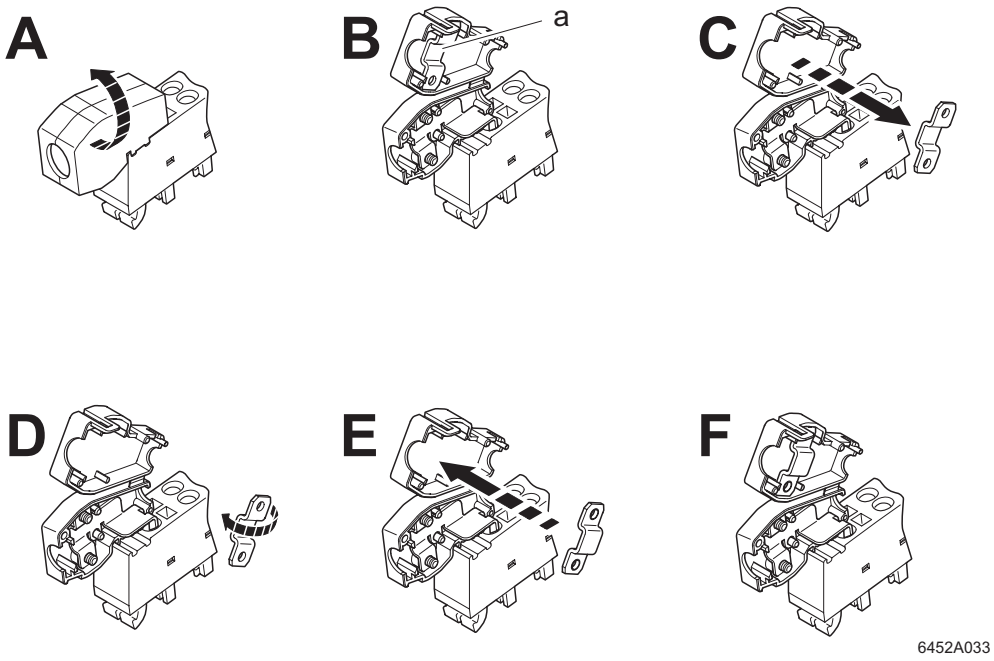


Figure 9-8 Shield connection clamp alignment

9.8 Connecting the Voltage Supply

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

The voltage supplies are connected using unshielded cables (see "Connecting Unshielded Cables" on page 77).

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.

9.8.1 Bus Coupler Supply

For information on this, please refer to the documentation of your bus coupler.

9.8.2 Power Terminal Supply

Depending on the power terminal, the following voltages may be fed in or provided:

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

Please refer to the information given in "Supply Terminals" on page 24.

9.8.3 Providing Segment Voltage at Segment Terminals

At segment terminals, the segment voltage U_S is provided from the main circuit U_M.

Please also refer to the information given in "Supply Terminals" on page 24.

9.8.4 Notes on 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 supply voltage U_{BK} is disconnected, the bus stops.

The supply voltage to the sensors and actuators (U_M/U_S) should be installed and protected independently of the supply of the bus coupler (U_{BK}). In this way the bus continues to run even if some I/O devices are switched off.

9.8.5 Voltage Supply Requirements

WARNING

Use power supply units with safe isolation.

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

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

9.8.6 Supply Voltage Requirements

The specifications for Inline system supply voltages are described in "Technical Data for Inline" on page 97. However, some terminals have specific requirements. Therefore, always refer to the corresponding data sheet.

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

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

9.9 Connecting the Bus

The bus cable of your system is connected to a bus coupler.

For information on this, please refer to the documentation of your bus coupler.

9.10 Connecting Sensors and Actuators

Sensors and actuators are connected using connectors. Each terminal-specific data sheet indicates which connector(s) can be used for which terminal.

Connect unshielded cables as described in "Connecting Unshielded Cables" on page 77.

Connect shielded cables as described in "Connecting Shielded Cables Using a Shield Connector" on page 78.

9.10.1 Connection Methods for Sensors and Actuators

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

Because of the different types of connectors, a single connector can support the following connection methods:

- 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 method for analog devices differs from that for digital devices.

Mounting/Removing InlineTerminals and Connecting Cables

9.10.2 Connections Used for Digital Input and Output Terminals

Different connection options are described below using 24 V DC terminals as an example. A connection example is given in each 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)	External	X	X	X
Ground GND	GND (⊥)	–	–	X	X
Ground/FE shielding	FE (⏚)	–	–	–	X

Detail 9-1 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 (⊥)	External	X	X	X
Ground/FE shielding	FE (⏚)	–	–	X	X

Detail 9-2 Overview of the connections used for digital output terminals

X Used

– Not used

In the following diagrams, U_S is the supply voltage because this potential jumper is accessed in the majority of terminals. Each terminal-specific data sheet indicates whether the I/O devices are supplied from the main circuit U_M or the segment circuit U_S.

9.10.3 Different Connection Methods for Sensors and Actuators

1-wire technology

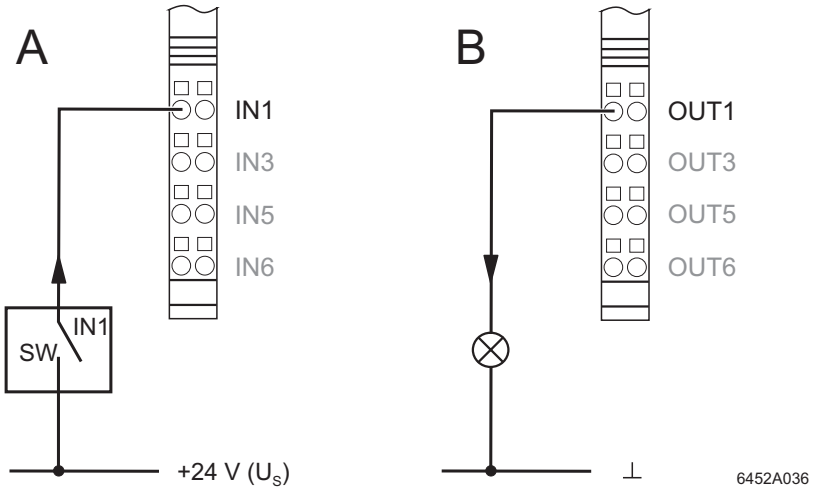


Figure 9-9 1-wire termination for digital devices

Sensor

Figure 9-10, detail A, shows the detection of a sensor signal in a schematic way. The SW switch provides the input signal. The sensor signal is routed to the IN1 terminal point. Sensor power is supplied from the voltage U_S.

CAUTION

The sensors and U_S of the Inline station must be supplied from the same voltage supply.

Actuator

Figure 9-10, detail B, shows the connection of an actuator. The actuator power is supplied via output OUT1. The load is switched directly via the output.

CAUTION

GND of the actuators and GND of the supply voltage U_S, which supply the actuators, must have the same potential.

The R-IB IL 24 DI 32/HD and R-IB IL 24 DO 32/HD Inline terminals are designed to connect sensors and actuators in 1-wire technology. For the connection examples, please refer to the corresponding data sheets.

Mounting/Removing InlineTerminals and Connecting Cables

2-wire technology

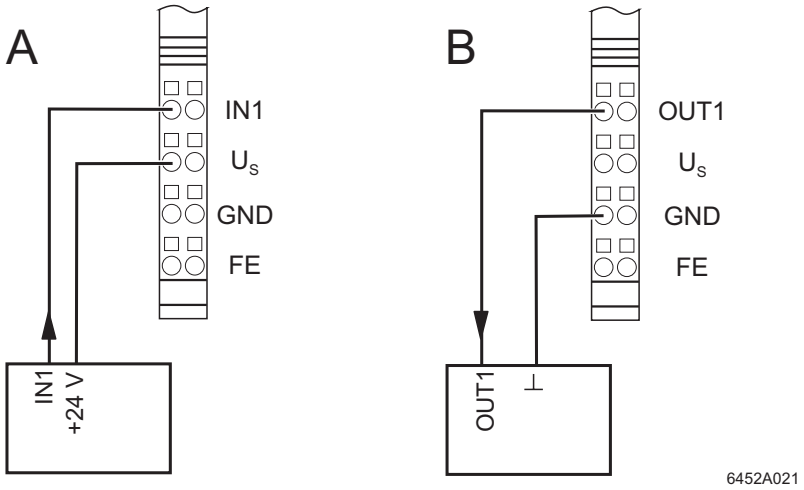


Figure 9-10 2-wire termination for digital devices

Sensor Figure 9-10, detail A shows the connection of a 2-wire sensor. The sensor signal is routed to the IN1 terminal point. Sensor power is supplied from the voltage U_S.

Actuator Figure 9-10, detail B, shows the connection of an actuator. The actuator power is supplied via output OUT1. The load is switched directly via the output.

3-wire technology

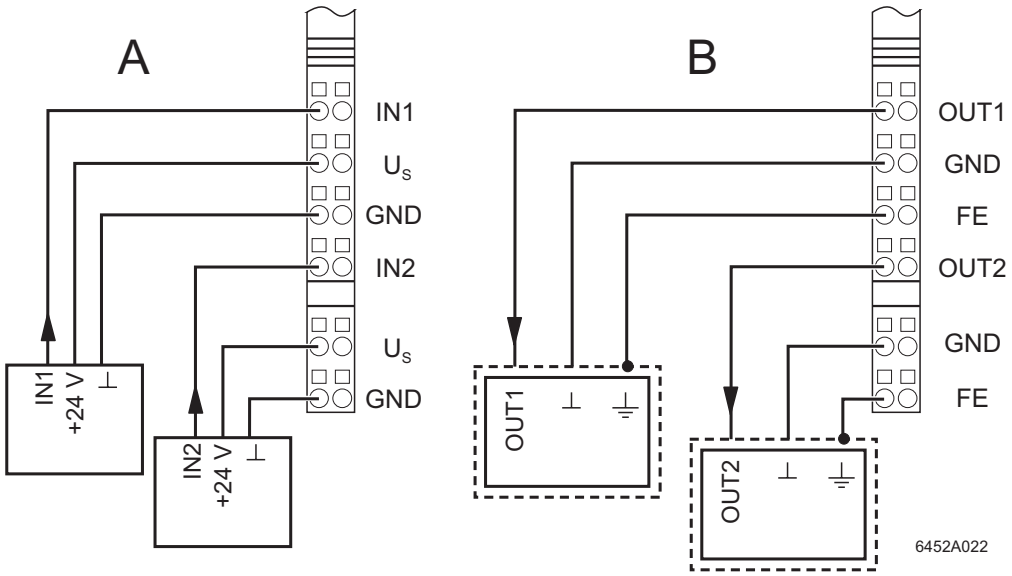


Figure 9-11 3-wire termination for digital devices

Sensor Figure 9-11, detail A shows the connection of a 3-wire sensor. The sensor signal is routed to the IN1 (IN2) terminal point. The sensor is supplied with power via terminal points U_S and GND.

Actuator Figure 9-11, detail B shows the connection of a shielded actuator. The actuator is supplied through output OUT1 (OUT2). The load is switched directly via the output.

4-wire technology

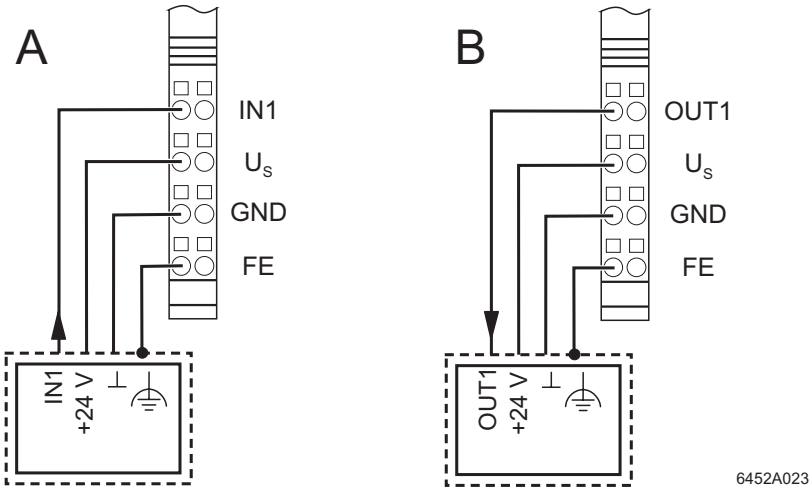


Figure 9-12 4-wire termination for digital devices

Sensor Figure 9-12, detail A shows the connection of a shielded 3-wire sensor. The sensor signal is routed to the IN1 terminal point. The sensor is supplied with power via terminal points U_S and GND. The sensor is grounded via the FE terminal point.

Notes

10 Examples and Tips

10.1 Tips for Working With Inline

Safe grounding

When grounding, always observe the notes in "Grounding Concept (Functional Earth Ground)" on page 74.

Sequence of the terminals

During configuration, always observe the notes in "Sequence of the Inline Terminals" on page 66.

10.2 Temperature Response of the Terminals

Please note that derating or simultaneity limitations must be taken into consideration depending on the ambient temperature. Notes on this are provided in the terminal-specific data sheets. The terms used in the data sheets are explained below:

Power dissipation of the electronics (P_{TOT})

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 operating temperature range must be defined.

Permissible operating temperature range

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 section below.

10.3 Calculation Examples for Power Dissipation and Operating Temperature Range

10.3.1 Constant Power Dissipation of the Housing Over the Operating Temperature Range

An example is calculated using the R-IB IL 24 DO 8 terminal.

Formula to Calculate the Power Dissipation of the Electronics

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

$$P_{TOT} = 0.19\ W + \sum_{n=1}^{8} (0.1\ W + I_{Ln}^2 \times 0.4\ \Omega)$$

Where

P_{TOT}	Total power dissipation of the module
n	Index of the number of set outputs n = 1 to 8
I_{Ln}	Load current of output n

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 (I_{L7} = I_{L8} = 0 A).

Power dissipation of the electronics

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

$$\begin{aligned} P_{TOT} = 0.19\ W &+ [0.1\ W + (0.5\ A)^2 \times 0.4\ \Omega] \\ &+ [0.1\ W + (0.4\ A)^2 \times 0.4\ \Omega] \\ &+ [0.1\ W + (0.2\ A)^2 \times 0.4\ \Omega] \\ &+ [0.1\ W + (0.5\ A)^2 \times 0.4\ \Omega] \\ &+ [0.1\ W + (0.3\ A)^2 \times 0.4\ \Omega] \\ &+ [0.1\ W + (0.4\ A)^2 \times 0.4\ \Omega] \\ &+ [0.1\ W + (0.0\ A)^2 \times 0.4\ \Omega] \\ &+ [0.1\ W + (0.0\ A)^2 \times 0.4\ \Omega] \end{aligned}$$

$$\begin{aligned} P_{TOT} = 0.19\ W &+ 0.200\ W + 0.164\ W + 0.116\ W + 0.200\ W \\ &+ 0.136\ W + 0.164\ W + 0.100\ W + 0.100\ W \end{aligned}$$

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

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 to +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 to +55°C.

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

$$P_{TOT} = 1.79\ W$$

10.3.2 Power Dissipation of the Housing Within the Operating Temperature Range Depending on the Ambient Temperature

An example is calculated using a terminal.

Formula to Calculate the Power Dissipation of the Electronics

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

$$P_{TOT} = 0.19\ W + \sum_{n=1}^{2} (0.12\ W + I_{Ln}^2 \times 0.09\ \Omega)$$

Where

P_{TOT}	Total power dissipation of the module
n	Index of the number of set outputs n = 1 to 2
I_{Ln}	Load current of output n

Example: Both outputs are enabled and operating 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:

$P_{TOT} = 0.19\ W + 2 \times [0.12\ W + (2\ A)^2 \times 0.09\ \Omega)]$

$P_{TOT} = 0.19\ W + 2 \times 0.48\ W$

$P_{TOT} = 0.19\ W + 0.96\ W$

$P_{TOT} = 1.15\ W$

Examples and Tips

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 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.

Permissible operating temperature range

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

To do this set $P_{TOT} = P_{HOU}$.

P_{TOT} = 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_{TOT}) x 37.5°C/W - 5°C

P_{TOT} = 1.15 W (from the calculation for the power dissipation of the electronics)

T_A = (2.4 W - 1.15 W) x 37.5°C/W - 5°C

T_A = 1.25 W x 37.5°C/W - 5°C

T_A = 41.875°C

With both outputs at full load, this terminal can be operated up to an ambient temperature of 41°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_{TOT} = 0.19 W + [0.12 W + $(2\ A)^2$ x 0.09 Ω)] + [0.12 W + $(0\ A)^2$ x 0.09 Ω)]

P_{TOT} = 0.19 W + 0.48 W + 0.12 W

P_{TOT} = 0.79 W

T_A = (2.4 W - P_{TOT}) x 37.5°C/W - 5°C

P_{TOT} = 0.79 W (from the calculation for the power dissipation of the electronics)

T_A = (2.4 W - 0.79 W) x 37.5°C/W - 5°C

T_A = 1.61 W x 37.5°C/W - 5°C

T_A = 55.375 °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 leads to a simultaneity of 50% at 55°C..

Examples and Tips

11 Technical Data and Ordering Data

For the system data for your bus system, please refer to the corresponding documentation.

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

The following tables provide standard data. For different values, please refer to the terminal-specific data sheets.

This data is valid for the preferred mounting position (vertical).

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

11.1 Technical Data for Inline

System Data	
Number of devices of an Inline station	63 devices, maximum; see documentation for bus couplers
Maximum Current Carrying Capacity of the Potential Jumper U_L	2 A (see technical data of the bus coupler and/or power terminal)
Maximum current carrying capacity of the potential jumper U_{ANA}	0.5 A
Maximum current carrying capacity of the potential jumpers U_M, U_S, GND (total current)	8 A

Observe the current consumption of every device on the individual potential jumpers when configuring an Inline station. It is given in the Inline device list and in each terminal-specific data sheet. It can differ depending on the individual terminal. If the maximum current carrying capacity of a potential jumper is reached, a new power terminal must be used or a new station must be created.

Maximum current consumption of the I/O terminals	See terminal-specific data sheet or Inline-device list

Technical Data and Ordering Data

Ambient Conditions

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

Regulations	Developed according to VDE 0160, UL 508
Ambient temperature	
Ambient temperature (operation)	-25°C to +55°C
Ambient temperature (storage/transport)	-25°C to +85°C
Maximum permissible temperature inside the terminal during operation	85°C
Temperature cycles (Speed of changing from positive to negative temperatures and vice versa)	0.5 K/min (no condensation)
Humidity	
Humidity (operation/storage/transport)	10% to 95%, according to DIN EN 61131-2
Air pressure	
Air pressure (operation/storage/transport)	70 kPa to 106 kPa (up to 3000 m above sea level)
Degree of protection according to DIN 40050, IEC 60529	IP20
Protection class according to DIN 57106-1	Class 3
Connection data for Inline connector	
Connection method	Spring-cage terminals
Conductor cross-section	0.2 mm^2 to 1.5 mm^2 (solid or stranded), 24 - 16 AWG
Air and creepage distances	According to IEC 60644/IEC 60664A/ DIN VDE 0110: 1989-01 and DIN VDE 0160: 1988-05
Housing material	Plastic, PVC-free, PBT, self-extinguishing (V0)
Pollution degree according to EN 50178	2; condensation not permitted during operation
Surge voltage class	II (24 V DC and 230 V AC areas)
Ambient compatibility	Not resistant to chloroform
Gases that may endanger functions according to DIN 40046-36, DIN 40046-37	
Sulfur dioxide (SO_2)	Concentration 10 ± 0.3 ppm Environmental conditions - Temperature: 25°C (± 2°C]) - Humidity: 75% (± 5%) - Test duration: 10 days
Hydrogen sulfide (H_2S)	Concentration 1 ± 0.3 ppm Environmental 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 and 230 V AC areas)
Shock test according to IEC 60068-2-27; EN 60068-2-27	25 g 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	0.78 g load, 2.5 hours in each space direction
Insertion/withdrawal cycles	
Terminal	10 cycles
Connector	10 cycles

Conformance With EMC Directive 89/336/EEC

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

Noise Immunity Test According to EN 50082-2		
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 Voltage supply: 2 kV I/O cables: 2 kV Criterion A All interfaces: 1 kV
Surge voltage	EN 61000-4-5/ IEC 61000-4-5	Criterion B AC supply cables: 2.0 kV/4.0 kV (symmetrical/asymmetrical) DC supply cables: 0.5 kV/0.5 kV (symmetrical/asymmetrical) Signal cables: 1.0 kV/2.0 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 50081-2		
Noise emission of housing	EN 55011	Class A

Data Transfer	
Protocol	EN 50254
Protocol chip	Optical Protocol Chip
Transmission	Data jumper
Level	Logic level

Technical Data and Ordering Data

24 V Bus Coupler Supply (U_{BK})	
Nominal voltage	24 V DC
Ripple	± 5%
Permissible voltage range	19.2 V DC to 30.0 V DC, ripple included
Connection	Spring-cage terminals

7.5 V Bus Logic Supply (U_L)	
Nominal voltage	7.5 V
Ripple	± 5%
Load current	2 A maximum (see technical data of the bus coupler)
Connection	Potential jumper on the side
Remark	Voltage is generated in the bus coupler by a DC/DC converter from the 24 V supply voltage. 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. The logic supply U_L is electronically short-circuit proof.

Supply of Terminals for Analog Signals (U_{ANA})	
Nominal voltage	24 V DC
Tolerance	- 15%/+ 20%
Ripple	± 5%
Permissible voltage range	19.2 V DC to 30.0 V DC, ripple included
Load current	500 mA maximum (see technical data of the bus coupler)
Connection	Potential jumper on the side
Remark	Decoupling of the 24 V input voltage by means of a diode Smoothing via π filter with base frequency 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 to 30.0 V DC, ripple included
Load current	8 A, maximum
Connection	Potential jumper on the side

Voltage Dips and Interruptions to the I/O Supply	
Intensity PS1	Interrupt time < 1 ms
Time interval between voltage dips	< 1 s
Behavior	Evaluation criterion 1 A dip in the supply voltage < 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 Section 7.2.2 „Current and Voltage Distribution“

Cable Connection Method/Cross Section	
Cable connection method for the low-level signal- and low voltage levels	Spring-cage terminals
Cable connection method for the power level	Screw terminal blocks
Cable cross section for the low-level signal and low voltage levels (typical)	0.2 mm² to 1.5 mm²
Cable cross section for the low-level signal and low voltage levels (Connection of the protective conductor PE)	1.5 mm² (16 AWG); cable is as short as possible
Cable cross section for the low-level signal and low voltage levels (Connection of equalizing conductors for thermocouples to the R-IB IL TEMP 2 UTH terminal)	0.13 mm² to 2.5 mm²
Cable cross section for the power level (Power terminal, motor connection, brake connection)	0.2 mm² to 2.5 mm² (26 to 16 AWG) (flexible and rigid cables)
Cable cross section for the power level (hand-held operator panel mode)	0.14 mm² to 1.5 mm² (26 to 16 AWG) (flexible and rigid cables)
Length of the sensor/actuator cables	< 30 m
Conductor pull-out force	
For 0.2 mm^2 (25 AWG) cables	10 N
For 1.5 mm^2 (16 AWG) cables	40 N
Frequency of cable use	5

Electrically Isolated Areas

See terminal-specific data sheets

Air 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

Technical Data and Ordering Data

Air and Creepage Distances (According to EN 50178, VDE 0109, VDE 0110) (Continued)			
Incoming/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/NO contact	See terminal-specific data sheet		
Relay contact/bus logic	See terminal-specific data sheet		

Test Voltages	
Isolating Distance	**Test Voltage**
Technology for 24 V Area (up to 60 V DC)	

For information about 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/NO contact	1000 V AC, 50 Hz, 1 min.
Relay contact/bus logic	2500 V AC, 50 Hz, 1 min.

Approvals

For the latest approvals, please visit www.boschrexroth.com.

11.2 Ordering Data

Ordering Data for Inline Terminals and Associated Connectors

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

Ordering Data for Accessories

Description	Type	MNR	Pcs./Pck.
Keying profile	On request		
Zack marker strip to label the terminals	On request		
Labeling field covering one connector	R-IB IL FIELD 2	R911289341	10
Labeling field covering four connectors	R-IB IL FIELD 8	R911289342	10
Labeling sheets for R-IB IL FIELD 2, perforated, can be labeled using a laser printer, marker pen or CMS system (72 sheets)	On request		1
Labeling sheets for R-IB IL FIELD 8, perforated, can be labeled using a laser printer, marker pen or CMS system (15 sheets)	On request		5
End clamp snapped on without tools	SUB-M01 ENDHALTER	R911170685	2

Ordering Data for Documentation

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

Notes

12 Disposal and Environmental Protection

12.1 Disposal

12.1.1 Products

Our products can be returned to us free of charge for disposal. However, it is a precondition that the products are free of oil, grease or other dirt.

Furthermore, the products returned for disposal must not contain any undue foreign matter or foreign component.

Please send the products free domicile to the following address:

Bosch Rexroth AG

Electric Drives and Controls

Bürgermeister-Dr.-Nebel-Straße 2

D-97816 Lohr am Main

12.1.2 Packaging Materials

The packaging materials consist of cardboard, wood and polystyrene. These materials can be easily recycled in any municipal recycling system. For ecological reasons, please refrain from returning the empty packages to us.

12.2 Environmental Protection

12.2.1 No Release of Hazardous Substances

Our products do not contain any hazardous substances which may be released in the case of appropriate use. Accordingly, our products will normally not have any negative effect on the environment.

12.2.2 Materials Contained in the Products

Electronic Devices

Electronic devices mainly contain:

- steel
- aluminium
- copper
- synthetic materials
- electronic components and modules

Motors

Motors mainly contain:

- steel
- aluminium
- copper
- brass
- magnetic materials
- electronic components and modules

Disposal and Environmental Protection

12.2.3 Recycling

Due to their high content of metal most of the product components can be recycled.In order to recycle the metal in the best possible way, the products must be disassembled into individual modules.

Metals contained in electric and electronic modules can also be recycled by means of special separation processes. The synthetic materials remaining after these processes can be thermally recycled.

If the products contain batteries or rechargeable batteries, these batteries are to be removed and disposed before they are recycled.

13 Service & Support

13.1 Helpdesk

Our service helpdesk at our headquarters in Lohr, Germany, will assist you with all kinds of enquiries.

Contact us:

- By phone through the Service Call Entry Center,
  Mo - Fr 7:00 am - 6:00 pm CET
  +49 (0) 9352 40 50 60
- By Fax
  +49 (0) 9352 40 49 41
- By email: service.svc@boschrexroth.de

13.2 Service Hotline

Out of helpdesk hours please contact our German service department directly:

+49 (0) 171 333 88 26

or

+49 (0) 172 660 04 06

Hotline numbers for other countries can be found in the addresses of each region (see below).

13.3 Internet

Additional notes regarding service, maintenance and training, as well as the current addresses of our sales and service offices can be found on

http://www.boschrexroth.com

Outwith Germany please contact our sales/service office in your area first.

13.4 Helpful Information

For quick and efficient help please have the following information ready:

- detailed description of the fault and the circumstances
- information on the type plate of the affected products, especially type codes and serial numbers
- your phone / fax numbers and e-mail address so we can contact you in case of questions

Service & Support

14 Glossary

14.1 Explanation of Abbreviations and Symbols

14.1.1 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 user manual 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)

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_{TOT} Power dissipation of the electronics

P_{HOU} Power dissipation of the housing

14.1.2 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

L Phase in the 120 V AC or 230 V AC voltage area

N Neutral conductor in the 120 V AC or 230 V AC voltage area

14.1.3 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

Glossary

Semiconductors

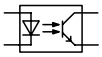
Semiconductor diode, general symbol

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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Notes

Notes

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