Automation terminals of the Inline product range

User manual

PHŒNIX CONTACT

User manual

Automation terminals of the Inline product range

IL SYS INST UM E, Revision 11 — 2025-06-12

This user manual is valid for:
All automation terminals in the Inline product range.

Table of contents

1 For your safety

Read this manual carefully and keep it for future reference.

1.1 Identification of warning notes

This symbol indicates hazards that could lead to personal injury.

There are three signal words indicating the severity of a potential injury.

DANGER
Indicates a hazard with a high risk level. If this hazardous situation is not avoided, it will result in death or serious injury.

WARNING
Indicates a hazard with a medium risk level. If this hazardous situation is not avoided, it could result in death or serious injury.

CAUTION
Indicates a hazard with a low risk level. If this hazardous situation is not avoided, it could result in minor or moderate injury.

This symbol together with the **NOTE** signal word warns the reader of actions that might cause property damage or a malfunction.

Here you will find additional information or detailed sources of information.

This symbol indicates potential security risks in devices, solutions or services from Phoenix Contact. These may be IT and security risks in industry automation, for example.

1.2 Qualification of users

The use of products described in this manual is oriented exclusively to electrically skilled persons or persons instructed by them. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.

1.3 Product changes

Modifications to hardware and firmware of the device are not permitted.

Incorrect operation or modifications to the device can endanger your safety or damage the device. Do not repair the device yourself. If the device is defective, please contact Phoenix Contact.

1.4   Security in the network

NOTE: Network security jeopardized by unauthorized access
Connecting devices to a network entails the danger of unauthorized access to the network.

Observe the following safety notes:

- If possible, deactivate unused communication channels.
- Use secure passwords reflecting the complexity and service life recommended in the latest guidelines.
- Only allow authorized persons to access the device. Limit the number of authorized persons to the necessary minimum.
- Always install the latest firmware version. The firmware can be downloaded via the item (phoenixcontact.com/products).
- Observe the IT security requirements and the standards applicable to your application. Take the necessary protective measures. These may include, for example, virtual networks for remote maintenance access or a firewall.
- In security-critical applications, always use the device with an additional security appliance.
  Phoenix Contact offers security appliances in the mGuard product range. The mGuard routers connect various networks for the remote maintenance and protection of the local network and protect these networks against cyberattacks.
- You must take defense-in-depth strategies into consideration when planning networks.

Additional measures for protection against unauthorized network access can be found in the "INDUSTRIAL SECURITY" application note. The application note can be downloaded via the item (phoenixcontact.co m/products).
German: AH DE INDUSTRIAL SECURITY, 107913
English: AH EN INDUSTRIAL SECURITY, 107913

If a security vulnerability exists for products, solutions, or services from Phoenix Contact, it will be published on the PSIRT (Product Security Incident Response Team) website: phoenixcontact.com/psirt

2 Documentation landscape of Inline

2.1 Available documents

The documentation for the Inline product group is modular, providing you with the optimum information to meet your requirements.

ℹ️ The term "module" is used here as an umbrella term for Inline terminals and Inline Block IO modules.

Table 2-1   Inline documentation

Document	Contents
System: information on the Inline system	
User manual "Automation terminals of the Inline product range" IL SYS INST UM E (this manual)	This manual is the generic system manual for Inline. It describes the Inline product group and everything about mounting, removing, and wiring the modules, regardless of a higher-level network.
Module: basic information on a specific terminal or a specific module	
Packing slip, installation notes for electrically skilled persons	A packing slip contains key information for the electrical installation of a module or group of modules. This includes, for example: – Short description – Safety notes – Mounting/removal – Terminal point assignment The packing slip is provided with the module upon delivery and/or is available on the Internet in the download area of the module. If no packing slip is available, the information can be found in the data sheet or the user manual for the product or the system used.
User manuals for safety modules and controllers	The user manual for each safety module or controller contains the complete information needed for use. This includes at the very least: – Description – Mounting, removal, and power supply – Startup via PC Worx or PLCnext Engineer – Technical data and ordering data
Module-specific data sheets	The data sheet for each module contains the complete information needed for use. This includes at the very least: – Function description – Technical data – Connection assignment or terminal point assignment – Local diagnostic and status indicators – Connection examples

Table 2-1   Inline documentation (continued)

Document	Contents
Additional: information on a specific module	
Additional user manuals	The additional user manuals either describe: – a bus system (e.g., INTERBUS) or network, – a bus coupler connected to a bus system or network or – a specific module. Each manual only describes the relevant module and/or bus-specific special features. Being a generic manual, the IL SYS INST UM E user manual also applies.
Quick-start guides	Quick-start guides are available for various topics. A quick-start guide describes the startup of a system or module step by step using an example.
Up-to-date pdf	
Generate PDF	On the corresponding product detail page of an item at phoenixcontact.com/products, you can click the "Show product details (PDF)" button and download up-to-date information on the product (see "Documentation on the Internet" on page 12). This includes, for example: – Commercial data – Technical data – Drawings – Approvals – Classifications – Environmental Product Compliance – Accessories

2.2   Documentation on the Internet

The documentation can be downloaded at phoenixcontact.com/products. Here, you will find information on each product. During your search, take into account the difference between "Show product details (PDF)" and "Downloads".

Show product details (PDF)

Click the "Show product details (PDF)" button to see the selected up-to-date information. This provides a brief overview of the module.
The generated PDF file contains the essential product information. If you require further information, you can use the "Downloads" menu item.

Downloads

Under the "Downloads" menu item, you can access the **complete** documentation and all other downloads related to a module.

2.3   Purpose of this manual

This manual informs you about the Inline system. It describes the system and everything about Inline module mounting and wiring regardless of a higher-level network.

3 The Inline product range

3.1 Inline - the highly modular I/O system

Inline is a highly modular I/O system for the control cabinet.

The Inline product range consists of:
– Inline terminals: Modular terminals
– Inline Block IOs: Compact remote I/O modules (no longer in product range)

i This manual mainly describes the Inline terminals.
For information about the Inline Block IOs, please refer to the module-specific data sheets.

3.2 No longer in our product range

i This manual provides a comprehensive overview of the Inline product family.
Since we regularly optimize our range, some items are no longer available.
In some places, the manual refers to item groups that are no longer in the range.
However, not every item that is no longer available is indicated.
If an item is no longer in the range, you will be informed of this on the Internet at phoenixcontact.com/products.

3.3   Product description

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

With just a few exceptions, the automation terminals consist of an electronics base (Inline) or an electronic module (Inline Block IO) and one or more connectors for connecting the I/O or power supply. The electronics can be replaced without removing a single wire from the connector.

Inline versions

The Inline product range offers terminals for all automation tasks:
–   Bus couplers to integrate the Inline station into various bus systems, some with input and output function for digital signals
     The bus can be connected using copper or fiber optic technology.
–   Terminals with remote bus branch for opening an INTERBUS remote bus branch
     The remote bus branch can be connected using copper or fiber optic technology.
–   Terminals for supplying the supply voltages and segmenting the station (with and without fuse)
–   Accessory terminals (potential distributor terminals, distance terminals)
–   Input and output terminals for digital and analog signals
–   Power-level terminals for switching, protecting, and monitoring three-phase standard motors
–   Branch terminals for integrating further product ranges (e.g., integration of a Fieldline Modular local bus in the Inline station) or to extend the local bus by several rows
–   Terminals for open and closed-loop control, communication, and position detection
–   Safety modules
–   Programmable terminals (CPU and Inline Controller)

Inline Block IO versions (no longer in product range)

–   Input modules, output modules, and I/O modules for digital and analog signals
–   Bus interface is integrated in the module

Mounting location

Inline terminals and Block IO modules meet IP20 protection. They can be used in closed control cabinets or in control boxes (terminal boxes) with IP54 protection or higher according to EN 60529/ IEC 60529. The compact design means that most Inline terminals and all Block IO modules can be installed in standard terminal boxes.

Please observe the mounting distances when selecting the housing (see Section "Mounting distances" on page 107).

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 terminals are properly installed.

See Section "Mounting/removing devices" on page 105.

Bus connection (network)   Inline: The Inline station is integrated in the bus system via a bus coupler or controller. The bus is controlled by the Inline station through data routing.

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

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

4 Important information about voltage areas

4.1 Voltage areas for Inline and Inline Block IO

Inline Block IO modules are available for the SELV area

Inline terminals are available for the SELV and low voltage areas. The terminals are divided into three product groups according to their use in a specific voltage area and their function.

Tabelle 4-1 Voltage ranges according to standards

Voltage range	Permissible voltage		Standard
	AC	DC	
Low voltage	≤ 1000 V	≤ 1500 V	DIN EN 61140 (VDE 0140-1) DIN VDE 0100-410
– Extra-low voltage (ELV)	≤ 50 V	≤ 120 V	
– Protective extra-low voltage (PELV)	≤ 50 V	≤ 120 V	
– Safety extra-low voltage (SELV)			
– Protective extra-low voltage (PELV)	≤ 30 V	≤ 60 V	DIN EN 61131-2 (PLC standard) DIN EN IEC 61010-2-201
– Safety extra-low voltage (SELV)			

Table 4-2 Voltage areas and corresponding terminal designations for Inline

Voltage area	Voltage used for Inline	Product group
Protective extra-low voltage	24 V DC	Extra-low voltage terminals; Inline Block IO modules
Low voltage	120 V AC	Low voltage terminals; AC terminals
	230 V AC	
	400 V AC	Power-level terminals

ℹ️ Observe the safety notes in the following sections when working outside the protective extra-low voltage area.

4.2 Correct usage

Inline Block IO modules and Inline terminals should only be used according to the instructions in the terminal-specific data sheets and this user manual. Phoenix Contact accepts no liability if the device is used for anything other than its designated use.

When used in the SELV area:

NOTE: Disregarding this warning may result in malfunction
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.

When used in the low voltage area:

WARNING: Dangerous contact voltage
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.

WARNING: Dangerous contact voltage
Please note that there are dangerous contact 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.

4.3 Notes for Inline

4.3.1 Safety notes for use in the low voltage area

Only qualified personnel may work on Inline terminals outside the PELV area.

In terms of this manual, qualified personnel are persons who, because of their education, experience, and instruction, and their knowledge of relevant standards, regulations, accident prevention, and service conditions, have been authorized to carry out any required operations, and who are able to recognize and avoid any possible dangers.

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

4.3.2 Safety notes for electrical equipment used in industrial plants with a 400 V AC voltage

⚠ **WARNING: Dangerous contact voltage**
The electrical power-level terminals for the 400 V AC area and connected machines refer to equipment used in industrial plants. During operation, this equipment has dangerous, live, moving or rotating parts. These can therefore cause considerable damage to health or equipment, e.g., due to the unauthorized removal of protective covers or inadequate maintenance.

– Only qualified personnel may work on the power-level terminals or system (for the definition, see Section 4.3.1 on page 17).
– When working on the power-level terminals and the system, you must always keep the operating instructions and other items of product documentation to hand and observe the information therein.
– It is prohibited for unqualified personnel to work on the power-level terminals, on the machine or in their vicinity.

The instructions given in the terminal-specific data sheets must be followed during installation and startup.
The notes on the procedures and the circuit details presented in the terminal-specific data sheets should be understood in a general sense and the relevant application should be tested to see if they apply.

Phoenix Contact cannot guarantee the suitability of the procedures or the circuit suggestions described for the relevant application.

4.3.3 Installation instructions and notes for low voltage terminals

⚠ **WARNING: Dangerous contact voltage**
Please note that there are dangerous contact voltages when switching circuits that do meet SELV requirements.

Connecting and disconnecting the terminals for the 120 V AC and 230 V AC voltage areas 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.

⚠ **WARNING: Dangerous contact voltage in the event of ground faults**
(e.g., because the FI circuit breaker has not tripped or the star point connection is "free")

Inline terminals for the 120 V AC and 230 V AC voltage areas should only be operated in grounded AC voltage networks (AC networks).

4.3.3.1 Structure of a 120 V AC/230 V AC area

A 120 V AC/230 V AC area **must** have a power terminal at one end and an end terminal at the other.

I/O terminals for these voltage areas can be used between these terminals. The number of terminals is limited by the system limits of the bus system and the Inline system (see Section 15, "Inline: Technical data and ordering data").

Figure 4-1 Typical structure of an Inline station with different voltage areas
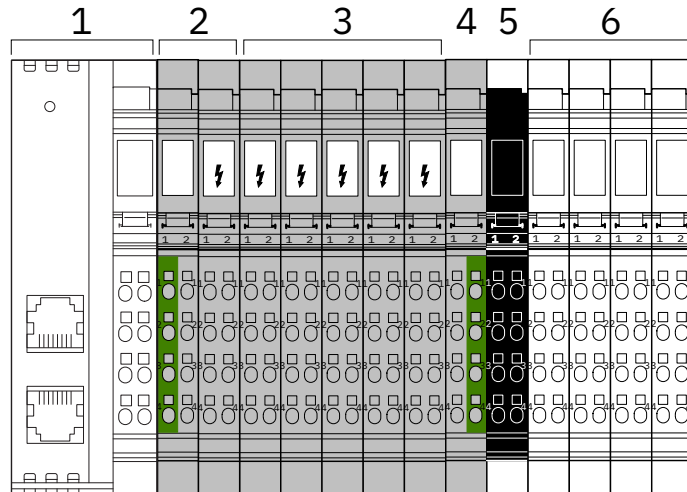
1 Bus coupler

2 Power terminal for the 120 V AC or 230 V AC area

3 Various I/O terminals for the 120 V AC or 230 V AC area

4 End terminal for the 120 V AC or 230 V AC area

5 Power terminal for the 24 V DC area

6 Various I/O terminals for the 24 V DC area

4.3.3.2 Fuse protection for a 120 V AC/230 V AC area

Each 120 V AC/230 V AC area must be protected by its own external fuse. Select the rating of the fuse according to the strength of the cable. The maximum fuse value is 8 A. For additional restrictions, please refer to the data sheets for the power terminals.

4.3.3.3 Connecting the power supply and I/O in the 120 V AC/230 V AC area

⚠ **WARNING: Dangerous contact voltage**
The supply voltage must **only** be provided at the appropriate power terminal.

If you provided voltage to several places in an incomplete Inline station, there would be a danger of touching live parts.

The connecting cables of all actuators and sensors must only be connected to the Inline terminals for the relevant voltage area. The use of external bus bars for group potentials is **not permitted**.

4.3.3.4 Interrupting PE jumpering in the 120 V AC/230 V AC area

The PE jumper begins at the power terminal of the 120 V AC/230 V AC area and, in a complete AC voltage area, ends at the end terminal.

If a terminal is removed from this area, the PE jumper is interrupted.

If the installation instructions have been followed, all subsequent terminals will be disconnected.

4.3.4 Electronics base and connectors for the different voltage areas

Power-level terminals are located in a power housing.

Extra-low voltage terminals and low voltage terminals are located in the same type of housing, which is referred to as extra-low voltagehousing. An external feature that distinguishes the base and the corresponding connectors of low voltage terminals from the base and connectors of extra-low voltage terminals is their color:

Table 4-3   Base and connector colors for the different voltage areas

Area	Terminal	Connector	Other differences
Extra-low voltage (24 V DC)	Green	Green or black	Light color for function identification (e.g., light blue)
Low voltage (120 V AC/ 230 V AC)	Gray	Gray	Dark color for function identification (e.g., dark blue) with white lightning bolt

4.3.5 Safety mechanisms to prevent incorrect connection of terminals for different voltage areas

4.3.5.1 Protection against the insertion of 24 V DC terminals and power-level terminals in the 120 V AC/230 V AC area

Extra-low voltage terminals and power-level terminals cannot be snaped-on within a low voltage area because there is no keyway on the right-hand side of the low voltage terminals (120 V AC/230 V AC).

⚠ **WARNING: Dangerous contact voltage**
The power terminals for the 24 V DC area can be inserted in a 120 V AC/230 V AC area. The minimum isolating distance in this case is the distance between two adjacent connectors. This isolating distance is not permitted. Therefore, only use end terminals that are designed for terminating the 120 V AC/230 V AC area.

4.3.5.2 Protection against the connection of 24 V connectors to 120 V AC/230 V AC terminals

The two terminal points for the low voltage I/O terminals are closed using filler plugs. The connectors for extra-low voltage terminals therefore do not fit on the low voltage terminals.

Exception 1: The extra-low voltage connectors can be plugged into 120 V AC/230 V AC power terminals.

This connection error has no hazardous effect on the electrical components, but it can lead to system malfunctions.

Only the appropriate connectors should therefore be plugged into the low voltage power terminals.

Exception 2: The extra-low voltage connectors can be plugged into relay terminals. Because the relay outputs are floating, this connection error has no adverse effects.

4.3.5.3 Protection against the connection of live 120 V AC/230 V AC connectors in the 24 V DC area

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

The following connectors may be live in the low voltage area:
– Connectors of the power terminals for the 120 V AC and 230 V AC areas
– Connectors for relay terminals

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

4.3.6 Response to the connection of a 120 V AC or 230 V AC terminal in the 24 V DC area

An AC terminal can be inserted in the 24 V DC area. The effects are described in Table 4-4.

i A 24 V DC terminal cannot be inserted accidentally in an AC area as these terminals are not mechanically compatible.

Table 4-4   Response to the connection of an AC terminal in the 24 V DC area

AC terminal in the 24 V DC area	Effect/description
AC power terminal in the 24 V DC area	No danger to people or machines. Specified interface between a 24 V DC area and an AC area. The AC power terminal consists of two function parts: – The left-hand part interrupts the jumpering of U_S, U_M, GND, and FE – The connections for the power supply and the jumper contacts for L, N, and PE are on the right-hand part
Digital AC output terminal in the 24 V DC area	No direct danger to people. If the output is activated, the Triac output may be forced to trip and no longer switch off because the supply voltage does not pass through zero. **(!) NOTE: Possible malfunction** This is likely to be caused by a malfunction of the actuator connected to the relevant output.
Digital AC input terminal in the 24 V DC area	No danger to people or machines. The input does not function due to missing ground.
Relay terminal in the 24 V DC area	No 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 (order designation IB IL DOR LV-SET-PAC) before and after the relay terminal.
AC end terminal in the 24 V DC area	No danger to people or machines. The terminal offers neither diagonal routing nor connector connection.

4.4 Dielectric tests

Observe the following for dielectric tests or when using insulation monitors in an Inline station:

Each Inline terminal contains leakage resistors. In case of large Inline stations, the parallel connection of leakage resistors can cause the total resistance of the station to drop below the expected total resistance. In this case, this low total resistance to ground is not a result of a technical defect or insulation fault.

For a correct insulation measurement:
• Take the initial total resistance of the station into consideration for the measurement results (offset).

Or
• Insulate the DIN rail from the system ground for the time of the measurement.

5 Inline product groups

The following sections provide an overview of the Inline product groups. For specific information about the individual terminals/modules, please refer to the specific data sheets and the individual sections in this manual.

ℹ️ The product range is continuously growing. Additional information can be found on the Internet at phoenixcontact.com/products.

5.1 Supported bus systems

Inline terminals/modules are available for the following bus systems:

Table 5-1 Bus systems supported by Inline

Bus system	Inline	Inline Block IO
PROFINET	Yes	Yes*
INTERBUS	Yes	Yes*
PROFIBUS DP	Yes	Yes*
Ethernet/IP™	Yes	No
Ethernet TCP/IP	Yes	Yes*
EtherCAT®	Yes	No
Modbus/TCP	Yes	Yes*
Modbus/RTU	Yes	No
Sercos II	Yes*	No
Sercos III	Yes	Yes*
DeviceNet™	Yes*	Yes*
CANopen®	Yes	Yes*
Mechatrolink	Yes*	No
Bluetooth	No	Yes*

* No longer in product range

5.2 Inline terminals

5.2.1 Versions

5.2.1.1 Extreme conditions version (IB IL ... -XC-PAC)

Thanks to special engineering measures and tests as well as coated PCBs, the XC modules can be used under extreme ambient conditions.

For use in the extended temperature range from -40°C to +70°C, please observe Section "Tested successfully: use under extreme ambient conditions", and the notes in the terminal-specific data sheet.

The function of an XC version is the same as the function of the corresponding standard version.

Tested successfully: Use under extreme ambient conditions

XC terminals have been tested successfully over 250 temperature change cycles in accordance with IEC 61131-2 in the range from -40°C to +70°C.

The following conditions were observed:

– The Inline devices for all connecting cables were connected with a minimum conductor cross section of 0.5 mm²
– The Inline station was assembled on a wall-mounted horizontal DIN rail
– Fans were used to ensure continuous movement of air in the control cabinet
– The Inline station was not exposed to vibration or shock
– The Inline station was operated with a maximum of 24.5 V (ensured by using regulated power supply units)

Figure 5-1 Temperature change cycle
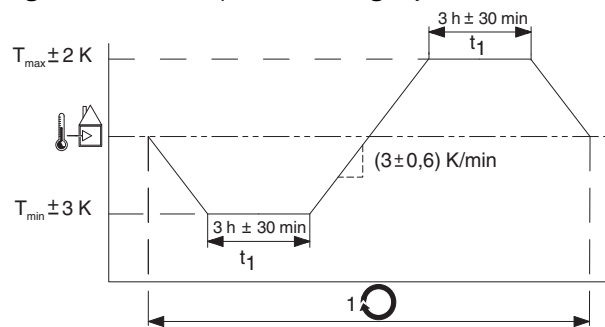
Temperature in the control cabinet/ambient temperature

Cycle

⚠ WARNING:
The terminal is not approved for use in potentially explosive areas.
The terminal is not approved for use in safety technology.

5.2.1.2 ECO version (IB IL ...-ECO)

ECO version

Inline ECO terminals enhance the Inline portfolio by inexpensive and especially simple terminals providing basic functionality. You can recognize these terminals by the "ECO" specified in the order designation. You can install Inline ECO terminals in series behind Inline bus couplers or Inline controllers, and combine them with standard terminals. Please note that if an Inline ECO terminal is used, the permissible ambient temperature for the station is limited to 0 °C to 55 °C.

Features of Inline ECO terminals
– No parameterization required (for digital and analog input and output terminals)
– Limited temperature range for operation: 0 °C ... 55 °C
– Scope of supply: electronics base and required connectors
    – Analog and function terminals come without shield plug.
      For notes on shielding, please refer to Section "Connecting cables using Inline connectors" on page 128.
    – Labeling fields are not included.
      For ordering data for labeling fields, please refer to the Section "General accessories" on page 162.

5.2.2 Scope of supply

Depending on the type, Inline terminals are available with varying accessories. Type "-PAC" and "-ME" Inline terminals come with:
– The electronics base,
– all required Inline connectors, and
– all required labeling fields.

Inline connectors are designed for connecting the cables. They are required for correct operation of the terminal.

Labeling fields are used for clear marking. They are optional accessories.

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

If your item comes without labeling field, you can separately order labeling fields as optional accessories.

Table 5-2   Scope of supply for Inline terminals, depending on the type

Type (example)	Connector	Labeling field
IB IL 24 DO 4-PAC	included in scope of supply	included in scope of supply
IB IL 24 DO 4-ME	included in scope of supply	included in scope of supply
IB IL 24 DO 4/EF-ECO	included in scope of supply	accessories (optional)
IB IL 24 PWR IN	accessories (required)	accessories (optional)

5.2.3 Transmission speed in the local bus

It is possible to operate at a transmission speed of 500 kbps **or** 2 Mbps within an Inline station.

Items designed for 2 Mbps are indicated by the extension "**-2MBD**" in the order designation. The versions without this extension are designed for 500 kbps.

> **i** In the product range, terminals with 500 kbps are basic versions. Some (not all) of the terminals are also available as 2MBD versions. Information about available terminals can be found on the Internet at phoenixcontact.com/products.

> **!** **NOTE:**
> Use the same transmission speed throughout an Inline station. The station cannot operate otherwise. Make sure that your bus coupler supports this transmission speed in the local bus.

For INTERBUS, a separate bus coupler version is available for each transmission speed. Bus couplers for other bus systems may only support terminals with 500 kbps or even both transmission speeds in the local bus.

> **i** For details of which transmission speed your bus coupler can use within the local bus, please refer to the corresponding documentation.

Examples

Examples of order designations:

IB IL 24 DO 4-PAC	500 kbps; complete with accessories (connector and labeling field)
IB IL 24 DO 4-2MBD-PAC	2 Mbps; complete with accessories (connector and labeling field)

Convention for this document

The PAC version for 500 kbps is used in the following examples. However, all information also applies for the versions for 2 Mbps and the versions without accessories.

5.2.4 Example of an Inline station

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

In addition, Figure 5-2 also shows the structure of the main and segment circuits. This structure can be created using power and/or segment terminals (see Section "Power, segment, and accessory terminals" on page 30).

Figure 5-2 Typical Inline station
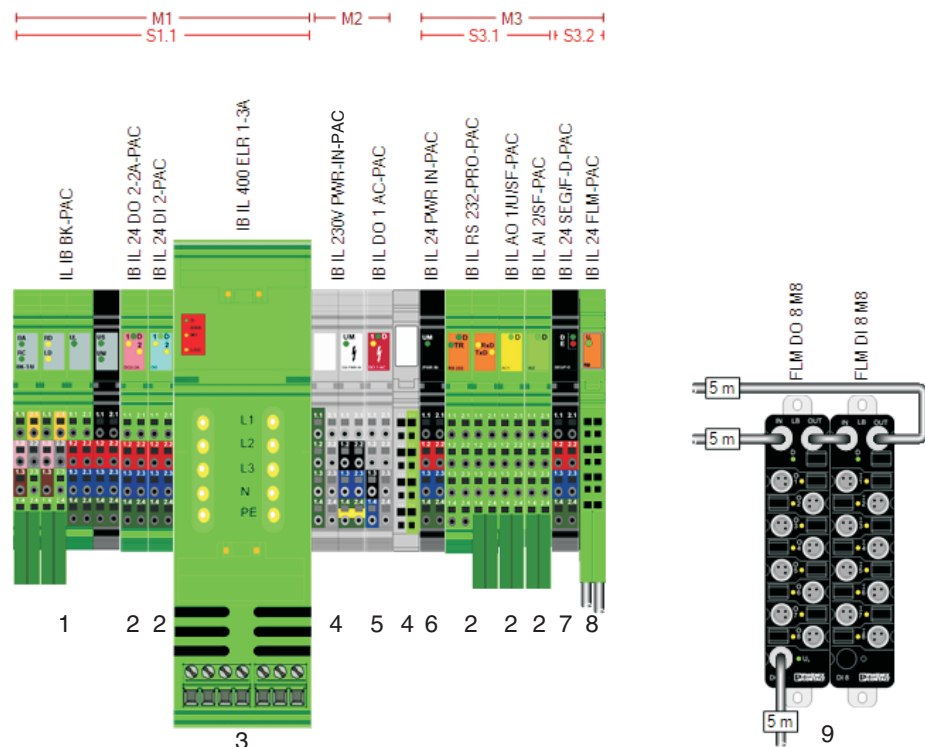
1 Bus coupler (here: with supply voltages supplied)
2 I/O terminals for 24 V area
3 Power-level terminal
4 Power and end terminal for a 230 V area
5 Output terminal for 230 V area
6 Power terminal for 24 V area
7 Segment terminal
8 Branch terminal (here: to connect Fieldline Modular M8 devices)
9 Fieldline Modular M8 devices

M1, M2, M3	Main circuit 1, 2, 3
S1.1	Segment circuit 1 in main circuit 1
S3.1, S3.2	Segment circuit 1 and 2 in main circuit 3

5.2.5 Bus couplers and terminals with remote bus branch

Figure 5-3   Example: Bus coupler and terminal with remote bus branch
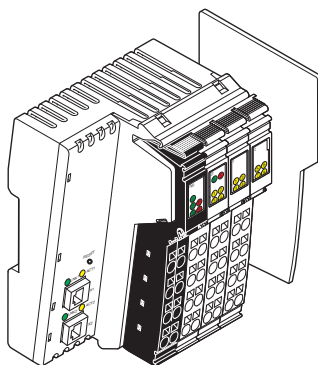
Bus coupler for PROFINET:
IL PN BK DI8 DO4 2TX-PAC
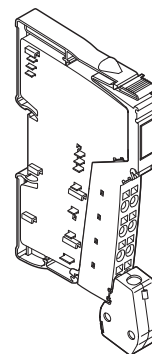
Terminal with remote bus branch:
IBS IL 24 RB-T-PAC

5.2.5.1 Bus coupler

A bus coupler is required to connect an Inline station to a bus. Bus couplers are available for various bus systems (see Table 5-1).

> The bus couplers are described in detail in a separate document.
> Not all Inline terminals can be used with every bus coupler.

INTERBUS:
Every Inline I/O terminal can be operated downstream of an INTERBUS bus coupler.

Other bus systems/networks:
The Project+ software is available as a configuration tool for Inline stations.
Use this software particularly when you configure stations at bus couplers that support a bus system or network other than INTERBUS.
You will be notified by the software if there are restrictions for I/O terminals.

5.2.5.2 Terminals with remote bus branch

A terminal with remote bus branch can be used downstream of the following bus couplers:

– INTERBUS bus coupler IBS IL 24 BK ...
– PROFINET bus coupler IL PN BK-PAC
– Ethernet bus coupler IL ETH BK-PAC

> For more detailed information about this, please refer to the IB IL SYS PRO UM E user manual or the data sheet for the terminal with remote bus branch.

5.2.6 Power, segment, and accessory terminals

> ℹ For more detailed information about the voltages used within an Inline station, please refer to Section "Circuits and provision of supply voltages" on page 80.

5.2.6.1 Overview of power and segment terminals

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

Table 5-3   Overview of power and segment terminals

Designation	Type	Supply/ provision	Fuse	Diagnostics (bus device)	Fused area
IB IL 24 PWR IN-PAC	Power terminal	U_M/U_S	No	No	None
IB IL 24 PWR IN/F-PAC			Yes	No	Main circuit
IB IL 24 PWR IN/2-F-PAC			Yes	No	Main circuit and segment circuit
IB IL 24 PWR IN/2-F-D-PAC			Yes	Yes (500 kbps)	Main circuit and segment circuit
IB IL 24 PWR IN/2F-DF-2MBD-PAC			Yes	Yes (2 Mbps)	Main circuit and segment circuit
IB IL 24 PWR IN/R/L-0.8A-PAC		U_{24V} (U_L)	No	No	None
IB IL 24 PWR IN/R-PAC		U_{24V} (U_L/U_{ANA})/U_M/U_S	No	No	None
IB IL 120 PWR IN-PAC		L	No	No	None
IB IL 230 PWR IN-PAC			No	No	None
IB IL 24 SEG-PAC	Segment terminal	U_S	No	No	None
IB IL 24 SEG/F-PAC			Yes	No	Segment circuit
IB IL 24 SEG/F-D-PAC			Yes	Yes (500 kbps)	Segment circuit
IB IL 24 SEG-ELF-PAC			Yes (electronic)	Yes (500 kbps)	Segment circuit
XC versions					
IB IL 24 PWR IN-XC-PAC	Power terminal	U_M / U_S	No	No	None
IB IL 24 SEG/F-XC-PAC	Segment terminal	U_S	Yes	No	Segment circuit

Table 5-3   Overview of power and segment terminals

Designation	Type	Supply/ provision	Fuse	Diagnostics (bus device)	Fused area
No longer in product range					
IB IL 24 PWR IN/F-D-PAC	Power terminal	U_M / U_S	Yes	Yes (500 kbps)	Main circuit
IB IL 24 PWR IN/2F-DF-PAC			Yes	Yes (500 kbps)	Main circuit and segment circuit
IB IL 24 PWR IN/2F-DF-2MBD-PAC			Yes	Yes (2 Mbps)	Main circuit and segment circuit
IB IL 24 PWR IN/2-F-XC-PAC		U_M / U_S	Yes	No	Main circuit and segment circuit
IB IL 24 PWR IN/R-XC-PAC		U_{24V} (U_L/U_{ANA}) / U_M / U_S	No	No	None
IB IL 24 PWR IN/PS-PAC					
IB IL 230 PWR IN/F-D-PAC		L	Yes	Yes (500 kbps)	Main circuit

U_M Main voltage

U_S Segment voltage

U_{24V} 24 V supply, generated from voltages U_L and U_{ANA}

U_L Communications power

U_{ANA} Analog voltage

ⓘ **NOTE: Consequential damage**
Protect the power supply externally, regardless of the power and/or segment terminal used.

ℹ️ Terminals that are not bus devices can be used in a local bus with 500 kbps as well as a local bus with 2 Mbps.

5.2.6.2 Power terminals

A power terminal is used to supply the required voltages to the internal station potential jumpers. Several power terminals can be used in one station. This means that different circuits can be electrically isolated and areas with different voltages can be created within the station (e.g., 24 V DC and 230 V AC).

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

A 24 V supply voltage is also supplied at the IB IL 24 PWR IN/R-PAC and IB IL 24 PWR IN/PS-PAC terminals, from which the communications power U_L and the analog voltage U_{ANA} are generated. These terminals are mainly designed to boost the communications power and analog voltage when the maximum current carrying capacity of the potential jumpers for U_L/U_{ANA} or the maximum current carrying capacity of the bus coupler for U_L/U_{ANA} is reached.

Figure 5-4   Example of a power terminal: IB IL 24 PWR IN-PAC
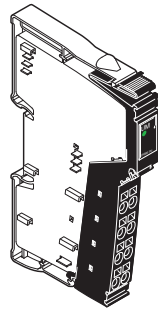
Voltage areas

Depending on the power terminal, it is possible to work with 24 V DC, 120 V AC or 230 V AC within an Inline station.

To utilize different voltage areas within a station, a new power terminal must be used for each area.

⚠ **WARNING: Dangerous contact voltage**
When the power terminal is removed, the metal contacts are freely accessible. With 120 V AC or 230 V AC power terminals, it should be assumed that dangerous contact voltage is present. You **must** disconnect power to the station **before removing** a terminal.

If these instructions are not followed, there is a danger of damage to health or even of a life-threatening injury.

ℹ **Observe safety notes**
Observe the notes provided in Section "Important information about voltage areas" on page 16 when using voltages outside the SELV area.

Potential jumpers	The power terminal interrupts all potential jumpers for the voltages to be reinjected, and recreates all potential jumpers (see also Section "Electrical potential and data routing (Inline)" on page 80).
Carrying capacity of the jumper contacts	The maximum current carrying capacity of the jumper contacts on the side is specified in Section "Current and voltage distribution" on page 91.
Electrical isolation	The power terminal is used to create electrically isolated I/O areas within a station.
Functional grounding (24 V DC)	24 V power terminals are connected to functional ground when they are snapped onto the grounded DIN rail via the FE spring on the bottom 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 it is snapped onto this terminal.
Required additional functional grounding (24 V DC)	A 120 V AC and 230 V AC voltage level area interrupts the FE jumper, which is connected to FE via the additional functional grounding at the bus coupler. A 24 V DC power terminal that is at a different voltage area must therefore be reconnected to functional ground via the FE connection to ensure reliable functional grounding of the station even if the FE spring is dirty or damaged. Connect the terminal points for the FE connection to a grounded PE terminal (see Section "Grounding concept" on page 112).
Protective grounding (120 V AC/230 V AC)	The PE terminal point of the power connector connects the 120 V AC and 230 V AC power terminals to protective ground (PE). This terminal point is connected to the PE potential jumper, which is led through the entire 120 V AC or 230 V AC voltage area.
Additional documentation	ⓘ For more detailed information about the function, properties, and wiring of the individual terminals, please refer to the terminal-specific documentation.

5.2.6.3   Segment terminals

Segment terminals can only be used in the 24 V DC area. Segment terminals can be 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 5-5   Example of a segment terminal: IB IL 24 SEG-PAC
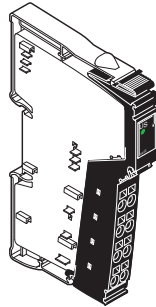
U_M	The potential jumper for the main circuit U_M is not interrupted in the segment terminal. The potential for the segment circuit U_S is tapped from the potential jumper at the segment terminal.
U_S	The segment terminal interrupts the segment circuit U_S in the potential jumper of the previous terminal. For more detailed information about the supply voltages, please refer to Section "Circuits and provision of supply voltages" on page 80.
Carrying capacity of the jumper contacts	The maximum current carrying capacity of the jumper contacts on the side is specified in Section "Current and voltage distribution" on page 91.
Functional grounding	The terminal is connected to functional ground when it is snapped onto the grounded DIN rail via the FE spring on the bottom of the terminal. This spring is connected to the FE potential jumper and to the terminal points for an FE connection. When snapped onto the previous terminal, the segment terminal is connected to the FE potential jumper of the station.
Additional documentation	For more detailed information about the function, properties, and wiring of the individual terminals, please refer to the terminal-specific documentation.

5.2.6.4 Accessory terminals

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

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

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

Figure 5-6   Example of a potential dis- Figure 5-7   Distance terminal set:
              tributor terminal: IB IL DOR LV-SET-PAC
              IB IL PD 24V-PAC
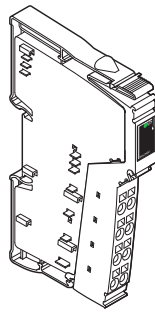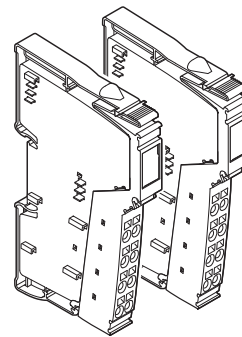
Additional documentation   For more detailed information about the function, properties, and wiring of the individual terminals, please refer to the terminal-specific documentation.

5.2.6.5 Supply and segmentation options

Figure 5-8 provides an overview of supply and segmentation. For more detailed information, please refer to Section "Electrical potential and data routing (Inline)" on page 80.

Figure 5-8   Supply and segmentation options

Supply and segmentation
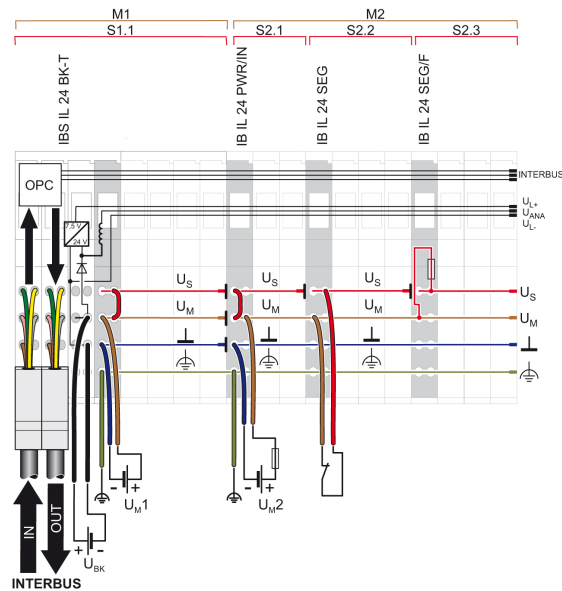
Segment terminals can be used to create different segment circuits within a 24 V area of an Inline station.

Structure of an AC area
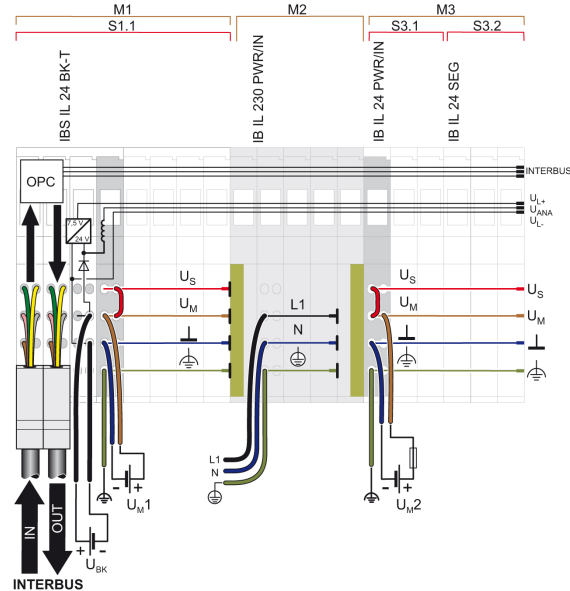
Special AC power and segment terminals can be used to create AC areas within an Inline station.

Integration of power-level terminals
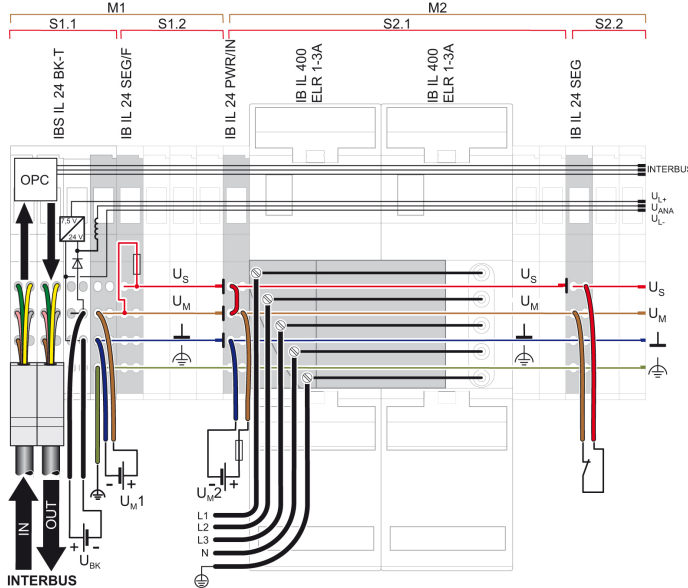
A 400 V power bus is supplied at the first power-level terminal and jumpered further.

5.2.7   I/O terminals

Functions

Terminals with different functions are available for **extra-low voltage level**. These include the following terminals, for example: The text in brackets indicates the function according to the order designation.

– Digital input and output terminals (DI, DO)
– Analog input and output terminals (AI, AO)
– Relay terminals (DOR)
– Temperature measurement terminals (TEMP)
– Communication terminals
  – Communication terminals with serial interface (RS232, RS485/422)
  – Inline/AS-i master (ASI MA)
  – DALI terminals (DALI)
  – Master terminals (IFS MA, PB MA)
– Position detection terminals (INC-IN, IMPULSE-IN, SSI-IN)
– Terminals for open and closed-loop control
  – Function terminals (PWM, CNT)
  – Positioning terminals (SSI, INC)
  – Temperature controller terminals (TEMPCON)

Digital input and output terminals and relay terminals are available for the **low voltage area**.

The 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.

Figure 5-9   Example of a digital input terminal: IB IL 24 DI 8-PAC
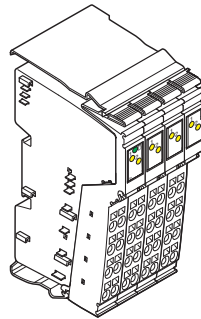
Protection

Overload protection of the system is provided centrally by a fuse in the power terminal or by an external fuse provided by the operator. 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 current carrying capacity of the jumper contacts on the side is specified in Section "Current and voltage distribution" on page 91.

Grounding (FE or PE)

Connection to functional ground (24 V DC area) or protective ground (120 V AC or 230 V AC area) is established via the corresponding potential jumpers when the terminal is snapped onto the previous terminal.

Voltage areas

I/O terminals are available for different voltage areas. Depending on the power terminal, it is possible to operate with 24 V DC, 120 V AC or 230 V AC.

To utilize different voltage areas within a station, a new power terminal must be used for each area.

Shielding

Inline shield connectors are available for connecting shielded cables.

Parameterization

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

Data formats

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

Diagnostics

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

Additional documentation

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

5.2.8 Power-level terminals (no longer in product range)

Figure 5-10   Power-level terminal
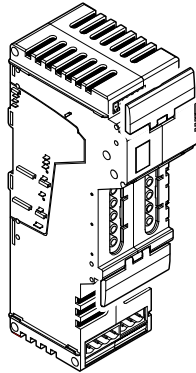
Different power-level terminals are available for direct switching, protection, and monitoring of three-phase standard motors via a bus system:

– Power-level terminal as electronic direct starter
for motors up to 1.5 kW/400 V AC
– Power-level terminal as electromechanical direct starter
for motors up to 3.7 kW/400 V AC
– Power-level terminal as electronic reversing load starter
for motors up to 1.5 kW/400 V AC

Features
– Electronic motor protection
– Motor current parameterization via a bus system
– Motor current monitoring
– Quick shutdown
– Mains voltage up to 400 V AC or 520 V AC, maximum (without tolerance in electro-mechanical versions)
– Nominal output power of 1.5 kW to 3.7 kW depending on the version
– Hand-held operator panel mode
– Can be extended with brake function as an option
– Thermal motor monitoring using connected thermistor terminal

Connections
Connections for the mains supply input, remote cabling, motor output, hand-held operator panel mode, and a brake are available on a power-level terminal.

Carrying capacity of the jumper contacts
The maximum current carrying capacity of the jumper contacts on the side is specified in Section "Current and voltage distribution" on page 91.

**Protective grounding (PE)**
The power-level terminal is connected to protective ground via the mains connection.

Voltage area
Power-level terminals must be installed in a 24 V DC area within an Inline station. Operation in a different voltage area is not permitted.

Additional documentation
For more detailed information about the function, properties, wiring, and parameterization of the individual terminals, please refer to the terminal-specific documentation.

5.2.9 Safety modules

5.2.9.1 Bus-independent safety modules

IB IL 24 SAFE 2-ECO (no longer in product range)

The Inline ECO safety module with sensor circuits is designed for use within the 24 V area of an Inline station.

The module monitors two sensor circuits. The sensor circuits can be designed as single/two-channel, non-equivalent/equivalent.

If at least one sensor circuit is interrupted, the safety module initiates the safe state, and switches off the subsequent segment circuit for safety.

Possible signal generators

– Emergency stop button
– Safety door monitoring
– Light grid

Suitable up to category 4, PL e (EN ISO 13849-1), SILCL 3 (EN 62061)

Figure 5-11   Safety module IB IL SAFE 2-ECO
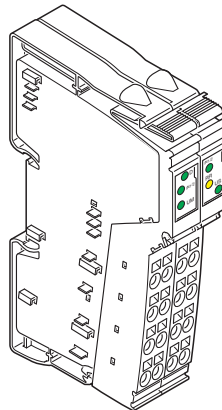
Safety-related segment circuit

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

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

The safety-related segment circuit starts at a safety module and finishes at the last Inline terminal before another power supply unit or at the end of the station. Only Inline terminals that are specifically designed for the safety-related segment circuit may be used. They are listed in the "Safety-related segment circuit" application note, AH EN IL SAFE. Please also refer to the data sheet for the safety module in use.

5.2.9.2 Safety modules in a bus system with a safe protocol

In addition to the use of bus-independent, conventional safety modules (such as IB IL SAFE 2-ECO (discontinued)) in an Inline station, safety modules can also be used in a bus system with a safe protocol (SafetyBridge technology, PROFIsafe). In this type of bus system, the safe data is transmitted between the safe controller and the safety modules via the bus using a safe protocol. This means that the same cable is used for both safety-related communication and standard communication.

Figure 5-12 Example of a safety module: IB IL 24 PSDO 8-PAC
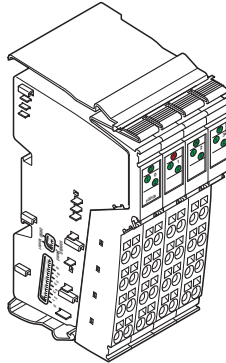
SafetyBridge Technology

SafetyBridge Technology means that input and output modules exchange safety-related signals with each other. Since the modules process the safety functions themselves, they use the standard controller and network only for transport purposes.

Without a safety controller or safe fieldbus system, this is a cost-effective solution for functional safety in standard applications.

With SafetyBridge Technology, safety functions with the following requirements can be met:

– up to category 4, PL e according to standard EN ISO 13849-1,
– up to SILCL 3 according to standard EN 62061.

Within the Inline product group, the following safety modules, for example, are available for SafetyBridge Technology:

– IB IL 24 LPSDO 8-PAC (No longer in product range)
– IB IL 24 LPSDO 8 V2-PAC
– IB IL 24 LPSDO 8 V3-PAC
– IB IL 24 PSDI 8-PAC
– IB IL 24 PSDI 16-PAC
– IB IL 24 PSDO 8-PAC
– IB IL 24 PSDO 4/4-PAC
– IB IL 24 PSDO 4/4-R-PAC
– IB IL 24 PSDOR 4-PAC
– IB IL 24 PSDOR 4-F-PA

> **i** For detailed information, please refer to the module-specific user manuals.

PROFIsafe

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

PROFIsafe can be used to achieve safety functions with the following requirements:
– up to category 4, PL e according to standard EN ISO 13849-1,
– up to SILCL 3 according to standard EN 62061.

Within the Inline product range, the following safety modules, for example, are available for PROFIsafe:
– IB IL 24 PSDI 8-PAC
– IB IL 24 PSDI 16-PAC
– IB IL 24 PSDO 8-PAC
– IB IL 24 PSDO 4/4-PAC
– IB IL 24 PSDO 4/4-R-PAC
– IB IL 24 PSDOR 4-PAC
– IB IL 24 PSDOR 4-F-PA

5.2.10 Intrinsically safe terminals for the Ex area (Ex i) (no longer in product range

5.2.10.1 Terminals for different zones in potentially explosive areas

There is a large selection of standard I/O terminals for use in potentially explosive areas up to Zone 2 available for this purpose.

> **ℹ** **Items manufactured as of the start of 2023 do not comply with directive 2014/34/EU (ATEX). Use in potentially explosive areas of category 3 is not permitted.**
> For previously manufactured items with ATEX-relevant printing applies:
> For an overview of the Inline terminals that are approved for potentially explosive areas up to Zone 2, please refer to the AH EN IL EX ZONE 2 application note. It can be downloaded from the Internet at phoenixcontact.com/products. It is available in the download area for the approved terminals.

Furthermore, intrinsically safe, blue I/O terminals are available: They can be installed in non-potentially explosive areas or potentially explosive areas of Zone 2. These terminals can be used for input or output signals present in Zone 1 or Zone 0.

Figure 5-13   Use of Inline terminals in potentially explosive areas
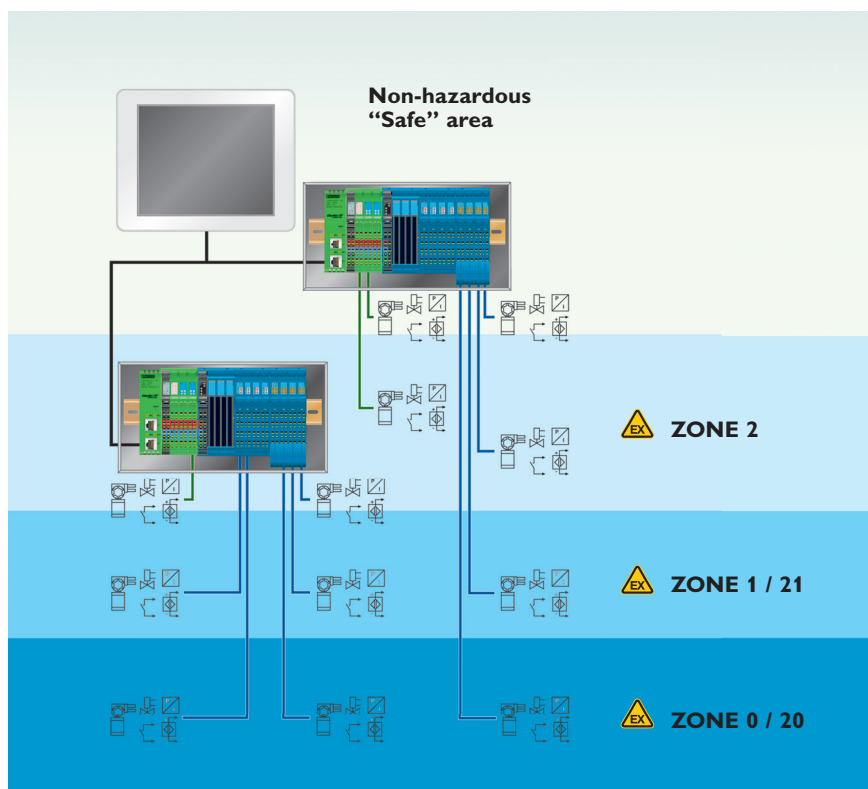
Table 5-4   Use of Inline terminals in potentially explosive areas

Inline terminal	ATEX approval for Zone 2	Installation in zone		Use of sensors/actuators in zone			
		Safe	2	Safe	2	1	0
Inline bus coupler/Inline controller without I/Os	✗	✓	✗	–	–	–	–
Inline bus coupler/Inline controller with I/Os standard I/O terminals	✗	✓	✗	✓	✗	✗	✗
Inline bus coupler/Inline controller without I/Os	✓	✓	✓	✓	✓	✗	✗
Inline bus coupler/Inline controller with I/Os standard I/O terminals	✓	✓	✓	✓	✓	✗	✗
Intrinsically safe I/O terminals	✓	✓	✓	✓	✓	✓	✓

⚠ **DANGER: Explosion hazard**
If at least one terminal in the Inline station does not have ATEX approval for Zone 2, the entire station must not be installed in this area.
In this case, install the station in a safe area.

ℹ Not all bus couplers support the operation of intrinsically safe I/O terminals. Table 5-6 on page 49 shows which bus couplers can be used in combination with intrinsically safe I/O terminals.

ℹ Check if the terminals you use are ATEX approved for Zone 2. Conformity is explained in the CE Declaration of Conformity. In addition, the terminals are marked accordingly.
For an overview of Inline terminals for use in Zone 2 potentially explosive areas, please refer to the application note AH EN IL EX ZONE 2.

5.2.10.2   EX-IS terminals (no longer in product range)

The following Inline terminals are available for creating an intrinsically safe Inline I/O system:

Table 5-5   Terminals for creating an area with intrinsically safe Inline terminals

Order No.	Type	Description	Remark
Intrinsically safe Inline terminals			
2869910	IB IL EX-IS PWR IN-PAC	Inline power terminal for supplying power to intrinsically safe I/O terminals	Using this power terminal is **mandatory** if IB IL EX-IS...IO... terminals are used in the Inline station.
2869911	IB IL EX-IS DIO 4/NAM-PAC	Intrinsically safe digital Inline I/O terminal, four configurable NAMUR input/output channels	
2869912	IB IL EX-IS AIO 4/EF-PAC	Intrinsically safe analog Inline I/O terminal, four configurable input/output channels	
2869913	IB IL EX-IS TEMP 4 RTD/TC-PAC	Intrinsically safe Inline temperature terminal, four configurable input channels	
Standard Inline terminal			
2869909	IB IL EX PWR-ISO-PAC	Inline terminal for use as an isolator between non-intrinsically safe Inline I/O expansion and intrinsically safe Inline power supply	The use of this isolator terminal block is **mandatory** if intrinsically safe Inline I/O terminals are to be used together with standard Inline I/O terminals within an Inline station.

For detailed information on the terminals, please refer to the terminal-specific data sheets.
They are available on the Internet at phoenixcontact.com/products.

5.2.10.3   Examples for using terminals in the Ex area

1.   Inline station with EX-IS terminals only

A simple intrinsically safe Inline Ex I/O station must comprise of the following terminals:
–   Inline bus coupler or Inline controller with integrated I/Os or without I/Os
–   IB IL EX-IS PWR IN-PAC: Inline power terminal for supplying power to intrinsically safe I/O terminals
–   IB IL EX IS ... I/O modules

> ℹ️   Only one IB IL EX-IS PWR IN-PAC power terminal can be installed in an Inline station. Create a new Inline station if the maximum station size is reached.

Figure 5-14   Inline station with EX-IS terminals only
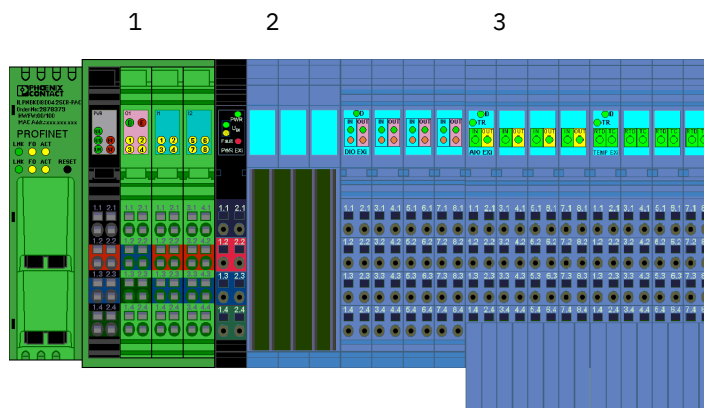
1   Inline bus coupler or Inline controller with integrated I/Os or without I/Os
2   IB IL EX-IS PWR IN-PAC: Inline power terminal for supplying power to intrinsically safe I/O terminals
3   IB IL EX-IS ...: intrinsically safe Inline I/O terminals according to the requirements of your application

2.   Inline station with standard terminals, safety modules, and EX-IS terminals

Figure 5-15   Inline station with standard terminals and EX-IS terminals
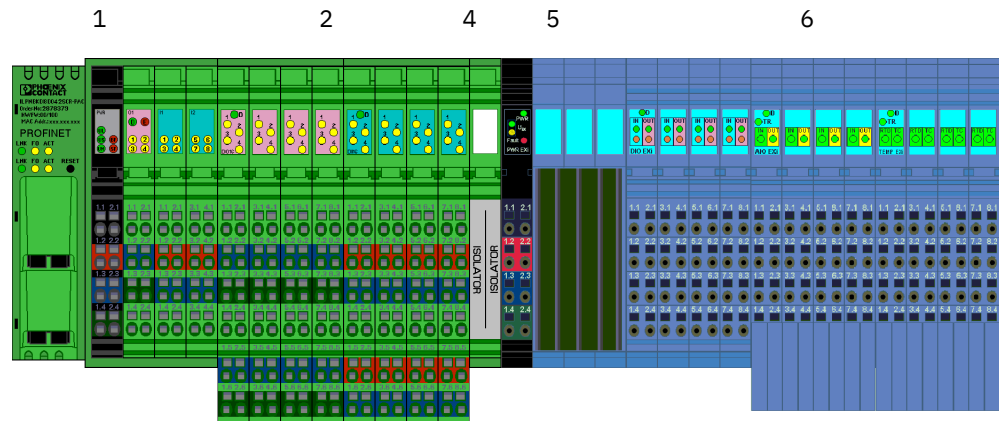
Figure 5-16   Inline station with standard terminals, a safety module, and EX-IS terminals
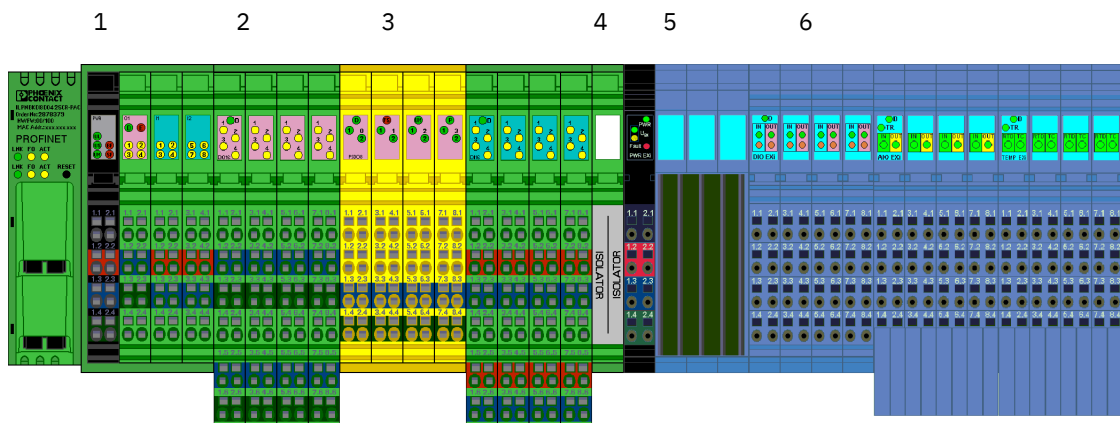
1   Inline bus coupler or Inline controller with integrated I/Os or without I/Os

2   Standard Inline terminals according to your application, without or with approval for potentially explosive areas of Zone 2

3   Safety modules according to your application

4   IB IL EX PWR-ISO-PAC: isolator between the non-intrinsically safe Inline I/O expansion and intrinsically safe Inline power supply

5   IB IL EX-IS PWR IN-PAC: Inline power terminal for supplying power to intrinsically safe I/O terminals

6   IB IL EX-IS ...: intrinsically safe Inline I/O terminals according to your application needs

> ℹ️ In mixed stations, standard terminals including safety modules must only be used **before the isolator terminal**.
> **Standard terminals** must not be used after the EX-IS terminals.

5.2.10.4 Voltage supply

There are two options for supplying voltage to the intrinsically safe area:

– Supply the 24 V supply voltage to an IB IL EX-IS PWR IN-PAC power terminal.
  Or:

– Supply the 24 V supply voltage to the IB IL EX-IS PWR IN-PAC power terminal by bridging it from the 24 V supply voltage U_S.

> **i** Do not bridge the supply voltage from U_{BK} in order to avoid negative impact.
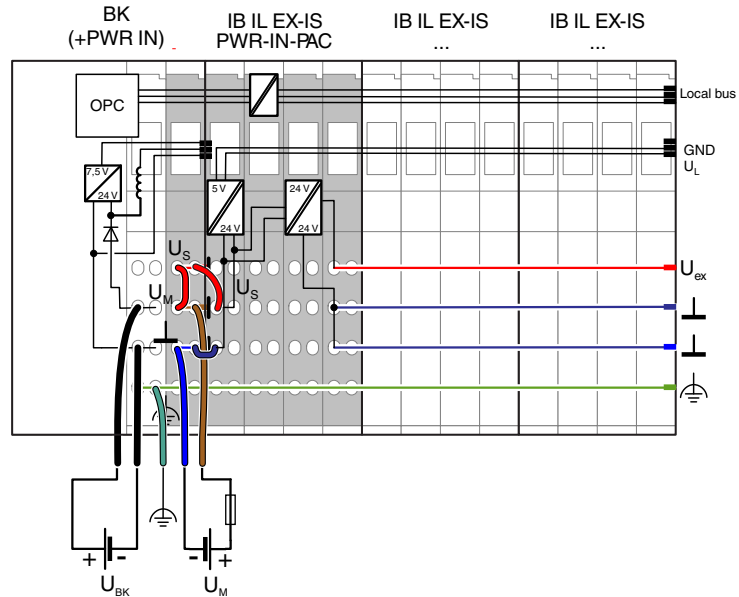
BK (+PWR IN)   Inline bus coupler with feed-in of the supply voltages U_{BK}, U_M, U_S

5.2.10.5 Bus couplers that support the operation of intrinsically safe I/O terminals

Not all bus couplers support the operation of intrinsically safe I/O terminals.

Table 5-6 shows which bus couplers can be used in combination with intrinsically safe I/O terminals.

Table 5-6   Bus couplers that support intrinsically safe I/O terminals

Network/bus system	Item no.	Type	Use in ATEX Zone 2	Production without ATEX-relevant identification as of
PROFINET	2703994	IL PN BK DI8 DO4 2TX-PAC	✓	2023
	2878379	IL PN BK DI8 DO4 2SCRJ-PAC	✓	2017
PROFIBUS DP	2692322	IL PB BK DI8 DO4/EF-PAC	✓	2023
Modbus/TCP (UDP)	2703981	IL ETH BK DI8 DO4 2TX-PAC	✓	2023
Modbus/RTU	2878696	IL MOD BK DI8 DO4-PAC	✓	2023
INTERBUS	2861218	IBS IL 24 BK-LK-PAC	✓	2017
	2861580	IBS IL 24 BK-T/U-PAC	✓	2023

Bus couplers marked with a "✓" comply with directive 2014/34/EU (ATEX).
Install these bus couplers in the safe area or in Zone 2 potentially explosive areas.

ℹ Bus couplers not listed do not support intrinsically safe I/O terminals.
Install these bus couplers in the safe area only.

ℹ Before using your bus coupler, check whether it is suitable for use in Zone 2 potentially explosive areas. Conformity is explained in the CE Declaration of Conformity. In addition, the bus coupler is marked accordingly.
For an overview of all Inline terminals for use in Zone 2 potentially explosive areas, please refer to the AH DE IL EX ZONE 2 application note.

ℹ **Date in the "Production without ATEX-relevant identification as of" column:**
Items manufactured **until 2017 or the start of 2023** comply with directive 2014/34/EU (ATEX).
You may use these items in potentially explosive areas of category 3.

Items manufactured **afterwards** do not meet the requirements of directive 2014/34/EU.
Use in potentially explosive areas of category 3 is **not permitted**.

• Do not include these items in plans for new installations.
• If you wish to replace an item, check that the new item has the appropriate approval.
• If you use an item with ATEX-relevant printing in a potentially explosive area, please observe the associated documentation.

If the item used by you does not feature ATEX-relevant identification, use in potentially explosive areas is not permitted.

5.2.11 Programmable logic controllers (PLC)

Programmable logic controllers, so-called Inline controllers, are available for control tasks.

Using an Inline Controller, the Inline station becomes a distributed control system. The Inline Controller integrates an IEC 61131-programmable PLC CPU in the Inline system. The Inline Controller enables direct signal processing of the distributed I/O points. The Inline Controller also enables the creation of independent subnetworks, which process automation tasks autonomously.

Figure 5-17   Example of an Inline Controller: ILC 151 ETH
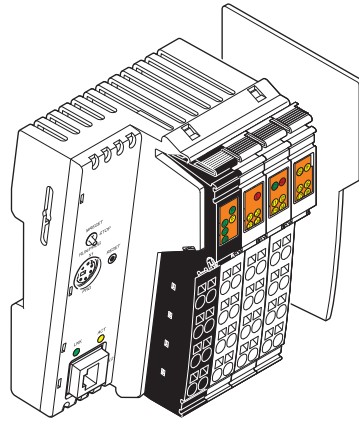
ℹ️ For more detailed information, please refer to the terminal-specific data sheets and user manuals.

5.2.12 Inline adapter terminal (INTERBUS-Master) at a PLCnext Control

The AXC F IL ADAPT Inline adapter terminal , item no. 1020304, is an INTERBUS master. The terminal is designed to be aligned to the right of an Axiocontrol series PLCnext Control device.

The Inline adapter terminal can be used to set up an Inline station for PLCnext Technology and to integrate INTERBUS devices.

Figure 5-18 Example of the design of an Inline station
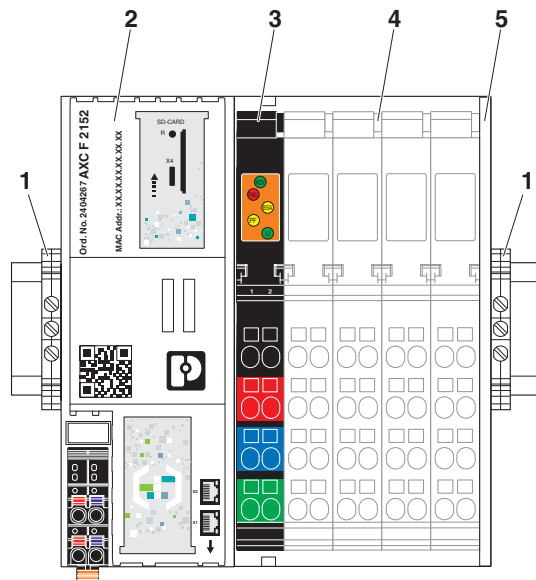
1 End clamp (e.g., CLIPFIX 35-5, Item No. 3022276)
2 PLCnext control for Axioline F (in the example: AXC F 2152)
3 Inline adapter terminal (AXC F IL ADAPT, Item No. 1020304)
4 Inline terminals corresponding to the application
5 End plate (snap onto the DIN rail as station end, included in the scope of supply of the Inline adapter terminal)

> ℹ Detailed information can be found in the terminal-specific data sheet.

5.2.13 Branch terminals (no longer in product range)

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

Figure 5-19   Example of a branch terminal: IB IL 24 FLM-PAC
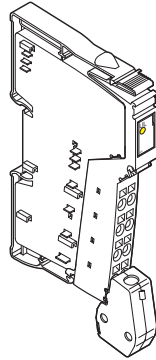
These branch terminals can be used to integrate sensors and actuators in close proximity to the station, which are connected to the Fieldline Modular M8 or M12 local bus with IP65/67 protection, in your bus system.

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

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

5.2.13.2 Local bus extension (jumping between two rows)

An Inline station can be extended by one or more rows. A combination of an IB IL 24 FLM-PAC branch terminal and an IB IL 24 LSKIP-PAC local bus extension terminal is used for this.

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

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

Figure 5-20   Example: Jumping between two rows within an Inline station
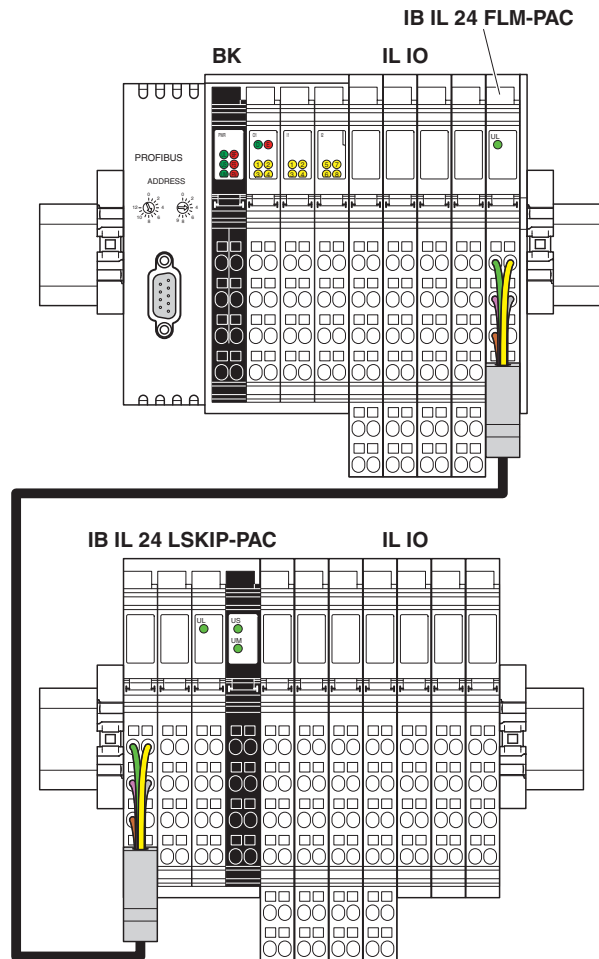
5.2.14   Typical structure of an Inline station

Figure 5-21   Example station with power-level terminals and 24 V DC terminals
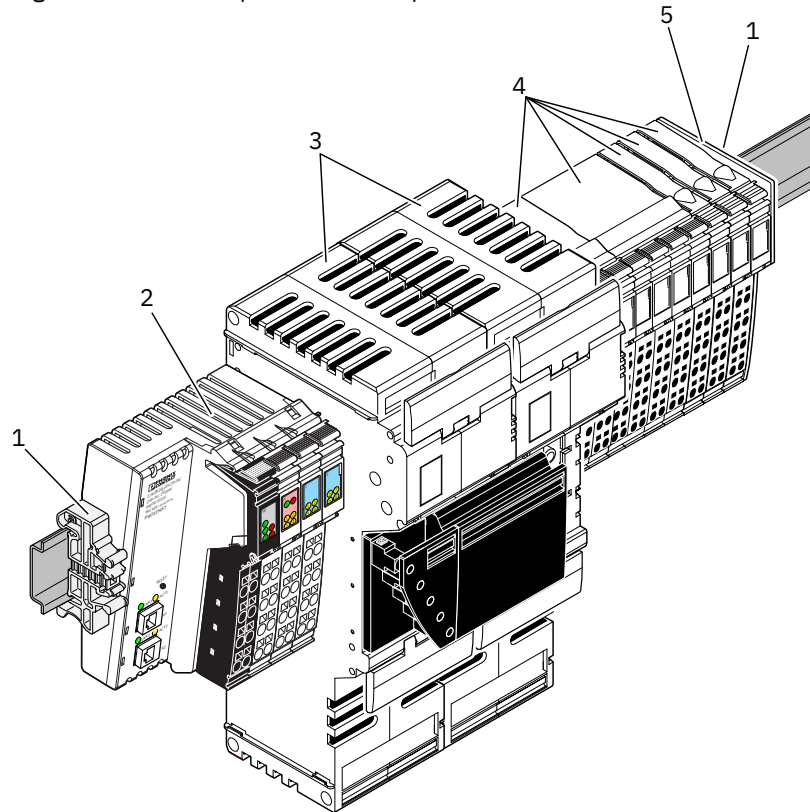
The example Inline station shown in Figure 5-21 consists of the following elements:

1   End clamps
2   Bus coupler (example)
3   Power-level terminals
4   Terminals for the 24 V DC area (e.g., I/O terminal)
5   End plate (end of the station)

5.3 Inline Block IO modules (no longer in product range)

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

Figure 5-22   Example: Modules of the Inline Block IO product range
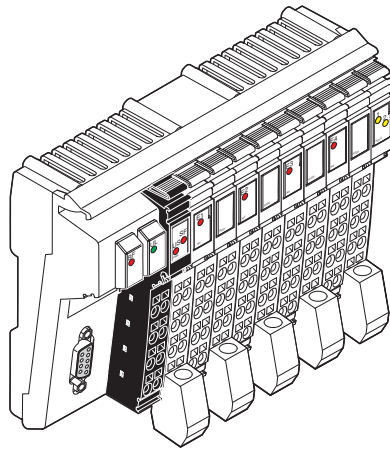
Module for PROFIBUS with four analog inputs and two analog outputs:
ILB PB AI4 AO2
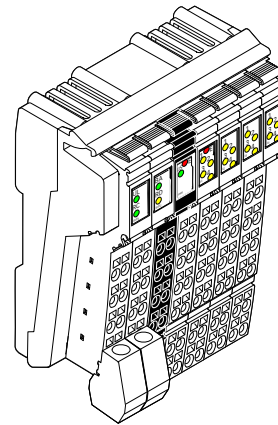
Module for INTERBUS with 16 digital inputs: ILB IB 24 DI16

Scope of supply

Inline Block IO modules are available as complete items. The following are supplied as standard with a complete item:
– The electronics base
– All required Inline connectors

Bus system

Inline Block IO modules are available for various bus systems (see Table 5-1).

Power supply

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

Voltage areas

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

Functions

Inline Block IO modules are available with various functions. These include the following modules, for example: The text in brackets indicates the function according to the order designation.
– Digital input and output modules (DI, DO, DIO)
– Analog input and output modules (AI, AO)

Protection

Overload protection of the system must be provided by the operator. 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 module, please refer to the module-specific data sheet.

Grounding (FE)   All Inline Block IO modules have an FE spring (metal clip) on the bottom of the electronics base. This spring establishes an electrical connection to the DIN rail. Use grounding terminals to connect the DIN rail to protective ground. The module is grounded when it is snapped onto the DIN rail.

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

Shielding   Shield connectors are available for connecting shielded cables.

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

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

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

Additional documentation | i | For more detailed information about the function, properties, wiring, and parameterization of the individual modules, please refer to the module-specific documentation.

6 Structure and dimensions

6.1 Structure and dimensions of Inline terminals

6.1.1 Basic structure of terminals in the 24 V DC and 120 V AC/230 V AC areas

Regardless of the function and design width, an Inline terminal for these voltage areas consists of the electronics base and the snap-on connector (Inline connector).

Figure 6-1   Basic structure of an Inline terminal
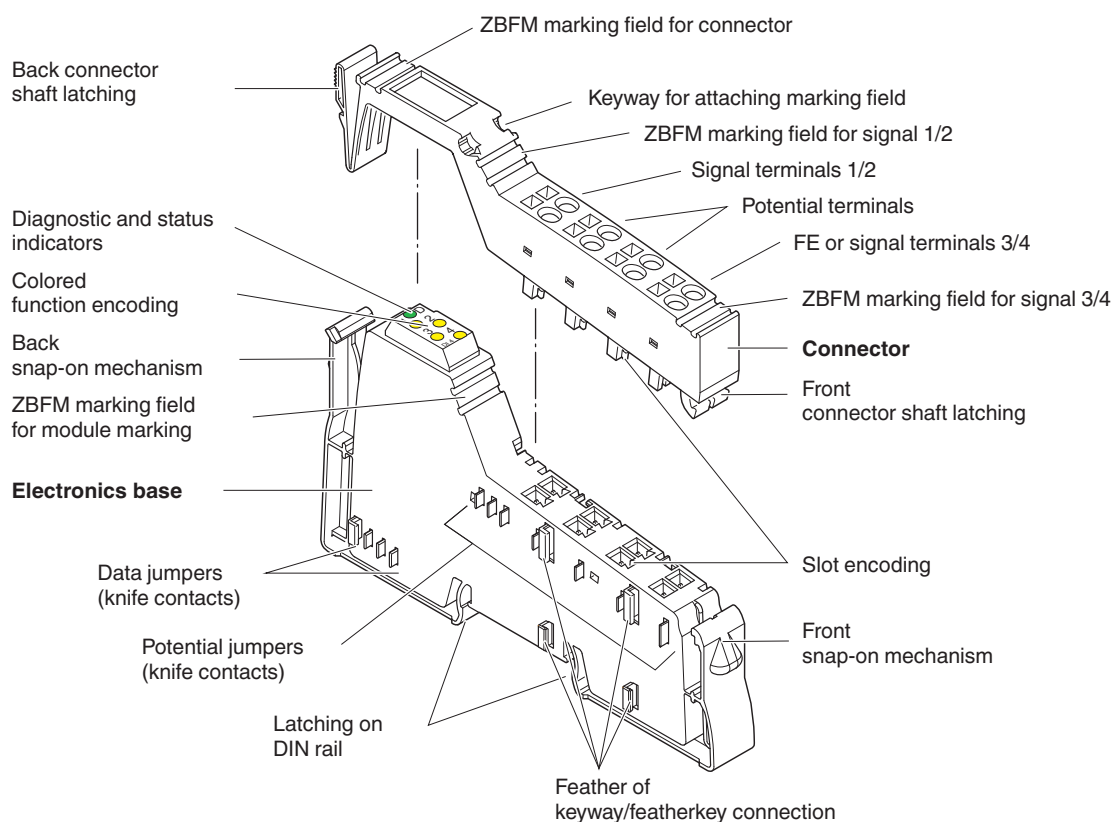
ZBFM: Zack marker sheets, flat

ⓘ The components required for marking are listed on the item page at phoenixcontact.com/products.

6.1.2 Electronics base

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

Potential and data routing

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

The knife contacts are located on the left-hand side of the terminal (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 the relevant 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 Section "Basic information about mounting" on page 105).

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 Section "Electronics base and connectors for the different voltage areas" on page 20).

6.1.3 Connectors for terminals in the 24 V DC and 120 V AC/230 V AC areas

The I/O or supply voltages are connected using a pluggable connector. For more detailed information about the Inline connectors, please refer to Section 7, "Inline connectors".

6.1.4 Basic structure of power-level terminals (no longer in product range)

Power-level terminals are located in a power housing.

Figure 6-2 Basic structure of Inline housing for power-level terminals

ZBFM: Zack marker sheets, flat

ℹ️ The components required for marking are listed on the item page at phoenixcontact.com/products.

The entire electronics for the Inline power-level terminal, the potential routing for the 24 V DC area, and the data routing are located in the power housing.

Potential and data routing

The potential and data jumpers that are led through the 24 V DC terminals are not interrupted by the power-level terminals. For more detailed information about the jumpers, please refer to Section "Electrical potential and data routing (Inline)" on page 80.

Release flaps

Remove the power-level terminal from the DIN rail by pulling both release flaps (see Section "Mounting/removing power-level terminals" on page 122).

Keyway/featherkey connection

The featherkeys are on the left-hand side of the terminal (Figure 6-2). They snap into the keyways of the next terminal on the left when the terminal is mounted on the DIN rail.

6.1.5 Connectors for power-level terminals (no longer in product range)

The mains voltage, motor output, brake module, hand-held operator panel mode, and the enable power level/24 V isolation functions are connected via connectors.

Power connector/ power bridge/ cover

A power connector is available for supplying the mains voltage (IB IL 400 CN-PWR-IN).

A power bridge is available for forwarding the mains voltage between power-level terminals (IB IL 400 CN-BRG).

A cover is available for covering unused connections for the 400 V mains connection of the Inline power-level terminals (IB IL 400 CN-COV).

Figure 6-3   Power connector, power bridge, and cover
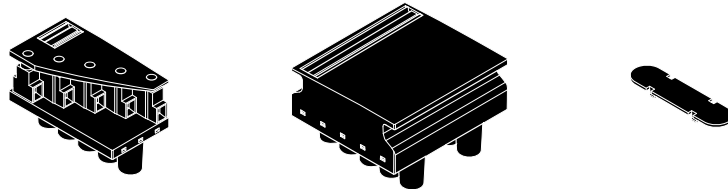
Other connectors

All other connectors are connected using COMBICON or MINI-COMBICON connectors (see phoenixcontact.com/products).

6.1.6 Printing

Bild 6-4 Example printing on an Inline terminal
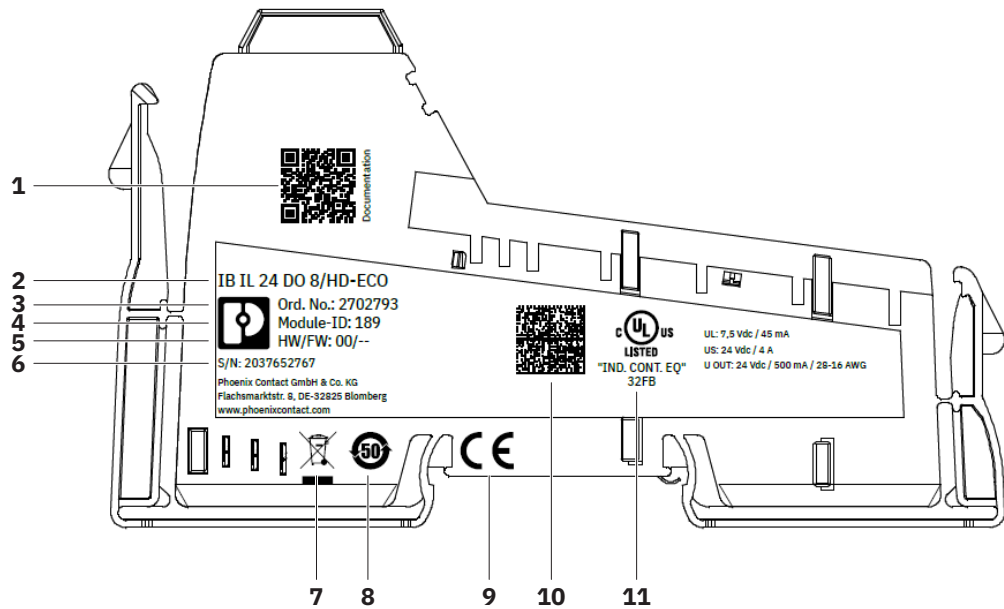
The following information is printed on an Inline terminal:

1 "Documentation" QR code
If you scan this QR code, you will be taken to the product detail page for the item. The corresponding documentation can be found under "Downloads".

2 Item designation

3 Item number

4 ID code

5 Hardware/firmware version

6 Serial number

7 Disposal identification

8 China RoHS marking

9 CE marking

10 Data matrix code
If you scan this QR code, you will receive information on the item.
This includes, for example:
- Serial number
- Item number
- Item revision
- Hardware version
- Firmware version

11 UL Mark

6.1.7   Function identification

Housing

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

Table 6-1   Field of application and housing

Housing type	Housing color	Connector color	Field of application	
Extra-low voltage housing	Green	Green	Extra-low voltage (24 V DC)	All functions except supply, safety, DALI
		Black	Extra-low voltage (24 V DC)	Supply, segmentation
	Yellow	Yellow	Extra-low voltage (24 V DC)	Safety
	Gray	Gray	Extra-low voltage (24 V DC)	DALI
			Low voltage (120 V AC/230 V AC)	I/O, supply
Power housing	Green		Power	

Function identification

The area for the diagnostic and status indicators on the terminals is color-coded to enable visual identification of the functions (1 in Figure 6-5).

Figure 6-5   Function identification
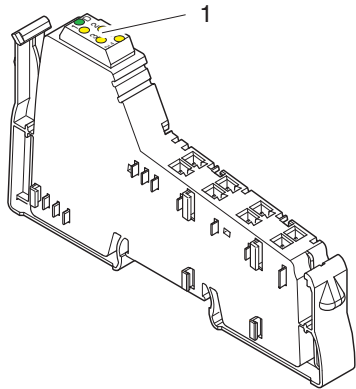
The following colors indicate the functions:

Table 6-2   Color-coding of terminal function

| Color	Terminal function
Gray	Bus couplers, terminals with remote bus branch
24 V DC area	
Black	Supply/segmentation
Light blue, blue	Digital input
Pink, red	Digital output
Light green, green	Analog input, temperature recording
Light yellow, yellow	Analog output
Orange	Open and closed-loop control, communication, position detection, programmable terminals
120 V AC/230 V AC area	
White	Distance
White with lightning bolt	Supply
Dark blue with lightning bolt	Digital input
Dark red with lightning bolt	Digital output

Identification of transmission speed

Terminals with a transmission speed of 500 kbps have solid color-coding.
Terminals with a transmission speed of 2 Mbps are identified by a white stripe at the level of the D LED.

Figure 6-6   Identification of transmission speed

500 kBit/s   2 MBit/s
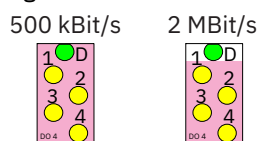
6.1.8   Housing dimensions of terminals in the 24 V DC and 120 V AC/230 V AC areas

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

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

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

When a connector is plugged in, each terminal has a depth of 71.5 mm (exception: container housing 4).

The height of the terminal depends on the connector used and is a maximum of 140.5 mm.

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

6.1.8.1 Dimensions of the electronics base with possible connectors

BK housing, example: IL xx BK-PAC

Figure 6-7   Dimensions of BK housing (in mm)
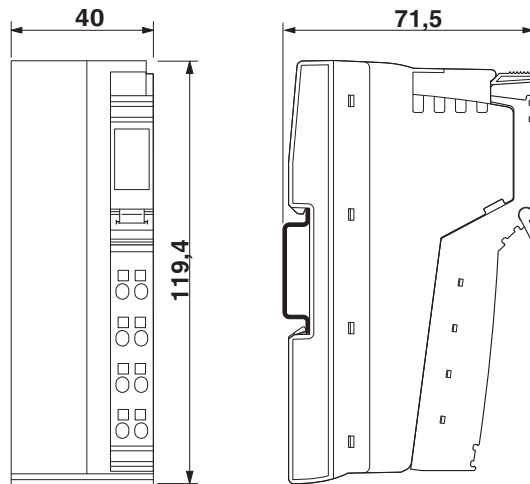
BK IO housing, example: IL xx BK DI8 DO4 2TX-PAC ILC 151 ETH

Figure 6-8   Dimensions of BK IO housing (in mm)
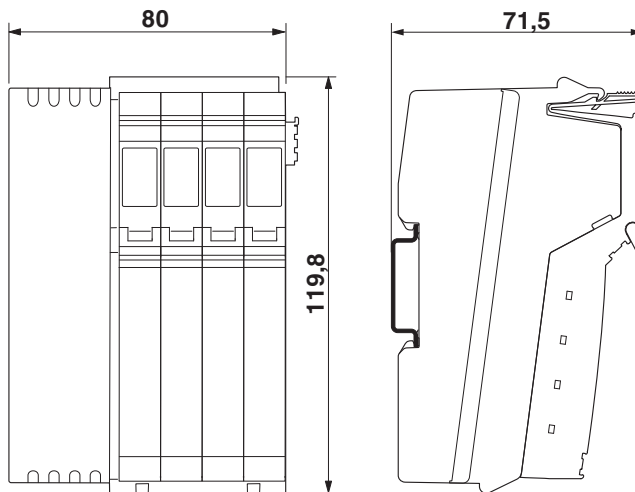
Container housing, example:
IBS IL 24 BK-LK-PAC
IL PB DP/V1-PAC

Figure 6-9   Dimensions of the electronics base (container housing 1, in mm)
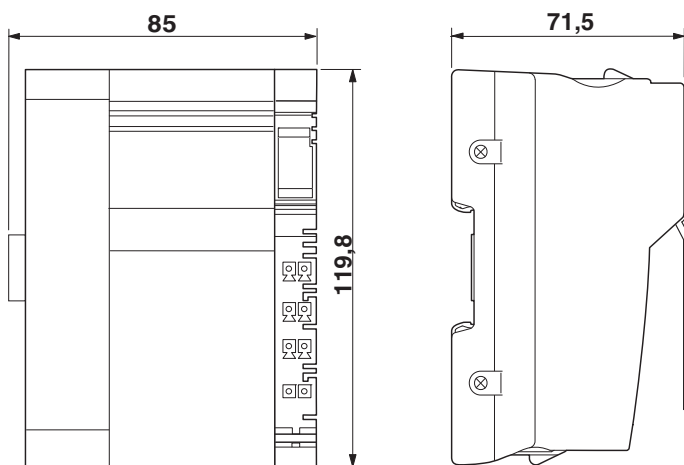
Dimensions of 2-slot, 4-slot, 8-slot housing

Figure 6-10   Dimensions of the electronics base with possible connectors (2-slot, 4-slot, 8-slot housing, in mm)
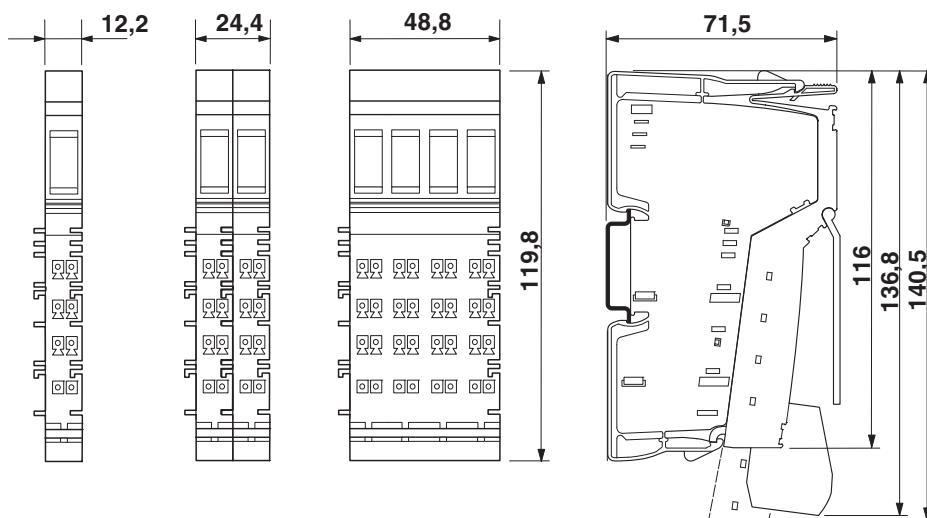
Examples for 2-slot, 4-slot or 8-slot housing:

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

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

Container housing

Figure 6-11   Dimensions of container housing 2 (in mm)
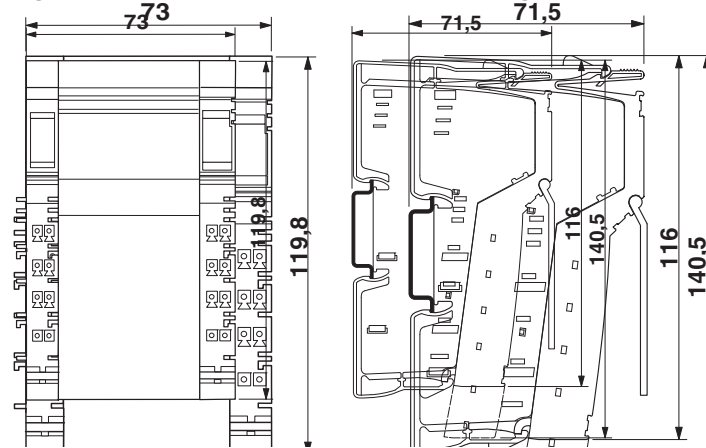
Figure 6-12   Dimensions of container housing 3 (in mm)
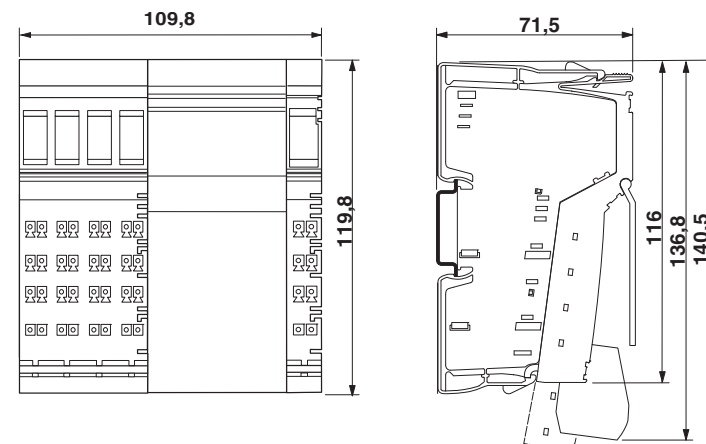
Figure 6-13   Dimensions of container housing 4 (in mm)
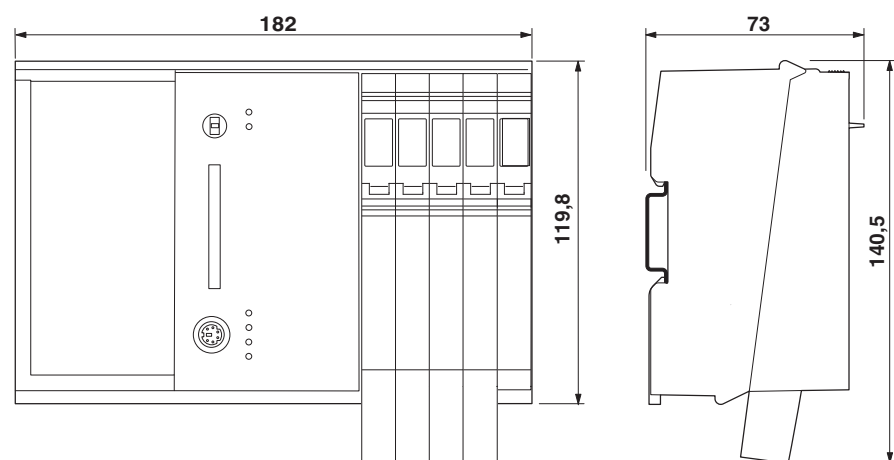
6.1.9 Dimensions of power-level terminals (no longer in product range)

Figure 6-14   Dimensions of power housing (in mm)
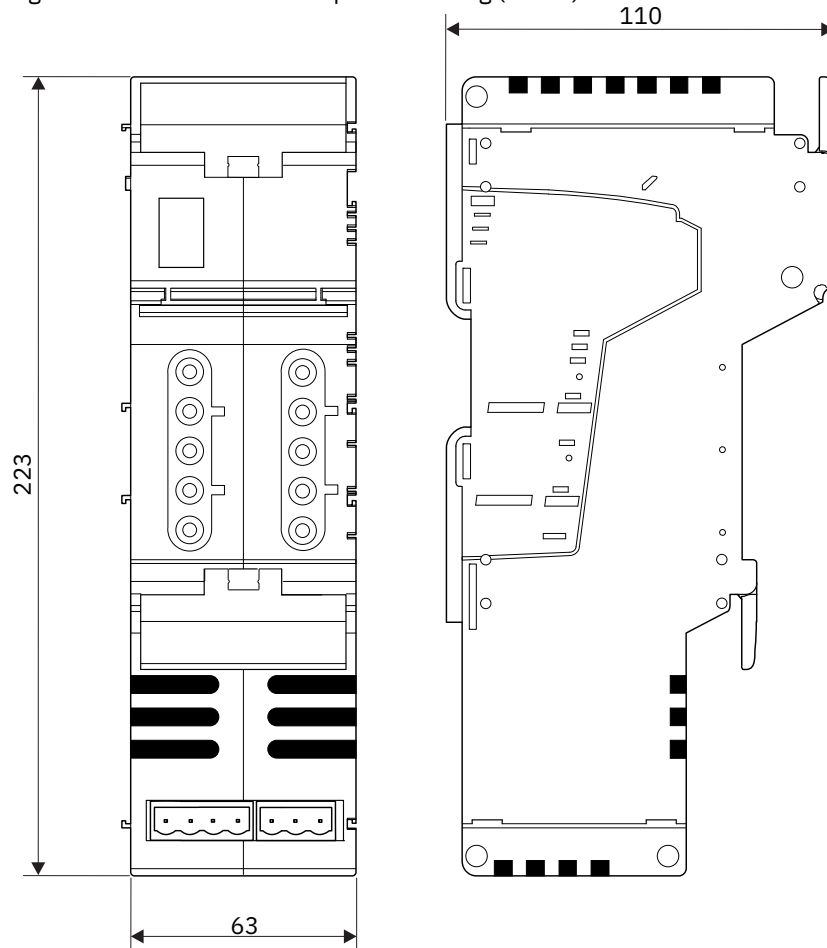
| | Please note the additional space required when inserting a connector for a hand-held operator panel. |

6.2 Structure and dimensions of Inline Block IO modules (no longer in product range)

6.2.1 Basic structure of modules

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

Figure 6-15   Basic structure of an Inline Block IO module
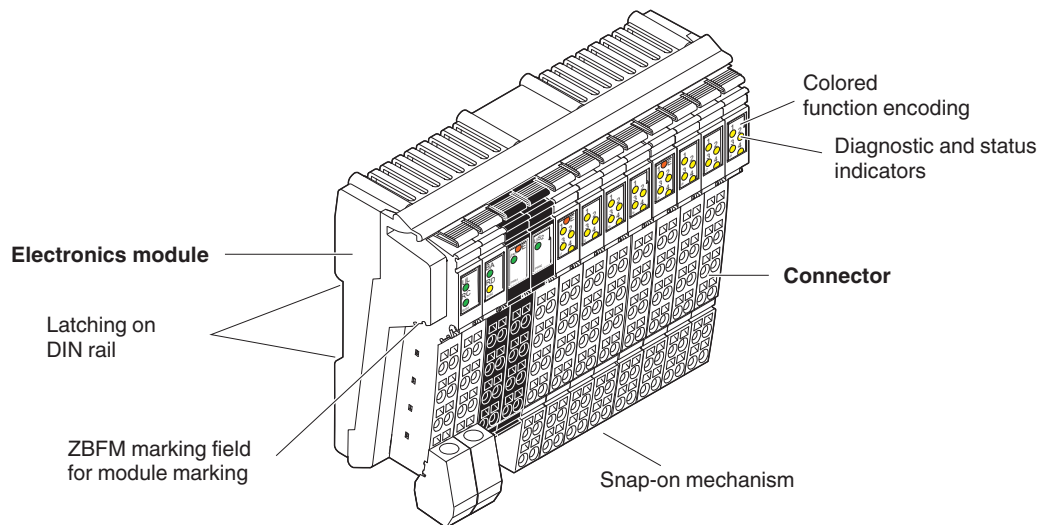
ZBFM: Zack marker sheets, flat

> ℹ️ The components required for marking can be found at
> phoenixcontact.com/products.

Electronic module

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

Pressing the snap-on mechanism releases the latching, enabling the terminal to be removed by pulling it straight back from the DIN rail (see Section "Basic information about mounting" on page 105).

Connector

The I/O or supply voltages are connected using a pluggable connector. For more detailed information about the Inline connectors, please refer to Section 7, "Inline connectors".

6.2.2 Function identification

Housing

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

Function identification

The Inline Block IO modules are color-coded to enable visual identification of the function areas (1 in Figure 6-16).

Figure 6-16   Function identification
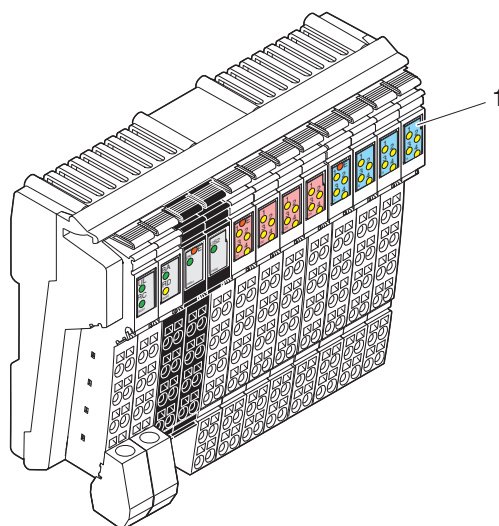
The following colors indicate the functions:

Table 6-3   Color-coding of module function areas

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

6.2.3   Housing dimensions

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

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

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

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

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

Figure 6-17   Maximum dimensions (in mm)
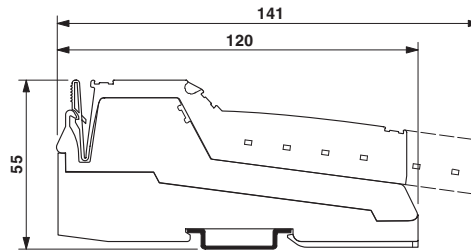
7 Inline connectors

Inline connectors are used on Inline terminals and Inline Block IO modules.

7.1 Basic structure and dimensions of Inline connectors

Connector width

The connectors have a width of two terminal points.

Connector colors

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

Green	Connectors for extra-low voltage terminals (24 V DC, excluding power/segment terminals)
Black	Connectors for extra-low voltage power/segment terminals (24 V DC)
Gray	Connectors for terminals in the 120 V AC and 230 V AC areas (not required for Inline Block IO modules)

Basic structure

Figure 7-1   Basic structure of an Inline connector
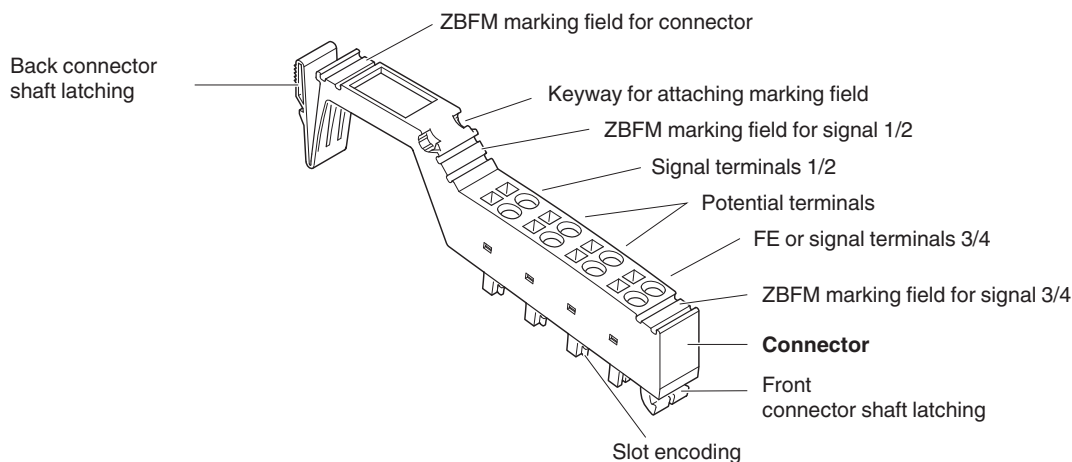
ZBFM: Zack marker sheets, flat

ℹ️ The components required for marking are listed on the item page at phoenixcontact.com/products.

Dimensions Figure 7-2   Connector dimensions (in mm)
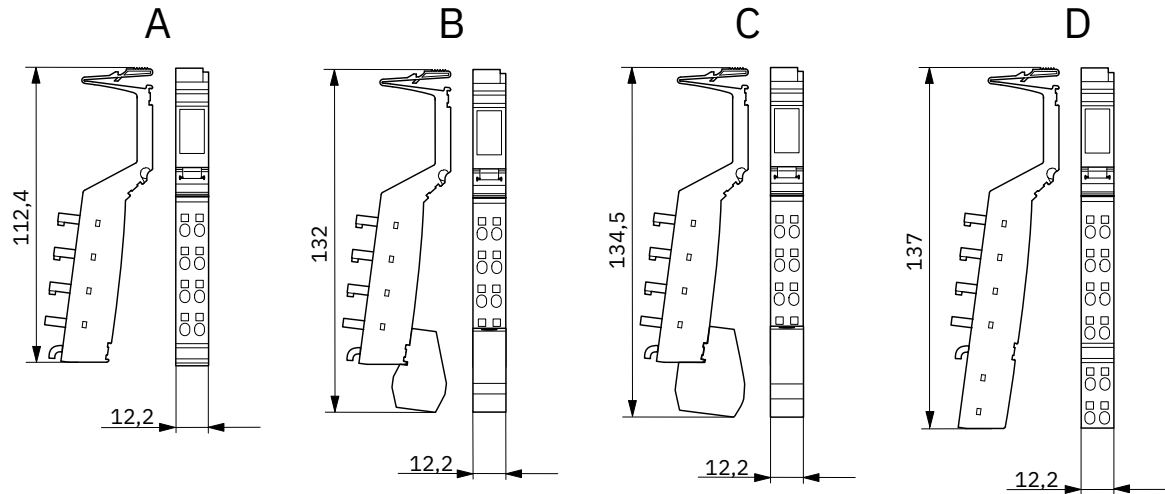
Key:

  A   Standard connector

  B   Shield connector for connecting one cable

  C   Shield connector for connecting two cables

  D   Extended double signal connector

The depth of the connector does not influence the overall depth of the Inline terminal or Inline Block IO module.

7.2 Connectors for the 24 V DC area

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

Figure 7-3   Connector types for Inline terminals
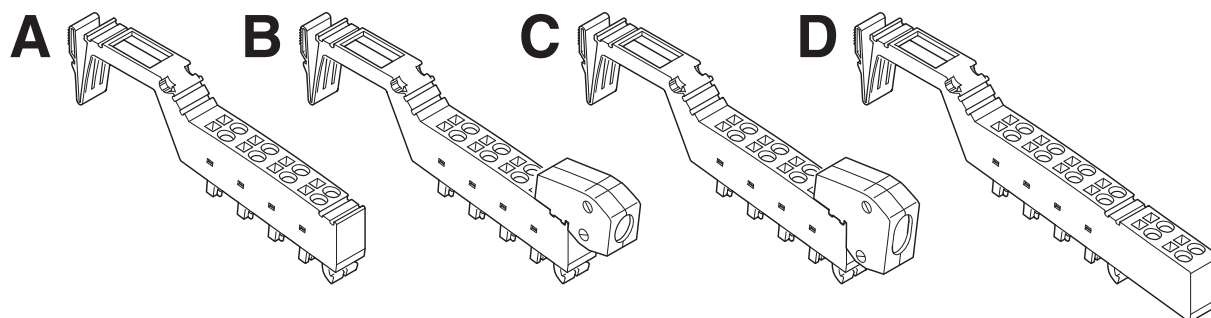
A   Standard connector

The green standard connector is used for the connection of two signals in 4-wire technology or 8 signals in 1-wire technology (e.g., digital I/O signals).

The black standard connector is used to supply the supply voltage. Some of the adjacent contacts can be jumpered internally (see Figure 7-4 on page 74).

B   Shield connector for connecting one cable

C   Shield connector for connecting two cables

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

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

D   Extended double signal connector

The green double signal connector is used for the connection of four signals in 3-wire technology (e.g., digital I/O signals).

The black double signal connector is used to supply the supply voltage. Some of the adjacent contacts can be jumpered internally (see Figure 7-4 on page 74).

Connector identification

All connectors are available with and without color print. The connectors with color print (indicated 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:

Table 7-1 Color-coding of terminal points (24 V DC)

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

Internal jumpering

Depending on their function, the connectors may support internal jumpering.

ⓘ **NOTE: Disregarding this warning may result in malfunction**
To avoid malfunction, only snap the connector onto an appropriate terminal. Refer to the relevant terminal-specific data sheet to select the correct connectors.
Only place **black** connectors on power or segment terminals.
When the terminal points are jumpered in the black connector, potential is routed 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.
A **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.

Figure 7-4 Internal jumpering in connectors for the 24 V DC area
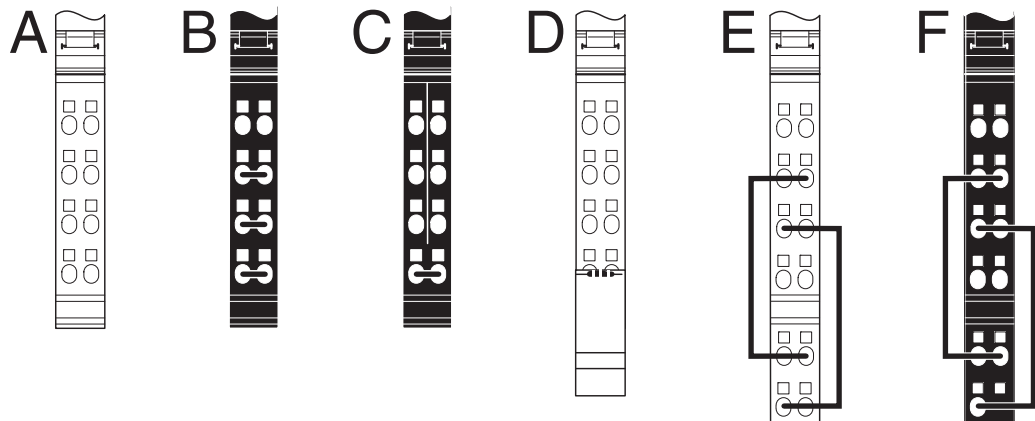
A   Green connector for connecting the I/O

B   Black connector for supplying the supply voltages
with jumpering of the terminal points for power supply

C   Black connector for supplying the supply voltages
without jumpering of the terminal points for power supply

D   Green shield connector for connecting shielded cables; the terminal points are jumpered via the shield connection.

E   Green double signal connector for connecting the I/O

F   Black connector for supplying the supply voltages
with jumpering of the terminal points for power supply

The shield connector is jumpered between terminal points 1.4 and 2.4 through the shield connection as seen in Figure 7-4. All other connectors are jumpered **internally** through the terminal point connections **in the connector**.

7.3   Connectors for the 120 V AC/230 V AC area (Inline)

Connector types

Gray standard connectors (see A in Figure 7-4) are available for the 120 V AC and 230 V AC areas. They have different color print according to their function.

Special features

The special features of the connectors and base for the 120 V AC and 230 V AC areas are described in Section "Electronics base and connectors for the different voltage areas" on page 20.

Table 7-2   Color-coding of terminal points (120 V AC/230 V AC)

Color	Signal at terminal point
Black	Phase (L)
Blue	Neutral conductor (N)
Green/yellow	Protective ground (PE)

ℹ️ The connectors for terminals used to isolate different voltage areas are color-coded with two colors. This includes connectors for power terminals and end terminals for the 120 V AC and 230 V AC areas, as well as distance terminals.
The green marked side must point in the direction of the 24 V area and the gray marked side in the direction of the AC area.

Internal jumpering and special features of the terminal points

Depending on their function, the connectors may support internal jumpering. In addition, some terminal points are not used or are indeed closed.

ⓘ **NOTE: Disregarding this warning may result in malfunction**
To avoid malfunction, only snap the connector onto an appropriate terminal. Refer to the relevant terminal-specific data sheet to select the correct connectors.

Figure 7-5   Internal jumpering and special features of connectors for the 120 V AC/230 V AC area
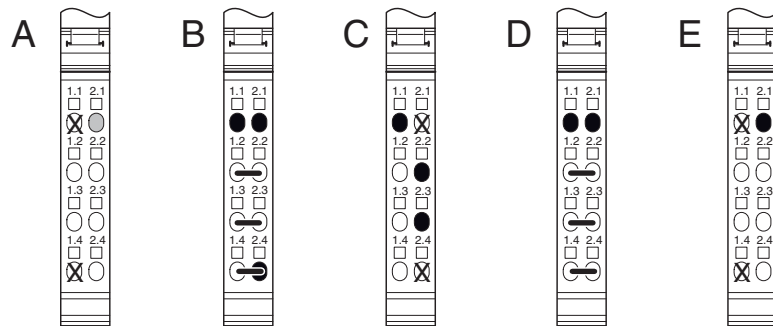
X	Connector contact not present
◌	Terminal point without metal contact
●	Terminal point closed
A	Gray connector for plugging onto the left-hand side of a power terminal (start of the AC area)
B	Gray connector for supplying the supply voltage
C	Gray connector for connecting the I/O
D	Gray connector for connecting the cables to a relay terminal
E	Gray connector for plugging onto an end terminal

7.4   Numbering and labeling of terminal points

Labeling/terminal numbering

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

Figure 7-6   Terminal point numbering
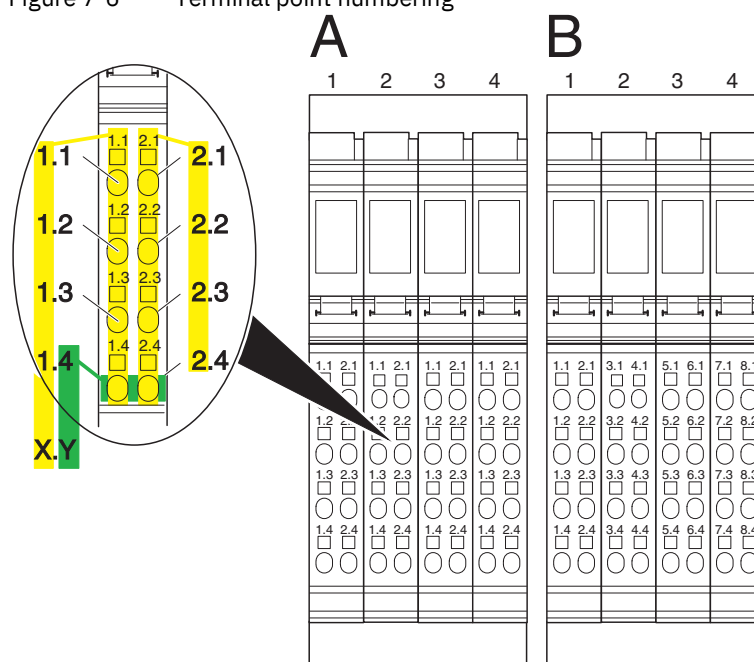
Slot/connector

The slots (connectors) on a base are numbered consecutively. This numbering is **not** indicated on the terminal (shown above the terminals in Figure 7-6).

Terminal point

Connectors are available with different forms of marking. In general, the numbering format X.Y is marked above the terminal point.

1   Terminal point numbering **by connector** (detail A in Figure 7-6):
On these connectors:
X: Number of the terminal point column on the connector.
Y: Number of the terminal point within the terminal point column.

2   Terminal point numbering **by channel** (detail B in Figure 7-6):
For terminals with 8, 16 or 32 I/Os, connector sets are available in which the terminal point rows are numbered by terminal (1 to 8) rather than by connector (1 and 2).
X: Number of the terminal point column on the Inline terminal.
Y: Number of the terminal point within the terminal point column.

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

Figure 7-7 Labeling
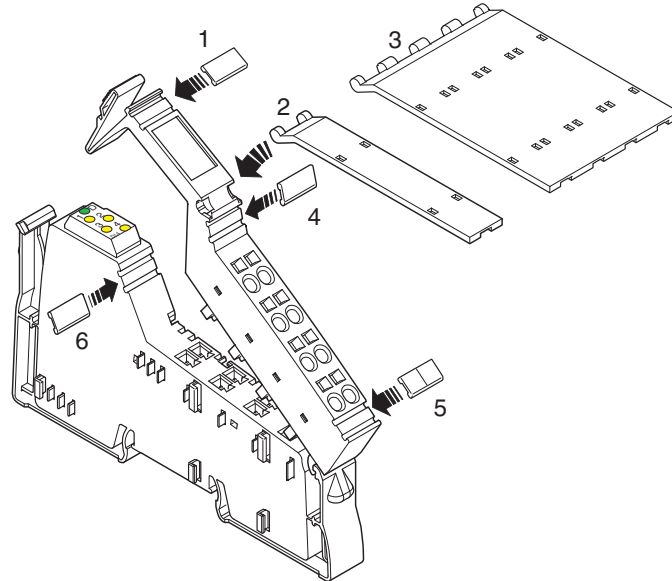
Various options are available for labeling the slots and terminal points:

1 Each connector can be labeled individually using Zack marker strips.

2/3 Another option is to use a labeling field. Labeling fields are available in two widths, either as a labeling field covering one connector (2; IB IL FIELD 2) or as a labeling field covering four connectors (3; 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.

4/5 Each signal can be labeled individually using Zack marker strips. On a double signal connector, the upper keyway (4) is designed for labeling signals 1 and 2 and the lower keyway (5) is for signals 3 and 4.

6 On the electronics base, each slot can be labeled individually using Zack marker strips. These marker strips are covered when a connector is plugged in.

Using the marker strips 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 IB IL FIELD 2 and IB IL FIELD 8 labeling fields.

The components required for marking are listed on the item page at phoenixcontact.com/products.

7.5   Terminal point keying

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

Figure 7-8   Connector and terminal keying
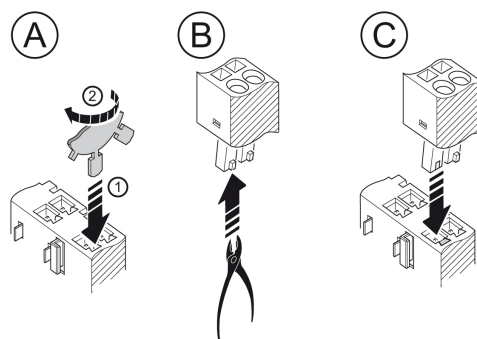
A   1. Insert a keying section of the keying profile in the corresponding keyway of the terminal point on the electronic housing.
      2. Twist the keying profile to break off the keying section.
B   Remove the keying tab from the corresponding slot keying on the connector.
C   Insert the keyed connector in the corresponding slot.

8 Electrical potential and data routing (Inline)

ℹ The Project+ software provides support when configuring an Inline station (see Section "Appendix: Software support" on page 176).

8.1 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 Section "Example of a circuit diagram" on page 85. The descriptions in the following sections refer to this example.

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

Carrying capacity of the jumper contacts

Observe the maximum current carrying capacity of the 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 Section "Current and voltage distribution" on page 91.

For the arrangement of the potential jumpers and information about current and voltage distribution on the potential jumpers, please refer to Section "Electrical potential and data routing" on page 87.

The connection of the supply voltages is described in Section "Connecting the power supplies" on page 133.

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

8.1.1 Bus coupler supply

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

8.1.2 Logic circuit

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

Function

The logic circuit (e.g., protocol chip, microcontroller) of the devices in a station is supplied with voltage 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 by the bus coupler or a corresponding power terminal from the connected supply voltage.

Current carrying capacity

The **maximum** current carrying capacity is **2 A**. If this value is reached, the voltage must be boosted 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 specified in the relevant terminal-specific data sheet.

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

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

8.1.3 Analog circuit

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

Function

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

Voltage

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

Provision of U_{ANA}

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

Current carrying capacity

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

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

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

8.1.4   Main circuit

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

> **i** Please note the special requirements 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 is supplied from the segment circuit.

Voltage

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

Current carrying capacity

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

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

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

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   Different voltage areas (e.g., 24 V DC and 120 V AC) are to be created.
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.

8.1.5 Segment circuit

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

ℹ️ Please note the special requirements 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 voltage for controlling circuit breakers 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 is 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 must not exceed 30 V DC.

Current carrying capacity

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

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

If the limit value of the potential jumpers U_M and U_S is reached (total current of U_S and U_M), a new power terminal must be 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. An IB IL 24 PWR IN/2-F...-PAC power terminal with fuse for the main and segment circuit or a segment terminal with fuse for the segment circuit can be used. In these terminals the segment voltage is automatically tapped from the main voltage.
4. A segment terminal can be used without a fuse and the segment voltage can be tapped from the main voltage using a jumper or a switch.

ℹ️ The creation of segments is not possible for the 120 V AC and 230 V AC voltage levels. Here, only one circuit is used, which corresponds to the main circuit.

8.1.6   Mains voltage for power-level terminals

The mains voltage for power-level terminals is not provided via the potential jumpers. It is either supplied to the power-level terminal via a power connector or led between directly adjacent power-level terminals via power bridges.

Voltage

The mains voltage must have the following values:

	IB IL 400 ELR ...	IB IL 400 MLR ...
Nominal voltage during operation (conductor voltage)	400 V AC	400 V AC
Voltage range	187 V AC ... 440 V AC + 0% with safe isolation between mains and SELV	187 V AC ... 519 V AC + 0% with safe isolation between mains and SELV;
		187 V AC ... 600 V AC + 0% with basic insulation between mains and SELV

Frequency

The frequency of the mains voltage must be 50 Hz or 60 Hz.

Current carrying capacity

The maximum current carrying capacity for the incoming mains must be 20 A. If this value is reached, it must be reinjected.

8.1.7 Example of a circuit diagram

Figure 8-1   Potential routing within an Inline station
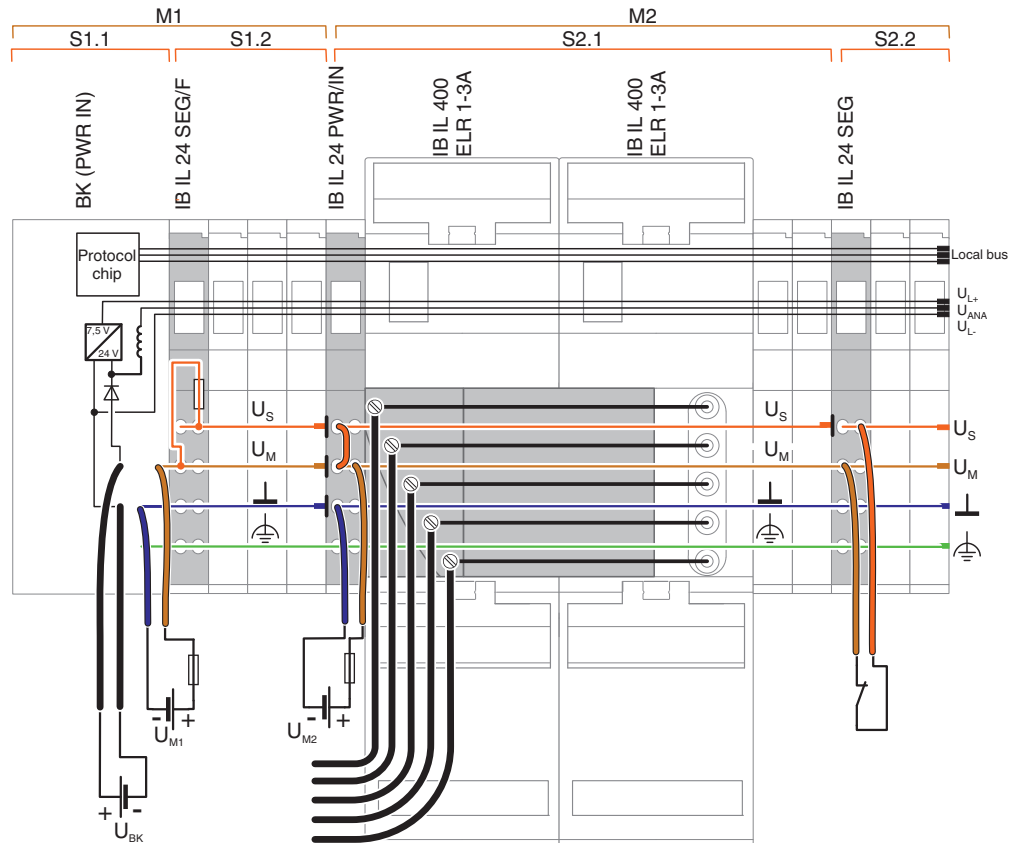
The illustrated Inline station is a typical example. It shows the supply and provision of different voltages and their forwarding via potential jumpers. Explanations for this can be found in the following sections.

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
U$_{BK}$	Bus coupler supply (supply for bus coupler, generates U$_{ANA}$ and U$_L$)
U$_M$	Main supply (I/O supply in the main circuit)
U$_S$	Segment supply (I/O supply in the segment circuit)
U$_{ANA}$	I/O supply for analog terminals
U$_L$	Communications power
Local bus	Data jumper for the local bus
$\perp$	Ground (GND for the supply voltages U$_M$ and U$_S$)

⏚	Noiseless ground (functional ground, FE)
⏚	Protective 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 supplied at the bus coupler (BK). In addition, the main voltage U_{M1} is supplied at the bus coupler or a subsequent power terminal.

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

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

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

No terminals are used in segment S1.1.

Segment S1.2

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

ⓘ This segment terminal has been specifically used to create a protected segment circuit without the need for an additional external fuse. 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 IB IL 24 PWR/IN-PAC terminal) or a switch (as shown on the IB IL 24 SEG-PAC terminal).

Main circuit M2/ segment S2.1

The supply voltage for the power-level terminals and the subsequent terminals should be supplied separately. For this, a new power terminal (e.g., IB IL 24 PWR/IN-PAC) is used, which supplies 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

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

Examples of errors and their effects:

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

2 If an error occurred in the system, the terminals in segment S2.2, for example, could be switched on or off without affecting the terminals in other segments.

8.2 Electrical potential and data routing

8.2.1 Arrangement of potential and data jumpers

An important feature of Inline is its 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 routing or cross-wiring.

> ℹ️ The 400 V AC mains voltage for power-level terminals is not led via the internal station potential routing. It is supplied via a power connector and is led between two power-level terminals via power bridges.

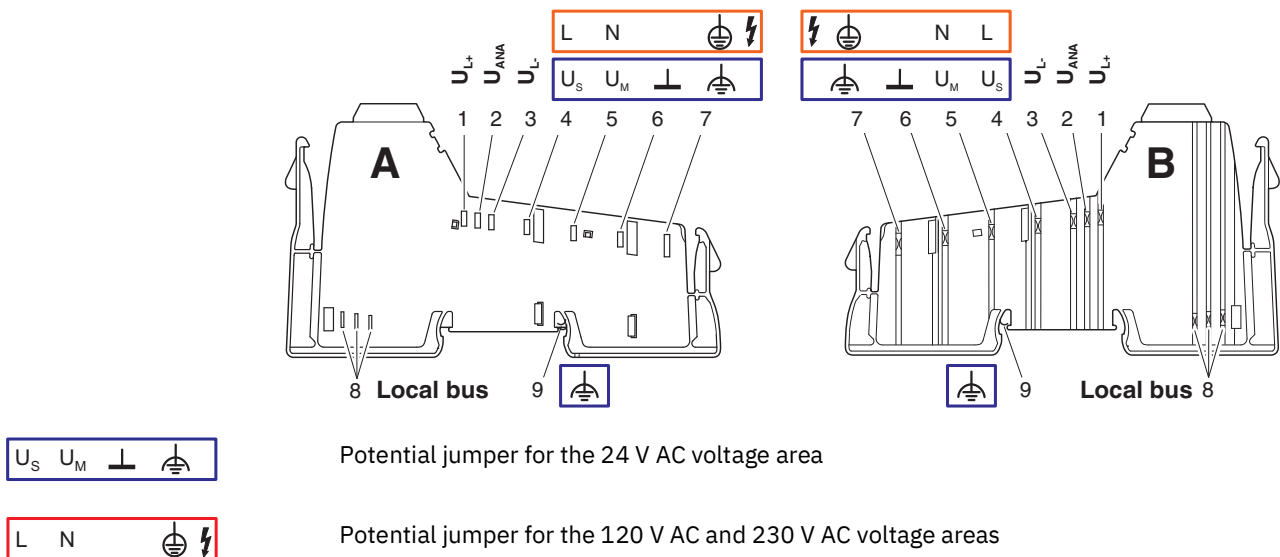Figure 8-2   Basic arrangement of potential and data jumpers

Potential jumper for the 24 V AC voltage area

Potential jumper for the 120 V AC and 230 V AC voltage areas

Table 8-1   Potential and data jumpers (24 V DC area)

No.	Function		Meaning
			See Figure 8-2 "Basic arrangement of potential and data jumpers" on page 87
Potential jumpers			
1	7.5 V DC	U_{L+}	Communications power for the bus interface
2	24 V DC	U_{ANA}	I/O supply for analog terminals
3	GNDL	U_{L-}	Ground of communications power and I/O supply for analog terminals
4	24 V DC	U_S	Segment circuit supply (if necessary with overload protection)
5	24 V DC	U_M	Main circuit supply (if necessary with overload protection)
6	GND	GND	Ground of segment and main supply
7	FE	FE	Functional 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

> **i** Terminal inputs and outputs are supplied with voltage via the segment circuit.
> The voltage for the segment circuit can be tapped from the main circuit. In addition, some terminals tap the voltage directly from the main circuit.
> For more detailed information about the circuits that are created via the potential jumpers U_L, U_{ANA}, U_M, and U_S, please refer to page 80.

> **i** Depending on the terminal function, not all of the jumpers listed in Figure 8-2 are present on a terminal. Please refer to the circuit diagram of the terminal to see which jumpers are available for a terminal and how they are internally connected. The circuit diagram is shown in the terminal-specific data sheet.

GND **(24 V DC area)**	This potential jumper is ground for the main and segment circuits.

      (!) NOTE: Overload

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

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

      [i] The Project+ software provides support when calculating the currents (see Section "Appendix: Software support" on page 176).

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

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

If the FE jumper is interrupted by a 120 V AC/230 V AC voltage level, reconnect the FE connection to a grounding terminal at the subsequent 24 V DC power terminal.

      [i] Please also observe the information in Section "Grounding concept" on page 112.

FE spring **(24 V DC area)**	This spring creates the FE contact between the bus coupler, a 24 V DC power terminal or a segment terminal, and the grounded DIN rail.
Data routing **(all areas)**	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 **(all areas)**	The maximum total current flowing through the potential jumpers is limited. The maximum current carrying capacity for each circuit is specified in Section "Circuits and provision of supply voltages" on page 80.

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

      (!) NOTE: Malfunctions

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

      [i] The Project+ software provides support when calculating the currents (see Section "Appendix: Software support" on page 176).

Table 8-2   Potential and data jumpers (120 V AC/230 V AC area)

No.	Function		Meaning
			See Figure 8-2 "Basic arrangement of potential and data jumpers" on page 87
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	120 V AC/ 230 V AC	L1	Phase L1
5	0 V	N	PEN conductor
6	–		Not present
7	PE	PE	Protective ground
(9)	–		Not present
Data jumper			
8			Local bus

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

PE (120 V AC/230 V AC area)   The PE potential jumper is used in the 120 V AC/230 V AC area. It must be connected to protective ground via the corresponding connection at the power terminal for these voltage areas.

8.2.2 Current and voltage distribution

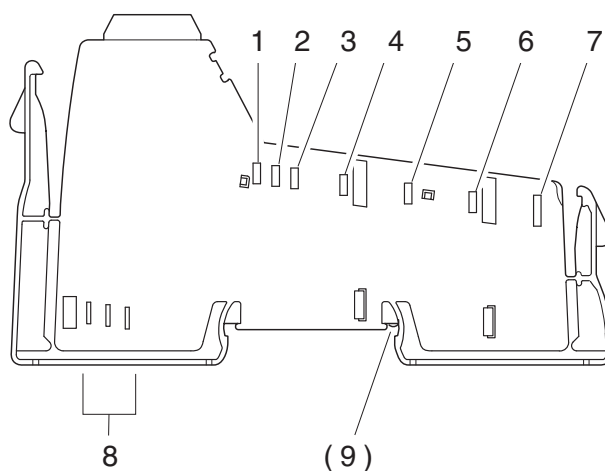Figure 8-3   Current and voltage distribution

Table 8-3   Current and voltage distribution in potential and data jumpers (24 V DC)

No.	Function		Voltage to contact*		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				

*   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.

Table 8-4   Current and voltage distribution in potential and data jumpers
(120 V AC/230 V AC)

No.	Function		Voltage to contact*		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	120 V AC/230 V AC	L1	12 V AC	253 V AC	8 A
5	PEN conductor	N	0 V	0 V	8 A
6	–				
7	PE	PE	Not defined	Not defined	Not defined
(9)	–				
Data jumpers					
8 a	Bus signal				
8 b	Bus signal				
8 c	Clock				

*   Contact no. 3 is reference potential for the logic.

Contact no. 5 is reference potential for the I/O.

9   Diagnostic and status indicators

All Inline Block IO modules and Inline terminals (referred to below as the device) are equipped with diagnostic and status indicators for quick local error diagnostics. They enable the clear localization of system errors (bus errors) or peripheral faults.

Diagnostics

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

Status

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

Extended diagnostics

Some devices have extended diagnostics. A short circuit or overload of the sensor supply is indicated for each input. If a short circuit occurs at an output, each channel is diagnosed individually. Information about the supply voltage is also reported. Information about peripheral faults is sent to the control system with precise details of the error type and is displayed using status indicators.

> **i** For information about the diagnostic and status indicators on a specific device, please refer to the device-specific data sheet.

9.1 Indicators on Inline terminals

9.1.1 Indicators on bus couplers and terminals with remote bus branch

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

9.1.2 Indicators available on different terminals in the Inline system

Some indicators can be found on various terminals (see section below) and generally have the same meaning:

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

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

D	Green LED	Diagnostics
	ON:	Data transmission active within the station
	Flashing:	
	0.5 Hz: (slow)	Communications power present, data transmission not active within the station
	2 Hz: (medium)	Communications power present, peripheral fault (e.g., fuse has blown, voltage not present)
	4 Hz: (fast)	Communications power 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 not present

9.1.3 Indicators on power and segment terminals

Figure 9-1   Possible indicators on power and segment terminals
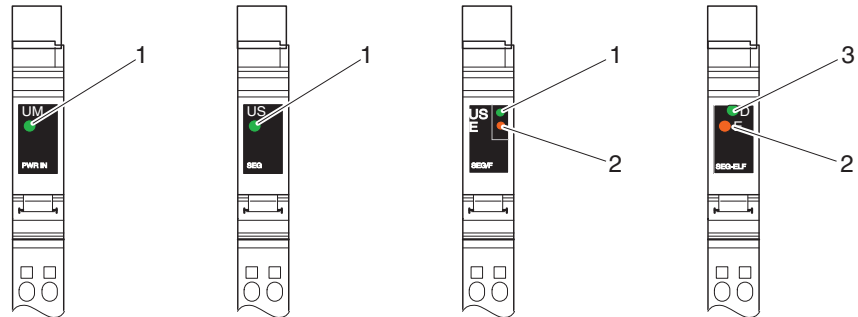
Diagnostics

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

Power terminal		
UM (1)	Green LED	Supply voltage in the main circuit (for meaning see page 94)
Segment terminal		
US (1)	Green LED	Supply voltage in the segment circuit (for meaning see page 94)
Power terminal with fuse and diagnostics/ segment terminal with electronic fuse		
D (3)	Green LED	Diagnostics (for meaning see page 94)
Also on terminals with fuse		
E (2)	Red LED	Fuse status
	ON:	Fuse not present or blown
	OFF:	Fuse OK

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

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

9.1.4   Indicators on I/O terminals

| i | In this section, I/O terminals are all terminals that acquire or output signals, i.e., all terminals excluding bus couplers, power, segment, and power-level terminals. |

| i | The LEDs of the I/O 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 9-2   Indicators on I/O terminals
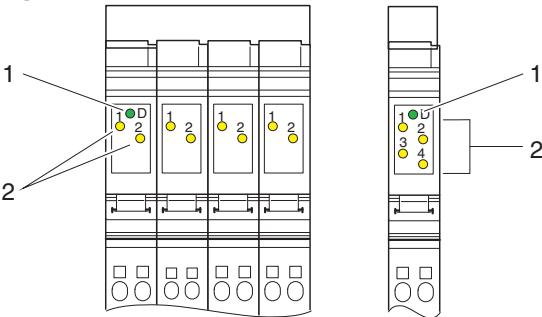
Diagnostics

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

D (1)	Green LED	Diagnostics (for meaning see page 94)

Status

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

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

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

Assignment between status LED and input/output

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

Figure 9-3   Assignment between status LED and input/output
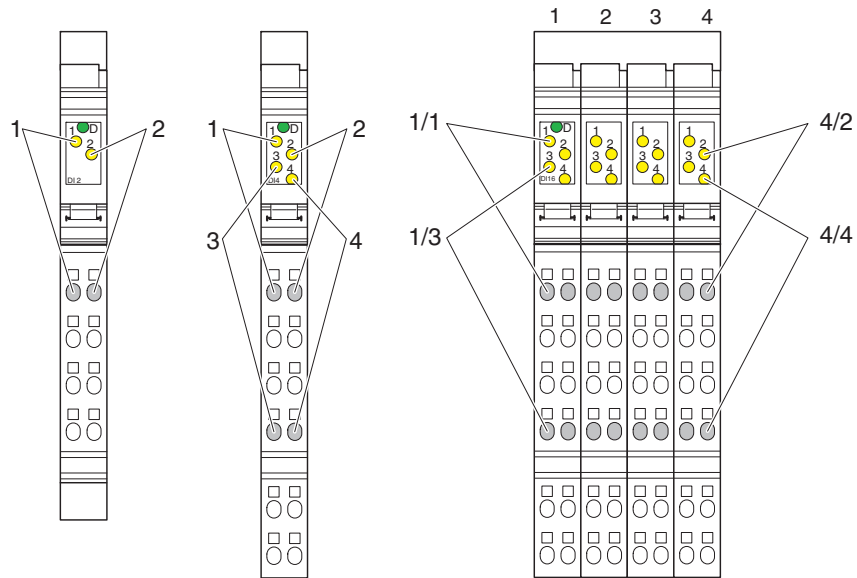
Please refer to Section "Function identification" on page 62 for an explanation of the numbering.

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 (middle example in Figure 9-3), 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 9-3 and Figure 9-4, e.g., with 4/2, LED 2 on slot 4 is indicated. The LED belongs to input 14 at terminal point 4.2.1 (slot 4, terminal point 2.1).

Figure 9-4   Assignment between status LED and input/output using the example of an IB IL 24 DI 16-PAC terminal
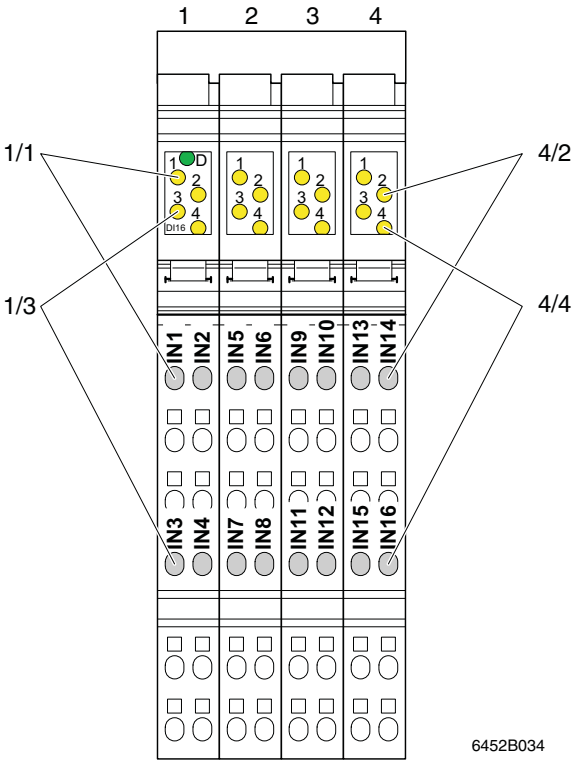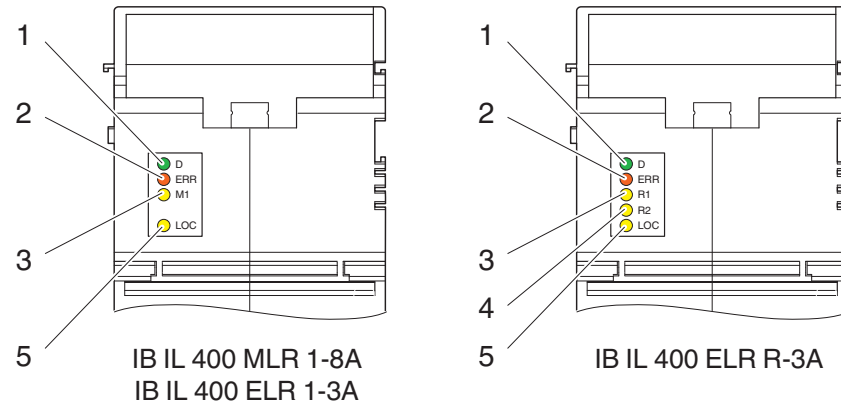

6452B034

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

9.1.5 Indicators on power-level terminals

Figure 9-5   Indicators on power-level terminals

IB IL 400 MLR 1-8A
IB IL 400 ELR 1-3A

IB IL 400 ELR R-3A

Diagnostics

The following states can be read on power-level terminals:

D (1)	Green LED	Diagnostics (for meaning see page 94)
ERR	Red LED	Group error message/motor protection
(2)	ON:	Operating error (motor protection has been triggered, contactor cannot be controlled)
	OFF:	No error

Status

The status of the motor and manual mode can be read from the corresponding yellow LED:

M1	Yellow LED	Motor
(3)	ON:	Motor switched on
	OFF:	Motor not switched on
R1	Yellow LED	Motor in direction of rotation 1
(3)	ON:	Motor in direction of rotation 1 switched on
	OFF:	Motor in direction of rotation 1 not switched on
R2	Yellow LED	Motor in direction of rotation 2
(4)	ON:	Motor in direction of rotation 2 switched on
	OFF:	Motor in direction of rotation 2 not switched on
LOC	Yellow LED	Manual mode (local)
(5)	ON:	Manual mode active
	OFF:	Bus mode active

9.2 Indicators on Inline Block IO modules

An Inline Block IO module can be divided into the function areas bus system, supply, and I/O. Local diagnostic and/or status indicators are assigned to each function area.
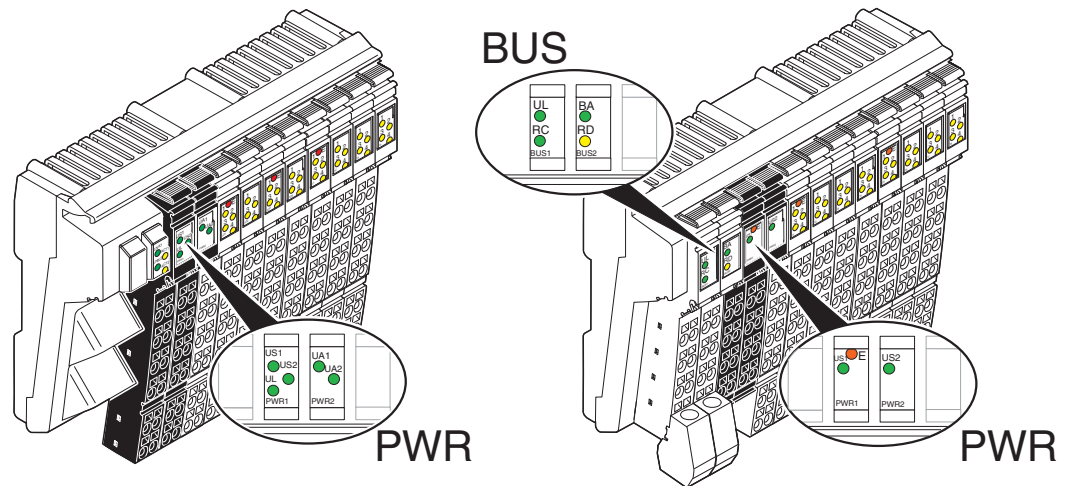
9.2.1 Indicators in the bus system function area (BUS)

For the meaning of the diagnostic and status indicators in the bus system function area (BUS in Figure 9-6 on page 101) of the modules, please refer to the corresponding documentation.

9.2.2 Indicators in the supply function area (PWR)

Figure 9-6 Possible indicators in the supply function area

Diagnostics

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

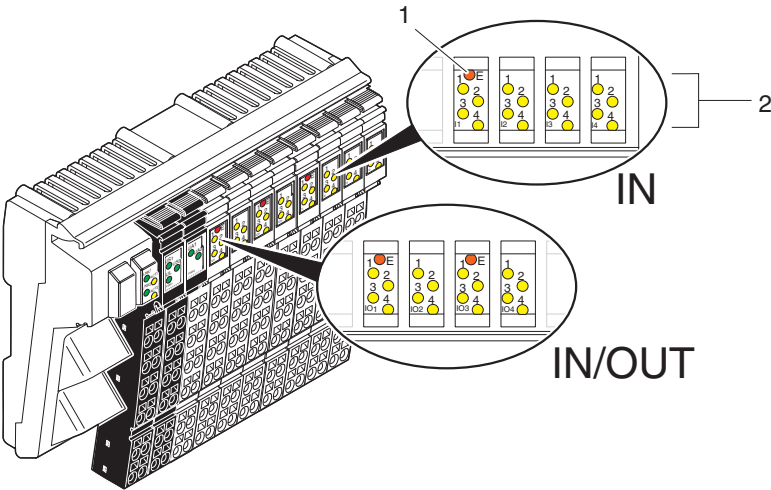| E	Red LED	Sensor supply undervoltage
	ON:	Sensor supply voltage too low
US	Green LED	Sensor supply
	ON:	Sensor supply present
	OFF:	Sensor supply not present
US1/2	Green LED	Sensor supply 1/2 (for connector ... to connector ... sensors)
	ON:	Sensor supply 1/2 present
	OFF:	Sensor supply 1/2 not present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

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

9.2.3   Indicators in the I/O function area (IN, OUT, IN/OUT)

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

Figure 9-7   Indicators on I/O terminals

Status

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

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

Assignment between status LED and input/output

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

Figure 9-8   Assignment between status LED and input/output
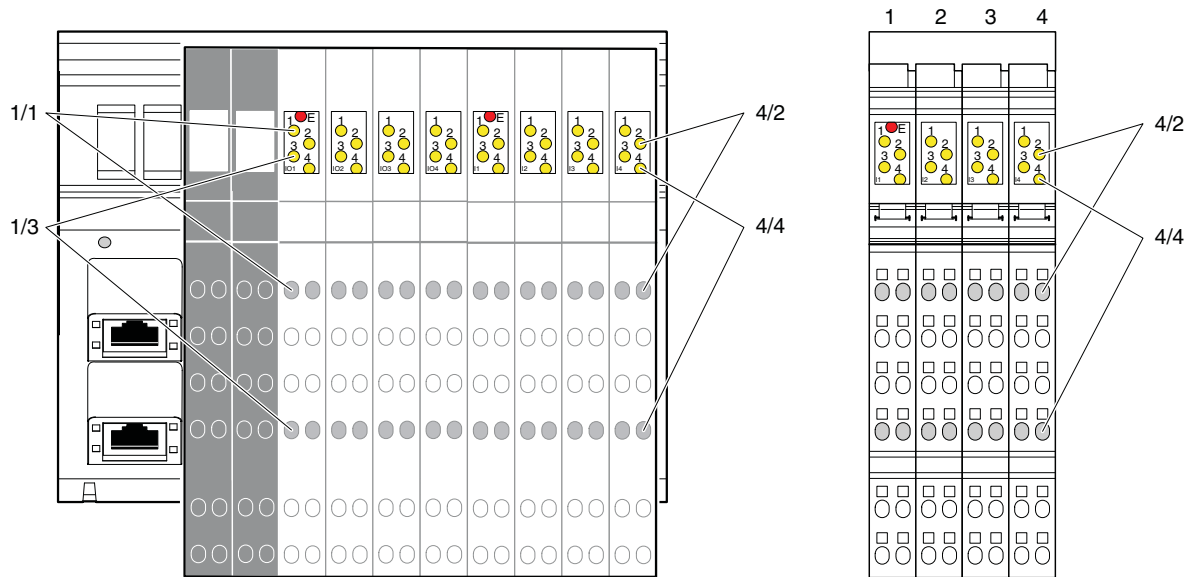
Each slot in the LED area is labeled with the function, in Figure 9-8, e.g., IO1, IO2, ... I3, I4.

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

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

On the module in Figure 9-8, e.g., with 4/2, LED 2 on slot I4 is indicated. According to the data sheet, the LED belongs to input 30 at terminal point I4.2.1 (slot I4, terminal point 2.1).

ℹ️ For every module, the assignment is specified in the module-specific data sheet.

10 Transport, storage, and unpacking

10.1 Transport

NOTE: Electrostatic discharge
The module contains components that can be damaged or destroyed by electrostatic discharge. When handling the module, observe the necessary safety precautions against electrostatic discharge (ESD), in accordance with EN 61340-5-1 and IEC 61340-5-1.

Inline modules are delivered packaged in a folded box.
• Please observe the notes on the packaging.

Suitable transport packaging
• Only transport the device in its original packaging or in packaging suitable for transport.

Technical data and environmental conditions
• During transport, observe the specifications regarding humidity and temperature range.
See Section "Technical data for Inline" on page 154 and technical data in the data sheet.

10.2 Storage

Suitable storage location
The storage location must meet the following requirements:
– Dry
– Protected from external influences
– Protected from harmful environmental influences such as UV light

Technical data and environmental conditions
• During storage, observe the specifications regarding temperature range, air pressure
• and humidity.
See Section "Technical data for Inline" on page 154 and technical data in the data sheet.

10.3 Unpacking

Observing the packing slip
• Read the complete packing slip carefully before unpacking the device.
• Retain the packing slip.

ng slip is not provided with the device, download the packing slip from the Internet. It can be found on the product details page for the device at
phoenixcontact.com/products.
packing slip is available, refer to the data sheet or user manual for the product or system used.

Checking the delivery
• Check delivery for damage and completeness.
• Submit claims for any transport damage immediately.

Scope of delivery
– Inline module with inserted connectors

11 Mounting/removing devices

11.1 Basic information about mounting

Mounting location

Modules and terminals of the Inline product range have IP20 protection and are therefore designed for use in a closed control cabinet or control box (terminal box) with IP54 protection or higher.
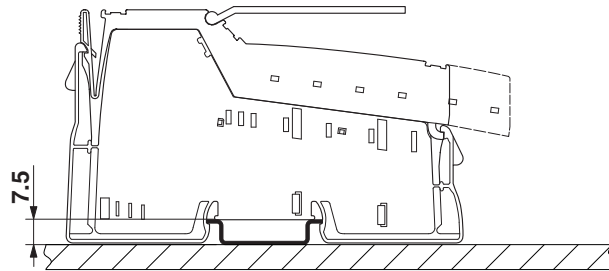
DIN rail

Install Inline Block IO modules and Inline terminals on a DIN rail with the following properties.

– 35 mm standard DIN rail (see "General accessories" on page 162)
– DIN rail height: 7.5 mm
– Mounted on a level surface

If these requirements are met, the module or terminal rests on the mounting surface.

Figure 11-1   Level surface with a DIN rail height of 7.5 mm

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 devices.

Figure 11-2   Fixing the DIN rail (dimension in mm)
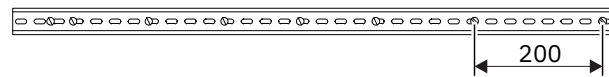
Mounting position

No specific mounting position is specified for the Inline Block IO modules or Inline terminals. However, please refer to the ambient temperatures and any other special requirements (such as derating) specified in the data sheets.

Analog terminals are a special case. The accuracy data specified in the data sheets for these devices refers to the documented mounting position (usually horizontal DIN rail; Figure 11-3, detail A). The **typical tolerance values** for the relevant configurations are determined in this mounting position. Experience from previous testing indicates that the typical tolerances of analog terminals are slightly affected by the mounting position. This means that another mounting position is also possible in principle.

To ensure sufficient mechanical fixing for the Inline station or Inline Block IO module when mounting on a vertical DIN rail (Figure 11-3, detail B), we recommend the E/AL-NS 35 end clamp. This prevents the station or module from slipping down, particularly in the event of vibration.

Figure 11-3   Mounting positions for an Inline station

CLIPFIX 35
CLIPFIX 35-5

E/AL-NS 35
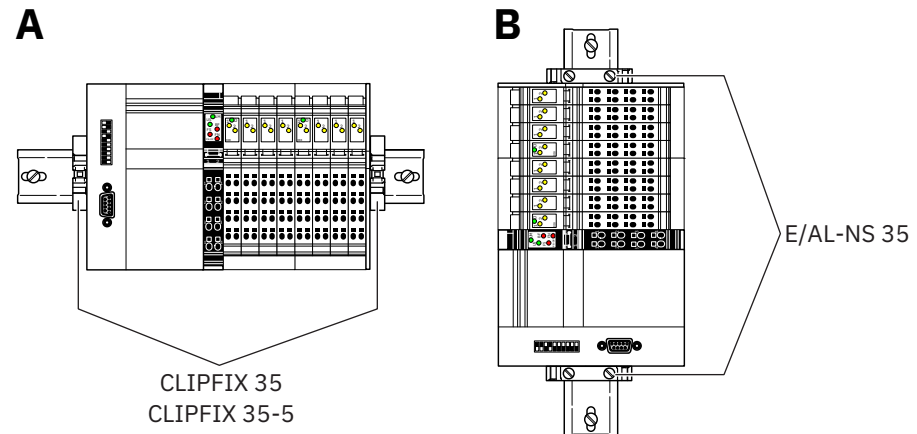
11.2 Mounting distances

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

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

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

11.2.1 Mounting distances for Inline terminals

11.2.1.1 Mounting distances for terminals in the 24 V DC, 120 V AC, and 230 V AC areas (excluding terminals with fiber optic connections)

Figure 11-4   Mounting distances for terminals in the 24 V DC, 120 V AC, and 230 V AC area (in mm)s
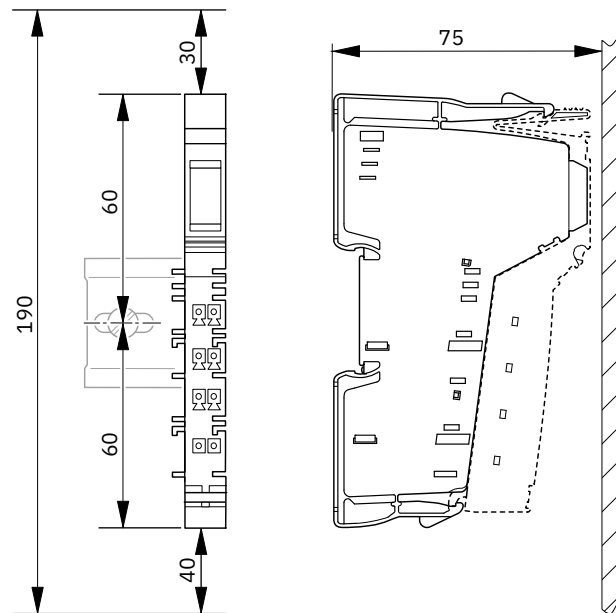
> **i** If the distances are smaller, the minimum bending radius of the cables, easy handling during installation, and a clear structure cannot be guaranteed.
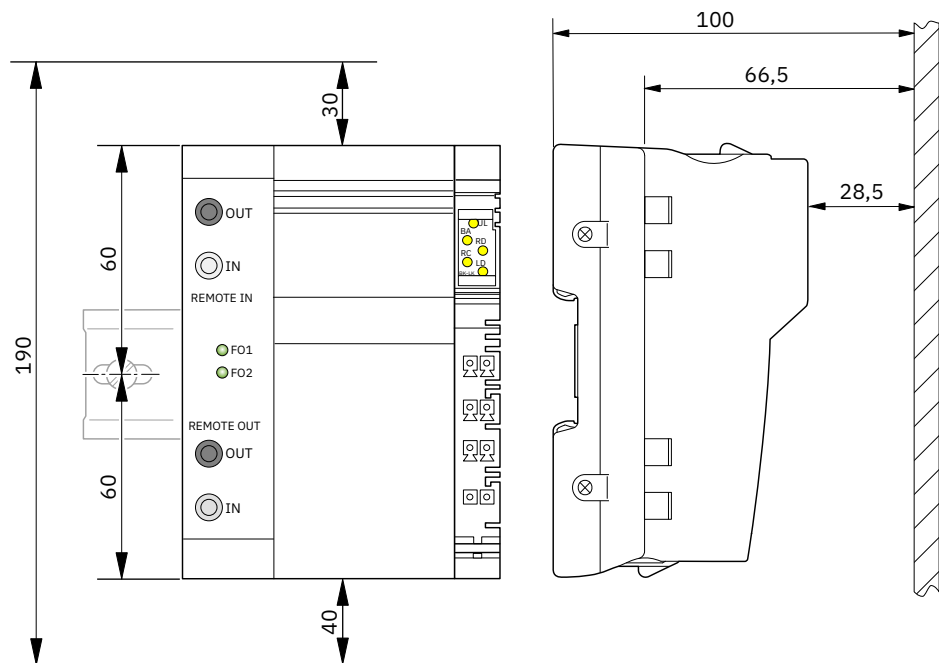
11.2.1.2 Mounting distances for terminals with fiber optic connections

The bending radius and the space required for mounting terminals with fiber optic connections depends on the fiberoptics used. Furthermore, the connector that is used affects the mounting distances.

ℹ️ Observe the instructions in the "IBS SYS FOC ASSEMBLY" fiber optic installation guidelines when determining the mounting distances.

According to the guidelines valid at the time of publication (Revision 03, 01/2007) the minimum bending radius for individual wires is 30 mm, and the minimum bending radius for a cable is either 50 mm or 65 mm depending on the cable. Using a fast connection connector with bend protection, for example, results in the following mounting distances:

Figure 11-5   Example mounting distances for the IBS IL 24 BK-LK-PAC bus coupler when using **individual wires (bending radius 30 mm)** (in mm)

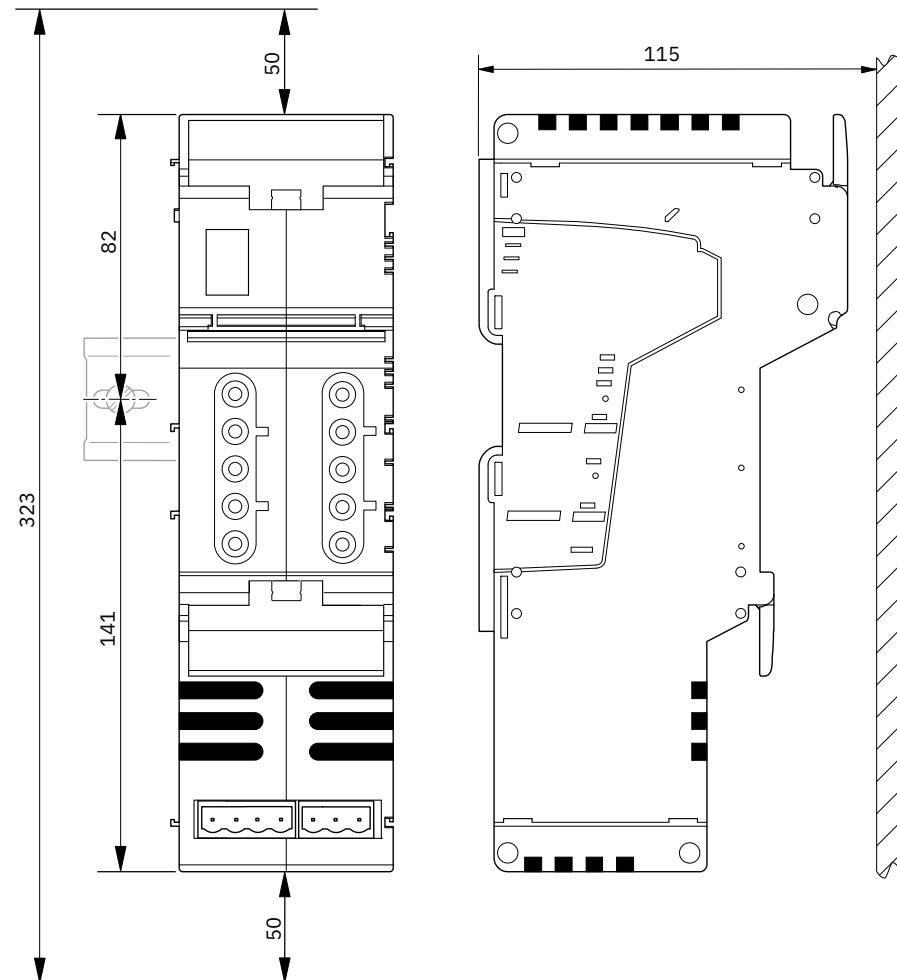### 11.2.1.3　Mounting distances for power-level terminals

🛈 **NOTE: Overheating**
The minimum vertical mounting distances shown in Figure 11-6 must be observed for power-level terminals to ensure sufficient ventilation of the power-level terminals.

ℹ Ensure additional space for installing the cables.

Figure 11-6　Mounting distances for power-level terminals (in mm)

### 11.2.1.4   Mounting distances for mounting outside a terminal box

If the Inline stations are housed, e.g., in a control cabinet rather than a terminal box, the DIN rail distances depend on the previously specified mounting distances and the particular configuration of the individual Inline stations. The possible mounting distances are shown in Figure 11-7.

Figure 11-7   Mounting distances for mounting outside the terminal box for different station structures (in mm)
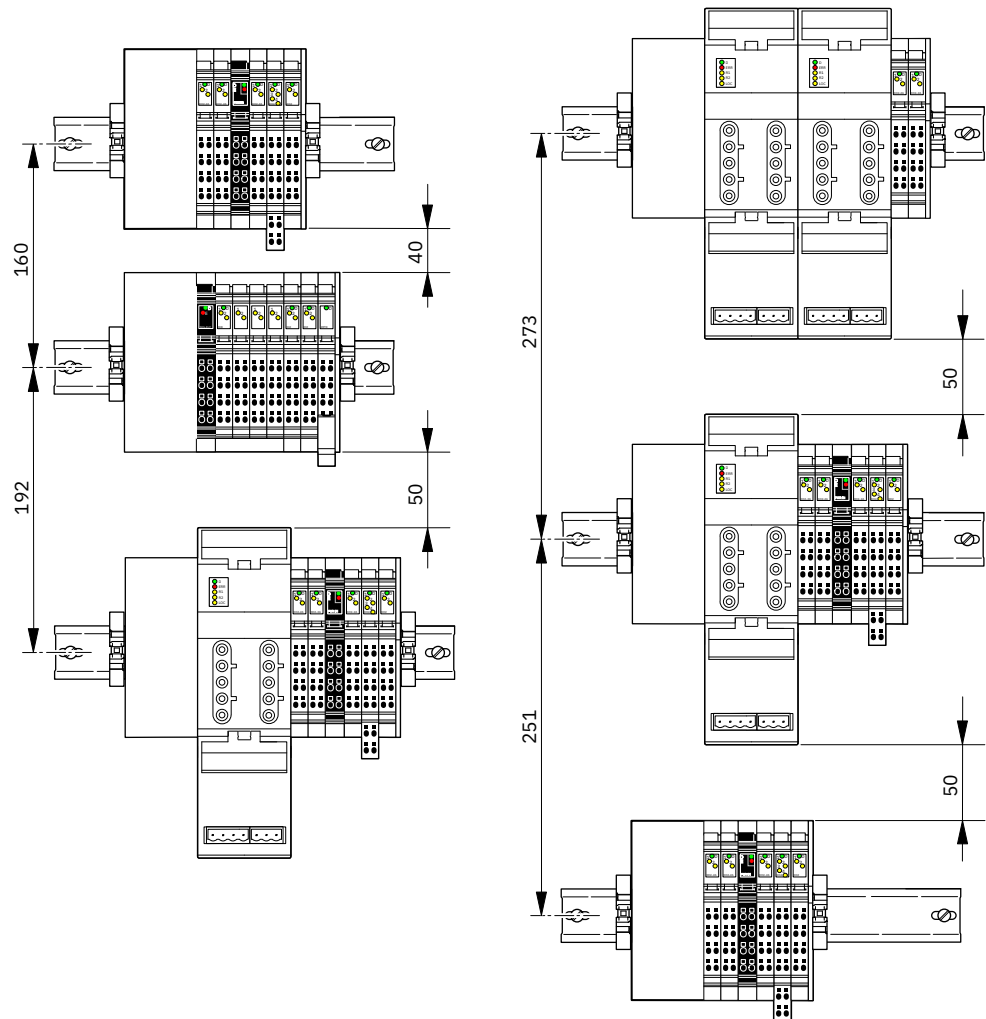
11.2.2 Mounting distances for Inline Block IO modules

Figure 11-8   Mounting distances (in mm)
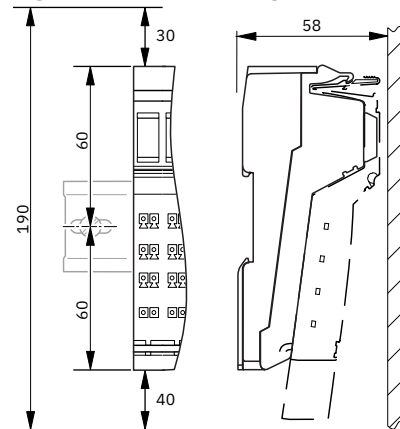
ℹ️ If the distances are smaller, the minimum bending radius of the cables, easy handling during installation, and a clear structure cannot be guaranteed.

11.3   Grounding concept

ℹ️ Within an Inline station, a distinction is made between functional ground (FE) and protective ground (PE).
For Inline Block IO modules, only functional grounding is used.

Protective grounding (PE) Protective grounding protects people and machines against hazardous voltages. To avoid these dangers, correct installation, taking the local conditions into account, is vital.

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

A 1.5 mm^2 wire must be used for grounding spring-cage terminals.

11.3.1   Functional ground (FE)

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

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

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

To ensure reliable functional grounding of the station, various points must be observed.

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

1 The bus coupler, power terminals, and segment terminals have an FE spring (metal clip) on the bottom of the electronics base. This spring establishes an electrical connection to the DIN rail. Use grounding terminals to connect the DIN rail to protective ground. The terminals are grounded when they are snapped onto the DIN rail.

2 Phoenix Contact also recommends grounding the Inline bus coupler via the FE terminal point of the corresponding connector to ensure reliable functional grounding even if the DIN rail is dirty or the metal clip is damaged (see terminal-specific data sheet).

3 A 120 V AC or 230 V AC voltage area interrupts the FE potential jumper. Therefore, a 24 V DC power terminal, which is installed directly after such an area, must also be grounded via the FE terminal point (see terminal-specific data sheet).

Any additional Inline extra-low voltage terminals are automatically grounded via the FE potential jumper when they are properly installed.

The FE potential jumper is looped through the power-level terminals.

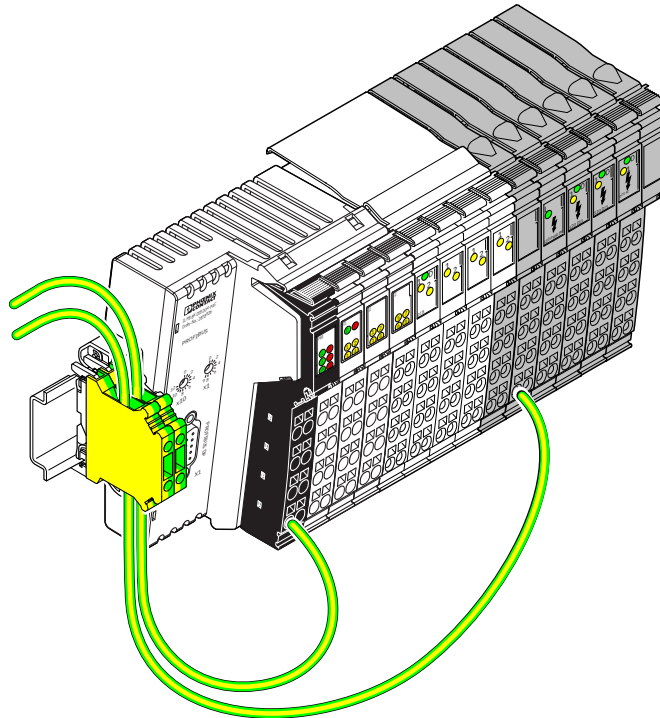Figure 11-9   Additional functional grounding of a bus coupler
(Example: IL PB BK DI8 DO4-PAC)
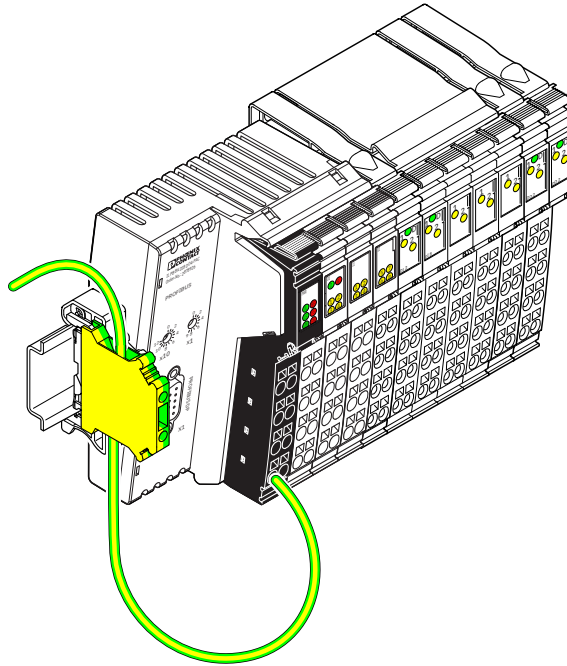
ℹ️ Figure 11-9 shows the additional grounding for a bus coupler using the example of
the IL PB BK DI8 DO4-PAC bus coupler. Connect the additional grounding to your
device according to the terminal-specific documentation.

Inline Block IO

1   The modules have an FE spring (metal clip) on the bottom of the electronics base.
This spring establishes an electrical connection to the DIN rail. Use grounding termi-
nals to connect the DIN rail to protective ground. The modules are grounded when
they are snapped onto the DIN rail.

2   Phoenix Contact also recommends grounding the Inline Block IO module via the
FE terminal point of the corresponding connector to ensure reliable functional
grounding even if the DIN rail is dirty or the metal clip is damaged (see terminal-spe-
cific data sheet).

11.3.2   Protective ground (PE) (Inline)

Protective ground is a low-impedance current path that minimizes the risk to the operator in the event of an error (including a high voltage and/or current error between an electrical circuit and ground).

In Inline terminals, protective ground is used outside the SELV.

⚠ **WARNING: Disregarding this warning may result in the loss of electrical safety**
Every power terminal of the 120 V AC or 230 V AC area must be connected to the DIN rail with low impedance, otherwise no protection is provided.

The PE (protective ground) potential jumper is led from the power terminal of the 120 V AC or 230 V AC area through this entire area to the next power terminal.

Power-level terminals are connected to PE using the power connector and voltage continuation between power-level terminals is ensured using the power bridge.

Figure 11-10   Additional grounding of a bus coupler and protective ground connection
(Example: IL PB BK DI8 DO4-PAC)

ℹ Figure 11-10 shows the additional grounding and protective ground connection using the example of the IL PB BK DI8 DO4-PAC bus coupler. Connect the additional grounding and protective ground to your devices according to the terminal-specific documentation.

11.4 Shielding concept

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

11.4.1 Inline shielding concept

In the Inline system, shielded cables are used with the following terminals:
–   Remote bus cables
–   Connecting cables
    –   At terminals for analog signals (analog input, analog output, temperature recording)
    –   At terminals for open and closed-loop control
    –   At communication terminals
    –   At detection terminals
    –   At programmable terminals

Observe the following points when installing shielding:

–   Secure 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.
–   When connecting the shielding, observe the specifications for the connector wiring.

### 11.4.2 Shielding when connecting analog sensors and actuators

–   Always connect analog sensors and actuators with shielded, twisted pair cables.
–   Connect the shielding via the Inline connector with shield connection (see Section "Connecting shielded cables using an Inline shield connector" on page 129).

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

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

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

Figure 11-11   Integration of analog shielding in a concept with central equipotential bonding at the control cabinet entry
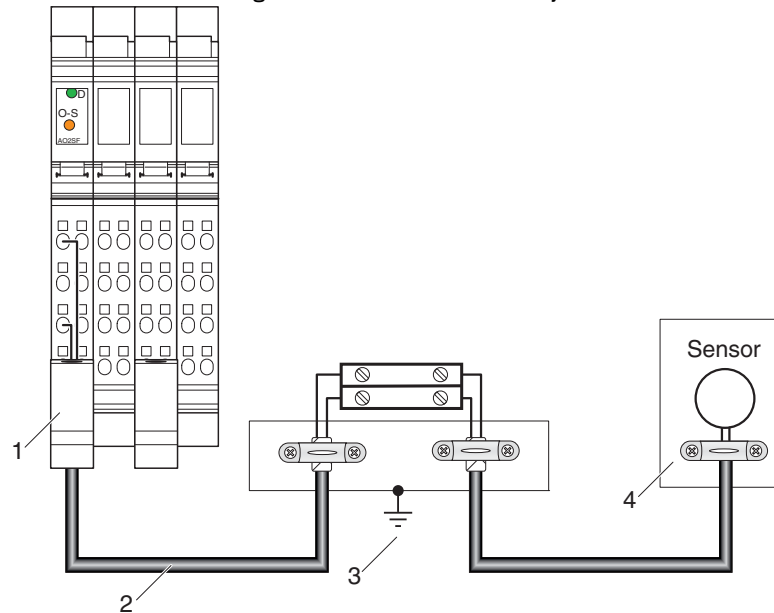
1   Lead the analog cable into the Inline connector making sure to maintain the cable insulation.

2   Use shielded twisted pair cables.

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

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

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

11.5 Mounting/removal

11.5.1 Inline: Mounting/removal

Mounting side by side (Inline)

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 establishes 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 clamps (Inline)

Mount end clamps on both sides of the Inline station. The end clamps ensure that the Inline station is correctly mounted. End clamps secure the Inline station on both sides and keep it from moving from side to side on the DIN rail. For the recommended end clamps, please refer to Section "Ordering data" on page 162.

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

When mounting on a vertical DIN rail, secure the end clamp on the left at the start of station assembly, so as to prevent the station from slipping down.

End plate (Inline)

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

Order of the Inline terminals

When mounting, observe the correct order of the Inline terminals (see Section "Order of the Inline terminals" on page 125).

11.5.1.1 Mounting/removing/replacing terminals in the 24 V DC and 120 V AC/230 V AC areas

Mounting

When mounting a terminal in these areas, proceed as shown in Figure 11-12 on page 119:

- 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).

> ℹ️ When doing this ensure that **all** featherkeys and keyways on adjacent terminals are securely interlocked (detail 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 onto the previous terminal (detail B1).

> ⊙ **NOTE: Malfunction in the event of no contacting**
> Press gently against the adjacent terminal on the left 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 is 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 press the top of the connector towards the base until it snaps into the back snap-on mechanism (detail D2).
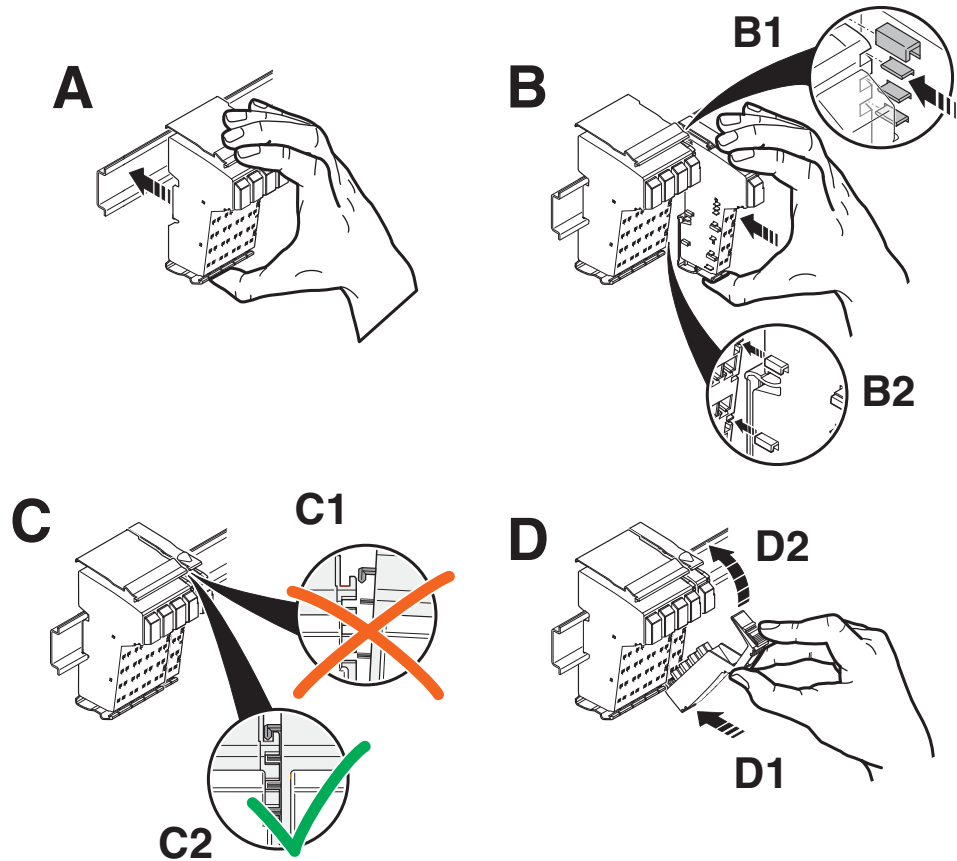
> ℹ️ The keyways of an electronics base do not continue on a connector. When snapping on an electronics base, there must be no connector on the left-hand side of the base. If a connector is present, it will have to be removed.

Figure 11-12   Mounting a terminal

Removal

When removing a terminal, proceed as shown in Figure 11-13 on page 120:

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

ℹ️ 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).

ℹ️ When using extended double signal connectors (long connectors), please ensure that you do not bend them 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 connections 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 11-13   Removing a terminal
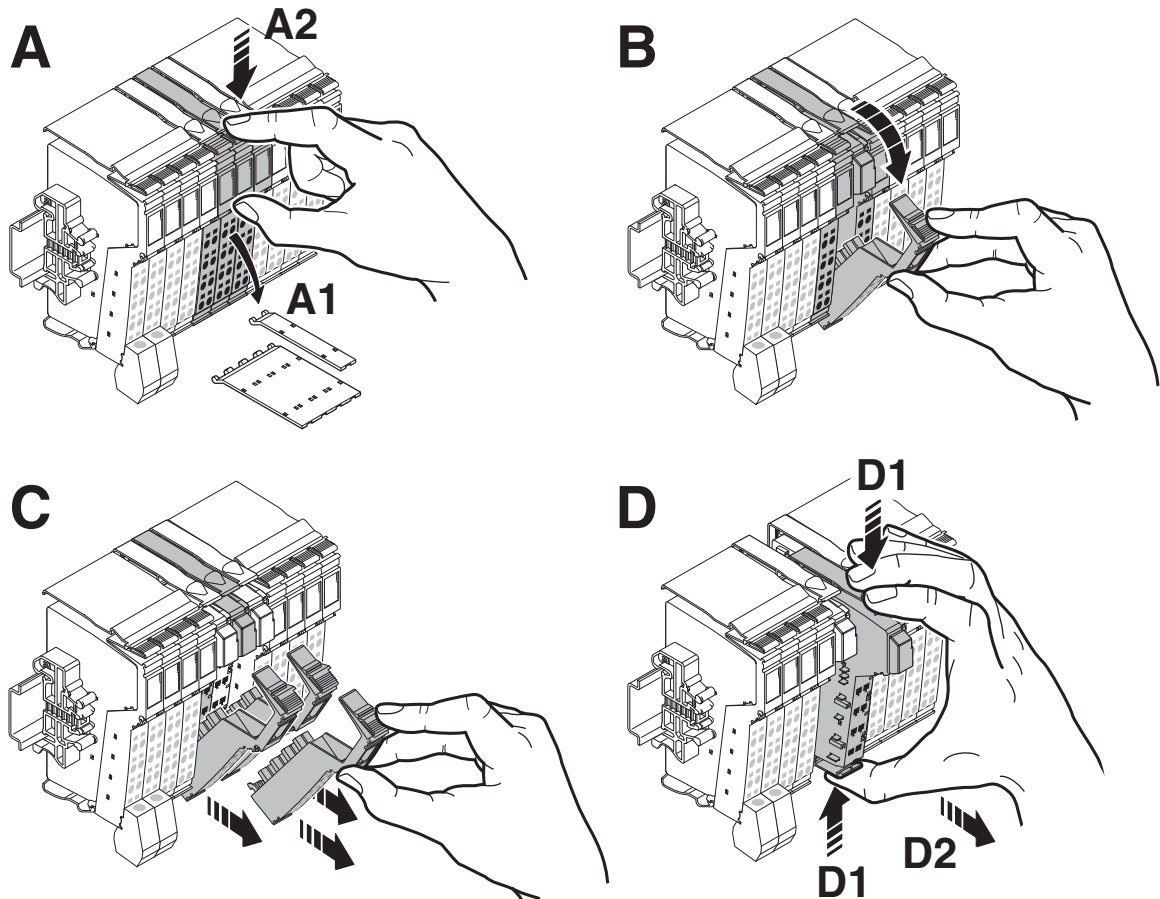
Replacing a terminal

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.

When doing this ensure that **all** featherkeys and keyways on adjacent terminals are securely interlocked.

Then reconnect all the connectors.

The top connector latching must click into place.

11.5.1.2 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.
3. 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 11-14 on page 121:

- 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 11-14 Replacing a fuse
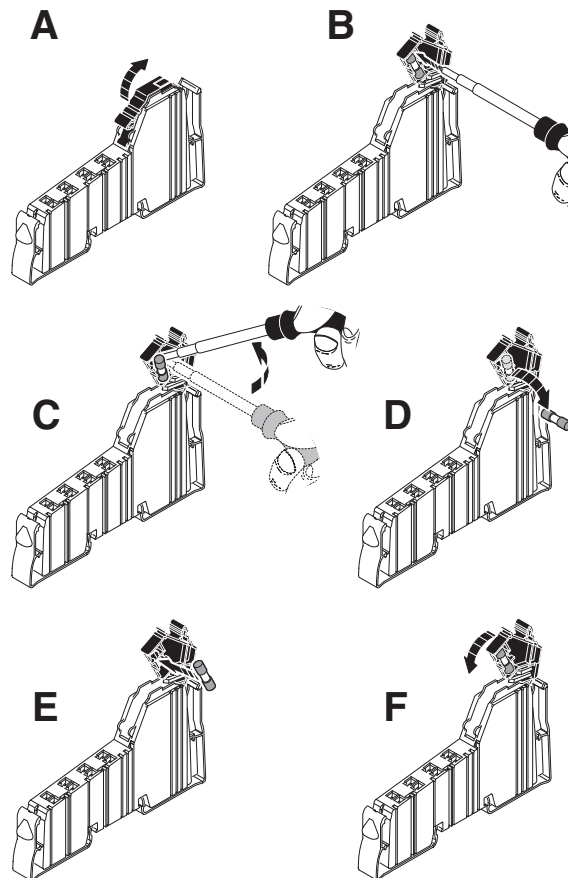
11.5.1.3 Mounting/removing power-level terminals

Observe the following safety notes and warning instructions when working on power-level terminals.

⚠️ **WARNING: Dangerous contact voltage**
Only work on power-level terminals and connectors when the power is disconnected.

ℹ️ Observe the safety notes and warning instructions provided in the terminal-specific data sheets.

Mounting

When mounting a power-level terminal, proceed as shown in Figure 11-15:

• Snap on the power housing, which is required for mounting the station, perpendicular to the DIN rail (detail A).

ℹ️ When doing this ensure that **all** featherkeys and keyways on adjacent terminals are securely interlocked.

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

ℹ️ The keyways of an electronics base do not continue on the connector of terminals for the 24 V DC area. When snapping on a power housing, there must be no 24 V connector on the left-hand side of the housing. If a connector is present, it will have to be removed.

Figure 11-15   Mounting a power-level terminal
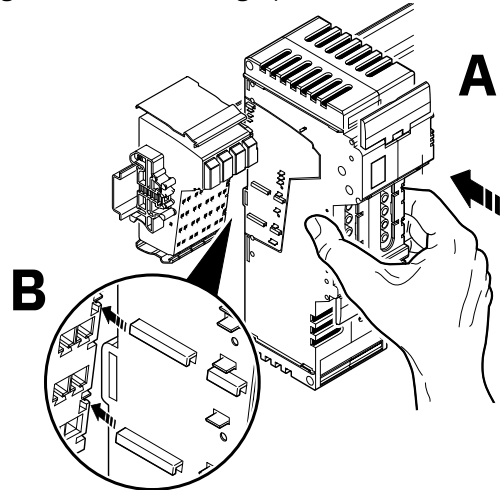
• Next, attach the required connectors to the housing.
The available connections are described in Section "Connections on a power-level terminal (Inline)" on page 144.

Removal

When removing a terminal, proceed as shown in Figure 11-16:

- If adjacent terminals belong to the 24 V DC or 120 V AC/230 V AC area: Remove the adjacent connectors of the neighboring terminals (Figure 11-13 on page 120). This prevents the potential routing knife contacts and the keyway/featherkey connection from being damaged.

- Lift the release flaps towards the center of the power-level terminal (Figure 11-16, detail A).

- Remove the power-level terminal by uniformly pulling the release flaps straight back from the DIN rail (detail B). If you have not removed the connector of the adjacent terminal on the left, remove it now in order to protect the potential routing feather-keys and the keyway/featherkey connection.

Figure 11-16   Removing a power-level terminal
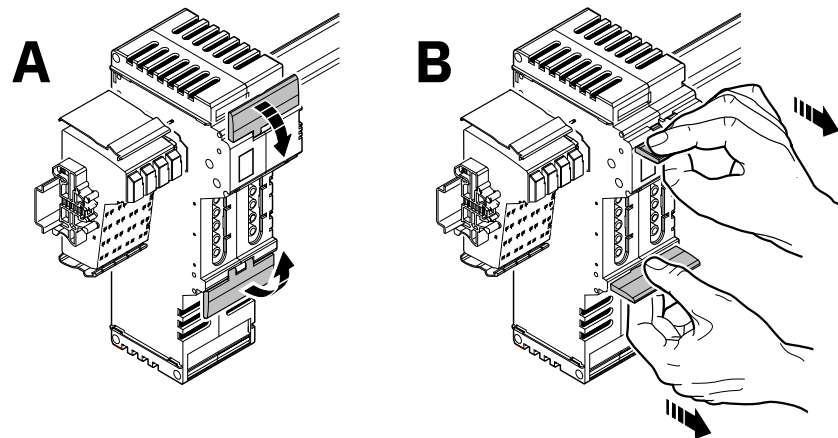
11.5.2   Inline Block IO: Mounting/removal

Mounting

Figure 11-17   Snapping on the base   Figure 11-18   Snapping on a connector
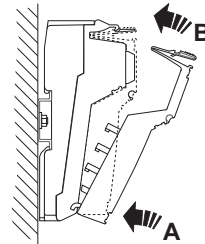
- Place the base onto the DIN rail from above (Figure 11-17, A) and press down firmly (B).

- Plug the connectors into the base (Figure 11-18).
  First, insert the front connector shaft latching (A).
  Then press the top of the connector towards the base until it snaps into place (B).

Removal

Figure 11-19   Removing a connector   Figure 11-20   Removing the base
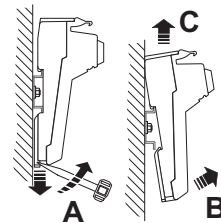
- Disconnect the power to the module.
- If there is a labeling field, which covers several connectors, it may have to be removed.

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

- Lift the connector that is to be removed by pressing on the back connector shaft latching (Figure 11-19, A).
- Remove the connector (B).
- Insert a tool in the base latch and pull gently upwards (Figure 11-20, A). Pull the module out from the DIN rail (B, C).

11.5.3 Order of the Inline terminals

11.5.3.1 General order

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

As the voltage at every power terminal is reinjected 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 another 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.

The following order is recommended.

Table 11-1   Order of the Inline terminals within a main circuit

	Function	Abbreviation in order designation	Function identi-fication	Note
1	Digital output	DO, SDO	Pink, red, dark red	In descending order of current consumption
2	Digital input	DI, SDI	Light blue, blue, dark blue	In descending order of current consumption
3	Relay	DOR, SDOR	Dark red	
4	Power	ELR, MLR, EC AR, DC AR	Dark red	See 11.5.3.4
5	Special functions		Orange	In descending order of current consumption
	– Open and closed-loop control	PWM, CNT, SSI, INC, TEMPCON		
	– Communication	RS, ASI MA, DALI		
	– Detection	INC-IN, SSI-IN, IMPULSE-IN		
	– Safety	SAFE		Please observe any special requirements (subsequent safety-related segment circuit or subsequent power-level terminals).
6	Analog output	AO	Yellow	In descending order of current consumption; see 11.5.3.3
7	Analog input	AI, SGI, TEMP	Green	In descending order of current consumption; see 11.5.3.3
		IB IL TEMP 2 UTH-PAC		As the last terminal

Please also observe the following notes:

– In the event of any further restrictions regarding the position of a terminal, please refer to the terminal-specific data sheet.

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

11.5.3.2   Remote bus branch in an Inline station

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

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

11.5.3.3   Positioning terminals for analog signals

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

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

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

11.5.3.4   Positioning power-level terminals

In a 24 V DC area, position the power-level terminals anywhere in the main circuit, but before the analog terminals.

In a 24 V DC area, power-level terminals can be positioned anywhere in the main circuit before terminals with a special function and analog terminals. Due to noise emissions, power-level terminals with mechanical load relay (MLR) should be positioned away from analog terminals, i.e., they must not be placed adjacent to them.

ⓘ Please note that only **adjacent** power-level terminals can be connected for potential jumpering using power bridges.

11.5.3.5 Example of the structure of a main circuit

Table 11-2   Example: Structure of a main circuit

Terminal		Type	Reason for position
1	IB IL 24 DO 16-PAC	Digital output terminal	DO, current higher than for 2; please observe note below table
2	IB IL 24 DO 2-PAC	Digital output terminal	DO
3	IB IL 24 DI 16-PAC	Digital input terminal	DI, current higher than for 4
4	IB IL 24 DI 2-PAC	Digital input terminal	DI
5	IB IL 400 MLR 1-8A	Power-level terminal	Any, before analog
6	IB IL CNT-PAC	Function terminal	
7	IB IL AO 2/SF-PAC	Analog output terminal	AO
8	IB IL TEMP 2 UTH-PAC	Analog input terminal	AI, after all others

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

If the maximum load of the outputs is 0.2 A, an additional power terminal is not required. This configuration is in Figure 11-21.

Figure 11-21   Suggested solution
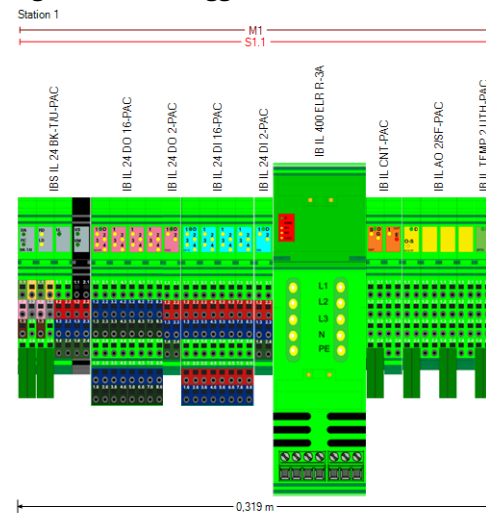
12 Connecting cables

12.1 Connecting cables using Inline connectors

Excluding a few exceptions, the cables for the I/O and supply voltages are connected via Inline connectors using the spring-cage method. This means that signals up to 250 V AC/DC and 8 A can be connected with a conductor cross-section of 0.08 mm^2 to 1.5 mm^2.

> **i** Please observe the permissible lengths for sensor/actuator cables (see Section "Cable connection method/cross-section" on page 160 or terminal-specific data sheet).

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

12.1.1 Connecting unshielded cables

Figure 12-1 Connecting unshielded cables
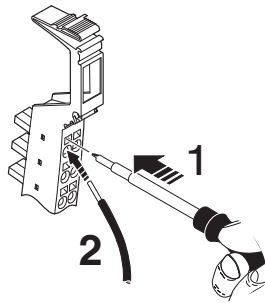
Wire the connectors according to your application.

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

When wiring, proceed as follows:

• Strip 8 mm off the cable.

> **i** 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 of the appropriate terminal point (Figure 12-1, detail 1), so that you can insert the wire into the spring opening.
  Phoenix Contact recommends using a SZF 1 - 0,6X3,5 screwdriver (Order No. 1204517).
• Insert the wire (Figure 12-1, detail 2). Remove the screwdriver from the opening. This clamps the wire.

Following installation, the wires and the terminal points should be labeled (see also Section "Function identification" on page 62).

12.1.2 Connecting shielded cables using an Inline shield connector

Shielded cables can be connected via IB IL SCN-6 SHIELD and
IB IL SCN 6-SHIELD-TWIN shield connectors. The IB IL SCN-6 SHIELD shield connector
is designed to connect one shielded cable. Two shielded cables can be easily connected
via the 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 12-2 on page 130 and
Figure 12-3 on page 131.

Figure 12-2 shows the connection of a shielded cable using a remote bus cable as an ex-
ample. In this example, the cables are twisted pair cables.

Figure 12-3 shows the connection of two shielded cables, using the wiring of the
IB IL AI 2/SF-PAC terminal as an example. As two channels can be used here, the
IB IL SCN 6-SHIELD-TWIN shield connector is used.

When connecting the cables proceed as shown in Figure 12-2 and Figure 12-3:

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).

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

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

Wiring the connectors

- Push a screwdriver into the actuation shaft of the appropriate terminal point
  (Figure 12-1 on page 128, detail 1), so that you can insert the wire into the spring
  opening.
  Phoenix Contact recommends using a SZF 1 - 0,6X3,5 screwdriver
  (Order No. 1204517).
- Insert the wire (Figure 12-1 on page 128, detail 2). Remove the screwdriver from the
  opening. This clamps the wire.

i For the connector pin assignment, please refer to the corresponding terminal-spe-
cific data sheet.

Connecting the shield

Figure 12-2 shows the shield connection for the IB IL SCN 6-SHIELD connector. The procedure for the IB IL SCN 6-SHIELD-TWIN connector (shown in Figure 12-3) 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 132).
- Place the cable with the folded braided shield in the shield connection (detail D).
- Close the shield connection (detail E).
- Tighten the screws on the shield connection with a screwdriver (detail F).

> **i** 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.

Figure 12-2   Connecting a shielded cable via the IB IL SCN-6 SHIELD shield connector (dimensions im mm)
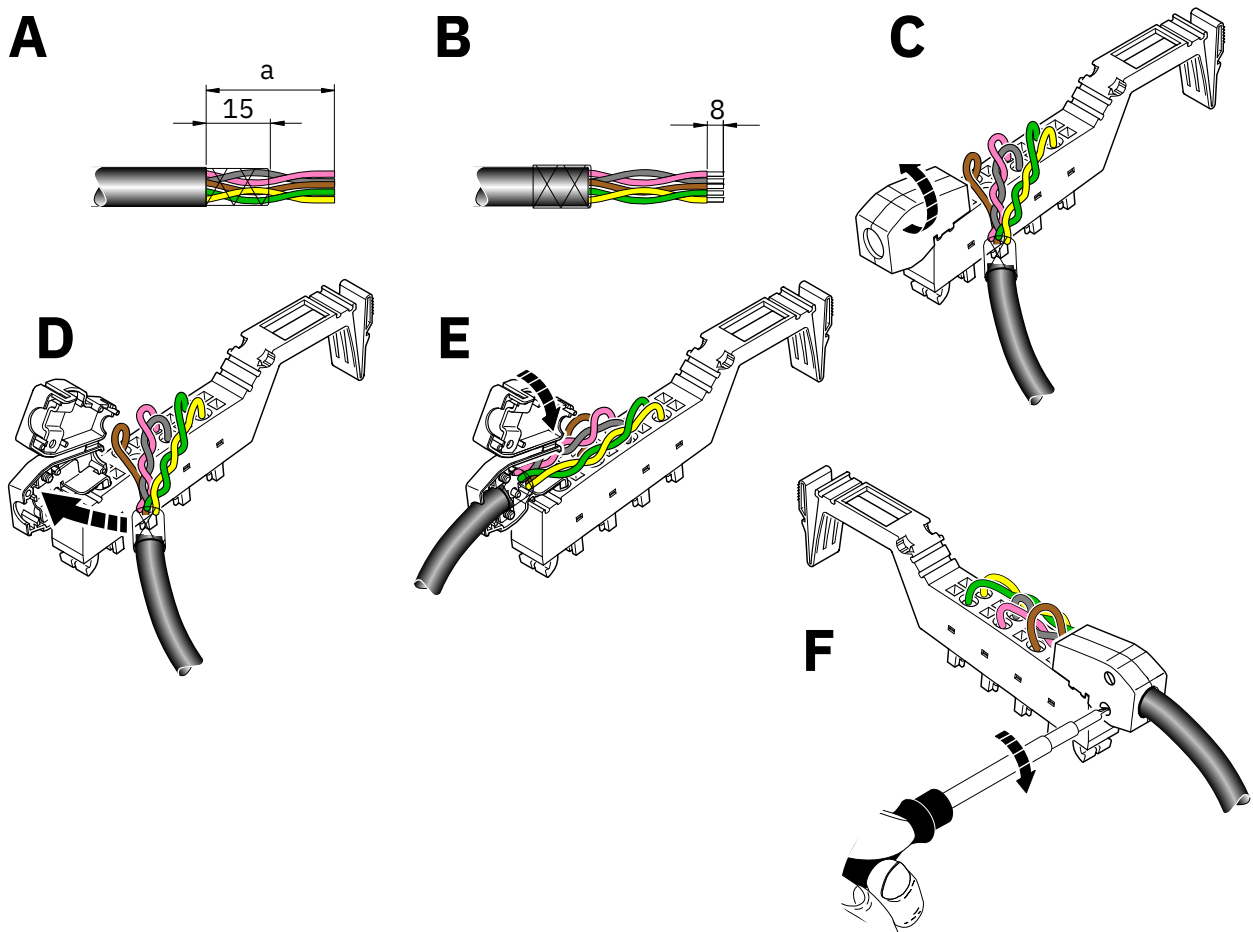
Figure 12-3   Connecting two shielded cables via the IB IL SCN 6-SHIELD-TWIN shield connector (dimensions in mm)
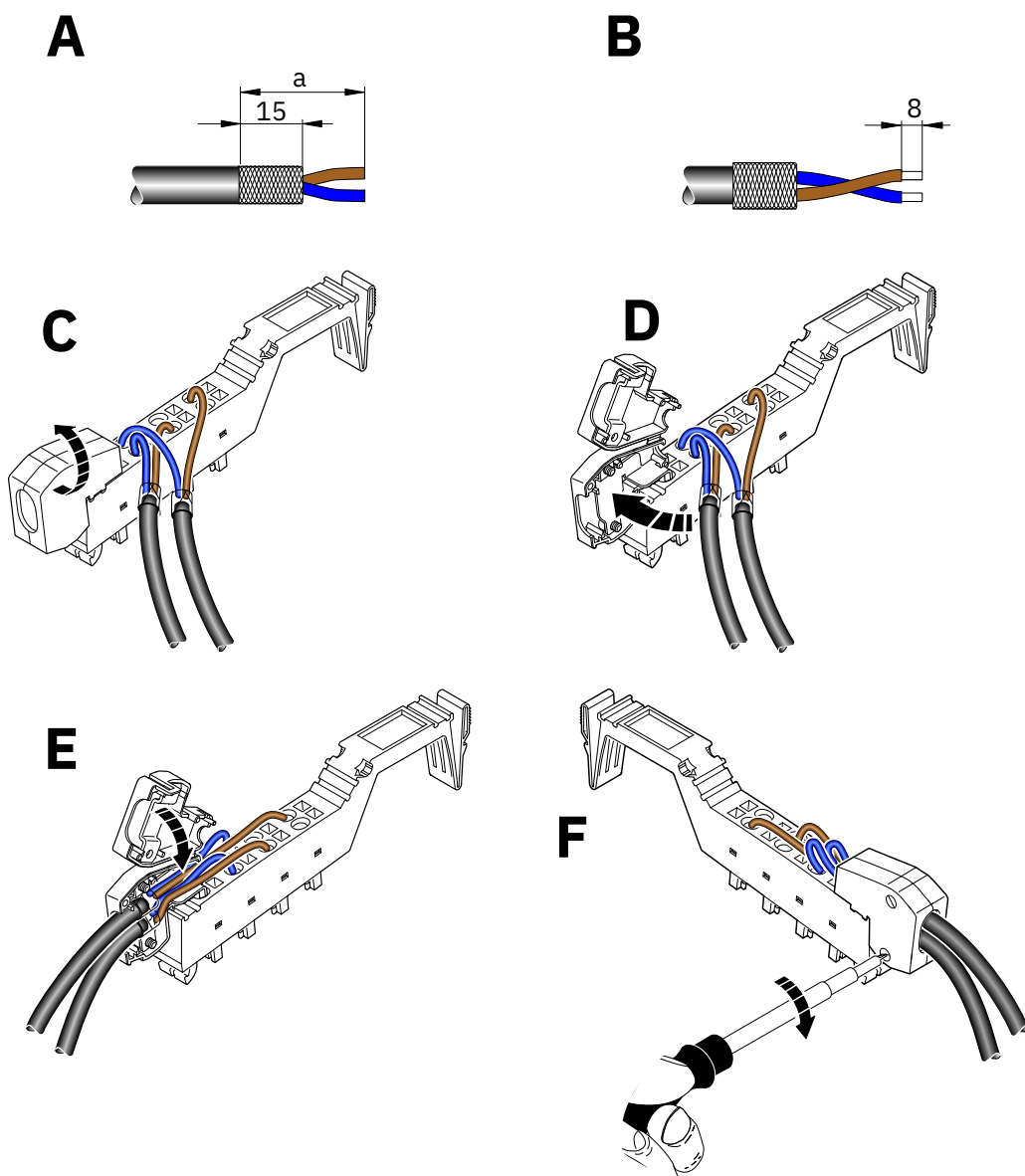
Shield connection clamp

The shield connection clamp (a in Figure 12-4, detail B) in the shield connection can be used in various ways depending on the cable cross-section. For thicker cables (e.g., bus cable), the dip in the clamp must be turned away from the cable (Figure 12-4, detail B). For thinner cables, the dip in the clamp must be turned towards the cable (Figure 12-4, detail F).

If you need to change the position of the shield connection clamp, proceed as shown in Figure 12-4:

• 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 12-4   Shield connection clamp alignment
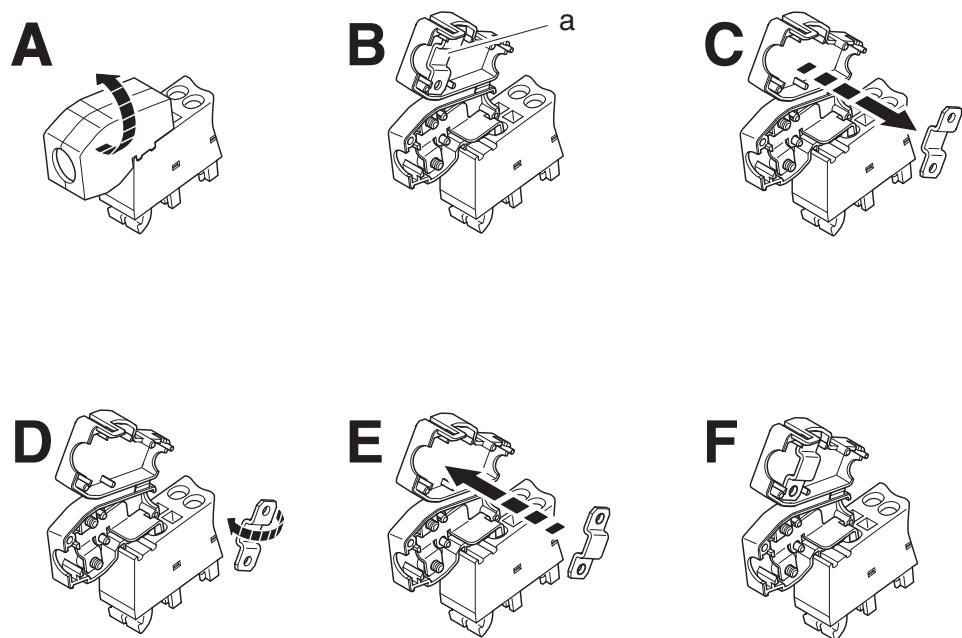
12.1.3   Connecting shielded cables using an Inline connector

With analog, function, or communication terminals without Inline shield plug, shielding can be connected by separate accessories.

ⓘ The recommended accessories can be found on the item page at phoenixcontact.com/products.

12.2   Connecting the power supplies

Inline

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

Connect the power supplies using unshielded cables as described in Section "Connecting unshielded cables" on page 128.

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

Inline Block IO

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

The power supplies are connected using unshielded cables. For connection via Inline connector, see Section "Connecting unshielded cables" on page 128.

| i | For the connector pin assignments for connecting supply voltages, please refer to the relevant module-specific data sheet. |

12.2.1   Inline: Supply options

Bus coupler supply

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

Power terminal supply

Depending on the type of power terminal, the following supply voltages can be supplied 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 (communications power and I/O supply voltage)

| i | Please also refer to the information provided in Section "Power, segment, and accessory terminals" on page 30. |

Providing the segment voltage at segment terminals

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

| i | Please also refer to the information provided in Section "Power, segment, and accessory terminals" on page 30. |

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 the 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 bus coupler supply (U_{BK}). In this way the bus continues to run even if some I/O devices are switched off.

12.2.2   Power supply requirements

⚠ **WARNING: Dangerous contact voltage**
Only use power supply units that ensure safe isolation between the primary and secondary circuits according to EN 50178.

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

Inline: Supply voltage requirements that differ from the system specifications

The specifications for Inline system supply voltages are described in "Technical data for Inline" on page 154. However, some terminals have specific requirements. Therefore, always refer to the corresponding data sheet.

This section provides information about the various possible requirements within an Inline system.

Table 12-1   Supply voltage requirements of various products (example)

	Inline (system requirements)	IB IL 400 MLR 1-8A (no longer in product range)
Nominal voltage	24 V DC	24 V DC
Permissible voltage range (incl. all tolerances, incl. ripple)	19.2 V DC to 30.0 V DC	19.2 V DC to **28.8** V DC
Documented in	"Technical data for Inline" on page 154	Data sheet

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

Two options are available when using terminals, which have special requirements regarding the power supply:
1   Observe the specific parameters for the power supply in the entire system.
2   Observe the specific parameters in the main circuit where the terminals are located.

12.3 Recommendation for supplying the supply voltage and resetting the voltage with regard to Inline

12.3.1 Supply at the bus head

In the Inline terminals, electrical isolation is implemented between the logic and I/O devices. To prevent decreasing the electrical isolation, the voltages for supplying the logic and for supplying the I/O devices must be provided separately using two separate power supply units.

Figure 12-5   Schematic example for supplying the supply voltage at the bus coupler (BK) using two separate power supply units
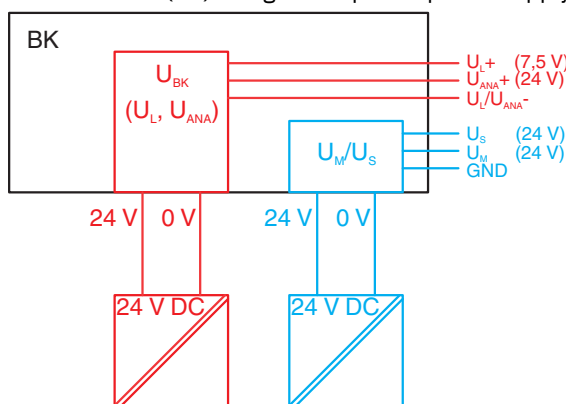
Depending on the device that forms the head of the Inline station, the voltage which is used to generate the U_L communications power and the U_{ANA} voltage for the analog terminals has different designations.

Table 12-2   Designation for the voltages

Device	Designation of the voltage which is used to generate U_L and U_{ANA}
Bus coupler	U_{BK}
Inline controller	U_{ILC}
Field multiplexer	U_{MUX}
Other	U_{24V}

12.3.2 Supply at power terminals and boost terminals

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

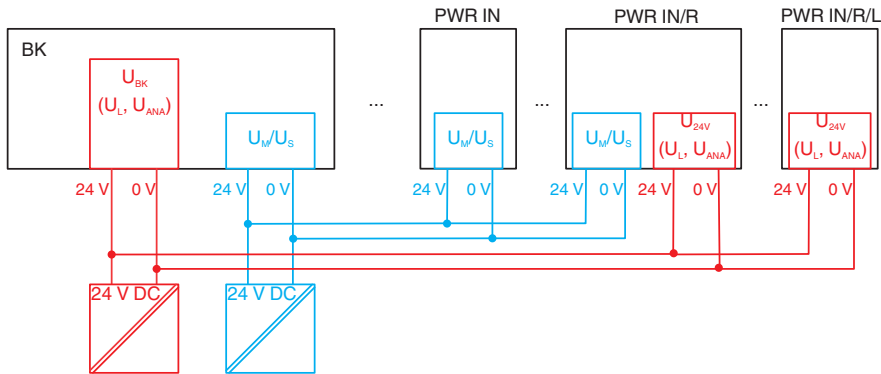Figure 12-6   Supply of the power terminals and boost terminals using two separate power supply units

Table 12-3   Inline power terminals and boost terminals

Type	Supply of	
	U_M/U_S	U_{24V} (U_L, U_{ANA})
IB IL 24 PWR IN-PAC	X	–
IB IL 24 PWR IN/2-F(-D)-PAC	X	–
IB IL 24 PWR IN/R-PAC	X	X
IB IL 24 PWR IN/R/L-0.8A-PAC	–	X

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

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

Figure 12-7 Supply when connecting sensors and actuators in 1-wire technology
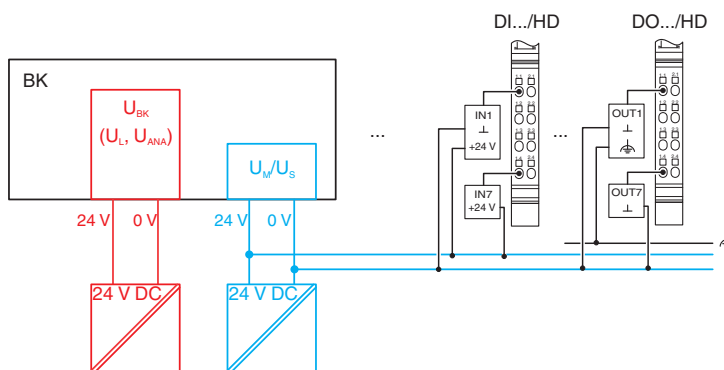
12.3.4 Testing the supply during startup

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

When using power terminals, make sure that they are assigned to the correct power supply unit in order not to decrease electrical isolation within the station.

12.3.5 Behavior during reset at the bus coupler, Inline controller or field multiplexer

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

Disregarding this measure may lead to unwanted feedback.

12.4   Connecting the bus

The bus cable for your system is connected directly to the module in the case of Inline Block IO and to a bus coupler in the case of Inline. Table 12-4 below lists the basic options for connecting the bus.

Table 12-4   Connection options for the individual fieldbus systems

Fieldbus	Connection method (to the Inline Block IO module or the Inline bus coupler)	Connection is available	
		Inline	Inline Block IO
PROFINET	RJ45 female connector	Yes	Yes*
	SCRJ female connector	Yes*	No
INTERBUS	Inline shield connector	Yes	Yes*
	9-pos. D-SUB female connector/ 9-pos. D-SUB male connector	Yes	Yes*
	F-SMA female connector	Yes	No
	E2000 female connector	Yes*	No
PROFIBUS DP	9-pos. D-SUB female connector	Yes	Yes*
Ethernet/IP™	RJ45 female connector	Yes	No
Ethernet TCP/IP	RJ45 female connector	Yes	Yes*
EtherCAT®	RJ45 female connector	Yes	No
Modbus/TCP	RJ45 female connector	Yes	Yes*
Modbus/RTU	9-pos. D-SUB female connector	Yes	No
Sercos II	F-SMA female connector	Yes*	No
Sercos III	RJ45 female connector	Yes	Yes*
DeviceNet™	2 x 5-pos. TWIN-COMBICON male connectors	Yes*	Yes*
CANopen®	2 x 5-pos. TWIN-COMBICON male connectors	Yes	No
	9-pos. D-SUB female connector	No	Yes*
Mechatrolink	USB type A	Yes*	No
Bluetooth	Radio, antenna connection with SMA female connector	No	Yes*

Key:

Yes   Connection method is available

No   Connection method is not available or
             no devices are available at present for this bus system

*   No longer in product range

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

12.5 Connecting sensors and actuators

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

Connect the unshielded cables as described in Section "Connecting unshielded cables" on page 128.

Connect the shielded cables as described in Section "Connecting shielded cables using an Inline shield connector" on page 129.

12.5.1 Connection methods for sensors and actuators

Most of the digital I/O terminals in the Inline product range support 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)

> **i** 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.

12.5.2 Connections used for digital input and output terminals

Different connection options are described below using 24 V DC terminals as an example. For the 120 V AC/230 V AC area, the data changes accordingly. A connection example is provided in the relevant terminal-specific data sheet.

Table 12-5   Overview of the connections used for digital input terminals

Connection	Representa-tion in the fig-ure	1-wire	2-wire	3-wire	4-wire
Sensor signal IN	IN	X	X	X	X
Sensor supply U_S/U_M	U_S (+24 V)	–	X	X	X
Ground GND	GND ($\perp$)	–	–	X	X
Ground/FE shielding	FE ($\frac{\perp}{=}$)	–	–	–	X

X   Used

–   Not used

Table 12-6   Overview of the connections used for digital output terminals

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 ($\perp$)	–	X	X	X
Ground/FE shielding	FE ($\frac{\perp}{=}$)	–	–	X	X

X   Used

–   Not used

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

12.5.3 The various connection methods for sensors and actuators

1-wire technology

Figure 12-8   1-wire termination for digital devices
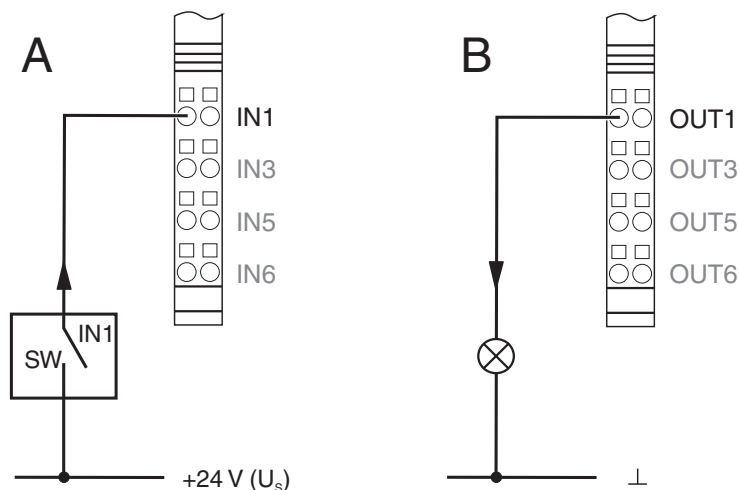
Sensor

Figure 12-9, detail A, shows the detection of a sensor signal schematically. The SW switch provides the input signal. The sensor signal is led to terminal point IN1. The sensor is supplied by the voltage U_S.

> **NOTE: Malfunction due to potential shifts**
> Supply the sensors and U_S of the Inline station from the same power supply. Make sure that there is at least one common GND as reference potential.
> This will prevent potential shifts, which can have undesirable effects on the function of the station.

Actuator

Figure 12-9, detail B, shows the connection of an actuator. The actuator is supplied by output OUT1. The load is switched directly via the output.

> **NOTE: Malfunction due to potential shifts**
> Make sure that GND of the actuators and GND of the supply voltage U_S, which supply the actuators, have the same potential.
> This will prevent potential shifts, which can have undesirable effects on the function of the station.

The following Inline terminals are designed to connect sensors and actuators in 1-wire technology:

– IB IL 24 DI8/HD-PAC, IB IL 24 DO8/HD-PAC
– IB IL 24 DI8/HD-ECO, IB IL 24 DO8/HD-ECO
– IB IL 24 DI 32/HD-PAC, IB IL 24 DO 32/HD-PAC

For connection examples, please refer to the corresponding data sheets.

2-wire technology

Figure 12-9   2-wire termination for digital devices
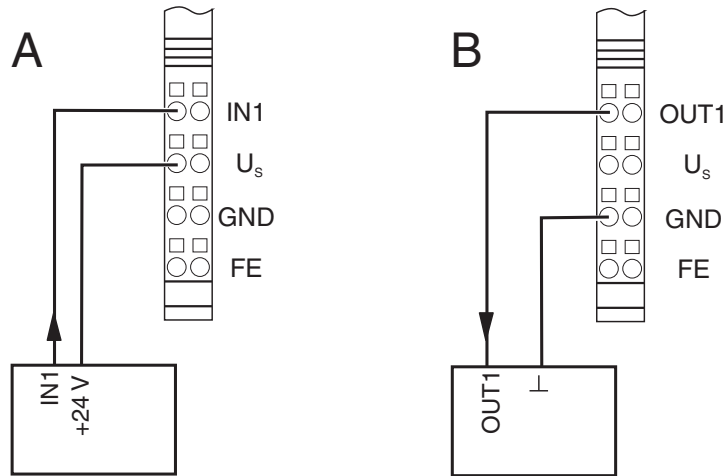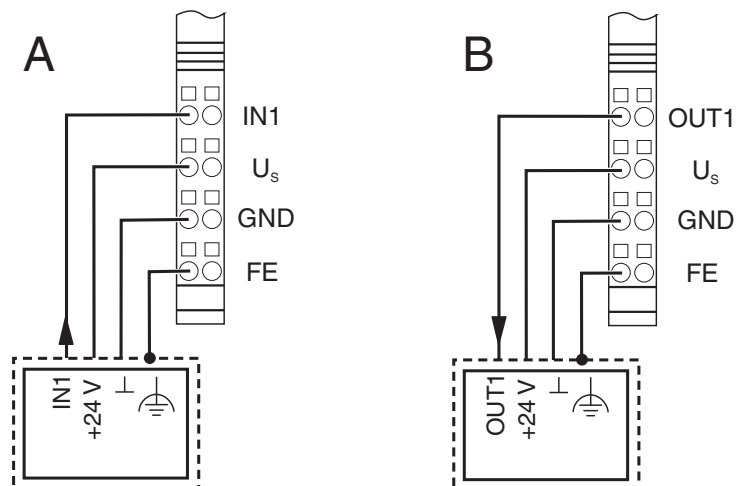

Sensor

Figure 12-9, detail A, shows the connection of a 2-wire sensor. The sensor signal is led to terminal point IN1. The sensor is supplied by the voltage U_S.

Actuator

Figure 12-9, detail B, shows the connection of an actuator. The actuator is supplied by output OUT1. The load is switched directly via the output.

3-wire technology

Figure 12-10   3-wire termination for digital devices
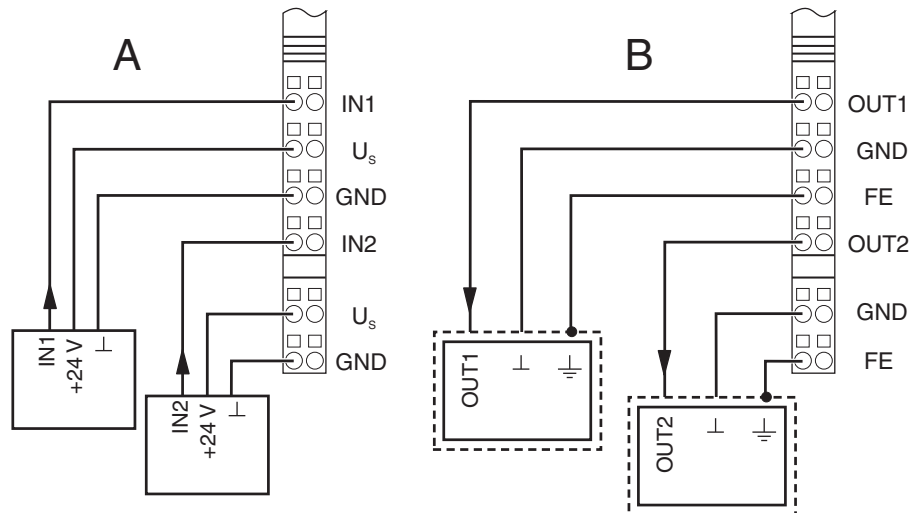
Sensor

Figure 12-10, detail A, shows the connection of a 3-wire sensor. The sensor signal is led to terminal point IN1 (IN2). The sensor is supplied via terminal points U_S and GND.

Actuator

Figure 12-10, detail B, shows the connection of a shielded actuator. The actuator is supplied by output OUT1 (OUT2). The load is switched directly via the output.

4-wire technology

Figure 12-11   4-wire termination for digital devices

Sensor

Figure 12-11, detail A, shows the connection of a shielded 4-wire sensor. The sensor signal is led to terminal point IN1. The sensor is supplied via terminal points U_S and GND. The sensor is grounded via the FE terminal point.

Actuator

Figure 12-11, detail B, shows the connection of a shielded actuator. The provision of the supply voltage U_S means that even actuators that require a separate 24 V supply can be connected directly to the terminal.

12.6 Connections on a power-level terminal (Inline)

⚠ **WARNING: Dangerous contact voltage**
Only connect and remove the connectors of a power-level terminal when the mains voltage is disconnected and cannot be switched on again.

A power-level terminal has slots for the following connections:

Figure 12-12   Power-level terminal with all possible connectors
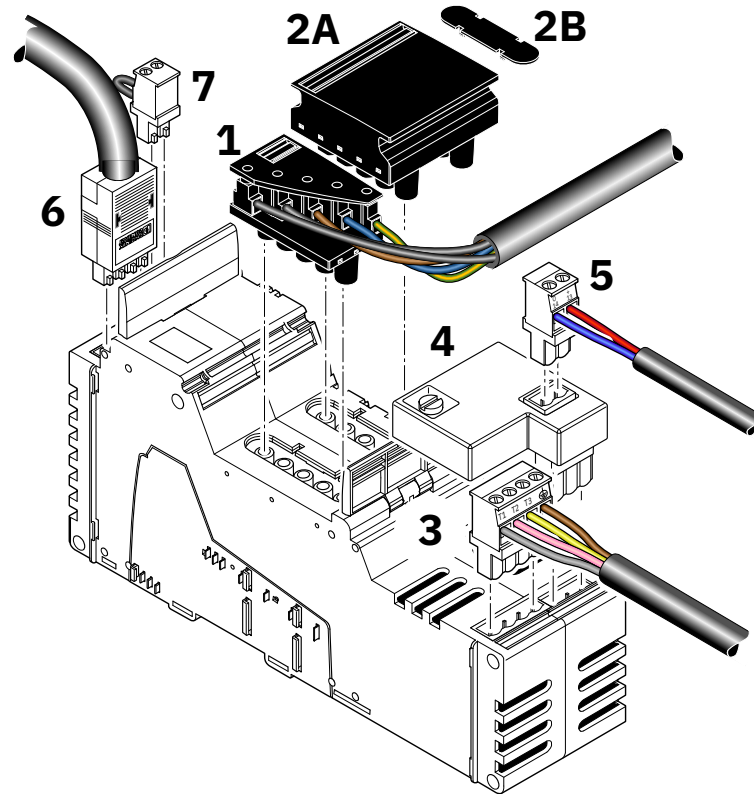
Table 12-7   Slots and connectors of a power-level terminal

No. in Figure 12-12	Slot	Connector/connection
1	X11	Incoming mains (here: power connector)
2	X12	Outgoing mains (power bridge (2A) or cover (2B))
3	X10	Motor output
4	X8	Brake module (including brake switch and connection for brake)
5	X9	Connection of the brake to the brake module
6	X32	Hand-held operator panel connection (hand-held operator panel mode)
7	X18	Enable power level

12.6.1   Connecting or forwarding the incoming mains

⚠ **WARNING: Dangerous contact voltage**
Only remove or insert the power connector or the power bridge when the mains voltage is disconnected.

There are two ways of connecting the incoming mains to a power-level terminal:

You can connect the incoming mains using a power connector.

When assembling the power connector, proceed as shown in Figure 12-13:

*   Strip approximately 80 mm off the cable sheath (detail A) and 7 mm off the wires (detail B). Fit the wire ends with ferrules.
*   Connect the wires to the connector (detail C). The assignment is shown in Figure 12-14.

Figure 12-13   Assembling a power connector (dimensions im mm)
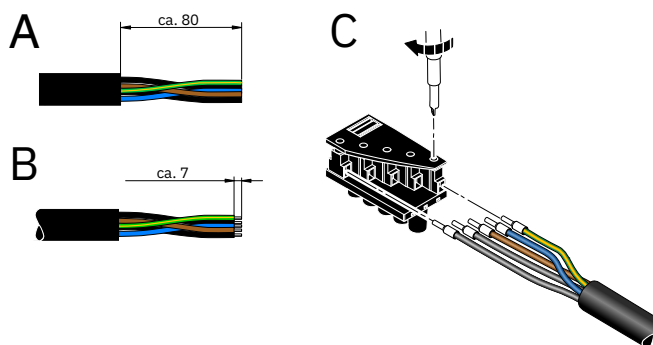
Figure 12-14   Power connector assignment
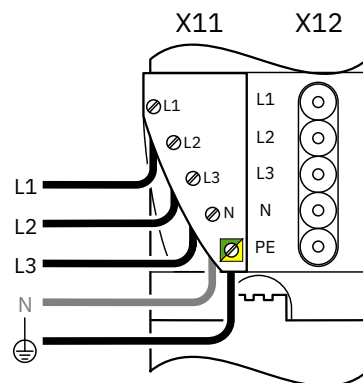
X11   Incoming mains

X12   Outgoing mains

ℹ The PEN conductor (N) is not required for power-level terminals. However, the connectors offer the option of connecting and forwarding the PEN conductor.

Insert the assembled connector into connection X11 () of the power-level terminal (Figure 12-14, Figure 12-15).

Figure 12-15   Connecting a power connector
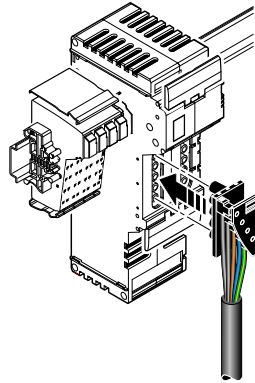
You can forward the mains supply using a power bridge.

If several power-level terminals are connected one after the other, a power-level terminal can be connected to the preceding power-level terminal using a power bridge. If the preceding terminal is supplied with voltage, this voltage is led via the power bridge.

• Insert the power bridge on two adjacent power-level terminals so that connection X12 (outgoing mains) of the preceding terminal is connected to connection X11 (incoming mains) of the following terminal. The power bridge can carry a maximum of 20 A.

Figure 12-16   Inserting a power bridge   Figure 12-17   Power-level terminals with a mains connector and power bridge
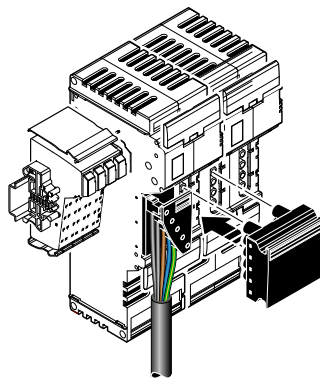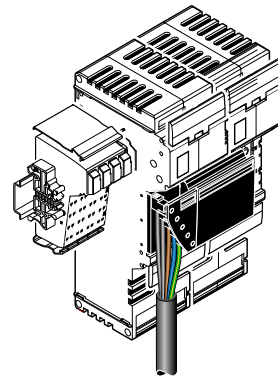
12.6.2 Connecting the motor circuit connector

⚠ **WARNING: Dangerous contact voltage**
Only connect or remove the motor circuit connector when the mains voltage is disconnected.

The motor output is connected via a 4-pos. HV-COMBICON connector.

When assembling the motor circuit connector, proceed as shown in Figure 12-18:
- Strip approximately 30 mm off the cable sheath (detail A) and 7 mm off the wires (detail B). Fit the wire ends with ferrules.
- Connect the wires to the connector (detail C). The pin assignment is shown in Table 12-8.

Figure 12-18 Assembling the motor circuit connector (dimensions in mm)
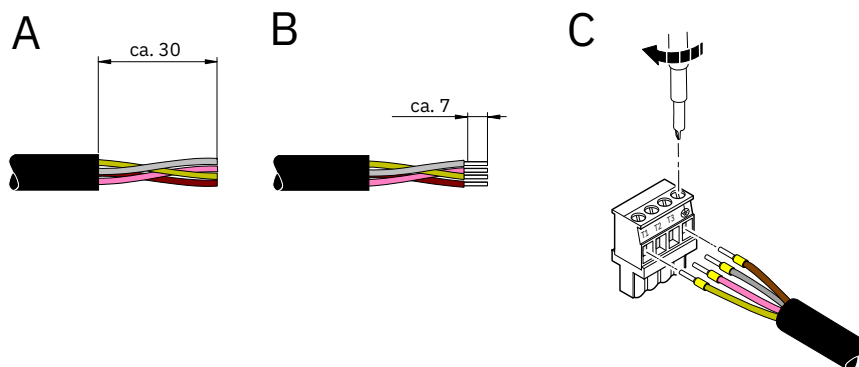
Figure 12-19   Motor output assignment
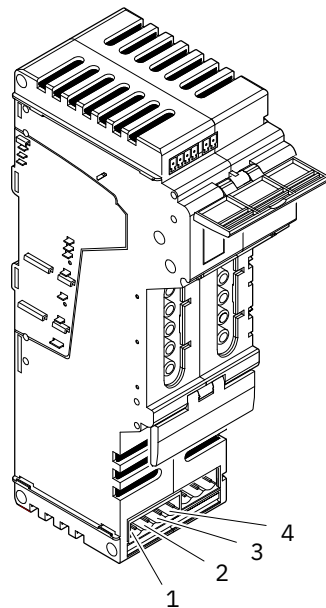
Table 12-8   Pin assignment of the motor circuit connector (HV-COMBICON)

Pin	X10 (motor)
1	Motor: T1
2	Motor: T2
3	Motor: T3
4	Motor: ⏚

Insert the assembled connector in connection X10 (Figure 12-20).

Figure 12-20   Inserting the motor circuit connector
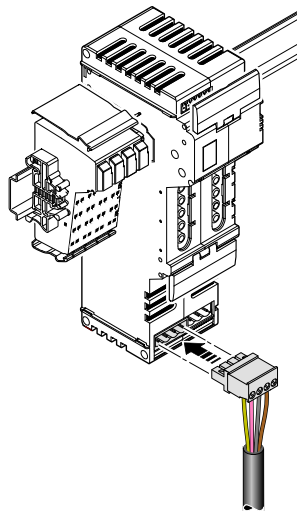
12.6.3   Connecting the brake module and brake (optional)

The brake module can be used to control the brake on motors with a brake. It contains a passive semiconductor, which can be used for quick motor braking. The brake module is designed for motors with a nominal voltage of 400 V AC.

Assemble the connector for the brake as shown in Figure 12-21:

- Strip approximately 30 mm off the outer cable sheath (detail A).
- Strip approximately 7 mm off the wires (detail B).
- Fit the wire ends with ferrules and connect the wires to the connector (detail C).

⚠ **NOTE: Malfunction**
Make sure that the brake is connected with the correct polarity, otherwise it may not operate correctly.

Figure 12-21   Assembling the connector for the brake (dimensions in mm)
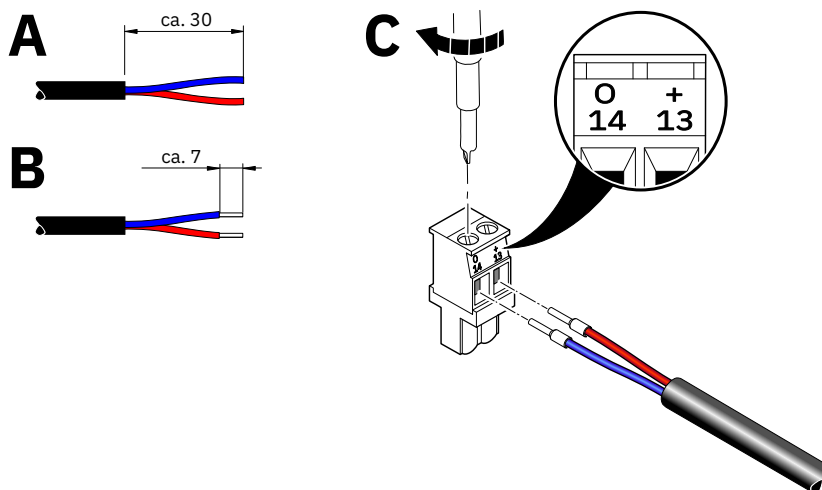
The brake module is snapped into connection X8 of a power-level terminal using a 3-pos. inverted COMBICON connector. The 2-pos. COMBICON connector for the brake is snapped into connection X9 of the brake module.

Connect the brake as shown in Figure 12-22:

- If the motor connector is plugged in, remove it. The entire module should be pre-pared (power-level terminal with brake module) before the I/O is connected.
- Lift up the lower release flap (detail A1).
- Snap the brake module into connection X8 (detail A2). Fasten the brake module by turning the interlocking screw (1) 90°. This secures the interlocking screw in a ventilation slot of the power-level terminal.
- Put the lower release flap down again (detail B1).
- Insert the assembled motor circuit connector into connection X10 (detail B2). (See also Section "Connecting the motor circuit connector" on page 147.)
- Insert the assembled connector for the brake into connection X9 of the brake module (detail B3).

Figure 12-22   Snapping on the brake module and the connector for the brake
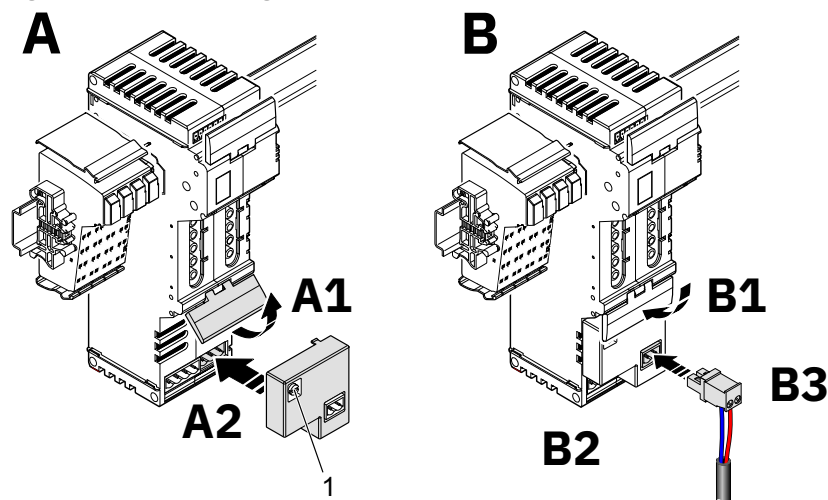
For additional information about the brake module, please refer to the module-spe-cific data sheet.

12.6.4   Connecting the hand-held operator panel

Hand-held operator panel mode (manual mode, IBS HVO/M12, item no. 2837006) is en-abled via a temporarily connected external hand-held operator panel. This panel is con-nected to the power-level terminal using a 4-pos. MINI-COMBICON connector. The slot is under the upper release flap (6 in Figure 12-12 on page 144). The hand-held operator panel can only be connected when the release flap is upright.

For additional information about hand-held operator panel mode, please refer to the data sheets for the power-level terminals.

12.6.5 Enabling the power level/24 V isolation

The MINI-COMBICON connector for terminal strip X18 (enable power level/24 V isolation) is under the upper release flap of a power-level terminal.

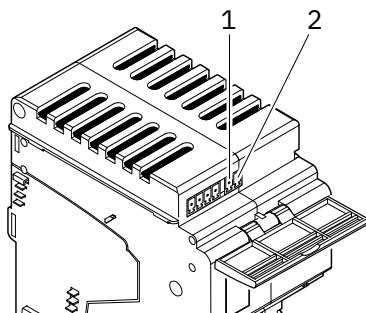Figure 12-23   Assignment of the enable power level/24 V isolation connection

Table 12-9   Enable power level X18 (MINI-COMBICON)

Pin	X18 (enable)
1	1 (24 V DC segment voltage U_S)
2	2 (enable power level)

The control voltage for the power level and the brake is supplied via pin 2 of the MINICOMBICON connector. The power level cannot be controlled without the 24 V control voltage.

The segment voltage U_S is used to enable the power level and can be made available using a jumper or a switch:

1 By default upon delivery, terminal strip X18 is supplied with a jumper inserted between pins 1 and 2.
  If no switch is connected to X18, the jumper can remain inserted. The power level of the power-level terminal is enabled because the 24 V segment voltage is directly available.

2 If an external switch is connected between pins 1 and 2 on terminal strip X18, the power level of the power-level terminal is enabled when the switch is closed.

ℹ️ For additional information and safety notes, please refer to the data sheets for the power-level terminals.

13 Device replacement, device defect and repair

13.1 Device replacement

Inline terminals can be replaced, if necessary.

Please note when replacing a device.
– In the SELV area:

NOTE: Disregarding this warning may result in malfunction
Do not replace devices while the power is connected.
Inline:
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.
– In the low voltage area (**Inline**):

WARNING: Dangerous contact voltage
Do not replace devices 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.

If you want to replace an Inline terminal, proceed as follows:
• Observe the information in Section 11, "Mounting/removing devices".
• If necessary, disconnect the wiring.
• Replace the Inline terminal in your application with a new Inline terminal.
• If necessary, connect the supply and the I/O devices.
See Section 12, "Connecting cables".

Observe the device type and version

The new terminal must meet the following requirements:
– Same device type
– Same or later version

13.2 Device defect and repair

Do not open the housing

nly be carried out by Phoenix Contact. Do not open the housing. If the housing is opened, the function of the device can no longer be ensured.

Defective devices

• Please contact Phoenix Contact.

14 Maintenance, decommissioning, and disposal

14.1 Maintenance

Inline terminals modules are maintenance free.

14.2 Decommissioning and disposal

Carry out decommissioning according to the requirements of the machine or system manufacturer.

When decommissioning, ensure the following for the Inline terminals used:

The device continues to be used only as intended:

• Observe the storage and transport requirements.
 See Section "Transport, storage, and unpacking" on page 104.

The device is not used any more:

Device disposal

The symbol with the crossed-out trash can indicates that this item must be collected and disposed of separately from other waste. Phoenix Contact or public collection sites will take the item back for free disposal. For information on the available disposal options, visit phoenixcontact.com.
Collect and dispose of included batteries separately from other waste. Delete personal data before returning the item.

Packaging disposal

• pose of packaging materials that are no longer needed (cardboard packaging, paper, bubble wrap sheets, tubular bags, etc.) with household waste in accordance with the currently applicable national regulations.

ℹ️ Please also follow the disposal instructions in the user documentation for each device.

15 Inline: 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 ranges, also observe the technical data for these product ranges. Please refer to the corresponding documentation for this technical data.

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

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

15.1 Technical data for Inline

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

When configuring an Inline station, observe the power supply through the bus couplers, power terminals, and segment terminals, as well as the current consumption of each device. This information is provided in the relevant 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.

General data

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

Instructions	Developed according to EN 50178/IEC 62103, UL 508
Ambient temperature	
Ambient temperature (operation) - standard versions	-25 °C ... +55 °C
Ambient temperature (operation) - XC version	-25 °C ... +55 °C (standard) -40 °C ... +70 °C (extended, see Section "Tested successfully: Use under extreme ambient conditions" on page 25 and the data sheet.)
Ambient temperature (operation) - ECO version	0 °C ... +55 °C
Ambient temperature (storage/transport)	-25°C ... +85°C
Temperature cycles (Speed of changing from positive to negative temperatures and vice versa)	0.5 K/min (no condensation)
Permissible humidity (operation/storage/transport)	10 % ... 95% (no condensation) The humidity requirements have been verified in accordance with IEC 60068-2-30.
Permissible air pressure (operation/storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20
Class of protection	IEC 61140
Protective extra-low voltage (24 V DC ... 60 V DC, 24 V AC ... 35 V AC)	III
Extra-low and low voltage (>60 V DC, >35 V AC)	II (installed in a suitable housing with at least IP54 protection)
Air and creepage distances	According to IEC 60644/IEC 60664A, DIN VDE 0110 and EN 50178/IEC 62103, DIN VDE 0160
Housing material	Plastic, PVC-free, PBT and others, self-extinguishing (V0)
Pollution degree according to EN 50178	2; condensation not permitted during operation
Overvoltage category	
Protective extra-low voltage (24 V DC ... 60 V DC, 24 V AC ... 35 V AC)	II
Extra-low and low voltage (>60 V DC, >35 V AC)	III

General data (continued)

Gases that may endanger functions according to DIN 40046-36, DIN 40046-37

Sulfur dioxide (SO_2)	Concentration 10 ±0.3 ppm Ambient conditions - Temperature: 25°C (±2°C) - Humidity: 75% (±5%) - Test duration: 10 days
Hydrogen sulfide (H_2S)	Concentration 1 ±0.3 ppm Ambient conditions - Temperature: 25°C (±2°C) - Humidity: 75% (±5%) - Test duration: 4 days
Resistance of the housing material to termites	Resistant
Resistance of the 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 direction (24 V DC, 120 V AC, and 230 V AC areas) 2g load, 2 hours in each direction (400 V AC area)
Shock test according to IEC 60068-2-27; EN 60068-2-27	25g load for 11 ms, half sinusoidal wave, three shocks in each direction and orientation
Broadband noise according to IEC 60068-2-64; EN 60068-2-64	0.78g load, 2.5 hours in each direction

Conformance with EMC directive 2014/30/EU

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

Noise immunity test in accordance with EN IEC 61000-6-2

Electrostatic discharge (ESD)	IEC 61000-4-2	Criterion B ±6 kV contact discharge, ±8 kV air discharge
Electromagnetic fields	IEC 61000-4-3	Criterion A, Field strength: 10 V/m
Fast transients (burst)	IEC 61000-4-4	Criterion B Remote bus: ±2 kV Power supply: ±2 kV I/O cables: ±2 kV Criterion A All interfaces: ±1 kV
Surge voltage	IEC 61000-4-5	Criterion B AC supply lines: ±1.0 kV/±2.0 kV (symmetrical/asymmetrical) DC supply lines: ±0.5 kV/±1.0 kV (symmetrical/asymmetrical) – In accordance with EN 61131-2/IEC 61131-2: No restriction – In accordance with IEC 6100-6.2: Lines < 30 m that do not leave the building Signal lines: ±1.0 kV/±1.0 kV (symmetrical/asymmetrical)
Conducted interference	IEC 61000-4-6	Criterion A Test voltage 10 V

Noise emission test in accordance with EN IEC 61000-6-4

Noise emission of housing	Class A

Data transfer in the local bus

Protocol	IEC 61158
Transmission speed	500 kbps or 2 Mbps
Transmission	Inline data jumpers

24 V bus coupler supply (U_{BK})

Nominal voltage	24 V DC
Permissible voltage range	19.2 V DC ... 30.0 V DC (incl. all tolerances, incl. ripple)
Connection	Inline connectors

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

7.5 V supply of the bus logic (U_{L}; generated from U_{BK})

Nominal voltage	7.5 V
Load current	See terminal-specific data sheet
Maximum	2 A
Terminal-specific	0.7 A (e.g., IL IB BK-PAC)

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

Connection	Inline potential jumpers
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 communications power U_L is electronically short-circuit-proof.

Supply of terminals for analog signals (U_{ANA}; generated from U_{BK})

Nominal voltage	24 V DC
Permissible voltage range	19.2 V DC ... 30.0 V DC (incl. all tolerances, incl. ripple)
Maximum load current	500 mA
Connection	Inline potential jumpers
Remark	Decoupling of the 24 V input voltage by means of a diode.
	Smoothing via π filter with base frequency of 9.8 kHz and attenuation of 40 dB/decade.
	U_{ANA} is not electrically isolated from the 24 V bus coupler supply voltage and the 7.5 V communications power.

Supply of terminals for digital signals (U$_M$, U$_S$) in the 24 V area

Nominal voltage	24 V DC
Permissible voltage range	19.2 V DC ... 30.0 V DC (incl. all tolerances, incl. ripple)
Load current at U$_M$ (main supply)	See terminal-specific data sheet
Maximum	8 A
Terminal-specific	6 A (e.g., IB IL 24 PWR IN/2-F-PAC) 4 A (e.g., IB IL 24 PWR IN/2-F-D-PAC)
Load current at U$_S$ (segment supply)	See terminal-specific data sheet
Maximum	8 A
Terminal-specific	6 A (e.g., IB IL 24 SEG/F-PAC) 4 A (e.g., IB IL 24 SEG/F-D-PAC) 2.5 A (e.g., IB IL 24 SEG-ELF-PAC)

ℹ️ Observe the specifications in the terminal-specific data sheet for the terminal used for power supply (U$_M$/U$_S$). These terminals can limit the maximum permissible load current.

Connection to corresponding terminals for supply	Inline connectors
Connection within the Inline station	Inline potential jumpers

Supply of terminals for digital signals (L) in the 120 V AC and 230 V AC areas

Nominal voltage	120 V AC
	230 V AC
Permissible voltage range	12 V AC ... 253 V AC (incl. all tolerances, incl. ripple)
Load current	8 A, maximum
Connection	Inline potential jumpers

Voltage dips and interrupts 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 "Current and voltage distribution" on page 91.

Cable connection method/cross-section

Cable connection method for the extra-low voltage and low voltage levels	Spring-cage terminals
Cable connection method for the power level	Screw terminals
Cable cross-section for the extra-low voltage and low voltage levels	
typical (solid/stranded)	0.08 mm² ... 1.5 mm² , AWG 28 ... 16
for UL approvals (solid/stranded)	0.2 mm² ... 1.5 mm², AWG 24 ... 14
Cable cross-section for the extra-low voltage and low voltage levels (Connection of the protective conductor PE)	1.5 mm²; AWG 16; cable is as short as possible
Cable cross-section for the power level (Power connection, motor connection, brake connection) (stranded and solid cables)	0.2 mm² ... 2.5 mm²; AWG 28 ... 14
Length of the sensor/actuator cables	
For digital terminals	< 30 m
For analog terminals	See Section "Maximum cable lengths for analog devices" on page 168

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	Impulse voltage withstand level
Technology for 24 V area			
Incoming bus/bus logic	0.3 mm	0.3 mm	0.5 kV
Outgoing bus/bus logic	0.3 mm	0.3 mm	0.5 kV
Incoming bus/outgoing bus	0.3 mm	0.3 mm	0.5 kV
Bus logic/I/O	0.3 mm	0.3 mm	0.5 kV
Technology for area up to 250 V DC			
Bus logic/I/O	3.1 mm	1.1 mm	4 kV
Technology for 230 V AC area single-phase (up to 253 V AC); safe isolation according to EN 50178			
Bus logic/I/O	5.5 mm	5.5 mm	6 kV
I/O/PE	3.2 mm	3.2 mm	4 kV
Technology for 400 V AC area three-phase; safe isolation according to EN 50178			
Bus logic/400 V AC I/O	5.5 mm	3.2 mm	6 kV
24 V DC I/O/400 V AC I/O	5.5 mm	3.2 mm	6 kV
Bus logic/24 V DC I/O	0.3 mm	0.3 mm	0.5 kV
Relay outputs			
Main contact/N/O contact	See terminal-specific data sheet		
Relay contact/bus logic	See terminal-specific data sheet		

Test voltages

Isolating distance	Test voltage
Technology for 24 V area (up to 60 V DC)	
ℹ 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 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 ground	500 V AC, 50 Hz, 1 min.
Technology for area up to 250 V DC	
Bus logic/I/O	2500 V AC, 50 Hz, 1 min.
Technology for 230 V AC area single-phase (up to 253 V AC)	
Bus logic/I/O	2500 V AC, 50 Hz, 1 min.
Routine test	1200 V AC, 50 Hz, 1 min.
Relay outputs	
Main contact/N/O contact	1000 V AC, 50 Hz, 1 min.
Relay contact/bus logic	2500 V AC, 50 Hz, 1 min.

15.2   Ordering data

15.2.1   Inline terminals and product-specific accessories

The ordering data for the Inline terminals and the available accessories can be found at
phoenixcontact.com/products.

15.2.2   General accessories

Description	Type	Order No.	Pcs./Pkt.
Power supply units	QUINT-PS …		
DIN rail perforated, acc. to EN 60715, material: Steel, galvanized, passivated with a thick layer, Standard profile, color: silver, Pack of 25 (50 m)	NS 35/ 7,5 PERF 2000MM	0801733	25
DIN rail, unperforated, acc. to EN 60715, material: Steel, galvanized, passivated with a thick layer, Standard profile, color: silver, Pack of 25 (50 m)	NS 35/ 7,5 UNPERF 2000MM	0801681	25
Actuation tool, for ST terminal blocks, also suitable for use as a bladed screwdriver, size: 0.6 x 3.5 x 100 mm, 2-component grip, with non-slip grip	SZF 1-0,6X3,5	1204517	10

15.2.3   Documentation

Description	Type	Order No.	Pcs./Pkt.
Application note, English, I/O modules at bus couplers	AH EN IL BK IO LIST	–	–
Application note, English, Inline terminals for use in zone 2 potentially explosive areas	AH EN IL EX ZONE 2	–	–

[i] The documentation can be downloaded at phoenixcontact.com/products.
Make sure you always use the latest documentation.

A   Appendix: Inline: Additional information

A 1   Use of Inline terminals at an elevation of more than 3000 meters

This section applies to terminals of the Inline product group that are operated with a DC voltage of < 60 V DC.

⚠ **WARNING: Dangerous contact voltage/loss of safety function**
This section does **not** apply to the following modules or applications:
– Terminals that are not operated with PELV (Protective Extra Low Voltage) (e.g. 120 V or 230 V)
– Terminals with safety functions (e.g. SafetyBridge, Profisafe)
– Use of a safe signal path
– Use in potentially explosive areas (IEC Ex, ATEX, Hazardous Location).
– XC variants
In these cases, consider the individual terminal or application separately.

The Inline terminals are approved for use up to an elevation of 3000 m above sea level, see "Technical data for Inline" on page 154.

The maximum permissible ambient temperature decreases at elevations above this level. Therefore, keep temperature derating in mind when using the terminals at an elevation greater than 3000 m up to 5000 m.

Figure A-1   Derating of the permissible ambient temperature depending on the operating elevation
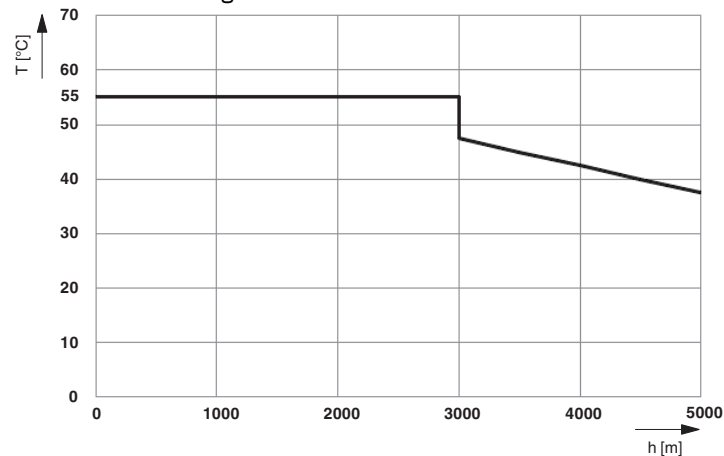
Key:

T [°C]   Maximum ambient temperature (operation) in °C
h [m]   Elevation in m

A 2 Tips for working with Inline

Safe grounding

When grounding, always observe the notes in Section "Grounding concept" on page 112.

Order of the terminals

During configuration, observe the notes in Section "Order of the Inline terminals" on page 125.

A 3 Configuration help for selecting the optimum analog input device for temperature recording

A 3.1 Inline

Table A-1 Configuration help for selecting Inline terminals for temperature recording (RTD)

Criterion		IB IL TEMP 2 RTD-PAC 2861328 IB IL TEMP 2 RTD-XC-PAC 2701217	IB IL TEMP 4/8 RTD-PAC 2863915	IB IL TEMP 4/8 RTD/EF-PAC 2897402 IB IL TEMP 4/8 RTD/EF-XC PAC 2701218 (no longer in product range)	IB IL RTD 4/PT100-ECO 2702499	IB IL RTD 4/PT1000-ECO 2702501
RTD detection	RTD detection (Inputs for resistance temperature detectors, e.g., Pt100, Pt1000, Ni100, Ni1000)	Yes	Yes	Yes	Yes (Pt 100)	Yes (Pt 1000)
	Number of RTD 2-wire sensors	2	8	8	4	4
	Number of RTD 3-wire sensors	2	8	8	–	–
	Number of RTD 4-wire sensors	1	-	8	–	–
Dynamic response	Dynamic response of measuring inputs	High	Very high	Low	Medium	Medium
	Measurements/second (typical for all channels)	30 ... 50	4 ... 165	0.3 ... 0.5	1.6	1.6
Precision	Precision	High	Medium	Very high	Medium	Medium
	Typical tolerance of Pt100 or TC (at T_A = +25°C)	±0.26 K	±0.50 K	±0.09 K	±0.8 K	±0.8 K
	Maximum tolerance of Pt100 or TC (at T_A = +25°C)	±1.0 K	±2.13 K	±0.19 K	±1.7 K	±1.7 K

Table A-2   Configuration help for selecting Inline terminals for temperature recording

Criterion		IB IL TEMP 2 UTH-PAC 2861386 IB IL TEMP 2 UTH-XC-PAC 2701216	IB IL UTH 4/J-ECO 2702502	IB IL UTH 4/K-ECO 2702503	IB IL UTH 4/L-ECO 2702504 (no longer in product range)
TC detection	TC detection (Thermocouple inputs, e.g., type B, C, E, J, K, N, R, S, T, U, W, HK)	Yes	Yes (type J)	Yes (type K)	Yes (type L)
	Number of TC 2-wire sensors	2	4		
	Internal cold junction compensation for thermocouple detection	Yes	Yes		
	Additional connection option for an external cold junction sensor (Pt1000, Ni1000)	Yes	No		
Dynamic response	Dynamic response of measuring inputs	High	Medium		
	Measurements/second (typical for all channels)	30	1.6		
Precision	Precision	Medium	Medium		
	Typical tolerance of Pt100 or TC (at T_A = +25°C)	0.6 K + tolerance of cold junction (TC type K)	±2.5 K	±2.7 K	±2.5 K
			(incl. tolerance of cold junction)		
	Maximum tolerance of Pt100 or TC (at T_A = +25°C)	2.4 K + tolerance of cold junction (TC type K)	±5.1 K	±5.5 K	±5.1 K
			(incl. tolerance of cold junction)		

A 3.2 Inline Block IO (no longer in product range)

Table A-3 Configuration help for selecting Inline Block IO modules for temperature recording

Criterion		ILB IB AI4 AO2	ILB PB AI4 AO2
		2878777	**2878874**
RTD detection	RTD detection (Inputs for resistance temperature detectors, e.g., Pt100, Pt1000, Ni100, Ni1000)	Yes	Yes
	Number of RTD 2-wire sensors	4	4
	Number of RTD 3-wire sensors	4	4
	Number of RTD 4-wire sensors	4	4
Dynamic response	Dynamic response of measuring inputs	Very high	Very high
	Measurements/second (typical for all channels)	43 ... 192	43 ... 192
Precision	Precision	High	Medium
	Typical tolerance of Pt100 or TC (at T_A = +25°C)	±0.3 K	±0.5 K
	Maximum tolerance of Pt100 or TC (at T_A = +25°C)	±1.6 K	±1.9 K

A 4 Maximum cable lengths for analog devices

A 4.1 Inline standard

ℹ️ Please also observe the information in the terminal-specific data sheet.

The following applies for the section below:

–   The values for the maximum cable length are valid in accordance with the installation instructions and have been determined using the following reference data for the sensor or actuator cable:

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

–   The values in the tables also apply for versions of the specified terminal with comparable technical properties (e.g., -2MBD or non-PAC versions).
–   Information about longer lengths or other cable types is available on request.

A 4.1.1 Analog input and temperature recording

Table A-4   Maximum cable lengths: Analog input

Criterion	IB IL AI2 /SF-PAC 2861302	IB IL AI8 /SF-PAC 2861412	IB IL AI8 /IS-PAC 2861661	IB IL AI2 /SF-230-PAC 2861577	IB IL AI4 /EF-PAC 2878447	IB IL AI 4 /I-PAC 2700458	IB IL AI4 /U-PAC 2700459
Number of channels	2	8	8	2	4	4	4
Maximum cable length	250 m	250 m	250 m	250 m	250 m	500 m	500 m

Table A-5   Maximum cable lengths: Temperature recording

Criterion	IB IL TEMP 2 RTD-PAC 2861328	IB IL TEMP 4/8 RTD-PAC 2863915	IB IL TEMP 4/8 RTD-EF-PAC 2897402
Number of channels	2	8	8
Maximum cable length	250 m[1]	250 m[1]	250 m

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

A 4.1.2 Analog output

Table A-6   Maximum cable lengths and immunity to short-circuiting: Analog output

Criterion	IB IL AO1/SF-PAC	IB IL AO1 /U/SF-PAC	IB IL AO 2 /U/BP-PAC	IB IL AO 2/UI-PAC	IB IL AO2/SF-PAC	IB IL AO4/8 /U/BP-PAC
	2861315	2861399	2861467	2700775	2863083	2878036
Number of channels	1	1	2	2	2	8
Signals	0 V ... 10 V 0 mA ... 20 mA 4 mA ... 20 mA	0 V ... 10 V	-10 V ... +10 V 0 V ... 10 V	-10 V ... +10 V 0 V ... 10 V 0 mA ... 20 mA 4 mA ... 20 mA -20 mA ... +20 mA	0 V ... 10 V 0 mA ... 20 mA 4 mA ... 20 mA	-10 V ... +10 V 0 V ... 10 V -5 V ... +5 V 0 V ... 5 V
Maximum cable length	250 m	250 m	500 m	500 m	250 m	250 m
Immunity to short-circuiting of analog voltage output	Yes, 1 minute	Yes, 1 minute	Yes, 1 minute	Yes, continuous	Yes, 1 minute	Yes, 1 minute
Immunity to short-circuiting of analog current output	Yes, continuous	Not present	Not present	Yes, continuous	Yes, continuous	Not present

A 4.1.3 Analog I/O (no longer in product range)

Table A-7   Maximum cable lengths and immunity to short-circuiting: Analog I/O

Criterion	ILB xx AI4 AO2
Number of channels for input	4
Number of channels for output	2
Signals	-10 V ... +10 V 0 V ... 10 V -5 V ... +5 V 0 V ... 5 V 0 mA ... 20 mA -20 mA ... +20 mA 4 mA ... 20 mA
Maximum cable length	250 m[1]
Immunity to short-circuiting of analog voltage output	Yes, continuous
Immunity to short-circuiting of analog current output	Yes, continuous

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

A 4.2   Inline ECO terminals

ℹ️ Please also observe the information in the terminal-specific data sheet.

Table A-8   Maximum cable lengths: Temperature recording

Criterion	IB IL RTD 4/PT100-ECO	IB IL RTD 4/PT1000-ECO	IB IL UTH 4/J-ECO	IB IL UTH 4/K-ECO	IB IL UTH 4/L-ECO
	2702499	2702501	2702502	2702503	2702504 (no longer in product range)
Number of channels	4	4	4	4	4
Cable type/standard	LiYCY(TP) N x 2 x 0,5	LiYCY(TP) N x 2 x 0,5	Type J according to DIN EN 60584-3	Type K according to DIN EN 60584-3	Type L according to DIN 43710
Maximum cable length	30 m*	100 m	100 m	100 m	100 m

*   Observe the cable resistances when carrying out a tolerance inspection (see terminal-specific data sheet).

Table A-9   Maximum cable lengths: Analog I/O

Criterion	IB IL AI 4/I/4-20-ECO	IB IL AI 4/U/0-10-ECO	IB IL AO 4/I/4-20-ECO	IB IL AO 4/U/0-10-ECO
	2702495	2702496	2702497	2702498
Number of channels	4	4	4	4
Cable type/standard	LiYCY(TP) N x 2 x 0,5	LiYCY(TP) N x 2 x 0,5	LiYCY(TP) N x 2 x 0,5	LiYCY(TP) N x 2 x 0,5
Maximum cable length	100 m	100 m	100 m	100 m

Table A-10   Maximum cable lengths: Communication

Criterion	IB IL RS 485-ECO	IB IL RS 232-ECO
	2702141	2702795
Number of channels	1	1
Cable type/standard	CAT5	CAT5
Maximum cable length	according to RS-485 specification	depending on the transmission speed

A 5 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 working point must be defined.

Permissible working point

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

Examples

Examples for calculating these values can be found in the section below.

A 6 Calculation examples for power dissipation and working points

A 6.1 Constant power dissipation of the housing over the operating temperature range

This calculation is illustrated using the IB IL 24 DO 8-PAC terminal as an example.

Formula to calculate the power dissipation of the electronics

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

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

Where

P_{TOT}	Total power dissipation of the electronics
i	Index
n	Number of set outputs (n = 1 to 8)
I_{Li}	Load current of output i

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

Example:

Load currents of the outputs:

$I_{L1} = 0.5\ A$, $I_{L2} = 0.4\ A$, $I_{L3} = 0.2\ A$, $I_{L4} = 0.5\ A$, $I_{L5} = 0.3\ A$, $I_{L6} = 0.4\ A$

Outputs 7 and 8 are not used.

Power dissipation of the electronics

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

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

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

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

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 therefore 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.

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

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

A 6.2 Power dissipation of the housing within the operating temperature range depending on the ambient temperature

This calculation is illustrated using the IB IL 24 DO 2-2A-PAC terminal as an example.

Formula to calculate the power dissipation of the electronics

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

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

Where

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

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

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:

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

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

$P_{TOT} = 0.18 \text{ W} + 1.20 \text{ W}$

$P_{TOT} = 1.38 \text{ W}$

Power dissipation of the housing

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

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

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

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 working point At an increased ambient temperature, you must calculate the permissible working point 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:

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

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

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

$T_A = 1.02\ W \times 37.5°C/W - 5°C$

$T_A = 33.25°C$

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

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

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

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

$P_{TOT} = 0.78\ W$

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

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

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

$T_A = 1.62\ W \times 37.5°C/W - 5°C$

$T_A = 55.75°C$

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

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

B   Appendix: Software support

Overview of the software

The following software from Phoenix Contact supports you when working with Inline:

PLCnext Engineer	PLC programming for PLCnext Control
PC WorX	PLC programming for conventional controllers
Project+	Planning and configuration
PROJECT complete	Planning and marking
Visu+	Visualization
AX OPC-Server	Communication interface for OPC-capable visualization with PC Worx-based controllers.
Config+	Configuration and diagnostics of an INTERBUS system
Diag+	Diagnostics of INTERBUS and PROFINET networks
CLIP PROJECT	Planning, configuration, and marking
(no longer in the range), replacement item:	
PROJECT complete	

You can also integrate Inline into any other system, e.g., via GSDML into TIA PORTAL or via ESI into TwinCAT®, etc.

ℹ️ For the software for supporting safety modules, please refer to the module-specific documentation.

ℹ️ Detailed information on the software of Phoenix Contact can be found under "Automation software" at phoenixcontact.com/products.

C Appendix: Explanation of abbreviations and symbols

C 1 Explanation of abbreviations

Ground

Ground, general symbol

FE

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

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

PE

Protective ground

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

Protective ground is a low-impedance current path that minimizes the risk to the user in the event of an error (EN 61131/IEC 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_{BK}

Bus coupler supply

The voltage U_{BK} 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_{BK}.

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 at the bus coupler, a power terminal or a segment terminal and is led through the potential jumper to the next power or segment 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 In-line 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 In-line station by means of potential routing.
P_{TOT}	Power dissipation of the electronics
P_{HOU}	Power dissipation of the housing

C 2   Representations used in basic 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

C 3   Frequently used symbols

Earth, ground, and equipotentials

Ground, general symbol

Noiseless ground, functional ground (FE)

Protective ground (PE)

Ground, housing (GND)

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

Shield
In basic 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

Semiconductors

Semiconductor diode, general symbol

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

Transistor

Miscellaneous

Protocol chip
(Bus logic including voltage conditioning)

Electrical isolation (optocoupler or isolator)

Electrical isolation for data or power supply;
Coupler with electrical isolation;
Power supply unit with electrical isolation, general symbol

Converter, general symbol

Analog/digital converter

Digital/analog converter

Amplifier

Fuse

D   Appendix: Index

Numerics

A

B

C

D

E   Appendix: Revision history

Table E-1   Revision history

Revision	Date	Contents	
B	01/2003	First publication	
02	07/2008	Completely revised – Inline Block IO added – Adaptation to current product portfolio	
03	11/2013	Addition of Section 10.3	Recommendation for supplying the supply voltage and resetting the voltage with regard to Inline
		Additions to Section 11.1	– Cable connection method/cross section: Cross section for the low-signal and low-voltage levels for UL approvals – AWG values added
04	02/2015	Correction to Section 11.1	Surge voltage
		Correction	AX SALES -> Project+
05	11/2016	Addition	XC versions, ECO versions
		Revision of Section 4.2.9	Updating of safety modules
		Correction in Section 4.2.10	Correction of description
		Correction in Section 5.1.7.1	Correction of dimensions, addition of BK housing
		Correction in Section 9.5.2	FE -> PE
		Addition of Section 10.1.3	Connecting shielded cables using an Inline connector
		Correction/additions in Section 11.1	– Added ECO and XC ambient temperatures – Changed information on humidity – Corrected information on the protection class – Corrected information on the overvoltage category – Updated EMC directive
		Additions to Section 11.2	Ordering data for accessories for connecting the shielding using an Inline connector
		Additions to Appendix A2	New items added to tables
06	2017-02-22	Additions to Appendix A	A1: Use of Inline terminals at an elevation of more than 3000 meters
07	2017-03-07	Correction in Section 11.1	Information on humidity
08	2017-04-25	Additions to Section 11.1	Information on humidity

Table E-1   Revision history

Revision	Date	Contents	
09	2018-05-30	New: Section 5.2.10	Intrinsically safe terminals for the Ex area (Ex i)
		Additions to Section 10.2	Basic information about mounting, Din rail
10	2023-02-26	General	Update
			Inline-Modular-I/O -> Inline
			Labeling of the corresponding products: – No longer in product range – Discontinued
		New: Section 1.4	Security in the network
		Changes: Section 5.2.10	– EX-IS: No longer in product range – ATEX: Items manufactured until the start of 2023 comply with directive 2014/34/EU (ATEX). You may use these items in potentially explosive areas of category 3.
		Changes: Section 5.2.10	Inline Block IO modules: No longer in product range)
		Changes: Section 12.1	Surge voltage: DC supply lines
11	2025-06-12	General	Update
		New: Section 4.4	Dielectric tests
		New: Section 5.2.12	Inline adapter terminal
		New: Section 6.1.6	Printing

Please observe the following notes

General Terms and Conditions of Use for technical documentation

Phoenix Contact reserves the right to alter, correct, and/or improve the technical documentation and the products described in the technical documentation at its own discretion and without giving prior notice, insofar as this is reasonable for the user. The same applies to any changes that serve the purpose of technical progress.

The receipt of technical documentation (in particular user documentation) does not constitute any further duty on the part of Phoenix Contact to furnish information on modifications to products and/or technical documentation. You are responsible to verify the suitability and intended use of the products in your specific application, in particular with regard to observing the applicable standards and regulations. All information made available in the technical documentation is supplied without any accompanying guarantee, whether expressly mentioned, implied or tacitly assumed.

In general, the provisions of the current General Terms and Conditions of Phoenix Contact apply exclusively, in particular as concerns any warranty liability.

This manual, including all illustrations contained herein, is copyright protected. Any changes to the contents or the publication of extracts of this document are prohibited.

Phoenix Contact reserves the right to register its own intellectual property rights for the product identifications of Phoenix Contact products that are used here. Registration of such intellectual property rights by third parties is prohibited.

Other product identifications may be afforded legal protection, even where they may not be indicated as such.

How to contact us

Internet

Up-to-date information on Phoenix Contact products and our Terms and Conditions can be found on the Internet at:
phoenixcontact.com

Make sure you always use the latest documentation.
It can be downloaded at:
phoenixcontact.com/products

Subsidiaries

If there are any problems that cannot be solved using the documentation, please contact your Phoenix Contact subsidiary.
Subsidiary contact information is available at phoenixcontact.com.

Published by

Phoenix Contact GmbH & Co. KG
Flachsmarktstraße 8
32825 Blomberg
GERMANY

Should you have any suggestions or recommendations for improvement of the contents and layout of our manuals, please send your comments to:
tecdoc@phoenixcontact.com