





# **AUTOMATION**

## **User Manual**

### **Configuring and installing the INTERBUS Inline product range**

07/2008

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Designation: IB IL SYS PRO UM E

Revision: 03

Order No.: 2743048

This user manual is valid for:

Inline Modular IO automation terminals for the INTERBUS bus system

## Please observe the following notes

In order to ensure the safe use of the product described, you have to read and understand this manual. The following notes provide information on how to use this manual.

### User group of this manual

The use of products described in this manual is oriented exclusively to qualified electricians or persons instructed by them, who are familiar with applicable standards and other regulations regarding electrical engineering and, in particular, the relevant safety concepts.

Phoenix Contact accepts no liability for erroneous handling or damage to products from Phoenix Contact or third-party products resulting from disregard of information contained in this manual.

### Explanation of symbols used and signal words



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



#### **DANGER**

This indicates a hazardous situation which, if not avoided, will result in death or serious injury.



#### **WARNING**

This indicates a hazardous situation which, if not avoided, could result in death or serious injury.



#### **CAUTION**

This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

The following types of messages provide information about possible property damage and general information concerning proper operation and ease-of-use.



#### **NOTE**

This symbol and the accompanying text alerts the reader to a situation which may cause damage or malfunction to the device, either hardware or software, or surrounding property.



This symbol and the accompanying text provides additional information to the reader. It is also used as a reference to other sources of information (manuals, data sheets, literature) on the subject matter, product, etc.

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**Published by**

PHOENIX CONTACT GmbH & Co. KG  
Flachmarktstraße 8  
32825 Blomberg  
Germany  
Phone +49 - (0) 52 35 - 3-00  
Fax +49 - (0) 52 35 - 3-4 12 00

PHOENIX CONTACT  
P.O. Box 4100  
Harrisburg, PA 17111-0100  
USA  
Phone +1-717-944-1300

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](mailto:tecdoc@phoenixcontact.com).

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# 1 Documentation landscape for Inline Modular IO on INTERBUS

The documentation for Inline Modular IO is modular, providing you with the optimum information for your specific bus system or Inline terminal.



The documentation can be downloaded at

[www.download.phoenixcontact.com](http://www.download.phoenixcontact.com).

For a comprehensive list of the documentation, please refer to the ordering data (see "Ordering data" on page 8-3).

Terminal-specific documentation can be found in the download area for the corresponding device.

Make sure you always use the latest documentation.

The following documentation is available for the **INTERBUS** bus system in association with Inline Modular IO:

## 1.1 INTERBUS



### "General introduction to the INTERBUS system" user manual, IBS SYS INTRO G4 UM E

This manual provides a general introduction to the INTERBUS system. This includes a description of the data transmission method and the topology, as well as an overview of the products.



### "Configuring and installing INTERBUS" user manual, IBS SYS PRO INST UM E

This manual contains specifications for the configuration and installation of an INTERBUS system. It mainly describes the general specifications and the older product lines for use on INTERBUS (ST, RT, CT, SAB).



### "INTERBUS & AUTOMATION - Terms and definitions" reference manual, IBS TERM RG UM E

This manual provides an overview of technical terms and definitions in the field of INTERBUS & AUTOMATION.



### "INTERBUS fiber optic installation guidelines" data sheet, DB GB IBS SYS FOC ASSEMBLY

This data sheet contains technical data, installation guidelines, and assembly specifications for fiber optics. In addition, it also contains notes on power measurement and optical diagnostics, as well as a checklist for complete installation and a fiber optic measured value protocol.



### "INTERBUS addressing" data sheet, DB GB IBS SYS ADDRESS

This data sheet provides an overview of the addressing options for INTERBUS. In addition, it includes an overview of the assignment of process data, which is illustrated in the relevant terminal-specific data sheet, to the various control and computer systems.

## 1.2 Inline



### "Automation terminals of the Inline product range" user manual, IL SYS INST UM E

This manual is the higher-level system manual for Inline and describes the use of terminals/modules in the Inline product range for all bus systems.

The following topics are covered:

- The device properties, which are the same for all bus systems
- Notes on the low voltage area
- Overview of the Inline product groups
- Structure and dimensions of Inline terminals
- Electrical potential and data routing
- Mounting and removal
- General technical data and ordering data
- Examples and tips



### User manuals (system or special terminal)

The **IB IL SYS PRO UM E** user manual describes Inline Modular IO in association with the INTERBUS bus system. It provides information about all the bus-specific properties.

The additional user manuals describe a special Inline terminal (e.g., counter terminal, positioning terminal).

Each manual only describes the relevant terminal-specific special features. As the higher-level manual, the "IL SYS INST UM E" user manual also applies.



### Quick Start Guides

A Quick Start Guide is available for various topics. A Quick Start Guide describes the startup of a system or a terminal step-by-step using an example (e.g., the Quick Start Guide for PC WorX describes an example project under INTERBUS).

## Documentation landscape for Inline Modular IO on INTERBUS

### Terminal-specific data sheets



The data sheet describes the specific properties of each Inline terminal. This includes at the very least:

- Function description
- Local diagnostic and status indicators
- Pin assignment/terminal point assignment and connection example
- Programming data/configuration data
- Technical data

### "Summary of key data for Inline devices" data sheet, DB GB IB IL DEVICE LIST



This data sheet is also referred to as a device list.

In addition to terminal-specific data sheets, this data sheet also includes the key data of every Inline Modular IO device. This includes, for example:

- Programming data: ID code, length code, process data channel, I/O address area
- Error messages
- Power supply/current consumption

### Application notes



Application notes provide additional information about special topics.

In conjunction with INTERBUS Inline terminals, these include, for example:

- General information about the safety-related segment circuit AH EN IL SAFE
- General information about use in zone 2 potentially explosive areas AH EN IL EX ZONE 2
- Information about firmware updates



Device-specific application notes are listed in the device-specific data sheet and are available in the download area for the relevant device.

### Package slips



A package slip contains key information for the electrical installation of an Inline terminal or group of Inline terminals. This includes, for example:

- Short description
- Safety notes
- Mounting/removal
- Terminal point assignment
- Local diagnostic and status indicators

## IB IL SYS PRO UM E

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## 2 Integration of Inline into the INTERBUS system



This user manual is only valid in association with the IL SYS INST UM E user manual.  
This user manual only describes the special features of an Inline system on **INTERBUS**.  
For bus-neutral properties, please refer to the IL SYS INST UM E user manual.

### 2.1 The INTERBUS system

INTERBUS is a serial bus system that transmits data between control systems (e.g., PLCs, PCs, VMEbus computers, robot controllers, etc.) and spatially distributed I/O modules that are connected to sensors and actuators (operating and display units, drives, etc.).

INTERBUS has a ring structure. The ring structure enables data to be sent and received simultaneously.

INTERBUS is a single master system, i.e., a master (e.g., controller board, control terminal) controls all devices of an INTERBUS ring.

From the master, all devices are connected to the bus system. Each device has two separate lines for data transmission: one for forward data transfer and one for return data transfer. This eliminates the need for a return line from the last device to the first device, which is necessary in a simple ring system. The forward and return lines run in one bus cable. From the installation point of view, INTERBUS has a tree structure, as only one cable is led from one device to the next.

## 2.2 Example topology of an INTERBUS system

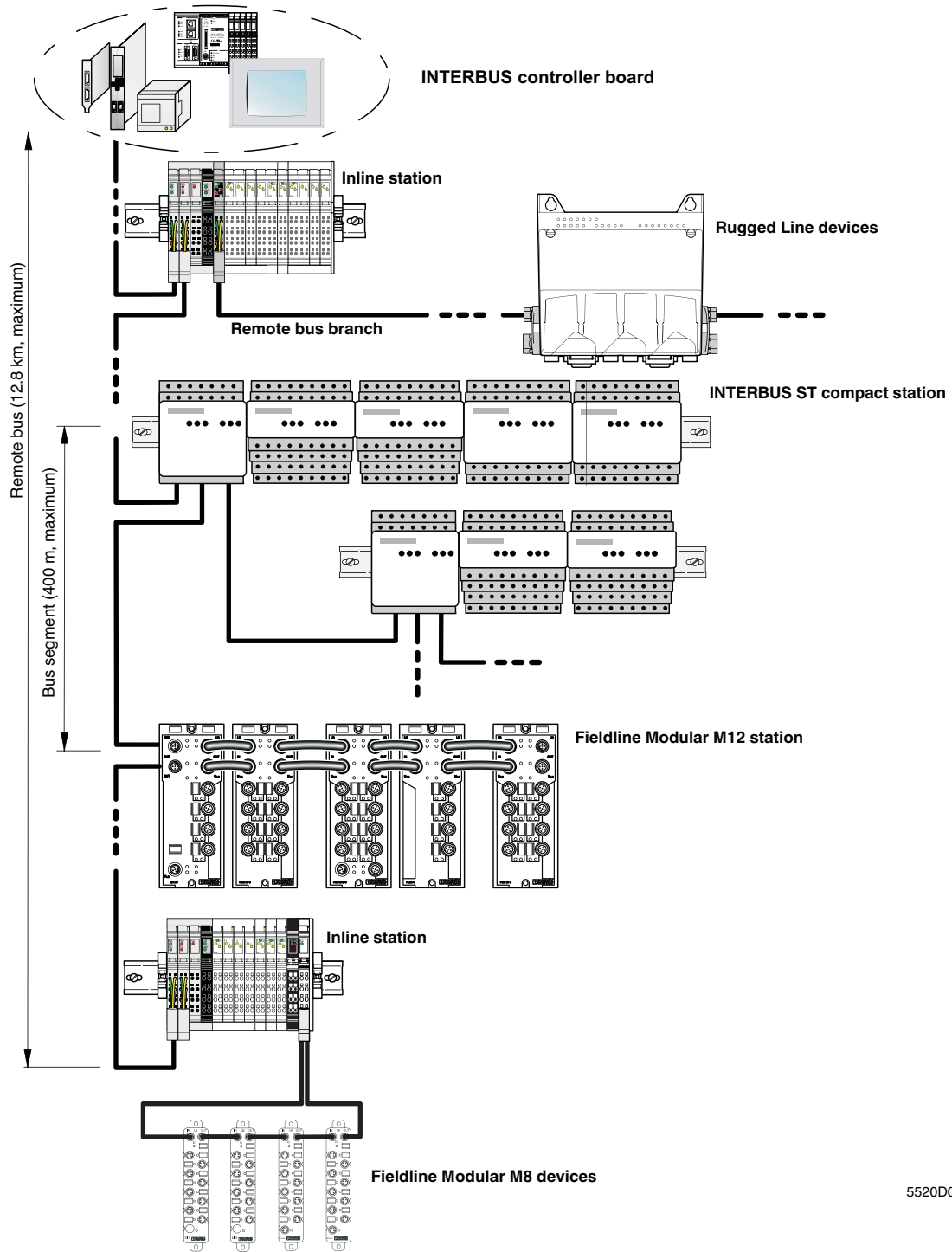


Figure 2-1 INTERBUS system

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**Integration of Inline into the INTERBUS system**


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<b>Control technology</b>	<p>Control technology from Phoenix Contact offers comprehensive networking options with INTERBUS. All control systems are suitable for central or distributed use.</p> <p>Basic tasks of control technology:</p> <ul style="list-style-type: none"> <li>– Transferring output data to the output modules</li> <li>– Receiving input data from the input modules</li> <li>– Monitoring INTERBUS</li> <li>– Sending error messages to the host system</li> <li>– Indicating diagnostic messages</li> <li>– Controlling the cyclic I/O protocol</li> </ul>
– <b>IEC 61131 embedded control systems</b>	<p>Inline Controllers, Remote Field Controllers</p> <p>Additional tasks:</p> <ul style="list-style-type: none"> <li>– Compact control system for various performance classes</li> <li>– Programming via PC WorX</li> <li>– Integration into other systems via Ethernet supported</li> </ul>
– <b>PC-based IEC 61131 control systems</b>	<p>Field Controllers, control panels, multi-functional control systems</p> <p>Additional tasks:</p> <ul style="list-style-type: none"> <li>– Control functions</li> <li>– System operation tailored to the application</li> <li>– Graphical user interface for operation and monitoring</li> <li>– Programming via PC WorX or high-level language</li> </ul>
– <b>Controller boards</b>	<p>PC controller boards, PLC controller boards</p> <p>Additional tasks:</p> <ul style="list-style-type: none"> <li>– Connecting programmable logic controllers (PLCs) or computer systems (PC, VMEbus, etc.) to INTERBUS</li> <li>– Master function in the INTERBUS system</li> <li>– Controlling data traffic on the INTERBUS system, independent of the control or computer system in which it is installed</li> </ul>
<b>Bus terminal/bus coupler</b>	<p>In the INTERBUS system, the head of an I/O station is referred to as a bus terminal module (e.g., ST) or bus coupler (e.g., IL) depending on the product group. The term bus coupler is used in this document, as this manual describes the Inline system.</p> <p>The first step in creating a modular I/O station is to connect a bus coupler to the INTERBUS remote bus. I/O modules may be installed branching off from this bus coupler, to create a local bus.</p> <p>A bus coupler divides the system into segments, thus enabling individual branches to be switched off during operation. It also supplies the communications power for the module electronics of the connected I/O modules.</p> <p>A bus coupler must be supplied with non-interruptible voltage. This means that the voltage must not be disconnected at the same time as the subsystem if the entire bus system is to continue operating. Supply voltage failure at a bus coupler stops the system and results in an error message for the bus segment.</p>

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Tasks of the bus coupler:

- Coupling the remote bus and local bus
- Supplying the I/O modules with communications power
- Refreshing the data signal (repeater function)
- Electrical isolation of the bus segments
- Connecting or disconnecting the local bus via firmware
- Connecting or disconnecting the outgoing remote bus via firmware
- If necessary, indicating errors via a floating alarm output (e.g., buzzer, light signal)

### Remote bus

The remote bus connects the controller board to the remote bus devices and interconnects the remote bus devices.

Remote bus devices are bus couplers, specific I/O modules or a mixture of both. Each has a local power supply and an electrically isolated outgoing INTERBUS segment.

### Remote bus branch

A remote bus branch branches off the remote bus. A branch is connected to the main line of the remote bus via a special bus coupler. This bus coupler enables the connection and disconnection of the branching bus segment.

### Local bus

A local bus is a bus connection that branches off from a remote bus via a bus coupler and interconnects the local bus devices. The bus coupler supplies the connected devices with communications power.

Local bus devices are I/O devices that are used to create a distributed substation in the control cabinet. The devices are connected to the remote bus via a bus coupler. Branching is not permitted within the local bus.

The maximum number of local bus devices depends on the bus coupler used.

### Bus segment

A bus segment consists of a remote bus device and the I/O modules connected to it. The preceding cable is also part of the segment.

### I/O modules

I/O modules connect INTERBUS to the sensors and actuators.



For additional information about the INTERBUS topology, please refer to the "General introduction to the INTERBUS system" user manual (IBS SYS INTRO G4 UM E) and the "Configuring and installing INTERBUS" user manual (IBS SYS PRO INST UM E).

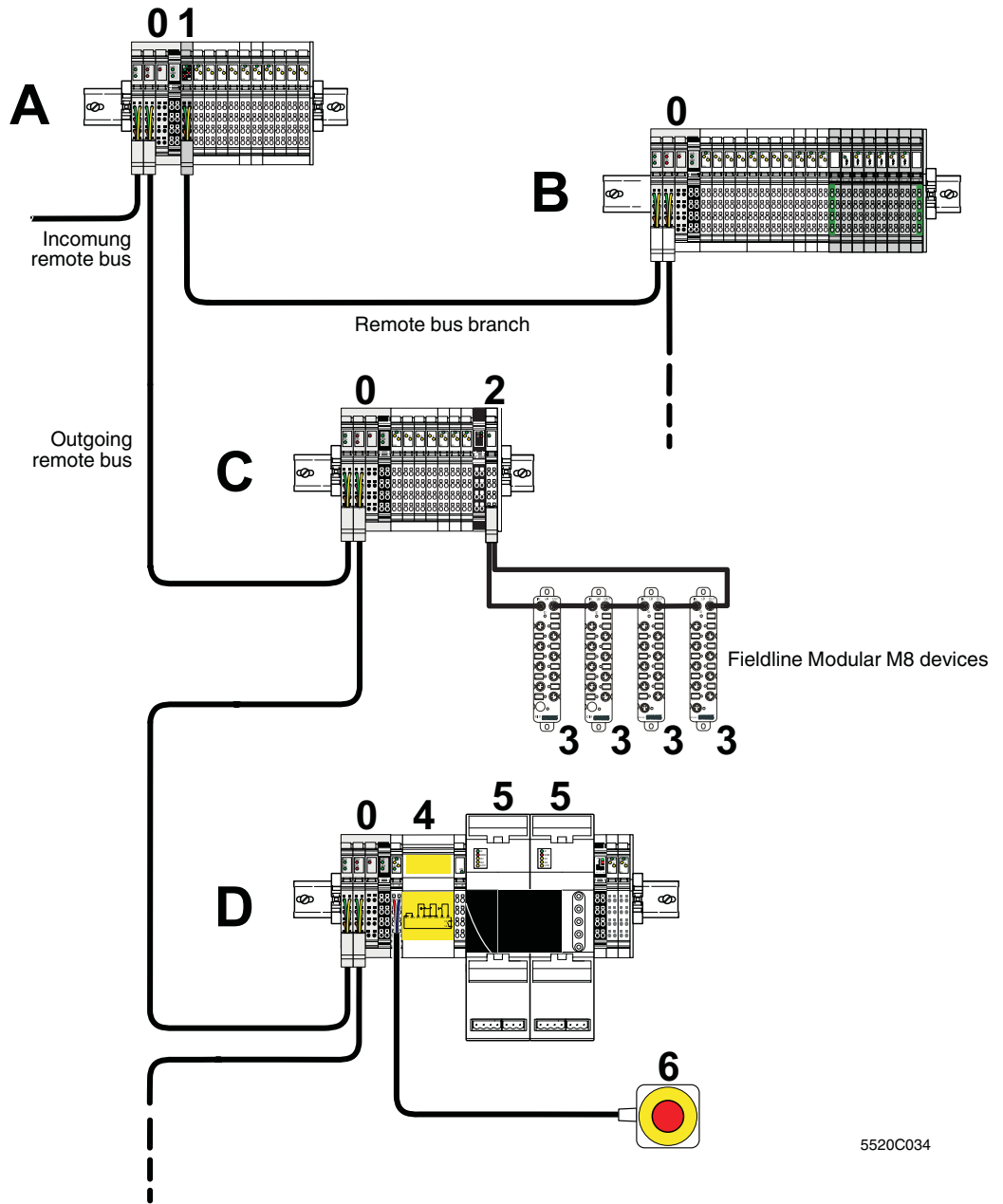
## 2.3 Inline, an INTERBUS product group

### 2.3.1 Features

Characteristic features of Inline:

- Can be easily installed side by side without tools
- Open, flexible, and modular structure
- Terminals of varying widths can be combined to create a time-saving, compact, and cost-effective station structure
- 2-slot terminals:  
These terminals enable optimum adaptation to the desired configuration. They enable a flexible and compact station structure without unnecessary reserve installation space.
- 8-slot terminals:  
These terminals provide a fast and effective station structure for larger stations.
- Functional orientation of the control box or control cabinet  
The modular structure makes it possible to assemble standard function blocks in advance. Parts of the system can be started up independently of one another. This means that pretests can be carried out when the system is set up and the whole system can be adapted and extended.
- Automatic creation of isolated groups, potential circuits, and data circuits
- The amount of costly parallel wiring is reduced  
Within a station, potential and data routing can be carried out without additional wiring.

2.3.2 Example of an Inline system



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Figure 2-2 Example of an Inline system

Figure 2-2 shows Inline stations for implementing different tasks within a system.

Key:

- A Station with terminals in the 24 V DC area  
A remote bus branch branches off from this station.
- B Station with terminals in the 24 V DC and 230 V AC areas
- C Station with terminals in the 24 V DC area  
In this station, Fieldline Modular M8 devices are integrated via a branch terminal.
- D Station with safety terminal, power-level terminals, and terminals in the 24 V DC area  
The power-level terminals are protected by an IB IL 24 SAFE 1-PAC safety terminal.
  
- 0 Bus coupler
- 1 Terminal with remote bus branch
- 2 Branch terminal
- 3 Fieldline Modular M8 devices
- 4 Safety terminal to ensure that the segment circuit is disconnected safely
- 5 Power-level terminal
- 6 Emergency stop button

### 2.3.3 System requirements

#### **Controller board**

A controller board with firmware Version 4.40 or later is required to operate the INTERBUS system. A Generation 4 (G4) controller board must therefore be used that can be operated with this firmware version.

#### **ILC/FC/RFC**

Firmware Version 4.4x or later is required to operate an Inline Controller, Field Controller or Remote Field Controller. A controller that can be operated with this firmware version must be used.

#### **Software**

For configuration, parameterization, and visualization of the system, CMD software Version 4.40 or later is available for standard controller boards. PC WorX software Version 1.30 or later is available for use with a Field Controller or Remote Field Controller.

### 2.3.4 Product description

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

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

The Inline terminals are connected to INTERBUS via a bus coupler. Up to 63 local bus devices can be connected to a bus coupler as long as the limit parameters are not exceeded (see "Number of devices" on page 3-2).

#### Versions

The Inline product range offers terminals for all automation tasks:

- Bus couplers for connecting the Inline station to the INTERBUS remote bus. The remote bus can be connected using copper or fiber optic technology.
- Terminals with remote bus branch for opening a remote bus branch. The remote bus branch can be connected using copper or fiber optic technology.
- Supply terminals for supplying the supply voltages and segmenting the station (with and without fuse)
- Input and output terminals for digital and analog signals
- Function terminals (e.g., counters, incremental encoders)
- Power-level terminals for switching, protecting, and monitoring three-phase standard motors
- Branch terminals for integrating a Fieldline Modular local bus
- Control terminals with distributed intelligence
- Safety-related terminals
- INTERBUS Safety modules

#### Mounting location

Inline terminals (IP20 protection) are designed for use in closed housing. The compact structure means that most of the Inline terminals can be installed in standard terminal boxes.

#### Mounting

Inline terminals can be snapped onto DIN rails without tools. Potential and data jumpers are automatically created when the terminals are properly installed.

#### Bus connection

The Inline station is connected to the remote bus via a bus coupler. The bus is controlled by the Inline station through data routing.

#### I/O connection

The Inline terminals 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.

### 3 Inline terminals specifically for INTERBUS

The following sections provide an overview of the Inline terminals for INTERBUS. For specific information about the individual terminals, please refer to the terminal-specific data sheets and the individual sections in this manual.

#### 3.1 Bus coupler

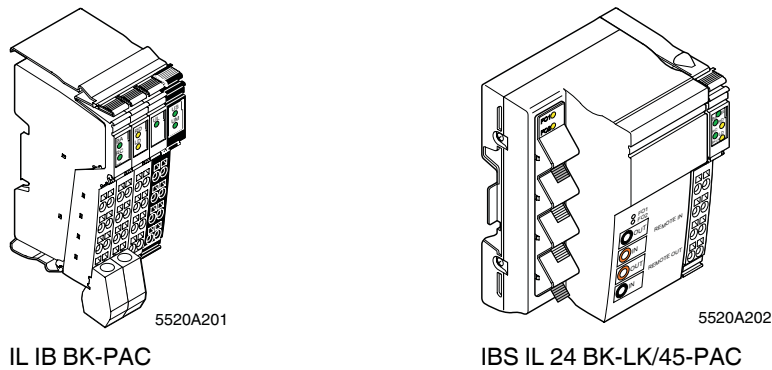


Figure 3-1 Examples of bus couplers

The bus coupler is available for connecting remote bus cables with copper or fiber optic technology.

#### Connecting the remote bus cables

Various bus couplers can be selected to connect to the INTERBUS remote bus via a copper connection. The INTERBUS remote bus is then connected via an Inline connector or a D-SUB connector.

Various bus couplers can be selected to connect to the INTERBUS remote bus via a fiber optic connection. The INTERBUS remote bus is then connected via an Inline F-SMA connector or an E2000 Compact fiber optic connector.

#### Functions

A bus coupler is used to amplify signals (repeater function), it divides the system into segments, and enables the outgoing remote bus and/or the connected station to be switched on or off during operation.

An Inline bus coupler forms the head of an Inline station. It connects the Inline station to the INTERBUS remote bus.

An Inline bus coupler provides the communications power  $U_L$  for the connected devices and the supply voltage for the connected analog terminals  $U_{ANA}$  from the supply voltage  $U_{BK}$ .

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### Number of devices

The maximum number of devices that can be connected to a bus coupler is determined by the following parameters:

- 1 The maximum number of devices in INTERBUS is limited to 512.
- 2 Up to 63 devices can be connected to an Inline bus coupler.  
This number includes all the devices after the bus coupler, i.e., the Inline terminals, as well as the devices that are connected via a branch terminal. The number of devices on a connected remote bus branch does not affect the number of Inline station devices.
- 3 The maximum current that can be supplied by the bus coupler in the logic area ( $U_L$ ) is limited (e.g., IL IB BK-PAC: 0.7 A).
- 4 The current carrying capacity of the potential jumpers is limited. For the limit values of the individual potential jumpers, please refer to the IL SYS INST UM E user manual.



Observe the specific values of each terminal when configuring an Inline station. This information is provided in the relevant terminal-specific data sheet and the DB GB IB IL DEVICE LIST data sheet.



The permissible number of devices that can be connected depends on the specific station structure. None of the parameters mentioned above may be exceeded.

### End plate

The end plate is supplied as standard with the bus coupler. The end plate terminates an Inline station and must be placed after the last terminal of the station. It has no electrical function. It protects the station against ESD pulses and the user against dangerous contact voltages.

### Protection

The bus coupler is protected against polarity reversal and surge voltage for the supplied voltages.

### Functional earth grounding

The terminal is grounded 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 (see "Required additional functional earth grounding").

### Required additional functional earth grounding

In addition, connect the bus coupler to functional earth ground via the FE connection to ensure reliable functional earth 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 the IL SYS INST UM E user manual).

### Carrying capacity of the jumper contacts

The maximum current carrying capacity of the jumper contacts on the side is specified in the IL SYS INST UM E user manual.

**Inline terminals specifically for INTERBUS**

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**Electrical isolation**

The different potential areas within a bus coupler are shown in the figures below.



Figure 3-2 to Figure 3-4 show the electrical isolation in the bus coupler. The internal wiring is not important here. It is shown in the terminal-specific data sheet.



In Figure 3-2 to Figure 3-4, the graphic symbols are not explained because they are not important for indicating the electrical isolation. For an explanation of the graphic symbols, please refer to the corresponding data sheet or the IL SYS INST UM E user manual.

**Electrical isolation:  
Incoming/outgoing  
remote bus**

The incoming and outgoing remote bus interface potentials are isolated from one another and from the rest of the station electronics.

**Electrical isolation:  
FE/FE capacitive**

FE and FE capacitive represent two individual isolated groups.

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**Electrical isolation:  
Other**

Other forms of electrical isolation depend on how the supply voltages are provided.

- 1 The bus coupler supply  $U_{BK}$  and the I/O supply  $U_M/U_S$  are supplied from separate power supply units:

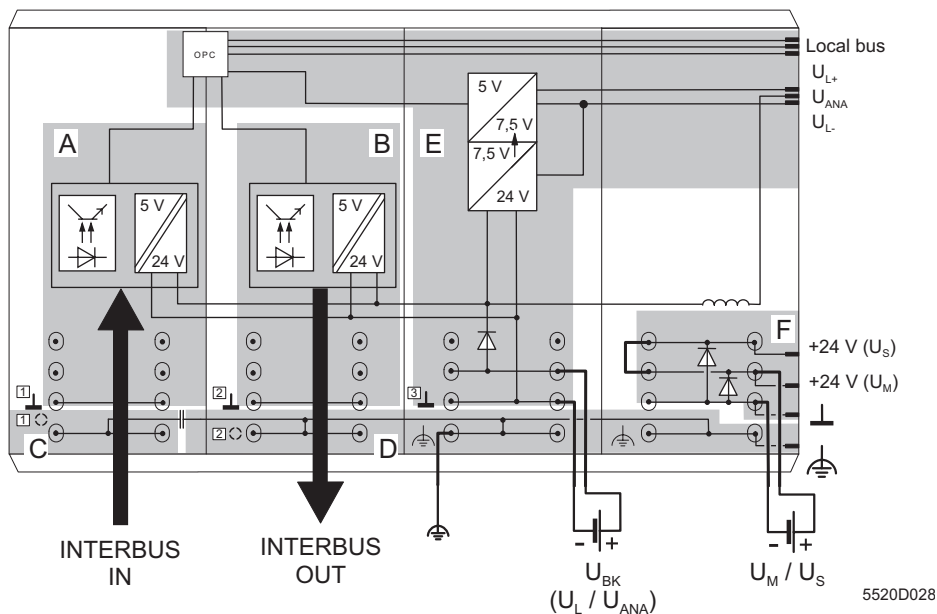


Figure 3-2 Electrical isolation in the IBS IL 24 BK-T/U-PAC bus coupler (separate power supply units)

Potential areas:

- A Area for incoming remote bus
- B Area for outgoing remote bus
- C Area for functional earth ground (FE) capacitive
- D Area for functional earth ground (FE)
- E Area for bus coupler supply  $U_{BK}$  from which the communications power  $U_L$  and the analog terminal supply  $U_{ANA}$  are generated
- F Area for the I/O voltages  $U_M$  and  $U_S$

Inline terminals specifically for INTERBUS

Electrical isolation can also be achieved if the power supply  $U_M/U_S$  is supplied via a power terminal from a separate power supply unit.

- 2 The bus coupler supply  $U_{BK}$  and the I/O supply  $U_M/U_S$  are supplied from one power supply unit:

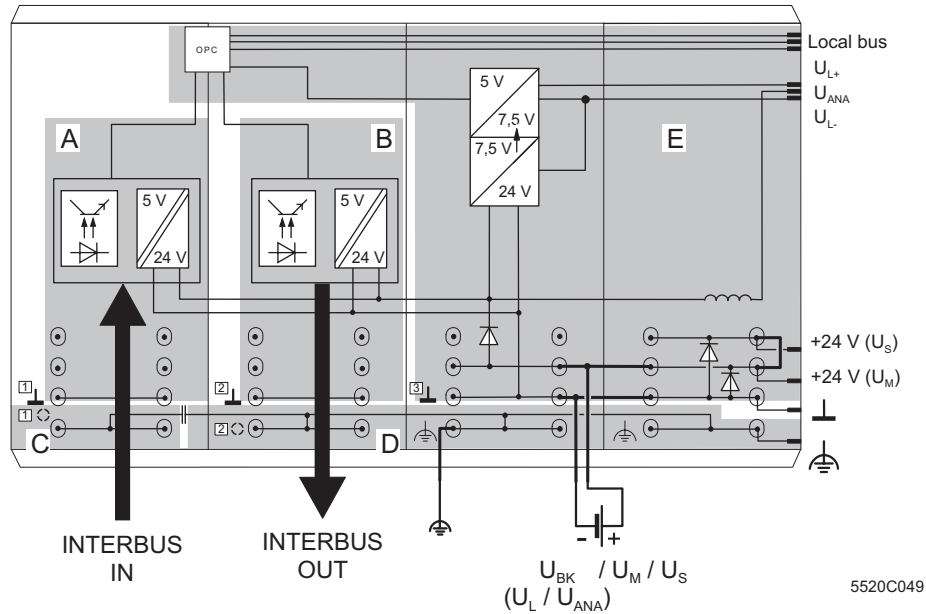


Figure 3-3 Electrical isolation in the IBS IL 24 BK-T/U-PAC bus coupler (one power supply unit)

Potential areas:

- A Area for incoming remote bus
- B Area for outgoing remote bus
- C Area for functional earth ground (FE) capacitive
- D Area for functional earth ground (FE)
- E Area for the bus coupler supply  $U_{BK}$  from which the communications power  $U_L$  and analog terminal supply  $U_{ANA}$  are generated **not isolated** from the I/O voltages  $U_M$  and  $U_S$

**IB IL SYS PRO UM E**

**Electrical isolation:  
Digital terminal**

The isolation of the I/O circuit of a digital terminal from the communications power is only ensured if  $U_{BK}$  and  $U_M/U_S$  are provided from separate power supply units.

**Electrical isolation:  
Analog terminal**

The I/O circuit for the analog terminal is supplied from the analog circuit  $U_{ANA}$ .  
The 24 V supply ( $U_S$ ,  $U_M$ ) is only looped through the analog terminal and is available again at the next terminal.

If the supply voltages  $U_{BK}$  and  $U_M/U_S$  are supplied separately at the bus coupler/power terminal, the I/O circuit of an analog terminal is electrically isolated from the 24 V voltages  $U_M$  and  $U_S$ .

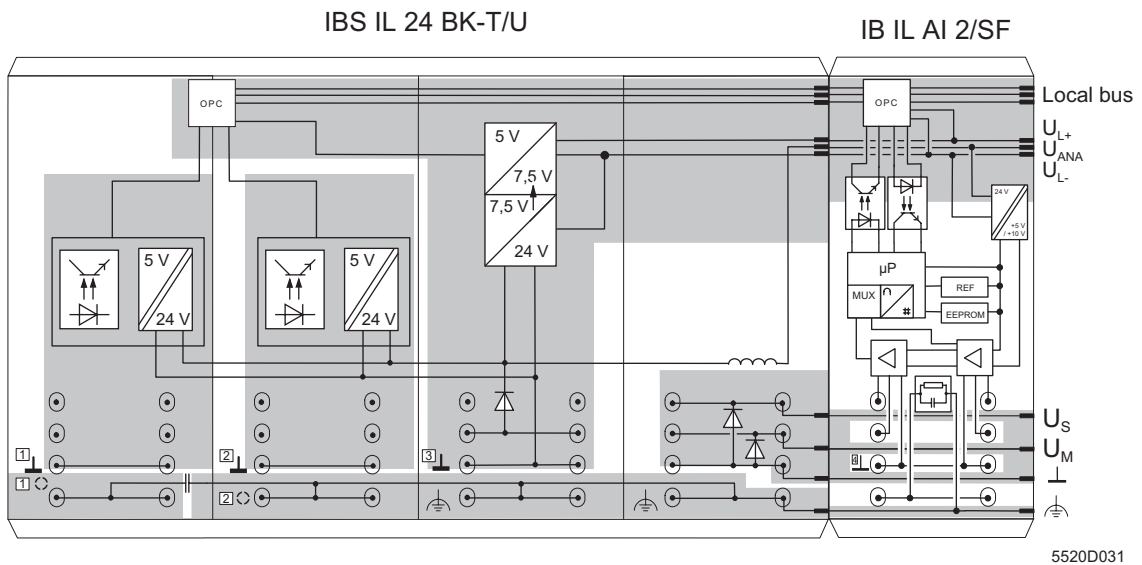


Figure 3-4 Electrical isolation in the bus coupler and analog terminal

### 3.1.1 Terminal with remote bus branch

This terminal can be used to create a remote bus branch from the Inline station. This enables further segmentation of the system so that, for example, star structures can be created. This terminal can be used to switch the connected remote bus branch on or off. A bus coupler is available that enables a remote bus branch to be branched.

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

Terminals with remote bus branch can only be placed **directly** after a bus coupler, a control terminal or another terminal with remote bus branch.

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



Observe any restrictions for your bus coupler regarding the terminal with remote bus branch.



When using a bus coupler with remote bus connections in fiber optic technology, a terminal with remote bus branch cannot be connected directly after the bus coupler because a power terminal must be installed directly after a fiber optic bus coupler. Make sure that the power terminal is **not a bus device**. IB IL 24 PWR IN-PAC or IB IL 24 PWR IN/F-PAC terminals can be installed because these terminals do not have a protocol chip and are therefore not bus devices.



Up to 15 terminals with remote bus branch can be installed within an Inline station. However, the information provided in the terminal-specific data sheets must be observed, as, for example, not all bus couplers support this maximum configuration.

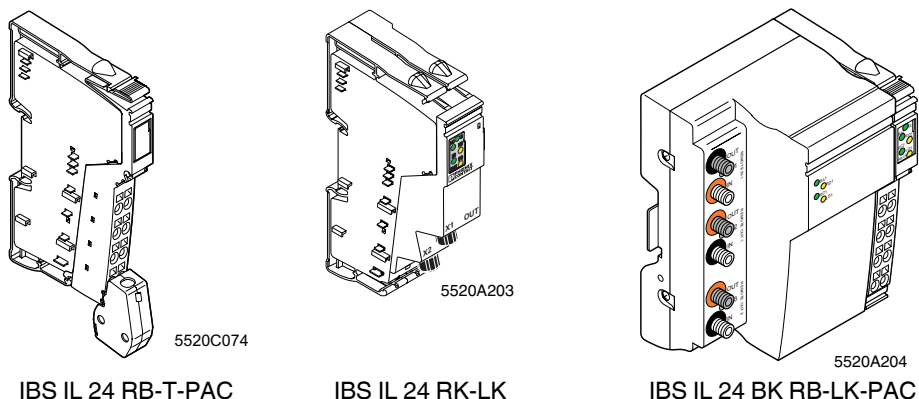


Figure 3-5 Terminals with remote bus branch

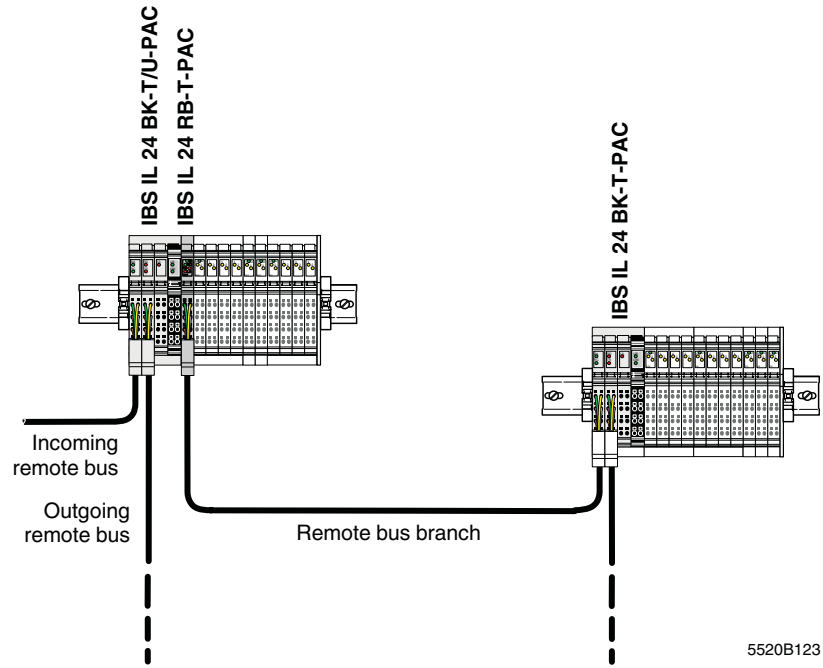


Figure 3-6 Example topology with remote bus branch

### 3.1.2 Interface recognition

The protocol chip of the bus coupler, control terminal or terminal with remote bus branch detects whether an additional remote bus device (terminal with remote bus branch) or a local bus device (e.g., I/O terminal) is installed. The outgoing interface is configured automatically.



The instructions given in the terminal-specific data sheets must be followed during configuration.

## 3.2 Control terminals

An Inline Controller is available as a control terminal with distributed intelligence. The Inline Controller is part of the Remote Field Controller (RFC) group. 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. It also enables the creation of independent INTERBUS subnetworks, which process automation tasks autonomously.

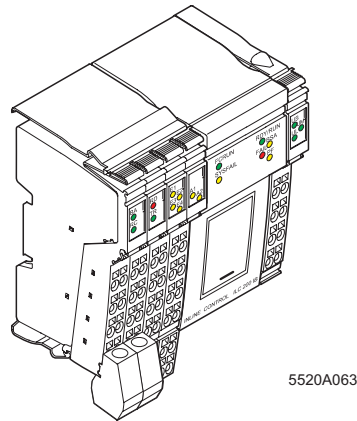


Figure 3-7 Example of an Inline Controller: ILC 200 IB-PAC



For more detailed information about Inline Controllers, please refer to the terminal-specific data sheets and user manuals.

## 3.3 Other terminals

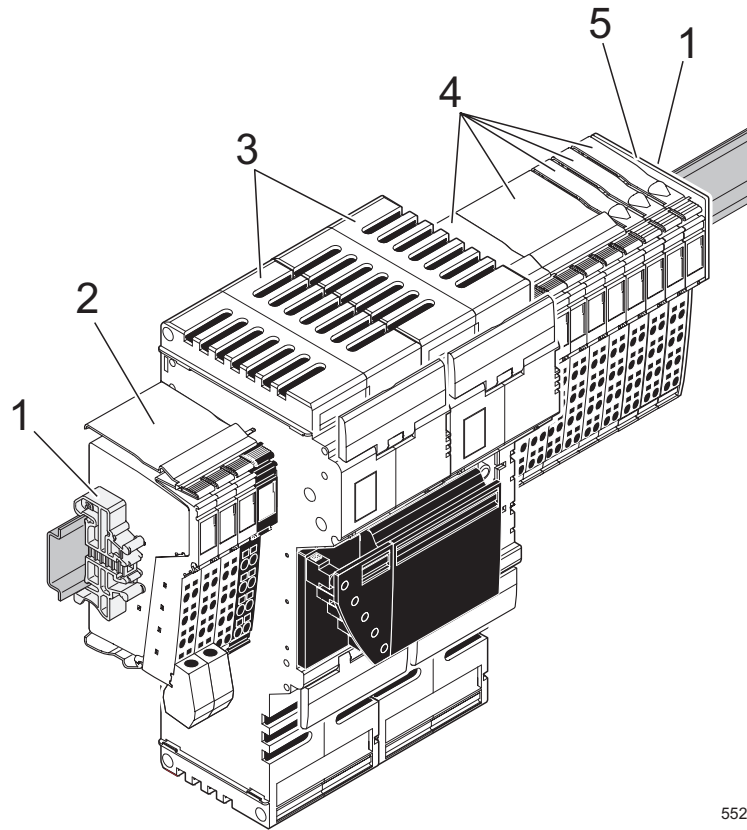
All available Inline terminals can be connected to INTERBUS bus couplers or control terminals. For a general overview of the terminals with a function description of the product groups, please refer to the IL SYS INST UM E user manual.

The following product groups are described:

- Bus couplers and terminals with remote bus branch
- Power, segment, and accessory terminals
- I/O terminals
- Power-level terminals
- Servo amplifiers
- Safety terminals
- Programmable terminals (control terminals)
- Branch terminals

For an overview of all the available terminals, please refer to the Phoenix Contact "AUTOMATION" catalog.

### 3.4 Typical structure of an Inline station



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Figure 3-8 Example station with power-level terminals and 24 V DC terminals

The example Inline station shown in Figure 3-8 consists of the following elements:

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

## 4 Electrical potential and data routing



For more detailed information, please refer to the IL SYS INST UM E user manual. This section contains information that exclusively concerns bus couplers for INTERBUS.

### 4.1 Circuits and provision of supply voltages

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

An example of the circuits within an Inline station is given in "Example of a circuit diagram" on page 4-2. The descriptions in the following sections refer to this example.



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

#### Carrying capacity of the jumper contacts

For information about the following topics, please refer to the IL SYS INST UM E user manual:

- The maximum current carrying capacity of all potential jumpers.  
Observe the current carrying capacity of the jumper contacts on the side for each circuit.
- The arrangement of the potential jumpers and information about current and voltage distribution on the potential jumpers.
- The connection of the supply voltages.



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

#### 4.1.1 Bus coupler supply

You **must** connect the supply voltage  $U_{BK}$  (bus coupler supply) to a bus coupler. The voltages for the logic circuit  $U_L$  and the supply of the terminals for analog signals  $U_{ANA}$  are internally generated from the bus coupler supply (see IL SYS INST UM E).

Which supply voltages can also be supplied at the bus coupler depends on the bus coupler itself. For additional information, please refer to the terminal-specific data sheets.

### 4.1.2 Example of a circuit diagram

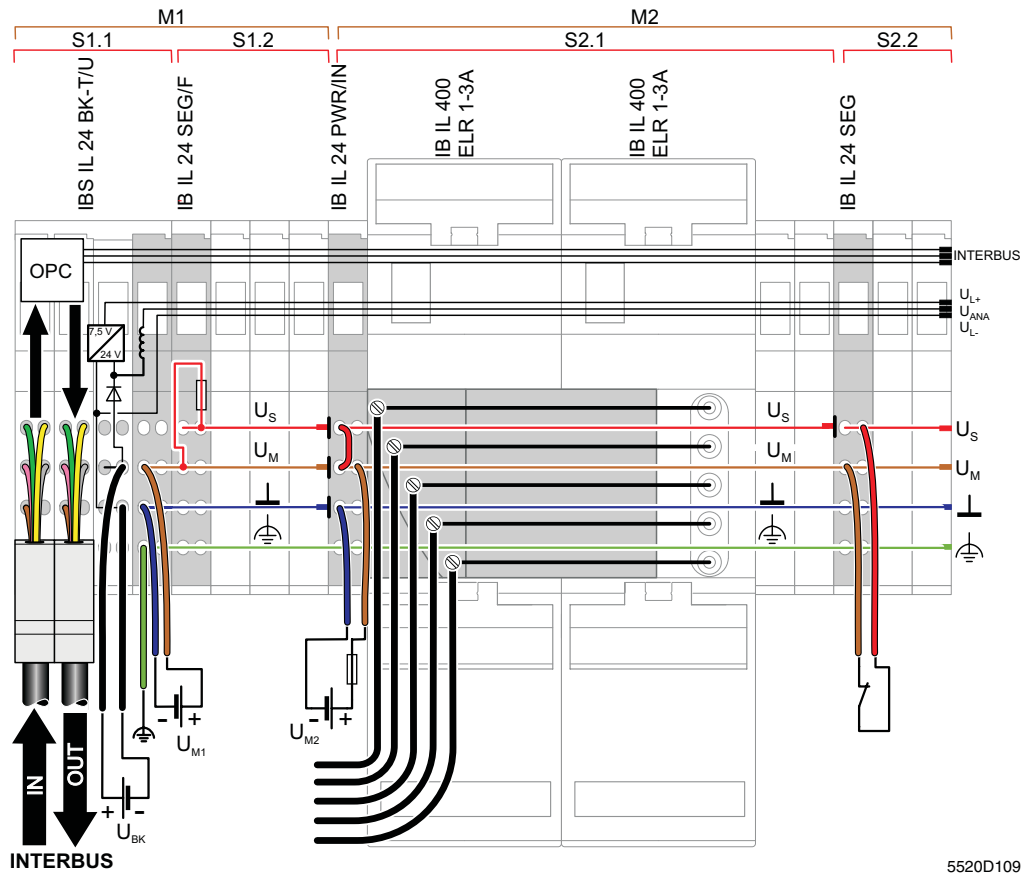






Figure 4-1 Potential routing within an InLine station

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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.

<b>Mx</b>	Main circuit (e.g., M1, M2)
<b>Sx,y</b>	Segment circuit y in main circuit x (e.g., S2.1, S2.2)
<b>BC</b>	Bus coupler in conjunction with a power terminal, if required
<b>U<sub>BK</sub></b>	Bus coupler supply (supply for bus coupler, generates U <sub>ANA</sub> and U <sub>L</sub> )
<b>U<sub>M</sub></b>	Main supply (I/O supply in the main circuit)
<b>U<sub>S</sub></b>	Segment supply (I/O supply in the segment circuit)
<b>U<sub>ANA</sub></b>	I/O supply for analog terminals
<b>U<sub>L</sub></b>	Communications power
<b>Local bus</b>	Data jumper for the local bus
	Ground (GND for the supply voltages U <sub>M</sub> and U <sub>S</sub> )
	Noiseless ground (functional earth ground, FE)
	Protective earth ground
<b>I</b>	Indicates the interruption of a potential jumper
<b>Main circuit M1/ segment S1.1</b>	<p>The bus coupler supply U<sub>BK</sub> and the main voltage U<sub>M1</sub> are supplied at the bus coupler (here: IBS IL 24 BK-T/U-PAC).</p> <p>The communications power U<sub>L</sub> and the supply voltage for the analog terminals U<sub>ANA</sub> are generated from the bus coupler supply and led through the entire station.</p> <p>Electrical isolation between logic and I/O is created through the separate supply of U<sub>BK</sub> and U<sub>M1</sub>.</p> <p>No terminals are used in segment S1.1.</p>
<b>Segment S1.2</b>	<p>In a segment terminal with fuse, the segment voltage U<sub>S</sub> for segment S1.2 is automatically tapped from the main voltage U<sub>M1</sub>. This segment circuit is protected by the internal fuse.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> 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<sub>M</sub> and U<sub>S</sub> 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).</p> </div>
<b>Main circuit M2/ segment S2.1</b>	<p>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<sub>M2</sub>.</p> <p>Using a jumper, the segment voltage U<sub>S</sub> for segment S2.1 is tapped from the main voltage U<sub>M2</sub> at this terminal.</p>
<b>Segment S2.2</b>	<p>The segment voltage U<sub>S</sub> is provided at the IB IL 24 SEG-PAC segment terminal via a switch. Output terminals installed here can therefore be switched externally.</p>

**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.

## 4.2 Electrical potential and data routing



For more detailed information, please refer to the IL SYS INST UM E user manual.

As a rule, the potential and data routing for the 24 V voltage area begins at the bus coupler.



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.



The AX SALES software provides support when configuring an Inline station (see also IL SYS INST UM E user manual).

## 5 Mounting/removing Inline terminals and connecting cables



As a rule, all the information in the corresponding section of the IL SYS INST UM E user manual applies. This section contains additional information that applies specifically to bus couplers for INTERBUS.



Secure each Inline station using an end plate, which is supplied as standard with the bus coupler, and an end clamp at the start and end of the station.

### 5.1 Connecting the power supplies

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.



For more detailed information, please refer to the IL SYS INST UM E user manual.

#### 5.1.1 Bus coupler supply

Depending on the bus coupler, there are various options for supplying supply voltages.

As a rule, the 24 V bus coupler supply  $U_{BK}$  **must** be supplied at a bus coupler.

Some bus couplers also offer the option of supplying all the required 24 V supply voltages at the bus coupler. In this case, the following supply voltages can be supplied or provided:

- 24 V bus coupler supply  $U_{BK}$
- 24 V supply in the main circuit  $U_M$
- 24 V supply in the segment circuit  $U_S$

If  $U_M$  and  $U_S$  are not supplied at the bus coupler:

- Implement the 24 V supplies in the main circuit  $U_M$  via a directly connected power terminal.
- The 24 V supplies in the segment circuit  $U_S$  can also be implemented at this power terminal or an additional segment terminal.



For information about which voltage is actually supplied at a specific bus coupler, please refer to the terminal-specific data sheet.

#### 5.1.2 Notes on supply voltages

The bus coupler supplies the module electronics of the connected terminals with communications power ( $U_L$ ), which is generated from the bus coupler supply voltage (e.g.,  $U_{BK}$ ). If this supply voltage 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 INTERBUS continues to run even if some I/O devices are switched off.

## 5.2 Connecting the bus

The INTERBUS remote bus is connected to a bus coupler. Bus couplers are available for connecting the remote bus using copper or fiber optic technology.

### Remote bus using copper technology

The bus cables are shielded cables. They are connected via an Inline connector with shield connection or via a D-SUB connector.

Connection via an Inline connector is the same as the connection of shielded cables via a shield connector and is described in the IL SYS INST UM E user manual.

Connection via a D-SUB connector is described in the terminal-specific data sheet.

### Remote bus using fiber optic technology

The connection is described in the terminal-specific data sheet.

When connecting the fiber optic cables, please observe the IBS SYS FOC ASSEMBLY fiber optic installation guidelines.



For the assignment of the connections and terminal points, please refer to the relevant bus coupler data sheet.

## 5.3 Connecting I/O devices

To connect the sensors and actuators, proceed as described in the IL SYS INST UM E user manual.

## 6 Diagnostic and status indicators

All terminals 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.

### Diagnosics

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

### Status

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

### Extended diagnostics

Some Inline terminals have extended diagnostics. A short circuit or overload of the sensor supply is indicated for each input. If a short circuit occurs at an output, each channel is diagnosed individually. Information 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.

### Optical diagnostics

For terminals with a fiber optic connection, the quality of the transmission path is determined and compensated for in limits (optical diagnostics). With this diagnostic function it is possible to detect a gradual deterioration of the transmission path before transmission errors occur or transmission is interrupted.

This transmission quality is available as information at the control system. If the system reserve of -3 dB is reached or exceeded during optical transmission, a warning for the affected interface is sent to the control system (MAU warning). In addition, information about the transmission quality is displayed at the terminal where the transmission path starts (see "Diagnostic indicators FO1 to FO3" on page 6-5).



For information about the diagnostic and status indicators on a specific terminal, please refer to the terminal-specific data sheet.

### 6.1 Diagnostic indicators on bus couplers

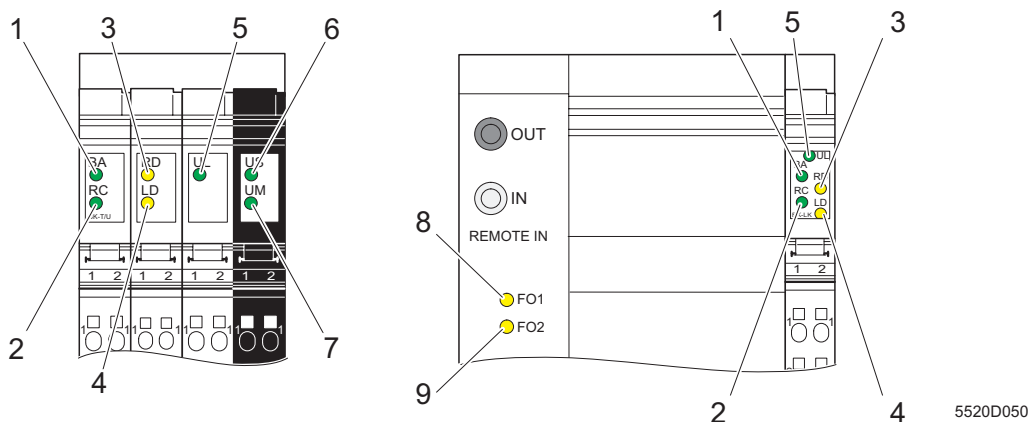


Figure 6-1 Indicators on bus couplers (e.g., IBS IL 24 BK-T/U-PAC and IBS IL 24 BK-LK-PAC)

The following states can be read on bus couplers:

<b>BA (1)</b>	Green LED	Remote bus active
	On:	Data transmission on INTERBUS (INTERBUS state: RUN)
	Flashing:	ID cycle; no data transmission (INTERBUS state: ACTIVE)
	Off:	No data transmission
<b>RC (2)</b>	Green LED	Remote bus connection (remote bus check)
	On:	Incoming remote bus connection established
	Off:	Incoming remote bus connection faulty
<b>RD (3)</b>	Yellow LED	Remote bus disabled
	On:	Outgoing remote bus interface disabled
	Off:	Outgoing remote bus interface not disabled
<b>LD (4)</b>	Red or yellow LED	Local bus disabled
	On yellow:	Local bus disabled
	On red:	Isolated disconnection of local bus after error
	Off:	Local bus not disabled
<b>UL (5)</b>	Green LED	Bus coupler supply/communications power/interface supply
	On:	Supply present
	Off:	Supply not present

## Diagnostic and status indicators

<b>Additionally on bus couplers with copper remote bus connections</b>		
<b>US (6)</b>	Green LED	Supply in the segment circuit
	On:	Supply present in the segment circuit
	Off:	Supply not present in the segment circuit
<b>UM (7)</b>	Green LED	Supply in the main circuit
	On:	Supply present in the main circuit
	Off:	Supply not present in the main circuit
<b>Additionally on bus couplers with fiber optic remote bus connections</b>		
<b>FO1 (8)</b>	Yellow LED	Status of the incoming fiber optic path
	On:	Incoming fiber optic path not OK or System reserve reached in controlled operation
	Off:	Incoming fiber optic path OK or not used
<b>FO2 (9)</b>	Yellow LED	Status of the outgoing fiber optic path
	On:	Outgoing fiber optic path not OK or System reserve reached in controlled operation
	Off:	Outgoing fiber optic path OK or not used

## 6.2 Indicators on terminals with remote bus branch

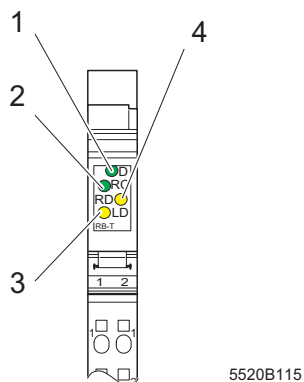


Figure 6-2 Indicators on the IBS IL 24 RB-T-PAC terminal

### Diagnostics

The following states can be read on terminals with remote bus branch:

<b>D (1)</b>	Green LED	Diagnostics (INTERBUS state: RUN)
	On:	INTERBUS active
	Flashing:	
	0.5 Hz: (slow)	Communications power present, INTERBUS not active
	2 Hz: (medium)	Communications power present, INTERBUS active, 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
<b>RC (2)</b>	Green LED	Remote bus connection (remote bus check)
	On:	Incoming remote bus connection established
	OFF:	Incoming remote bus connection faulty
<b>RD (3)</b>	Yellow LED	Remote bus branch disabled
	On:	Branching remote bus interface disabled
	Off:	Branching remote bus interface not disabled.

<b>LD (4)</b>	Red or yellow LED	Local bus disabled
	On yellow:	Local bus disabled
	On red:	Isolated disconnection of local bus after error
	Off:	Local bus not disabled
<b>Additionally on terminals with fiber optic remote bus branch</b>		
<b>FO3</b>	Yellow LED	Status of the branching fiber optic path
	On:	Branching fiber optic path not OK or System reserve reached in controlled operation
	Off:	Branching fiber optic path OK or not used

### 6.3 Diagnostic indicators FO1 to FO3

For terminals with fiber optic connection, diagnostic indicators FO1 to FO3 not only indicate the interface (incoming (FO1)/outgoing(FO2)/branching(FO3)) at which transmission is not optimal, but also whether forward or return data transfer is affected.

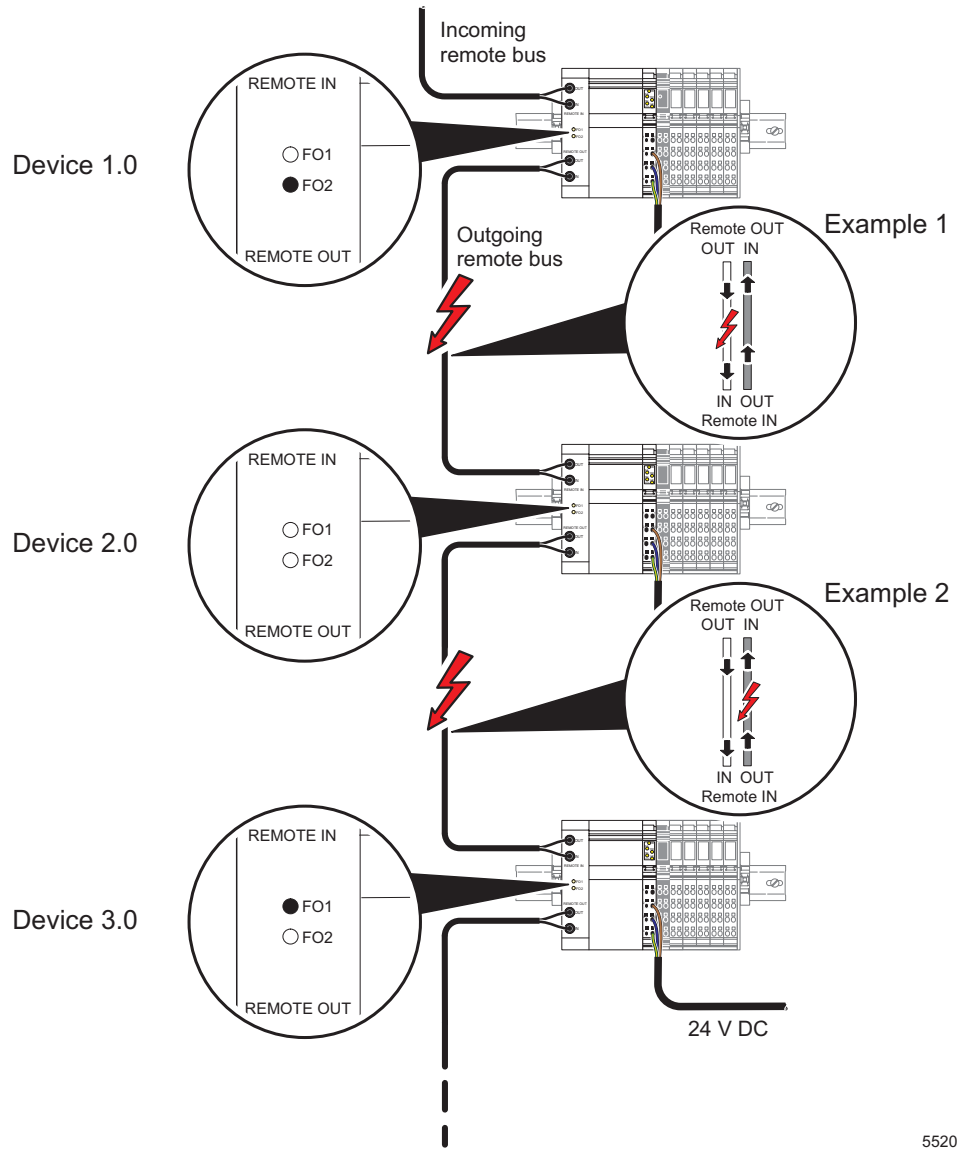
**Example 1**  
**Figure 6-3**

The FO2 LED on device 1.0 indicates that the forward path of the outgoing interface is affected.

**Example 2**  
**Figure 6-3**

The FO1 LED lights up on device 3.0 if the system reserve has been reached or exceeded on the return path of the incoming interface.

For the branching interface of an Inline terminal with remote bus branch, the same applies as for the "standard" outgoing interface. The FO3 LED then indicates that the forward path of the branching interface is affected.



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Figure 6-3 Example of diagnostics using indicators at outgoing interfaces

## 6.4 Indicators on other terminals



For general information about the indicators on other terminals, please refer to the IL SYS INST UM E user manual. For specific information about a particular terminal, please refer to the terminal-specific data sheet.

## 6.5 Error localization

Inline diagnostic and status indicators enable clear error localization. An error is displayed in the station. In addition, the device on which the error has occurred is indicated to the control system and can be read using the IBS CMD G4 or PC WorX software.

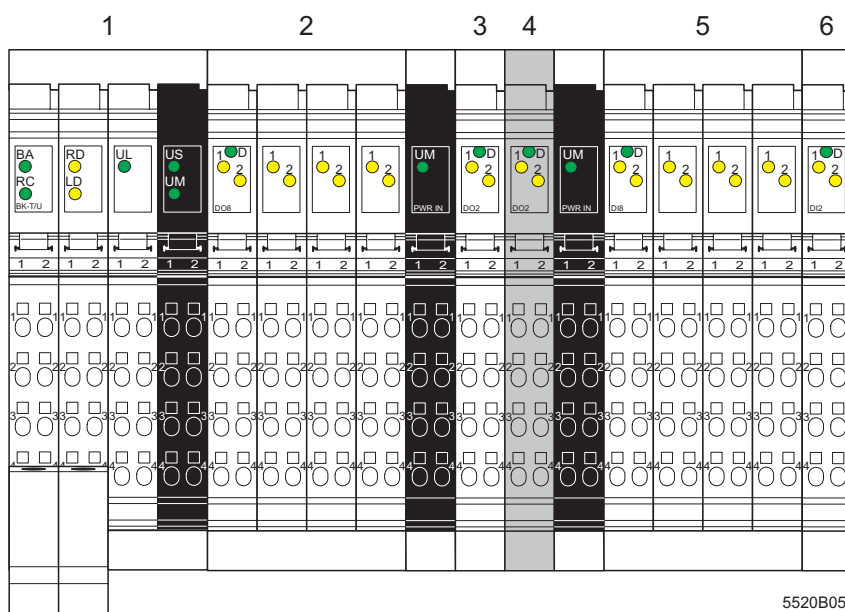


Figure 6-4 Example station for error localization

Terminals used in the example station:

- |   |                      |   |                      |
|---|----------------------|---|----------------------|
| 1 | IBS IL 24 BK-T/U-PAC | 4 | IB IL 24 DO 2-2A-PAC |
| 2 | IB IL 24 DO 8-PAC    | 5 | IB IL 24 DI 8-PAC    |
| 3 | IB IL 24 DO 2-2A-PAC | 6 | IB IL 24 DI 2-PAC    |

IB IL 24 PWR IN-PAC power terminals are not numbered because they are not bus devices and therefore do not have indicators for error diagnostics.

When the system is operating correctly, the green LEDs on the bus coupler and the other terminals remain lit (Figure 6-5, detail A).

IB IL SYS PRO UM E

Figure 6-5 shows a station with possible error states. It shows that errors have been detected at terminal 5 or that terminal 4 has failed, and shows the behavior of the diagnostic indicators on the adjacent terminals.

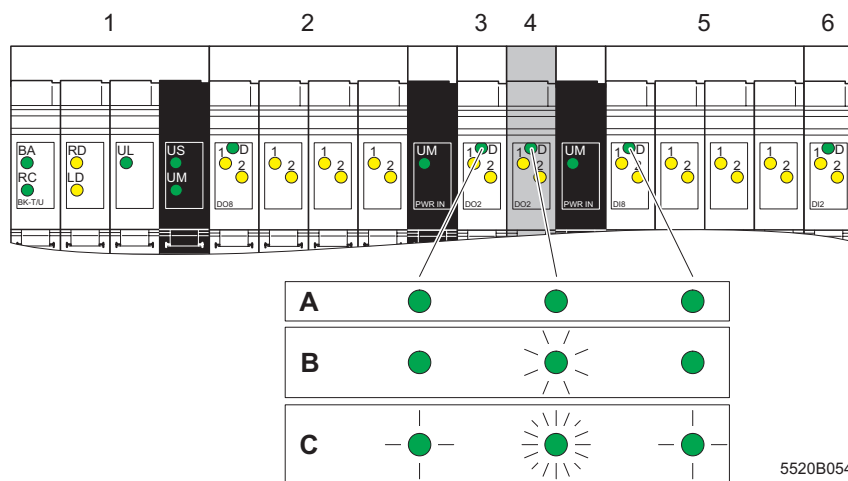


Figure 6-5 Station with diagnostic indicators

<b>A</b>	No error	LED ON	LED flashes at		
<b>B</b>	Peripheral fault		0.5 Hz (slow)	2 Hz (medium)	4 Hz (fast)
<b>C</b>	Bus error				

Peripheral fault

(Figure 6-5, detail B)

Error:	Short circuit at terminal 4 (IB IL 24 DO 2-2A-PAC)
Effect:	
Control system:	Error message to the control system (peripheral fault)
Bus coupler:	Indicators remain unchanged
Terminal 4:	Green D LED flashes at 2 Hz
Other terminals:	Remain unchanged

Bus error

(Figure 6-5, detail C)

Error:	Bus has been interrupted after terminal 3 and before terminal 4
Effect:	
Control system:	Error can be localized by the control system
Bus coupler:	Red LD LED (local bus disabled) is ON
Terminal 4:	Green D LED flashes at 4 Hz (bus error)
Other terminals:	Green D LEDs on all other terminals flash at 0.5 Hz

## 7 Configuration, installation, and startup of an Inline system (example)

This section uses an example project to illustrate the configuration and installation of an Inline station. It is designed to help you to carry out the following steps on your own project.



The AX SALES software provides support when configuring an Inline station (see also IL SYS INST UM E user manual).

The following sequence should generally be observed during configuration, installation, and startup:

- Define and describe the task. Specify the number of signals, the transmission medium, the distance to be covered, etc.
- Select the required I/O terminals. Select suitable power and segment terminals according to your requirements for electrically isolated areas and the current consumption of the individual terminals.



When selecting the terminals, please observe the system limits of Inline and INTERBUS in general.

- Select suitable power supplies.
- Mount and install all terminals according to the instructions in the IL SYS INST UM E user manual.
- Switch on the supply voltage of the control or computer system.
- Switch on the supply voltages of the Inline station.

The initialization of the bus system now begins.

## 7.1 Task

### Example project

- 1 You want to acquire signals from twelve digital 4-wire sensors each with 50 mA current consumption at 24 V in one system.
- 2 You want a short-circuit-proof initiator supply, diagnostics via the bus, and easy operation in the event of an error.
- 3 Your application contains:
  - 1 Six lamps, each with 0.5 A nominal current using 3-wire connection method.
  - 2 Four power contactors, each with 2 A nominal current, and a DC motor with 1.2 A current consumption, all connected to a 24 V supply voltage. A high degree of simultaneity can be assumed for the channels.
- 4 You also want to measure a slowly changing temperature in the range from 0°C to 120°C in two places in your application with 1% accuracy.
- 5 You must switch a 3-phase motor with 1 kW of power.
- 6 Only complete items (...-PAC) may be used.

## 7.2 Selecting the required I/O terminals

### 7.2.1 Inline station devices

Select the appropriate Inline terminals for the I/O signals in your project.

You can make your selection using the "AUTOMATION" catalog or the DB GB IB IL DEVICE LIST data sheet.

#### Task point 1: 12 digital inputs

Possible terminals	Requirements met?	
	4-wire technology	12 channels
... DI 4/... DI 16	No	
... DI 2/... DI 8	Yes	1 x DI 8 and 2 x DI 2

## Configuration, installation, and startup of an Inline system (example)

### Task point 2: Initiator supply

Possible terminals	Requirements met?		
	Short-circuit-proof	Diagnostics via INTERBUS	Easy operation in the event of an error
... SEG	No	No	–
... SEG/F	Yes	No	–
... SEG/F-D	Yes	Yes	No*
... SEG ELF	Yes	Yes	Yes†

\* In the event of a short circuit in the segment, you must replace the fuse.

† In the event of a short circuit in the segment, the terminal can be reset electronically, which means that the fuses do not have to be replaced during troubleshooting.

### Task point 3/1: 6 digital outputs, lamp load of 0.5 A each

Possible terminals	Requirements met?		
	Load current up to 0.5 A	Reserve	6 channels
... DO 2-2A	No (2 A not required)		
... DO 2/... DO 4	Yes	No	1 x DO 4 and 1 x DO 2
... DO 8/... DO 16	Yes	Yes	

### Task point 3/2: 5 digital outputs > 0.5 A

Possible terminals	Requirements met?		
	Load current > 0.5 A	High degree of simultaneity	5 channels
... DOR 1/W	Yes	–	
... DO 2-2A	Yes	Yes	3 x DO 2-2A
... DO 8-2A	Yes	No	
... DO 2/4/8/16	No	Yes	

### Task point 4: 2 channels for temperature measurement

Possible terminals	Requirements met?		
	Temperature range 0°C to 120°C	Rate of change	2 channels
... TEMP 2 RTD	-200°C to +850°C	Low	1 x TEMP 2 RTD
... TEMP 2 UTH	> +850°C (not required)	High (not required)	

**Task point 5: Switch 1 motor up to 1 kW**

Possible terminals	Requirements met?	
	Mechanical/electronic	1 channel
... ELR ...	Electronic (not required)	Yes
... MLR ...	Mechanical	Yes

**7.2.2 System limits**

When configuring an Inline station, you must take into consideration the system data of INTERBUS and an Inline station. This system data is listed in Section 8 "Technical data and ordering data".

Also take into account any restrictions for specific terminals. These are listed in the terminal-specific data sheets.



Observe the current consumption of each device at the individual potential jumpers when configuring an Inline station. This can be found in:

- The DB GB IB IL DEVICE LIST data sheet
- The relevant terminal-specific data sheet

If the limit value for the current load is reached at one of the potential jumpers  $U_S$ ,  $U_M$  or GND, a new power terminal must be used.

If the limit value for the current load is reached at one of the potential jumpers  $U_L$  or  $U_{ANA}$ , a corresponding power terminal must be used or a new Inline station must be created using a new bus coupler.



These conditions are taken into consideration in the AX Sales configuration tool and corresponding power terminals are used.

### Configuration, installation, and startup of an Inline system (example)

#### Testing the "current consumption" system limit:

Table 7-1 Current consumption in the example project

Terminal	Number	Current consumption at				
		$U_L$ (terminal)	$U_L$ (total)	$U_{ANA}$	$U_S$ (at one terminal)	$U_S$ (total)
IB IL 24 DI 8-PAC	1	50 mA	50 mA		8 x 50 mA = 400 mA	0.4 A
IB IL 24 DI 2-PAC	2	35 mA	70 mA		2 x 50 mA = 100 mA	0.2 A
IB IL 24 SEG ELF-PAC	1	30 mA	30 mA			
IB IL 24 DO 4-PAC	1	44 mA	44 mA		4 x 0.5 A = 2 A	2 A
IB IL 24 DO 2-PAC	1	33 mA	33 mA		2 x 0.5 A = 1 A	1 A
IB IL 24 DO 2-2A-PAC (4 power contactors with 2 A each)	2	35 mA	70 mA		2 x 2 A = 4 A	8 A
IB IL 24 DO 2-2A-PAC (1.2 A DC motor)	1	35 mA	35 mA		1.2 A	1.2 A
IB IL TEMP 2 RTD-PAC	1	43 mA	43 mA	11 mA		
IB IL 400 MLR 1-8A	1	50 mA	50 mA		160 mA	0.16 A
Current load			<b>425 mA</b>	<b>11 mA</b>		<b>12.96 A</b>
Permissible current load of the potential jumper			<b>2 A</b>	<b>0.5 A</b>		<b>8 A</b>
Permissible current load of the potential jumper $U_M$ of the IB IL 24 SEG ELF-PAC terminal						<b>2.5 A at <math>U_M</math> (total current with <math>U_S</math>)</b>

Additional power terminals must be used so that the permissible current load of the potential jumper  $U_S$  is not exceeded. In this case, the number of power terminals to be used depends on the arrangement of the terminals.

Based on the information regarding the order of the Inline terminals provided in the IL SYS INST UM E user manual, the order of the listed terminals is as follows, for example:

	IBS IL 24 BK-T/U-PAC	IB IL 24 DO 2-2A-PAC	B IL 24 DO 2-2A-PAC	B IL 24 DO 2-2A-PAC	B IL 24 DO 4-PAC	B IL 24 DO 2-PAC	IB IL 400 MLR	IB IL 24 SEG-ELF-PAC	IB IL 24 DI 8-PAC	IB IL 24 DI 2-PAC	IB IL 24 DI 2-PAC	IB IL TEMP 2 RTD-PAC
$U_S/U_M$ :		4 A	1.2 A	4 A	2 A	1 A	0.16 A		0.4 A	0.1 A	0.1 A	

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If this terminal arrangement is to be maintained, an additional power terminal is required:

<b>IBS IL 24 BK-T/U-PAC</b>	<b>IB IL 24 DO 2-2A-PAC</b>	<b>B IL 24 DO 2-2A-PAC</b>	<b>IB IL 24 PWR IN-PAC</b>	<b>B IL 24 DO 2-2A-PAC</b>	<b>B IL 24 DO 4-PAC</b>	<b>B IL 24 DO 2-PAC</b>	<b>IB IL 400 MLR</b>	<b>IB IL 24 SEG-ELF-PAC</b>	<b>IB IL 24 DI 8-PAC</b>	<b>IB IL 24 DI 2-PAC</b>	<b>IB IL 24 DI 2-PAC</b>	<b>IB IL TEMP 2 RTD-PAC</b>		
	4 A	1.2 A		4 A	2 A	1 A	0.16 A		0.4 A	0.1 A	0.1 A			
$U_S/U_M:$				5.2					7.16 A				0.6 A	

In addition to the terminals listed, a bus coupler (IBS IL 24 BK-T/U-PAC) and a power terminal (e.g., IB IL 24 PWR IN-PAC) are also required.

The structure with an additional power terminal is considered below.



Secure each Inline station using an end plate, which is supplied as standard with the bus coupler, and an end clamp at the start and end of the station.

## 7.3 Selecting accessories

### 7.3.1 Power supplies



For information about the individual circuits within an Inline station, please refer to the IL SYS INST UM E user manual.

For additional information about the connection of the various supply voltages, please refer to Section 5.1, "Connecting the power supplies".

The selection of suitable power supplies always depends on the individual system. 24 V DC power supplies should, however, always meet the following criteria:

Nominal value:	24 V DC
Ripple:	±5%
Permissible range:	19.2 V to 30 V (ripple included)

#### Electrical isolation

If electrical isolation is required between logic and I/O, you must provide the bus coupler supply  $U_{BK}$  and the I/O supply  $U_M/U_S$  from separate power supply units.

If you want to set up various electrically isolated areas within an Inline station, you must use additional power terminals that are supplied from separate power supply units.



A selection of suitable power supply units can be found in the Phoenix Contact "INTERFACE" catalog.

#### Example project

Logic and I/O are to be electrically isolated in an Inline station. They must therefore be supplied from separate voltage sources.

The logic current consumption of the terminals is 425 mA according to table "Current consumption in the example project" on page 7-5.

For example, the QUINT PS-1 AC/24DC/3.5 power supply unit would be suitable for this current consumption.

For the voltage supply in the circuits  $U_M/U_S$  via the bus coupler and the power terminal, two QUINT-PS-1 AC/24DC/10 power supplies would be suitable, for example.

### 7.3.2 Connectors

If you do not order complete modules (PAC items), the Inline terminals will be delivered without connectors and labeling fields. In this case, order the connectors and labeling fields as accessories, as per your requirements, according to the data sheet. For example, you have the option of fitting digital I/O terminals with plain or color-printed connectors. As complete items are used in the example, the selection of connectors is only considered for the motor starter terminal.

Table 7-2 Connectors

Terminal	Number	Number of connectors	Note	Pcs./Pkt.	Number of packages required
IB IL 400 MLR 1-8A	1	1	IB IL 400 CN-PWR-IN (power connector)	1	1
		1	GMVSTBW 2,5 HV/4-ST-7,62 NZIL (motor circuit connector)	10	1

### 7.3.3 End clamps and labeling fields

Two end clamps are needed to secure an Inline station on the DIN rail. Mount these on both sides of the Inline station to keep it from moving from side to side. Depending on the mounting position, Phoenix Contact recommends CLIPFIX 35-5 end clamps (mounting on a horizontal DIN rail; snapped on without tools) or E/AL-NS 35 end clamps (mounting on a vertical DIN rail; secured with screws).

Select a suitable material for labeling the terminals from the "AUTOMATION" catalog.

### 7.3.4 Minimizing interference

Correct installation and assembly can minimize electromagnetic interference.

Therefore, please observe the grounding and shielding measures described in the IL SYS INST UM E user manual when installing an Inline station.

## Configuration, installation, and startup of an Inline system (example)

### 7.4 Installing an Inline station


**NOTICE:**

Before setting up an Inline station or inserting a terminal, ensure that the entire station is disconnected from the power. Make sure the entire station is reassembled before switching the power back on.

When installing a station, always observe the notes in the IL SYS INST UM E user manual.



Also refer to the terminal-specific data sheets for the individual terminals (e.g., for the connection of sensors/actuators).

**Example project**

Figure 7-1 shows the structure of the Inline station for the example project.

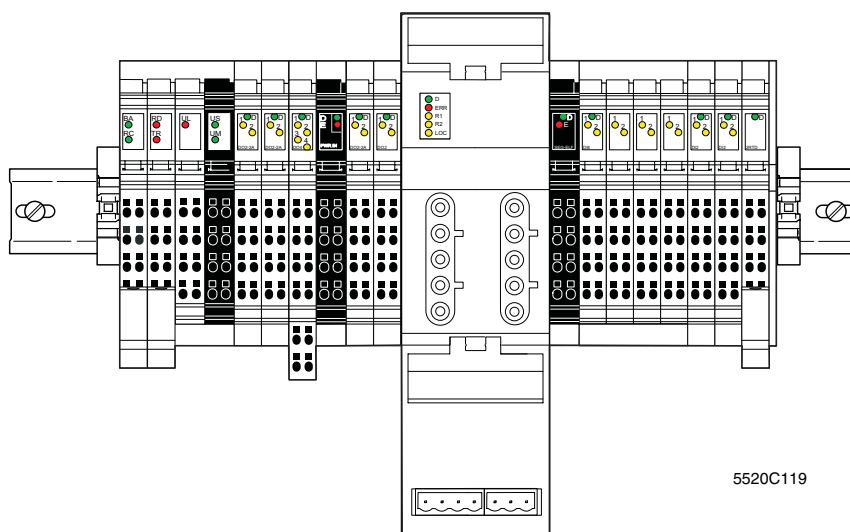


Figure 7-1 Typical structure of an Inline station

## 7.5 Connecting the bus coupler

The INTERBUS remote bus and the supply voltages are connected to the bus coupler. The terminal point assignment is listed in the data sheet for the bus coupler. The following is just a brief overview.

The incoming remote bus is connected to **connector 1**.

The outgoing remote bus is connected to **connector 2**.

**Connector 3** is used to supply the bus coupler supply voltage  $U_{BK}$ .

**Connector 4** provides the contacts for supplying the supply voltage for the main circuit ( $U_M$ ) and the segment circuit ( $U_S$ ).

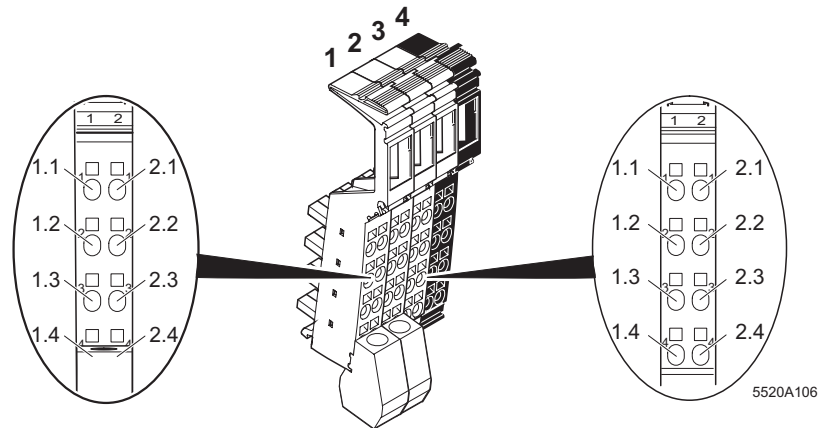


Figure 7-2 Bus coupler connectors

### Safe grounding

To ensure reliable grounding of the Inline station, ground the bus coupler via the FE connection.

Connect the terminal points for the FE connection to a grounded PE terminal (e.g., USLKG 5 universal ground terminal block, Order No. 0441504).

## 7.6 Checking the installation

The following points should be checked before the system is switched on or in the event of an error:

1. Have all system limits been observed?  
(See "Technical data and ordering data" on page 8-1)
2. Has the wiring of the power supply/supplies for the bus coupler and all other terminals been installed correctly? (See terminal-specific data sheets)
3. Are all the sensors and actuators correctly connected to the I/O terminals? (See terminal-specific data sheets)

If all of these points have been checked, the INTERBUS system power supply can be switched on.

## 7.7 Software configuration for INTERBUS

From the planning phase through to system servicing, our software solutions guide you through every stage of the value added chain of an automation solution.

The software tools from Phoenix Contact are perfectly designed to work together, have a modular design, and are based on international standards, which means that even complex applications can be implemented easily.

Software can be used to perform the following tasks:

- Automated planning and configuration of Inline stations:  
AX SALES
- Planning, configuration, and labeling of Inline stations (terminal strips):  
CLIP PROJECT
- Network and device configuration:  
PC WorX, Config+, AutomationXplorer+, CMD
- Application programming:  
PC WorX, programming blocks, Steeplechase VLC
- System visualization:  
Visu+, AX OPC Server
- System diagnostics:  
Diag+



Additional information can be found in the latest "CLIPLINE" and "AUTOMATION" catalogs or on the Internet at [www.phoenixcontact.com](http://www.phoenixcontact.com).

## 7.8 Addressing



For general information about addressing, please refer to the "General introduction to the INTERBUS system" user manual (IBS SYS INTRO G4 UM E).

For information about INTERBUS addressing, please refer to the "INTERBUS addressing" data sheet (DB GB IBS SYS ADDRESS).

## 7.9 Startup



During startup, please refer to the documentation for your controller board and software.

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## 8 Technical data and ordering 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.

### 8.1 INTERBUS system data

#### INTERBUS system

Number of I/O points	4096, maximum (firmware Version 4.4x or later) 8192, maximum (firmware Version 4.6x or later)
Number of data words	256, maximum
Transmission speed	500 kbps or 2 Mbps
Transmission reliability	CR check (hamming distance: 4)
Protocol	IEC 61158

#### Number of devices

Total number of bus devices	512, maximum
Number of remote bus devices	254, maximum
Number of PCP devices	62, maximum (firmware Version 4.4x or later) 126, maximum (firmware Version 4.6x or later)
Number of remote bus levels	16, maximum

#### Distances

From the controller board to the last bus coupler	12.8 km, maximum (copper)
	80 km, maximum (glass fiber)
From the controller board to the first device	400 m, maximum (copper)
	50 m, maximum (polymer fiber)
	300 m, maximum (HCS fiber)
	3000 m, maximum (glass fiber)
Between two remote bus devices	400 m, maximum (copper)
	50 m, maximum (polymer fiber)
	300 m, maximum (HCS fiber)
	3000 m, maximum (glass fiber)
Between two installation remote bus devices	50 m, maximum (copper)
Between a bus coupler and installation remote bus device	50 m, maximum (copper)

## 8.2 Technical data for Inline Modular IO on INTERBUS



For all technical data that generally applies to Inline, please refer to the IL SYS INST UM E user manual. This section only lists data that applies specifically for use on INTERBUS.

### System data

Controller board firmware	Version 4.40 or later
CMD software (for standard controller boards)	Version 4.40 or later
PC WorX software	Version 1.30 or later
Number of devices in an Inline station	63, maximum; see documentation for bus couplers
Maximum current consumption of the Inline terminals	See terminal-specific data sheet or DB GB IB IL DEVICE LIST 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 DB GB IB IL DEVICE LIST data sheet and 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.

### Data transfer

Protocol	IEC 61158; INTERBUS 2-wire 500 kbps or 2 Mbps
Transmission speed	500 kbps or 2 Mbps
Transmission	Inline data jumpers

### Test voltages

#### Isolating distance

#### Test voltage

#### Technology for 24 V area (up to 60 V DC)

5 V supply incoming remote bus/ 5 V supply outgoing remote bus	500 V AC, 50 Hz, 1 min.
5 V supply incoming remote bus/ 7.5 V communications power, 24 V BK supply	500 V AC, 50 Hz, 1 min.
5 V supply incoming remote bus/ 24 V main supply, 24 V segment supply	500 V AC, 50 Hz, 1 min.
5 V supply incoming remote bus/ functional earth ground	500 V AC, 50 Hz, 1 min.
5 V supply outgoing remote bus/ 7.5 V communications power, 24 V BK supply	500 V AC, 50 Hz, 1 min.
5 V supply outgoing remote bus/ 24 V main supply, 24 V segment supply	500 V AC, 50 Hz, 1 min.
5 V supply outgoing remote bus/ functional earth ground	500 V AC, 50 Hz, 1 min.

For additional isolating distances, please refer to the IL SYS INST UM E user manual

## 8.3 Ordering data

### Ordering data for Inline terminals, corresponding connectors, and accessories

For the ordering data for the Inline terminals, corresponding connectors, and accessories, please refer to the corresponding data sheet or the "AUTOMATION" catalog. The catalog is available in electronic form at [www.eshop.phoenixcontact.com](http://www.eshop.phoenixcontact.com).

### Ordering data for documentation

Description	Type	Order No.	Pcs./Pkt.
<b>INTERBUS</b>			
"General introduction to the INTERBUS system" user manual	IBS SYS INTRO G4 UM E	2745211	1
"Configuring and installing INTERBUS" user manual	IBS SYS PRO INST UM E	2743802	1
"INTERBUS & AUTOMATION - Terms and definitions" user manual	IBS TERM RG UM E	2743695	1
"INTERBUS fiber optic installation guidelines" data sheet	DB GB IBS SYS FOC ASSEMBLY	9423439	1
"INTERBUS addressing" data sheet	DB GB IBS SYS ADDRESS	9000990	1
<b>Inline</b>			
"Automation terminals of the Inline product range" user manual	IL SYS INST UM E	2698737	1
"Summary of key data for Inline devices" data sheet	DB GB IB IL DEVICE LIST	-	-



The documentation listed above and all terminal-specific documentation can be downloaded in the download area for the corresponding Inline terminal at [www.download.phoenixcontact.com](http://www.download.phoenixcontact.com).

Make sure you always use the latest documentation.

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## A Examples and tips

### A 1 Tips for working with Inline

#### G4 controller boards

A controller board with firmware Version 4.40 or later is required to operate the INTERBUS installation system. A Generation 4 controller board must therefore be used that can be operated with this firmware version.

Firmware Version 4.4x or later is required to operate a Field Controller or Remote Field Controller. A controller that can be operated with this firmware version must be used



#### Safe grounding

When grounding, always observe the notes in the IL SYS INST UM E user manual.

#### A 1.1 Configuring a station

When configuring an Inline station, you must observe the limit parameters of an Inline station in addition to the INTERBUS system parameters. For example, when using the IBS IL 24 BK-T/U-PAC bus coupler, these limit parameters are:

- Maximum of 63 devices
- Maximum current consumption at  $U_L = 2 \text{ A}$
- Maximum current consumption at  $U_{ANA} = 0.5 \text{ A}$
- Maximum current consumption at  $U_S$  and  $U_M$  (total current) = 8 A

You can configure the station using the DB GB IB IL DEVICE LIST data sheet. This document is available on the Internet at [www.download.phoenixcontact.com](http://www.download.phoenixcontact.com).

Another option is to use the "AX Sales" configuration tool from Phoenix Contact. This is also available on the Internet at [www.download.phoenixcontact.com](http://www.download.phoenixcontact.com).

#### Order of the terminals

Please observe the information in the IL SYS INST UM E user manual.

## A 1.2 Voltage failure diagnostics

There are various ways to diagnose a voltage failure:

### PF on the controller board

A peripheral fault (PF) on the controller board is triggered by:

- The bus coupler if the main or segment voltage on the bus coupler fails
- The IB IL PWR IN/F-D-PAC power terminal with diagnostics if the main voltage is not present
- The IB IL SEG/F-D-PAC segment terminal with diagnostics if the segment voltage is not present

### Diagnostics via the bus

Power and segment terminals with diagnostics use two additional input data bits. In this way they offer the option of diagnosing a voltage failure via the bus.

### Terminals without diagnostics via the bus

With power and segment terminals without diagnostics it is not possible to diagnose a voltage failure via the bus.

With terminals that have an integrated fuse, the error is indicated locally by a red LED on the affected terminal.

We recommend checking for voltage failure by monitoring the segment voltage with a digital input (wiring to a DI terminal).

## **A 2 Voltage concept using the example of a station with an IBS IL 24 BK-T/U-PAC**

The incoming and outgoing remote bus potentials are isolated from one another and from the station electronics. The incoming bus interface shield is connected to FE via a Y capacitor. The outgoing bus interface shield is connected directly to FE.

FE and FE capacitive represent two individual isolated groups.

By providing separate supply options for the communications power and I/O supply, it is easier to create electrical isolation between the logic and I/O.

The I/O circuit of analog terminals always features electrical isolation for the 24 V bus coupler supply. The 24 V bus coupler supply is only looped through here and is available again after the analog terminal.

Electrical isolation between different I/O areas can be created, e.g., by inserting a new 24 V main supply using a power terminal. During this process the 24 V power supply units on the low voltage side must not be connected with one another.

Figure A-1 shows the electrical isolation. A connection between GND (-) of the supply voltage and functional earth ground may only be implemented at one point in the station (point A). If ground (GND) of the bus coupler supply voltage were also connected to functional earth ground, electrical isolation would be lost.

Electrically isolated areas within the station in Figure A-1:

- 1** Bus logic of the station
- 2** I/O (outputs)
- 3** I/O (inputs)

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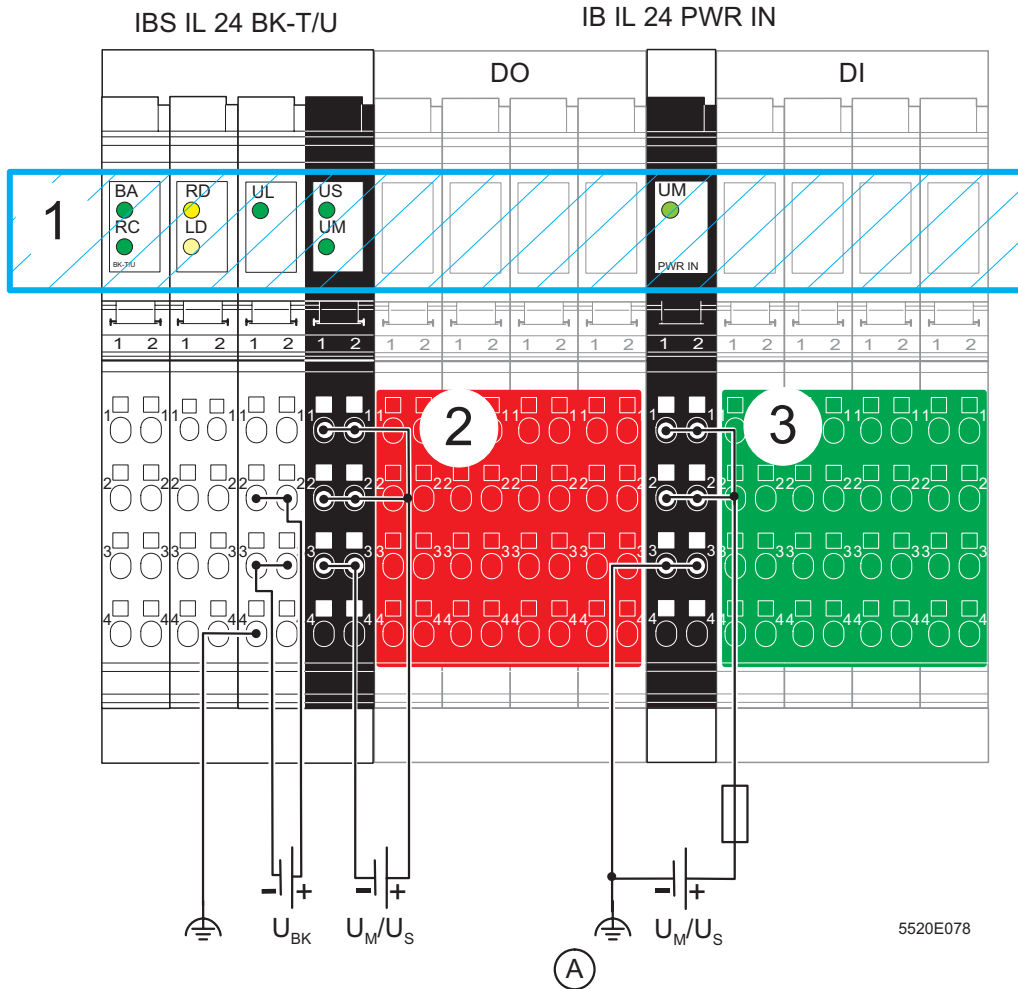


Figure A-1 Creating electrical isolation

In the bus coupler, the power terminal, and the segment terminal, the electronics has a capacitive connection to FE.

For notes on the electrical isolation of the individual terminals, please refer to Section 3.

### A 3 Example of a plant

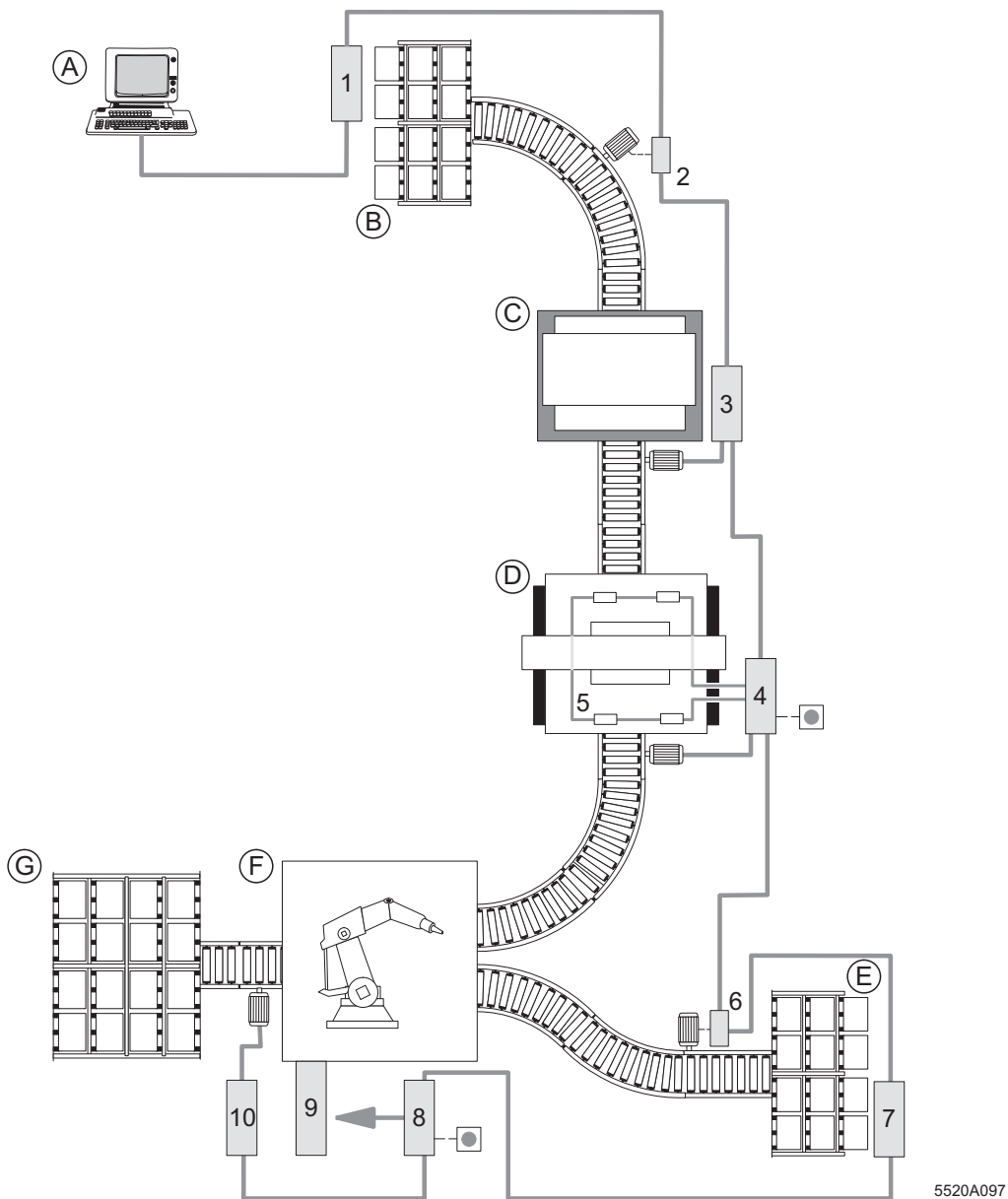


Figure A-2 Example plant

- A Plant control
- B Removal of material from area 1
- C Press
- D Punching machine
- E Removal of material from area 2

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F	Welding robot
G	Material area 3
1, 7, 8	Inline stations
3, 4, 10	Inline stations with power-level terminals
2, 6	Motor starter
5	Fieldline Modular modules
9	Robot controller
	Emergency stop switch

Figure A-2 is a schematic diagram of a plant, which is controlled by a PC.

The Inline station 1 terminals control the removal of material from area 1.

The motor starter (2) is connected directly to the remote bus. This controls a motor, which moves the conveyor belt.

Inline station 3 controls the press. A motor, which moves the conveyor belt, is controlled using a power-level terminal within the Inline station. Because this machine poses a potential risk, it has an integrated safety terminal (IB IL 24 SAFE 1-PAC).

Inline station 4 controls the punching machine. Fieldline Modular devices are connected to the station. These devices monitor the states of the press. An emergency stop switch is integrated here.

A motor, which moves the conveyor belt, is controlled using a power-level terminal within the Inline station.

The next motor for controlling the conveyor belt is connected via a motor starter in the remote bus.

Inline station 7 controls the removal of material from area 2.

A robot controller (9) is connected to INTERBUS via Inline station 8. An emergency stop switch is also connected here.

Inline station 10 controls the storage of material in area 3. The motor for controlling the conveyor belt is connected via a power-level terminal.

## A 4 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 IL SYS INST UM E user manual.

## A 5 Explanation of abbreviations and symbols

For an explanation of the abbreviations and symbols used in basic circuit diagrams, please refer to the IL SYS INST UM E user manual.

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