SIEMENS

SIMATIC

Distributed I/O ET 200iSP

Operating Instructions

11/2022

A5E00247483-AK

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.

⚠ DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
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:

⚠ WARNING
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

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

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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Ⓟ 01/2023 Subject to change

Preface

Purpose of the documentation

This documentation provides the information you need to plan, install, wire and commission the product " ET 200iSP distributed I/O device" in automation systems.

Configuration variants of the ET 200iSP station	Requirements
Station on the PROFINET IO	Connection of the PROFINET IO device via fiber-optic cable
Station on the PROFIBUS RS 485-IS	Connection of the PROFIBUS DP device via RS 485-IS coupler

Guide

This documentation describes the hardware of the ET 200iSP distributed I/O device. It consists of instructional sections and sections for reference (technical specifications):

- Installing and wiring the distributed I/O device
- Commissioning and diagnostics of the distributed I/O device
- Components of the distributed I/O device
- Article numbers

Basic knowledge required

General knowledge in the field of automation technology and qualifications are required to understand the documentation:

Activities	Qualifications
Installing the ET 200iSP	• Basic technical training • Knowledge of safety regulations regarding the workplace
Wiring of the ET 200iSP	• Basic practical training in electro-engineering • Knowledge of the relevant electrotechnical safety regulations • Knowledge of methods of installing explosion-proof electrical equipment • Knowledge of safety regulations regarding the workplace
Commissioning of the ET 200iSP	• Knowledge of all electrical and functional parameters and properties of the ET 200iSP • Knowledge of the function and commissioning of the network connection (PROFINET IO/PROFIBUS DP) • Knowledge of the connected encoders, actuators, and HART field devices • Knowledge of the safety regulations regarding the workplace, particularly regarding procedures in hazardous areas

Validity of the documentation

This documentation is valid for the ET 200iSP distributed I/O device.

Changes since with the previous edition

This documentation contains the following changes/additions:

Compared to the version published 07/2014

- Network connection to PROFINET IO as IO device with IM 152-1PN
- The terminal modules TM-PS-A/B (6ES7193-7DA20-0AA0, 6ES7193-7DB20-0AA0) can also be used for the PS DC24V (as of product version 7)
- The terminal modules TM-PS-A/B (6ES7193-7DA10-0AA0, 6ES7193-7DB10-0AA0) are only available as replacement parts
- The approvals have been updated.

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/cert.

Additional support

Additional support

If you have any questions relating to the described products, and do not find the answers in this documentation, please contact your Siemens representative at our local offices.

You can find your contact person on the Internet (https://www.siemens.com/automation/partner).

A guide to the technical documentation for the various SIMATIC products and systems is available on the Internet (https://www.siemens.de/simatic-tech-doku-portal).

The online catalog and the online ordering systems are available on the Internet.

Approvals, CE approval and standards

See section Standards and certifications (Page 239)

Position in the information landscape

In the section Article numbers (Page 419), you will find a list of additional sources of information on SIMATIC S7 and the ET 200iSP Distributed I/O System.

Special notes

The EC-Type Examination Certificates and EC Certificates of Conformity for the ET 200iSP distributed I/O station can be found under Service & Support on the Internet (https://www.siemens.com/automation/service&support).

Recycling and disposal

The ET 200iSP distributed I/O device is recyclable due to its low-emission equipment. For environmentally compliant recycling and disposal of your electronic waste, contact a company certified for the disposal of electronic waste.

Training Center

We offer relevant courses to help you get started with the ET 200iSP distributed I/O device and the SIMATIC S7 automation system. For details, please contact your local Training Center or the Central Training Center in Nuremberg, D -90327 Germany.

You can find more information on the Internet (https://www.sitrain.com).

Technical support

You can contact the Technical Support for all the A&D products by means of the Web form Internet (https://www.siemens.de/automation/support-request) for the support request.

You can find additional information about our Technical Support on the Web (https://www.siemens.com/automation/service).

Service & Support on the Internet

In addition to our documentation pool, we offer our complete online knowledge base on the Internet (https://www.siemens.com/automation/service&support).

There you will find:

- The newsletter, which provides you with the latest information about your products.
- The documentation you need, by using our Service & Support search engine.
- A forum where users and experts from all over the world exchange experiences.
- Your local contact for Automation & Drives.
- Information about on-site services, repairs, spare parts, and lots more.

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.

Examples:

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

Table of contents

System planning 1

1.1 Distributed I/O device

Distributed I/O stations - Area of application

When a system is set up, it is common for the inputs to and outputs from the process to be incorporated centrally in the automation system.

If the inputs/outputs are located at greater distances from the automation system, the wiring can become very extensive and complex, and electromagnetic interferences can impair reliability.

In such systems, it is often advisable to use distributed I/O stations:

- The controller CPU is located centrally.
- the I/O devices are distributed on site
- The high-performance network connection with high data transfer speeds ensures that the control CPU and I/O devices communicate smoothly.
- Less installation effort since less cables are required.

Configuration variants

- ET 200iSP station on PROFINET IO (Page 17)
- ET 200iSP station on PROFIBUS DP (Page 21)

1.2 Figure Integration in the Control System

Example for the connection to a process control system

The figure shows an example of the connection of ET 200iSP stations to a process control system.

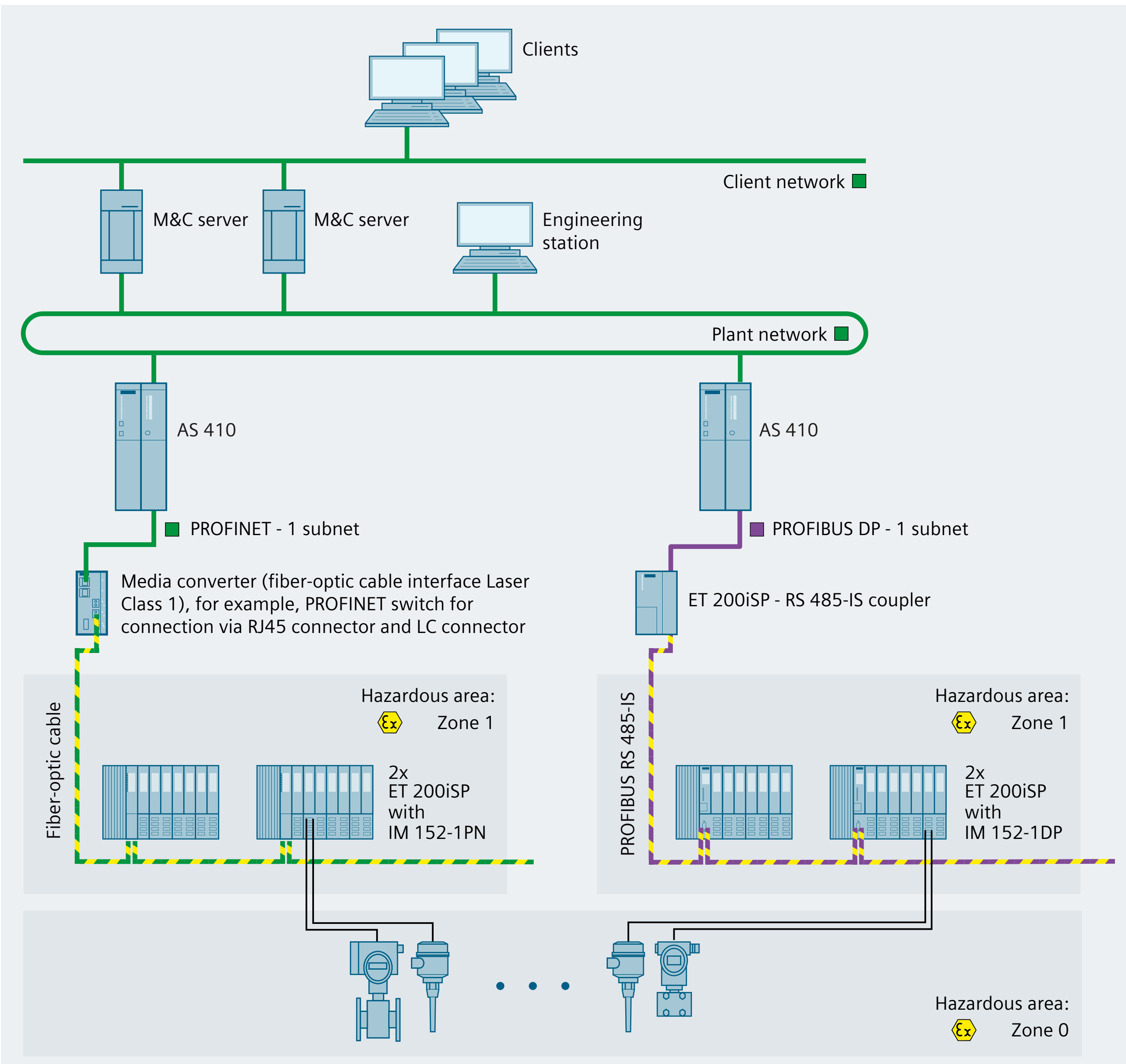


Figure 1-1 Example: Connection of the ET 200iSP to the control system on the PROFINET IO or on the PROFIBUS RS 485-IS.

Note

Interface modules

It is not possible to operate a redundant station with different interface module types.

1.3 ET 200iSP station on PROFINET IO

PROFINET IO

PROcess FIeld NETwork
Open Industrial Ethernet standard which continues PROFIBUS and Industrial Ethernet. A cross-manufacturer communication, automation and engineering model by PROFIBUS International e.V., defined as an automation standard.

PROFINET IO
Communication concept for the implementation of modular, distributed applications within the scope of PROFINET.

PROFINET IO controller
Device via which connected IO devices are addressed. This means that the IO controller exchanges input and output signals with assigned I/O devices. The CPU is often an IO controller.

PROFINET IO device
Distributed field device that can be assigned to one or more IO controllers, for example, distributed I/O system, valve terminals, frequency converters, switches.

Intrinsic safety
The basis for intrinsic safety is the connection of the station via intrinsically safe fiber-optic cables.

The optical transceiver on the media converter or on the switch must be approved for ATEX/IECEx Zone 1.

PROFINET IO controller and IO device

The PROFINET IO controller is the communications interface of the control CPU. The PROFINET IO controller exchanges data with the distributed I/O devices via PROFINET IO and monitors the PROFINET IO. A distributed I/O device with PROFINET IO interface is an IO device. The interface of the IO device in the ET 200iSP is located in the interface module.

The distributed I/O devices prepare the data of the encoders and actuators on site so that the control CPU can process the data.

Devices that can be connected to PROFINET devices

A large variety of devices can be connected to the PROFINET IO – provided they behave according to the standard IEC 61158-6-10:2019.

Devices of the following product families can be used:

- SIMATIC stations
- SIMATIC engineering stations and engineering PCs
- SIMATIC HMI (operator control and monitoring devices)
- Distributed I/O stations
- Devices from other manufacturers

Setting up a network based on PROFINET IO

In the following sections, you will find example configurations for setting up a PROFINET IO network.

- The IO controller is integrated into the CPU of the automation system, e.g. a SIMATIC S7 410-5H has two PROFINET IO interfaces.
- The ET 200iSP distributed I/O devices are connected to the CPU of the automation system via PROFINET IO.

Example configurations:

- Example configuration with a single CPU (Page 19)
- Example configuration with redundant CPU (Page 20)

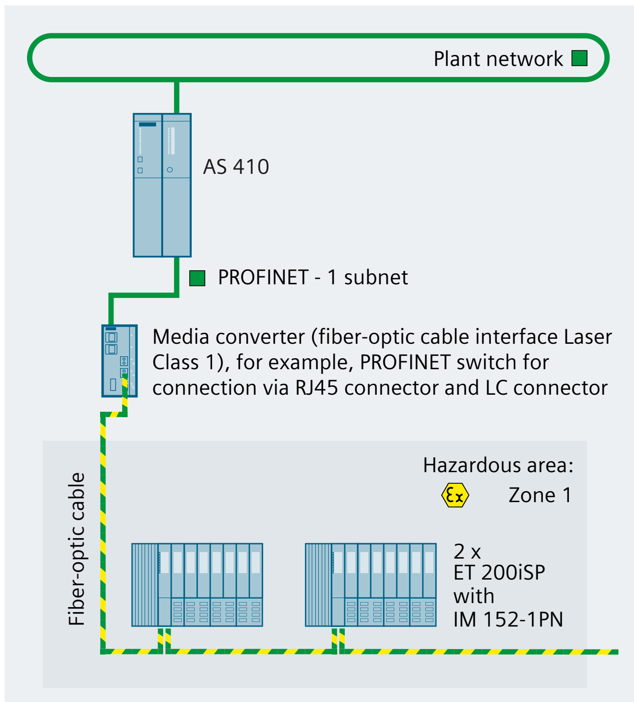
See also

PROFINET in process automation with SIMATIC PCS 7 (https://support.industry.siemens.com/cs/ww/en/view/72887082)

1.3.1 Example configuration with a single CPU

Example

The connection of the I/O device via media redundancy is possible.

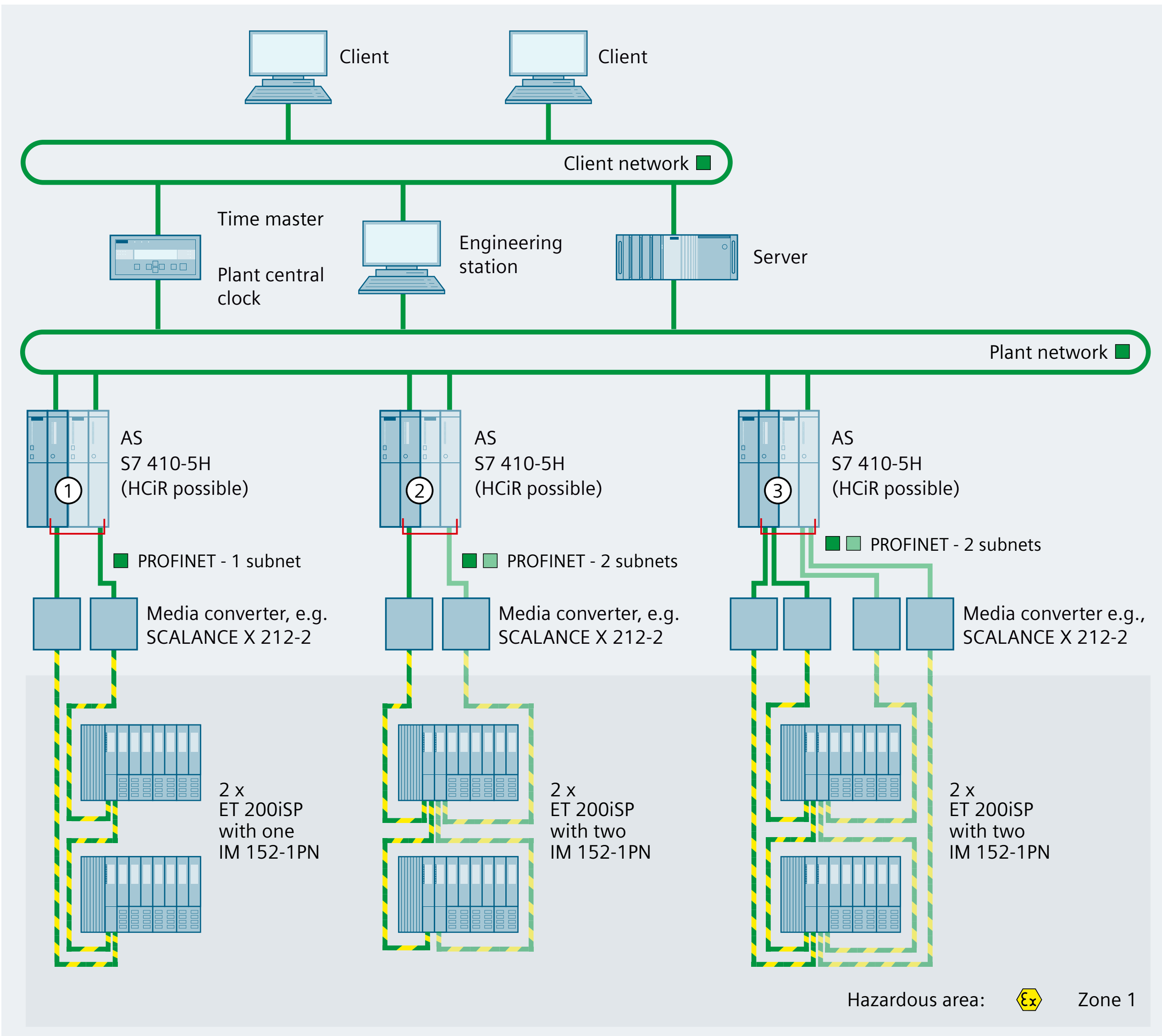


Automation system	CPU 410-5H in 1oo1 mode
Plant bus	1 PN/IO subnet on an internal PN/IO interface of the IO controller (e.g CPU 410-5H: Terminal X5)
Configurations	**Note:** The configurations are not suitable for time stamping with an accuracy of 1 ms.
Fieldbus	1 PN/IO subnet on an internal PN/IO interface of the IO controller (e.g CPU 410-5H: Terminal X8)
Distributed I/O	IO devices with ET 200iSP with one interface module in 1oo1 mode

1.3.2 Example configuration with redundant CPU

Example

The redundant connection of the IO device is shown in the following examples:



Time master	Central system clock with 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: Terminal X5)
Configurations ①②③	**Note:** The configurations are not suitable for time stamping with an accuracy of 1 ms.

Fieldbus	PN/IO subnet on the same internal PN/IO interface of the IO controller (e.g. CPU 410-5H: Terminal X8) • ①: 1 PROFINET IO subnet • ②: 2 PROFINET IO subnets • ③: 2 PROFINET IO subnets with MRP
Distributed I/O	IO devices based on ET 200iSP: • ①: With one interface module on a redundant IO controller (S2 redundancy) • ②: With two interface modules on a redundant IO controller (R1 redundancy) • ③: With two interface modules on a redundant IO controller (R1 redundancy)

1.4 ET 200iSP station on PROFIBUS DP

PROFIBUS DP

PROFIBUS DP is an open bus system according to the *IEC 61784-1:2002 Ed1 CP 3/1* standard with the "DP" transmission protocol. (DP stands for distributed I/O).

Physically, the PROFIBUS DP is either an electrical network based on a shielded two-wire line or an optical network based on a fiber-optic cable.

The "DP" protocol allows fast, cyclic data exchange between the control CPU and the distributed I/O devices.

PROFIBUS RS 485-IS

The PROFIBUS DP is intrinsically safe with respect to the PROFIBUS RS 485-IS (intrinsically safe protection type i). Intrinsic safety is ensured by the RS 485-IS coupler - which acts like a safety barrier. You can find more information on the PROFIBUS RS 485-IS at the "PROFIBUS RS485-IS User and Installation Guideline (https://www.profibus.com)".

DP master and DP devices

The link between the control CPU and the distributed I/O devices is the DP master. The DP master exchanges data via PROFIBUS DP with the distributed I/O devices and monitors the PROFIBUS DP.

The distributed I/O devices (= DP devices) prepare the data of the encoders and actuators on site so that they can be transferred to the control CPU via PROFIBUS DP.

Devices that can be connected to PROFIBUS DP devices

A large variety of devices can be connected to the PROFIBUS DP as DP masters or DP devices, provided they behave according to the *IEC 61784-1:2002 Ed1 CP 3/1* standard. These include the devices of the following product families:

- SIMATIC S7/M7/C7
- SIMATIC PG/PC
- SIMATIC HMI (operator control and monitoring devices OP, OS, TD)

- Distributed I/O stations
- Devices from other manufacturers

Setting up a network based on PROFIBUS DP

The following figure shows an example of the configuration with PROFIBUS DP.

- The DP master is integrated in the respective device, e.g. the S7-400 has a PROFIBUS DP interface.
- The ET 200iSP distributed I/O devices are connected to the DP masters via PROFIBUS DP and PROFIBUS RS 485-IS.

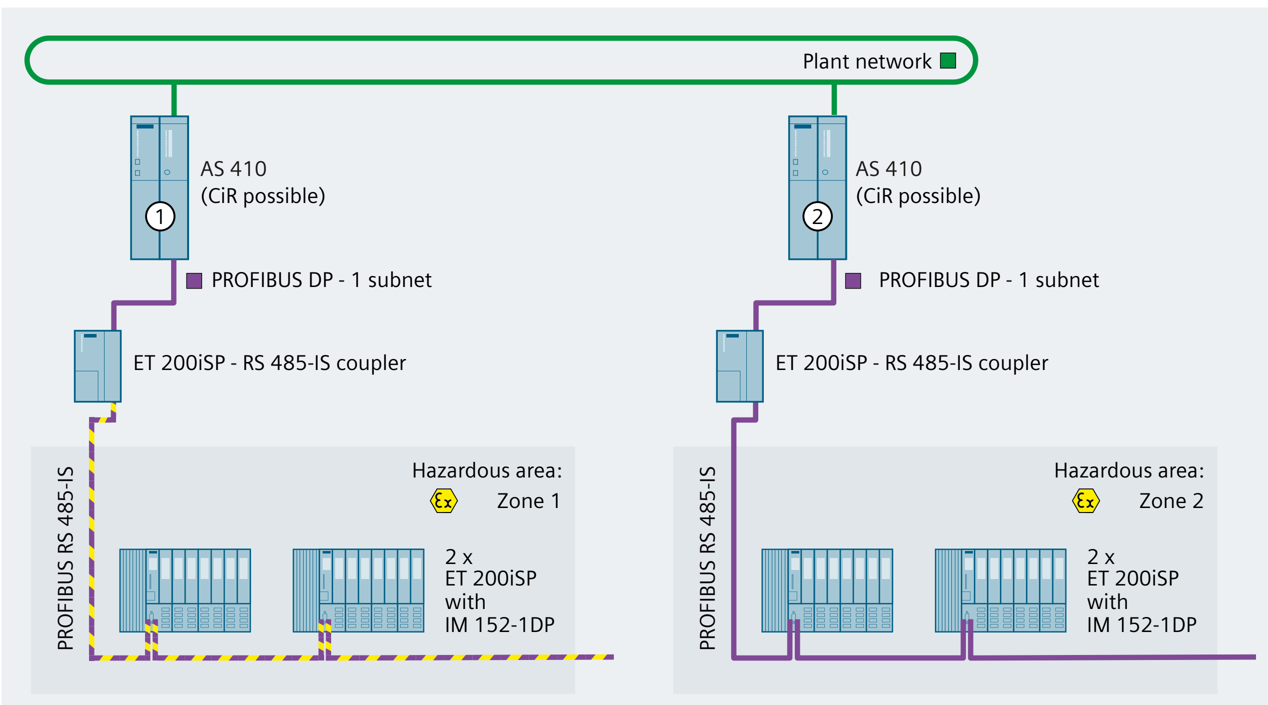


Figure 1-2 Example for the configuration of a PROFIBUS DP network

Example configuration with redundant CPU

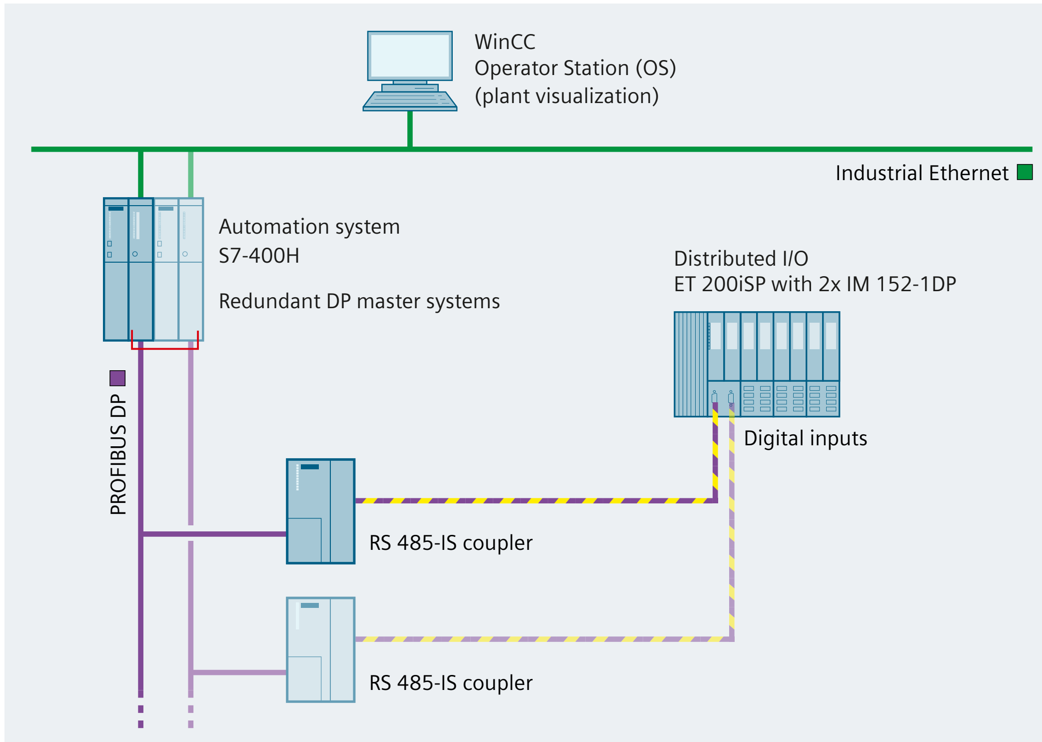


Figure 1-3 Example configuration with redundant CPU

Product overview

2

2.1 ET 200iSP Distributed I/O Station

Definition

The ET 200iSP distributed I/O device is a finely modular and intrinsically safe device in IP30 degree of protection.

Area of application

The ET 200iSP distributed I/O device can be used in the following areas:

- Safe area
- Hazardous areas with a gas and dust atmosphere (Zone 1/21, Zone 2/22)
  See section "ET 200iSP in the Hazardous Area (Page 32)"

Table 2-1 Areas of application

Approval	ET 200iSP station*	Inputs and outputs
ATEX IECEx	Zone 1, Zone 21	up to Zone 0, Zone 20 **
	Zone 2, Zone 22	up to Zone 0, Zone 20 **
No approval required	Safe area	Safe area
* in connection with a corresponding enclosure ** for the electronic module 2 DO Relay UC60V/2A: up to Zone 1, Zone 21		

Terminal modules and network connection

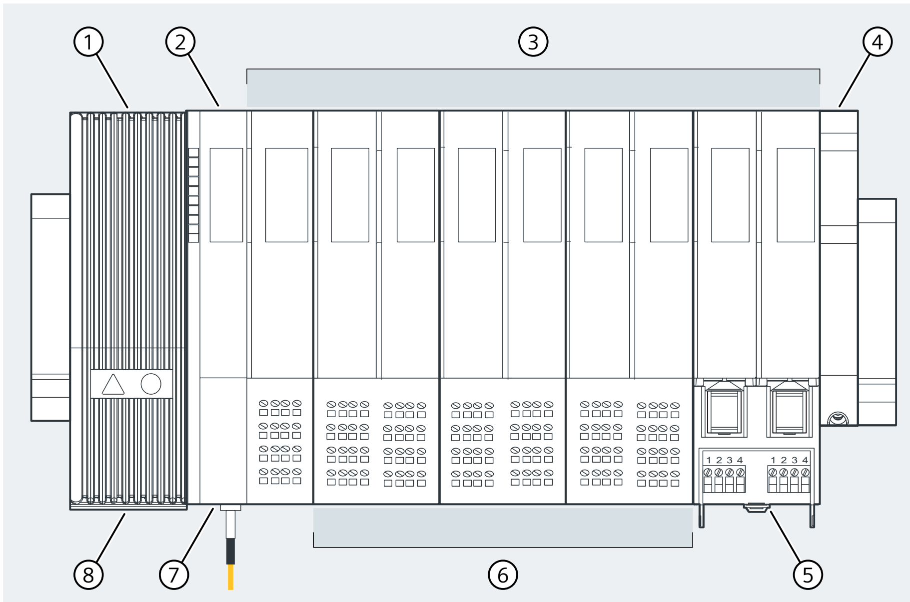
The configuration of the ET 200iSP distributed I/O device starts with passive terminal modules to which you plug the power supply and the electronic modules.

The connection to the network of the higher-level station (e.g. CPU with IO controller or DP master) depends on the interface module of the ET 200iSP. In general, a converter is required in the network connection for the connection to the higher-level station (media converter RJ45/FOC or DP/DP coupler). The network cables are connected using a connection plug.

> **WARNING**
>
> **Installation of the ET 200iSP in hazardous areas**
>
> - When configured as a PROFINET IO device, the ET 200iSP is connected to PROFINET IO via fiber-optic cables. The energy of the light beam is limited. The media converter must also have a fiber-optic cable interface with limited energy of the light beam.
> - When configured as a PROFIBUS DP device, the ET 200iSP is connected to the intrinsically safe PROFIBUS RS 485-IS via copper cables.

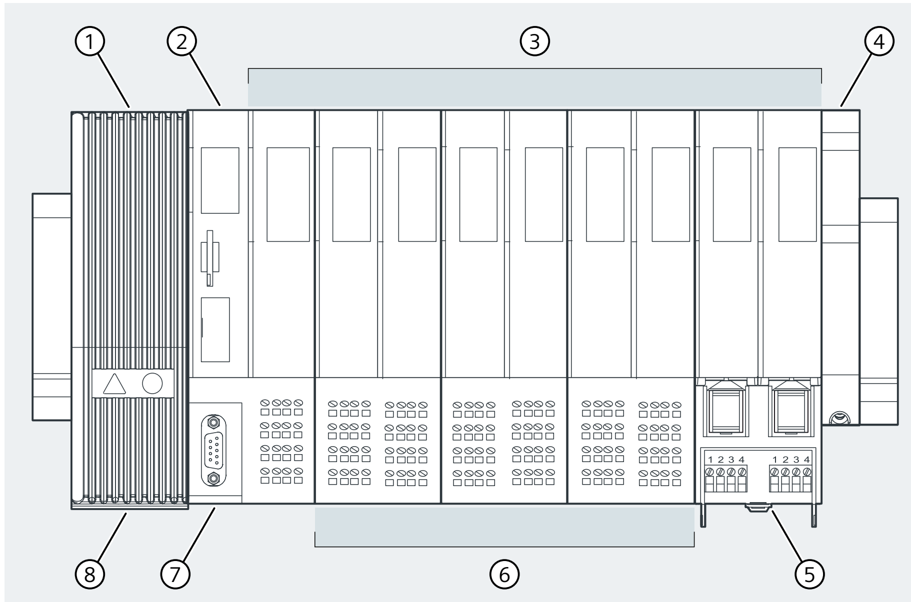
View

The following figure shows an example configuration of an ET 200iSP distributed I/O device.



①	Power supply PS
②	Interface module IM 152-1PN
③	Electronic modules
④	Termination module
⑤	Terminal module TM-RM/RM
⑥	Terminal modules TM-EM/EM
⑦	Terminal module TM-IM/EM
⑧	Terminal module TM-PS-A

Figure 2-1 View of the ET 200iSP distributed I/O device with IM 152-1PN



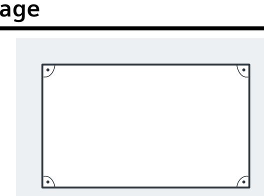
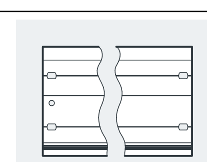
①	Power supply PS
②	Interface module IM 152-1DP
③	Electronic modules
④	Termination module
⑤	Terminal module TM-RM/RM
⑥	Terminal modules TM-EM/EM
⑦	Terminal module TM-IM/EM
⑧	Terminal module TM-PS-A

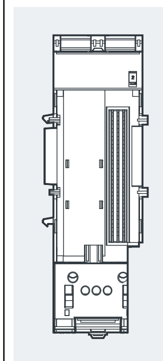
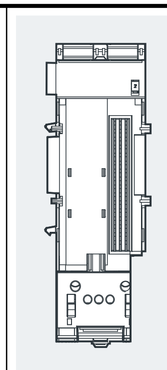
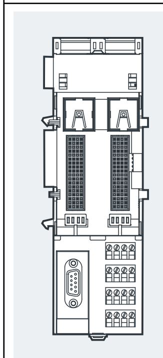
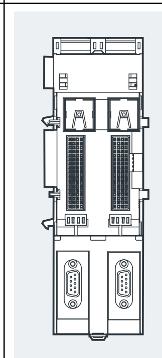
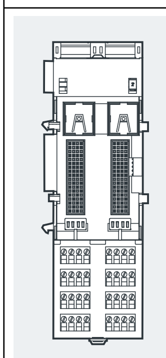
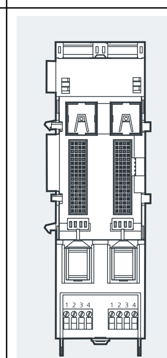
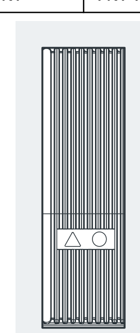
Figure 2-2 View of the ET 200iSP distributed I/O device with IM 152-1DP

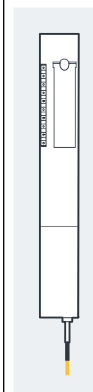
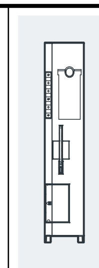
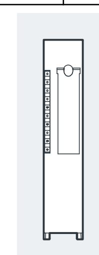
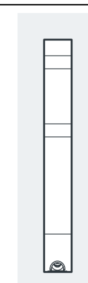
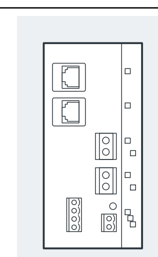
Components of the ET 200iSP distributed I/O device

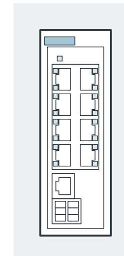
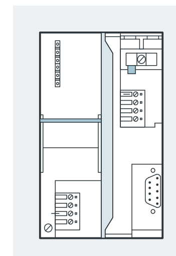
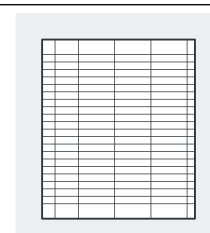
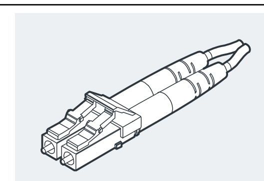
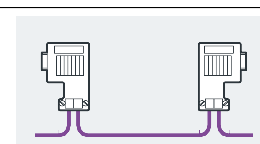
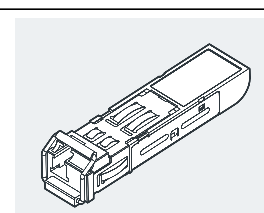
The following table provides an overview of the most important components of a station of the ET 200iSP distributed I/O device (hereafter referred to as station).

Table 2-2 Components of the station

Component	Function	Image
Enclosure	... is a measure required to prevent high temperatures, sparks and arcing from forming with a higher degree of certainty.	
Mounting rail	... is the rack for the station. You have to mount the other components on the DIN rail.	

Component	Function	Image
Terminal module	... carries the wiring and holds the power supply, interface module and the electronic modules. Terminal modules are available in the following variants: • TM-PS-A (6ES7193-7DA10-0AA0) for the power supply PS DC24V • TM-PS-B (6ES7193-7DB10-0AA0) for the redundant power supply PS DC24V • TM-PS-A (6ES7193-7DA20-0AA0) for the power supply PS AC120/230V and PS DC24V (as of product version 7) • TM-PS-B (6ES7193-7DB20-0AA0) for the redundant power supply PS AC120/230V and PS DC24V (as of product version 7) • TM-IM/EM for the interface module • TM-IM/IM for the redundant interface module • TM-EM/EM for the electronic modules • TM-RM/RM for the electronic module 2 DO Relay UC60V/2A Both terminal modules and can be used for TM IM/EM and TM IM/IM as well as for IM 152-1PN and IM 152-1DP. The DP plug of the terminal module has no function when PROFINET is being used and is covered by the IM 152-1PN.	 TM-PS-A  TM-PS-B  TM-IM/EM  TM-IM/IM  TM-EM/EM  TM-RM/RM
Power supply PS	... is plugged onto the terminal module TM-PS-A or TM-PS-B. The power supply module supplies the electronic circuits and sensors with voltage. • Power supply PS DC24V to TM-PS-A (6ES7193-7DA10-0AA0), TM-PS-B (6ES7193-7DB10-0AA0) • Power supply PS AC120/230V and PS DC24V (as of product version 7) to TM-PS-A (6ES7193-7DA20-0AA0), TM-PS-B (6ES7193-7DB20-0AA0)	

Component	Function	Image
Interface module	...is plugged onto the terminal module. The interface module connects the station to the CPU of the automation system and prepares the data for the assembled electronic modules. **Note IM 152-1PN:** A media converter is required to connect the IM 152-1PN interface module to a CPU. The media converter converts PROFINET IO into an intrinsically safe optical signal. The optical transceiver on the media converter or on the switch must be approved for ATEX/IECEx Zone 1/21. **Note IM 152-1DP:** When you operate the distributed I/O in a hazardous area of Zone 1, you need an RS 485-IS coupler. **Note IM 152-1PN and IM 152-1DP:** The electronic modules are the same for both interface modules.	 IM 152-1PN  IM 152-1DP
Electronic module	... is plugged onto the terminal module and determines the function: • Digital electronic modules for NAMUR encoders, digital output, relay module • Analog electronic modules with current and resistance measurement circuit, thermoresistor and thermocouples, analog output • Reserve module • WATCHDOG module	
Termination module	...terminates the station	
Media converter with SFP transceivers approved for ATEX/ IECEx Zone 1/21	... converts the PROFINET IO into an optical signal when an IM 152-1PN is used.	

Component	Function	Image
Ethernet switch	... converts the PROFINET IO into an optical signal when an IM 152-1PN is used.	
RS 485-IS coupler	... converts the PROFIBUS DP into the PROFIBUS RS 485-IS when an IM 152-1DP is used.	
Labeling sheet (DIN A4, perforated, foil)	... for labeling or printing by machine 80 strips per labeling sheet	
Slot number plates	... for identification of the slots on the terminal module.	
Fiber-optic cable with FO plug connector	... connects the station to a PROFINET IO network via fiber-optic cables (e.g. connection to: Switch, media converter, BusAdapter with optical connection (can be used with ET 200 SP HA or CFU) or another station of the ET 200iSP). In the hazardous area, only fiber-optic cables with limited energy of the light beam is allowed. The transceiver on the media converter must be approved for ATEX/IECEx Zone 1/21.	
PROFIBUS cable with bus connector	... connects the nodes of a PROFIBUS RS 485-IS configuration to each other or connects the RS 485-IS coupler to the station. PROFIBUS bus connector RS 485-IS including switchable terminating resistor	
SFP transceiver for IM 152-1PN (A5E51793919)	Intrinsically safe optical transceiver for ET 200iSP.	

WARNING

Danger of explosion with wrong transceiver

The IM 152-1PN only works with intrinsically safe SFP transceiver A5E51793919. Plugging in other transceivers may cause explosions.

Do not plug another transceiver into the IM 152-1PN.

Properties and benefits of ET 200iSP

Table 2-3 Features and benefits

Properties	Benefits
Structure	
Modular structure based on 4- or 8-channel electronic modules	• Station design optimized to contain costs • Reduced configuration and documentation effort • Space savings due to the ability to string modules together in any order
Extensive range of electronic modules	Broad area of application
Permanent wiring due to the separation of mechanical and electronic components	• Prewiring possible • Module change during operation of the station ("hot-swapping") is possible if at least 2 electronic modules are present.
Integrated power bus	Reduced effort required for wiring
Connection system	
Screw or spring terminals	Use of most suitable connection method
Intrinsically safe inputs and outputs according to Ex ia IIC	Intrinsically safe sensors, actuators and HART field devices up to Zone 0/ 20 can be connected
Automatic coding of the electronic modules	Quick and reliable module replacement
Large label	Adequate space for clear identification
Disabling all digital outputs of a module by an intrinsically safe switching signal	Control of the outputs independent of the process image
Functionality	
Changing parameter settings and expansion during operation	No restart of the station necessary
Time stamping, flutter monitoring, pulse stretching	Efficient monitoring of the inputs
Counting and frequency measurement	Options for use in technological applications
Identification and maintenance data I&M	Unique identification/assignment of the modules used (for example, for validation, quality assurance)
Analog value representation in S7 format	
IEEE variables	Analog modules with HART support up to 4 IEEE variables in IEEE754 format

Properties	Benefits
Redundancy of the IM	• With two IM 152-1PN (as of V1.0) on IO controller (e.g. S7-400H via PROFINET IO) or • With two IM 152-1DP (as of V2.0) on DP masters (e.g. S7-400H via PROFIBUS DP) • With software redundancy
Redundancy of the Power Supply PS	With TM-PS-B

Fieldbus communication

If an IM 152-1DP is used in the station, all modules of the station can communicate with all DP masters that are compatible with the "DP" transfer protocol according to the *IEC 61784-1:2002 Ed1 CP 3/1* standard (DP stands for distributed I/O).

2.2 ET 200iSP in the Hazardous Area

Properties of zones

Hazardous areas are classified into zones. The zones are distinguished according to the probability of the existence of an explosive atmosphere.

The ET 200iSP can be used in hazardous areas (Zone 1/ 21, Zone 2/ 22) and in the safe area.

You can connect intrinsically safe encoders, actuators and HART field devices to the ET 200iSP which may be located up to zone 0/ 20 and in the safe area. The sensors, actuators, and HART field devices must be certified for operation in the corresponding hazardous areas.

You will find an overview of the zone divisions in the following table:

Table 2-4 Classification of zones

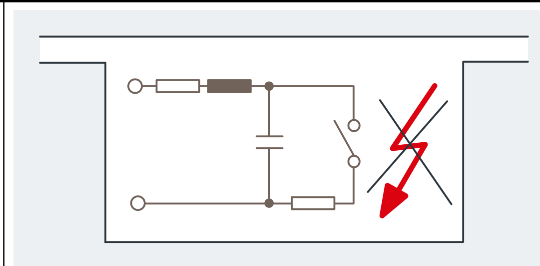
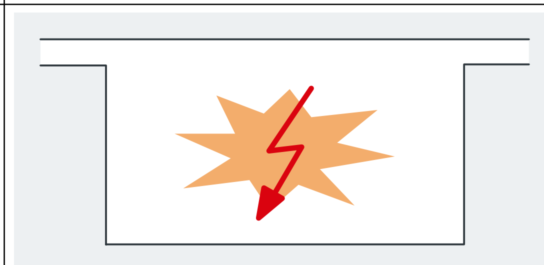
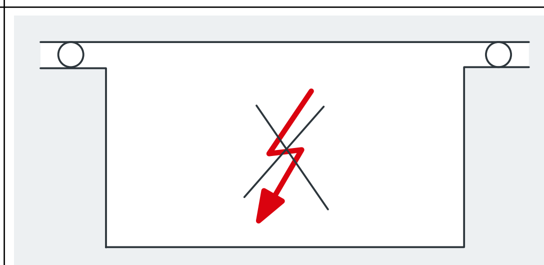
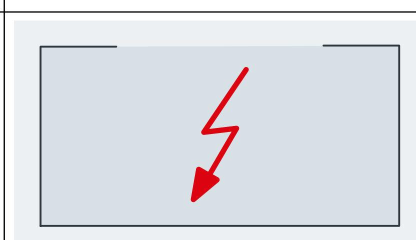
Hazardous areas	Explosion hazard	Example
Zone 0/ 20	Long-term, frequent or permanent presence of explosive gas or dust atmosphere	Within containers.
Zone 1/ 21	Infrequent presence of potentially explosive gas or dust atmosphere	In the region of openings for filling and emptying.
Zone 2/ 22	Rare or short-term presence of potentially explosive gas or dust atmosphere	Areas bordering on zone 1/ 21

For more information, refer to the "Principles of explosion protection (https://support.automation.siemens.com/WW/view/en/12521844)" manual.

Types of protection of ET 200iSP

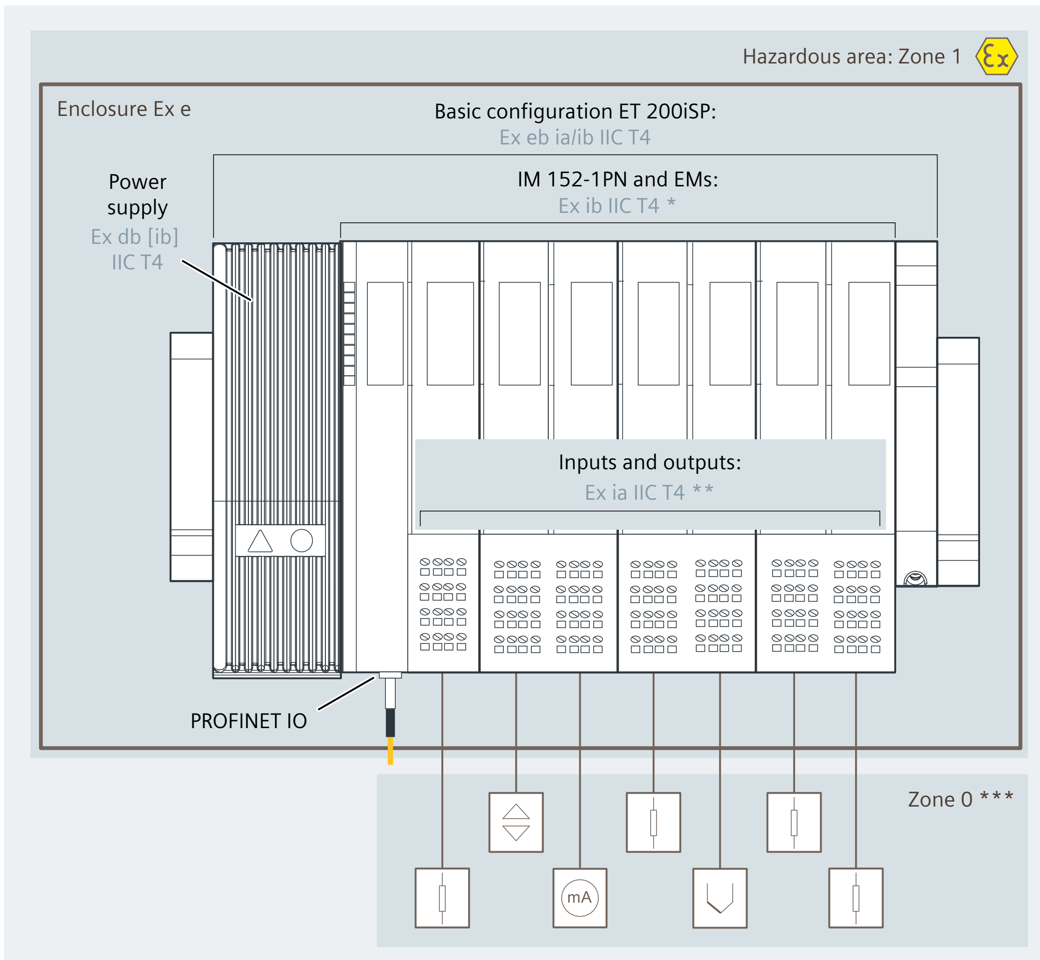
The types of protection include design and electrical measures relating to the equipment to achieve explosion protection in the hazardous areas.

Table 2-5 Types of protection

Type of Protection	Meaning	Representation
Intrinsic safety i	All voltages, currents, inductance and capacitance occurring are limited by electrical measures (intrinsically safe) - sparks or thermal effects capable of causing ignition cannot occur.	
Explosion-proof enclosure d	The power supply module is installed in a stable (explosion-proof) enclosure. If the explosive atmosphere within the enclosure ignites, the enclosure will withstand the explosion and contain the explosion within the module.	
Increased-safety enclosure e	The ET 200iSP must be mounted in an additional enclosure in the hazardous area Zone 1. The enclosure must have the increased safety e type of protection. This explosion protection type is an additional measure to prevent high temperatures, sparks and arcing from forming with a higher degree of certainty. In the Zone 2 hazardous area, this type of protection is unnecessary. Here, the ET 200iSP only has to be mounted in an enclosure suitable for zone 2 with at least degree of protection IP54.	
Encapsulation "m"	In the 2 DO Relay UC60V/2A electronic module, the internal relay is embedded in a potting compound. This means that an explosive atmosphere surrounding the equipment can be ignited neither by sparks nor by unacceptable heating.	

Labeling of the ET 200iSP

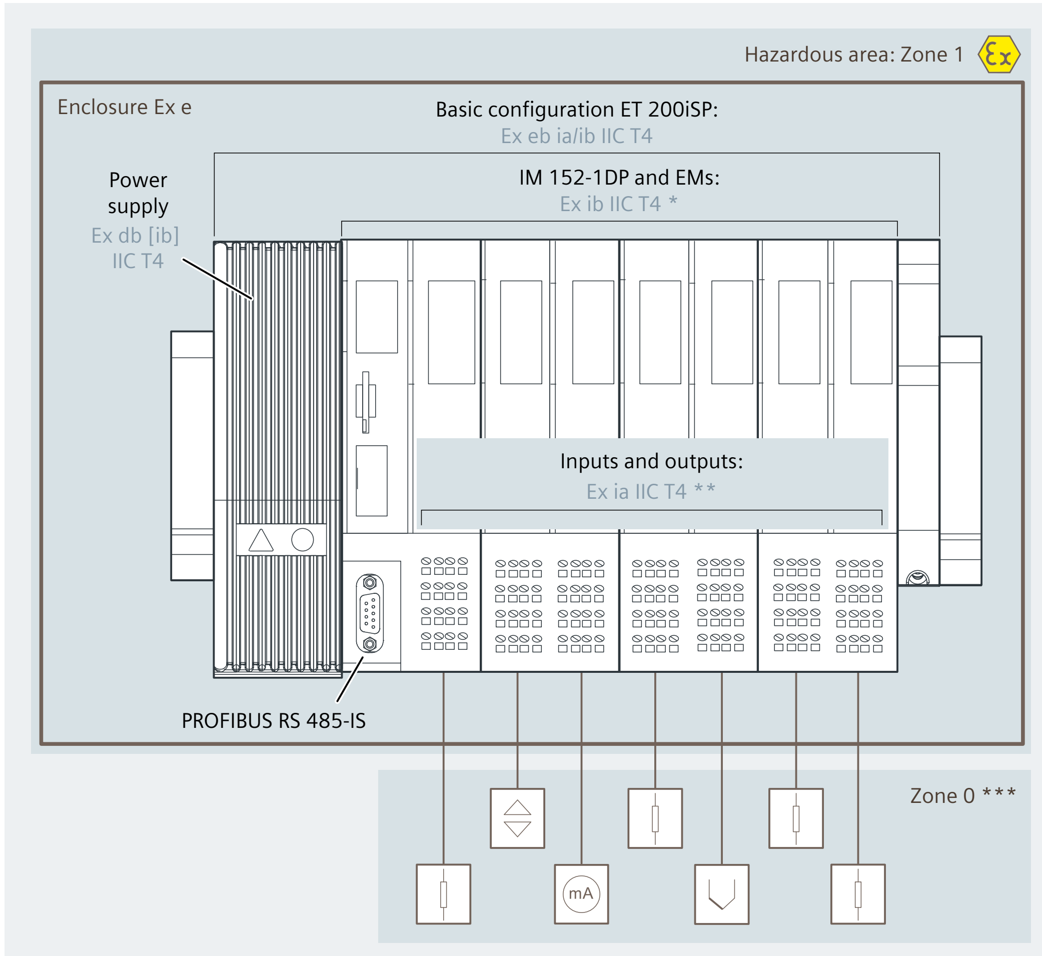
Equipment for operation in hazardous areas is marked with an identifier indicating the hazardous environments in which the equipment can be used. The ET 200iSP has the following interfaces:



Ex Explosion protection marking
ia Intrinsically safe protection type (up to zone 0)
ib Intrinsically safe protection type (up to zone 1)
d Type of protection explosion-proof enclosure
e Type of protection increased safety
IIC Explosion group for hydrogen
T4 Temperature Class: Highest permissible surface temperature 135 °C

* electronic module 2 DO Relay UC60V/2A: Ex e ib mb IIC T4
** Terminal module TM-RM/RM: Ex d e ib IIC T4
*** Ex Zone 0 not for electronic module 2 DO Relay UC60V/2A

Figure 2-3 Markings ET 200iSP with PROFINET interface module



Ex	Explosion protection marking
ia	Intrinsically safe protection type (up to zone 0)
ib	Intrinsically safe protection type (up to zone 1)
d	Type of protection explosion-proof enclosure
e	Type of protection increased safety
IIC	Explosion group for hydrogen
T4	Temperature Class: Highest permissible surface temperature 135 °C

* electronic module 2 DO Relay UC60V/2A: Ex e ib mb IIC T4

** Terminal module TM-RM/RM: Ex d e ib IIC T4

*** Ex Zone 0 not for electronic module 2 DO Relay UC60V/2A

Figure 2-4 Markings ET 200iSP with PROFIBUS interface module

Certificates for the ET 200iSP distributed I/O device

The EC type-examination certificates and EC certificates of conformity for the ET 200iSP distributed I/O device are available on the internet at: "Service & Support (https://www.siemens.com/automation/service&support)".

Commissioning guideline 3

3.1 Introduction

Introduction

These instructions will guide you step by step to a working application using a concrete example. In the process, you will learn the basic hardware and software functions of your ET 200iSP.

3.2 Prerequisites

Requirements

The following requirements must be met:

- You must be familiar with the basics of electrical and electronic engineering and the procedures relating to potentially explosive atmospheres and have experience working with computers and Microsoft® Windows™.
- You have selected a variant of the connection of the ET 200iSP with the CPU:
  - Connection via PROFINET IO (interface module IM 152-1PN required)
  - Connection via PROFIBUS DP (interface module IM 152-1DP required)
- If you implement this example in a hazardous area, you must adhere to all the rules and regulations explained and listed in this manual.

Note

During functional checks, you must observe the guidelines according to EN 60079-17. This standard contains the provisions of international standard IEC 60079-17.

DANGER

Observe the installation regulations

When laying cables and wiring in hazardous areas, adhere to the installation regulations in accordance with EN 60079-14 and any regulations specific to your country.

DANGER

Observe permitted components

When using the IM 152-1PN interface module, observe the Class 1 limits according to IEC 60825-1. Only use approved media converters and fiber-optic cables.

Optical radiation that is high in energy (laser) can be an ignition source.

WARNING

Observe the safety regulations

The ET 200iSP distributed I/O station is subject to special rules and regulations depending on its application.

Please observe the applicable safety and accident prevention regulations, e.g. IEC 204 (EMERGENCY-STOP devices).

You risk severe injuries or damage to machines and equipment if you ignore these directives.

See also

Basics of commissioning and diagnostics (Page 155)

3.3 Materials and Tools Required to Set Up the Example

Table 3-1 Required materials and tools

Quantity	Article	Article number (Siemens)	Required for the configuration variant	
			PROFINET IO	**PROFIBUS DP**
1	**Interface module IM 152-1PN**	6ES7152-1BA00-0AB0	YES	**NO**
1	Engineering tool • Programming device (PG) with Ethernet interface and RJ45 cable • Installed software (versions) – STEP 7 (as of V5.7 SP1 and the current hardware update of the interface module and electronic modules) – PCS 7 (as of V9.1 SP2 and the current HSP for ET 200iSP)	Various	YES	**NO**
1	Media converter RJ45/FOC with SFP transceiver certified as intrinsically safe (e.g. SCALANCE X 212-2; see "Optical connection (https://support.industry.siemens.com/cs/ww/en/view/109761426)")	Contact your Siemens representative	YES	**NO**
1	Ethernet cable with RJ45 connector (e.g. "Passive network components (https://support.industry.siemens.com/cs/ww/en/view/84922825)")		YES	**NO**
1	Fiber-optic cable with LC plug (e.g. "Passive network components (https://support.industry.siemens.com/cs/ww/en/view/84922825)")		YES	**NO**
1	Enclosure for ET 200iSP with Ex e type of protection (for use of the ET 200iSP in Zone 1 hazardous area)		YES	YES
1	**Interface module IM 152-1DP**	6ES7152-1AA00-0AB0	**NO**	YES
1	Engineering tool • Programming device (PG) with Ethernet interface, communications processor such as CP 5611 and PG cable • Installed software: STEP 7 (as of version 5.4 SP1 and current hardware update)	Various	**NO**	YES
1	RS 485-IS coupler	6ES7972-0AC80-0XA0	**NO**	YES
2	PROFIBUS bus connector (for master and RS 485-IS coupler)	6ES7972-0BB50-0XA0	**NO**	YES
1	PROFIBUS bus connector RS 485-IS including switchable terminating resistor	6ES7972-0DA60-0XA0	**NO**	YES
1	PROFIBUS DP cable	e.g. 6XV1830-0EH10	**NO**	YES
1	SIMATIC S7-300, mounting rail L=160 mm (for RS 485-IS coupler)	6ES7390-1AB60-0AA0	YES	YES
2	SIMATIC S7-300, mounting rail L=480 mm (for ET 200iSP)	6ES7390-1AE80-0AA0	YES	YES
1	Terminal module TM-PS-A	6ES7193-7DA10-0AA0	YES	YES
1	Terminal module TM-IM/EM with terminating module	6ES7193-7AA00-0AA0	YES	YES
2	Terminal module TM-EM/EM	6ES7193-7CA00-0AA0	YES	YES
1	Power supply PS DC24V	6ES7138-7EA01-0AA0	YES	YES

Quantity	Article	Article number (Siemens)	Required for the configuration variant	
			PROFINET IO	PROFIBUS DP
2	8 DI NAMUR	6ES7131-7RF00-0AB0	YES	YES
3	4 DO DC17.4V/27mA shut down "H"	6ES7132-7RD11-0AB0	YES	YES
2	NAMUR sensor	for example, BERO 3RG 4612-1NA00	YES	YES
1	1-wire On button	commercially available	YES	YES
3	LEDs with series resistor	commercially available	YES	YES
1	Universal rack	6ES7400-1TA01-0AA0	YES	YES
1	Power supply module PS S7-400	6ES7407-0DA02-0AA0	YES	YES
1	Central processing unit CPU S7-410-5H	6ES7410-5HX08-0AB0	YES	YES
1	Screwdriver with 3 mm blade width	commercially available	YES	YES
1	Screwdriver with 4.5 mm blade	commercially available	YES	YES
1	Cutting tool for the DIN rails	commercially available	YES	YES
1	Cable cutters and wire stripping tools	commercially available	YES	YES
1	Tool for crimping wire-end ferrules	commercially available	YES	YES
1	Cable for grounding mounting rails with 10 mm² cross-section with cable lug to fit M6, length to suit local situation	commercially available	YES	YES
1	Cable lug for M6	commercially available	YES	YES
1	Stranded wire with 1 mm² cross-section with matching ferrules, form A, length 6 mm	commercially available	YES	YES

3.4 Overview of the Configuration

Overview

Overview of the sample configuration (wiring and power sources not illustrated)

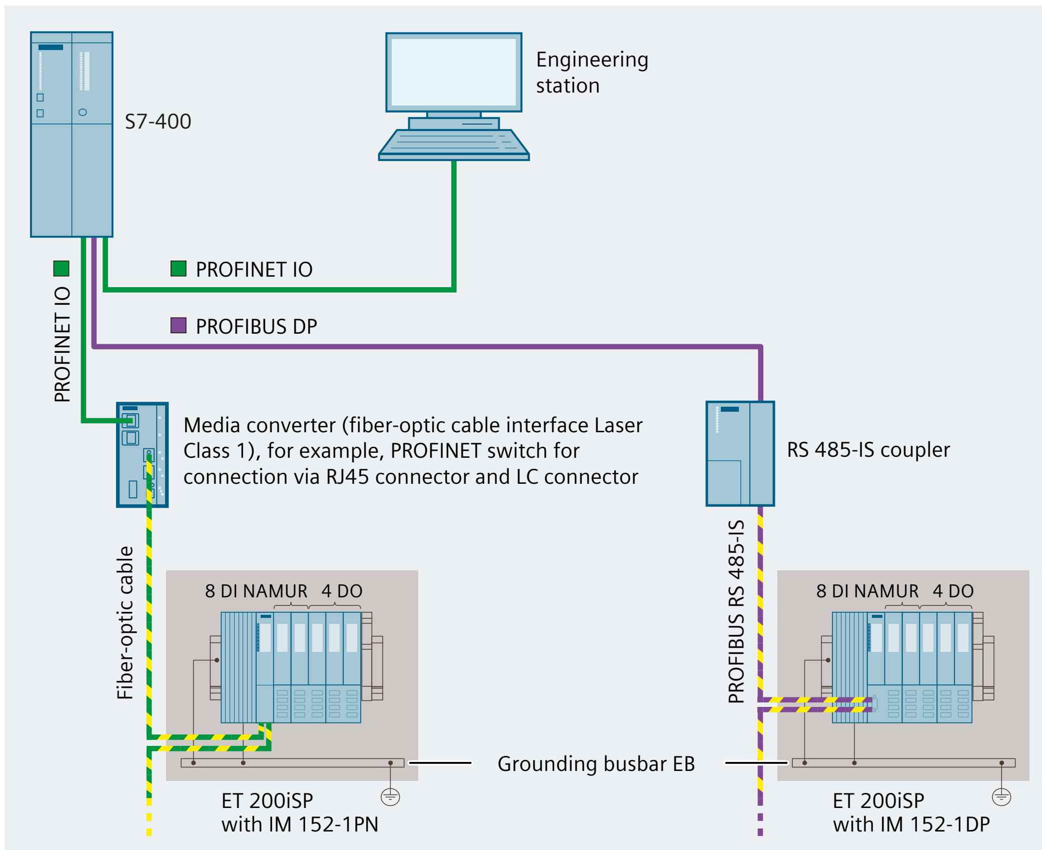


Figure 3-1 Overview of the sample configuration

3.5 Installing the the Sample Configuration

3.5.1 Installing the ET 200iSP

Installing the ET 200iSP

1. Install the mounting rail (480 mm) into the enclosure which has been mounted on a solid base.
2. Install the modules starting at the left-hand end of the DIN rail. Start with the terminal module TM-PS-A (hook in - swivel in - 2 x screw on). Continue with the remaining modules (fit onto top of rail - push in at the bottom - push to the left). Insert the modules in the following order:
   – Terminal module TM-PS-A
   – Terminal module TM-IM/EM
   – Terminal module TM-EM/EM
   – Terminating module

3.5.2 Installing the S7-400

Installing the S7-400

1. Install the rack on a stable surface. See operating instructions Automation System S7-400: Hardware and Installation (https://support.automation.siemens.com/WW/view/en/1117849)
2. On the left of the rack, start by installing the separate modules (hang in - swivel into position - screw on tightly). Insert the modules in the following order:
   – Power supply module PS
   – Central processing unit CPU

3.5.3 Installing RJ45/FOC media converter or RS 485-IS coupler

The installation of the component depends on the selected configuration:

- With a PROFINET system, you need to connect the IM 152-1PN to a PROFINET IO via a fiber-optic cable and a media converter (e.g. RJ45/FOC) with an intrinsically safe output.
- With a PROFIBUS system, you need to connect the IM 152-1DP to PROFIBUS DP via an intrinsically safe PROFIBUS RS 485-IS and an RS 485-IS coupler.

Installing the component

1. Install the mounting rail (160 mm) on a stable base.
2. Place the component from below onto the DIN rail and turn it into place.

Note

Install the component in Zone 2 or in a safe area. Use an enclosure.

3.6 Wiring the example configuration for PROFINET

Wiring of the TM-PS-A

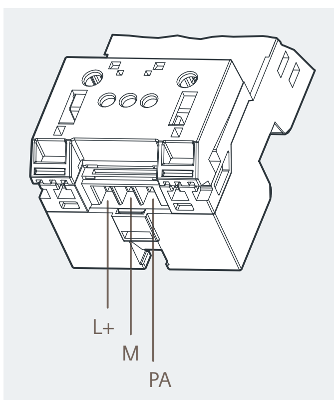


Figure 3-2 Wiring TM-PS-A

Requirements for example configuration with PROFINET IO/fiber-optic cable

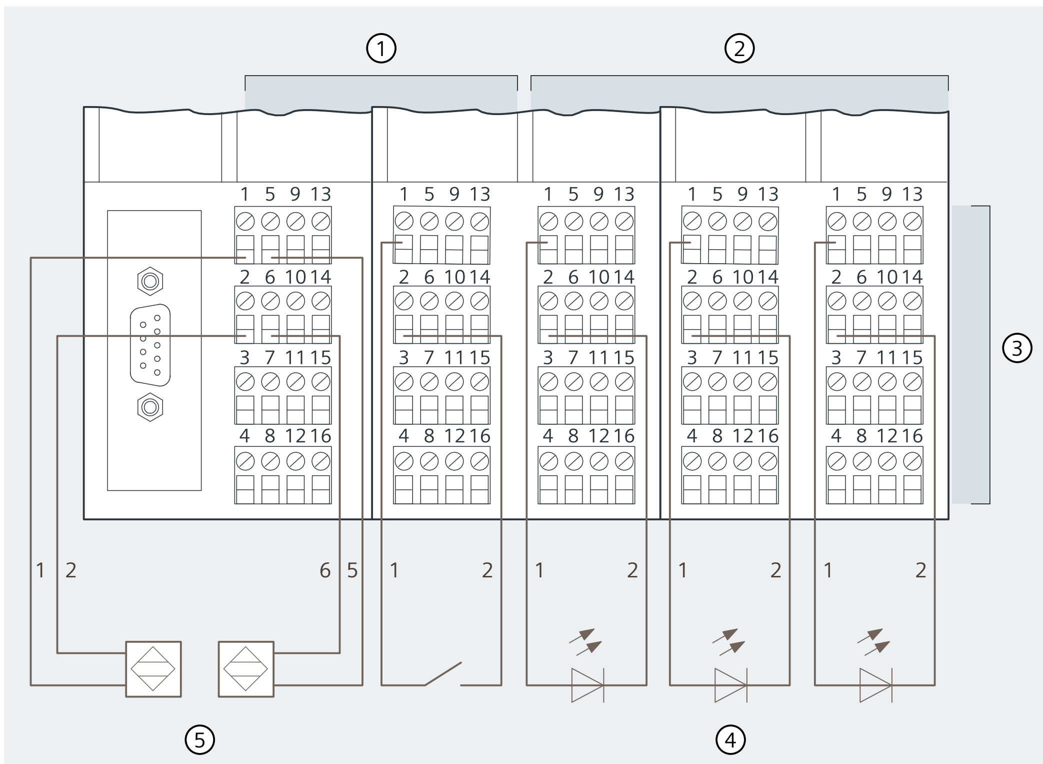
- PROFINET IO cable with RJ45 or FastConnect plug at both ends
- Fiber-optic cable with LC plug at both ends
  Observe the following information:
  – Optical connection in and through ATEX/IECEx Zone 1 or 21 (https://support.industry.siemens.com/cs/ww/en/view/109761426)

Wiring the example configuration

1. Connect the engineering tool (PG) and the PROFINET IO interface of the CPU using your own cable.
2. Connect the DIN rails of the CPU with the protective conductor.
3. Connect the mounting rail of the ET 200iSP and the power supply PS with the equipotential bonding PE. Use the grounding bolt for fastening to the DIN rail.

4. Connect the PROFINET IO interface of the CPU to the media converter using an Ethernet RJ45 cable.
5. Connect the media converter to IM 152-1PN using a fiber-optic cable with LC plugs at both ends.
6. Connect the terminal module TM-PS-A, the RS 485-IS coupler or media converter and the PS power module S7-400 to the power supply.

Wire the ET 200iSP as shown below:



① 2 x 8 DI NAMUR
② 3 x 4 DO DC17.4/27mA
③ Terminals
④ LEDs
⑤ NAMUR sensor

Figure 3-3 Wiring of the ET 200iSP modules

3.7 Wiring the example configuration for PROFIBUS

Wiring of the TM-PS-A

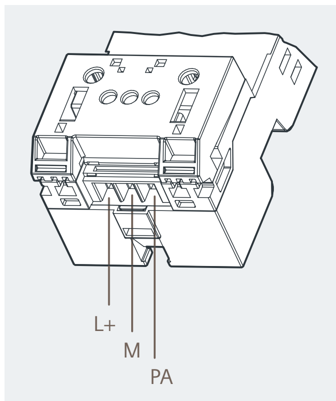


Figure 3-4 Wiring TM-PS-A

Wiring of the RS 485-IS coupler

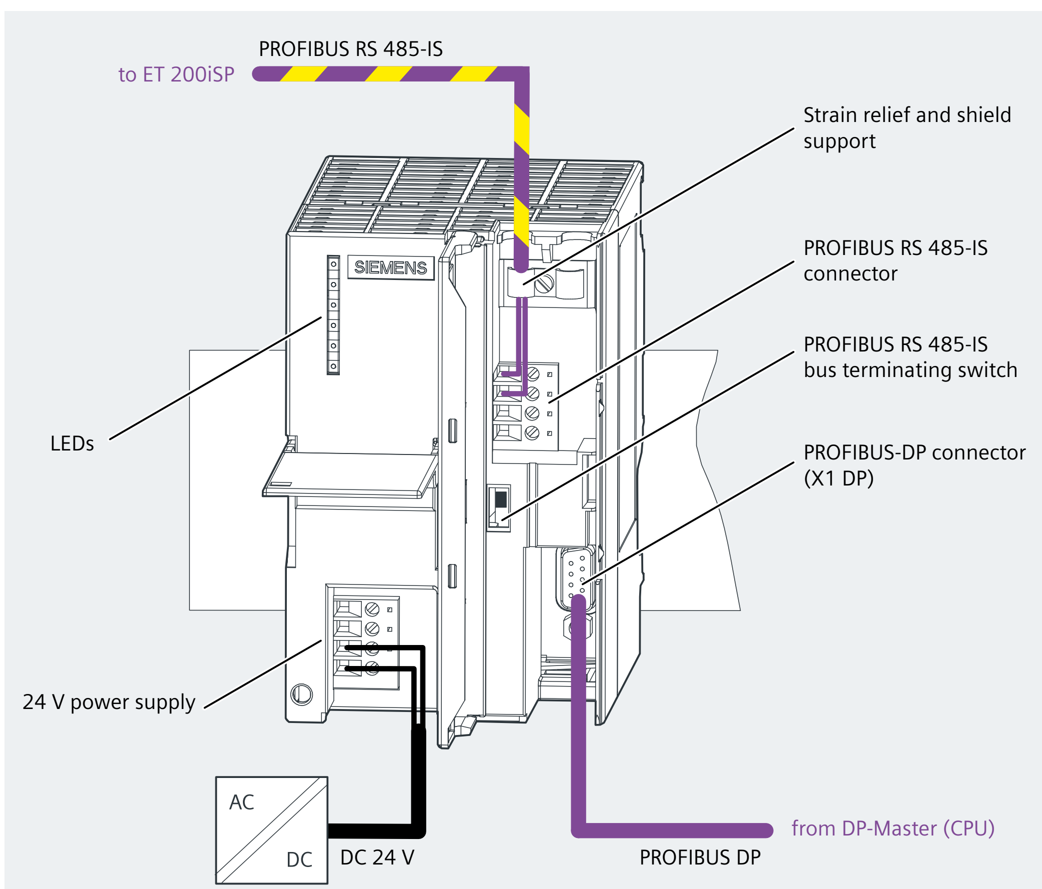


Figure 3-5 Wiring of the RS 485-IS coupler

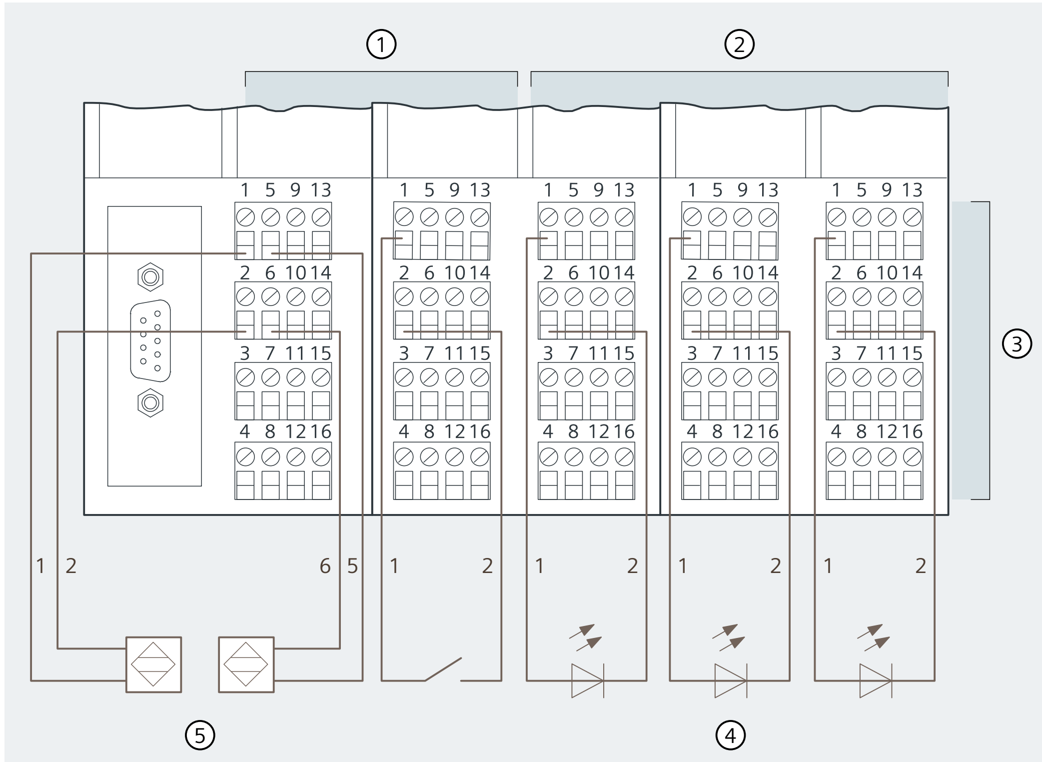
Requirements for example configuration with PROFIBUS DP/PROFIBUS RS 485-IS

- PROFIBUS DP cable with PROFIBUS bus connector at both ends (6ES7972-0BB50-0XA0)

Wiring the example configuration

1. Connect the engineering tool (PG) and the PROFINET IO interface of the CPU using your own cable.
2. Connect the DIN rails of the CPU with the protective conductor.
3. Connect the mounting rail of the ET 200iSP and the power supply PS with the equipotential bonding PE. Use the grounding bolt for fastening to the DIN rail.
4. Connect the PROFIBUS DP interface of the CPU to the RS 485-IS coupler using a PROFIBUS DP cable.
5. Connect the interface module IM 152-1DP to the RS 485-IS coupler as shown above using a PROFIBUS cable (PROFIBUS RS 485-IS) that is appropriate for the location of use.
6. Connect the terminal module TM-PS-A, the RS 485-IS coupler or media converter and the PS power module S7-400 to the power supply.

Wire the ET 200iSP as shown below:



① 2 x 8 DI NAMUR
② 3 x 4 DO DC17.4/27mA
③ Terminals
④ LEDs
⑤ NAMUR sensor

Figure 3-6 Wiring of the ET 200iSP modules

3.8 Inserting the interface module and the electronics modules

Inserting Modules

Insert the modules in the following order:

- Power Supply PS DC24V
- Interface module
- 2 x 8 DI NAMUR
- 3 x 4 DO DC17.4V/27mA

See also

Installing Terminal Modules for the Interface Module and Electronics Modules (Page 112)

3.9 Setting a PROFIBUS address on IM 152-1DP

Requirements

You have selected the PROFIBUS configuration.

Setting the PROFIBUS address

Set the PROFIBUS address on the interface module IM 152-1DP.

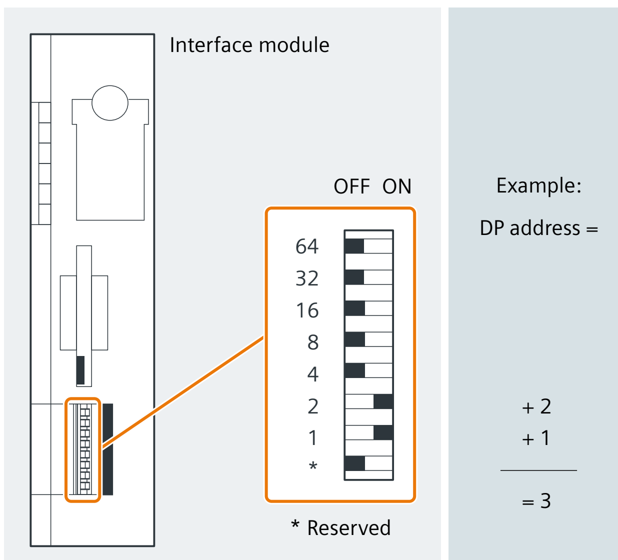


Figure 3-7 Example of the setting on PROFIBUS address 3

See also

Configuring PROFIBUS DP address (Page 179)

3.10 Configuring the Example

3.10.1 Configuring S7-400

Introduction

The configuration of a ET 200iSP using a hardware support package (HSP) installed on the configuration tool is described below.

Note

Integrate ET 200iSP via GSD file

If a ET 200iSP is to be operated on a CPU via PROFIBUS but the CPU cannot be operated in DPV1 mode, the ET 200iSP must be included via the GSD file. Parameter assignment is possible with SIMATIC PDM.

Note

The following procedure is only valid for PCS 7/STEP 7. The configuration can also be performed with PCS neo or TIA Portal.

Procedure

1. Open STEP 7
2. If the New Project Wizard appears after opening it, close it with **Cancel**.
3. In the main menu of the SIMATIC Manager, navigate to **File > New**. In the dialog box that appears, enter "ET 200iSP" as the name and close the dialog with **OK**.
4. Navigate to **Insert > Station** and click **SIMATIC 400 Station** in the list. An icon with the name SIMATIC 400(1) appears in the right half of the project window.
5. In the SIMATIC Manager, navigate to the SIMATIC 400 station and double-click the icon. An icon labeled "Hardware" now appears in the right part of the window. Double-click on this icon. HW Config opens.
6. If no catalog with components is displayed in the right part of the window, activate it by selecting **View > Catalog** from the menu.
   Navigate in the catalog via SIMATIC 400 and RACK-400 to UR1. Double-click on this icon.
7. Select slot 1 (appears highlighted in blue) and navigate to PS 407 4A via SIMATIC 400, PS 400 and Standard PS 400 and double-click on it. The power supply module now occupies slot 1.
8. Next, mark slot 3 and navigate back under SIMATIC 400 via CPU 410, CPU 410-5H and "Article number of the CPU". After a double-click, a window with the title "Properties <network interface>" opens, which you can acknowledge with **OK**. The CPU is entered in slot 2.

9. Depending on the required network connection of the ET 200iSP station:
   - **Connection to a PROFINET IO system with interface module IM 152-1PN**:
     In the window, look for the row with the label "PN-IO" and highlight it. Right-click on the row and select **Object Properties** from the menu. The "Properties-PROFINET IO" dialog opens. Click the **Properties** button and in the next dialog, click **New**. A new PROFINET IO system is now created. Confirm by clicking **OK** three times in succession.
   - **Connection to a PROFIBUS DP master system with interface module IM 152-1DP**:
     In the window, look for the row with the label DP and highlight it. Right-click on the row and select **Object Properties** from the menu. The "Properties-PROFIBUS DP" dialog opens. Click the **Properties** button and in the next dialog, click **New**. A new DP subnet with 1.5 Mbps is now created. Confirm by clicking **OK** three times in succession.
10. You can save the changes in the main menu with **Station > Save and compile**.

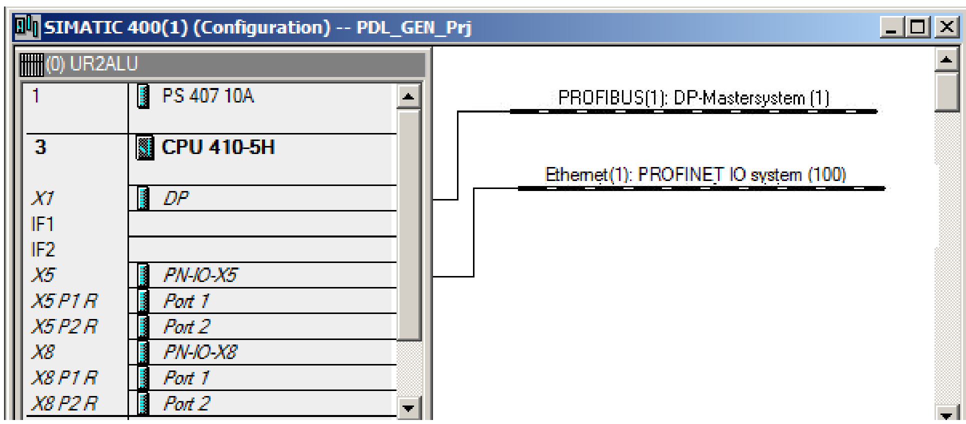


Figure 3-8 Configuration of the S7-400

3.10.2 Setting the IP address of the IM 152-1PN on PROFINET IO

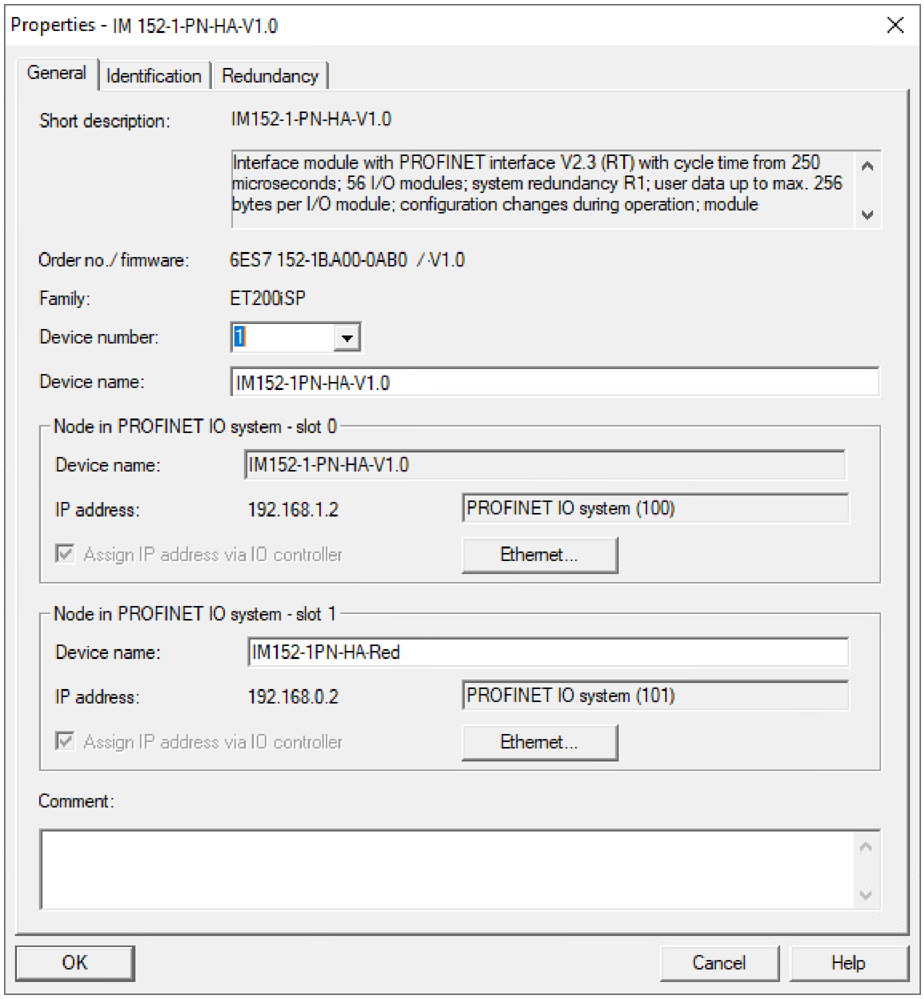
Requirements

- You have selected the PROFINET configuration.
- A PROFINET IO system is configured at a PN IO interface of the CPU.

Procedure

1. Select the interface module in HW Config.
2. Select the menu command **Edit > Object Properties**.

3. Enter a unique designation for the interface module in the "Device name" entry field of the "General" tab.
   The unique designation is mandatory for the PROFINET node.



4. Click the "Ethernet" button in the "PROFINET IO System node - Slot 0" area.
   The dialog window "Properties - IM 152-1PN..." opens.
5. Enter the IP address of the interface module as device on the PROFINET IO on the "Parameters" tab.
6. In the "Subnet" area, select the PROFINET IO subnet.
7. Other optional settings:
   – "Topology" tab Specify a "Port interconnection".
   – "Options:" tab To enable port diagnostics, at "Connection" under "Transmission medium / Duplex" select: "Automatic settings (monitor)".
8. When you operate the IO device with a redundant interface module:
   Repeat steps 4 to 7 for "Device in PROFINET IO System - Slot 1".
9. Click "OK" to apply the settings.

3.10.3 Configuring and assigning parameters for the ET 200iSP

Procedure

1. Click with the mouse to select the stylized selected fieldbus (PROFINET IO or PROFIBUS DP) in the upper left part of the HW Config window. Now navigate in the catalog via the fieldbus (PROFINET IO or PROFIBUS DP) and ET 200iSP to the interface module and double-click it to insert an ET 200iSP station.
   Change the network address in the window that opens.
   - For the PROFINET IO configuration:
     Enter the correct network parameters (network address and subnet mask) in the properties of the IM 152-1PN
   - For the PROFIBUS DP configuration:
     In the properties of the IM 152-1DP, change the PROFIBUS node number to 3 and confirm the changes with **OK**. New slots now appear at the bottom left with an IM 152-1DP in slot 2.
2. For the PROFINET IO configuration: Select the slot 2 and, from there, insert 2 8 DI NAMUR modules and 3 4 DO DC17.4V/27mA modules.
   For configuration of the PROFIBUS DP: As slot 3 must remain free, select slot 4 and insert two 8 DI NAMUR modules and three 4 DO DC17.4V/27mA after that.

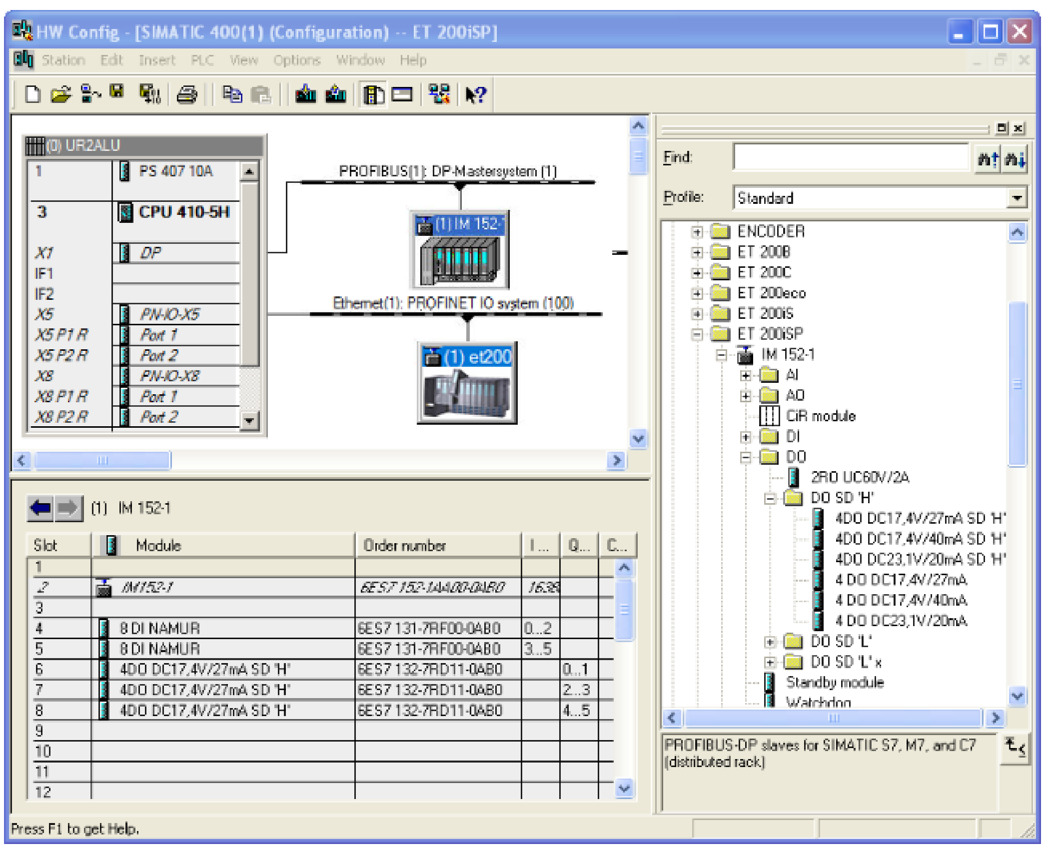


Figure 3-9 Configuring and assigning parameters for ET 200iSP

3. Double click on the first module in the configuration table (8 DI NAMUR, slot 2 for the PROFINET IO configuration, slot 4 for the PROFIBUS DP configuration) and select the "Parameters" tab.
   For channels 0 and 1, change the sensor type to "NAMUR sensor". For all other channels, select "disabled".

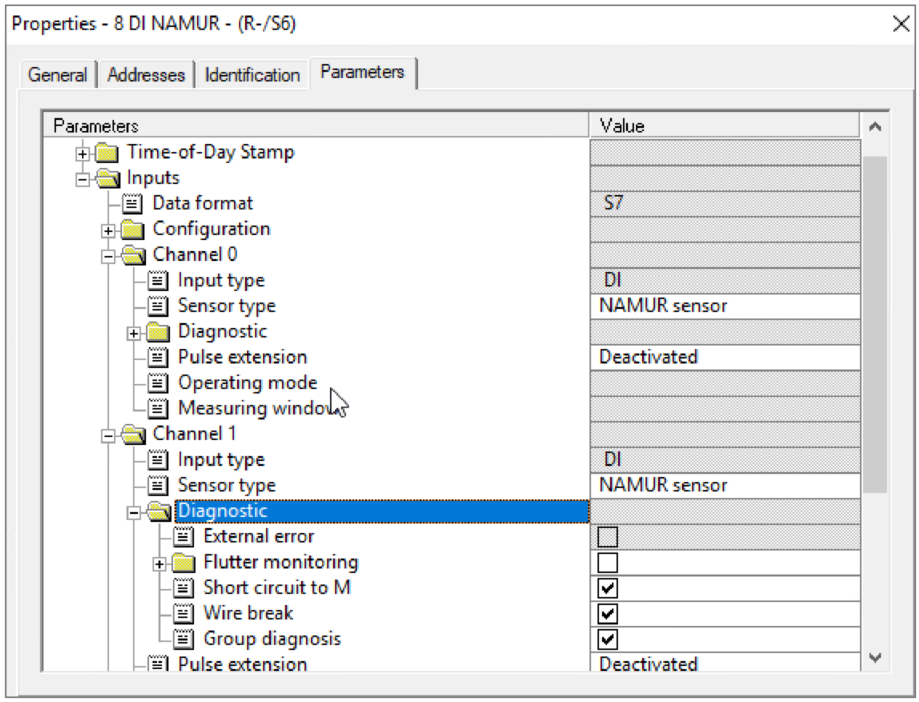


Figure 3-10 ET 200iSP, activate channels:

4. For each of the ET 200iSP modules, proceed as described in step 3 and make the changes as described in the following table.

Module	Slot for PROFINET	Slot for PROFIBUS	Type	Channel 0	Channel 1	Channel 2-7
1	2	4	8 x DI NAMUR	NAMUR sensor	NAMUR sensor	Sensor type: Disabled
2	3	5	8 x DI NAMUR	NAMUR sensor	Sensor type: Channel disabled	Sensor type: Disabled
3	4	6	4 x DO	No change	No change	---
4	5	7	4 x DO	No change	No change	---
5	6	8	4 x DO	No change	No change	---

5. Save the configuration with **File > Save** and load it in the CPU with **PLC > Load.**

3.11 Programming the Sample Configuration

Operating principle

The state of the sensors connected to inputs I512.0 , I513.0 and I514.0 is looked up and analyzed. I512.0 increments an internal counter and I513.0 decrements it. Input I514.0 resets the counter to zero.

Depending on the counter reading, the outputs A512.0, A513.0 and A514.0 are set or deleted. Q512.0 is set when the count is 0. At a count < 3, Q514.0 is set and at ≥ 3, Q513.0 is set.

Programming

Switch to the component view with **View > Component view.**

Navigate to the block OB1 via SIMATIC 400(1), CPU 410-5H, S7 program (1) and blocks. Double-click it and confirm the dialog with **OK**.

Enter the following STL program:

STL	**Explanation**
`A I 514.0`	`If button 514.0 is active,`
`R C 0`	`set counter to 0`
`A I 512.0`	`If BERO 512.0 is active,`
`CU C 0`	`increment by 1`
`A I 513.0`	`If BERO 513.0 is active,`
`CD C 0`	`decrement by 1`
`AN C 0`	`Is counter = 0 ?`
`= Q 512.0`	`YES, then output 512.0 is active`
`L C 0`	`Load counter in ACCU`
`L 3`	`Charge 3 in the ACCU`
`>=I`	`Is counter => 3 ?`
`= Q 513.0`	`YES, then output 513.0 is active`
`<I`	`Is counter < 3 ?`
`= Q 514.0`	`Yes, then output 514.0 is active`

Save the program with **File > Save** and load it in the CPU with **PLC > Load.**

3.12 Putting the Example into Operation

Commissioning

1. Switch on the power supply of the ET 200iSP.
2. Observe the status LED at the S7-400 and at the ET 200iSP:
   LEDs of the CPU:
   - RUN: on (means: LED lights up)
   - All other LEDs: off (means: LED does not light up)

   For PROFINET configuration - LEDs on the interface module IM 152-1PN of the ET 200iSP:
   - ER: Off
   - MT: Off
   - ACT: Off
   - RN: on
   - PS1: On, PS2: Off
   - LK1 and/or LK2: on (when a network connection is set up from one device to another; otherwise off)

   For PROFIBUS configuration - LEDs on the interface module IM 152-1DP of the ET 200iSP:
   - SF: Off
   - BF: Off
   - ACT: Off
   - ON: on
   - PS1: On, PS2: Off

3.13 Evaluating the diagnostics

Evaluating the diagnostics

If an error occurs, OB82 is started. Evaluate the startup information in OB82.

Tip: Call the SFC13 within the OB82 and evaluate the diagnostics frame from section "Commissioning and Diagnostics (Page 155)".

3.14 Removing and inserting of modules

Pulling and plugging digital electronics module 8 DI NAMUR

1. Swing the first of the three 8 DI NAMUR electronic modules out from the terminal module during operation.
2. Observe the status LEDs.
   For PROFINET configuration - LEDs on the interface module IM 152-1PN of the ET 200iSP:
   – ER: on (means: LED lights up)
   – MT: off (means: LED does not light up)
   – ACT: On
   – RN: On
   – PS1: On, PS2: Off
   – LK1 and/or LK2: on (when a network connection is set up from one device to another; otherwise off)

   For PROFIBUS configuration - LEDs on the interface module IM 152-1DP of the ET 200iSP:
   – SF: on --> diagnostic message is available.
   – BF: Off
   – ON: On
   – PS1: On, PS2: Off

   Result: The ET 200iSP continues operating without fault.

3. Analyze the diagnostic message:
   Result for PROFINET configuration:
   - Identifier-related diagnostics: Bit 3 in byte 7 is set -> Slot 2

   Result for PROFIBUS configuration:
   - Station status 1 (byte 0): Bit 3 is set -> External diagnostics
   - Identifier-related diagnostics: Bit 3 in byte 7 is set -> Slot 4
   - Module status: Byte 16.7 / 16.6: 11_B -> No module
4. Plug the pulled electronic module back into the terminal module.
   Result:
   For PROFINET configuration - LEDs on the interface module IM 152-1PN of the ET 200iSP:
   - ER: Off
   - MT: Off
   - ACT: On
   - RN: On
   - PS1: On, PS2: Off
   - LK1 and/or LK2: on (depending on the nodes connected via fiber-optic cables)

   For PROFIBUS configuration - LEDs on the interface module IM 152-1DP of the ET 200iSP:
   - SF: Off
   - BF: Off
   - ON: On
   - PS1: On, PS2: Off

   The diagnostic message has been deleted.

3.15 Wire break of NAMUR encoder on digital input module

Procedure

1. Remove the cable from terminal 1 of the **first** electronic module 8 DI NAMUR.
2. For PROFINET configuration - LEDs on the interface module IM 152-1PN of the ET 200iSP:
   - ER: Flashes

   For PROFIBUS configuration - LEDs on the interface module IM 152-1DP of the ET 200iSP:
   - SF: Flashes --> diagnostic message is available.
3. Status LEDs on the electronic module 8 DI NAMUR:
   - SF: on --> diagnostic message is available.
   - 3: off/on

4. Analyze the diagnostic message.
   Result for PROFINET configuration:
   – Identifier-related diagnostics: Bit 7.3 is set -> Slot 2
   – Slot: 2
     Subslot: 1
     Channel fault type: 6 - Wire break

   Result for PROFIBUS configuration:
   – Station status 1 (byte 0): Bit 3 is set -> External diagnostics
   – Identifier-related diagnostics: Bit 7.3 is set -> Slot 4
   – Channel-related diagnostics:
     Byte 25: 10000011_B -> Slot 4
     Byte 26: 01000000_B -> Channel 0
     Byte 27: 00110_B -> Wire break
5. Connect the cable to the BERO back to terminal 1 and analyze the diagnostics again:
   Result:
   For PROFINET configuration - LEDs on the interface module IM 152-1PN of the ET 200iSP:
   – ER: Off

   For PROFIBUS configuration - LEDs on the interface module IM 152-1DP of the ET 200iSP:
   – SF: Off

   Status LEDs electronic module 8 DI NAMUR:
   – SF: Off
   – 3: off/on

   The diagnostic message has been deleted.

Configurations (principle)

4

4.1 Modular system

Modular system

With ET 200iSP, modular means: You can adapt the design to your applications by using 4-channel and 8-channel electronic modules.

Example

The following figure shows an example of the configuration of the ET 200iSP distributed I/O device:

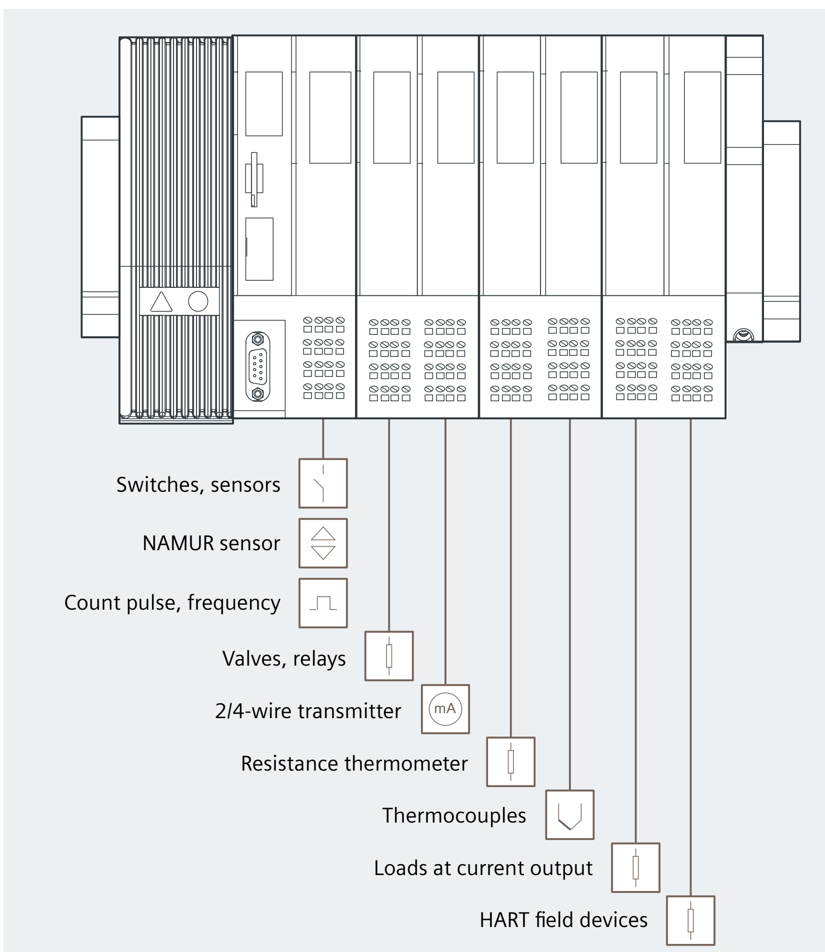


Figure 4-1 Configuration example ET 200iSP

4.2 Electronics modules suitable for your application

Selection guide for the electronic modules

The following table is a selection guide for the applications of the electronic modules of the ET 200iSP distributed I/O device.

Table 4-1 Which electronic modules match your application

Application		Electronic modules
Analyzing NAMUR sensors Analyzing connected, disconnected mechanical contacts Acquiring count pulses Measuring frequencies	8 input channels	8 DI NAMUR
Activation of solenoid valves, DC relays, indicator lights, actuators	4 output channels Deactivation via High active, intrinsically safe switching signal	4 DO DC23.1V/20mA shut down "H" 4 DO DC17.4V/27mA shut down "H" 4 DO DC17.4V/40mA shut down "H"
	4 output channels Deactivation via Low active, intrinsically safe switching signal	4 DO DC23.1V/20mA shut down "L" 4 DO DC17.4V/27mA shut down "L" 4 DO DC17.4V/40mA shut down "L"
	Two output channels DC to 60 V/ AC to 60 V	2 DO Relay UC60V/2A
Measuring currents with two wire transmitters (standard applications) Measuring currents with HART field devices (two wire transmitter) HART communication	4 input channels Input range • 4 to 20 mA • HART	4 AI I 2WIRE HART
Measuring currents with four wire transmitters (standard applications) Measuring currents with HART field devices (four wire transmitter) HART communication	4 input channels Input ranges • 0 to 20 mA • 4 to 20 mA • HART	4 AI I 4WIRE HART
Measuring temperatures with thermistors Measuring resistances	4 input channels Input ranges • Pt 100, Ni 100 • 600 Ω	4 AI RTD

Application		Electronic modules
Measuring temperatures with thermocouples Measuring thermoelectric voltages	4 input channels Input ranges • ±80 mV • Type J, K, T, U, E, L, N, R, S, B	4 AI TC
Output of currents with HART field devices HART communication Output of currents	4 output channels Output ranges • 0 to 20 mA • 4 to 20 mA • HART	4 AO I HART

4.3 Terminal modules and the suitable modules for them

Modules and terminal modules

The table below shows you which modules you can use on the various terminal modules.

Table 4-2 Modules and terminal modules

Modules	Terminal modules										
	TM-PS-A 1) TM-PS-B 1)	TM-PS-A TM-PS-B	TM-IM/IM		TM-IM/EM 60S TM-IM/EM 60C TM-IM/EM		TM-EM/EM 60S TM-EM/EM 60C TM-EM/EM		TM-RM/ RM 60S	
Article number 6ES7193-	7DA10-0AA0 7DB10-0AA0	7DA20-0AA0 7DB20-0AA0	7AB00-0AA0		7AA00-0AA0 7AA10-0AA0 7AA20-0AA0		7CA00-0AA0 7CA10-0AA0 7CA20-0AA0		7CB00-0AA0	
Power supply PS DC24V (up to product version 6)	x									
Power supply PS DC24V (product version 7 and higher)	x	x								
Power supply PS AC120/230V		x								
Interface module IM 152-1PN			x	x	x					
Interface module IM 152-1DP			x	x	x					
8 DI NAMUR						x	x	x		
4 DO DC23.1V/20mA						x	x	x		
4 DO DC17.4V/27mA						x	x	x		
4 DO DC17.4V/40mA						x	x	x		
2 DO Relay UC60V/2A									x	x
4 AI I 2WIRE HART						x	x	x		

Modules	Terminal modules									
4 AI I 4WIRE HART						x	x	x		
4 AI RTD						x	x	x		
4 AI TC						x	x	x		
4 AO I HART						x	x	x		
Reserve module						x	x	x	x [2)]	x [2)]
WATCHDOG						x	x	x		

[1)] Only available as replacement part
[2)] As of product version 3 of the reserve module

4.4 Rules for operation in hazardous areas

4.4.1 PROFINET configurations in zones for IM 152-1PN

General rules

Regardless of the configuration of the ET 200iSP in the hazardous areas or in the safe area, the following applies:

The ET 200iSP distributed I/O device can only be operated on fiber-optic cables:

Secure optical connections are required in the following cases:

- When the communication devices are located in an ATEX/IECEx Zone 1 or 21.
- When the connections run through an ATEX/IECEx Zone 1 or 21.

The requirement for the previously mentioned use cases is regulated in EN/IEC 60079-28. The devices that meet the standard have been labeled with "Ex nA [op is Gb] IIC T4 Gc" until now.

A change in this standard with version 2015 exempts devices with optical transceivers that meet the limits of Class 1 according to IEC 60825-1 from this directive.

WARNING

Explosion hazard

Only connect intrinsically safe devices to PROFINET IO.

The connection of bus testers to the fiber-optic cable is not permitted.

1. Media converters RJ45/FOC are required for connection to the CPU.
2. Marking of the SFP transceiver in the media converter as Class 1 according to IEC 60825-1 (not only for hazardous areas!)
3. Marking of the cables/lines to the actuators and sensors as intrinsically safe (e.g. light blue in color).

Rules for the configuration of the ET 200iSP in Zone 1

If you use the ET 200iSP in zone 1, then you must observe the following rules:

1. Install the ET 200iSP in an enclosure with degree of protection Ex e (increased safety) (see section "Installation rules (Page 101)", see Appendix "Article numbers (Page 419)").
2. Disconnection of the PROFINET IO through the media converter (SCALANCE X 212-2 (see Appendix "Article numbers (Page 419)") with optical safe transceiver. The media converter guarantees protection in hazardous areas according to EN/IEC 60079-28. You can install the media converter in the hazardous area of Zone 2 or in the safe area.
3. You can use normal PROFINET IO bus cables in hazardous areas (see Appendix "Article numbers (Page 419)"). However, you must mark these as "Ex i bus cables" (e.g. attach blue tape/blue shrink-on sleeve on the ends; mark the cable with blue color).
4. Connecting the fiber-optic cable to the IM 152-1PN using the LC plug (see Appendix "Article numbers (Page 419)").
   The maximum length of the PROFINET IO via fiber-optic cable is 3000 m.

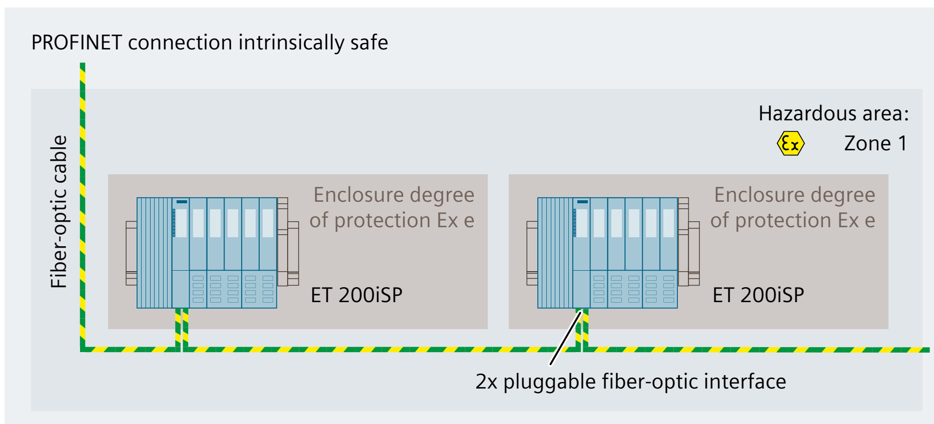


Figure 4-2 ET 200iSP configuration Options in Zone 1

Rules for configuration of the ET 200iSP in Zone 21

If you use the ET 200iSP in zone 21, then you must observe the following rules:

1. Install the ET 200iSP in a dust-proof (certified) enclosure with at least degree of protection IP6X (according to directive 2014/34/EU for category 2D). Additional requirements (surface temperature, for example) can be found in the certification document for the enclosure (see section "Installation rules (Page 101)", see Appendix "Article numbers (Page 419)").
2. See points 2 to 4: *Rules for the configuration of the ET 200iSP in Zone 1*

Rules for configuration of the ET 200iSP in Zone 2

If you use the ET 200iSP in zone 2, then you must observe the following rules:

1. Install the ET 200iSP in an enclosure with degree of protection IP54. A declaration of the manufacturer for fulfilment of Zone 2 must be available for the enclosure (in accordance with EN 60079-15: Protection against mechanical damage; degree of protection IP54; avoidance of ignition hazards due to electrostatic charging) (see section "Installation rules (Page 101)", see Appendix "Article numbers (Page 419)").
2. See points 2 to 4: *Rules for the configuration of the ET 200iSP in Zone 1*

Rules for configuration of the ET 200iSP in Zone 22

If you use the ET 200iSP in zone 22, then you must observe the following rules:

1. Install the ET 200iSP in a metallic (see section "Installation rules (Page 101)"), dust-protected enclosure with at least degree of protection IP5X (according to directive 2014/34/EU for category 3D). Additional requirements (surface temperature, for example) can be found in the certification document for the enclosure (see Appendix "Article numbers (Page 419)").
2. See points 2 to 4: *Rules for the configuration of the ET 200iSP in Zone 1*

> **DANGER**
>
> **Conductive dust**
>
> If the Zone 22 potentially explosive area is subject to conductive dust (for example, metal dust), the rules for zone 21 apply.

Rules for the configuration of ET 200iSP in the safe area

If you use the ET 200iSP in the safe area, then you must observe the following rules:

1. Install the ET 200iSP in an enclosure with degree of protection IP20.
2. See points 2 and 4: *Rules for the configuration of the ET 200iSP in Zone 1*

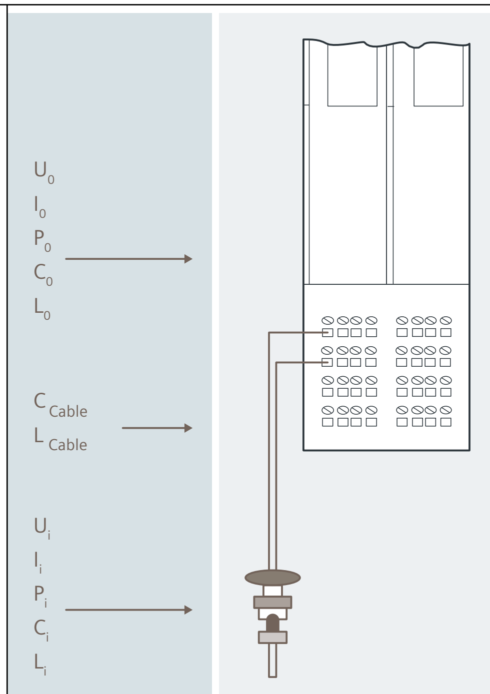
Rules for configuring the encoders, actuators, HART field devices in the hazardous area

The verification of intrinsic safety for each field circuit must be made according to the regulations stipulated by the relevant standards for configuration, selection and installation.

A simple, intrinsically safe circuit results from attaching a sensor, actuator or HART field device to an input or output of the electronic modules.

The following table describes the conditions for checking the maximum safe values for a simple, intrinsically safe circuit:

Table 4-3 Rules for configuration

Relevant Standard / Conditions for Electrical Parameters	Usable Sensors and Actuators
Standard: EN 60079-14 The following applies to the electrical parameters: • $U_0 \leq U_i$ • $I_0 \leq I_i$ • $P_0 \leq P_i$ • $C_0 \geq C_i + C_{cable}$ • $L_0 \geq L_i + L_{cable}$	The maximum safe values of the sensors and actuators must be adapted to the maximum values of the electronic modules. You will find these maximum values • in the Ex certificate of the sensors and actuators • in the technical specifications of the electronic modules of the ET 200iSP
Modules ET 200iSP  Encoders Actuators HART field devices	U_0 max. output voltage I_0 max. output current P_0 max. output power C_0 max. external capacitance L_0 max. external inductance C_{line} max. capacitance line/cable L_{line} max. inductance U_i max. input voltage I_i max. input current P_i max. input power C_i max. internal capacitance IiL$_i$ max. internal inductance

Safety information

Note

During the configuration you must observe the guidelines according to EN 60079-14.

> **⚠ WARNING**
>
> **Intrinsically safe circuit**
>
> Connecting an intrinsically safe sensor, actuator, or HART field device to the input/output of an electronic module must produce an intrinsically safe circuit! Always check for resultant safety values when you select the sensors, actuators and HART field devices for an electronic module.

4.4.2 PROFIBUS configurations in zones for IM 152-1DP

General rules

Regardless of the configuration of the ET 200iSP in the hazardous areas or in the safe area, the following applies:

The ET 200iSP distributed I/O device can only be **operated** on the intrinsically safe **PROFIBUS RS 485-IS:**

1. RS 485-IS coupler (fieldbus isolating transformer) always required
2. Marking of the PROFIBUS DP as Ex i (not only for hazardous areas!)
3. Marking of the cables/lines to the actuators and sensors as Ex i (e.g. light blue in color).

> **⚠ WARNING**
>
> **Only connect intrinsically safe devices to PROFIBUS RS 485-IS**
>
> All devices that you connect to the PROFIBUS RS 485-IS must be intrinsically safe.
>
> The connection of voltmeters, oscillographs and bus testers to the PROFIBUS RS 485-IS is not permitted.

Rules for the configuration of the ET 200iSP in Zone 1

If you use the ET 200iSP in zone 1, then you must observe the following rules:

1. Install the ET 200iSP in an enclosure with degree of protection Ex e (increased safety) (see section "Installation rules (Page 101)", see Appendix "Article numbers (Page 419)").
2. Disconnect thePROFIBUS DP using the RS 485-IS coupler (see Appendix "Article numbers (Page 419)"). The RS 485-IS coupler ensures the degree of protection Ex i of the PROFIBUS DP in hazardous areas. You can install the RS 485-IS coupler in the hazardous area of Zone 2 or in the safe area.
3. You can use normal PROFIBUS DP bus cables in hazardous areas (see Appendix "Article numbers (Page 419)"). However, you must mark these as "Ex i bus cables" (e.g. attach blue tape/blue shrink-on sleeve on the ends; mark the cable with blue color).

4. Connecting the PROFIBUS RS 485-IS bus cable to the IM 152-1DP via the PROFIBUS bus connector RS 485-IS (see Appendix "Article numbers (Page 419)").
5. Connect the PROFIBUS RS 485-IS with the PROFIBUS bus connector RS 485-IS: (see appendix "Article numbers (Page 419)"). The maximum length of the PROFIBUS RS 485-IS depends on the baud rate (see product information RS 485-IS coupler (https://support.industry.siemens.com/cs/ww/en/view/29306413)).

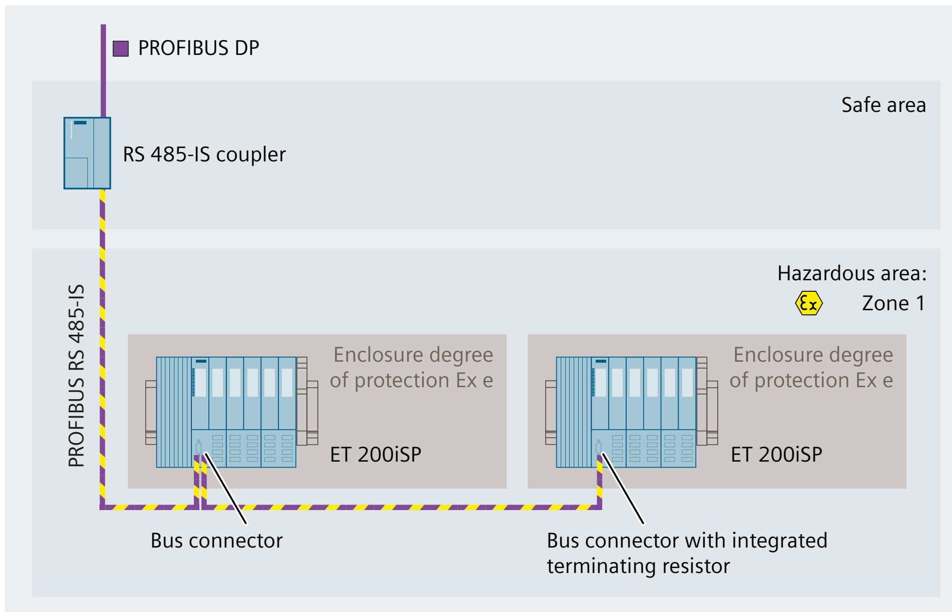


Figure 4-3 ET 200iSP configuration Options in Zone 1

Rules for configuration of the ET 200iSP in Zone 21

If you use the ET 200iSP in zone 21, then you must observe the following rules:

1. Install the ET 200iSP in a dust-proof (certified) enclosure with at least degree of protection IP6X (according to directive 2014/34/EU for category 2D). Additional requirements (surface temperature, for example) can be found in the certification document for the enclosure (see section "Installation rules (Page 101)", see Appendix "Article numbers (Page 419)").
2. See points 2 to 5: *Rules for the configuration of the ET 200iSP in Zone 1*

Rules for configuration of the ET 200iSP in Zone 2

If you use the ET 200iSP in zone 2, then you must observe the following rules:

1. Install the ET 200iSP in an enclosure with degree of protection IP54. A declaration of the manufacturer for fulfilment of Zone 2 must be available for the enclosure (in accordance with EN 60079-15: Protection against mechanical damage; degree of protection IP54; avoidance of ignition hazards due to electrostatic charging) (see section "Installation rules (Page 101)", see Appendix "Article numbers (Page 419)").
2. See points 2 to 5: *Rules for the configuration of the ET 200iSP in Zone 1*

Rules for configuration of the ET 200iSP in Zone 22

If you use the ET 200iSP in zone 22, then you must observe the following rules:

1. Install the ET 200iSP in a metallic (see section "Installation rules (Page 101)"), dust-protected enclosure with at least degree of protection IP5X (according to directive 2014/34/EU for category 3D). Additional requirements (surface temperature, for example) can be found in the certification document for the enclosure (see Appendix "Article numbers (Page 419)").
2. See points 2 to 5: *Rules for the configuration of the ET 200iSP in Zone 1*

DANGER

Conductive dust

If the Zone 22 potentially explosive area is subject to conductive dust (for example, metal dust), the rules for zone 21 apply.

Rules for the configuration of ET 200iSP in the safe area

If you use the ET 200iSP in the safe area, then you must observe the following rules:

1. Install the ET 200iSP in an enclosure with degree of protection IP20.
2. See points 2, 4 and 5: *Rules for the configuration of the ET 200iSP in Zone 1*

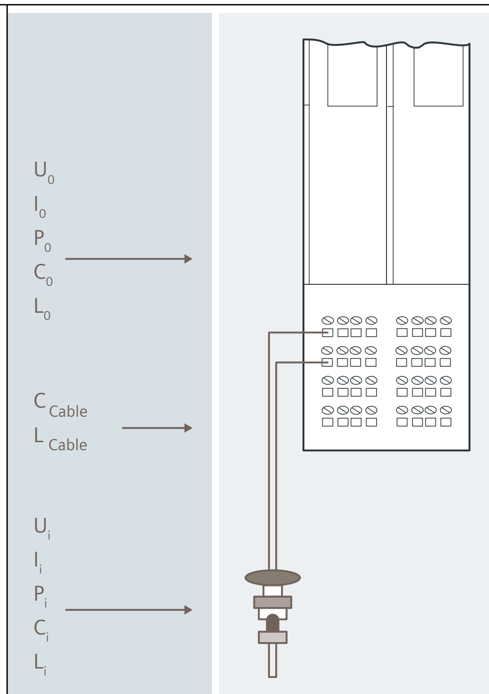
Rules for configuring the encoders, actuators, HART field devices in the hazardous area

The verification of intrinsic safety for each field circuit must be made according to the regulations stipulated by the relevant standards for configuration, selection and installation.

A simple, intrinsically safe circuit results from attaching a sensor, actuator or HART field device to an input or output of the electronic modules.

The following table describes the conditions for checking the maximum safe values for a simple, intrinsically safe circuit:

Table 4-4 Rules for configuration

Relevant Standard / Conditions for Electrical Parameters	Usable Sensors and Actuators
Standard: EN 60079-14 The following applies to the electrical parameters: • $U_0 \leq U_i$ • $I_0 \leq I_i$ • $P_0 \leq P_i$ • $C_0 \geq C_i + C_{cable}$ • $L_0 \geq L_i + L_{cable}$	The maximum safe values of the sensors and actuators must be adapted to the maximum values of the electronic modules. You will find these maximum values • in the Ex certificate of the sensors and actuators • in the technical specifications of the electronic modules of the ET 200iSP
Modules ET 200iSP  Encoders Actuators HART field devices	U_0 max. output voltage I_0 max. output current P_0 max. output power C_0 max. external capacitance L_0 max. external inductance C_{line} max. capacitance line/cable L_{line} max. inductance U_i max. input voltage I_i max. input current P_i max. input power C_i max. internal capacitance liL_i max. internal inductance

Safety information

Note

During the configuration you must observe the guidelines according to EN 60079-14.

WARNING

Intrinsically safe circuit

Connecting an intrinsically safe sensor, actuator, or HART field device to the input/output of an electronic module must produce an intrinsically safe circuit! Always check for resultant safety values when you select the sensors, actuators and HART field devices for an electronic module.

4.5 Use of the ET 200iSP in category M2 of equipment-group I (mining)

Requirements

The following conditions must be fulfilled if the ET 200iSP is used in device group I (underground mining operations and their overground systems) Category M2:

CAUTION

To avoid ignitable sparks, the power supply (PS) and the mounting rail of the ET 200iSP must be packaged in shock-proof packaging for transportation and storage (e.g. for servicing) and immediately removed from the hazardous area.

The enclosure in which the ET 200iSP is installed must be approved for device group I, category M2.

Observe all other requirements concerning use of the ET 200iSP in the hazardous area.

4.6 Restricted Number of Connectable Electronics Modules

Number of electronic modules

Each ET 200iSP station consists of max. 31 electronic modules without redundancy of the interface module or of max. 32 electronic modules with redundancy of the interface module. These include digital and analog electronic modules.

The number of electronic modules is limited by the functional current output of the power supply PS. This maximum permissible current must not be exceeded.

You have to check the configuration with the **calculation table** (see below) or with the TIA Selection Tool.

Calculation table

With the calculation table, you can check the operational current consumption of the ET 200iSP.

Note

The safety-related current consumption (limit value < 15 A, see EC type-examination certificate KEMA 04 ATEX 2242) is always complied with in the ET 200iSP. With all configurations, the number of modules is restricted only by the effective current output (refer to following table) or the maximum number of electronic modules (31 or 32).

Configuration	Power supply		Maximum operational current output
Normal operation	PS DC24V[1]		5 A
	PS AC120/230V[2]		
Redundancy	PS DC24V[1]	PS DC24V[1]	
	PS AC120/230V[2]	PS AC120/230V[2]	
	PS DC24V[3]	PS AC120/230V[2]	

[1] Product version 3 and higher:

[2] Maximum functional current output 5 A for 170 V AC to 264 V (to 60 °C) or for 85 V AC to 132 V (to 50 °C). Refer to technical specifications in the section "Power Supply PS AC120/230V".

[3] Product version 5 and higher:

Procedure

Check the **operational current consumption** of your ET 200iSP configuration! The limit value specified in the table column *=operational current consumption in mA* must **not be exceeded**.

1. Multiply the operational current per module by the number of modules, then enter the values in the *= operational current consumption in mA* column.
2. Add all modules and enter the value in the field *Total electronic modules* (max. 31 or 32 electronic modules).
3. Add the operational current consumption and enter the value in the *Total Current Consumption* box.
4. Compare the calculated totals with the specified limits.

Table 4-5 Calculation table current consumption

Electronic modules	x number of modules	Operational current per module in mA	= Operational current consumption in mA
Power supply PS DC24V/ PS AC120/230V	x	15 mA	=
IM 152-1PN (PROFINET connection of the ET 200iSP)	x	200 mA	=
IM 152-1DP (PROFIBUS connection of the ET 200iSP)	x	30 mA	=

Electronic modules	**x number of modules**	**Operational current per module in mA**	**= Operational current consumption in mA**
8 DI NAMUR	x	80 mA	=
4 DO DC23.1V/20mA shut down "H"	x	290 mA	=
4 DO DC17.4V/27mA shut down "H"	x	260 mA	=
4 DO DC17.4V/40mA shut down "H"	x	380 mA	=
4 DO DC23.1V/20mA shut down "L"	x	290 mA	=
4 DO DC17.4V/27mA shut down "L"	x	260 mA	=
4 DO DC17.4V/40mA shut down "L"	x	380 mA	=
4 DO DC25.5V/22mA shut down "L"	x	310 mA	=
2 DO Relay UC60V/2A	x	100 mA	=
4 AI I 2WIRE HART	x	280 mA	=
4 AI I 4WIRE HART	x	27 mA	=
4 AI RTD	x	19 mA	=
4 AI TC	x	17 mA	=
4 AO I HART	x	295 mA	=
Reserved	x	---	---
WATCHDOG	x	2 mA x DO **	
	Total electronic modules =		Total Current Consumption =
	max. 31 or 32*		**< max. effective current output*****

* Without power supply PS and interface module IM 152-1PN, IM 152-1DP

** Functional current consumption of the WATCHDOG module = 2 mA x number of connected digital output modules

*** See above table for values

Example

An ET 200iSP consists, for example, of the following electronic modules:

- 1 power supply module PS DC24V
- 1 interface module IM 152-1PN
- 5 modules 8 DI NAMUR
- 2 modules 4 DO DC23.1V/20mA shut down "H"
- 5 modules 4 DO DC17.4V/27mA shut down "H"
- 3 modules 4 AI I 2WIRE HART
- 5 modules 4 AI I 4WIRE HART
- 5 modules 4 AI RTD
- 3 modules 4 AI TC
- 3 modules 4 AO I HART

Check the number of electronic modules and the current consumption:

Table 4-6 Calculation table current consumption

Electronic modules	**x number of modules**	**Operational current per module in mA**	**= Operational current consumption in mA**
Power supply PS DC24V/ PS AC120/230V	x 1	15 mA	= 15 mA
IM 152-1PN	x 1	200 mA	= 200 mA
8 DI NAMUR	x 5	80 mA	= 400 mA
4 DO DC23.1V/20mA shut down "H"	x 2	290 mA	= 580 mA
4 DO DC17.4V/27mA shut down "H"	x 5	260 mA	= 1300 mA
4 DO DC17.4V/40mA shut down "H"	x ---	380 mA	= ---
4 DO DC23.1V/20mA shut down "L"	x ---	290 mA	= ---
4 DO DC17.4V/27mA shut down "L"	x ---	260 mA	= ---
4 DO DC17.4V/40mA shut down "L"	x ---	380 mA	= ---
4 DO DC25.5V/22mA shut down "L"	x ---	310 mA	= ---
2 DO Relay UC60V/2A	x ---	100 mA	= ---
4 AI I 2WIRE HART	x 3	280 mA	= 840 mA
4 AI I 4WIRE HART	x 5	27 mA	= 135 mA
4 AI RTD	x 5	19 mA	= 95 mA
4 AI TC	x 3	17 mA	= 51 mA
4 AO I HART	x 3	295 mA	= 885 mA
Reserved	x ---	---	---
WATCHDOG	x ---	2 mA x DO **	= ---
	Total electronic modules = 31		Total Current Consumption = 4501 mA
	max. 31*		**< 5000 mA**
* Without power supply PS and interface module IM 152-1PN, IM 152-1DP ** Functional current consumption of the WATCHDOG module = 2 mA x number of connected digital output modules			

Note

The limit values are adhered to in the example.

Result: The ET 200iSP can be operated with this configuration.

Note

If you replace the IM 152-1DP with IM 152-1PN, note the higher functional current consumption of the IM 152-1PN.

Fail-safe modules have a higher functional current consumption than standard modules. See "ET 200iSP Distributed I/O Device - Fail-safe Modules (https://support.industry.siemens.com/cs/us/en/view/47357221)".

Calculating the ET 200iSP power loss

You can calculate the power loss of the ET 200iSP using the following formula:

$P_{Vtotal} = x*5W + 1.2*\sum_{PV\_Type\_I/O}$

Explanation:

x*5W = basic power loss of power supply (x = 1 for standard configuration, x = 2 for redundant configuration)

$1.2*\sum_{PV\_Type\_I/O}$ = Typical power loss of the input and output modules including resulting P_V in power supply.

See also

Power supply PS 120/230 VAC (Page 272)

4.7 Maximum configuration of the ET 200iSP

Number of the ET 200iSP stations

- Connection via PROFINET IO
  The number of ET 200iSP stations on an IO controller is limited by the quantity structure of the IO controller.
- Connection via PROFIBUS
  The number of ET 200iSP stations on DP masters is limited:
  For S1 and S2 configuration with an IM 152-1DP: Maximum of 31 ET 200iSP stations per segment of the PROFIBUS RS 485-IS (connection via the RS 485-IS coupler required)
  For R1 configuration with IM 152-1DP: Maximum of 32 ET 200iSP stations per segment of the PROFIBUS RS 485-IS (connection via the RS 485-IS coupler required)

Current consumption of the ET 200iSP at maximum configuration

Information on the permissible current consumption can be found in the technical specifications of the connected power supply:

- Power supply PS 24 VDC (Page 269)
- Power supply PS 120/230 VAC (Page 272)

Width of the ET 200iSP

The maximum installation width of ET 200iSP is:

- without redundancy: 1040 mm = 60 mm + 30 mm + 31 * 30 mm + 20 mm (power supply + interface module + 31 electronic modules + termination module)
- with redundancy: 1160 mm = 2 * 60 mm + 2 * 30 mm + 32 * 30 mm + 20 mm (2 power supplies + 2 interface modules + 32 electronic modules + termination module)

Address space

The interface modules support a maximum of 244 input and 244 output bytes.

Note

Connection via PROFIBUS

There are DP masters that do not control the entire address space.

4.8 Power Supply of the ET 200iSP

Power supply PS

At the terminal module TM-PS-A of the power supply, connect the supply voltage of the ET 200iSP. The power supply provides all the necessary output voltages for the ET 200iSP. The output voltages are electrically isolated from the supply voltage.

- Power supply PS DC24V: 24 V DC
- Power supply PS AC120/230V: 85–264 V AC

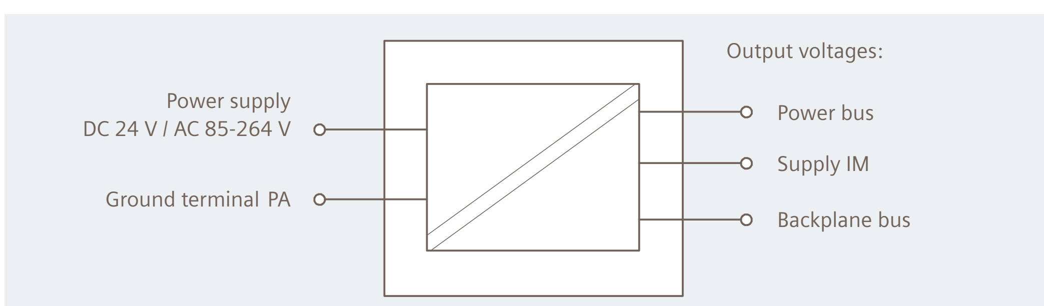


Figure 4-4 Power supply PS

Note

The power supply must be protected with a 6 A circuit breaker and tripping characteristic C (for each ET 200iSP station).

4.9 Direct data exchange via PROFIBUS DP

Requirements

The ET 200iSP can be used as a sender (publisher) for direct data exchange (direct communication). No configuration is required for this.

Of course the DP master used must support direct data exchange. Additional information can be found in the description of the DP master.

Operating principle

Direct data exchange is also characterized by the fact that PROFIBUS DP devices "listen in" to which data a DP device sends back to its DP master. By this mechanism the "listener" (receiver) can directly access changes of input data of remote DP devices.

When configuring in STEP 7 you define, via the respective I/O input addresses, to which address range of the receiver the desired data of the sender is to be read.

Example

The figure below shows an example of which direct data exchange "relations" you can configure with a ET 200iSP as sender and which devices can "listen in" as possible receivers.

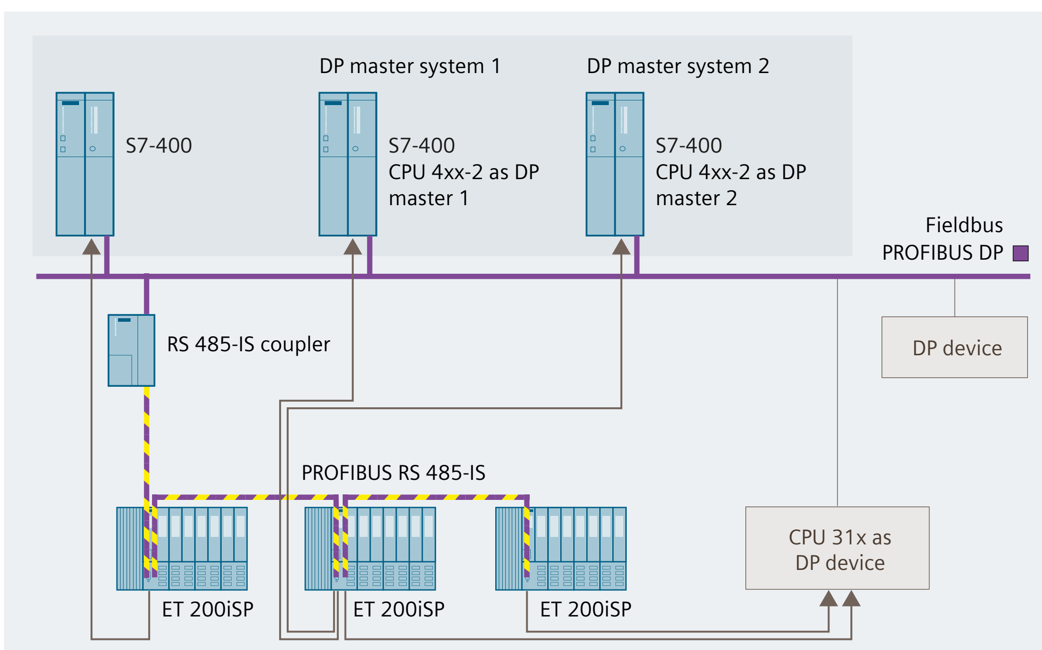


Figure 4-5 Example of direct data exchange

4.10 Identification and maintenance data I&M

Properties

Identification data (I data): Information about the module that is normally printed on the enclosure of the module. I data is read-only.

Maintenance data (M data): System-specific information such as the installation location and date. M data is generated during configuration and written to the module.

Identification and maintenance data (I&M) is information stored in a module that supports you in

- Troubleshooting in a system
- Checking the system configuration
- Locating hardware changes in a system

Reading and writing the identification and maintenance data with STEP 7

- PROFINET connection via IM 152-1PN:
  In HW Config, the I&M are displayed in the "Module status - IM 152-1PN" and "Properties - IM-152-1PN" tabs.
- PROFIBUS connection via IM 152-1DP:
  In HW Config, the I&M are displayed in the "Module status - IM 152-1DP" and "Properties - DP Slave" tabs.

For additional information on this: See STEP 7 online help.

Reading and writing of the I&M with SIMATIC PDM

With SIMATIC PDM you can read the parameters and I&M e.g. via the menu command **File > Full upload to PG/PC** and write via the menu command **Device > Full download to device** .

Reading the I&M with SFB52

With the standard function block SFB 52 you can read data records of the distributed I/O.

- PROFINET connection via IM 152-1PN:
  You read the I&M data IM0 to IM3 via data records. The following data record numbers are assigned to the data records according to the standard for PROFINET IO:

I&M data	Data record number		TYPE	Description
IM0	0xAFF0	45040	PNIO_IM0_TYPE	PNIO_IM0_TYPE (I&M0 data record)
IM1	0xAFF1	45041	PNIO_IM1_TYPE	PNIO_IM1_TYPE (I&M1 data record)
IM2	0xAFF2	45042	PNIO_IM2_TYPE	PNIO_IM2_TYPE (I&M2 data record)
IM3	0xAFF3	45043	PNIO_IM3_TYPE	PNIO_IM3_TYPE (I&M3 data record)

- PROFIBUS connection via IM 152-1DP:
  To read the I&M data, you must load the data records 231 to 234 (see following table).

Note

At present, the I&M data record objects cannot be read or written to by means of data record DS 255.

For more information on I&M records, see the documents provided by the PROFIBUS user organization:

- Profile Guidelines Part 1: Identification & Maintenance functions. Version 2.1, 08/2016
- Test specifications for I&M Functions, Version 1.0.0, 04/2009
- GSDML specification for PROFINET IO, Version 2.42, 04/2021

or:

- IEC 61158-6-3 (PROFIBUS)
- IEC 61158-6-10 (PROFINET)

Identification and maintenance data I&M

Table 4-7 Identification and maintenance data I&M

I&M	Access	Default	Explanation
I data 0: Index 1 (data record 45040 for PROFINET, data record 231 for PROFIBUS)			
MANUFACTOR_ID	read (2 bytes)	$2A_H$ (=42_D)	The name of the manufacturer is stored here. (42_D = Siemens AG)
ORDER_ID	read (20 bytes)	Dependent on the module	Article number of the module
SERIAL_NUMBER	read (16 bytes)	Depends on the product version	The serial number of the module is stored here. This makes unique identification of the module possible.
HW_REVISION	read (2 bytes)	Depends on the product version	This provides information on the product version of the module. This is incremented when the product version and/or the firmware of the module changes.

I&M	Access	Default	Explanation
SW_REVISION	read (4 bytes)	Depends on the product version	Provides information on the firmware version of the module. If the firmware version is incremented, then the product version (HW_REVISION) of the module is incremented as well.
REVISIONS_COUNTER	read (2 bytes)	---	Provides information on the assigned changes on the module. After each change, the REVISION_ COUNTER is incremented.
PROFILE_ID[1]	read (2 bytes)	Not applicable	
PROFILE_SPECIFIC_TYPE[1]	read (2 bytes)	Not applicable	
IM_VERSION[1]	read (2 bytes)	10_H	Provides information on the version of the I&M (10_H = Version 1.0).
IM_SUPPORTED[1]	read (2 bytes)	$3E_H$	Provides information on available I&M data (index 1 to 4).
M data 1: Index 2 (data record 45041 for PROFINET, data record 232 for PROFIBUS)			
TAG_FUNCTION	read / write (32 bytes)	---	Enter a system-wide unique identifier for the module here.
TAG_LOCATION	read / write (22 bytes)	---	Enter the installation location of the module here.
M data 2: Index 3 (data record 45042 for PROFINET, data record 233 for PROFIBUS)			
DEVICE_INSTALL_DATE	read / write (16 bytes)	---	Enter the installation date of the module here.
M data 3: Index 4 (data record 45043 for PROFINET, data record 234 for PROFIBUS)			
DESCRIPTOR	read / write (54 bytes)	---	Enter a comment on the module here.
[1] The display of this I&M depends on the engineering software.			

See also

Project Engineering with GSD File and SIMATIC PDM (Page 161)

PROFINET IO-Base user programming interface (https://support.industry.siemens.com/cs/us/en/view/26435491)

4.11 Redundant interface modules in the ET 200iSP

4.11.1 Introduction

Properties

You can operate the ET 200iSP station redundantly on the IO controller or on the DP master (e.g. S7-400H).

Note

In a redundant station, a mixed configuration (IM 152-1PN together with IM 152-1DP) is not allowed.

Power supply of the ET 200iSP

To ensure the consistently high availability in redundancy mode with two identical interface modules, we recommend additionally setting up the ET 200iSP with a redundant power supply PS.

See also

Redundancy of the Power Supply (Page 82)

4.11.2 Redundant interface modules

Operating principle

Redundancy on an H system gives you the greatest availability. In case of a failure of an interface module, the switchover to the redundant interface module takes place without interruption.

Requirements

- H system (e.g. S7-400H)
- Terminal module TM-IM/IM
- Depending on the selected configuration:
  - PROFINET configuration: 2 x IM 152-1PN (V1.0 and higher) + 2 media converters
  - PROFIBUS configuration: 2 x IM 152-1DP (V2.0 and higher) + 2 RS 485-IS couplers
    You can only use the IM 152-1DP in a redundant system on DP masters that support the "Fail-safe" parameter. On DP masters that do not support this parameter, the IM 152-1DP does not start and the BF LED flashes.
    Tip: You recognize in the GSD file of the DP master whether it supports "Fail-Safe".
- Software package *STEP 7* and *SIMATIC S7 H systems*
- The H system is completely set up, configured and parameterized.

WARNING

SYNC/FREEZE function

The SYNC/FREEZE function must not be enabled in redundant mode. If you do not observe this condition, invalid process values can occur.

In case of redundancy, there is no synchronization of SYNC/FREEZE commands across lines.

Mounting and wiring

1. Install the ET 200iSP with the terminal module TM-IM/IM.
2. Depending on the selected configuration:
   - PROFINET configuration:
     A separate media converter is required for each PROFINET IO system
     Connect a fiber-optic cable with an LC plug to each bus connection and connect it to the media converter.
     Connect the media converter and the CPU with a RJ45 cable.
   - PROFIBUS configuration:
     A separate PROFIBUS RS 485-IS coupler is required for each RS 485-IS.
     Connect a PROFIBUS RS 485-IS to each bus connector.
3. Equip the TM-IM/IM with two identical interface modules (configuration-dependent).

PROFINET configuration: Configuring and assigning parameters

1. Select a suitable IO controller (CPU or PROFINET CP) in the "Hardware catalog" of HW Config and place it in both racks.
   In the automatically displayed property dialog, you can create a PROFINET IO system for both IO controllers.
2. Insert a PROFINET IO system for each of the two IO controllers. Result: STEP 7 automatically creates the redundancy.
3. Drag **one** IM 152-1PN from the "Hardware catalog" to a PROFINET IO system in the station window. Result: STEP 7 automatically creates the connection to both PROFINET IO systems.
4. Open the property view of the IM 152-1PN and enable both PROFINET IO connections in the "Redundancy" tab: "PN-IO" and "PN-IO-Red".
5. Save the hardware configuration and download it to the CPU.

PROFIBUS configuration: Configuring and assigning parameters

1. In the "Hardware catalog" of HW Config, select a suitable DP master interface and place it in both racks. At the same time, create PROFIBUS DP networks with identical parameters for both DP master interfaces in the automatically displayed property dialog.
2. Add one DP master system each for both DP master systems. Result: STEP 7 automatically creates the redundancy.
3. Drag **one** IM 152-1DP (as of V2.0) from the "Hardware catalog" to a PROFIBUS DP system in the station window. Result: STEP 7 automatically creates the connection to both PROFIBUS DPs.
4. Open the property view of the IM 152-1DP and enable both PROFIBUS DP connections in the "Redundancy" tab: "PROFIBUS" and "PROFIBUS Red".
5. Save the hardware configuration and download it to the CPU.

Example configuration of a redundant bus system and the interface modules

The following figure shows a configuration using an S7-400H as an example. You can find a detailed description of H systems in the manual *S7-400H Automation system*, Introduction to the system.

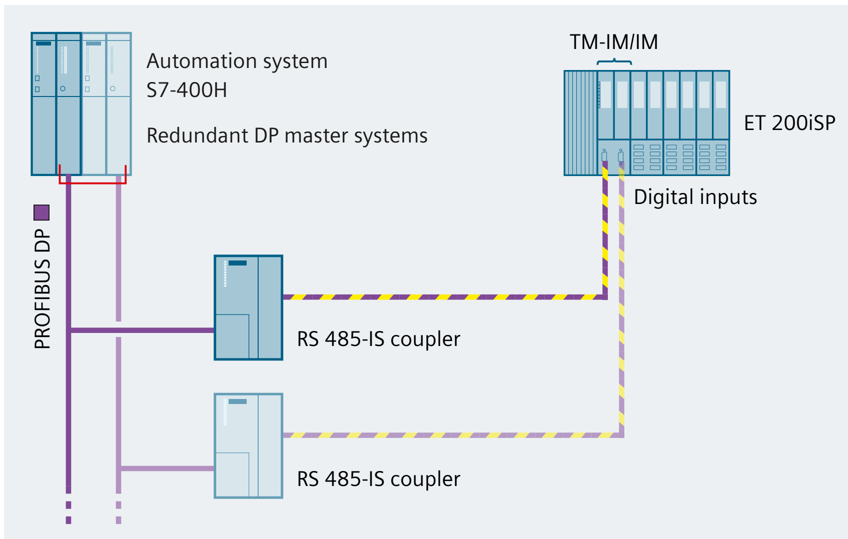


Figure 4-6 Redundancy with 2 x IM 152-1DP in one H system

S7-400H as DP master

You require *STEP 7* V5.0 and higher and the *SIMATIC S7 H systems* software package to configure the S7-400H system.

DP master 1 and DP master 2:

- Run the same user program.
- Have the same parameter assignments and configuration for the IM 152-1DP.

4.12 Redundancy of the Power Supply

Properties

With the ET 200iSP you can set up a redundant power supply PS. When one power supply PS fails, the system fails over to the second power supply PS without interruption.

Requirements

- Terminal module TM-PS-A
- Terminal module TM-PS-B

- 2 x Power Supply PS
- Interface module:
  - For connection on the PROFINET IO: IM 152-1PN (V1.0 and higher):
    or
  - For connection on the PROFIBUS DP: IM 152-1DP (V2.0 and higher):

Combination options of the power supply PS with TM-PS-A (6ES7193-7DA10-0AA0) and TM-PS-B (6ES7193-7DB10-0AA0)

TM-PS-A (6ES7193-7DA10-0AA0)	TM-PS-B (6ES7193-7DB10-0AA0)
PS DC24V*	PS DC24V*

* All product versions

Combination options of the power supply PS with TM-PS-A (6ES7193-7DA20-0AA0) and TM-PS-B (6ES7193-7DA20-0AA0)

TM-PS-A (6ES7193-7DA20-0AA0)	TM-PS-B (6ES7193-7DB20-0AA0)
PS DC24V*	PS DC24V*
PS AC120/230V**	PS AC120/230V**
PS DC24V*	PS AC120/230V**

* Product version 7 and higher

** Maximum output current, see technical specifications in section *Power Supply PS AC120/230V*

Combination options of the power supply PS with TM-PS-A (6ES7193-7DA10-0AA0) and TM-PS-B (6ES7193-7DA20-0AA0) or TM-PS-A (6ES7193-7DA20-0AA0) and TM-PS-B (6ES7193-7DB10-0AA0)

TM-PS-A (6ES7193-7DA10-0AA0)	TM-PS-B (6ES7193-7DA20-0AA0)
PS DC24V*	PS AC120/230V**

TM-PS-A (6ES7193-7DA20-0AA0)	TM-PS-B (6ES7193-7DB10-0AA0)
PS AC120/230V**	PS DC24V*

* Product version 5 and higher

** Maximum output current, see technical specifications in section *Power Supply PS AC120/230V*

Mounting and wiring

1. When installing, start with the TM-PS-A.
2. Install the TM-PS-A to the right of the TM-PS-B.
3. Complete the ET 200iSP configuration.

4. Connect a separate power supply to each TM.
5. Finally, fit the TMs with Power Supply PS 1 and PS 2.

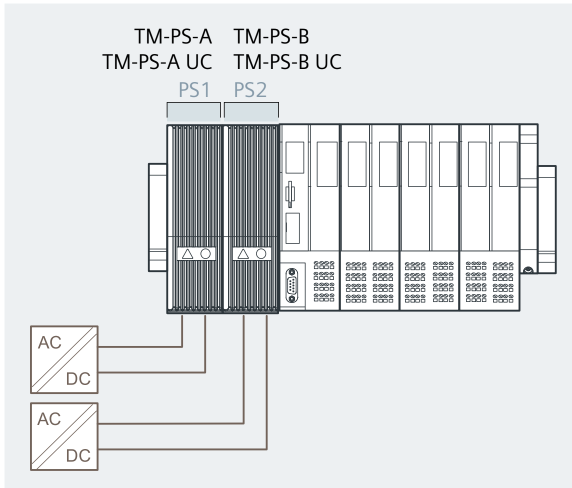


Figure 4-7 Redundancy of the power supply (example with IM 152-1DP)

Parameter assignment

Only those parameters that are relevant for the redundancy of the power supply are explained below. These are part of the interface module parameters.

Table 4-8 Parameters for redundancy of the Power Supply PS

Parameters	Setting	Description
Self-diagnosis	Enabled	---
Redundant Power Supply diagnostics	Redundant Power Supply	Diagnostics in the event of failure of Power Supply PS 1 or PS 2

See also

Power supply PS 120/230 VAC (Page 272)

Power supply PS 24 VDC (Page 269)

4.13 System configuration in RUN (CiR)

4.13.1 System modification in a non-redundant system

Properties

There are plants that must not be closed down while they are running. This may be due to the complexity of the automated process or because of the costs involved in restarting. A modification or removal of system components may nonetheless be necessary.

Certain system configurations and parameters can be modified in RUN by means of the CiR function. To make the modifications, the process is halted for a brief time. The process inputs retain their last value during this time period.

The configuration of the ET 200iSP can be changed with CiR during operation.

You will find a detailed description of this function and the settings for it in the function manual Modifying the System during Operation via CiR (https://support.automation.siemens.com/WW/view/en/14044916).

What do you have to pay attention to when planning the ET 200iSP stations?

- Set up the ET 200iSP station with terminal modules and termination module.
- Equip the ET 200iSP starting from the interface module with the required electronic modules. Fill the remaining slots with the reserve modules as far as the terminating module. All the reserve modules must be inserted and there must be no gaps.
- You must not configure these reserve modules.

Rules for making changes to the system while it is in use

- Replace the reserve modules with the planned electronic modules. Start with the first reserve module in the lowest slot (to the right of the last electronic module). This may create a gap, i.e. only replace a reserve module with the electronic module.
- If you have fitted a slot cover on the last free slot, it is not expandable.
- Note that the terminal modules TM-RM/RM are required for the electronic modules 2 DO Relay UC60V/2A.

Changing the parameter settings in RUN mode

Observe the operating steps listed in the Changes to the plant during operation by means of CiR (https://support.automation.siemens.com/WW/view/en/14044916) function manual when re-assigning the parameters.

Reaction of the I/O to parameter reassignment in RUN

When changing the parameter settings for certain modules (see table), make sure that there is no diagnostic event pending for this module (for example wire break signal) prior to changing the settings otherwise diagnostic events exiting the state may no longer be signaled in some situations. The effect is that the LEDs on the CPU, IM, or module stay lit even though the reconfigured module is operating properly. If, this situation nevertheless arises, the module must be pulled and plugged again.

Table 4-9 Behavior of the inputs/outputs

<table>
<tr><th>Electronic module</th><th>Behavior of the inputs/outputs</th><th>Points to note when changing parameter settings</th></tr>
<tr><td>8 DI NAMUR</td><td>They return the process value that applied before the parameters were set. Inputs not affected return their last valid value (with value status).</td><td rowspan="4">SF LED is lit.
If a diagnostic event was reported before you started to reassign parameters, the SF LEDs (on the CPU, IM or module) may be lit even though the module is operating properly and the diagnostic event has been cleared.
• Only make new parameters settings when there is no diagnostic event pending, or
• Pull and plug module.</td></tr>
<tr><td>4 DO DC23.1V/20mA shut down "H"/"L"
4 DO DC17.4V/27mA shut down "H"/"L"
4 DO DC17.4V/40mA shut down "H"/"L"
2 DO Relay UC60V/2A</td><td>They output the output value that applied before the parameters were set. Unaffected outputs return their last valid value.</td></tr>
<tr><td>4 AI I 2WIRE HART
4 AI I 4WIRE HART
4 AI RTD
4 AI TC</td><td>They return the process value that applied before the parameters were set. Inputs not affected return their last valid value.</td></tr>
<tr><td>4 AO I HART</td><td>They output the output value that applied before the parameters were set. Unaffected outputs return their last valid value.</td></tr>
</table>

4.13.2 System modification in a redundant system

Properties

For information on using this function in the redundant configuration, refer to the "S7-400H automation system, high availability systems (https://support.industry.siemens.com/cs/ww/en/view/1186523)" manual and the online help of the H option package for *STEP 7*.

Requirements

PROFIBUS configuration:

- Configuration with interface module IM 152-1DP
- STEP 7 as of V5.3 SP2 and hardware update 0042 (version 3.0)
- PCS 7 is released with the current service packs as of PCS 7 V6.1

What do you need to consider when selecting the interface module?

The interface modules support the following redundancy configurations:

Configuration	S2	R1	Change of the configuration is possible during operation
An interface module in the terminal module TM-IM/EM in ring configuration in a redundant CPU in the automation system (use of MRP)	X		X
Two interface modules in the terminal module TM-IM/IM in a redundant CPU in the automation system (optional additional use of MRP)		X	X

What do you have to pay attention to when planning the ET 200iSP stations?

- Set up the ET 200iSP station with terminal modules and termination module.
- Equip the ET 200iSP with the required electronic modules. Fill the remaining slots with the reserve modules. All the reserve modules must be inserted and there must be no gaps.
- You do not have to configure reserve modules.

Rules for making changes to the system while it is in use

- If you are modifying the real hardware configuration, there may be only one gap each. When removing electronic modules, replace the electronic modules one by one with reserve modules and when adding electronic modules, replace the inserted reserve modules one by one with electronic modules.
- If you have fitted a slot cover on the last free slot, it is not expandable.
- Note that the terminal modules TM-RM/RM are required for the electronic modules 2 DO Relay UC60V/2A.

Example: Replacement of configured electronic modules

1. Replace the electronic modules or reserve modules with gaps in the configuration (HW config).
2. Execute the Save and Compile menu command.
3. Download the station configuration to the H station in RUN mode.
4. Change the real hardware configuration: Pull and plug one module at a time (for example, remove slot 5 --> install slot 5). **Note: two empty slots are not permitted.**

5. Replace the gaps in the configuration (HW config) with the new electronic modules.
6. Execute the Save and Compile menu command.
7. Download the station configuration to the H station in RUN mode.

Result

The system modification was successfully completed.

4.14 Operation of the ET 200iSP IM PROFIBUS variant with older CPUs

Operation of the ET 200iSP with older CPUs

CPUs must support DPV1 mode.

4.15 Time synchronization with a flexible time interval

Description

Time-of-day synchronization ensures that all clocks in a plant have the same time. A master clock distributes the time in a configurable cycle to all other components in the automation system that have a clock. The components use this time to set their own clocks.

Time synchronization is the basis for time stamping.

The higher-level component (CPU) of the ET 200iSP bus system must provide the signal for clock synchronization.

The synchronization interval can be set in the configuration tool in the properties of the interface module.

The longer the synchronization interval is set, the lower the accuracy of the time stamping.

4.16 Time stamping

4.16.1 Fundamentals of Time Stamping

Properties

Digital modules of the ET 200iSP enable the "time stamping" function.

- in customer applications using the FB 62 (FB TIMESTMP)
  (for more information, see the STEP 7 online help)
- with the PCS 7 system solution with 20 ms accuracy.
  You can find a detailed description of time stamping and time-of-day synchronization in the *PCS 7* function manual "High-precision time stamping".

Operating principle

Time stamping enables the monitoring of digital inputs for signal changes. A changed input signal is given a time stamp in the interface module and stored in a buffer (data record). When signals with time stamp exist or a data record is full, a hardware interrupt is generated (to the DP master/to the IO controller). The buffer is evaluated with "Read data record". Special alarms are generated for events that influence time stamping (communication interrupted, frame failure from time master, etc.).

Parameter assignment

You use the parameter assignment to specify which payload of the interface module is being monitored.

Parameter	Setting	Description
Time stamping	• Disabled • Enabled	Enable time stamping for the channels of the electronic module 8 DI NAMUR.
Edge evaluation incoming event	• rising edge • falling edge	Specify the type of signal change that is given a time stamp.

4.16.2 Time stamps accurate to 20 ms

Introduction

The time stamping of binary signal changes is continuously supported by all hardware and software components in the PCS 7 system: From the ET 200iSP via the S7-400 to the OS.

Requirements

- The synchronization interval must be set to 20 ms for the master and for the ET 200iSP.
- For time stamping you need the electronic module 8 DI NAMUR with the configuration "8 DI NAMUR". Time stamping is not possible with all other configurations of the electronic module 8 DI NAMUR.

How time stamping works

In a system, you can monitor digital inputs for signal changes using configuration in HW Config. The following are monitored: "Incoming/outgoing signal" (as "rising or falling edge"). The interface module stamps these changed input signals with the current time (time stamping) and stores them as message lists. A message list is a data record with a maximum of 20 messages about time-stamped signal changes. The interface module can store up to 15 data records.

After a certain time and if there are messages or if a data record is full, the interface module triggers a hardware interrupt at the CPU (IO controller/DP master). The CPU then reads the data record and forwards the message lists to an OS using the driver block FB 90 "IM_DRV".

Time stamping example

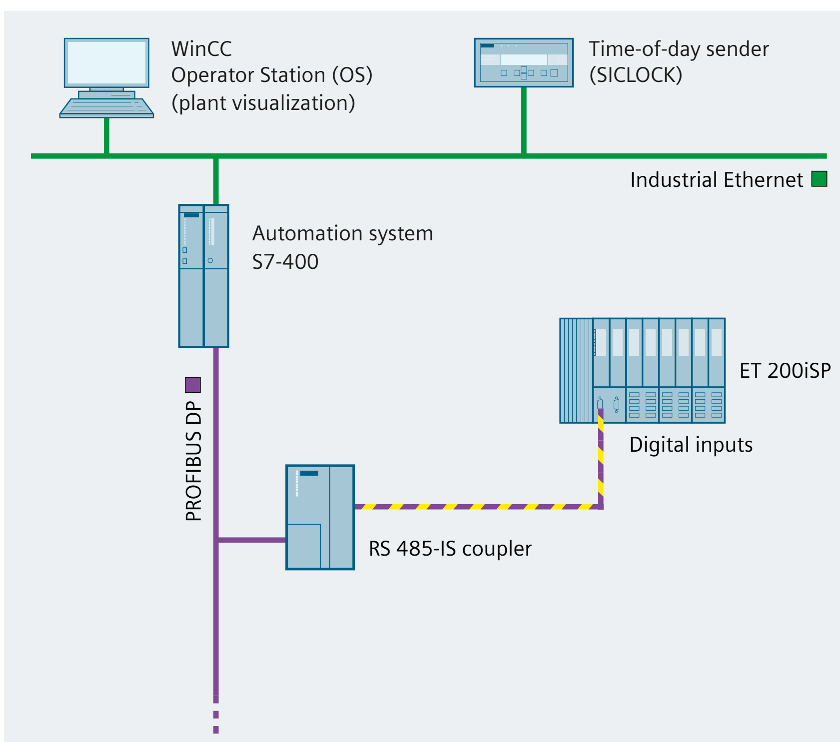


Figure 4-8 Example for time stamping and edge evaluation

How time stamping works in the redundant system

Both interface modules store the messages of the time stamped signals. This means the "new" active interface module can forward the latest messages to the OS after switching from the active to the passive interface module.

The signal changes are not time stamped while switching between the two interface modules. In the OS, you can see in which time period no time stamping took place.

Example time stamping in redundant system

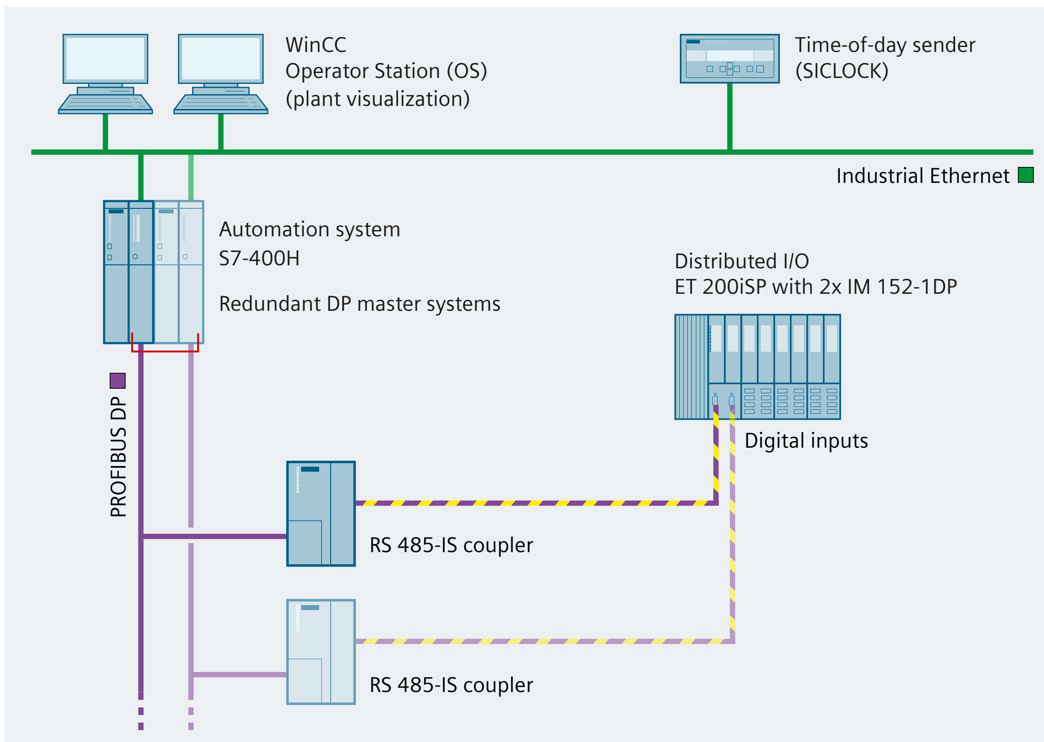


Figure 4-9 Example configuration with two interface modules for redundancy in an H-system

4.17 Counting

4.17.1 Properties

Counting functions

The electronic module 8 DI NAMUR is equipped with parameterizable counting functions:

- 2 x 16-bit up-counters (standard counting function) or
- 2 x 16-bit down counters (standard counting function) or

- 1 x 32-bit down counter (cascading counter function)
- Setting a setpoint via the PIQ
- GATE function
- You can configure the control signals of the counters:
  - Configuration "2 Count/ 6 DI NAMUR": Two counters are configured. The control signals of the counters are stored in the POI (process output image).
  - Configuration "2 Count/ 6 Control": Two counters are configured. The control signals of the counters are stored in the POI (process output image). In addition, they are controlled by the digital inputs of the 8 DI NAMUR.
- You configure and parameterize the counters of the electronic module 8 DI NAMUR in the configuration software, e.g. HW Config.

4.17.2 Principle of operation

16-bit up-counters (standard counting function)

The counting range is always 0 to 65535.

The counter value increases by the value 1 with each counting pulse at the digital input. When the count limit is reached, the counter reading is set to the value 0 and incremented starting from this value.

If there is counter overflow, the corresponding output is set in the PII.

A positive edge of the *Reset output* control signal resets the output in the PII. The current counter value is not affected by this.

In 16-bit up counting operations, the system does not set any outputs in the POI. These are always reset.

The positive edge of the *Reset counter* control signal resets the counter reading to the value 0 and the set counter output.

The *GATE* control signal pauses the counting on a positive edge. Count pulses are processed at the digital input again, but only at the negative edge. The "*Reset counter*" control signal also has an effect when *TOR* is activated.

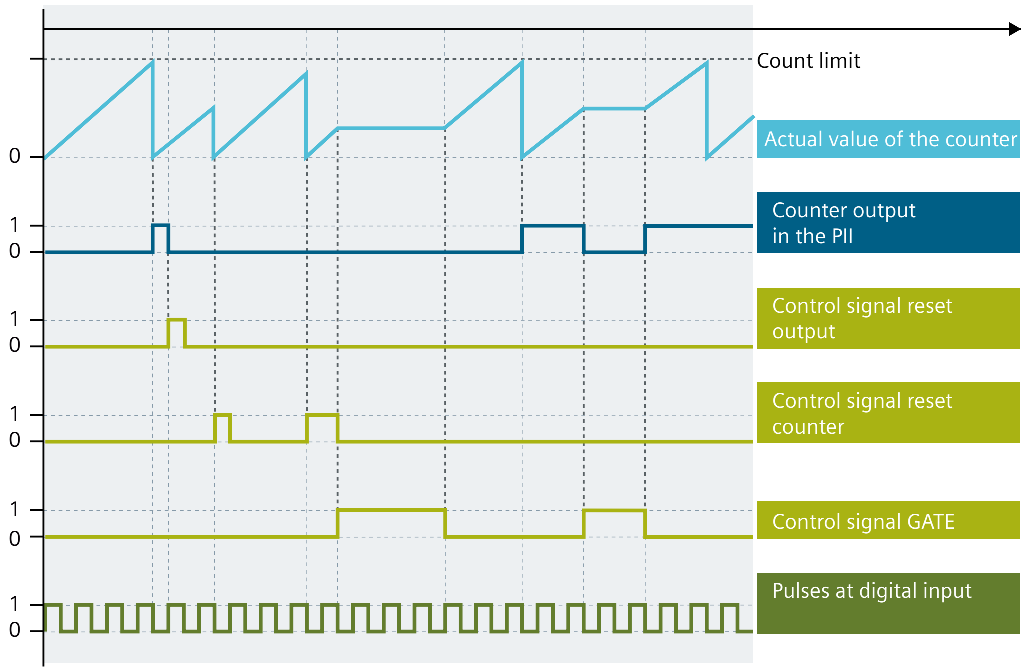


Figure 4-10 Principle of operation of the 16-bit up-counter

16-bit down counters (periodic counting function)

The maximum counting range is 65535 to 0.

When the counter is started, the actual value is set to the selected setpoint. The actual value is reduced by the value 1 with each counting pulse. If the actual value reaches the value 0, the corresponding output in the PII is switched on and the actual value is reset to the specified setpoint. The counter then counts down from this value.

The positive edge of the *Reset counter* control signal resets the actual value to the specified setpoint and the associated output in the PII.

A positive edge of the *Reset output* control signal resets the output in the PII. The current counter value is not affected by this.

The *GATE* control signal pauses the counting on a positive edge. At the same time, the assigned output in the PII is reset. Count pulses are processed at the digital input again, but only at the negative edge. The *Reset output* and *Reset counter* control signals also have an effect when *TOR* is activated.

The setpoint of the counter is set and changed using the POI. A positive edge of the *Reset counter* control signal or a zero crossing of the counter causes the setpoint to be applied.

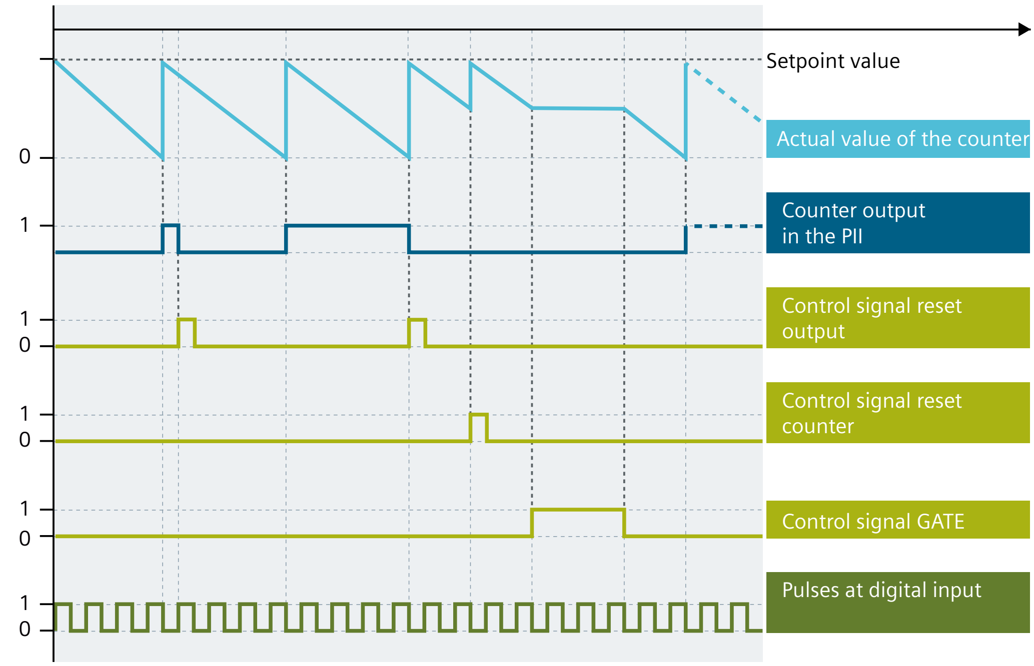


Figure 4-11 Principle of operation of the 16-bit down counter

32-bit down counter (cascading counter function)

The maximum counting range is 4294967295 to 0.

The principle of operation is identical to that of the 16-bit down counter. Channel 1 has no function.

4.17.3 Configuring counters

Procedure in HW Config

Use the mouse to drag the desired configuration "2 Count/ 6 DI NAMUR" or "2 Count/ 6 Control" from the hardware catalog into the configuration table or set the configuration with the parameters.

Configuration "2 Count/ 6 DI NAMUR"

- Assignment of the digital inputs at the electronic module 8 DI NAMUR
  For More information on the pin assignment, refer to Digital electronics module 8 DI NAMUR (Page 295).

Table 4-10 Assignment of the digital inputs for 2 Count/ 6 DI NAMUR

Digital input	Terminal	Assignment
Channel 0	1, 2	Counter 1
Channel 1	5, 6	Counter 2 (does not apply to 32-bit down counters)

Digital input	Terminal	Assignment
Channel 2	9, 10	Digital input 2
Channel 3	13, 14	Digital input 3
Channel 4	3, 4	Digital input 4
Channel 5	7, 8	Digital input 5
Channel 6	11, 12	Digital input 6
Channel 7	15, 16	Digital input 7

Assignment of the process image input (PII)

Table 4-11 PII for configuration "2 Count/ 6 DI NAMUR" (S7 format)

<table>
<tr><th>PII</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th colspan="4">Description</th></tr>
<tr><td>IB x</td><td colspan="4"></td><td colspan="4"></td><td>Bit 15 to 8</td><td rowspan="2">Actual value counter 1</td><td>Bit 31 to 24</td><td rowspan="4">Setpoint counter 1 (32-bit backward counter)</td></tr>
<tr><td>IB x+1</td><td colspan="4"></td><td colspan="4"></td><td>Bit 7 to 0:</td><td>Bit 23 to 16</td></tr>
<tr><td>IB x+2</td><td colspan="4"></td><td colspan="4"></td><td>Bit 15 to 8</td><td rowspan="2">Actual value counter 2</td><td>Bit 15 to 8</td></tr>
<tr><td>IB x+3:</td><td colspan="4"></td><td colspan="4"></td><td>Bit 7 to 0:</td><td>Bit 7 to 0:</td></tr>
<tr><td>IB x+4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">Bit 0: Counter output 1
Bit 1: Counter output 2
Bit 2 to Bit 7: Digital input 2 to digital input 7</td></tr>
<tr><td>IB x+5</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td></td><td></td><td colspan="4"></td></tr>
<tr><td>IB x+6</td><td colspan="8">Not occupied</td><td colspan="4"></td></tr>
<tr><td colspan="13">Value status for channels 2 to 7:
• 1_B: Input signal is valid
• 0_B: Input signal is invalid</td></tr>
</table>

Assignment of the process image outputs (PIQ)

Table 4-12 PIQ for configuration "2 Count/ 6 DI NAMUR"

<table>
<tr><th>PIQ</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th colspan="4">Description</th></tr>
<tr><td>QB x</td><td colspan="4"></td><td colspan="4"></td><td>Bit 15 to 8</td><td rowspan="2">Setpoint counter 1</td><td>Bit 31 to 24</td><td rowspan="4">Setpoint counter 1 (32-bit backward counter)</td></tr>
<tr><td>QB x+1</td><td colspan="4"></td><td colspan="4"></td><td>Bit 7 to 0:</td><td>Bit 23 to 16</td></tr>
<tr><td>QB x+2</td><td colspan="4"></td><td colspan="4"></td><td>Bit 15 to 8</td><td rowspan="2">Setpoint counter 2</td><td>Bit 15 to 8</td></tr>
<tr><td>QB x+3</td><td colspan="4"></td><td colspan="4"></td><td>Bit 7 to 0:</td><td>Bit 7 to 0:</td></tr>
<tr><td>QB x+4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">Bit 0: Not occupied
Bit 1: Not occupied
Bit 2: Control signal GATE 1
Bit 3: Control signal GATE 2
Bit 4: Control signal reset counter 1
Bit 5: Control signal reset counter 2
Bit 6: Control signal reset counter output 1
Bit 7: Control signal reset counter output 2</td></tr>
</table>

Configuration "2 Count/ 6 Control"

With this configuration, you can also control the counters over the digital inputs.

- Assignment of the digital inputs at the electronic module 8 DI NAMUR
  You can find more information on the pin assignment in the technical specifications of the electronic module 8 DI NAMUR.

Table 4-13 Assignment of the digital inputs for 2 Count/ 6 Control

Digital input	Terminal	Assignment
Channel 0	1, 2	Counter 1
Channel 1	5, 6	Counter 2 (does not apply to 32-bit down counters)
Channel 2	9, 10	control signal *GATE 1*
Channel 3	13, 14	control signal *GATE 2*
Channel 4	3, 4	control signal *Reset counter 1*
Channel 5	7, 8	control signal *Reset counter 2*
Channel 6	11, 12	control signal *Reset counter output 1*
Channel 7	15, 16	control signal *Reset counter output 2*

- Assignment of the process image inputs (PII)
  The assignment is identical to the "2 Count/ 6 DI NAMUR" configuration.
- Assignment of the process image outputs (PIQ)
  The assignment is identical to the "2 Count/ 6 DI NAMUR" configuration.

4.17.4 Assigning parameters to counters

Procedure in HW Config

Double-click with the mouse on the electronic module 8 DI NAMUR in the configuration table and start the parameter assignment.

Parameters

Only the parameters that are relevant for the counters are explained below. These are part of the parameters of the electronic module 8 DI NAMUR and depend on the selected configuration:

Table 4-14 Parameters for the counters

Parameters	Setting	Description
Encoder type counter inputs	• Channel disabled • NAMUR sensor • Single contact unconnected	Select the sensor for the respective counter for channel 0 or 1.
Counter 1 mode	• Standard counting function • Periodic counting function • Cascaded counting function	Select the operating mode of the counter 1.
Counter 2 mode	• Standard counting function • Periodic counting function • Cascaded counting function	Select the operating mode of the counter 2. This parameter is not relevant if you have set the "Counter 1 mode" parameter to "Cascade counting function".

4.18 Metering frequencies

4.18.1 Properties

Properties

The electronic module 8 DI NAMUR enables the measurement of frequencies on channels 0 and 1:

- 2 frequency meters from 1 Hz to 5 kHz
- Configurable metering window (GATE)
- The signals of the frequency meter are read in by means of the digital inputs of the electronic module.
- You configure and parameterize the frequency meters of the electronic module 8 DI NAMUR in the configuration software, e.g. HW Config.
- Configuration "2 Trace/ 6 DI NAMUR": This configuration makes available 2 frequency meters.

4.18.2 Principle of operation

Frequency measurement

The signal frequencies are determined from the input signals of channel 0 or 1 of the electronic module. To calculate the frequency, the signals are measured within a parameterizable measuring window.

The frequency is represented as a 16-bit value in fixed point format and transferred to the PII.

The frequency meters calculate the frequency according to the following formula:

$$\text{Frequency [Hz]} = \frac{\text{Number of rising edges at the digital input}}{\text{Measuring window [s]}}$$

Exceeding the input frequency

If the input frequency exceeds 5 kHz, then $7FFF_H$ is reported as the actual value. At an input frequency above approx. 8 kHz, correct actual values can no longer be output.

4.18.3 Configuring frequency meters

Procedure in HW Config

Use the mouse to drag the configuration "2 Trace/ 6 DI NAMUR" from the hardware catalog to the configuration table or set the configuration with the parameters.

Configuration "2 Trace/ 6 DI NAMUR"

Assignment of the digital inputs at the electronic module 8 DI NAMUR

You can find more information on the pin assignment in the technical specifications of the electronic module 8 DI NAMUR.

Table 4-15 Assignment of digital inputs for "2 Trace/ 6 DI NAMUR"

Digital input	Terminal	Assignment
Channel 0	1, 2	Frequency meter 1
Channel 1	5, 6	Frequency meter 2
Channel 2	9, 10	Digital input 2
Channel 3	13, 14	Digital input 3
Channel 4	3, 4	Digital input 4
Channel 5	7, 8	Digital input 5
Channel 6	11, 12	Digital input 6
Channel 7	15, 16	Digital input 7

Assignment of the process image inputs (PII)

Table 4-16 PII for configuration "2 Trace/ 6 DI NAMUR" (S7 format)

PII	7	6	5	4	3	2	1	0	Description	
IB x									Bit 15 to 8	Frequency meter 1
IB x+1									Bit 7 to 0:	
IB x+2									Bit 15 to 8	Frequency meter 2
IB x+3:									Bit 7 to 0:	
IB x+4									Bit 0 and Bit 1: Not occupied Bit 2 to Bit 7: Digital input 2 to digital input 7	
IB x+5	7	6	5	4	3	2				
IB x+6	Not occupied									
Value status for channels 2 to 7: • 1_B: Input signal is valid • 0_B: Input signal is invalid										

Assignment of the process image outputs (PIQ)

The PIQ is not assigned.

4.18.4 Assigning parameters for the frequency meters

Procedure in HW Config

Double-click with the mouse on the electronic module 8 DI NAMUR in the configuration table and start the parameter assignment.

Parameters

Only the parameters that are relevant for the frequency meter are explained below. These are part of the parameters of the electronic module 8 DI NAMUR:

Table 4-17 Parameters for the frequency meter

Parameters	Setting	Description
Encoder type frequency inputs	• Channel disabled • NAMUR sensor • Single contact unconnected	For channel 0 or 1, select the sensor for the respective frequency meter.
Measuring window (TOR)	• 50 ms • 200 ms • 1 s	Select the required measuring window for channel 0 or 1. To achieve the highest possible accuracy in frequency measurement, observe the following rules: • High frequencies (>4 kHz): Set low measuring window (50 ms) • Variable/ medium frequencies: Set middle measuring window (200 ms) • Low frequencies (<1 kHz): Set high measuring window (1 s)

Installing 5

5.1 Installation rules

Safety information

WARNING
Death or serious physical injury may result
During mounting, observe the guidelines according to EN 60079-14. The conditions required by the standard for electrical parameters apply to simple circuits. See sections "PROFINET configurations in zones for IM 152-1PN (Page 62)" and "PROFIBUS configurations in zones for IM 152-1DP (Page 66)".

WARNING
Never install when an explosive atmosphere is present!
In some circumstances, sparks capable of ignition or unacceptable surface temperatures can occur during installation.
The following activities/jobs are forbidden when the ET 200iSP is operating and the supply voltage is applied to the terminal module TM-PS-A: • Isolation/disconnection of the supply voltage on the terminal module TM-PS-A. • Releasing the fastening screw of the termination module. • Uninstalling the termination module and any other modifications that affect the configuration of the terminal modules.

Maximum configuration

Without redundancy, the ET 200iSP distributed I/O device contains 1 power supply, 1 interface module, 31 electronic modules and 1 termination module in the maximum configuration.

With redundancy, the ET 200iSP distributed I/O device contains 2 power supplies, 2 interface modules, 32 electronic modules and 1 termination module in the maximum configuration.

Remember not to exceed the maximum current consumption.

Mounting dimensions

Table 5-1 Mounting dimensions

Dimensions		
Mounting width	Terminal module with power supply module	60 mm
	Terminal module with interface module/electronic module	60 mm
	Terminal module with electronic modules	60 mm
	Termination module	20 mm
Mounting height	Terminal module with power supply module	190 mm
	Terminal module with interface module/electronic module	190 mm
	Terminal modules with electronic modules	190 mm
	Termination module	155 mm
Mounting depth	ET 200iSP on S7-300 mounting rail	167 mm

Enclosure for ET 200iSP in Zone 1

The ET 200iSP must be installed in an enclosure with degree of protection Ex e (increased safety). See Appendix "Article numbers (Page 419)".

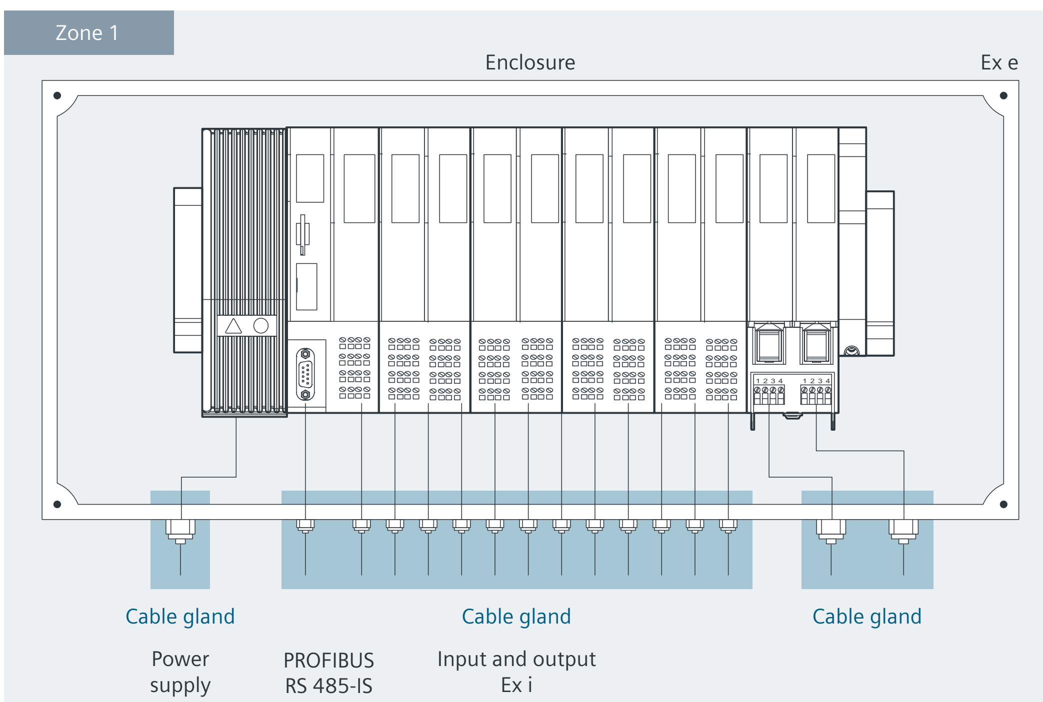


Figure 5-1 Enclosure for ET 200iSP in Zone 1

Enclosure for ET 200iSP in Zone 21

The ET 200iSP must be installed in a dust-proof (certified) enclosure with degree of protection IP6X (according to directive 2014/34/EU for category 2D). Further requirements (surface temperature, for example) can be found in the certification document for the enclosure. See Appendix "Article numbers (Page 419)".

Remove dust deposits from the enclosure and its immediate environment at regular intervals; in other words, always install the enclosure in a location with easy access for cleaning.

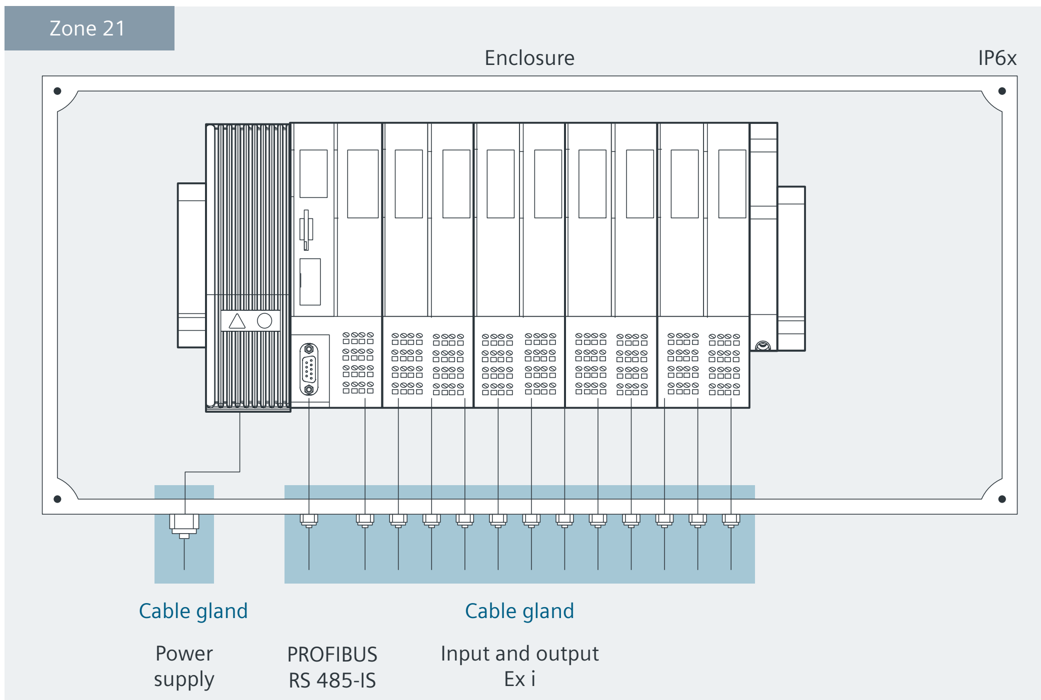


Figure 5-2 Enclosure for ET 200iSP in Zone 21

Enclosure for ET 200iSP in Zone 2

The ET 200iSP must be installed in an enclosure with at least IP54 degree of protection certified for Zone 2 (according to EN 60079-7). See Appendix "Article numbers (Page 419)".

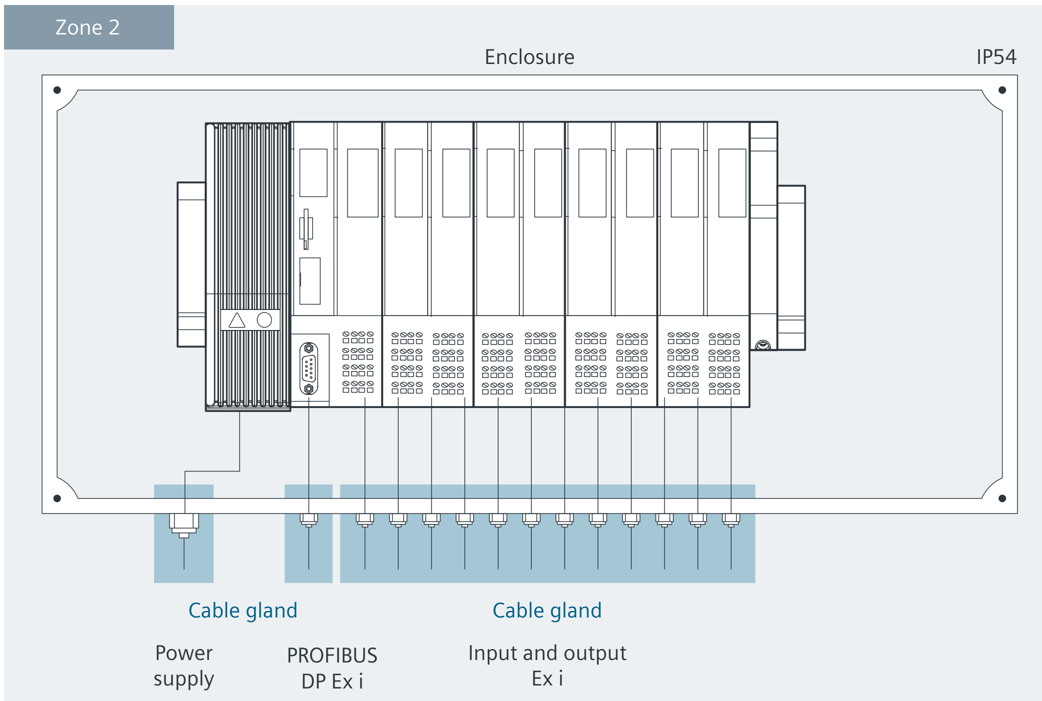


Figure 5-3 Enclosure for ET 200iSP in Zone 2

Enclosure for ET 200iSP in Zone 22

The ET 200iSP must be installed in a dust-protected enclosure with degree of protection IP5X (according to directive 2014/34/EU for category 3D). Further requirements (surface temperature, for example) can be found in the certification document for the enclosure. See Appendix "Article numbers (Page 419)".

Remove dust deposits from the enclosure and its immediate environment at regular intervals; in other words, always install the enclosure in a location with easy access for cleaning.

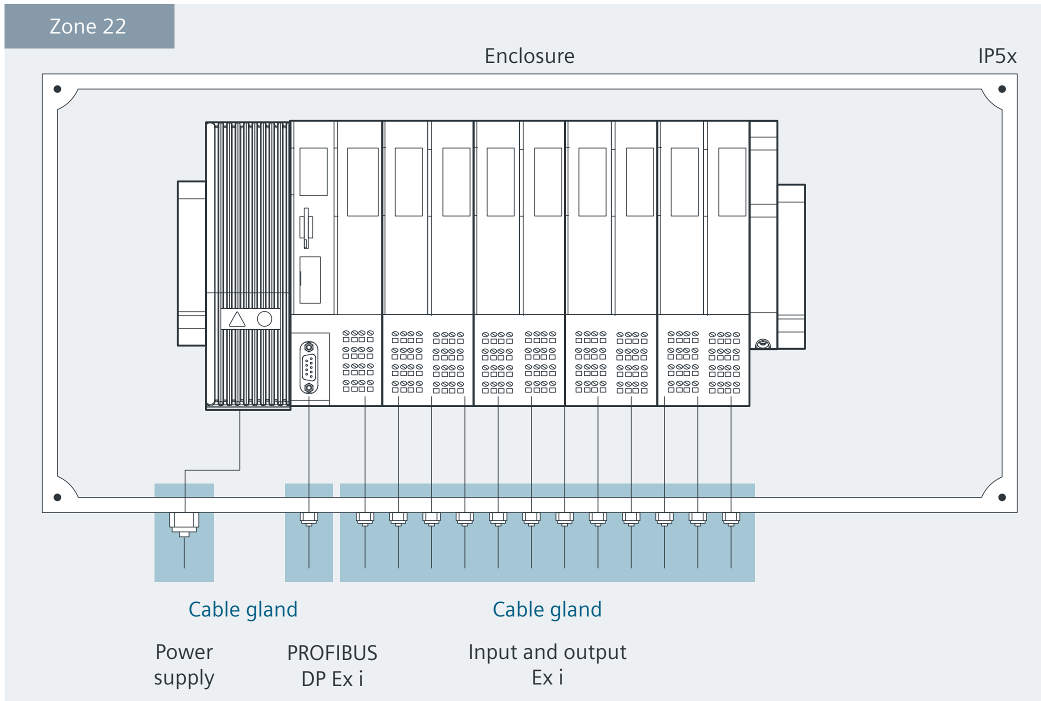


Figure 5-4 Enclosure for ET 200iSP in Zone 22

Enclosure for ET 200iSP in the safe area

The ET 200iSP must be installed in an enclosure with degree of protection IP20.

Mounting position

The ideal installation position is horizontal on a vertical surface. Any other installation position is also possible; however, there are limitations with regard to ambient temperature.

Minimum clearances to the enclosure for installation, wiring, and ventilation

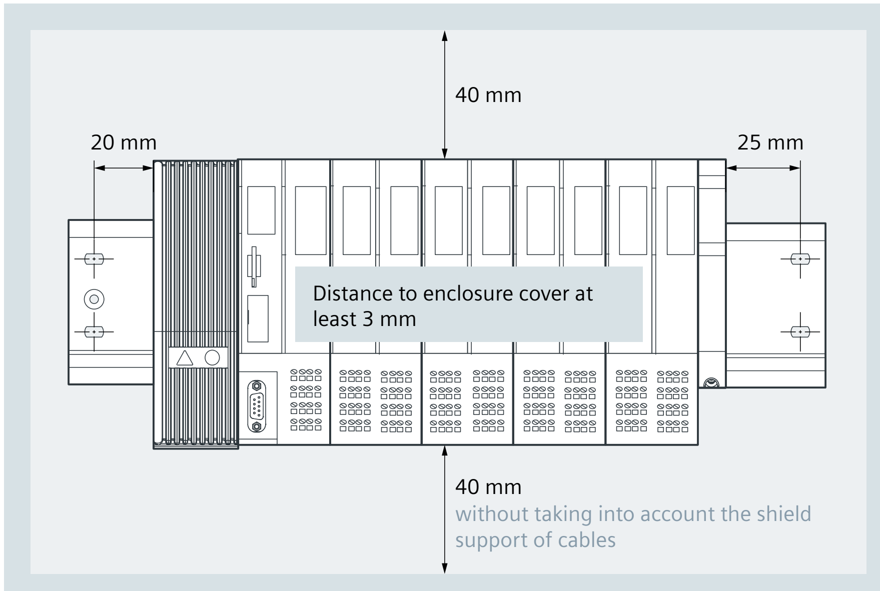
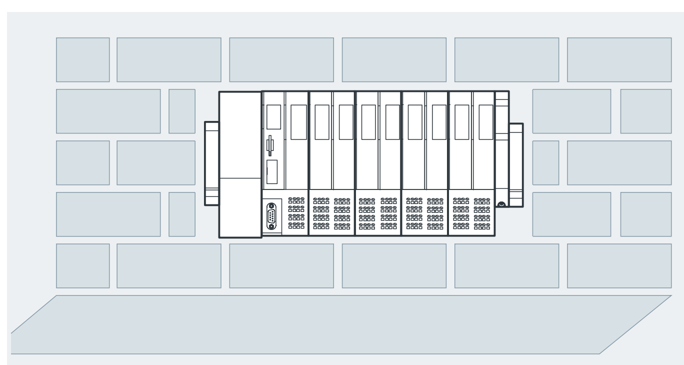


Figure 5-5 Minimum clearances to the enclosure

Ambient temperature	Mounting positions
• Power supply PS DC24V: – from -20 to 70 °C • Power supply PS AC120/230V: At AC 120 V – from -20 to 70 °C (3 A) – from -20 to 60 °C (4 A) – from -20 to 50 °C (5 A) • Power supply PS AC120/230V: At AC 230 V – from -20 to 70 °C (4 A) – from -20 to 60 °C (5 A)	For horizontal installation of the ET 200iSP on a vertical wall 
• Power supply PS DC24V: – from -20 to 40 °C (up to product version 2 of the power supply PS) – From -20 to 50 °C (as of product version 3 of the power supply PS) • Power supply PS AC120/230V – from -20 to 50 °C	For all other mounting positions of the ET 200iSP

Rules for installation

During installation, make sure that you keep to the following rules:

- The mechanical design of the ET 200iSP starts with the terminal module TM-PS-A. Start with the installation of the terminal module approx. 10 mm right of the grounding pin, in order that the mounting location on the mounting rail can be optimally used.
- The terminal module TM-PS-A is followed by the terminal module TM-IM/EM.
- These are followed by the terminal modules TM-EM/EM and TM-RM/RM.
- The ET 200iSP is completed by the termination module. The termination module accompanies the terminal module TM-IM/EM and/or TM-IM/IM. If your ET 200iSP configuration leaves you with a gap in the last slot, you must install the slot cover or a reserve module in this slot.
  - Install a slot cover if the ET 200iSP will not be expanded in the future. The slot cover is integrated in the termination module.
    Replacing the slot cover with an electronic module during operation will cause a station failure of the ET 200iSP.
  - Install a reserve module if you want to use the free slot for a future expansion (by means of an electronic module).

Note

Due to integrated coding, the terminal modules can only be installed in the order described.

5.2 Installing the mounting rail

Properties

The ET 200iSP distributed I/O device is mounted on the mounting rail for the S7 mounting system (see Appendix "Article numbers (Page 419)"). These rails are ready to install and have 4 holes for the securing screws and a grounding bolt.

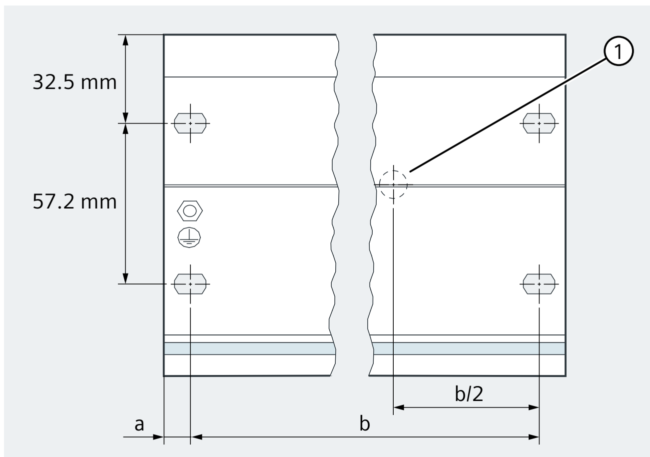
The following configuration is recommended for optimal use of the rail when mounting the terminal modules.

Dimensions for the securing holes

The following table contains the dimensions for the holes for securing mounting rails.

Table 5-2 Diagram for securing mounting rails

"Standard" Mounting Rail



①	Mark for additional bore hole for applications with increased vibration and shock stress.		
Length of the mounting rail	**Distance a**	**Distance b**	**Maximum number of terminal modules[1] within distance b**
482.6 mm	8.3 mm	466 mm	6
530 mm	15 mm	500 mm	7
585 mm	8.5 mm	568 mm	8
830 mm	15 mm	800 mm	12
885 mm	8.5 mm	868 mm	13

[1] Width of the terminal modules: 60 mm

Required tools

Wrench or screwdriver suitable for selected securing screws.

Required accessories

To secure the mounting rail, you can use the following types of screws:

Table 5-3 Securing screws

For	You can use...	Explanation
Outer securing screws	Cylinder head screw M6 according to ISO 1207/ISO 1580 (DIN 84/DIN 85)	Select the screw length to suit the situation.
	Cylinder head screw M6 according to ISO 4017 (DIN 4017)	You will also need washers 6.4 according to ISO 7092 (DIN 433).

Installing the mounting rail

1. Mount the rail in the cabinet so that you have sufficient space for installation and heat dissipation of the modules (*maintain the minimum clearance to the casing*).
2. If necessary, mark the mounting holes on the base of the enclosure and drill the holes with a diameter of 6.5 mm$^{\pm 0.2}$.
3. Screw the mounting rail to the base surface of the cabinet (screw size M6).

Note

Make sure there is a low-resistance connection between the mounting rail and the base of the cabinet.

If the ET 200iSP is subjected to increased vibration and shock loads, we recommend screwing the mounting rail to the mounting surface centrally between the two outer fixing holes (at b/2). The securing screws require an additional M6 hole at b/2 on the mounting rail (see table above).

5.3 Installing the terminal module for power supply PS

Properties

- The terminal module TM-PS-A is used to accommodate the power supply PS.
- The terminal module TM-PS-B is used to accommodate a second power supply PS of the ET 200iSP for redundancy.
- The terminal modules TM-PS-A and TM-PS-B must be pre-wired (without power supply PS).
- All other terminal modules are mounted to the right of the terminal module TM-PS-A or TM-PS-B.

Requirements

The mounting rail is installed.

Required tools

4.5 mm screwdriver (cylindrical design)

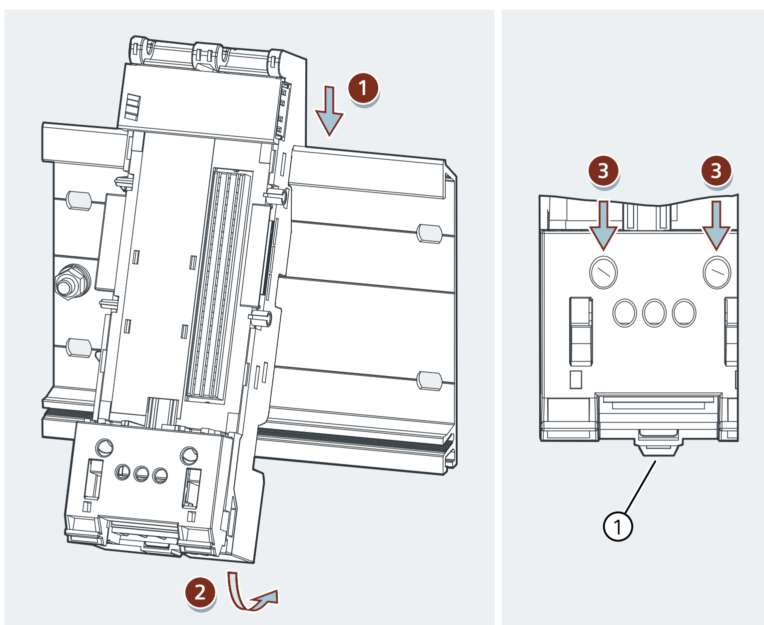
Installing terminal module TM-PS-A

1. Fit the terminal module onto the rail.
2. Push in the terminal module at the bottom until you can hear the catch lock.
3. Screw the terminal module to the mounting rail (2 screws - torque 0.8 to 1.1 Nm). Use a screwdriver with a 4.5 mm wide blade.

Note

To prevent the ET 200iSP from slipping sideways on the mounting rail, you must secure the terminal module mechanically (see point 3). The 2 fastening screws are located on the front at the bottom of the terminal module.

An inserted Power Supply PS can only be uninstalled if both fastening screws are tightened on the terminal module.



① Catch

Figure 5-6 Installing terminal module TM-PS-A

Installing terminal module TM-PS-B (second power supply PS)

1. Hang the server module in the mounting rail TM-PS-B to the right of the TM-PS-A.
2. Swivel the TM-PS-B backwards until the slide audibly engages.

3. Move the TM-PS-B to the left until it audibly latches onto the previous terminal module TM-PS-A.
4. Bolt the terminal module to the mounting rail. See *Installing terminal module TM-PS-A* Step 3.

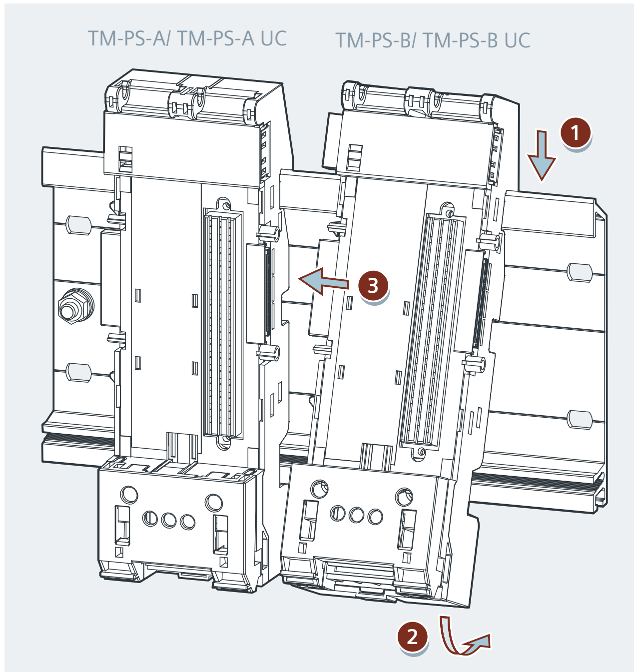


Figure 5-7 Installing terminal module TM-PS-B

Removing terminal module TM-PS-A or TM-PS-B

Requirements: The terminal module is wired and to the right of it there are other terminal modules.

1. Switch off the supply voltage of the terminal module TM-PS-A and, if present, at TM-PS-B.
2. Loosen the wiring on the terminal module TM-PS-A with the screwdriver.
3. Release the two fastening screws of the terminal module.
4. Use the screwdriver to lever the slide on the terminal module TM-PS-A downward as far as it will go and move the terminal module to the left.

Note

The slider is located below the terminal module (see figure above).

5. While pulling on the slider, swivel the terminal module off the mounting rail.
6. If available, repeat steps 2 to 5 for the terminal module TM-PS-B.

5.4 Installing Terminal Modules for the Interface Module and Electronics Modules

Properties

- The terminal modules are used to accommodate the interface module and the electronic modules
  - TM-IM/EM: Terminal module for the interface module and electronic module, located directly to the right of the terminal module TM-PS-A
  - TM-IM/IM: Terminal module for 2 interface modules (redundancy of the interface modules), located to the right of the TM-PS-A or TM-PS-B.
  - TM-EM/EM: Terminal module for the electronic modules, are located to the right of the TM-IM/EM or TM-IM/IM terminal module.
  - TM-RM/RM: Terminal module for the digital output modules 2 DO Relay UC60V/2A, are located to the right of the terminal module TM-IM/EM or TM-IM/IM.
- The terminal modules can be prewired (without electronic modules).

Requirements

The mounting rail is installed.

Required tools

3.5 mm screwdriver.

4.5 mm screwdriver.

Mount terminal module TM-IM/EM, TM-IM/IM, TM-EM/EM and TM-RM/RM

1. Fit the terminal module onto the rail.
2. Push in the terminal module at the bottom until you can hear the catch lock.
3. Push the terminal module to the left until you hear it lock into the previous terminal module.

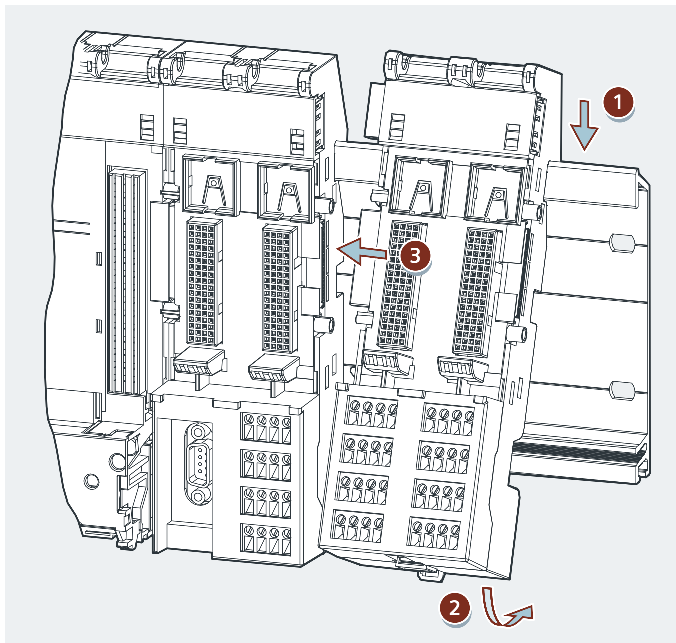


Figure 5-8 Mount terminal module TM-IM/EM and TM-EM/EM

Remove terminal module TM-IM/EM, TM-IM/IM, TM-EM/EM and TM-RM/RM

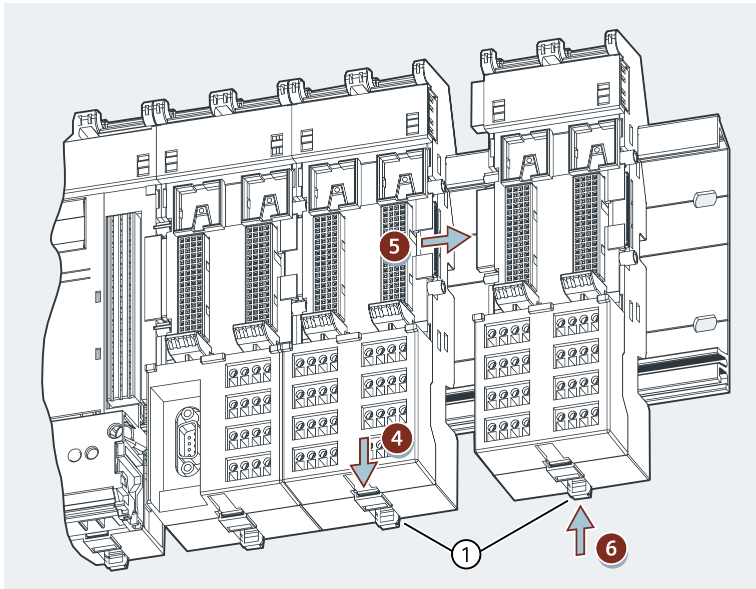
Requirements: The terminal module is wired and other terminal modules are situated to the right.

To uninstall starting from the right, proceed as follows:

1. Switch off the supply voltage on the power supply PS or uninstall the power supply PS.
2. Use a screwdriver (3.5 mm) to detach the wiring at the terminal module.
3. Use a screwdriver (4.5 mm) to loosen the lock screws on the terminating module.
4. Use the screwdriver to lever the catch on the previous (left) terminal module down to the stop.
5. At the same time push the terminating module to the right.
6. Keeping the catch pressed down, swivel the terminating module out of the mounting rail.
7. Repeat steps 4 to 6 for each additional terminal module.

Note

You can also uninstall the distributed I/O stations starting from left (to right).



① Catch

Figure 5-9 Remove terminal module TM-EM/EM from right side

5.5 Installing the Terminating Module and the Slot Cover

Properties

- The distributed I/O device ET 200iSP is terminated with the terminating module at the right end of the ET 200iSP. If you have not plugged a terminating module, then the ET 200iSP is not ready for operating (EMC is not guaranteed), the ET 200iSP starts up but pulling an electronic module leads to a station failure.
- Pulling an electronic module leads to a station failure of the ET 200iSP.
- To mechanically secure the ET 200iSP, you must screw the terminating module tightly onto the mounting rail.
- If your ET 200iSP configuration leaves you with a gap in the last slot, you must install the reserve module or the slot cover in this slot:
  – Install a slot cover if the ET 200iSP will not be expanded in the future. The slot cover is integrated in the terminating module.
    Replacing the slot cover with an electronic module during operation will cause a station failure of the ET 200iSP.
  – Install a reserve module if you want to use the free slot for a future expansion (by means of an electronic module).
- The terminating module accompanies the terminal module TM-IM/EM and TM-IM/IM.

Requirements

The last terminal module of the ET 200iSP is mounted.

Required tools

4.5 mm screwdriver.

Installing the terminating module

1. Hook the terminating module onto the mounting rail to the right of the last terminal module.
2. Pivot the terminating module backwards onto the mounting rail.
3. Move the terminating module to the left until you hear it latch onto the last terminal module.
4. Screw the terminating module to the mounting rail (1 screw - torque 0.8 to 1.1 Nm). Use a screwdriver with a 4.5 mm wide blade.

Note

To prevent the ET 200iSP from slipping sideways on the mounting rail , you must secure the terminating module mechanically (see point 4). The fixing screw is located on the front on the terminating module.

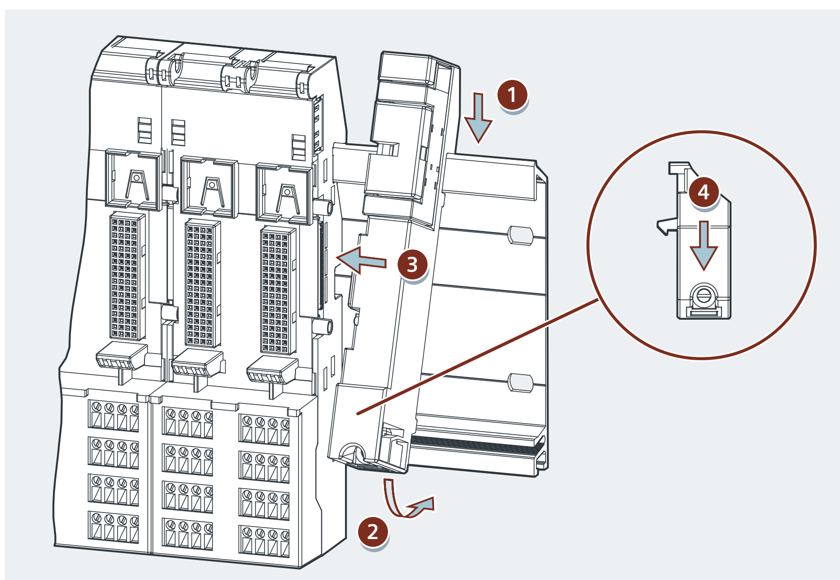


Figure 5-10 Installing the terminating module

Uninstalling terminating module

1. Switch off the supply voltage on the power supply PS or uninstall the power supply PS.
2. Remove the lock screw of the terminal module.
3. Use the screwdriver to push the catch on the last terminal module down to the stop and slide the terminating module to the right.
4. Swivel the terminating module out of the mounting rail.

Installing the slot cover

1. Use the screwdriver to lever the slot cover out of the terminating module. The slot cover is fixed in bracket on the right of the terminating module.
2. Plug it into the last slot of the ET 200iSP.

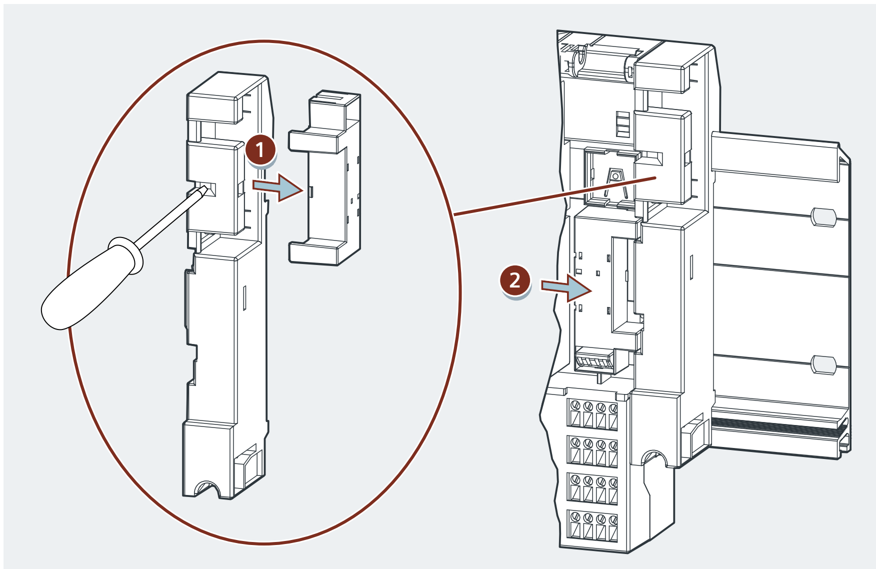


Figure 5-11 Installing the slot cover

Removing the slot cover

1. Push the screwdrivers into the lower opening on the slot cover and lever this out of the terminal module.
2. Press the Slot Cover into the bracket on the terminating module.

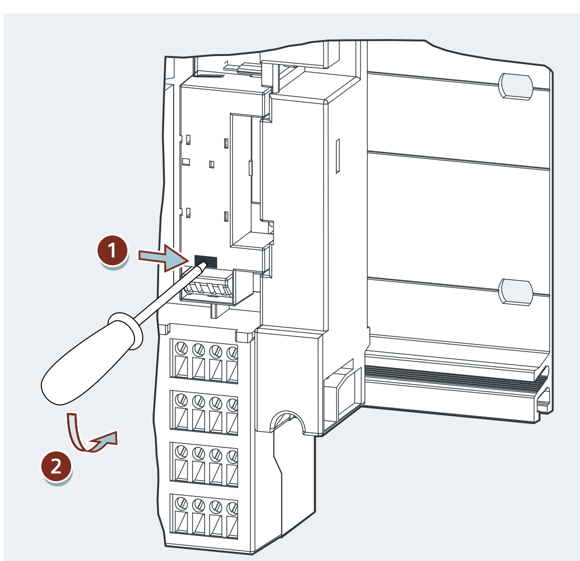


Figure 5-12 Installing the slot cover

5.6 Installing the Slot Number Labels

Properties

The slot number plates identify the individual electronic modules with a slot (1 to 34).

Requirements

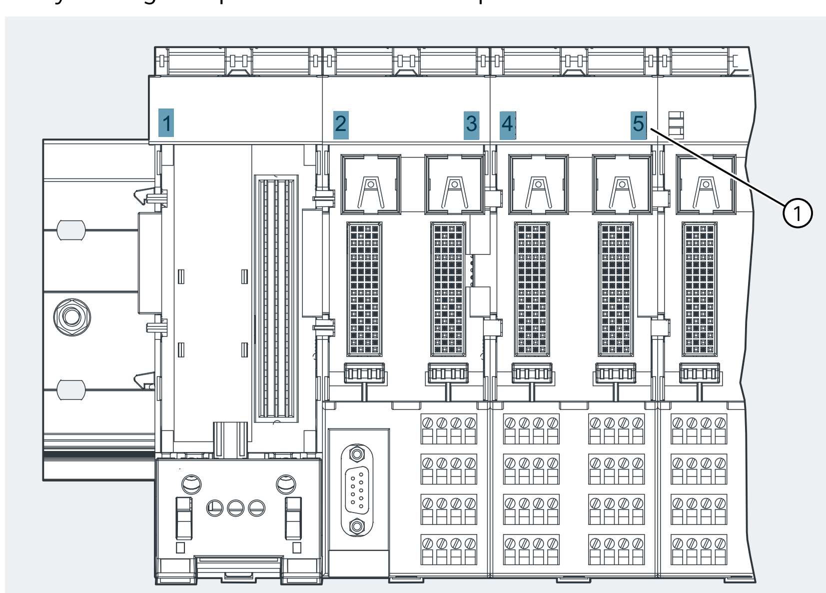
- The terminal modules are installed.
- There must not be any electronic modules inserted when you apply the slot number plates.
- Position terminal module TM-PS-A: One plate at the top left
  Position terminal modules TM-IM/EM. TM-EM/EM and TM-RM/RM: One plate at the top left and right.

Required tools

3.5 mm screwdriver (for removal only).

Installing the slot number plates

1. Break off the slot number plates (1 to 34) from the strip.
2. Use your finger to press the slot number plates into the terminal module.



① Slot number plates

Figure 5-13 Installing the slot number plates

Removing slot number plates

1. Remove the electronic module from the terminal module.
2. Using the screwdriver, lever the slot number plate carefully from below out of the bracket.

Wiring 6

6.1 General Rules and Regulations for Wiring

Introduction

The ET 200iSP distributed I/O device is subject to special rules and regulations depending on its application. This section provides you with an overview of the most important rules when integrating the ET 200iSP distributed I/O device a plant or system.

Specific application

Keep to the safety and accident prevention regulations applying to specific applications, for example, the machine protection guidelines. When laying cables and lines, adhere to the installation regulations in accordance with EN 60079-14 and any regulations specific to your country. When operating the ET 200iSP in areas with combustible dust (zone 21, zone 22), you must also comply with EN 61241-14.

EMERGENCY STOP devices in the safe area

EMERGENCY STOP devices according to IEC 204 (equivalent to DIN VDE 0113) must remain effective in all operating modes of the plant or system.

Startup of the system after certain events

The following table describes points to remember when your plant starts up following certain events:

Table 6-1 Startup of the system after certain events

If...	then...
Startup after voltage dips or failure, startup of ET 200iSP after bus communication was interrupted,	no dangerous states must result. If necessary, force an EMERGENCY STOP!
Startup after releasing the EMERGENCY STOP mechanism,	There must not be an uncontrolled or undefined startup.

Line voltage in the safe area

The following table describes points to remember relating to the line voltage:

Table 6-2 Line voltage in the safe area

With ...	Requirements
A fixed installation or systems without all-pole disconnector	A disconnector or a fuse must exist in the building installation.
Load power supplies, power supply modules	The set rated voltage range must correspond to the local line voltage.
All circuits of the ET 200iSP distributed I/O device	The fluctuation/deviation of the mains voltage from the nominal value are within the permissible tolerance (see "General technical specifications (Page 239)").

DC 24 V supply in the safe area

The following table shows what you have to note with the DC 24 V supply:

Table 6-3 DC 24V supply in the safe area

<table>
<tr><th>With ...</th><th colspan="2">you must note the following...</th></tr>
<tr><td>Buildings</td><td>exterior lightning protection</td><td rowspan="2">Provide lightning protection measures (e.g. overvoltage suppressor)</td></tr>
<tr><td>DC 24 V supply lines, signal lines</td><td>Interior lightning protection</td></tr>
<tr><td>DC 24 V supply</td><td colspan="2">Safety isolation</td></tr>
</table>

Protection against exterior electric effects

The following table shows what you have to note to protect against electric effects or faults:

Table 6-4 Protection against exterior electric effects

With ...	you must note the following...
All systems in which ET 200iSP is installed	Functional ground is required for the plant or system to conduct EMC influences out.
Supply, signal and bus lines	The cable routing and installation must be correct.
Signal and bus lines	that a cable or wire break cannot lead to undefined system states.

6.2 Operating the ET 200iSP with equipotential bonding

Components and protective measures

When setting up a system, various components and protective devices are mandatory. The types of components and the degree to which the protective measures are mandatory depend on the DIN VDE regulation that applies to your plant setup. The table below relates to the schematic that follows.

Table 6-5 DC 24V supply in the safe area

Compare	Relates to figure	DIN VDE 0100	DIN VDE 0113
Shutdown device for controllers, transducers and actuators	(1)	...Part 460: Main switch	...Part 1: Disconnector
Short-circuit and overload protection	(2)	...Part 725: Single-pole protection of circuits	...Part 1: With a grounded secondary circuit: single-pole protection

Safety isolation

Reliable electrical isolation is required with modules that are powered with voltages ≤ DC 60 V or AC 250 V, in other words, the supply voltage of the ET 200iSP must be reliably electrically isolated.

ET 200iSP with ungrounded reference potential

With the ET 200iSP, the reference potential M of the supply voltage is not connected to the functional ground (mounting rail, connection equipotential bonding on the terminal module).

ET 200iSP in the overall configuration

The following schematic shows the distributed I/O device ET 200iSP within the overall configuration in the Zone 1 hazardous area (supply voltage and grounding concept) when powered from a TN-S system.

- Overall configuration with power supply PS DC24V

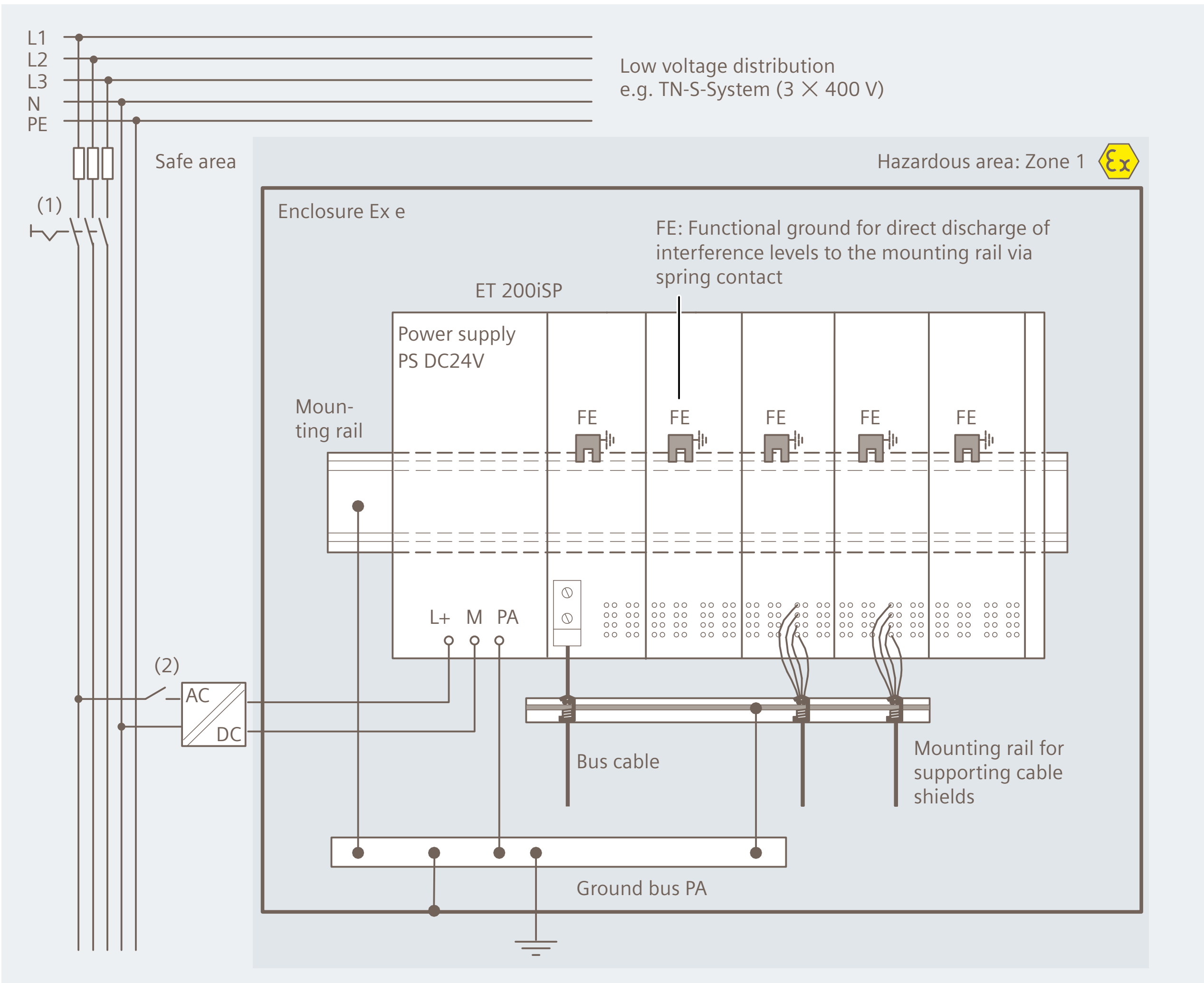


Figure 6-1 Operating ET 200iSP and PS DC24V with equipotential bonding

- Overall configuration with power supply PS AC120/230V

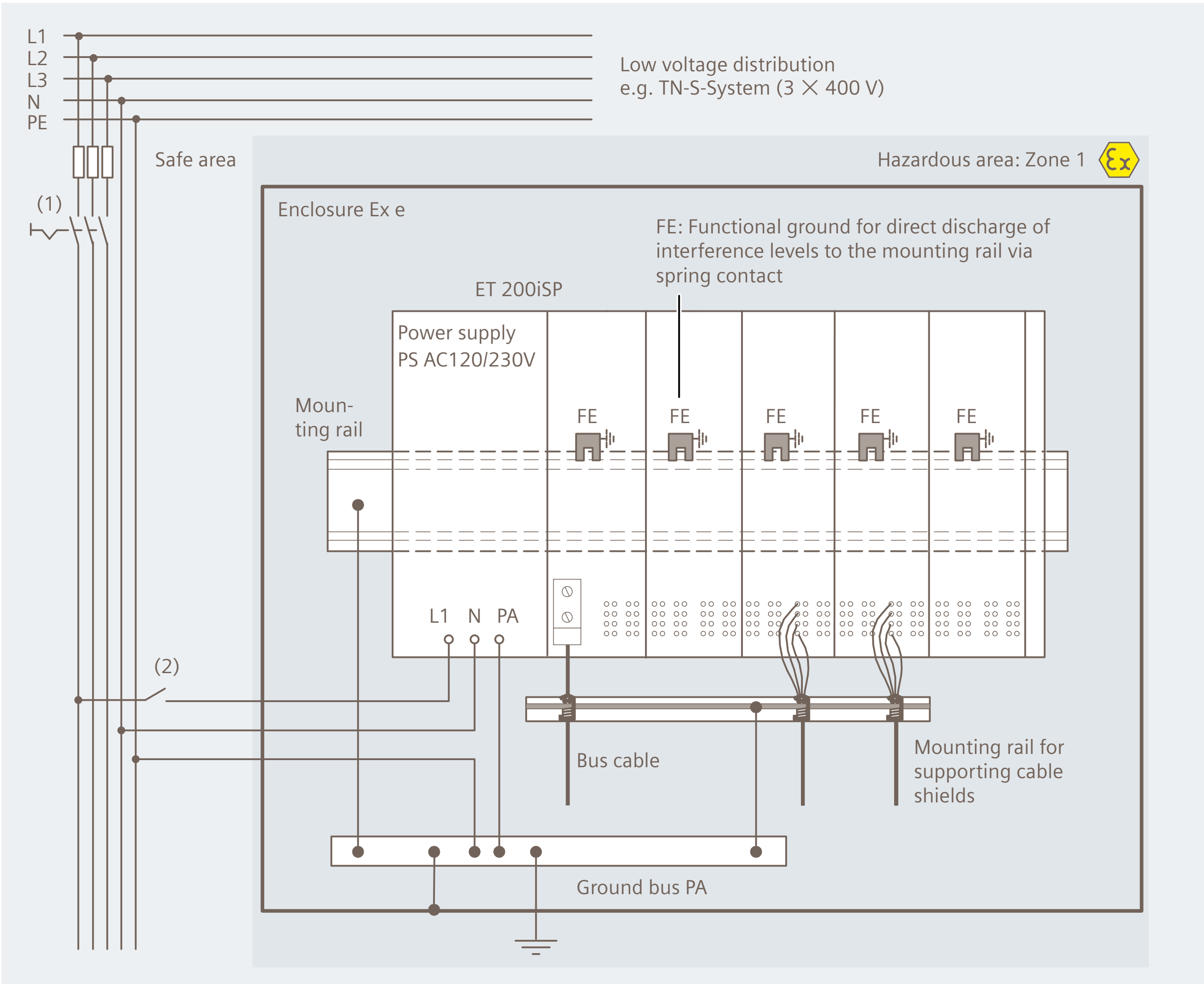


Figure 6-2 Operating ET 200iSP and PS AC120/230V with equipotential bonding

Note

Requirement for connecting the protective conductor

The connection of the protective conductor to the equipotential bonding rail, EB, is optionally possible.

A requirement for connecting the PE conductor to the equipotential bonding rail EB is standard-compliant equipotential bonding of the EB and PE potentials on the line-side.

Equipotential bonding EB

Connect the following to the equipotential bonding EB

- The mounting rail of the ET 200iSP system (with the grounding bolts Ex e)
- The terminal module TM-PS-A via the equipotential bonding connection terminal

- The terminal module TM-PS-B via the equipotential bonding connection terminal
- Mounting rail for mounting the cable shields (with an Ex e terminal)

> **DANGER**
>
> **Connect the equipotential bonding EB terminal correctly**
>
> The equipotential bonding connection terminal EB on the power supply module ET 200iSP must be connected to the equipotential bonding EB according to EN 60079-14 in hazardous areas.

According to EN 60079-14, equipotential bonding is mandatory in hazardous areas.

You can find more information on equipotential bonding in the system manual "Principles of explosion protection (https://support.automation.siemens.com/WW/view/en/12521844)".

6.3 Electrical Design of the ET 200iSP

Electrical isolation

With the ET 200iSP, there is electrical isolation between the following components:

- The load circuits/process and all the other circuit components of the ET 200iSP.
- The network interface in the interface module and all other circuit sections
- The supply voltage (auxiliary power) and all output voltages

The following figure shows the potentials for ET 200iSP. Only the most important components are shown in the figure:

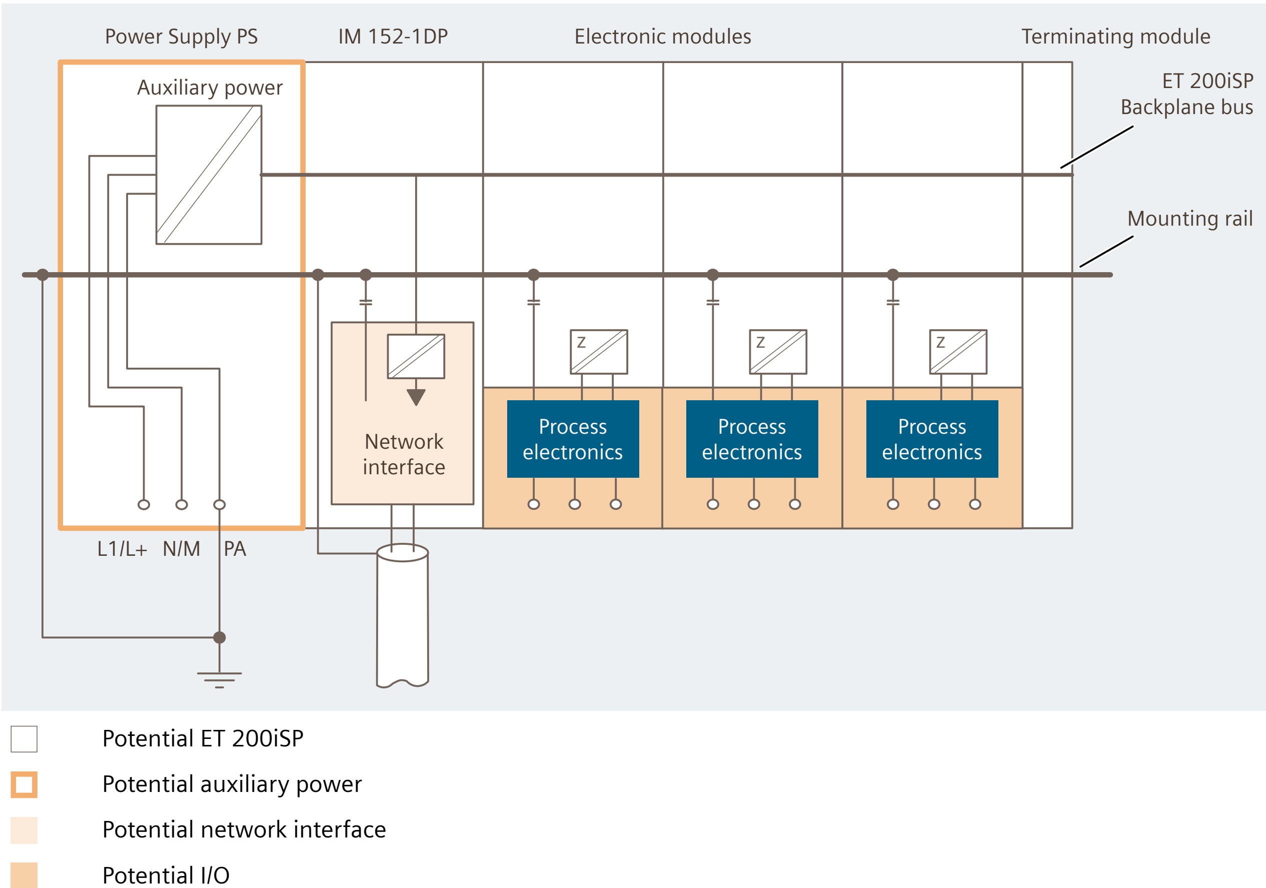


Figure 6-3 Potentials for ET 200iSP

For IM 152-1PN, no further potentials are required.

6.4 Wiring the ET 200iSP

6.4.1 Wiring Rules for the ET 200iSP

DANGER

Reviewing regulations

When laying cables and wiring, adhere to the installation regulations in accordance with EN 60079-14 and any regulations specific to your country.

When operating the ET 200iSP in areas with combustible dust (zone 21, zone 22), you must also comply with EN 61241-14.

DANGER

Check safety-related values

Connecting an intrinsically safe sensor, actuator, or HART field device to the input/output of an electronic module must produce an intrinsically safe circuit! For this reason:

When you select the encoder, actuator or HART field device to be connected to the electronic module, the resulting safety-related values must be checked!

The inductance and capacitance of the cable must also be taken into account! Refer to Configuration Options in Zones (Page 66).

WARNING

Check the wiring

If the wrong electronic module is used or the terminals are connected incorrectly to the sensors, actuators or HART field devices, the intrinsic safety is put at risk:

Connect only Ex i circuits to the intrinsically safe inputs and outputs of the electronic modules.

Check the wiring between the electronic modules and sensors, actuators, and HART field devices.

When wiring according to NAMUR recommendation NE21, read the notes A.2. and A.3. in Appendix A of the recommendation. This means that all signal lines do not need to be shielded. However, it is recommended to shield the analog signals for optimal accuracy. The communication cables are laid shielded and connected centrally to the equipotential bonding rail in the Ex area.

Wiring rules

Table 6-6 Wiring rules for ET 200iSP

Wiring rules for ...		TM-PS-A, TM-PS-B	TM-IM/EM, TM-EM/EM (spring and screw terminal)
Connectable wire cross-sections for solid wires		0.5 mm to 4 mm²	0.14 mm to 2.5 mm²
Connectable wire cross-sections for flexible wires	Without end sleeve	0.5 mm to 2.5 mm²	0.14 mm to 2.5 mm²
	with wire end ferrules	0.5 mm to 2.5 mm²	0.14 mm to 1.5 mm²
Number of conductors per terminal		1 wire	1 or combination of 2 wires up to 1.5 mm (total) in a common wire-end ferrule
Length of insulation to be stripped		11 mm	
Ferrules according to DIN 46228	without insulation collar	Form A, up to 12 mm long	Form A, up to 12 mm long
	With insulation collar 0.25 to 1.5 mm	Form E, up to 12 mm long	Form E, up to 12 mm long
Tightening torque		0.5 to 0.7 Nm	

6.4.2 Wiring Terminal Modules with Screw Terminals

Properties

- In terminal modules with screw terminals, the individual wires are screwed into the terminal.
- Wire-end ferrules are not necessary.

Prerequisites

Observe the wiring rules.

Required tool

3.5 mm screwdriver

Procedure

1. Strip insulation from the wires.
2. Insert the individual wires into the terminal.
3. Tighten the screw. Result: The wire is clamped into the terminal module.

6.4.3 Wiring terminal modules with spring terminals

Properties

In terminal modules with spring terminals, the individual wires are affixed by inserting them into the terminal.

Requirements

Observe the wiring rules.

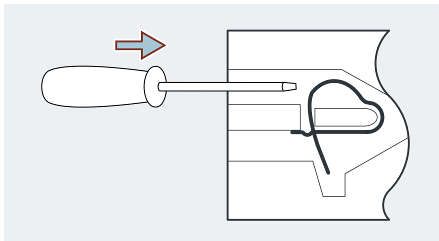
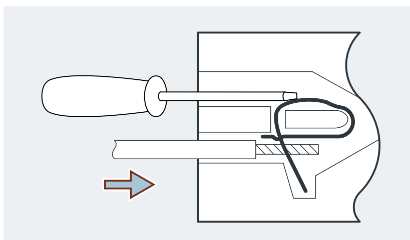
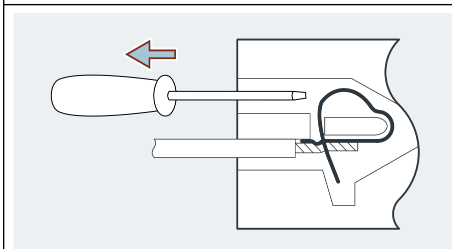
Required tools

3.5 mm screwdriver

Procedure

1. Strip insulation from the wires.
2. Insert the screwdriver into the upper (square) opening of the terminal and press it into the opening.
3. Insert the wire into the lower (round) opening of the terminal to the end stop.
4. Remove the screwdriver.

Table 6-7 Wiring the spring terminal

	Insert screwdriver
	Insert cable up to stop in spring-type terminal
	Pull out screwdriver; cable clamps to contact

6.4.4 Grounding the mounting rail

Properties

The mounting rail of the distributed I/O device must be connected to the ground bus (EB).

Requirements

- Perform the wiring with the power supply turned off .
- Fastening the grounding conductor to the grounding bolt Ex e of the mounting rail.
- To prevent possible interference, the cross-section of the grounding conductor for the mounting rail must be greater than the cross-section of the grounding cable at the terminal module TM-PS-A or TM-PS-B.

Required tools

- Wrench 10 mm
- Insulation stripper
- Cable lug pliers

Procedure

1. Strip the insulation from the grounding conductor. Attach an M6 (ring) cable lug to the grounding conductor.
   The grounding conductor must have a cross-section of at least 4 mm^2.
2. Attach the grounding conductor to the left of the TM-PS-A on the mounting rail on the ground bolt (M6 nut, shim washer and spring lock washer). The tightening torque is 2 to 2.5 Nm.
3. Secure the other end to the ground bus EB.

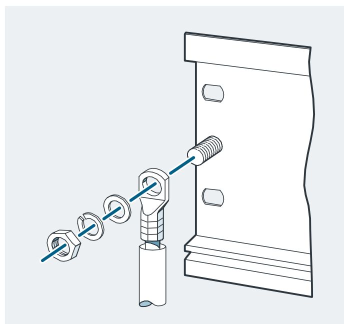


Figure 6-4 Grounding the mounting rail

6.4.5 Wiring terminal module TM-PS-A or TM-PS-B

Safety instructions for the power supply PS DC24V

⚠ DANGER

Threat to explosion protection in the Zone 1 and Zone 21 potentially explosive area:

The isolating or disconnecting of the cables for the supply voltage of the power supply PS DC24V at the terminal module TM-PS-A or TM-PS-B may be carried out in Zone 1/Zone 21 only in the voltage-free state. In zone 21, you may only open the enclosure of the ET 200iSP if no explosive dust is present!

⚠ DANGER

Threat to explosion protection in the Zone 2 and Zone 22 potentially explosive area:

The isolating or disconnecting of the cables for the supply voltage of the power supply PS DC24V at the terminal module TM-PS-A or TM-PS-B may only be carried out in Zone 2/Zone 22 in case of explosion hazard only in the voltage-free state.

If there is no danger of explosion, you may isolate and disconnect the lines for the supply voltage of the power supply PS DC24V at the terminal module TM-PS-A or TM-PS-B in Zone 2/Zone 22 under voltage.

Safety note for the power supply PS AC120/230V

DANGER

Unplug cable only in a voltage-free state

The isolating or disconnecting of the cables for the supply voltage of the power supply PS AC120/230V at the terminal module TM-PS-A (6ES7193-7DA20-0AA0) or TM-PS-B (6ES7193-7DB20-0AA0) may only be carried out in Zone 1/Zone 21, Zone 2/Zone 22 and in the safe area in a voltage-free state. In zone 21, you may only open the enclosure of the ET 200iSP if no explosive dust is present!

Properties

At the terminal module TM-PS-A, connect the supply voltage for the ET 200iSP.

At the terminal module TM-PS-B, connect the supply voltage for the power supply for redundancy.

The active Power Supply PS supplies the interface module and all electronic modules with the required voltage.

Requirements

- Wire the terminal module with the power supply turned off.
- Observe the wiring rules.

Required tools

- 3.5 mm screwdriver
- Insulation stripper

Procedure

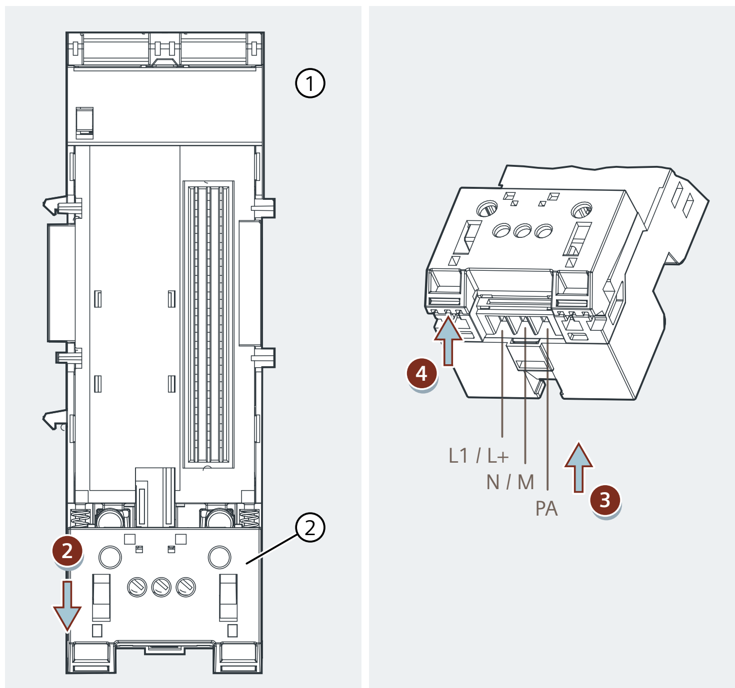
1. Strip the wires for the supply voltage of the ET 200iSP.
2. Pull the slide down as far as the end stop until it clicks into place.
   You can only pull the slide down when the two fastening screws on the terminal module are screw to the DIN rail.

3. Secure the individual wires using the 3.5 mm screwdriver.

Note

The grounding conductor EB must have a cross-section of at least 4 mm^2. Connect the other end of the grounding conductor EB with the ground bus EB.

4. Lift up the slide at the front until it moves up by itself.



① Terminal module TM-PS-A

② Catch

Figure 6-5 Connect supply voltage and grounding conductor EB to the TM-PS-A

Note

When wiring the TM-PS-A (6ES7193-7DA20-0AA0) or TM-PS-B (6ES7193-7DB20-0AA0), make sure that you connect phase L1 and neutral N correctly. Only then is trouble-free operation of the ET 200iSP guaranteed.

6.4.6 Wiring Terminal Modules TM-IM/EM and TM-IM/IM

Properties

At the terminal module TM-IM/EM, connect the bus connector for the PROFIBUS RS 485-IS. The connector is on the left-hand side of the module. The terminal module TM-IM/EM is also the interface to the actuators and sensors. The connectors are on the right-hand side of the module.

At the terminal module TM-IM/IM, connect the bus connectors for redundant operation of the two interface modules.

Requirements for Zone 1 and Zone 21 for the configuration with PROFINET connection

DANGER

Explosion hazard

When the fiber-optic cables that are connected to the ET 200iSP run through hazardous areas, all devices must be certified according to the EN/IEC 60079-28 standard.

Keep to the following rules in Zone 1 and Zone 21:

1. Use a suitable media converter (see Appendix "Article numbers (Page 419)").
2. For the connection of the PROFINET IO, the interface module IM 152-1PN must be plugged in: "Inserting and labeling the interface module and electronic modules (Page 143)"
3. If you want to loop through the PROFINET connection to the next ET 200iSP, use a fiber-optic cable with LC plug. To loop-through, connect the fiber-optic cable to the second fiber-optic cable connection of the interface module.
4. Use the fiber-optic cables specified in the Appendix "Article numbers (Page 419)" for the PROFINET IO connection and mark the bus cable as "Ex i bus cable". If you use a color as the identifier, you must select light blue.

Requirements for Zone 1 and Zone 21 for the configuration with PROFIBUS connection

Keep to the following rules in Zone 1 and Zone 21:

1. Use the RS 485-IS coupler (see Appendix "Article numbers (Page 419)").
2. If you want to loop-through the PROFIBUS RS 485-IS connection to the next ET 200iSP, use the PROFIBUS bus connector RS 485-IS (article number 6ES7972-0DA60-0XA0). To loop the module through, connect the bus cable to the second cable outlet of the bus connector.
3. Terminate the PROFIBUS RS 485-IS with the PROFIBUS bus connector RS 485-IS. The PROFIBUS bus connector RS 485-IS (6ES7972-0DA60-0XA0) has an integrated terminating resistor.
4. Use the bus cables specified in the Appendix "Article numbers (Page 419)" for the PROFIBUS RS 485-IS connection and mark the bus cable as "Ex i bus cable". If you use a color as the identifier, you must select light blue.
5. The shield of the bus cable must be connected to one of the following locations providing a sure ground connection EB:
   – Either at the transition of the bus cable from the safe area to the hazardous area
   – or in the safe area directly at the RS 485-IS coupler. In this case, the shield must be installed like an active intrinsically safe circuit, i.e. protection against accidental contact must also be provided for the shield of the bus cable (IP20).

Prerequisites for Zone 2 and Zone 22

Keep to the following rules in Zone 2:

- See points 1 to 5: *Prerequisites for Zone 1 and Zone 21*

Prerequisites for safe area

- See points 1 to 4: *Prerequisites for Zone 1 and Zone 21*

Wiring terminal module TM-IM/EM

For configuration with PROFINET IO connection: Connecting FO cables

1. Plug a fiber-optic cable into the media converter or when looping through the PROFINET IO into the bottom connection of the interface module of the previously connected ET 200iSP station.
2. Mark the bus cable as "Ex i bus cable".
3. Plug the other end of the fiber-optic cable into the top connection of the interface module.

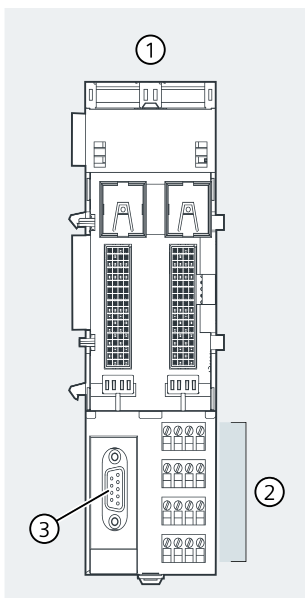
For configuration with PROFIBUS connection: Connect **PROFIBUS RS 485-IS (left module)**

1. Insert the bus connector into the PROFIBUS RS 485-IS connection.

Note

The cable shield of the bus cable is connected in service to the terminal module TM-IM/EM by means of a spring contact with the mounting rail and consequently with the equipotential bonding PA.

2. Use the 3.5 mm screwdriver to tighten the lockscrews of the bus connection (torque: 0.5 to 0.7 Nm).
3. Mark the bus cable as "Ex i bus cable".



① Terminal module TM-IM/EM
② Connector for the electronic module: channel 0 to 3, or channel 0 to 7
③ Connection for IM 152-1DP: PROFIBUS RS 485-IS

Figure 6-6 Wiring terminal module TM-IM/EM (PROFIBUS RS 485-IS)

For pin configuration, refer to the Chapter "Terminal module TM-IM/EM 60S and TM-IM/EM 60C (Page 254)".

Note

The PROFIBUS RS 485-IS of the ET 200iSP is intrinsically safe due to the RS 485-IS coupler. It is therefore permitted to remove and insert the bus connector during running operation in Zone 1 and Zone 2. In Zone 21 and Zone 22, you may only open the enclosure of the ET 200iSP if no combustible dust is present.

Note

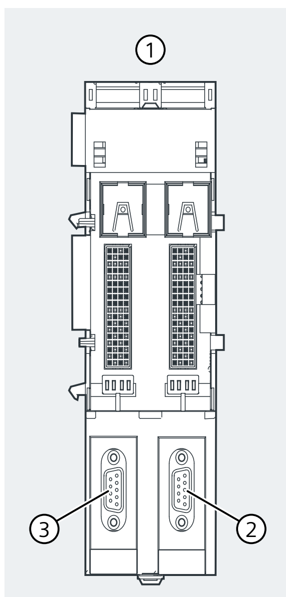
Pulling and plugging the fiber-optic cable and transceiver during operation (hot-swapping) in Zone 1 and Zone 2. In Zone 21 and Zone 22, you may only open the enclosure of the ET 200iSP if no combustible dust is present.

Connecting sensors and actuators (right-hand module)

Refer to the Chapter "Wiring terminal module TM-EM/EM (Page 135)".

Wiring terminal module TM-IM/IM

Connect the two bus connectors for the redundant IMs. The procedure is described for the TM-IM/EM. Repeat the same steps for the right-hand module.



① Terminal module TM-IM/IM
② Connection for IM 152-1DP (b): PROFIBUS RS 485-IS
③ Connection for IM 152-1DP (a): PROFIBUS RS 485-IS

Figure 6-7 Wiring terminal module TM-IM/IM (PROFIBUS RS 485-IS)

For pin configuration, refer to the Chapter "Terminal module TM-IM/IM (Page 258)".

6.4.7 Wiring Terminal Modules TM-EM/EM

Properties

The terminal module TM-EM/EM is the interface to the sensors and actuators.

Requirements

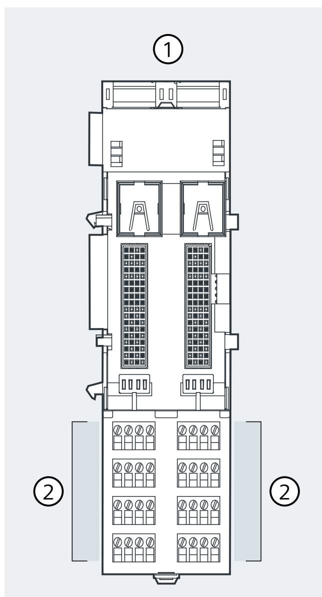
Observe the wiring rules.

Required tools

3.5 mm screwdriver

Procedure

1. Strip the insulation from the wires to the sensors / actuators.
2. Secure the individual wires in the screw or spring terminals.



① Terminal module TM-EM/EM

② Connector for the electronic module:
channel 0 to 3, or
channel 0 to 7

Figure 6-8 Wiring terminal module TM-EM/EM

Pin assignment see section "Terminal modules TM-EM/EM 60S and TM-EM/EM 60C (Page 261)".

Note

The inputs/outputs of the ET 200iSP distributed I/O device are intrinsically safe. The isolating or disconnecting the cables to the encoders, actuators and HART field devices at the terminal module TM-EM/EM is permitted during operation in Zone 1 and Zone 2. In Zone 21 and Zone 22, you may only open the enclosure of the ET 200iSP if no explosive dust is present.

6.4.8 Wiring terminal module TM-RM/RM

> **DANGER**
>
> **Threat to explosion protection in the Zone 1 and Zone 21 potentially explosive area:**
>
> The isolating or disconnecting of the cables for the actuators on the terminal module TM-RM/RM may only be carried out in Zone 1/ Zone 21 when the rated load voltage (of the relay contacts) is switched off. In zone 21, you may only open the enclosure of the ET 200iSP if no explosive dust is present!

> **DANGER**
>
> **Threat to explosion protection in the Zone 2 and Zone 22 potentially explosive area:**
>
> The isolating or disconnecting of the cables for the actuators on the terminal module TM-RM/RM may only be carried out in Zone 2/ Zone 22 in the event of explosion hazard when the rated load voltage (of the relay contacts) is switched off.
>
> If there is no risk of explosion, then you may isolate and disconnect the lines for the actuators on the terminal module TM-RM/RM in Zone 2/ Zone 22 with the rated load voltage switched on.

Properties

The terminal module TM-RM/RM is the interface to the actuators of the electronic module 2 DO Relay UC60V/2A. The terminals of the terminal module TM-RM/RM are designed in the Increased Safety Ex e type of protection.

Requirements

- Switch off the rated load voltage before you wire the terminal module.
- Observe the wiring rules.

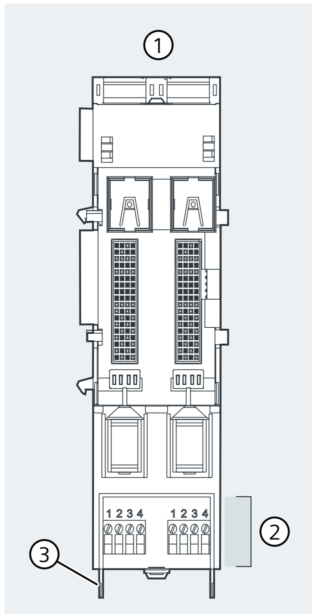
Required tools

- 3.5 mm screwdriver
- Insulation stripper

Procedure

1. Open the terminal cover.
2. Strip the insulation from the wires to the sensors / actuators.

3. Fasten the individual lines in the screw terminal Ex e.
4. Close the terminal cover.



① Terminal module TM-RM/RM
② Connection for electronic module 2 DO Relay UC60V/2A channels 0 and 1
③ Terminal cover

Figure 6-9 Wiring terminal module TM-RM/RM

Pin assignment, see section Terminal module TM-RM/RM (Page 264).

6.4.9 Connecting cable shields

Properties

The cable shields of the analog electronic modules must be connected to the ground bus (equipotential bonding) of the enclosure.

Requirements

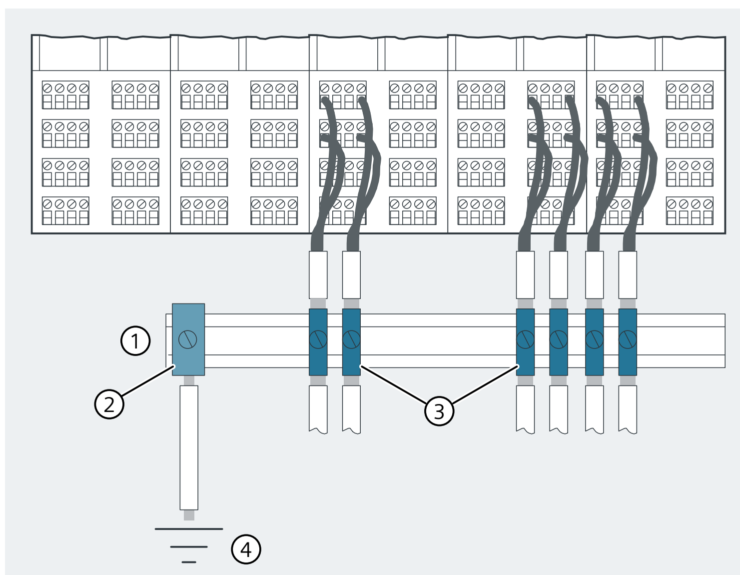
- Tin-coated or zinc-coated standard mounting rail according to EN 50022 (35 x 15/35 x 7.5) and fixing accessories
- Shield terminals (6ES5728-8MA11)
- Securing the ground cable to the standard mounting rail:
  - Zone 1 or Zone 21: Ex e terminal. Use the WP 16/E terminal from Weidmüller (see Appendix "Article numbers (Page 419)").
  - Zone 2, zone 22 or safe area: Normal terminal

- 4.5 mm screwdriver
- Insulation stripper

Procedure

The following procedure describes an example of how to contact the shield. You can also use the enclosure features to connect the shield.

1. Mount the standard mounting rail below the ET 200iSP in the enclosure (distance to the ET 200iSP: approx. 40 mm).
2. Remove the insulation material of the cable in the area of the standard mounting rail (approx. 40 mm).
3. Secure the cable to the standard mounting rail with the shield clamp (torque: 0.8 to 1.2 Nm). Make sure that the shield clamp contacts only the cable shield.
4. Repeat steps 2 and 3 if you need to connect other cable shields.



①	Standard mounting rail for shield support
②	Ex e terminal
③	Shield terminals
④	Ground bus PA

Figure 6-10 Connecting cable shields

Connecting standard mounting rail with ground bus PA

1. Strip the insulation from the cable for grounding (from 4 to 16 mm²) and fasten it to the standard mounting rail with the ground terminal (torque: 2 to 2.5 Nm).
2. Connect the other end to the ground bus PA.

6.4.10 How to Connect a TC Sensor Module

Properties

The TC sensor module enables internal compensation of the reference junction temperature. It is included in the scope of delivery of the 4 AI TC.

Requirements

The TC sensor module can only be connected to terminal modules with screw terminals.

Required tools

3.5 mm screwdriver

Procedure

1. Plug the TC sensor module into the 3rd row of terminals on the terminal module: I/Os in 3, 7, 11; pin in terminal 15.
2. Use a 3.5 mm screwdriver to fasten the TC sensor module. Tighten the screws of terminals 3, 7 and 11.

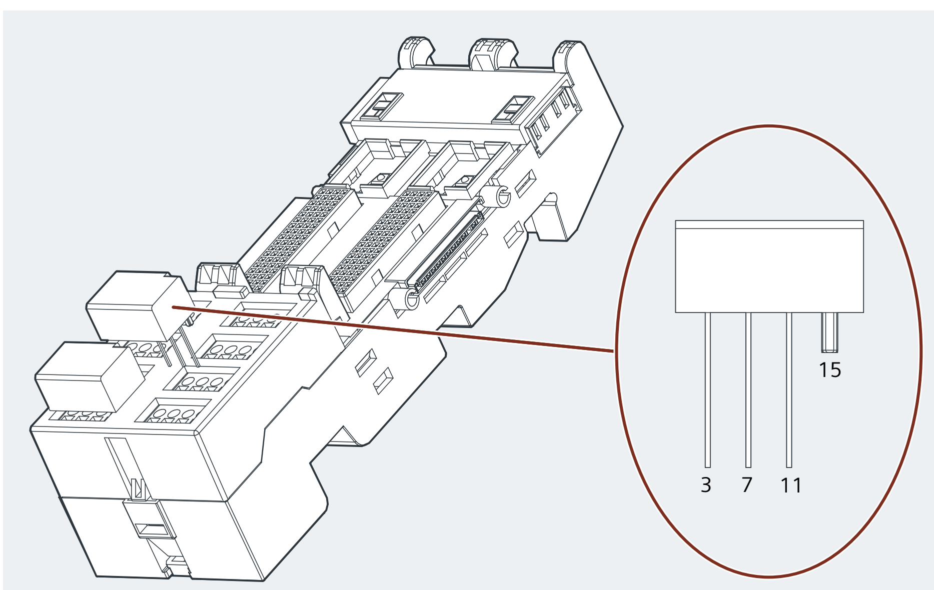


Figure 6-11 TC sensor module

Note

Please note:

For the application area of the NE21, use the sensor module as of function version FS02. You recognize the module by the date 2016 and the gray color.

6.5 Inserting and labeling the power supply, interface module, and electronic modules

6.5.1 Requirements

Properties

- The modules are mounted on the associated terminal modules.
- A labeling strip enables the interface module and the electronic modules to be labeled.
- When an interface or electronic module is plugged in for the first time, the coding element latches into place on the terminal module. This prevents the insertion of a wrong module. The interface module and the electronic modules are self-coding.

Requirements

Observe the plugging rules.

Required tools

4.5 mm screwdriver

6.5.2 Inserting power supply PS

Installing the Power Supply PS

1. Hang the power supply at the top of the bearing position of the terminal module TM-PS-A.
2. Swivel the Power Supply downwards until it latches on to the terminal module.
3. If your configuration includes a power supply for redundancy, then repeat steps 1 and 2 on the TM-PS-B terminal module.

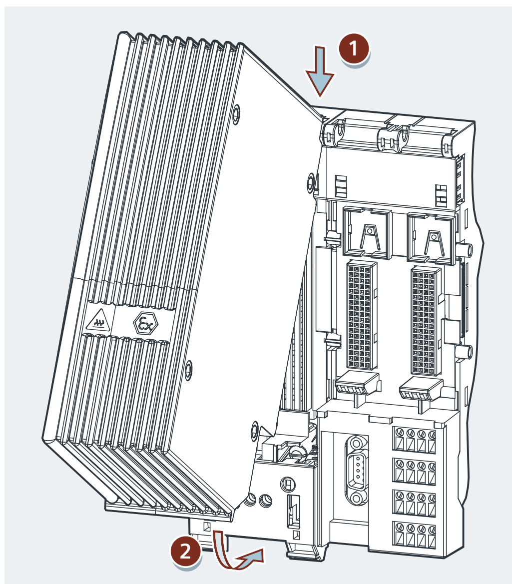


Figure 6-12 Installing the Power Supply PS

> ⚠ **CAUTION**
>
> **Danger of crushing!**
>
> Despite its small size, the Power Supply PS weighs 2.7 kg because it is compact. Therefore, please make sure to hold the Power Supply PS firmly in your hand.

Uninstalling the Power Supply PS

1. Operate the slide with the 4.5 mm screwdriver on the bottom of the terminal module TM-PS-A or TM-PS-B and pull it downward until it engages.
2. Swivel the power supply out of the bearing position of the terminal module TM-PS-A or TM-PS-B.

⚠ CAUTION
Danger of burns
The enclosure of the power supply PS can reach a temperature of up to 90 °C during operation. There is a danger of burning!

⚠ WARNING
Death or serious injury may occur if the following precautions are not taken.
If a power supply is disconnected too early, sparking could cause an explosion.
After unlocking a power supply of the ET 200iSP, wait at least 2 minutes before removing the power supply in a potentially explosive atmosphere.

6.5.3 Inserting and labeling the interface module and electronic modules

Installing and labeling interface module and electronic modules

1. Hang the interface or electronic module on the top of the bearing position of the terminal module.
2. Swing the interface or electronic module down until it latches onto the terminal module.

3. Label the module using the enclosed labeling strips.
4. Then insert the labeling strip back into the interface or electronic module.

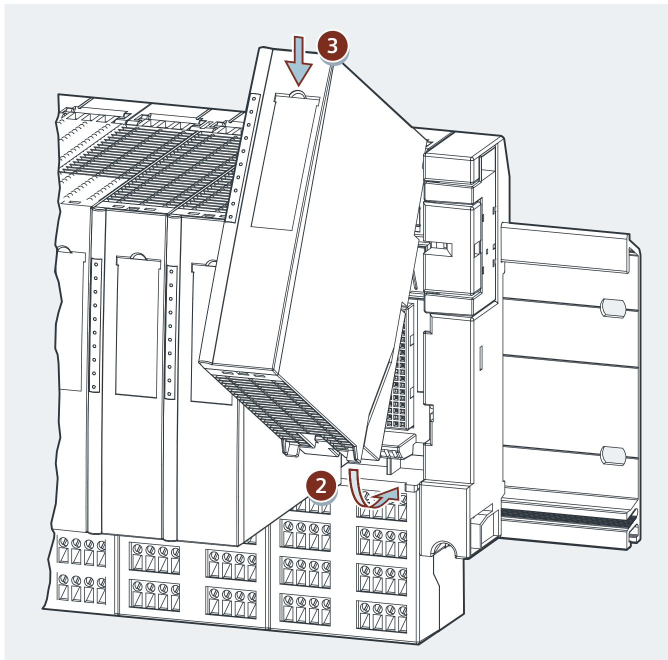


Figure 6-13 Installing and labeling interface and electronic modules

⚠ **WARNING**
Make sure that the assignment between terminal and electronic module is correct for your application.

Note

If a gap (of an electronic module) occurs due to the ET 200iSP configuration, the following rules apply:

- The gap is located at the last slot of the ET 200iSP: Insert the slot cover (or a reserve module) into this gap.
- The gap is at a different slot (for electronic modules): Insert a reserve module into this gap.

Removing interface module and electronic modules

1. Only with IM 152-1PN: Remove the transceiver.
   If the transceivers are still plugged in, they could be damaged with the screwdriver.
2. Use the screwdriver to operate the latch on the underside of the interface or electronic module.
3. Swivel the module upwards.
4. Remove the module from the bearing position of the terminal module.

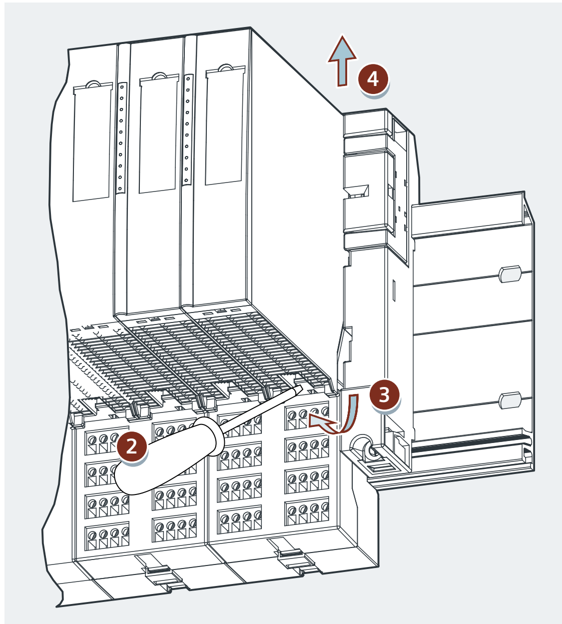


Figure 6-14 Removing the interface and electronic modules

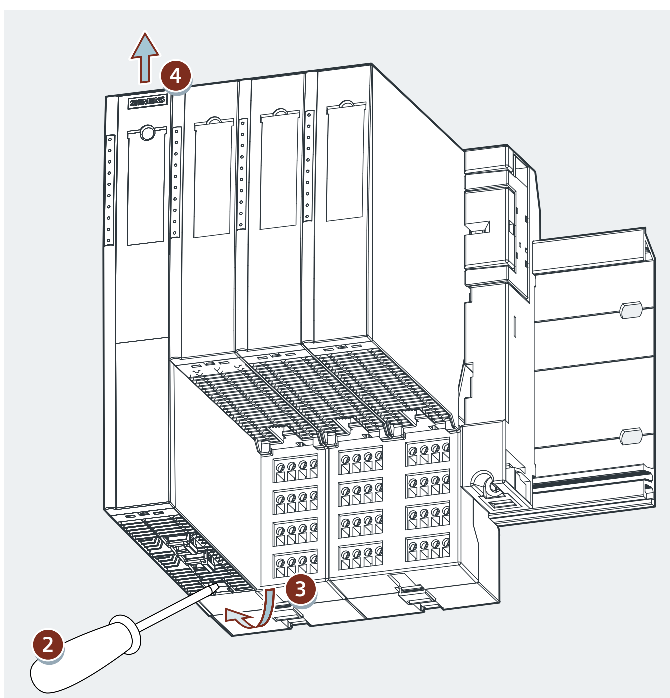


Figure 6-15 Removing the IM 152-1PN interface module

Replace defective interface or electronic module

You have already removed the interface or electronic module:

1. Remove the removable part of the coding element from the new interface or electronic module. The coding element is located on the underside of the interface or electronic module.
2. Mount the new interface or electronic module (same type) onto the terminal module until it audibly clicks into place.
3. Label the new interface or electronic module.

Note

Check the coding element before you install the new interface or electronic module.

Changing the type of an electronic module

You have already pulled the electronic module:

1. Press the coding element out of the terminal module using the screwdriver.
2. Plug this coding element onto the used electronic module.
3. Mount the new electronic module (different type) on the terminal module until it audibly latches into place.
4. Label the new electronic module.

DANGER

If you make changes to the coding, then this can lead to dangerous states in your plant. In this case, you must check the installation and adjust it if necessary. Please also observe the safety data of the electronic module.

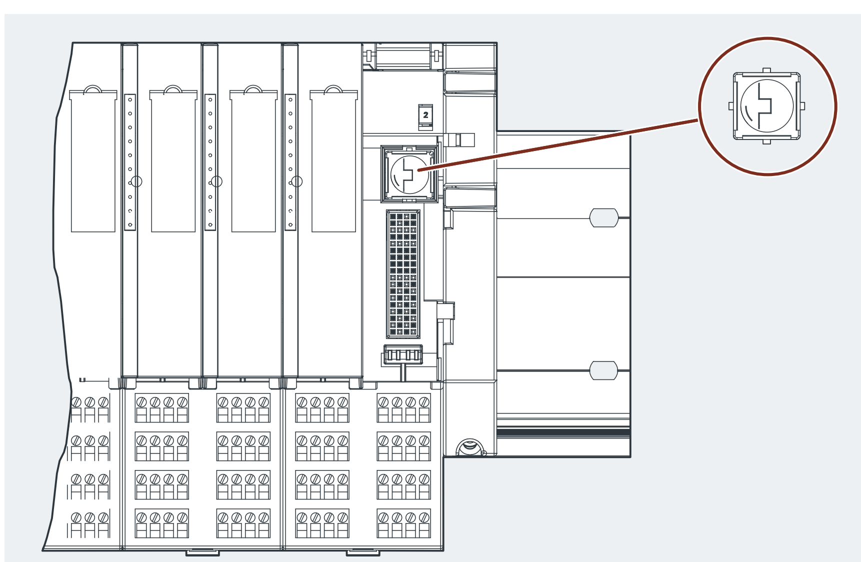


Figure 6-16 Type change of an electronic module

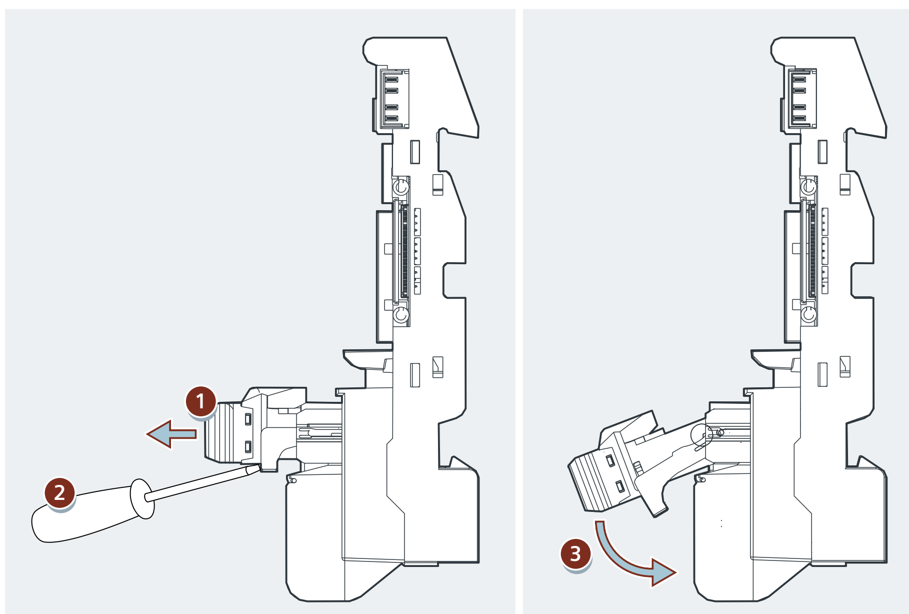
See also

Modular system (Page 59)

6.5.4 Inserting and labeling electronic modules 2 DO Relay UC60V/2A

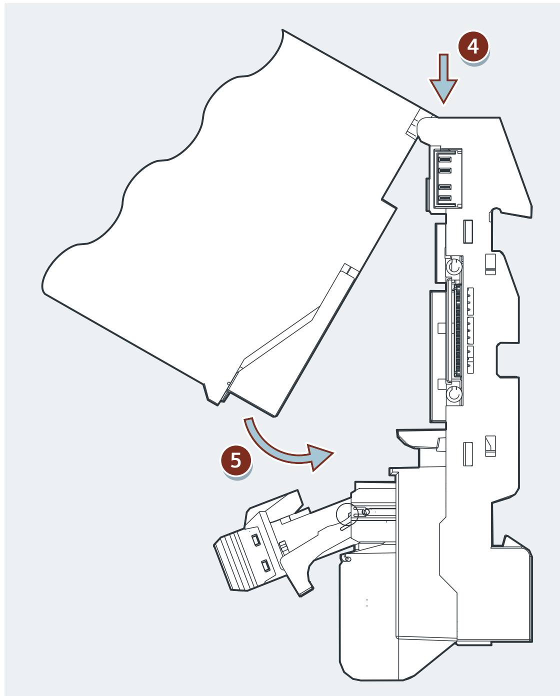
Mount and label electronic modules 2 DO Relay UC60V/2A

1. Pull out the Ex d disconnecting plug as far as it will go.
2. Use a screwdriver to loosen the locking lever from the latch and swivel the lever down.
3. Pull out the Ex d disconnecting plug further forward as far as it will go, it will fold down in this position.

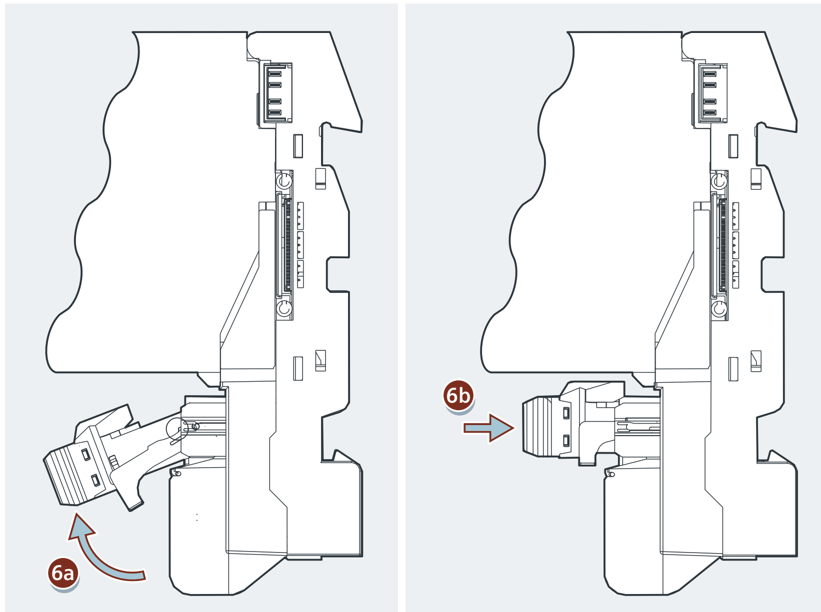


4. Hang the top of electronic module 2 DO Relay UC60V/2A in the bearing position of the terminal module.

5. Push in the bottom of the electronic module 2 DO Relay UC60V/2A power supply until it engages on the terminal module.



6. Swing the Ex d disconnecting plug back into the horizontal position and push it in backwards to the end stop. Pay attention that the locking lever is flush with the plug and is engaged.



7. Label the electronic module using the labeling strips provided and reinsert the labeling strips into the electronic module.

Note

If a gap (of an electronic module ET 200iSP) occurs due to the 2 DO Relay UC60V/2A configuration, the following rules apply:

- The gap is located at the last slot of the ET 200iSP: insert the slot cover (or a reserve module as of product version 3 or later) in this gap.
- The gap is located at another slot (for the electronic module 2 DO Relay UC60V/2A): insert a reserve module (as of product version 3) in this gap.

Uninstalling electronic modules 2 DO Relay UC60V/2A

1. Follow steps 1 to 3, see Installing and labeling electronic modules 2 DO Relay UC60V/2A.
2. Use the screwdriver to operate the catch on the underside of the electronic module.
3. Swing the electronic module upwards.
4. Remove the module from the bearing position of the terminal module.

Replacing a defective electronic module

You have already uninstalled the electronic module:

1. Remove the removable part of the coding element from the new electronic module. The coding element is located on the underside of the electronic module.
2. Install the new electronic module (same type) on the terminal module, checking for an audible latching sound.
3. Follow steps 4 to 7, see Installing and labeling electronic modules2 DO Relay UC60V/2A.

Note

Check the coding element before you install the new interface or electronic module.

6.5.5 Pulling and plugging optical transceivers

Compatibility of the optical transceivers

The IM 152-1PN interface module has SFP sockets for two optical transceivers. Only one type of optical transceiver is supported. Only this type of optical transceiver is approved for use in hazardous areas.

If the interface module detects another optical transceiver, a diagnostic interrupt is triggered.

WARNING

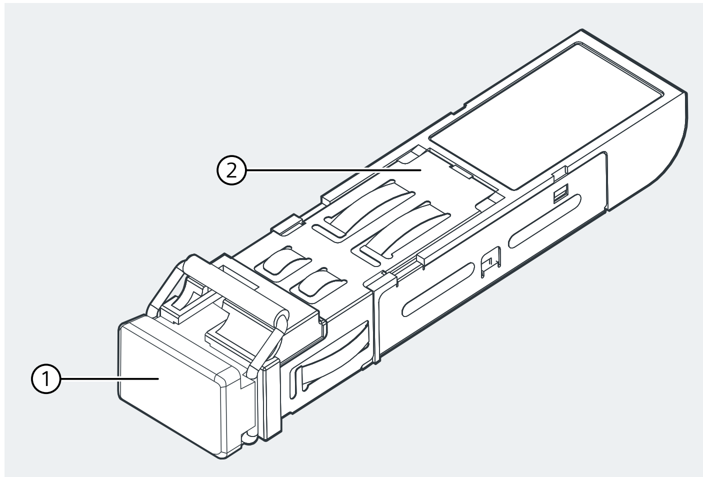
Danger of explosion with wrong transceiver

The IM 152-1PN only works with intrinsically safe SFP transceiver A5E51793919. Plugging in other transceivers may cause explosions.

Do not plug another transceiver into the IM 152-1PN.

The optical transceivers can also be removed and replaced during operation, even in the hazardous area.

Mechanical design



① Blanking plugs
② SFP transceiver

Figure 6-17 SFP transceiver

Unused transceivers must be sealed with blanking plugs to protect the optical interface. The blanking plugs are located in the optical transceiver when it is delivered.

Inserting and wiring the optical transceiver

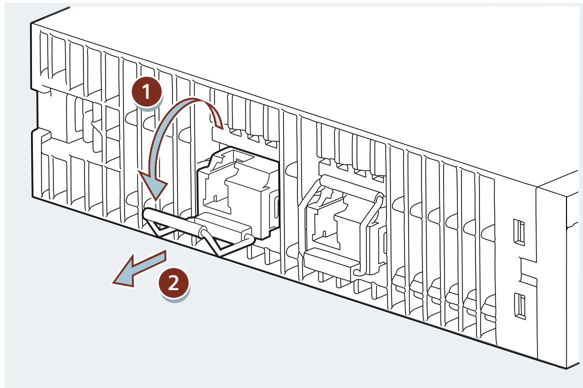
1. Remove the blanking plug of the SFP socket of the IM 152-1PN interface module.
2. Insert the optical transceiver into the IM 152-1PN until the transceiver snaps into place.
3. Remove the blanking plug of the optical transceiver.
4. Insert the end of the fiber-optic cable into the optical transceiver until the cable snaps into place.

Replacing optical transceivers

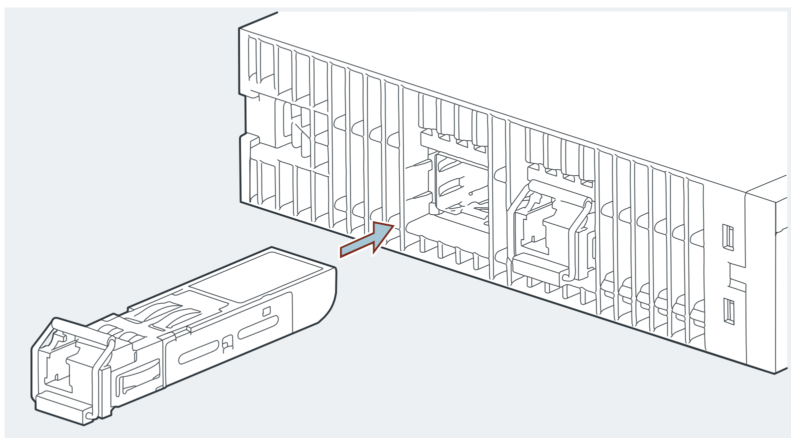
While one transceiver is being replaced during operation, the other transceiver remains plugged in to maintain device communication.

1. During operation of the IM 152-1PN, check the LED of the other SFP connection to prevent device communication from being interrupted.
   Before replacing transceiver 1, check that the "LK 2" LED is green.
   Before replacing transceiver 2, check that the "LK 1" LED is green.
2. Pull the fiber-optic cable out of the optical transceiver.
3. Flip the clip of the optical transceiver forward (away from the IM 152-1PN) to unlatch the transceiver.
   If you cannot open the clip with your fingers, use a screwdriver to open the clip.

4. Pull the (old) optical transceiver out of the IM 152-1PN.



5. Insert the (new) optical transceiver into the IM 152-1PN until the transceiver snaps into place.



6. Insert the end of the fiber-optic cable into the optical transceiver until the cable snaps into place.
7. Check that the LEDs "LK 1" and "LK 2" of the IM 152-1PN are lit green.
   Both LEDs must be green to prevent loss of the data connection during operation.

6.5.6 Plugging and pulling the fiber-optic cable into the transceiver

Cable pulling

Observe the following points when pulling fiber-optic cables:

- Note the permissible pull forces for the respective fiber-optic cable in the associated data sheet and adhere to them.
- Avoid laying cable out (longer unwinding) before pulling in the cable.
- If possible, lay the fiber-optic cable directly from the cable reel.
- Do not unwind the fiber-optic cable laterally over the reel flange (risk of twisting).
- If possible, use a cable pull sock when pulling in the fiber-optic cable.

- Observe the specified bending radii when laying the cable.
- Do not use lubricants containing grease or oil.
  You can use the lubricants listed below to facilitate pulling in the fiber-optic cables.
  - Yellow ground (wire-pulling, lubricant from Klein Tools; 51000)
  - Soft soap
  - Dishwashing liquid
  - Talcum powder
  - Detergent

Pressure

Do not exert any pressure on the cable, for example, by the inappropriate use of clamps (cable quick-mount) or cable ties. Furthermore, you must prevent anyone from stepping on the fiber-optic cables.

Exposure to heat

The cables are sensitive to direct heat effects, i.e., the fiber-optic cable must not be worked on with a hot air gun or gas burner, as is practiced, for example, with shrink-on sleeve technology.

6.5.7 Installation of fiber-optic cables in the enclosure

Permissible bending radii for assembled cables

When laying the cables (6XV1847-2C) assembled by SIEMENS, the bending radii must not fall below the following values:

- When pulling in: 88 mm (multiple)
- After pulling in: 59 mm (once)

Use cable glands to avoid damage to the edges.

Note

When routing the cables, make sure that the two fiber-optic cables in a redundant system are always routed separately. The separate routing increases the availability and protects against possible double faults, e.g. in case of simultaneous interruption of the fiber-optic cables.

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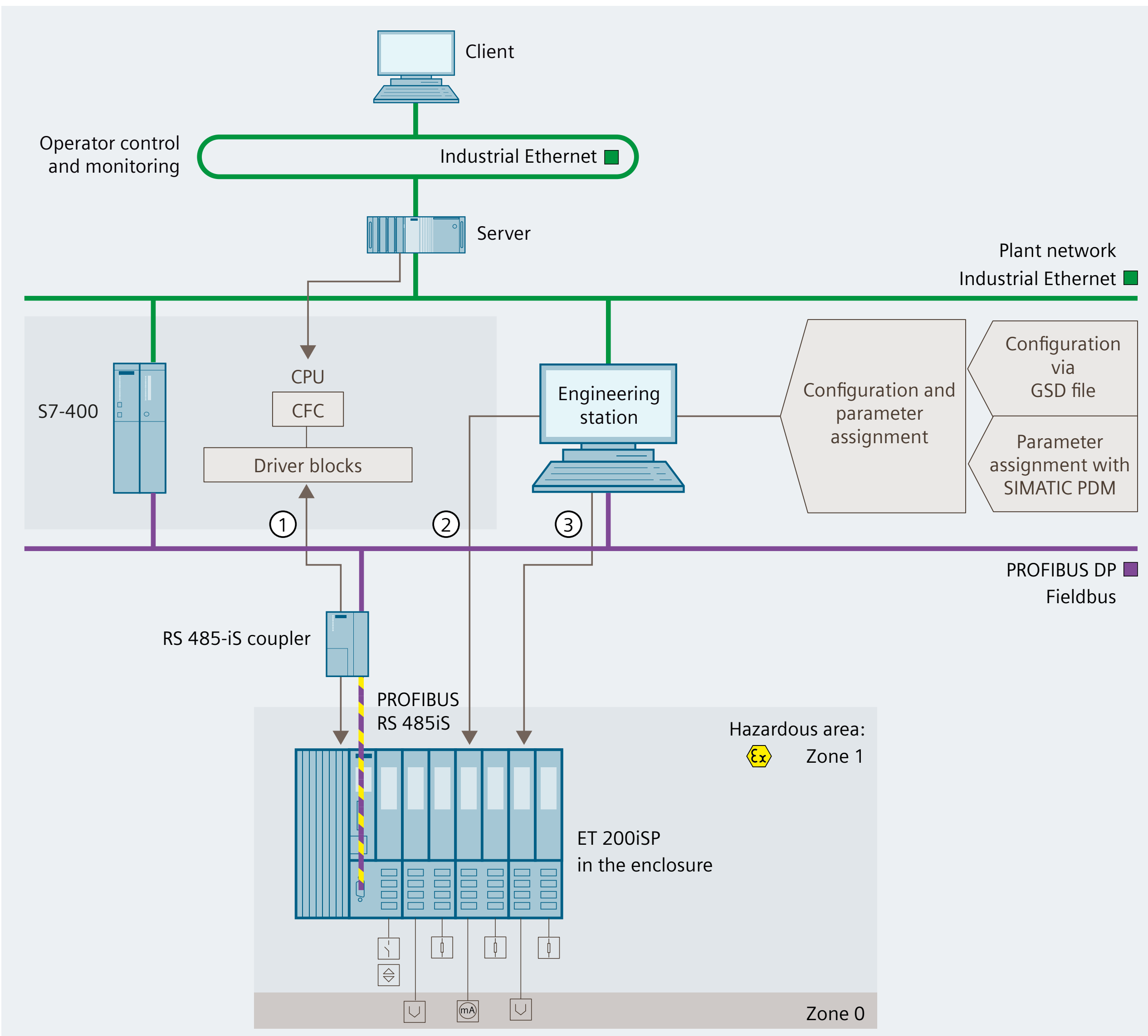
7 Commissioning and Diagnostics

7.1 Basics of commissioning and diagnostics

Principle of Configuration



① Cyclic data exchange:

- Payload inputs and outputs/value status

② Cyclic data exchange:
- Configuration
- Parameters
- Read identification and maintenance data
- Diagnostic interrupts

③ Acyclic data exchange:
- Parameters
- Read and write identification and maintenance data
- HART access

Figure 7-1 Principle of project engineering

Configuring

Configuration is the configuration and parameter assignment of the ET 200iSP with the PG.

Configuring

- Configuration with PROFINET connection
  During configuration you set the properties of the IO device (e.g. network parameters, module selection in HW Config). You configure the ET 200iSP with
  - Engineering tool (e.g. STEP 7; PCS 7)
- Configuration with PROFIBUS connection
  Only set the basic properties of the DP device during configuration (e.g. network parameters, module selection in HW Config). You configure the ET 200iSP with
  - Engineering tool (e.g. STEP 7; PCS 7)
  - COM PROFIBUS or with a suitable engineering tool (via the GSD file).

Note

Slots as reserve for changes during operation (CiR)

If you want to make changes during operation, you must observe the following:

Adjacent slots are not permitted as spare slots if the spare slots are followed by configured electronic modules.

Parameter assignment

During parameter assignment, you set the parameters of the ET 200iSP and the HART field devices.

- You the engineering tool you parameterize the ET 200iSP from HW Config.
- Outside PCS 7   STEP 7 parameterize the HART field devices with SIMATIC PDM. You must install SIMATIC PDM as a stand-alone version.
  If you want to configure HART field devices and do not use a parameter assignment tool integrated in the engineering for the HART field devices, we recommend SIMATIC PDM as parameter assignment tool.
- All modules have (ex works) a basic parameter assignment (see default settings for the parameters). After switching on the supply voltage of the ET 200iSP, the modules are initially in a safe state:
  – Digital inputs: input values 0, value status 0
  – Digital outputs: no current or voltage (no substitute values)
  – Analog inputs: Input value $7FFF_H$
  – Analog outputs: no current or voltage (no substitute values)
  – All parameters (which you set with SIMATIC PDM): Disabled
    After an error-free parameter assignment (with HW Config or SIMATIC PDM), the parameters are stored retentively in the modules. The next time you turn on the supply voltage at the Power Supply PS, the parameters will be adopted.
    The retentitively stored parameters are deleted if you set the PROFIBUS address to "0" and then switch the supply voltage at the power supply PS off and on.
    For PROFINET, the retentively stored parameters are deleted when you reset to factory settings.

Data exchange via PROFINET IO

Data exchange takes place between the CPU (e.g. S7-400) and the ET 200iSP. According to the PROFINET protocol, both cyclic and acyclic data are transmitted.

In the process control system, visualization of this data is possible through the specific drivers and in the online mode of the charts (CFC and SFC). The data are processed in the CPU and then displayed on the operator control and monitoring system.

Cyclic data exchange via PROFIBUS DP

Data exchange takes place between the CPU (e.g. S7-400) and the ET 200iSP.

The cyclic payload of the inputs and outputs, including the value status of the inputs, are transferred.

For the process control system, a visualization of this data is possible through the PCS 7 driver and the CFC (Continuous Function Chart). The data is prepared in the CPU and then shown in the OS.

Acyclic data exchange via PROFIBUS DP

An acyclic data exchange takes place between the SIMATIC PDM and the PG/PC (ET 200iSP). The ET 200iSP is configured via acyclic data exchange. In addition, identification and maintenance data is transmitted and displayed in SIMATIC PDM.

- Diagnostics and interrupts (with S7 DP device and DPV1 device)
- Data records

Software requirements

Table 7-1 Software requirements

Configuration software used	Version	Explanations
STEP 7	PROFINET: STEP 7 as of V5.7 SP1 and current hardware update	The ET 200iSP is included in the hardware catalog of HW Config. You configure and parameterize the ET 200iSP with HW Config.
	PROFIBUS: STEP 7 as of V5.3 SP1 and current hardware update	
STEP 7 and SIMATIC PDM (SIMATIC PDM is integrated and available as "stand-alone" version)	STEP 7 as of V4.02	You need the GSD file from the ET 200iSP and configure with HW config...
	PROFINET: SIMATIC PDM as of V9.2.2	... and configure them with SIMATIC PDM.
	PROFIBUS: SIMATIC PDM as of V6.0	
PCS 7 (contains, among other things, STEP 7 and SIMATIC PDM)	PROFINET: PCS 7 as of V9.1 SP2	See documentation for PCS 7
	PROFIBUS: PCS 7 as of V6.1	
PCS neo	PROFINET: PCS neo as of V4.0	See documentation for PCS neo
	PROFIBUS: PCS neo as of V3.0	
TIA Portal	PROFINET: TIA Portal as of V18	See documentation for TIA Portal
	PROFIBUS: TIA Portal as of V13	
COM PROFIBUS and SIMATIC PDM (SIMATIC PDM is integrated and available as "stand-alone" version)	COM PROFIBUS as of V5.0	You need the GSD file from the ET 200iSP and configure with COM PROFIBUS...
	PROFINET: SIMATIC PDM as of V9.2.2	... and configure them with SIMATIC PDM.
	PROFIBUS: SIMATIC PDM as of V5.2	
Other configuration software and SIMATIC PDM (SIMATIC PDM is integrated and available as "stand alone" version)	Other configuration software (see manufacturer for version)	You need the GSD file from the ET 200iSP and configure with a suitable configuration software...
	PROFINET: SIMATIC PDM as of V9.2.2	... and configure them with SIMATIC PDM.
	PROFIBUS: SIMATIC PDM as of V5.2	

Note

If you configure the ET 200iSP in STEP 7 with the GSD file, then SIMATIC PDM is required for parameter assignment!

7.2 ET 200iSP on PROFIBUS as DPV0, S7 DP or DPV1 device

ET 200iSP on PROFIBUS as DPV0, S7 DP or DPV1 device

The ET 200iSP can be operated either as DPV0, S7 DP or as DPV1 device.

The respective higher-level systems must be able to process the required data.

The following table compares the functions.

Table 7-2 Comparison of DPV0, S7 DP and DPV1

<table>
<tr><th colspan="2">Function</th><th>DPV0 device</th><th>S7 DP device</th><th>DPV1 device</th><th>Comment</th></tr>
<tr><td colspan="2">Parameter assignment and configuration with GSD file</td><td>X</td><td>---</td><td>X</td><td></td></tr>
<tr><td colspan="2">Configuration and parameter assignment with HW Config</td><td>X[1]</td><td>X</td><td>X[1]</td><td></td></tr>
<tr><td colspan="2">Cyclic data exchange</td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td rowspan="2">Acyclic data traffic (read/write data record)
• Free access to parameters on the field device
• Reassignment of parameters of the application process</td><td>Class 1 services (parameter assignment master, e.g. PLC)</td><td>---</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Class 2 services (for example, PD/OP)</td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td colspan="5">Diagnostics</td><td rowspan="9">One interrupt can be reported per diagnostic frame. With DPV1 and S7 DP, an interrupt consists of device diagnostics accompanied by an acknowledgment mechanism that does not exist for DPV0.</td></tr>
<tr><td colspan="2">• Identifier-related diagnostics:</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">• Module status</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">• Channel-related diagnostics</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="5">Interrupts</td></tr>
<tr><td colspan="2">• Diagnostic interrupt</td><td>---</td><td>X[2]</td><td>X</td></tr>
<tr><td colspan="2">• Hardware interrupt</td><td>---</td><td>X[2]</td><td>X</td></tr>
<tr><td colspan="2">• Pull/plug interrupt</td><td>---</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">• Update interrupt</td><td>---</td><td>---</td><td>X</td></tr>
</table>

Function	DPV0 device	S7 DP device	DPV1 device	Comment
• Time stamping	---	X	X	
[1] If you configure the ET 200iSP with the GSD file (in HW Config), then you need SIMATIC PDM for the parameter assignment. [2] With the S7 DP device, diagnostic and hardware interrupts are only signaled when the CPU is in RUN mode.				

DPV0

"DPV0" mode designates a mode for communication between devices on the PROFIBUS.

The mode includes the basic functions of the PROFIBUS DP communication protocol

- Cyclic data exchange between control system and devices
- Configuration via GSD files
- Diagnostics

DPV1

"DPV1" mode is a further development of the original PROFIBUS standard *IEC 61784-1:2002 Ed1 CP 3/1*.

DPV1 designates a mode for communication between devices on the PROFIBUS.

The mode extends the functions of the PROFIBUS DP communication protocol compared to "DPV0" mode. The changes are specified in the IEC 61158 standard:

- Acyclic data exchange between control system and devices
- Integration into engineering systems via EDD or FDT / DTM
- Transferable PLC software function blocks (IEC 61131-3)
- Fail-safe communication (PROFIsafe)
- Interrupts (hardware interrupt, status interrupt, update interrupt, vendor-specific interrupt, diagnostic interrupt, plug interrupt, pull interrupt)

7.3 Project engineering with STEP 7

Properties

- The ET 200iSP is included in the STEP 7 hardware catalog.
- Diagnostic interrupts, hardware interrupts, pull/plug interrupts (only for S7-400) and time stamping are supported.

Requirements

The required software was installed on the PG/ PC or PCS 7 ES.

Procedure for configuring and assigning parameters

1. Start the SIMATIC Manager.
2. Configure the ET 200iSP with HW Config.
   – Create a new project
   – Drag modules from the hardware catalog to the configuration table
3. Configure the time stamping (option).
4. Double-click the first module of the ET 200iSP in the configuration table and set the parameters.
5. Parameterize the other modules of the ET 200iSP.
6. Save the configuration or download the configuration (e.g. typically to the CPU 410-5H):
   – Configuration with IM 152-1PN: In the IO controller
   – Configuration with IM 152-1DP: In the DP master.

7.4 Project Engineering with GSD File and SIMATIC PDM

Integration of the station

The integration of the station into the automation system depends on the type of network used:

- When connected via PROFINET IO, the station is integrated as an IO device with an interface module IM 152-1PN.
- When connected via PROFIBUS DP, the station is integrated as a DPV0/DPV1 device with an IM 152-1DP interface module.

Requirements

- The required software was installed on the PG/ PC or PCS 7 ES.
- You need the GSD file.
  - PROFINET GSD file xxx-GSD-FILE
  - PROFIBUS GSD file: SI028110.GSG

  You can download these on the Internet from Service & Support (https://www.siemens.com/automation/service&support).
  The GSD file is integrated into the configuration software as described below:

  Note

  The GSD file for the ET 200iSP is based on revision 4. Result: Not all parameters are available in COM PROFIBUS.

  Make sure that your configuration tool supports GSD files as of revision 4; all parameters will then be available.

STEP 7 as of V4.02	COM PROFIBUS as of V5.0
1. Star STEP 7 an call in HW Config the menu command **Options > Install new GSD file**. 2. In the following dialog, select the GSD file to be installed and confirm with OK. The ET 200iSP is displayed in the hardware catalog in the following directory: – PROFINET GSD integrated: In the PROFINET IO directory – PROFIBUS GSD integrated: In the PROFIBUS DP directory	1. Copy the GSD file from ET 200iSP to the COM PROFIBUS directory: **...COMPB5\GSD** (default setting). Copy the bitmap file to the directory **...COMPB5\BITMAPS**. 2. Start COM PROFIBUS and call the menu command **File > Read GSD file**. The ET 200iSP is displayed in the hardware catalog during the device configuration.

- A suitable interface is required so that you can work online with SIMATIC PDM:
  - For PROFINET IO: Standard access of the configuration tool to the AS and further to the IO device
  - For PROFIBUS DP e.g., CP5611 (6GK1561-1AA00). The CP must be set to the PROFIBUS DP interface (in the SIMATIC manager: Menu command **Options > Set PG/PC interface**).

WARNING

Configuration with GSD file and SIMATIC PDM

If you configure the GSD file and SIMATIC PDM, then you create the configuration in 2 steps:

1st step: Configuring by means of GSD file

2nd step: Parameter assignment with SIMATIC PDM

Make sure that the configuration (1st step) is consistent with the parameter assignment with SIMATIC PDM (2nd step). The assignment of the slots from step 1 must match the parameters generated from SIMATIC PDM (step 2).

Procedure for configuring

STEP 7 as of V4.02	COM PROFIBUS as of V5.0 or other configuration software
1. Start the SIMATIC Manager. 2. Integrate the GSD file into HW Config (see requirements). 3. Configure the ET 200iSP with HW Config. – Create a new project – Drag modules from the hardware catalog to the configuration table 4. Save the configuration or download this to the station of ET 200iSP.	1. Start COM PROFIBUS or the configuration software. 2. Integrate the GSD file into COM PROFIBUS or the configuration software (see Requirements). 3. Configure the ET 200iSP with COM PROFIBUS or the configuration software. 4. Save the configuration and download the configuration to the DP master.

Procedure for parameter assignment of electronic modules

1. Start the SIMATIC Manager.
2. Select the process device network view as the default view using the menu command **Options > Settings > View > Process network view**.
3. Create a new project with the menu command **File > New**. In the "New" dialog box that appears, enter the desired project name and confirm the entry with "OK".
4. Now select the networks symbol, choose **Insert new object > PC** and **Insert new object** in the shortcut menu
   – PROFINET IO: **PROFINET IO system.**
   – PROFIBUS DP: **PROFIBUS DP master system.**
5. In the left-hand pane of the window, select the PC icon. An icon labeled DP Interface now appears in the right-hand pane of the window. Select it and choose "Object properties" in the shortcut menu.
   In the dialog box, select "PROFIBUS DP networks" under networks and confirm with "OK".
6. Select the network to which you want to connect the ET 200iSP.

Action	PROFINET	PROFIBUS
In the shortcut menu, select	Insert new object > PROFINET IO.	Insert new object > Remote I/O.
In the following dialog box, enter:	• **Name:** Designation of the ET 200iSP station (e.g. ET 200iSP). • **Address:** PROFINET IO address that you have set on the interface module. • **Subnet mask:** Parameters of the network on the IO controller	• **Name:** Designation of the ET 200iSP station (e.g. ET 200iSP). • **Address:** PROFIBUS address that you have set on the interface module. • **Number of "Remote I/O" objects**: Number of ET 200iSP stations that you parameterize.
Confirm with "OK". The right part of the window displays the new ET 200iSP station.		

7. Select the remote I/O object created in the previous step (ET 200iSP), select **Insert new object > Remote I/O module** in the shortcut menu. In the following dialog box, enter:
   Name: Designation for the module (e.g. 8 DI NAMUR).
   Address: Slot of the 1st electronic module in the ET 200iSP station.
   Number of "Remote I/O" objects: Number of electronic modules in the ET 200iSP station.
   Confirm with "OK". Result: The electronic modules are now displayed in the right-hand pane of the window.
8. Select the first remote I/O object (electronic module in the left pane of the SIMATIC Manager), select **Open objects** in the shortcut menu. In the following dialog box "SIMATIC PDM device selection" select **SIEMENS > ET 200iSP > Modules** and confirm with "OK".
9. In the following dialog box, select "Specialist" as the user and confirm with "OK". In this mode, you can assign parameters. Result: SIMATIC PDM starts.
10. After SIMATIC PDM has been started, select the corresponding electronic module as "Module type". Then click in one of the gray fields to update the window. Result: The parameters and I&M of the electronic module are displayed.
11. Now set the parameters of the electronic module. Save the changes with the menu command **File > Save** and download the parameters with the menu command **Device > Download to device** in the electronic module. Exit SIMATIC PDM.
12. For each of the ET 200iSP objects (electronic modules), proceed as described in points 8 to 11.

Procedure for assigning parameters to the interface module

1. Select the remote I/O object (ET 200iSP in the left pane of the SIMATIC Manager), select **Open objects** in the shortcut menu.
   In the following dialog box "SIMATIC PDM device selection" select **SIEMENS > ET 200iSP > Header-end** and confirm with "OK".
2. In the following dialog box, select "Specialist" as the user and confirm with "OK". In this mode, you can assign parameters. Result: SIMATIC PDM starts.
3. Now set the parameters of the interface module. Save the changes with the menu command **File > Save** and download the parameters to the interface module with the menu command **Device > Download to device**. Exit SIMATIC PDM.

Procedure for parameter assignment of all modules of the ET 200iSP

1. Select the remote I/O object (ET 200iSP in the left pane of the SIMATIC Manager), select **Open objects** in the shortcut menu.
2. In the following dialog box "SIMATIC PDM device selection" select **SIEMENS > ET 200iSP > Header-end** and confirm with "OK".
3. In the following dialog box, select "Specialist" as the user and confirm with "OK".
4. Load all parameters of the modules (menu command **File > Full upload to PG/PC**).
5. Set the parameters for all required modules. In the left pane of SIMATIC PDM you can navigate to all modules of the ET 200iSP.

6. Save the changes (menu command **File > Save**) to update the file.
7. Load all parameters into the modules (menu command **Device > Full download to device**). Exit SIMATIC PDM.

Reference

You can find additional information on the parameter assignment in the documentation and online help of SIMATIC PDM.

7.5 Assigning Parameters for the ET 200iSP during Operation using SIMATIC PDM

Properties

- You can configure the modules during operation using SIMATIC PDM. Each new parameter assignment that is correct is applied by the module and retentively stored.
- Incorrect parameters are ignored. The module remains in the previous configuration state.
- Restarting the modules (after supply voltage of the ET 200iSP off ---> on) results in the currently retentively stored configuration being applied in the modules: LED "SF" of the electronic modules off
- Applying the retentively stored configuration in the modules is independent of the communication of the ET 200iSP to the higher-level component (IO controller/DP master).
- The outputs of the modules are controlled by the higher-level components (IO controller/ Class 1 DP master).

Requirements

- PROFINET: SIMATIC PDM as of V9.2.2 (integrated or "stand alone" version)
- PROFIBUS: SIMATIC PDM as of V6.0 (integrated or "stand alone" version)

Procedure for re-configuration

1. Start SIMATIC PDM.
2. Open the project.
3. Switch the view in the SIMATIC Manager: Menu command **View > Process Network View**.
4. Select the desired ET 200iSP module in the left part of the window. Select "Open objects" in the shortcut menu. Result: SIMATIC PDM starts.
5. Load the parameters and/or I&M of the module into the PG/PC.
6. Change the parameters and/or I&M.

7. Save the changes and load the parameters and/or identification and maintenance data into the module.
8. Control step: Load the parameters and/or I&M of the module into the PG/PC again and check the new parameter assignment.

Reference

You can find additional information on configuration in the documentation and online help of SIMATIC PDM.

7.6 Diagnostics Using the Process Image Input Table

Properties

In addition to the diagnostic messages via LED and module/bus diagnostics, the module provides information about the validity of each input signal - the value status. The value status is entered in the process image along with the input signal.

Value Status of the Digital Input Modules

The value status is additional binary information in a digital input signal. It is entered in the process image input table at the same time as the process signal and provides information on the validity of the input signal.

The value status is influenced by the wire break check/short-circuit, chatter monitoring, pulse stretching and validation check of changeover contacts.

- S7 format with value status
  - Input signal is valid: "1_B"
  - Input signal is invalid: "0_B"

Value status from the analog input modules

The input values of the analog input modules are stored in the process image of the inputs. For a measured value, the following value status is entered as input value:

- S7 format
  - Input signal is valid: No value status
  - Input signal is invalid: "$7FFF_H$" (bit 0 to 15 of the analog value)

Assignment of the inputs and value status in the PII

Each channel of the module is assigned a value status in the process image of the inputs. You can find the assignment in "Address space of the inputs and outputs (Page 435)".

Evaluation of the value status in PCS 7

The value status is evaluated via the PCS 7 channel driver.

1. The PCS 7 channel driver reads the value status from the process image of the inputs...
2. ...and uses it to form the quality code for PCS 7.

For a detailed description of the evaluation and processing of the respective input signals, refer to the help for the block library.

See also

Digital input module (Page 435)

PCS 7 documentation (https://support.automation.siemens.com/WW/view/en/10806846/130000)

7.7 Diagnostic interrupts of the transceiver

Diagnostic block OB82

Diagnostics of the interface module

OB82 is called if an incompatible transceiver is plugged in.

Diagnostics of the transceiver

In the dialog of the module status tab, you can display the following channel-specific diagnostic data for the selected transceiver:

Channel-specific diagnostics	Channel error type (CET)	Extended channel error type (ECET)	Meaning	Remedy
SFP – Temperature threshold violation (High)	0x8007	0x8001	The internal temperature exceeds the high alarm limit. The transceiver is too hot.	1. Check to ensure that the alarm limit is set to the correct value. 2. Check whether the ambient temperature of the IM is within the specified temperature range. 3. Replace the SFP transceiver. 4. Contact Technical Support.
SFP – TXBias threshold violation (High)	0x8007	0x8002	The TX Bias voltage exceeds the high alarm limit. The transmit diode current is too high.	1. Check to ensure that the alarm limit is set to the correct value. 2. Replace the SFP transceiver. 3. Contact Technical Support.
SFP – TXBias threshold violation (Low)	0x8007	0x8003	The TX Bias voltage drops below the low alarm limit. The transmit diode current is too low.	
SFP – TXPower threshold violation (High)	0x8007	0x8004	The optical TX power exceeds the high alarm limit. The sent optical power is too high.	
SFP – TXPower threshold violation (Low)	0x8007	0x8005	The optical TX power drops below the low alarm limit. The sent optical power is too low.	
SFP – RXPower threshold violation (High)	0x8007	0x8006	The optical RX power exceeds the high alarm limit. The received optical power is too high.	1. Check to ensure that the alarm limit is set to the correct value. 2. Check the remote SFP transceiver (same wavelength, optical transmit power). 3. Replace the SFP transceiver. 4. Contact Technical Support.

Channel-specific diagnostics	Channel error type (CET)	Extended channel error type (ECET)	Meaning	Remedy
SFP – RXPower threshold violation (Low)	0x8007	0x8007	The optical Rx power drops below the low alarm limit. The received optical power is too low.	1. Check to ensure that the alarm limit is set to the correct value. 2. Check the connected fiber-optic cable: Make sure that the connection to the local SFP transceiver and the remote SFP transceiver is correct. Check whether the type of fiber is the right one for the optical modules. 3. Verify the damping of the optical fiber. 4. Check the SFP transceiver (same wavelength; make sure that the optical transmit power does not drop below the low limit). 5. Replace the SFP transceiver. 6. Contact Technical Support.
SFP – RXLoss State indication	0x8007	0x8009	Loss of the RX signal.	1. Check the connected fiber-optic cable: Make sure that the connection to the local SFP transceiver and the remote SFP transceiver is correct. Check whether the type of fiber is the right one for the optical modules. 2. Verify the damping of the optical fiber. 3. Check the SFP transceiver (same wavelength; make sure that the optical transmit power does not drop below the low limit). 4. Replace the SFP transceiver. 5. Contact Technical Support.

Diagnostic block OB83

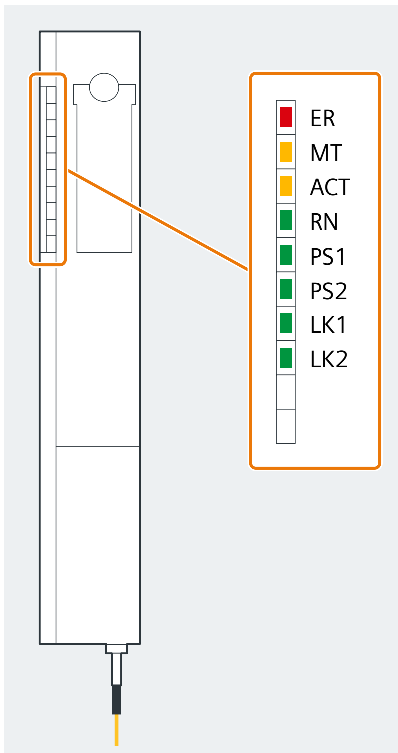
OB83 is called when an optical transceiver is pulled or plugged.

Failure in both transceivers

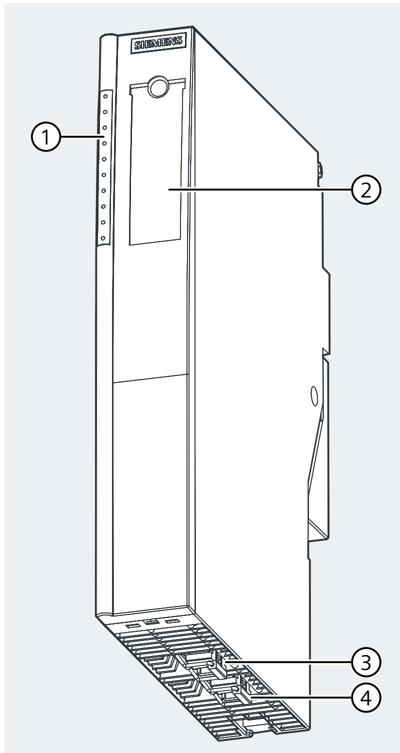
If both optical transceivers fail, the status is signaled by LEDs. The ERR and MT LEDs flash. This state can occur if both optical transceivers are pulled or are incompatible.

7.8 Status and error LEDs on the IM 152-1PN

Interface module IM 152-1PN



ER	Group error (red)
MT	Maintenance demanded (orange)
ACT	Active IM with redundancy (orange)
RN	Connection status (green)
PS1	Operating state Power Supply PS 1 (green, right PS)
PS2	Operating state Power Supply PS 2 (green, left PS)
LK1	Operating state transceiver 1 (green, front transceiver)
LK2	Operating state transceiver 2 (green, rear transceiver)



① LEDs
② Labeling strips
③ Transceiver 1
④ Transceiver 2

Figure 7-2 Interface module IM 152-1PN

Status and error LEDs on the IM 152-1PN

- LED PS1: On --> power supply is switched on at Power Supply 1
- LED PS2: On --> for Power Supply PS when redundancy is configured: power supply is switched on at Power Supply 2

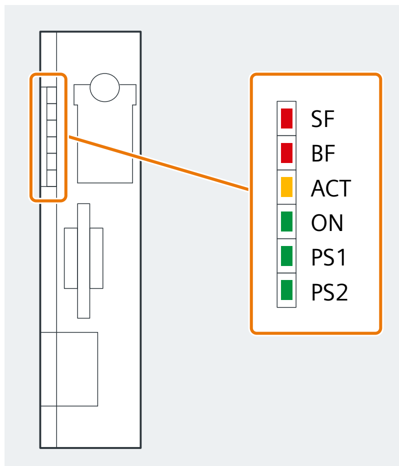
Table 7-3 Status and error LEDs on the IM 152-1PN

LEDs				Meaning	Remedy
ER	MT	ACT	RN		
Off	Off	Off	Off	No voltage is applied. Power supply PS or IM 152-1PN defective.	Turn on the power at the Power Supply PS. Replace the PS power supply or the IM 152-1PN.
On	On	On	On	Hardware test after power on.	
*	*	*	Flash-es	Device waits for communication to be set up (AR)	
*	*	*	On	Communication to the IO controller (AR) set up successfully	
*	On	*	On	Maintenance demanded	

LEDs				Meaning	Remedy
ER	**MT**	**ACT**	**RN**		
*	Flash-es	*	On	Maintenance required	Check the process wiring. Check the electronic modules.
*	*	On	On	Active data exchange with the input and output modules takes place via this interface module. The partner interface module can take over the data exchange. Valid only in R1 redundancy.	
*	*	Off	On	S1/S2 - Active data exchange with the input and output modules takes place via this interface module. R1 - No active data exchange with the input and output modules takes place via this interface module.	
*	*	Flash-es	On	Active data exchange with the input and output modules takes place via this interface module. The partner interface module cannot take over the data exchange.	
Flash-es	Flash-es	Flash-es	Flash-es	Flash test (STEP 7 - Feature for device identification) – Port LEDs are also flashing	
Flash-es	Flash-es	Flash-es	Off	Internal error has occurred (Fatal error)	
Flash-es	*	*	*	Diagnostics available	
* Not applicable					

7.9 Status and error LEDs on the IM 152-1DP

Interface module IM 152-1DP



SF	Group error (red)
BF	Bus fault (red)
ACT	Active IM with redundancy (yellow)
ON	Supply voltage (green)
PS1	Power Supply PS 1 status (green, right-hand PS)
PS2	Power Supply PS 2 status (green, left-hand PS)

Status and error LEDs on the IM 152-1DP

- LED PS1: On --> power supply is switched on at Power Supply 1
- LED PS2: On --> for Power Supply PS when redundancy is configured: power supply is switched on at Power Supply 2

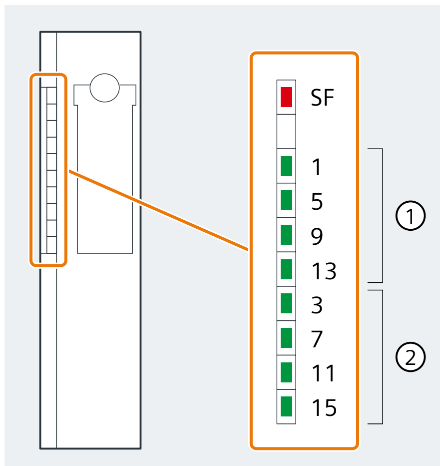
Table 7-4 Status and error LEDs on the IM 152-1DP

LEDs				Meaning	Remedy
SF	**BF**	**ACT**	**ON**		
Off	Off	Off	Off	No voltage is applied. Power supply PS or IM 152-1DP defective.	Turn on the power at the Power Supply PS. Replace the PS power supply or the IM 152-1DP.
on	on	on	on	Hardware test after power on.	---
Off	Off	*	on	Data exchange of the ET 200iSP with the DP master Preset and actual configuration match, no diagnostics.	---

LEDs				Meaning	Remedy
SF	BF	ACT	ON		
on	Off	*	on	Data exchange between the ET 200iSP and the DP master, there is at least one diagnostic and/or one deviation from the nominal and actual configuration.	Check the process wiring. Check the electronic modules. Check the preset and actual configuration (missing or wrong module).
*	on	*	on	No connection with the DP master (baud rate search): Cause: Communication via the network is interrupted.	Check the bus (is the bus connector inserted correctly). Check the terminating resistor and the RS 485-IS coupler.
*	Flashes	*	on	IM 152-1DP is incorrectly configured - there is no data exchange between the DP master and the ET 200iSP. Causes: Wrong network address. Inconsistent preset and actual configuration. Faults in the network.	Check the configuration (network address). Check the preset and actual configuration (missing or wrong module). Check the bus configuration (bus connector, terminating resistor, RS 485-IS coupler).
on	Off	*	on	Invalid network address. • PROFIBUS DP address 126 or 127 set. • PROFIBUS DP address changed without deleting retentive data.	For PROFIBUS DP • Set a valid PROFIBUS DP address on the IM 152-1DP. • If you have changed the PROFIBUS DP address, then delete the retentive data.
on	on	*	Off	Delete retentive data • Switch on with PROFIBUS DP address "0".	---
Off	Flashes at 0.5 Hz	*	Off	Retentive data is deleted, turn off.	Set the desired network parameters/ addresses before switching on the next time.
*	Off	on	on	The IM 152-1DP is exchanging data with the higher-level bus component and the electronic modules of the ET 200iSP. In redundancy mode, this IM 152-1DP is the **active** module of the ET 200iSP.	---
*	Off	Off	on	Voltage is applied to the IM 152-1DP. In redundancy mode, this IM 152-1DP is the **passive** module, i.e. there is no data exchange with the electronic modules.	---
Flashes at 0.5 Hz **	Off	Off	on	In redundancy mode, this IM 152-1DP is the **passive** module, and not ready for bumpless switchover (for example, associated CPU in STOP).	Bring the H-system to the redundant state.
Flashes 2 Hz	Flashes 2 Hz	Flashes 2 Hz	Flashes 2 Hz	The IM 152-1DP is in the safe state.	Pull and plug the IM 152-1DP. If the flash code continues to occur, contact Siemens Support.
* Not applicable ** After the transition to redundant operation, the SF LED flashes for another 20 s.					

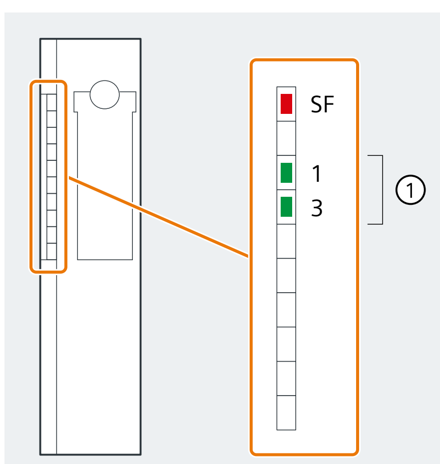
7.10 Status and error LEDs on the electronic modules of the ET 200iSP

Digital electronic modules



SF	Group error (red)
①	Status for input/output status (green)
②	Status for the input status (green)

Digital electronic module 2 DO Relay



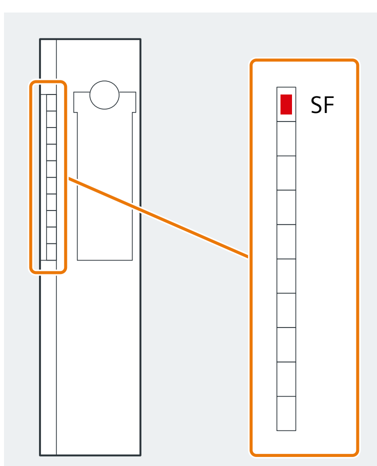
SF	Group error (red)
①	Status for input/output status (green)

Status and Error LEDs on the Digital Electronic Modules

Table 7-5 Status and Error LEDs on the Digital Electronic Modules

LEDs									Meaning	Remedy
SF	**1**	**5**	**9**	**13**	**3**	**7**	**11**	**15**		
on									Wrong module inserted or diagnostic message is present.	Analyze the diagnostic data.
	on								Input DI_0 or counter output 1 or output DO_0 activated	
		On							Input DI_1 or counter output 2 or output DO_1 activated	
			On						Input DI_2 or GATE 1 or output DO_2 activated	
				On					Input DI_3 or GATE 2 or output DO_3 activated	
					On				Input DI_4 or Reset counter 1 activated	
						On			Input DI_5 or reset counter 2 enabled	
							On		Input DI_6 or Reset output 1 activated	
								on	Input DI_7 or Reset output 2 activated	

Analog electronic modules



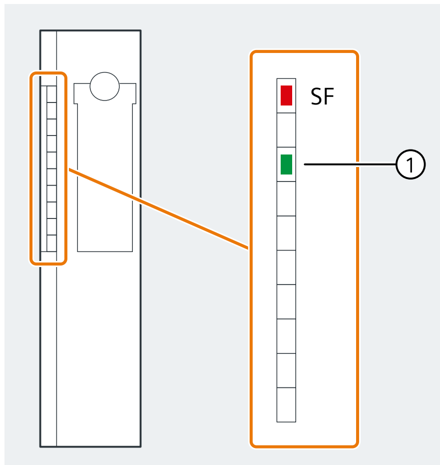
SF Group error (red)

Status and error LEDs on the analog electronic modules

Table 7-6 Status and error LEDs on the analog electronic modules

LEDs	Meaning	Remedy
SF		
on	Wrong module inserted or diagnostic message is present.	Analyze the diagnostic data.

WATCHDOG module



SF Group error (red)
① Bit 0: Status (green)

Status and error LEDs on the WATCHDOG module

Table 7-7 Status and error LEDs on the WATCHDOG module

LEDs		Meaning	Remedy
SF	**Bit 0**		
on		Wrong module inserted or diagnostic message is present.	Analyze the diagnostic data.
	Flashes	The LED flashes at the assigned frequency (toggle: 0.1 Hz / 0.5 Hz; 1 Hz; 2 Hz)	---
	on	Output signal (bit 0 active)	---

7.11 Commissioning and starting up the ET 200iSP

7.11.1 Safety Information

Safety information

Note

You must observe the national regulations during commissioning.

During functional checks, you must observe the guidelines according to EN 60079-17. This standard contains the provisions of international standard IEC 60079-17.

Perform tests

Note

You must ensure the safety of your installation. Before the final commissioning of a system, you should perform a complete function test and the necessary safety tests.

In the tests, also plan for foreseeable possible errors. In this way, you avoid putting persons or plant at risk during operation.

7.11.2 Requirements for commissioning

Requirements

Table 7-8 Requirement for commissioning

<table>
<tr><th>Step</th><th>Prior Activity</th><th>See...</th></tr>
<tr><td>1</td><td>ET 200iSP is installed.</td><td>Section "Installing (Page 101)"</td></tr>
<tr><td rowspan="3">2</td><td>The network parameters of the ET 200iSP are set:</td><td>Section "Wiring (Page 119)"</td></tr>
<tr><td>• Network parameters
(Ethernet address; subnet mask)</td><td>Section "Configuring the PROFINET connection (Page 179)"</td></tr>
<tr><td>• Setting the PROFIBUS address,</td><td>Section "Configuring PROFIBUS DP address (Page 179)"</td></tr>
<tr><td>3</td><td>ET 200iSP is wired.</td><td>Section "Wiring (Page 119)"</td></tr>
<tr><td>4</td><td>Zone 1, zone 21, zone 2 and zone 22: Additional check (inspection) of the installation and wiring of ET 200iSP, connections, enclosure and supply line.</td><td></td></tr>
<tr><td>5</td><td>ET 200iSP is configured (and parameters assigned)</td><td>Section "Basics of commissioning and diagnostics (Page 155)"</td></tr>
<tr><td>6</td><td>Supply voltage for the higher-level bus components is switched on.</td><td>Documentation of the higher-level bus components
• IO controller and media converter
• DP master and PROFIBUS coupler</td></tr>
<tr><td>7</td><td>Higher-level bus components are in RUN mode</td><td>Documentation of the higher-level bus components
• IO controller and media converter
• DP master and PROFIBUS coupler</td></tr>
</table>

7.11.3 Configuring the PROFINET connection

Properties

With the PROFINET IO parameters you define at which address the ET 200iSP distributed I/O device is addressed at the PROFINET IO.

Requirements

- The network parameters are set in the hardware configuration of the interface module and are downloaded to the interface module.
- An IO controller with a PROFINET IO system and an ET 200iSP is created.
- The required network address and the subnet mask are known.
- The MAC address of the IM 152-1PN device is known.
- The rules for the configuration of Ethernet interfaces must be observed.
- HW-Config is open.

Setting the network configuration

1. Select the "IM 152-1PN", right-click it and select "Object properties".
   The "Properties - IM 152-1PN" dialog box opens.
2. In the "Nodes in PROFINET IO system" area, click "Ethernet".
   The "Properties - Ethernet interface IM 152-1PN" dialog box opens.
3. Enter the IP address in the "IP address" input field.
4. In the "Subnet" area, mark the "Plant bus" entry and click "OK".
5. In the "Properties – IM 152-1PN" dialog box, click "OK".

For an online connection to the automation system and connected ET 200iSP, you can search for the station using the MAC address.

Then load the station.

Changing the network configuration

1. Proceed as described for "Set network configuration". If necessary, a STOP of the station/bus system is required.

7.11.4 Configuring PROFIBUS DP address

Properties

With the PROFIBUS DP address you define under which address the ET 200iSP distributed I/O device is addressed at the PROFIBUS RS 485-IS.

Requirements

- The PROFIBUS DP address for the ET 200iSP is set on the interface module via DIP switch. The DIP switch is located on the front of the interface module, protected by a swivel cover.
- Permitted PROFIBUS DP addresses are 1 to 125
- Each address can be assigned only once on the PROFIBUS.

Required tools

3.5 mm screwdriver

Setting the PROFIBUS DP address

1. To open, swivel the cover to the right.
2. Use the screwdriver to set the desired PROFIBUS DP address using the DIP switches.
3. Close the cover.

Changing the PROFIBUS DP address

1. Use the screwdriver to set the PROFIBUS DP address "0" via the DIP switches.
2. Switch the supply voltage of the ET 200iSP off and on at the power supply PS. The deletion process is completed when the BF LED flashes (0.5 Hz, duration approx. 10 s).
   The ET 200iSP stores the parameters retentively in the flash memory of the IM 152-1DP. Therefore, you should delete the retentitively stored parameters during the first commissioning or after the modification of the plant.
3. Now set the new PROFIBUS DP address via the DIP switches and switch the supply voltage at the power supply PS off and on again.

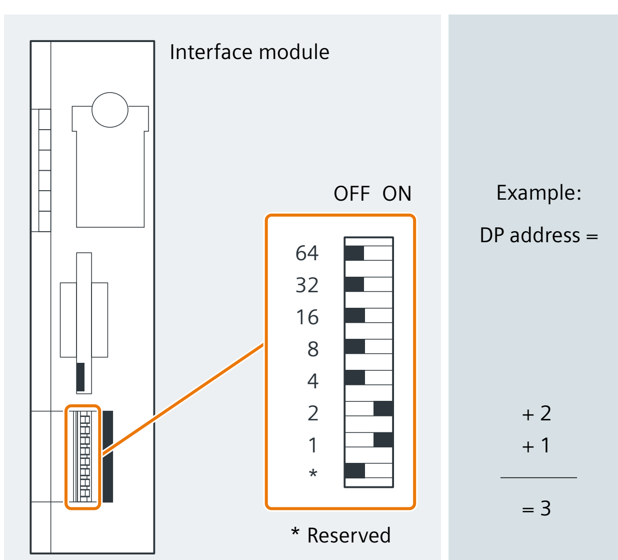


Figure 7-3 Setting the PROFIBUS DP address

Note

If you change the PROFIBUS DP address without first deleting the retentive parameters in the flash memory, then the ET 200iSP does not log on to the PROFIBUS DP with either the new or the old address.

7.11.5 Commissioning the ET 200iSP

Commissioning of the ET 200iSP

Table 7-9 Commissioning ET 200iSP

Step	Procedure	See
1	Switch on the supply voltage for the ET 200iSP.	Section "Wiring (Page 119)"
2	Observe the status LEDs on the ET 200iSP and on the higher-level bus components.	• Section "Basics of commissioning and diagnostics (Page 155)" • Documentation of the higher-level bus component – IO controller – DP master

Note

The ET 200iSP supports the default startup.

The following conditions then apply:

- Transferred parameters are saved and used after the supply voltage is switched on at the Power Supply PS.
- The configuration can be made with the GIF (General Identifier Format according to PROFIBUS standard).

7.11.6 Startup of ET 200iSP with IM 152-1PN

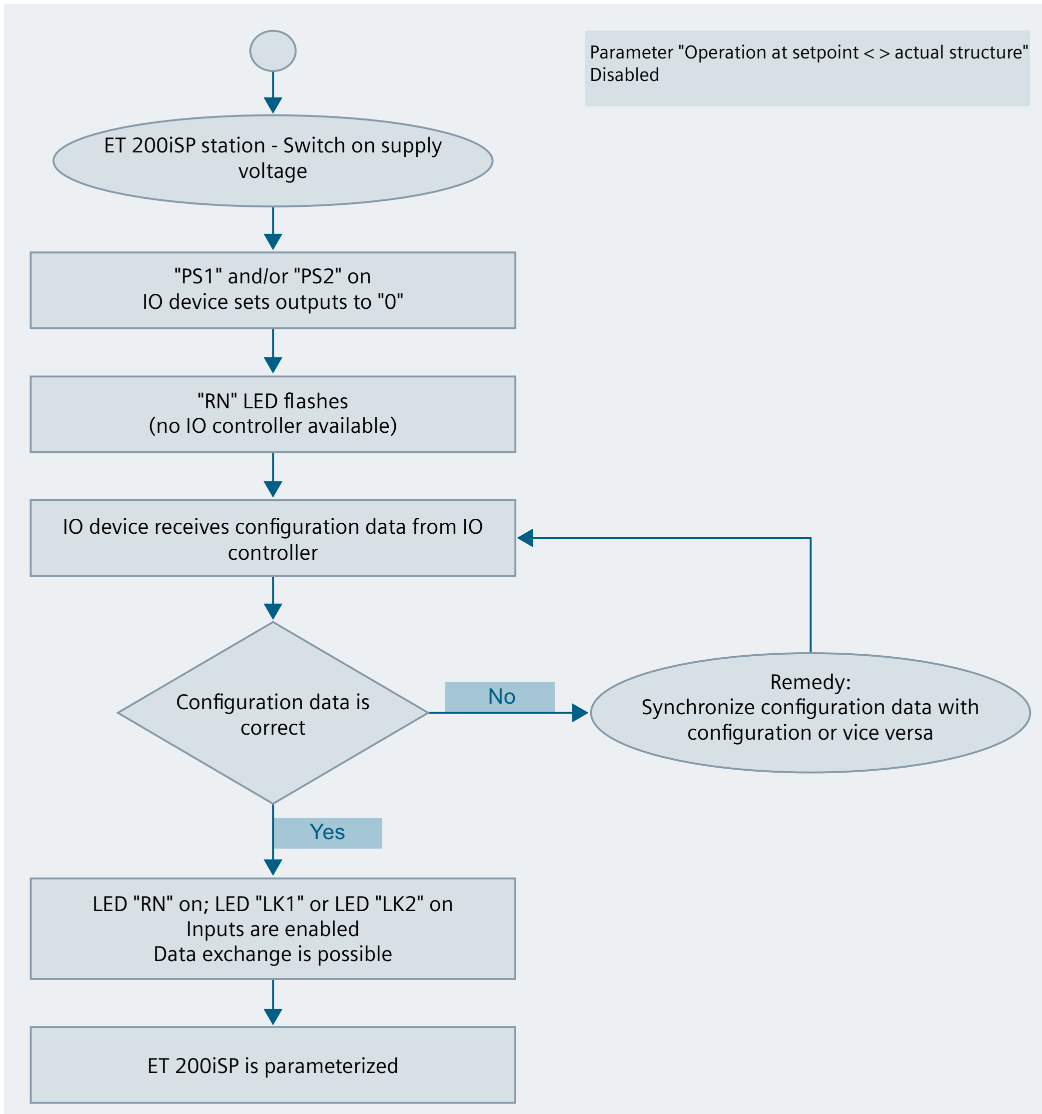


Figure 7-4 **Startup of the ET 200iSP with IM 152-1PN**

7.11.7 Startup of ET 200iSP with IM 152-1DP

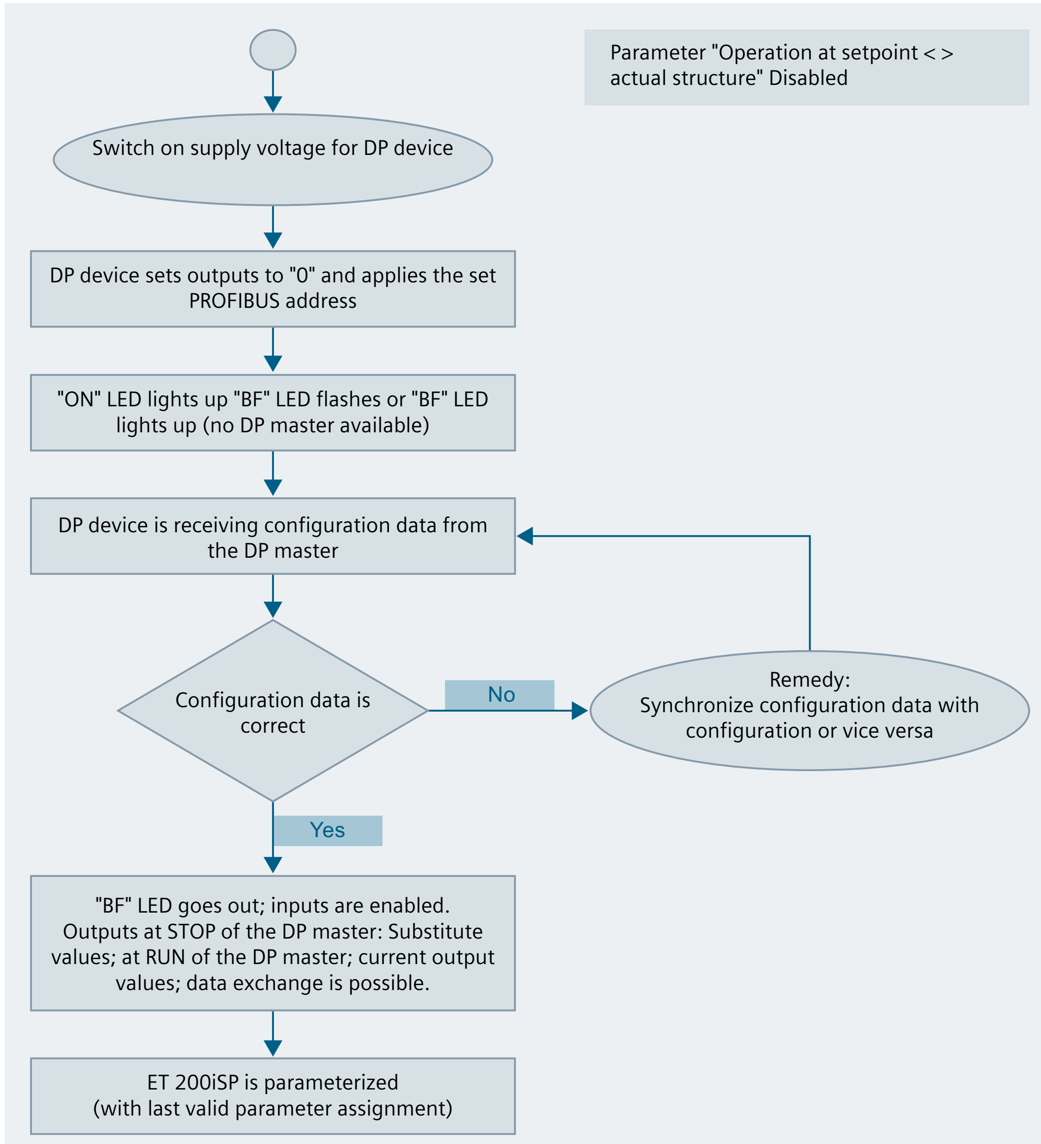
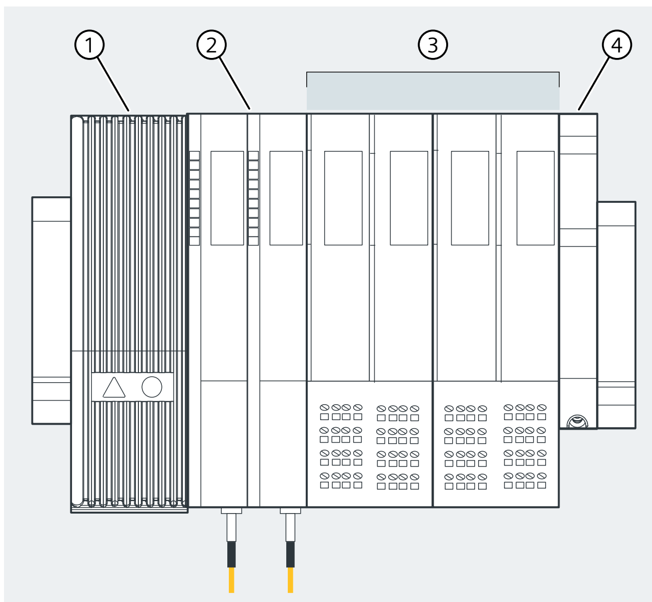


Figure 7-5 **Startup of the ET 200iSP with IM 152-1DP**

7.11.8 Startup of the ET 200iSP with redundancy of the IM 152-1PN

Operating principle

In the case of redundancy, the two plugged IM 152-1PN start up independently of each other. The following flow diagram shows the startup of the IM 152-1PN (a, left interface module). If we consider the IM 152-1PN (b, right interface module), the following flow diagram applies accordingly with reversed designations.



① Terminal module TM-PS-A with PS
② Terminal module TM-IM/IM with interface modules IM 152-1PN (a) and IM 152-1PN (b)
③ Terminal modules TM-EM/EM with electronic modules
④ Terminating module

Figure 7-6 ET 200iSP with PROFINET interface modules

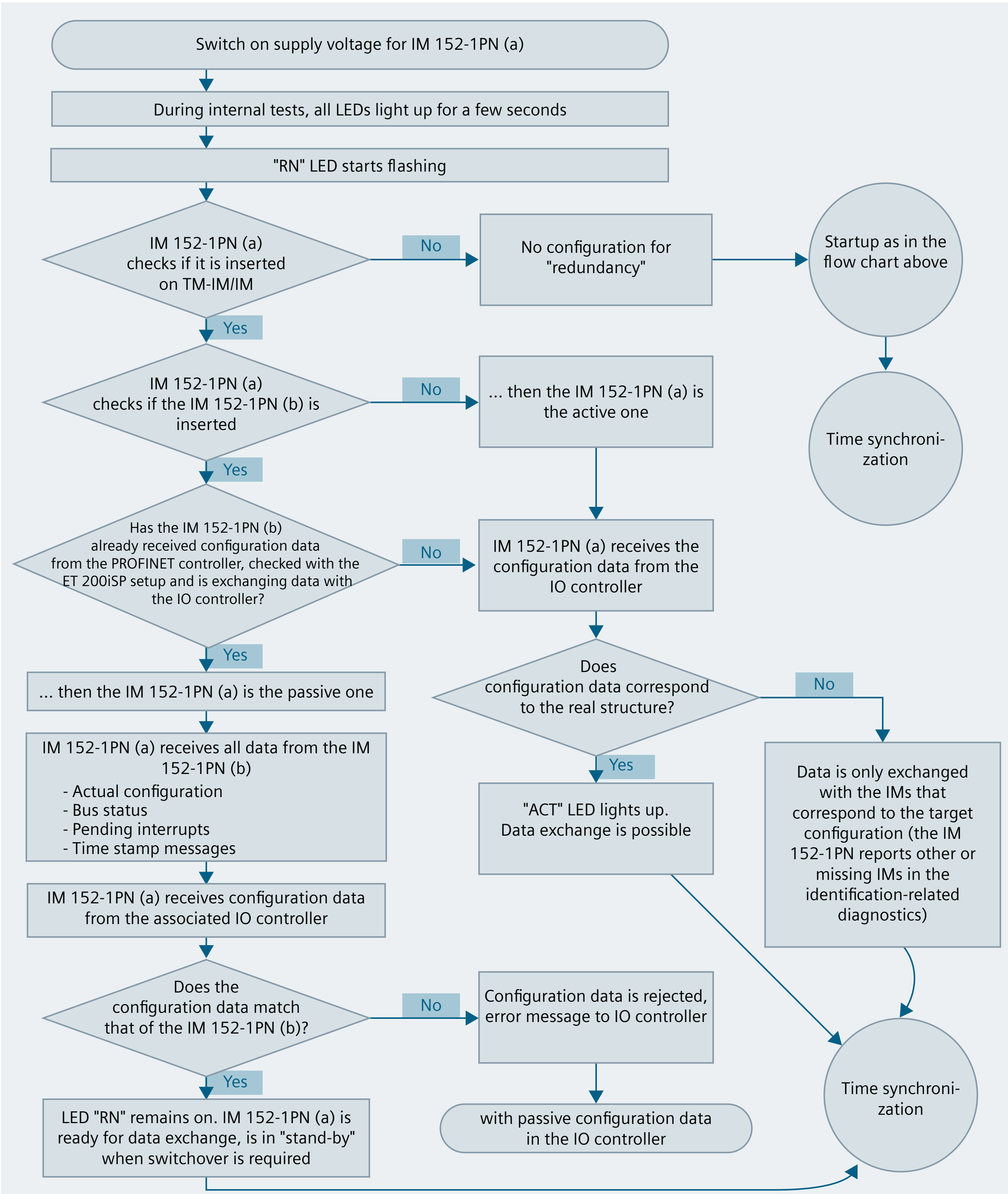
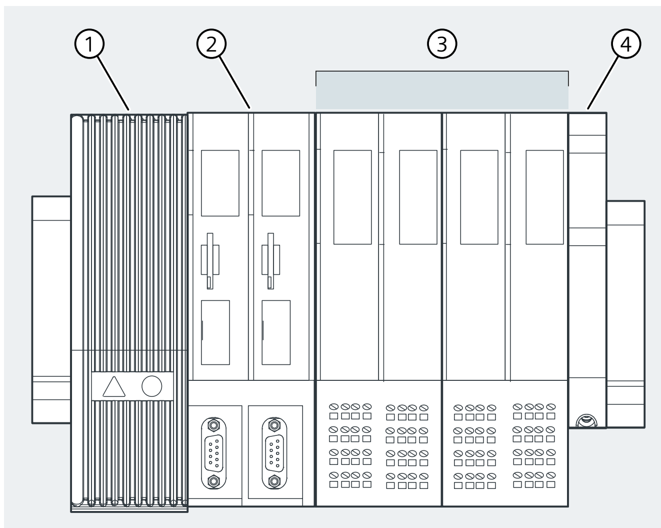


Figure 7-7 **Startup of the ET 200iSP with redundancy of the IM 152-1PN**

7.11.9 Starting the ET 200iSP with redundancy of the IM 152-1DP

Operating principle

In the case of redundancy, the two plugged IM 152-1DP start up independently of each other. The following flow diagram shows the startup of the IM 152-1DP (a). If we consider the IM 152-1DP (b), the following flow diagram applies accordingly with reversed designations.



① Terminal module TM-PS-A with PS
② Terminal module TM-IM/IM with interface modules IM 152-1DP (a) and IM 152-1DP (b)
③ Terminal modules TM-EM/EM with electronic modules
④ Terminating module

Figure 7-8 ET 200iSP with PROFIBUS interface modules

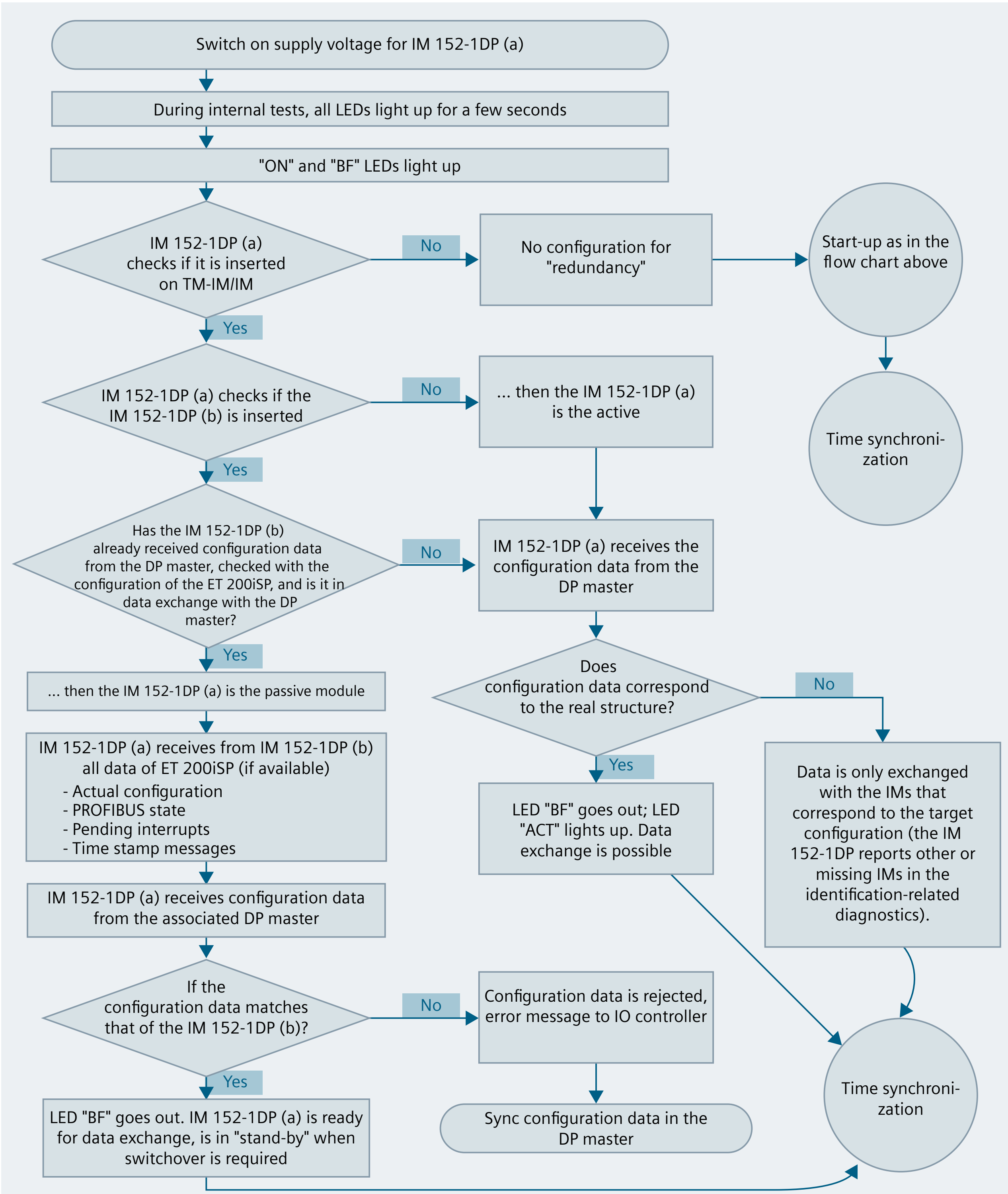


Figure 7-9 Startup of the ET 200iSP with redundancy of the IM 152-1DP

7.11.10 Startup for time synchronization / time stamping of signal changes

Principle of operation

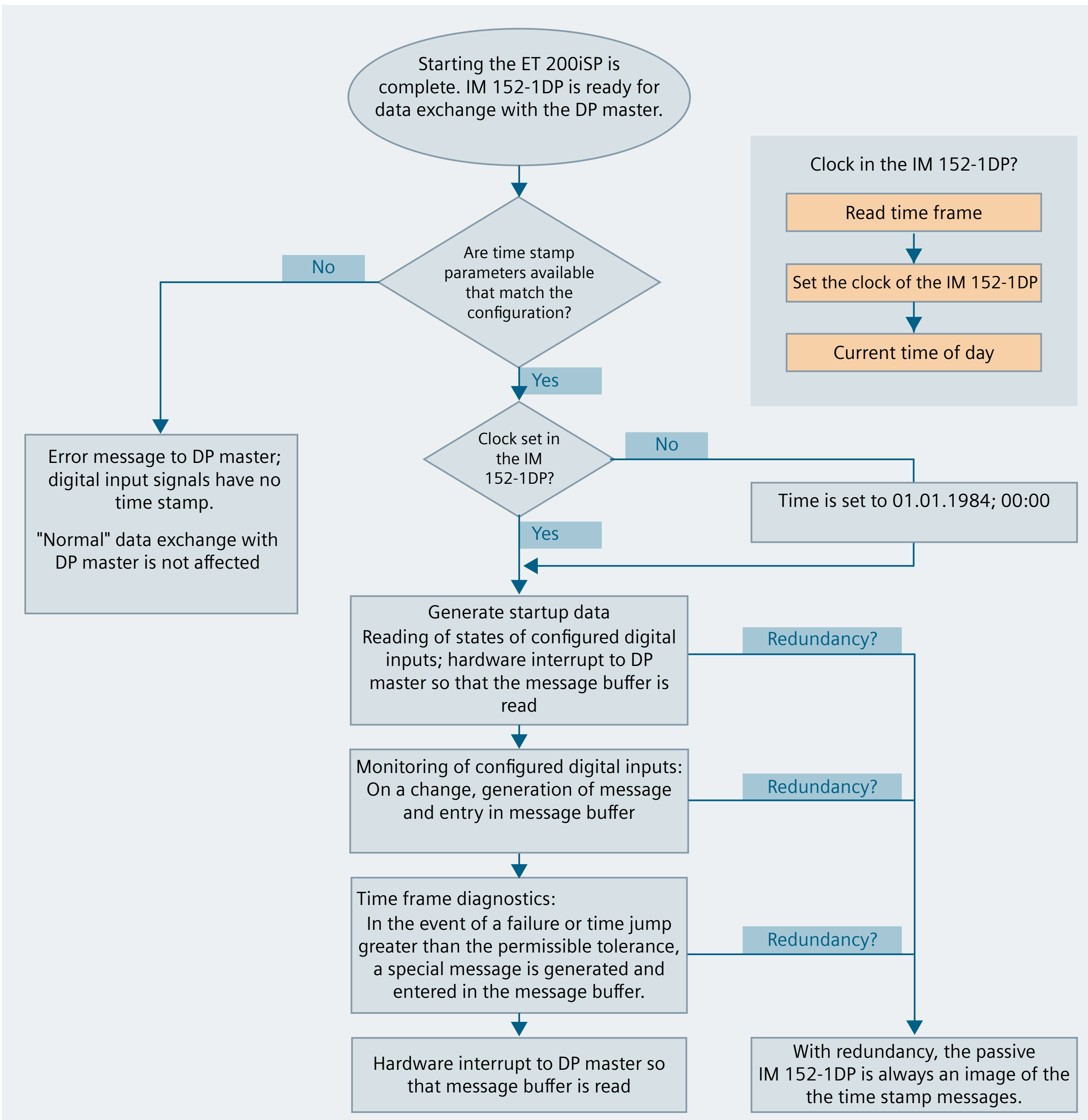


Figure 7-10 Startup for time synchronization/time stamping

7.12 Diagnostics with STEP 7 with PROFINET

7.12.1 Reading the diagnostics for PROFINET

PROFINET uses the standard diagnostics. See System software for S7-300/400 System and standard functions (https://support.automation.siemens.com/WW/view/en/1214574).

7.12.2 Diagnostic messages of the electronic modules with PROFINET

Introduction

You can set parameters for the diagnostic messages of the following modules:

- Digital input modules
- Digital output modules
- Analog input modules
- Analog output modules

Digital input modules

Table 7-10 Digital input modules

Diagnostic message	Applicability	Can be set
Short-circuit	Channel	Yes
Wire break	Channel	Yes
Error	Module	No
External fault	Channel	No

Digital output modules

Table 7-11 Digital output modules

Diagnostic message	Applicability	Can be set
Short-circuit	Channel	Yes
Wire break	Channel	Yes
Error	Module	No
Actuator disconnection	Channel	Yes[1]
[1] Enabling the actuator disconnection by means of the group diagnostics parameter		

Digital output module 2 DO Relay UC60V/2A

Table 7-12 Digital output module 2 DO Relay UC60V/2A

Diagnostic message	Applicability	Can be set
Error	Module	No

Analog input modules

Table 7-13 Analog input modules

Diagnostic message	Applicability	Can be set
Short circuit[1]	Channel	Yes
Wire break	Channel	Yes
Upper measuring range exceeded	Channel	Yes
Lower measuring range exceeded	Channel	Yes
Error	Module	No
Reference channel error	Module	No
[1] Not possible with 4 AI TC and with 4 AI I 4WIRE HART		

Analog output modules

Table 7-14 Analog output modules

diagnostic message[1]	Applicability	Can be set
Short-circuit	Channel	Yes
Wire break	Channel	Yes
Error	Module	No
[1] Diagnostic message only for currents > 1 mA.		

WATCHDOG module

Table 7-15 WATCHDOG module

Diagnostic message	Applicability	Can be set
Error	Module	No

Actions after diagnostic message

Each diagnostic message leads to the following actions:

- In S7 or DPV1 mode, diagnoses are reported as diagnostic interrupts.
- After a diagnostic message this is
  - entered in the diagnostic frame as diagnostic interrupt block (always only one interrupt)
  - stored in the diagnostic buffer of the CPU
  - entered in the channel related diagnostics
- The MT or ERR LED lights up on the IM 152-1PN interface module.
- The OB82 is called. If there is no OB82, the CPU goes to STOP operating state.
- Acknowledgment of the diagnostic interrupt (after which new interrupt is possible)

Causes of Error and Troubleshooting

The causes of errors and remedial measures of the diagnostic messages are described in the section "Diagnostics of the IM 152-1PN (Page 193)".

7.12.3 Evaluating interrupts of the ET 200iSP by the CPU with PROFINET

Introduction

The interface module triggers interrupts for specific errors. The interrupt evaluation varies depending on the CPU used.

Evaluate interrupts using the CPU

Requirements: You have configured the ET 200iSP with the engineering tool STEP 7; i.e. interrupts are only supported if you integrate the ET 200iSP as follows:

- IO device
- S7 DP device
- DPV1 device

In case of an interrupt, interrupt OBs run automatically in the CPU (see programming manual System software for S7-300/S7-400, program draft (http://support.automation.siemens.com/WW/view/en/1136533)).

Triggering of a diagnostic interrupt

With an incoming or outgoing event (wire break, for example) the module triggers a diagnostic interrupt upon "Release: Diagnostic Interrupt".

The CPU interrupts the processing of the user program and processes the diagnostics block OB82. The event that led to the triggering of the interrupt is entered in the start information of the OB82.

Triggering of a Hardware Interrupt

In the event of a hardware interrupt the CPU interrupts the processing of the user program and processes the hardware interrupt block OB40.

The channel of the module that triggered the hardware interrupt is entered in the start information of the OB40 in the tag OB40_POINT_ADDR. The following table shows the assignment to the bits of the local data double word 8.

Table 7-16 Interrupts from analog input modules

<table>
<tr><th colspan="8">LB 8</th><th colspan="5">LB 9</th><th>LB 10</th><th colspan="3">LB 11</th><th></th></tr>
<tr><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>...</td><td>19</td><td>18</td><td>17</td><td>16</td><td>...</td><td>...</td><td>1</td><td>0</td><td>Bit no. LD 8</td></tr>
<tr><td></td><td></td><td></td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>...</td><td>...</td><td></td><td></td><td></td></tr>
<tr><td colspan="18">Bit no. 16: Violation of the low limit channel 0
Bit no. 17: Violation of the low limit channel 1
Bit no. 18: Violation of the low limit channel 2
Bit no. 19: Violation of the low limit channel 3
Bit no. 24: Violation of the high limit channel 0
Bit no. 25: Violation of the high limit channel 1
Bit no. 26: Violation of the high limit channel 2
Bit no. 27: Violation of the high limit channel 3</td></tr>
</table>

Note

A description of the OB40 can be found in the reference manual System and standard functions (https://support.automation.siemens.com/WW/view/en/1214574).

Triggering of a remove/insert interrupt

Pull/plug interrupts are only supported for S7-400 or in DPV1 mode.

The CPU (S7-400) interrupts the processing of the user program and processes the diagnostic block OB83. The event which led to the triggering of the interrupt is entered in the start information of the OB83.

Triggering of an Update Interrupt

Update interrupts are only supported in DPV1 operation.

The CPU interrupts the processing of the user program and processes the diagnostic block OB56. The event which led to the triggering of the interrupt is entered in the start information of the OB56.

7.12.4 Diagnostics of the IM 152-1PN

Diagnostic options

A wide range of information and tools are available for diagnosing the status of the IM 152-1PN.

- **Displays**
  Some LED displays are located on the front of the IM 152-1PN. This provides you with an overview of the status of the IM 152-1PN. You can find information on this in section "Status and error LEDs on the IM 152-1PN (Page 170)".
- **Tools**
  Information about the most important tools for diagnosing PCS 7 systems is available in the Service Manual PCS 7 Process Control System; Service Support and Diagnostics (www.siemens.com/pcs7-documentation).
  - **Maintenance Station**
    With the Maintenance Station, PCS 7 offers you the possibility to call up information about the status of all the PCS 7 components in hierarchically structured diagnostics screens. For this, the data of a component is analyzed with the existing online functions of the associated tools. You can access the ES data from the diagnostics screens (can be controlled via access protection mechanisms).
  - **Module information**
    Select the IM 152-1PN in HW Config.
    Select the menu command **PLC > Module information ... .**
  - **Connection status**
    Called from Start menu Siemens SIMATIC programs: **STEP 7 > NCM S7 > Diagnostics**
  - **Inventory data**
    Called up via Siemens SIMATIC program: **SIMATIC > SIMATIC Management Console** (license required) **> Plant view >** shortcut menu command "Determine inventory data"
  - **Status of field devices and bus lines**
    Called via SIMATIC PDM
    The IM 152-1PN does not undertake any detailed diagnostics of field devices and bus cables. Detailed diagnostics are possible, provided that the required device descriptions are available in suitable programs (e.g. SIMATIC PDM).
    Open **SIMATIC PDM > Device > CFU <V...> Configuration**.

Diagnostic messages

A diagnostics message is generated for each diagnostics event and the ER LED flashes on the module.

The diagnostic messages can, for example, be read from the diagnostic buffer of the CPU.

There can be more than one diagnostic message at the same time.

Table 7-17 Diagnostic messages, their meaning and possible remedies

Diagnostic message	Channel error type (CET)	Extended channel error type (ECET)	Meaning	Remedy
Configuration error: Unsupported transceiver in port <port number>	0x602	0x6A0	Transceivers have been plugged in that are not approved for use in IM 152-1PN.	Replace the transceiver with a supported SFP transceiver.
Configuration error: The configuration of redundant interface modules differs.	0x602	0x6A1	The configuration of the interface modules differ.	Check the consistency of the configuration.
Configuration error: IO data is suppressed	0x602	0x6A2	IO data is suppressed because a configured event has occurred.	Bring the station into the state expected by the configuration.
Redundancy error: Power supply unit <item> missing or is not available	0x630	0x6D1	Problem with power supply.	Check the power supply for possible errors, e.g. overload, short-circuit. Replace the power supply if necessary.
Redundancy error: Redundancy partners have different hardware/firmware versions	0x630	0x6D3	The HW/FW version of the redundant IO modules is inconsistent.	Replace the module or update the firmware.

7.12.5 Error types of the electronic modules with PROFINET

Table 7-18 Error types of the electronic modules

Error type		Error text	Meaning	Remedy
00001_B	1_D	Short-circuit	• Sensor line short circuited to P potential • Sensor line short circuited to M potential • Output line short circuited to P potential • Output line short circuited to M potential	Correction of the process wiring
			Encoder is defect	Exchange the encoder
			Incorrect encoder type configured	Correction of the configuration
			Output overloaded	Eliminate overload
00010_B	2_D	Undervoltage (HART diagnostics)	HART analog output current set (HART diagnostics)	---
00100_B	4_D	Overload (HART diagnostics)	HART analog output current saturated (HART diagnostics)	---

Error type		Error text	Meaning	Remedy
00110_B	6_D	Wire break	• Signal line to an encoder interrupted • Signal line to an actuator interrupted • Encoder supply line interrupted	Correction of the process interconnection
			Error on the external circuit (resistance)	Eliminate errors
			Encoder is defect	Exchange the encoder
			Incorrect encoder type configured	Correction of the configuration
			Input/output channel is unused (open)	Deactivation of the "Diagnostic Group Diagnostics" parameter for this output channel
			Load impedance is too large	Use actuator with lower load impedance
00111_B	7_D	High limit exceeded	Value is above the overrange	• Correction tuning of module/actuator • Modify measuring range by means of configuration
01000_B	8_D	Lower limit exceeded	Value is below the overrange	• Correction tuning of module/actuator • Modify measuring range by means of configuration
01001_B	9_D	Error	Encoder signal flutters	Eliminate cause of error
			Hardware error in the module	Exchange of the module
			EMC interference	Eliminate cause of error
10001_B	17_D	Encoder- or load voltage missing	• Supply voltage at the Power Supply PS missing or too low • Power Supply PS is faulty	• Check the supply voltage at the Power Supply PS • Exchange the Power Supply PS
10011_B	19_D	HART communication error (HART diagnostics)	• HARD field device is not responding • Timing error	• Check the process wiring • Correction of the configuration
10101_B	21_D	Reference channel error	• internal reference junction: TC sensor module defective or not present • external reference junction (RTD): Parameters do not point to the RTD module	• Exchanging or connecting the TC Sensor Module • Correction of the configuration
10110_B	22_D	HART additional status available (HART warning)	---	---
10111_B	23_D	Reserved for HART (HART warning)	---	---
11000_B	24_D	Actuator disconnection	Intrinsically safe switching signal with 4 DO switched on	---

Error type		Error text	Meaning	Remedy
11010_B	26_D	External fault	• Encoder error • Encoder supply faulty • Changeover contact error • Actuator error • HART field device error	• Replacement of encoder/ actuator/HART field device • Correction of the process wiring
11011_B	27_D	HART configuration modified (HART warning)	---	---
11101_B	29_D	HART main variable outside of the limits (HART diagnostics)	---	---
11110_B	30_D	HART non-primary variable outside of the limits (HART diagnostics)	---	---

Note

Control response

A control behavior is implemented in the electronic modules of the ET 200iSP for parameter assignment.

If the electronic module receives a faulty parameter, this is rejected. The electronic then continues to operate with its already valid parameters (the default parameters from the initial parameter assignment). A "Parameterization error" diagnostic message is not output.

7.12.6 Diagnostics for incorrect configuration states of the ET 200iSP with PROFINET

Incorrect configuration states

The following incorrect expansion states of the ET 200iSP lead to a station failure of theET 200iSP or prevent entry into the data exchange. These reactions are independent of the release of the interface module parameter "Operation at setpoint <> actual configuration":

- Two missing electronic modules
- Terminating module missing

- Number of modules exceeds maximum configuration
- Faulty backplane bus (e.g. defective terminal module)

Note

If a module is missing (gap) and the ET 200iSP POWER OFF/POWER ON is switched, then the ET 200iSP starts. The startup with more than one missing module is not possible. If more than one electronic module is missing, then after plugging in these modules a safe start-up of the ET 200iSP is only guaranteed after POWER OFF/ POWER ON.

7.13 Diagnostics with STEP 7 with PROFIBUS

7.13.1 Introduction

Introduction

The device diagnostics behave according to the *IEC 61784-1:2002 Ed1 CP 3/1* standard. Depending on the DP master, it can be read out with STEP 7 for all DP devices that behave according to the standard.

The reading out and the configuration of the device diagnostics is described in the following sections.

7.13.2 Reading the diagnostics for PROFIBUS

Options for reading out the diagnostics

Table 7-19 Reading the diagnostics with STEP 7

Automation system with DP master	Block or tab in STEP 7	Application	See...
SIMATIC S7	"DP Slave Diagnostics" tab	Device diagnostics as plain text on STEP 7 interface	"Diagnose hardware" in the STEP 7 online help
	SFC13 "DPNRM_DG"	Read out device diagnostics (store in data area of user program)	Configuration see section "Configuration of device diagnostics for PROFIBUS (Page 202)"; SFC see Reference Manual System and standard functions (https://support.automation.siemens.com/WW/view/en/1214574)
	SFC 59 "RD_REC"	Read out data records (DS0/1) of S7 diagnostics (store in data area of user program)	

Example of reading out the S7 diagnostics with SFC 13 "DPNRM_DG".

Here you find an example how to read the device diagnostics for a DP device in the STEP 7 user program with the SFC 13.

Assumptions

The following assumptions apply to this STEP 7 user program:

- The diagnostic address of the ET 200iSP is 1022 ($3FE_H$).
- The device diagnostics are stored in DB 82: from address 0.0, length 96 bytes.
- Device diagnostics comprises 96 bytes.

STEP 7 user program

STL	Explanation
`Call SFC 13`	Read request
`REQ :=TRUE`	Diagnostic address of the ET 200iSP
`LADDR :=W#16#3FE`	RET_VAL from SFC 13
`RET_VAL :=MW 0`	Data compartment for the diagnostics in DB 82
`RECORD :=P#DB82.DBX 0.0 BYTE 96`	Read process runs over several OB1 cycles
`BUSY :=M2.0`	

7.13.3 Diagnostic messages of the electronic modules with PROFIBUS

Introduction

You can set parameters for the diagnostic messages of the following modules:

- Digital input modules
- Digital output modules
- Analog input modules
- Analog output modules

Digital input modules

Table 7-20 Digital input modules

Diagnostic message	Applicability	Can be set
Short-circuit	Channel	Yes
Wire break	Channel	Yes
Error	Module	No
External fault	Channel	No

Digital output modules

Table 7-21 Digital output modules

Diagnostic message	Applicability	Can be set
Short-circuit	Channel	Yes
Wire break	Channel	Yes
Error	Module	No
Actuator disconnection	Channel	Yes[1]
[1] Enabling the actuator disconnection by means of the group diagnostics parameter		

Digital output module 2 DO Relay UC60V/2A

Table 7-22 Digital output module 2 DO Relay UC60V/2A

Diagnostic message	Applicability	Can be set
Error	Module	No

Analog input modules

Table 7-23 Analog input modules

Diagnostic message	Applicability	Can be set
Short circuit[1]	Channel	Yes
Wire break	Channel	Yes
Upper measuring range exceeded	Channel	Yes
Lower measuring range exceeded	Channel	Yes
Error	Module	No
Reference channel error	Module	No
[1] Not possible with 4 AI TC and with 4 AI I 4WIRE HART		

Analog output modules

Table 7-24 Analog output modules

diagnostic message[1]	Applicability	Can be set
Short-circuit	Channel	Yes
Wire break	Channel	Yes
Error	Module	No
[1] Diagnostic message only for currents > 1 mA.		

WATCHDOG module

Table 7-25 WATCHDOG module

Diagnostic message	Applicability	Can be set
Error	Module	No

Actions after diagnostic message

Each diagnostic message leads to the following actions:

- In S7 or DPV1 mode, diagnoses are reported as diagnostic interrupts.
- Diagnostics are also signaled while the CPU is in STOP, when a PROFIBUS configuration works in the "DPV1" mode.
- After a diagnostic message this is
  - entered in the diagnostic frame as diagnostic interrupt block (always only one interrupt)
  - stored in the diagnostic buffer of the CPU
  - entered in the channel related diagnostics
- The SF LED lights up on the IM 152-1DP interface module.
- The OB82 is called. If there is no OB82, the CPU goes to STOP operating state.
- Acknowledgment of the diagnostic interrupt (after which new interrupt is possible)

Actions after a diagnostic message in DPV0 mode

The error is entered in the diagnostic frame in the channel-related diagnostics:

- The SF LED lights up on the IM 152-1DP interface module.
- There can be more than one diagnostic message at the same time.

Causes of Error and Troubleshooting

The causes of errors and remedial measures of the diagnostic messages are described in the section "Channel-related diagnostics with PROFIBUS (Page 207)".

7.13.4 Evaluating interrupts of the ET 200iSP by the CPU with PROFIBUS

Introduction

The interface module triggers interrupts for specific errors. The interrupt evaluation varies depending on the CPU used.

Evaluate interrupts using the CPU

Requirements: You have configured the ET 200iSP with the engineering tool STEP 7; i.e. interrupts are only supported if you integrate the ET 200iSP as follows:

- IO device
- S7 DP device
- DPV1 device

In case of an interrupt, interrupt OBs run automatically in the CPU (see programming manual System software for S7-300/S7-400, program draft (http://support.automation.siemens.com/WW/view/en/1136533)).

Evaluate interrupts at PROFIBUS with other DP master

If you operate the ET 200iSP with another DP master or as DP standard device, then no interrupts are generated.

Triggering of a diagnostic interrupt

With an incoming or outgoing event (wire break, for example) the module triggers a diagnostic interrupt upon "Release: Diagnostic Interrupt".

The CPU interrupts the processing of the user program and processes the diagnostics block OB82. The event that led to the triggering of the interrupt is entered in the start information of the OB82.

Triggering of a Hardware Interrupt

In the event of a hardware interrupt the CPU interrupts the processing of the user program and processes the hardware interrupt block OB40.

The channel of the module that triggered the hardware interrupt is entered in the start information of the OB40 in the tag OB40_POINT_ADDR. The following table shows the assignment to the bits of the local data double word 8.

Table 7-26 Interrupts from analog input modules

<table>
<tr><th colspan="8">LB 8</th><th colspan="5">LB 9</th><th>LB 10</th><th colspan="3">LB 11</th><th></th></tr>
<tr><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>...</td><td>19</td><td>18</td><td>17</td><td>16</td><td>...</td><td>...</td><td>1</td><td>0</td><td>Bit no. LD 8</td></tr>
<tr><td></td><td></td><td></td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>...</td><td>...</td><td></td><td></td><td></td></tr>
<tr><td colspan="18">Bit no. 16: Violation of the low limit channel 0
Bit no. 17: Violation of the low limit channel 1
Bit no. 18: Violation of the low limit channel 2
Bit no. 19: Violation of the low limit channel 3
Bit no. 24: Violation of the high limit channel 0
Bit no. 25: Violation of the high limit channel 1
Bit no. 26: Violation of the high limit channel 2
Bit no. 27: Violation of the high limit channel 3</td></tr>
</table>

Note

A description of the OB40 can be found in the reference manual System and standard functions (https://support.automation.siemens.com/WW/view/en/1214574).

Triggering of a remove/insert interrupt

If you use only DPV0 mode, no interrupts are supported.

The CPU (S7-400) interrupts the processing of the user program and processes the diagnostic block OB83. The event which led to the triggering of the interrupt is entered in the start information of the OB83.

Triggering of an Update Interrupt

Update interrupts are only supported in DPV1 operation.

The CPU interrupts the processing of the user program and processes the diagnostic block OB56. The event which led to the triggering of the interrupt is entered in the start information of the OB56.

7.13.5 Configuration of device diagnostics for PROFIBUS

Table 7-27 Configuration of the device diagnostics for DPV0, S7 DP and DPV1

<table>
<tr><th>Byte</th><th colspan="2">Description</th></tr>
<tr><td>Byte 0</td><td colspan="2" rowspan="3">Station status 1 to 3
See section "Station status 1 to 3 for PROFIBUS (Page 203)"</td></tr>
<tr><td>Byte 1</td></tr>
<tr><td>Byte 2</td></tr>
<tr><td>Byte 3</td><td colspan="2">Master PROFIBUS address
See section "Master PROFIBUS address (Page 204)"</td></tr>
<tr><td>Byte 4</td><td>High byte</td><td rowspan="2">Manufacturer's ID
See section "Manufacturer's ID (Page 205)"</td></tr>
<tr><td>Byte 5</td><td>Low byte</td></tr>
<tr><td>Byte 6
... Byte 11</td><td colspan="2">Identifier-related diagnostics [1]
See section "Identifier-related diagnostics in PROFIBUS (Page 205)"</td></tr>
<tr><td>Byte 12
... Byte 24</td><td colspan="2">Module status[1]
See section "Module status in PROFIBUS (Page 206)"</td></tr>
<tr><td>Byte 25
...</td><td colspan="2">Channel-related diagnostics (3 bytes per channel)[1]
See section "Channel-related diagnostics with PROFIBUS (Page 207)"</td></tr>
<tr><td>Byte z
...</td><td colspan="2">H status only with S7-400H and standard redundancy
max. 6 bytes
See section "H status with PROFIBUS (only for S7-400H and standard redundancy) (Page 211)"</td></tr>
</table>

Byte	Description
up to max. byte 95	Interrupts (only 1 interrupt per device diagnostic telegram possible) max. 48 bytes Interrupts are only supported if you configure the ET 200iSP with STEP 7 as S7 DP or DPV1 device. See section "Interrupts in PROFIBUS (Page 212)"
[1] If you configure with the GSD file, you may deselect this diagnostics.	

7.13.6 Station status 1 to 3 for PROFIBUS

Definition

The station statuses 1 to 3 provide an overview about the status of a DP device.

Station status 1

Table 7-28 Setup of station status 1 (byte 0)

Bit	Meaning	Cause - remedy
0	1: The DP device cannot be addressed by the DP master. The bit is always "0" in the DP device.	• Correct PROFIBUS address set on the DP device? • Are the bus connectors connected? • Voltage on the DP device? • Is RS 485 reporter set correctly? • RESET performed on the DP device (power off/on)?
1	1: The DP device is not yet ready for data exchange.	• Wait as DP device is starting up.
2	1: The configuration data transmitted by the DP master to the DP device do not correspond to the structure of the DP device.	The DP device is okay, but the configuration does not correspond to the actual configuration of the device. Compare the target configuration with the actual configuration. Note: If the last slot is not assembled, you must mount the slot cover! This is located in the termination module.
3	1: An external diagnostic function is provided.	Evaluate the identifier-related, the module status and/or the channel-related diagnostics. As soon as all errors are corrected, bit 3 is reset. The bit is reset when a new diagnostic message is present in the bytes of the above-mentioned diagnostics.
4	1: The requested function is not supported by the DP device (e.g. changing the PROFIBUS address via the software).	Check the configuration.
5	1: The DP master cannot interpret the response of the DP device.	Check the bus structure.

Bit	Meaning	Cause - remedy
6	1: The DP parameter assignment telegram is not correct (wrong device type, parameter).	Correct the target and actual configuration.
7	1: The DP device has been parameterized by another DP master (not by the DP master that currently has access to the DP device).	The bit is always 1 if you are currently accessing the DP device with the PG or another DP master, for example. The PROFIBUS address of the DP master, which has parameterized the DP device, is included in the diagnostic byte "Master PROFIBUS address".

Station status 2

Table 7-29 Setup of station status 2 (byte 1)

Bit	Meaning
0	1: The DP device must be parameterized anew.
1	1: A diagnostic message is present. The DP device will not function until the error is eliminated (static diagnostic message).
2	1: The bit is always "1" in the DP device.
3	1: Response monitoring is activated for this DP device.
4	1: The DP device has received the control command "FREEZE".
5	1: The DP device has received the control command "SYNC".
6	0: Bit is always set to "0".
7	1: Bit is always set to "0". Note: When reading the station status from the DP master, the bit is "1" if the DP device has been deactivated in the DP master, that is, it is released from the current processing.

Station status 3

Table 7-30 Setup of station status 3 (byte 2)

Bit	Meaning
0 to 6	0: Bit is always set to "0".
7	1: More channel-related diagnostic messages are available than can be displayed in the diagnostic telegram (diagnostic overflow).

7.13.7 Master PROFIBUS address

Definition

The PROFIBUS address of the DP master is stored in the diagnostic byte master PROFIBUS address:

- that has parameterized the DP device
- that has read and write access to the DP device.

The master PROFIBUS address is located in byte 3 of the device diagnostics.

DP device from DP master (class 1) not parameterized

If the FF_H value is in byte 3 as the master PROFIBUS address, the DP device has then not been parameterized by the DP master.

No cyclic data exchange takes place.

7.13.8 Manufacturer's ID

Definition

The manufacturer ID contains a code that describes the DP device type.

Manufacturer's ID

Table 7-31 Configuration of the manufacturer's ID

Byte 4	Byte 5	Manufacturer ID for
81_H	10_H	IM 152-1DP

7.13.9 Identifier-related diagnostics in PROFIBUS

Evaluation of the device diagnostics

The following figure describes a procedure of how you can systematically evaluate the device diagnostics. You start with ID-related diagnostics.

Table 7-32 Evaluation of the device diagnostics

Byte	7	6	5	4	3	2	1	0	Description
Byte 6									Identifier-related diagnostics (byte 6) Bit 6 and Bit 7: • 01: Identifier-related diagnostics • 10: See section "Channel-related diagnostics with PROFIBUS (Page 207)" • 00: See next row
Byte 13/ Byte x+1									Module status (byte 13)/interrupts (byte x+1) Bit 7: • 1: See section "Module status in PROFIBUS (Page 206)" • 0: See section "Interrupts in PROFIBUS (Page 212)"

Definition

The identifier-related diagnostics indicates whether modules of the ET 200iSP are faulty or not. Identifier-related diagnostics starts at byte 6 and is 6 bytes long.

Identifier-related diagnostics:

The bits in slots 2, 4 through 35 (bytes 7 through 11) of the modules are set if one of the following situations occurs:

- A module is removed.
- A module is inserted that was not configured.
- An plugged module cannot be accessed.
- A module reports a diagnostics event.

Unused slots have the value "0" entered.

The identifier-related diagnostics for ET 200iSP is configured as follows:

Table 7-33 Configuration of the identifier-related diagnostics for ET 200iSP

Byte	7	6	5	4	3	2	1	0	Description
Byte 6	0	1	0	0	0	1	1	0	Bit 0 to 5: Length of the identifier-related diagnostics including byte 6 (= 6 bytes) Bit 6 and Bit 7: Code for identifier-related diagnostics
Byte 7	8	7	6	5	4		2		Entries for IM 152-1DP on slot 2 and modules on slots 4 to 8
Byte 8	16	15	14	13	12	11	10	9	Entries for modules on slot 9 to 16
Byte 9	24	23	22	21	20	19	18	17	Entries for modules on slot 17 to 24
Byte 10	32	31	30	29	28	27	26	25	Entries for modules on slot 25 to 32
Byte 11						35	34	33	Entries for modules on slot 33 to 35

7.13.10 Module status in PROFIBUS

Definition

The module status indicates the status of the configured modules and provides more detailed information than ID-related diagnostics in terms of the configuration or indicates a module fault. The module status begins after the ID-related diagnostics and comprises 13 bytes.

Module Status

The module status for ET 200iSP is configured as follows:

Table 7-34 Module status of the ET 200iSP

<table>
<tr><th>Byte</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th>Description</th></tr>
<tr><td>Byte 12</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Bit 0 to 5: Length of the module status including byte 12 (=13 byte)
Bit 6 and Bit 7: Code for device-specific diagnostics</td></tr>
<tr><td>Byte 13</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Status type: Module status
Bit 0 to bit 6: 2_H = Module status
Bit 7: Code for status message</td></tr>
<tr><td>Byte 14</td><td colspan="8">0_H</td><td>Always "0"</td></tr>
<tr><td>Byte 15</td><td colspan="8">0_H</td><td>Always "0"</td></tr>
<tr><td>Byte 16</td><td colspan="2">4</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>Slot 4</td></tr>
<tr><td>Byte 17</td><td colspan="2">8</td><td colspan="2">7</td><td colspan="2">6</td><td colspan="2">5</td><td>Slot 5 to 8</td></tr>
<tr><td>Byte 18</td><td colspan="2">12</td><td colspan="2">11</td><td colspan="2">10</td><td colspan="2">9</td><td>Slot 9 to 12</td></tr>
<tr><td>Byte 19</td><td colspan="2">16</td><td colspan="2">15</td><td colspan="2">14</td><td colspan="2">13</td><td>Slot 13 to 16</td></tr>
<tr><td>Byte 20</td><td colspan="2">20</td><td colspan="2">19</td><td colspan="2">18</td><td colspan="2">17</td><td>Slot 17 to 20</td></tr>
<tr><td>Byte 21</td><td colspan="2">24</td><td colspan="2">23</td><td colspan="2">22</td><td colspan="2">21</td><td>Slot 21 to 24</td></tr>
<tr><td>Byte 22</td><td colspan="2">28</td><td colspan="2">27</td><td colspan="2">26</td><td colspan="2">25</td><td>Slot 25 to 28</td></tr>
<tr><td>Byte 23</td><td colspan="2">32</td><td colspan="2">31</td><td colspan="2">30</td><td colspan="2">29</td><td>Slot 29 to 32</td></tr>
<tr><td>Byte 24</td><td colspan="2"></td><td colspan="2">35</td><td colspan="2">34</td><td colspan="2">33</td><td>Slot 33 to 35</td></tr>
<tr><td colspan="10">Legend for the entry of the module status on slot x:
• 00_B: Module OK; valid data
• 01_B: Module error; invalid data
• 10_B: incorrect module; invalid data
• 11_B: no module (or failure of the module); invalid data</td></tr>
</table>

Table 7-35 Example: Slot 35

Byte	7	6	5	4	3	2	1	0	Description
Byte 24			1	0					10_B: incorrect module; invalid data

7.13.11 Channel-related diagnostics with PROFIBUS

Definition

Channel-related diagnostics provides information on channel faults of modules and provides more detail than ID-related diagnostics.

For each channel-related diagnostics, 3 bytes are inserted according to the *IEC 61784-1:2002 Ed1 CP 3/1* standard.

The channel-related diagnostic information follows the module status.

Channel-related diagnostics does not affect the module status.

Important: The group diagnostics must be switched on for each module!

Channel-related diagnostics

The maximum number of channel-related diagnostics is limited by the maximum total length of the device diagnostics of 96 bytes with IM 152-1DP. The length of the device diagnostics depends on the number of channel-related diagnostics currently present. If there are more channel-related diagnostics than can be shown in the device diagnostics, bit 7 "Diagnostics overflow" is set in station status 3.

Table 7-36 Configuration of the channel-related diagnostics from byte 25 (without deselection of the diagnostics in the configuration)

Byte	7	6	5	4	3	2	1	0	Description
Byte x	1	0							Bit 0 to 5: 00001_B to 100010_B: Identification number of the module that supplies channel-related diagnostics (Example: Slot 4 has the identification number 3; slot 5 has the identification number 4, etc.) Bit 6 and Bit 7: Code for channel-related diagnostics (for 00_B, see section "Interrupts in PROFIBUS (Page 212)")
Byte x+1									Bit 0 to 5: 00000_B to 11111_B: Number of the channel or channel group that provides diagnostics Bit 6 and Bit 7: Input/output: • 01_B: Entry • 10_B: Output • 11_B: Input/output
Byte x+2									Bit 0 to Bit 4: Error type according to PROFIBUS standard Bit 5 to bit 7: Channel type • 001_B: Bit • 010_B: 2 bit • 011_B: 4 bit • 100_B: Byte • 101_B: Word • 110_B: 2 words
Byte x+3 ... x+5									Next channel-related diagnostic message (assignment like byte x to x+2)
... up to max. byte 95 for IM 152-1DP									

Error types of the electronic modules

See Error types of the electronic modules with PROFIBUS (Page 209).

7.13.12 Error types of the electronic modules with PROFIBUS

Table 7-37 Error types of the electronic modules

Error type		Error text	Meaning	Remedy
00001_B	1_D	Short-circuit	• Sensor line short circuited to P potential • Sensor line short circuited to M potential • Output line short circuited to P potential • Output line short circuited to M potential	Correction of the process wiring
			Encoder is defect	Exchange the encoder
			Incorrect encoder type configured	Correction of the configuration
			Output overloaded	Eliminate overload
00010_B	2_D	Undervoltage (HART diagnostics)	HART analog output current set (HART diagnostics)	---
00100_B	4_D	Overload (HART diagnostics)	HART analog output current saturated (HART diagnostics)	---
00110_B	6_D	Wire break	• Signal line to an encoder interrupted • Signal line to an actuator interrupted • Encoder supply line interrupted	Correction of the process interconnection
			Error on the external circuit (resistance)	Eliminate errors
			Encoder is defect	Exchange the encoder
			Incorrect encoder type configured	Correction of the configuration
			Input/output channel is unused (open)	Deactivation of the "Diagnostic Group Diagnostics" parameter for this output channel
			Load impedance is too large	Use actuator with lower load impedance
00111_B	7_D	High limit exceeded	Value is above the overrange	• Correction tuning of module/actuator • Modify measuring range by means of configuration
01000_B	8_D	Lower limit exceeded	Value is below the overrange	• Correction tuning of module/actuator • Modify measuring range by means of configuration
01001_B	9_D	Error	Encoder signal flutters	Eliminate cause of error
			Hardware error in the module	Exchange of the module
			EMC interference	Eliminate cause of error

Error type		Error text	Meaning	Remedy
10001_B	17_D	Encoder- or load voltage missing	• Supply voltage at the Power Supply PS missing or too low • Power Supply PS is faulty	• Check the supply voltage at the Power Supply PS • Exchange the Power Supply PS
10011_B	19_D	HART communication error (HART diagnostics)	• HARD field device is not responding • Timing error	• Check the process wiring • Correction of the configuration
10101_B	21_D	Reference channel error	• internal reference junction: TC sensor module defective or not present • external reference junction (RTD): Parameters do not point to the RTD module	• Exchanging or connecting the TC Sensor Module • Correction of the configuration
10110_B	22_D	HART additional status available (HART warning)	---	---
10111_B	23_D	Reserved for HART (HART warning)	---	---
11000_B	24_D	Actuator disconnection	Intrinsically safe switching signal with 4 DO switched on	---
11010_B	26_D	External fault	• Encoder error • Encoder supply faulty • Changeover contact error • Actuator error • HART field device error	• Replacement of encoder/actuator/HART field device • Correction of the process wiring
11011_B	27_D	HART configuration modified (HART warning)	---	---
11101_B	29_D	HART main variable outside of the limits (HART diagnostics)	---	---
11110_B	30_D	HART non-primary variable outside of the limits (HART diagnostics)	---	---

Note

Control response

A control behavior is implemented in the electronic modules of the ET 200iSP for parameter assignment.

If the electronic module receives a faulty parameter, this is rejected. The electronic then continues to operate with its already valid parameters (the default parameters from the initial parameter assignment). A "Parameterization error" diagnostic message is not output.

The update interrupt function can be used to check the changed parameters of the electronic modules. See section "Interrupts in PROFIBUS (Page 212)".

No update interrupt is generated in the case of faulty parameters.

7.13.13 H status with PROFIBUS (only for S7-400H and standard redundancy)

The IM 152-1DP only supplies the H status if it operates on an S7-400H-DP master or is operated redundantly according to the standard.

The H-status is included as an additional block in the configuration of the device diagnostics, generally after the manufacturer identification.

Table 7-38 Configuration of the H status of the IM 152-1DP (only for S7-400H)

Byte	7	6	5	4	3	2	1	0	Description
Byte z	0	0	0	0	1	0	0	0	Bit 0 to 5: Length of the H status including byte x (= 8 bytes) Bit 6 and Bit 7: Code for device-related diagnostics
Byte z+1	1								Bit 0 to Bit 6: $1E_H$ = Parameter assignment status (switchover by DP master) $1F_H$ = H-status Bit 7: Code for status message
Byte z+2	0_H								Always "0"
Byte z+3									Not applicable
Byte z+4									Not applicable
Byte x+5	0	0	0						H status of the IM 152-1DP that sends the status Bit 0: Disabled Bit 1: Activated Bit 2: Hardware defect Bit 3: IM 152-1DP in the data exchange Bit 4: Master-State-Clear

Byte	7	6	5	4	3	2	1	0	Description
Byte x+6	0	0	0						H status of the other IM 152-1DP Bit 0: Disabled Bit 1: Activated Bit 2: Hardware defect Bit 3: IM 152-1DP in the data exchange Bit 4: Master-State-Clear
Byte z+7	0_H								Always "0"

7.13.14 Interrupts in PROFIBUS

Definition

The interrupt section of the device diagnostics provides information on the type of interrupt and the cause leading to an interrupt being triggered. The interrupt part comprises a maximum of 48 bytes.

Position in the diagnostic frame

The position of the interrupt part is after the channel-related diagnostics or after the identification-related diagnostics (for STEP 7).

Example: If three channel-related diagnostics are present, the interrupt part starts from byte 34. See "Configuration of device diagnostics for PROFIBUS (Page 202)".

In the event of an interrupt, the channel-specific diagnostics are shortened in favor of the interrupt information.

Contents

The content of the interrupt function depends on the type of alarm:

In the case of diagnostic interrupts, 4 bytes of interrupt header and up to 44 bytes of additional interrupt information (diagnostic data record 1) for SIMATIC S7 are sent.

For hardware interrupts the length is 4 bytes interrupt header and 4 bytes interrupt state information.

For pull/plug interrupts, the length is 4 bytes of interrupt header and 5 bytes of additional interrupt information.

For update interrupts the length is 4 bytes interrupt header and 2 bytes additional interrupt information.

The meaning of these bytes is described on the following pages.

Interrupts

The interrupt part for ET 200iSP is configured as follows:

Table 7-39 Structure of the interrupt status of the interrupt section

Byte	7	6	5	4	3	2	1	0	Description
Byte x	0	0							Bit 0 to 5: Length of the interrupt part including byte x (= max. 48 bytes) Bit 6 and Bit 7: Code for interrupt diagnostics (for 10_B, see section "Channel-related diagnostics with PROFIBUS (Page 207)")
Byte x+1	0								Bit 0 to Bit 6: Interrupt type: • 0000001_B: Diagnostic interrupt • 0000010_B: Hardware interrupt • 0000011_B: Pull interrupt • 0000100_B: Plug interrupt • 0000110_B: Update interrupt
Byte x+2									Bit 0 to bit 7: Slot address 02: IM 152-1DP supplies interrupt (diagnostic interrupt, hardware interrupt for time stamping) 04 to 35: Slot of the module that supplies interrupt
Byte x+3									Bit 0 and Bit 1: • 00_B: Hardware interrupt, pull/plug interrupt or update interrupt • 01_B: At least one error is present • 10_B: Outgoing error • 11_B: Reserved Bit 3 to bit 7: Interrupt sequence number (1 to 31)
Byte x+4									See diagnostic interrupt, byte x+4 to x+7 See hardware interrupt for analog input modules See time stamping hardware interrupt at slot 2 (IM 152-1DP) See pull/plug interrupt See update interrupt

Diagnostic interrupt, byte x+4 to x+7

Bytes x+4 to x+7 correspond to diagnostic data record 0 in STEP 7.

The bytes from byte x+8 to x+43 correspond to diagnostic data record 1 in STEP 7.

Table 7-40 Structure of bytes x+4 to x+7 for diagnostic interrupt

Byte	7	6	5	4	3	2	1	0	Description
Byte x+4	0	0	0	0	1	1	1	1	Bit 0: Module fault, i.e. an error was detected Bit 1: Internal error in the module Bit 2: External error, module no longer responsive Bit 3: Channel fault in module
Byte x+5	0	0	1	1					Bit 0 to Bit 3: Module class: 0100 for the IM 152-1DP; set with message for time stamping or self-diagnostics 1001 for one electronic module: as of byte x+8 Bit 4: Channel information available Bit 5: User information available
Byte x+6									Always "0"
Byte x+7									Always "0"
Byte x+8									See diagnostic interrupt from interface module IM 152-1DP See diagnostic interrupt of input or output modules without HART See diagnostic interrupt of input or output modules with HART

Diagnostic interrupt from interface module IM 152-1DP

Table 7-41 Configuration from byte x+8 for diagnostic interrupt from interface module

Byte	7	6	5	4	3	2	1	0	Description
Byte x+8									55_H: Self-diagnosis
Byte x+9									Length of each channel-specific diagnostic information in bits
Byte x+10									Number of channels per module
Byte x+11									Bit 0: Diagnostic event an channel 0 of the module Bit 1: Diagnostic event on channel 1 of the module (in case of redundancy)
Byte x+12	7	6	5	4	3	2	1	0	Error type on channel 0: Byte x+12 to x+19 The corresponding error type number of the channel-related diagnostics is placed in brackets. You can find additional notes on the meaning and solution in section "Error types of the electronic modules with PROFIBUS (Page 209)". Bit 3: Fehler Power Supply 1 (17) Bit 5: Error Power Supply 2 (17)
Byte x+13	15	14	13	12	11	10	9	8	
Byte x+14	23	22	21	20	19	18	17	16	Bit 21: MMC content invalid (26)
Byte x+15	31	30	29	28	27	26	25	24	

Byte	7	6	5	4	3	2	1	0	Description
Byte x+16	39	38	37	36	35	34	33	32	
Byte x+17	47	46	45	44	43	42	41	40	
Byte x+18	55	54	53	52	51	50	49	48	
Byte x+19	63	62	61	60	59	58	57	56	
Byte x+20 … x+27									Error type on channel 1: See byte x+12 to x+19: Only available with redundancy of the IM 152-1DP

Diagnostic interrupt of input or output modules without HART

Table 7-42 Configuration from byte x+8 for diagnostic interrupt (input or output modules without HART)

Byte	7	6	5	4	3	2	1	0	Description
Byte x+8									$7B_H$: Input channel $7C_H$: Output channel
Byte x+9									Length of each channel-specific diagnostic information in bits
Byte x+10									Number of channels per module
Byte x+11									Bit 0: Diagnostic event an channel 0 of the module … Bit 7: Diagnostic event an channel 7 of the module
Byte x+12	7	6	5	4	3	2	1	0	Error type on channel 0: Byte x+12 to x+15 The set bit (0 to 31) corresponds to the error type number. You can find additional notes on the meaning and solution in section "Error types of the electronic modules with PROFIBUS (Page 209)". Bit 1: Short-circuit Bit 6: Wire break Bit 7: Upper measuring range exceeded
Byte x+13	15	14	13	12	11	10	9	8	Bit 8: Lower measuring range exceeded Bit 9: Error
Byte x+14	23	22	21	20	19	18	17	16	
Byte x+15	31	30	29	28	27	26	25	24	Bit 24: Actuator disconnection in safety-related operation Bit 26: External fault
Byte x+16 … x+19									Error type on channel 1: See Byte x+12 to x+15
Byte x+20 … x+23									Error type on channel 2: See Byte x+12 to x+15
Byte x+24 … x+27									Error type on channel 3: See Byte x+12 to x+15
Byte x+28 … x+31									Error type on channel 4: See Byte x+12 to x+15
Byte x+32 … x+35									Error type on channel 5: See Byte x+12 to x+15

Byte	7	6	5	4	3	2	1	0	Description
Byte x+36 ... x+39									Error type on channel 6: See Byte x+12 to x+15
Byte x+40 ... x+43									Error type on channel 7: See Byte x+12 to x+15

Diagnostic interrupt of input or output modules with HART

Table 7-43 Configuration from byte x+8 for diagnostic interrupt (input or output modules with HART)

Byte	7	6	5	4	3	2	1	0	Description
Byte x+8									65_H: HART input or output channel
Byte x+9				1					Bit 4: Length of each channel-specific diagnostics in bits = 16 bits
Byte x+10									Number of channels per module
Byte x+11									Bit 0: Diagnostic event an channel 0 of the module Bit 1: Diagnostic event an channel 1 of the module Bit 2: Diagnostic event an channel 2 of the module Bit 3: Diagnostic event an channel 3 of the module
Byte x+12									Error type on channel 0: Byte x+12 to x+13 The corresponding error type number of the channel-related diagnostics is placed in brackets. You can find additional notes on the meaning and solution in section "Error types of the electronic modules with PROFIBUS (Page 209)". Bit 1: HART communication error (19) Bit 2: Short circuit, short circuit to P (1) Bit 3: Short circuit, short circuit to ground (1) Bit 4: Wire break (6) Bit 5: Load voltage missing (17) Bit 6: Overflow (7) Bit 7: Underflow (8)
Byte x+13									Bit 0: HART primary variable outside of the limits (29) Bit 1: HART non-primary variable outside of the limits (30) Bit 2: HART analog output current saturated (4) Bit 3: HART analog output current specified (2) Bit 4: HART additional status available (22) Bit 5: Reserved for HART (23) Bit 6: HART configuration changed (27) Bit 7: HART field device error (26)
Byte x+14 ... x+15									Error type on channel 1: See Byte x+12 to x+13
Byte x+16 ... x+17									Error type on channel 2: See Byte x+12 to x+13
Byte x+18 ... x+19									Error type on channel 3: See Byte x+12 to x+13

Example of a diagnostic interrupt

The electronic module 8 DI NAMUR reports the diagnostic interrupt "Wire break" on channel 2.

Table 7-44 Example of a diagnostic interrupt

Byte	7	6	5	4	3	2	1	0	Description
Byte x	0	0	1	0	1	1	0	0	Bit 0 to 5: Length of the interrupt part = 44 bytes Bit 7: Code for device-specific diagnostics
Byte x+1	0	0	0	0	0	0	0	1	Bit 0: Diagnostic interrupt Bit 7: Code for interrupt
Byte x+2	0	0	0	0	1	0	1	0	Bit 0 to Bit 4: Slot address 10
Byte x+3	0	0	0	0	1	0	0	1	Bit 0: At least 1 error is present Bit 3: Interrupt sequence number = 1
Byte x+4	0	0	0	0	1	0	0	0	Bit 3: Channel fault is present
Byte x+5	0	0	0	1	1	1	1	1	Bit 0 to Bit 3: Digital electronics module Bit 4: Channel information available
Byte x+6									Always "0"
Byte x+7									Always "0"
Byte x+8	0	1	1	1	1	0	1	1	Bit 0 to Bit 6: Input module = $7B_H$
Byte x+9	0	0	1	0	0	0	0	0	Bit 0 to 5: Length of the channel related diagnostics = 32 bits
Byte x+10	0	0	0	0	1	0	0	0	Bit 0 to Bit 3: Number of channels per module = 8
Byte x+11	0	0	0	0	0	1	0	0	Bit 2: Diagnostic result is available on channel 2
Byte x+12 ... x+15									"0" (channel 0)
Byte x+16 ... x+19									"0" (channel 1)
Byte x+20	0	1	0	0	0	0	0	0	Bit 6: Error type 6 on channel 2 = wire break
Byte x+21 ... x+23									"0" (channel 2)
Byte x+24 ... x+27									"0" (channel 3)
Byte x+28 ... x+31									"0" (channel 4)
Byte x+32 ... x+35									"0" (channel 5)
Byte x+36 ... x+39									"0" (channel 6)
Byte x+40 ... x+43									"0" (channel 7)

Hardware interrupt for analog input modules

Table 7-45 Configuration from byte x+4 for hardware interrupt (analog input)

Byte	7	6	5	4	3	2	1	0	Description
Byte x+4									Bit 0: 1: Violation of the high limit channel 0 Bit 1: 1: Violation of the high limit channel 1 Bit 2: 1: Violation of the high limit channel 2 Bit 3: 1: Violation of the high limit channel 3
Byte x+5									Bit 0: 1: Violation of the low limit channel 0 Bit 1: 1: Violation of the low limit channel 1 Bit 2: 1: Violation of the low limit channel 2 Bit 3: 1: Violation of the low limit channel 3
Byte x+6									Always 00_H
Byte x+7									Always 00_H

Hardware interrupt time stamping at slot 2 (IM 152-1DP)

Table 7-46 Configuration from byte x+4 for hardware interrupt (time stamping)

Byte	7	6	5	4	3	2	1	0	Description
Byte x+4									Time stamping status Bit 0: 1: Message buffer is ready for retrieval on IM 152-1DP Bit 1: 1: Overflow of the message buffer "external": Permissible message buffers are filled. Bit 2: 1: Overflow of the message buffer "internal": There is a risk of message loss. Bit 3: Redundancy: Active IM 152-1DP 0: Right IM of the TM-IM/IM is the active one 1: Left IM of the TM-IM/IM is the active one Bit 4: Redundancy: Redundancy mode active/not active 0: No redundant operation 1: Redundant operation Bit 5: Resetting the time stamping 0: no resetting takes place 1: Reset just completed Bit 6: Not applicable Bit 7: State of synchronization via time frame 0: No synchronization available 1: Synchronization available
Byte x+5									Data record number, if a data record is to be retrieved
Byte x+6									Number of message blocks contained in the data record 1 to 20
Byte x+7									Reserved

Pull/plug interrupt

The byte x+4 to x+8 contains the identification of the module that was removed or inserted. The identifier for the individual modules can be found in the GSD file.

You can tell whether the modules have been pulled out or plugged in by the interrupt type in byte x+1 (see table *Configuration of the interrupt status of the interrupt part*).

Table 7-47 Configuration from byte x+4 for pull/plug interrupt

Byte	7	6	5	4	3	2	1	0	Description	
Byte x+4									Not applicable	
Byte x+5										
Byte x+6										
Byte x+7									Type recognition of the module; high byte	SKF identifier (STEP 7), see table below
Byte x+8									Type recognition of the module; low byte	

Table 7-48 SKF identifiers (STEP 7)

Modules	SKF identifier
8 DI NAMUR	79 CA_H
4 DO DC23.1V/20mA shut down "H"	79 $D1_H$
4 DO DC17.4V/27mA shut down "H"	79 $D2_H$
4 DO DC17.4V/40mA shut down "H"	79 $D3_H$
4 DO DC23.1V/20mA shut down "L"	79 $D5_H$
4 DO DC17.4V/27mA shut down "L"	79 $D6_H$
4 DO DC17.4V/40mA shut down "L"	79 $D7_H$
2 DO Relay UC60V/2A	79 $D4_H$
4 AI I 2WIRE HART	79 EB_H
4 AI I 4WIRE HART	79 EC_H
4 AI RTD	79 EF_H
4 AI TC	79 EE_H
4 AO I HART	79 $F2_H$
Reserve module	8F $C0_H$
WATCHDOG module	79 DD_H
Pulled module	DE $C0_H$
Reserve identifier (CiR)	B6 40_H

Update interrupt

The update interrupt is reported when the following conditions are met:

- The parameter assignment has been carried out without errors.
- The parameter assignment of the ET 200iSP is different from the parameters and identification and maintenance data stored retentively in the modules.

Table 7-49 Configuration from byte x+4 for update interrupt

Byte	7	6	5	4	3	2	1	0	Description
Byte x+4									Data record index: Is the number of the parameter assignment data record that led to the update interrupt.
Byte x+5									Number of updates that could not be reported to the CPU.

7.13.15 Diagnostics for incorrect configuration states of the ET 200iSP with PROFIBUS

Incorrect configuration states

The following incorrect expansion states of the ET 200iSP lead to a station failure of theET 200iSP or prevent entry into the data exchange. These reactions are independent of the release of the interface module parameter "Operation at setpoint <> actual configuration":

- Two missing electronic modules
- Terminating module missing
- Number of modules exceeds maximum configuration
- Faulty backplane bus (e.g. defective terminal module)

Note

If a module is missing (gap) and the ET 200iSP POWER OFF/POWER ON is switched, then the ET 200iSP starts. The startup with more than one missing module is not possible. If more than one electronic module is missing, then after plugging in these modules a safe start-up of the ET 200iSP is only guaranteed after POWER OFF/ POWER ON.

Diagnostics for PROFIBUS

You can recognize all incorrect configuration states by the following diagnosis:

Table 7-50 Diagnostics for incorrect configuration states of the ET 200iSP

Identifier-related diagnostics:	Module status
All bits from slot 4 to 35 are set	01_B: "Module error, invalid payload" up to the slot of the cause of failure 11_B: "No module; invalid payload" from the slot of the cause of failure

7.14 Changing PROFIBUS station to PROFINET station

This section describes the requirements and procedure for changing a PROFIBUS station to a PROFINET station in Step 7.

Requirements

Software requirements:

- PCS7 V9.1 SP2
- Step 7 V5.7 SP1
- S7 F-systems V6.4 Update 1
- PDM V9.2.2
- Latest version of the HSPs of the interface module and electronic modules:
  - IM 152-1PN: HSP 0289 V1.0 or higher
  - 8 DI NAMUR: HSP 0045 V2.11 or higher
  - 4 DO: HSP 2009 V2.4 or higher
  - 2 DO Relay UC60V/2A: HSP 2031 V1.7 or higher
  - 4 AI RTD: HSP 2032 V1.5 or higher
- Current version of the EDD – PN_IOSYSTEM_SIEMENS_ET200iSP

Additional requirements:

- SIMATIC CPU 410-5H is used for R1 redundancy.
- The power consumption of the ET 200iSP station has been recalculated. It was taken into account that IM 152-1PN requires more power than IM 152-1DP. See section "Restricted Number of Connectable Electronics Modules (Page 70)".
- The compatibility of the electronic modules with IM 152-1PN was considered. See section "Compatible electronic modules (Page 282)".

> **WARNING**
>
> - Replacement of IM 152-1DP by IM 152-1PN is not allowed in process mode.
> - In a redundant station, a mixed configuration (IM 152-1PN together with IM 152-1DP) is not allowed.
> - When using the IM 152-1PN interface module, observe the Class 1 limits according to IEC 60825-1. Only use approved media converters and fiber-optic cables.

Replacement of the interface module

1. Switch off the supply voltage of the ET 200iSP station.
2. Pull out the PROFIBUS cable (PROFIBUS RS 485-IS) from the termination module.
3. Remove the IM 152-1DP interface module (or both interface modules in case of R1 redundancy) from the termination module. See section "Inserting and labeling the interface module and electronic modules (Page 143)".
4. If the ET 200iSP RS 485-IS coupler is not used for other stations, remove the ET 200iSP RS 485-IS coupler.

5. Install the optical transceiver into the IM 152-1PN interface module (or both interface modules for R1 redundancy). See section "Pulling and plugging optical transceivers (Page 150)".
6. Plug the IM 152-1PN interface module (or both interface modules in case of R1 redundancy) into the existing termination module. See section "Inserting and labeling the interface module and electronic modules (Page 143)".
7. Insert the end of the fiber-optic cable into the optical transceiver until the cable snaps into place.
8. Switch on the supply voltage of the ET 200iSP station.

Commissioning

1. Create a new Step 7 project or use an existing Step 7 project, taking into account the software requirements.
2. Create a PROFINET network.
3. Insert the IM 152-1PN interface module from the hardware catalog into the HW Config.
4. Insert the required electronic modules into the device.
5. Configure the parameters for the interface module and the electronic modules.
6. Update the project-specific data, e.g. the addresses of the process values.
7. Perform the standard commissioning for PROFINET devices. See section "Commissioning and Diagnostics (Page 155)".
8. Download the project and change the operating mode of the CPU to RUN.

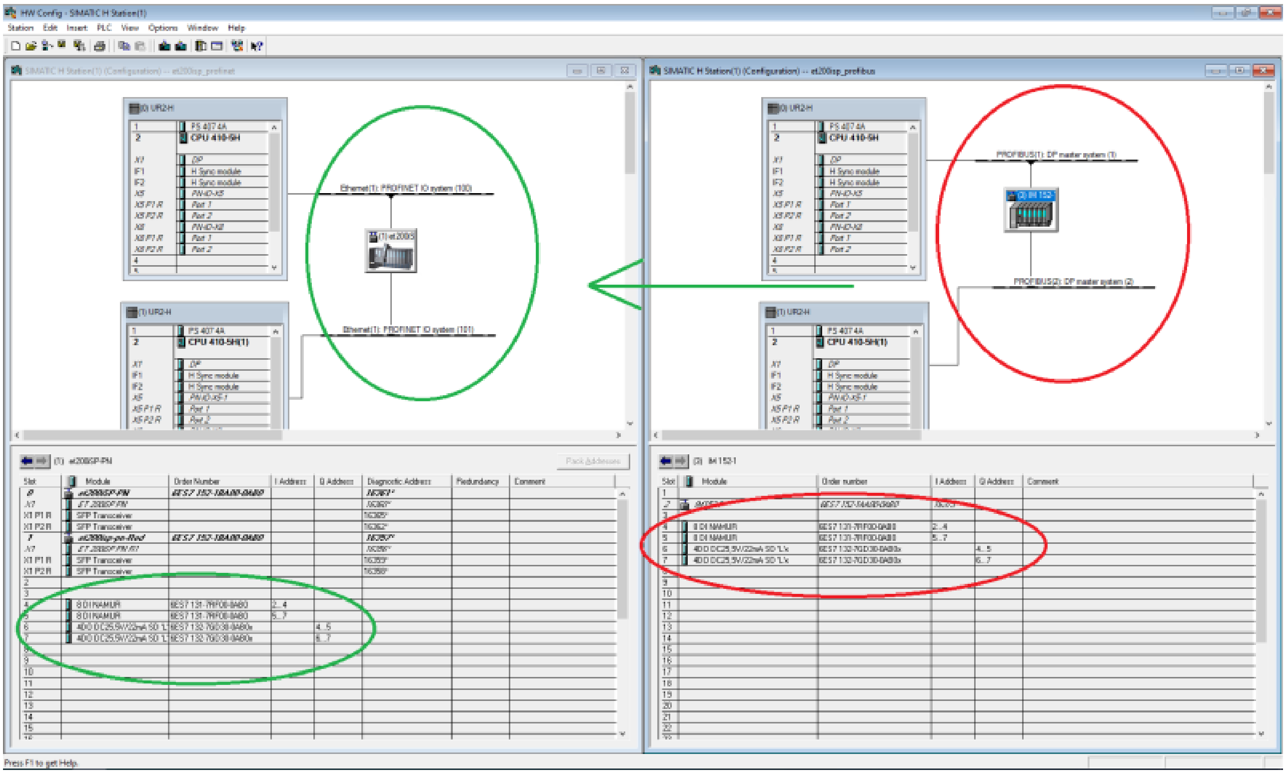


Figure 7-11 Changing a PROFIBUS station (right) to a PROFINET station (left)

Maintenance 8

8.1 Activities during operation

Properties

The following table describes which activities are permitted on the ET 200iSP in Zone 1, Zone 2, Zone 21 and Zone 22 during operation.

Requirements

> **WARNING**
>
> **Death or serious injury may occur if the following precautions are not taken.**
>
> Hazardous location zone 1 and zone 2: You may open the enclosure of the ET 200iSP briefly for the permitted maintenance work.
>
> Hazardous location zone 21 and zone 22: Do not open the enclosure of the ET 200iSP in areas with combustible dust.

Permitted activities in hazardous locations

Table 8-1 Permitted activities in hazardous locations

Activities	Zone 1	Zone 2	Zone 21	Zone 22	See section ...
Pulling and plugging modules during operation (hot-swapping) in Zone 1 and Zone 2	X	X			Maintenance (Page 225)
Maintenance during operation (visual checks)	X	X	X[1]	X[1]	Maintenance (Page 225)
Cleaning	X	X			Maintenance (Page 225)
Pulling and plugging Ex SFP transceiver on IM 152-1PN	X	X	X[1]	X[1]	Wiring (Page 119)
Remove and insert the bus connector at the TM-IM/EM terminal module in Zone 1 and Zone 2	X	X			Wiring (Page 119)
Isolating and disconnecting the cables to the encoders, actuators and HART field devices at the terminal module TM-EM/EM in Zone 1 and Zone 2	X	X			Wiring (Page 119)
Isolating and disconnecting the cables to the actuators at the terminal module TM-RM/RM in Zone 1 and Zone 2. Requirements: The Ex d disconnecting plug on the TM-RM/RM must be pulled! See section Wiring terminal module TM-RM/RM (Page 137).	X	X			Wiring (Page 119)
Reparameterization and diagnostics of the ET 200iSP	X	X			Commissioning and Diagnostics (Page 155)

Activities	Zone 1	Zone 2	Zone 21	Zone 22	See section ...
Firmware update of the IM 152-1PN via PROFINET IO	X	X	X[1]	X[1]	Maintenance (Page 225)
Firmware update of the IM 152-1DP via PROFIBUS DP	X	X	X[1]	X[1]	Maintenance (Page 225)
[1] In areas with combustible dust, the enclosure of the ET 200iSP may not be opened for this handling/activity.					

WARNING

Death or serious injury may occur if the following precautions are not taken

If a power supply is disconnected too early, sparking could cause an explosion.

After unlocking a power supply of the ET 200iSP, wait at least 2 minutes before removing the power supply in a potentially explosive atmosphere.

WARNING

Disconnecting the fiber-optic cable

Do not look directly at the end of the fiber optic cables (do not look into the opening of the optical transmitting diodes). The emitted light beam could damage your eyes.

Permitted activities in zone 2

In addition to the activities permitted in zone 1, the following activity is also permitted:

- Inserting and labeling electronic modules 2 DO Relay UC60V/2A (Page 147)

WARNING

Death or serious injury may occur if the following precautions are not taken

Disconnect and connect the cables for the supply voltage of the power supply PS DC24V at the terminal module TM-PS-A or TM-PS-B during operation. This action is only permitted if there is no danger of explosion or if no voltage is applied to the terminal module TM-PS-A or TM-PS-B.

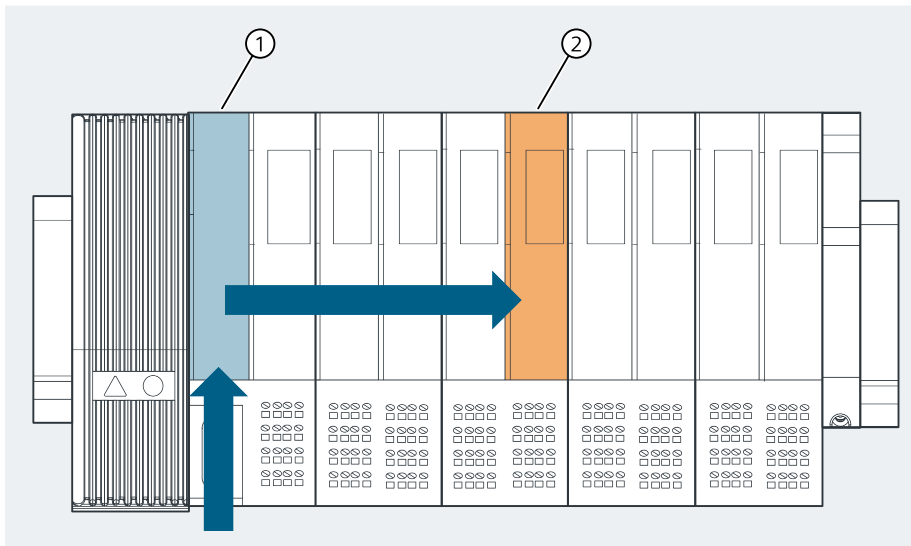
Disconnect and connect the cables to the actuators on the terminal module TM-RM/RM during operation. This action is only permitted if there is no danger of explosion or if no voltage is applied to the terminal module TM-RM/RM.

8.2 Pulling and plugging electronic modules during operation (hot swapping)

Properties

- The ET 200iSP distributed I/O device supports the removing and inserting of an electronic module (1 gap) during operation (RUN mode).
- When an electronic module is removed the ET 200iSP remains in the RUN mode.
- If you have pulled more than one electronic module, then this leads to a station failure of the ET 200iSP. After you have plugged in all electronic modules again, you must perform a restart of the ET 200iSP, i.e. switch the supply voltage on and off at the power supply module PS.
- If you configure a ET 200iSP with only one electronic module, then pulling this electronic module will lead to a station failure of the ET 200iSP. When the electronic module is plugged in, the ET 200iSP starts up again.

- IM 152-1DP: After loading the ET 200iSP, all current parameters and identification and maintenance data are stored in the interface module. After replacing an electronic module, the interface module automatically transfers the current parameters and identification and maintenance data to the new module. This function is always activated in the ET 200iSP and cannot be parameterized.
  - The current parameters and identification and maintenance data remain safely stored in the interface module even after a failure of the ET 200iSP supply voltage.
  - The default parameters of an electronic module are overwritten.



① Interface module
② New electronic module

Figure 8-1 Automatic parameter assignment after replacing a module

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Note

If you reduce an existing configuration and then extend it again, you should erase the flash memory before the extension.

The flash memory (parameters and identification and maintenance data) of the IM 152-1DP is erased if you set the PROFIBUS address to "0" and then switch the supply voltage of the ET 200iSP off and on at the PS power supply.

- IM 152-1PN does not store current parameters, identification and maintenance data. The parameters are processed at every connection to the IO controller. The identification and maintenance data are not updated automatically and the user must take care to make the correct setting of these values. It is no longer necessary to perform a reset to factory settings for a configuration extension.

Requirements

- During startup of the ET 200iSP all modules must be inserted.
- Removing and inserting electronic modules during operation (RUN mode) is only possible if you have enabled the parameter **Operation at preset <> actual configuration** on the interface module.
- Only **one** electronic module may be removed at one time.
- The following table describes which module you can pull and plug during operation:

Table 8-2 Requirements

Module exchange	Pulling and plugging	Effects on ET 200iSP
Power supply PS	Yes	Pull: Failure of the ET 200iSP (state as with supply voltage switched off) Insert: Starting of the ET 200iSP
Interface module	Yes	Pull: Failure of the ET 200iSP Insert: Parameter assignment of the ET 200iSP via PG required (for STEP 7 only the I&M data)
Electronic module	Yes	Pull: Failure of the sensor/actuator Insert: Sensor/actuator in operation

Pulling and plugging of electronic modules

Pull and plug the electronic modules as described in the section Plugging and labeling the power supply, interface module and electronic modules (Page 143).

Note

Check the coding element before you insert the new electronic module in the terminal module.

See also

Resetting the IM 152-1PN to factory settings using STEP 7 (Page 236)

8.3 Replacing interface module IM 152-1PN

Properties

The interface module stores the parameters and I&M in an internal memory. The content is retained even after a power failure of the ET 200iSP.

Recommendation

If you set the device name and/or the network parameters in the replacement interface module before installation in the plant, the CPU takes over the configuration of the IM.

Requirements

- The ET 200iSP was already loaded.
- There is an active communication connection to the CPU.

Optical transceiver

WARNING

Disconnecting the fiber-optic cable

Do not look directly at the end of the fiber optic cables (do not look into the opening of the optical transmitting diodes). The emitted light beam could damage your eyes.

In safe environments and explosive environments up to zone 1/21 the replacement of the transceiver is permitted (requirements according to IEC 60079-0/11/28 are fulfilled.).

No startup of the interface module is possible in case of a missing or faulty transceiver.

Replacing the interface module

1. Remove the fiber-optic cable connector on the interface module to be replaced.
2. Remove the SFP transceiver.
3. Pull the (defective) IM 152-1PN from the terminal module.
4. Plug the (new) IM 152-1PN into the terminal module.
5. Plug the fiber-optic cable into the replaced interface module.
   The interface module receives its bus parameters through the neighbor relations and the CPU automatically transfers the parameters and identification and maintenance data.
6. Wait until the replaced IM has started.

8.4 Replacing interface module IM 152-1DP

Properties

- The IM 152-1DP stores the parameters and I&M in an internal flash memory. The content is retained even after a power failure of the ET 200iSP.
- After the IM 152-1DP has been replaced, the ET 200iSP is automatically configured by the CPU (e.g. S7-400). You only need to load the I&M data (if required) with HW Config or SIMATIC PDM into the ET 200iSP.

Requirements

Replacement interface module for replacement

Replacing the interface module on the PROFIBUS DP

Note

Switching the bus terminating resistor

When switching the bus terminating resistor on and off, the PROFIBUS DP line remains connected.

1. Note the setting of the bus terminating resistor on the IM to be replaced.
2. Ensure that the bus terminating resistor is set to "ON" at **exactly** one of the adjacent IMs.
3. Ensure that the bus terminating resistor on the IM to be replaced is set to "OFF".
4. Pull out the bus plug on the IM to be replaced.
5. Pull the (defective) IM 152-1DP from the terminal module.
6. Set the PROFIBUS DP address "0" on the new IM 152-1DP and plug it into the terminal module.
7. Switch the supply voltage of the ET 200iSP off and on.
8. Wait until the retentive data of the interface module has been erased (BF LED flashes with 0.5 Hz).
9. Switch off the supply voltage of the ET 200iSP.
10. Now set the PROFIBUS DP address of the old (defective) IM 152-1DP on the new interface module.
11. Switch the supply voltage of the ET 200iSP on again.
12. Wait until the replaced IM has started.
13. Connect the bus plug to the replaced IM.
14. Ensure that the bus terminating resistor is set to the setting noted in the first step.
15. Assigning ET 200iSP parameters with STEP 7:
    - The ET 200iSP is automatically reconfigured by the CPU and then changes to data exchange with the DP master.
      If you need the I&M data, you also need to load it into the ET 200iSP (menu command HW Config **PLC > Modules**).
    - If you use SIMATIC PDM, you need to download all parameters and I&M into the ET 200iSP (menu command **Device > Full download to device**).
    - In a redundant station, a mixed configuration (IM 152-1PN together with IM 152-1DP) is not allowed.

8.5 Maintenance during operation

Properties

Maintenance of the ET 200iSP is essentially limited to visual inspections. The ET 200iSP can be in operation at the same time.

Requirements

In the hazardous area, the visual inspection should be performed every 6 months.

Procedure

1. Check the tightness and the integrity of the enclosure's cable entries.
2. Check whether there is any water or dust inside the enclosure. If there is, find out how it got there.
3. Check that the wiring is secure (terminals, cables).

8.6 Cleaning

Safety note for Zone 1 and Zone 2

WARNING

Plastic parts can become electrostatically charged during cleaning. If you have installed the ET 200iSP in Zone 1 or Zone 2, then this can be a hazard:

The ET 200iSP may only be cleaned with damp cloths.

A warning notice "Clean ET 200iSP only with damp cloths" must be affixed inside the enclosure.

After the cleaning, run a functional check of the ET 200iSP.

CAUTION

Cleaning of optical components

Optical components can be damaged if they come into contact with cleaning agents.

Do not use any cleaning agents to clean the optical components.

Safety note for Zone 21 and Zone 22

WARNING

The dust layer on and at the enclosure of the ET 200iSP must not exceed a thickness of 5 mm.

You must remove the dust layer on and at the enclosure at regular intervals! Ensure there is no risk of explosion during cleaning!

8.7 Firmware update of the IM 152-1PN

Properties

- After (compatible) function extensions, security updates or performance improvements, you should upgrade (update) the interface module to the latest firmware version.
- You can obtain the most recent firmware versions from your Siemens representative, or download it from the Internet at: http://www.siemens.com/automation/service&support (https://www.siemens.com/automation/service&support)
  Tip:
  - Before updating, note down the current version of your firmware. You can read out the version with HW Config.
  - If you encounter problems with the new firmware, you can also download the previous (current) firmware from the Internet and transfer it to the interface module again.
- The firmware update is performed by the PG/PC via network using the CPU.

Requirements

NOTICE
Requirements for the firmware update of the fail-safe electronic modules • The F-CPU must be in the "STOP" operating state. • The supply voltage of the respective fail-safe electronic module is connected.

Note

Updating electronic modules in IO redundancy

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

The update of the second electronic module must not be started until the electronic module that was updated first is fully operational again.

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

- You are familiar with the general procedure for updating the firmware.
- A connection to the IO device is possible.
- The storage location of the file for the firmware update is known.
- The engineering system is open.

Procedure

1. Open the hardware configuration.
2. Select the electronic module in the device view.
3. In the shortcut menu, select the "Online & Diagnostics" menu command.

4. In the "Functions" folder, select the "Firmware update" group.
   To select the path to the firmware update files, click the "Browse" button in the "Firmware update" area.
5. Select the appropriate firmware file.
   The table in the firmware update area lists all electronic modules for which an update is possible with the selected firmware file.
   Select the header.upd file.
6. Click "Run update".
   If the electronic module can interpret the selected file, the file is loaded into the electronic module.

Bad update

If the update fails, the IM 152-1PN starts up with the ("old") firmware that was active before the update after the supply voltage is switched off/on. See table *Status and error LEDs on the IM 152-1PN* in the section Status and error LEDs on the IM 152-1PN (Page 170).

Result

The firmware of the electronic module is updated.

8.8 Firmware update of the IM 152-1DP

Properties

- After (compatible) function extensions or after performance improvements, you should upgrade (update) the interface module to the latest firmware version.
- You can obtain the most recent firmware versions from your Siemens representative, or download it from the Internet at: http://www.siemens.com/automation/service&support (https://www.siemens.com/automation/service&support)
  Tip:
  – Before updating, note down the current version of your firmware. You can read out the version with HW Config or with SIMATIC PDM.
  – If you encounter problems with the new firmware, you can also download the previous (current) firmware from the Internet and transfer it to the interface module again.
- The firmware update is performed by the PG/PC via network using the CPU.

Requirements

Update via PROFIBUS DP

- STEP 7 as of V5.3 SP1
- The IM 152-1DP in the station to be updated can be accessed online.

- The files with the current (new) firmware version are available in the file system of your PG/PC.
- You have selected the header.upd file.

Updating firmware via network connection

For information on the procedure, see the STEP 7 online help.

Restarting following an update

The following setting options are available via the "Update firmware after download" parameter to restart after updating the interface module:

- "Update firmware after download" enabled:
  When the update is completed successfully, a reset of the IM 152-1DP is performed automatically. The module restarts with the newly loaded firmware.

> **CAUTION**
>
> **STOP of CPU possible**
>
> If the "Update firmware after download" field is selected, the ET 200iSP station will be briefly interrupted. If you have not made any provisions for this situation, the update will cause to CPU to go to STOP mode due to a rack failure.

- "Update firmware after download" disabled:
  If the update is completed successfully, the IM 152-1DP continues to run with the firmware loaded before the update.
  The newly loaded firmware is only restarted after the supply voltage is temporarily not available.
  For redundant systems, the "Update firmware after download" parameter cannot be disabled.

Bad update

If the update fails, the IM 152-1DP starts up with the ("old") firmware that was active before the update after the supply voltage is switched off/on. See table *Status and error LEDs on the IM 152-1DP* in the section Status and error LEDs on the IM 152-1DP (Page 173).

8.9 Reading service data

Properties

The service data contains special information about the status of an ET 200iSP station for diagnostic purposes.

If you want to transfer the service data of your system to the customer support in case of service, you have to consider the following:

The service data can be read out from the following FW version of the interface module:

- PROFINET IM 152-1PN: As of FW version V1.0.0
- PROFIBUS IM 152-1DP: As of FW version V2.0.5

You can read out the service data with the menu command "PLC -> Save service data", save it in a file and forward it to Customer Support.

Requirements

You must have STEP 7 as of V5.3 installed to use this function.

Note the following:

- If possible, save the service data immediately after the ET 200iSP station has failed.
- Establish a network connection to the interface module:
  - Connection via media converter and PROFINET IO to the IM 152-1PN
  - Direct connection via RS 485-IS coupler and PROFIBUS RS 485-IS to the IM 152-1DP

  Note

  Connect the PG to the PROFIBUS DP and access the IM 152-1DP via the RS 485-IS coupler (of the intrinsically safe PROFIBUS RS 485-IS).

- In the redundant configuration, it is sufficient to establish the connection to one of the two interface modules.

Procedure

1. In the SIMATIC Manager, select "PLC > Show accessible devices".
2. Select the affected station.
3. Select the "PLC > Save service data" menu command.
   In the next dialog box, select the file path and the file names for the service data.
4. Save the file.
5. Forward these files to Customer Support on request.

8.10 Resetting the IM 152-1PN to factory settings using STEP 7

Requirements

- There is a direct connection to the interface module.
- The configuration tool is open.

Procedure

Note

Redundant configuration

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

1. Select the interface module.
2. Switch to edit mode.
3. Reset the interface module with the respective option to the factory settings.

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 behavior of the plugged electronic modules when resetting to factory settings

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

Result

- The interface module performs "Reset to factory settings".
- The properties of the interface module are reset to the following values:

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

8.11 Resetting the interface module IM 152-1DP to the factory settings

Definition

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

9 General technical specifications

9.1 General technical specifications

Definition

The general technical specifications contain the standards and test values which the ET 200iSP distributed I/O device complies with and fulfills or according to which test criteria the ET 200iSP distributed I/O device has been tested.

9.2 Standards and certifications

CE mark

CE

The ET 200iSP 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:

- 2014/30/EU "Electromagnetic Compatibility" (EMC Directive)
- 2014/34/EU "Equipment and protective systems intended for use in potentially explosive atmospheres" (Explosion-protection directive)

The EC Declarations of Conformity are available to the responsible authorities at:

Siemens AG

Process Automation

DI PA AE

Östliche Rheinbrückenstr. 50

76181 Karlsruhe, Germany

EMC Directive

SIMATIC products are designed for use in industrial environments.

Use in industrial environment

Table 9-1 Use in industrial environment

Area of application	Requirement for	
	Interference emission	**Interference immunity**
Industry	EN 61000-6-4:2007 + A1:2011	EN 61000-6-2:2005

Use in residential areas

Note

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

If you use the ET 200iSP in residential areas, then you must ensure the values of the EN 61000-6-3 measured according to EN 55016-2-3 for emission of radio frequency interference.

Individual measures are, for example:

- Installation of the ET 200iSP in grounded control cabinets/switch boxes
- Use of filters in supply lines

Approvals

ATEX- directive	Ex		KEMA 04ATEX2242 (ET 200iSP system) The module markings are described in the specifications. See technical specifications of the ET 200iSP modules.
IECEx approval			See technical specifications of the ET 200iSP modules.
INMETRO	INMETRO	UL BR OCP-0029	See technical specifications of the ET 200iSP modules.
FM approval	FM C US APPROVED		Factory Mutual Research (FM) See technical specifications of the ET 200iSP modules.
cULus approval	c UL us LISTED E334384		Underwriters Laboratories Inc. See technical specifications of the ET 200iSP modules.
CCC Ex approval	CCC		See technical specifications of the ET 200iSP modules.

UKCA	UK CA		DEKRA 21UKEX0032 (ET 200iSP system) Importer UK: Siemens plc Manchester M20 2UR See technical specifications of the ET 200iSP modules.
Marking for Australia			The ET 200iSP distributed I/O device meets the requirements of standard EN 61000-6-4:2007 + A1:2011.

WARNING

Do not remove plug-in connectors during operation

Personal injury and property damage can occur.

In hazardous areas, personal injury and property damage may occur if plug connections are disconnected during operation of a ET 200iSP plug-in connection.

Be aware of which activities are permitted in potentially explosive areas. See section "Activities during operation (Page 225)".

IEC 61131

The ET 200iSP distributed I/O device meets the requirements and criteria of the standard IEC 61131-2 (Programmable Logic Controllers, Part 2: Equipment Requirements and Tests).

PROFINET standards

The CC-B ET 200iSP distributed I/O device is based on the standards IEC 61158 and IEC 61784.

PROFIBUS standard

The ET 200iSP distributed I/O device is based on the standard *IEC 61784-1:2002 Ed1 CP 3/1*.

Marine approval

Classification authorities:

- ABS (American Bureau of Shipping)
- BV (Bureau Veritas)
- DNV (Det Norske Veritas)
- GL (Germanischer Lloyd)
- LRS (Lloyds Register of Shipping)
- Class NK (Nippon Kaiji Kyokai)

Use of the ET 200iSP distributed I/O device in device group I (mining) Category M2

The following conditions must be fulfilled if the ET 200iSP is used in device group I (underground mining operations and their overground systems) Category M2:

CAUTION

Transport and storage of the ET 200iSP

- To avoid ignitable sparks, the power supply (PS) and the mounting rail of the ET 200iSP must be packaged in shock-proof packaging for transportation and storage (e.g. for servicing) and immediately removed from the hazardous area.
- The enclosure in which the ET 200iSP is installed must be approved for device group I, category M2.
- Observe all other requirements concerning use of the ET 200iSP in the hazardous areas given in this manual.

9.3 Electromagnetic compatibility, transport and storage conditions

Definition of EMC

Electromagnetic compatibility is the ability of electrical equipment to function satisfactorily in its electromagnetic environment without influencing this environment.

The ET 200iSP distributed I/O device also meets the requirements of the EMC law of the European market. This requires that the ET 200iSP distributed I/O device meets the specifications and directives for electrical installation.

EMC in accordance with NE21

The ET 200iSP distributed I/O system complies with the EMC requirements of NEMUR directive NE21.

Pulseshaped interference

The following table shows the electromagnetic compatibility of the ET 200iSP distributed I/O device in relation to pulse-shaped interference variables.

Pulse-shaped interference	Test voltage	Corresponds to degree of severity
Electrostatic discharge in accordance with IEC 61000-4-2.	Air discharge: +/- 8 kV Contact-mode discharge: +/- 6 kV	3
Burst pulses (fast transients) in accordance with IEC 61000-4-4.	+/- 2 kV (supply line) +/- 2 kV (signal line)	3

Pulse-shaped interference	Test voltage	Corresponds to degree of severity
High-energy single pulse (surge) in accordance with IEC 61000-4-5 As of product version 3 of power supply PS (6ES7138-7EA01-0AA0), the overvoltage suppressor for the DC 24V supply at the power supply PS is no longer mandatory. Surge arresters are required for all signal modules (for appropriate types, see Appendix Lightning and overvoltage protection (Page 442))		3
• asymmetric connection	+/- 2 kV (supply line) +/- 2 kV (signal line / data cable)	
• symmetrical coupling	+/- 1 kV (supply line) +/- 1 kV (signal line / data cable)	
NAMUR recommendation NE21		
Electrostatic discharge according to NAMUR recommendation NE21	Air discharge: +/-8 kV Contact-mode discharge: +/- 6 kV	3
Burst pulses according to NAMUR recommendation NE21	+/- 2 kV (supply line) +/- 1 kV (signal line)	3
High-energy single pulse (surge) according to Namur recommendation NE21		3
• asymmetric connection	+/- 1 kV (supply line) +/- 1 KV (signal line / data cable)	
• symmetrical coupling	+/- 0.5 kV (supply line)	

Modules that can be wired according to NAMUR recommendation NE21

Type	Article number
PS DC24V	6ES7138-7EA01-0AA0
PS AC120/230V	6ES7138-7EC00-0AB0
IM 152-1PN	6ES7152-1BA00-0AB0
IM 152-1DP	6ES7152-1AA00-0AB0
4 DO DC23.1V/20mA	6ES7132-7RD01-0AB0
4 DO DC25.5V/22mA	6ES7132-7GD30-0AB0
4 DO DC17.4V/40mA	6ES7132-7GD21-0AB0
4 AI I 2WIRE HART	6ES7134-7TD00-0AB0
4 AI I 4WIRE HART	6ES7134-7TD50-0AB0
4 AI TC	6ES7134-7SD00-0AB0
4 AO I HART	6ES7135-7TD00-0AB0

Sinusoidal interference variables

The following table shows the electromagnetic compatibility of the ET 200iSP distributed I/O device in relation to sinusoidal interference variables.

- HF irradiation

HF radiation according to IEC 61000-4-3 Electromagnetic HF field, amplitude-modulated	
80 to 1000 MHz; 1.4 to 2 GHz	2.0 GHz to 2.7 GHz
10 V/m	3 V/m
80 % AM (1 kHz)	

- HF coupling

HF current feed according to IEC 61000-4-6
0.15 to 80 MHz
10 V
80 % AM (1 kHz)

Emission of radio interference

Interference emission of electromagnetic fields according to EN 55016. Limit class A, group 1 (measured at distance of 10 m).

Frequency	Interference emission
from 30 to 230 MHz	< 40 dB (μV/m)Q
from 230 to 1000 MHz	< 47 dB (μV/m)Q

Shipping and storage conditions

The ET 200iSP distributed I/O device exceeds the requirements in terms of transport and storage conditions according to IEC 61131-2. The following specifications apply for modules that are transported or stored in their original packaging.

Type of condition	permissible range
at user's discretion	≤ 1 m
Temperature	from - 40 °C to + 70 °C
Temperature change	20 K/h
Barometric pressure	from 1080 to 660 hPa (corresponds to an altitude of -1000 to 3500 m)
Relative humidity	from 5 to 95 %, without condensation

See also

General Rules and Regulations for Wiring (Page 119)

9.4 Mechanical and climatic environmental conditions

Operating conditions

The ET 200iSP is intended for weather-protected, stationary use. The operating conditions exceed requirements according to DIN IEC 60721-3-3:

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

Climatic environmental conditions

The following climatic environmental conditions apply:

Environmental conditions	Areas of application	Remarks
Temperature	from -20 to 70 °C [1 2]	For horizontal installation
	from -20 to 50 °C [1 2]	For all other mounting positions
Temperature change	10 K/h	-
Relative humidity	from 5 to max. 95 %	Without condensation
Barometric pressure	from 1080 to 795 hPa	corresponds to a height of -1000 to 2000 m
Concentration of pollutants	SO_2: < 0,5 ppm; rel. humidity < 60 %, no condensation H_2S: < 0.1 ppm; rel. humidity < 60 %, no condensation	Test: 10 ppm; 4 days 1 ppm; 4 days
	ISA-S71.04 severity level G1; G2; G3	-

[1] Output current of the power supply PS DC24V (6ES7138-7EA01-0AA0): Power supply PS 24 VDC (Page 269)
[2] Power supply output current PS AC120/230V (6ES7138-7EC00-0AA0): Power supply PS 120/230 VAC (Page 272)

Mechanical environmental conditions

The table below shows the mechanical environmental conditions in the form of sinusoidal oscillations.

Frequency band	Continuous	Infrequently
5 ≤ f ≤ 9 Hz	1.75 mm amplitude	3.5 mm amplitude
9 ≤ f ≤ 150 Hz	0.5 g constant acceleration	1 g constant acceleration

Test of mechanical environmental conditions

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

Condition tested	Test Standard	Terminal modules and electronic modules
Vibration	Vibration test according to IEC 60068-2-6 (sine)	Type of oscillation: Frequency sweep with a rate of change of 1 octave/ minute. 5 Hz ≤ f ≤ 9 Hz, constant amplitude 3.5 mm 9 Hz ≤ f ≤ 150 Hz, constant acceleration 1 g Duration of oscillation: 10 frequency sweeps per axis in each of the 3 mutually vertical axes
Shock	Shock tested to IEC 60068-2-27	Type of shock: half-sine Shock intensity: 15 g peak value, 11 ms duration Shock direction: 3 shocks each in +/- direction in each of the 3 mutually vertical axes

9.5 Information on dielectric strength tests, class of protection, degree of protection and rated voltage of the ET 200iSP

Test voltage

Insulation strength is demonstrated in the type test with the following proof voltages specified in IEC 61131-2:2007.

Pollution degree/overvoltage category according to IEC 61131

- Pollution degree 2
- Overvoltage category
  - for U_N = DC 24 V: II
  - for U_N = AC 120/230 V: II

Protection class

Protection class II according to IEC 61131-2:2007

Degree of protection IP30

Degree of protection IP30 according to IEC 60529 for all modules of the ET 200iSP, i. e.:

- protection against contact with standard probe
- Protection against solid bodies with diameters in excess of 2.5 mm
- No special protection against water

Rated voltage for operation

The ET 200iSP distributed I/O station operates with the rated voltage shown in the following table and the corresponding tolerances.

rated voltage	Tolerance range
DC 24 V	DC 20 V to 30 V (up to product version 2 of the power supply PS)
	19.2 V to 30 V DC (as of product version 3 of the power supply PS)
AC 120/230 V	AC 85 V to 264 V

Terminal modules 10

10.1 Terminal modules and the suitable modules for them

Modules and terminal modules

The table below shows you which modules you can use on the various terminal modules.

Table 10-1 Modules and terminal modules

Modules	**Terminal modules**									
	TM-PS-A [1] TM-PS-B [1]	TM-PS-A TM-PS-B	TM-IM/IM		TM-IM/EM 60S TM-IM/EM 60C TM-IM/EM		TM-EM/EM 60S TM-EM/EM 60C TM-EM/EM		TM-RM/ RM 60S	
Article number 6ES7193-	7DA10-0AA0 7DB10-0AA0	7DA20-0AA0 7DB20-0AA0	7AB00-0AA0		7AA00-0AA0 7AA10-0AA0 7AA20-0AA0		7CA00-0AA0 7CA10-0AA0 7CA20-0AA0		7CB00-0AA0	
Power supply PS DC24V (up to product version 6)	x									
Power supply PS DC24V (product version 7 and higher)	x	x								
Power supply PS AC120/230V		x								
Interface module IM 152-1PN			x	x	x					
Interface module IM 152-1DP			x	x	x					
8 DI NAMUR						x	x	x		
4 DO DC23.1V/20mA						x	x	x		
4 DO DC17.4V/27mA						x	x	x		
4 DO DC17.4V/40mA						x	x	x		
2 DO Relay UC60V/2A									x	x
4 AI I 2WIRE HART						x	x	x		
4 AI I 4WIRE HART						x	x	x		
4 AI RTD						x	x	x		
4 AI TC						x	x	x		
4 AO I HART						x	x	x		
Reserve module						x	x	x	x [2]	x [2]
WATCHDOG						x	x	x		

[1] Only available as replacement part

[2] As of product version 3 of the reserve module

10.2 Terminal Modules TM-PS-A and TM-PS-B

Article number

Type	Article number
TM-PS-A	6ES7193-7DA10-0AA0, only still available as spare part
TM-PS-A	6ES7193-7DA20-0AA0
TM-PS-B	6ES7193-7DB10-0AA0, only still available as spare part
TM-PS-B	6ES7193-7DB20-0AA0

Properties

- Terminal module for Power Supply PS
- Current infeed for the entire ET 200iSP station
- Connected using screw terminals
- 3 terminals for connection of the supply voltage/ equipotential bonding
- Prewiring of the terminal module is possible
- Self-generating interference leakage from the terminal module to the DIN rail by means of a spring contact
- Reverse polarity protection is ensured by the power supply module (only for PS DC24V)

Note

On the terminal modules TM-PS-A/TM-PS-B (6ES7193-7DA10-0AA0/6ES7192-7DB10-0AA0) only the power supply PS as of article number 6ES7138-7EA01-0AA0 can be plugged in.

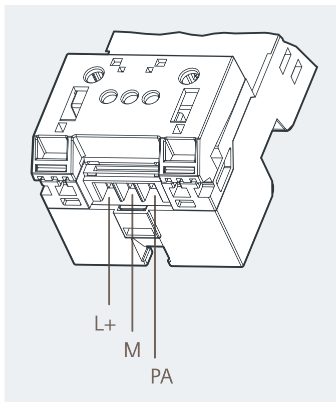
Plugging in the predecessor power supply PS with article number 6ES7138-7EA00-0AA0 is prevented by corresponding coding.

Compatibility with predecessor modules

Terminal modules TM-PS-A TM-PS-B	Power supply PS DC24V 6ES7138-7EA01-0AA0 up to product version 6	Power supply PS DC24V 6ES7138-7EA01-0AA0 product version 7 and higher	Power supply PS AC120/230V 6ES7138-7EC00-0AA0 as of product version 1
6ES7193-7DA10-0AA0	X	X	---
6ES7193-7DB10-0AA0	X	X	---
6ES7193-7DA20-0AA0	---	X	X
6ES7193-7DB20-0AA0	---	X	X

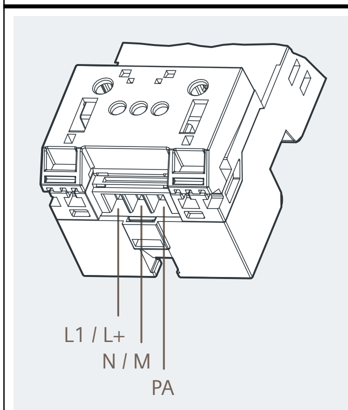
Pin assignment TM-PS-A (6ES7193-7DA10-0AA0) and TM-PS-B (6ES7193-7DB10-0AA0)

Table 10-2 Pin assignment on the terminal modules TM-PS-A (6ES7193-7DA10-0AA0) and TM-PS-B (6ES7193-7DB10-0AA0)

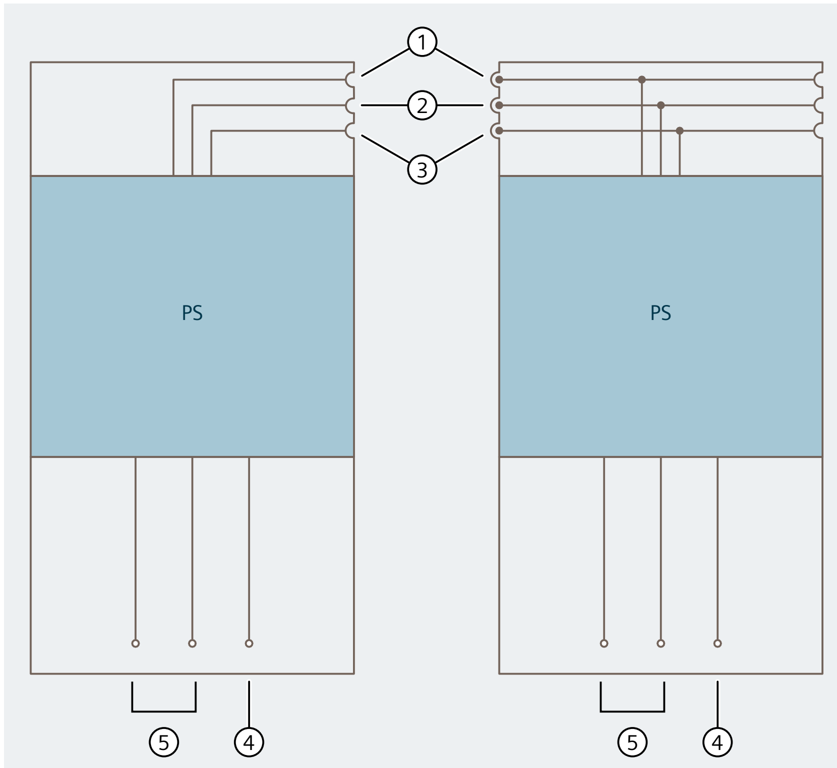
View	Terminal	Designation
	L+	Supply voltage for the plugged power supply PS DC24V
	M	
	PA	Equipotential bonding

Pin assignment TM-PS-A (6ES7193-7DA20-0AA0) and TM-PS-B (6ES7193-7DB20-0AA0)

Table 10-3 Pin assignment on the terminal modules TM-PS-A (6ES7193-7DA20-0AA0) and TM-PS-B (6ES7193-7DB20-0AA0)

View	Terminal	Designation
	L1/L+	Supply voltage for the plugged power supply PS DC24V (as of product version 7) or PS AC120/230V
	N/M	
	PA	Equipotential bonding

Block diagram



①	Power bus
②	Interface module
③	Backplane bus
④	Equipotential bonding
⑤	Supply voltage terminals

Figure 10-1 Block diagram of terminal module TM-PS-A and TM-PS-B

Technical specifications

Terminal module TM-PS-A

Article number	6ES7193-7DA20-0AA0
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	see ET 200iSP system
Dimensions	
Width	60 mm
Height	190 mm
Depth	52 mm
Weights	
Weight, approx.	230 g

Terminal module TM-PS-B

Article number	6ES7193-7DB20-0AA0
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	see ET 200iSP system
Dimensions	
Width	60 mm
Height	190 mm
Depth	52 mm
Weights	
Weight, approx.	230 g

Technical specifications	
Module-specific data	
Number of terminals	3
Cable cross-section	0.5 to 4 mm²*
Voltages, currents, electrical potentials	
Insulation tested	
• between supply voltages and all output voltag-es	DC 2500 V (for TM-PS-A (6ES7193-7DA10-0AA0), TM-PS-B (6ES7193-7DB10-0AA0)) AC 2500 V (for TM-PS-A (6ES7193-7DA20-0AA0), TM-PS-B (6ES7193-7DB20-0AA0))
Safety data	
For TM-PS-A (6ES7193-7DA10-0AA0), TM-PS-B (6ES7193-7DB10-0AA0): U = 30 VDC max; I = 5 A max For TM-PS-A (6ES7193-7DA20-0AA0), TM-PS-B (6ES7193-7DB20-0AA0): U = 264 VAC max; I = 5 A max For additional information, see certificate IECEx KEM 05.0003 https://www.iecex.com (https://www.iecex.com) INMETRO UL-BR 12.0077 https://support.industry.siemens.com (https://support.industry.siemens.com)	
* See "Wiring Rules for the ET 200iSP (Page 125)".	

Approvals

ATEX		II 2 G (1) GD and I M2 Ex eb [ia Ga/ib] IIC T4 Gb Ex eb [ia IIIC Da] IIC T4 Gb Ex eb [ia/ib] Mb KEMA 04 ATEX 2242	CE 0344
IECEx		IECEx KEM 05.0003	

INMETRO	INMETRO	BR OCP-0029	BR-Ex eb [ia Ga/ib] IIC T4 Gb BR-Ex eb [ia IIIC Da] IIC T4 Gb BR-Ex eb [ia/ib] Mb
FM	FM C US APPROVED		Class I, Zone 1, AEx eb [ib/ia] IIC T4; Ex eb [ib/ia] IIC T4 Class I, DIV. 2, GP A,B,C,D T4 Class II, III, GP E,F,G
cULus	C US LISTED E334384		Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx eb [ib/ia] IIC T4; Ex eb [ib/ia] IIC T4 Class I, DIV. 2, GP. A,B,C,D T4
CCC			Ex e [ia Ga/ib] IIC T4 Gb Ex e [iaD] IIC T4 Gb
UKCA	UK CA		DEKRA 21UKEX0032

10.3 Terminal modules TM-IM/EM 60S and TM-IM/EM 60C

Article number

6ES7193-7AA00-0AA0 (screw terminal)

6ES7193-7AA10-0AA0 (spring terminal)

6ES7193-7AA20-0AA0 (black terminal)

Properties

- Terminal module for an interface module (left-hand side) and an electronic module (right-hand side)
  for interface modules:
  - IM 152-1PN
    6ES7152-1BA00-0AB0
  - IM 152-1DP
    6ES7152-1AA00-0AB0
- PROFIBUS RS 485-IS connection via 9-pole Sub D socket
- Connection of actuators and sensors by means of screw terminals for TM-IM/EM 60S
- Connection of actuators and sensors by means of spring terminals for TM-IM/EM 60C

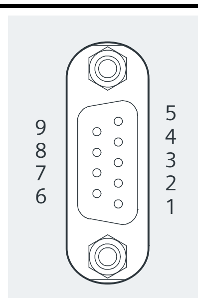
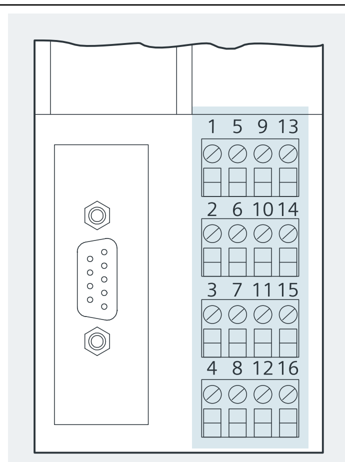
- Self-generating interference leakage from the terminal module to the mounting rail by means of a spring contact
- Prewiring of the terminal module is possible

Note

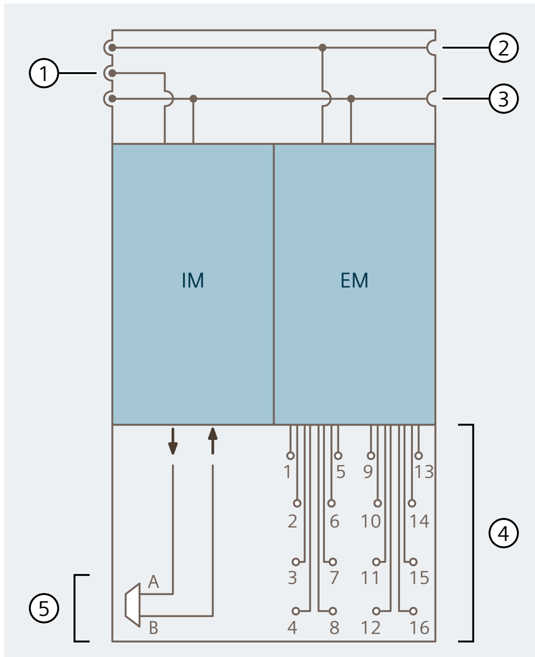
The cable shield of the PROFIBUS DP cable is operationally connected to the equipotential bonding via the spring contact to the mounting rail.

Pin assignment

Table 10-4 Pin assignment on the TM-IM/EM

<table>
<tr><th>View</th><th colspan="2">Terminal</th><th>Designation</th></tr>
<tr><td rowspan="9">
</td><td>1</td><td>PA</td><td>Equipotential bonding</td></tr>
<tr><td>2</td><td>-</td><td>-</td></tr>
<tr><td>3</td><td>RxD/TxD-P</td><td>Data line B</td></tr>
<tr><td>4</td><td>-</td><td>-</td></tr>
<tr><td>5</td><td>ISGND</td><td>Bus termination ground</td></tr>
<tr><td>6</td><td>ISP</td><td>Bus termination P</td></tr>
<tr><td>7</td><td>-</td><td>-</td></tr>
<tr><td>8</td><td>RxD/TxD-N</td><td>Data line A</td></tr>
<tr><td>9</td><td>-</td><td></td></tr>
<tr><td>
</td><td colspan="3">Pin assignment, see sections "Digital electronic modules (Page 295)" and "Analog electronic modules (Page 345)"</td></tr>
</table>

Block diagram



① Supply of the interface modules
② Power bus
③ Backplane bus
④ Terminals with connection to the electronic module
⑤ Terminal PROFIBUS RS 485-IS

Figure 10-2 Block diagram of terminal module TM-IM/EM

Technical specifications

Terminal module TM-IM/EM 60S

Article number	6ES7193-7AA00-0AA0
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	see ET 200iSP system
Dimensions	
Width	60 mm
Height	190 mm
Depth	52 mm
Weights	
Weight, approx.	235 g

Terminal module TM-IM/EM 60C

Article number	6ES7193-7AA10-0AA0
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	see ET 200iSP system
Dimensions	
Width	60 mm
Height	190 mm
Depth	52 mm
Weights	
Weight, approx.	235 g

Technical specifications	
Module-specific data	
Terminal element	9-pole sub D socket for PROFIBUS RS 485-IS
Number of terminals	4 x 4
Cable cross-sections	0.14 mm to 2.5 mm^{2}*
Safety data	
See EC type-examination certificate	
* See "Wiring Rules for the ET 200iSP (Page 125)".	

Approvals

ATEX	II 2 G (1) GD and I M2 Ex eb [ia Ga/ib] IIC T4 Gb Ex eb [ia IIIC Da] IIC T4 Gb Ex eb [ia/ib] Mb KEMA 04 ATEX 2242	CE 0344
IECEx	IECEx KEM 05.0003	
INMETRO	INMETRO; BR OCP-0029 BR-Ex eb [ia Ga/ib] IIC T4 Gb BR-Ex eb [ia IIIC Da] IIC T4 Gb BR-Ex eb [ia/ib] Mb	
FM	Class I, Zone 1, AEx eb [ib/ia] IIC T4; Ex eb [ib/ia] IIC T4 Class I, DIV. 2, GP A,B,C,D T4 Class II, III, GP E,F,G	
cULus	LISTED E334384 Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx eb [ib/ia] IIC T4; Ex eb [ib/ia] IIC T4 Class I, DIV. 2, GP. A,B,C,D T4	

CCC		Ex e [ia Ga/ib] IIC T4 Gb Ex e [iaD] IIC T4 Gb
UKCA		DEKRA 21UKEX0032

See also

https://www.iecex.com (https://www.iecex.com)

https://support.industry.siemens.com (https://support.industry.siemens.com)

10.4 Terminal module TM-IM/IM

Article number

6ES7193-7AB00-0AA0

Properties

- Terminal module for two interface modules (left and right side) with redundancy of the interface modules:
  - IM 152-1PN
    6ES7152-1BA00-0AB0
  - IM 152-1DP
    6ES7152-1AA00-0AB0
- PROFIBUS RS 485-IS connection via two 9-pole Sub D sockets
- Self-generating interference leakage from the terminal module to the mounting rail by means of spring contacts
- Prewiring of the terminal module is possible

Note

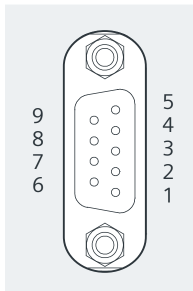
The cable shield of the PROFIBUS DP cable is operationally connected to the equipotential bonding via the spring contact to the mounting rail.

Note

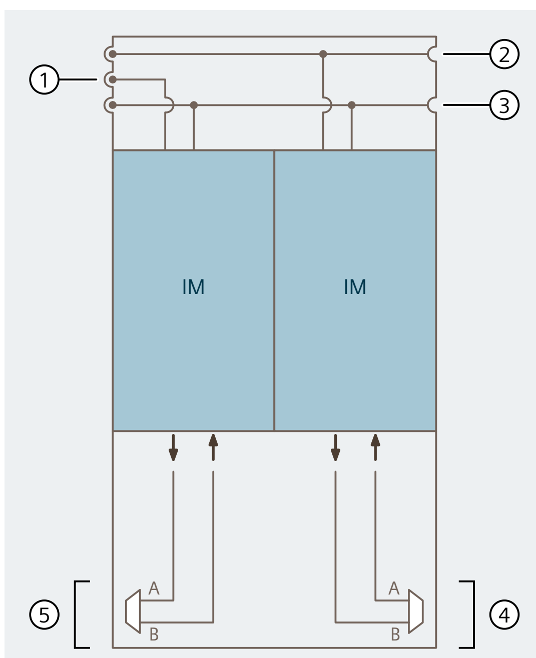
The D-sub sockets of the IM 152-1PN are not connected within the IM 152-1PN.

Pin assignment

Table 10-5 Pin assignment on the TM-IM/IM

View	Terminal		Designation
	1	PA	Equipotential bonding
	2	-	-
	3	RxD/TxD-P	Data line B
	4	-	-
	5	ISGND	Bus termination ground
	6	ISP	Bus termination P
	7	-	-
	8	RxD/TxD-N	Data line A
	9	-	

Block diagram



1 IM 152-1DP supply
2 Power bus
3 Backplane bus
4 PROFIBUS RS 485-IS connection (b)
5 PROFIBUS RS 485-IS connection (a)

Figure 10-3 Block diagram of terminal module TM-IM/IM

Technical specifications

Article number	6ES7193-7AB00-0AA0
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	see ET 200iSP system
Dimensions	
Width	60 mm
Height	190 mm
Depth	52 mm
Weights	
Weight, approx.	195 g

Technical specifications	
Module-specific data	
Terminal element	Two 9-pole sub D sockets for PROFIBUS RS 485-IS
Safety data	
See EC type-examination certificate	

Approvals

ATEX		II 2 G (1) GD and I M2 Ex eb [ia Ga/ib] IIC T4 Gb Ex eb [ia IIIC Da] IIC T4 Gb Ex eb [ia/ib] Mb KEMA 04 ATEX 2242	CE 0344
IECEx		IECEx KEM 05.0003	
INMETRO	INMETRO BR OCP-0029	BR-Ex eb [ia Ga/ib] IIC T4 Gb BR-Ex eb [ia IIIC Da] IIC T4 Gb BR-Ex eb [ia/ib] Mb	
FM	FM APPROVED	Class I, Zone 1, AEx eb [ib/ia] IIC T4; Ex eb [ib/ia] IIC T4 Class I, DIV. 2, GP A,B,C,D T4 Class II, III, GP E,F,G	
cULus	LISTED E334384	Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx eb [ib/ia] IIC T4; Ex eb [ib/ia] IIC T4 Class I, DIV. 2, GP. A,B,C,D T4	

CCC		Ex e [ia Ga/ib] IIC T4 Gb Ex e [iaD] IIC T4 Gb
UKCA		DEKRA 21UKEX0032

10.5 Terminal modules TM-EM/EM 60S and TM-EM/EM 60C

Article number

6ES7193-7CA00-0AA0 (screw terminal)

6ES7193-7CA10-0AA0 (spring terminal)

6ES7193-7CA20-0AA0 (black terminal)

For use in safe areas and identification of non-intrinsically safe signals, the terminal modules are also available in a version with black terminals.

Note that the following rules for their use still apply:

- Terminal modules with blue terminals and terminal modules with black terminals may not be combined within a ET 200iSP station.
  Combining the terminals will not meet the requirements regarding explosion protection.

  Note

  This restriction does not apply to the TM-RM/RM terminal module, article number 6ES7193-7CB00-0AA0

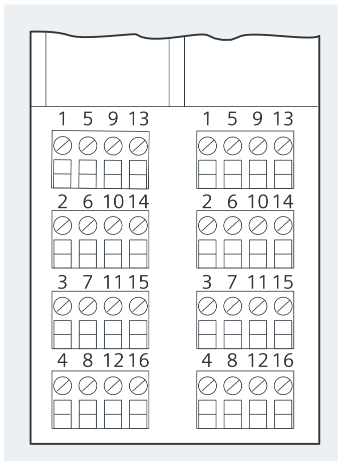
- An ET 200iSP station that is configured with only black terminals and a ET 200iSP station configured with only blue terminals must not be connected to the same RS 485-IS coupler. Combining the terminals will not meet the requirements regarding explosion protection.
- In additional, an ET 200iSP station which is built exclusively with black terminals may not be operated without an RS 485-IS coupler.
  The RS 485-IS coupler not only performs the function of ensuring explosion protection by providing an intrinsically safe PROFIBUS signal, it also provides the required bus impedance that is required by ET 200iSP stations for the operation.
- Only the blue PROFIBUS connector with the part number 6ES7972-0DA60-0XA0 ensures the correct bus impedances or bus connections in the system.

Properties

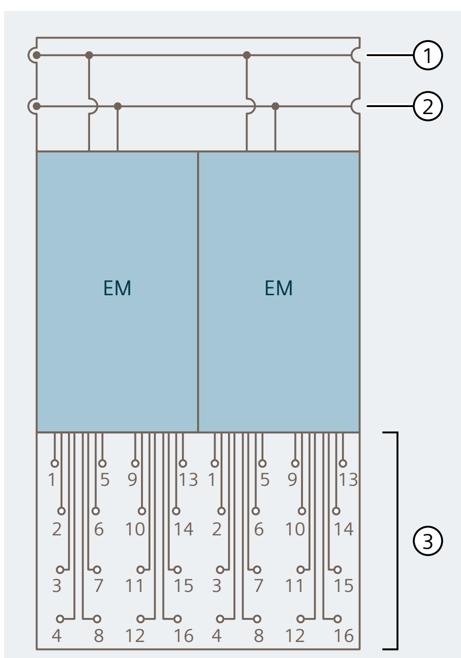
- Terminal module for 2 electronic modules
- Connection of actuators and sensors by means of screw terminals for TM-EM/EM 60S
- Connection of actuators and sensors by means of spring terminals for TM-EM/EM 60C
- Self-generating interference leakage from the terminal module to the mounting rail by means of a spring contact
- Prewiring of the terminal module is possible

Pin assignment

Table 10-6 Pin assignment of terminal module TM-EM/EM

View	Terminal	Designation
	Pin assignment, see sections "Digital electronic modules (Page 295)" and "Analog electronic modules (Page 345)"	

Block diagram



① Power bus
② Backplane bus
③ Terminals with connection to the electronic module

Figure 10-4 Block diagram of terminal module TM-EM/EM

Technical specifications

Terminal module TM-EM/EM 60S

Article number	6ES7193-7CA00-0AA0
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	see ET 200iSP system
Dimensions	
Width	60 mm
Height	190 mm
Depth	52 mm
Weights	
Weight, approx.	275 g

Terminal module TM-EM/EM 60C

Article number	6ES7193-7CA10-0AA0
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	see ET 200iSP system
Dimensions	
Width	60 mm
Height	190 mm
Depth	52 mm
Weights	
Weight, approx.	275 g

Terminal module TM-EM/EM

Article number	6ES7193-7CA20-0AA0
Standards, approvals, certificates	
CE mark	Yes
Dimensions	
Width	60 mm
Height	190 mm
Depth	52 mm
Weights	
Weight, approx.	235 g

Technical specifications	
Module-specific data	
Number of terminals	8 x 4
Cable cross-sections	0.14 mm to 2.5 mm²*
Safety data	
See EC type-examination certificate	
* See "Wiring Rules for the ET 200iSP (Page 125)".	

Approvals

ATEX			II 2 G (1) GD and I M2 Ex eb [ia Ga/ib] IIC T4 Gb Ex eb [ia IIIC Da] IIC T4 Gb Ex eb [ia/ib] Mb KEMA 04 ATEX 2242	0344
IECEx			IECEx KEM 05.0003	
INMETRO	INMETRO	BR OCP-0029	BR-Ex eb [ia Ga/ib] IIC T4 Gb BR-Ex eb [ia IIIC Da] IIC T4 Gb BR-Ex eb [ia/ib] Mb	
FM	C FM US APPROVED		Class I, Zone 1, AEx eb [ib/ia] IIC T4; Ex eb [ib/ia] IIC T4 Class I, DIV. 2, GP A,B,C,D T4 Class II, III, GP E,F,G	
cULus	LISTED E334384		Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx eb [ib/ia] IIC T4; Ex eb [ib/ia] IIC T4 Class I, DIV. 2, GP. A,B,C,D T4	
CCC			Ex e [ia Ga/ib] IIC T4 Gb Ex e [iaD] IIC T4 Gb	
UKCA	UK CA		DEKRA 21UKEX0032	

10.6 Terminal module TM-RM/RM

Article number

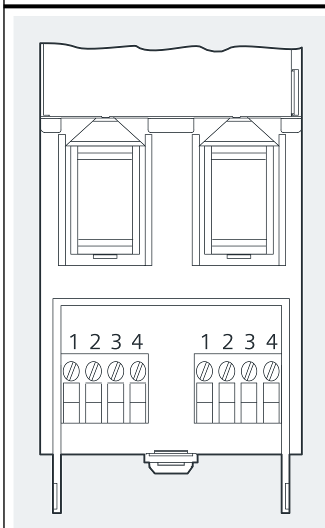
6ES7193-7CB00-0AA0 (screw terminal)

Properties

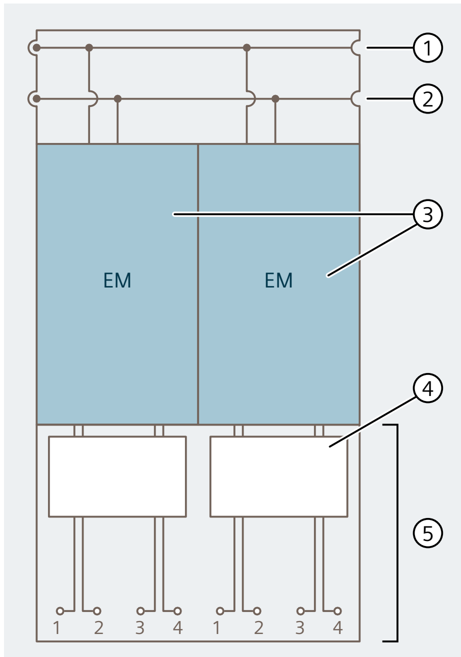
- Terminal module for 2 electronic modules 2 DO Relay UC60V/2A or reserve modules (product version 3 and higher).
- Connection of actuators by means of screw terminals for TM-RM/RM 60S.
- Screw terminals of the TM-RM/RM 60S are designed in increased safety Ex e type of protection.
- Self-generating interference leakage from the terminal module to the mounting rail by means of a spring contact
- Prewiring of the terminal module is possible.
- Ex d disconnecting plug for removing and inserting the 2 DO Relay UC60V/2A.
- Terminal cover of the Ex e terminals must be closed during operation.

Pin assignment

Table 10-7 Pin assignment of terminal module TM-RM/RM

View	Terminal	Designation
	Pin assignment, see sections "Digital electronic modules (Page 295)" and "Analog electronic modules (Page 345)"	

Block diagram



① Power bus
② Backplane bus
③ Electronics module 2 DO Relay UC60V/2A or reserve module (product version 3 and higher)
④ Ex d disconnecting plug
⑤ Ex e terminals with connection to the electronic module

Figure 10-5 Block diagram of terminal module TM-RM/RM

Technical specifications

Article number	6ES7193-7CB00-0AA0
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	see ET 200iSP system
Dimensions	
Width	60 mm
Height	190 mm
Depth	52 mm
Weights	
Weight, approx.	340 g

Technical specifications	
Module-specific data	
Number of terminals	2 x 4
Cable cross-sections	0.2 mm to 2.0 mm²*
Safety data	
U = AC 60 V or DC 60 V I = 2 A For details, see certificate IECEx KEM 07.0060 https://www.iecex.com (https://www.iecex.com) INMETRO UL-BR 12.0079 https://support.industry.siemens.com (https://support.industry.siemens.com)	
* See "Wiring Rules for the ET 200iSP (Page 125)".	

Note

Make sure to separate intrinsically safe cables from non-intrinsically safe cables.

Approvals

ATEX		II 2 G and I M2 Ex db eb ib IIC T4 Gb Ex db eb ib I Mb KEMA 07 ATEX 0205	CE 0344
IECEx		IECEx KEM 07.0060	
INMETRO	INMETRO BR OCP-0029	BR-Ex db eb ib IIC T4 Gb BR-Ex db eb ib I Mb	
FM	C FM US APPROVED	Class I, Zone 1, AEx db eb ib IIC T4; Ex db eb ib IIC T4 Class I, DIV. 2, GP A,B,C,D T4 Class II, III, GP E,F,G	
cULus	c UL us LISTED E334384	Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx db eb ib IIC T4; Ex db eb ib IIC T4 Class I, DIV. 2, GP A,B,C,D T4	
CCC		Ex d e ib IIC T4 Gb	
UKCA	UK CA	DEKRA 21UKEX0031	

Power Supply 11

11.1 Power supply PS 24 VDC

Article number

6ES7138-7EA01-0AA0

Properties

⚠ WARNING
Death or serious injury may occur if the following precautions are not taken
There must be a wait of at least 2 minutes after unlocking the power supply in potentially explosive atmospheres. Then the power supply of the ET 200iSP can be safely disconnected.

- The PS DC24V supplies the ET 200iSP galvanically isolated with the required output voltages:
  - Power bus
  - Interface module supply
  - Backplane bus
- The PS DC24V takes over the safety-related limitation of the output voltages.
- Properties of the PS DC24V depending on the product version:

Properties	Product version of the PS 24 V DC		
	up to 4	5, 6	7 or higher
Pluggable on TM-PS-A (6ES7193-7DA10-0AA0) or TM-PS-B (6ES7193-7DB10-0AA0)	X	X	X
Pluggable on TM-PS-A (6ES7193-7DA20-0AA0) or TM-PS-B (6ES7193-7DB20-0AA0)			X
Mixed operation in case of redundancy: PS DC24V/PS AC120/230V		X	X

Note

Surge arrester

As of product version 3 of power supply PS DC24V, the overvoltage suppressor for the DC 24V supply at the power supply is no longer mandatory. See consecutive number from figure (1) in section Application example for protection of ET 200iSP from overvoltages (Page 449).

Block diagram

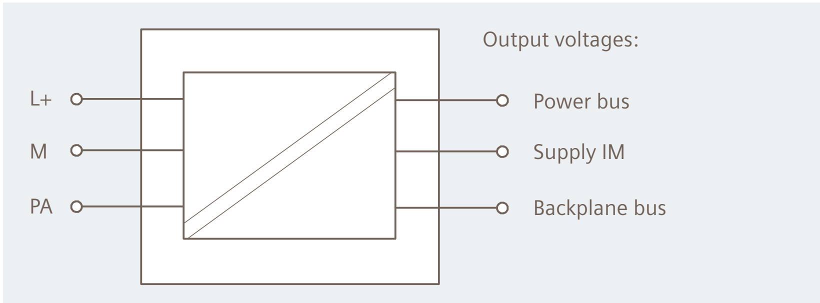


Figure 11-1 Block diagram of the power supply PS DC24V

Technical specifications

Article number	**6ES7138-7EA01-0AA0**
Supply voltage	
Rated value (DC)	24 V
Reverse polarity protection	Yes
Input current	
from supply voltage L+, max.	4 A
Power loss	
Power loss, typ.	20 W
Interrupts/diagnostics/status information	
Status indicator	Yes
Alarms	No
Diagnoses	
• Diagnostic information readable	Yes; via IM 152
Diagnostics indication LED	
• Group error SF (red)	No
Potential separation	
primary/secondary	Yes
between supply voltage and electronics	Yes
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	Ex de [ib]IIC T4
Dimensions	
Width	60 mm
Height	190 mm
Depth	136.5 mm
Weights	
Weight, approx.	2 700 g

Technical specifications	
Voltages, currents, electrical potentials	
• Power failure buffering power bus	min. 0.25 ms
• Voltage failure backup interface module	min. 15 ms
• Power failure buffering backplane bus	min. 0.25 ms
Insulation tested	
• between supply voltage and all output voltages	DC 600 V
Current consumption	
• from power supply L+	max. 4 A [2]
Starting current inrush	
• for DC 24 V	24.8 A
Power loss of the module	20 W [3]
Permitted input power	Max. 78.6 W
Output current at ambient temperature up to product version 2 of Power Supply PS	
• from -20 °C to +60 °C with horizontal mounting and -20 °C to +40 °C with all other mounting positions	max. 5 A
• from +60 °C to +70 °C with horizontal mounting	Max. 3.5 A
Output current at ambient temperature as of product version 3 of Power Supply PS	
• from -20 °C to +70 °C with horizontal mounting and -20 °C to +50 °C with all other mounting positions	max. 5 A
Status, interrupts, diagnostics	
Status display	Yes (on interface module)
Interrupts	No
Diagnostic functions	
• Group error display	No
• Diagnostic information can be read	Ys (via interface module)
Safety data	
UM = DC 250 V / AC 250 V For additional information, see certificate IECEx KEM 05.0004 https://www.iecex.com (https://www.iecex.com) KEMA 04 ATEX2263 INMETRO UL-BR 12.0051 https://support.industry.siemens.com (https://support.industry.siemens.com)	
[1] up to product version 2: Tolerance rangeDC 20 V to 30 V, protection version 3 and higher Tolerance range DC 19.2 V to 30 V. Protection with automatic circuit breaker 6 A and tripping characteristic C (per ET 200iSP station) [2] Rated current: 3.3 A (for DC 24 V) [3] You can find additional information about power loss in the section Restricted Number of Connectable Electronics Modules (Page 70)	

Note

You must take appropriate measures to ensure that U_m = 250 V DC, 250 V AC is not exceeded.

Approvals

ATEX			II 2 G and I M2 Ex db eb [ib] IIC T4 Gb Ex db eb [ib] Mb KEMA 04 ATEX 2263	CE 0344
IECEx			IECEx KEM 05.0004	
INMETRO	INMETRO	BR OCP-0029	BR-Ex db eb [ib] IIC T4 Gb BR-Ex db eb [ib] Mb	
FM	C FM US APPROVED		Class I, Zone 1, AEx db eb [ib] IIC T4; Ex db eb [ib] IIC T4 NI, Class I, DIV.2, GP. A,B,C,D T4 Class II, III, GP E,F,G	
cULus	c UL us LISTED E334384		Process Cont. Eq. for use in HAZ.LOC. Class I, Zone 1, AEx db eb [ib] IIC T4; Ex de [ib] IIC T4 Class I, DIV.2, GP. A,B,C,D T4	
CCC			Ex d e [ib Gb] IIC T4 GB	
UKCA	UK CA		DEKRA 21UKEX0027	

11.2 Power supply PS 120/230 VAC

Article number

6ES7138-7EC00-0AA0

Properties

WARNING

Death or serious injury may occur if the following precautions are not taken

There must be a wait of at least 2 minutes after unlocking the power supply in potentially explosive atmospheres. Then the power supply of the ET 200iSP can be safely disconnected.

- The PS AC120/230V supplies the ET 200iSP galvanically isolated with the required output voltages:
  - Power bus
  - Interface module supply
  - Backplane bus
- The PS AC120/230V takes over the safety-related limitation of the output voltages.
- The PS AC120/230V can be inserted onto the TM-PS-A (6ES7193-7DA20-0AA0), TM-PS-B (6ES7193-7DB20-0AA0)

Block diagram

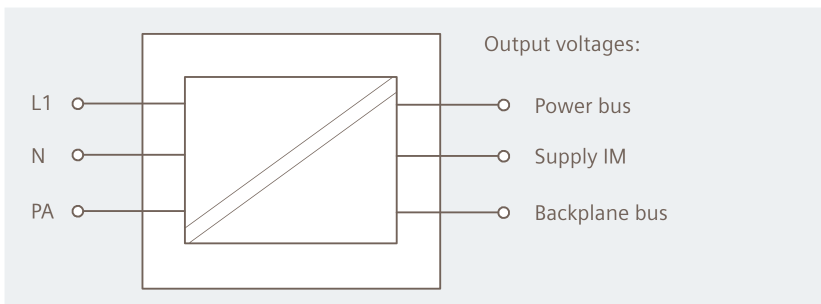


Figure 11-2 Block diagram of the power supply PS AC120/230V

Technical specifications

Article number	6ES7138-7EC00-0AA0
Supply voltage	
Rated value (AC)	230 V; 120/230 V AC
Line frequency	
• permissible range, lower limit	47 Hz
• permissible range, upper limit	63 Hz
Input current	
from supply voltage L1, max.	1.04 A; at rated voltage 230 VAC:0.45A at rated voltage 120 VAC:0.75A
Power loss	
Power loss, typ.	5 W; 5 W + 1.2 x total power loss of the electronics modules
Power loss, max.	21.3 W
Interrupts/diagnostics/status information	
Status indicator	Yes
Alarms	No
Diagnoses	
• Diagnostic information readable	Yes; via IM 152
Diagnostics indication LED	
• Group error SF (red)	No
Potential separation	
primary/secondary	Yes
between supply voltage and electronics	No
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	Ex de [ib]IIC T4
Dimensions	
Width	60 mm
Height	190 mm
Depth	136.5 mm
Weights	
Weight, approx.	2 700 g

Technical specifications	
Voltages, currents, electrical potentials	
Nominal power supply voltage	AC 120/230 V [2]
• Power failure buffering power bus	min. 20 ms
• Voltage failure backup interface module	min. 20 ms
• Power failure buffering backplane bus	min. 20 ms
Insulation tested	

Technical specifications	
• between supply voltage and all output voltages	AC 2500 V
Starting current inrush	
• for AC 120/230 V	28 A
Permitted input power	max. 82.2 W
Output current at AC 230 V (AC 170 V to 264 V) and ambient temperature	
• from -20 °C to +70 °C with horizontal mounting	max. 4 A
• from -20 °C to +60 °C with horizontal mounting and -20 °C to +50 °C with all other mounting positions	max. 5 A
Output current at AC 120 V (AC 85 V to 132 V) and ambient temperature	
• from -20 °C to +70 °C with horizontal mounting and -20 °C to +50 °C with all other mounting positions	max. 3 A
• from -20 °C to +60 °C with horizontal mounting	max. 4 A
• from -20 °C to +50 °C with horizontal mounting	max. 5 A
Safety data	
[2] Tolerance range AC 85 V to 264 V. Protection with automatic circuit breaker 6 A and tripping characteristic C (per ET 200iSP station) [3] Rated current: 0.75 A (at AC 120 V)/ 0.45 A (at AC 230 V) [4] You can find additional information about in the section "Restricted Number of Connectable Electronics Modules (Page 70)"	

Note

You must take appropriate measures to ensure that U_m = 264 V DC, 264 V AC is not exceeded.

Approvals

ATEX			II 2 G and I M2 Ex db eb [ib] IIC T4 Gb Ex db eb [ib] Mb KEMA 09 ATEX 0156	CE 0344
IECEx			IECEx KEM 09.0070	
INMETRO	INMETRO	BR OCP-0029	BR-Ex db eb [ib] IIC T4 Gb BR-Ex db eb [ib] Mb	
FM	FM C US APPROVED		Class I, Zone 1, AEx db eb [ib] IIC T4; Ex db eb [ib] IIC T4 NI, Class I, DIV.2, GP. A.B.C.D T4 Class II, III, GP E,F,G	
cULus	C UL US LISTED E334384		Process Cont. Eq. for use in HAZ.LOC. Class I, Zone 1, AEx db eb [ib] IIC T4; Ex db eb [ib] IIC T4 Class I, DIV.2, GP. A,B,C,D T4	

CCC		Ex d e [ib] IIC T4 Gb
UKCA		DEKRA 21UKEX0033

See also

https://www.iecex.com (https://www.iecex.com)

https://support.industry.siemens.com (https://support.industry.siemens.com)

Network interface module 12

12.1 PROFINET interface module IM 152-1PN

Article number

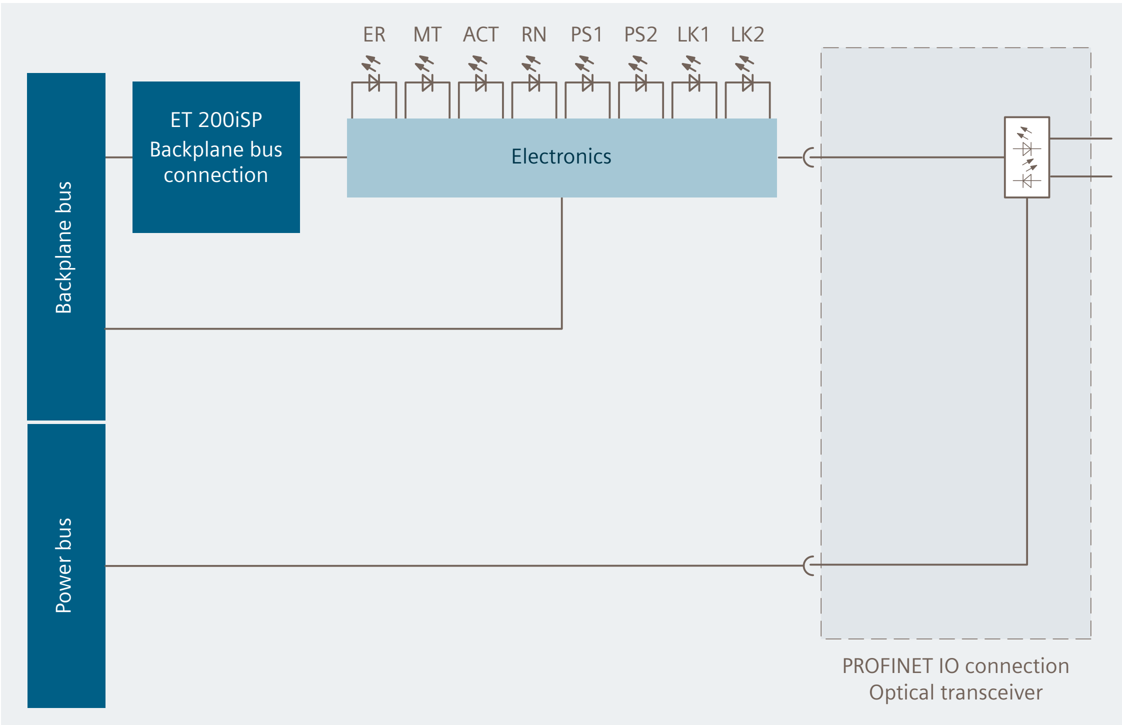
6ES7152-1BA00-0AB0

Properties

The interface module IM 152-1PN has the following properties:

- Operation as IO device
- Preparing the data for the installed electronic modules
- The PROFINET IO configuration can be set via the network.
- Switching off the DC 24 V supply voltage at the terminal module TM-PS-A also switches off the interface module.
- The maximum address space is 244 bytes for inputs and 244 bytes for outputs.
- Update firmware via PROFINET IO
- Redundancy
- Connecting the station of the ET 200iSP to PROFINET IO via fiber-optic cables (up to 3 km in length)
- Redundant connection (MRP, S2, R1 system redundancy)
- Backing up the parameters of the electronic modules:
  - The parameters / data are saved in the interface module.
- Startup
  - After switching on the power supply of the station, the interface module distributes the saved parameters/data to the electronic modules (e.g. substitute values for the output modules).
  - Next, the connection to the network is enabled and the automation system is commissioned by the IO controller.
  - Only when the station exchanges data with the IO controller are the substitute values (of the flash memory) replaced with the actual data of the IO controller.

Block diagram



Technical specifications

Article number	6ES7152-1BA00-0AB0
General information	
Product function	
• Isochronous mode	No
Supply voltage	
Rated value (DC)	11.5 V supply voltage; 3.55 V bus
Input current	
from supply voltage L+, max.	150 mA
Power loss	
Power loss, typ.	1.6 W
Interfaces	
Interfaces/bus type	PROFINET IO
Transmission rate, max.	100 Mbit/s
Supports protocol for PROFINET IO	
Cable length	
– Multimode graded-index fiber 50/125 µm	3 000 m
– Multimode graded-index fiber 62.5/125 µm	3 000 m
1. Interface	
Interface type	multimode fiber-optic cable
Interface types	
• RJ 45 (Ethernet)	No
• Number of ports	2
• integrated switch	Yes
• BusAdapter (PROFINET)	No
Protocols	
• PROFINET IO Device	Yes
• Media redundancy	Yes
PROFINET IO Device	
Services	
– Shared device	No
Protocols	
PROFIBUS DP	No
Redundancy mode	
• PROFINET system redundancy (S2)	Yes
• PROFINET system redundancy (R1)	Yes
Media redundancy	
– MRP	Yes
Open IE communication	
• LLDP	Yes
Interrupts/diagnostics/status information	
Alarms	Yes

Article number	6ES7152-1BA00-0AB0
Diagnostics function	Yes
Alarms	
• acyclic function, interrupts	Yes
• acyclic function, parameters	Yes
Diagnostics indication LED	
• RUN LED	Yes; green LED
• ERROR LED	Yes; red LED
• MAINT LED	Yes; Yellow LED
• LINK LED	Yes; green LED
• Monitoring of the supply voltage (PWR-LED)	Yes; green LED
• Bus fault BF (red)	No
• Group error SF (red)	No
• Monitoring 24 V voltage supply ON (green)	No
Potential separation	
between supply voltage and electronics	No
Standards, approvals, certificates	
CE mark	Yes
UKCA mark	No
Use in hazardous areas	
• ATEX marking	II 2 G Ex ib IIC T4 Gb and I M2 Ex ib I Mb
• ATEX certificate	DEKRA 22ATEX0036
• IECEx	Yes; IECEx DEK 22.0020
• EAC Ex	No
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	-20 °C
• horizontal installation, max.	70 °C
• vertical installation, min.	-20 °C
• vertical installation, max.	50 °C
Ambient temperature during storage/transportation	
• min.	-40 °C
• max.	70 °C
Altitude during operation relating to sea level	
• Ambient air temperature-barometric pressure-altitude	Up to max. 2 000 m
Relative humidity	
• Operation, max.	95 %
Dimensions	
Width	30 mm
Height	190 mm
Depth	130 mm

Article number	6ES7152-1BA00-0AB0
Weights	
Weight, approx.	440 g

Approvals

ATEX		II 2 G Ex ib T4 IIC Gb Ex ib T4 IIC Gb DEKRA 22ATEX0036	CE 0344
IECEx		IECEx DEK 22.0020	
INMETRO	INMETRO; BR OCP-0029	BR-Ex ib IIC T4 Gb; BR-Ex ib I Mb	
FM	FM APPROVED	Class I; Zone 1, AEx ib IIC T4; Ex ib IIC T4 NI, Class I, DIV.2, GP. A.B.C.D T4 Class II, III, GP. E,F,G	
cULus	LISTED E334384	Process Cont. Eq. for use in HAZ.LOC. Class I; Zone 1, AEx ib IIC T4; Ex ib IIC T4 Class I, DIV.2, GP. A.B.C.D T4	
CCC		Ex ib IIC T4 Gb	
UKCA	UKCA		

12.1.1 Parameters for IM 152-1PN

Parameters

The procedure for setting parameters is described in the Chapter "Commissioning (Page 155)".

Table 12-1 Parameter for the interface module IM 152-1PN

Parameters IM 152-1PN	Range of values	Default	Applicability
Operation at Preset <> Actual Configuration	• Disable • Enable	Disable	ET 200iSP
Redundant Power Supply diagnostics	• No redundant power supply • Redundant Power Supply • Redundant Power Supply required	No redundant power supply	ET 200iSP

Parameters IM 152-1PN	Range of values	Default	Applicability
Diagnostic interrupts[1]	• Disable • Enable	Disable	ET 200iSP
Hardware interrupts[1)]	• Disable • Enable	Disable	ET 200iSP
Edge evaluation event entering state[2]	• Rising edge (0-->1) • Falling edge (1-->0) • Channel-specific	Rising edge (0-->1)	ET 200iSP Module Channel
Data format	• SIMATIC S7	SIMATIC S7	ET 200iSP
Noise suppression	• 50 Hz • 60 Hz	50 Hz	ET 200iSP
Temperature unit	• Celsius • Fahrenheit	Celsius	ET 200iSP
Slot reference junction 1 to 2	• None • 2 to 33	None	ET 200iSP
Input reference junction 1 to 4	• RTD on channel 0 • RTD on channel 1 • RTD on channel 2 • RTD on channel 3	RTD on channel 0	ET 200iSP
Advanced diagnostics	Yes/No	No	ET 200iSP **No**: 29 bytes for IM 152-1PN **Yes**: 96 bytes for IM 152-1PN Diagnostics frame
Identifier-related diagnostics	Enable / disable	Enable	ET 200iSP- only IM 152-1PN
Module status	Enable / disable	Enable	ET 200iSP- only IM 152-1PN
Channel-related diagnostics	Enable / disable	Enable	ET 200iSP- only IM 152-1PN

[1] It may or may not be possible to edit these parameters, depending on the configuration tool used.

[2] Configurable only in HW Config and when you operate the ET 200iSP on PROFINET IO and when time stamping is also enabled for the automation system.

12.1.2 Compatible electronic modules

The following electronic modules can be used with IM 152-1PN:

Module	Article number	Compatible
8 DI NAMUR	6ES7131-7RF00-0AB0	Yes
4 DO DC23.1V/20mA	6ES7132-7RD00-0AB0	No
4 DO DC23.1V/20mA shut down "H"	6ES7132-7RD01-0AB0	Yes
4 DO DC17.4V/27mA	6ES7132-7RD10-0AB0	No
4 DO DC17.4V/27mA shut down "H"	6ES7132-7RD11-0AB0	Yes
4 DO DC17.4V/40mA	6ES7132-7RD20-0AB0	No
4 DO DC17.4V/40mA shut down "H"	6ES7132-7RD21-0AB0	No

Module	Article number	Compatible
4 DO DC17.4V/40mA shut down "H"	6ES7132-7RD22-0AB0	Yes
4 DO DC23.1V/20mA shut down "L"	6ES7132-7GD00-0AB0	Yes
4 DO DC17.4V/27mA shut down "L"	6ES7132-7GD10-0AB0	Yes
4 DO DC17.4V/40mA shut down "L"	6ES7132-7GD20-0AB0	No
4 DO DC17.4V/40mA shut down "L"	6ES7132-7GD21-0AB0	Yes
4 DO DC25.5V/22mA shut down "L"	6ES7132-7GD30-0AB0	Yes
2 DO Relay UC60V/2A	6ES7132-7HB00-0AB0	Yes
4 AI I 2WIRE HART	6ES7134-7TD00-0AB0	Yes
4 AI I 4WIRE HART	6ES7134-7TD50-0AB0	Yes
4 AI RTD	6ES7134-7SD50-0AB0	No
4 AI RTD	6ES7134-7SD51-0AB0	Yes
4 AI TC	6ES7134-7SD00-0AB0	Yes
4 AO I HART	6ES7135-7TD00-0AB0	Yes
Reserve module	6ES7138-7AA00-0AA0	Yes
WATCHDOG	6ES7138-7BB00-0AB0	Yes
4 F-AI I 2WIRE Fail-safe	6ES7138-7FA00-0AB0	Yes
4 F-DO DC17.4V/40mA Fail-safe	6ES7138-7FD00-0AB0	Yes
8 F-DI NAMUR Fail-safe	6ES7138-7FN00-0AB0	Yes

12.2 PROFIBUS interface module IM 152-1DP

Article number

6ES7152-1AA00-0AB0

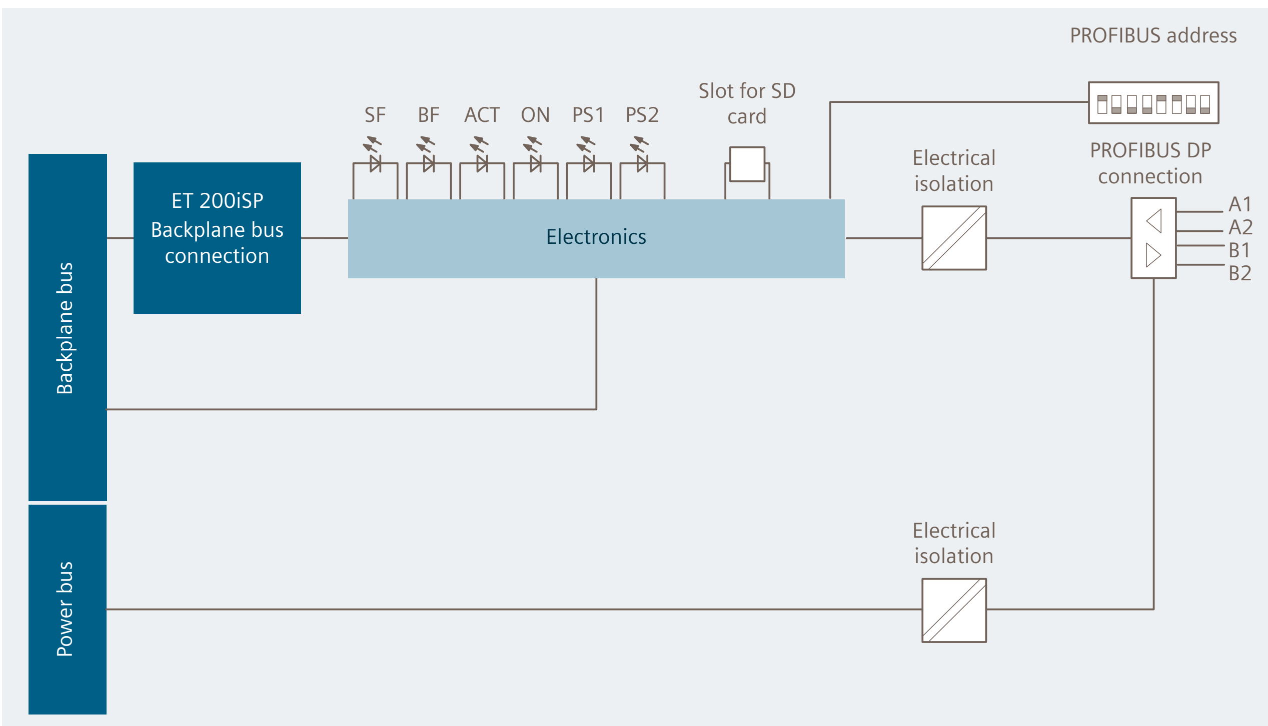
Properties

The interface module IM 152-1DP has the following properties:

- Connect ET 200iSP to PROFIBUS RS 485-IS
- Preparing the data for the installed electronic modules
- PROFIBUS address can be set via switches
- Operation as DPV0, S7 DP or DPV1 device
- The maximum address space is 244 bytes for inputs and 244 bytes for outputs.
- Update firmware via PROFIBUS DP
- Redundancy of the IM 152-1DP as of V2.0
- Switching off the supply voltage DC 24 V at the terminal module TM-PS-A also switches off the interface module IM 152-1DP.

- Backing up the parameters of the electronic modules:
  - The parameters/data are stored in the flash memory of the IM 152-1DP.
- Startup
  - After switching on the power supply of the ET 200iSP, the IM 152-1DP distributes the saved parameters/data to the electronic modules (e.g. substitute values for the output modules).
  - The PROFIBUS DP is then enabled and the automation system is commissioned by the DP master.
  - The substitute values (of the flash memory) are replaced with the actual data of the IO controller only when the ET 200iSP exchanges data with the IO controller.

Block diagram



Technical specifications

Article number	6ES7152-1AA00-0AB0
General information	
Product function	
• Isochronous mode	No
Input current	
from supply voltage L+, max.	30 mA
Power loss	
Power loss, typ.	0.5 W
Time stamping	
Description	for each digital input, digital input module, total ET 200iS
Accuracy	20 ms
Number of stampable digital inputs, max.	64; for accuracy class 20 ms
Time format	RFC 1119 Internet (ISP)
Time resolution	1 ms
Time interval for transmitting the message buffer if a message is present	1 000 ms
Time stamp on signal change	rising / falling edge as signal entering or exiting
Interfaces	
Interfaces/bus type	RS 485
Transmission rate, max.	1.5 Mbit/s; 9,6 / 19,2 / 45,45 / 93,75 / 187,5 / 500 kbit/s; 1,5 Mbit/s
Protocols	
PROFIBUS DP	Yes
PROFIBUS DP	
Services	
– SYNC capability	Yes
– FREEZE capability	Yes
– Direct data exchange (slave-to-slave communication)	Yes
Interrupts/diagnostics/status information	
Alarms	Yes
Diagnostics function	Yes
Alarms	
• acyclic function, interrupts	Yes
• acyclic function, parameters	Yes
Diagnostics indication LED	
• Bus fault BF (red)	Yes
• Group error SF (red)	Yes
• Monitoring 24 V voltage supply ON (green)	Yes
Potential separation	
between supply voltage and electronics	Yes
Standards, approvals, certificates	

Article number	**6ES7152-1AA00-0AB0**
CE mark	Yes
Use in hazardous areas	
• ATEX marking	II2 G Ex ib IIC T4 and I M2 Ex ib I
• ATEX certificate	04 ATEX 1243
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	245 g

Technical specifications		
Module-specific data		
Bus protocol	PROFIBUS RS 485-IS	
Interface	RS 485 (intrinsically safe)	
Manufacturer's ID	8110_H	
PROFIBUS addresses	1 to 125 permitted	
Time stamping	Yes (only for STEP 7)	
• Message buffer	15 message buffers each for 20 messages	
Acyclic functions	Yes	
• Diagnostics	Yes	
• Data records	Yes	
Voltages, currents, electrical potentials		
Electrical isolation		
• Between the backplane bus and electronic components	No	
• Between PROFIBUS RS 485-IS and electronics	Yes	
Safety data		
See EC type-examination certificate	KEMA 04 ATEX1243	Service & Support (https://www.siemens.com/automation/service&support)
	INMETRO	
	UL-BR 12.0067	
	For additional information, see certificate IECEx KEM 05.0005	https://www.iecex.com (https://www.iecex.com)
Maximum values for PROFIBUS RS 485-IS interface:		
U_o	± 3.9 V	
I_o	±136 mA	

Technical specifications	
P_o	132 mW
U_i	± 4.2 V

Approvals

ATEX			II 2 G and I M2 Ex ib IIC T4 Gb; Ex ib I Mb KEMA 04 ATEX 1243	CE 0344
IECEx			IECEx KEM 05.0005	
INMETRO	INMETRO	BR OCP-0029	BR-Ex ib IIC T4 Gb; BR-Ex ib I Mb	
FM	C FM US APPROVED		Class I, Zone 1, AEx ib IIC T4; Ex ib IIC T4 NI, Class I, DIV. 2, GP. A,B,C,D T4 Class II, III, GP. E,F,G	
cULus	c UL us LISTED E334384		Process Cont. Eq. for use in HAZ.LOC. Class I, Zone 1, AEx ib IIC T4; Ex ib IIC T4 Class I, Div 2, GP. A,B,C,D T4	
CCC			Ex ib IIC T4 Gb	
UKCA	UK CA		DEKRA 21UKEX0029	

12.2.1 Identification and maintenance functions (I&M)

Reference

For information on the I&M, refer to the Chapter "Identification and maintenance data I&M (Page 77)".

12.2.2 Parameters for IM 152-1DP

Parameters

The procedure for setting parameters is described in the Chapter "Commissioning (Page 155)".

Table 12-2 Parameter for the interface module IM 152-1DP

Parameters IM 152-1DP	Range of values	Default	Applicability
Operation at Preset <> Actual Configuration	• disable • enable	disable	ET 200iSP
Self-diagnosis	• disable • enable	disable	ET 200iSP
Redundant power supply diagnostics	• No redundant power supply • Redundant Power Supply • Redundant Power Supply required	No redundant power supply	ET 200iSP
Diagnostic interrupts[1]	• disable • enable	disable	ET 200iSP
Hardware interrupts[1)]	• disable • enable	disable	ET 200iSP
Time stamping (enable parameter)[2]	• Yes • No	No	ET 200iSP
Edge evaluation event entering state[2]	• Rising edge (0-->1) • Falling edge (1-->0) • Channel-specific	Rising edge (0-->1)	ET 200iSP
Data format	• SIMATIC S7	SIMATIC S7	ET 200iSP
Noise suppression	• 50 Hz • 60 Hz	50 Hz	ET 200iSP
Temperature unit	• Celsius • Fahrenheit	Celsius	ET 200iSP
Slot reference junction 1 to 2	• None • 4 to 35	None	ET 200iSP
Input reference junction 1 to 4	• RTD on channel 0 • RTD on channel 1 • RTD on channel 2 • RTD on channel 3	RTD on channel 0	ET 200iSP
[1] It may or may not be possible to edit these parameters, depending on the configuration tool used. [2] Configurable only in HW Config and when you operate the ET 200iSP as an S7 DP device.			

12.3 Description of the parameters for the interface modules

12.3.1 Operation at Preset <> Actual Configuration

Description

When the parameter is enabled and

- a module is plugged and unplugged during operation it does not lead to a station failure of the ET 200iSP.
- the setpoint configuration differs from the actual configuration, the ET 200iSP remains in data exchange with the DP master / PN IO controller.

If the parameter is locked and

- modules are unplugged and plugged during operation it leads to a station failure of the ET 200iSP.
- the setpoint configuration differs from the actual configuration, no data exchange takes place between the DP master / PN IO controller and the ET 200iSP.

12.3.2 Self-diagnostics

Description

When the parameter is enabled, the diagnostics of the redundant power supply PS is evaluated.

The "Self-diagnosis" parameter is only available for IM 152-1DP.

12.3.3 Redundant power supply diagnostics

Description

With this parameter you set the diagnostic behavior of the redundant power supply:

- "No redundant power supply": No diagnostics; station failure with failure of power supply.
- "Redundant power supply": Diagnostics with failure of power supply PS 1 or PS 2.
  This setting is required when you are using two power supplies for redundant power supply.
- "Redundant power supply required": Diagnostics and station failure (processing of input and output data is stopped) when a power supply fails.

12.3.4 Diagnostic interrupts

Description

You can use this parameter to enable or disable diagnostic interrupts ("main switch" for the ET 200iSP). Diagnostic interrupts are only supported if the ET 200iSP is in S7 DP or DPV1 mode.

12.3.5 Hardware interrupts

Description

You can use this parameter to enable or disable hardware interrupts ("main switch" for the ET 200iSP). Hardware interrupts are only supported if the ET 200iSP is in S7 DP or DPV1 mode or with PROFINET.

12.3.6 Time stamping / edge evaluation

Description

The description for time stamping can be found in section "Fundamentals of Time Stamping (Page 89)".

12.3.7 Data format

Description

This parameter displays the data format of all electronic modules of the ET 200iSP.

12.3.8 Noise suppression

Description

The frequency of your alternating voltage system can affect measured values negatively, particularly in the case of both measurements in small voltage ranges and thermocouples. Enter here the line frequency prevailing in your plant (50 Hz or 60 Hz).

The interference frequency suppression parameter is valid for all analog electronic modules. The integration time and conversion time of the individual modules are also set by means of this parameter.

Reference

For more information, refer to the technical specifications of the "Analog electronic modules (Page 345)" in this manual.

12.3.9 Temperature unit

Description

With this parameter you set the temperature unit for the temperature sensors and thermocouples.

Data format "S7 format": Temperature unit "Celsius" or "Fahrenheit" selectable

The temperature unit parameter is used with the 4 AI RTD and 4 AI TC analog electronic modules.

12.3.10 Slot reference junction/reference junction input

Description

You will find the description in the section "Fundamentals of analog value processing (Page 386)".

12.4 Installation of fiber-optic cables

Introduction

Fiber-optic cables may only be installed by trained and qualified personnel. Always observe the applicable rules and statutory regulations. The installation must be carried out with meticulous care, because faulty installations represent the most common source of error. Causes are:

- Kinking of the fiber-optic cable due to an insufficient bending radius.
- Crushing of the cable as a result of excess forces caused by persons treading on the cable, or by pinching, or by the load of other heavy cables.
- Overstretching due to high tensile forces.
- Damage on sharp edges etc.

Local quality assurance

Check the points outlined below before you install the fiber-optic cables:

- Does the delivered package contain the correct fiber-optic cables?
- Any visible transport damage to the product?

- Have you organized a suitable intermediate on-site storage for the fiber-optic cables?
- Does the category of the cables match the connecting components?

Check the attenuation of the fiber-optic cables after installation.

Storage of the fiber-optic cables

if you do not install the fiber-optic cable immediately after you received the package, it is advisable to store it in a dry location where it is protected from mechanical and thermal influences. Observe the permitted storage temperatures specified in the data sheet of the fiber-optic cable. You should not remove the fiber-optic cables from the original packaging until you are going to install them.

NOTICE
Reduced optical performance due to dirt Even slight amounts of dirt at the end of a fiber-optic cable will adversely affect its optical performance and thus the quality of the signal transmission. This can lead to synchronization losses during operation. Protect the ends of the fiber-optic cables against dirt during storing and installation. If the ends of the fiber-optic cable are covered when delivered, do not remove these covers.

Open installation, wall breakthroughs, cable ducts:

Note the points outlined below when you install fiber-optic cables:

- The fiber-optic cables can be installed openly if damage is excluded in these areas (riser zones, connection shafts, telephone distribution rooms, etc.).
- Cables are fastened with cable ties to a mounting rail (cable tray, lattice cable duct), whereby the fiber-optic cable must not be squeezed by the respective fastening.
- Always deburr or round the edges of the breakthrough before you install the fiber-optic cable, in order to prevent damage to the sheathing when you pull in and fasten the cable.

12.5 Selecting fiber-optic cables

Check or make allowance for the following conditions and situations when selecting a suitable fiber-optic cable:

- Required cable lengths
- Indoor or outdoor installation
- Any particular protection against mechanical stress required?
- Any particular protection against rodents required?
- Can an outside cable be routed directly underground?
- Does the fiber-optic cable need to be water-proof?
- Which temperatures influence the installed fiber-optic cable?

Use fiber-optic cables with the following specifications:

- Multimode fiber-optic cable of type 50/125 µm or 62.5/125 µm
- 2 x duplex cable per high-availability system, cross-over
- LC type plug at the interface module end. The other end depends on the type of switch connected.
- Maximum length up to 3 km (based on a real installation)

For multimode fiber-optics of type 50/125 µm with LC duplex plug and cable length up to 3000 m, see "SIMATIC NET: Industrial Ethernet / PROFINET Passive network components (https://support.industry.siemens.com/cs/ww/en/view/84922825)", "Glass FO cables" section.

Digital electronic modules 13

13.1 Digital electronics module 8 DI NAMUR

Article number

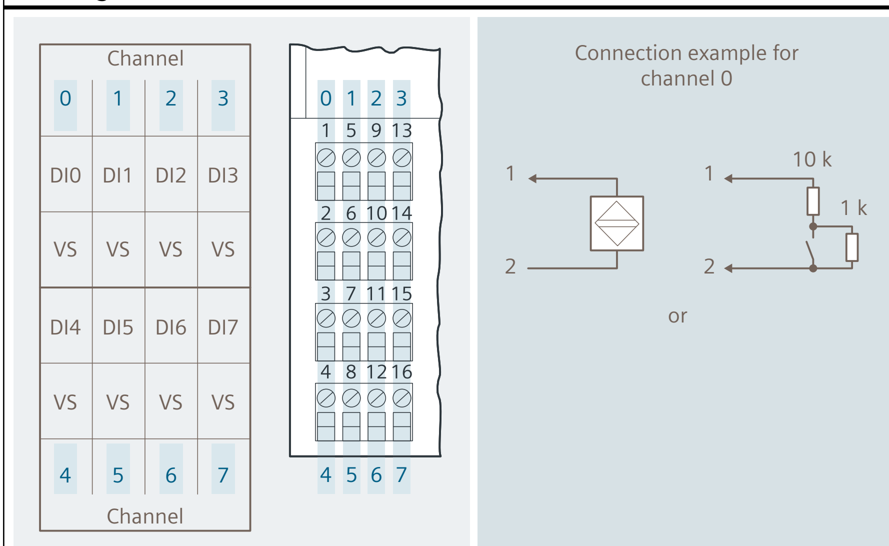
6ES7131-7RF00-0AB0

Properties

- Digital electronics module with 8 inputs
- Sensor supply DC 8 V
- Suitable for NAMUR sensors and both closed and open mechanical contacts
- Counting and frequency measurement

Pin assignment NAMUR encoders or encoders according to DIN 19234

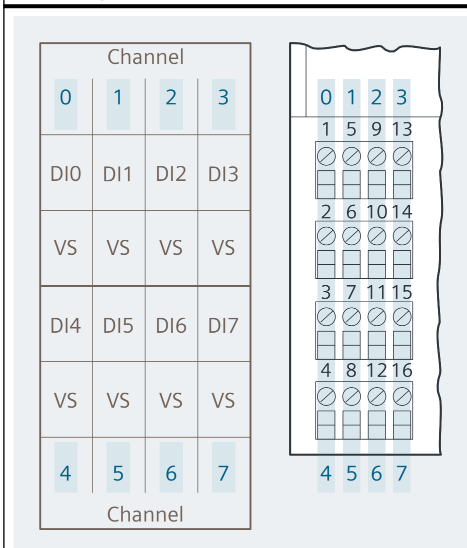
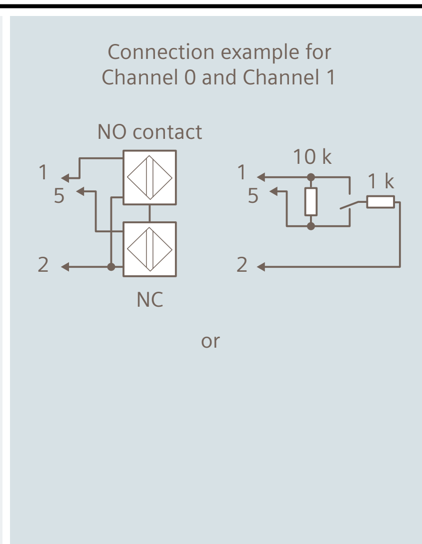
Table 13-1 Pin assignment NAMUR encoders or encoders according to DIN 19234

Pin assignment and view	Remarks
	**Sensor 1:** Channel 0: Terminals 1 and 2 **Sensor 2:** Channel 1: Terminals 5 and 6 **Sensor 3:** Channel 2: Terminals 9 and 10 **Sensor 4:** Channel 3: Terminals 13 and 14 **Sensor 5:** Channel 4: Terminals 3 and 4 **Sensor 6:** Channel 5: Terminals 7 and 8 **Sensor 7:** Channel 6: Terminals 11 and 12 **Sensor 8:** Channel 7: Terminals 15 and 16 DI: Input signal V_S: Sensor supply

> **Note**
>
> **Address space assignment**
>
> The occupied address range of the process image of the 8 DI NAMUR depends on the configuration. For more information on this, refer to Digital input module (Page 435)

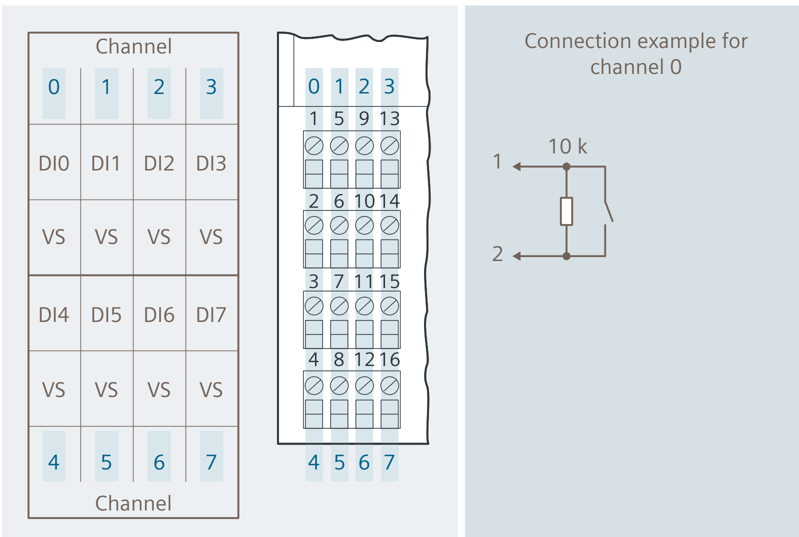
Pin assignment NAMUR changeover contact or encoder after DIN 19234 changeover contact

Table 13-2 Pin assignment NAMUR changeover contact or encoder after DIN 19234 changeover contact

Pin assignment and view	Remarks
 	**Changeover contact 1:** Channel 0: Terminals 1 and 2 Channel 1: Terminal 5 **Changeover contact 2:** Channel 2: Terminals 9 and 10 Channel 3: Terminal 13 **Changeover contact 3:** Channel 4: Terminals 3 and 4 Channel 5: Terminal 7 **Changeover contact 4:** Channel 6: Terminals 11 and 12 Channel 7: Terminal 15 DI: Input signal V_S: Sensor supply

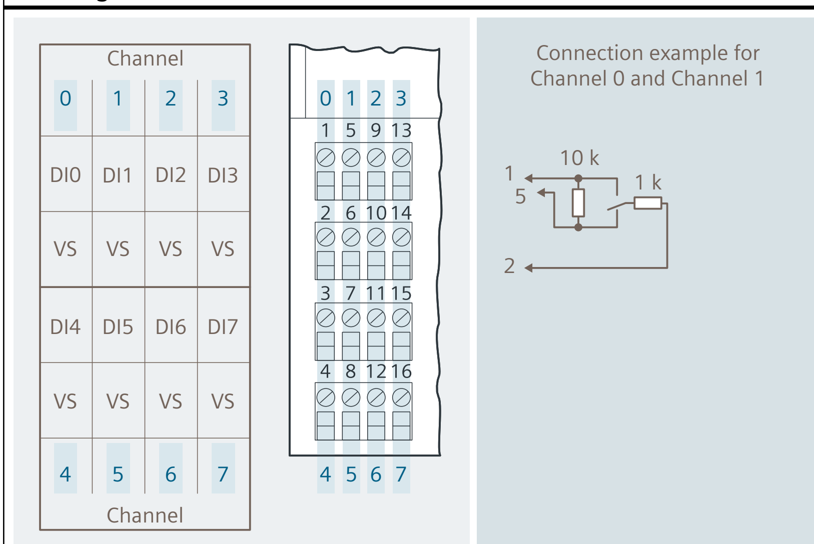
Pin assignment of single contact with 10 kΩ (mechanical normally open contact)

Table 13-3 Pin assignment of single contact with 10 kΩ (mechanical normally open contact)

Pin assignment and view	Remarks
	**Single contact 1:** Channel 0: Terminals 1 and 2 **Single contact 2:** Channel 1: Terminals 5 and 6 **Single contact 3:** Channel 2: Terminals 9 and 10 **Single contact 4:** Channel 3: Terminals 13 and 14 **Single contact 5:** Channel 4: Terminals 3 and 4 **Single contact 6:** Channel 5: Terminals 7 and 8 **Single contact 7:** Channel 6: Terminals 11 and 12 **Point of contact 8:** Channel 7 Terminals 15 and 16 DI: Input signal V_S: Sensor supply

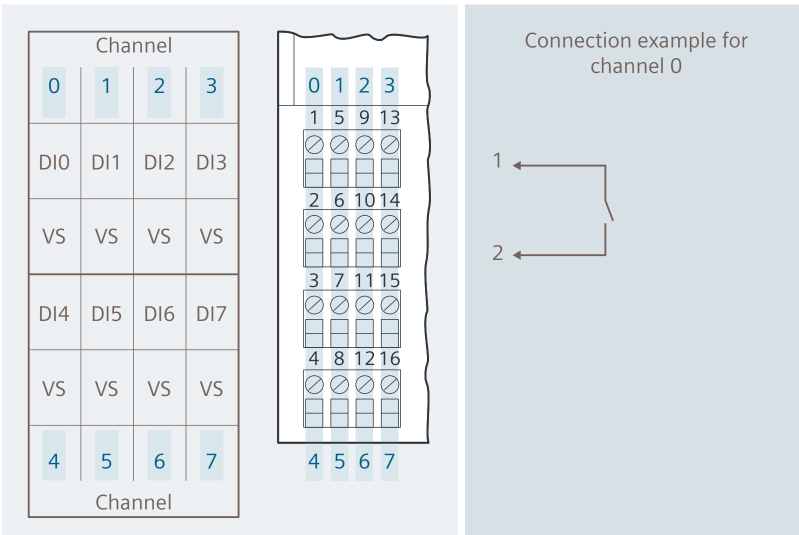
Changeover contact connected with 10 kΩ (mechanical change-over contact)

Table 13-4 Changeover contact connected with 10 kΩ (mechanical change-over contact)

Pin assignment and view	Remarks
	**Changeover contact 1:** Channel 0: Terminals 1 and 2 Channel 1: Terminal 5 **Changeover contact 2:** Channel 2: Terminals 9 and 10 Channel 3: Terminal 13 **Changeover contact 3:** Channel 4: Terminals 3 and 4 Channel 5: Terminal 7 **Changeover contact 4:** Channel 6: Terminals 11 and 12 Channel 7: Terminal 15 DI: Input signal V_S: Sensor supply

Pin assignment of a single contact without load resistance (mechanical NO contact with single contact)

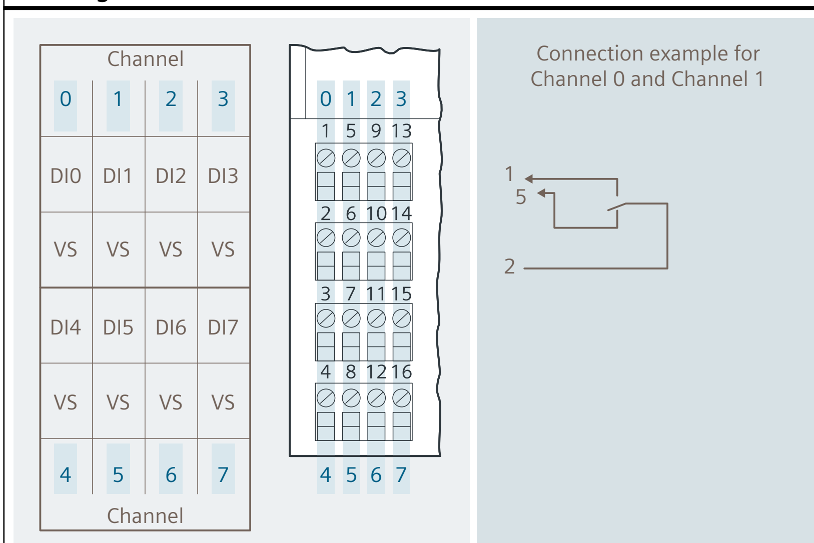
Table 13-5 Pin assignment of a single contact without load resistance (mechanical NO contact with single contact)

<table>
<tr><th>Pin assignment and view</th><th>Remarks</th></tr>
<tr><td>


</td><td>
Single contact 1:
Channel 0: Terminals 1 and 2
Single contact 2:
Channel 1: Terminals 5 and 6
Single contact 3:
Channel 2: Terminals 9 and 10
Single contact 4:
Channel 3: Terminals 13 and 14
Single contact 5:
Channel 4: Terminals 3 and 4
Single contact 6:
Channel 5: Terminals 7 and 8
Single contact 7:
Channel 6: Terminals 11 and 12
Point of contact 8:
Channel 7 Terminals 15 and 16
DI: Input signal
V_S: Sensor supply
</td></tr>
</table>

Pin assignment of a changeover contact without load resistance (mechanical changeover contact)

Table 13-6 Pin assignment of a changeover contact without load resistance (mechanical changeover contact)

<table>
<tr><th>Pin assignment and view</th><th>Remarks</th></tr>
<tr><td>


</td><td>
Changeover contact 1:
Channel 0: Terminals 1 and 2
Channel 1: Terminal 5
Changeover contact 2:
Channel 2: Terminals 9 and 10
Channel 3: Terminal 13
Changeover contact 3:
Channel 4: Terminals 3 and 4
Channel 5: Terminal 7
Changeover contact 4:
Channel 6: Terminals 11 and 12
Channel 7: Terminal 15
DI: Input signal
V_S: Sensor supply
</td></tr>
</table>

Block diagram

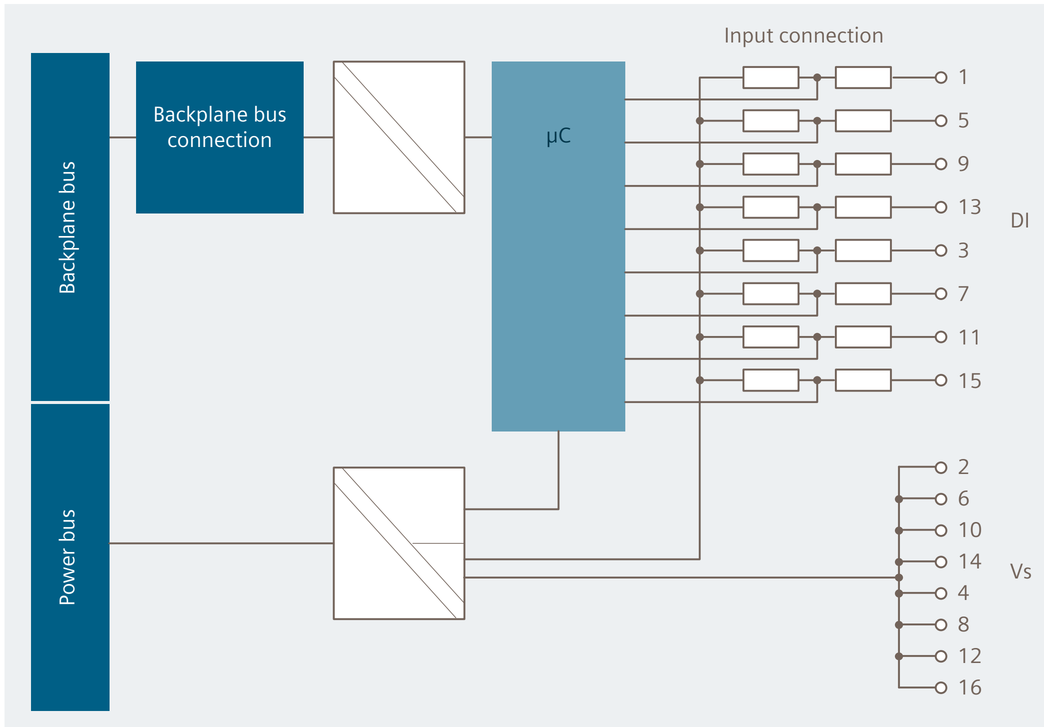


Figure 13-1 Block diagram of the 8 DI NAMUR

Technical specifications

Article number	6ES7131-7RF00-0AB0
General information	
Product type designation	8DI NAMUR
Input current	
Current consumption, typ.	80 mA
from supply voltage L+, max.	90 mA
Digital inputs	
Number of digital inputs	8
Input current	
• for signal "0", max. (permissible quiescent current)	1.2 mA
• for signal "1", min.	2.1 mA
Input delay (for rated value of input voltage)	
for standard inputs	
– at "0" to "1", min.	2.8 ms
– at "0" to "1", max.	3.5 ms
– at "1" to "0", min.	2.8 ms
– at "1" to "0", max.	3.5 ms
Cable length	
• shielded, max.	500 m
Encoder	
Number of connectable encoders, max.	8
Connectable encoders	
• NAMUR encoder	Yes
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes; Parameterizable
• Hardware interrupt	No
Diagnoses	
• Diagnostic information readable	Yes
• Short-circuit	Yes; R load < 150 ohms with NAMUR sensor/sensor and NAMUR changeover contact/sensor to DIN 19234
Diagnostics indication LED	
• Group error SF (red)	Yes
• Status indicator digital input (green)	Yes
Integrated Functions	
Frequency measurement	Yes; (Gate time) 50 ms; 200 ms; 1 s
• Number of frequency meters	2
Potential separation	
Potential separation digital inputs	
• between the channels	No

Article number	**6ES7131-7RF00-0AB0**
• between the channels and backplane bus	Yes
Permissible potential difference	
between different circuits	60 V DC/30 V AC
Standards, approvals, certificates	
CE mark	Yes
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	255 g

Technical specifications	
Voltages, currents, electrical potentials	
Power loss of the module	
• with 8 x NAMUR sensors	0.84 W
• For unconnected contact	1.1 W
Status, interrupts, diagnostics	
Status display	
• Inputs	Green LED for each channel
Diagnostic functions	
• Group error display	Red "SF" LED
Monitoring for	
• Short-circuit	$R_{Load} < 150\ \Omega$ [2]
• Wire break	$I_{load} < 0.2$ mA [3]
Safety data	
$U_o = 9.6$ V $I_o = 20$ mA $P_o = 48$ mW $C_o = 3.6$ µF $L_o = 90$ mH For additional C_o / L_o combinations, see certificate IECEx KEM 05.0010 https://www.iecex.com (https://www.iecex.com) KEMA 04 ATEX1248 INMETRO UL-BR 12.0068 https://support.industry.siemens.com (https://support.industry.siemens.com)	
Data for selecting a sensor	
Input current for NAMUR sensor [4]	according to NAMUR or EN 50227
• for "1" signal	min. 2.1 mA
• for "0" signal	max. 1.2 mA
Input current for 10 kΩ connected contact [3]	
• for "1" signal	min. 2.1 mA

Technical specifications	
• for "0" signal	max. 1.2 mA
Input current for an unconnected contact	
• for signal "1" (channel 0,1)	typ. 9.5 mA
• for signal "1" (channel 2 to 7)	typ. 7.5 mA
• Permissible quiescent current	0.5 mA
Input delay	
• for "0" to "1"	2.8 ms to 3.5 ms
• for "1" to "0"	2.8 ms to 3.5 ms
Tolerated changeover time for changeover contacts	300 ms
Parallel connection of inputs	No
Counter	
Normal or periodic counting functions	
• Quantity	2
• Channel	0, 1
Cascaded counting function	
• Quantity	1
• Channel	0
Cascaded counting function	
Sensor (max. frequency)	
• Pulse-no-pulse ratio	1:1
• Edge steepness	min. 100 ms
• Line resistance	$R_{Cable} \leq 1\ k\Omega$
Input frequency	
• Max. cable length 20 m	5 kHz
• Max. cable length 100 m	1 kHz
• Max. cable length 200 m	500 Hz
Pulse time	200 μs
Frequency meter	
Quantity	2
Channel	0, 1
Measuring frequency (GATE time)	50 ms, 200 ms, 1 s
Resolution frequency	
• at GATE time 50 ms	20 Hz
• at GATE time 200 ms	5 Hz
• at GATE time 1 s	1 Hz
Input frequency[5]	
• Max. cable length 20 m	5 kHz
• Max. cable length 100 m	1 kHz

Technical specifications	
• Max. cable length 200 m	500 Hz
[1] For the counter and frequency meter, the maximum cable length is 200 m. [2] Applies to NAMUR sensors/sensors according to DIN 19234 and NAMUR changeover contact/sensor according to DIN 19234 changeover contact. [3] applies to NAMUR sensor/sensor according to DIN 19234/ single contact connected with 10 kΩ and NAMUR changeover contact/sensor according to DIN 19234 changeover contact/changeover contact connected with 10 kΩ. [4] The input has a switching hysteresis of 0.2 mA (as of product version 5 of the 8 DI NAMUR). [5] If the input frequency rises above approx. 8 kHz, then correct actual values can no longer be output.	

Approvals

ATEX			II 2 G(1) GD and I M2 Ex ib [ia Ga] IIC T4 Gb Ex ib [ia IIIC Da] IIC T4 Gb Ex ib [ia] I Mb KEMA 04 ATEX 1248	CE 0344
IECEx			IECEx KEM 05.0010	
INMETRO	INMETRO	BR OCP-0029	BR-Ex ib [ia Ga] IIC T4 Gb BR-Ex ib [ia IIIC Da] IIC T4 Gb BR-Ex ib [ia] Mb	
FM	C FM US APPROVED		Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 AIS, Class I DIV. 1, GP. A,B,C,D; Class II, III, GP. E, F, G	
cULus	c UL us LISTED E334384		Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 ASSOC APP. CL. I, DIV.2, GP. A,B,C,D PROVIDING INT. SAFE CIRCUITS FOR CL. I, GP. A,B,C,D; CL. II, III, GP. E,F,G	
CCC			Ex ib [ia Ga] IIC T4 Gb Ex ib [iaD] IIC T4 Gb	
UKCA	UK CA		DEKRA 21UKEX0084	

Diagnosis for changeover contact sensor types

When a diagnosis is made for the changeover contact sensor type, the digital electronic module controls the switchover between two input channels. If there is no signal change in the normally closed contact after the set switchover time (see technical specifications), the module reports diagnostic information.

Purpose

You can use the diagnosis for

- checking the sensor
- to make absolutely sure that there has been a switchover between a normally open contact and normally closed contact.

Principle

If the digital inputs of a channel group are assigned parameters as changeover contacts, the module runs diagnostics for changeover contact sensor types for this channel group. The tolerated changeover time between the two channels is set to the fixed value of 300 ms.

If the plausibility check is negative, then

- The module designates the value status of the normally open contact channel as invalid.
- The module creates a diagnostic entry for the NO contact channel.
- The module triggers a diagnostic interrupt.

The digital input signal and the value status are only updated for the NO contact channel (channel 0, 2, 4, 6). For the normally closed channel (channel 1, 3, 5, 7), the digital input signal is fixed at "zero" and the value status is "invalid", as this channel is only used for plausibility checking of the sensor.

Note the following points when carrying out a diagnosis for a changeover contact sensor type:

- If there is already an error on the normally open contact channel (a wire break, for example), the module no longer performs diagnostics for changeover contact errors. The diagnostics for changeover contact errors continues on the second channel.
- You will find additional points to note in the following table:

Table 13-7 Diagnosis for changeover contacts

<table>
<tr><th>Changeover contact</th><th colspan="2">A negative check means...</th></tr>
<tr><td>Changeover contact as NAMUR</td><td>• Short-circuit or
• Wire break</td><td rowspan="3">Additionally:
Changeover contact or external fault (in case of DP diagnostics)</td></tr>
<tr><td>Closed changeover contact</td><td>• Sensor defective or short-circuit
No distinction can be made here between a defective-sensor and short circuit</td></tr>
<tr><td>Open changeover contact</td><td>Caution: no differentiation possible between
• signal "0" and wire break
• Signal "1" and short circuit</td></tr>
</table>

13.2 Digital electronics module 4 DO

Article numbers

Type	Article number
4 DO DC23.1V/20mA shut down "H"	6ES7132-7RD01-0AB0
4 DO DC17.4V/27mA shut down "H"	6ES7132-7RD11-0AB0
4 DO DC17.4V/40mA shut down "H"	6ES7132-7RD22-0AB0
4 DO DC23.1V/20mA shut down "L"	6ES7132-7GD00-0AB0
4 DO DC17.4V/27mA shut down "L"	6ES7132-7GD10-0AB0
4 DO DC17.4V/40mA shut down "L"	6ES7132-7GD21-0AB0
4 DO DC25.5V/22mA shut down "L"	6ES7132-7GD30-0AB0

Properties

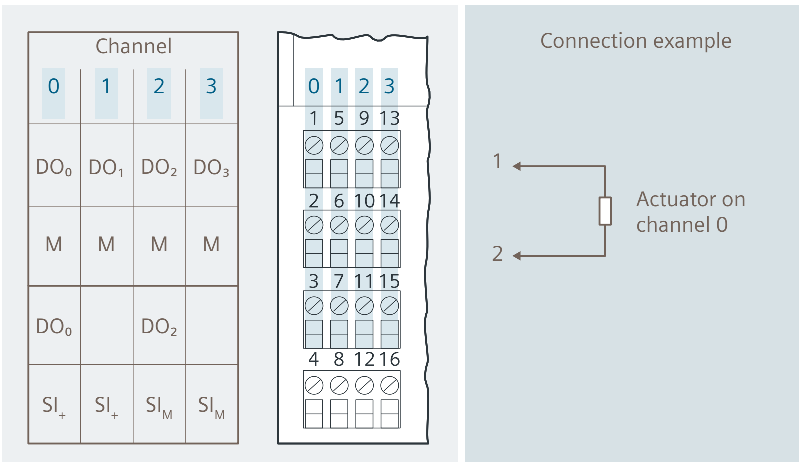
- 3 variants shut down "H" output modules
- 4 variants shut down "L" output modules
- 4 outputs per module
- Nominal load voltage DC 25.5V, 23.1V or 17.4V
- Outputs suitable for Ex i solenoid valves, DC relays and actuators
- To enhance performance, you can connect in parallel two digital outputs of electronic modules 4 DO DC17.4V/27mA or 4 DO DC 17.4V/40mA for one actuator. This increased power is permitted only on the same module and between the following channels:
  – Channel 0 and channel 1 Jumper from terminal 1 to terminal 5; DO connection to terminal 3
  – Channel 2 and channel 3 Jumper from terminal 9 to terminal 13; DO connection to terminal 11
- You must connect an intrinsically safe shutdown signal to the actuator disconnection input. This allow the simultaneous deactivation of all outputs of the electronic module. The function does not affect the process image output table (POI).
  – Shut down "H" output modules: Deactivation via High active, intrinsically safe switching signal.
  – Shut down "L" output modules: Deactivation via Low active, intrinsically safe switching signal.

Note

Note that shut down "H" output modules and shut down "L" output modules require separate switching signal connections.

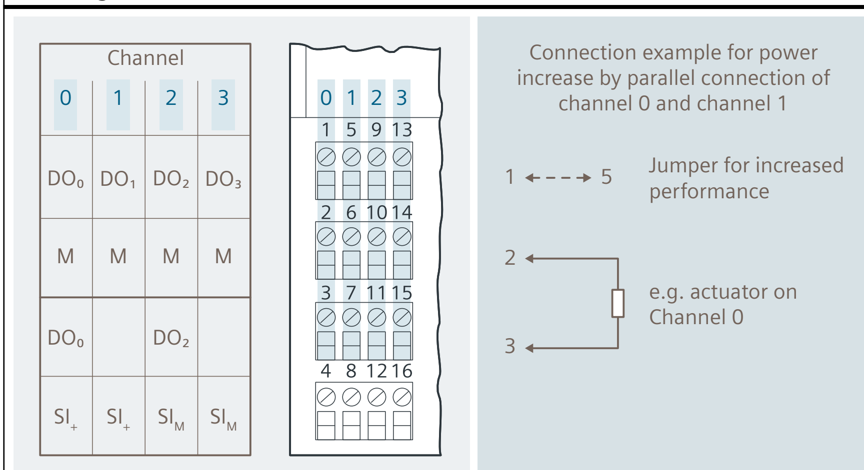
Pin assignment of actuators

Table 13-8 Pin assignment of actuators

<table>
<tr><th>Pin assignment and view</th><th>Remarks</th></tr>
<tr><td>
</td><td>Actuator terminals:
Channel 0: Terminals 1 and 2
Channel 1: Terminals 5 and 6
Channel 2: Terminals 9 and 10
Channel 3: Terminals 13 and 14
DO: Digital outputs
M: Ground</td></tr>
</table>

Pin assignment for enhanced performance (only for 4 DO DC17.4V/27mA, 4 DO DC17.4V/40mA)

Table 13-9 Pin assignment for enhanced performance

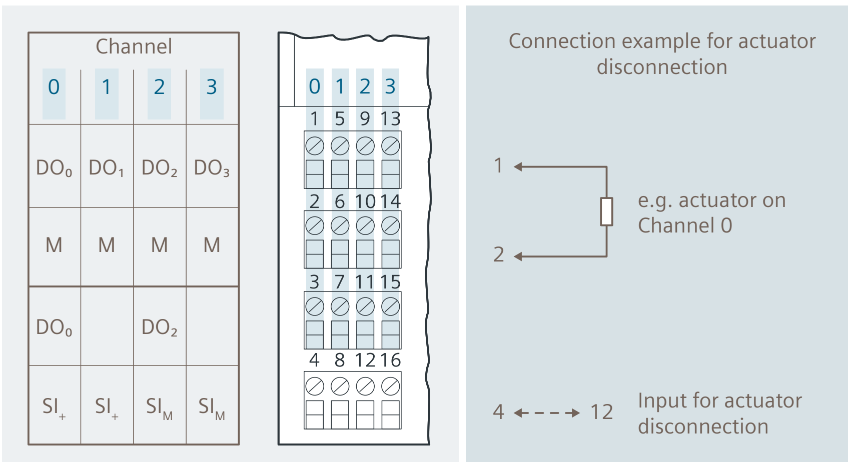
<table>
<tr><th>Pin assignment and view</th><th>Remarks</th></tr>
<tr><td>
</td><td>Increased power:
Parallel connection of channel 0 and channel 1: Jumper from 1 to 5; actuator at 2 and 3
Parallel connection of channel 2 and channel 3 Jumper from 9 to 13; actuator at 10 and 11
DO: Digital outputs
M: Ground</td></tr>
</table>

Note

If the actuator shutdown signal is connected in parallel via terminals 4/8 and 12/16, note that this signals is interrupted when a 4 DO module is pulled. If "hot swapping" is intended when the actuator disconnection is activated, the individual modules must be connected directly to the signal source.

Pin assignment for actuator disconnection

Table 13-10 Pin assignment for actuator disconnection

Pin assignment and view	Remarks
	**Actuator disconnection of all outputs channel 0 to channel 3:** Terminal 4/8: High active (intrinsically safe) or low active signal (see figure, "Actuator disconnection via intrinsically safe shutdown signal for shut down "H" output modules") Terminal 12/16: Ground DO: Digital outputs M: Chassis ground SI_+: Signal input for actuator disconnection SI_M: Ground

Block diagram

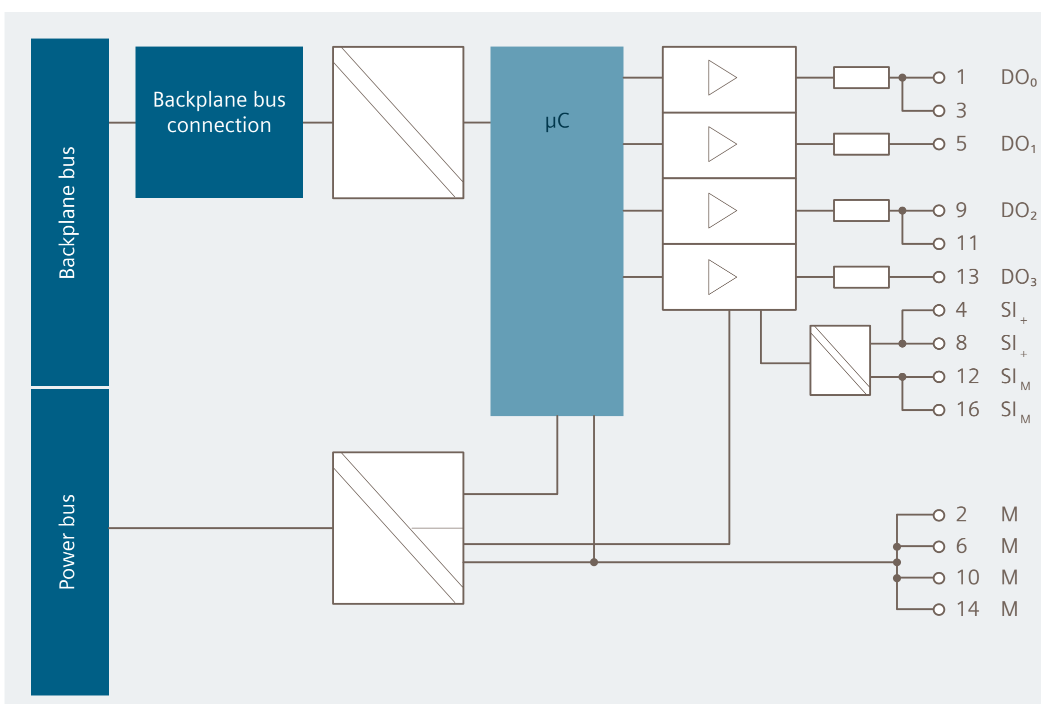


Figure 13-2 Block diagram of 4 DO

Technical specifications

4 DO DC23.1V/20mA shut down "H"

Article number	6ES7132-7RD01-0AB0
General information	
Product type designation	4DQ 23.1 V DC/20 mA
Input current	
Current consumption, typ.	290 mA
from load voltage L+ (without load), max.	340 mA; with actuator supply
from backplane bus 3.3 V DC, max.	10 mA
Power loss	
Power loss, typ.	2.5 W
Address area	
Address space per module	
• Address space per module, max.	2 byte
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	4; additionally 1 intrinsically-safe input for H shut-down
Short-circuit protection	Yes
No-load voltage Uao (DC)	23.1 V
Internal resistor Ri	275 Ω
Trend key points E	
• Voltage Ue (DC)	17.6 V
• Current Ie	20 mA
Output current	
• for signal "1" rated value	0.02 A
Output delay with resistive load	
• "0" to "1", max.	2 ms
• "1" to "0", max.	1.5 ms
Parallel switching of two outputs	
• for uprating	No; for Ex reasons not possible; nor for predecessor
Switching frequency	
• with resistive load, max.	100 Hz
• with inductive load, max.	2 Hz
Cable length	
• shielded, max.	500 m
• unshielded, max.	500 m
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes

Article number	6ES7132-7RD01-0AB0
• Wire-break	Yes; R > 10 kohms, I < 100 µA
• Short-circuit	Yes; R< 800 ohms (one output), R< 40 ohms (outputs connected in parallel)
Diagnostics indication LED	
• Group error SF (red)	Yes
• Status indicator digital output (green)	Yes
Potential separation	
Potential separation digital outputs	
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
Standards, approvals, certificates	
Highest safety class achievable in safety mode	
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	255 g

4 DO DC17.4V/27mA shut down "H"

Article number	6ES7132-7RD11-0AB0
General information	
Product type designation	4DQ 17.4 V DC/27 mA
Input current	
Current consumption, typ.	260 mA
from load voltage L+ (without load), max.	300 mA
from backplane bus 3.3 V DC, max.	10 mA
Power loss	
Power loss, typ.	2.1 W
Address area	
Address space per module	
• Address space per module, max.	2 byte
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	4; additionally 1 intrinsically-safe input for H shut-down
Short-circuit protection	Yes
No-load voltage Uao (DC)	17.4 V
Internal resistor Ri	150 Ω
Trend key points E	
• Voltage Ue (DC)	13.3 V
• Current Ie	27 mA
Output current	
• for signal "1" rated value	0.027 A
Output delay with resistive load	
• "0" to "1", max.	2 ms
• "1" to "0", max.	1.5 ms
Parallel switching of two outputs	
• for uprating	Yes
Switching frequency	
• with resistive load, max.	100 Hz
• with inductive load, max.	2 Hz
Cable length	
• shielded, max.	500 m
• unshielded, max.	500 m
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes

Article number	6ES7132-7RD11-0AB0
• Short-circuit	Yes
Diagnostics indication LED	
• Group error SF (red)	Yes
• Status indicator digital output (green)	Yes
Potential separation	
Potential separation digital outputs	
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	255 g

4 DO DC17.4V/40mA shut down "H"

Article number	6ES7132-7RD22-0AB0
General information	
Product type designation	4DQ 17.4 V DC/40 mA
Input current	
Current consumption, typ.	380 mA
from load voltage L+ (without load), max.	400 mA
Power loss	
Power loss, typ.	2.8 W
Address area	
Address space per module	
• Address space per module, max.	2 byte
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	4; additionally 1 intrinsically-safe input for H shut-down
Short-circuit protection	Yes
No-load voltage Uao (DC)	17.4 V
Internal resistor Ri	167 Ω
Trend key points E	
• Voltage Ue (DC)	10.7 V
• Current Ie	40 mA; 80 mA when outputs connected in parallel
Output current	
• for signal "1" rated value	0.04 A
Output delay with resistive load	
• "0" to "1", max.	2 ms
• "1" to "0", max.	1.5 ms
Parallel switching of two outputs	
• for uprating	Yes
Switching frequency	
• with resistive load, max.	100 Hz
• with inductive load, max.	2 Hz
Cable length	
• shielded, max.	500 m
• unshielded, max.	500 m
Interrupts/diagnostics/status information	
Alarms	
• Diagnostic alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes; R > 10 kohms, I < 100 μA
• Short-circuit	Yes; R< 80 Ohm (one output), R< 40 Ohm (outputs connected in parallel)
Diagnostics indication LED	

Article number	6ES7132-7RD22-0AB0
• Group error SF (red)	Yes
• Status indicator digital output (green)	Yes; Per channel
Ex(i) characteristics	
maximum values for connecting terminals for gas group IIC	
• Uo (no-load voltage), max.	19.4 V
• Io (short-circuit current), max.	118 mA
• Po (power output), max.	572 mW
• Co (permissible external capacity), max.	241 nF; For IIC, 1507 nF for IIB
• Lo (permissible external inductivity), max.	1.7 mH; For IIC, 10.4 mH for IIB
Potential separation	
Potential separation digital outputs	
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
Permissible potential difference	
between different circuits	60 V DC/30 V AC
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	255 g

4 DO DC23.1V/20mA shut down "L"

Article number	6ES7132-7GD00-0AB0
General information	
Product type designation	4DQ 23.1 V DC/20 mA
Input current	
Current consumption, typ.	290 mA
from load voltage L+ (without load), max.	340 mA; with actuator supply
from backplane bus 3.3 V DC, max.	10 mA
Power loss	
Power loss, typ.	2.5 W
Address area	
Address space per module	
• Address space per module, max.	2 byte
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	4; additionally 1 intrinsically-safe input for L shut-down
Short-circuit protection	Yes
No-load voltage Uao (DC)	23.1 V
Internal resistor Ri	275 Ω
Trend key points E	
• Voltage Ue (DC)	17.6 V
• Current Ie	20 mA
Output current	
• for signal "1" rated value	0.02 A
Output delay with resistive load	
• "0" to "1", max.	2 ms
• "1" to "0", max.	1.5 ms
Parallel switching of two outputs	
• for uprating	No; for Ex reasons not possible; nor for predecessor
Switching frequency	
• with resistive load, max.	100 Hz
• with inductive load, max.	2 Hz
Cable length	
• shielded, max.	500 m
• unshielded, max.	500 m
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes; R > 10 kohms, I < 100 μA

Article number	6ES7132-7GD00-0AB0
• Short-circuit	Yes; R< 80 Ohm (one output), R< 40 Ohm (outputs connected in parallel)
Diagnostics indication LED	
• Group error SF (red)	Yes
• Status indicator digital output (green)	Yes
Potential separation	
Potential separation digital outputs	
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	255 g

4 DO DC17.4V/27mA shut down "L"

Article number	6ES7132-7GD10-0AB0
General information	
Product type designation	4DQ 17.4 V DC/27 mA
Input current	
Current consumption, typ.	260 mA
from load voltage L+ (without load), max.	300 mA; with actuator supply
from backplane bus 3.3 V DC, max.	10 mA
Power loss	
Power loss, typ.	2.1 W
Address area	
Address space per module	
• Address space per module, max.	2 byte
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	4; additionally 1 intrinsically-safe input for L shut-down
Short-circuit protection	Yes
No-load voltage Uao (DC)	17.4 V
Internal resistor Ri	150 Ω
Trend key points E	
• Voltage Ue (DC)	13.3 V
• Current Ie	27 mA; 54 mA when outputs connected in parallel
Output current	
• for signal "1" rated value	0.027 A
Output delay with resistive load	
• "0" to "1", max.	2 ms
• "1" to "0", max.	1.5 ms
Parallel switching of two outputs	
• for uprating	Yes
Switching frequency	
• with resistive load, max.	100 Hz
• with inductive load, max.	2 Hz
Cable length	
• shielded, max.	500 m
• unshielded, max.	500 m
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes; R > 10 kohms, I < 100 μA

Article number	6ES7132-7GD10-0AB0
• Short-circuit	Yes; R< 800 ohms (one output), R< 40 ohms (outputs connected in parallel)
Diagnostics indication LED	
• Group error SF (red)	Yes
• Status indicator digital output (green)	Yes
Potential separation	
Potential separation digital outputs	
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	255 g

4 DO DC17.4V/40mA shut down "L"

Article number	6ES7132-7GD21-0AB0
General information	
Product type designation	4DQ 17.4 V DC/40 mA
Input current	
Current consumption, typ.	380 mA
from load voltage L+ (without load), max.	400 mA
Power loss	
Power loss, typ.	2.8 W
Address area	
Address space per module	
• Address space per module, max.	2 byte
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	4; additionally 1 intrinsically-safe input for L shut-down
Short-circuit protection	Yes
No-load voltage Uao (DC)	17.4 V
Internal resistor Ri	167 Ω
Trend key points E	
• Voltage Ue (DC)	10.7 V
• Current Ie	40 mA
Output current	
• for signal "1" rated value	0.04 A
Output delay with resistive load	
• "0" to "1", max.	2 ms
• "1" to "0", max.	1.5 ms
Parallel switching of two outputs	
• for uprating	Yes
Switching frequency	
• with resistive load, max.	100 Hz
• with inductive load, max.	2 Hz
Cable length	
• shielded, max.	500 m
• unshielded, max.	500 m
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes; R > 10 kohms, I < 100 µA
• Short-circuit	Yes; R< 80 Ohm (one output), R< 40 Ohm (outputs connected in parallel)

Article number	6ES7132-7GD21-0AB0
Diagnostics indication LED	
• Group error SF (red)	Yes
• Status indicator digital output (green)	Yes; Per channel
Ex(i) characteristics	
maximum values for connecting terminals for gas group IIC	
• Uo (no-load voltage), max.	19.4 V
• Io (short-circuit current), max.	118 mA
• Po (power output), max.	572 mW
• Co (permissible external capacity), max.	241 nF; For IIC, 1507 nF for IIB
• Lo (permissible external inductivity), max.	1.7 mH; For IIC, 10.4 mH for IIB
Potential separation	
Potential separation digital outputs	
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
Permissible potential difference	
between different circuits	60 V DC/30 V AC
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	255 g

4 DO DC25.5V/22mA shut down "L"

Article number	6ES7132-7GD30-0AB0
General information	
Product type designation	4DQ 25.5 V DC/22 mA
Input current	
Current consumption, typ.	380 mA
from load voltage L+ (without load), max.	400 mA
Power loss	
Power loss, typ.	2.8 W
Address area	
Address space per module	
• Address space per module, max.	2 byte
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	4; additionally 1 intrinsically-safe input for L shut-down
Short-circuit protection	Yes
No-load voltage Uao (DC)	25.5 V
Internal resistor Ri	260 Ω
Trend key points E	
• Voltage Ue (DC)	19.8 V
• Current Ie	22 mA
Output current	
• for signal "1" rated value	0.022 A
Output delay with resistive load	
• "0" to "1", max.	2 ms
• "1" to "0", max.	1.5 ms
Parallel switching of two outputs	
• for uprating	No
Switching frequency	
• with resistive load, max.	100 Hz
• with inductive load, max.	2 Hz
Cable length	
• shielded, max.	500 m
• unshielded, max.	500 m
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes; R > 10 kohms, I < 100 µA
• Short-circuit	Yes; R < 80 ohms

Article number	6ES7132-7GD30-0AB0
Diagnostics indication LED	
• Group error SF (red)	Yes
• Status indicator digital output (green)	Yes; Per channel
Ex(i) characteristics	
maximum values for connecting terminals for gas group IIC	
• Uo (no-load voltage), max.	27.9 V
• Io (short-circuit current), max.	110 mA
• Po (power output), max.	764 mW
• Co (permissible external capacity), max.	81 nF; For IIC, 651 nF for IIB
• Lo (permissible external inductivity), max.	1.7 mH; For IIC, 11.5 mH for IIB
Potential separation	
Potential separation digital outputs	
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
Permissible potential difference	
between different circuits	60 V DC/30 V AC
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	255 g

Technical specifications	
Module-specific data	
Voltages, currents, electrical potentials	
Electrical isolation	
• Between the channels and actuator disconnection input	Yes
Status, interrupts, diagnostics	
Status display	
• Outputs	Green LED for each channel
Interrupts	
• Hardware interrupt	No
Diagnostic functions	
• Group error display	Red "SF" LED

Technical specifications	
Monitoring for	
• Short-circuit	R < 80 Ω (one output) R < 40 Ω (outputs connected in parallel)
• Wire break	R^1 > 10 kΩ I < 100 µA
Safety data	
Maximum values for intrinsically safe switching signal SO: U_i = 28 V I_i = not relevant P_i = 1.2 W C_i = 3 nF L_i = 0 mH	
Modules 4 DO 6ES7132-7RD01-0AB0 and 6ES7132-7GD00-0AB0: U_o = 25.6 V I_o = 96 mA P_o = 0.61 W C_o = 98 nF L_o = 3 mH	
Modules 4 DO 6ES7132-7GD30-0AB0: U_o = 27.9 V I_o = 110 mA P_o = 0.76 W C_o = 81 nF L_o = 3 mH	
Modules 4 DO 6ES7132-7RD22-0AB0 and 6ES7132-7GD21-0AB0: U_o = 19.4 V I_o = 118 mA P_o = 0.57 W C_o = 0.24 µF L_o = 2.5 mH	
Modules 4 DO 6ES7132-7RD11-0AB0 and 6ES7132-7GD10-0AB0: U_o = 19.4 V I_o = 132 mA P_o = 0.64 W C_o = 0.23 µF L_o = 1.9 mH	
For additional C_o / L_o combinations, see certificate IECEx KEM 05.0011 https://www.iecex.com (https://www.iecex.com) KEMA 04 ATEX1249 INMETRO UL-BR 12.0073 https://support.industry.siemens.com (https://support.industry.siemens.com)	
Actuator selection data	
No load voltage U_{AO}	
• 4 DO DC25.5V/22mA shut down "L"	min. 25.5 V
• 4 DO DC23.1V/20mA shut down "H"/"L"	min. 23.1 V

Technical specifications	
• 4 DO DC17.4V/27mA shut down "H"/"L"	min. 17.4 V
• 4 DO DC17.4V/40mA shut down "H"/"L"	min. 17.4 V
Internal resistance R_i	
• 4 DO DC25.5V/22mA shut down "L"	260 Ω
• 4 DO DC23.1V/20mA shut down "H"/"L"	275 Ω
• 4 DO DC17.4V/27mA shut down "H"/"L"	150 Ω
• 4 DO DC17.4V/40mA shut down "H"/"L"	167 Ω
Curve corner points E for 4 DO DC25.5V/22mA shut down "L"	
• Voltage U_E	min. 19.8 V
• Current I_E	at least 22 mA (one output)
Curve corner points E for 4 DO DC23.1V/20mA shut down "H"/"L"	
• Voltage U_E	min. 17.6 V
• Current I_E	at least 20 mA (one output)
Curve corner points E for 4 DO DC17.4V/27mA shut down "H"/"L"	
• Voltage U_E	min. 13.3 V
• Current I_E	at least 27 mA (one output) min. 54 mA (outputs connected in parallel)
Curve corner points E for 4 DO DC17.4V/40mA shut down "H"/"L"	
• Voltage U_E	min. 10.7 V
• Current I_E	at least 40 mA (one output) min. 80 mA (outputs connected in parallel)
Output delay (resistive load)	
• for "0" to "1"	2 ms
• for "1" to "0"	1.5 ms
Wiring two outputs in parallel	
4 DO DC25.5V/22mA shut down "L"	No
4 DO DC23.1V/20mA shut down "H"/"L"	No
4 DO DC17.4V/27mA shut down "H"/"L"	Yes
4 DO DC17.4V/40mA shut down "H"/"L"	Yes
Switching frequency	No
• with resistive load	100 Hz
• with inductive load	2 Hz
Short circuit-proof output	Yes
Leakage current of the output	max. 25 µA
Data for selecting a sensor for the safety barrier[2]	
Minimum switching voltage	10.5 V

Technical specifications	
Minimum switching current	2 mA
[1] R = load resistance + line resistance	
[2] An unconnected contact is required as the input	

Approvals

ATEX		II 2 G(1) GD and I M2 Ex ib [ia Ga] IIC T4 Gb Ex ib [ia IIIC Da] IIC T4 Gb Ex ib [ia] IMb KEMA 04 ATEX 1249	CE 0344
IECEx		IECEx KEM 05.0011	
INMETRO	INMETRO; BR OCP-0029	BR-Ex ib [ia Ga] IIC T4 Gb BR-Ex ib [ia IIIC Da] IIC T4 Gb BR-Ex ib [ia] I Mb	
FM	FM APPROVED	Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 NI, Class I, DIV. 2, GP. A,B,C,D AIS, Class I DIV. 1, GP. A,B,C,D; Class II, III, GP. E, F, G	
cULus	LISTED E334384	Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 ASSOC APP. CL. I, DIV.2, GP. A,B,C,D PROVIDING INT. SAFE CIRCUITS FOR CL. I, GP. A,B,C,D; CL. II, III, GP. E,F,G	
CCC		Ex ib [ia Ga] IIC T4 Gb Ex ib [iaD] IIC T4 Gb	
UKCA	UK CA	DEKRA 21UKEX0085	

Output characteristic 4 DO DC25.5V/22mA shut down "L"

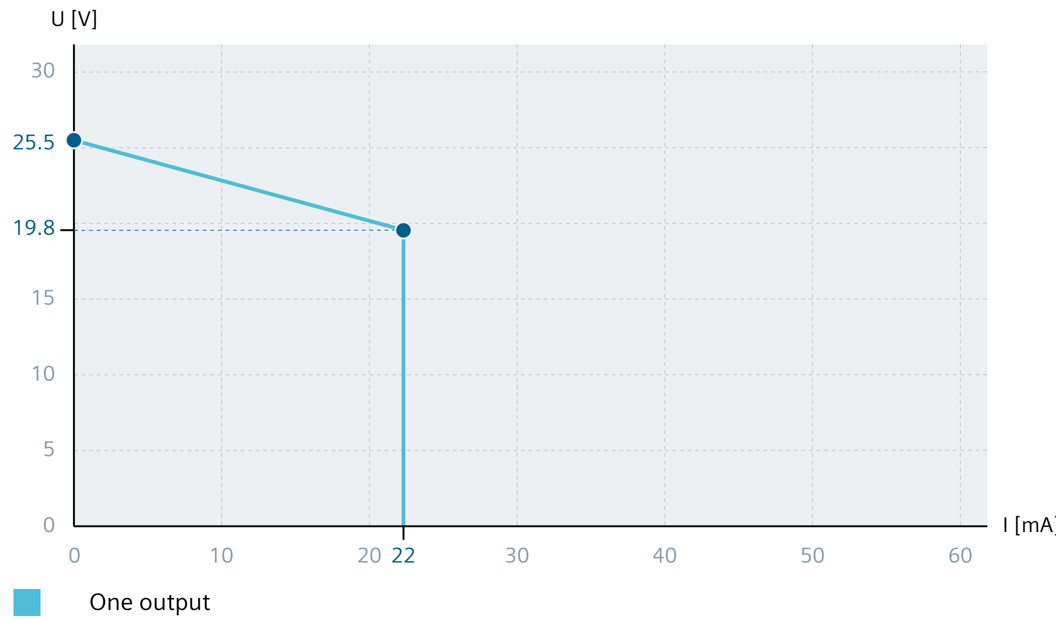


Figure 13-3 Output characteristic 4 DO DC25.5V/22mA shut down "L"

Output characteristic 4 DO DC23.1V/20mA shut down "H"/"L"

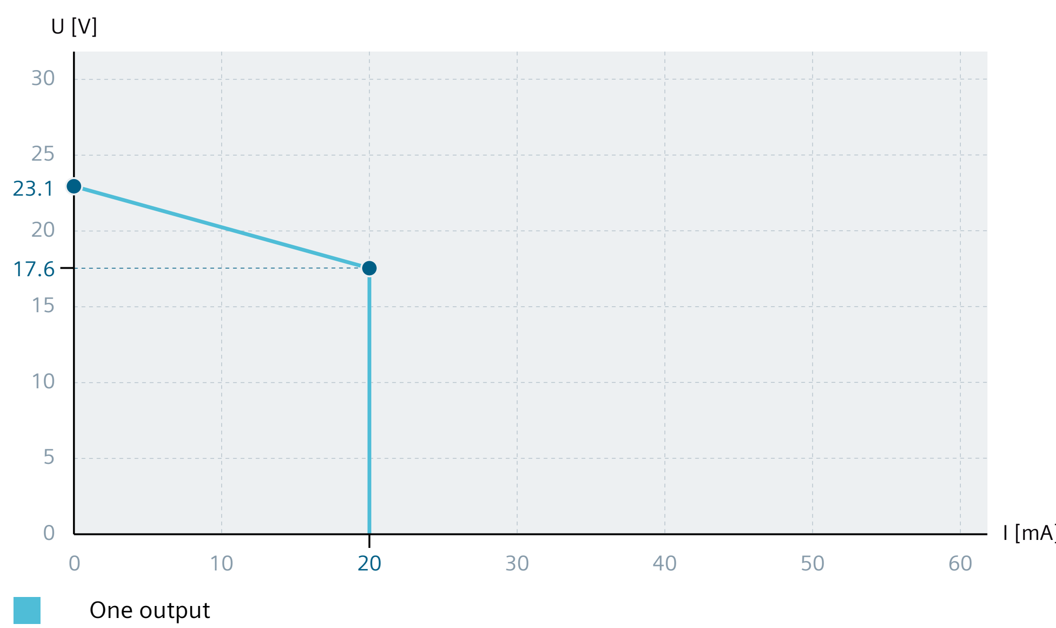


Figure 13-4 Output characteristic 4 DO DC23.1V/20mA shut down "H"/"L"

Output characteristic 4 DO DC17.4V/27mA shut down "H"/"L"

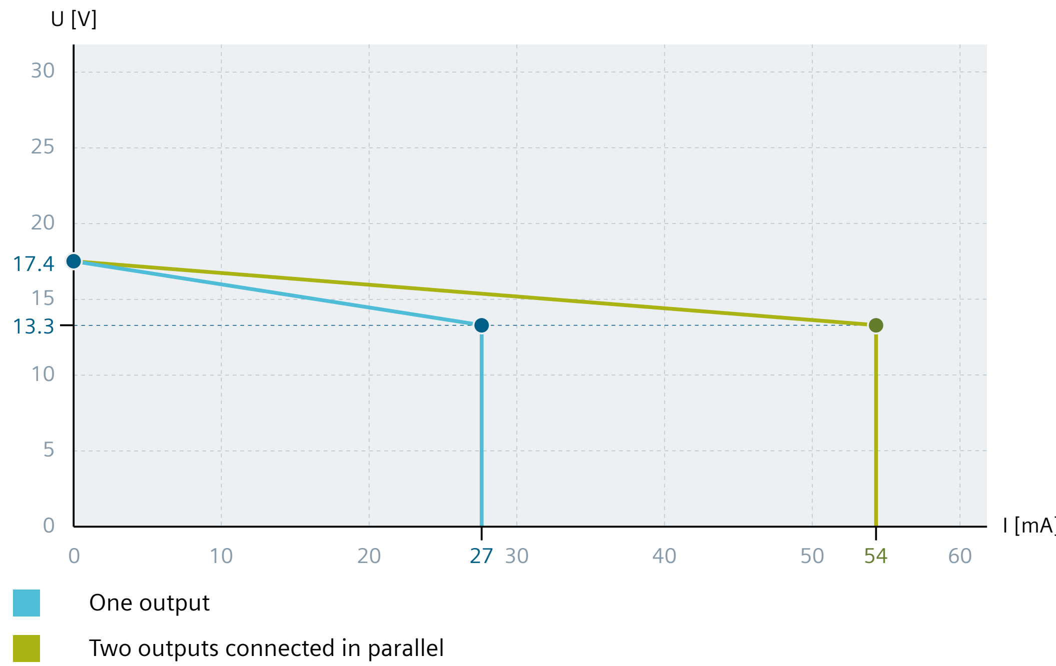


Figure 13-5 Output characteristic 4 DO DC17.4V/27mA shut down "H"/"L"

Output characteristic 4 DO DC17.4V/40mA shut down "H"/"L"

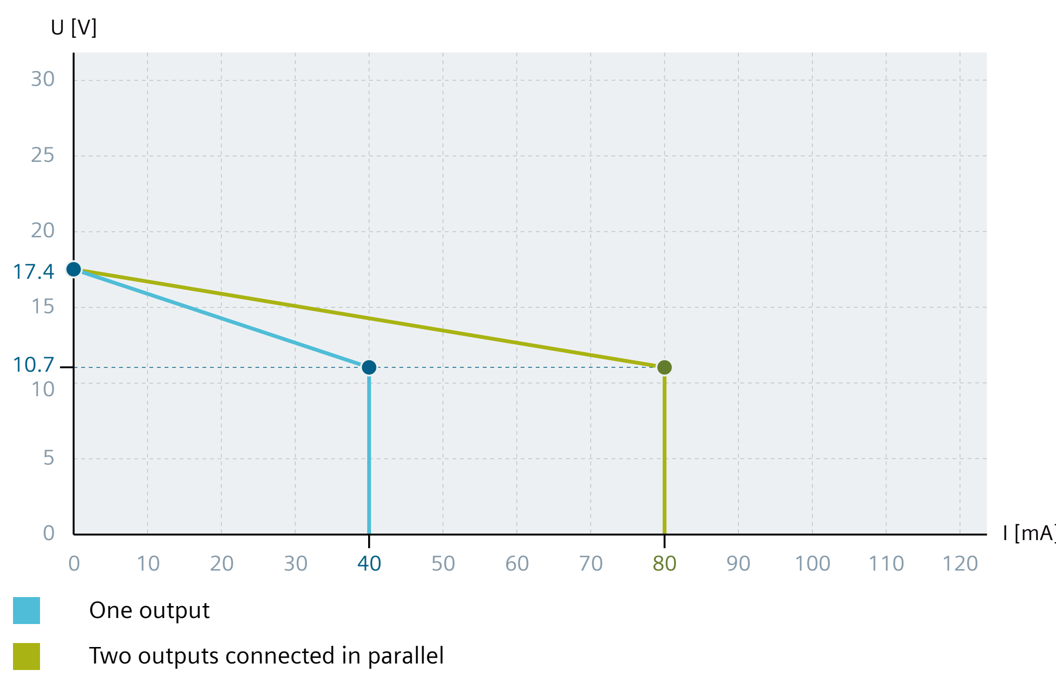


Figure 13-6 Output characteristic 4 DO DC17.4V/40mA shut down "H"/"L"

Actuator disconnection with an intrinsically safe shutdown signal (safety barrier)

You can use an intrinsically safe shutdown signal to shut down one or more digital output modules.

You do this by connecting the voltage of the safety barrier to terminals 4/8 (+) and 12/16 (-) of the digital output module.

You can also shut down several digital output modules switched in parallel, depending on the maximum output current at the safety barrier (see the following figure). Remember that current I_{max} = 8 mA for each digital output module.

Shut down "H" output modules:

If no intrinsically safe shutdown signal is applied, the digital output module operates with its normal functionality.

Shut down "L" output modules:

If no intrinsically safe shutdown signal is used, you must enable the "Disable shutdown signal" parameter for the shut down "L" output modules.

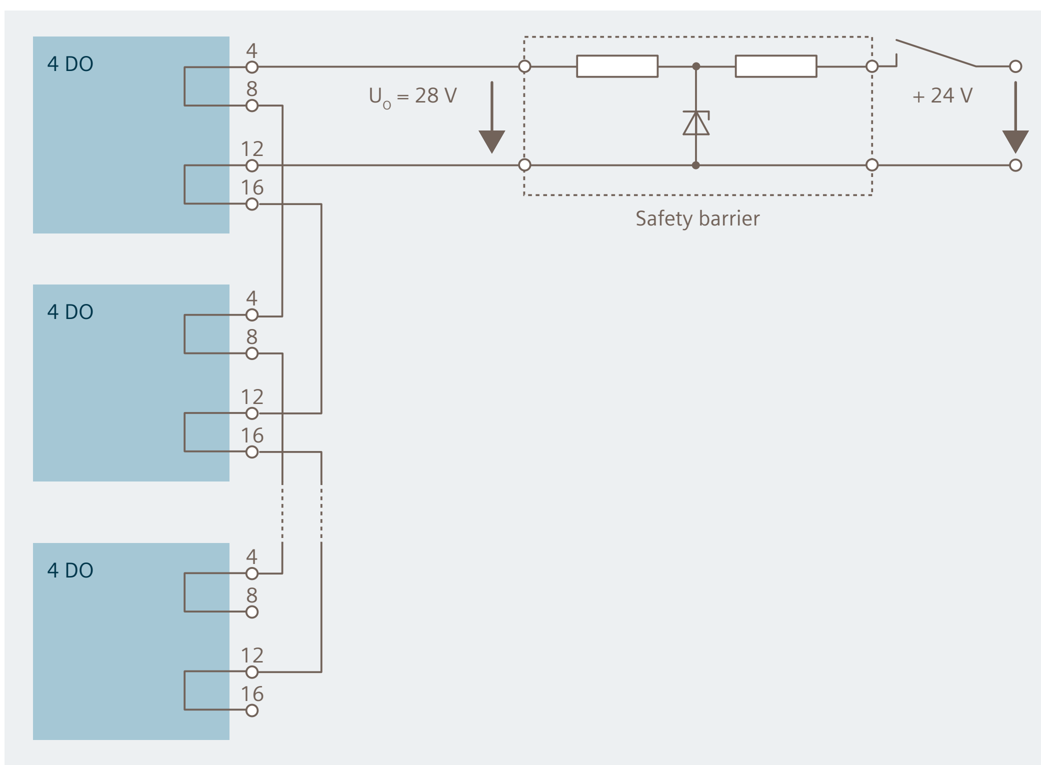


Figure 13-7 Actuator disconnection via intrinsically safe shutdown signal for shut down "H" output modules and for shut down "L" output modules

---

Note

You can only use the "Disable shutdown signal" parameter in HW Config for objects from the hardware catalog with an "*" after the article number 6ES7...

Actuator shutdown with 11 Vsupply from the WATCHDOG module

The WATCHDOG module can supply 2 mA current consumption each for up to 16 digital output modules via one intrinsically safe contact K1 (e.g. Category 2G relay for installation in the hazardous area Zone 1).

You do this by connecting the terminals of the intrinsically safe contact to the Pi terminal on the WATCHDOG module and terminals 4/8 (+) of the digital output module.

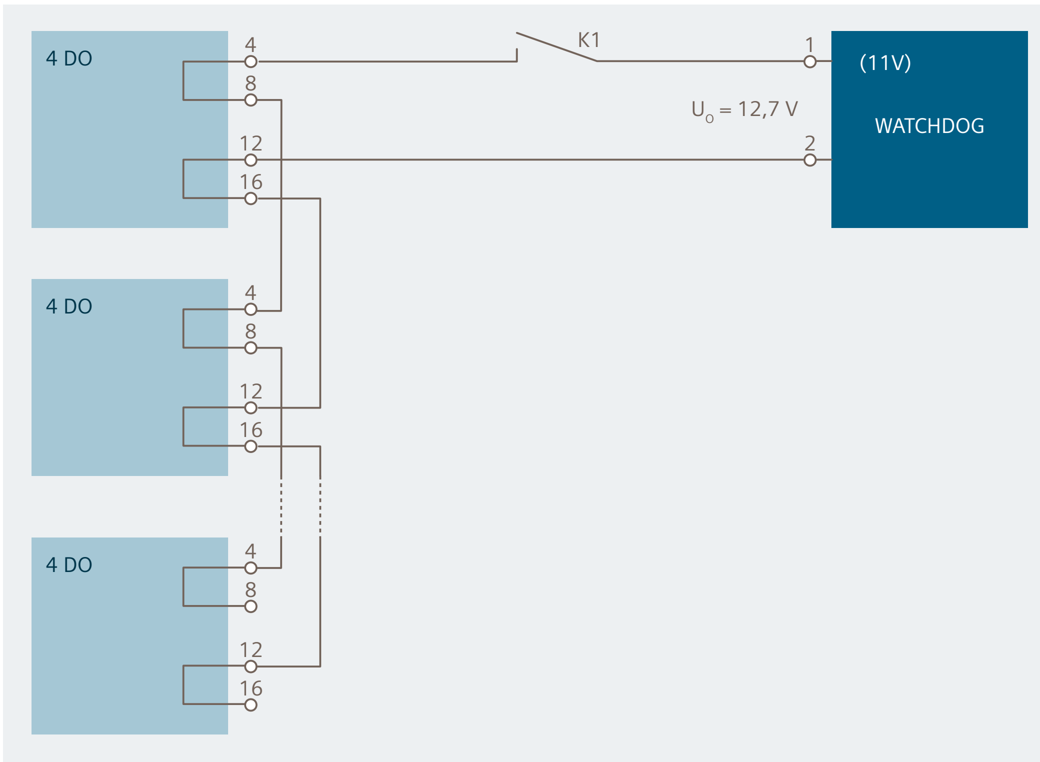


Figure 13-8 Actuator disconnection with 11 V supply from the WATCHDOG module

Note

Only safety barriers with equipotential bonding are permitted!

Connect the safety barrier and the (last) digital output module controlled by the switching signal securely to the equipotential bonding. With this wiring, all the chassis grounds of the outputs are connected to the equipotential bonding.

See also

Pulling and plugging electronic modules during operation (hot swapping) (Page 227)

PROFIBUS interface module IM 152-1DP (Page 283)

13.3 Digital electronic module 2 DO Relay UC60V/2A

Article number

6ES7132-7HB00-0AB0

Properties

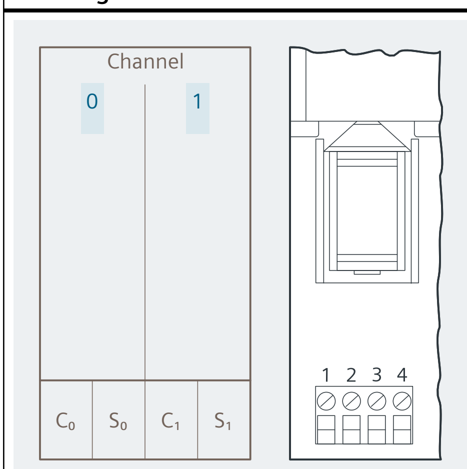
- Digital electronics module with two relay outputs
- For the PROFINET IO configuration: Only pluggable on the termination module TM-RM/RM, i.e. in the normal configuration of the ET 200iSP, thus usable from slot 3 and in the redundant configuration from slot 2. This configuration is checked by STEP 7.
- For the PROFIBUS DP configuration: Only pluggable on the terminal module TM-RM/RM, i.e. in the normal configuration of the ET 200iSP, thus usable from slot 5 and in the redundant configuration from slot 4. This configuration is checked by STEP 7.
- Output current 2 A per output
- Substitute value
- Suitable for solenoid valves, DC contactors, and indicator lights
- Isolated from the supply voltage
- NO contact

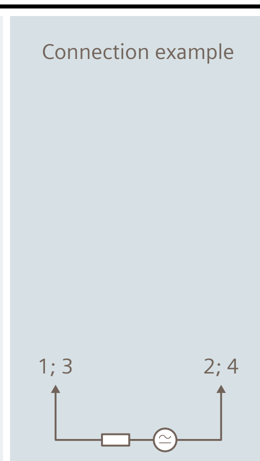
Note

If you connect an extra-low voltage (SELV/PELV) to one channel of the relay module, then you may also only use an extra-low voltage (SELV/PELV) on the other channel.

Pin assignment of actuators

Table 13-11 Pin assignment of actuators

<table>
<tr><th>Pin assignment and view</th><th>Remarks</th></tr>
<tr><td>


</td><td>Actuator terminals:
Channel 0: Terminals 1 and 2
Channel 1: Terminals 3 and 4

C_n: Common 0, 1
NO_n: NO contact 0, 1</td></tr>
</table>

Block diagram

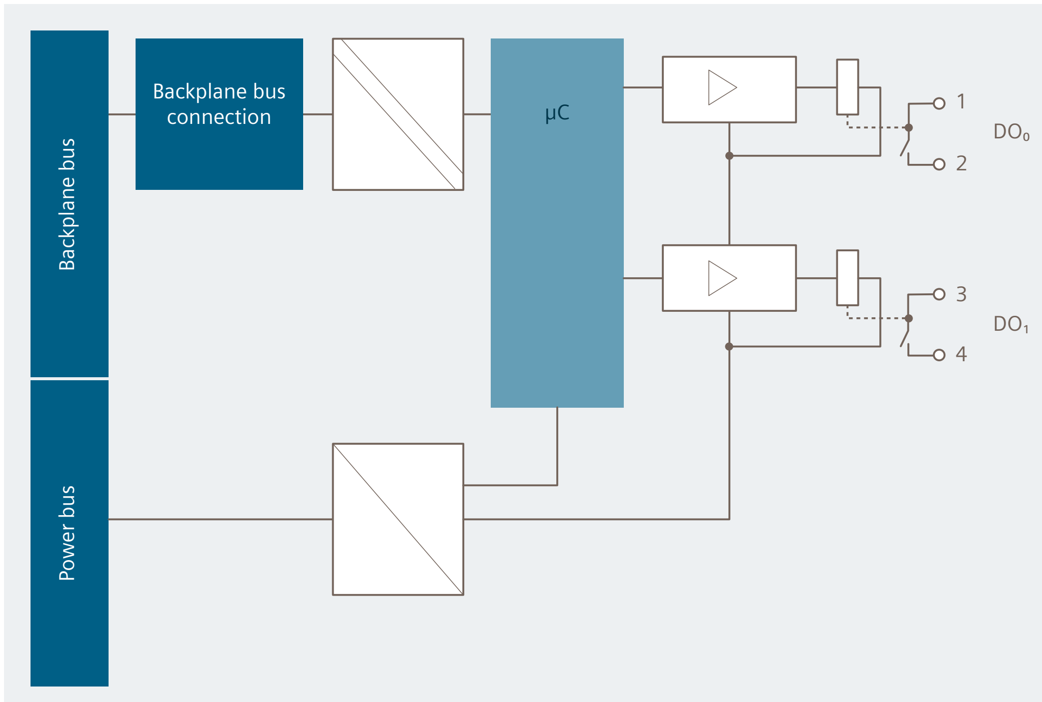


Figure 13-9   Block diagram of the 2 DO Relay UC60V/2A

Technical specifications

Article number	6ES7132-7HB00-0AB0
General information	
Product type designation	2DQ relay 60 V UC/2 A
Input current	
Current consumption, typ.	100 mA
from load voltage L+ (without load), max.	120 mA
Power loss	
Power loss, typ.	1.1 W
Digital outputs	
Type of digital output	Relays
Number of digital outputs	2
Short-circuit protection	No
Output current	
• for signal "1" rated value	2 A
Output delay with resistive load	
• "0" to "1", max.	8 ms
• "1" to "0", max.	3 ms
Parallel switching of two outputs	
• for uprating	No
• for redundant control of a load	No
Switching frequency	
• with resistive load, max.	0.5 Hz; See data in manual
• with inductive load, max.	0.2 Hz; See data in manual
Relay outputs	
Switching capacity of contacts	
– with resistive load, up to 60 °C, max.	2 A; See data in manual
– Thermal continuous current, max.	2 A; See data in manual
Cable length	
• shielded, max.	500 m
• unshielded, max.	500 m
Interrupts/diagnostics/status information	
Substitute values connectable	Yes
Alarms	
• Diagnostic alarm	Yes
• Hardware interrupt	No
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	No; Cannot be determined in contact power circuit
• Short-circuit	No; Cannot be determined in contact power circuit
Diagnostics indication LED	
• Group error SF (red)	Yes
• Status indicator digital output (green)	Yes; Per channel

Article number	6ES7132-7HB00-0AB0
Ex(i) characteristics	
maximum values for connecting terminals for gas group IIC	
• Uo (no-load voltage), max.	60 V
• Um (voltage at non-intrinsically safe connecting terminals), max.	250 V
Potential separation	
Potential separation digital outputs	
• between the channels	Yes
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes; Channels and power bus
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	255 g

Technical specifications	
Module-specific data	
Voltages, currents, electrical potentials	
Permissible potential difference	
• between different circuits	DC 60 V
Current consumption from load voltage (power bus)	max. 105 mA
Status, interrupts, diagnostics	
Status display	
• Outputs	Green LED for each channel
Diagnostic functions	
• Group error display	Red "SF" LED
Safety data	
U_m = DC 250 V / AC 250 V For additional information, see certificate IECEx KEM 07.0059 https://www.iecex.com (https://www.iecex.com) KEMA 07 ATEX0180 INMETRO UL-BR 12.0078 https://support.industry.siemens.com (https://support.industry.siemens.com)	
Output delay (resistive load)	

Technical specifications	
• for "0" to "1" *	7 ms
• for "1" to "0" **	3 ms
Wiring two outputs in parallel	No
Switching frequency	
• with resistive load	100 Hz
• with inductive load	2 Hz
* Response time of the relay ** Release time of the relay	

Approvals

ATEX	Ex		II 2 G(1) GD and I M2 Ex eb ib mb IIC T4 Gb Ex eb ib mb I Mb KEMA 07 ATEX 0180	CE 0344
IECEx			IECEx KEM 07.0059	
INMETRO	INMETRO	UL BR OCP-0029	BR-Ex eb ib mb IIC T4 Gb; BR-Ex eb ib mb I Mb	
FM	C FM US APPROVED		Class I, Zone 1, AEx eb ib mb IIC T4; Ex eb ib mb IIC T4 NI, Class I, DIV. 2, GP A,B,C,D T4 Class II, III, GP E, F, G	
cULus	c UL us LISTED E334384		Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx eb ib mb IIC T4; Ex eb ib mb IIC T4 Class I, DIV. 2, GP. A,B,C,D T4	
CCC	CCC		Ex e ib mb IIC T4 Gb	
UKCA	UK CA		DEKRA 21UKEX0025	

Switching capacity and service life of contacts

With an external protective circuit, the contacts will last longer than specified in the following table.

The normally open contacts of the relay have a different service life. The table shows the switching capacity and service life of the contacts.

Table 13-12 Switching capacity and service life of contacts

Resistive load	Voltage	Current	Operation examples (typical) NO contact
for resistive load	24 V DC	2.0 A	0.5 million
		1.0 A	1.6 million
		0.5 A	4 million
		0.1 A	7 million
	60 V DC	0.5 A	1.6 million
	60 V AC	2.0 A	1.2 million
		1.0 A	2.4 million
		0.5 A	4 million
With an inductive load in accordance with IEC 947-5-1 13DC/ 15AC	24 V DC	2.0 A	0.01 million
		1.0 A	0.2 million
		0.5 A	0.6 million
	60 V DC	0.5 A	0.3 million
	60 V AC	2.0 A	0.3 million
		1.0 A	0.5 million
		0.5 A	1 million
According to UL 508	60 V DC	C150 (max. 0.5 A)	0.06 million
		R150 (max. 0.5 A)	0.06 million
	60 V AC	C150 (max. 2.0 A)	0.06 million
		R150	0.06 million

Table 13-13 Permissible switching frequency for max. 1000 switching operations

Resistive load	Voltage	Current (max.)	Switching frequency (max.)
for resistive load, inductive load up to L/R = 10 ms	24 V DC	2.0 A	1 Hz
		1.0 A	1 Hz
	60 V DC	0.5 A	1 Hz
	60 V AC	2.0 A	0.5 Hz
		1.0 A	1 Hz
With an inductive load in accordance with IEC 947-5-1 13DC/ 15AC	24 V DC	2.0 A	0.2 Hz
		1.0 A	0.5 Hz
	60 V DC	0.5 A	0.5 Hz
	60 V AC	2.0 A	0.2 Hz
		1.0 A	0.5 Hz

Note

The supplied voltage at the relay outputs must be protected with a circuit breaker 6 A and tripping characteristic C.

13.4 Identification and maintenance functions (I&M)

Description

See section "Identification and maintenance data I&M (Page 77)".

13.5 Parameters of the digital electronic modules

13.5.1 Digital electronic module 8 DI NAMUR

Configuration with STEP 7 as of V5.3 SP1 and current hardware update

For description, see online help STEP 7.

Configuration with GSD file

For the digital electronic module 8 DI NAMUR there are different configurations that you can select via the following entries in the hardware catalog of the configuration software:

- Configuration "8 DI NAMUR": 8 digital inputs
- Configuration "2 Count/ 6 DI NAMUR": 2 counters and 6 digital inputs
- Configuration "2 Count/ 6 Control": 2 counters and 6 control signals
- Configuration "2 Trace/ 6 DI NAMUR": 2 frequency meters and 6 digital inputs

Parameters 8 DI NAMUR, configuration "8 DI NAMUR"

Table 13-14 Parameters for "8 DI NAMUR"

Parameters	Range of values	Default	Applicability
Time stamping[1]	• Enabled • Disabled	Disabled	Channel
Edge evaluation of incoming event[1]	• Rising edge (0-->1) • Falling edge (1-->0)	Rising edge (0-->1)	Channel

Parameters	Range of values	Default	Applicability
Sensor type	• Channel disabled • NAMUR sensor • Single contact unconnected • Single contact connected with 10 kΩ • NAMUR change-over contact • Change-over contact, unconnected • Change-over contact connected with 10 kΩ	NAMUR sensor	Channel
Pulse stretching	• None • 0.5 s • 1 s • 2 s	None	Channel
Group diagnostics	• Enabled • Disabled	Enabled	Channel
Diagnostics: wire break	• Enabled • Disabled	Enabled	Channel
Diagnostics: short-circuit	• Enabled • Disabled	Enabled	Channel
Diagnostics: flutter error	• Enabled • Disabled	Disabled	Channel
External error (changeover contact error or encoder supply faulty)	• Enabled • Disabled	Disabled	Channel
Flutter monitoring: Monitoring window[2]	• 0.5 s • 1 s to 100 s (adjustable in 1 s steps)	2 s	Channel
Flutter monitoring: Number of signal changes[2]	2 to 31	5	Channel

[1] Configurable only in HW Config and when you operate the ET 200iSP as an S7 DP device. Time stamping is only allowed for IM 152-1DP.

[2] The parameter can only be set if the chatter error diagnostics has been enabled.

Parameters 8 DI NAMUR, configuration "2 Count/ 6 DI NAMUR" and "2 Count/ 6 Control"

In addition to the configuration "8 DI NAMUR", the following parameters can be set for counting:

Table 13-15 Parameters for "2 Count/ 6 DI NAMUR" and "2 Count/ 6 Control"

Parameters	Range of values	Default	Applicability
Encoder type counter inputs	• Channel disabled • NAMUR sensor • Single contact unconnected	NAMUR sensor	Channel
Counter 1 mode	• Standard counting function • Periodic counting function • Cascaded counting function	Standard counting function	Channel 0
Counter 2 mode	• Standard counting function • Periodic counting function	Standard counting function	Channel 1

Parameters 8 DI NAMUR, configuration "2 Count/ 6 Control"

In addition to the configuration "8 DI NAMUR", the following parameters can be set for counting:

Table 13-16 Parameters for "2 Count/ 6 Control"

Parameters	Range of values	Default	Applicability
Control channel	• Channel disabled • NAMUR sensor • Single contact unconnected	NAMUR sensor	Channel

Parameters 8 DI NAMUR, configuration "2 Trace/ 6 DI NAMUR"

In addition to the configuration "8 DI NAMUR", the following parameters can be set when measuring frequencies:

Table 13-17 Parameters for "2 Trace/ 6 DI NAMUR"

Parameters	Range of values	Default	Applicability
Encoder type frequency inputs	• Channel disabled • NAMUR sensor • Single contact unconnected	NAMUR sensor	Channel
Measuring window (TOR)	• 50 ms • 200 ms • 1 s	1 s	Channel

13.5.2 Digital electronic module 4 DO

Parameters 4 DO

Table 13-18 Parameters for 4 DO

Parameters: shut down "H" modules	Parameters: shut down "L" modules	Range of values	Default	Applicability
Parallel connection of channels[1]		• Yes • No	No	Channel 0 Channel 2
Response to CPU/ master STOP		• Use substitute value • Keep last value	Use substitute value	Channel
Substitute value		• 0 • 1	0	Channel
Group diagnostics		• Enabled • Disabled	Enabled	Channel
Diagnostics, Wire break[2]		• Enabled • Disabled	Enabled	Channel
Diagnostics: wire break		• Enabled • Disabled	Enabled	Channel
---	Disable shutdown signal[3]	• Enabled • Disabled	Disabled	Module

[1] Not possible with 4 DO DC23.1V/20mA.
[2] The wire break is detected in the digital output module only with "1" signal.
[3] Only possible with SIMATIC PDM and in HW Config with "*" after the article number.

> **DANGER**
>
> **Substitute values in Flash memory**
>
> The substitute values are stored in the flash memory of the interface module. These are output at the next startup of the ET 200iSP until the ET 200iSP exchanges data with the DP master.
>
> Note this behavior when changing the ET 200iSP to another configuration environment.
>
> Remedy: Delete the flash memory of the interface module beforehand.

13.5.3 Digital electronic module 2 DO Relay UC60V/2A

Parameters 2 DO Relay UC60V/2A

Table 13-19 Parameters for 2 DO Relay UC60V/2A

Parameters	Range of values	Default	Applicability
Response to CPU/ master STOP	• Use substitute value • Keep last value	Use substitute value	Channel
Substitute value	• 0 • 1	0	Channel

13.6 Description of the parameters of the digital electronic modules

13.6.1 Time stamping

Description

With this parameter you can enable time stamping channel by channel for each digital input of the module. The time stamps are passed on from the ET 200iSP to the S7-400 or to the OS if you also enable the "Time stamping" parameter in the IM 152-1DP.

Time stamping is only allowed for IM 152-1DP. Time stamping is not supported for IM 152-1PN.

13.6.2 Pulse stretching

Description

Pulse extension is a function for changing a digital input signal. A pulse at a digital input is extended to at least the configured length. If the input pulse is already longer than the configured length, then the pulse will not be changed.

Principle of pulse stretching

The following figure uses examples to show if and how input pulses are changed.

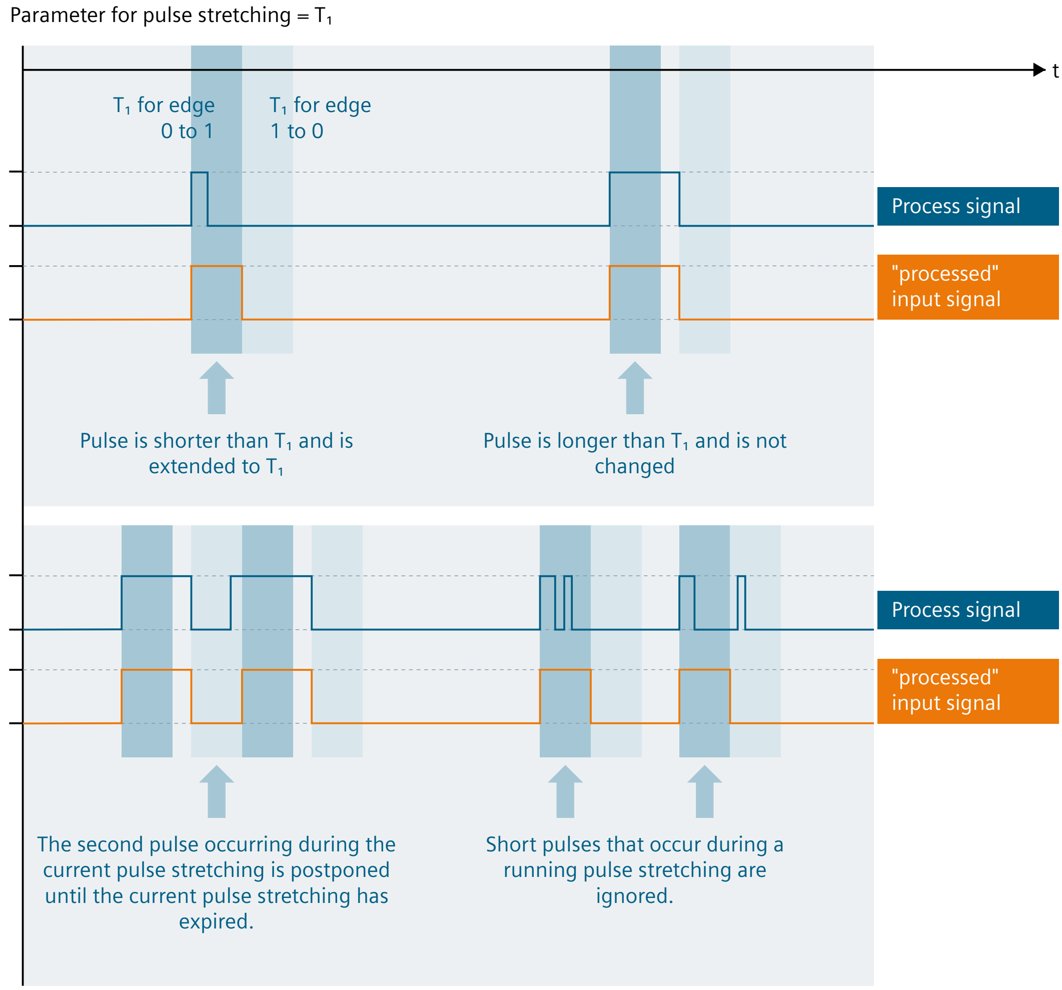


Figure 13-10 Principle of pulse stretching

Note

If you set a pulse extension for an input channel, this will also affect the flutter monitoring that you enabled for this channel. The "pulse-extended" signal is the input signal for the flutter monitoring. You should therefore match the parameter settings for pulse extension, and flutter monitoring to one another. By selecting the appropriate values for the parameters you can adjust the functions optimally to your process.

13.6.3 Flutter monitoring

Description

Flutter monitoring is a process control function for digital input signals. It detects and reports signal characteristics unusual in process engineering, e.g. too frequent fluctuation of the input signal between "0" and "1". If signal characteristics like these occur, it is a sign that the sensors are faulty or that there are instabilities from a process engineering viewpoint.

Activation of chatter monitoring

You activate the chatter monitoring by setting the number of signal changes for the chatter monitoring to a value which is not "zero".

Recognizing unusual signal patterns:

Each input channel has a monitoring window that has been assigned parameters. The monitoring window is started the first time upon a signal change of the input signal.

The number of signal changes is monitored in the monitoring window. The reaction of the system depends on whether the configured number of signal changes is reached within the monitoring window:

- Number of signal changes is **not reached**.
  With the next signal change the monitoring window is restarted.
- Number of signal changes is **reached**.
  The event is recognized as chatter error.

Reporting a chatter error

If a chatter error is detected, the following occurs:

- The current signal state is entered into the process image.
- The value status of the signal is set to "invalid".
- The "Chatter error" diagnostic information is entered and an incoming diagnostic interrupt is triggered.

The value status and the diagnostic information must be evaluated and processed in the user program.

Resetting a chatter error

If no chatter error was detected within the triple monitoring window, the diagnostic entry is removed and an outgoing diagnostic interrupt is triggered. The value state of the current signal in the process image is set to "valid".

Principle

The following figure graphically illustrates the principle of chatter monitoring.

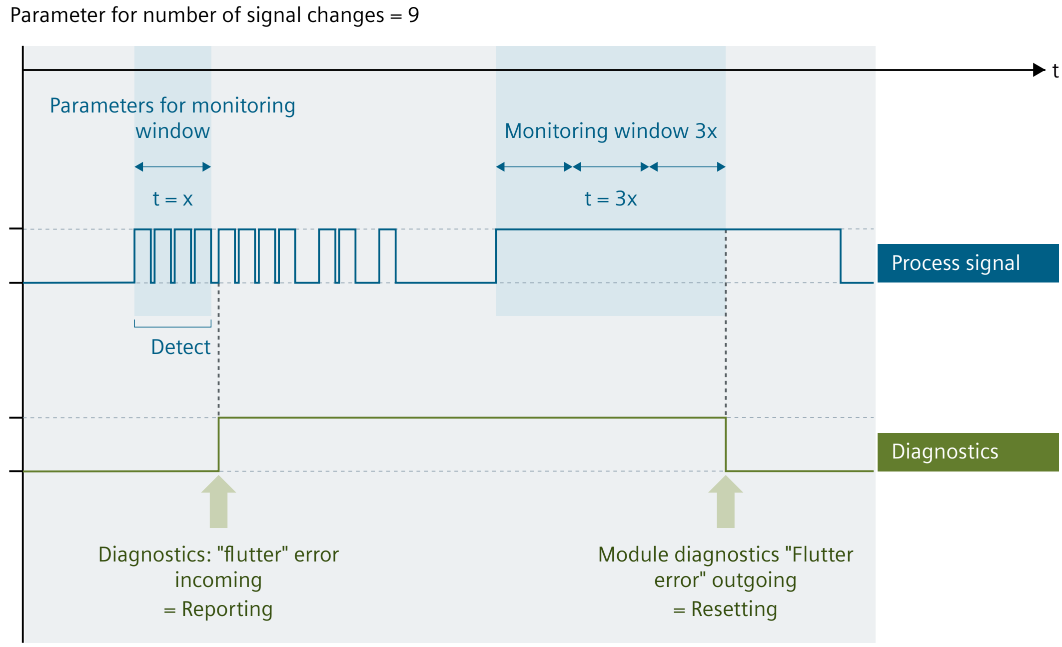


Figure 13-11 The principle of chatter monitoring

13.6.4 Shutdown signal

Parameter description: Shutdown signal

The parameter **Shutdown signal** can only be set for the shut down "L" output modules.

Enable shutdown signal: You have connected a shutdown signal.

Shutdown signal disabled: You have no shutdown signal connected.

13.6.5 Parameters for counting

Description

See section "Counting (Page 91)"

13.6.6 Parameters for metering frequencies

Description

Refer to the Chapter "Measuring frequency (Page 97)".

14 Analog electronic modules

14.1 Behavior of the analog modules during operation and in the event of problems

Influence of the supply voltage and the operating state

The input and output values of the analog modules depend on the supply voltage for electronics/encoder and on the operating state of the PLC (CPU of the DP master).

Table 14-1 Dependencies of the analog input/output values on the operating state of the PLC (CPU of the DP master) and the supply voltage L +.

Operating state of the PLC (CPU of the DP master)		**Supply voltage L + on ET 200iSP (power supply module)**	**Input value of the electronic module with analog inputs (evaluation in CPU of the DP master possible).**	**Output value of the electronic module with analog outputs**
			S7 format	
POWER ON	RUN	L + available	Process values	PLC values
			$7FFF_H$ until the 1st conversion is completed after switching on or after the parameter assignment of the module.	Only to 1st value output: • after switching on, a signal of 0 V is output. • depending on the parameter "CPU/Master STOP".
POWER ON	STOP	L + available	Process value	depending on the parameter "CPU/Master STOP".
		L + missing	$7FFF_H$	-

Influence of the value range for the analog input

The behavior of the electronic modules with analog inputs depends on the part of the value range in which the input values lie. The following table shows this dependency.

Table 14-2 Behavior of the analog modules depending on the position of the analog input value in the value range

Measured value in the	input value in SIMATIC S7 format
Nominal range	Measured value
Overrange/underrange	Measured value
Overflow	$7FFF_H$
Underflow	8000_H
Until valid measured values are available	$7FFF_H$

Influence of the value range for the analog output

The behavior of the electronic modules with analog outputs depends on the part of the value range in which the output values lie. The following table shows this dependency.

Table 14-3 Behavior of the analog modules depending on the position of the analog output value in the value range

Measured value in the	Output value in SIMATIC S7 format
Nominal range	Value from DP master
Overrange/underrange	Value from DP master
Overflow	0 signal
Underflow	0 signal
of parameter assignment	0 signal

14.2 Analog electronics module 4 AI I 2WIRE HART

Article number

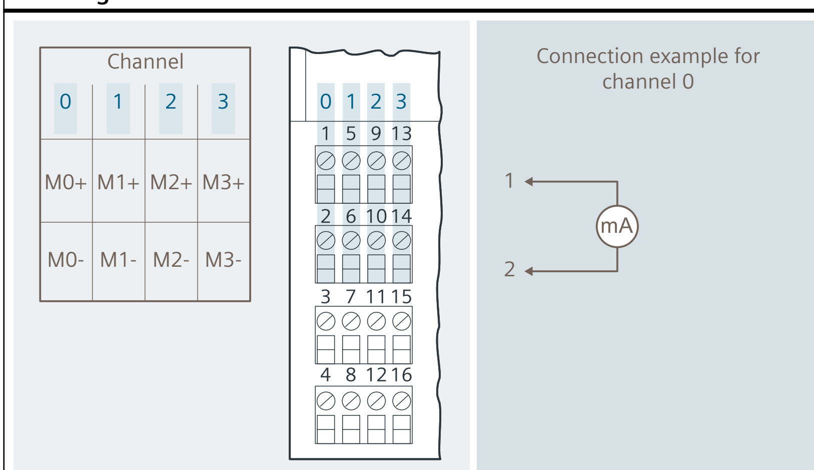
6ES7134-7TD00-0AB0

Properties

- 4 inputs for connecting HART field devices, 2-wire transmitters (standard applications)
- Configurable input range: HART, 4 to 20 mA
- Resolution 12 bits + sign

Pin assignment

Table 14-4 Pin assignment of the 4 AI I 2WIRE HART

<table>
<tr><th>Pin assignment and view</th><th>Remarks</th></tr>
<tr><td>
</td><td>2-wire transmitter 1
Channel 0: Terminals 1 and 2
2-wire transmitter 2
Channel 1: Terminals 5 and 6
2-wire transmitter 3
Channel 2: Terminals 9 and 10
2-wire transmitter 4
Channel 3: Terminals 13 and 14
M+: Input signal "+"
M-: Input signal "-"
The 2-wire transmitters are supplied over the measurement leads.</td></tr>
</table>

Block diagram

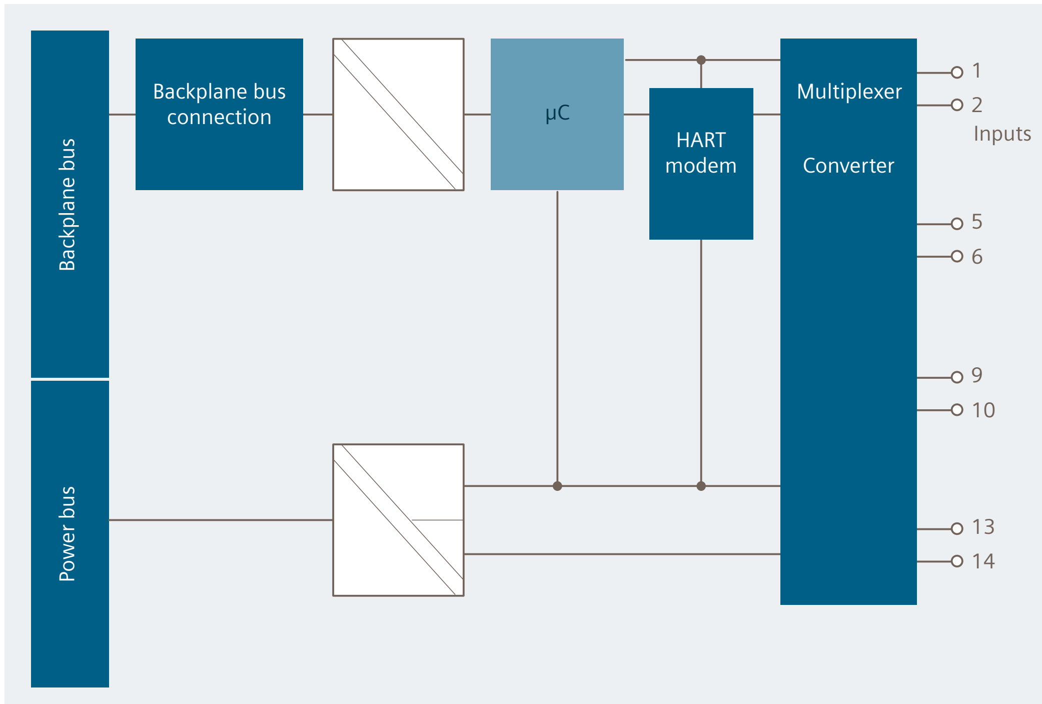


Figure 14-1 Block diagram of the 4 AI I 2WIRE HART

Technical specifications

Article number	6ES7134-7TD00-0AB0
General information	
Product type designation	4AI I 2WIRE HART
Input current	
Current consumption, typ.	280 mA
from supply voltage L+, max.	320 mA
output voltage / header	
supply voltage of the transmitters / header	
• product feature / of the supply voltage for transmitters / short-circuit proof	Yes
• supply current / from supply voltage for transmitter / maximum	23 mA; per channel
Power loss	
Power loss, typ.	2.7 W
Analog inputs	
Number of analog inputs	4
permissible input current for current input (destruction limit), max.	90 mA
Cycle time (all channels) max.	120 ms; 30 ms basic conversion time x4 channels with 60 Hz, 50 Hz interference frequency suppression
Technical unit for temperature measurement adjustable	Yes
Input ranges (rated values), currents	
• 4 mA to 20 mA	Yes
Cable length	
• shielded, max.	500 m
Analog value generation for the inputs	
Measurement principle	integrating (Sigma-Delta)
Integration and conversion time/resolution per channel	
• Resolution with overrange (bit including sign), max.	13 bit
• Integration time, parameterizable	No
• Interference voltage suppression for interference frequency f1 in Hz	50 / 60 Hz
Smoothing of measured values	
• parameterizable	Yes; in 4 stages
• Step: None	Yes; 1x cycle time
• Step: low	Yes; 4x cycle time
• Step: Medium	Yes; 32x cycle time
• Step: High	Yes; 64x cycle time
Encoder	
Connection of signal encoders	

Article number	6ES7134-7TD00-0AB0
• for current measurement as 2-wire transducer	Yes
– Burden of 2-wire transmitter, max.	750 Ω
Errors/accuracies	
Linearity error (relative to input range), (+/-)	0.015 %
Temperature error (relative to input range), (+/-)	0.005 %/K
Crosstalk between the inputs, min.	-50 dB
Repeat accuracy in steady state at 25 °C (relative to input range), (+/-)	0.01 %
Operational error limit in overall temperature range	
• Current, relative to input range, (+/-)	0.15 %
Basic error limit (operational limit at 25 °C)	
• Current, relative to input range, (+/-)	0.1 %
Interference voltage suppression for f = n x (f1 +/- 1 %), f1 = interference frequency	
• Series mode interference (peak value of interference < rated value of input range), min.	70 dB
Interrupts/diagnostics/status information	
Alarms	
• Diagnostic alarm	Yes; Parameterizable
• Limit value alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes
• Short-circuit	Yes
Diagnostics indication LED	
• Group error SF (red)	Yes
Potential separation	
Potential separation analog inputs	
• between the channels	No
• between the channels and backplane bus	Yes
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• Performance level according to ISO 13849-1	none
• SIL acc. to IEC 61508	No
Use in hazardous areas	
• ATEX marking	II2 G (1) GD Ex ib[ia] IIC T4 and I M2 Ex ib[ia] I
• ATEX certificate	04 ATEX 1244
Dimensions	
Width	30 mm
Height	129 mm

Article number	6ES7134-7TD00-0AB0
Depth	136.5 mm
Weights	
Weight, approx.	230 g

Technical specifications	
Module-specific data	
Isochronous mode supported	No
Voltages, currents, electrical potentials	
Electrical isolation	
• Between channels and power bus	Yes
Formation of analog values	
Integration/conversion time/resolution (per channel)	
• Cycle time in ms	Number of active channels per module x basic conversion time
• Resolution (including overrange)	12 bits + sign
Status, interrupts, diagnostics	
Diagnostic functions	
• Group error display	Red "SF" LED
Monitoring for	
• Short-circuit	$I_{Load} > 25$ mA [2]
• Wire break	$I_{load} < 3.6$ mA
Safety information	
$U_o = 27.6$ V $I_o = 91$ mA $P_o = 0.63$ W $C_o = 83$ nF $L_o = 3$ mH For additional C_o / L_o combinations, see certificate IECEx KEM 05.0006 https://www.iecex.com (https://www.iecex.com) KEMA 04 ATEX1244 INMETRO UL-BR 12.0072 https://support.industry.siemens.com (https://support.industry.siemens.com)	
Data for selecting a sensor	
Input ranges (rated values) / input resistance	
• Current	4 to 20 mA
Permissible input current for current input (destruction limit)	90 mA
Connection of signal generators	supported
• for current measurement as 2-wire transmitter	supported

Technical specifications	
• Load of 2-wire transmitter	max. 750 Ω
[1] Time taken to reach 63 % of the jump value [2] Phase current is located in the current limitation. The current limitation starts at 25 mA. Short circuit when output load <100 Ω.	

Approvals

ATEX		II 2 G(1) GD and I M2 Ex ib [ia Ga] IIC T4 Gb Ex ib [ia IIIC Da] IIC T4 Gb Ex ib [ia] I Mb KEMA 04 ATEX 1244	0344
IECEx		IECEx KEM 05.0006	
INMETRO	INMETRO / BR OCP-0029	BR-Ex ib [ia Ga] IIC T4 Gb BR-Ex ib [ia IIIC Da] IIC T4 Gb BR-Ex ib [ia] I Mb	
FM		Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 NI, Class I, DIV. 2, GP A,B,C,D T4 AIS, Class I DIV. 1, GP. A,B,C,D Class II, III, GP. E,F,G	
cULus	LISTED E334384	Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 ASSOC APP. CL. I, DIV.2, GP. A,B,C,D PROVIDING INT. SAFE CIRCUITS FOR CL. I, GP. A,B,C,D; CL. II, III, GP. E,F,G	
CCC		Ex ib [ia Ga] IIC T4 Gb Ex ib [iaD] IIC T4 Gb	
UKCA		DEKRA 21UKEX0089	

14.3 Analog electronics module 4 AI I 4WIRE HART

Article number

6ES7134-7TD50-0AB0

Properties

- 4 inputs for connecting HART field devices, 4-wire transmitters (standard applications)
- Configurable input range: HART, 0 to 20 mA, 4 to 20 mA
- Resolution 12 bits + sign
- For external power supply of the HART field device, see the notes in the field device manual.

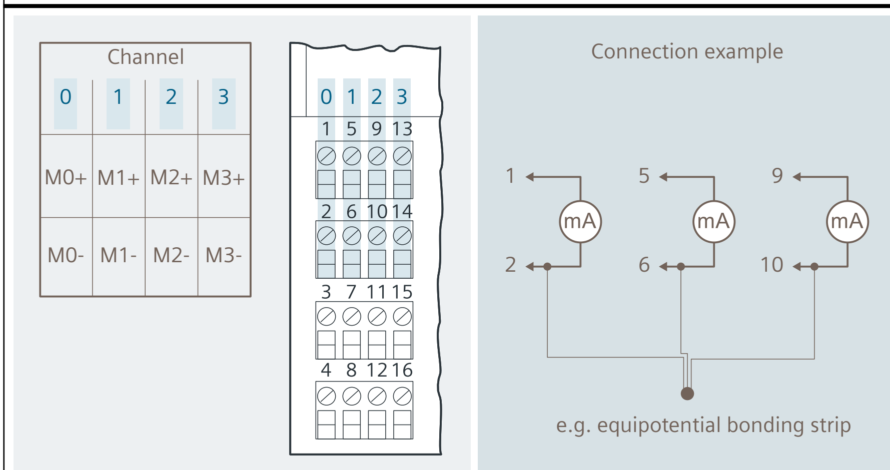
Note

If you connect up to four sensors to the electronic module, you must connect the "-" measuring connections of the sensors one below the other or connect each with equipotential bonding using wires. The wires must be arranged so that they are not liable to interrupted.

If you connect up to 2 sensors to channel 0 and channel 2 (channel 1 and 3 unconnected), no further measures are necessary.

Pin assignment

Table 14-5 Pin assignment of the 4 AI I 4WIRE HART

Pin assignment and view	Remarks
	**4-wire transmitter 1** Channel 0: Terminals 1 and 2 **4-wire transmitter 2** Channel 1: Terminals 5 and 6 **4-wire transmitter 3** Channel 2: Terminals 9 and 10 **4-wire transmitter 4** Channel 3: Terminals 13 and 14 M+: Input signal "+" M-: Input signal "-"

Block diagram

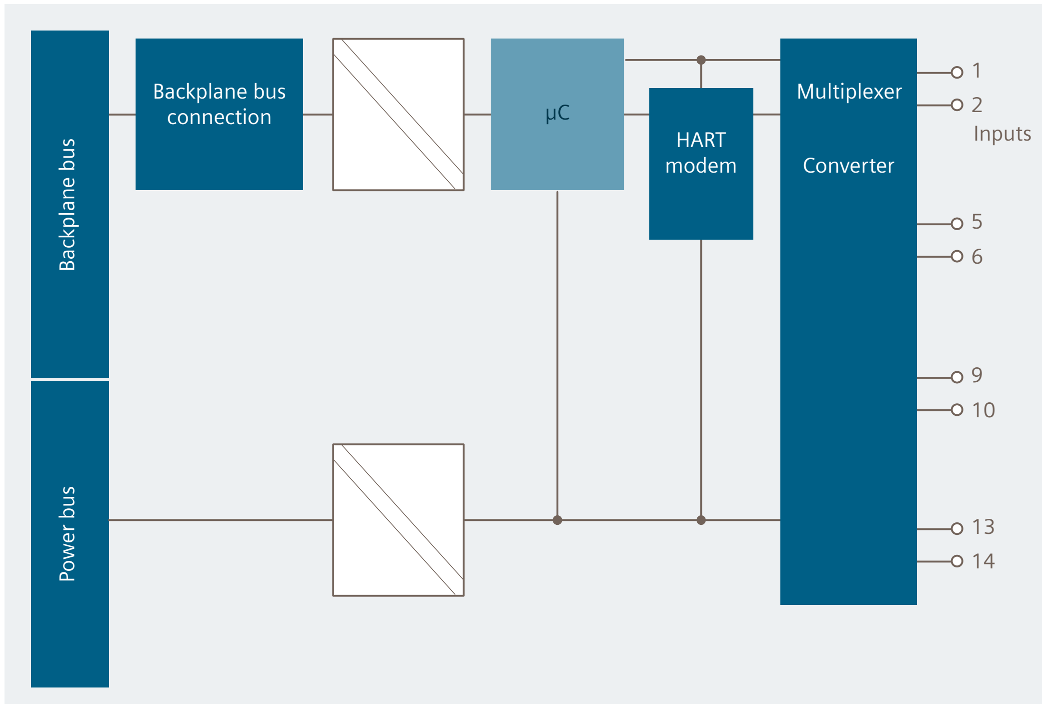


Figure 14-2 Block diagram of the 4 AI I 4WIRE HART

Technical specifications

Article number	6ES7134-7TD50-0AB0
General information	
Product type designation	4AI I 4WIRE HART
Input current	
Current consumption, typ.	27 mA
from supply voltage L+, max.	30 mA
Power loss	
Power loss, typ.	0.4 W
Analog inputs	
Number of analog inputs	4
permissible input current for current input (destruction limit), max.	50 mA
Cycle time (all channels) max.	120 ms; 30 ms basic conversion time x4 channels with 60 Hz, 50 Hz interference frequency suppression
Technical unit for temperature measurement adjustable	Yes
Input ranges (rated values), currents	
• 4 mA to 20 mA	Yes
– Input resistance (4 mA to 20 mA)	295 Ω
Cable length	
• shielded, max.	500 m
Analog value generation for the inputs	
Measurement principle	integrating (Sigma-Delta)
Integration and conversion time/resolution per channel	
• Resolution with overrange (bit including sign), max.	12 bit; + sign
• Integration time, parameterizable	Yes
• Basic conversion time, including integration time (ms)	30 ms
• Interference voltage suppression for interference frequency f1 in Hz	50 / 60 Hz
Smoothing of measured values	
• parameterizable	Yes; in 4 stages
• Step: None	Yes; 1x cycle time
• Step: low	Yes; 4x cycle time
• Step: Medium	Yes; 32x cycle time
• Step: High	Yes; 64x cycle time
Encoder	
Connection of signal encoders	
• for current measurement as 4-wire transducer	Yes
Errors/accuracies	

Article number	6ES7134-7TD50-0AB0
Linearity error (relative to input range), (+/-)	0.015 %
Temperature error (relative to input range), (+/-)	0.005 %/K
Crosstalk between the inputs, min.	-50 dB
Repeat accuracy in steady state at 25 °C (relative to input range), (+/-)	0.01 %
Operational error limit in overall temperature range	
• Current, relative to input range, (+/-)	0.15 %
Basic error limit (operational limit at 25 °C)	
• Current, relative to input range, (+/-)	0.1 %
Interference voltage suppression for f = n x (f1 +/- 1 %), f1 = interference frequency	
• Series mode interference (peak value of interference < rated value of input range), min.	70 dB
Interrupts/diagnostics/status information	
Alarms	
• Diagnostic alarm	Yes; Parameterizable
• Limit value alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes
Diagnostics indication LED	
• Group error SF (red)	Yes
Potential separation	
Potential separation analog inputs	
• between the channels	No
• between the channels and backplane bus	Yes
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• Performance level according to ISO 13849-1	none
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	230 g

Technical specifications	
Module-specific data	
Isochronous mode supported	No

Technical specifications	
Voltages, currents, electrical potentials	
Transmitter power supply	No
Electrical isolation	
• Between channels and power bus	Yes
Formation of analog values	
• Cycle time in ms	Number of active channels per module x basic conversion time
Noise suppression, error limits	
Interference voltage suppression for f = n x (f1±1%), f1 = interference frequency	
• Series mode interference (peak value of disturbance < rated input range)	min 70 dB
Crosstalk between inputs	min. - 50 dB
Status, interrupts, diagnostics	
Diagnostic functions	
• Group error display	Red "SF" LED
Monitoring for	
• Wire break	I < 3.6 mA
Safety information	
U_o = 0.9 V I_o = 0.8 mA P_o = 0.2 W C_o = 1000 µF L_o = 1000 mH For additional C_o / L_o combinations, see certificate IECEx KEM 05.0007 https://www.iecex.com (https://www.iecex.com) KEMA 04 ATEX124587 INMETRO UL-BR 12.0074 https://support.industry.siemens.com (https://support.industry.siemens.com)	
Data for selecting a sensor	
Input ranges (rated values) / input resistance	
• Current	0 to 20 mA / 360 Ω to 20 mA 4 to 20 mA / 360 Ω at 20 mA
Permissible input current for current input (destruction limit)	50 mA
Connection of signal generators	supported
• for current measurement as 4-wire transmitter	supported
[1] Time taken to reach 63 % of the jump value	

Approvals

ATEX			II 2 G(1) GD and I M2 Ex ib [ia Ga] IIC T4 Gb Ex ib [ia IIIC Da] IIC T4 Gb Ex ib [ia] I Mb KEMA 04 ATEX 1245	CE 0344
IECEx			IECEx KEM 05.0007	
INMETRO	INMETRO	BR OCP-0029	BR-Ex ib [ia Ga] IIC T4 Gb BR-Ex ib [ia IIIC Da] IIC T4 Gb BR-Ex ib [ia] I Mb	
FM	FM C US APPROVED		Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 NI, Class I, DIV. 2, GP. A,B,C,D T4 AIS, Class I, DIV. 1, GP. A,B,C,D Class II, III, GP. E,F,G	
cULus	LISTED E334384		Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx ib [ia] IIC T4 Ex ib [ia] IIC T4 ASSOC APP. CL. I, DIV.2, GP. A,B,C,D PROVIDING INT. SAFE CIRCUITS FOR CL. I, GP. A,B,C,D; CL. II, III, GP. E,F,G	
CCC			Ex ib [ia Ga] IIC T4 Gb Ex ib [iaD] IIC T4 Gb	
UKCA	UK CA		DEKRA 21UKEX0090	

14.4 Analog electronics module 4 AI RTD

Article number

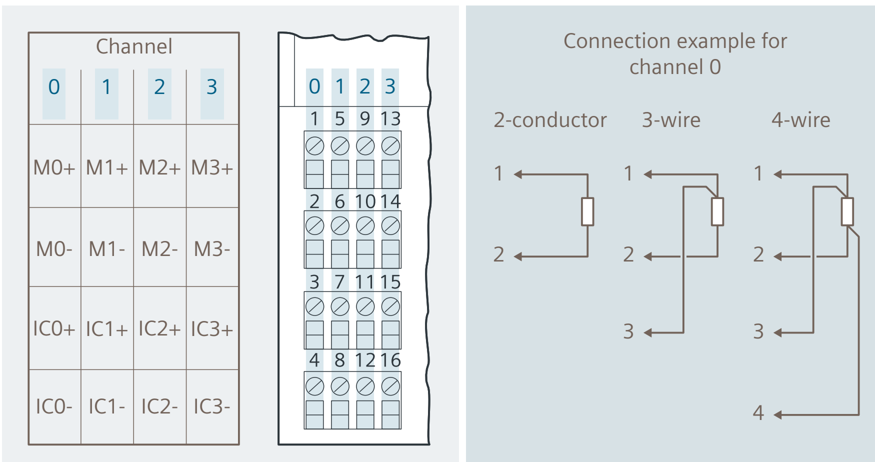
6ES7134-7SD51-0AB0

Properties

- 4 inputs for resistance thermometers or resistance measurement
- Input ranges:
  - Resistance thermometer: Pt 100; Ni 100
  - Resistance measurement: 600 Ω absolute and 1000 Ω absolute
- Resolution of 15 bits + sign

Pin assignment

Table 14-6   Pin assignment of the 4 AI RTD

<table>
<tr><th>Pin assignment and view</th><th>Remarks</th></tr>
<tr><td>
</td><td>Resistance thermometer 1
Channel 0: Terminals 1 to 4
Resistance thermometer 2
Channel 1: Terminals 5 to 8
Resistance thermometer 3
Channel 2: Terminals 9 to 12
Resistance thermometer 4
Channel 3: Terminals 13 to 16
M+: Measuring cable (positive)
M-: Measuring cable (negative)
I_C+: Constantcurrent cable (positive)
I_C-: Constant-current cable (negative)</td></tr>
</table>

Block diagram

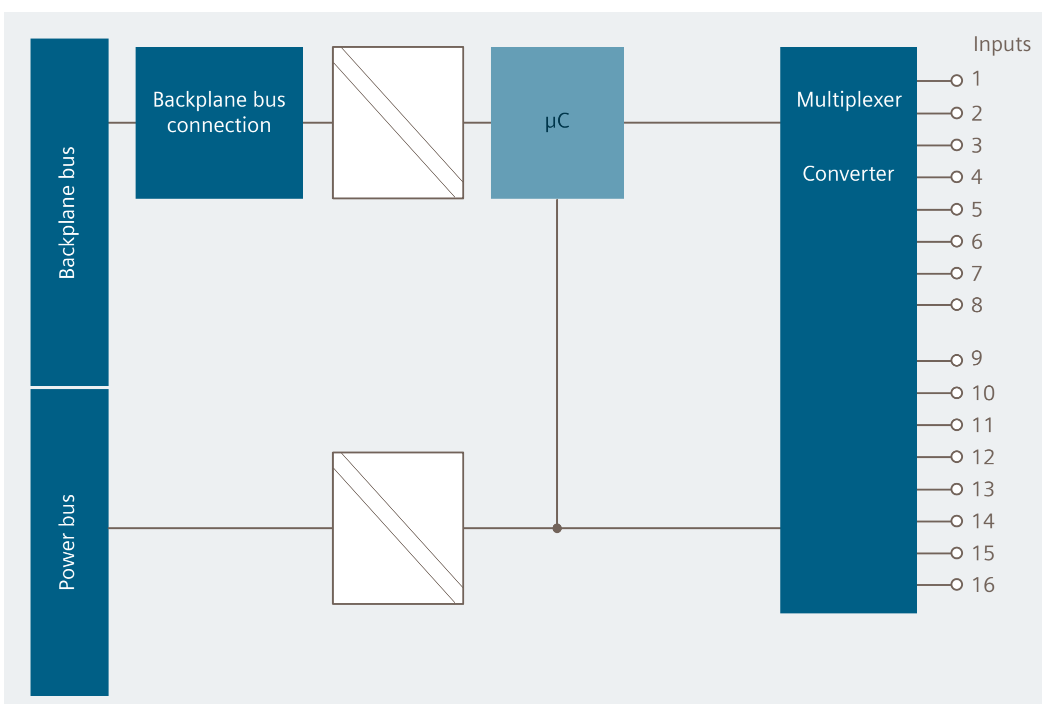


Figure 14-3   Block diagram of the 4 AI RTD

Technical specifications

Article number	6ES7134-7SD51-0AB0
General information	
Product type designation	4AI RTD
Input current	
Current consumption, typ.	19 mA
from supply voltage L+, max.	22 mA
Power loss	
Power loss, typ.	0.4 W
Analog inputs	
Number of analog inputs	4
Cycle time (all channels) max.	320 ms; 66 ms basic conversion time x 4 channels with interference frequency suppression 60 Hz, 80 ms basic conversion time x 4 channels with interference frequency suppression 50 Hz
Technical unit for temperature measurement adjustable	Yes
Input ranges (rated values), resistance thermometer	
• Ni 100	Yes
– Input resistance (Ni 100)	2 000 kΩ
• Pt 100	Yes
– Input resistance (Pt 100)	2 000 kΩ
Input ranges (rated values), resistors	
• 0 to 600 ohms	Yes; also 1 000 ohms
– Input resistance (0 to 600 ohms)	1 000 kΩ
Characteristic linearization	
• parameterizable	Yes
– for resistance thermometer	Yes
Cable length	
• shielded, max.	500 m
Analog value generation for the inputs	
Measurement principle	integrating (Sigma-Delta)
Integration and conversion time/resolution per channel	
• Resolution with overrange (bit including sign), max.	16 bit
• Integration time, parameterizable	Yes
• Basic conversion time, including integration time (ms)	80 ms at 50 Hz; 66 ms at 60 Hz
– additional conversion time for wire-break monitoring	5 ms
• Interference voltage suppression for interference frequency f1 in Hz	50 / 60 Hz
Smoothing of measured values	

Article number	6ES7134-7SD51-0AB0
• parameterizable	Yes; in 4 stages
• Step: None	Yes; 1x cycle time
• Step: low	Yes; 4x cycle time
• Step: Medium	Yes; 32x cycle time
• Step: High	Yes; 64x cycle time
Encoder	
Connection of signal encoders	
• for resistance measurement with two-wire connection	Yes
• for resistance measurement with three-wire connection	Yes
• for resistance measurement with four-wire connection	Yes
Errors/accuracies	
Linearity error (relative to input range), (+/-)	0.015 %
Temperature error (relative to input range), (+/-)	0.02 %/K
Crosstalk between the inputs, min.	-50 dB
Repeat accuracy in steady state at 25 °C (relative to input range), (+/-)	0.01 %
Operational error limit in overall temperature range	
• Resistance thermometer, relative to input range, (+/-)	0.15 %; Applies to resistances standard ±0.8 K, climatic ±0.3 K
Basic error limit (operational limit at 25 °C)	
• Resistance thermometer, relative to input range, (+/-)	0.1 %; Applies to resistances standard ±0.5 K, climatic ±0.2 K
Interference voltage suppression for f = n x (f1 +/- 1 %), f1 = interference frequency	
• Series mode interference (peak value of interference < rated value of input range), min.	70 dB
• Common mode interference, min.	90 dB
Interrupts/diagnostics/status information	
Alarms	
• Diagnostic alarm	Yes
• Limit value alarm	Yes
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes
• Short-circuit	Yes
• Group error	Yes
Diagnostics indication LED	
• Group error SF (red)	Yes
Potential separation	
Potential separation analog inputs	

Article number	6ES7134-7SD51-0AB0
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes; Channels and power bus
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• Performance level according to ISO 13849-1	none
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	230 g

Technical specifications	
Module-specific data	
Isochronous mode supported	No
Voltages, currents, electrical potentials	
Constant measuring current for resistive transducers	type 1 mA
Electrical isolation	
• Between channels and power bus	Yes
Formation of analog values	
• Additional conversion time for wire-break check	5
• Cycle time in ms	Number of active channels per module x basic conversion time
• Resolution (including overrange)	15 bits + sign
Noise suppression, error limits	
Interference voltage suppression for f = n x (f1±1%), f1 = interference frequency	
Crosstalk between inputs	min. - 50 dB
Operational limits (in the entire temperature range, relative to the input range)	
• Resistive sensor	± 0.15%
• Pt100, Ni100 standard	±0.8 K
• Pt100, Ni100 climate	±0.3 K
Basic error limit (operational limit at 25 °C, relative to the input range)	
• Resistive sensor	±0.1 %
• Pt100, Ni100 standard	±0.5 K
• Pt100, Ni100 climate	± 0.2 K
Temperature error (relative to the input range)	±0.02%/K

Technical specifications	
Linearity error (relative to the input range)	± 0.015%
Repeatability (in settled state at 25 °C, relative to input range)	± 0.01 %
Status, interrupts, diagnostics	
• Group error display	Red "SF" LED
Monitoring for	
• Wire break	R > 2 kΩ
Safety information	
U_o = 5.9 V I_o = 24 mA P_o = 36 mW C_o = 43 µF L_o = 50 mH For additional C_o / L_o combinations, see certificate IECEx KEM 05.0009 https://www.iecex.com (https://www.iecex.com) KEMA 04 ATEX1247 INMETRO UL-BR 12.0069 https://support.industry.siemens.com (https://support.industry.siemens.com)	
Data for selecting a sensor	
Input ranges (rated values) / input resistance	
• Resistance	600 Ω / 1000 Ω absolute / min 2 MΩ
• Resistance thermometer	Pt100 / min 2 MΩ; Ni100 / min 2 MΩ
Connection of signal generators	
• For resistance measurement / RTD 4-wire connection 3-wire connection[2] 2-wire connection	 supported supported supported
Characteristics linearization	Yes
• of resistance thermometers	
Technical unit of data formats	Can be set
[1] Time taken to reach 63 % of the jump value [2] With compensation of the connecting cables	

Approvals

ATEX			II 2 G(1) GD and I M2 Ex ib [ia Ga] IIC T4 Gb Ex ib [ia IIIC Da] IIC T4 Gb Ex ib [ia/] I Mb KEMA 04 ATEX 1247	0344
IECEx			IECEx KEM 05.0009	
INMETRO	INMETRO	BR OCP-0029	BR-Ex ib [ia Ga] IIC T4 Gb BR-Ex ib [ia IIIC Da] IIC T4 Gb BR-Ex ib [ia] I Mb	

FM		Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 NI, Class I, DIV. 2, GP. A,B,C,D T4 AIS, Class I, DIV. 1, GP. A,B,C,D Class II, III, GP. E,F,G
cULus	LISTED E334384	Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx ib [ia] IIC T4 Ex ib [ia] IIC T4 ASSOC APP. CL. I, DIV.2, GP. A,B,C,D PROVIDING INT. SAFE CIRCUITS FOR CL. I, GP. A,B,C,D; CL. II, III, GP. E,F,G
CCC		Ex ib [ia Ga] IIC T4 Gb Ex ib [iaD] IIC T4 Gb
UKCA		DEKRA 21UKEX0088

14.5 Analog electronics module 4 AI TC

Article number

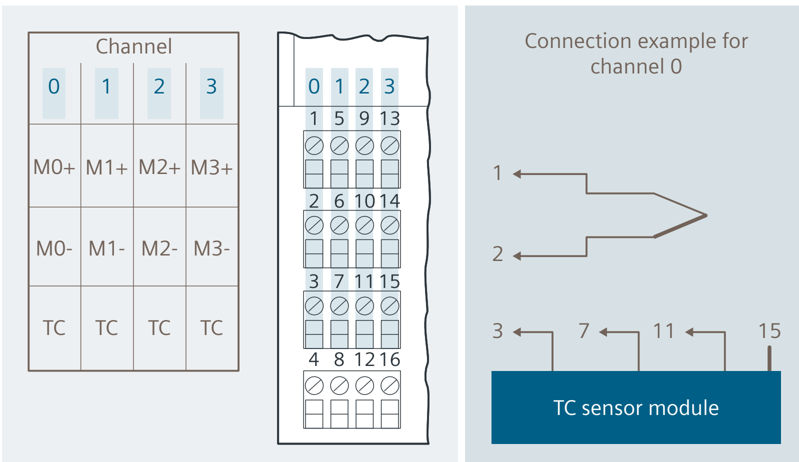
6ES7134-7SD00-0AB0

Properties

- 4 inputs for thermocouple or thermoelectrical voltage
- Input ranges
  - Thermo voltage measurement: ± 80 mV
  - Thermocouples: Type B, E, J, K, L, N, R, S, T, U
  - Functionally galvanically isolated, permissible common mode voltage 6.5 V DC, 30 V AC_{SS}
- Linearization of the sensor characteristic curves
- Resolution of 15 bits + sign
- Internal compensation of the reference junction temperature by means of TC sensor module (temperature sensor). The TC sensor module is included in the scope of delivery of the 4 AI TC. This is mounted on the terminal module of the 4 AI TC.

Pin assignment

Table 14-7 Pin assignment of the 4 AI TC

<table>
<tr><th>Pin assignment and view</th><th>Remarks</th></tr>
<tr><td>
</td><td>Thermocouple 1
Channel 0: Terminals 1 and 2
Thermocouple 2
Channel 1: Terminals 5 and 6
Thermocouple 3
Channel 2: Terminals 9 and 10
Thermocouple 4
Channel 3: Terminals 13 and 14
TC sensor module
Terminals 3, 7, 11, 15
M+: Measuring cable (positive)
M-: Measuring cable (negative)</td></tr>
</table>

Block diagram

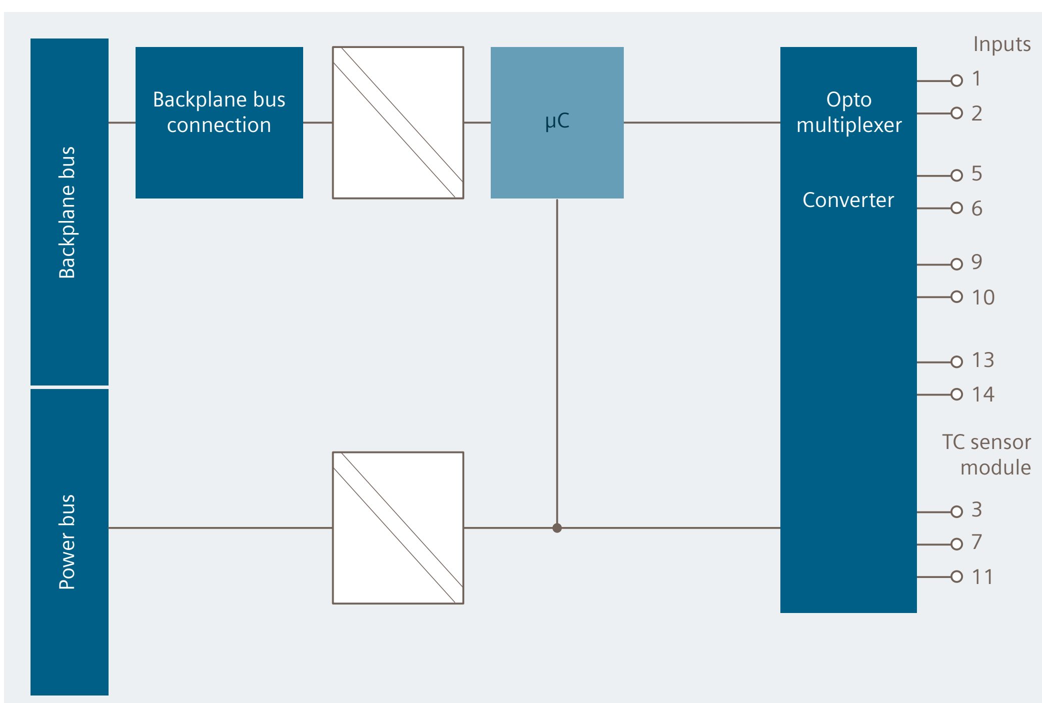


Figure 14-4 Block diagram of the 4 AI TC

Technical specifications

Article number	6ES7134-7SD00-0AB0
General information	
Product type designation	4AI TC
Input current	
Current consumption, typ.	17 mA
from supply voltage L+, max.	30 mA
Power loss	
Power loss, typ.	0.4 W
Analog inputs	
Number of analog inputs	4
Cycle time (all channels) max.	320 ms; 66 ms basic conversion time x 4 channels with interference frequency suppression 60 Hz, 80 ms basic conversion time x 4 channels with interference frequency suppression 50 Hz
Technical unit for temperature measurement adjustable	Yes
Input ranges (rated values), voltages	
• -80 mV to +80 mV	Yes
– Input resistance (-80 mV to +80 mV)	1 000 kΩ
Input ranges (rated values), thermocouples	
• Type B	Yes
– Input resistance (Type B)	1 000 kΩ
• Type C	Yes
– Input resistance (Type C)	1 000 kΩ
• Type E	Yes
– Input resistance (Type E)	1 000 kΩ
• Type J	Yes
– Input resistance (type J)	1 000 kΩ
• Type K	Yes
– Input resistance (Type K)	1 000 kΩ
• Type L	Yes
– Input resistance (Type L)	1 000 kΩ
• Type N	Yes
– Input resistance (Type N)	1 000 kΩ
• Type R	Yes
– Input resistance (Type R)	1 000 kΩ
• Type S	Yes
– Input resistance (Type S)	1 000 kΩ
• Type T	Yes
– Input resistance (Type T)	1 000 kΩ
• Type U	Yes
– Input resistance (Type U)	1 000 kΩ

Article number	6ES7134-7SD00-0AB0
Thermocouple (TC)	
Temperature compensation	
– internal temperature compensation	Yes; via supplied TC sensor module
– external temperature compensation with compensations socket	Yes; via temperature value, acquired by an analog module of the same ET 200iSP station
Characteristic linearization	
• parameterizable	Yes
– for thermocouples	Yes
Cable length	
• shielded, max.	50 m
Analog value generation for the inputs	
Measurement principle	integrating (Sigma-Delta)
Integration and conversion time/resolution per channel	
• Resolution with overrange (bit including sign), max.	16 bit
• Integration time, parameterizable	Yes
• Basic conversion time, including integration time (ms)	80 ms at 50 Hz; 66 ms at 60 Hz
– additional conversion time for wire-break monitoring	5 ms
• Interference voltage suppression for interference frequency f1 in Hz	50 / 60 Hz
Smoothing of measured values	
• parameterizable	Yes; in 4 stages
• Step: None	Yes; 1x cycle time
• Step: low	Yes; 4x cycle time
• Step: Medium	Yes; 32x cycle time
• Step: High	Yes; 64x cycle time
Errors/accuracies	
Linearity error (relative to input range), (+/-)	0.015 %
Temperature error (relative to input range), (+/-)	0.02 %/K
Crosstalk between the inputs, min.	-50 dB
Repeat accuracy in steady state at 25 °C (relative to input range), (+/-)	0.01 %
Operational error limit in overall temperature range	
• Voltage, relative to input range, (+/-)	0.15 %
Basic error limit (operational limit at 25 °C)	
• Voltage, relative to input range, (+/-)	0.1 %
Interference voltage suppression for f = n x (f1 +/- 1 %), f1 = interference frequency	
• Series mode interference (peak value of interference < rated value of input range), min.	70 dB

Article number	6ES7134-7SD00-0AB0
• Common mode interference, min.	90 dB
Interrupts/diagnostics/status information	
Alarms	
• Diagnostic alarm	Yes; Parameterizable
• Limit value alarm	Yes; Parameterizable
Diagnoses	
• Diagnostic information readable	Yes
Diagnostics indication LED	
• Group error SF (red)	Yes
Potential separation	
Potential separation analog inputs	
• between the channels	Yes; Functional
• between the channels and backplane bus	Yes
Standards, approvals, certificates	
CE mark	Yes
Highest safety class achievable in safety mode	
• Performance level according to ISO 13849-1	none
• SIL acc. to IEC 61508	No
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	230 g

Technical specifications	
Approvals	
Voltages, currents, electrical potentials	
Electrical isolation	
• Between channels and power bus	Yes
Formation of analog values	
Measuring principle	Integrating (sigma-delta)
Integration/conversion time/resolution (per channel)	
• Integration time can be configured	Yes
• Interference frequency suppression in Hz	60; 50
• Basic conversion time including integration time (per channel) in ms	66; 80
• Additional conversion time for wire-break check in ms	5
• Cycle time in ms	Number of active channels per module x basic conversion time
• Resolution (including overrange)	15 bits + sign

Technical specifications	
Noise suppression, error limits	
Operational limit (over the entire temperature range, relative to the input range)[2]	±1.5 K
Basic error limit (operational limit at 25 °C, relative to the input range)[2]	±1 K
Linearity error (relative to the input range)	± 0.015%
Repeatability (in settled state at 25 °C, relative to input range)	± 0.01 %
Limits of total error when using internal compensation with TC sensor module	
• Operational limit (in the entire temperature range at static thermal state, ambient temperature change < 10 K/hour).	±3.5 K
• Basic error limit (operational limit at 25 °C at static thermal state, ambient temperature change < 0,3 K/min)	±2 K
Status, interrupts, diagnostics	
• Group error display	Red "SF" LED
Monitoring for	
• Wire break	Yes, can be set R> 1.7 kΩ
• TC sensor module for internal temperature compensation	Yes
Safety information	
U_o = 5.9 V I_o = 15 mA P_o = 23 mW C_o = 43 µF L_o = 100 mH For additional C_o / L_o combinations, see certificate IECEx KEM 05.0008 https://www.iecex.com (https://www.iecex.com) KEMA 04 ATEX1246 INMETRO UL-BR 12.0071 https://support.industry.siemens.com (https://support.industry.siemens.com)	
[1] Time taken to reach 63 % of the jump value [2] The specified error limits apply as of the following temperatures: Thermocouple type T: -200 °C Thermocouple type B: +700 °C Thermocouple type N: -150 °C Thermocouple type E: -150 °C Thermocouple type R: +200 °C Thermocouple type S: +100 °C	
Data for selecting a sensor	
Input ranges (rated values) / input resistance	
• Thermoelectric voltage	±80 mV/ min. 1 MΩ

Technical specifications	
• Thermocouple	Type E, N, J, K, L, S, R, B, T, U/ min. 1 MΩ
Connection of signal generators	
• for thermal e.m.f. measurement	supported
Characteristic linearization	Yes
• Thermal e.m.f. measurement	Nominal range linear
• Thermocouple	Type E, N, J, K, L, S, R, B, T, U
Temperature compensation	
• Internal temperature compensation	possible via the TC sensor module supplied
• External temperature compensation	Possible via temperature value recorded at an analog module of the same ET 200iSP station.

Approvals

ATEX		II 2 G(1) GD and I M2 Ex ib [ia Ga] IIC T4 Gb Ex ib [ia IIIC Da] IIC T4 Gb Ex ib [ia/] I Mb KEMA 04 ATEX 1246 CE 0344
IECEx		IECEx KEM 05.0008
INMETRO	INMETRO; BR OCP-0029	BR-Ex ib [ia Ga] IIC T4 Gb BR-Ex ib [ia IIIC Da] IIC T4 Gb BR-Ex ib [ia] I Mb
FM	FM C US APPROVED	Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 NI, Class I, DIV. 2, GP. A,B,C,D T4 AIS, Class I, DIV. 1, GP. A,B,C,D Class II, III, GP. E,F,G
cULus	C UL US LISTED E334384	Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx ib [ia] IIC T4 Ex ib [ia] IIC T4 ASSOC APP. CL. I, DIV.2, GP. A,B,C,D PROVIDING INT. SAFE CIRCUITS FOR CL. I, GP. A,B,C,D; CL. II, III, GP. E,F,G
CCC		Ex ib [ia Ga] IIC T4 Gb Ex ib [iaD] IIC T4 Gb
UKCA	UK CA	DEKRA 21UKEX0086

14.6 Analog electronic module 4 AO I HART

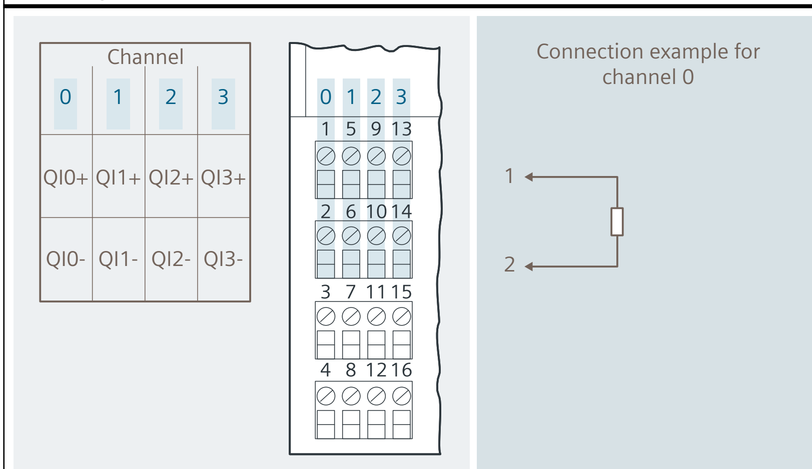
Article number

6ES7135-7TD00-0AB0

Properties

- 4 outputs for current output
- Output ranges (selectable)
  - HART
  - 4 to 20 mA
  - 0 to 20 mA
- Resolution 14 bits

Pin assignment

Pin assignment and view	Remarks
	**Actuator 1** Channel 0: Terminals 1 and 2 **Actuator 2** Channel 1: Terminals 5 and 6 **Actuator 3** Channel 2: Terminals 9 and 10 **Actuator 4** Channel 3: Terminals 13 and 14 QI: Output positive (analog output current) M: Ground

Block diagram

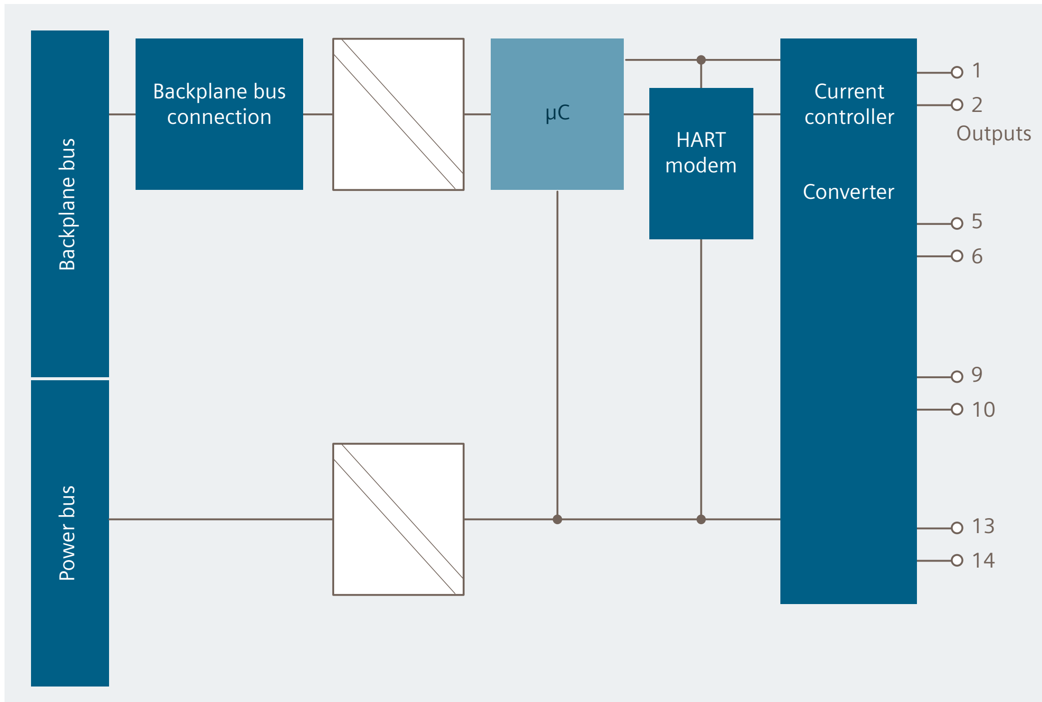


Figure 14-5 Block diagram of the 4 AO I HART

Technical specifications

Article number	6ES7135-7TD00-0AB0
General information	
Product type designation	4AQ I HART
Input current	
Current consumption, typ.	295 mA
from load voltage L+ (without load), max.	330 mA
Power loss	
Power loss, typ.	2.7 W
Analog outputs	
Number of analog outputs	4
Cycle time (all channels) max.	3.6 ms
Output ranges, current	
• 0 to 20 mA	Yes
• 4 mA to 20 mA	Yes
Connection of actuators	
• for current output two-wire connection	Yes
Load impedance (in rated range of output)	
• with current outputs, max.	750 Ω
Cable length	
• shielded, max.	500 m
Analog value generation for the outputs	
Integration and conversion time/resolution per channel	
• Resolution with overrange (bit including sign), max.	14 bit
Settling time	
• for resistive load	4 ms
• for capacitive load	40 ms
• for inductive load	40 ms
Errors/accuracies	
Linearity error (relative to output range), (+/-)	0.015 %
Temperature error (relative to output range), (+/-)	0.005 %/K
Crosstalk between the outputs, min.	-50 dB
Repeat accuracy in steady state at 25 °C (relative to output range), (+/-)	0.01 %
Operational error limit in overall temperature range	
• Current, relative to output range, (+/-)	0.15 %
Basic error limit (operational limit at 25 °C)	
• Current, relative to output range, (+/-)	0.1 %
Interrupts/diagnostics/status information	
Substitute values connectable	Yes

Article number	6ES7135-7TD00-0AB0
Alarms	
• Diagnostic alarm	Yes
Diagnoses	
• Diagnostic information readable	Yes
• Wire-break	Yes
• Short-circuit	Yes
Diagnostics indication LED	
• Group error SF (red)	Yes
Potential separation	
Potential separation analog outputs	
• between the channels	No
• between the channels and backplane bus	Yes
Standards, approvals, certificates	
CE mark	Yes
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	265 g

Technical specifications	
Voltages, currents, electrical potentials	
Electrical isolation	
• Between channels and power bus	Yes
Status, interrupts, diagnostics	
Interrupts	
• Diagnostic interrupt	Yes, can be set
Diagnostic functions	
• Group error display	Red "SF" LED
Monitoring for	
• Short-circuit	$I_{Load} > 1$ mA $R_{Load} < 30...60\ \Omega$
• Wire break	$I_{Load} > 1$ mA $R_{Load} < 0.68...24\ k\Omega$[1]
Injection of substitute values	Yes, can be set
Safety information	

Technical specifications	
U_o = 27.6 V I_o = 91 mA P_o = 0.63 W C_o = 83 µF L_o = 3 mH For additional C_o / L_o combinations, see certificate IECEx KEM 05.0012 https://www.iecex.com (https://www.iecex.com) KEMA 04 ATEX1250 INMETRO UL-BR 12.0070 https://support.industry.siemens.com (https://support.industry.siemens.com)	
Actuator selection data	
Output ranges (rated values)	
• Current	0 to 20 mA 4 to 20 mA
[1] Wire break depends on current of the load	

Approvals

ATEX	II 2 G(1) GD and I M2 Ex ib [ia Ga] IIC T4 Gb Ex ib [ia IIIC Da] IIC T4 Gb Ex ib [ia/] I Mb KEMA 04 ATEX 1250	0344
IECEx	IECEx KEM 05.0012	
INMETRO (INMETRO; BR OCP-0029)	BR-Ex ib [ia Ga] IIC T4 Gb BR-Ex ib [ia IIIC Da] IIC T4 Gb BR-Ex ib [ia] I Mb	
FM (C US APPROVED)	Class I, Zone 1, AEx ib [ia] IIC T4; Ex ib [ia] IIC T4 NI, Class I, DIV. 2, GP. A,B,C,D T4 AIS, Class I, DIV. 1, GP. A,B,C,D Class II, III, GP. E,F,G	
cULus (c us LISTED E334384)	Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx ib [ia] IIC T4 Ex ib [ia] IIC T4 ASSOC APP. CL. I, DIV.2, GP. A,B,C,D PROVIDING INT. SAFE CIRCUITS FOR CL. I, GP. A,B,C,D; CL. II, III, GP. E,F,G	
CCC	Ex ib [ia Ga] IIC T4 Gb Ex ib [iaD] IIC T4 Gb	
UKCA	DEKRA 21UKEX0091	

14.7 Identification and maintenance functions (I&M)

Description

See section "Identification and maintenance data I&M (Page 77)".

14.8 Representation of analog values

14.8.1 Overview

Electronic modules with analog inputs

The electronic modules with analog inputs allow continuously variable signals, such as those occurring in temperature measurement and pressure measurement, to be acquired, evaluated and converted to digital values for further processing.

Electronic modules with analog outputs

With the electronic modules with analog outputs, digital values set by a controller can be converted to a corresponding analog signal (current) in an analog output module and used to control suitable actuators (setpoint input for speed controllers, temperature controllers and similar).

Measured values in the case of a wire break depending on diagnostic being enabled

The rules and additions outlined below apply to the following measuring ranges:

- 4 to 20 mA
- Temperature sensor Pt100 standard and climatic, Ni100 standard and climatic
- Thermocouples types B, E, J, K, L, N, R, S, T, U

The following additions and rules apply:

Format of the analog values S7

Table 14-8 Measured values in the event of a wire break depending on diagnostic enables (format S7)

Module	Parameter assignment	Measured values		Explanation
		decimal	hexadecimal	
4 AI I	• "Wire break" diagnostics enabled	32767	$7FFF_H$	• Diagnostic message "Wire break"
	• "Wire break" diagnostics disabled[1] • Enable "Overflow/Underflow" diagnostics	-32768	8000_H	• Measured value after exiting the underrange • Diagnostic message " Low limit exceeded"
	• "Wire break" diagnostics disabled[1] • "Overflow/underflow" diagnostics disabled	-	-	• Measured value after exiting the underrange
4 AI RTD 4 AI TC	• "Wire break" diagnostics enabled	32767	$7FFF_H$	• Diagnostic message "Wire break"
	• "Wire break" diagnostics disabled	-	-	• Open input: Undefined measured value

[1] Measuring range limits for the detection of wire breaks in the measuring range 4 to 20 mA: at < 3.6 mA

14.8.2 Analog value representation for measuring ranges with SIMATIC S7

Analog value representation

The digitized analog value is the same for input and output values with the same nominal range. Analog values are represented in two's complement.

The following table shows the analog value representation of the analog electronic modules.

Table 14-9 Analog value representation (SIMATIC S7)

Resolution	Analog value															
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Pulse value of the bits	Sign	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Sign

The sign of the analog value is always in bit number 15:

- "0" → +
- "1" → -

Examples

Table 14-10 Examples

Analog value		
Decimal	**Binary**	**Hexadecimal**
-1	1111 1111 1111 1111	$FFFF_H$
-32768	1000 0000 0000 0000	8000_H

Measured value resolution

The following table shows the representation of the binary analog values and the corresponding decimal or hexadecimal representation of the units of the analog values.

The following table shows the resolutions 11-, 12-, 13- and 15-bit + sign. Each analog value is entered left-justified in the ACCU. The bits marked with "x" are set to "0".

Table 14-11 Measured value resolution of the analog values (SIMATIC S7 format)

Resolution in bits	Units		Analog value	
	Decimal	**Hexadecimal**	**High byte**	**Low byte**
11 + sign	16	10_H	SIGN 0 0 0 0 0 0 0	0 0 0 1 x x x x
12 + sign	8	8_H	SIGN 0 0 0 0 0 0 0	0 0 0 0 1 x x x
13 + sign	4	4_H	SIGN 0 0 0 0 0 0 0	0 0 0 0 0 1 x x
15 + sign	1	1_H	SIGN 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1

Note

This resolution does not apply to temperature values. The converted temperature values are the result of a conversion in the analog electronic module.

14.8.3 Measuring ranges of the analog input modules in S7 format

Introduction

The tables in this section contain the digitalized analog values for the measuring ranges of the analog input modules.

As the binary representation of the analog values is always the same, these tables only contain the comparison of the measuring ranges to the units.

Measuring ranges for voltage: ± 80 mV

Table 14-12 SIMATIC S7 format: Measuring ranges ±80 mV

Measuring range ± 80 mV	Units		Range
	Decimal	Hexadecimal	
> 94.071	32767	$7FFF_H$	Overflow
94.071	32511	$7EFF_H$	Overrange
:	:	:	
80.003	27649	$6C01_H$	
80.000	27648	$6C00_H$	
60.000	20736	5100_H	
:	:	:	Nominal range
-60.000	-20736	$AF00_H$	
-80.000	-27648	9400_H	
-80.003	-27649	$93FF_H$	Underrange
:	:	:	
-94.074	-32512	8100_H	
< -94.074	-32768	8000_H	Underflow

Measuring ranges for current: 0 to 20 mA, 4 to 20 mA

Table 14-13 SIMATIC S7 format: Measuring ranges 0 to 20 mA, 4 to 20 mA

Measuring range 0 to 20 mA	Measuring range 4 to 20 mA	Units		Range
		Decimal	Hexadecimal	
> 23.5178	> 22.8142	32767	$7FFF_H$	Overflow
23.5178	22.8142	32511	$7EFF_H$	Overrange
:	:	:	:	
20.0007	20.0005	27649	$6C01_H$	
20.0000	20.0000	27648	$6C00_H$	
15.0000	16.0000	20736	5100_H	
:	:	:	:	Nominal range
0.0000	4.0000	0	0_H	
negative values are not possible	3.9995	-1	$FFFF_H$	Underrange
	:	:	:	
	1.1852	-4864	$ED00_H$	
	< 1.1852	-32768	8000_H	Underflow

Measuring ranges for resistance-based sensors: 600 Ω absolute and 1000 Ω absolute

Table 14-14 SIMATIC S7 format: Measuring ranges 600 Ω absolute and 1000 Ω absolute

Measuring range 600 Ω	Measuring range 1000 Ω	Units		Range
		Decimal	Hexadecimal	
> 705.53	> 1175.89	32767	$7FFF_H$	Overflow
705.53	1175.89	32511	$7EFF_H$	Overrange
:	:	:	:	
600.02	1000.04	27649	$6C01_H$	
600.00	1000.00	27648	$6C00_H$	
450.00	750.00	20736	5100_H	
:	:	:	:	Nominal range
0.00	0.00	0	0_H	
(negative values are physically impossible)		-1	$FFFF_H$	Underrange [1]
		:	:	
		-4864	$ED00_H$	
		-32768	8000_H	Underflow[1]
[1] If the connection is faulty				

Measuring ranges for resistance thermometers Pt 100 standard

Table 14-15 SIMATIC S7 format: Measuring ranges Pt 100 standard in °C and °F

Pt 100 standard in °C (1 digit = 0.1 °C)	Units		Pt 100 Standard in °F (1 digit = 0.1 °F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 1000.0	32767	$7FFF_H$	> 1832.0	32767	$7FFF_H$	Overflow
1000.0 : 850.1	10000 : 8501	2710_H : 2135_H	1832.0 : 1562.1	18320 : 15621	4790_H : $3D05_H$	Overrange
850.0 : -200.0	8500 : -2000	2134_H : $F830_H$	1562.0 : -328.0	15620 : -3280	$3D04_H$: $F330_H$	Nominal range
-200.1 : -243.0	-2001 : -2430	$F82F_H$: $F682_H$	-328.1 : -405.4	-3281 : -4054	$F32F_H$: $F02A_H$	Underrange
< - 243.0	-32768	8000_H	< -405.4	-32768	8000_H	Underflow

Measuring ranges for resistance thermometers Pt 100 climate

Table 14-16 SIMATIC S7 format: Measuring ranges Pt 100 climate in °C and °F

Pt 100 climate in °C (1 digit = 0.01 °C)	Units		Pt 100 climate in °F (1 digit = 0.01 °F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 155.00	32767	$7FFF_H$	> 311.00	32767	$7FFF_H$	Overflow
155.00 : 130.01	15500 : 13001	$3C8C_H$: $32C9_H$	311.00 : 266.01	31100 : 26601	$797C_H$: $67E9_H$	Overrange
130.00 : -120.00	13000 : -12000	$32C8_H$: $D120_H$	266.00 : -184.00	26600 : -18400	$67E8_H$: $B820_H$	Nominal range
-120.01 : -145.00	-12001 : -14500	$D11F_H$: $C75C_H$	-184.01 : -229.00	-18401 : -22900	$B81F_H$: $A68C_H$	Underrange
< -145.00	-32768	8000_H	< -229.00	-32768	8000_H	Underflow

Measuring ranges for resistance thermometers Ni 100 standard

Table 14-17 SIMATIC S7 format: Measuring ranges Ni 100 standard in °C and °F

Ni 100 standard in °C (1 digit = 0.1 °C)	Units		Ni 100 standard in °F (1 digit = 0.1 °F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 295.0	32767	$7FFF_H$	> 563.0	32767	$7FFF_H$	Overflow
295.0	2950	$B86_H$	563.0	5630	$15FE_H$	Overrange
:	:	:	:	:	:	
250.1	2501	$9C5_H$	482.1	4821	$12D5_H$	
250.0	2500	$9C4_H$	482.0	4820	$12D4_H$	
:	:	:	:	:	:	Nominal range
-60.0	-600	$FDA8_H$	-76.0	-760	$FD08_H$	
-60.1	-601	$FDA7_H$	-76.1	-761	$FD07_H$	Underrange
:	:	:	:	:	:	
-105.0	-1050	$FBE6_H$	-157.0	-1570	$F9DE_H$	
< -105.0	-32768	8000_H	< -157.0	-32768	8000_H	Underflow

Measuring ranges for resistance thermometers Ni 100 climate

Table 14-18 SIMATIC S7 format: Measuring ranges Ni 100 climate in °C and °F

Ni 100 climate in °C(1 digit = 0.01 °C)	Units		Ni 100 climate in °F(1 digit = 0.01 °F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 295.00	32767	$7FFF_H$	> 325.11	32767	$7FFF_H$	Overflow
295.00 : 250.01	29500 : 25001	$733C_H$: $61A9_H$	327.66 : 280.01	32766 : 28001	$7FFE_H$: $6D61_H$	Overrange
250.00 : -60.00	25000 : -6000	$61A8_H$: $E890_H$	280.00 : -76.00	28000 : -7600	$6D60_H$: $E250_H$	Nominal range
-60.01 : -105.00	-6001 : -10500	$E88F_H$: $D6FC_H$	-76.01 : -157.00	-7601 : -15700	$E24F_H$: $C2AC_H$	Underrange
< -105.00	-32768	8000_H	< -157.00	-32768	8000_H	Underflow

Measuring range for thermocouple: Type B

Table 14-19 SIMATIC S7 format: Measuring range type B in °C and °F

Type B in °C	Units		Type B in °F	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 2070.0	32767	$7FFF_H$	> 3276.6	32767	$7FFF_H$	Overflow
2070.0 : 1820.1	20700 : 18201	$50DC_H$: 4719_H	3276.6 : 2786.6	32766 : 27866	$7FFE_H$: $6CDA_H$	Overrange
1820.0 : 0.0	18200 : 0	4718_H : 0000_H	2786.5 : 32	27865 : 320	$6CD9_H$: 0140_H	Nominal range
-0.1 : -120.0	-1 : -1200	$FFFF_H$: $FB50_H$	31.9 : -184.0	319 : -1840	$013F_H$: $F8D0_H$	Underrange
< -120.0	-32768	8000_H	< -184.0	-32768	8000_H	Underflow

Measuring range for thermocouple type E

Table 14-20 SIMATIC S7 format: Measuring range type E in °C and °F

Type E in °C	Units		Type E in °F	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 1200.0	32767	$7FFF_H$	> 2192.0	32767	$7FFF_H$	Overflow
1200.0 : 1000.1	12000 : 10001	$2EE0_H$: 2711_H	2192.0 : 1832.1	21920 : 18321	$55A0_H$: 4791_H	Overrange
1000.0 : -270.0	10000 : -2700	2710_H : $F574_H$	1832.0 : -454.0	18320 : -4540	4790_H : $EE44_H$	Nominal range
< -270.0	- 32768	8000_H	< -454.0	- 32768	8000_H	Underflow

Measuring range for thermocouple type J

Table 14-21 SIMATIC S7 format: Measuring range type J in °C and °F

Type J in °C	Units		Type J in °F	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 1450.0	32767	$7FFF_H$	> 2642.0	32767	$7FFF_H$	Overflow
1450.0 : 1200.1	14500 : 12010	$38A4_H$: $2EEA_H$	2642.0 : 2192.1	26420 : 21921	6734_H : $55A1_H$	Overrange
1200.0 : -210.0	12000 : -2100	$2EE0_H$: $F7CC_H$	2192.0 : -346.0	21920 : -3460	$55A0_H$: $F27C_H$	Nominal range
< -210.0	- 32768	8000_H	< -346.0	- 32768	8000_H	Underflow

Measuring range for thermocouple type K

Table 14-22 SIMATIC S7 format: Measuring range type K in °C and °F

Type K in °C	Units		Type K in °F	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 1622.0	32767	$7FFF_H$	> 2951.6	32767	$7FFF_H$	Overflow
1622.0 : 1372.1	16220 : 13721	$3F5C_H$: 3599_H	2951.6 : 2501.7	29516 : 25062	$734C_H$: $61B9_H$	Overrange

Type K in °C	Units		Type K in °F	Units		Range
	Decimal	Hexadec-imal		Decimal	Hexa-decimal	
1372.0 : -270.0	13720 : -2700	3598_H : $F574_H$	2501.6 : -454.0	25061 : -4540	$61B8_H$: $EE44_H$	Nominal range
< -270.0	- 32768	8000_H	< -454.0	- 32768	8000_H	Underflow

Measuring range for thermocouple type L

Table 14-23 SIMATIC S7 format: Measuring range type L in °C and °F

Type L in °C	Units		Type L in °F	Units		Range
	Decimal	Hexa-decimal		Decimal	Hexa-decimal	
> 1150.0	32767	$7FFF_H$	> 2102.0	32767	$7FFF_H$	Overflow
1150.0 : 900.1	11500 : 9001	$2CEC_H$: 2329_H	2102.0 : 1652.1	21020 : 16521	$521C_H$: 4089_H	Overrange
900.0 : -200.0	9000 : -2000	2328_H : $F830_H$	1652.0 : -328.0	16520 : -3280	4088_H : $F330_H$	Nominal range
< -200.0	-32768	8000_H	< -328.0	-32768	80000_H	Underflow

Measuring range for thermocouple type N

Table 14-24 SIMATIC S7 format: Measuring range type N in °C and °F

Type N in °C	Units		Type N in °F	Units		Range
	Decimal	Hexadec-imal		Decimal	Hexa-decimal	
> 1550.0	32767	$7FFF_H$	> 2822.0	32767	$7FFF_H$	Overflow
1550.0 : 1300.1	15500 : 13001	$3C8C_H$: $32C9_H$	2822.0 : 2372.1	28220 : 23721	$6E3C_H$: $5CA9_H$	Overrange
1300.0 : -270.0	13000 : -2700	$32C8_H$: $F574_H$	2372.0 : -454.0	23720 : -4540	$5CA8_H$: $EE44_H$	Nominal range
< -270.0	-32768	8000_H	-32768	8000_H	$<EE44_H$	Underflow

Measuring range for thermocouple type R, S

Table 14-25 SIMATIC S7 format: Measuring range type R, S in °C and °F

Types R, S in °C	Units		Types R, S in °F	Units		Range
	Decimal	Hexa-decimal		Decimal	Hexa-decimal	
> 2019.0	32767	$7FFF_H$	> 3276.6	32767	$7FFF_H$	Overflow
2019.0 : 1769.1	20190 : 17691	$4EDE_H$: $451B_H$	3276.6 : 3216.3	32766 : 32163	$7FFE_H$: $7DA3_H$	Overrange
1769.0 : -50.0	17690 : -500	$451A_H$: $FE0C_H$	3216.2 : -58.0	32162 : -580	$7DA2_H$: $FDBC_H$	Nominal range
-50.1 : -170.0	-510 : -1700	$FE0B_H$: $F95C_H$	-58.1 : -274.0	-581 : -2740	$FDBB_H$: $F54C_H$	Underrange
< -170.0	-32768	8000_H	< -274.0	-32768	8000_H	Underflow

Measuring range for thermocouple type T

Table 14-26 SIMATIC S7 format: Measuring range type T in °C and °F

Type T in °C	Units		Type T in °F	Units		Range
	Decimal	Hexa-decimal		Decimal	Hexa-decimal	
> 540.0	32767	$7FFF_H$	> 1004.0	32767	$7FFF_H$	Overflow
540.0 : 400.1	5400 : 4001	1518_H : $0FA1_H$	1004.0 752.1	10040 7521	2738_H $1DC1_H$	Overrange
400.0 : -270.0	4000 : -2700	$0FA0_H$: $F574_H$	752.0 : -454.0	7520 : -4540	$1D60_H$: $EE44_H$	Nominal range
< -270.0	-32768	8000_H	< -454.0	-32768	8000_H	Underflow

Measuring range for thermocouple type U

Table 14-27 SIMATIC S7 format: Measuring range type U in °C and °F

Type U in °C	Units		Type U in °F	Units		Range
	Decimal	Hexa-decimal		Decimal	Hexa-decimal	
> 850.0	32767	7FFF$_H$	> 1562.0	32767	7FFF$_H$	Overflow
850.0 : 600.1	8500 : 6001	2134$_H$: 17771$_H$	1562.0 1112.1	15620 11121	3D04$_H$ 2B71$_H$	Overrange
600.0 : -200.0	2000 : -2000	1770$_H$: F830$_H$	1112.0 : -328.0	11120 : -3280	2B70$_H$: F330$_H$	Nominal range
< -200.0	-32768	8000$_H$	< -328.0	-32768	8000$_H$	Underflow

14.8.4 Output ranges of the analog output modules in S7 format

Introduction

The tables in this section contain the digitized analog values for the measuring ranges of the analog output modules.

Since the binary representation of the analog values is always the same, these tables only contain the comparison of the output ranges to the units.

Output ranges for current: 0 to 20 mA, 4 to 20 mA

Table 14-28 SIMATIC S7 format: Output ranges 0 to 20 mA, 4 to 20 mA

Output range 0 to 20 mA	Output range 4 to 20 mA	Units		Range
		Decimal	Hexadecimal	
0	0	> 32511	> 7EFF$_H$	Overflow
23.5178	22.8100	32511	7EFF$_H$	Overrange
:	:	:	:	
20.0007	20.0005	27649	6C01$_H$	
20.0000	20.0000	27648	6C00$_H$	
:	:	:	:	Nominal range
0	4.0000	0	0$_H$	
0	3.9995	-1	FFFF$_H$	Underrange
:	:	:	:	
0	0	-6912	E500$_H$	
0	0	< -6913	< E4FF$_H$	Underflow

14.9 Fundamentals of analog value processing

14.9.1 Wiring thermocouples

Introduction

This section contains additional information on connecting thermocouples.

Compensation of the reference junction temperature

There are various ways of obtaining the reference junction temperature in order to get an absolute temperature value from the temperature difference between the reference junction and the measuring point.

Table 14-29 Compensation of the reference junction temperature

Option	Explanation	Reference junction parameters
No compensation	You record not only the temperature of the measurement point. The temperature of the reference junction (transition from Cu line to thermocouple line) also affects the thermo-electromotive force. The measured value then includes an error.	None
Use of a Pt100 Climatic Range resistance thermometer to record the reference junction temperature (best method)	You can record the reference junction temperature using a resistance thermometer (Pt100 climatic range). This temperature value is distributed to the ET 200iSP modules in the 4 AI TC with corresponding parameter assignment and offset in the modules with the determined temperature value of the measuring point. Number of reference junctions: 2	The parameter assignment of the interface module and the 4 AI TC must be coordinated: • 4 AI RTD parameterized to Pt100 climatic range at the correct slot; • 4 AI TC: Reference junction: "yes"; reference junction number "1" or "2" • Interface module: Assignment of the reference junction to a slot with 4 AI RTD; selection of a channel;
Internal compensation 4 AI TC	The TC sensor module (temperature sensor) is mounted on the terminals of the terminal module of the EM 4 AI TC. The temperature sensor reports the terminal temperature to the 4 AI TC. This value is then calculated together with the measured value from the channel of the electronic module.	• 4 AI TC: Reference junction number "internal"

Extension to a reference junction

From their point of connection, thermocouples can be extended using equalizing cables as far as the reference junction (transition to copper wiring). The reference junction can also be a ET 200iSP terminal module.

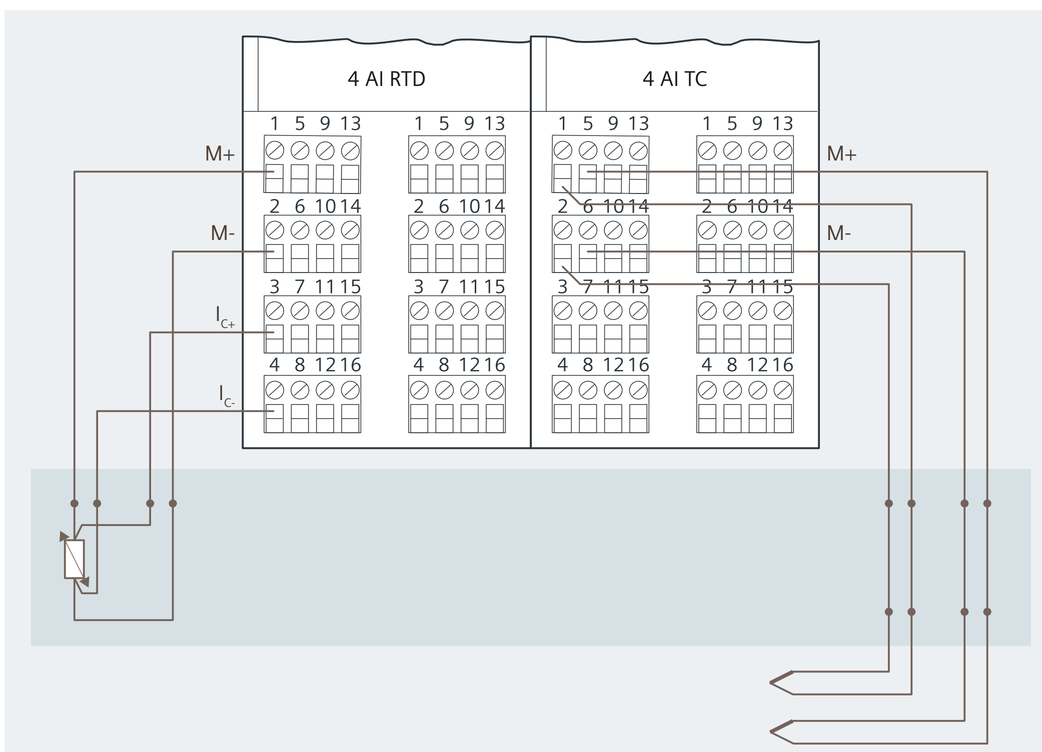
These compensating wires are made of the same material as the thermocouple wires. The supply lines are made of copper. Ensure correct polarity when connecting.

Compensation by resistance thermometer at the 4 AI RTD

If thermocouples connected to the inputs of the 4 AI TC share a common reference junction, compensate using a 4 AI RTD:

For the channels of the 4 AI TC module, you can select "1", "2" or "Internal" as the reference junction number. If you select "1" or "2", the same reference junction (RTD channel) is always used for all four channels.

In the following figure, the electronic module 4 AI RTD is parameterized for the measuring range Pt100 climatic range. The isolated thermocouples are compensated externally by a resistance thermometer connected to the 4 AI RTD (channel 0).



M+ Measuring cable (positive)

M- Measuring cable (negative)

I_C+ Constantcurrent cable (positive)

I_C- Constant-current cable (negative)

Figure 14-6 Compensation using 4 AI RTD

Setting parameters for the reference junction

You set the reference junctions for the electronic modules 4 AI TC using the following parameters:

Table 14-30 Reference junction parameters

Parameter	Module	Range of values	Explanation
Slot reference junction 1 to slot 2	Interface module	IM 152-1PN: none, 2 to 33 IM 152-1DP: none, 4 to 35	With this parameter, you can assign up to 2 slots on which the channels for comparison temperature measurement (determination of the compensation value) are located.
Input for reference junction (reference junction E0 to E3)	Interface module	RTD on channel 0 RTD on channel 1 RTD on channel 2 RTD on channel 3	With this parameter you specify the channel (0/1/2/3) for comparison temperature measurement (measurement of the compensation value) for the assigned slot.
Reference junction (E0 to E3)	4 AI TC	None Yes	This parameter allows you to enable the use of the reference junction.
Reference junction number	4 AI TC	1 2 Internal	This parameter allows you to assign the reference junction (1, 2) that contains the reference temperature (compensation value).

Example of reference junction parameter assignments

- Configuration: For simplification purposes, this figure shows only RTD and TC modules:

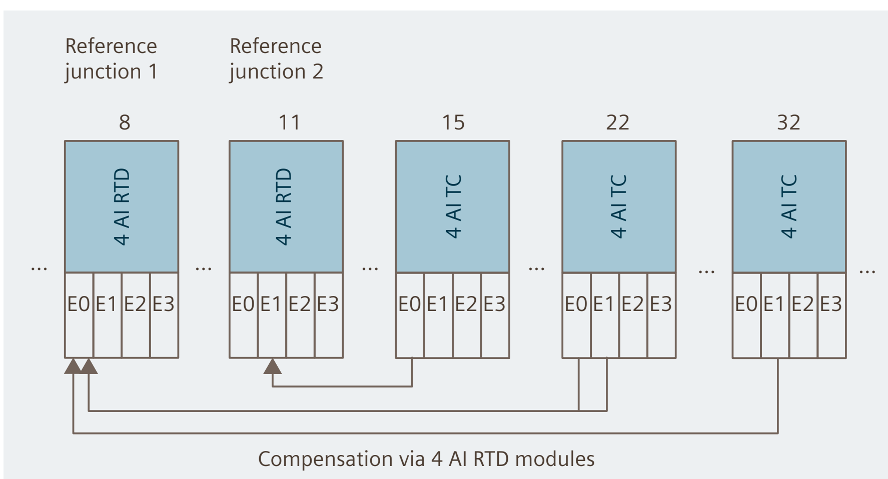


Figure 14-7 Example of reference junction parameter assignments

- (Relevant) parameters to be set for the interface module

Parameter	Value
Slot reference junction 1	8
Input reference junction 1	RTD on channel 0
Slot reference junction 2	11
Input reference junction 2	RTD on channel 1

- (Relevant) parameters to be set for 4 AI RTD and 4 AI TC:

Slot for PROFI-NET	Slot for PROFI-BUS	Parameter	Value
6 (4 AI RTD)	8 (4 AI RTD)	Type/range of measurement I0	RTD-4 wire connection/ Pt 100 climatic range
9 (4 AI RTD)	11 (4 AI RTD)	Type/range of measurement I1	RTD-4 wire connection/ Pt 100 climatic range
13 (4 AI TC)	15 (4 AI TC)	Reference junction I0	Yes
		Reference junction I1/I2/I3	None
		Reference junction number	2
		Measuring range I0	Type...
		Measuring range I1/I2/I3	(any)
20 (4 AI TC)	22 (4 AI TC)	Reference junction I0/I1	Yes
		Reference junction I2/I3	None
		Reference junction number	1
		Measuring range I0/I1	Type...
		Measuring range I2/I3	(any)
30 (4 AI TC)	32 (4 AI TC)	Reference junction I0	None
		Reference junction I1	Yes
		Reference junction I2/I3	None
		Reference junction number	1
		Measuring range I0	(any)
		Measuring range I1	Type...
		Measuring range I2/I3	(any)

Non-isolated thermocouples

When you use non-isolated thermocouples, you must comply with the permitted common-mode voltage.

14.10 Basics of HART

14.10.1 Introduction

Description

With the HART functionality, you can additionally operate the analog modules with digital communication options. The HART protocol is generally accepted as a standard protocol for communication with intelligent field devices. HART is a registered trademark of the "HART Communication Foundation" (HCF), which owns all the rights to the HART protocol.

Note

The HART analog modules support the HART protocol version 6.0.

14.10.2 Properties of HART

Advantages of HART

Using HART analog modules offers the following benefits:

- Connection compatibility with analog modules: Current loop 4-20 mA
- Additional digital communication using the HART protocol
- Low energy consumption with HART, important for use in hazardous areas
- Numerous field devices with HART functions are in use

Typical applications of HART

- Commissioning of field devices (centralized setting of parameters)
- Online modification of field device parameters
- Information, maintenance and diagnostic displays for the field devices

14.10.3 Principles of HART operation

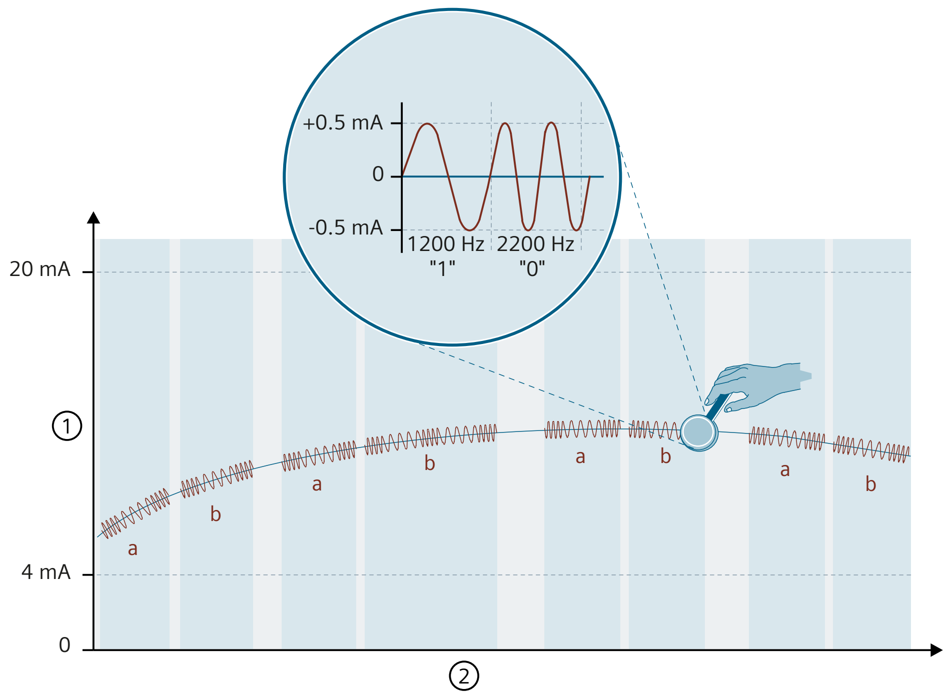
Introduction

The HART protocol describes the physical form of the transfer:

Transfer procedures, message structure, data formats and commands.

HART signal

The figure below shows the analog signal with the modulated HART signal (FSK method), which consists of sine waves of 1200 Hz and 2200 Hz and has a mean value of 0. It can be filtered out using an input filter so that the original analog signal is available again.



① Analog signal

② Time in seconds

a Command

b Response

Figure 14-8 The HART signal

HART commands and parameters

With SIMATIC PDM you can set the parameters of the HART field devices via **HART commands** and read them out via **HART responses**. The HART commands and their parameters are divided into three groups with the following properties:

- Universal
- Common practice
- Device-specific

Universal commands must be supported by all manufacturers of HART field devices and common practice commands should be supported. There are also device-specific commands that apply only to the particular field device.

Examples of HART parameters

The following table represents HART parameters of the different groups:

Table 14-31 Examples of HART parameters

Parameter group	Parameters of the HART field device
Universal	Measured value or manipulated variable (primary variable), manufacturer name, measuring point identifier ("tag"), or identifier for actuator, additional measured values or manipulated variables.
Common practice	Measuring range, filter time, interrupt parameters (message, interrupt and warning limits), output range
Device-specific	Special diagnostics information

14.10.4 Integration of HART field devices with ET 200iSP

Use in ET 200iSP

With a HART analog module, you can connect one field device to each of the four channels. The module operates as HART master, the field devices as HART devices.

SIMATIC PDM sends and receives data via the HART analog module, comparable to a client for which the HART analog module is user as a server.

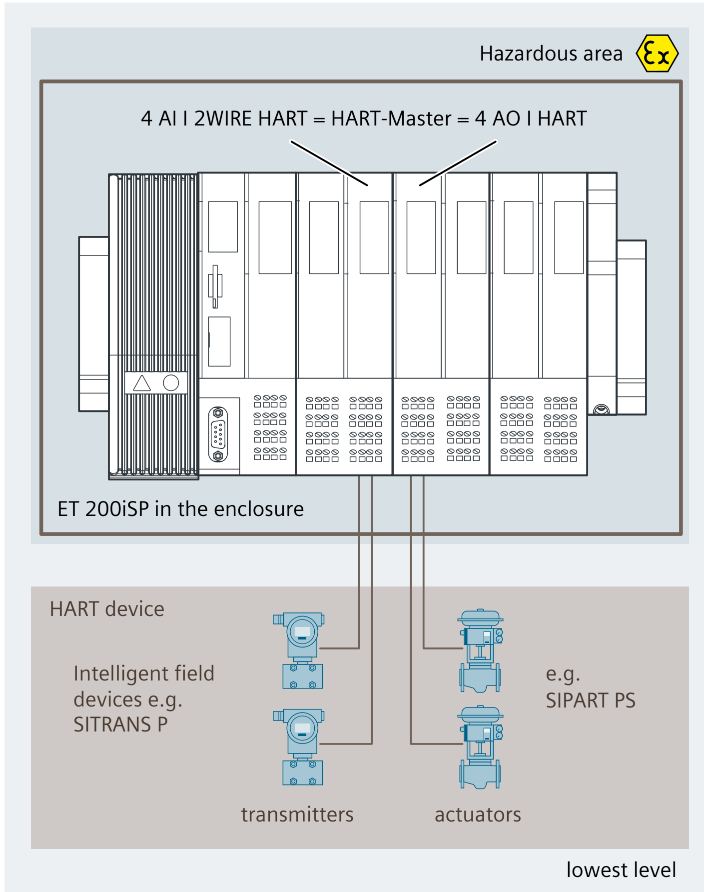


Figure 14-9 Location of the HART analog modules in the distributed system

14.10.5 Using HART

System environment for using HART

To operate an intelligent field device with HART functionality, you require the following system environment:

Current loop 4 - 20 mA via the analog electronic modules: 4 AI I 2WIRE HART, 4 AI I 4WIRE HART or 4 AO I HART.

The HART analog module takes over the function of a "master" by receiving the commands from the HART parameter assignment tool, passing them on to the smart field device and then returning the reply messages. The interface of the HART analog module is represented by data records that are transferred via the I/O bus. These data records are generated or interpreted by the HART parameter assignment tool (SIMATIC PDM).

The analog values in 16-bit format and up to 4 IEEE variables (primary or non-primary variable) are entered in the process image of the inputs and outputs.

STEP 7, SIMATIC PDM, HART handheld

You can set the HART parameters either via an external hand-held device (HART handheld) or with SIMATIC PDM. SIMATIC PDM reaches through the HART analog module, while the HART handheld is connected directly in parallel to the field device.

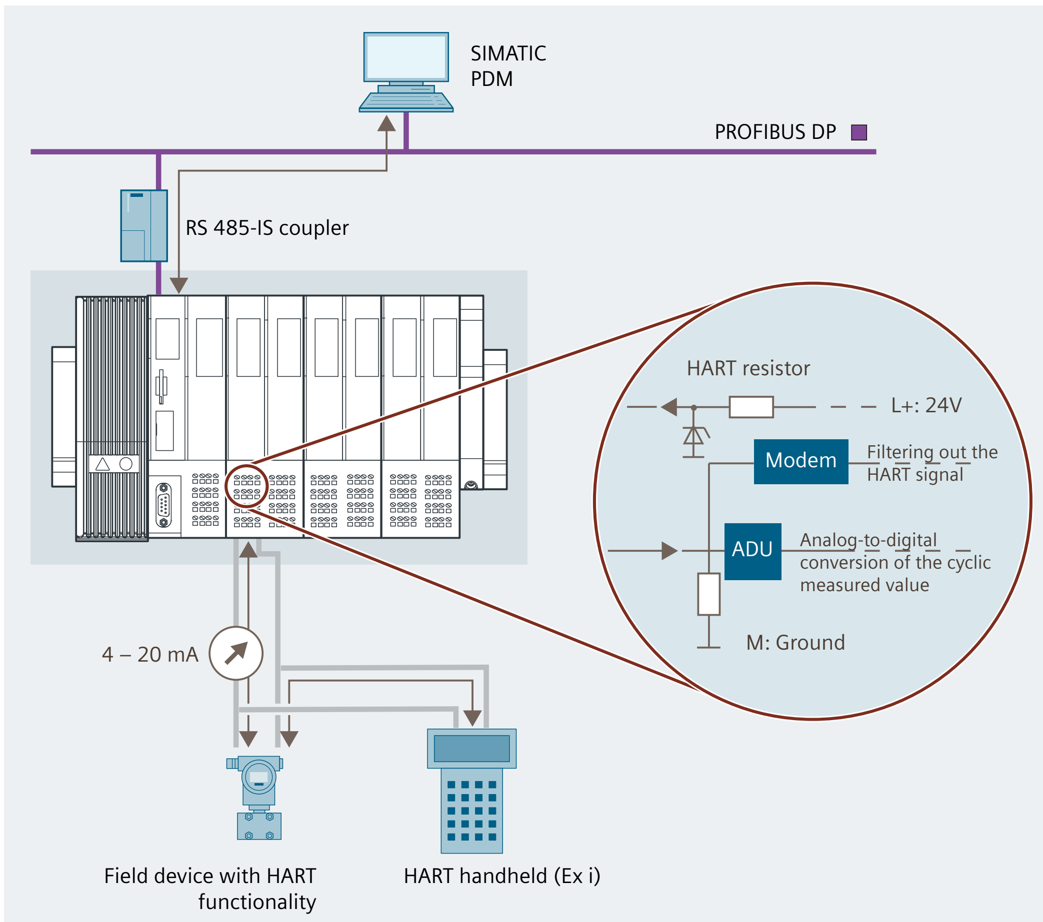


Figure 14-10 System environment for the use of HART

Transparent message data - Format

The ET 200iSP HART analog modules support the *transparent message data* format. SIMATIC PDM therefore provides you with direct access to the HART field device for the commands and responses.

Each HART analog module is equipped with a common HART modem for the 4 channels. This means you can only access one channel of the module directly at a time with SIMATIC PDM (multiplexing the channels). It is not possible to simultaneously directly access another channel of the same module.

If the channels are on different HART analog modules, then you can access a maximum of six channels directly with SIMATIC PDM.

Others properties of the ET 200iSP HART analog modules

Table 14-32 Others properties of the ET 200iSP HART analog modules

Properties	Explanation
Secondary master cannot be connected (Secondary master exclusion)	No
After a Write Request there is direct feedback on the validity of the data. (Application Supported Parameter Check)	Yes
Several HART field devices are supplied by means of a single line. (Multi-Drop Mode)	No, analog value =0
Communication type with HART, in which the master requests that the HART field device respond cyclically and continuously to a predefined HART commend to send (the reading of the measured variable, for example). (Burst mode)	No
HART master cyclically sends a predefined HART command to the connected HART field device. (Scan mode)	No
Use of the compact data format (Compact HART Message Format)	Yes
A HART client sends a sequence of HART commands. No other client can interrupt this process. (Successive HART Commands mode)	Yes
Parameters are stored retentively. (Parameter Stored Non Volatile)	No
Automatic deactivation of burst mode (Burst-Mode Auto Disable)	No
Maximum data field length (data length)	64 bytes (corresponds to 75 bytes data record in transparent-message-data format)
Client management (Client Management)	No, only one client per channel (four "mailboxes" per module)

14.10.6 HART Fast Mode

Introduction

With HART-Fast-Mode enabled, the HART electronic modules support the processing of HART commands as SHC string (Successive HART Command).

Requirements

As of the following product statuses/ STEP 7 hardware update, the HART electronic modules support the HART fast mode:

HART electronic modules	Product version	STEP 7 hardware update (HSP)
4 AI I 2WIRE HART	9	053 as of V3.0
4 AI I 4WIRE HART	8	
4 AO I HART	9	057 as of V3.0

HART Fast Mode

If a HART command with set SHC bit is recognized by the electronic module for a channel, the complete HART command processing on the electronic module is reserved for this channel for approx. 2 s. No other HART command processing is performed during this time on any other channels of the electronic module.

With each additional HART command with set SHC bit, the electronic module reserves the HART command processing for this channel again for a further 2 s. If a HART command without SHC bit set is detected for this channel or if no other command for this channel occurs within 2 s after the previous HART command, the electronic module returns to "normal" HART command processing. Result: All HART channels are processed again.

Note

- During the time a HART channel of the electronic module is processing a SHC sequence, which means that full HART processing capacity of the electronic module is reserved for this channel, the HART variables of all HART channels are no longer updated. Their values and quality codes remain unchanged.
- HART requests for other channels are not processed and they are acknowledged accordingly.
- If a HART channel is handled by several clients (e.g. SIMATIC PDM, user program), the response made available by the module cannot then be allocated to one client with certainty. HART electronic modules do not support client management.

As of V6.0 SP5, PDM supports the processing of HART jobs with SHC string. To do this, you must also enable "HART RIO SHC mode" in the "Communication" tab under "Options > Settings" in PDM.

14.10.7 IEEE tags

Properties

For each analog module with HART, you can read in up to 4 IEEE variables in addition to the analog value. These variables are shown in IEEE754 format. This is the float format according to *IEEEStandard 754 Short Real Number* (floating point format).

Each IEEE variable is accompanied by a status byte. The status byte provides information on the validity of the measured value.

4 bytes + 1 status byte are required for the representation of a variable in IEEE754 format.

Table 14-33 Variable in IEEE754 format

Byte	7	6	5	4	3	2	1	0	Description
Byte x									IEEE variable (IEEE754 format)
Byte x+1									
Byte x+2									
Byte x+3									
Byte x+4									Status byte

HART measured value in IEEE format (byte x to byte x+3)

The following shows the representation of a HART measured value in IEEE format and the conversion of an IEEE word to a decimal value.

Table 14-34 IEEE754 format (byte x and byte x+1)

Byte x								Byte x+1							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Sign	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}
	Exponent								Mantissa						

Table 14-35 IEEE754 format (byte x+2 and byte x+3)

Byte x+2								Byte x+3							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}	2^{-23}
Mantissa															

Table 14-36 Example: Conversion of IEEE value to decimal value

Byte x								Byte x+1								Byte x+2								Byte x+3							
0	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sign	Exponent = $2^7 + 2^0$ = 129								Mantissa = $2^{-1} + 2^{-2} + 2^{-3}$ = 0,5 + 0,25 + 0,125 = 0,875																						
Measured value = $(-1)^{sign} \times 2^{(exponent-127)} \times (1+mantissa) = (-1)^0 \times 2^{(129-127)} \times (1+0{,}875) = 1 \times 4 \times (1{,}875) = 7{,}5$																															

Status byte (byte x+4)

The structure of the status byte corresponds to the PROFIBUS PA profile. With the ET 200iSP, the following status codes of the PROFIBUS PA profile are used:

Table 14-37 Status byte

	7	6	5	4	3	2	1	0	Description
Byte x+4									HART status byte for HART measured value 1, as specified for HART Bit 0 and Bit 1: Limits: Reports limit violations Bit 2 to bit 5: Sub-status: differentiates and refines the quality of the associated measured value. Meaning depends on "Quality". See operating instructions of the HART field device Bit 6 and Bit 7: Quality: Describes the basic quality of the measured value

Status codes used by the PROFIBUS PA profile for ET 200iSP:

- 01001100 ($4C_H$) uncertain, initial value (before first contact)
- 00011000 (18_H) bad, no communication (communication error)
- 00001100 ($0C_H$) bad, device failure (device fault)
- 01000111 (47_H) uncertain, last usable event, constant (device is busy)
- 10000100 (84_H) good, update event (re-configuring)
- 10000000 (80_H) good, ok (no error)

See also

Analog input modules with HART (4 AI I 2WIRE HART, 4 AI I 4WIRE HART) (Page 439)

Analog output module with HART (4 AO I HART) (Page 441)

14.10.8 HART data records

Requirements

You need this information if you go beyond the standard applications of STEP 7 and SIMATIC PDM applications or use your own configuration tool for HART communication.

Data record interface

The analog modules with HART use data records as the input and output interface:

The mapping of the HART commands and HART responses into the PROFIBUS DP data records is based on the *PROFIBUS Profile HART Version 1.0*. For more information on the HART protocol, refer to the *PROFIBUS DP HART Profile Application Guidelines*.

You can obtain the above documentation from the PNO (PROFIBUS User Organization) on the Internet PROFIBUS (https://www.profibus.com).

Table 14-38 HART data records

Data record number	Read / write	Size in bytes	Designation
148	read	13	Directory process data
	DR information (data record directory): This data record contains the data record numbers (index) of all HART data records and information on the configuration limits and for revision.		
149	read	3	HMD Feature Parameter Process Data
	HART feature flags: This data record describes which optional HART functions are supported.		
129	Read / write	6	HMD Parameter Process Data
	HART parameters: This data record contains the parameters for the HART master. The status of the parameter assignment can be evaluated during the reading of the data record. There are no manufacturer specific parameters for the analog modules with HART.		
140	Read / write	12	HART Mapping data record
	HART mapping data record: This data record contains the assignment of the individual HART measured values to the channels of the module.		
80	Write	75	HART Request Write Process Data
	Letterbox channel 0: This data record contains the transfer data for the command from the client to the HART field device (on channel 0).		
81	read	75	HART Response Read Process Data
	Letterbox channel 0: This date record contains the transfer data for the response from the HART field device (on channel 0) to the client.		
82	Write	75	HART Request Write Process Data
	Letterbox channel 1: This data record contains the transfer data for the command from the client to the HART field device (on channel 1).		
83	read	75	HART Response Read Process Data
	Letterbox channel 1: This date record contains the transfer data for the response from the HART field device (on channel 1) to the client.		
84	Write	75	HART Request Write Process Data
	Letterbox channel 2: This data record contains the transfer data for the command from the client to the HART field device (on channel 2).		
85	read	75	HART Response Read Process Data
	Letterbox channel 2: This date record contains the transfer data for the response from the HART field device (on channel 2) to the client.		
86	Write	75	HART Request Write Process Data
	Letterbox channel 3: This data record contains the transfer data for the command from the client to the HART field device (on channel 3).		
87	read	75	HART Response Read Process Data
	Letterbox channel 3: This date record contains the transfer data for the response from the HART field device (on channel 3) to the client.		

You can find more information on the HART operating data records in section "HART operating data records (Page 451)".

Read and write data records

To read and write data records, use the following SFCs or SFBs:

- PROFIBUS:
  - Read data record: SFC 59 "RD_REC"
  - Write data record: SFC 58 "WR_REC"
- PROFIBUS/PROFINET:
  - Read data record: SFB 52 "RDREC"
  - Write data record: SFB 53 "WRREC"

For more detailed information on SFCs, refer to the "System Software for S7-300/400 (https://support.automation.siemens.com/WW/view/en/1214574)" manual.

14.11 Parameters of the analog electronic modules

14.11.1 Parameters for analog electronics modules 4 AI I 2WIRE HART, 4 AI I 4WIRE HART

Configuration with STEP 7 as of V5.3 SP1 and current hardware update

For description, see online help STEP 7.

Configuration with GSD file

There are different configurations for the analog electronic modules 4 AI I 2WIRE HART and 4 AI I 4WIRE HART that you can select via the following entries in the hardware catalog of the configuration software:

- Configuration "4 AI I 2WIRE HART" and "4 AI I 4WIRE HART"
  The analog values are shown in S7 format.
- Configurations "4 AI I 4W+x" and "4 AI I 4W+x":
  The analog values are shown in S7 format. In addition, up to 4 IEEE variables (primary or non-primary variable) are available in IEEE 754 format. You select the number of IEEE variables (1 to 4) via the configuration:
  - ...4W+1
  - ...4W+2
  - ...4W+3
  - ...4W+4

Parameters for configuration "4 AI I 2WIRE HART", "4 AI I 4WIRE HART"

Table 14-39 Parameters for configuration "4 AI I 2WIRE HART", "4 AI I 4WIRE HART"

Parameter		Range of values	Default	Applicability
4 AI I 2WIRE HART	4 AI I 4WIRE HART			
Hardware interrupt (on limit violation)		• Enabled • Disabled	Disabled	Channel
Measuring range	---	• Disabled • 4 to 20 mA • HART	HART	Channel
---	Measuring range	• Disabled • 0 to 20 mA • 4 to 20 mA • HART	HART	Channel
Group diagnostics		• Enabled • Disabled	Enabled	Module
Overflow/underflow diagnostics		• Enabled • Disabled	Enabled	Module
Smoothing		• None • Low • Average • Strong	None	Channel
High limit		Low to high limit of the overrange (SIMATIC S7)	High limit	Channel
Low limit		Low to high limit of the overrange (SIMATIC S7)	Low limit	Channel
Diagnostics: wire break		• Enabled • Disabled	Enabled	Channel
Diagnostics: short-circuit	---	• Enabled • Disabled	Enabled	Channel

Parameters for configuration "4 AI I 2W+x", "4 AI I 4W+x"

In addition to the "4 AI I 2WIRE HART" and "4 AI I 4WIRE HART" configuration, the following parameters can be set in the "...W+x" configurations:

Table 14-40 Parameters for configuration "...W+x"

Parameter		Range of values	Default	Applicability
4 AI I 2WIRE HART	4 AI I 4WIRE HART			
HART retries (number of retries)		0 to 10	2	Module
HART Fast Mode		• Enabled • Disabled	Disabled	Module

Parameter		Range of values	Default	Applicability
4 AI I 2WIRE HART	4 AI I 4WIRE HART			
Channel		• 0 • 1 • 2 • 3	0	Channel
IEEE variable,		• None • Primary variable • 1st non-primary variable • 2nd non-primary variable • 3rd non-primary variable	None	Channel
HART warning		• Enabled • Disabled	Disabled	Module
HART diagnostics		• Enabled • Disabled	Disabled	Module

14.11.2 Parameters relevant for 4 AI RTD, 4 AI TC analog electronics modules

Parameters 4 AI RTD, 4 AI TC

Table 14-41 Parameter 4 AI RTD, 4 AI TC

Parameters		Range of values	Default	Applicability
4 AI RTD	4 AI TC			
Hardware interrupt (on limit violation)[1]		• Enabled • Disabled	Disabled	Channel
Measurement type	---	• Disabled • RTD 4-wire connection • RTD 3-wire connection • RTD 2-wire connection • R-4-wire connection • R-3-wire connection • R-2-wire connection	RTD 4-wire connection	Channel

Parameters		Range of values	Default	Applicability
4 AI RTD	4 AI TC			
Measuring range	---	• Pt 100 standard range • Pt 100 climatic range • Ni 100 standard range • Ni 100 climatic range • 600 Ω absolute • 1000 Ω absolute	Pt 100 standard range	Channel
---	Measuring range	• Disabled • ± 80 mV • Type B [PtRh-PtRh] • Type N [NiCrSi-NiSi] • Type E [NiCr-CuNi] • Type R [PtPh-Pt] • Type S [PtPh-Pt] • Type J [Fe-CuNi] • Type L [Fe-CuNi] • Type T [Cu-CuNi] • Type K [NiCr-Ni] • Type U [Cu-CuNi]	Type K [NiCr-Ni]	Channel
Group diagnostics		• Enabled • Disabled	Enabled	Module
Diagnostics overflow/underflow		• Enabled • Disabled	Enabled	Module
Diagnostics: wire break		• Enabled • Disabled	Enabled	Channel
Diagnostics short-circuit[2]	---	• Enabled • Disabled	Enabled	Channel
---	Reference junction	• None • Yes • RTD	None	Channel
---	Reference junction number	• 1 • 2 • Internal	1	Channel
Smoothing		• None • Low • Average • Strong	None	Channel
High limit		Low to high limit of the overrange (SIMATIC S7)	High limit	Channel

Parameters		Range of values	Default	Applicability
4 AI RTD	4 AI TC			
Low limit		Low to high limit of the overrange (SIMATIC S7)	Low limit	Channel
[1] Refers to "High limit" and "Low limit" parameters [2] If short-circuit diagnostics is enabled, then no underflow is displayed.				

14.11.3 Parameters for analog electronic module 4 AO I HART

Configuration with STEP 7 as of V5.3 SP1 and current hardware update

For description, see online help STEP 7.

Configuration with GSD file

There are different configurations for the 4 AO I HART analog electronic module, which you can select via the following entries in the hardware catalog of the configuration software:

- Configuration "4 AO I HART":
  The analog values are shown in S7 format.
- Configurations "4 AO I +x":
  The analog values are shown in S7 format. In addition, up to 4 IEEE variables (primary or non-primary variable) are available in IEEE 754 format. You select the number of IEEE variables (1 to 4) via the configuration:
  - ...I +1
  - ...I +2
  - ...I +3
  - ...I +4

Parameters for configuration "4 AO I HART"

Table 14-42 Parameters for configuration "4 AO I HART"

Parameter	Range of values	Default	Applicability
Group diagnostics	• Enabled • Disabled	Enabled	Module
Diagnostics: wire break	• Enabled • Disabled	Enabled	Channel
Diagnostics: short-circuit	• Enabled • Disabled	Enabled	Channel

Parameter	Range of values	Default	Applicability
Output range	• Disabled • 0 to 20 mA • 4 to 20 mA • HART	HART	Channel
Response to CPU/ master STOP	• Zero output current/voltage • Use substitute value • Keep last value	Use substitute value	Channel
Substitute value	Every value of the nominal range	0 to 20 mA: 0 mA 4 to 20 mA and HART: 4 mA	Channel

WARNING

The substitute values are stored in the flash memory of the interface module. These are output at the next startup of the ET 200iSP until the ET 200iSP exchanges data with the DP master.

Note this behavior when changing the ET 200iSP to another configuration environment.

Remedy: Delete the flash memory of the interface module beforehand.

Parameters for configuration "...I +x"

In addition to the "4 AO I HART" configuration, the following parameters can be set in the "...I +x" configurations:

Table 14-43 Parameters for configuration "I +x"

Parameter	Range of values	Default	Applicability
HART retries (number of retries)	0 to 10	2	Module
HART Fast Mode	• Enabled • Disabled	Disabled	Module
Channel	• 0 • 1 • 2 • 3	0	Channel
IEEE variable,	• None • Primary variable • 1st non-primary variable • 2nd non-primary variable • 3rd non-primary variable	None	Channel

Parameter	Range of values	Default	Applicability
HART warning	• Enabled • Disabled	Disabled	Module
HART diagnostics	• Enabled • Disabled	Disabled	Module

14.12 Parameter description of the analog electronic modules

14.12.1 Reference junction / reference junction number

Description

Refer to "Connecting thermocouples (Page 386)".

14.12.2 Smoothing

Using the smoothing

Smoothing of analog values provides a stable analog signal for further processing.

Smoothing of analog values is useful for slow changes in measured values, e.g. temperature changes.

Parameters

The measured values are smoothed using a digital filter. Smoothing is achieved by the module averaging a fixed number of converted (digitized) analog values.

You parameterize the smoothing in a maximum of 4 levels (none, weak, medium, strong). The level determines the number of analog signals that are used for generating the moving average.

The stronger the smoothing is performed, the more stable the smoothed analog value is and the longer it takes until the smoothed analog signal is present after a step response (see the example below).

Example

The following figure shows after how many module cycles it takes for the smoothed analog value to approach 100 % in the case of a step response, depending on the set smoothing. This specification is valid for all signal changes at the analog input.

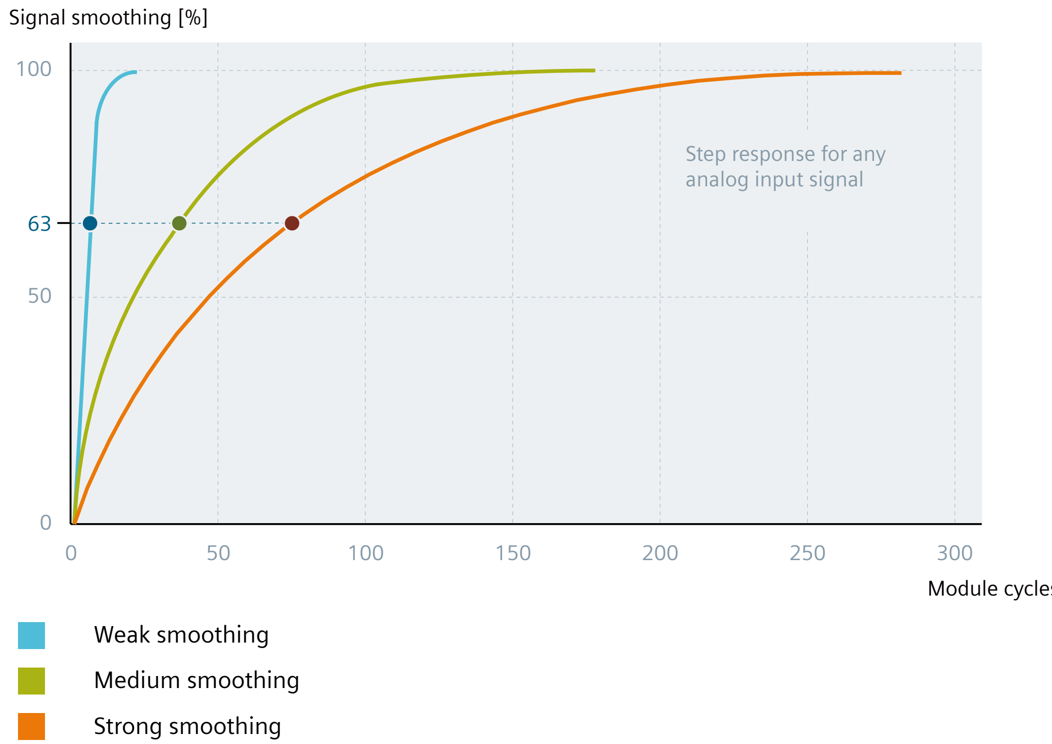


Figure 14-11 Example of the influence of smoothing on the step response

14.12.3 Assigning the channel and IEEE tag

Properties

The analog electronic modules 4 AI I 2WIRE HART, 4 AI I 4WIRE HART and 4 AO I HART support up to four IEEE variables.

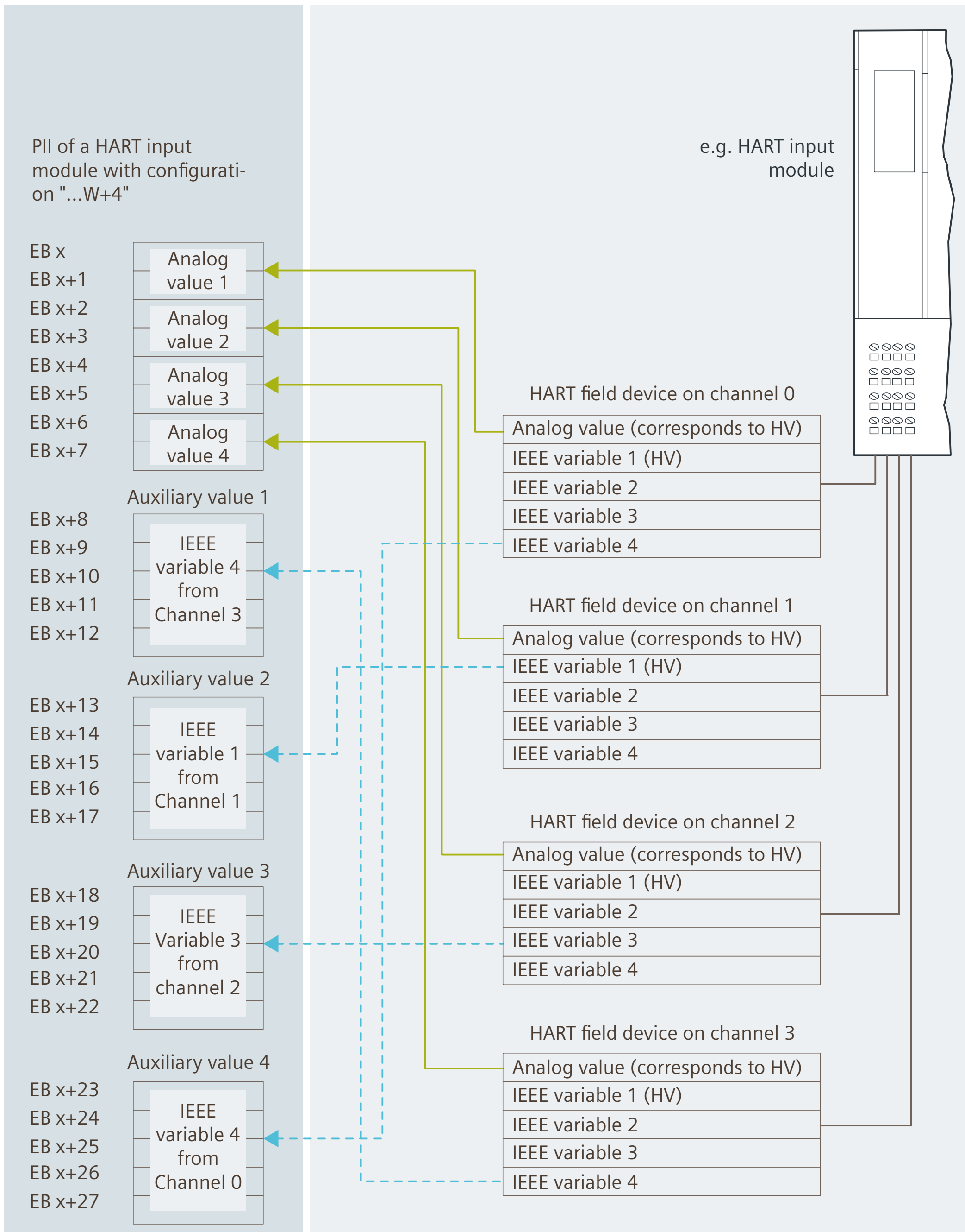
In the process image input (PII), a maximum of 20 bytes per module are available for the IEEE variables. For the four IEEE variables, there are thus four blocks of 5 bytes each within the PII.

Requirements

The HART field device must support the parameterized number of the IEEE variables.

Assigning IEEE variables

You assign the IEEE variables of the field devices to the 4 blocks in the PII as required.



(green)	Fixed assignment of the analog values in the PII
(blue)	Any assignment of the IEEE variables in the PII.
HV	Primary variable

Figure 14-12 Assignment of the IEEE variables

Configuring IEEE variables with STEP 7 as of V5.3 SP1 and current hardware update

For description, see online help STEP 7.

Configuring IEEE variables with GSD file

First, you must configure the number of IEEE variables required (1 to 4). To do this, select the corresponding entry in the configuration table of the configuration software:

- ...+1
- ...+2
- ...+3
- ...+4

Assigning parameters for IEEE variables

Now you have to select the desired IEEE variables of the field device. For this purpose, the following parameters are available for each block in the PII at the analog electronic modules 4 AI I 2WIRE HART, 4 AI I 4WIRE HART and 4 AO I HART:

Channel parameter: This parameter is used to specify the channel or field device from which the IEEE variable is read in.

Parameter **IEEE variable**: Select here the IEEE variable (1 to 4) of the field device that is assigned to the PII.

14.12.4 HART repetitions

Description

You can use this parameter to specify the number of retries made before a diagnostic result is output for HART communication errors.

14.12.5 HART Fast Mode

Description

For enabled HART fast mode, the HART electronic modules support the processing of HART commands as SHC string (Successive HART Command).

14.12.6 HART warning

Description

If you enable this parameter, then a diagnostic interrupt is triggered for the following HART warnings (see Error types of the electronic modules with PROFIBUS (Page 209)):

- HART additional status available
- HART configuration changed

14.12.7 HART diagnostics

Description

If you enable this parameter, a diagnostic interrupt is triggered for the following HART diagnostics (see Error types of the electronic modules with PROFIBUS (Page 209)):

- HART analog output current specified
- HART analog output current saturated
- HART communication error
- HART primary variable outside of the limits
- HART non-primary variable outside of the limits

Other modules 15

15.1 Reserve module (Standby module)

Article number

6ES7138-7AA00-0AA0

Properties

The reserve module (standby module) is characterized by the following properties:

- Is suitable for all terminal modules on which you can insert an electronic module.
- Reserves a slot for any electronic module. Plug the reserve module into the reserved slot of the ET 200iSP configuration.
- If a gap (of an electronic module) occurs due to the ET 200iSP configuration, the following rules apply:
  - The gap is located at the last slot of the ET 200iSP: Insert a reserve module or the slot cover into the gap.
  - The gap is at a different slot (for electronic modules): Plug a reserve module into this gap (see section Diagnostics for incorrect configuration states of the ET 200iSP with PROFIBUS (Page 220)).
- As of product version 3, the reserve module can also be inserted onto the terminal module TM-RM/RM.

Procedure with CiR

See function manual "Modifying the system during operation via CiR (https://support.automation.siemens.com/WW/view/en/14044916)".

Pin assignment

The reserve module has no connection to the terminals of the terminal module. This means that you can wire the terminal module completely and prepare it for the future application.

Technical specifications

Article number	6ES7138-7AA00-0AA0
General information	
Product type designation	Reserve module
Digital inputs	
Number of digital inputs	0
Standards, approvals, certificates	
CE mark	Yes
Use in hazardous areas	
• ATEX marking	II2 G EEx ib IIC T4
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm
Weights	
Weight, approx.	180 g

Technical specifications	
Module-specific data	
Power loss of the module	max. 0.03 W

Approvals

ATEX			II 2 G and I M2 Ex ib IIC T4 Gb Ex ib I Mb KEMA 04 ATEX 1251	0344
IECEx			IECEx KEM 05.0013	
INMETRO	INMETRO	BR OCP-0029	BR-Ex ib IIC T4 Gb BR-Ex ib I Mb	
FM	C US APPROVED		Class I, Zone 1, AEx ib IIC T4; Ex ib IIC T4 NI, Class I, DIV. 2, GP A,B,C,D T4 Class II, III, GP E,F,G	
cULus	LISTED E334384		Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx ib IIC T4 Ex ib IIC T4 CL I, DIV. 2, GP. A,B,C,D	

CCC		Ex ib IIC T4 Gb
UKCA		DEKRA 21UKEX0026

See also

Installing the Terminating Module and the Slot Cover (Page 114)

15.2 Watchdog module

Article number

6ES7138-7BB00-0AB0

Properties

Functional check of the ET 200iSP: The written value is transferred to the input data according to the assigned function (see parameters of the WATCHDOG module). Wiring is not required for this purpose.

Note

You have to integrate the functional check of the WATCHDOG module into your user program and evaluate it programmatically.

- Provision of an intrinsically safe 11 V supply for the shutdown signal of the digital output modules. See Digital electronics module 4 DO (Page 305)

  Note

  The intrinsically safe supply for the shutdown signal may only be used within the ET 200iSP station in which the WATCHDOG module is located.

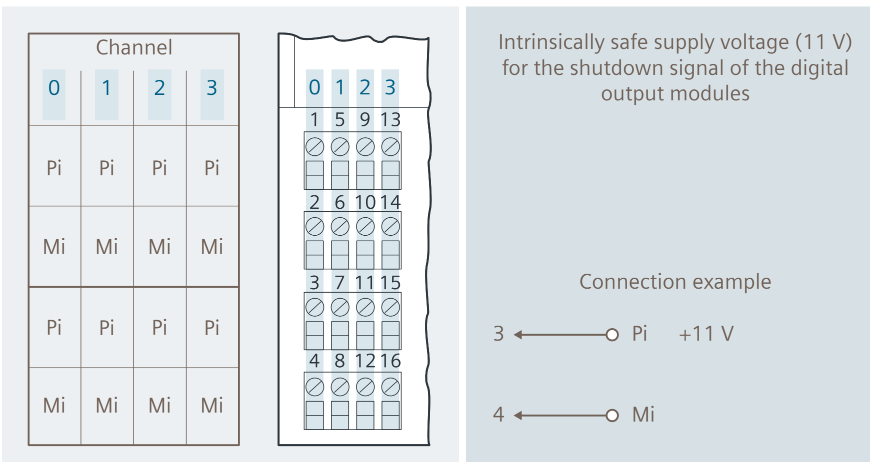
  The maximum cable length for the shutdown signal is 20 m.

- Identification and maintenance data I&M

Pin assignment

Pin assignment for plugged WATCHDOG module

Table 15-1 Pin assignment of terminal module WATCHDOG

<table>
<tr><th>Pin assignment and view</th><th>Remarks</th></tr>
<tr><td>


</td><td>Connections:
Pi: Terminals 1, 3, 5, 7, 9, 11, 13, 15
Mi: Terminals 2, 4, 6, 8, 10, 12, 14, 16

Pi: Intrinsically safe supply voltage (11 V)
Mi: Ground</td></tr>
</table>

Block diagram

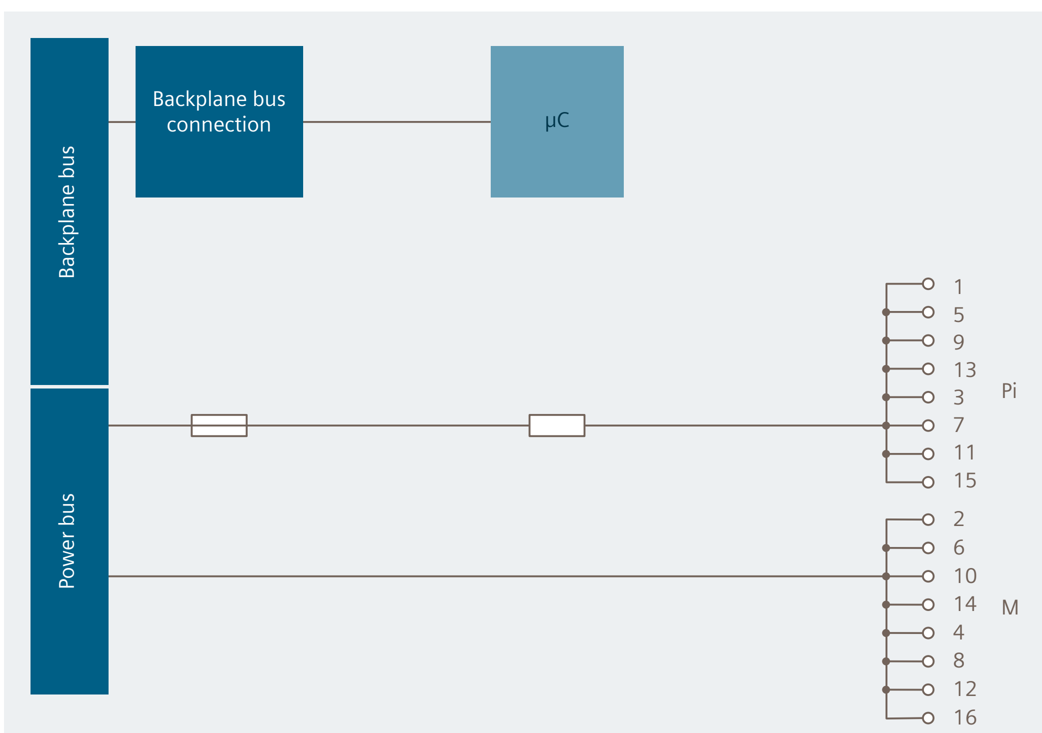


Figure 15-1 Block diagram of WATCHDOG module

Technical specifications

Article number	6ES7138-7BB00-0AB0
General information	
Product type designation	Watchdog module
Digital inputs	
Number of digital inputs	0
Dimensions	
Width	30 mm
Height	129 mm
Depth	136.5 mm

Technical specifications	
Voltages, currents, electrical potentials	
Electrical isolation	
• Between the channels and backplane bus	Yes
• Between channels	No
• Between the channels and load voltage (power bus)	Yes
Permissible potential difference	
• Between different circuits	DC 60 V, AC 30 V
Current consumption from load voltage (power bus)	2 mA * Number of connected digital output modules.
Power loss of the module	0.05 W
Status, interrupts, diagnostics	
Status display	
• Input (bit)	Green LED
Diagnostic function	
• Group error display	Red "SF" LED
• Diagnostic function can be read	Yes
Safety data	
U_o = 12.7 V I_o = 329 mA P_o = 0.91 W C_o = 1 μF L_o = 0.3 mH For additional C_o / L_o combinations, see certificate IECEx KEM 06.0026 https://www.iecex.com (https://www.iecex.com) KEMA 06 ATEX0086 INMETRO UL-BR 12.0075 https://support.industry.siemens.com (https://support.industry.siemens.com)	

Approvals

ATEX		II 2 G and I M2 Ex ib IIC T4 Gb Ex ib I Mb KEMA 06 ATEX 0086	0344
IECEx		IECEx KEM 06.0026	
INMETRO	INMETRO / BR OCP-0029	BR-Ex ib IIC T4 Gb BR-Ex ib I Mb	
FM	C FM US APPROVED	Class I, Zone 1, AEx ib IIC T4; Ex ib IIC T4 NI, Class I, DIV. 2, GP A,B,C,D T4 Class II, III, GP E,F,G	
cULus	LISTED E334384	Process Cont. Eq. for Use in HAZ.LOC. Class I, Zone 1, AEx ib IIC T4 Ex ib IIC T4 Class I, DIV. 2, GP. A,B,C,D T4	
CCC		Ex ib IIC T4 Gb	
UKCA		DEKRA 21UKEX0028	

Parameters

Parameter	Range of values	Default	Applicability
Operating mode	• Disabled • write/ read • write/ read neg. • toggle 0.1 Hz • toggle 0.5 Hz • toggle 1 Hz • toggle 2 Hz	write/ read	Module
Response to CPU/ Master STOP	• Keep last value • set to 00_H • set to FF_H	Keep last value	Module

Parameter description: Operating mode

Disabled: A value that you write to the output byte is not transferred to the input byte.

write/ read: A value that you write to the output byte is transferred to the input byte.

write/ read neg.: A value that you write to the output byte is inverted and transferred to the input byte.

toggle 0.1 Hz; toggle 0.5 Hz; toggle 1 Hz; toggle 2 Hz: The bit 0 (see Address space of the inputs and outputs (Page 435)) in the input byte of the PII toggles (flashes) with the specified frequency.

Parameter description: Response to CPU/ master STOP

Keep last value: The last value in the output byte of the PIQ is retained.

Set to 00_H: The value in the output byte of the PIQ is set to 00_H.

Set to FF_H: The value in the output byte of the PIQ is set to FF_H.

Appendix A

A.1 Article numbers

Introduction

In the following, you can find article numbers of the ET 200iSP distributed I/O device and of the accessories for the network connection that you may need for using ET 200iSP.

Interface module

Table A-1 Interface module

Designation	Quantity	Article number
Interface module IM 152-1PN (PROFINET IO)	1 unit	6ES7152-1BA00-0AB0
Interface module IM 152-1DP (PROFIBUS DP)	1 unit	6ES7152-1AA00-0AB0
PN Ex-optical Transceiver Module	1 unit	A5E51793919

Terminal modules

Table A-2 Terminal modules

Designation	Quantity	Article number
TM-PS-A	1 unit	6ES7193-7DA10-0AA0, only still available as spare part
TM-PS-A	1 unit	6ES7193-7DA20-0AA0
TM-PS-B	1 unit	6ES7193-7DB10-0AA0, only still available as spare part
TM-PS-B	1 unit	6ES7193-7DB20-0AA0
TM-IM/IM and termination module	1 unit	6ES7193-7AB00-0AA0
TM-IM/EM 60S (screw terminal) and termination module	1 unit	6ES7193-7AA00-0AA0
TM-IM/EM 60C (spring terminal) and termination module	1 unit	6ES7193-7AA10-0AA0
TM-EM/EM 60S (screw terminal)	1 unit	6ES7193-7CA00-0AA0
TM-EM/EM 60C (spring terminal)	1 unit	6ES7193-7CA10-0AA0
TM-RM/RM (screw terminal)	1 unit	6ES7193-7CB00-0AA0
TM-EM/EM (black screw terminals)	1 unit	6ES7193-7CA20-0AA0
TM-IM/EM (black screw terminals)	1 unit	6ES7193-7AA20-0AA0

Note

Terminal modules with blue and black terminals

Terminal modules with blue terminals and terminal modules with black terminals may not be combined within a ET 200iSP station. Exception: TM-RM/RM, any combination is possible here.

An ET 200iSP station constructed with black terminals only, and an ET 200iSP station constructed with blue terminals only, must not be connected to the same RS 485-IS coupler if the station is connected to blue terminals with signal lines from the explosion-proof area.

Power supply

Table A-3 Power supply

Designation	Quantity	Article number
Power supply PS DC24V	1 unit	6ES7138-7EA01-0AA0
Power supply PS AC120/230V	1 unit	6ES7138-7EC00-0AA0

Digital electronic modules

Table A-4 Digital electronic modules

Designation	Quantity	Article number
8 DI NAMUR	1 unit	6ES7131-7RF00-0AB0
4 DO DC23.1V/20mA shut down "H"	1 unit	6ES7132-7RD01-0AB0
4 DO DC17.4V/27mA shut down "H"	1 unit	6ES7132-7RD11-0AB0
4 DO DC17.4V/40mA shut down "H"	1 unit	6ES7132-7RD22-0AB0
4 DO DC23.1V/20mA shut down "L"	1 unit	6ES7132-7GD00-0AB0
4 DO DC17.4V/27mA shut down "L"	1 unit	6ES7132-7GD10-0AB0
4 DO DC17.4V/40mA shut down "L"	1 unit	6ES7132-7GD21-0AB0
4 DO DC25.5V/22mA shut down "L"	1 unit	6ES7132-7GD30-0AB0
2 DO Relay UC60V/2A	1 unit	6ES7132-7HB00-0AB0

Analog electronic modules

Table A-5 Analog electronic modules

Designation	Quantity	Article number
4 AI I 2WIRE HART	1 unit	6ES7134-7TD00-0AB0
4 AI I 4WIRE HART	1 unit	6ES7134-7TD50-0AB0
4 AI RTD	1 unit	6ES7134-7SD51-0AB0
4 AI TC and TC sensor module	1 unit	6ES7134-7SD00-0AB0
4 AO I HART	1 unit	6ES7135-7TD00-0AB0

Fail-safe electronic modules

Table A-6 Fail-safe electronic modules

Designation	Quantity	Article number
4 F-AI I 2WIRE Fail-safe	1 unit	6ES7138-7FA00-0AB0
4 F-DO DC17.4V/40mA Fail-safe	1 unit	6ES7138-7FD00-0AB0
8 F-DI NAMUR Fail-safe	1 unit	6ES7138-7FN00-0AB0

Other modules

Table A-7 Other modules

Designation	Quantity	Article number
Reserve module	1 unit	6ES7138-7AA00-0AA0
WATCHDOG module	1 unit	6ES7138-7BB00-0AB0

ET 200iSP accessories

Table A-8 ET 200iSP accessories

Designation	Quantity	Article number
Ex e terminal WPE 16/E (for shield support mounting rail)	1 unit	1010400000*
Mounting rail for the S7 technical setup 480 mm 530 mm 585 mm 830 mm 885 mm	1 unit	 6ES7390-1AE80-0AA0 6ES7390-1AF30-0AA0 6ES7390-1AF85-0AA0 6ES7390-1AJ30-0AA0 6ES7390-1AJ85-0AA0
DIN A4 labeling strips, 20 labeling strips for interface module and 60 labeling strips for electronic modules, foil for printing with laser printer or plotter. • Yellow • petrol	10 sheets	6ES7193-7BB00-0AA0 6ES7193-7BH00-0AA0
Unlabeled slot number plate	100 units	8WA8848-2AY
Slot number plates 10 x labeled 1 to 20	200 units	8WA8861-0AB
Slot number plates 5 x labeled 1 to 40	200 units	8WA8861-0AC
Slot number plate 2 x labeled 1 to 68 and 1 x labeled 1 to 64	200 units	8WA8861-0DA
* Article number: Fa. Weidmüller GmbH & Co. KG, P.O. Box 3054, 32720 Detmold http://www.weidmueller.com (https://www.weidmueller.com) http://catalog.weidmueller.com (https://catalog.weidmueller.com)		

Enclosure for the ET 200iSP

Table A-9 Enclosure for the ET 200iSP

Designation	Quantity	Article number
Wall box for Zone 1/2 degree of protection Ex e; stainless steel; foldable box cover; 3 rows of cable inlets M16 (41 pcs at 650 mm wide 68 pcs at 950 mm wide) and 2 rows of blanking plugs **Empty enclosure prepared:** • 650x450x230 suitable for max. 15 electronic modules • 950x450x230 suitable for max. 25 electronic modules **With installation and interconnection of the ET 200iSP in the wall box[1]:** • 650x450x230 suitable for max. 15 electronic modules • 950x450x230 suitable for max. 25 electronic modules	1 unit	6DL2804-0AD30 6DL2804-0AE30 6DL2804-1AD30 6DL2804-1AE30
Wall box for Zone 1/2 degree of protection Ex e; stainless steel; hinged enclosure cover; 5 rows cable entries M16=max. Components (66 pcs. for 650 mm width and 111 pcs. for 950 mm width) **Empty enclosure prepared:** • 650x450x230 suitable for max. 15 electronic modules • 950x450x230 suitable for max. 25 electronic modules **With installation and interconnection of the ET 200iSP in the wall box[1]:** • 650x450x230 suitable for max. 15 electronic modules • 950x450x230 suitable for max. 25 electronic modules	1 unit	6DL2804-0AD50 6DL2804-0AE50 6DL2804-1AD50 6DL2804-1AE50

Designation	Quantity	Article number
Wall box for Zone 21/22 degree of protection IP65; stainless steel; foldable box cover; 3 rows of cable inlets M16 (41 pcs at 650 mm wide 68 pcs at 950 mm wide) and 2 rows of blanking plugs **Empty enclosure prepared:** • 650x450x230 suitable for max. 15 electronic modules • 950x450x230 suitable for max. 25 electronic modules **With installation and interconnection of the ET 200iSP in the wall box[1]:** • 650x450x230 suitable for max. 15 electronic modules • 950x450x230 suitable for max. 25 electronic modules	1 unit	 6DL2804-0DD30 6DL2804-0DE30 6DL2804-1DD30 6DL2804-1DE30
Wall box for Zone 21/22 degree of protection IP65; stainless steel; hinged enclosure cover; 5 rows cable entries M16=max. Components (66 pcs. for 650 mm width and 111 pcs. for 950 mm width) **Empty enclosure prepared:** • 650x450x230 suitable for max. 15 electronic modules • 950x450x230 suitable for max. 25 electronic modules **With installation and interconnection of the ET 200iSP in the wall box[1]:** • 650x450x230 suitable for max. 15 electronic modules • 950x450x230 suitable for max. 25 electronic modules	1 unit	 6DL2804-0DD50 6DL2804-0DE50 6DL2804-1DD50 6DL2804-1DE50
[1] The components of the ET 200iSP are not included. These must be ordered and purchased separately.		

Network components

The following table lists all network components required for the use of the ET 200iSP.

Note

Bus cable

The recommended bus cable serves as a reference and is not mandatory. However, the cable you use must match the characteristic values of this cable (e.g. capacity, inductance).

Table A-10 Network components for ET 200iSP

Designation	Quantity	Article number	Required for the configuration variant	
			PROFINET IO	**PROFIBUS DP**
Media converter RJ45/FOC (e.g. "Optical connection (https://support.industry.siemens.com/cs/ww/en/view/109761426)")	1 unit	Contact your Siemens representative Siemens.	YES	**NO**
Ethernet cable with RJ45 connector (e.g. "Passive network components (https://support.industry.siemens.com/cs/ww/en/view/84922825)")	1 unit		YES	**NO**
LC cable (e.g. "Passive network components (https://support.industry.siemens.com/cs/ww/en/view/84922825)")	1 unit		YES	**NO**
RS 485-IS coupler	1 unit	6ES7972-0AC80-0XA0	**NO**	YES
PROFIBUS bus connector RS 485-IS, with inclined cable outlet, reversible active bus terminating resistor	1 unit	6ES7972-0DA60-0XA0	**NO**	YES
Bus cable for PROFIBUS	Sold in meters	6XV1830-0EH10	**NO**	YES
Bus cable for PROFIBUS RS 485 IS, blue (PB FC Standard Cable IS GP)	Sold in meters	6XV1831-2A	**NO**	YES

Automation Systems Principles of Explosion Protection manual

Manual	Contents
Automation systems basics of explosion protection as download from Technical Support: Technical Support (https://www.siemens.com/automation/service)	for example • Current explosion protection standards and guidelines • Explanation of protective measures and marking of equipment • Notes on setup, operation and maintenance of equipment for hazardous areas

Product information RS 485-IS coupler

Product information	Contents
RS 485-IS coupler as download from Technical Support: Technical Support (https://www.siemens.com/automation/service)	for example • Properties • Installation • Wiring • Technical specifications

Reference book "Dezentralisieren mit PROFIBUS-DP"

Technical book	Article numbers	Contents
Decentralizing with PROFIBUS DP - Installation, configuration and use of PROFIBUS-DP with SIMATIC S7 - Josef Weigmann, Gerhard Kilian Publicis MCD Verlag, 3rd printing	In bookstores: ISBN 3895781894 at your Siemens branch: A19100-L531-B772	Instruction manual for getting started with PROFIBUS DP and with the implementation of automation tasks using PROFIBUS-DP and SIMATIC S7. Based on SIMATIC S7, the use of PROFIBUS-DP is demonstrated with many practical application examples.

SIMATIC Manual Collection - DVD

Designation	Article number	Contents
SIMATIC Manual Collection	6ES7998-8XC01-8YE2	Contains all SIMATIC manuals in electronic format

Technical product data - DVD

Designation	Article number	Contents
Technical product data for S7-300, S7-400 and ET 200	6ES7991-0CD01-0YX0	Contains the following technical product data for CAD/CAE systems: • Technical data according to ECAD component standard V1.2 • Graphical data (drawings) • Circuit-diagram macros

A.2 Dimensional drawings

Introduction

Below you will find the dimension drawings of the most important components for the ET 200iSP.

Terminal module TM-PS-A, TM-PS-B with plugged power supply PS

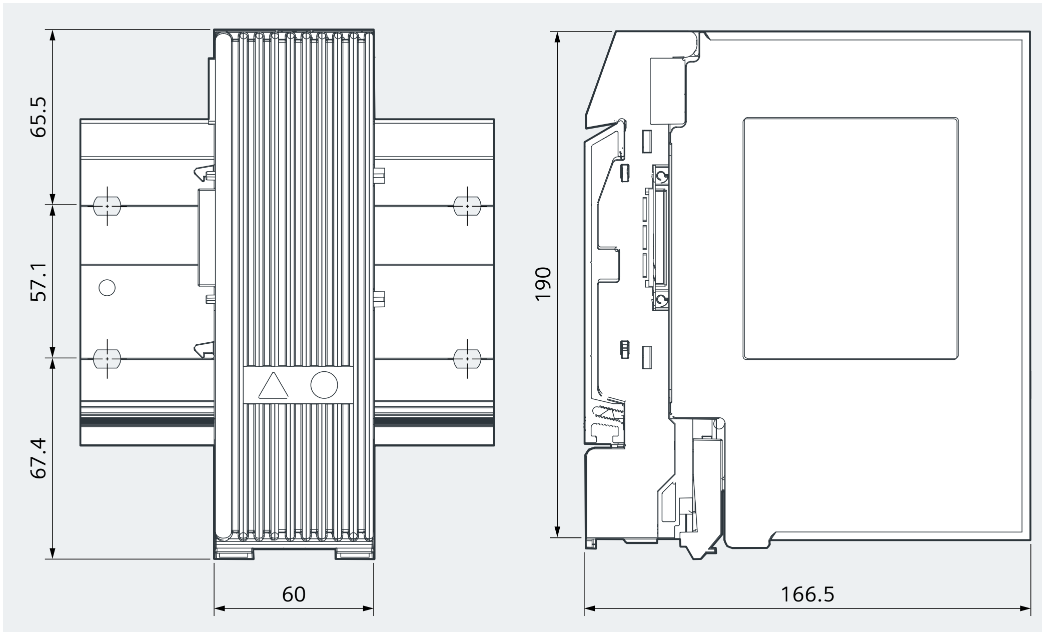


Figure A-1 Terminal module TM-PS-A with plugged power supply PS

Terminal module TM-IM/EM with plugged IM 152-1PN and electronic modules

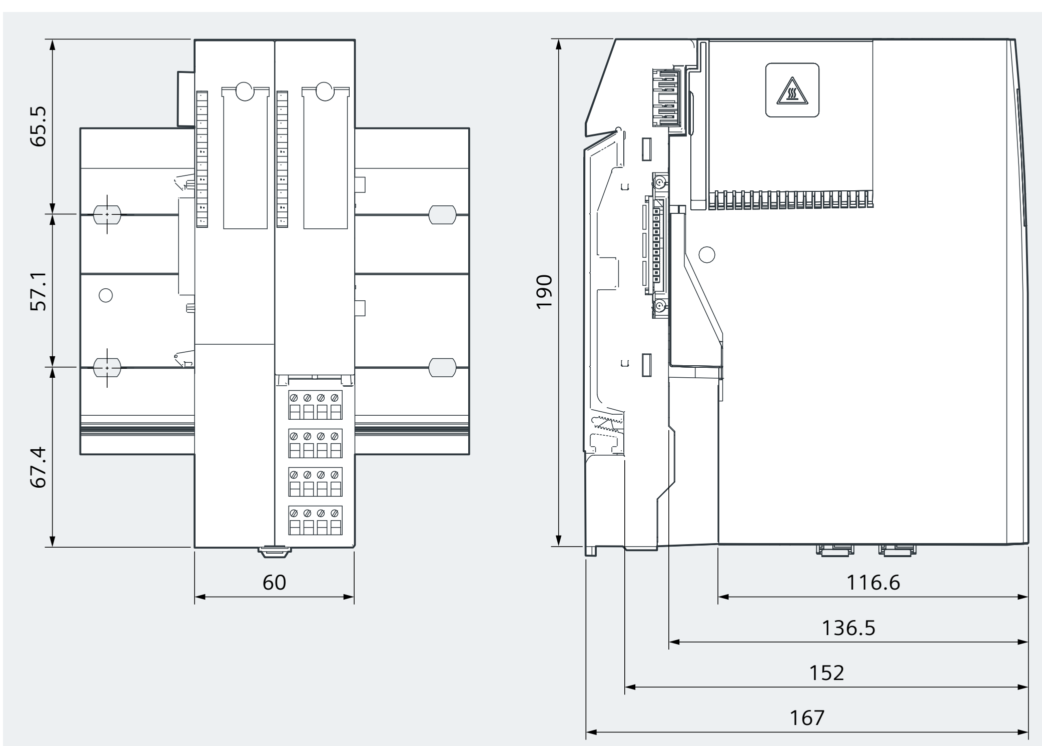


Figure A-2 Terminal module TM-IM/EM with plugged IM 152-1PN and electronic modules

Terminal module TM-IM/EM with plugged IM 152-1DP and electronic modules

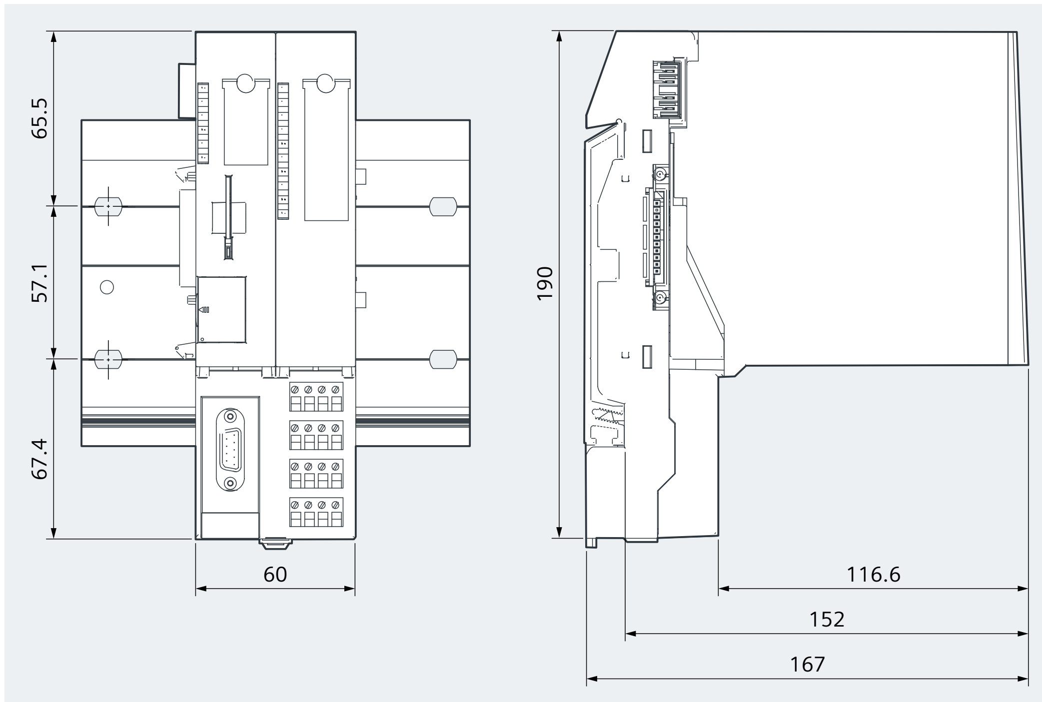


Figure A-3 Terminal module TM-IM/EM with plugged IM 152-1DP and electronic modules

Terminal module TM-EM/EM with plugged electronic modules

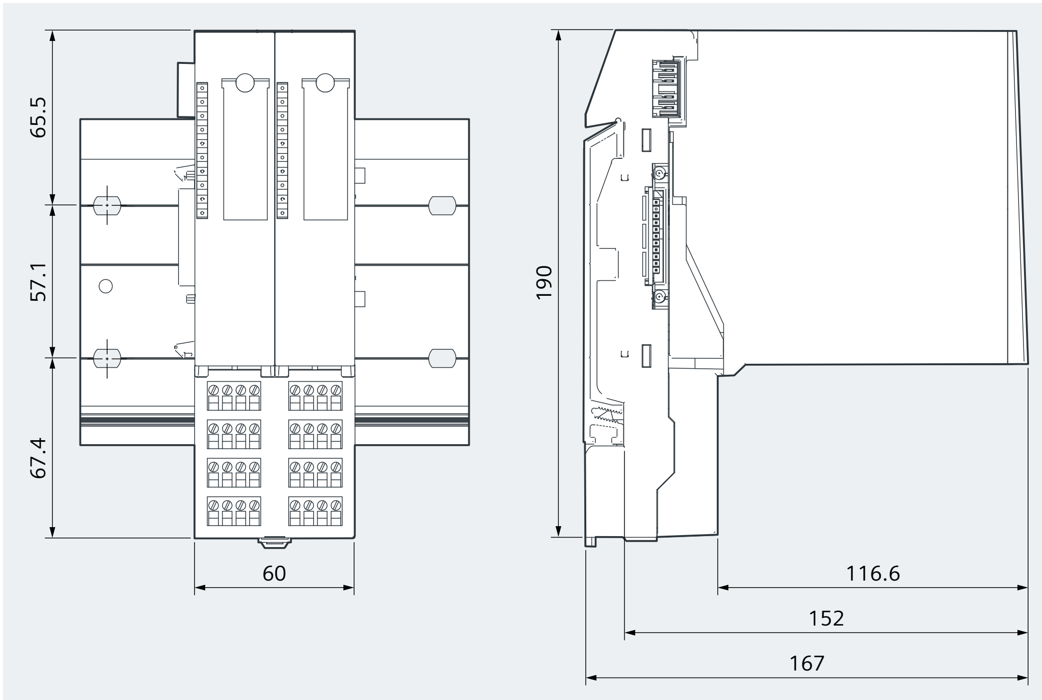


Figure A-4 Terminal module TM-EM/EM with plugged electronic modules

Terminal module TM-RM/RM with plugged electronic modules

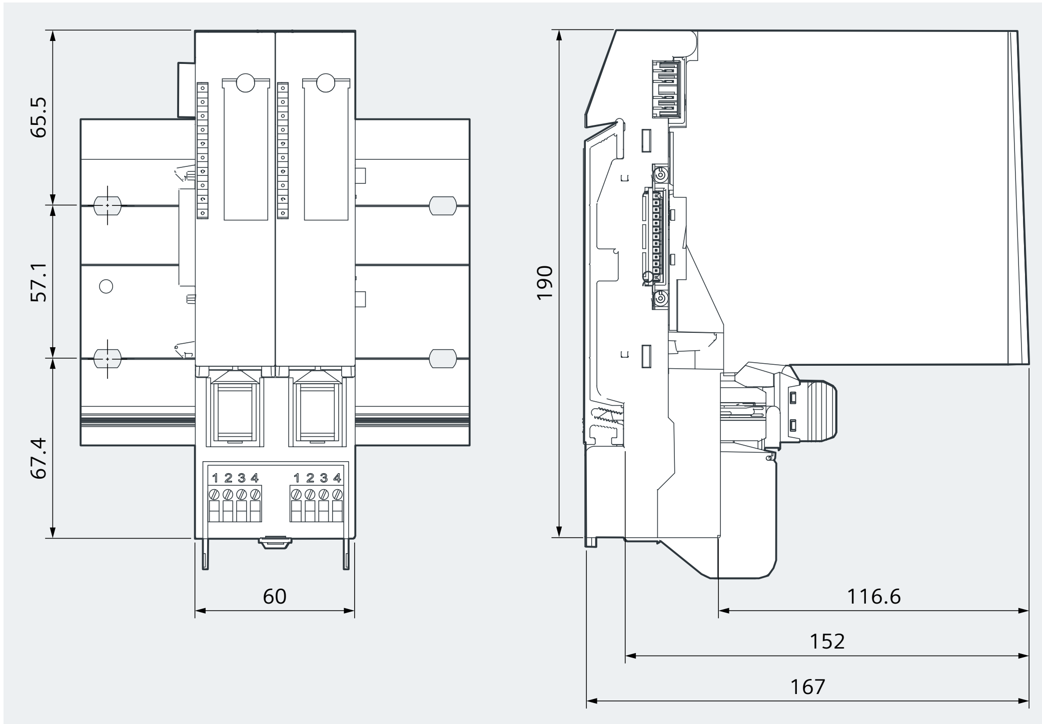


Figure A-5 Terminal module TM-RM/RM with plugged electronic modules

Terminating module

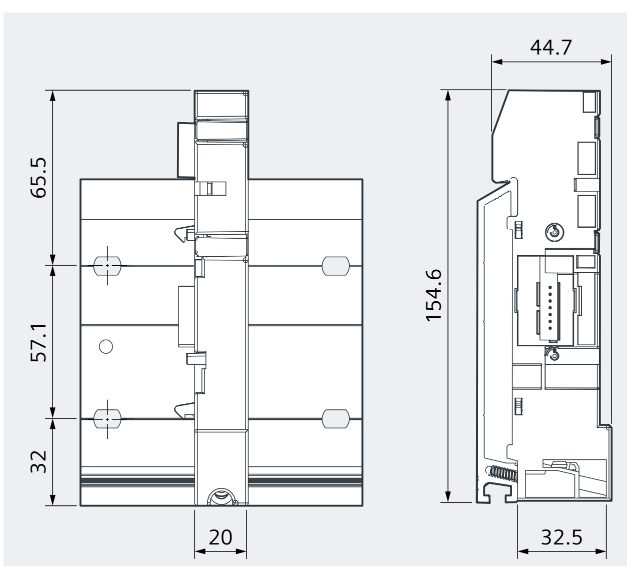


Figure A-6 Terminating module

A.3 Reaction times

Operating principle

The following figure shows the different response times between DP master and ET 200iSP.

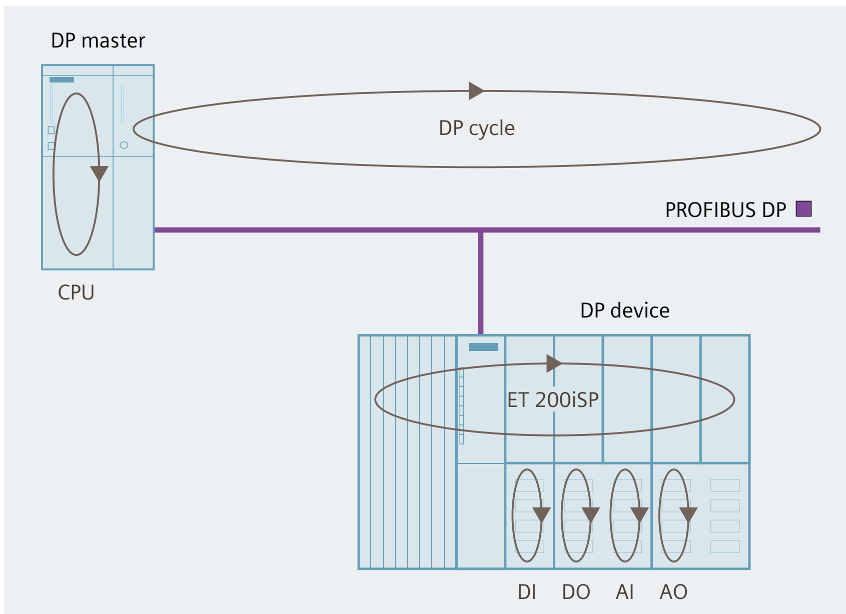


Figure A-7 Reaction times between DP master and ET 200iSP

A.3.1 Response times at the DP master

Reference

For information on response times, refer to the manual of the DP master used.

A.3.2 Reaction times on the ET 200iSP

The response time of the ET 200iSP depends on

- Number of modules
- Number of diagnostic messages
- Pulling and plugging modules
- Interrupts

Calculating the reaction time of the ET 200iSP

The following formula allows an approximate calculation of the ET 200iSP response time with the IM 152-1DP:

Response time [ms] = g + b × 0.065 ms

Explanation of the parameters:

- g: Basic value of the IM 152-1DP according to operating mode
- b: Sum of all input and output bytes of the electronic modules

Table A-11 The following assignment applies to the basic value of IM 152-1DP:

Operating mode	Basic value (g) *)
IM 152-1DP (no redundancy mode)	1.5 ms
Redundancy mode IM 152-1DP	2 ms

*) The specified basic values only apply to cyclic data exchange. Acyclic activities (e.g. diagnostic interrupts) are ignored.

Table A-12 The following table applies for determining all input and output bytes (I/O bytes) and as a template for calculation:

Electronic modules	Number of I/O bytes *)	x number of modules	Total I/O bytes
8 DI NAMUR with digital inputs	3	X	=
8 DI NAMUR with counting Inputs	7	X	=
4 DO / 2 DO Relay	2	X	=
4 AI / 4 AO without HART	8	X	=
8 x = 4 AI / 4 AO with HART	28 (max.)	X	=
WATCHDOG	2	X	=
		Total of all I/O bytes (b)	=

*) Only a partial spectrum, the input and output bytes of each electronic module must be added together.

Example for the calculation of the response time

ET 200iSP with the following configuration:

- IM 152-1DP (no redundancy mode)
- 3 modules 8 DI NAMUR with digital inputs
- 3 modules 4 DO
- 1 WATCHDOG module

Basic value = 1.5 ms

Sum of all I/O bytes = 3 × 3 + 2 × 3 + 2 × 1 = 9 + 6 + 2 = 17

Response time [ms] = 1.5 ms + 17 × 0.065 ms = 2.605 ms

A.3.3 Reaction times of digital input modules

Input delay

The reaction times of the digital input modules depend on the input delay. See technical specifications in section "Digital electronic modules (Page 295)"

A.3.4 Reaction times for the digital output modules

Output delay

The response times correspond to the output delay. See technical specifications in section "Digital electronic modules (Page 295)".

A.3.5 Reaction times for analog input modules

Conversion time

The conversion time is made up of the basic conversion time and the processing time for diagnostic wire-break monitoring (see technical specifications 4 AI RTD and 4 AI TC in section "Analog electronic modules (Page 345)").

The integration time of integrating conversions has a direct influence on conversion times.

Cycle time

The analog/digital conversion and the transfer of the digitized measured values to memory or to the backplane bus take place sequentially. In other words, the analog input channels are converted one after the other. The cycle time, that is, the time until an analog output value is converted again, is the sum of the conversion times of all the activated analog output channels of the analog input modules. You should deactivate unused analog input channels during parameter assignment in order to reduce the cycle time. The conversion and integration time for a deactivated channel is 0.

The following figure provides you with an overview of what makes up the cycle time for an n-channel analog input module.

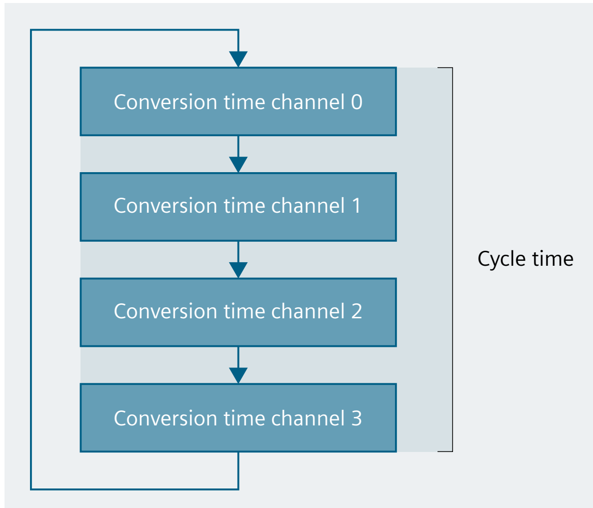


Figure A-8 Cycle time of the analog input module

A.3.6 Reaction times for analog output modules

Conversion time

The conversion time of the analog output channels includes the transfer of the digitized output values from the internal memory and the digital-to-analog conversion.

Cycle time

The conversion of the analog output channels is performed for the module with a processing time and sequentially with a conversion time for channels 0, 1, 2 and 3.

The cycle time, i.e. the time until an analog output value is converted again, is the sum of the conversion times of all activated analog output channels and the processing time of the analog output module.

The following figure shows an overview of how the cycle time for an analog output module is composed.

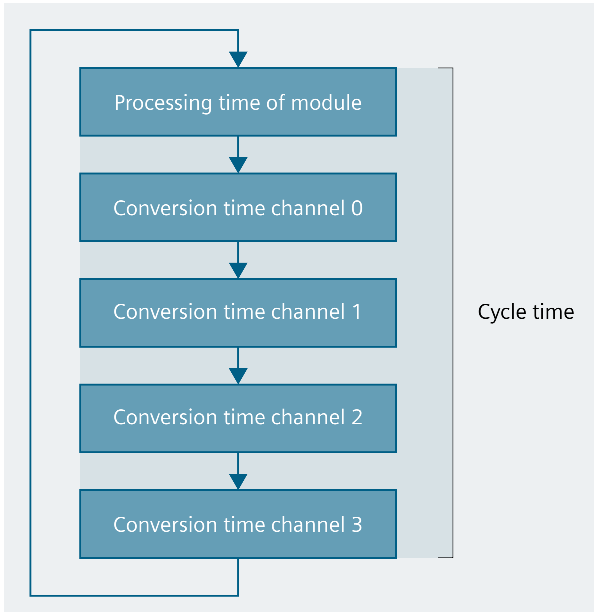


Figure A-9 Cycle time of the analog output module

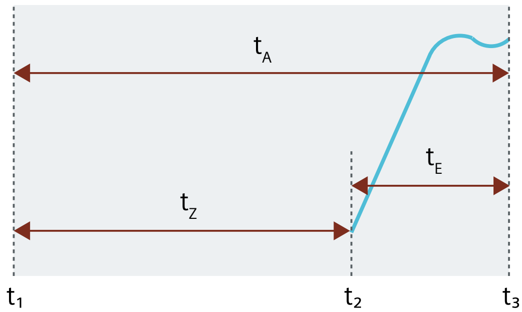
Settling time

The settling time (t_2 to t_3), that is, the time from the application of the converted value until the specified value is reached at the analog output, depends on the load. A distinction must be made between resistive, capacitive and inductive loads.

Response time

The response time (t_1 to t_3), that is, the time from the digital output values being present in the internal memory until the specified value is reached at the analog output, in the worst case, is the sum of cycle time and settling time. The most unfavorable case is when the analog channel was converted shortly before transmission of a new output value and is only converted again after conversion of the other channels (cycle time).

The following figure shows the response time of the analog output channel.



t_Q Response time

t_Z Cycle time corresponds to the processing time of the module and the conversion time of the channel

t_I Settling time

t_1 new digital output value is present

t_2 Output value applied and converted

t_3 specified output value reached

Figure A-10 Response time of an analog output channel

A.4 Address space of the inputs and outputs

A.4.1 Digital input module

8 DI NAMUR

The address range of the process image inputs and outputs (PII) that is occupied is dependent on the configuration, that is, on the selection of the corresponding entry in the configuring software.

8 DI NAMUR mit configuration "8 DI NAMUR"

Assignment of the process image inputs (PII)

Table A-13 PII for configuration "8 DI NAMUR" (S7 format)

PII	7	6	5	4	3	2	1	0	Description
IB x	7	6	5	4	3	2	1	0	Channels 0 to 7 of the input signal
IB x+1	7	6	5	4	3	2	1	0	
IB x+2	Not occupied								
Value status for channels 0 to 7: • 1_B: Input signal is valid • 0_B: Input signal is invalid									

Assignment of the process image outputs (PIQ)

The PIQ is not assigned.

8 DI NAMUR with configuration "2 Count/ 6 DI NAMUR" or "2 Count/ 6 control signals"

Assignment of the process image inputs (PII)

Table A-14 PII for configuration "2 Count/ 6 DI NAMUR" (S7 format)

PII	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**Description**	
IB x									Actual value counter 1	Actual value counter 1 (cascading counting function)
IB x+1										
IB x+2									Actual value counter 2	
IB x+3:										
IB x+4									Bit 0: Counter output 1 Bit 1: Counter output 2 Bit 2 to Bit 7: Digital input 2 to digital input 7	
IB x+5	7	6	5	4	3	2				
IB x+6	Not occupied									
Value status for channels 2 to 7: • 1_B: Input signal is valid • 0_B: Input signal is invalid										

Table A-15 Example: Actual value counter 1 normal counting function

PII	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**Description**
IB x	$2A_H$								10885
IB x+1	85_H								

Table A-16 Example: Actual value counter 1 cascading counting function

PII	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**Description**
IB x	00_H								117573
IB x+1	01_H								
IB x+2	CB_H								
IB x+3:	45_H								

Assignment of the process image outputs (PIQ)

Table A-17 PIQ for configuration "2 Count/ 6 DI NAMUR"

PIQ	7	6	5	4	3	2	1	0	Description	
QB x									Setpoint counter 1	Setpoint counter 1 (cascading counter function)
QB x+1										
QB x+2									Setpoint counter 2	
QB x+3										
QB x+4									Bit 0: Not occupied Bit 1: Not occupied Bit 2: Control signal GATE 1 Bit 3: Control signal GATE 2 Bit 4: Control signal reset counter 1 Bit 5: Control signal reset counter 2 Bit 6: Control signal reset counter output 1 Bit 7: Control signal reset counter output 2	

8 DI NAMUR mit configuration "2 Trace/ 6 DI NAMUR"

Assignment of the process image inputs (PII)

Table A-18 PII for configuration "2 Trace/ 6 DI NAMUR" (S7 format)

PII	7	6	5	4	3	2	1	0	Description
IB x									Frequency meter 1
IB x+1									
IB x+2									Frequency meter 2
IB x+3:									
IB x+4									Bit 0 and Bit 1: Not occupied Bit 2 to Bit 7: Digital input 2 to digital input 7
IB x+5	7	6	5	4	3	2			
IB x+6	Not occupied								
Value status for channels 2 to 7: • 1_B: Input signal is valid • 0_B: Input signal is invalid									

Table A-19 Example: Frequency meter 1 (S7 format)

PII	7	6	5	4	3	2	1	0	Description
IB x	09_H								2317 Hz = 2,317 kHz
IB x+1	$0D_H$								

Assignment of the process image outputs (PIQ)

The PIQ is not assigned.

A.4.2 Digital output module

Address space digital output module

Table A-20 PIQ for digital output module (S7 format)

PIQ	7	6	5	4	3	2	1	0	Description
QB x									Channels 0 to 3 of the output signal Bit 0: Channel 0 (output DO_0) Bit 1: Channel 1 (output DO_1) Bit 2: Channel 2 (output DO_2) Bit 3: Channel 3 (output DO_3)
QB x+1	Not occupied								

A.4.3 Digital output module 2 DO Relay UC60V/2A

Address space digital output module 2 DO Relay UC60V/2A

Table A-21 PIQ for digital output module 2 DO Relay UC60V/2A (S7 format)

PIQ	7	6	5	4	3	2	1	0	Description
QB x									Channels 0 to 1 of the output signal Bit 0: Channel 0 (output DO_0) Bit 1: Channel 1 (output DO_1)
QB x+1	Not occupied								

A.4.4 Analog input modules

Address space analog input modules

Table A-22 PII for analog input modules (S7 format)

PII	7	6	5	4	3	2	1	0	Description
IB x									Input value channel 0
IB x+1									
IB x+2									Input value channel 1
IB x+3:									
IB x+4									Input value channel 2
IB x+5									
IB x+6									Input value channel 3
IB x+7									

Table A-23 Example: Input value on channel 0: $61A8_H$ (S7 format)

PII	7	6	5	4	3	2	1	0	Description
IB x	61_H								Input value channel 0: 25000
IB x+1	$A8_H$								

A.4.5 Analog output modules

Address space analog output modules

Table A-24 PIQ for analog output modules (S7 format)

PIQ	7	6	5	4	3	2	1	0	Description
QB x									Output value channel 0
QB x+1									
QB x+2									Output value channel 1
QB x+3									
QB x+4									Output value channel 2
QB x+5									
QB x+6									Output value channel 3
QB x+7									

Table A-25 Example: Output value on channel 0: $61A8_H$ (S7 format)

PIQ	7	6	5	4	3	2	1	0	Description
QB x	61_H								Output value channel 0: 25000
QB x+1	$A8_H$								

A.4.6 Analog input modules with HART (4 AI I 2WIRE HART, 4 AI I 4WIRE HART)

Address space of analog input modules with HART (4 AI I 2WIRE HART, 4 AI I 4WIRE HART)

Table A-26 PII for analog input modules with HART (S7 format)

PII	7	6	5	4	3	2	1	0	Analog value
IB x									Input value channel 0
IB x+1									
IB x+2									Input value channel 1
IB x+3:									
IB x+4									Input value channel 2
IB x+5									

PII	7	6	5	4	3	2	1	0	Analog value
IB x+6									Input value channel 3
IB x+7									

Table A-27 PII for analog input modules with HART (IEEE754 floating point format)

<table>
<tr><th>PII</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th colspan="2">Description</th></tr>
<tr><td>IB x+8</td><td colspan="8"></td><td rowspan="4">IEEE variable 1 in floating point representation, as specified for HART</td><td rowspan="8">You can select the number of IEEE variables in the configuration.

You can map any IEEE variable of a field device into the PII. See section "IEEE tags (Page 396)"</td></tr>
<tr><td>IB x+9</td><td colspan="8"></td></tr>
<tr><td>IB x+10</td><td colspan="8"></td></tr>
<tr><td>IB x+11</td><td colspan="8"></td></tr>
<tr><td>IB x+12</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>HART status byte for IEEE variable 1, as specified for HART. See section "IEEE tags (Page 396)"</td></tr>
<tr><td>IB x+13
...
IB x+17</td><td colspan="8"></td><td>IEEE variable 2 in floating point representation, as specified for HART and HART status byte (for configuration see IEEE variable 1)</td></tr>
<tr><td>IB x+18
...
IB x+22</td><td colspan="8"></td><td>IEEE variable 3 in floating point representation, as specified for HART and HART status byte (for configuration see IEEE variable 1)</td></tr>
<tr><td>IB x+23
...
IB x+27</td><td colspan="8"></td><td>IEEE variable 4 in floating point representation, as specified for HART and HART status byte (for structure see IEEE variable 1)</td></tr>
</table>

HART status byte: Status codes used by the PROFIBUS PA profile for ET 200iSP:

- 01001100 ($4C_H$) uncertain, initial value (before first contact)
- 00011000 (18_H) bad, no communication (communication error)
- 00001100 ($0C_H$) bad, device failure (device fault)
- 01000111 (47_H) uncertain, last usable event, constant (device is busy)
- 10000100 (84_H) good, update event (re-configuring)
- 10000000 (80_H) good, ok (no error)

A.4.7 Analog output module with HART (4 AO I HART)

Address space of analog output module with HART (4 AO I HART)

Table A-28 PIQ with analog output module with HART (S7 format)

<table>
<tr><th>PIQ</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th>Analog value</th></tr>
<tr><td>QB x</td><td colspan="8"></td><td rowspan="2">Output value channel 0</td></tr>
<tr><td>QB x+1</td><td colspan="8"></td></tr>
<tr><td>QB x+2</td><td colspan="8"></td><td rowspan="2">Output value channel 1</td></tr>
<tr><td>QB x+3</td><td colspan="8"></td></tr>
<tr><td>QB x+4</td><td colspan="8"></td><td rowspan="2">Output value channel 2</td></tr>
<tr><td>QB x+5</td><td colspan="8"></td></tr>
<tr><td>QB x+6</td><td colspan="8"></td><td rowspan="2">Output value channel 3</td></tr>
<tr><td>QB x+7</td><td colspan="8"></td></tr>
</table>

Table A-29 PII for analog output module with HART (IEEE754 floating point format)

<table>
<tr><th>PII</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th colspan="2">Description</th></tr>
<tr><td>IB x</td><td colspan="8"></td><td rowspan="4">IEEE variable 1 in floating point representation, as specified for HART</td><td rowspan="8">You can select the number of IEEE variables in the configuration.

You can map any IEEE variable of a field device into the PII. See section "IEEE tags (Page 396)"</td></tr>
<tr><td>IB x+1</td><td colspan="8"></td></tr>
<tr><td>IB x+2</td><td colspan="8"></td></tr>
<tr><td>IB x+3:</td><td colspan="8"></td></tr>
<tr><td>IB x+4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>HART status byte for IEEE variable 1, as specified for HART. See section "IEEE tags (Page 396)"</td></tr>
<tr><td>IB x+5
...
IB x+9</td><td colspan="8"></td><td>IEEE variable 2 in floating point representation, as specified for HART and HART status byte (for configuration see IEEE variable 1)</td></tr>
<tr><td>IB x+10
...
IB x+14</td><td colspan="8"></td><td>IEEE variable 3 in floating point representation, as specified for HART and HART status byte (for configuration see IEEE variable 1)</td></tr>
<tr><td>IB x+15
...
IB x+19</td><td colspan="8"></td><td>IEEE variable 4 in floating point representation, as specified for HART and HART status byte (for structure see IEEE variable 1)</td></tr>
</table>

HART status byte: Status codes used by the PROFIBUS PA profile for ET 200iSP:

- 01001100 ($4C_H$) uncertain, initial value (before first contact)
- 00011000 (18_H) bad, no communication (communication error)
- 00001100 ($0C_H$) bad, device failure (device fault)

- 01000111 (47_H) uncertain, last usable event, constant (device is busy)
- 10000100 (84_H) good, update event (re-configuring)
- 10000000 (80_H) good, ok (no error)

A.4.8 Watchdog module

Address space WATCHDOG module

Table A-30 PIQ WATCHDOG module

PIQ	7	6	5	4	3	2	1	0	Description
QB x									Output byte

Table A-31 Process image input for WATCHDOG module

PII	7	6	5	4	3	2	1	0	Description
IB x									Input byte Parameterizable, toggle input bit (1: green LED)

A.5 Lightning and overvoltage protection

A.5.1 Overview

Introduction

Common causes of failure include overvoltages caused by:

- atmospheric or
- electrical discharges

The concepts or measures for protection against overvoltages are based on the lightning protection zone concept.

The rules to be observed for the transitions between the individual lightning protection zones are shown in the process.

Note

This section can only give you advice on protecting the ET 200iSP from overvoltage.

However, complete protection against overvoltages is only guaranteed if the entire plant is built based on the lightning protection zone concept. Extensive considerations must be made in this regard as early as the planning phase of the plant.

If you wish to obtain comprehensive information on protection against overvoltages, we recommend that you contact your Siemens representative or a company that specializes in lightning and overvoltage protection.

In the following, the normative term of surge protection device is divided into overvoltage suppressor for pulse shape 8/20 μs and lightning arrester for pulse shape 10/350 μs depending on the expected extent of the threat (pulse shape 8/20 μs or pulse shape 10/350 μs).

Additional literature

The following information is based on the lightning protection zone concept described in the standard IEC 62305-4 "Protection against LEMP".

A.5.2 Lightning protection zone concept

Principle of the lightning protection zone concept according to IEC 62305-4, DIN EN 62305-4, VDE 0185-4

The principle of the lightning protection zone concept states that the volume to be protected against overvoltages, e.g. a control room, is divided into lightning protection zones from an EMC point of view (see the figure below).

The individual lightning protection zones (LPZ: Lightning Protection Zone) delineate spatially as follows and are not necessarily physical boundaries such as walls, floors, etc.

Table A-32 Lightning protection zones

Lightning protection zones (LPZ: Lightning Protection Zone)	
Exterior areas of a plant with direct risk of lightning strike	Lightning protection zone (LPZ) 0_A
Exterior areas of a plant that are not exposed to a direct risk of lightning strike.	Lightning protection zone (LPZ) 0_B
Interior areas of a plant that follow lightning protection zone 0_B.	Lightning protection zone (LPZ) 1
Interior areas of a plant that is usually separate EMC-reducing areas and are located in lightning protection zone 1.	Lightning protection zone (LPZ) 2
Electrical equipment (with shielding properties) in lightning protection zone 2	Lightning protection zone (LPZ) 3

Effect of the lightning strike

Direct lightning strikes occur in lightning protection zone 0_A. Effects of the lightning strike are high-energy lightning currents and strong electromagnetic fields. As direct lightning strikes only occur in lightning protection zone 0_A (as described in the next section), they are not considered.

Only lightning protection zone transitions from 0_B to 1 and higher are considered.

Effects are to be reduced from one lightning protection zone to the next lightning protection zone by means of suitable lightning current or combined lightning current arresters or shielding measures.

As described in EN 1127-1, direct lightning strikes ignite potentially explosive atmospheres. Permanently effective lightning protection systems are therefore mandatory for such installations according to current lightning protection standards.

Overvoltages

Electromagnetic fields of the lightning channel can be reduced with appropriate shielding measures. Overvoltages caused by inductions can be reduced to a harmless level from lightning protection zone 0_B by means of overvoltage suppressors.

Schematic of lightning protection zones

The following figure shows in schematic form the implementation of the lightning protection zone concept for a plant with external lightning protection. The lightning protection zone 0 shown in the figure is divided into lightning protection zone 0_A and 0_B according to the following definitions.

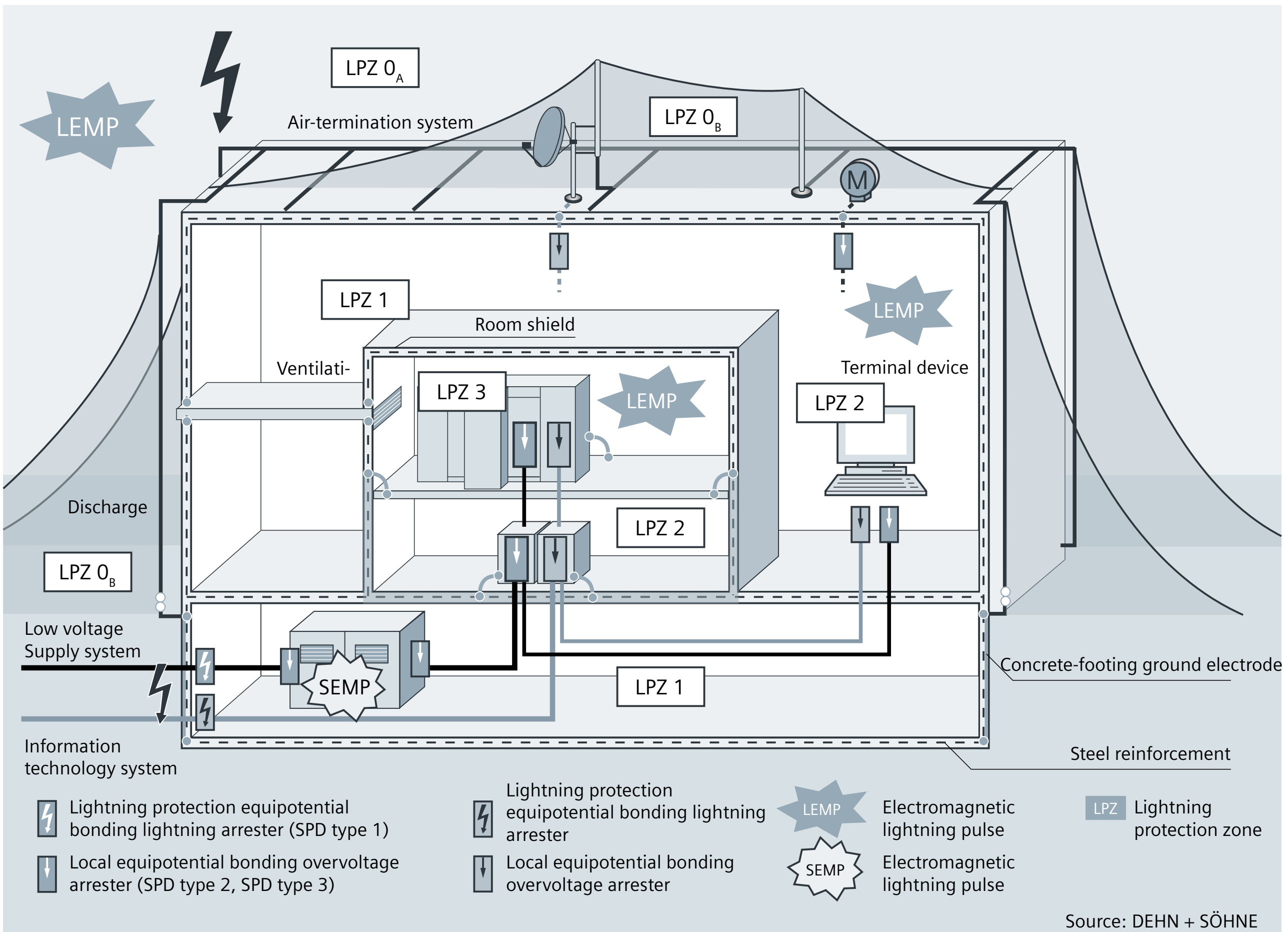


Figure A-11 Lightning protection zones of a plant with external lightning protection

Principle of interfaces between lightning protection zones

At the interfaces between the lightning protection zones, measures must be taken which have a reducing effect on the surge current load and on the magnetic fields.

Each zone-penetrating metallic/electrical system must be included in the equipotential bonding located at the zone transition.

Note

Metal systems include ducts, structural members, pipes (e.g., water, gas, and heat), etc.

Electrical systems include power and information technology cables and lines (e.g. mains voltage, bus line).

A.5.3 Rules for the interfaces between Lightning Protection Zones 0 and 1

Rules for the lightning protection zone transition 0_A to 1 (lightning protection equipotential bonding)

For lightning protection equipotential bonding at the interface of lightning protection zone 0_A to 1, the following applies:

- No introduction of lightning component currents into the plant in hazardous areas. Sufficient clearances of conductors and cables through which lightning current passes and that are fed into hazardous areas.
- Define the zone transition 0_A to 1 in the non-hazardous area.

Note

Since this zone transition is not relevant for the typical applications of the ET 200iSP, this will be discussed in no further detail in this manual.

Rules for the lightning protection zone transition 0_B to 1 (strong electromagnetic couplings)

For overvoltage protection at the interface of lightning protection zone 0_B to 1, the following applies:

- Use of power cables with peak current-capable cable shields (e.g., NYCWY) or twisted-pair IT cables (for example, A2Y(K)Y).
- Laying cables and lines
  - In continuous, peak current-capable metal pipes that are grounded at both ends, or
  - In reinforced concrete channels in which the reinforcement is grounded at both ends, or
  - On closed metal cable racks that are grounded at the beginning and end.
- Use of fiber optic cables without a metal shield if such a transmission is intended.

Other measures

If the actions listed above cannot be performed, protection by means of overvoltage suppressors must be provided. The following table contains overvoltage suppressors that may be used to protect facilities.

We recommend that the overvoltage suppressors for the signal cables and the 24 V supply be integrated into an appropriate enclosure according to the specifications of the manufacturer of the overvoltage suppressor. See "Enclosure specifications" in the section "Application example for protection of ET 200iSP from overvoltages (Page 449)".

Note

To ensure the availability of a cable connection using overvoltage protection, both ends of the cable must be connected to overvoltage suppressors.

Components for the overvoltage protection

Table A-33 Components for the overvoltage protection

Cons. number	Modules	Connection of cables at the interface of 0_B to 1 with:	Article number
1	Power supply PS DC24V for power supply and looping through	1 unit DEHNguard DG S 75 FM	952 091* **
		1 unit DEHNgap DGP C S FM	952 035* **
		1 unit busbar MVS 1 2	900 617* **
		1 unit pin-shaped terminal STAK 2x16	900 589* **
	Power supply PS AC120/230V for power supply and looping through	No overvoltage protection required	---
2	Interface module IM 152-1PN	No overvoltage protection required	---
	Interface module IM 152-1DP PROFIBUS RS 485-IS	1x Blitzductor base part BXT BAS EX	920 301**
		1 unit Blitzductor module BXT ML2 BD HF EX 6	920 538**
3	8 DI NAMUR	4x Blitzductor basic part BXT BAS EX	920 301**
		4x Blitzductor module BXT ML4 BD EX 24	920 381**
4	4 DO	2x Blitzductor basic part BXT BAS EX	920 301**
		2x Blitzductor module BXT ML4 BD EX 24	920 381**
5	2 DO Relay UC60V/2A	Clarification of requirements with DEHN + SÖHNE GmbH + Co. KG **	
6	4 AI I 2WIRE HART	2x Blitzductor basic part BXT BAS EX	920 301**
		2x Blitzductor module BXT ML4 BD EX 24	920 381**
7	4 AI I 4WIRE HART	2x Blitzductor basic part BXT BAS EX	920 301**
		2x Blitzductor module BXT ML4 BD EX 24	920 381**
8	4 AI RTD	4x Blitzductor basic part BXT BAS EX	920 301**
		4x Blitzductor module BXT ML4 BD EX 24	920 381**
9	4 AI TC	2x Blitzductor basic part BXT BAS EX	920 301**
		2x Blitzductor module BXT ML4 BD EX 24	920 381**
10	4 AO I HART	2x Blitzductor basic part BXT BAS EX	920 301**
		2x Blitzductor module BXT ML4 BD EX 24	920 381**

* These components are designed for non-hazardous zones. If these units are installed in hazardous area Zone 1, the components must be installed in a certified EX d enclosure (flameproof encapsulated). For further information and purchase, contact:
Siemens AG
DF FA SE
Breslauer Straße 4
90766 Fürth

** Direct purchase of components via:
DEHN + SÖHNE GmbH + Co. KG
Hans-Dehn-Str. 1
D-92318 Neumarkt

http://www.dehn.de (https://www.dehn.de)

Note

For all other PROFIBUS DP components outside the hazardous area, we recommend the procedure described in the manual PROFIBUS SIMATIC NET (https://support.automation.siemens.com/WW/view/en/1971286).

Note

If you use surge protection devices, the equipotential bonding should be installed using a minimum cross section of 6 mm² Cu.

A.5.4 Rules for the interfaces between lightning protection zones 1 and 2 and higher

Rules for the lightning protection zone transition 1 to 2 (strong electromagnetic couplings)

For overvoltage protection at the interface of lightning protection zone 1 to 2, the following applies:

- Use of power cables with peak current-capable cable shields (e.g., NYCWY) or twisted-pair IT cables (for example, A2Y(K)Y).
- Laying cables and lines
  - In continuous, peak current-capable metal pipes that are grounded at both ends, or
  - In reinforced concrete channels in which the reinforcement is grounded at both ends, or
  - On closed metal cable racks that are grounded at the beginning and end.
- Use of fiber optic cables without a metal shield if such a transmission is intended.
- Creation of local equipotential bonding at the transitions of lightning protection zones, including metallic supply systems (pipes, ventilation ducts, cable ducts, cable trays, etc.) and electrical line and cable installations.

Other measures

If the actions listed above cannot be performed, protection by means of overvoltage suppressors must be provided if unshielded electrical wiring and cable systems are routed within a lightning protection zone. See table "Components for the overvoltage protection" in section "Rules for the interfaces between Lightning Protection Zones 0 and 1 (Page 446)".

We recommend that the overvoltage suppressors for the signal cables and the 24 V supply be integrated into an appropriate enclosure according to the specifications of the manufacturer of the overvoltage suppressor. See "Enclosure specifications" in the section "Application example for protection of ET 200iSP from overvoltages (Page 449)".

Overvoltage suppressors at lightning protection zone transition 2 --> and higher

When installing the ET 200iSP, the zone transition 2 --> and greater is usually not applied.

A.5.5 Application example for protection of ET 200iSP from overvoltages

Application example with IM 152-1DP

The following figure shows the necessary measures for two networked ET 200iSP. Based on agreement, all cables and wires from lightning protection zone 0_B and higher, i.e. lightning component currents, must be excluded.

In the application example, the cable and wire systems are unshielded.

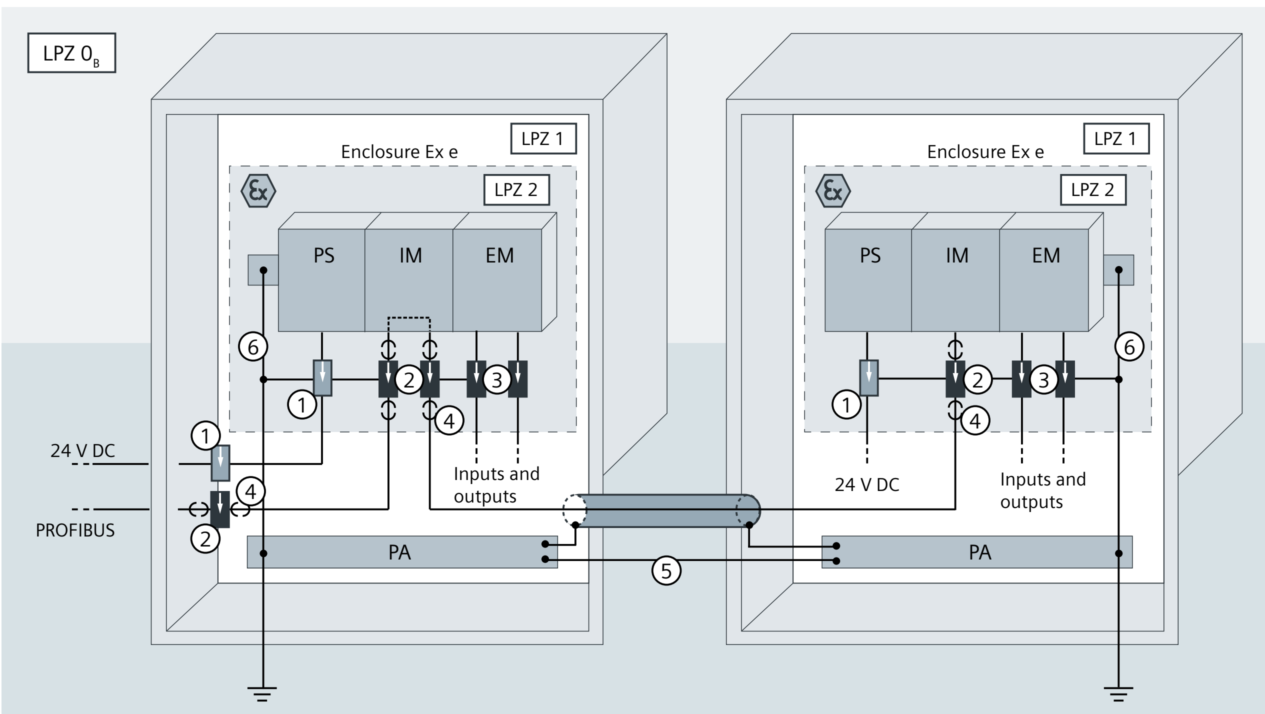


Figure A-12 Application example of two networked ET 200iSP

Components of the application example

The following table explains the components of the application example.

Table A-34 Components for overvoltage protection of the application example

Consecutive number from the figure	Component	Meaning
①	Overvoltage suppressors 24 V supply: DEHNguard DG S 75 FM Article number 952 091* ** DEHNgap DGP C S FM Article number 952 035* ** Comb rail MVS 1 2 Article number 900 617* ** Pin terminal STAK 2x16 Article number 900 589* **	Protection against indirect lightning effects and overvoltages at zone transition 0_B to 1 and 1 to 2
②	Overvoltage suppressors PROFIBUS RS 485-IS lightning conductor base part BXT BAS EX, article number 920 301** Blitzductor module BXT ML2 BD HF EX 6, Article number 920 538**	Protection against indirect lightning effects and overvoltages at zone transition 0_B to 1 and 1 to 2
③	Overvoltage suppressor I/Os, depending on the number of double cores used Blitzductor base part BXT BAS EX, Article number 920 301** Blitzductor module BXT ML4 BD EX 24, Article number 920 381**	Protection against indirect lightning effects and overvoltages at zone transition 0_B to 1 and 1 to 2
④	Additional terminal for the shield connection of the bus line	Discharging of interference currents
⑤	Equipotential-bonding cable 16 mm^2 Cu	Standardization of reference potentials
⑥	Equipotential-bonding cable 6 mm^2 Cu	Discharging of interference currents
* These components are designed for non-hazardous zones. If these units are installed in hazardous area Zone 1, the components must be installed in a certified Ex d enclosure (flameproof encapsulated). For further information and purchase, contact: Siemens AG DF FA SE Breslauer Straße 4 90766 Fürth ** Direct purchase of components via: DEHN + SÖHNE GmbH + Co. KG Hans-Dehn-Str. 1 D-92318 Neumarkt http://www.dehn.de (https://www.dehn.de)		

Enclosure specifications for accommodation of intrinsically safe overvoltage suppressors in potentially explosive areas

Overvoltage suppressors in hazardous areas must be installed in a metal enclosure or an enclosure certified for the device application. If the application is in areas with combustible dust, enclosure degree of protection IP6X shall be selected.

- Zone 1: Enclosure with degree of protection Ex e (increased safety)
- Zone 2: Enclosure with at least IP54 (with manufacturer's declaration for Zone 2)
- Zone 21: Dust-tight (certified) enclosure with degree of protection of at least IP6X
- Zone 22: Dust-tight (certified) enclosure with degree of protection of at least IP5X

Testing the overvoltage suppressors used

An overloading of the overvoltage suppressor of the Blitzductor BXT ML4 BD EX 24 series can be detected by the implemented LifeCheck technology using the DRC LC M3 testing device (Article number 910 653) before the final destruction. Use of this test device is only permitted outside the hazardous zone. As before, these lightning conductors have the fail-safe function that generates a signal-type interruption when the overvoltage suppressor is irrevocably destroyed, thus placing the downstream system out of operation but protecting it from further overvoltages.

A.6 HART operating data records

A.6.1 HART command interface

Data records

The HART commands are sent as so-called external HART requests from the client (e.g. PDM) to the connected field device using data records. The response of the field device is made available again in the system via data records.

The HART communication may only be handled by one client per channel. If a channel is handled by several clients, the response made available by the I/O module cannot be allocated to one client with certainty. The I/O module does not support client management.

Rules

- After having written a request data record, a client must read the response data record before it may write another request data record.
- The client can evaluate the "processing status" in the response data record: If the "processing status" indicates "successful" or "error," the response data record contains current response data or error indications, respectively.

- The response data record must always be read in full as the data record can be changed by the I/O module after it is first read with a successful or error status.
  If the processing status in the response data record indicates "successful" or "error", the data record contains current response data or fault displays.
- The client may only write a request data record to the I/O module again when it has read the response to the previously written request data record via the corresponding response data record. Otherwise, the response from the I/O module is overwritten.
- The STATUS component in the response frame (HART device status in the response data) provides information on whether errors have occurred and, if so, which errors.

Each request is stored on a channel-specific basis, and the corresponding request data record is locked. Another writing of the same request data record is thus not possible and is acknowledged with BUSY.

The disable of the request data record is reset after the termination or completion of the requested HART command.

A.6.2 HART operating data records

Reading/writing data in RUN

HART operating data records are transmitted to the module with the "WRREC" instruction and read from the module with the "RDREC" instruction.

Errors during transmission are indicated at the output parameter STATUS of the "WRREC" or "RDREC".

The following HART operating data records are available:

Data record number	Description	Length (bytes)	Writable	Readable
80	HART job channel 0	240	Yes	Yes
81	HART response channel 0	240	No	Yes
82	HART job channel 1	240	Yes	Yes
83	HART response channel 1	240	No	Yes
84	HART request channel 2	240	Yes	Yes
85	HART response channel 2	240	No	Yes
86	HART request channel 3	240	Yes	Yes
87	HART response channel 3	240	No	Yes
121	HART variables	320	No	Yes
131	HART parameter channel 0	8	Yes	Yes
132	HART parameter channel 1	8	Yes	Yes
133	HART parameter channel 2	8	Yes	Yes
134	HART parameter channel 3	8	Yes	Yes
148	HART directory	17	No	Yes
149	HART feature data	3	No	Yes

A.6.3 HART job and response data records

HART commands are handled on a channel-specific basis using a separate command interface with one request data record and one response data record each.

Channel	Data record number	
	Request to the field device	Response from the field device
0	80	81
1	82	83
2	84	85
3	86	87

Structure of the request data records 80, 82, 84, 86

Byte	Meaning	Comment
0	Request control	
1	Number of preamble bytes	5...20, 255
2...239	Communication data according to HART specification	

"Request control" coding:

Bit 0...1: Reserved = 0
Bit 2: 0 = Parameters are not checked
Bit 3...4: Reserved = 0
Bit 5: 0 = Transparent format *
1 = Compact format
Bit 6: 1 = Enable SHC mode
Bit 7: 0 = HART request

* HART commands are processed by the I/O module in both transparent message format and compact message format. However, the response data from the I/O module is always made available in transparent message format.

Note

When "Number of Preamble Bytes" = 255, the number of preambles set with the parameters is used. The default setting is five. You can reconfigure the number of preamble bytes using the HART-specific settings (see section HART-specific settings (Page 460)).

Structure of the response data records 81, 83, 85, 87

In case of response error

Byte	Meaning	Comment
0	Response control	
1	HART group error display	

Byte	Meaning	Comment
2	Protocol error	
3...239	Response data according to HART specification	Only present when "Response result" = 6 = "Error, with data"

In case of response error

Byte	Meaning	Comment
0	Response control	
1	HART group error display	
2...239	Response data according to HART specification	Only present when "Response result" = 4 = "Successful, with data"

"Response control" coding:

Bits 0-2: Response result (processing status)
0 = Inactive
1 = Inactive (reserved)
2 = Waiting
3 = Waiting, executing
4 = Successful, with data
5 = Successful, without data
6 = Error, with data
7 = Error, without data
Bit 3: 0 = Burst mode not active
Bit 4: 0 = Response data come directly from the HART device
Bit 5: 0 = Response data in transparent message format
Bit 6: 0 = SHC mode is not active
1 = SHC mode active
Bit 7: 0 = HART response

"HART group fault display" coding

Bit number	Meaning	Explanation
0	Additional status information available	(2nd HART status byte) You obtain additional status information, if required, with HART command 48.
1	HART communication error	The field device has detected a communication error when receiving the command. The error information is in the first HART status byte
2	Parameter check	0: HMD parameters unchanged 1: Check HMD parameters

Bit number	Meaning	Explanation
3	Reserved	Always 0
4...7	HART protocol error during response	0: Unspecified error 1: HMD error 2: Channel fault 3: Command error 4: Query error 5: Response error 6: Query rejected 7: Profile query rejected 8: Manufacturer-specific query rejected 9 - 15: Not used

"HART protocol error during response" coding

HART protocol error during response	Meaning	Explanation
0	Unspecified error	Always 0
1	HMD error	0: Not specified 1: Internal communication error 2: Parameter assignment error 3: HW fault 4: Wait time expired 5: HART timer expired 6...127: Reserved 128...255: Manufacturer-specific
2	Channel fault	0: Not specified 1: Line fault 2: Short-circuit 3: Open line 4: Low current output 5: Parameter assignment error 6...127: Reserved 128...255: Manufacturer-specific
3	Command error	0-127: HART protocol, Bit 7 = Always 0
4	Query error	Bit 0 = 0: Reserved Bit 1 = 1: Receive buffer overflow Bit 2 = 0: Reserved Bit 3 = 1: Checksum error Bit 4 = 1: Framing error Bit 5 = 1: Overflow error Bit 6 = 1: Parity error Bit 7 = 1: Reserved

HART protocol error during response	Meaning	Explanation
5	Response error	Bit 0 = 1: GAP timeout Bit 1 = 1: Receive buffer overflow Bit 2 = 1: Timeout Bit 3 = 1: Checksum error Bit 4 = 1: Framing error Bit 5 = 1: Overflow error Bit 6 = 1: Parity error Bit 7 = 1: Reserved
6	Query rejected	0: Not specified 1: Short format (compact format) not supported 2: SHC not supported 3: Impermissible command 4: No resources 5: Channel in standby mode [1] 6 to 127: Reserved 128 to 255: Manufacturer-specific
7	Profile query rejected	0: Not specified (not supported)
8	Manufacturer-specific query rejected	0: Not specified (not supported)

[1] An external HART request was refused because the channel is not the active channel of a redundancy pair. The request must be sent to the connected field device via the partner module

Example of HART programming (HART command interface)

For the HART channel 0, the command 01 is to be sent in the transparent message format to the HART field device with the address "98 CF 38 84 F0".

A positive edge at input 4.0 of a digital input module leads to the writing of the HART command.

The following assumptions are made:

- The module address of the I/O module is 512 (200_H)
- The data record is stored in DB80: starting from address 0.0, length of 11 bytes.
- The DB80 (request data record for channel 0) in this example consists of 11 bytes

```
                                  Explanation
    U E 4.0
    FP M 101.0
    = M 104.0
m2: CALL SFB53, DB53
    REQ :=M104.0                  Write request
    ID :=DW#16#200                Module address
    INDEX :=80                    Data record number 80
```

```
LEN :=11                          Length 11 bytes
DONE :=M51.7
BUSY :=M51.0
ERROR :=M51.6
STATUS :=MD92                     Block status or error information
RECORD :=P#DB80.DBX0.0 BYTE 11    Source area in DB80
U M 51.0
SPB m2
BE
```

Table A-35 DB80: Transparent message format

Byte	Initial value (hex)	Comment (Hex)
0	00	Req_Control (00 = Transparent message format. 40 = Transparent message format with SHC sequence)
1	05	Number of preamble bytes (05-14)
2	82	Start character (02 = Short Frame with command 0) (82 = Long Frame with other commands)
3	98	Address (with command 0, the address is exactly 1 byte long and has the value 0.)
4	CF	
5	38	
6	84	
7	F0	
8	01	Command (CMD)
9	00	Length in bytes
10	98	Checksum (CHK) (calculated as EXOR addition starting from byte 2 "Start character" up to the last byte of the command. The check-sum must not be sent with the job.)

A HART command can also be sent in compact message format. In this case, the data transferred via DB80 is reduced to 4 bytes.

Table A-36 DB80: Compact message format

Byte	Initial value (hex)	Comment (Hex)
0	20	Req_Control (20 = Compact message format 60 = Compact message format with SHC string)
1	05	Number of preamble bytes (5...20, 255)
2	01	Command (CMD)
3	00	Length in bytes

You can learn when the response from the field device was received by cyclically reading data record DS81 for HART channel 0. The response is always supplied in transparent message format.

Table A-37 FC81: Read the response with SFB 52 into DB81

```
                                                  Explanation
m3: CALL SFB52, DB52
    REQ :=M1                                      Read request
    ID :=DW#16#200                                Module address
    INDEX :=81                                    Data record number 81
    MLEN :=200                                    Target length
    VALID :=M49.7
    BUSY :=M49.1
    ERROR :=M49.6
    STATUS :=MD100                                Block status or error information
    LEN :=MW104
    RECORD :=P#DB81.DBX0.0 BYTE 200               Target area in DB81
    U M 49.1
    SPB m3
    BE
```

The program part A M 49.1 to SPB m3 is only required if reading is to occur within a block cycle.

As long as the processing status (byte 0 of DB81) is at 3 (waiting, executing), the response has not yet been received from the field device. As soon as the processing status changes to greater than 3, the HART request is finished.

With a processing status of 4, the request finished without errors and the response data can be evaluated.

With a processing status of 5, the request also finished without errors but without response data from the field device.

With a processing status of 6 or 7, the request finished with errors. You can find more detailed information in byte 1 of DB81 (see table "HART group fault display") and for a HART protocol error also in byte 2 of DB81 (see table "HART protocol error during response").

A.6.4 HART directory

Structure of the HART directory

Byte	Meaning	Comment
0	Profile Revision Number	= 1, 0 (Revision 1.0)
1		= 2, 0 (Revision 2.0)
2	Index of Client Management	= 255 (not relevant)
3	Number of Clients	= 1

Byte	Meaning	Comment
4	Number of Channels	= 16
5	Write Read Index Offset	= 1 (The response to a request data record is made with the data record number of the request data record + 1)
6	Index of HMD Feature Parameter	= 149
7	Index of HMD Module Parameter	= 255 (not relevant)
8	Start Index of Burst Buffer Area	= 255 (not relevant)
9+n	Index of HMD Channel Parameter (Channel n)	= 131+n
9+n+4	Index of HART Client Channel Message Data	= 80+(2*n) The HART request data sets are not configurable. The data records from data record number 80 (80, 82, 84, 86) are permanently used.

A.6.5 HART feature data

Structure of the HART feature data

Byte	Meaning	Comment
0	Feature data parameter 1	Bit 1 = 1: "Parameter check result is given with a read response" Bit 5 = 1: "Compact format is supported" Bit 6 = 1: "SHC mode is supported"
1	Feature data parameter 2	0
2	Max Length Data Unit	maximum data length of request/response

A.6.6 HART variable data record

The I/O module supports a maximum of 4 HART variables per channel in enabled HART operation. These variables are read cyclically, provided they are supported by the connected field device. These 64 HART variables are made available readable in HART variable data record 121.

Each HART variable consists of a 4-byte real value and one byte of quality code.

In IO redundancy mode, the HART variables are only updated if the HART interface is on the corresponding module/channel. The channel may not be in standby mode. If the HART interface is on the partner module/partner channel, the corresponding HART variable is initialized (quality code = 0x37).

Structure of the HART variable data record

Byte	Meaning	
Channel 0		
0...3	Value	Primary Variable (PV)
4	Quality code	
5...8	Value	Secondary Variable (SV)
9	Quality code	
10...13	Value	Tertiary Variable (TV)
14	Quality code	
15...18	Value	Quaternary Variable (QV)
19	Quality code	
Channel 1		
20...39	HART variables same as for channel 0	
Channel 2		
40...59	HART variables same as for channel 0	
Channel 3		
60...79	HART variables same as for channel 0	

If HART is not enabled or the respective HART variable is not supplied from the connected field device, the corresponding variable = 0 and the QC = 0x37 (initialization value from the analog module).

A.6.7 HART-specific settings

HART communication is available via standard parameter assignment.

Additional HART-specific settings can be defined channel-specific via the data records 131...134.

The parameters set in STEP 7 are not changed in the CPU, which means that the parameters set in STEP 7 will be valid again after a startup.

Every new parameter assignment of the analog module resets the HART-specific settings back to the initial values from parameter data record 128.

Channel	Data record number
0	131
1	132
2	133
3	134

Structure of the HART-specific settings

Byte	7	6	5	4	3	2	1	0	Description
Byte 0	Must be 128								Bit 7 is reset after evaluation of data record by module
Byte 1	Must be 5								Offset for manufacturer-specific parameters according to HART specification
Byte 2									Number of HART repetitions (0...10) Initial value from parameter data record 128
Byte 3									Number of HART preamble bytes (0, 5...20, 255) Initial value = 5*
Byte 4	Must be 0								Field device mode according to HART specification
Byte 5									Client timeout in s (1...255 s) Initial value = 60 s
Byte 6	0	0	0	0	0	0			Initial value according to HART activation from parameter data record 128 always as primary master Bit 0: 1 = Switch on HART 0 = Switch off HART Bit 1: 1 = Primary master 0 = Secondary master
Byte 7	Must be 0								Reserved

Settings

* When the number of HART preamble bytes = 0, the number of preamble bytes required by the connected field device is used, but no fewer than 5.

If number of HART preamble bytes = 255, 20 preamble bytes are used.

Glossary

ACCU

Accumulators are registers in the CPU used as buffer storage for load and transfer operations, as well as comparison, arithmetic, and conversion operations.

Accumulated current

Total current of all output channels of a digital output module.

Automation system

An automation system is a programmable control system, consisting of at least one CPU, various input and output modules as well as operating and monitoring devices.

Backplane bus

The backplane bus is a serial data bus via which the interface module communicates with the electronic modules and supplies them with the necessary voltage. The various modules are interconnected by means of terminal modules.

Baud rate

The baud rate is a unit for the step rate of data transmission. On the PROFIBUS DP the baud rate corresponds approximately to the bit rate. The transmission rate specifies the number of bits transmitted per second.

Bus

Shared data transmission path to which all nodes are connected. It has two defined ends.

For ET 200, the bus is a two-wire line or a fiber-optic cable.

Bus connector

Physical connection between the bus nodes and the bus cable.

Controller

See "CPU"

See "IO controller"

CPU

Central Processing Unit > Central processing unit of an automation system.

Derating

Adjustment of the permissible ambient temperature depending on the air pressure (usually corresponds to a specific geographical installation position - elevation above sea level).

Device

A device can only exchange data after being requested to do so by the master. Devices are, for example, DP devices - stations of the distributed I/O with PROFIBUS DP interface module. Master and devices are only available for PROFIBUS.

Diagnostics

The detection, localization, classification, visualization and further evaluation of errors, faults and messages.

Diagnostics provides monitoring functions which run automatically while the plant is in use. This increases plant availability by reducing commissioning times and down times.

Distributed I/O systems

are input/output units that are not used in the central device but are configured remotely by the CPU of the automation system, for example:

- ET 200SP HA, ET 200M, ET 200X, ET 200L, ET 200S, ET 200iSP
- CFU
- DP/AS-I link
- Additional IO devices or DP devices from Siemens AG or other manufacturers

The distributed I/O systems are connected:

- As IO device via PROFINET IO with the IO controller of the CPU
- As DP devices via PROFIBUS DP with the DP master of the CPU

DP device

A device that is operated on the PROFIBUS with the PROFIBUS DP protocol and that behaves in conformity with the standard *IEC 61784-1:2002 Ed1 CP 3/1* is termed a DP device.

DP master

A master that behaves in conformity with *IEC 61784-1:2002 Ed1 CP 3/1* is termed a DP master.

DP standard

DP standard is the bus protocol of the ET 200 distributed I/O system in accordance with the standard *IEC 61784-1:2002 Ed1 CP 3/1*.

DPV0

"DPV0" mode designates a mode for communication between devices on the PROFIBUS.

The mode includes the basic functions of the PROFIBUS DP communication protocol

- Cyclic data exchange between control system and devices
- Configuration via GSD files
- Diagnostics

DPV1

"DPV1" mode is a further development of the original PROFIBUS standard *IEC 61784-1:2002 Ed1 CP 3/1*.

DPV1 designates a mode for communication between devices on the PROFIBUS.

The mode extends the functions of the PROFIBUS DP communication protocol compared to "DPV0" mode. The changes are specified in the IEC 61158 standard:

- Acyclic data exchange between control system and devices
- Integration into engineering systems via EDD or FDT / DTM
- Transferable PLC software function blocks (IEC 61131-3)
- Fail-safe communication (PROFIsafe)
- Interrupts (hardware interrupt, status interrupt, update interrupt, vendor-specific interrupt, diagnostic interrupt, plug interrupt, pull interrupt)

Electronic module

Modules of distributed I/O with signal processing:

- For acquiring the signals from sensors
- For outputting signals to actuators
- For special signal processing (e.g. counting, measuring frequency ...)

Equipotential bonding

Electrical connection (equipotential bonding conductor) that keeps electrical equipment and extraneous conductive objects at the same or roughly identical potential in order to prevent disturbing or dangerous voltages between these objects.

ET 200

Distributed I/O systems of the ET 200 family enable the connection of distributed I/O devices to a CPU or an adequate device.

The connection is made with interface modules for PROFINET IO or PROFIBUS DP.

Firmware update

Upgrading the firmware for modules (interface modules, electronic modules etc..), e.g. after function extensions, to the most recent firmware version (update).

Flutter monitoring

Flutter monitoring is a process control function for digital input signals. Flutter monitoring detects and reports unusual signal profiles.

FREEZE

FREEZE is a control command of the DP master to a group of DP devices. FREEZE is only available for PROFIBUS.

After receiving the FREEZE control command, the DP device freezes the current state of the **inputs** and transfers these cyclically to the DP master.

The DP device freezes the state of the **inputs** after each new FREEZE control command.

The input data is transmitted cyclically again from the DP device to the DP master after the DP master sends the UNFREEZE control command.

Ground

The electrical potential of conductive ground can be pulled down to zero at any point. In the vicinity of ground connections, ground may assume a potential other than zero. For this reason, the term ”reference ground” is often used.

Chassis ground includes all the interconnected inactive parts of equipment that must not carry a hazardous voltage even in the event of a fault.

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Chassis ground includes all the interconnected inactive parts of equipment that must not carry a hazardous voltage even in the event of a fault.

Grounding

Refers to connecting a conductive element to ground via a grounding system.

Grounding busbar EB

Terminal designation for electrical equipment operated in hazardous areas and connected to the equipotential busbar.

GSD file

All DP device-specific properties are stored in a GSD file (General Station Description). The format of the GSD file is to be found in the *IEC 61784-1:2002 Ed1 CP 3/1* standard.

HART

engl.: **H**ighway **A**dressable **R**emote **T**ransducer

Hot swapping

Pulling and plugging modules during the operation of the ET 200iSP.

I&M (identification and maintenance data)

Identification and maintenance data (I&M) is information stored in a module.

Identification data (I data): Information about the module that is normally printed on the enclosure of the module. I data is read-only.

Maintenance data (M data): System-specific information such as the installation location and date. M data is generated during configuration and written to the module.

I/O module

See electronic module

IO controller

Device used to address connected I/O devices. This means: The IO controller exchanges input and output signals with assigned I/O devices. The CPU is often an IO controller. IO controllers and IO devices are only available for PROFINET.

IO device

Distributed field device that can be assigned to one or more IO controllers (e.g. distributed I/O system, valve terminals, frequency converters, switches). IO controllers and IO devices are only available for PROFINET.

Isolated

For isolated I/O modules, the reference potentials of the control and load circuits are electrically isolated, for example, by means of optical isolators, relays, or transformers. Input/output circuits may be grouped.

MAC address

MAC address is a worldwide unique device identification that is already assigned in the factory to each PROFINET device. Its 6 bytes are divided into 3 bytes for the manufacturer ID and 3 bytes for the device ID (serial number). The MAC address is usually legible on the device.

Master

When a master is in possession of the token, it can send data to other nodes and request data from other nodes (= active station). DP masters are, for example, the CPU 410-5H or the IM 308-C. Master and devices are only available for PROFIBUS.

Media Redundancy Protocol (MRP)

The Media Redundancy Protocol (MRP) is a communication protocol that can be used for ring topologies. In a ring topology, MRP enables switchover of communication paths if a component fails. MRP works independently of the communication protocol used on the communication path.

NAMUR sensor

A NAMUR sensor provides functions for monitoring cable breaks and short-circuits.

Node

Device that can send, receive or amplify data via the bus, for example, DP master, DP device, RS 485 repeater.

Non-isolated

For non-isolated I/O modules, the reference potentials of the control and load circuits are electrically connected.

Parameter assignment

Parameter assignment is the setting of parameters and the transfer of the parameter-assignment data to the interface module of the distributed I/O.

PCS 7-OS

Operator Station (operator control and monitoring system) for the SIMATIC PCS 7 or PCS neo process control system.

PELV

Protective Extra Low Voltage

Permanent wiring

All the elements carrying wiring (terminal modules) are installed on a mounting rail. The electronic modules are inserted into the terminal modules.

PII

Process image inputs

Prewiring

Wiring the terminal modules before the electronic modules are inserted.

Process image

The process image is part of the system memory of the CPU (IO controller/DP master). At the start of the cyclic program, the signal states of the input modules are transmitted to the process image input. At the end of the cyclic program, the process image output is transmitted as signal state to the ET 200iSP (distributed I/O).

PROFIBUS

PROcess FIeld BUS, process and fieldbus standard that is specified in the standard IEC 61158 Type 3. It specifies the functional, electrical and mechanical characteristics of a bit-serial fieldbus system.

PROFIBUS is available with the following protocols: DP (= Distributed Periphery), FMS (= Fieldbus Message Specification), PA (= Process Automation) or TF (= Technological Functions).

PROFIBUS address

For the purpose of unique identification on the PROFIBUS, each bus node must be given a PROFIBUS address.

PCs and programming devices have the PROFIBUS address "0".

The ET 200iSP addresses 1 to 125 are permissible for the distributed I/O device PROFIBUS.

PROFINET IO

Communication concept for the implementation of modular, distributed applications within the scope of PROFINET.

Pulse stretching

Function used to extend the duration of a digital input signal. It extends the signal at a digital input by a set value.

Redundancy

In redundant systems, important automation components are available in multiple units (redundant). If a redundant component fails there the processing of the program is not interrupted.

With S2 redundancy, one interface module is connected to the two (redundant) IO controllers.

With R1 redundancy, each of the two interface modules is connected to the two (redundant) IO controllers.

Reference potential

The potential from which the voltages of the electrical circuits are evaluated and/or measured.

RTD

Measuring temperatures with resistance thermometers RTD (resistance temperature detection).

Segment

The bus cable between two terminating resistors forms a segment. One RS 485-IS segment (on the RS 485-IS coupler) contains 31 bus nodes.

SELV

Safety Extra Low Voltage

SIMATIC mode

SIMATIC mode is a communication protocol developed by Siemens for synchronizing clocks in automation systems via Industrial Ethernet. SIMATIC mode uses a connectionless multicast protocol. Mode:

- PCS 7 compatible mode
- S5-compatible mode

SIMATIC PCS 7

PCS 7 is a powerful process control system with integrated programming, operator control and monitoring. Information on this can be found in the St 70 catalog and the help integrated in the PCS 7 engineering tool (ES) and operator control and monitoring system (OS).

SIMATIC PDM

SIMATIC PDM (Process Device Manager) is a tool for configuring, parameterizing, commissioning and diagnosing intelligent process devices. SIMATIC PDM makes it possible to configure a large number of process devices from different manufacturers under a uniform user interface using one software.

Slave

See "Device".

See "DP Device".

SYNC

SYNC is a control command of the DP master to a group of DP devices. SYNC is only available for PROFIBUS.

With the SYNC control command, the DP master causes the DP device to freeze the states of the **outputs** to the current value. With the following telegrams, the DP device saves the output data, but the states of the outputs remain unchanged.

After each new SYNC control command, the DP device sets the outputs that it has saved as output data. The outputs are not cyclically updated again until the DP master sends the UNSYNC control command.

TC

Measuring temperatures with thermocouples (TC = thermocouple).

Termination module

The distributed I/O device is terminated with the termination module. Without a termination module, the distributed I/O device ET 200iSP is not ready for operation.

TIA Portal

Totally Integrated Automation Portal

The TIA Portal is the key to the full performance capability of Totally Integrated Automation. The software optimizes all operator control, machine and process sequences.

Time stamp

Information on the date and time of messages.

Time stamping

In automation engineering, the change of state of a process signal is an event. If time information is assigned to the event, this is regarded as time stamping. The basis is the time synchronization. The objective is to show temporal relationships between events.

Time synchronization

Time-of-day synchronization ensures that all clocks in a plant have the same time. A master clock distributes the time in a configurable cycle to all other components in the automation system that have a clock. The components use this time to set their own clocks.

Transmission rate

The transmission rate v_D represents the number of characteristic states v_S that are transmitted within a step (transmitted signal values within a time period T).

$v_D = m \cdot v_S \cdot \log_2(n)$ in bit/s

- v_S = step rate
- m = number of transmission channels
- n = number of characteristic states

Value status

The value status is additional binary information in a digital input signal. The value status is entered in the PII at the same time as the process signal, and provides information on the validity of the input signal.

WinCC

Basic package of PCS 7.

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