

# SIEMENS

## SIMATIC

### ET 200SP HA ET 200SP HA Distributed I/O system




#### System Manual

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## Legal information

### Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

 <b>DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.
 <b>WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
 <b>CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.
<b>NOTICE</b>
indicates that property damage can result if proper precautions are not taken.


If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

### Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

### Proper use of Siemens products

Note the following:

 <b>WARNING</b>
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

### Trademarks

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### Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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## Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit  
<https://www.siemens.com/industrialsecurity>.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under  
<https://www.siemens.com/industrialsecurity>.



# Preface

## Purpose of the documentation

This documentation provides comprehensive information on using the ET 200SP HA distributed I/O system in the automation system:

- General information on the ET 200SP HA distributed I/O system
- Configuring
- Installation
- Wiring
- Commissioning

## Basic knowledge required

A basic knowledge of automation technology is required to understand the documentation.

## Validity of the documentation

This documentation applies to the ET 200SP HA distributed I/O system.

The PROFINET IO system based on the ET 200SP HA distributed I/O system can be used in the following combination:

Process control system	As of version	CPU in the automation system
SIMATIC PCS 7	V9.0	SIMATIC CPU 410-5H

## Configuration of the ET 200SP HA

You can configure the following components of the ET 200SP HA when the following updates are installed:

Component of the ET 200SP HA	Required updates
Shared device for IM155-6 PN	HSP0272 V1.01.00
AI (potential distributor terminal block)	HSP0273
AQ (potential distributor terminal block)	HSP0274
DI 32x24VDC HA	HSP0275 V2.00.00
DQ 32x24VDC/0.5A HA	HSP0276 V2.00.00
BusAdapter (types: LC/FC; LC/RJ45)	HSP0278

## Conventions

Please pay particular attention to notes highlighted as follows:

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### Note

Notes contain important information on the product, handling the product or on part of the documentation to which you should pay particular attention.

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## Special information

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### Note

#### Important note for maintaining operational safety of your plant

Plants with safety-related features are subject to special operational safety requirements on the part of the operator. Even suppliers are required to observe special measures during product monitoring. We can notify you of product developments and features that are (or could be) important for operation of safety-related systems.

To ensure you are always up to date in this regard and can make changes to your system, if necessary, you need to subscribe to the corresponding notifications.

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### Newsletter

1. Register for the following newsletters on the Internet ([http://www.industry.siemens.com/newsletter\\_v4/public/LoginPage.aspx](http://www.industry.siemens.com/newsletter_v4/public/LoginPage.aspx)):
  - SIMATIC S7-4xx
  - PCS 7 as of V9.0
  - Distributed I/O
  - SIMATIC Industrial Software
2. Select the "Current" check box for these newsletters.

## Recycling and disposal

The products are low in pollutants and can be recycled. For environmentally compliant recycling and disposal of your electronic waste, please contact a company certified for the disposal of electronic waste.

## Additional support

- Information about the technical support available can be found in the appendix to this documentation (Page 175).
- The technical documentation for the individual SIMATIC products and systems is available on the Internet (<http://www.siemens.com/simatic-tech-doku-portal>).
- The online catalog and the ordering system are available on the Internet (<https://mall.industry.siemens.com>).

## Changes compared to the previous version

You can find an overview of the most important changes here:

- V1.2 or higher:
  - Counter function integrated
  - Additional approvals

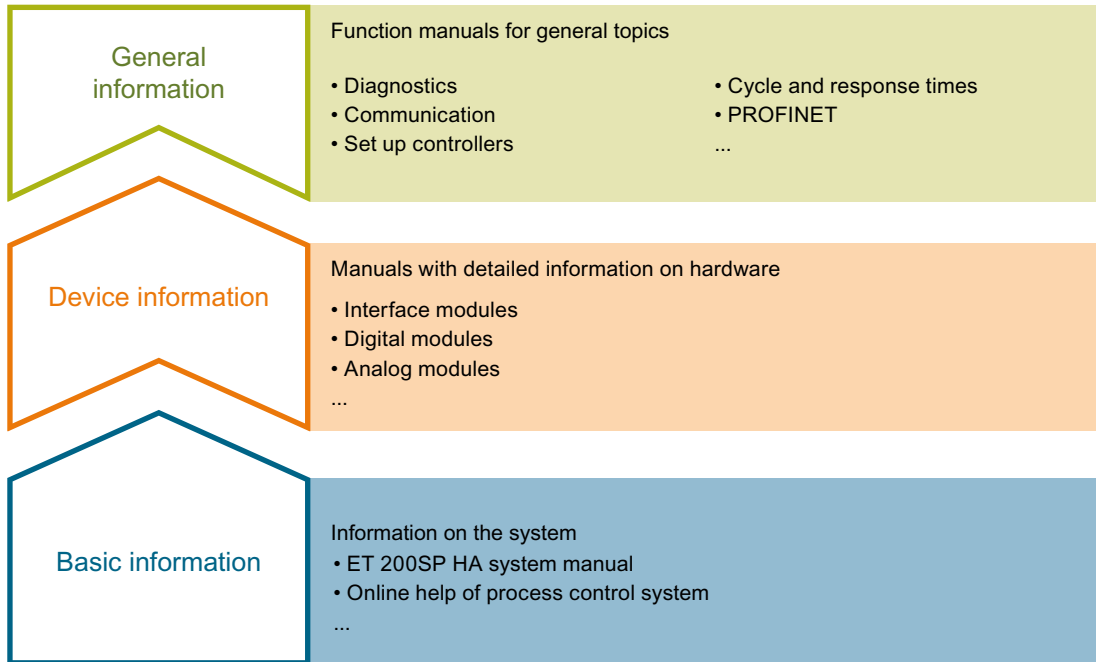
## See also

Contact ([http://support.industry.siemens.com/aspa\\_app/](http://support.industry.siemens.com/aspa_app/))

## 2.1 Documentation guide for ET 200SP HA

The documentation for the distributed I/O system SIMATIC ET 200SP HA is divided into three areas.

This division allows you easier access to the specific information you require.



### Basic information

- The system manual includes a detailed description of installation and wiring of the ET 200SP HA.
- Information on configuring ET 200SP HA is available in the following sections of the documentation:  
Configuration with PCS 7:
  - Configuration Manual *PCS 7 process control system; Engineering System*
  - Function Manual *PCS 7 process control system; High-availability process control systems*
  - Function Manual *PCS 7 process control system; Time synchronization*
  - Function manual *SIMATIC; ET 200SP HA; High-precision time stamping with ET 200SP HA*

### Device information

Product manuals contain a compact description of the module-specific information, such as properties, terminal diagrams, characteristics and technical specifications.

### Comprehensive information

The function manuals contain detailed descriptions of general topics relating to the ET 200SP HA, for example, diagnostics, communication, designing interference-free controllers.

### Information on changes

Changes and additions to the manuals are documented in a product information file when necessary.

## Downloads

You can find the full versions of the documentation as of PCS 7 V9.0 as downloads for the "Technical Documentation of SIMATIC PCS 7" on the Internet (<http://www.siemens.com/pcs7-documentation>):

Technical documentation SIMATIC PCS 7 > "Manuals for SIMATIC PCS 7 Vx.x" area > "Hardware manuals SIMATIC PCS 7 Vx.x" > Distributed I/O

Documentation can be downloaded free of charge.

### ET 200SP HA Manual Collection

- The Manual Collection contains the complete documentation for the ET 200SP HA in a single file.

### My Documentation Manager

- The My Documentation Manager is used to combine entire manuals or only parts of these to your own manual.  
You can export the manual as PDF file or in a format that can be edited later.
- You can find the My Documentation Manager on the Internet (<http://support.industry.siemens.com/My/ww/en/documentation>).

### Application examples

- Applications examples support you with various tools and examples for solving your automation tasks. Solutions are shown in interplay with multiple components in the system - separated from the focus in individual products.
- You can find application examples on the Internet (<http://support.industry.siemens.com/cs/ww/en/ps/ae>).

### CAx data

- You can use the CAx Download Manager to access current product information for your CAD or CAE system.
- You configure your own download package with a few clicks.
- In doing so you can select:
  - Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files
  - Manuals, characteristics, operating manuals, certificates
  - Product master data
- You can find the CAx Download Manager on the Internet (<http://support.industry.siemens.com/my/ww/en/CAxOnline>).

## 2.2 2D matrix code (QR code / EAN code)

The 2D matrix code on the product is a coded representation of the product-specific article number.

### Access to product-related information

For reading the 2D matrix code, SIEMENS offers an app for mobile use.

Information about the app and the download can be found on the Internet: "Mobile use via app (<https://support.industry.siemens.com/cs/ww/en/sc/2067>)".

The app provides direct access to the technical forum and product related posts, such as:

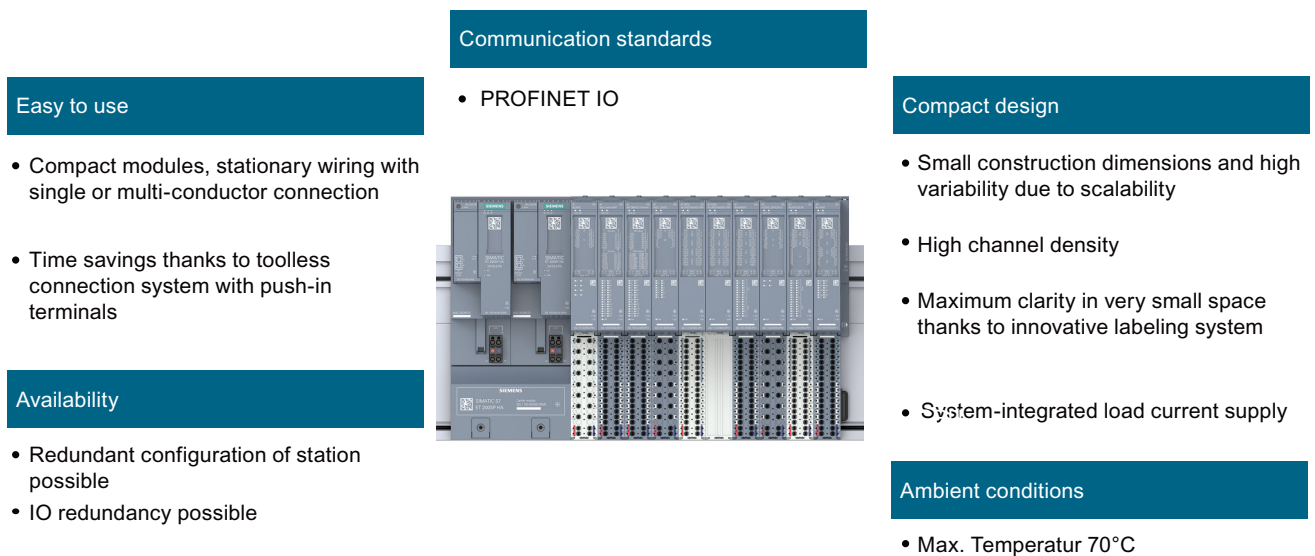
- FAQs
- Application examples
- Manuals
- Certificates
- Product notices

## System overview

### 3.1 What is the SIMATIC ET 200SP HA distributed I/O system?

The SIMATIC ET 200SP HA distributed I/O system is a scalable and highly flexible I/O system that enables you to connect process signals to a higher-level controller via PROFINET IO.

#### Customer benefits of the system



#### Area of application

The SIMATIC ET 200SP HA distributed I/O system is suitable for a variety of applications. The scalable design allows you to adjust your configuration to the specific local requirements.

The range of I/O modules is constantly expanding.

- You can obtain information on new modules through the newsletter.
- You can find information about the existing product range in the current catalog.

ET 200SP HA is designed with IP 20 degree of protection and for installation in a control cabinet.

#### Applications for safety engineering

Through use of fail-safe CPUs, you implement applications for safety engineering. You perform configuration and programming of your safety program, just like the configuration and programming for your standard CPUs.

3.1 What is the SIMATIC ET 200SP HA distributed I/O system?

**Configuration example**

For use in an automation system, you combine the following components of the SIMATIC ET 200SP HA distributed I/O system into an IO device. An example configuration of an IO device is shown in the following figure:

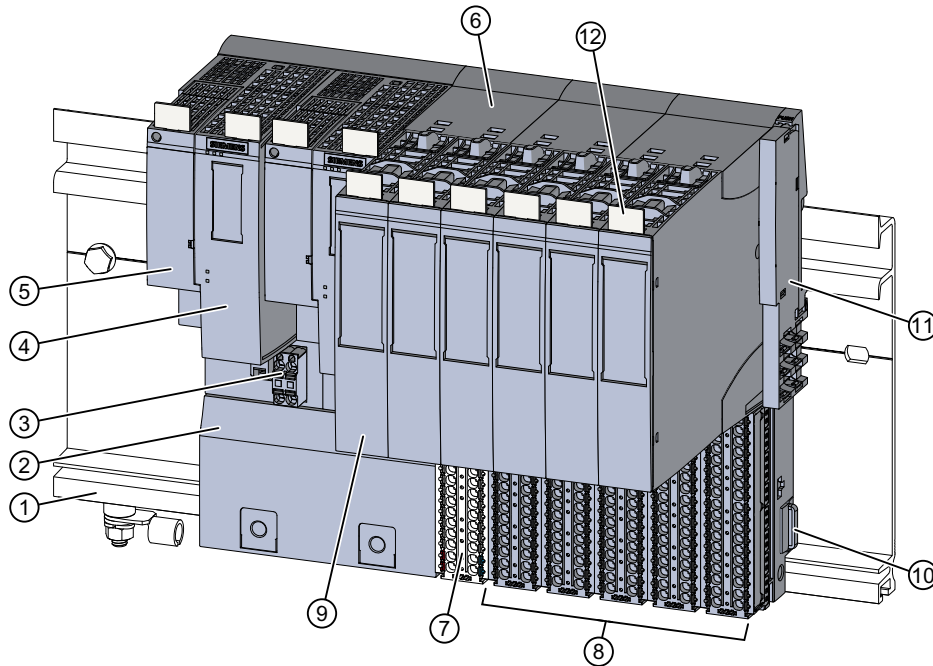


Figure 3-1 Example configuration for an IO device

Table 3-1 Legend for sample configuration (numbering in the installation sequence)

①	<b>Rail:</b> The rail is the type-specific installation platform of the IO device.
②	<b>Carrier module</b> for interface module: The carrier modules are used for the electrical and mechanical connection of the individual modules.
③	<b>Plug-in connector</b> 4-pin: Connection for supply voltage (X80)
④	<b>Interface module:</b> An interface module is the interface of the distributed I/O system to the central unit of the automation system.
⑤	<b>BusAdapter:</b> The BusAdapter connects the IO device to the IO controller (CPU) via PROFINET IO.
⑥	<b>Carrier modules</b> for I/O: The slots for the I/O modules are created by the connection of these carrier modules to the terminal blocks.
⑦	<b>Terminal blocks:</b> The terminal blocks provide the process terminals for connecting sensors, actuators and other devices.
⑧	⑦ Light-colored terminal block TB..D: Separation of potential groups and terminals for connection to the supply voltage ⑧ Dark-colored terminal blocks TB..B: Extending the potential group
⑨	<b>I/O modules:</b> The I/O modules are converters between the process signals and the digital data of the interface modules.
⑩	<b>Power bus cover:</b> Server module and power bus cover complete the configuration of the IO device.
⑪	<b>Server module:</b> Server module and power bus cover complete the configuration of the IO device.
⑫	<b>Reference identification label:</b> The reference identification labels are used to identify the slots.

## 3.2 Basic components of the IO device

### Basic components for configuration of IO devices

The following tables show the components for configuring IO devices based on the ET 200SP HA distributed I/O.

Table 3-2 Rail

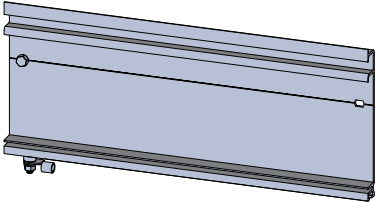
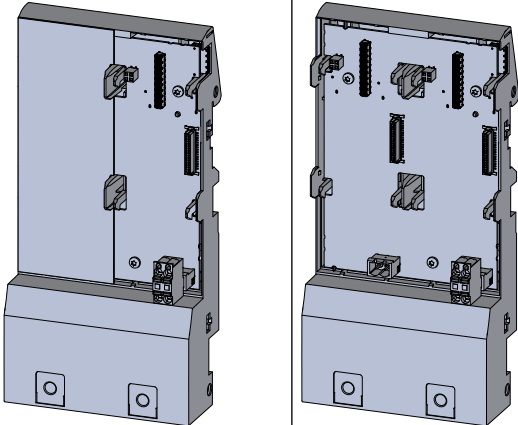
Function	Figure
<p>The rail is the component on which the modules of the IO device are attached.</p> <p>The upper part corresponds to a standard rail (width 35 mm).</p>	

Table 3-3 Carrier module for interface module

Function	Figure
<p>Carrier modules for interface modules are available in the following versions:</p> <ul style="list-style-type: none"> <li>Carrier module for 1 interface module (required for singular connection of the IO device to PROFINET IO)</li> <li>Carrier module for 2 interface modules (required for redundant connection of the IO device to PROFINET IO)</li> </ul> <p>The carrier modules connect the interface module to the backplane bus.</p> <p>They enable data exchange with the I/O modules.</p> <p><b>Note:</b> Interface modules cannot be plugged in if the corresponding connector for the supply voltage is plugged in beforehand.</p>	

3.2 Basic components of the IO device

Table 3-4 Interface module (module for PROFINET IO)

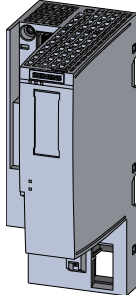
Function	Figure
<p>The interface module:</p> <ul style="list-style-type: none"> <li>• Connects the IO device to the IO controller</li> <li>• Exchanges data with I/O modules via the backplane bus.</li> </ul>	

Table 3-5 BusAdapter

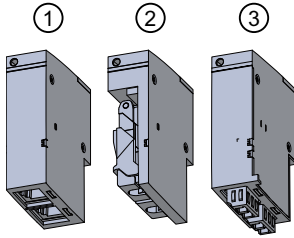
Function	Figure
<p>The BusAdapters for PROFINET IO allow you to freely choose the connection system for the IO device. Several versions of the BusAdapter are available for the interface modules (see documentation SIMATIC Distributed I/O; BusAdapter for distributed I/O (<a href="https://support.industry.siemens.com/cs/ww/en/view/109747250">https://support.industry.siemens.com/cs/ww/en/view/109747250</a>)):</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>• BusAdapter with standard RJ45-connector (BusAdapter 2xRJ45) ①</li> <li>• BusAdapter with FastConnect connector for direct connection of the bus cable (BA 2xFC) ②</li> <li>• BusAdapter with connector for fiber-optic cable (BA 2xLC) ③</li> </ul>	

Table 3-6 Carrier module

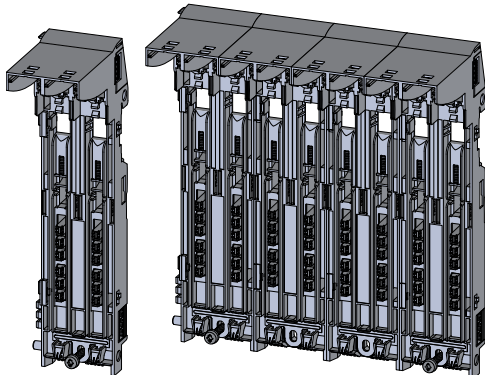
Function	Figure
<p>The carrier module routes the backplane bus to all I/O modules. The power bus is extended depending on each placed terminal block. Carrier modules for I/O modules are available in the following versions:</p> <ul style="list-style-type: none"> <li>• Carrier module 2x</li> <li>• Carrier module 8x</li> </ul> <p><b>Note:</b> The fixing screws are secured for transport in the factory state. Remove these transport locks before tightening the fixing screws.</p>	

Table 3-7 Terminal block

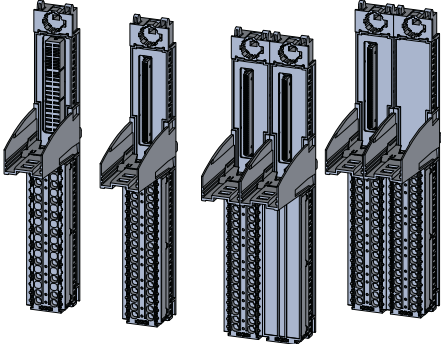
Function	Figure
<p>The selection of terminal blocks determines the following properties:</p> <ul style="list-style-type: none"> <li>• Type of supply voltage</li> <li>• Formation of potential groups</li> <li>• Type of the required I/O module</li> <li>• Redundant configuration of the I/O modules</li> <li>• Terminal block with potential distributor</li> </ul> <p>Select the terminal blocks according to the plant-specific requirements. You can find information on this in the section "Selecting a terminal block for I/O modules (Page 32)".</p> <p>Example illustration: Basic view of selected terminal blocks (dark-colored type in this case)</p>	

Table 3-8 I/O module

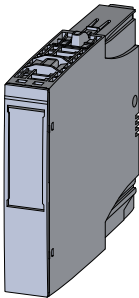
Function	Figure
<p>With ET 200SP HA, the I/O modules are inserted in slots, which arise from the combination of carrier module and terminal block. The I/O modules detect the current process status or trigger corresponding reactions through the sensors and actuators connected to the terminal block.</p> <p>In addition to the standard modules (DI; DQ; AI; AQ), there are the following types of modules:</p> <ul style="list-style-type: none"> <li>• Relay module (RQ)</li> <li>• Universal module</li> </ul> <p><b>Note:</b> All I/O modules with a signal voltage up to 24 V can be used for IO redundancy.</p>	

Table 3-9 Slot cover


Function	Figure
<p>Insert a slot cover on terminal blocks:</p> <ul style="list-style-type: none"> <li>• When slots are not plugged with I/O modules.</li> <li>• When slots are reserved for future expansion (as empty spaces).</li> </ul> <p>You can insert a label strip for the planned I/O module on the front of the slot cover.</p>	

Table 3-10 Server module and power bus cover



Function	Figure
<p>Server module and power bus cover complete the configuration of the IO device.</p> <p>The power bus cover is used to protect the power bus contacts.</p>	

Table 3-11 Coding element (for terminal block)

Function	Figure
<p>There is a mechanical coding element for the ET 200SP HA distributed I/O system. This element encodes the type of the installed I/O module.</p> <p>You can find additional information on this in the section "Replacing an I/O module with another type (Page 123)".</p>	

### Component for the supply voltage

You can find information on suitable components on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/9172884>): *Interactive Catalog CA01; Automation and Drives*

### 3.3 Accessories for the IO device

The following accessories are available for SIMATIC ET 200SP HA:

Table 3-12 Shield connector

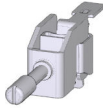
Function	Figure
The shield connector allows the low-impedance contacting of cable shields with minimum installation times.	

Table 3-13 Labeling strips

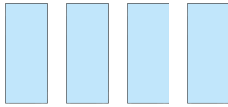
Function	Figure
Attach the labeling strips on the modules for plant-specific labeling of the IO device. The labeling strips can be printed. The labeling strips can be ordered as accessories (Page 171): <ul style="list-style-type: none"> <li>• for thermal transfer printers on a roll</li> <li>• for laser printers as A4 sheets</li> </ul>	

Table 3-14 Reference identification labels

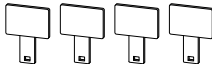
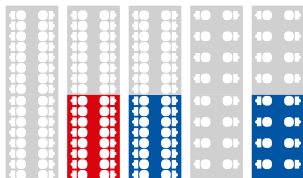
Function	Figure
The labels enable the reference identification of the IO device components. The labels can be ordered as accessories (Page 171): <ul style="list-style-type: none"> <li>• for thermal transfer and inkjet printers on a sheet</li> </ul>	

Table 3-15 Color-coded labels

Function	Figure
The color-coded labels can be ordered for specific modules and for process terminals as accessories (Page 171).	



# Plant planning

## 4.1 Topology

An overview of various options for setting up a PROFINET network is given below.

### Linear



All the communication nodes are connected in a linear bus topology.

If a connecting element (for example switch) fails, data exchange beyond the failed connecting element is no longer possible.

For PROFINET the line topology is implemented with switches that are integrated in the IO devices. Therefore, the linear bus topology at PROFINET is merely a special form of tree / star topology.

Linear bus topology structures require the least wiring.

### Ring



In order to increase the availability of a network, use ring structures. In principal, a linear topology is connected to a ring through a so-called redundancy manager. Typical redundancy managers are:

- CPU that supports the Media Redundancy Protocol (MRP)
- Communication processor that supports the Media Redundancy Protocol (MRP)
- External switch (SCALANCE X)

If there is a break in the network, the redundancy manager ensures that the data is redirected over an intact network connection.

### Star



When IO devices are connected to a switch with more than two PROFINET ports, a star topology arises automatically.

Unlike in other structures, if an individual IO device fails, this does not necessarily result in failure of the entire network. The failure of the switch results in the failure of the IO devices connected to this switch.

### Tree

If you interconnect multiple star structures, a tree-shaped topology arises.

## Network

All IO devices connected via switches are located in one and the same network. All IO devices in a network can communicate directly with one another.

The subnet mask is identical for all IO devices in the same network.

A network is physically limited by a router.

---

### Note

If IO devices are to communicate with one another across network boundaries, you must configure the router in such a way that it permits this communication.

The communication from PROFINET IO functions exclusively within a network. You have the option of connecting various PROFINET IO networks via PN/PN coupler.

---

## Additional information

You can find more detailed information in the SIMATIC NET manual Communication with SIMATIC (<https://support.industry.siemens.com/cs/ww/en/view/1254686>).

You should also read the PROFINET Installation Guideline from the PROFIBUS User Organization (<http://www.profibus.com/download/>).

You can find basic information in the manual SIMATIC NET Twisted Pair and Fiber Optic Networks (<https://support.industry.siemens.com/cs/ww/en/view/8763736>).

## 4.2 Basics

In accordance with the standards for electrical devices, all components of the ET 200SP HA distributed IO system are classified as open equipment.

---

### Note

You must ensure the following for the operation of the ET 200SP HA:

- Only authorized, trained or authorized personnel have access to the IO devices (e.g. protection by enclosure, control cabinet or control room).
  - The ambient conditions for the IO devices have been taken into account in the plant (see section "Mechanical and climatic environmental conditions (Page 143)").
-

## 4.3 Special conditions for safe use of the ET 200SP HA

The ET 200SP HA must be installed in a suitable enclosure which ensures at least IP 54 degree of protection according to EN 60529.

Use a safety enclosure that meets the requirements regarding spread of fire and exhibits an appropriate strength according to UL61010-1 and UL 61010-2-201.

Observe the applicable ambient conditions when using the ET 200SP HA.

The ET 200SP HA may only be used in an environment with no more than pollution degree 2 (as defined in EN 60664-1).

### Use in hazardous area Zone 2

- A permissible installation location is below the maximum permissible installation height of 2000 m above sea level.
- A manufacturer declaration in accordance with EN 60079-0 or a manufacturer declaration for fulfillment of Zone 2 in accordance with EN 60079-15 must be available for the enclosure.

### Additional information

Section "Mechanical and climatic environmental conditions (Page 143)"

## 4.4 Potential relationships in the IO device

The following potential relationships apply in the IO device based on the ET 200SP HA distributed IO system:

- Same potential:
  - The same potential only exists for the supply voltages of I/O modules of one potential group.  
You can find information on this in the section "Forming potential groups (Page 34)".
- There is electrical isolation between:
  - The power circuits of the supply voltage / process signals and all other circuit elements of the IO device.
  - The communication interfaces of the interface module (PROFINET) and all other circuit elements of the IO device.

## 4.5 Hardware configuration

### Maximum mechanical configuration

As soon as **one** of the following rules applies, the maximum configuration has been reached for an IO device based on the ET 200SP HA distributed I/O:

Table 4-1 Maximum mechanical configuration

Properties	Rule
Number of modules	Maximum 56 slots for I/O modules, regardless of their use
Backplane bus length of the IO device	Maximum configuration width (without interface module) = 1.3 m Even number of I/O modules (max. 56) x width of the I/O modules in the IO device (22.5 mm) + server module (5 mm) = 1265 mm Observe the width of the carrier modules (45 mm/180 mm).
Configuration	Read section "Minimum clearances in the control cabinet (Page 60)".

### Maximum electrical configuration

The permissible load current of a potential group is **max. 10 A** (supply voltage L+/M on the light-colored terminal block).

This load current is divided into the following portions:

- Power requirements of all I/O modules
- Power requirements of the components supplied via these I/O modules

The maximum number of I/O modules contained in a potential group is thereby limited.

Table 4-2 Permissible load current depending on the number of installed terminal blocks

Number of terminal blocks	Permissible load current in amperes
4	10
5	8
6	7
7	6
8	5
10	4
15	3
20	2

### Address space

The address space depends on the following used components:

- Interface module
- IO controller/IO device

The documentation is available on the Internet (Page 12).

## **Distances for the fieldbus (PROFINET)**

The permissible cable length between nodes on PROFINET depends on the following factors:

- Cable types (electrical/optical)
- Transmission paths (use of amplifiers/repeaters)

You can find information on this in the Catalog ST PCS 7 on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/9172884>).

## 4.6 Selecting the carrier module

### Carrier modules for interface modules (types)

You determine the type of carrier modules based on availability requirements.

Carrier modules for interface modules are available in ET 200SP HA in following versions:

- Carrier module for 1 interface module
- Carrier module for 2 interface modules (for redundant configuration of the interface modules)

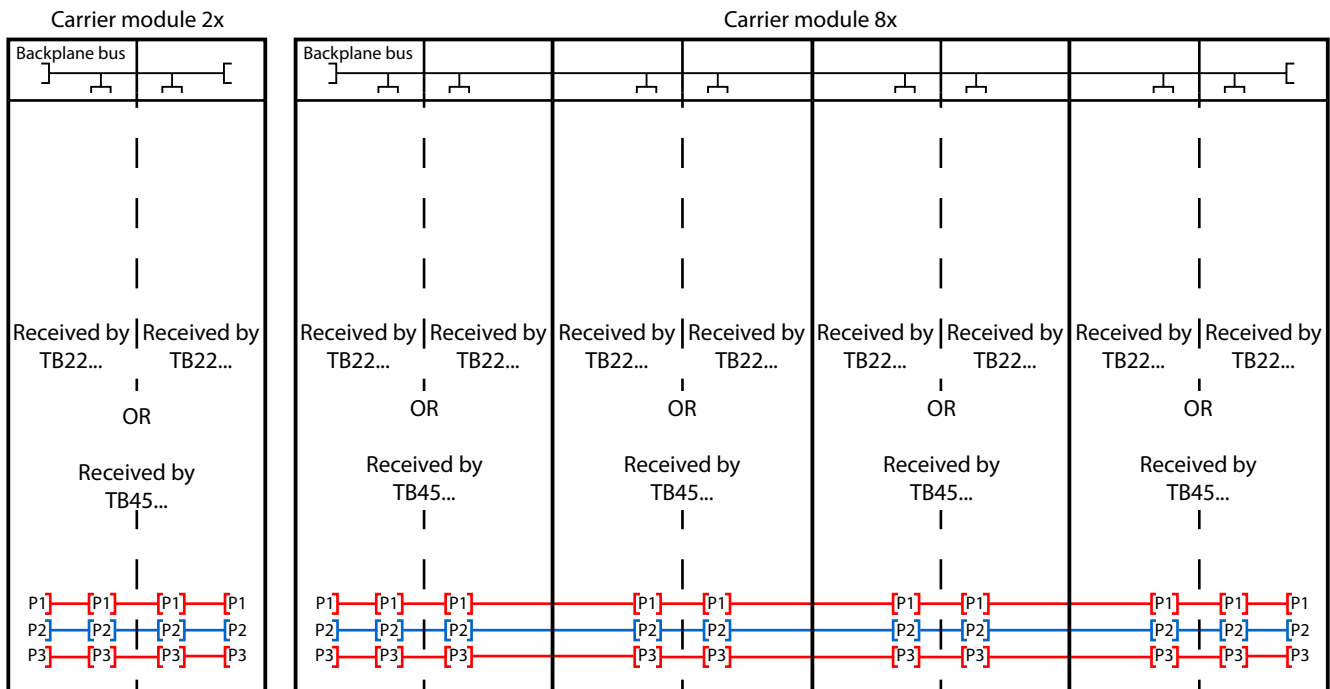
You can find additional information on use in the section "Mounting the interface module (Page 66)".

### Carrier modules for I/O modules (types)

You determine the number and type of carrier modules based on the planned I/O modules. You can find information on configuration limits in an IO device in the section "Hardware configuration (Page 28)".

The following types of carrier modules are available in ET 200SP HA:

- Carrier module with 2 slots (width: 45 mm)
- Carrier module with 8 slots (width: 180 mm)



### **Additional information**

- You can find the article numbers in the section "Accessories/spare parts (Page 171)".
- You can find information on the function and design of the carrier modules in the manual (for download, see "Documentation guide for ET 200SP HA (Page 12)")

## 4.7 Configurations of the slots of I/O modules

### 4.7.1 Selecting a terminal block for I/O modules

Table 4-3 ET 200SP HA TERMINAL BLOCKS

Category	Type	Color	Article number	Short	Properties
ET 200SP HA TERMINAL BLOCK (24V)	TYPE H1	LIGHT	6DL1193-6TP0 0-0DH1	TB22-P32+4D/T	24 V terminal block, new power bus group (light gray), temperature compensation
	TYPE H1	DARK	6DL1193-6TP0 0-0BH1	TB22-P32+4B/T	24 V terminal block, power bus jumper (dark gray), temperature compensation
	TYPE M1	LIGHT	6DL1193-6TP0 0-0DM1	TB45R-P32+4D/T	24 V terminal block, I/O redundancy, new power bus group (light gray)
	TYPE M1	DARK	6DL1193-6TP0 0-0BM1	TB45R-P32+4B/T	24 V terminal block, I/O redundancy, power bus jumper (dark gray)
	TYPE P0	LIGHT	6DL1193-6TP0 0-0DP0	TB45-P32+32x24V+4M+4D	24 V terminal block, additional 32 sensor supply, new power bus group (light gray)
	TYPE P0	DARK	6DL1193-6TP0 0-0BP0	TB45-P32+32x24V+4M+4B	24 V terminal block, additional 32 sensor supply, power bus jumper (dark gray)
	TYPE N0	LIGHT	6DL1193-6TP0 0-0DN0	TB45-P32+36xM+4D	24 V terminal block, additional 32 M terminals, new power bus group (light gray)
	TYPE N0	DARK	6DL1193-6TP0 0-0BN0	TB45-P32+36xM+4B	24 V terminal block, additional 32 M terminals, power bus jumper (dark gray)
ET 200SP HA TERMINAL BLOCK (highly insulated)	TYPE K0	LIGHT	6DL1193-6TP0 0-0DK0	TB22-P16+4D	Highly insulated terminal block, new power bus group (light gray)
	TYPE K0	DARK	6DL1193-6TP0 0-0BK0	TB22-P16+4B	Highly insulated terminal block, power bus jumper (dark gray)

You can find additional information on this and the technical specifications in the section "Technical specifications - Terminal blocks (Page 153)".

Table 4-4 Assignment terminal blocks to I/O modules

I/O module	ET 200SP HA TERMINAL BLOCK (TYPE)				
	24V St TB (H1)	24V Red TB (M1)	24V L+ TB (P0)	24V M TB (N0)	Isol TB (K0)
DI 16x24VDC	x	Optional		Optional **)	
DI 32x24VDC	Optional		x	Optional **)	
DI 16xNAMUR	x	Optional		Optional **)	
DI 8x125VDC					x
DI 8x230VAC					x
DQ 16x24V/0.5A	x	Optional		Optional **)	
DQ 32x24V/0.5A	Optional			x	

I/O module	ET 200SP HA TERMINAL BLOCK (TYPE)				
	24V St TB (H1)	24V Red TB (M1)	24V L+ TB (P0)	24V M TB (N0)	Isol TB (K0)
RQ 4x230/5A CO					x
DI-AI 16x / DQ16x	x	Optional		Optional **)	
AI 16xI HART	x	Optional		Optional **)	
AI 16xTC 8xRTD	x	Optional		Optional **)	
AQ 8xI HART	x	Optional		Optional **)	

\*\*) For connection of additional ground cables from the field

## Selecting terminal blocks

Select the terminal block for the slot of an I/O module based on the following dependencies:

- Definition of I/O modules associated with a potential group
- Requirement for configuring redundant I/O modules
- Parameters of the required I/O module (number of process terminals, temperature detection)

You can find additional information on this and the technical specifications in the section "Technical specifications - Terminal blocks (Page 153)".

Plug the terminal blocks into carrier modules.

### Note

#### Voltage in a potential group

- A mixed configuration of I/O modules with different signal voltage is allowed within a potential group.
- The supply voltage for all I/O modules is: 24 V DC

You can find additional information on this in following sections:

- Section "Forming potential groups (Page 34)"
- Section "Installing the terminal block (Page 71)"
- Section "Wiring the terminal block (Page 86)"

## Name of the terminal blocks: TBxxZ-Kyy+n\_/T

TBxxZ-Kyy+n_/T	Meaning
TB	Terminal block
xx	Width of the terminal block: <ul style="list-style-type: none"> <li>• 22=TB is 22.5 mm wide</li> <li>• 45=TB is 45.0 mm wide</li> </ul>
Z	R=IO redundancy
C	P=Push-in terminal
yy	Process terminals: (P) number

TBxxZ-Kyy+n_/T	Meaning
n	Infeed: Number of supply terminal and type e.g. 32x24V+4M: 32 supply terminals for 24V and 4 supply terminals for ground
-	B=Power bus is connected to the left module D=Power bus is interrupted to the left
/T	T=Temperature detection possible (This marking is only available for terminal blocks with temperature detection.)

**Additional information**

Additional information on assigning the terminals of the terminal blocks:

- Section "Hardware configuration (Page 28)"
- Section "Wiring rules (Page 85)"
- You can find information on the function and design of the respective terminal block in the manual (download, see "Documentation guide for ET 200SP HA (Page 12)")

**4.7.2 Forming potential groups**

**4.7.2.1 Forming potential groups by arranging terminal blocks**

You form the potential groups by arranging the terminal blocks for the distributed IO system ET 200SP HA.

**Requirements**

You can position terminal blocks when the following components of the IO device have been installed:

- Carrier module for the interface module
- At least one carrier module for I/O modules

**Rules for positioning terminal blocks**

Start the assembly on the first carrier module for I/O modules to the right next to the carrier module for the interface module.

**Starting a potential group**

- The first (left-hand) terminal block which you install in the IO device (on the first carrier module to the right next to the interface module) is a light-colored terminal block.
- Connect the supply voltage to a light-colored terminal block.
- Each light-colored terminal block which you install in the IO device starts a new potential group.
- The power bus is interrupted to the left.

**Extending the potential group**

- Each dark-colored terminal block passes the supply voltage connected on the light-colored terminal block to the I/O modules and to the dark terminal block positioned to the right of it.
- The power bus is continuous.

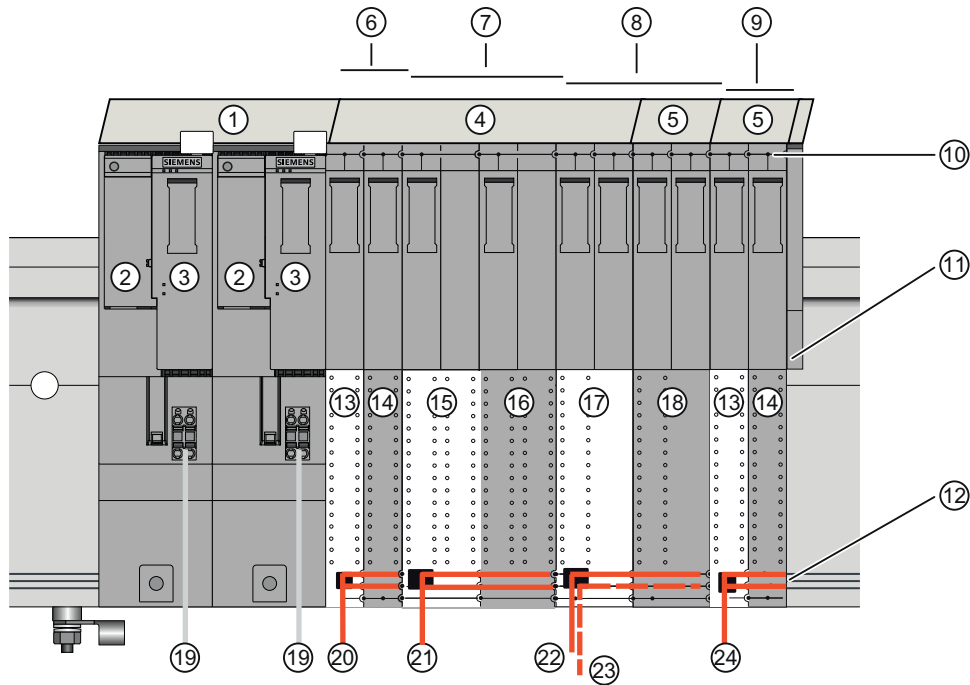
**Replacing a terminal block with another terminal block type**

- When you position a light-colored terminal block on the left next to a dark-colored terminal block, the light-colored terminal block interrupts the power bus to the left and starts a new potential group at the same time.  
You can find additional information on this in the section "Replacing a terminal block (Page 125)".

**Load current**

- You can find information on this in the section "Hardware configuration (Page 28)".

Example for the configuration of an IO device



- |   |   |    |  |
|---|---|----|--|
| 1 | Carrier module IM                                 | 13 | Light-colored terminal block   |
| 2 | BusAdapter  | 14 | Dark-colored terminal block  |
| 3 | Interface module (IM)                             | 19 | Supply voltage L+ of the IM  |
| 4 | Carrier module 8x                                 | 20 | Supply voltage L+ (of potential group 1)   |
| 5 | Carrier module 2x                                 | 21 | Supply voltage L+ (of potential group 2)   |
| 6 | Potential group 1                                 | 22 | Supply voltage 1L+ of the IO redundant load root (of potential group 2) 1L+ = 1P1, M = 1P2: supplies left-hand I/O module  |
| • | ④ Carrier module 8x (2 slots used)                | 23 | Supply voltage 2L+ of the IO-redundant load root (of potential group 3) 2L+ = 1P3, M = 2P2: supplies right-hand I/O module |
| 7 | Potential group 2                                 |    |  |
| • | ④ Carrier module 8x (4 slots used)                |    |  |
| • | Terminal block with potential distributor         |    |  |
| – | ⑮ Light terminal block with potential distributor |    |  |
| – | ⑯ Dark terminal block with potential distributor  |    |  |
| 8 | Potential group 3                                 |    |  |
| • | ④ Carrier module 8x (last 2 slots)                |    |  |
| • | ⑤ 1 carrier module 2x                             |    |  |
| • | Terminal block for I/O redundancy                 |    |  |
| – | ⑰ Light terminal block for IO redundancy          |    |  |
| – | ⑱ Dark terminal block for IO redundancy           |    |  |

- 9 Potential group 4
  - ⑤ Carrier module 2x
- 10 Backplane bus (hidden)
- 11 Server module
- 12 Power bus and power bus cover

Figure 4-1 Example for positioning terminal blocks

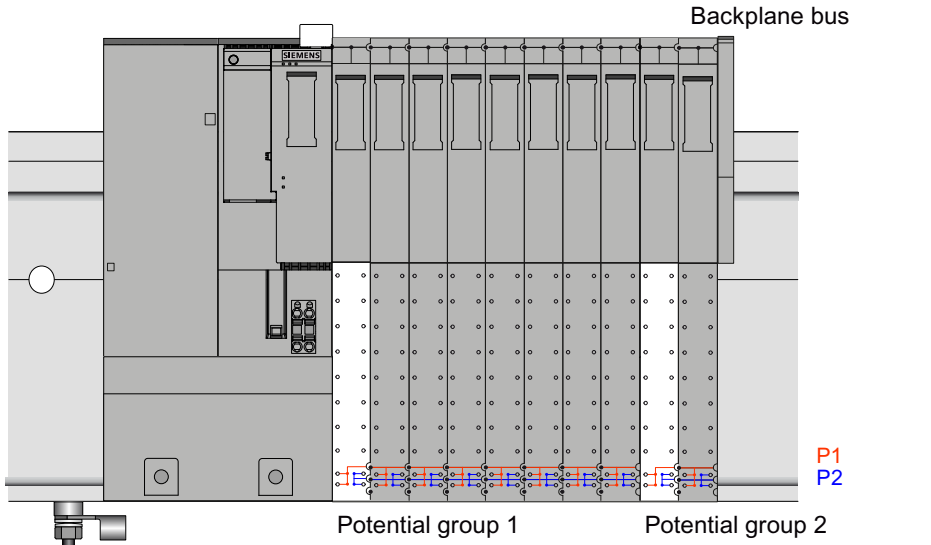
### 4.7.2.2 Configuration examples for potential groups

The following tables show basic configuration examples with I/O modules on terminal blocks.

The different distribution of the supply voltage via the power bus using the terminal block types is shown for the terminals on the terminal blocks.

### Configuration examples

Table 4-5 Configuration example for terminal blocks with 16 process terminals

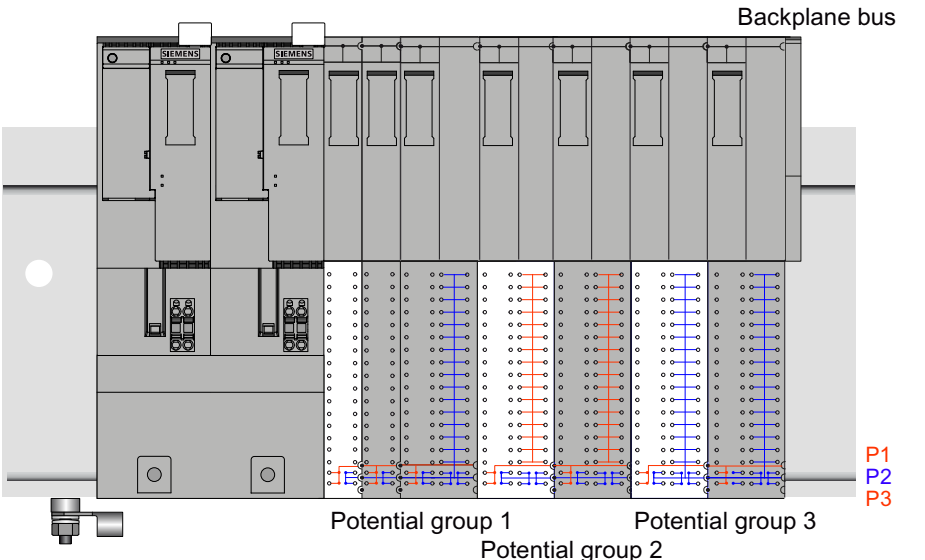
Terminal blocks	Configuration
<p><b>Width: 22.5 mm</b></p> <ul style="list-style-type: none"> <li>• <b>TB22-P16+4D</b> Enable new potential group (light terminal block) Article number: 6DL1193-6TP00-<b>0DK0</b></li> <li>• <b>TB22-P16+4B</b> Use potential group of the left module (dark terminal block) Article number: 6DL1193-6TP00-<b>0BK0</b></li> </ul>	 <p>The diagram illustrates the internal wiring of a terminal block. It shows a central 'Backplane bus' at the top. Below it, two rows of terminal blocks are shown, labeled 'Potential group 1' and 'Potential group 2'. Each terminal block has 16 terminals. The wiring shows connections from the backplane bus to the terminals, with specific connections labeled 'P1' (red) and 'P2' (blue) at the bottom right.</p>

4.7 Configurations of the slots of I/O modules

Table 4-6 Configuration example for terminal blocks with 32 process terminals

Terminal blocks	Configuration
<p><b>Width: 22.5 mm</b></p> <ul style="list-style-type: none"> <li>• <b>TB22-P32+4D/T:</b> Enable new potential group (light terminal block) Article number: 6DL1193-6TP00-0DH1</li> <li>• Terminal block dark-colored; <b>TB22-P32+4B/T:</b> Potential group is extended Article number: 6DL1193-6TP00-0BH1</li> </ul> <p><b>Width: 45 mm (terminal block for I/O redundancy - e.g. potential group 2)</b></p> <ul style="list-style-type: none"> <li>• <b>TB45R-P32+4D/T:</b> Enable new potential group (light terminal block) Article number: 6DL1193-6TP00-0DM1</li> <li>• <b>TB45R-P32+4B/T:</b> Use potential group of the left module (dark terminal block) Article number: 6DL1193-6TP00-0BM1</li> </ul>	<p>The diagram illustrates a rack configuration with a backplane bus at the top. Two potential groups are shown: Potential group 1 (light-colored) and Potential group 2 (dark-colored). The terminal blocks are arranged in two rows. The top row contains two light-colored terminal blocks (TB22-P32+4D/T) and ten dark-colored terminal blocks (TB22-P32+4B/T). The bottom row contains two dark-colored terminal blocks (TB45R-P32+4B/T) and ten light-colored terminal blocks (TB45R-P32+4D/T). The terminal blocks are connected to the backplane bus. The diagram also shows the connection of the terminal blocks to the potential groups. The labels 'P1', 'P2', and 'P3' are shown on the right side of the diagram, indicating the potential groups.</p>

Table 4-7 Configuration example for terminal block with 32 process terminals and 32 terminal-potential distributors

Terminal blocks	Configuration
<p><b>Width: 22.5 millimeter terminal block</b> (see configuration example for terminal blocks with 32 process terminals)</p> <p><b>Width: 45 mm</b></p> <p><b>Terminal block with L+ potential distributor (e.g. potential group 2)</b></p> <ul style="list-style-type: none"> <li>• <b>TB45-P32+32x24V+4M+4D:</b> Enable new potential group (light terminal block) Article number: 6DL1193-6TP00-0DP0</li> <li>• <b>TB45-P32+32x24V+4M+4B:</b> Use potential group of the left module (dark terminal block) Article number: 6DL1193-6TP00-0BP0</li> </ul> <p><b>Terminal block with M potential distributor (e.g. potential group 3)</b></p> <ul style="list-style-type: none"> <li>• <b>TB45-P32+36xM+4D:</b> Enable new potential group (light terminal block) Article number: 6DL1193-6TP00-0DN0</li> <li>• <b>TB45-P32+36xM+4B:</b> Use potential group of the left module (dark terminal block) Article number: 6DL1193-6TP00-0BN0</li> </ul>	 <p style="text-align: right;">Backplane bus</p> <p style="text-align: center;">Potential group 1      Potential group 3 Potential group 2</p> <p style="text-align: right;">P1 P2 P3</p>

### 4.7.2.3 Terminal block with potential distributor (L+ potential)

#### General pin assignment with potential distributor

- The pin assignment on the left side of the terminal blocks with a potential distributor should be set in accordance with the configured I/O module.
- The potential distributor with the following terminals is located on the right side of the terminal block:
  - 32 L+ terminals for power supply of sensors.
  - Four M terminals

**Note**

- The L+ terminals on the potential distributor are intended exclusively for the sensors connected to the I/O module using a 2-wire connection system.
- You may not use these terminals as voltage source for other devices in the system.

**Recommendation: Use terminal blocks with potential distributors**

The following terminal block should be used to connect sensors with two wires:

Article No.	Function/parameter <sup>1)</sup>
6DL1193-6TP00-0DP0	Allow new potential group (light terminal block)
6DL1193-6TP00-0BP0	Use potential group of the left module (dark terminal block)

<sup>1)</sup> Make sure that this parameter is enabled in HW Config starting with the commissioning.

Table 4-8 Benefits of potential distributors compared to using external power supply units

Advantage with terminal block with potential distributor	Disadvantage without potential distributor
<p>The L+ terminals on the potential distributor are connected individually using automatic circuit breakers to a maximum of 20 mA.</p> <p>In the event of a short-circuit or overload, "only" the affected channel fails.</p>	<p>No separate protection</p> <p>Short circuit or overload affects the entire system.</p>

## Pin assignment of the potential distributor

Table 4-9 Pin assignment of terminal blocks with a potential distributor (right side of terminal block: Terminals 33 to 64)

Terminal	Assignment	Terminal	Assignment	Explanations
33	L+	34	L+	L+: Supply voltage L+, for sensors 3P2: Ground reference of the voltage bus 1P 4P2: Ground reference of the voltage bus 2P 5P2: Ground reference of the voltage bus 1P 6P2: Ground reference of the voltage bus 2P
35	L+	36	L+	
37	L+	38	L+	
39	L+	40	L+	
41	L+	42	L+	
43	L+	44	L+	
45	L+	46	L+	
47	L+	48	L+	
49	L+	50	L+	
51	L+	52	L+	
53	L+	54	L+	
55	L+	56	L+	
57	L+	58	L+	
59	L+	60	L+	
61	L+	62	L+	
63	L+	64	L+	
3P2	M	5P2	M	
4P2	M	6P2	M	

### 4.7.2.4 Terminal block with potential distributor (M potential)

#### General pin assignment with potential distributor

- The pin assignment on the left side of the terminal blocks with a potential distributor should be set in accordance with the configured I/O module.
- 36 M terminals are located on the right side of the potential distributor.

---

#### Note

##### Connection information

- The M terminals on the right side are intended exclusively for the loads connected to the I/O using 2-wire connection system. You may not use these terminals as the ground terminals for other devices in the system.
  - Ensure that the total current does not exceed 10 A.
-

4.7 Configurations of the slots of I/O modules

**Recommendation: Use a terminal block with potential distributor**

The following terminal block should be used to connect actuators with two wires:

Article No.	Function/parameter <sup>1)</sup>
6DL1193-6TP00-0DN0	Allow new potential group (light terminal block)
6DL1193-6TP00-0BN0	Use potential group of the left module (dark terminal block)

<sup>1)</sup> Make sure that this parameter is enabled in HW Config starting with the commissioning.

**Pin assignment of the potential distributor**

Table 4-10 Pin assignment of terminal blocks with a potential distributor (right side of terminal block: Terminals 33 to 64)

Terminal	Assignment	Terminal	Assignment	Explanations
33	M	34	M	M33 to M64: Supply voltage ground reference for actuator 3P2: Ground reference of the voltage bus 1P 4P2: Ground reference of the voltage bus 2P 5P2: Ground reference of the voltage bus 1P 6P2: Ground reference of the voltage bus 2P
35	M	36	M	
37	M	38	M	
39	M	40	M	
41	M	42	M	
43	M	44	M	
45	M	46	M	
47	M	48	M	
49	M	50	M	
51	M	52	M	
53	M	54	M	
55	M	56	M	
57	M	58	M	
59	M	60	M	
61	M	62	M	
63	M	64	M	
3P2	M	5P2	M	
4P2	M	6P2	M	

## 4.8 Redundancy and changes during operation

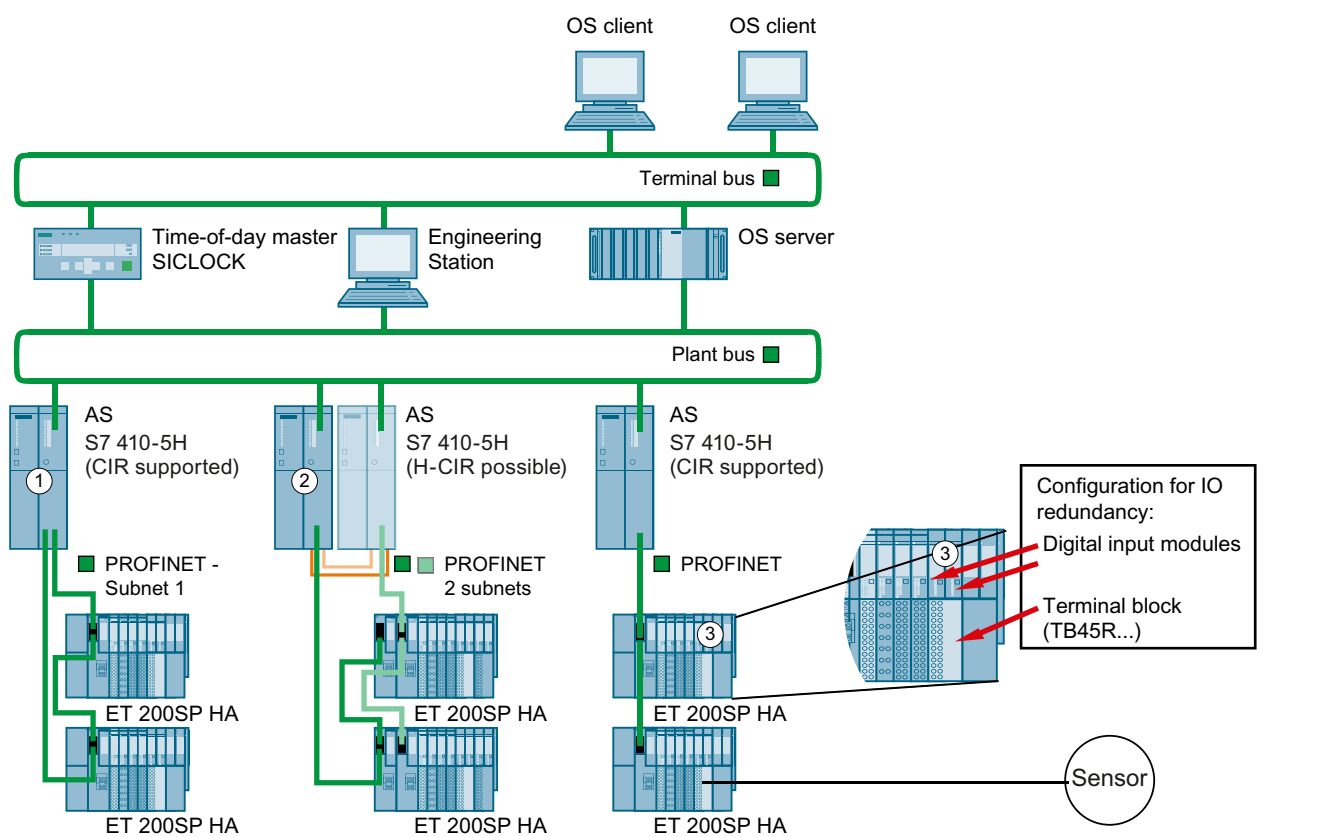
### Introduction

This section describes the possibilities for increasing the availability of a plant with an IO device based on the ET 200SP HA distributed I/O.

### Basic redundancy configurations

You can increase the availability of the distributed I/O by implementing redundancy configurations in the plant. Multiple redundancy configurations can be combined.

The figure below shows an example of some of the possible redundancy configurations:



Configuration	① Media redundancy	② System redundancy	③ IO redundancy
Brief information	Use Media Redundancy Protocol (MRP)	Connection via redundant media (2 subnets) and/or redundant interface modules	Use of redundant I/O modules in an IO device
Configuration example: See section:	Connection of the IO device via media redundancy (Page 47)	Connection of the IO device via system redundancy (Page 44)	IO redundancy (Page 49)

Figure 4-2 Redundancy configurations of the distributed I/O with ET 200SP HA

### Allow changes to the plant in runtime (CiR and H-CiR)

You can use the ET 200SP HA to create hardware configurations that allow certain changes to be made during ongoing operation under defined conditions.

The following procedures should be followed to perform the changes.

- Use of CiR (Configuration in RUN) in a system with a single CPU - 1oo1  
You can perform certain configuration changes during operation.
- Use of H-CiR (Configuration in RUN in a system with a redundant CPU - 1oo2)  
You can perform configuration changes in subsystems with redundant CPU system changes during operation.

You can find information on the configuration guidelines, requirements and procedures in the system manual SIMATIC; Fault-tolerant systems; S7-400H (<http://support.industry.siemens.com/cs/ww/en/view/82478488>)

### Additional information

- Documentation of the I/O module used
- System manual SIMATIC Process Control System PCS 7 - CPU 410-5H Process Automation (<https://support.industry.siemens.com/cs/ww/en/view/96839331>)

### See also

Contact ([http://support.industry.siemens.com/aspa\\_app/](http://support.industry.siemens.com/aspa_app/))

## 4.8.1 Connection of the IO device via system redundancy

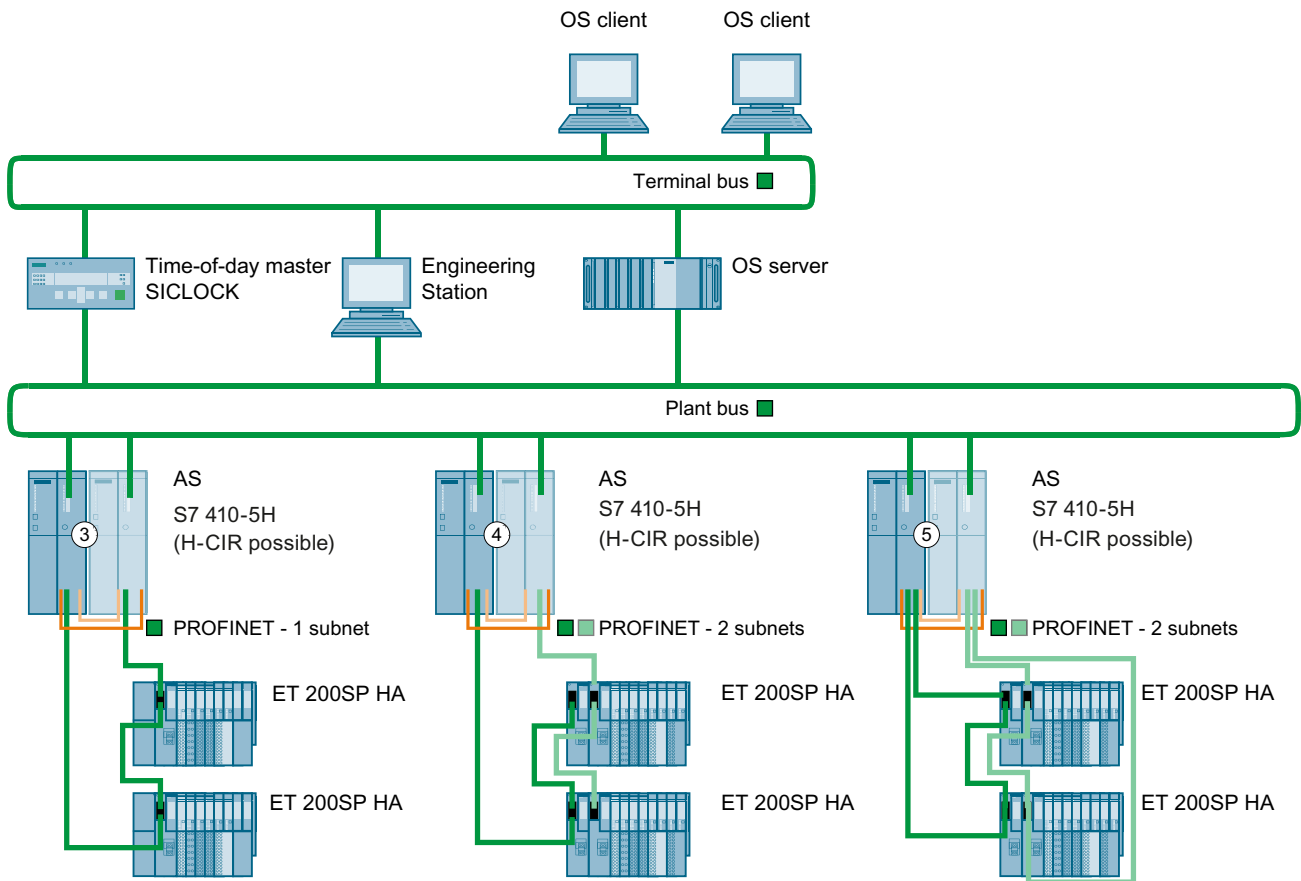
### Connection of the IO device with system redundancy

IO devices are connected to a redundant IO controller.

With system redundancy, all redundantly used components are in continuous operation. When a redundancy partner fails, the function is maintained when the master role is assumed or a different communication path is selected.

### Configuration

The following figure shows examples for the connection of the IO devices to the H-system.



### Application planning

Observe the following rules for configuring the IO devices:

Configuration (see figure under Configuration)	③ System redundancy (1 subnet)	④ System redundancy (2 subnets in a line structure)	⑤ System redundancy + Media redundancy (2 subnets in a ring structure)
Coupling			
Hardware	IO device with 1 interface module	Redundant IO device (IO device with 2 interface modules)	
Mounting rule	No special considerations	Redundantly used interface modules must be identical, i.e. they must have the same article number and the same hardware version or firmware version.	

Configuration (see figure under Configuration)	③ System redundancy (1 subnet)	④ System redundancy (2 subnets in a line structure)	⑤ System redundancy + Media redundancy (2 subnets in a ring structure)
Subnet configuration	The PROFINET IO system begins and ends at an IO controller.	An interface module is connected to each of the two IO controllers. The PROFINET IO systems can be created in a subnet.	
Media redundancy	Possible		Yes: The subnet ring is closed by the MRP connection to the same CPU.
Configuring in HW Config	If a PROFINET IO system is created at each PN-IO connection of the CPU, a newly inserted interface module is automatically connected to both PROFINET IO systems of the CPU.		
Node name	The nodes on the fieldbus (PROFINET IO) must be assigned unique names.		
Network connections (example):	<ul style="list-style-type: none"> <li>• Network1: CPU (0) X5 port 1 + CPU (1) X5 port 1</li> </ul>	<ul style="list-style-type: none"> <li>• Network1: CPU (0) X5 port 1</li> <li>• Network2: CPU (1) X5 port 1</li> </ul>	<ul style="list-style-type: none"> <li>• Network1: CPU (0) X5 port 1 + CPU (0) X5 port 2</li> <li>• Network2: CPU (1) X5 port 1 + CPU (1) X5 port 2</li> </ul>

### Activating system redundancy type R1 for distributed I/O

The system redundancy type R1 for distributed I/O can be activated through a license key. This license key must be transferred onto the SEC of the CPU. You can perform the activation without swapping the SEC.

You can activate system redundancy type R1 for distributed I/O as the upgrade of the system expansion card of a CPU 410-5H.

You can find information on this in the documentation *Process Control System PCS 7, Service Support and Diagnostics*.

### Response to failure

The following applies when a CPU or PROFINET cable fails:

The IO devices continue to be available in the PROFINET IO system.

### Maintenance and service

One of the following functions is possible in runtime:

- Connecting and removing IO devices
- Replacing PROFINET cables
- Replacing a CPU

## 4.8.2 Connection of the IO device via media redundancy

### Connection of the IO device with media redundancy

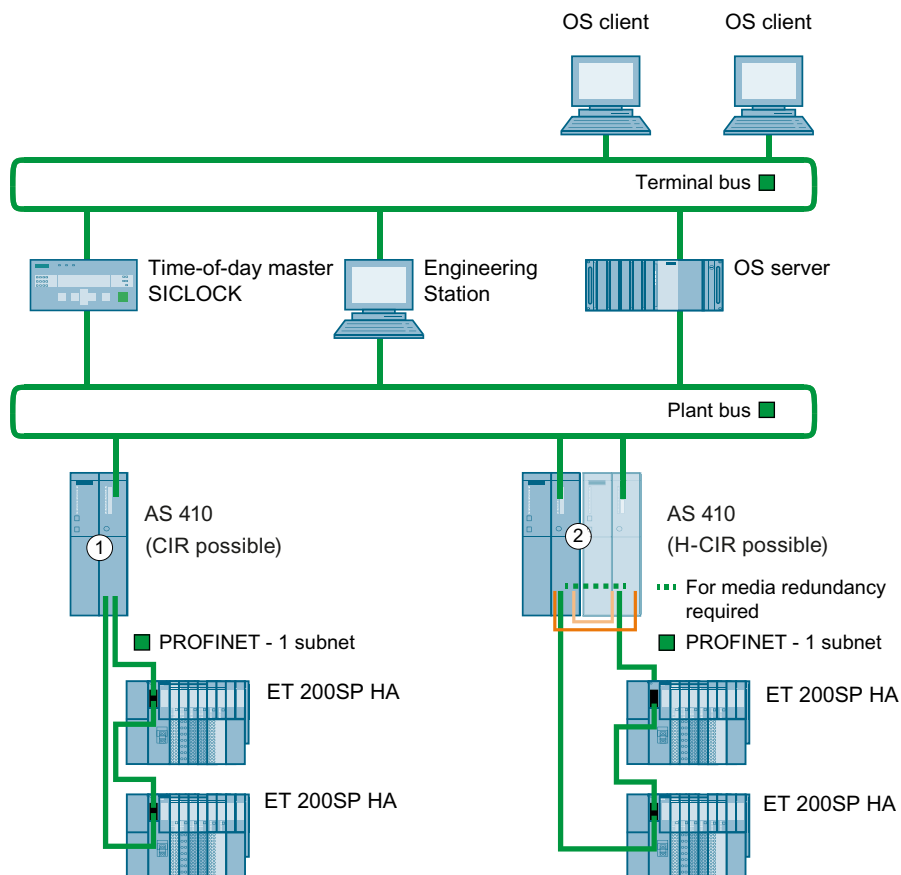
IO devices (1 interface module for each IO device) are connected to an IO controller in a ring topology. All nodes of the ring must support the "Media redundancy" function. The IO controller must be configured as an MRP manager.

To set up a ring topology with media redundancy, you must join both free ends of a linear network topology in the same device. Closing the linear bus topology to form a ring is achieved with two ports (ring ports) of a device in the ring. At least one device of the ring takes over the role of the redundancy manager. All other devices in the ring are redundancy clients.

### Configuration

The following figure shows examples for the connection of the IO devices in the PROFINET IO system:



- Media redundancy (1 subnet ring)
- Media redundancy + System redundancy (1 subnet ring)



**Application planning**

Observe the following rules for configuring the IO devices:

MRP must be enabled for ring configurations. All nodes of the ring are in an MRP domain.

Configuration (see figure under Configuration)	① Media redundancy (1 subnet ring)	② Media redundancy + System redundancy (1 subnet ring)
Coupling		
Hardware	IO device with 1 interface module	
Mounting rule	No special considerations	
Subnet configuration	Each node is connected to two other nodes in a ring configuration.	The PROFINET IO system begins and ends at an IO controller. Each node is connected to two other nodes in a ring configuration.
Configuration in HW Config	The IO controller must be configured as an MRP manager	The MRP parameter assignment must be completed. If a PROFINET IO system is created at each PN-IO connection of the CPU, a newly inserted interface module is automatically connected to the PROFINET IO system of the CPU.
Node name	The nodes on the fieldbus (PROFINET IO) must be assigned unique names.	
Network connections (example):	Network1: CPU (0) X5 port 1 + CPU (0) X5 port 2	Network1: CPU (0) X5 port 1 + CPU (1) X5 port 1  Connection CPU (0) X5 port 2 with CPU (1) X5 port 2

**Application planning**

Observe the following rule for installing the IO devices:

The IO devices must be configured in a ring structure.

**Response to failure**

If the ring structure is interrupted, the following applies:

The IO devices continue to be available in the system.

**Maintenance and service**

One of the following functions is possible in runtime:

- Connecting and removing IO devices
- Replacing PROFINET cables

### 4.8.3 IO redundancy

#### IO redundancy

To configure the IO redundancy, plug 2 input/output modules (module pair) of the same type next to each other on a special terminal block (TB45R...).

This terminal block connects the process signals of the two IO modules to a common process terminal.

- There is less wiring work compared to connecting separate I/O modules, because the interconnection of the process signals is integrated in the system.
- The redundant signal processing of the sensors and actuators on the module level increases the availability of the system.

#### Application planning

Observe the following rules for installing I/O modules in IO redundancy:

##### Hardware rule

- The I/O modules must be approved for redundant operation. You can find this information in the manual for the respective module.
- Redundantly deployed I/O modules must be identical, i.e. they must have the same article number, the same hardware version and the same firmware version.

##### Mounting rule

I/O modules of the same type are plugged in pairs next to each other in the same IO device.

IO redundancy:

- Both slots are located in the same adapter module.  
Read section "Selecting the carrier module (Page 30)".
- Both slots are in the same terminal block (**TB45R**).  
Read the section "Selecting a terminal block for I/O modules (Page 32)".

---

#### Note

##### Specific wiring

Always read the documentation of the I/O module used.

---

##### Configuration

- Configure redundancy for the I/O module.
- The settings you make for an I/O module always apply to the module pair.

### Configuration

The following figure shows an example for the connection of the sensors or actuators each with two redundantly used input/output modules.

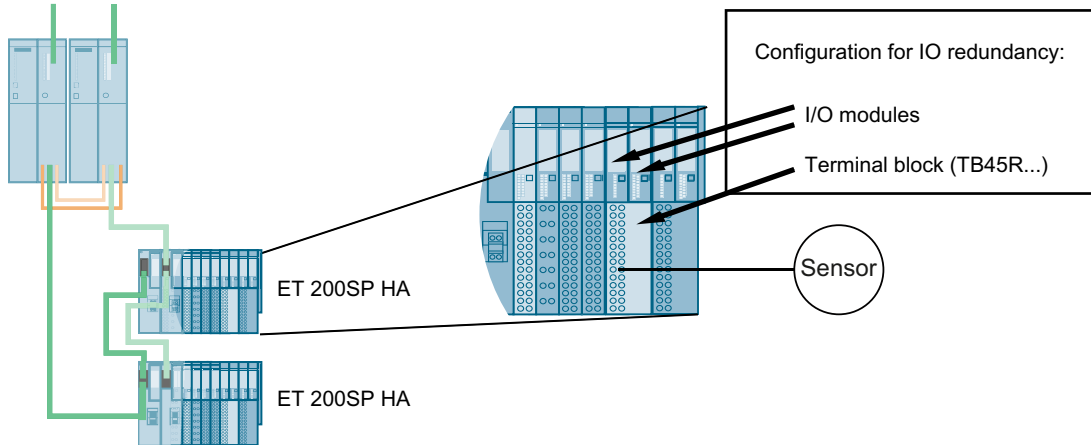


Figure 4-3 S7-400 H-system with sensors and actuators on module pairs (redundant signal processing)

### Response to failure

The following applies when a I/O module or a channel of the two I/O modules fails (valid for input/output and mixed modules):

The following applies when individual channels when a fault occurs:

- Error-free inputs remain available in the system.
- Error-free outputs are still controlled in the system.

### Maintenance and service

In the ongoing, error-free operation, one of the following functions is possible for one I/O module of a module pair:

- Firmware update
- Replacing a module

#### NOTICE

**I/O modules in the I/O redundancy mode for which at least one channel is configured with "Keep last value"**

When the CPU is in "STOP" mode or the PROFINET cable is pulled, the following action are also prohibited one after the other:

- Replacement of both I/O modules
- Firmware update for both I/O modules

Without an active connection to the CPU in "RUN" mode, the online parameter "Keep last value" is reset in both I/O modules. Both I/O modules output the value 0.

### **Additional information**

- Documentation of the I/O module used
- System manual *SIMATIC STEP 7; CPU 410-5H Process Automation*
  - Changes to the plant in runtime by means of CiR
  - Changes to the plant in runtime by means of H-CiR
- Configuration Manual *PCS 7 Process Control System; Engineering System*

## 4.9 Time synchronization and time stamping

### 4.9.1 Overview - Time synchronization and time stamping with ET 200SP HA

#### Introduction

The following sections show the possibilities for time synchronization of distributed I/O based on SIMATIC ET 200SP HA.

The time synchronization is only relevant when using time stamping.

#### Time synchronization options

Table 4-11 Explanations of the configurations with time stamping by the distributed I/O with ET 200SP HA

No.	Configuration	Quick reference guide	Setup example
1	<b>Split plant bus</b>	Division of the plant bus is mandatory when using time stamping with an accuracy of 1 ms.	You can find information on this in the section "Plant-wide time synchronization and time stamping with a precision of 1 ms (Page 52)"
2	<b>Configurations with a single CPU</b>	Connection via redundant media (2 PROFINET IO systems) using redundant interface modules	You can find information on this in the section "Time synchronization and time stamping with a single CPU (Page 55)"
3	<b>Configurations with redundant CPU</b>	Using redundant I/O modules in an IO device	You can find information on this in the section "Time synchronization and time stamping with redundant CPU (Page 56)"

#### Additional information

- Function manual *SIMATIC; ET 200SP HA; ET 200SP HA - Time Stamping*
- If PCS 7 is used:  
Function manual *SIMATIC; Process Control System PCS 7; High-precision Time Stamping with ET 200SP HA*

### 4.9.2 Plant-wide time synchronization and time stamping with a precision of 1 ms

#### Time synchronization of events

When a plant has multiple automation systems, the time stamps of events should be comparable.

The comparison of time stamps of events is based on the time synchronization of the associated automation systems.

You can find additional information on this in Function Manual *PCS 7 Process Control System; Time Synchronization*.

### Recommendation

To increase the **plant-wide** time synchronism, separate the network for time synchronization of the automation systems (referred to hereinafter as the TIME-Net) from the system bus.

### Separation of the system bus

- **Section of the system bus for synchronization of the AS with the central system clock**
  - This network only connects the time master (SICLOCK TC400) and the AS to each other.
  - There is a **direct connection** between the central system clock and the first CPU (see figure below).
- **Section of the system bus for communication of the automation systems with other systems (e.g. engineering system; OS)**
  - This network is connected via a separate communication channel (e.g. CP 443-1).

The figure shows an example of the connection of an H-system to the time master. The two parts of the figure show the difference in the connection between the example configurations:

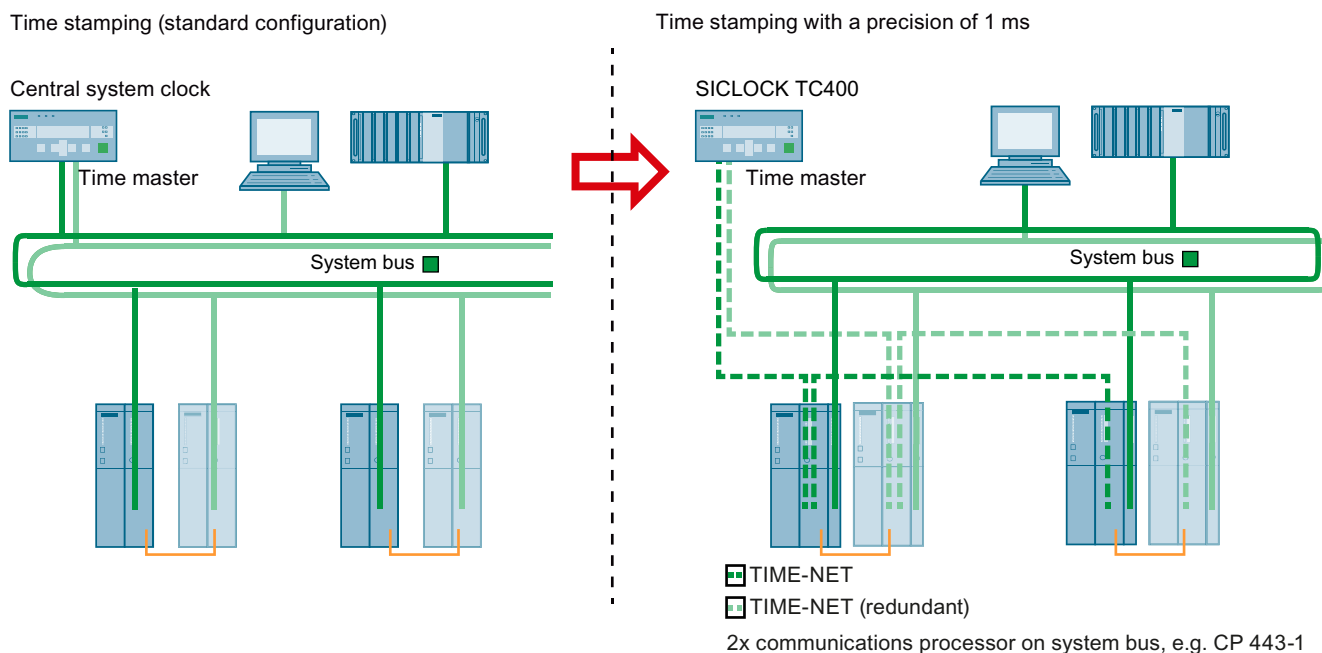


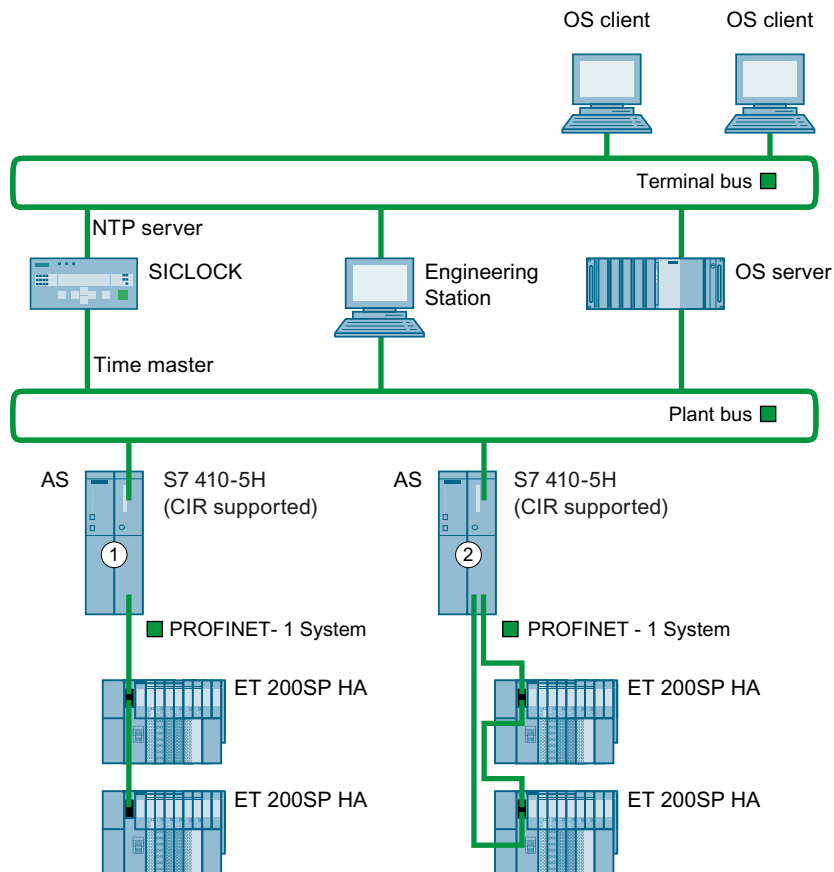
Figure 4-4 Application of configurations for time stamping

## Result

- A network (labeled "TIME-NET" here) only connects the central system clock to the first CPU configured for time stamping.  
This CPU sends time frames to other nodes in the TIME-NET.
- A central system clock of **SICLOCK TC400** type sends the time frames via Industrial Ethernet.
- There is a **direct connection** between the central system clock and the integrated PN-IO interface of the CPU.
- The time synchronization of the CPU is performed with the **SIMATIC procedure**.

### 4.9.3 Time synchronization and time stamping with a single CPU

#### Example configurations



Time master  
Automation system  
Plant bus

A SICLOCK with SIMATIC time-of-day synchronization.  
CPU 410-5H in 1oo1 mode  
1 PN/IO subnet on an internal PN/IO interface of the IO controller (e.g. CPU 410-5H: X5 connection)

Configurations  
① ②

**Note:**  
The configurations are not suitable for time stamping with an accuracy of 1 ms. You can find additional information on the required configuration changes in section "Plant-wide time synchronization and time stamping with a precision of 1 ms (Page 52)". For complete information, see the function manual *SIMATIC; ET 200SP HA; Time Stamping with ET 200SP HA*.

Fieldbus

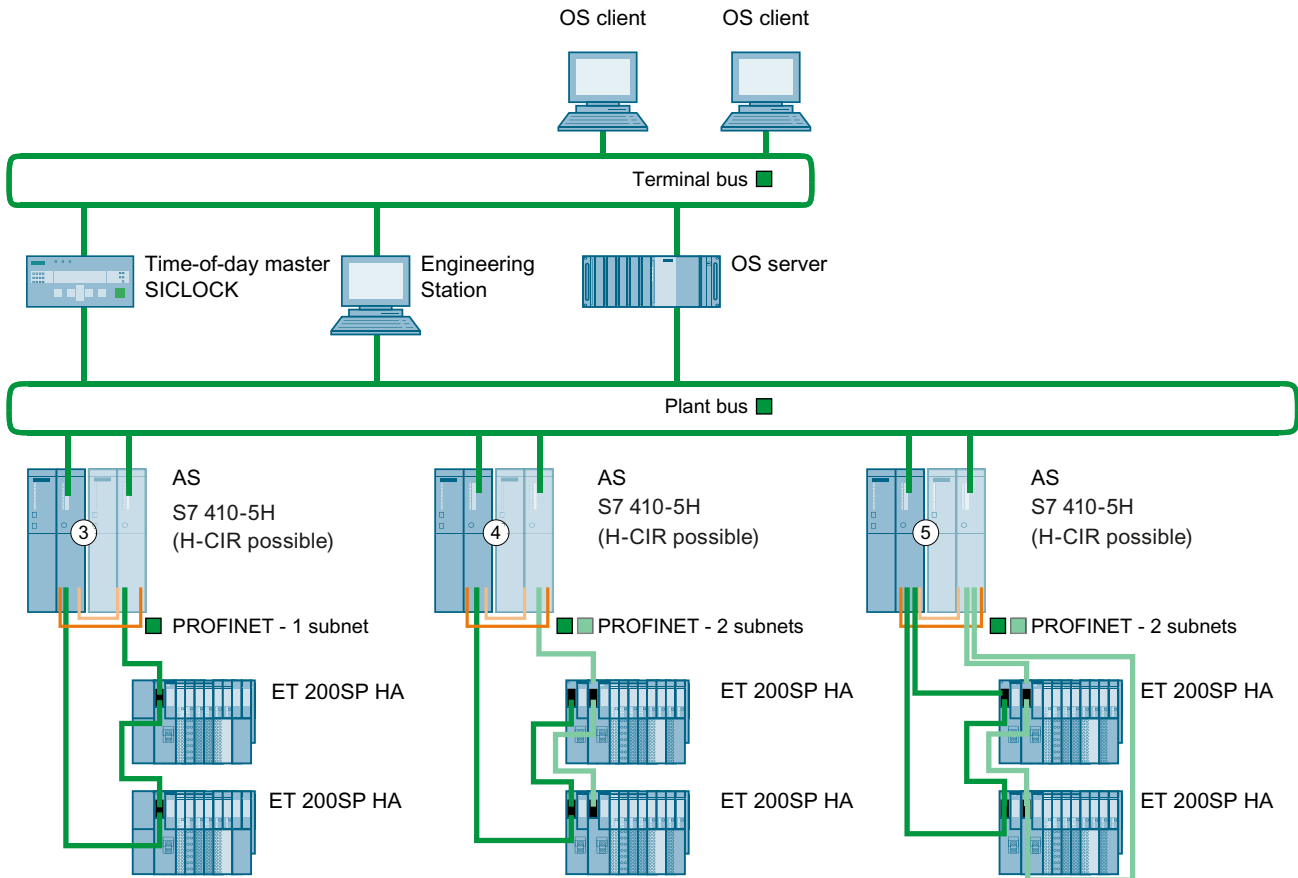
1 PN/IO subnet on an internal PN/IO interface of the IO controller (e.g. CPU 410-5H: X8 connection)

Distributed I/O

IO devices based on ET 200SP HA with 1x IM in the 1oo1 mode

4.9.4 Time synchronization and time stamping with redundant CPU

Example configurations



- Time master A SICLOCK with SIMATIC time-of-day synchronization.
- Automation system IO controller in 1oo2 mode (2x CPU 410-5H)
- Plant bus 1 PN/IO subnet on an internal PN/IO interface of the IO controller (e.g. CPU 410-5H: X5 connection)

Configurations

- ③ ④ ⑤

**Note:**

The configurations are not suitable for time stamping with an accuracy of 1 ms. You can find additional information on the required configuration changes in section "Plant-wide time synchronization and time stamping with a precision of 1 ms (Page 52)". For complete information, see the function manual *SIMATIC; ET 200SP HA; Time Stamping with ET 200SP HA*.

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Fieldbus	PN/IO subnet on the same internal PN/IO interface of the IO controller (e.g. CPU 410-5H: X8 connection) <ul style="list-style-type: none"><li>• ③: 1 PROFINET IO subnet with MRP</li><li>• ④: 2 PROFINET IO subnets</li><li>• ⑤: 2 PROFINET IO subnets with MRP</li></ul>
Distributed I/O	IO devices based on ET 200SP HA: <ul style="list-style-type: none"><li>• ③: With one interface module to a single IO controller</li><li>• ④: With two interface modules to a redundant IO controller</li><li>• ⑤: With two interface modules to a redundant IO controller</li></ul>




# Installation

## 5.1 Overview

### Mounting position

You can install the IO device on the basis of the distributed I/O ET 200SP HA in the horizontal or vertical mounting position. The preferred mounting position is horizontal mounting to a vertical wall.

- **Ambient temperature**

 <b>CAUTION</b>
<b>Restrictions for vertical installation</b>
With vertical installation, the maximum permissible ambient temperature is 10 °C lower.

- You can find additional information on this in the section "Mechanical and climatic environmental conditions (Page 143)".

### Mounting rules

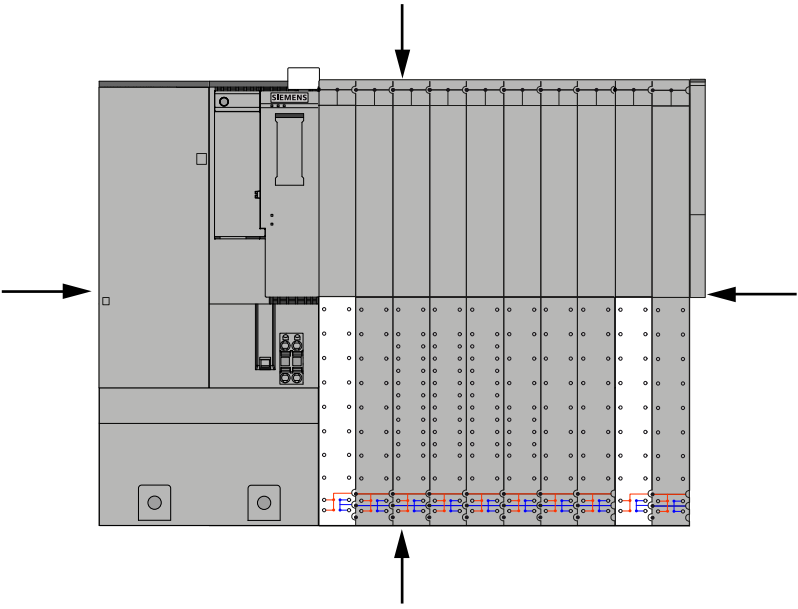
1. Only install the IO device when the supply voltage is switched off.
2. Install a rail for mounting the IO device.
3. The configuration starts on the left with the IM carrier module and the interface module.
4. The carrier modules for configuring 2 or 8 slots for the I/O modules then follows on the right next to the IM carrier module.
5. The terminal blocks can be plugged into the mounted carrier modules.
  - A light-colored TB..D terminal block (supply voltage for the potential group) comes after the interface module or at the beginning of each potential group.
  - Dark-colored terminal blocks follow.
  - The slots for the I/O modules are created by the connection of the carrier modules to the terminal blocks.  
You can find the combinations of mutually compatible terminal blocks and I/O modules in the section "Configurations of the slots of I/O modules (Page 32)".
  - Read section "Installing the terminal block (Page 71)".
6. You complete the configuration of the IO device by installing the server module and power bus cover.

You can find information on securing components in the section "Mounting rules (Page 178)".

## 5.2 Minimum clearances in the control cabinet

You must ensure the following clearances when installing the rail:

Table 5-1 Minimum clearances for the installation of the IO device in the control cabinet

	Upper 40 mm	
Left 10 mm		Right 10 mm
	Lower 20 mm	
<p>The mounting depth of the ET 200SP HA results from the interlocking components (standard rail, carrier module, terminal module and I/O module). The mounting depth is 162 mm. There should be at least 10 mm of space in front of the front panel of the modules.</p>		

Ensure the heat dissipation.

Observe the minimum clearances of the IO device in the control panel or to surrounding components. Leave sufficient space for the wiring and the communication cable connection.

### See also

Mechanical and climatic environmental conditions (Page 143)

## 5.3 Installing the rail

The type-specific rail is the installation platform for an IO device based on the ET 200SP HA.

### Basics

- For reasons of electromagnetic compatibility, you need to ensure that the rail is conductively connected to functional earth during operation of the plant.  
The grounding for the rail must comply with the requirements for functional earth (FE). You can find additional information about electromagnetic compatibility in the section "Electromagnetic compatibility (Page 138)".
  - The installation location (e.g. enclosure, control cabinet) must have a protective conductor connection compliant with standards.
  - The rail can also be connected to a protective conductor. This protective conductor is not absolutely required.

Examples of functional earth (FE):

- Ground rail separately in the control cabinet
- Mount rail on grounded and galvanized mounting plates
- You can find the article numbers in the section Accessories/spare parts (Page 171).

### Lengths and drill holes

The rails are available in the following versions:

- **Rail 482.6 mm**  
This rail has two drill holes for fixing screws.  
A set of screws for grounding is provided.
- **Rail 1500 mm**  
This rail is intended for construction with special lengths and only has holes at the ends for fixing screws.  
The set of screws for grounding must be ordered separately if needed.

You can find the article numbers in the section Accessories/spare parts (Page 171).

### Tools required

- If the rail is too long:  
Suitable tools for shortening the rail (e.g. hacksaw)
- Drill  $\varnothing$  6.5 mm
- Tool suitable for the selected fastening type (e.g. screwdriver)
- Wrench or socket wrench, size 10 for connecting the ground cable and possibly a tool for connecting the functional earth
- Stripping tool and crimp tool for the grounding cable

**Required accessories**

You can use the following screw types for fastening the rails:

Table 5-2 Required accessories

For ...	you can use ...	Explanation
outer fixing screws	M6 cylinder head screw according to ISO 1207/ ISO 1580 (DIN 84/DIN 85)	Choose a suitable screw length for your assembly. You also need washers for cylinder head screws with an internal diameter of 6.4 mm and an external diameter of 11 mm in accordance with ISO 7092 (DIN 433).
Additional mounting screws (for mounting rails > 482.6 mm)	M6 hexagonal head screw according to ISO 4017 (DIN 4017)	

**Dimensions for the drill holes**

Table 5-3 Dimensions for the drill holes

Rails		
a = Length of the rail	482.6 mm	1500 mm (> 530 mm)
b	65 mm	
c	155 mm	
d	8.3 mm	15 mm
e	466 mm	See x
f	10.2 mm	10.2 mm (for information on additional drill holes, see the following paragraph)
x	Not available	Recommended distance between 2 mounting points max. 500 mm

### Prepare the rail for installation (for rails > 530 mm)

To prepare the 1500 mm rail for installation, proceed as follows:

1. Shorten the rail to the required length.
2. Mark the holes. The necessary dimensions can be found in the table "Dimensions for the drill holes":
  - Drill holes after the beginning and before the end of the rail fastening points (15 mm distance).
  - Recommendation for fastening rails > 530 mm:  
Determine additional drill holes between the first and last fixing points (maximum distance 500 mm).

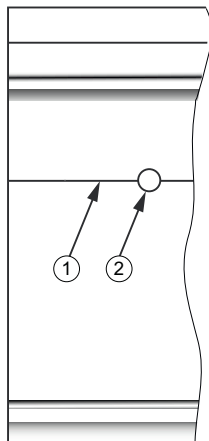
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#### Note

Ensure that there are no burrs or shavings on the rail.

To ensure secure installation of the modules, make sure you position the drill holes centered on the identification groove and only use screws of the maximum size.

---



① Identification groove for additional drill holes

② Additional drill hole

Figure 5-1 Preparing a rail for installation

### Installing the rail

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#### Note

##### Minimum clearances

Observe the minimum clearances in the control cabinet.

You can find additional information on this in the section "Minimum clearances in the control cabinet (Page 60)".

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5.3 Installing the rail

Install the rail to allow enough space for mounting and cooling the modules.

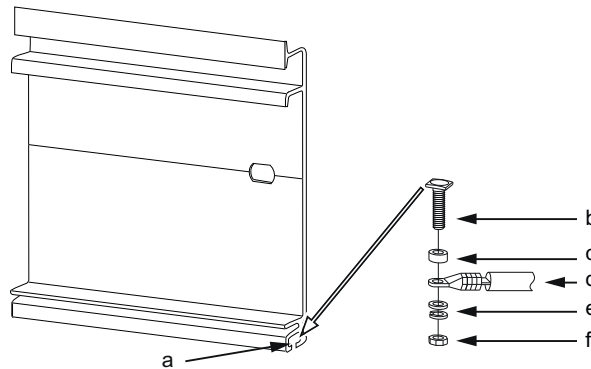
Screw the rail onto the mounting surface.

**Installing the functional earth**

You must connect the IO device with the functional earth to ensure electromagnetic compatibility.

Proceed as follows:

1. Isolate the grounding cable with a minimum cross-section of 10 mm<sup>2</sup>.
2. Attach a ring cable lug for M6 screws with the crimp tool.
3. Slide the enclosed bolt into the T profile groove.
4. Insert the spacer, ring cable lug with the grounding connector, flat washer, and lock washer onto the bolt (in that order). Fasten the components with the nut (tightening torque 4 Nm).



- a T profile groove
- b Bolt
- c Spacer
- d Ring cable lug with the ground cable
- e Washer and spring washer
- f M6 hexagon nut

Figure 5-2 Installing a protective conductor

5. Connect the other end of the grounding cable to the functional earth.

**Note**

**Alternative grounding of the rail**

If it is ensured that the rail is permanently connected to functional earth by means of an equivalent, standard-compliant installation, for example, with a permanent attachment to a grounded enclosure wall, grounding via the ground screw can be omitted.

### **Additional information**

- You can find additional information about the exact dimensions of the rails in the section Dimension drawings of the rails (Page 165).
- Section "Mounting rules (Page 178)"

## 5.4 Mounting the interface module

### Introduction

The interface module connects the IO device to the fieldbus and exchanges data between the IO controller and the I/O modules.

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#### Note

##### Scope of delivery (server module and power bus cover)

A server module and a power bus cover are supplied for the interface module with every carrier module.

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### Requirement

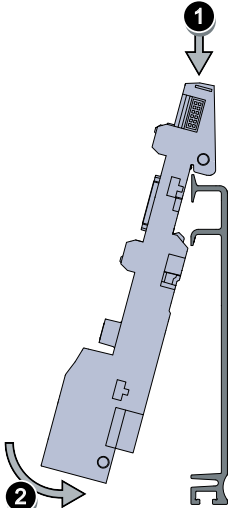
The rail is fitted.

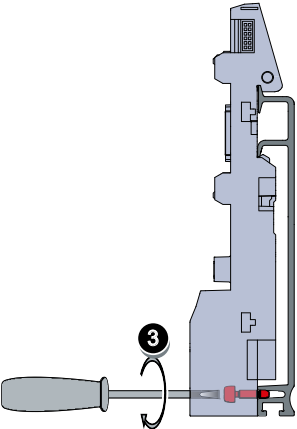
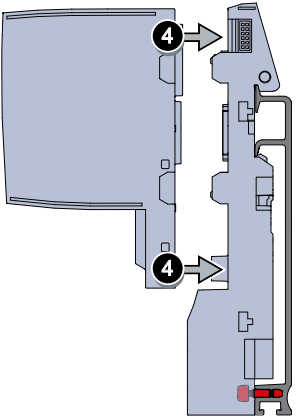
### Tools required

- Screwdriver 3.5 mm or TORX T10 (recommended): Only for installation of the BusAdapter
- Screwdriver 4.5 mm or TORX T15 (recommended): For fastening the fixing screws to the rail.

### Mounting the interface module

To mount the interface module, proceed as follows:

Step	Procedure	Illustration
1	Hang the carrier module (for assembling the interface module) on the rail. <b>Note:</b> Take into consideration the required version of the carrier module (redundant configuration/non-redundant configuration) There is a difference between IM (removable "module") and the subrack module.	
2	Swivel the carrier module backwards until you hear the carrier module click into place on the rail.	

Step	Procedure	Illustration
3	Fasten the fixing screws securely onto the rail on the carrier module.	 <p>The illustration shows a side view of a carrier module. A screwdriver is positioned to tighten a screw on a horizontal rail. A circular arrow with the number '3' indicates the clockwise direction of rotation.</p>
4	Set the interface module parallel onto the carrier module until you hear the module latch click into place.	 <p>The illustration shows an interface module being inserted into the carrier module. Two arrows with the number '4' point to the top and bottom edges of the interface module as it is being aligned with the carrier module's rail.</p>

**See also**

Mounting rules (Page 178)

## 5.5 Mounting an carrier module for I/O module slots

### Introduction

The slots are created by the connection of the carrier modules to the terminal blocks for the I/O modules when the IO device is installed.

- **Carrier module**  
Subrack modules are used for electrical and mechanical connection of the individual modules.
- **Terminal block**  
Terminal blocks provide the process terminals for connecting sensors, actuators and other devices.

### Requirements

- The rail is installed.  
You can find information on this in the section "Installing the rail (Page 61)".
- The carrier module for the interface module is installed.  
You can find information on this in the section "Mounting the interface module (Page 66)".

### Tools required

Screwdriver 4.5 mm or TORX T15 (recommended): For fastening the fixing screws on the carrier module to the rail.

Information on the tightening torque is available in the section "Mounting rules (Page 178)".

### Transport lock for fixing screws

The fixing screws are secured to carrier modules for transport.



- ① Remove these transport locks before tightening the fixing screws.

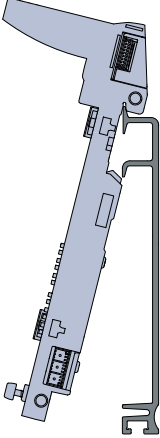
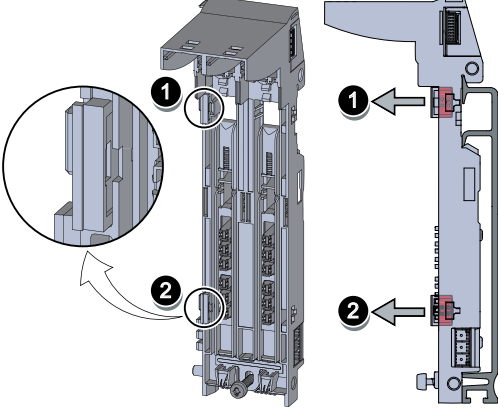
**Procedure**

To install this module, proceed as follows: (installation always from left to right)

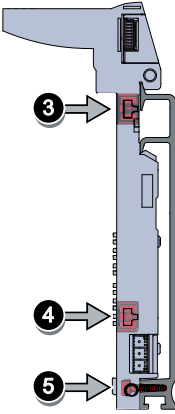
**Note**

**Recommendation**

Install all carrier modules **one after the other** before you begin installing the terminal blocks.

Step	Procedure	Illustration
1	1. Hang the carrier module (for setting up the modular slots) on the rail. Adhere to the maximum configuration length; section "Hardware configuration (Page 28)". 2. Swivel the carrier module backwards on the rail.	
2	Ensure that the interlocks (① and ②) of the carrier module have been removed.	
3	Push the carrier module sideways to the left until it meets the previous component (carrier module of the interface module or carrier module for I/O modules).	
4	Ensure that the transport lock under the fixing screws is removed.	

5.5 Mounting an carrier module for I/O module slots

Step	Procedure	Illustration
5	<p>Press the interlocks (③) and (④) of the carrier module into the carrier module.</p> <p><b>Recommendation:</b> Avoid angle errors during installation: Before tightening the fixing screw, you should latch several carrier modules onto the rail and connect them to one another with the interlocks. In this way, the carrier modules automatically align themselves parallel to the rail.</p> <p>Tighten the fixing screws (⑤) on the carrier module to the rail.</p> <p>When the screws are tightened, the position of the carrier module to the rail is fixed and cannot be changed by latching of the next carrier module.</p>	

## 5.6 Installing the terminal block

### Introduction

The slots are created by the connection of the carrier modules to the terminal blocks for the I/O modules when the IO device is installed.

### Requirements

#### Note

#### Installing terminal blocks for individual I/O modules and for IO redundancy in an IO device

Only terminal blocks for individual I/O modules or for IO redundancy may be plugged in a potential group.

The carrier modules must be screwed in.

- The carrier module for the I/O modules is mounted.  
You can find information on this in the section "Mounting an carrier module for I/O module slots (Page 68)".
- The requirements of the plant were taken into consideration when selecting the terminal blocks.  
You can find information on this in the section "Selecting a terminal block for I/O modules (Page 32)".
- Terminal blocks must be completely installed on an carrier module.

#### 45 millimeter wide terminal blocks (TB45... - terminal blocks for I/O-redundancy or potential distributors) :

- The terminal blocks (TB45...) must be plugged into the slots of the carrier module beginning with odd slot numbers.
- The terminal blocks (TB45...) may **not** be plugged over two adjacent carrier modules.

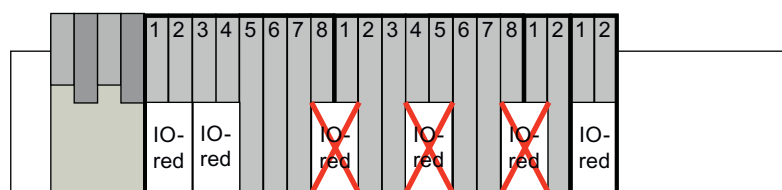


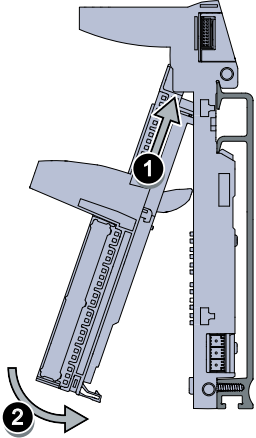
Figure 5-3 Example: Installing terminal blocks for IO redundancy or potential distributor on an 8x and 2x carrier module **The crossed-out versions are not permitted.**

#### Slots for modules on terminal block for IO redundancy (TB45R...)

- The slots for modules in IO redundancy are located on the same terminal block (TB45R).
- The I/O modules of the same type have to be placed in pairs, side-by-side in the same IO device.

**Procedure**

To install these modules, proceed as follows:  
(installation always from left to right)

Step	Procedure	Illustration
1	Slide the terminal block diagonally into the holder of the carrier module.	
2	Swivel the terminal block downwards until the fastening elements on the carrier module click into place. (See figure "Fastening the terminal block")	

You can find information on wiring in following sections:

- Wiring rules (Page 85)
- Wiring the terminal block (Page 86)

## 5.7 Installing the server module and power bus cover

### Introduction

The server module together with the power bus cover at the right end complete the configuration or the line of the IO device.

#### Note

##### Scope of delivery (server module and power bus cover)

The following components are supplied with each carrier module for the interface module:

- A server module
- A power bus cover

### Requirement

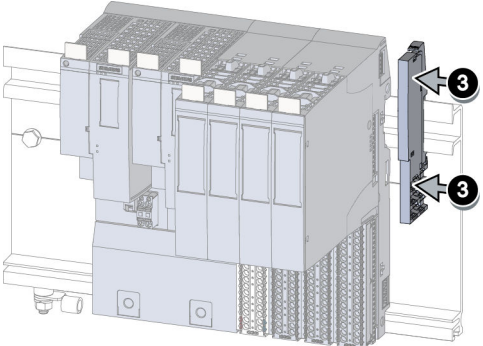
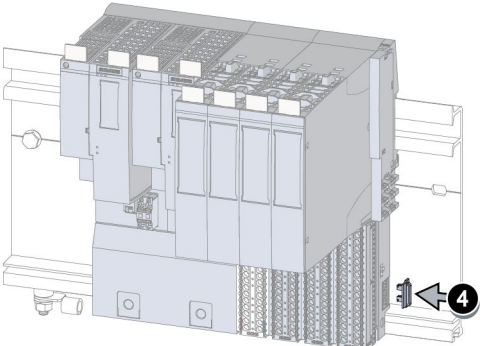
The carrier modules are mounted.

### Installing the server module and power bus cover

To mount the server module and power bus cover, proceed as follows:

Step	Procedure	Illustration
1	Hang the server module in the rail to the right of the last carrier module.	
2	Swivel the server module downwards until the fastening elements click into place on the rail.	

5.7 Installing the server module and power bus cover

Step	Procedure	Illustration
3	Move the server module sideways to the left until it audibly latches onto the last carrier module.	
3	Press the power bus cover into the last carrier module.	

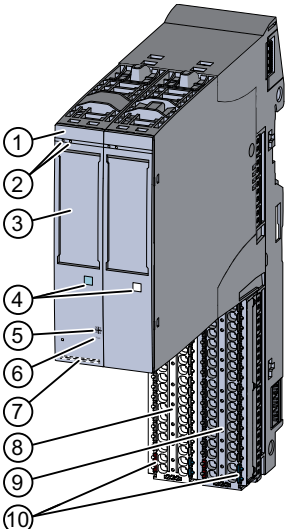




## Wiring

### 6.1 Markings of IO device components

#### 6.1.1 Factory markings

The following table shows the markings that are present ex factory. The markings supports the installation of the modules and the configuration of the distributed I/O with existing modules.

Table 6-1 Markings

Markings	What is labeled?	In the figure	Identifier for	Markings or colors	
	Module labeling	①	Type of I/O module		
		②	Labeling of the LED		
		③	Labeling strips	Plant-specific labeling possible	
		⑤	Function version		
		⑥	Firmware version		
		⑦	Article number		
		Color coding of the I/O module classes (identification of basic types)	④	Digital input module	white
			Digital output module	black	
			Analog input module	light blue	
			Analog output module	dark blue	
	Universal input/output module		bright gray-green (IP Basic)		
Color coding of the potential group	⑧	Opening the potential group	Light-colored terminal block		
	⑨	Extending the potential group	Dark-colored terminal block		
Color coding of the spring releases	⑩	Process terminals	gray, white		
		Terminals for the supply voltage (light-colored terminal block)	red, blue		
		Measuring point - voltage of the voltage buses (dark-colored terminal block)	red, blue		

## 6.1.2 Optional markings

### Introduction

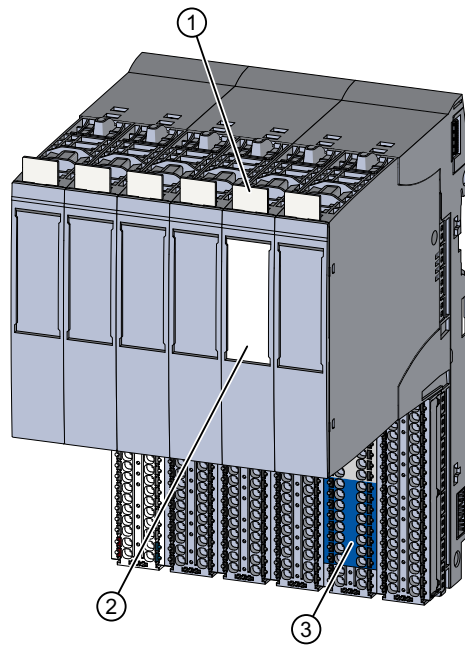
In addition to the factory markings, there are other options for labeling or identifying the ET 200SP HA modules:

- Interface module
- I/O module
- Slot cover
- Terminal block

### Optional markings

- The color-coded labels are module-specific labels for color coding the potentials of the I/O modules. A color code (**Color Code**, e.g. CC01) is printed on each color-coded label and I/O module. The color code can be read directly on the I/O module to determine which color-coded label you need for the terminal block.
  - Module-specific color combinations are available for the process terminals. Meaning (see manuals I/O modules (<http://support.automation.siemens.com/WW/view/en/55679691/133300>)).
- The reference identification labels (according to EN 81346) can be attached to every interface module, BusAdapter and I/O module.  
Due to the standard markings for printing, the reference identification label is suitable for automatic labeling with E-CAD systems.

- The labeling strips allow you to identify the IO device and can be inserted into the following modules:
  - Interface module
  - I/O module
  - Slot cover
- Printable labeling strips can be ordered:
  - Labeling strips for thermal transfer printer on a roll
  - Labeling strips for laser printer as DIN A4 sheets



- ① Reference identification labels
- ② Labeling strips
- ③ Color-coded labels

Figure 6-1 Optional markings

### 6.1.3 Applying color-coded labels

#### Requirements

The terminal blocks cannot be wired when installing the color-coded labels.

### Applying color-coded labels

Press the color-coded labels into the terminal box of the terminal block.

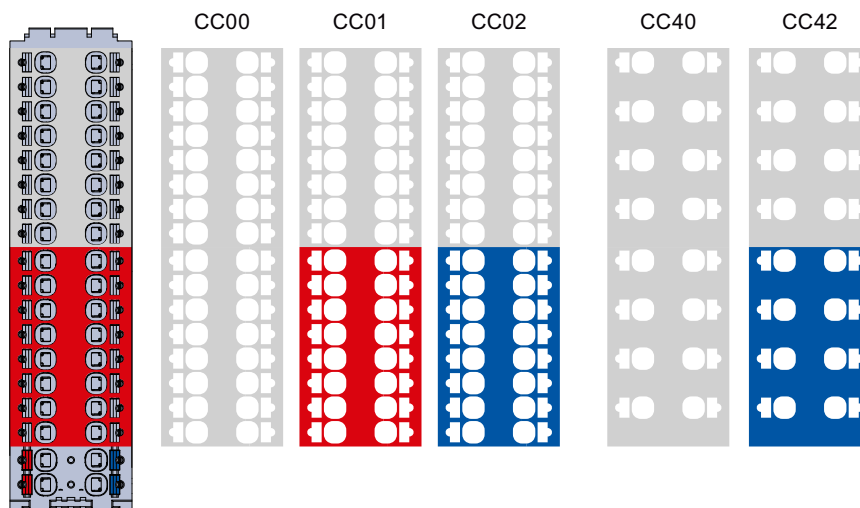


Figure 6-2 Applying color-coded labels

### Additional information

- Module-specific color-coded labels (22.5 mm) for the process terminals (see manual I/O module (<http://www.siemens.com/pcs7-documentation>))
- Ordering information (see section "Accessories/spare parts (Page 171)"; "Table B-2 Accessories, color-coded labels for I/O modules (Page 172)")

## 6.1.4 Applying labeling strips

### Procedure

Proceed as follows to install a labeling strip:

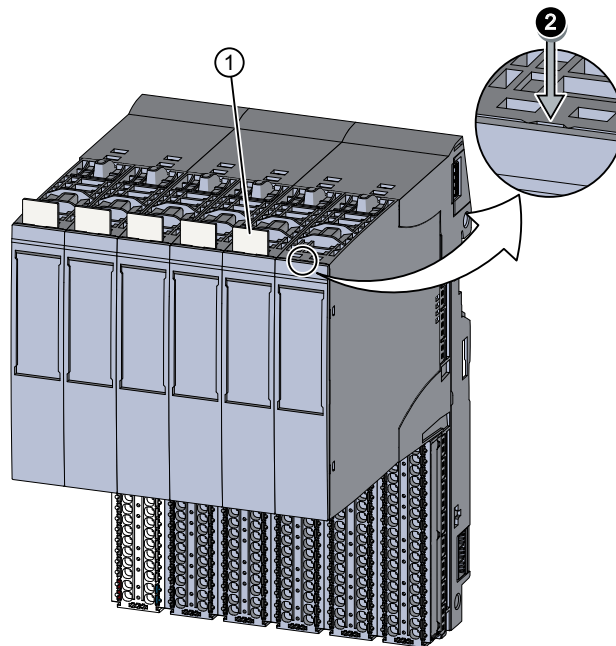
1. Label the strips.
2. Insert the labeling strip into the interface module or I/O module.

## 6.1.5 Applying reference identification labels

### Procedure

Proceed as follows to apply a reference identification label:

1. Break off the reference identification labels from the sheet.
2. Insert the reference identification labels into the insert opening on the top of the modules:
  - Interface module
  - BusAdapter
  - I/O module
  - Slot cover



- ① Reference identification labels
- ② Opening for label

Figure 6-3 Applying reference identification labels

## 6.2 Rules and regulations for operation

### Introduction

The integration of IO devices in a plant or system demands that specific rules and regulations are observed, depending on the area of application.

This section provides an overview of the most important rules that must be observed.

### Specific application

Keep to the safety and accident prevention regulations applying to specific applications, for example machine protection guidelines.

### EMERGENCY STOP devices

EMERGENCY STOP devices in accordance with IEC 60204 (corresponds to DIN VDE 0113) must remain effective in all operating modes of the plant or system.

### Excluding hazardous plant states

You need to implement suitable measures to ensure that dangerous operating conditions are excluded, also in the following situations:

- When the system restarts after a voltage dip or power failure.
- Bus communication starts automatically after a fault.

If necessary, EMERGENCY STOP must be forced!

An uncontrolled or undefined startup must not occur after the EMERGENCY STOP is unlocked.

### Supply voltage

The following section describes the important factors you need to consider with respect to the power supply:

- For buildings: In the event of danger through overload, you must provide lightning protection measures for external lightning protection (e.g. lightning protection elements).
- For the cables of the supply voltage (24 V DC) and the signals:  
If there is danger of overvoltage, you must implement lightning protection measures for internal lightning protection (for example, lightning protection elements; see section Accessories/spare parts (Page 171)).
- For supply voltage:  
Ensure that there is a safe (electrical) separation of low voltage (SELV/PELV).  
The following standard must be complied with: IEC/UL61010-2-201

- Typical functional extra-low voltage ( $V_{nom}=24VDC \pm 20\%$ )
- IO device in PROFINET networks:  
In LANs (Local Area Networks) you may only operate IO devices with PROFINET IO interfaces in LANs (Local Area Networks) if the following condition is met:  
All connected nodes are operated with power supplies (e.g. power pack, battery) of the type SELV/PELV with guaranteed electrically isolated extra-low voltage.

## Line voltage

The points to note with regard to the line voltage is described below (see section Information on insulation, protection class, degree of protection and rated voltage (Page 146)):

- For stationary plants or systems without an all-pole mains circuit breaker, there must be a circuit breaker mechanism (all-pole) fitted in the building installation.
- For the power supply, the configured rated voltage range must correspond to the local line voltage.
- The fluctuation/deviation of the line voltage from the rated value must be within the permitted tolerance for all power circuits of the IO device.

## Protection against outside electrical influences

Below is a description of what you must pay attention to in terms of protection against electrical impacts and/or faults:

- In plants with HA distributed I/O, ensure that the system is connected to a protective conductor with sufficient cross-section for discharge of electromagnetic interference.
- For supply, signal and bus lines, you must ensure that the laying of the lines and the installation is correct.
- For signal and bus lines, you must ensure that a wire/cable breakage or a cross-circuit does not lead to undefined states of the plant or system.

## Reference

You can find more information in the Designing interference-free controllers (<http://support.automation.siemens.com/WW/view/en/59193566>) function manual.

## See also

Hardware configuration (Page 28)

## 6.3 Operation of the IO device on a grounded power supply

### Introduction

This section provides information on the overall configuration of an IO device based on the ET 200pro distributed I/O system on a grounded power supply (e.g. TN-S network). The specific subjects discussed are:

- Disconnecting devices and short-circuit and overload protection according to IEC 60364 (corresponds to DIN VDE 0100) and IEC 60204 (corresponds to DIN VDE 0113)
- Power supplies and load power circuits

### Grounded incoming supply

In the case of grounded incoming supplies (TN-S system) the neutral conductor (N) and the protective conductor (PE) are each grounded. Both conductors form a part of the overvoltage concept. When a plant is in operation, the current flows across the neutral conductor. When a fault occurs, for example, a single ground fault between a live conductor and ground, the current flows through the protective conductor.

### Installing the IO device with ungrounded reference potential

To discharge interference current, the reference potential of the interface module and terminal blocks TB..D must be connected via an RC combination (IM:  $R = 10 \text{ M}\Omega / C = 100 \text{ nF}$ , TB...D:  $R = 10 \text{ M}\Omega / C = 4 \text{ nF}$ ) to the rail (protective conductor).

- This configuration conducts high-frequency interference currents and prevents static charges.
- An ungrounded configuration of the IO device is always possible since there is no fixed ground connection on the IO device. The power supply used (power pack / power supply module / battery) for 24 V DC must also be ungrounded and electrically isolated.

If you want to install the IO device with grounded reference potential, electrically connect the 1M connector to the protective conductor.

### Short-circuit / overload protection

Various measures as protection against short-circuits and overloads are required for setting up a full installation.

## 6.3 Operation of the IO device on a grounded power supply

The type of components and the binding protective measures depend on which IEC (DIN VDE) regulation applies to your system configuration.

Table 6-2 Protective measures and components

Protective measures and areas of applications	Reference for following figure	IEC 60364 (DIN VDE 0100)	IEC 60204 (DIN VDE 0113)
Shutdown device for controllers, signal transmitters and actuators	①	Main switch	Disconnecter
Disconnecter / protection element for load power supply for AC load circuits with more than five electromagnetic devices	②	Galvanic isolation by transformer <b>recommended</b>	Galvanic isolation by transformer <b>recommended</b>
Short-circuit / overload protection: In groups for sensors and actuators	② / ③	Single-pole protection of circuits	Load power circuit <ul style="list-style-type: none"> <li>• With grounded secondary circuit: <b>single-pole</b> protection</li> <li>• otherwise: Secure all pins</li> </ul>

The tables refer to the following figure and compares the IEC (DIN VDE) regulations.

**Power supply and grounding concept in the overall configuration**

The following figure shows the IO device based on the ET 200SP HA distributed I/O system in its overall configuration (supply voltage and ground concept) when supplied from a TN-S network.

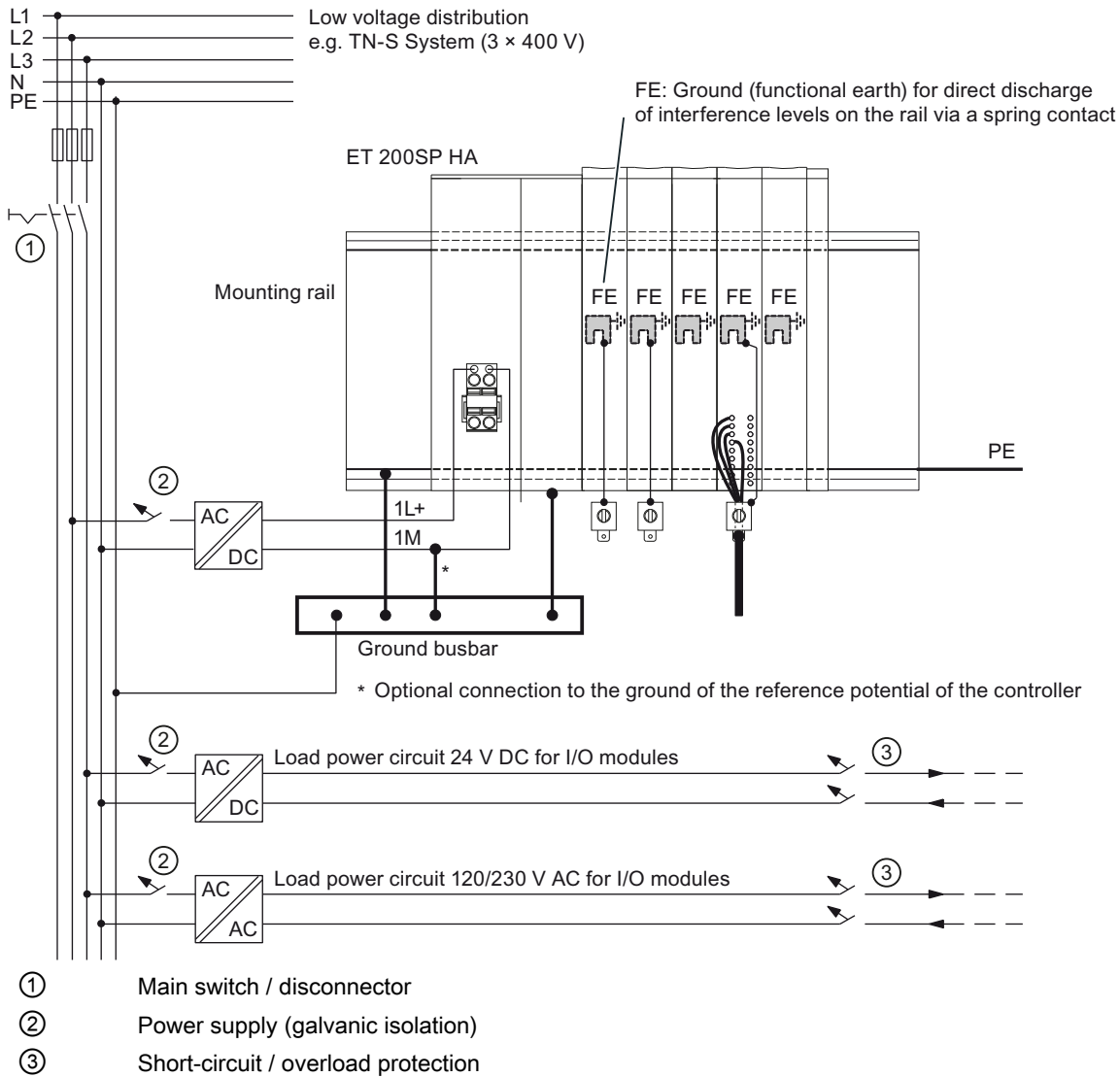


Figure 6-4 ET 200SP HA in its overall configuration

**See also**

Power supply (SELV/PELV) (Page 148)

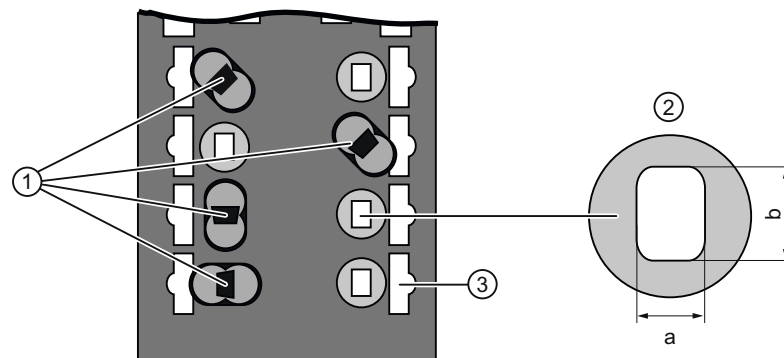
## 6.4 Wiring rules

### Cable cross-sections and ferrules

You can find information about this in section "Cable cross-sections and ferrules (Page 179)".

### TWIN ferrules for wires of the push-in terminals

Due to the space required by TWIN ferrules with  $0.75 \text{ mm}^2$  cross-section, you must ensure a correct angle for the conductor arrangement when crimping the TWIN ferrule so that the wires are optimally arranged.



- ① Crimp TWIN ferrules in the correct angle
- ② Cross-section of the terminal compartment
  - a: 1.8 mm
  - b: 2.4 mm
- ③ Spring release

Figure 6-5 TWIN ferrules

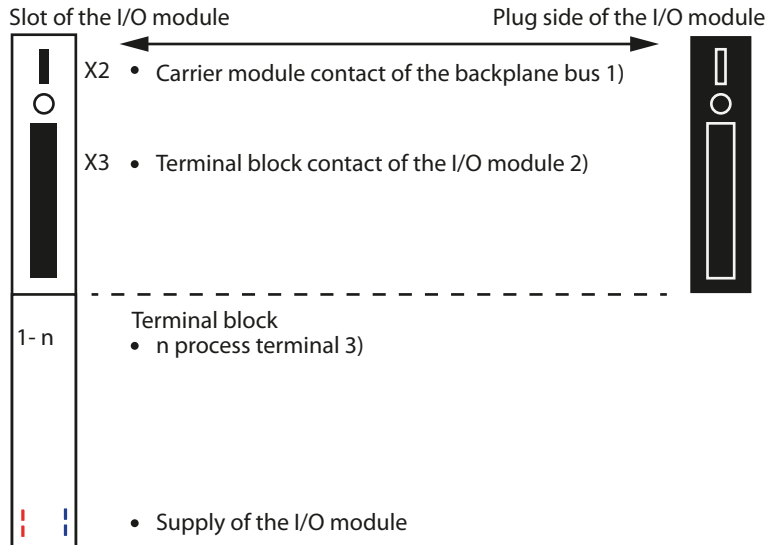
### Permissible cable temperature

Read the information in section "Mechanical and climatic environmental conditions (Page 143)".

## 6.5 Wiring the terminal block

### Connection on the slot and I/O module

The following figure shows the connections on the terminal block/terminal module and the I/O module.



1 Carrier module contact (max. 50 mA; max. 3.5V DC ---)

2 For the terminal block contacts (for maximum voltages and currents, refer to the documentation of the respective I/O module)

3 For the process terminal on the terminal block (number, maximum/permissible voltages and currents, refer to the documentation of the respective I/O module).

You can find additional information on the pin assignment of the I/O module (terminal block) in the documentation of the I/O module.

### Introduction


The following terminals are located on the terminal blocks.

- Terminals for the supply voltage
  - Light-colored terminal block: Only connect the supply voltage to a terminal block of the type TB..D.
  - Dark-colored terminal block: Measure the supply voltage and extend it if necessary
- Process terminals
  - The signal lines of sensors and actuators must be connected to the process terminals on the terminal block.

## Power supply

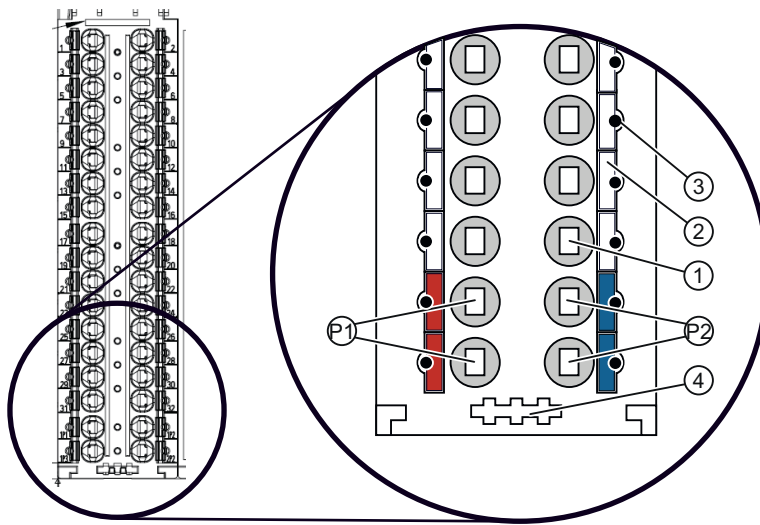
Read the technical specifications and information on supply voltage in section "Rules and regulations for operation (Page 80)".

## Assignment of the terminals on the terminal block

 <b>CAUTION</b>
<b>Different assignment of the terminals for the supply voltage</b>
<ul style="list-style-type: none"><li>• The terminals at which L+ supply voltage is applied are <b>separated</b> in the following terminal blocks:<ul style="list-style-type: none"><li>– TB45R-P32+4D/T</li><li>– TB45R-P32+4B/T</li></ul></li><li>• The terminals at which L+ supply voltage is applied are <b>connected</b> in the following terminal blocks:<ul style="list-style-type: none"><li>– TB22-P32+4D/T</li><li>– TB22-P32+4B/T</li><li>– TB22-P16+4D</li><li>– TB22-P16+4B</li><li>– TB45-P32+32x24V+4M+4B</li><li>– TB45-P32+32x24V+4M+4D</li><li>– TB45-P32+36xM+4B</li><li>– TB45-P32+36xM+4D</li></ul></li></ul>

The allocation of the process terminals for the terminal blocks depends on the inserted I/O module. You can find information on the terminal blocks and I/O modules in the corresponding manuals.

6.5 Wiring the terminal block



- ① Push-in terminal
- ② Spring release
- ③ Measuring tap  
(suitable probes: Diameter 1.0 mm, cone height max 1.15 mm; length  $\geq$  10 mm in compliance with the approved voltage category)
- ④ Holder for shield contact
- P1 Supply voltage L+: The terminal assignment depends on the type of terminal block (see tables in the following section "Supply voltage")
- P2 Supply voltage M

Figure 6-6 View of the terminal block (example for the terminal block TB22-P32+4B/T)

**Note**

**Specific designations of the process terminals in the wiring and block diagrams of the I/O modules / terminal blocks**

- **RES:** Reserved, these process terminals must be left unconnected for future expansions
- **n.c.:** Not connected, these process terminals have no function. However, they can be connected to potentials specifically defined for a module, for example, for the laying unused wires.

**Supply voltage**

Connect the supply voltage to a light-colored terminal block. The following two tables show the terminal blocks to which you need to connect the cables of the supply voltage.

Table 6-3 Connection terminals for the supply voltage on the terminal block TB22.../ TB45-P32...

Potential	Terminals on the terminal block	Labeling of the terminal	Voltage on the power bus
• Ground	• 1P2 and 2P2	Blue	• P2
• L+	• 1P1 and 2P1 <b>Note: Terminals connected</b>	Red	• P1

Table 6-4 Connection terminals for the supply voltage on the terminal block TB45R.../ TB22-C32

Potential	Terminals on the terminal block	Labeling of the terminal	Voltage on the power bus
<ul style="list-style-type: none"> <li>• Ground</li> </ul>	<ul style="list-style-type: none"> <li>• 1P2 and 2P2</li> </ul>	Blue	<ul style="list-style-type: none"> <li>• P2</li> </ul>
<ul style="list-style-type: none"> <li>• 1L+</li> <li>• 2L+</li> </ul>	<ul style="list-style-type: none"> <li>• 1P1</li> <li>• 1P3</li> </ul> <p><b>Note: Terminals not connected</b></p>	Red	<ul style="list-style-type: none"> <li>• P1</li> <li>• P3</li> </ul>

**Extending the supply voltage via the power bus**

The illustrations in the table show the ladder diagrams of the connection terminals for the supply voltage and the routing through the power bus.

Terminal block (types)	Process terminals	Circuit diagram for supply voltage
Light-colored terminal block (TB..D):	<ul style="list-style-type: none"> <li>• 16</li> <li>• 32</li> </ul>	<p>Terminal block (TB22-P32+4D/T; TB22-P16+4D; TB45-P32...+4D)</p>
	<ul style="list-style-type: none"> <li>• 32</li> </ul>	<p>Terminal block for IO redundancy (TB45R-P32+4D/T)</p>
Dark-colored terminal block (TB..B):	<ul style="list-style-type: none"> <li>• 16</li> <li>• 32</li> </ul>	<p>Terminal block (TB22-P32+4B/T; TB22-P16+4B; TB45-P32...+4B)</p>
	<ul style="list-style-type: none"> <li>• 32</li> </ul>	<p>Terminal block for IO redundancy (TB45R-P32+4B/T)</p>

6.5 Wiring the terminal block

Each dark-colored terminal block allows access to the supply voltage via terminals (red/blue).

**Requirements for connecting the cable for the supply voltages**

- The supply voltages are turned off.
- Color coding labels (Page 77) (optional) have been applied.

**Tools required**

Depending on conductor type

- Single wire without ferrule: Toolless
- Multi-core (stranded wire) with ferrule or ultrasonic compacting: Suitable tool to prepare the cable.
- Multi-core (stranded wire) without ferrule, unprocessed: 3 to 3.5 mm screwdriver

Read the section "Wiring rules (Page 85)".

**Connecting conductors**

Follow these steps

Conductor (type)	Solid	Multi-core (stranded wire)	
	Without ferrule	With ferrule or ultrasonic compression	Without ferrule, unprocessed
Step 1	Strip 8 to 10 mm of the wires.		
Step 2	Only for multi-stranded wires: Compress or crimp the cable with ferrules		-
Step 3		-	Press the screwdriver into the spring release.
Step 4	Insert the wire into the push-in terminal as far as it will go.		
Step 5		-	Pull the screwdriver out of the spring release.

**Removing wires**

Using the screwdriver, press the spring release of the terminal as far as it will go and pull out the wire.

**Additional information**

- Replacing the terminal blocks is described in the section "Replacing a terminal block (Page 125)".
- Removing wires is described in the section "Removing wires (Page 128)".

## 6.6 Connecting cable shields

### Introduction

- You need the shield connector to contact cable shields (e.g. for analog modules). The shield connector conducts interference currents on cable shields to ground via the rail. It is not necessary to contact the shield at where the cable enters the cabinet.
- You attach the shield connection on the terminal block.
- The shield connector consists of a shield contact and a shield terminal.
- The shield connector is automatically connected to the functional earth (FE) of the rail after installation.

### Requirements

- Terminal block
- The shield terminal is suitable for cables with max.  $\varnothing$  7 mm each.

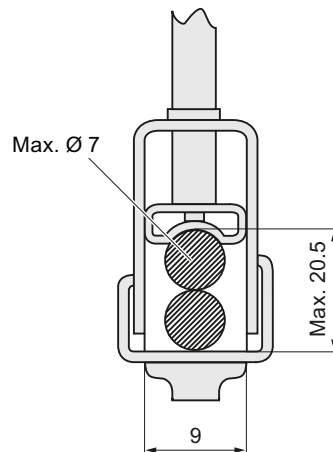


Figure 6-7 Shield terminal

### Tools required

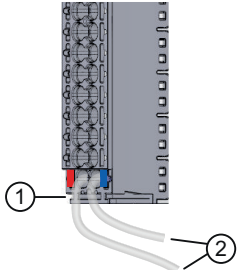
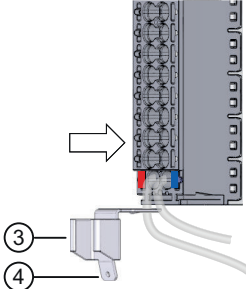
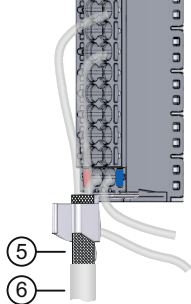
- Stripping tool

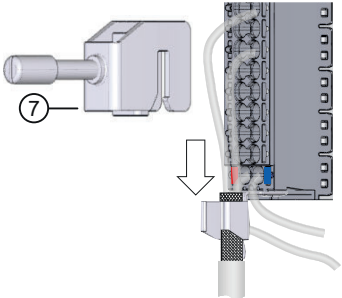
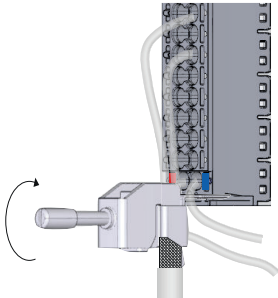
6.6 Connecting cable shields

**Procedure**

To connect the cable shield, follow these steps:

Table 6-5 Mounting the shield contact

Step	Procedure	Illustration	
1	If necessary, connect the supply voltage L+ and M on the terminal block.		
	①		Holder
	②		Supply voltage L+, M
2	Press the shield contact up into the holder until you hear it click into place.		
	③		Shield contact
	④		Flat connector for push-on contact (6.3 × 0.8 mm)
3	<ul style="list-style-type: none"> <li>Remove the cable insulation material around the shield terminal.</li> <li>Connect the cable to the terminal block and insert the cable into the shield contact.</li> </ul>		
	⑤		Insulating material removed (approx. 20 mm)
	⑥		Cable to sensor/actuator

Step	Procedure	Illustration
4	Insert the shield terminal into the shield contact. ⑦ Shield terminal	
5	Tighten the shield terminal with approximately 0.5 Nm.	

## 6.7 Connecting the power supply to the interface module

### Introduction

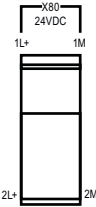
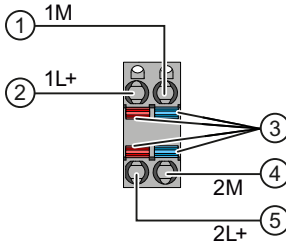
The supply voltage of the interface module is connected via a 4-pin connector that is located on the front of the interface module.

### Power supply

Read the technical specifications and information on supply voltage in section "Rules and regulations for operation (Page 80)".

### Connection for power supply (X80)

The contacts of the connector plug are designed for the following connections:

IM: Slot X80	Connector	Pin assignment	Verbunden
		① Supply voltage: Ground (permitted current 10 A)	The following contacts are interconnected in the connector plug: <ul style="list-style-type: none"> <li>• 1L+ and 2L+</li> <li>• 1M and 2M</li> </ul> This enables the supply voltage to be looped through.
		② Supply voltage: L+ 24 V DC (permitted current 10 A)	
		③ Spring release	
		④ Loop through supply voltage: Ground (permitted current 10 A)	
		⑤ Loop through supply voltage: L+ 24 V DC (permitted current 10 A)	

The maximum cross-section of the connection is 2.5 mm<sup>2</sup>. A strain relief is not present.

### Requirement

Only wire up the connector plug when the supply voltage is turned off.

### Tools required

Depending on conductor type

- Single wire without ferrule: Toolless
- Multi-core (stranded wire) with ferrule or ultrasonic compacting: Suitable tool
- Multi-core (stranded wire) without ferrule, unprocessed: 3 to 3.5 mm screwdriver

Read the section "Wiring rules (Page 85)".

## Connecting conductors

Follow these steps

Conductor (type)	Multi-core (stranded wire)		
	Solid	Without ferrule	With ferrule or ultrasonic compression
Step 1	Strip 8 to 10 mm of the wires.		
Step 2	-	Compress or crimp the cable with ferrules	-
Step 3	-	-	Press the screwdriver into the spring release.
Step 4	Insert the wire into the push-in terminal as far as it will go.		
Step 5	-	-	Pull the screwdriver out of the spring release.
Step 6	Push the wired connector plug into the socket in the interface module.		

## Removing a wire

Using the screwdriver, press the spring release as far as it will go and pull out the wire.

## 6.8 Connecting interfaces for communication

### Installing a PROFINET cable on the BusAdapter

Depending on the configuration of the PROFINET IO system, you select electrical or optical PROFINET IO cables for the connection of the distributed I/O.

- Electrical PROFINET IO cables:
  - PROFINET cable with RJ45 connector (electrical)
    - 8-wire cable
    - 2-wire cable - 2-wire transfer function (variable distance)
  - Connecting a FastConnect cable directly to the BusAdapter (electrical)
- Optical PROFINET IO cables:
  - Fiber-optic cable with LC connector (optical)

The type of connecting cable determines the BusAdapter required for connecting the distributed I/O.

---

#### Note

##### Strain relief of the bus cables

Make sure to secure the bus cables by installing an appropriate strain relief. Refer to the installation guidelines of the manufacturer.

---

### PROFINET IO loop-through

2-port switches are integrated in all BusAdapters of ET 200SP HA. These switches allow you to loop-through the PROFINET IO system from one station to the next.

### Number of media interfaces

Avoid a network structure in which there are more than 4 interfaces between electrical and optical media in a PROFINET IO system between the CPU and any IO device.

From this it follows, for example:

- CPU > **Media Interface** > IO Device > IO Device > **Media Interface** > **Media Interface** > IO Device > **Media Interface** > IO Device  
Result: Configuration of PROFINET IO system **OK**
- CPU > **Media Interface** > **Media Interface** > IO Device > > **Media Interface** > **Media Interface** > IO Device > > **Media Interface** > **Media Interface** > IO Device  
Result: Configuration of PROFINET IO system **NOT RECOMMENDED**

### Additional information

- You can find information on the bus cables in the system manual SIMATIC NET Industrial Ethernet / PROFINET Passive Network Components (<http://support.industry.siemens.com/cs/ww/en/view/84922825>)
- Refer to the specifications in the "PROFINET Installation Guide (<http://www.profibus.com>)".

### See also

Accessories/spare parts (Page 171)

## 6.8.1 Connecting the BusAdapter

### Introduction

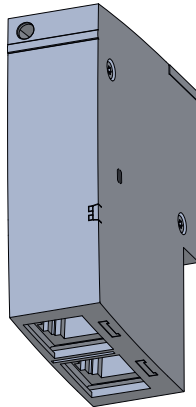


Figure 6-8 Example of BusAdapter BA 2×RJ45

Connect PROFINET IO to the IO device via the BusAdapter.

The connection options with the PROFINET cables depend on the type of the BusAdapter.

You can find information on BusAdapters in the documentation SIMATIC Distributed I/O; BusAdapter for distributed I/O (<https://support.industry.siemens.com/cs/ww/en/view/109747250>).

### Power supply

Read the technical specifications and information on supply voltage in section "Rules and regulations for operation (Page 80)".

#### **Configuration guidelines for IO device with PROFINET IO interfaces**

In LANs (Local Area Networks) you may only operate IO devices with PROFINET IO interfaces in LANs (Local Area Networks) if the following condition is met:

All connected modes are operated with power supplies (e.g. power supply unit, battery) of SELV/PELV type with guaranteed electrically isolated extra-low voltage.

---

## 6.8 Connecting interfaces for communication

A data transfer point is prescribed for connection to the WAN (Wide Area Network) that guarantees this degree of safety.

### Tools required

Screwdriver 3.5 mm or TORX T10 (recommended):

### Mounting the bus connector

Connect the PROFINET cable to the BusAdapter.

#### Required accessories and installation

You can find additional information on this in the documentation *Industrial Ethernet / PROFINET Passive network components*.

You can find this documentation on the Internet at <http://support.industry.siemens.com/cs/ww/en/view/84922825> (<https://support.industry.siemens.com/cs/ww/en/view/84922825>).

### Requirement

The PROFINET connection cables are connected to the BusAdapter (e.g. BusAdapter with FastConnect cable) or can be retrofitted (e.g. BusAdapter for RJ45 connectors or LC connectors).

### Procedure

---

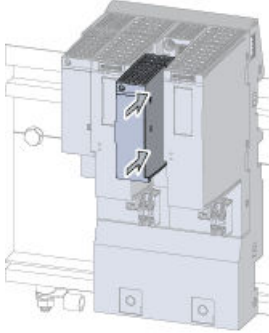
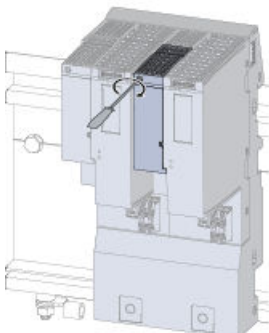
#### Note

##### Basic representation

The following illustrations show the basic representations using the ET 200SP HA as an example.

---

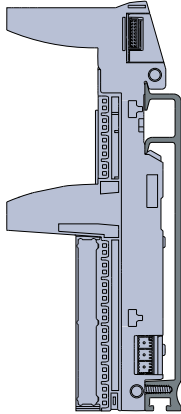
To connect PROFINET IO to the IO device via the BusAdapter, proceed as follows:

Step	Procedure	Illustration
1	Insert the BusAdapter into the IO device.	 <p>The illustration shows a grey BusAdapter being inserted into a slot on the front panel of a grey IO device. The device is mounted on a DIN rail. The BusAdapter has a black top cover and a blue front panel. Arrows indicate the insertion direction.</p>
2	Screw the BusAdapter to the IO device. Use a screwdriver to do this. Tightening torque: see "Mounting rules (Page 178)"	 <p>The illustration shows a screwdriver being used to tighten a screw on the BusAdapter. The screwdriver is positioned at the top of the BusAdapter, and the screw is being driven into the IO device's front panel. The IO device is mounted on a DIN rail.</p>

## 6.9 Inserting I/O modules or slot cover

### Slots

The slots for the I/O modules are created by the connection of the carrier modules to the terminal blocks.



### Coding element



There is a mechanical coding element for the ET 200SP HA distributed I/O system.

- The coding element has two parts.
- When it leaves the factory, both parts are in the I/O module.
- The first time you insert an I/O module, part of the coding element locks into the terminal block.  
This part of the coding element encodes this slot for the type of the I/O module.
- The coding element serves as mechanical barrier to prevent the connection of incompatible I/O modules to the terminal block.

### Slot covers

The slot covers are plugged in when there is no I/O module inserted in the respective slot.

- The slot covers have a holder for the reference identification label on the left exterior. In the event of an expansion of an IO device later in time, remove the reference identification label from the holder and insert it on the new I/O module.
- Reference identification labels cannot be attached to a slot cover itself.



## Requirement

Refer to the section Selecting a terminal block for I/O modules (Page 32).

## Inserting I/O module or slot cover

Insert the I/O module or slot cover parallel into the slot until you hear both interlocks lock into place.

---

### Note

Avoid inserting an I/O module at an angle.

---

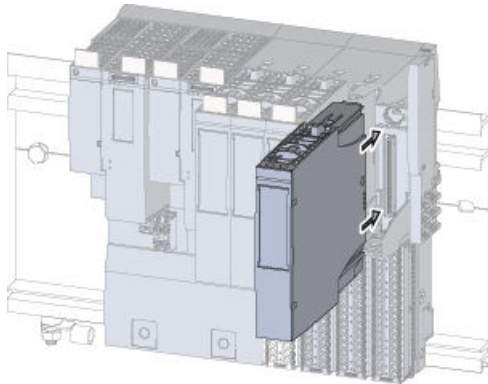


Figure 6-9 Inserting the IO module or slot cover (using the example of an I/O module)



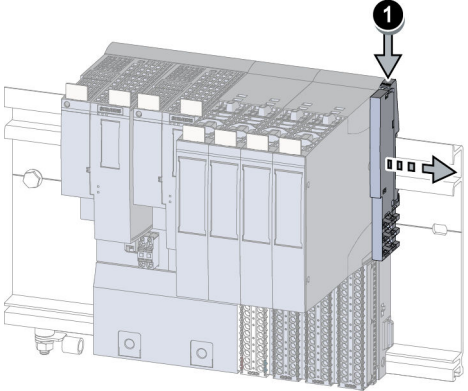
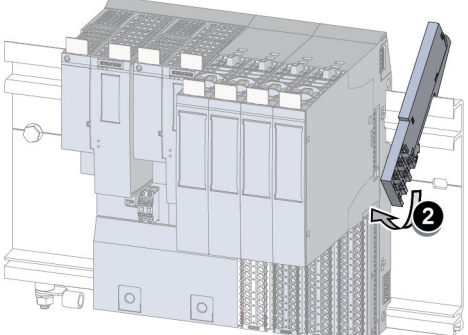
## Removal

### 7.1 Removing a server module and power bus cover

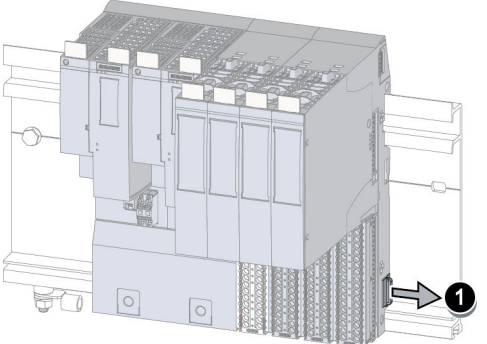
#### Requirement

The supply voltages are switched off.

#### Removing the server module

Step	Procedure	Illustration
1	Press the rail release on the server module and move the server module in parallel to the right.	
2	While pressing the rail release button, swivel the server module off the rail.	

Removing the power bus cover

Step	Procedure	Illustration
1	Pull the power bus cover out of the carrier module.	 A technical illustration of a server carrier module. The module is shown from a three-quarter perspective, highlighting its front and right sides. It features a top section with various ports and a lower section with a power bus cover. An arrow points from the right side of the cover towards the right edge of the carrier module, with a circled number '1' at the tip of the arrow, indicating the direction to pull the cover out.

## 7.2 Removing a terminal block

### Tools required

Screwdriver 3.5 mm:

- For removing the wiring on the terminal block
- For removing the coding element

### Removing a terminal block

If no I/O module is connected to a terminal block, you can remove the carrier module from the terminal block at any time.

#### **Requirement:**

The supply voltages are switched off.

#### **Removing a terminal block:**

---

#### **Note**

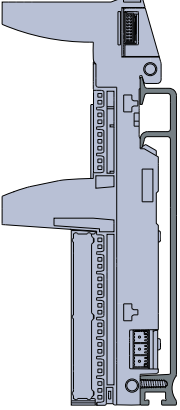
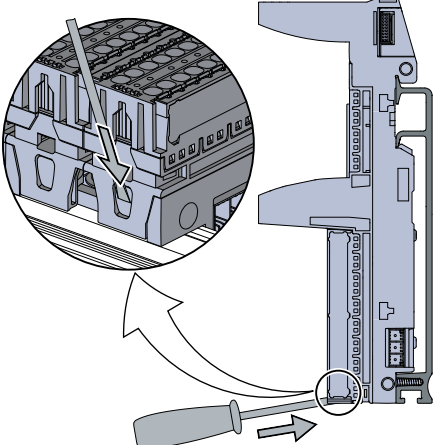
#### **Power bus is disconnected**

The current potential group is interrupted if a terminal block is removed.

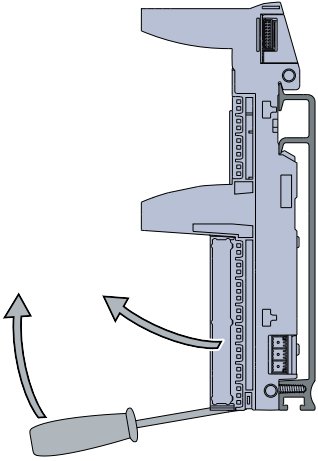
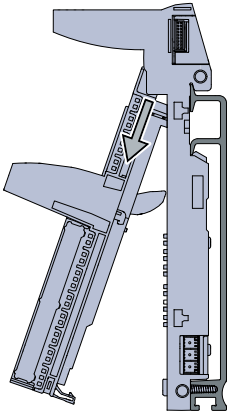
---

Removal

7.2 Removing a terminal block

Step	Procedure	Illustration
1	If necessary, loosen the wiring on the terminal block (with screwdriver 3.5 mm). Not required when replacing the carrier module.	 A side-view illustration of a terminal block carrier module. It is a long, narrow metal component with a series of terminal blocks along its length. A 3.5 mm screwdriver is shown inserted into a small opening at the bottom of the module.
2	The release of the terminal block is located on the bottom of the terminal block. Push the screwdriver into the small opening.	 This illustration shows the terminal block carrier module from step 1. A circular inset provides a magnified view of the bottom of the terminal block. A 3.5 mm screwdriver is shown being pushed into a small opening at the bottom of the terminal block. An arrow points from the screwdriver in the inset to the corresponding location on the main carrier module.

## 7.2 Removing a terminal block

Step	Procedure	Illustration
3	To release the latch of the terminal block, tilt the screwdriver slightly upwards while pulling the terminal block upward out of the carrier module.	
4	Disconnect the terminal block from the carrier module.	

## 7.3 Removing the carrier module

### Tools required

- Screwdriver 4.5 mm: For removing the interlocks (1 and 2) of the carrier module
- Screwdriver 4.5 mm or TORX T15 (recommended): For loosening the fixing screws for the rail.

### Requirements

- The supply voltages are switched off.
- All terminal blocks are remote from the carrier module.

---

#### Note

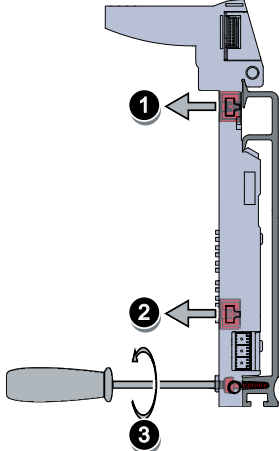
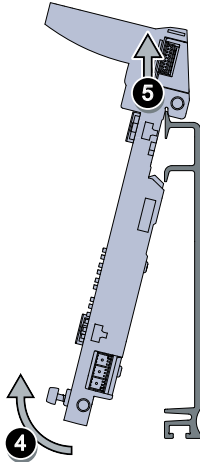
##### Adjacent components

To remove a specific carrier module, you need to remove the adjacent components on the right (carrier modules or server module). Once there is clearance of approx. 8 mm to the adjacent carrier modules, you can remove the carrier module.

---

- There are no other components to the right next to the carrier module.

Procedure

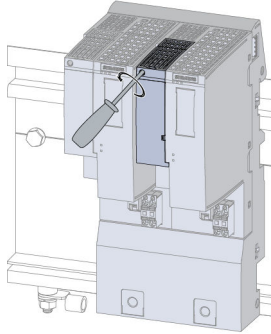
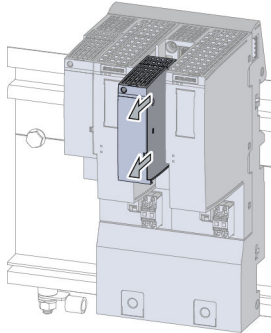
Step	Procedure	Illustration
1	1. Use the screwdriver to pull the interlocks (① and ②) out of the carrier module up to the latching point of the carrier module. 2. Loosen the fixing screws ③ for the rail on the carrier module.	
2	Move the carrier module parallel to the right by at least 8 mm.	
3	1. Swivel the carrier module out of the rail ④. 2. Lift the carrier module up off the rail ⑤.	

## 7.4 Removing a BusAdapter from the interface module

### Tools required

Screwdriver 3.5 mm or TORX T10 (recommended): For loosening the fixing screws on the BusAdapter.

### Procedure

Step	Procedure	Illustration
1	Remove the bus cable from the BusAdapter if necessary.	To do this, remove the bus connectors (RJ45 and FO) or the cable (BA 2xFC).
2	Loosen the screws of the BusAdapter. Use a screwdriver to do so.	
3	Remove the BusAdapter.	

## 7.5 Removing the interface module

### Tools required

- Screwdriver 4.5 mm or TORX T15 (recommended): For loosening the fixing screws for the rail.
- Screwdriver with 3.5 to 4.5 mm blade width for releasing the interface module

### Procedure

The interface module is wired. Carrier modules with terminal blocks and I/O modules are located to the right of the interface module.

Follow these steps to remove the interface module:

Step	Procedure	Illustration
1	Switch off the supply voltage on the interface module.	
2	Pull the plug of the supply voltage from the interface module ①. Note: If this plug is not pulled, the release of the interface module is blocked.	
3	Insert the tip of the screwdriver gently into the opening of the interface module's release ②.	
4	Use the screwdriver ③ to gently lever up the interface module ④ while pulling on it at the same time.	

### Note

The BusAdapter can remain plugged into the interface module.

## 7.6 Removing the carrier module for the interface module

### Tools required

Screwdriver 4.5 mm or TORX T15 (recommended): For loosening the fixing screws for the rail.

### Initial situation

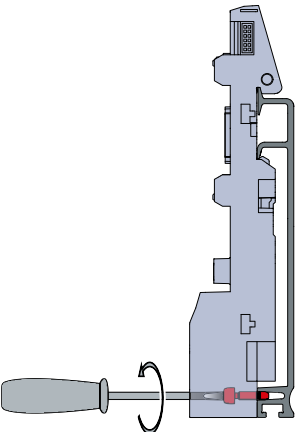
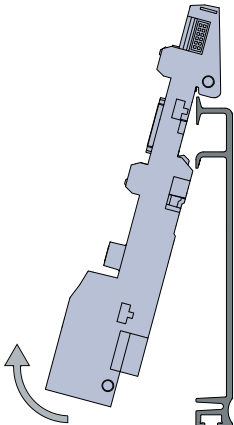
The IO device is wired. There are additional components (carrier modules and I/O modules) to the right of interface module.

### Requirement

- The supply voltages for this IO device are shut off.
- All adjacent components to the right (carrier modules or server module) have been removed.  
You can find information on this in the following sections:
  - Section "Removing a server module and power bus cover (Page 103)"
  - Section "Removing a terminal block (Page 105)"
  - Section "Removing the carrier module (Page 108)"
  - Section "Removing the interface module (Page 111)"
- There must be at least 8 mm of clearance to adjacent carrier modules.

## 7.6 Removing the carrier module for the interface module

## Procedure

Step	Procedure	Illustration
1	On the carrier module, loosen the 2 fixing screws to the rail.	 An illustration showing a screwdriver with a grey handle and a red-tipped shaft. The tip of the screwdriver is inserted into the head of a red screw. A curved arrow indicates a counter-clockwise rotation, signifying the loosening of the screw. The screw is attached to a blue carrier module which is mounted on a vertical metal rail.
2	Swivel the carrier module out of the rail.	 An illustration showing the blue carrier module being swiveled away from the vertical metal rail. A curved arrow at the bottom left indicates the direction of rotation, showing the module moving from a vertical position to a more horizontal one.

## 7.7 Removing I/O modules

### NOTICE

#### Dangerous plant conditions possible (disconnect the load)

- **Inserting or removing** digital output modules with applied load and with applied supply voltage can result in dangerous conditions in your plant.
- I/O modules with output disable switch (see figure below):  
If you want to put these modules into operation, **you need to press the output disable switch for 3 seconds** in order to disconnect the load from the module.  
Only then it is permissible to pull out the module during operation.  
I/O modules with no load can run again only after restarting the IM or pulling/plugging.

Failure to comply may result in material damage to the IO device or to the connected sensors.

Insert and remove an I/O module only with disconnected load.

When using in hazardous areas, read the information in section "Currently valid markings and approvals (Page 133)".

### NOTICE

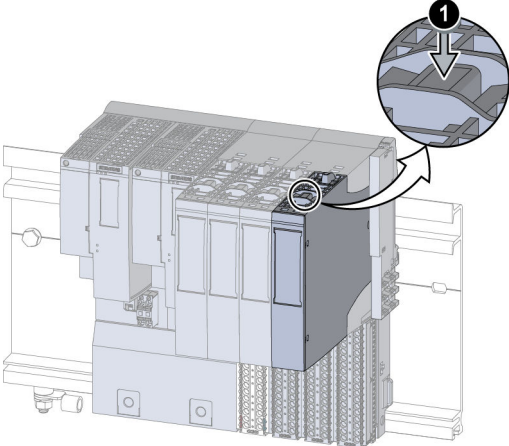
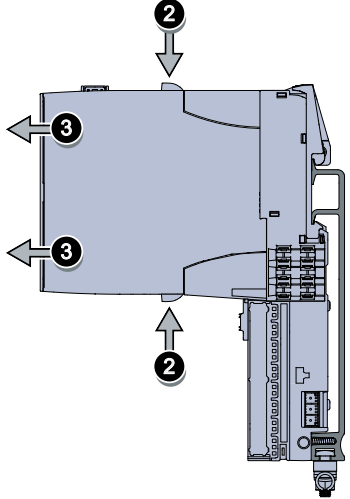
#### I/O modules in the I/O redundancy mode for which at least one channel is configured with "Keep last value"

When the CPU is in "STOP" mode or the PROFINET cable is pulled, the following action are also prohibited one after the other:

- Replacement of both I/O modules
- Firmware update for both I/O modules

## Removing I/O modules

To remove an I/O module, follow these steps:

Step	Procedure	Illustration
1	<p>Press the output disable switch for <b>3 seconds</b>, if it is available and you want to pull the I/O module during operation.</p> <p><b>Note:</b></p> <p>The I/O module signals the "Activated" state with LEDs:</p> <ul style="list-style-type: none"> <li>• LED DIAG: Flashes red</li> <li>• LED MT: lights up yellow</li> </ul> <p>The following diagnostics alarm is generated: "Shutdown with output disable switch" (error ID: 290)</p>	 <p>I/O module with output disable switch</p>
2	<p>Simultaneously press the two release buttons ② on the top and bottom of the I/O module.</p>	
3	<p>Hold down the release buttons and pull the I/O module parallel towards the front and out of the slot ③. Avoid pulling out an I/O module at a slanted angle.</p>	

## Inserting I/O modules

See section "Inserting I/O modules or slot cover (Page 100)"

## **7.8 Removing color-coded labels**

### **Tools required**

Screwdriver 3 mm

### **Procedure**

1. To remove the color-coded labels, you first need to remove the wiring on the terminal block.
2. You can then use a screwdriver to carefully pry the color-coded labels out of the holder.

# Maintenance

## 8.1 Pulling and plugging modules in runtime (overview)

<b>NOTICE</b>
<p><b>I/O modules in the I/O redundancy mode for which at least one channel is configured with "Keep last value"</b></p> <p>When the CPU is in "STOP" mode or the PROFINET cable is pulled, the following action are also prohibited one after the other:</p> <ul style="list-style-type: none"> <li>• Replacement of both I/O modules</li> <li>• Firmware update for both I/O modules</li> </ul> <p>Without an active connection to the CPU in "RUN" mode, the online parameter "Keep last value" is reset in both I/O modules. Both I/O modules output the value 0.</p>

### Requirements

The following table describes which modules you may insert and remove under which conditions:

Table 8-1 Inserting and removing in process mode

Modules	Inserting and removing	Conditions
BusAdapter	Yes	Only in redundant mode.
Interface module	Yes	Only in redundant mode.
Carrier module	Yes	During operation, only expandable or remove last module without an I/O module.
Terminal block	Yes	During operation, only expandable or removable without an I/O module <b>NOTE:</b> This interrupts the power bus.
I/O modules	Yes	<b>NOTICE</b> <b>Removing or inserting digital output modules with applied load and with applied supply voltage</b> can result in dangerous conditions in your plant. You can find information on disconnecting the load in the section "Removing I/O modules (Page 114)". IO redundancy: You can remove an I/O module during operation when the other I/O module is fully functional.
Server module	Yes	---

### **Operating principle**

You can remove and insert any number of I/O modules during operation. The interface module and the inserted I/O modules remain in operation.

## 8.2 Set the I/O module to the maintenance position

### ⚠ CAUTION

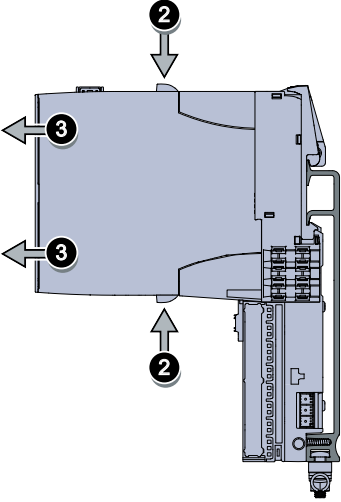
#### Using the maintenance position

If I/O modules are in the maintenance position, you must ensure the following:

**That no dangerous situations can occur by pushing the I/O modules into the terminal block.**

You can avoid this in principle if you completely remove the I/O modules from the IO device.

### Procedure

Step	Procedure	Illustration
1	Perform change in runtime: Read section "Removing I/O modules (Page 114)".	
2	Simultaneously press the two release buttons ② on the top and bottom of the I/O module.	
3	Hold down the release buttons and pull the I/O module <b>slightly (approx 3 mm)</b> towards the front and out of the slot ③. Avoid pulling out an I/O module at a slanted angle.	
4	Release the release buttons.	
5	Pull the I/O module further out of the terminal block until it locks into the maintenance position. When the maintenance position has been reached, the I/O module cannot be fully pulled out without pressing the release buttons.	

## 8.3 Replacing an I/O module

### Introduction

The first time you insert an I/O module, part of the coding element locks into the terminal block. If you replace an I/O module with the same module type, the correct coding element is already in the terminal block.

You can find information on the coding element in the section "Inserting I/O modules or slot cover (Page 100)".

### Module identification - read and transfer data

If data have been configured for module identification in the plant, you must transfer this data after plugging a module in again.

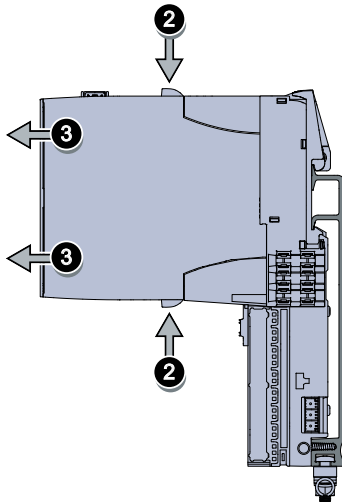
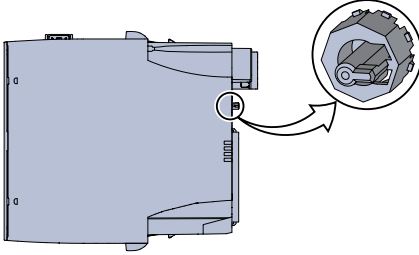
- Data transmitted to the I/O module for the module identification can be read back into the project.  
Configure the I/O module in HW Config and select the menu command **CPU > Upload Module Identification to PG...** .
- Transfer any data for module identification in the configuration after plugging in the I/O module.  
Configure the I/O module in HW Config and select the menu command **CPU > Upload Module Identification...** .

### Requirement

- Read the section "Plant planning (Page 23)".

## Replacing an I/O module

Table 8-2 Changing the type of an I/O module

Step	Procedure	Illustration
1	Perform change in runtime: Read section "Removing I/O modules (Page 114)".	
2	<p>Simultaneously press the two release buttons ② on the top and bottom of the I/O module.</p> <p>Hold down the release buttons and pull the I/O module parallel towards the front and out of the slot ③. Avoid pulling out an I/O module at a slanted angle.</p>	
3	Remove the loose part of the coding element of the new I/O module on its underside (see figure).	
4	<ul style="list-style-type: none"> <li>Insert the new I/O module (same module type) in the terminal block until you hear it latch into place.</li> </ul> <p><b>Note:</b> Avoid inserting an I/O module at an angle.</p> <ul style="list-style-type: none"> <li>Identify the new I/O module with labeling strips and a reference identification label.</li> </ul>	

### See also

Communication error "IO redundancy warning" (maintenance event: error code 121H)  
(Page 122)

## 8.4 Communication error "IO redundancy warning" (maintenance event: error code 121H)

The maintenance event "IO redundancy warning" (error code 121H) indicates an error in the communication between I/O modules with IO redundancy.

Possible causes are the following:

- Right I/O module defective
- Left I/O module defective
- Terminal block defective

To rectify the error, proceed in the order described below.

### Procedure

1. Replace the right module - if the error remains unchanged:
2. Replace the left module - if the error continues:
3. Replace the terminal block.

---

### Note

#### Switching behavior

As soon as you pull the left module, the right module takes over process management. With input modules, the process values fail for the maximum duration of the redundancy changeover time.

You can find information on the redundancy changeover time in the technical specifications of the respective I/O module.

---

### Additional information

- Error correction: Replacing I/O modules  
You can find information on this in the section "Replacing an I/O module (Page 120)"
- Error correction: Replacing a terminal block  
You can find information on this in the section "Replacing a terminal block (Page 125)"

## 8.5 Replacing an I/O module with another type

### Requirements

- The application planning is completed.  
See section Plant planning (Page 23).
- The terminal block is suitable for accommodating the new I/O module.
- The wiring has been or will be adapted to the new I/O module.
- The configuration has been or will be adapted to the new I/O module.

#### NOTICE

##### Do not manipulate the coding element

Changes to the coding element can result in dangerous states in your plant and/or damage to the outputs of the I/O module.

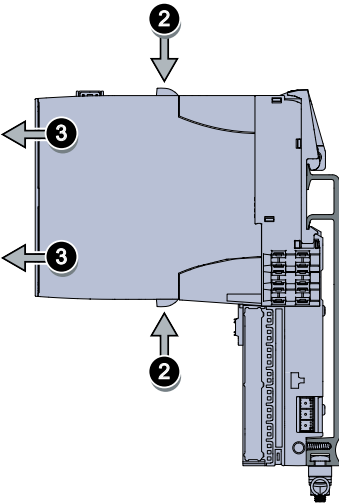
To avoid physical damage, do not manipulate the coding.

You can find information on the coding element in the section "Inserting I/O modules or slot cover (Page 100)".

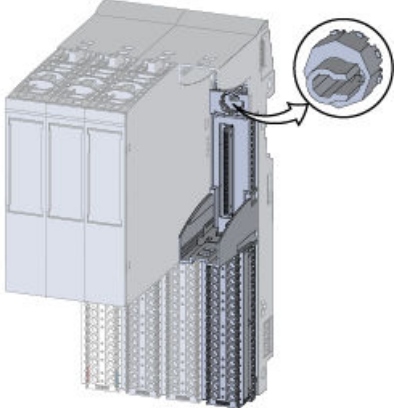
### Procedure

To make a type change for an I/O module, follow these steps:

Table 8-3 Changing the type of an I/O module

Step	Procedure	Illustration
1	Perform change in runtime: Read section "Removing I/O modules (Page 114)".	
2	Simultaneously press the two release buttons ② on the top and bottom of the I/O module.	
3	Hold down the release buttons and pull the I/O module towards the front and out of the slot ③. Avoid pulling out an I/O module at a slanted angle.	

8.5 Replacing an I/O module with another type

Step	Procedure	Illustration
2	<ol style="list-style-type: none"><li>1. Use a screwdriver to lever the coding element from the terminal block.</li><li>2. Insert the coding element into the removed I/O module.</li></ol>	
3	<ul style="list-style-type: none"><li>• Insert the new I/O module (other module type) into the terminal block until you hear it latch into place.</li><li>• Label the new I/O module.</li></ul>	

## 8.6 Replacing a terminal block

### Introduction

The terminals for connecting the supply voltage and process terminals are components of the terminal block. You can replace the terminal block if necessary. This requires the I/O module to be removed.

<b>NOTICE</b>
<b>Power busbars of the potential group are interrupted</b>
The power busbars of potential groups are interrupted when a terminal block is replaced.

- When you position a light-colored terminal block on the left next to a dark-colored terminal block, the light-colored terminal block interrupts the power bus to the left and opens a new potential group at the same time.
- When you replace a light-colored terminal block with a dark-colored terminal block, the potential groups are interconnected.

### Requirements

- The terminal block is installed, wired and equipped with an I/O module.
- Only replace the terminal block when the supply voltage is switched off.

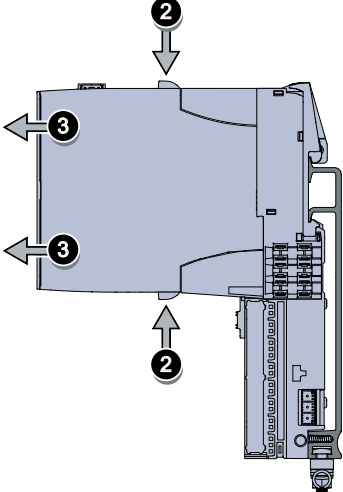
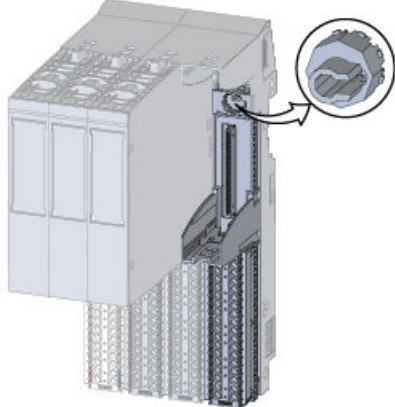
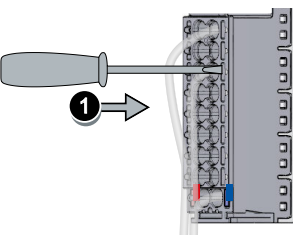
### Tools required

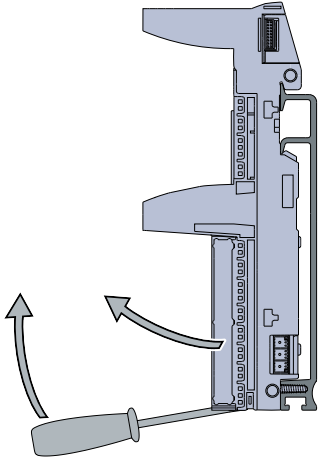
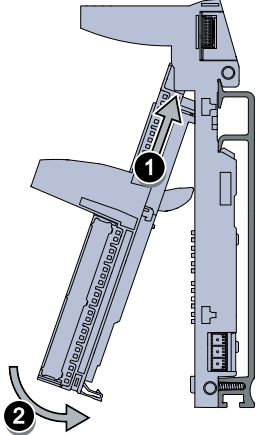
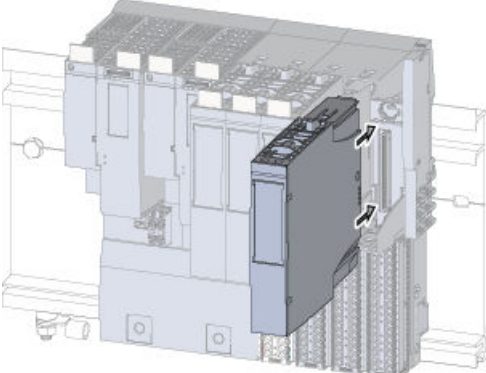
3 to 3.5 mm screwdriver

8.6 Replacing a terminal block

Procedure

To replace a terminal block, follow these steps:

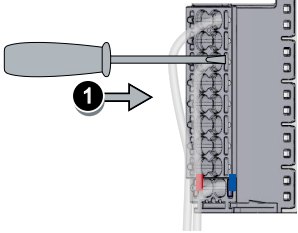
Step	Procedure	Illustration
1	Switch off any supply voltage on the terminal block.	
2	Remove the I/O module. Read section "Removing I/O modules (Page 114)".	
3	Remove the coding element (part) from the terminal block and press this on to the coding element (part) of the I/O module that you removed in the second step.	
4	Loosen the wiring on the terminal block. You can find information on this in the section "Removing wires (Page 128)".	

Step	Procedure	Illustration
5	Remove the terminal block. You can find information on this in the section "Removing a terminal block (Page 105)".	
6	Mount the new terminal block. You can find information on this in the section "Installing the terminal block (Page 71)".	
7	Wire the terminal block. You can find information on this in the section "Wiring the terminal block (Page 86)".	
8	Insert the I/O module into the terminal block. Switch on the supply voltage on the terminal block.	

## 8.7 Removing wires

### Procedure

Adhere to the following sequence:

Step	Procedure	Illustration
1	Press the screwdriver into the spring release of the terminal as far as it will go. <ul style="list-style-type: none"><li data-bbox="268 559 767 619">• The terminal opens. Leave the screwdriver in the spring release.</li></ul>	 A technical illustration showing a screwdriver being used to press a spring release on a terminal. The screwdriver is shown from the side, with its tip inserted into a slot on the terminal. A black circle with the number '1' and an arrow points to the screwdriver's tip, indicating the first step in the procedure. The terminal is shown in a cross-sectional view, revealing internal components like a spring and a contact point.
2	Pull out the cable.	

---

#### Note

#### Avoid damaging the terminal

Never pull on the wire/cable while pressing the spring release.

---

## 8.8 Resetting the interface module to factory settings

### Function

The "Reset to factory settings" function resets the interface module to the factory state.

### Procedure using STEP 7

---

#### Note

##### Redundant configuration

For an IO device with 2 interface modules (redundant configuration), this action must be performed separately for each interface module.

---

To reset an interface module to factory settings using STEP 7, follow these steps:

Ensure that there is a direct connection to the interface module.

1. Select the IO device in HW Config.
2. Select the menu command **Target system > Ethernet > Edit node**.  
The "Edit Ethernet Node" dialog window opens.
3. Click the "Browse" button and select the IO device in the selection window.
4. Click "OK".
5. Click the "Reset" button in the "Reset to factory settings" area.
6. Click "OK" in response to the security prompt.

Result: The interface module then performs "Reset to factory settings".

### Result after resetting to factory settings

The following table shows the values of the interface module properties after a factory reset:

Table 8-4 Properties of the interface module as shipped

Properties	Value
Parameters	Default setting
IP address	Not available
Device name	Not available
MAC address	Available
I&M data	Identification data (I&M0) available Maintenance data (I&M1, I&M2, I&M3) not available
Firmware version	Available

---

**Note**

**Failure of downstream stations is possible**

Downstream stations on a bus segment can fail when the factory settings are restored on an interface module.

---

**Note**

**Substitute value reaction of the installed I/O modules on reset to factory settings**

The I/O modules of the ET 200SP HA distributed I/O system are placed in a non-configured state when they are reset to the factory settings.

---

**Reference**

You will find more information on the procedure in the STEP 7 online help.

## 8.9 Firmware update for interface modules / I/O modules

This section describes the basic procedure for updating the firmware of the interface module or I/O modules.

---

### Note

#### Updating I/O modules in IO redundancy

If the firmware of two redundantly operating I/O modules is to be changed, note the following:

The update of the second I/O module must not be started until the I/O module, which was first updated, is fully operational again.

Readiness for operation is displayed in the input address space on a channel-specific basis (value status QI = good).

---

### Requirements

- A connection to the IO device (ET 200SP HA Station) is possible.
- The storage location of the file for the firmware update is known.

### Procedure

1. Open the hardware configuration in the engineering system.
2. Perform the firmware update.

### Additional information

You can find specific information on firmware updates when using your engineering system in the online help of the engineering system.

## 8.10 Firmware update for the server module

By default, the server module of the ET 200SP HA is not configured in HW Config. Consequently, you cannot select the module in HW Config.

This section describes the steps required to update the firmware of the server module.

### Requirements

- A connection to the IO device (ET 200SP HA Station) is possible.
- The storage location of the file for the firmware update is known.

### Procedure

1. Open SIMATIC Manager.
2. Select the menu command **PLC > Show accessible devices**.
3. Select the station.
4. Select the menu command **PLC > Update Firmware**.  
The "Update Firmware" dialog opens.
5. Select the "Change slot" button.
6. Enter the slot of the server module in the "Change slot" dialog.
7. Select the "Browse" button in the "Firmware File" area.
8. Navigate to the firmware file and select it.
9. Check the suitability of the selected file for the firmware update in the "Firmware File" area.
10. Select the "Activate firmware after update" check box.
11. Click the "Execute" button.

### See also

Technical specifications for the modules (Page 148)

# Technical specifications

## 9.1 Standards and approvals

### 9.1.1 Currently valid markings and approvals

#### Introduction

This section contains the technical specifications of the system:

- The standards and test values that the ET 200SP HA complies with and fulfills.
- The test criteria according to which the ET 200SP HA was tested.

#### Technical specifications of the modules

The technical specifications of the individual modules are also provided in the manuals for the relevant modules. If the information in this document differs from that in the manuals, the manuals take priority.


#### Validity of the information on the components


<b>NOTICE</b>
<b>Markings and approvals</b>
In the manual you can find the markings and approvals which are generally possible or planned in the system.
The identification or approval that is printed on the components of the ET 200SP HA system continues to be exclusively valid!


#### Reference

The certificates for the markings and approvals can be found on the Internet under Service&Support (<http://support.industry.siemens.com/cs/>).

## Safety information

 <b>WARNING</b>
<b>Personal injury and damage to property may occur</b>
Note the following information for use in hazardous areas:
<ul style="list-style-type: none"><li>• Personal injury and property damage can be incurred if the ET 200SP HA connectors are pulled out during operation or if the output disable switch is pressed.</li><li>• In hazardous areas, always ensure that power to the ET 200SP HA is turned off before removing the plug connections or pressing the output disable switch.</li></ul>

 <b>WARNING</b>
<b>Explosion hazard</b>
If you replace components, compliance with Class I, DIV 2 can become invalid.

 <b>WARNING</b>
<b>Area of application</b>
This device is only suitable for use in Class I, Div. 2, Group A, B, C, D, or in non-hazardous areas.

### 9.1.2 CE marking

#### Introduction



The ET 200SP HA distributed I/O system meets the requirements and protective objectives of the following EC directives, and satisfies the Harmonized European Standards (EN) for Programmable Logic Controllers which were published in the official pamphlets of the European Community:

- Low voltage directive
- EMC directive
- Explosion protection directive

You can find the EC declarations of conformity for download on the Internet (keyword "Declaration of conformity").

#### Low voltage directive

2014/35/EU "Electrical equipment designed for use within certain voltage limits" (Low Voltage Directive)

According to the requirements of EN 61010-2-201, the components of the distributed I/O system ET 200SP HA have been tested in compliance with the low voltage directive.

## EMC directive

2014/30/EU "Electromagnetic compatibility" (EMC directive)

### Use in the industrial environment

SIMATIC products are designed for use in industry.

Area of application	Interference emission requirements	Interference immunity requirements
Industry	EN 61000-6-4	EN 61000-6-2

### Use in residential areas

#### Note

The ET 200SP HA distributed I/O system is intended for use in industrial environments; when used in residential areas, it can affect radio/television reception.

If you are using the ET 200SP HA distributed I/O system in residential areas, you must ensure compliance to the regulations on the emission of radio interference according to EN 61000-6-3.

Suitable measures for achieving RF interference level Class B include, for example:

- Installation of the ET 200SP HA distributed I/O system in grounded control cabinets/boxes
- Use of filters in the supply lines

### Use in the field of power plants

The ET 200SP HA distributed I/O system fulfills the EMC specifications according to EN 61000-6-5.

## 9.1.3 Explosion protection

### ATEX Approval



ATEX certification according to the following standards:

- EN 60079-15 (Electrical apparatus for potentially explosive atmospheres; Type of protection "n")
- EN 60079-0 (Electrical apparatus for potentially explosive gas atmospheres - Part 0: General Requirements)

### IECEx Approval

Approval to IEC 60079-15 (Explosive atmospheres - Part 15: Equipment protection by type of protection "n") and IEC 60079-0 (Explosive atmospheres - Part 0: Equipment - General requirements)

IECEx Ex nA IIC Tx Gc IEC Ex DEK 13.0011X

9.1 Standards and approvals

9.1.4 cULus approval



Underwriters Laboratories Inc., complying with

- UL 61010-2-201 (Industrial Control Equipment)
- CSA/ CAN 61010-2-201 (Process Control Equipment)

9.1.5 cULus HAZ. LOC. approval



Underwriters Laboratories Inc., complying with

- UL 61010-2-201 (Industrial Control Equipment)
- CSA / CAN 61010-2-201 (Process Control Equipment)
- ANSI/ISA 12.12.01
- CSA C22.2 No. 213 (Hazardous Location)

APPROVED for use in  
Class I, Division 2, Group A, B, C, D Tx;  
Class I, Zone 2, Group IIC Tx

9.1.6 cFMus approval



Factory Mutual Research (FM) according to  
Approval Standard Class Number 3611, 3600, 3810 (ANSI/ISA 82.02.01)  
CSA C22.2 No. 213  
CSA C22.2 No. 61010-1  
APPROVED for use in Class I, Division 2, Group A, B, C, D Tx;  
Class I, Zone 2, Group IIC Tx

Table 9-1 Factory Mutual Research (FM) certification

FM certification	
Classification	NI, Class I, Div 2, Groups A, B, C and D
	NI, Class I, Zone 2, Groups IIC
Standards	Class No. 3600:2018
	Class No. 3611:2018
	Class No. 3810:2018
	ANSI/ISA-61010-1:2015

9.1.7 Marking for Australia and New Zealand



The ET 200SP HA distributed I/O system fulfills the requirements of the EN 61000-6-4 standard.

### 9.1.8 Korea Certificate



Note that this device corresponds to limit class A in terms of the emission of radio frequency interference. This device can be used in all areas, except residential areas.

이 기기는 업무용(A급) 전자파 적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 가정 외의 지역에서 사용하는 것을 목적으로 합니다.

### 9.1.9 Marking for the Eurasian Customs Union



EAC (Eurasian Conformity)

Customs Union of Russia, Belarus and Kazakhstan

Declaration of conformity with the technical requirements of the Customs Union (TR CU).

## 9.2 Electromagnetic compatibility

### Definition

The electromagnetic compatibility (EMC) is the ability of an electrical device to function in its electromagnetic environment without influencing this environment.

### EMC requirements fulfilled

The ET 200SP HA distributed I/O system also fulfills the requirements of the EMC directive for the European domestic market.

#### Requirement

You must ensure that the configuration of the ET 200SP HA corresponds to the specifications and guidelines for electrical setup.

### EMC in accordance with NE21

The ET 200SP HA distributed I/O system fulfills the EMC specifications according to NAMUR directive NE21.

### Pulse-shaped disturbance variables

The following table shows the electromagnetic compatibility of the ET 200SP HA distributed IO system with pulse-shaped interference.

Table 9-2 Pulse-shaped disturbance variables

Disturbance variable	Tested with	Corresponds to degree of severity
Electrostatic discharge in accordance with IEC 61000-4-2	Air discharge: $\pm 8$ kV	3
	Contact discharge: $\pm 6$ kV	3
Burst pulses (fast transients) in accordance with IEC 61000-4-4 for the frequencies 5 kHz and 100 kHz	$\pm 2$ kV (power supply line)	3
	$\pm 2$ kV (signal line)	3
High-energy single pulse (surge) in accordance with IEC 61000-4-5 Basic information about the external protective circuit, see the " Designing interference-free controllers ( <a href="https://support.industry.siemens.com/cs/ww/en/view/59193566">https://support.industry.siemens.com/cs/ww/en/view/59193566</a> )" function manual.		
• Signals	$\pm 1$ kV asymmetrical (line to ground)	2
• Signals (with external protection)	$\pm 2$ kV unbalanced (line to ground) $\pm 1$ kV balanced (line to line)	3
• Signals directly in AC network	$\pm 2$ kV unbalanced (line to ground) $\pm 1$ kV balanced (line to line)	3
• DC supply	$\pm 1$ kV unbalanced (line to ground) $\pm 0.5$ kV balanced (line to line)	2
• DC supply (with external protection)	$\pm 2$ kV asymmetrical (line to ground) $\pm 1$ kV balanced (line to line)	3

### Sinusoidal disturbance variables

The following tables show the electromagnetic compatibility of the ET 200SP HA distributed I/O system to sinusoidal interference.

Table 9-3 HF radiation - sinusoidal interference

HF radiation according to IEC 61000-4-3/NAMUR NE21 Electromagnetic RF field, amplitude-modulated		Corresponds to degree of severity
80 MHz to 2.0 GHz	2.0 GHz to 6 GHz	3
10 V/m	3 V/m	
80% AM (1 kHz)		

Table 9-4 HF coupling - sinusoidal interference

RF coupling in accordance with IEC 61000-4-6	Corresponds to degree of severity
(10 kHz) 150 kHz to 80 MHz	3
10 V <sub>rms</sub> unmodulated	
80% AM (1 kHz)	

Table 9-5 Magnetic field IEC 61000-4-8

Magnetic field according to IEC 61000-4-8	Corresponds to degree of severity
50/60 Hz 100 A /m	5
50/60 Hz 1 kA/m for 1 s	5

Table 9-6 Voltage with power engineering frequency (line frequency)

Test according to IEC 61000-4-16	Corresponds to degree of severity
10 V	3
100 V for 1 s	3

Table 9-7 Asymmetrical conducted interference

Inspection according to IEC 61000-4-16 and IEC 61000-4-18	Corresponds to degree of severity
<ul style="list-style-type: none"> <li>• 10 V - 1 V (15 Hz - 150 Hz)</li> <li>• 1 V (150 Hz - 1.5 kHz)</li> <li>• 1 V - 10 V (1.5 kHz - 15 kHz)</li> <li>• 10 V (15kHz - 150 kHz)</li> </ul>	3

See the table "Conditions for the design of field wiring".

Table 9-8 Damped oscillatory waves

Inspection according to IEC 61000-4-16 and IEC 61000-4-18	Corresponds to degree of severity
Signals: <ul style="list-style-type: none"> <li>• 1.0 kV (common mode, 1 MHz)</li> <li>• 0.5 kV (differential mode, 1 MHz)</li> </ul>	2
DC supply: <ul style="list-style-type: none"> <li>• 1.0 kV (common mode, 1 MHz)</li> <li>• 0.5 kV (differential mode, 1 MHz)</li> <li>• 0.5 kV (common mode, 10 MHz)</li> </ul>	2

See the table "Conditions for the design of field wiring".

### Conditions for the design of field wiring

To fulfill these requirements, the field wiring for the modules should be performed as stipulated in the following table.

Module	Article number	Design of the field wiring
AI 16xI 2-wire HART HA	6DL1134-6TH00-0PH1	Shielded
AI16xTC/8xRTD 2-/3-/4-wire HA	6DL1134-6JH00-0PH1	Shielded
AI-DI16/DQ16x24VDC HART HA	6DL1133-6EW00-0PH1	Shielded
AQ 8xI HART HA	6DL1135-6TF00-0PH1	Shielded
DI 16x24VDC HA	6DL1131-6BH00-0PH1	Unshielded
DI 8x230VAC HA	6DL1131-6GF00-0PK0	Unshielded
DI 8x24..125VDC HA	6DL1131-6DF00-0PK0	Unshielded
DI 16xNAMUR HA	6DL1131-6TH00-0PH1	Shielded
DI 32x24VDC HA	6DL1131-6BL00-0PH1	Unshielded
DQ 16x24VDC/0,5A HA	6DL1132-6BH00-0PH1	Unshielded
DQ 32x24VDC/0.5A HA	6DL1132-6BL00-0PH1	Unshielded
AI16xTC/8xRTD 2-/3-/4-wire HA	6DL1134-6JH00-0EH1	Shielded
AI-DI16/DQ16x24VDC HART HA	6DL1133-6EW00-0EH1	Shielded

Module	Article number	Design of the field wiring
AQ 8xI HART HA	6DL1135-6TF00-0EH1	Shielded
DI 8x230VAC HA	6DL1131-6GF00-0EK0	Unshielded
DI 8x24...125VDC HA	6DL1131-6DF00-0EK0	Unshielded
RQ 4x120VDC-230VAC/5A CO HA	6DL1132-6HD50-0PK0	Unshielded

### Emission of radio frequency interference

- Emission of electromagnetic interference according to EN 61000-6-4.
- Interference emission via the mains AC power supply according to EN 61000-6-4.

## 9.3 Shipping and storage conditions

### Introduction

The ET 200SP HA distributed I/O system surpasses requirements for transport and storage conditions according to IEC 61131-2. The following information applies to modules that are shipped and/or stored in their original packaging.

Table 9-9 Shipping and storage conditions for modules

Type of condition	Permissible range
Free fall (in shipping package)	≤1 m
Temperature	From -40 °C to +70 °C
Air pressure <sup>1)</sup>	From 1080 hPa (corresponds to a depth of approx. -1000 m) Up to 606 hPa (corresponds to an elevation of approx. 4000 m)
Relative humidity	5% to 95%, without condensation
Sinusoidal oscillations according to IEC 60068-2-6	5 - 8.4 Hz: 3.5 mm 8.4 - 500 Hz: 9.8 m/s <sup>2</sup>
Impact according to IEC 60068-2-27	250 m/s <sup>2</sup> , 6 ms, 1000 shocks

<sup>1)</sup> Note that I/O modules with relay contacts are only suitable for an elevation up to 3000 m (corresponds to air pressure of around 690 hPa).

## 9.4 Mechanical and climatic environmental conditions

### Information on the documentation

---

#### Note

#### Higher-priority documentation

The information for the specific components takes precedence over the information in this documentation. The statements in the product information always takes precedence over all other information.

---

### Operating conditions

The ET 200SP HA must be installed in a suitable enclosure which ensures at least IP 54 degree of protection according to EN 60529. Use a safety enclosure that meets the requirements regarding spread of fire and exhibits an appropriate strength according to UL61010-1 and UL 61010-2-201. Observe the applicable ambient conditions when using the ET 200SP HA. The ET 200SP HA may only be used in an environment with no more than pollution degree 2 (as defined in EN 60664-1).

The ET 200SP HA distributed I/O system is designed for stationary use in weather-proof locations. The operating conditions exceed requirements according to DIN IEC 60721-3-3:

- Class 3M3 (mechanical requirements)
- Class 3K3 (climatic requirements)

### Use with additional measures

The described components may not be used without additional measures:

- At locations with a high degree of ionizing radiation
- In harsh operating environments caused, for example, by:
  - Accumulation of dust
  - Corrosive vapors or gases
  - Strong electrical or magnetic fields
- In installations requiring special monitoring, for example:
  - Elevator systems
  - Electrical systems in potentially hazardous areas

An additional measure, for example, can be installation in a cabinet or enclosure.

### Mechanical ambient conditions

The following table shows the mechanical ambient conditions in the form of sinusoidal vibrations.

Table 9-10 Mechanical ambient conditions

Frequency range in Hz	
$5 \leq f \leq 8.4$	Amplitude 3.5 mm
$8.4 \leq f \leq 150$	constant acceleration 9.8 m/s <sup>2</sup>

### Reduction of vibration

If the described components are subject to big shock or vibration, appropriate measures must be taken to reduce the acceleration or the amplitude.

We recommend mounting the described components on damping materials (rubber-metal anti-vibration mountings, for example).

### Tests of mechanical ambient conditions

The following table provides important information with respect to the type and scope of the tests of mechanical ambient conditions.

Table 9-11 Tests of mechanical ambient conditions

Condition tested	Test standard	Comment
Vibration	Vibration test according to IEC 60068-2-6 (sinusoidal)	Type of vibration: <ul style="list-style-type: none"> <li>• Frequency sweeps with a rate of change of 1 octave/minute.                             <ul style="list-style-type: none"> <li>– <math>5 \text{ Hz} \leq f \leq 8.4 \text{ Hz}</math>, constant amplitude 3.5 mm</li> <li>– <math>8.4 \text{ Hz} \leq f \leq 150 \text{ Hz}</math>, constant acceleration 9.8 m/s<sup>2</sup></li> </ul> </li> </ul> Duration of vibration: <ul style="list-style-type: none"> <li>• 10 frequency sweeps per axis at each of three vertically aligned axes</li> </ul>
Shock	Shock, tested according to IEC 60068-2-27	Type of shock: <ul style="list-style-type: none"> <li>• Half-sine</li> </ul> Shock intensity <sup>1)</sup> : <ul style="list-style-type: none"> <li>• Peak value 150 m/s<sup>2</sup></li> <li>• Duration 11 ms</li> </ul> Direction of shock: <ul style="list-style-type: none"> <li>• 3 shocks in each direction (+/-) at each of three vertically aligned axes</li> </ul>

<sup>1)</sup> Note that I/O modules with relay contacts are tested and approved in accordance with the relay manufacturer's specifications. You can find further information in the documentation of I/O module with relay contacts.

### Climatic ambient conditions

The following table shows the permissible climatic ambient conditions for the ET 200SP HA distributed I/O system.

Table 9-12 Climatic ambient conditions

Ambient conditions	Permissible range	Comments
Temperature	<ul style="list-style-type: none"> <li>Horizontal installation: from -40°C to 70°C</li> <li>Vertical installation: from -40°C to 60°C</li> </ul> Note: No icing	Observe any load-dependent limitations. Refer to the documentation of the employed component. Tested according to IEC 60068-2-2 (Dry heat)
Air pressure	<ul style="list-style-type: none"> <li>From 1 080 hPa (corresponds to a depth of approximately -1 000 m)</li> <li>Up to 606 hPa (corresponds to an elevation of approximately 4 000 m)</li> </ul>	The density of the air decreases with increasing altitude. The cooling effect of air in accordance with the elevation is shown in the following table on derating.
Relative humidity	From 10 to 95% Max. 95% at +25 °C	Without condensation, corresponds to relative humidity (RH) stress grade 2 in accordance with IEC 61131 part 2 Tested according to IEC 60068-2-78 (Damp heat)
Concentration of pollutants	<ul style="list-style-type: none"> <li>SO<sub>2</sub>: &lt;0.5 ppm</li> <li>RH: &lt;60 %, no condensation</li> <li>H<sub>2</sub>S: &lt;0.1 ppm</li> <li>RH: &lt;60 %, no condensation</li> </ul>	Test: 10 ppm; 4 days Test: 1 ppm; 4 days
	ISA-S71.04 severity level G1; G2; G3	-

### Derating

The cooling effect of air decreases at higher altitudes as a result of its lower density.

The table shows the derating factor for the maximum permissible ambient temperature depending on the use of the devices at an elevation above sea level.

Table 9-13 Derating when devices are used at an elevation above sea level

Elevation above sea level <sup>1)</sup>	Derating factor for ambient temperature <sup>2)</sup>
(-1 000 m) up to 2 000 m	1.0
3 000 m	0.9
4 000 m	0.8

<sup>1)</sup> Please note that I/O modules with relay contacts are only suitable for an elevation up to 3 000 m.

<sup>2)</sup> Relating to the maximum permissible ambient temperature in °C for 2 000 m

## 9.5 Information on insulation, protection class, degree of protection and rated voltage

The information for the specific components takes precedence over the information in this documentation. The statements in the product information always have priority over all other information.

### Insulation

The insulation is designed to fulfill the requirements of EN 61010-2-201 .

Location	Test
Backplane bus to supply voltage L+	1500 V DC/1 min, type test

### Pollution severity/overvoltage category according to IEC 61010-2-201

- Pollution degree 2
- Overvoltage category: II

### Protection class according to IEC 61010-2-201

The ET 200SP HA distributed I/O system fulfills Safety Class III. Safety classes I and II may apply to I/O modules. You can find additional information on this in the documentation of the I/O modules. The grounding of the rail must meet the requirements for functional earth (FE).

Recommendation:

To ensure interference-free installation, the cable for the functional grounding should have a cross-section  $> 6 \text{ mm}^2$ .

The installation location (e.g. enclosure, control cabinet) must have a protective conductor connection that meets the standard to maintain protection class I.

### Degree of protection IP20

IP20 degree of protection according to IEC 60529 for all modules of the distributed I/O system ET 200SP HA, i.e.:

- Protection against contact with standard probe
- Protection against foreign objects with diameters in excess of 12.5 mm
- No protection against water

### Rated voltage for operation

The ET 200SP HA distributed I/O system works with the nominal voltage that is shown in the following table.

- Observe the tolerance range of the nominal voltage.
- When selecting the nominal voltage, note the maximum permissible supply voltage of each module.

9.5 Information on insulation, protection class, degree of protection and rated voltage

Table 9-14 Rated voltage for operation

Rated voltage	Tolerance range
24 V DC	19.2 to 28.8 V DC <sup>1</sup>
	18.5 to 30.2 V DC <sup>2</sup>

<sup>1</sup> Static value: Creation as functional extra-low voltage with safe electrical isolation according to IEC 60364-4-41

<sup>2</sup> Dynamic value: Including ripple, e.g. as in the case of three-phase bridge power rectification

## 9.6 Technical specifications of subcomponents of the ET 200SP HA

### 9.6.1 Power supply (SELV/PELV)

Ensure that the power supply is safely disconnected in accordance with the following standard: IEC/UL61010-2-201. This separation is referred to in the standard as SELV (Safety Extra Low Voltage) / PELV (Protective Extra Low Voltage).

Make sure that the supply and input voltages of the ET 200SP HA IO device are generated safely separately:

Nominal value: 24 VDC +-20% (---)

### 9.6.2 Technical specifications for the modules

The technical specifications of the individual modules can be found in the manuals of the modules themselves. In the event of deviations between the statements in this document and the manuals, the statements in the manuals take priority.

### 9.6.3 Technical specifications - Carrier modules (TM)

#### Use

You can find information on this in section "Selecting the carrier module (Page 30)".

### Carrier module (for interface module - single)

A server module and a power bus cover are supplied for the interface module with every carrier module.

<b>Article number</b>	<b>6DL1193-6BH00-0SM0</b>
<b>General information</b>	
Product type designation	Carrier module IM single
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes; Asset data
<b>Supply voltage</b>	
Rated value (DC)	24 V
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes
<b>Isolation</b>	
Isolation tested with	1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> <li>horizontal installation, max.</li> <li>vertical installation, min.</li> <li>vertical installation, max.</li> </ul>	-40 °C 70 °C -40 °C 60 °C
<b>Dimensions</b>	
Width	100 mm
Height	204 mm
Depth	52 mm
<b>Weights</b>	
Weight, approx.	250 g

**Carrier module (for interface module - redundant 6DL1193-6BH00)**

A server module and a power bus cover are supplied for the interface module with every carrier module.

<b>Article number</b>	<b>6DL1193-6BH00-0RM0</b>
<b>General information</b>	
Product type designation	Carrier module IM redundant
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes; Asset data
<b>Supply voltage</b>	
Rated value (DC)	24 V
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes
<b>Isolation</b>	
Isolation tested with	1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>horizontal installation, max.</li> </ul>	70 °C
<ul style="list-style-type: none"> <li>vertical installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>vertical installation, max.</li> </ul>	60 °C
<b>Dimensions</b>	
Width	100 mm
Height	204 mm
Depth	52 mm
<b>Weights</b>	
Weight, approx.	224 g

Carrier module 2x (6DL1193-6GA00-0NN0)

<b>Article number</b>	<b>6DL1193-6GA00-0NN0</b>
<b>General information</b>	
Product type designation	Carrier module 2 times
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes; Asset data
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test
between the potential groups	Yes; 3 510 V AC/ 5 s, type test (between the power supply groups; due to isolating distance (increased isolation) for future ÜK-III requirement of F technology)
<b>Isolation</b>	
Isolation tested with	1 500 V DC/1 min, type test (between backplane bus and functional ground)
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> <li>horizontal installation, max.</li> <li>vertical installation, min.</li> <li>vertical installation, max.</li> </ul>	<p>-40 °C</p> <p>70 °C</p> <p>-40 °C</p> <p>60 °C</p>
<b>Dimensions</b>	
Width	52.5 mm; 45 mm when installed
Height	203 mm
Depth	79 mm
<b>Weights</b>	
Weight, approx.	111 g

**Carrier module 8x (6DL1193-6GC00-0NN0)**

<b>Article number</b>	<b>6DL1193-6GC00-0NN0</b>
<b>General information</b>	
Product type designation	Carrier module 8 times
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes; Asset data
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test
between the potential groups	Yes; 3 510 V AC/ 5 s, type test (between the power supply groups; due to isolating distance (increased isolation) for future ÜK-III requirement of F technology)
<b>Isolation</b>	
Isolation tested with	1 500 V DC/1 min, type test (between backplane bus and functional ground)
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> <li>horizontal installation, max.</li> <li>vertical installation, min.</li> <li>vertical installation, max.</li> </ul>	<p>-40 °C</p> <p>70 °C</p> <p>-40 °C</p> <p>60 °C</p>
<b>Dimensions</b>	
Width	187.5 mm; 180 mm when installed
Height	203 mm
Depth	79 mm
<b>Weights</b>	
Weight, approx.	450 g

## 9.6.4 Technical specifications - Terminal blocks

### Use

You can find additional information on this in the section "Selecting a terminal block for I/O modules (Page 32)".

Signal voltage	Potential group	Redundant configuration	Potential distributor	Process terminals	Temperature detection	Terminal block type	Article number
Up to 24 V DC	Start again	No	No	32	Yes	H1 light	6DL1193-6TP00-0DH1
		Yes	No	32	Yes	M1 light	6DL1193-6TP00-0DM1 <sup>1)</sup>
		No	Yes, 32x L-distributor	32+32	No	P0 light	6DL1193-6TP00-0DP0 <sup>2)</sup>
		No	Yes, 32x M-distributor	32+32	No	N0 light	6DL1193-6TP00-0DN0 <sup>2)</sup>
	Forwarding	No	No	32	Yes	H1 dark	6DL1193-6TP00-0BH1
		Yes	No	32	Yes	M1 dark	6DL1193-6TP00-0BM1 <sup>1)</sup>
		No	Yes, 32x L-distributor	32+32	No	P0 dark	6DL1193-6TP00-0BP0 <sup>2)</sup>
		No	Yes, 32x M-distributor	32+32	No	N0 dark	6DL1193-6TP00-0BN0 <sup>2)</sup>
24 V DC with channel isolation; 125 V DC to 230 V DC	Start again	No	No	16	No	K0 light	6DL1193-6TP00-0DK0
	Forwarding	No	No	16	No	K0 dark	6DL1193-6TP00-0BK0

<sup>1)</sup> The terminal blocks (TB 45R...) are to be used exclusively for operating the I/O modules in IO redundancy or slot covers. The process terminals run parallel to the contacts of the two I/O modules.

<sup>2)</sup> Potential distributor for 32-channel I/O modules

Terminal block TB22-P32-4D/T

<b>Article number</b>	<b>6DL1193-6TP00-0DH1</b>
<b>General information</b>	
Product type designation	Type H1
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes; Asset data
<b>Supply voltage</b>	
Rated value (DC)	24 V
external protection for power supply lines	Yes; 24 V DC/10 A miniature circuit breaker with type B or C tripping characteristic
<b>Current carrying capacity</b>	
up to 70 °C, max.	10 A
For process terminals, max.	2 A
<b>Hardware configuration</b>	
Temperature sensor	Yes; For internal reference junction with connecting thermocouple
<b>Formation of potential groups</b>	
<ul style="list-style-type: none"> <li>New potential group</li> </ul>	Yes
<ul style="list-style-type: none"> <li>Potential group continued from the left</li> </ul>	No
<b>Analog inputs</b>	
<b>Thermocouple (TC)</b>	
<b>Temperature compensation</b>	
– internal temperature compensation	Yes
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test (due to half the isolating distance (basic isolation) for ÜK-III requirement of F technology)
between the potential groups	Yes; 1 500 V DC/1 min, type test (to functional ground FE)
between process terminals and supply voltage	Yes; 1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>horizontal installation, max.</li> </ul>	70 °C
<ul style="list-style-type: none"> <li>vertical installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>vertical installation, max.</li> </ul>	60 °C
<b>Dimensions</b>	
Width	22.5 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	80 g

### Terminal block TB22-P32-4B/T

<b>Article number</b>	<b>6DL1193-6TP00-0BH1</b>
<b>General information</b>	
Product type designation	Type H1
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes; Asset data
<b>Supply voltage</b>	
Rated value (DC)	24 V
<b>Current carrying capacity</b>	
up to 70 °C, max.	10 A
For process terminals, max.	2 A
<b>Hardware configuration</b>	
Temperature sensor	Yes; For internal reference junction with connecting thermocouple
<b>Formation of potential groups</b>	
<ul style="list-style-type: none"> <li>New potential group</li> </ul>	No
<ul style="list-style-type: none"> <li>Potential group continued from the left</li> </ul>	Yes
<b>Analog inputs</b>	
<b>Thermocouple (TC)</b>	
<b>Temperature compensation</b>	
– internal temperature compensation	Yes
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test (due to half the isolating distance (basic isolation) for ÜK-III requirement of F technology)
between the potential groups	Yes; 1 500 V DC/1 min, type test (to functional ground FE)
between process terminals and supply voltage	Yes; 1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>horizontal installation, max.</li> </ul>	70 °C
<ul style="list-style-type: none"> <li>vertical installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>vertical installation, max.</li> </ul>	60 °C
<b>Dimensions</b>	
Width	22.5 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	80 g

Terminal block TB45R-P32+4D/T

<b>Article number</b>	<b>6DL1193-6TP00-0DM1</b>
<b>General information</b>	
Product type designation	Type M1
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes; Asset data
<b>Supply voltage</b>	
Rated value (DC)	24 V
external protection for power supply lines	Yes; 24 V DC/10 A miniature circuit breaker with type B or C tripping characteristic
<b>Current carrying capacity</b>	
up to 70 °C, max.	10 A
For process terminals, max.	2 A
<b>Hardware configuration</b>	
Temperature sensor	Yes; For internal reference junction with connecting thermocouple
<b>Formation of potential groups</b>	
<ul style="list-style-type: none"> <li>New potential group</li> </ul>	Yes
<ul style="list-style-type: none"> <li>Potential group continued from the left</li> </ul>	No
<b>Analog inputs</b>	
<b>Thermocouple (TC)</b>	
<b>Temperature compensation</b>	
– internal temperature compensation	Yes
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test (due to half the isolating distance (basic isolation) for ÜK-III requirement of F technology)
between the potential groups	Yes; 1 500 V DC/1 min, type test (to functional ground FE)
between process terminals and supply voltage	Yes; 1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>horizontal installation, max.</li> </ul>	70 °C
<ul style="list-style-type: none"> <li>vertical installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>vertical installation, max.</li> </ul>	60 °C
<b>Dimensions</b>	
Width	45 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	155 g

Terminal block TB45R-P32+4B/T

<b>Article number</b>	<b>6DL1193-6TP00-0BM1</b>
<b>General information</b>	
Product type designation	Type M1
<b>Product function</b>	
• I&M data	Yes; Asset data
<b>Supply voltage</b>	
Rated value (DC)	24 V
<b>Current carrying capacity</b>	
up to 70 °C, max.	10 A
For process terminals, max.	2 A
<b>Hardware configuration</b>	
Temperature sensor	Yes; For internal reference junction with connecting thermocouple
<b>Formation of potential groups</b>	
• New potential group	No
• Potential group continued from the left	Yes
<b>Analog inputs</b>	
<b>Thermocouple (TC)</b>	
<b>Temperature compensation</b>	
– internal temperature compensation	Yes
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test (due to half the isolating distance (basic isolation) for ÜK-III requirement of F technology)
between the potential groups	Yes; 1 500 V DC/1 min, type test (to functional ground FE)
between process terminals and supply voltage	Yes; 1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
• horizontal installation, min.	-40 °C
• horizontal installation, max.	70 °C
• vertical installation, min.	-40 °C
• vertical installation, max.	60 °C
<b>Dimensions</b>	
Width	45 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	155 g

Terminal block TB45-P32+32x24V+4M+4D

<b>Article number</b>	<b>6DL1193-6TP00-0DP0</b>
<b>General information</b>	
Product type designation	Type P0
<b>Product function</b>	
• I&M data	Yes
<b>Supply voltage</b>	
Rated value (DC)	24 V
external protection for power supply lines	Yes; 24 V DC/10 A miniature circuit breaker with type B or C tripping characteristic
<b>Current carrying capacity</b>	
up to 70 °C, max.	10 A
For process terminals, max.	2 A; Process terminals on the right side are protected by resettable fuses for a maximum continuous current of 20 mA
<b>Hardware configuration</b>	
<b>Formation of potential groups</b>	
• New potential group	Yes
• Potential group continued from the left	No
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test
between the potential groups	Yes; 1 500 V DC/1 min, type test (SELV / PELV to functional ground FE)
between process terminals and supply voltage	Yes; 1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
• horizontal installation, min.	-40 °C
• horizontal installation, max.	70 °C
• vertical installation, min.	-40 °C
• vertical installation, max.	60 °C
<b>Dimensions</b>	
Width	45 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	155 g

### Terminal block TB45-P32+32x24V+4M+4B

<b>Article number</b>	<b>6DL1193-6TP00-0BP0</b>
<b>General information</b>	
Product type designation	Type P0
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes
<b>Supply voltage</b>	
Rated value (DC)	24 V
<b>Current carrying capacity</b>	
up to 70 °C, max. For process terminals, max.	10 A 2 A; Process terminals on the right side are protected by resettable fuses for a maximum continuous current of 20 mA
<b>Hardware configuration</b>	
<b>Formation of potential groups</b>	
<ul style="list-style-type: none"> <li>New potential group</li> <li>Potential group continued from the left</li> </ul>	No Yes
<b>Potential separation</b>	
between backplane bus and supply voltage between the potential groups	Yes; 4 200 V DC/1 min, type test Yes; 1 500 V DC/1 min, type test (to functional ground FE)
between process terminals and supply voltage	Yes; 1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> <li>horizontal installation, max.</li> <li>vertical installation, min.</li> <li>vertical installation, max.</li> </ul>	-40 °C 70 °C -40 °C 60 °C
<b>Dimensions</b>	
Width	45 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	155 g

### Terminal block TB45-P32+36xM+4D

<b>Article number</b>	<b>6DL1193-6TP00-0DN0</b>
<b>General information</b>	
Product type designation	Type N0
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes
<b>Supply voltage</b>	
Rated value (DC)	24 V
external protection for power supply lines	Yes; 10 A miniature circuit breaker with type B or C tripping characteristic for the respective rated supply voltage
<b>Current carrying capacity</b>	
up to 70 °C, max.	10 A
For process terminals, max.	2 A
<b>Hardware configuration</b>	
<b>Formation of potential groups</b>	
<ul style="list-style-type: none"> <li>New potential group</li> </ul>	Yes
<ul style="list-style-type: none"> <li>Potential group continued from the left</li> </ul>	No
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test (due to half the isolating distance (basic isolation) for ÜK-III requirement of F technology)
between the potential groups	Yes; 1 500 V DC/1 min, type test (to functional ground FE)
between process terminals and supply voltage	Yes; 1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>horizontal installation, max.</li> </ul>	70 °C
<ul style="list-style-type: none"> <li>vertical installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>vertical installation, max.</li> </ul>	60 °C
<b>Dimensions</b>	
Width	45 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	155 g

### Terminal block TB45-P32+36xM+4B

<b>Article number</b>	<b>6DL1193-6TP00-0BN0</b>
<b>General information</b>	
Product type designation	Type N0
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes
<b>Supply voltage</b>	
Rated value (DC)	24 V
<b>Current carrying capacity</b>	
up to 70 °C, max.	10 A
For process terminals, max.	2 A
<b>Hardware configuration</b>	
<b>Formation of potential groups</b>	
<ul style="list-style-type: none"> <li>New potential group</li> </ul>	No
<ul style="list-style-type: none"> <li>Potential group continued from the left</li> </ul>	Yes
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test (due to half the isolating distance (basic isolation) for ÜK-III requirement of F technology)
between the potential groups	Yes; 1 500 V DC/1 min, type test (SELV / PELV to functional ground FE)
between process terminals and supply voltage	Yes; 1 500 V DC/1 min, type test
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>horizontal installation, max.</li> </ul>	70 °C
<ul style="list-style-type: none"> <li>vertical installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>vertical installation, max.</li> </ul>	60 °C
<b>Dimensions</b>	
Width	45 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	155 g

Terminal block TB22-P16+4D

<b>Article number</b>	<b>6DL1193-6TP00-0DK0</b>
<b>General information</b>	
Product type designation	Type K0
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes; Asset data
<b>Supply voltage</b>	
Rated value (DC)	24 V
external protection for power supply lines	Yes; 24 V DC/10 A miniature circuit breaker with type B or C tripping characteristic
<b>Current carrying capacity</b>	
up to 70 °C, max.	10 A
For process terminals, max.	5 A
<b>Hardware configuration</b>	
<b>Formation of potential groups</b>	
<ul style="list-style-type: none"> <li>New potential group</li> </ul>	Yes
<ul style="list-style-type: none"> <li>Potential group continued from the left</li> </ul>	No
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test (due to half the isolating distance (basic isolation) for ÜK-III requirement of F technology)
between the potential groups	Yes; 1 500 V DC/1 min, type test (SELV / PELV to functional ground FE)
between process terminals and supply voltage	Yes; 4 200 V DC/1 min, type test (safe separation also exists between the 4 groups within the process terminals; furthermore, a safe separation 120 V AC to 120 V AC between all process terminals exists, with a test voltage of 3 800 V DC/1 min, type test)
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>horizontal installation, max.</li> </ul>	70 °C
<ul style="list-style-type: none"> <li>vertical installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>vertical installation, max.</li> </ul>	60 °C
<b>Dimensions</b>	
Width	22.5 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	78 g

## Terminal block TB22-P16+4B

<b>Article number</b>	<b>6DL1193-6TP00-0BK0</b>
<b>General information</b>	
Product type designation	Type K0
<b>Product function</b>	
<ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>	Yes; Asset data
<b>Supply voltage</b>	
Rated value (DC)	24 V
<b>Current carrying capacity</b>	
up to 70 °C, max.	10 A
For process terminals, max.	5 A
<b>Hardware configuration</b>	
<b>Formation of potential groups</b>	
<ul style="list-style-type: none"> <li>New potential group</li> </ul>	No
<ul style="list-style-type: none"> <li>Potential group continued from the left</li> </ul>	Yes
<b>Potential separation</b>	
between backplane bus and supply voltage	Yes; 4 200 V DC/1 min, type test (due to half the isolating distance (basic isolation) for ÜK-III requirement of F technology)
between the potential groups	Yes; 1 500 V DC/1 min, type test (SELV / PELV to functional ground FE)
between process terminals and supply voltage	Yes; 4 200 V DC/1 min, type test (safe separation also exists between the 4 groups within the process terminals; furthermore, a safe separation 120 V AC to 120 V AC between all process terminals exists, with a test voltage of 3 800 V DC/1 min, type test)
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
<ul style="list-style-type: none"> <li>horizontal installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>horizontal installation, max.</li> </ul>	70 °C
<ul style="list-style-type: none"> <li>vertical installation, min.</li> </ul>	-40 °C
<ul style="list-style-type: none"> <li>vertical installation, max.</li> </ul>	60 °C
<b>Dimensions</b>	
Width	22.5 mm
Height	175 mm
Depth	77 mm
<b>Weights</b>	
Weight, approx.	78 g

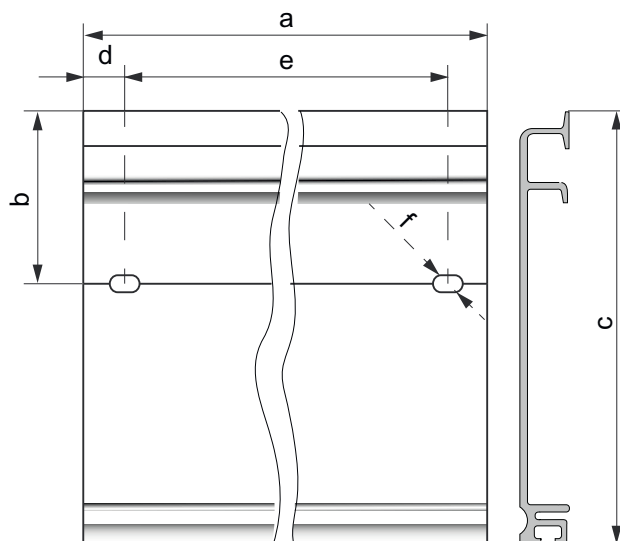
### 9.6.5 Technical specifications - Server module

<b>Article number</b>	<b>6DL1193-6PA00-0AA0</b>
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
• min.	-40 °C
• max.	70 °C
<b>Dimensions</b>	
Width	7 mm
Height	117 mm
Depth	36 mm
<b>Weights</b>	
Weight, approx.	19 g

## Dimension drawings

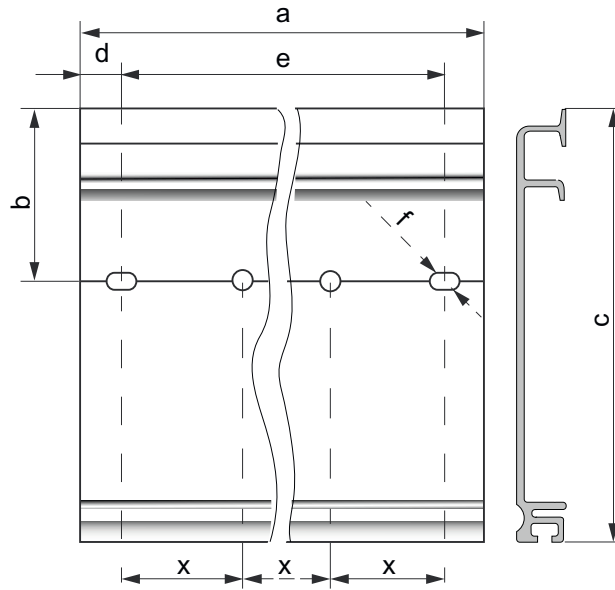
### A.1 Dimension drawings of the rails

Rail 482.6 mm (19" rack)



a	482.6 mm
b	65 mm
c	155 mm
d	8.3 mm
e	466 mm
f	10.2 mm

Rail 1500 mm



- a 1500 mm
- b 65 mm
- c 155 mm
- d 8.3 mm
- e 466 mm
- f 10.2 mm
- x Recommended distance between 2 mounting points max. 500 mm

## A.2 Shield connector

Dimensional diagram of the shield connector

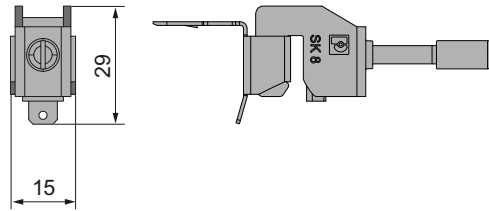


Figure A-1 Dimensional diagram of the shield connector

### A.3 Labeling strip

#### Dimensional diagram of labeling strips and roll

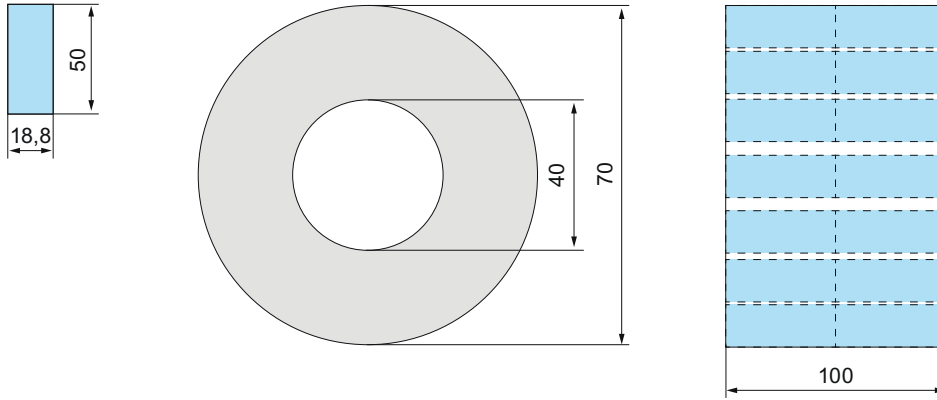


Figure A-2 Dimensional diagram of labeling strips and roll

## A.4 Reference identification labels

### Dimensional diagram of reference identification label and sheet

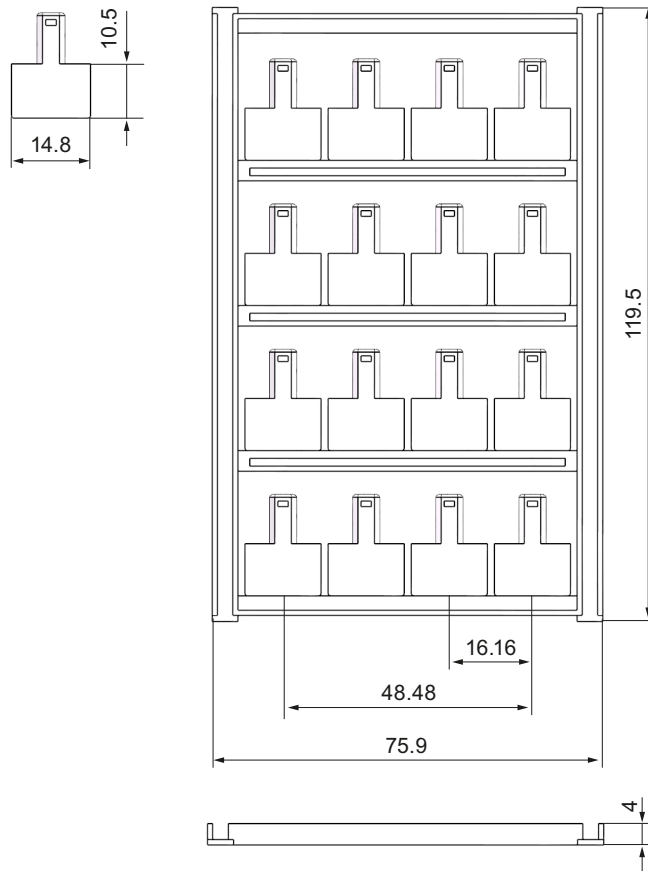


Figure A-3 Dimensional diagram of reference identification label and sheet

## A.5 Color-coded labels

You can find information on the module-specific color identification label for an I/O module at the following locations:

- In the technical specifications of the I/O module in the line:  
Color code for module-specific color identification label
- Color code for selection of the color-coded labels

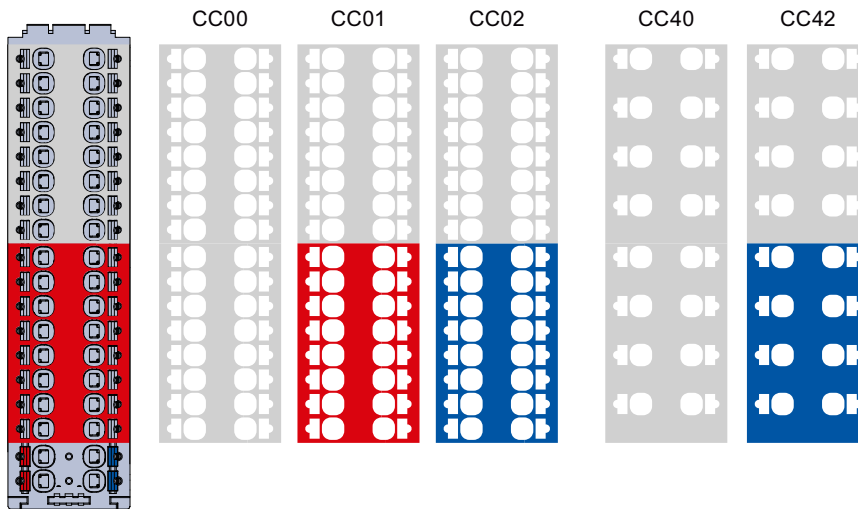


Figure A-4 Mounting the color identification plates and types (CC...)

## Accessories/spare parts

### Accessories for the distributed I/O system ET 200SP HA

Table B-1 Accessories, general

Accessories section	Packing unit	Article number
Carrier module (for interface module - a server module and a power bus cover are supplied for the interface module with every carrier module.)	Single Redundant	6DL1193-6BH00-0SM0 6DL1193-6BH00-0RM0
Interface module	1 unit	6DL1155-6AU00-0PM0
Carrier module		
• Carrier module 2x	1 unit	6DL1193-6GA00-0NN0
• Carrier module 8x	1 unit	6DL1193-6GC00-0NN0
BusAdapter		
• PROFINET BusAdapter with standard Ethernet socket (BA 2xRJ45)	1 unit	6DL1193-6AR00-0AA0
• PROFINET BusAdapter with Fast connect Ethernet connection (BA 2xFC)	1 unit	6DL1193-6AF00-0AA0
• PROFINET BusAdapter with fiber-optic cable connection (BA 2xLC)	1 unit	6DL1193-6AG00-0AA0
• PROFINET BusAdapter with glass fiber optic connection (BA LC/RJ45)	1 unit	6DL1193-6AG20-0AA0
• PROFINET BusAdapter with FastConnect Ethernet connection (BA LC/FC)	1 unit	6DL1193-6AG40-0AA0
• PROFINET BusAdapter for variable distances with standard Ethernet socket (BA 2xRJ45VD HA)	1 unit	6GK5991-2VA00-8AA2
Server module (spare part)	1 unit	6DL1193-6PA00-0AA0
Slot cover		
• 22.5 mm wide (for I/O module slots)	5 units	6DL1133-6CV22-0AM0
• 50.0 mm wide (for interface module slots)	1 unit	6DL1133-6CV50-0AM0
Shield connection for terminal block (shield contacts and shield terminals)	5 units	6ES7193-6SC00-1AM0
Reference identification label, white, sheet with 16 labels	10 units	6ES7193-6LF30-0AW0
Labeling strips (for labeling the I/O modules)		
• Roll, light gray (with a total of 500 labeling strips)	1 unit	6DL1193-6LR00-0AA0
• DIN A4 sheets, light gray (with a total of 1000 labeling strips)	10 units	6DL1193-6LA00-0AA0
Standard rails, aluminum		
• Length: 483 mm (for 19" rack)	1 unit	6DL1193-6MC00-0AA0
• Length: 1500 mm (with full configuration; vertical in cabinet)	1 unit	6DL1193-6MD00-0AA0

Table B-2 Accessories, color-coded labels for I/O modules

Accessories, color-coded labels (push-in terminals)	Packing unit	Article number
Color code <b>CC00</b> ; <ul style="list-style-type: none"> <li>• <b>Gray</b> (terminals 1 to 32)</li> </ul>	10 units	6DL1193-6CP00-2HH1
Color code <b>CC01</b> <ul style="list-style-type: none"> <li>• <b>Gray</b> (terminals 1 to 16)</li> <li>• <b>Red</b> (terminals 17 to 32)</li> </ul>	10 units	6DL1193-6CP01-2HH1
Color code <b>CC02</b> <ul style="list-style-type: none"> <li>• <b>Gray</b> (terminals 1 to 16)</li> <li>• <b>Blue</b> (terminals 17 to 32)</li> </ul>	10 units	6DL1193-6CP02-2HH1
Color code <b>CC40</b> <ul style="list-style-type: none"> <li>• <b>Gray</b> (terminals 1 to 16)</li> </ul>	10 units	6DL1193-6CP40-2HK0
<ul style="list-style-type: none"> <li>• Color code <b>CC42</b></li> <li>• <b>Gray</b> (terminals 1 to 8)</li> <li>• <b>Blue</b> (terminals 9 to 16)</li> </ul>	10 units	6DL1193-6CP42-2HK0

### Components for lightning protection (lightning protection zone transition 0<sub>b</sub> to 1, 1 to 2 and 2 to 3)

You need to use surge protection devices in ET 200SP HA distributed I/O system for lightning protection. You can find more information in the Designing interference-free controllers (<https://support.industry.siemens.com/cs/ww/en/view/59193566>) function manual.

### Online catalog

You can find additional article numbers for the ET 200SP HA on the Internet (<http://mall.industry.siemens.com>) in the online catalog and online ordering system.

# Leakage resistance of the IO device

## Introduction

If you want to protect the IO device with ground fault monitoring or an FI switch, you need the leakage resistance to select the correct safety component.

## Ohmic resistance

You must consider the ohmic resistance from the RC combination of the respective module when determining the leakage resistance of the IO device:

Table C-1 Ohmic resistance

Module	Ohmic resistance from RC network
Interface module	10 MΩ
Terminal block TB...D for feeding the supply voltage	10 MΩ

## Formula

If you protect all of the above modules with ground fault monitoring, you can calculate the leakage resistance of the IO device using the following formula:

$$R_{ET200SPHA} = R_{module} / N$$

$R_{ET200SPHA}$  = Leakage resistance of the ET 200SP HA  
 $R_{module}$  = Leakage resistance of a module (see "Ohmic resistance" table)  
 $N$  = Number of modules in the ET 200SP HA (interface modules and TB...D terminal block only)

If you protect the modules listed above within an IO device with several ground fault monitors, you must determine the leakage resistance for every single ground fault monitor.

## Example

The following components are in an IO device:

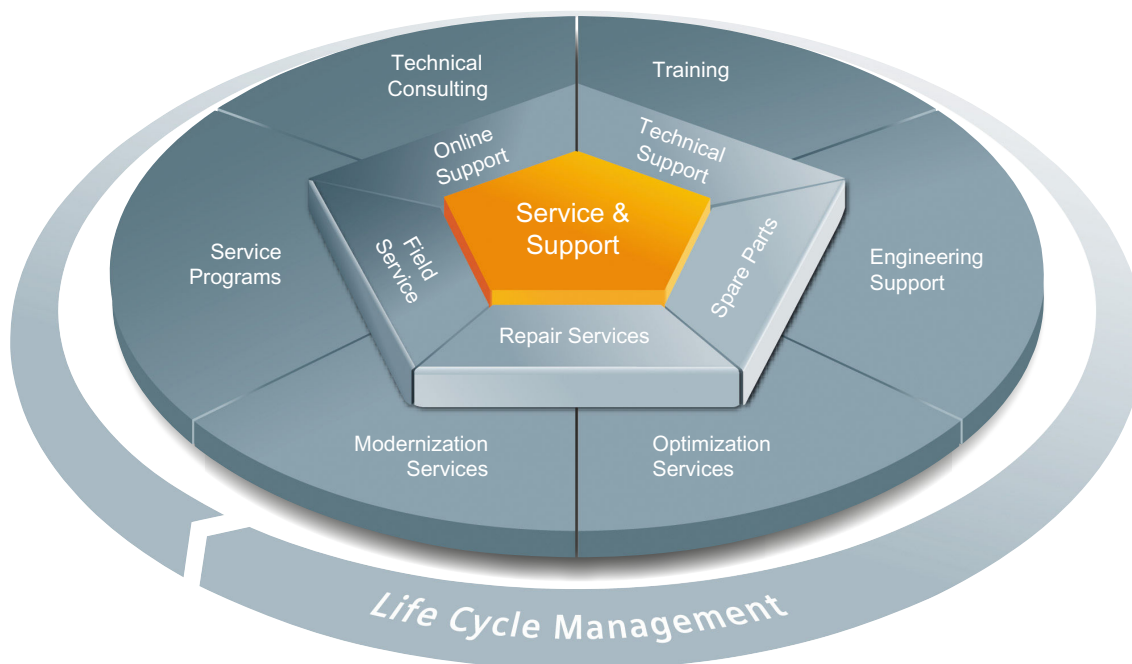
- An interface module
- Two TB...D terminal blocks
- Various I/O modules

The complete IO device is secured with **one** ground fault monitor:

$$R_{ET 200SPHA} = \frac{9.5 \text{ M}\Omega}{3} = 3.17 \text{ M}\Omega$$

Figure C-1 Calculation example for leakage resistance

## Service & Support



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### Spare parts

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### Repairs

Downtimes cause problems in the plant as well as unnecessary costs. We can help you to reduce both to a minimum – with our worldwide repair facilities.

### Optimization

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You can also rely on our support when it comes to modernization – with comprehensive services from the planning phase all the way to commissioning.

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The services of a Service Program can be flexibly adapted at any time and used separately.

Examples of service programs:

- Service contracts
- Plant IT Security Services
- Life Cycle Services for Drive Engineering
- SIMATIC PCS 7 Life Cycle Services
- SINUMERIK Manufacturing Excellence
- SIMATIC Remote Support Services

Advantages at a glance:

- Reduced downtimes for increased productivity
- Optimized maintenance costs due to a tailored scope of services
- Costs that can be calculated and therefore planned
- Service reliability due to guaranteed response times and spare part delivery times
- Customer service personnel will be supported and relieved of additional tasks
- Comprehensive service from a single source, fewer interfaces and greater expertise

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## D.1 Mounting rules

### Distances

Mounting and heat dissipation

- Fixing points on the rail:  
Maximum distance 500 mm - measured between the first and last fixing points
- Horizontal installation of the rail:
  - Distance above
  - Distance below
  - Distance left
  - Distance right

### Fastening/unfastening components

Component	Fastening/unfastening	Tool	Tightening torque
Rail	Drill hole: Diameter 6.5 mm	TORX T15 screwdriver or 4.5 mm blade width	1.5 Nm
IM carrier module	Screws are located in the IM carrier module	TORX T15 screwdriver or 4.5 mm blade width	1.5 Nm
Carrier module (slots for I/O modules)	Screw is located in the carrier module Note: 4 fixing screws on the carrier module 8x	TORX T15 screwdriver or 4.5 mm blade width	1.5 Nm
Terminal block	Pluggable / pry with a screwdriver (see section "Removing a terminal block (Page 105)")	None	None
Interface module	Latching/releasing with a screwdriver (see section "Removing the interface module (Page 111)")	Screwdriver 4.5 mm blade width	None
I/O module	Latching/releasing buttons	None	None
Bus adapter	Screw is located in the bus adapter	TORX T10 screwdriver or 3.5 mm blade width	0.25 Nm
Server module	Click mounting	None	None
Power bus cover	Click mounting	None	None
Wires on the terminal block (see section "Cable cross-sections and ferrules (Page 179)")	Spring release (see section "Wiring the terminal block (Page 86)")	Screwdriver with 3.5 to 4.5 mm blade width	None
Shield connection for process cable in the terminal block (shield terminal)	Screw is located in the shield terminal Note: Cables with max. $\varnothing$ 7 mm each	Screwdriver with 3.5 to 4.5 mm blade width	0.5 Nm

## D.2 Cable cross-sections and ferrules

### Cables with and without ferrule

Rule for ...		Interface module (supply voltage)	Terminal blocks (push-in terminal)
Permitted cable cross-sections for solid cables		0.2 to 2.5 mm <sup>2</sup>	
		AWG*: 24 to 13	
Permitted cable cross-sections for flexible cables	Without ferrule	0.2 to 2.5 mm <sup>2</sup>	
		AWG*: 24 to 13	
	With ferrule (with plastic sleeve)***	0.25 mm to 1.5 mm <sup>2</sup> **	
		AWG*: 24 to 16	
	With TWIN ferrule***	0.14 mm to 1.5 mm <sup>2</sup>	
		AWG*: 26 to 16	
With TWIN ferrule***		0.5 mm to 1 mm <sup>2</sup>	
		0.5 to 0.75 mm <sup>2</sup> (see below)	
Stripped length of the cables		8 to 10 mm	
Wire end ferrules in accordance with DIN 46228 with plastic sleeve***		8 and 10 mm long	

\* AWG: American Wire Gauge

\*\* Ferrules without plastic sleeve: 0.25 to 2.5 mm<sup>2</sup>/AWG: 24 to 13

\*\*\* See note on ferrules

#### Note

#### Ferrules

You can achieve optimal results with respect to a high-quality and durable electrical connection and maximum conductor extraction forces at the same time by using crimping dies preferably with smooth surfaces. Options include rectangular and trapezoidal crimping cross-sections.

Due to the large number of crimping dies used in the industry, we can recommend others on request. **Crimping dies with a pronounced wave profile are not permitted in ET 200SP HA.**



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