SIEMENS

SIMATIC

ET 200X Distributed I/O Device

Manual

Safety Guidelines

This manual contains notices intended to ensure personal safety, as well as to protect the products and connected equipment against damage. These notices are highlighted by the symbols shown below and graded according to severity by the following texts:

Danger

indicates that death, severe personal injury or substantial property damage will result if proper precautions are not taken.

Warning

indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.

Caution

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

Caution

indicates that property damage can result if proper precautions are not taken.

Notice

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

Qualified Personnel

Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Correct Usage

Note the following:

Warning

This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

Trademarks

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Preface

Purpose of the manual

The information contained in this manual will enable you to operate the ET 200X distributed I/O device as a DP slave on PROFIBUS-DP.

Required basic knowledge

General knowledge of automation engineering is required to understand the manual.

Scope of validity of the manual

This manual is valid for the ET 200X distributed I/O system components specified in Appendix A.

This manual contains a description of the components that were valid at the time the manual was published. We reserve the right to enclose a Product Information bulletin containing up-to-date information about new components and new versions of components.

Changes since the previous version

Compared to the previous version, the manual contains the following changes and additions:

*   DPV1 support of DPV1 of all basic modules with DDB file SI0380**.GS*

Note: You can recognize the previous version of this ET 200X manual by the number EWA-4NEB 78060160x-04 in the footer.

The current number is EWA-4NEB 78060160x-05.

Certification

See Section 6.1 Standards, certificates, and approvals.

CE certification

See Section 6.1 Standards, certificates, and approvals.

Identification code for Australia (C-tick mark)

See Section 6.1 Standards, certificates, and approvals.

Standards

See Section 6.1 Standards, certificates, and approvals.

Position in the information landscape

This delivery package (order number 6ES7 198-8FA01-8AA0) consists of 4 manuals with the following contents:

BM 147/CPU basic module	**Distributed I/O Device ET 200X**	**EM300 Motor Starter**	**Frequency converter EM 148-FC**
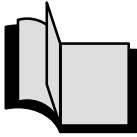
- Addressing
- ET 200X with BM 147/CPU with PROFIBUS-DP
- Commissioning and diagnostics
- Technical data
- Order numbers
- *STEP 7* list of operations

- Installation and wiring
- Commissioning and diagnostics
- Technical specifications of digital and analog modules
- Order numbers for digital and analog modules

- Wiring
- Commissioning and diagnostics
- Technical data
- Order numbers

- Wiring
- Commissioning and diagnostics
- Functions and technical data
- Order numbers

Guide

You can quickly access specific information in the manual by using the following aids:

- At the beginning of the manual you will find a comprehensive table of contents and lists of the figures and tables in the entire manual.
- In the left margin on each page in every chapter you will find information that provides you with an overview of the contents of each section .
- Following the appendices, you will find a glossary in which important technical terms used in the manual are defined.
- At the end of the manual you will find a comprehensive index enabling rapid access to the information you are looking for.

Points to note

In addition to this manual, you will also need the manual for the DP master (see Appendix A).

Note

You will find a detailed list of the contents of the ET 200X manuals in Section 1.8 of this manual. We recommend that you begin by reading this section so as to find out which parts of which manuals are most relevant to you in helping you to do what you want to do.

Recycling and disposal

The ET 200X is suitable for recycling on account of its low-emission components. To ensure that your old devices are recycled and disposed of in an environmentally sound way, contact an authorized company for electronic waste.

Additional support

If you have any questions that are not answered here on the use on any of the products described in this manual, please contact your Siemens office or agency.

`http://www.ad.siemens.com/automation/partner`

Training center

We offer the relevant courses to get you started more easily with xxx and the SIMATIC S7 programmable controller. Please contact either your regional training center or the central training center in
D-90327 Nuremberg.
Telephone: +49 (911) 895-3200.

Internet: `http://www.sitrain.com`

A&D Technical Support

Available at any time of the day:

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GMT: +1:00		
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Authorization	**Technical Support and Authorization**	**Technical Support and Authorization**
Loc. time: Mon-Fri 8:00 to 17:00	Loc. time: Mon-Fri 8:00 to 17:00	Loc. time: Mon-Fri 8:00 to 17:00
Teleph.: +49 (0) 180 5050-222	Teleph.: +1 (0) 423 262 2522	Teleph.: +86 10 64 75 75 75
Fax: +49 (0) 180 5050-223	Fax: +1 (0) 423 262 2289	Fax: +86 10 64 74 74 74
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Technical support and authorization staff usually speak German and English.		

Service & Support on the Internet

In addition to our documentation, you can also find comprehensive information on the Internet.

`http://www.siemens.com/automation/service&support`

There you can find:

- Our newsletter with the latest product information.

- Any documents you may require via our search in Service & Support.

- A forum in which users and specialists worldwide exchange their experiences.

- Your contact person in Automation & Drives via the contact database.

- Information on local service, repairs, spare parts. You will also find lots more under "Services".

Contents

Figures

Tables

Product Overview

<div align="right">1</div>

In this Chapter

The product overview tells you

- how to incorporate the ET 200X distributed I/O device into the Siemens programmable controller landscape.

- The components which make up the ET 200X distributed I/O device

- Which manuals in the ET 200X manual package contain what information

Contents of Chapter

1.1 What are distributed I/O devices?

Distributed I/O devices – usage

When a system is set up, the inputs and outputs to and from the process are often located centrally in the programmable controller.

If there are inputs and outputs at considerable distances from the programmable logic controller, there may be long runs of cabling which are not immediately comprehensible, and electromagnetic interference may impair reliability.

The use of distributed I/O devices is suitable for such systems:

- The controller CPU is located centrally.
- The I/O devices (inputs and outputs) are operating locally on a distributed basis.
- The high-performance PROFIBUS-DP ensures with its high baud rates that the controller CPU and I/O devices communicate smoothly.

What is PROFIBUS-DP?

PROFIBUS-DP is an open bus system complying with IEC 61784-1:2002 Ed1 CP 3/1 with the "DP" transmission log (DP stands for Distributed Peripheral).

Physically, 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" transmission log allows a rapid, cyclic exchange of data between the controller CPU and the distributed I/O devices.

What are DP masters and DP slaves?

The link between the controller CPU and distributed I/O devices is the DP master. The DP master exchanges data by means of PROFIBUS-DP with the distributed I/O devices and monitors PROFIBUS-DP.

The distributed I/O devices (= DP slaves) prepare the data of the sensors and actuators so that it can be transferred via PROFIBUS-DP to the controller CPU.

What devices can be connected to PROFIBUS-DP?

Different devices can be connected on PROFIBUS-DP as DP masters or DP slaves provided they behave in accordance with the IEC 61784-1:2002 Ed1 CP 3/1 standard. You can use devices from the following product families amongst others:

- SIMATIC S5
- SIMATIC S7/M7/C7
- SIMATIC programmer/PC
- SIMATIC HMI (operator interface OP, OS, TD)
- Devices from other manufacturers

Configuring a PROFIBUS-DP network

In the figure below you can see a typical installation of a PROFIBUS-DP network. The DP masters are integrated in the relevant device – for example, the S7-400 has a PROFIBUS-DP interface, and the IM 308-C master interface module is inserted in the S5-115U. The DP slaves are the distributed I/O devices connected to the DP masters via PROFIBUS-DP.
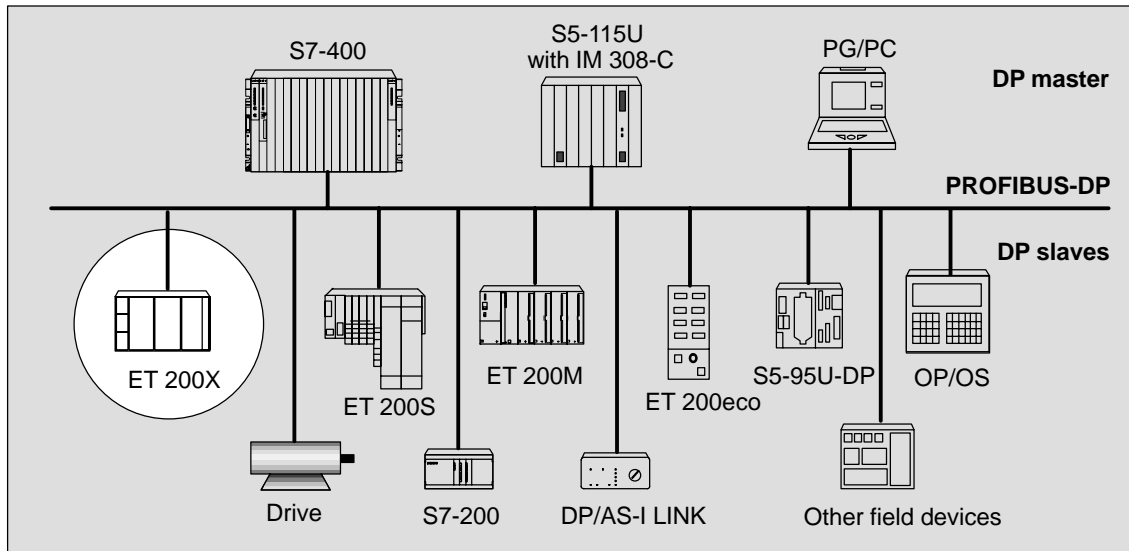
Figure 1-1   Typical PROFIBUS-DP network installation

1.2   What is the ET 200X distributed I/O device?

Definition

The ET 200X distributed I/O device is a modular DP slave in the IP 65 to IP 67 degrees of protection.

Usage

Owing to its robust design and the IP 65 to IP 67 degrees of protection, the ET 200X distributed I/O device is particularly suitable for usage in harsh industrial environments.

Rapid and optimum adaptation of the ET 200X to the technological functional units of your machine is ensured thanks to the option of integrating motor starters (switching and protecting any three-phase loads up to 5.5 kW), frequency converters (actuating asynchronous motors up to 0.75 kW rated power) and I/O modules.

Basic and expansion modules

An ET 200X distributed I/O device consists of a basic module in which some digital inputs and outputs have already been integrated. Up to 7 expansion modules can be added to the basic module.

An ET 200X distributed I/O device is connected to PROFIBUS-DP by means of cable connectors for PROFIBUS-DP on the basic module. Every ET 200X distributed I/O device is a DP slave on PROFIBUS-DP.

ET 200X with BM 147/CPU can also be configured for standalone operation (i.e. not connected to a bus).

Configuration of ET 200X (example)
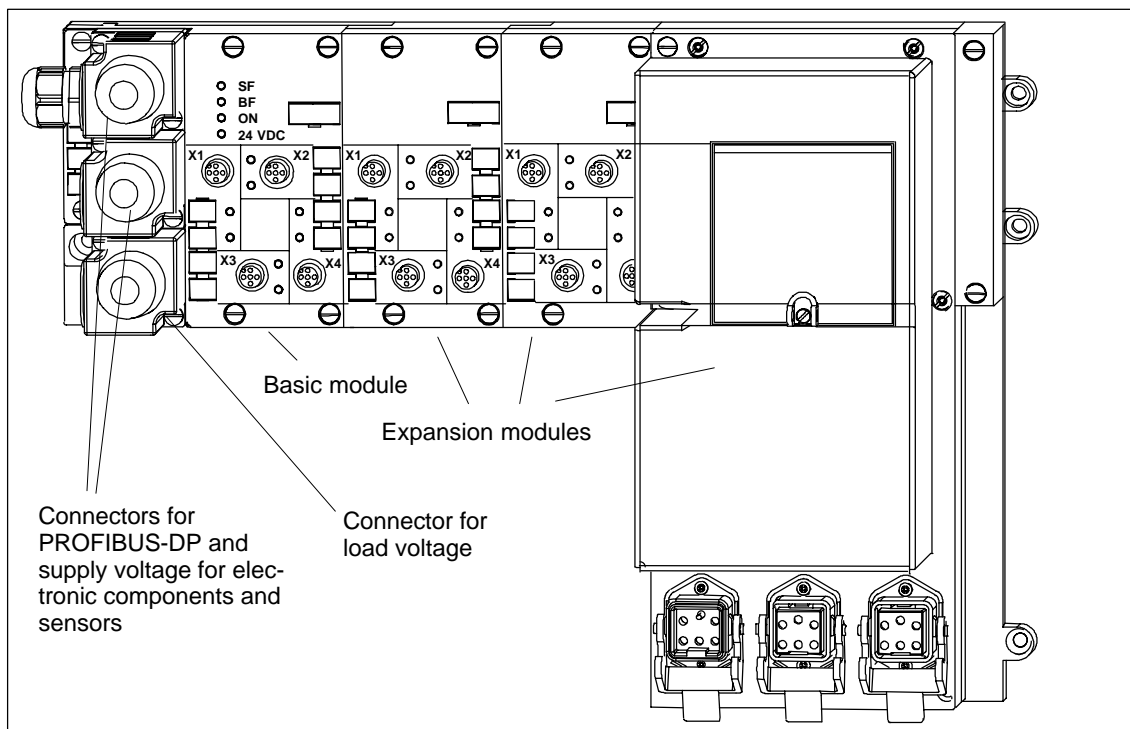
Figure 1-2   Configuration of the ET 200X distributed I/O device (example)

Components

The components of the ET 200X include the following **basic modules**:

- BM 141 DI 8 $\times$ DC 24V basic module
- BM 141 DI 8 $\times$ DC 24V ECOFAST basic module
- BM 141 DI 8 $\times$ DC 24V ECOFAST DIAG basic module
- BM 142 DO 4 $\times$ DC 24V/2A basic module
- BM 143-DESINA FO basic module
- BM 143-DESINA RS485 basic module
- BM 147/CPU basic module

The following **expansion modules** can be added to each of the basic modules:

- EM 141 DI 4 $\times$ DC 24V expansion module
- EM 141 DI 8 $\times$ DC 24V expansion module
- EM 141 DI 8 $\times$ DC 24V expansion module (short and long types)
- EM 142 DO 4 $\times$ DC 24V/0.5A expansion module
- EM 142 DO 8 $\times$ DC 24V/1.2A expansion module
- EM 142 DO 4 $\times$ DC 24V/2A expansion module
- EM 143-DESINA expansion module (only with BM 143-DESINA)
- EM 144 AI 2 $\times$ U ($\pm$10 V) expansion module
- EM 144 AI 2 $\times$ I ($\pm$20 mA or 4 to 20 mA) expansion module
- EM 144 AI 2 $\times$ I (4 to 20 mA) expansion module
- EM 144 AI 2 $\times$ RTD (Pt 100) expansion module
- EM 145 AO 2 $\times$ U ($\pm$10 V) expansion module
- EM 145 AO 2 $\times$ I ($\pm$20 mA or 4 to 20 mA) expansion module
- EM 300... expansion module (motor starter)
- EM 148-FC frequency converter
- EM 148-P DI 4 $\times$ DC 24V/DO 2 $\times$ P expansion module (pneumatic module)
- EM 148-P DO 16 $\times$ P/CPV10 expansion module
  (pneumatic interface module for FESTO valve island CPV10)
- EM 148-P DO 16 $\times$ P/CPV14 expansion module
  (pneumatic interface module for FESTO valve island CPV14)
- PM 148 DO 4 $\times$ DC 24V/2A power module
- SITOP power 24V/10A power supply unit
- CP 142-2 communication processor as AS-i master

Features of the ET 200X

- The supply voltage for the electronic components and sensors, the load voltage and PROFIBUS-DP are connected to the basic module by means of connectors.

- The BM 141... and BM 142... basic modules contain a number of inputs and outputs. Basic modules can be expanded on a modular basis.

- Motor starters (direct-on-line and reversing starters) can be used as expansion modules for switching and protecting any three-phase loads up to 5.5 kW, at 400 VAC (refer to the manual *EM 300 Motor Starters*).

- Frequency converters can be used as expansion modules for actuating asynchronous motors up to 0.75 kW rated power at 400 VAC (refer to the manual *EM 148-FC Frequency Converters*).

- Pneumatic modules having two 4/2-way valves and pneumatic interface modules for connecting two regular FESTO valve islands to the ET 200X can be used as expansion modules (refer to Section 1.4).

- When expansion modules are installed, the supply voltage for the electronic components and the sensors and the load voltage are automatically fed to these modules from the basic module.

- The voltage and the bus signals can be looped through to the next ET 200X via connectors.

- The supply voltage for the electronic components and the sensors and PROFIBUS-DP can be fed to the first ET 200X via separate cables and then looped through to the next ET 200X via a common cable.

- The PROFIBUS address of the ET 200X can be set between 1 and 125 by means of switches in the basic module.

- There are 4 LEDs on the front of the basic module that indicate faults in the hardware of an ET 200X (SF), bus faults (BF), and the supply voltage for the electronic components and sensors (ON) and load voltage (24 VDC).

- Transmission rates of 9.6 kbps to 12 Mbps are permitted for the ET 200X.

- CP 142-2 as AS-i master

DP Master for ET 200X

The ET 200X can communicate with all DP masters that behave in compliance with IEC 61784-1:2002 Ed1 CP 3/1. However, some DP masters can process only limited frame lengths.

Check whether the DP master you are using can receive frames from the ET 200X in their entirety. To ascertain this, you will find a list of maximum frame lengths in the *configuration and parameter assignment frames for ET 200X* at http://www.ad.siemens.de/simatic-cs.

1.3 ET 200X-DESINA/ET 200X-ECOFAST

ET 200X-DESINA

DESINA is the acronym for **D**istributed and **S**tandardized **IN**st**A**llation technique for machine tools.

DESINA is a uniform installation system and specifies all components in terms of function and connection system.

The followings modules fulfill the requirements of the DESINA specification:

* BM 143-DESINA FO   (fiber-optic PROFIBUS-DP)
                                       (FO = **F**ibre **O**ptic)

* BM 143-DESINA RS485   (copper wire PROFIBUS-DP based on
  RS 485)

* EM 143-DESINA

ET 200X-ECOFAST

ECOFAST is the trade name for **E**nergy and **CO**mmunication **F**ield Inst**A**llation **S**ys**T**em.

The following ECOFAST module has a terminal system compliant with the DESINA specification:

* BM 141 DI 8 × DC 24V ECOFAST   (copper wire PROFIBUS-DP
                                       based on RS 485)

Comparison of features

Table 1-1   Features of the ET200X-DESINA and ET200X-ECOFAST

ET200X-DESINA	ET200X-ECOFAST
PROFIBUS-DP is connected via DESINA connectors by means of: • **Copper conductors to RS 485** • **Fiber-optic cables** for use in environments with high interference	
Each DESINA basic module and expansion module has 8 digital channels, and each channel can be configured as an input or output. With a maximum of seven EM 143-DESINA expansion modules, an ET 200X-DESINA has a total of 64 DESINA-compliant inputs/outputs.	The BM 141 DI 8 × DC 24V ECOFAST basic module has 8 digital inputs.
There **is** an additional diagnostic input for each channel. The connected DESINA-compatible sensors and actuators can be directly monitored by means of the diagnostic input. Alternatively, the diagnostic input can be configured as an input with NC functionality.	–
The field bus (PROFIBUS-DP) and the switched and non-switched load voltages are carried to the basic module by a single cable set. The cable connects to the basic module by means of DESINA connectors.	
When expansion modules are installed, the non-switched and switched load voltages are fed from the basic module to the expansion modules.	
The voltages and bus signals can be looped through to the next ET 200X-DESINA by means of a second DESINA connector.	
The PROFIBUS address is set by means of DIL switches in a removable configuration connector. This means that the basic module can be replaced without resetting the address.	
The BM 143-DESINA and BM 141 DI 8 × DC 24V ECOFAST basic modules can be combined with all the other expansion modules of the ET 200X.	
Four LEDs are provided on the front of the basic modules for indicating: • Errors on the ET-DESINA (SF) • Data transfer to the BM 143-DESINA (RUN) • Non-switched load voltage (DC 24 V-NS)) • Switched load voltage (DC 24 V-S)	
Transmission rates of 9.6 kbps to 12 Mbps are permitted.	

Note

The EM 143-DESINA expansion module can **only** be used with the
BM 143-DESINA and BM 141-ECOFAST basic modules. It is not compatible with
the BM 141, BM 142 and BM 147/CPU basic modules.

DP master for ET 200X-DESINA/ET 200X-ECOFAST

The ET-DESINA and ET 200X-ECOFAST can communicate with all DP masters that behave in compliance with EN 50170, Volume 2, PROFIBUS. However, some DP masters can process only limited frame lengths.

Check whether the DP master you are using can receive frames from the ET 200X-DESINA and ET 200X-ECOFAST in their entirety. To ascertain this, you will find a list of maximum frame lengths in the *configuration and parameter assignment frames for ET 200X* at http://www.ad.siemens.de/simatic-cs.

Configuration of ET 200X-DESINA/ECOFAST (examples)
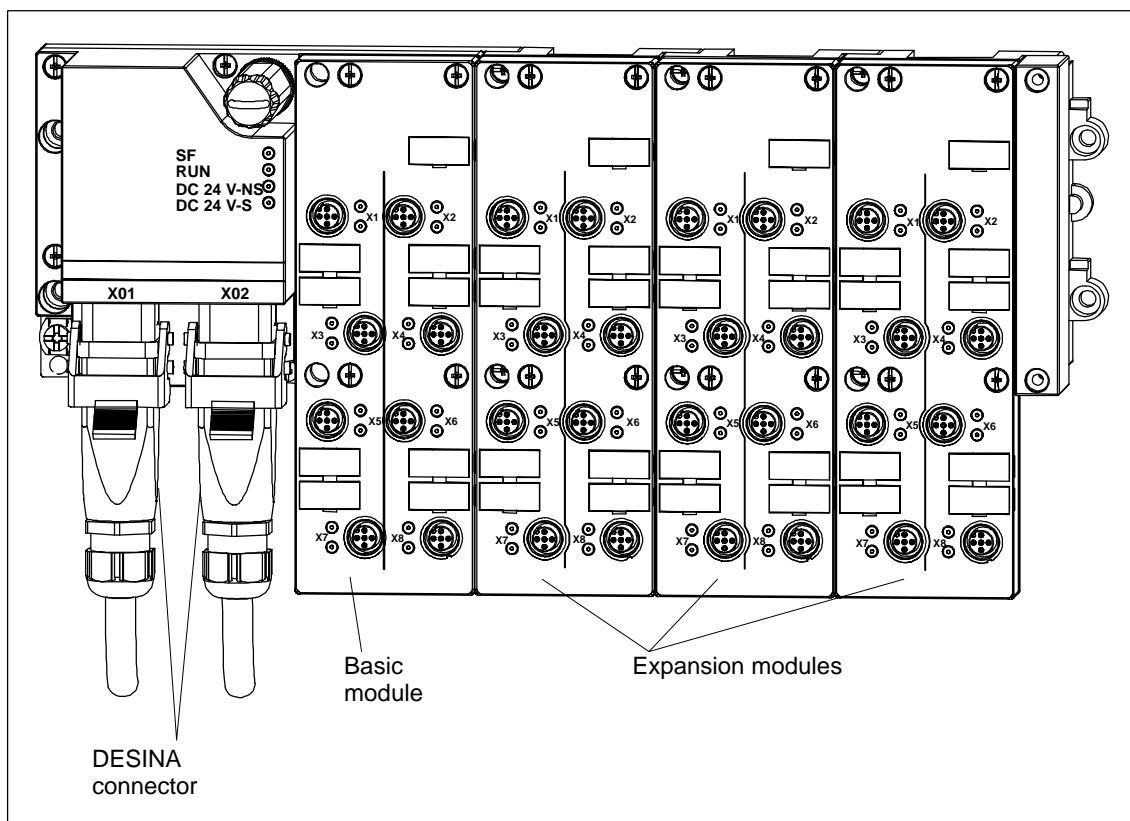
Figure 1-3   Configuration of the ET 200X-DESINA/ET 200X-ECOFAST distributed I/O device (example)
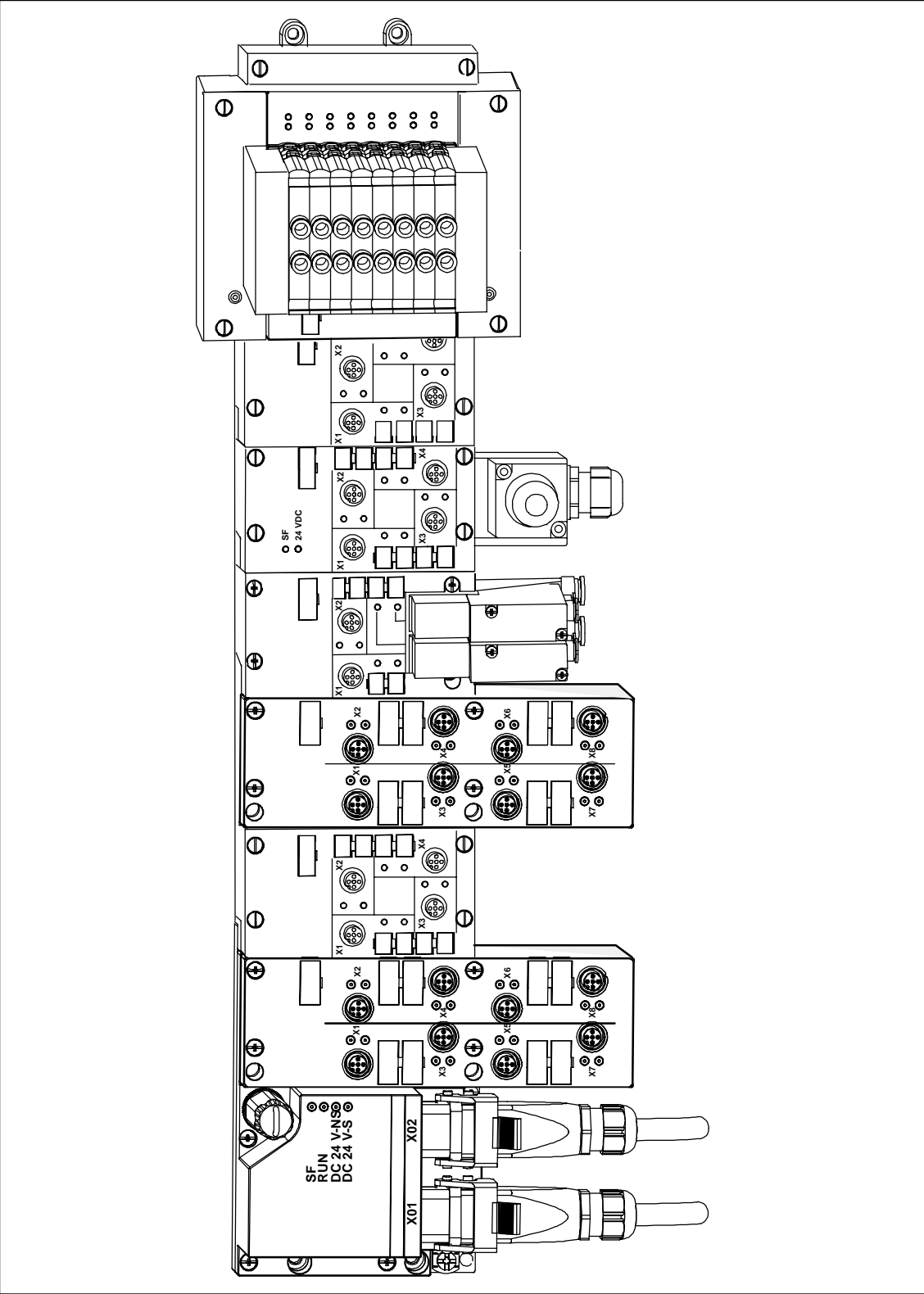
Figure 1-4   Configuration of the ET 200X-DESINA/ET 200X-ECOFAST distributed I/O device with various expansion modules

1.4   ET 200X with pneumatic functionality

40 per cent of all actuators are pneumatic cylinders. Three expansion modules for the pneumatic connection to the ET 200X are available for optimum adaptation of the ET 200X to the overall process:

- EM 148-P DI 4 × DC 24V/DO 2 × P expansion module (pneumatic module)

- EM 148-P DO 16 × P/CPV10 expansion module
  (pneumatic interface module for FESTO valve island CPV10)

- EM 148-P DO 16 × P/CPV14 expansion module
  (pneumatic interface module for FESTO valve island CPV14)

Pneumatic module

The pneumatic module is an expansion module with four digital inputs and two separate 4/2-way valves. The pneumatic module is used to control:

- a maximum of two double-acting pneumatic cylinders having a piston diameter of up to 50 mm

- a single-acting pneumatic cylinder with a piston diameter up to 50 mm when a plug is used for the second connection to the valve

- other pneumatic drives such as rotary actuators or

- a nozzle.

Pneumatic cylinders having a piston diameter greater than 50 mm can similarly be controlled with constraints at the piston speed.

The digital inputs can be used to acquire the limits of travel of the pneumatic cylinders.

You can integrate up to seven pneumatic modules into an ET 200X.

Configuration of the ET 200X with pneumatic modules (example)
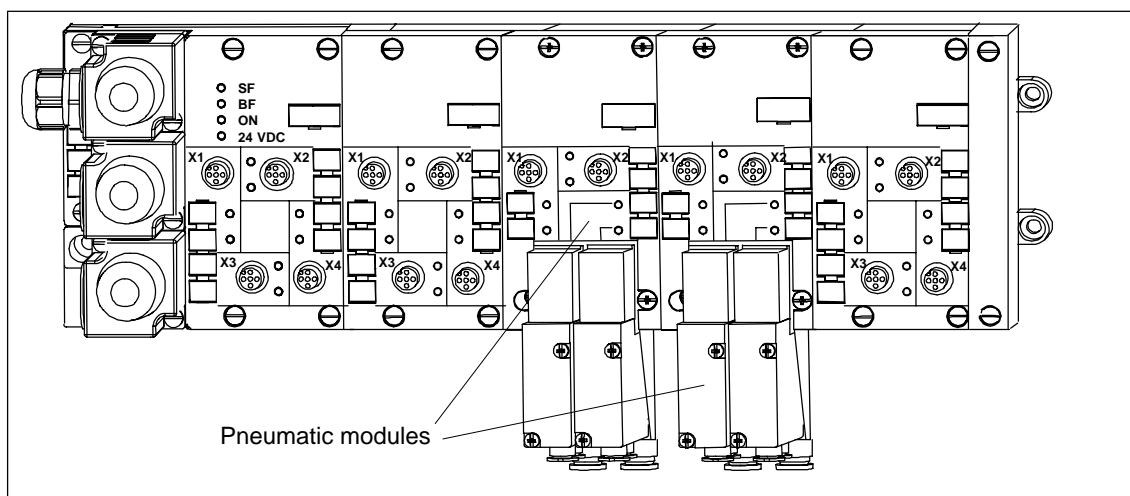
Pneumatic modules

Figure 1-5   Configuration of the ET 200X with pneumatic modules (example)

Pneumatic interface module for the CPV10 and CPV14

The pneumatic interface modules are expansion modules for connecting two Regular CPV10 or CPV14 FESTO valve islands.

Each of the two FESTO valve islands can be equipped with as many as 16 valves (standard components of the FESTO company). The valve islands differ in respect of their rated air flows (CPV10: 400 l/min; CPV14: 800 l/min).

You can integrate up to six pneumatic interface modules into an ET 200X.

Configuration of the ET 200X with pneumatic interface module and FESTO valve island (example)

Pneumatic interface module for CPV10

FESTO valve island CPV10
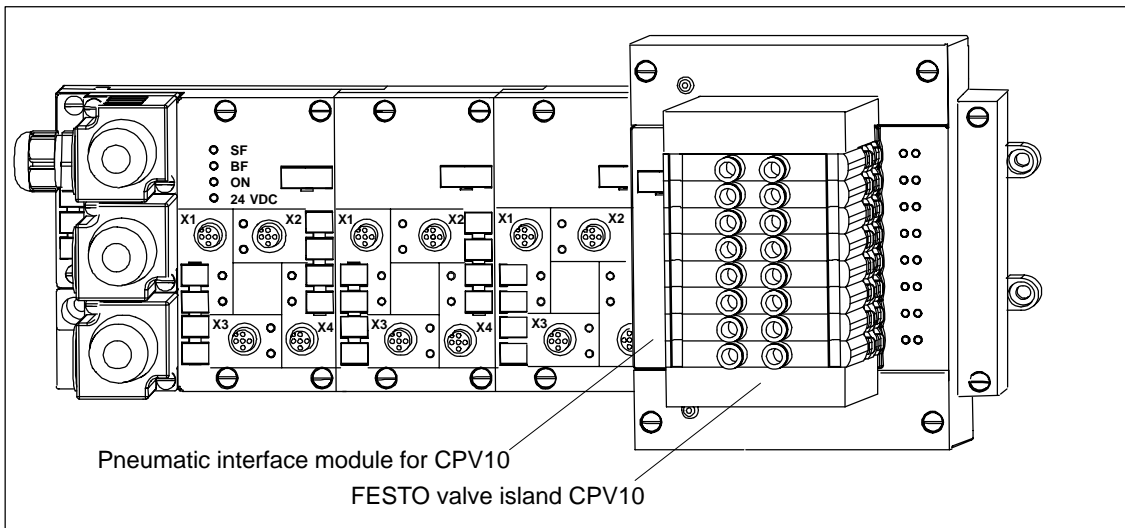
Figure 1-6   Configuration of the ET 200X with pneumatic interface module (example)

Address assignment, pneumatic interface module for CPV10 and CPV14

The figure below shows the pneumatic interface module with FESTO CPV10 valve island and addresses.
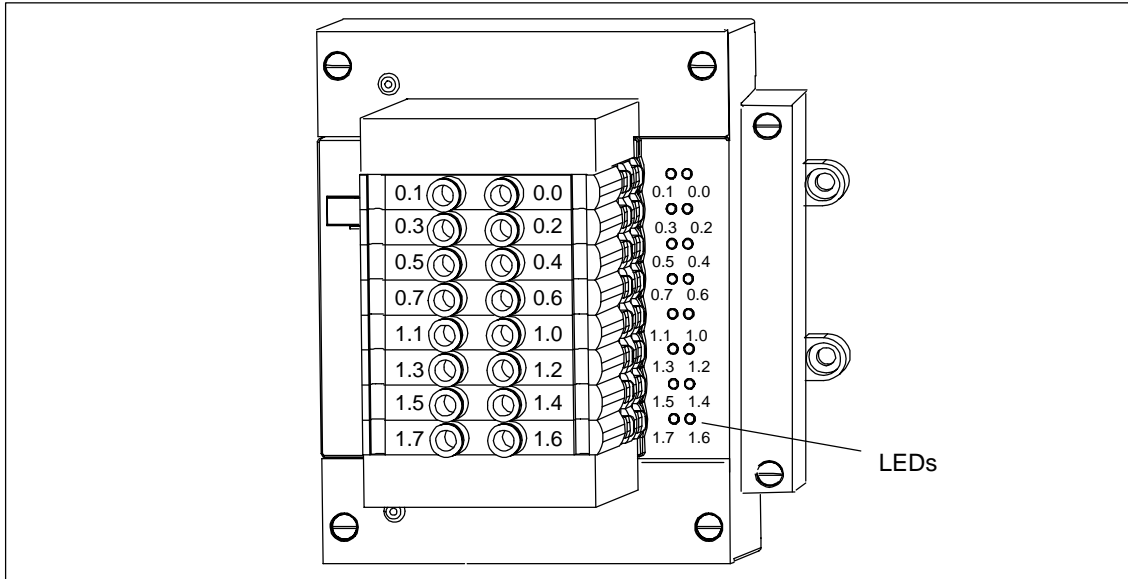
Figure 1-7   Assigning addresses to the pneumatic interface module

1.5 ET 200X with PM 148 DO 4 × DC 24V/2A power module

Function

The power module is an expansion module for ET-voltage feed. You can use power modules to loop through or feed load voltage separately from multiple supply points to the digital-output modules of the ET 200X.

You can integrate a maximum of 7 power modules into an ET 200X.

Switching load voltage ON/Off selectively

A separate load-voltage supply means that you can switch load voltage on and off selectively for individual modules. The "DC 24V" LED on the power module indicates whether or not load voltage is applied.

Configuration of ET 200X with power module (example)
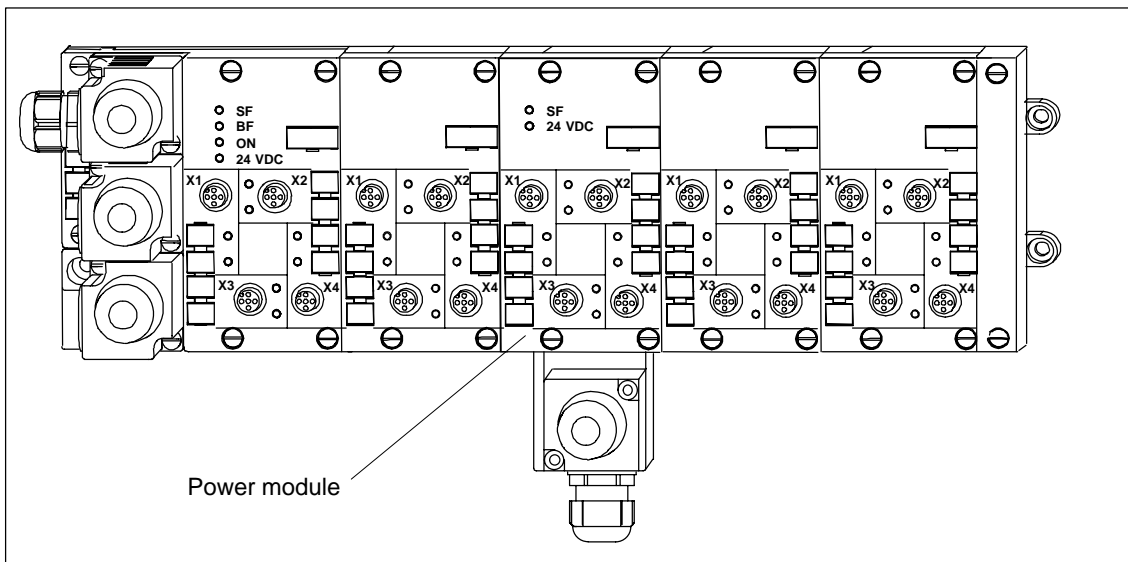
Figure 1-8   Configuration of ET 200X with power module (example)

1.6 ET 200X with SITOP power

Function

SITOP-mode power supply unit for ET 200X.

It integrates into the ET 200X without additional wiring and supply the power for electronics/sensors and/or the load voltage. Response to faults is parameterizable (restart or shutdown following a short circuit on the output side).

Note

- SITOP power 24V/10A must always be installed in the rightmost slot of the ET 200X.
- If a SITOP power module is installed on a BM 143-DESINA or BM 141-ECOFAST, do not use the DESINA hybrid cable to supply power (power is supplied by the SITOP power). In this case the DESINA hybrid cable is used only for connection to PROFIBUS-DP.
  Do not loop through the power supply from a BM 143-DESINA or BM 141-ECOFAST with SITOP power.

Configuration of ET 200X with SITOP power 24V/10A (example)
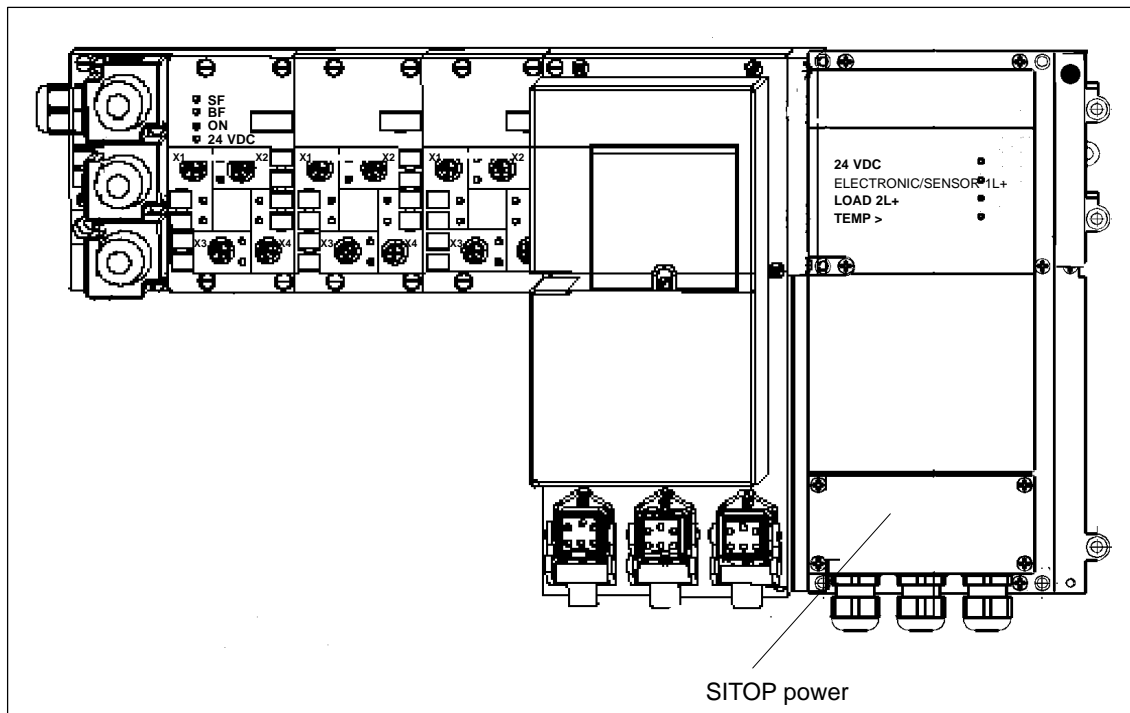
Figure 1-9   Configuration of ET 200X with SITOP power (Example)

1.7 ET 200X with CP 142-2 communication processor

Function

You can connect an AS interface to the ET 200X with the aid of the CP 142-2 (as AS-i master). A configuration of this nature can include a maximum of 31 AS-i slaves. LEDs on the front panel of the CP 142-2 indicate the operating statuses of the slaves.

The CP 142-2 is parameterized with STEP 7. Separate configuration for AS-i is not necessary.

You can connect a maximum of 6 CP 142-2 communication processors to each basic module (except the BM 147/CPU).

You can connect a maximum of 7 CP 142-2 communication processors to the BM 147/CPU basic module.

Configuration of ET 200X with CP 142-2 (example)
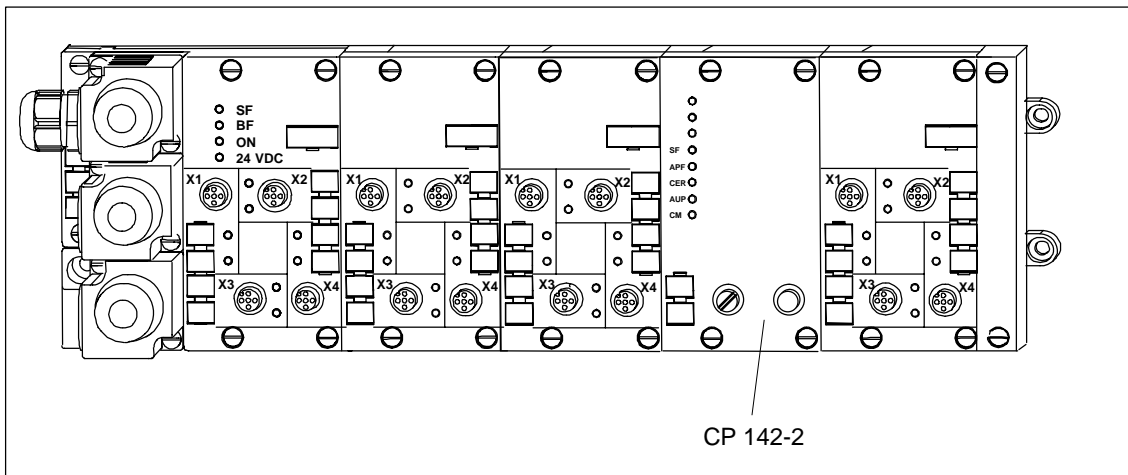
Figure 1-10   Configuration of ET 200X with CP 142-2 (Example)

1.8   Guide to the ET 200X manuals

Components and the manuals required for them

The components of the ET 200X are described in various manuals in the ET 200X package. The figure below shows possible ET 200X configurations and the manuals required for them.
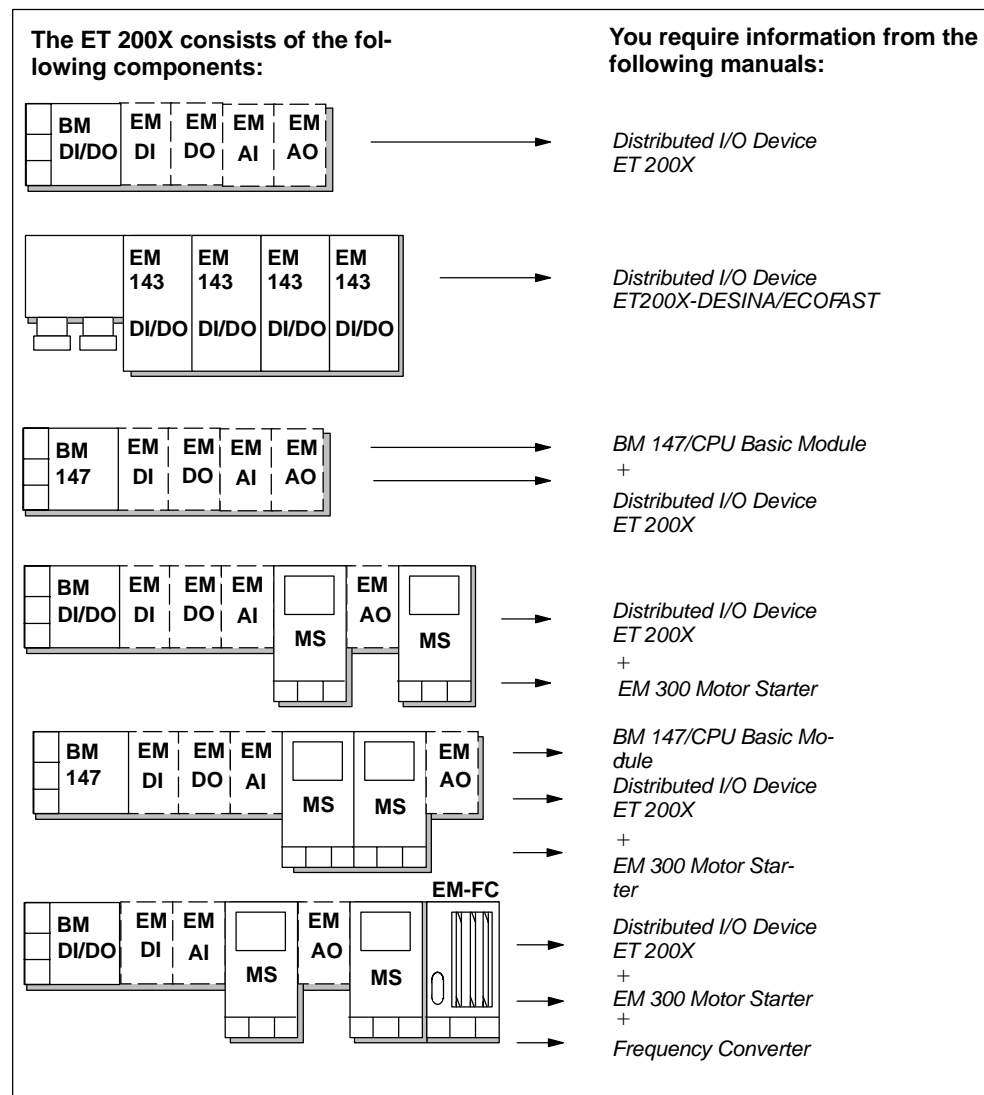
Figure 1-11   Components and the manuals required for them

Where do you find what information?

The table below will help you get your bearings and find the information you need quickly. It tells you which manual you need to refer to and which chapter deals with the topic you are interested in.

Table 1-2   Topics of the manuals in the ET 200X manual package

Subject	Manual				Chap-ter/Appen-dix
	Distributed I/O device ET 200X	*BM 147/CPU basic module*	*EM 300 motor starter*	*EM 148-FC frequency converter*	
ET 200X configuration options	x				2
Installation of ET 200X, motor starters and frequency converters; setting the PROFIBUS address connecting the terminating resistor	x				3
Installation of ET 200X-DESINA/ECOFAST; setting the PROFIBUS address	x				3
BM 147/CPU addressing		x			2
Electrical configuration and wiring of the ET 200X	x				4
Electrical configuration and wiring of the ET 200X-DESINA/ECOFAST	x				4
Wiring of motor starters			x		2
Wiring of frequency converters				x	2
ET 200X with BM 147/CPU with PROFIBUS-DP		x			3
Commissioning and diagnostics of the ET 200X	x				5
Commissioning and diagnostics of the ET 200X-DESINA/ECOFAST	x				5
Commissioning and diagnostics of the ET 200X with the BM 147/CPU		x			4
Commissioning and diagnostics of the ET 200X with motor starters			x		3
Commissioning and diagnostics of the ET 200X with frequency converters				x	3
General technical specifications of the ET 200X (standards, certificates and approvals, EMC, environmental conditions, etc.)	x				6
Technical specifications of the basic and expansion modules with DI, DO, AI and AO	x				7
Technical specifications of the BM 147/CPU		x			5
Technical specifications of the motor starters			x		5
Functions and technical specifications of the frequency converters				x	4
BM 147/CPU cycle and response times		x			6
Order numbers of the components	x				A

Table 1-2   Topics of the manuals in the ET 200X manual package, continued

| Subject | Manual | | | | Chap-ter/ Appen-dix |
	Distributed I/O device ET 200X	*BM 147/CPU basic module*	*EM 300 motor starter*	*EM 148-FC frequency converter*	
Order numbers of the motor starters			x		A
Order numbers of the frequency converters				x	A
Dimensioned drawings of the basic modules and digital and analog expansion modules	x				C
Dimensioned drawings of the motor starters			x		B
Dimensioned drawings of the frequency converters				x	B
Configuration and parameter assignment frames for the BM 147/CPU		x			A
Configuration assignment frame for the motor starter			x		C
STEP 7 list of operations		x			B
Execution times of SFCs		x			C
Glossary	x	x			Glossary

Table 1-3   Separate manuals for ET 200X components

Subject	Manual
Using a CP 142-2	CP 142-2 Manual Order No.: 6GK7 142-2AH00-8AA0

Configuration Options

2

Configuration options

There are several different ways in which ET 200X distributed I/O devices can be connected to PROFIBUS-DP. This chapter provides an overview of the various configuration options. The restrictions regarding the maximum number of modules allowed in each configuration are described in a separate section.

Contents of Chapter

Modules for the ET 200X

This chapter does not contain any further information about the types of module that can be used for the ET 200X. Please refer to Chapter 7 for the technical specifications, pinouts, basic circuit diagrams, etc.

Terminating resistor

There must be a terminating resistor on the first and last node of a PROFIBUS-DP network with copper conductors (see Section 3.4).

The ET 200X-DESINA FO has a fiber-optic waveguide to transmit bus signals. This waveguide does not require a terminating resistor.

Configuring a PROFIBUS-DP network

The principles and rules for configuring a PROFIBUS-DP network are described in the manual for the DP master.

2.1 Brief overview of the different basic modules

Table 2-1   Brief overview of the different basic modules

Common features	• Operation as a DPV0 slave • Operation as a DPV1 slave • Operation as a S7 slave • Diagnostic interrupt • Hardware interrupt • Direct communication • IP 67
BM 141 DI 8 × DC 24V (6ES7 141-1BF12-0XB0)	• 8 digital inputs • Connectors for the supply and PROFIBUS-DP (copper conductors) • DDB file for DPV1: SI03803D.GSG (as of version 1 of the basic module)
BM 141 DI 8 × DC 24V ECOFAST (6ES7 141-1BF01-0AB0)	• 8 digital inputs • ECOFAST connectors for the supply and PROFIBUS-DP (copper conductors) • DDB file for DPV1: SI0380D2.GSG (as of version 1 of the basic module)
BM 141 DI 8 × DC 24V ECOFAST DIAG (6ES7 141-1BF40-0AB0)	• 8 digital inputs • ECOFAST connectors for the supply and PROFIBUS-DP (copper conductors) • Diagnostic interrupt for short circuit and wire break for each channel • Hardware interrupt at rising and falling edge for each channel • DDB file for DPV1: SI0380D3.GSG (as of version 2 of the basic module)
BM 142 DO 4 × DC 24V/2A (6ES7 142-1BD22-0XB0)	• 4 digital outputs (2A per output) • Connectors for the supply and PROFIBUS-DP (copper conductors) • DDB file for DPV1: SI03803C.GSG (as of version 3 of the basic module)
BM 143-DESINA FO (6ES7 143-1BF00-0XB0)	• 8 digital inputs or outputs (separately parameterizable as an input or output), diagnostic input for each channel • ECOFAST connectors for the supply and PROFIBUS-DP (fiber-optic cables) • DDB file for DPV1: SI03809A.GSG as of version 5 of the basic module
BM 143-DESINA RS485 (6ES7 143-1BF00-0AB0)	• 8 digital inputs or outputs (separately parameterizable as an input or output), diagnostic input for each channel • ECOFAST connectors for the supply and PROFIBUS-DP (fiber-optic cables) • DDB file for DPV1: SI03809A.GSG (as of version 2 of the basic module)

2.2 Feeding and looping through the supply voltage for the electronic components/sensors and PROFIBUS-DP

Configuration options

Each ET 200X consists of a basic module (BM) and up to 7 expansion modules (EM). There are various ways of connecting ET 200X distributed I/O devices to PROFIBUS-DP:

- feeding and looping through the supply voltage for the electronics/sensors and PROFIBUS-DP via a common cable [1]

- feeding and looping through the supply voltage for the electronics/sensors and PROFIBUS-DP via separate cables [2]

- feeding and looping through the supply voltage for the electronics/sensors and PROFIBUS-DP via separate cables [3]

- feeding the supply voltage for the electronics/sensors to every ET 200X and looping through PROFIBUS-DP via separate cables [4]

Each of the above configuration options is described below using an example.

Connection

You can hook up the supply voltage and PROFIBUS-DP by means of a connector on the basic module of the ET 200X. Use a second connector for looping through.

① **Feeding via a common cable**

The supply voltage for the electronic components and the sensors is fed to the first ET 200X and looped through to the downstream ET 200Xs via the same cable as PROFIBUS-DP.
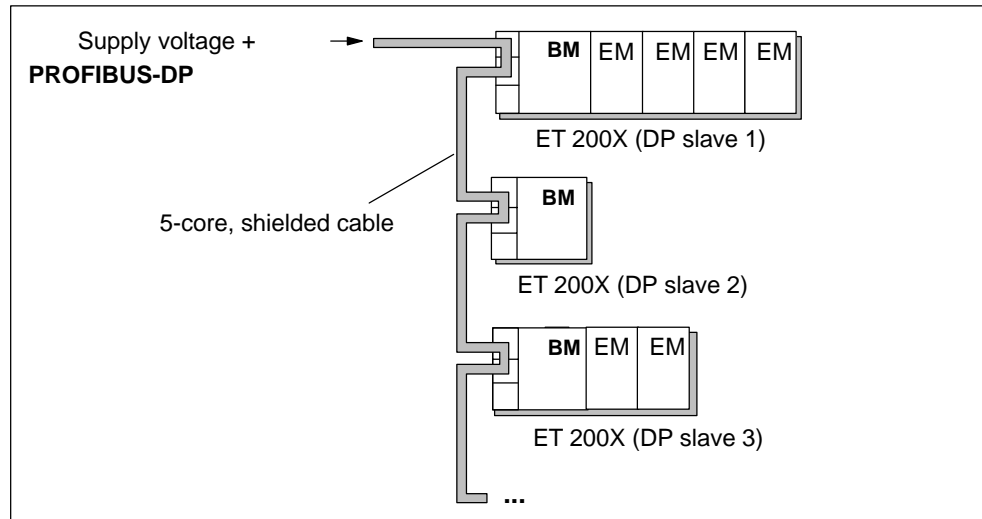
Figure 2-1   Feeding and looping through the supply voltage and PROFIBUS-DP via a common cable

② **Looping through via a common cable**

The supply voltage for the electronic components/sensors and PROFIBUS-DP are fed to the first ET 200X via two separate cables. They are looped through to the downstream ET 200Xs via a common cable.
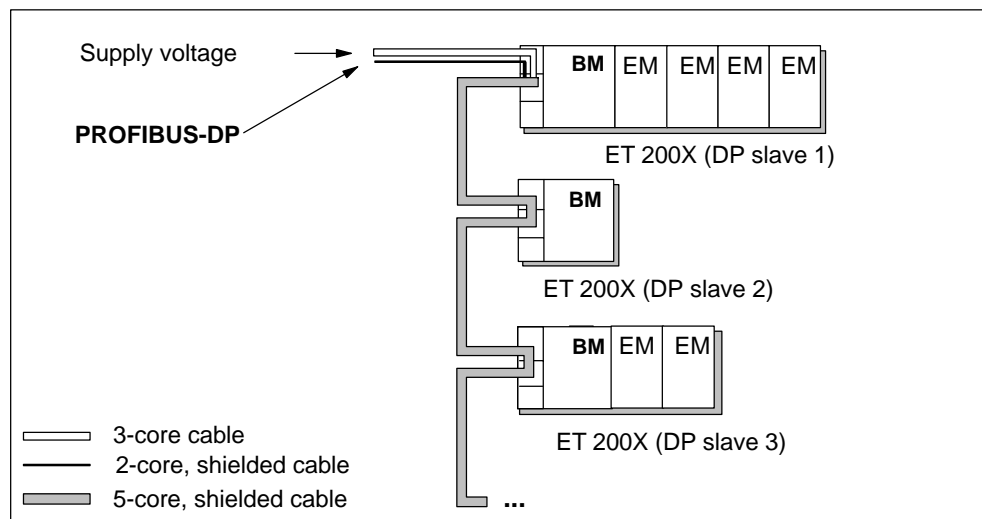
Figure 2-2   Feeding the supply voltage and PROFIBUS-DP via separate cables and looping them through via a common cable

⌷3 **Feeding/looping through via separate cables**

The supply voltage for the electronic components/sensors and PROFIBUS-DP are fed to the first ET 200X and looped through to the downstream ET 200Xs via two separate cables.
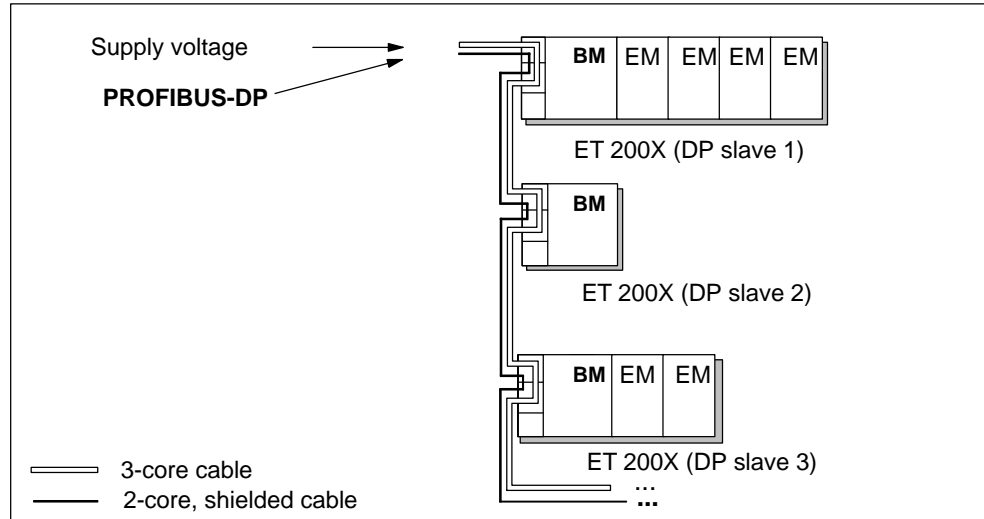
Figure 2-3   Feeding the supply voltage and PROFIBUS-DP and looping them through via separate cables

⌷4 **Feeding/looping through of PROFIBUS-DP via 1 cable**

The supply voltage for the electronic components/sensors is fed to each ET 200X separately. PROFIBUS-DP is fed and looped through to the downstream ET 200Xs via a common cable.
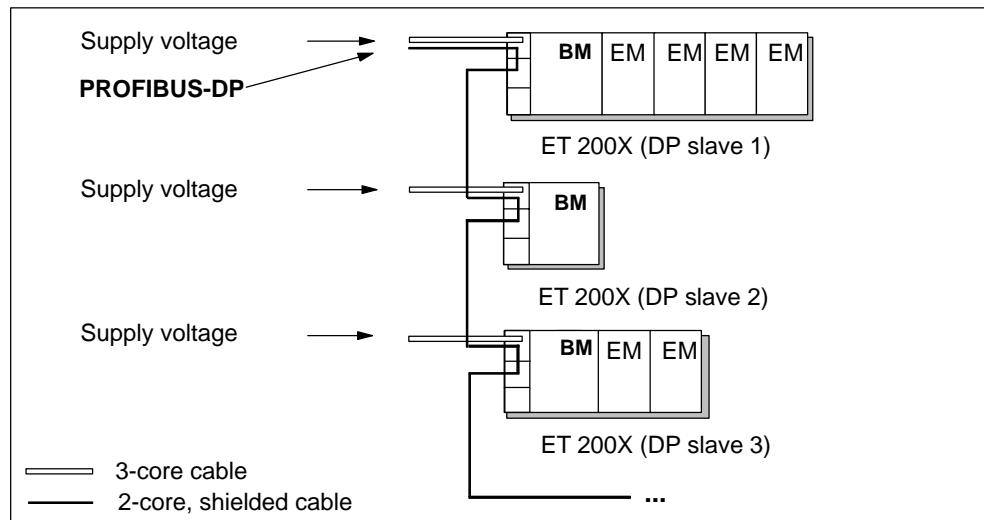
Figure 2-4   Feeding the supply voltage separately to each ET 200X and looping PROFIBUS-DP through via a separate cable

Cables

Please refer to Section 4.4 and Appendix A for a list of suitable cable types.

Load supply voltage

If you use motor starters (EM 300...) and/or frequency converters, you must supply them with 400 VAC (see Chapter 2.4).

Load power supply

If you use basic/expansion modules that have outputs, you must connect the relevant ET 200X to a load power supply (see Section 2.5).
Exception: ET 200X-DESINA (see Figure 4-4).

2.3 Disconnecting ET 200X from the bus and looping through the supply voltage/PROFIBUS-DP (not ET 200X-DESINA/ET 200X-ECOFAST)

Looping through PROFIBUS-DP

The two connectors for feeding and looping through the supply voltage and PROFIBUS-DP are plugged into a connector plate in the basic module. Remove the two connectors from the BM 141/BM 142/BM 147 basic module of the ET 200X **together with the connector plate beneath them**.

Advantage

The relevant ET 200X distributed I/O device is disconnected from PROFIBUS-DP, but the supply voltage and PROFIBUS-DP are still looped through to the next ET 200X.

Example

This principle is demonstrated by the example shown in the diagram below.
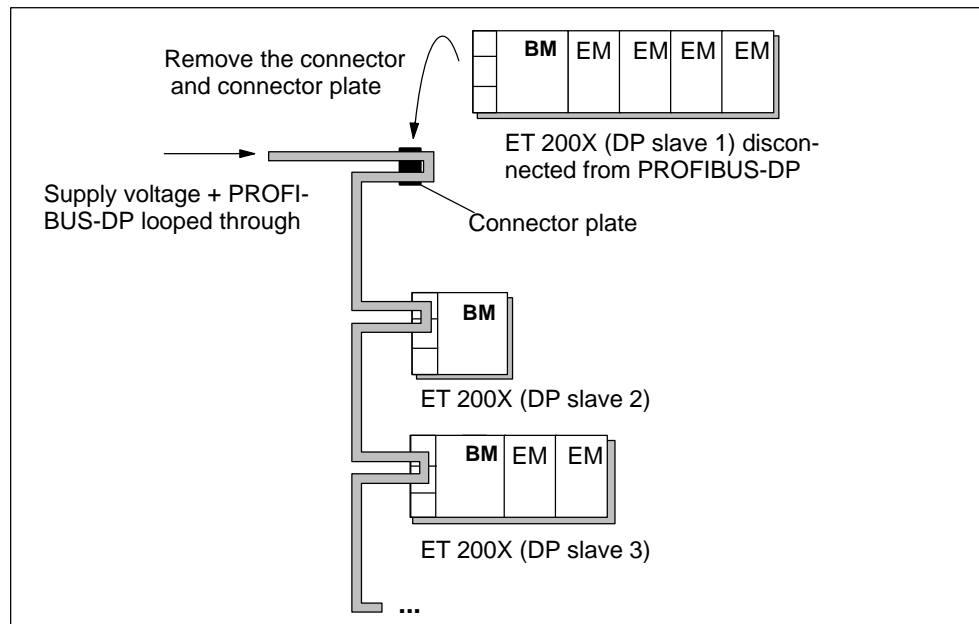
Figure 2-5   Disconnecting the ET 200X from the bus and looping through the supply voltage/PROFIBUS-DP

⚠ **Caution**

There are freely accessible live contacts on the underside of the connector plate. Take steps to ensure that no short-circuits can occur between these contacts, or the fuse on the connector plate may be tripped and damage caused to other connected devices.

2.4 Connecting the load supply voltage to motor starters/frequency converters and looping it through

Necessity

If you use motor starters (EM 300...) and/or frequency converters (EM148-FC), you must supply them with a 400 VAC load voltage. You must also supply the basic module of the relevant ET 200X with DC 24V load voltage (exception: ET 200X-DESINA and ET 200X-ECOFAST, see Figure 4-4 and Figure 4-5).

Connection

Hook up the load supply voltage and the load to the power socket and power connector on the motor starter/frequency converter.

Looping through

The load supply voltage can be looped through from one motor starter/frequency converter to the next by connecting an additional power connector to the motor starter/frequency converter. The load supply voltage can be looped through both within the same ET 200X and from one ET 200X to the next.

Configuration example

The diagram below shows you three possible configurations with connections for the 400 VAC load supply voltage, the load and looping through. The possible configurations for motor starters and frequency converters are the same. You must take into account that the frequency converters have to be positioned to the right of the motor starters.
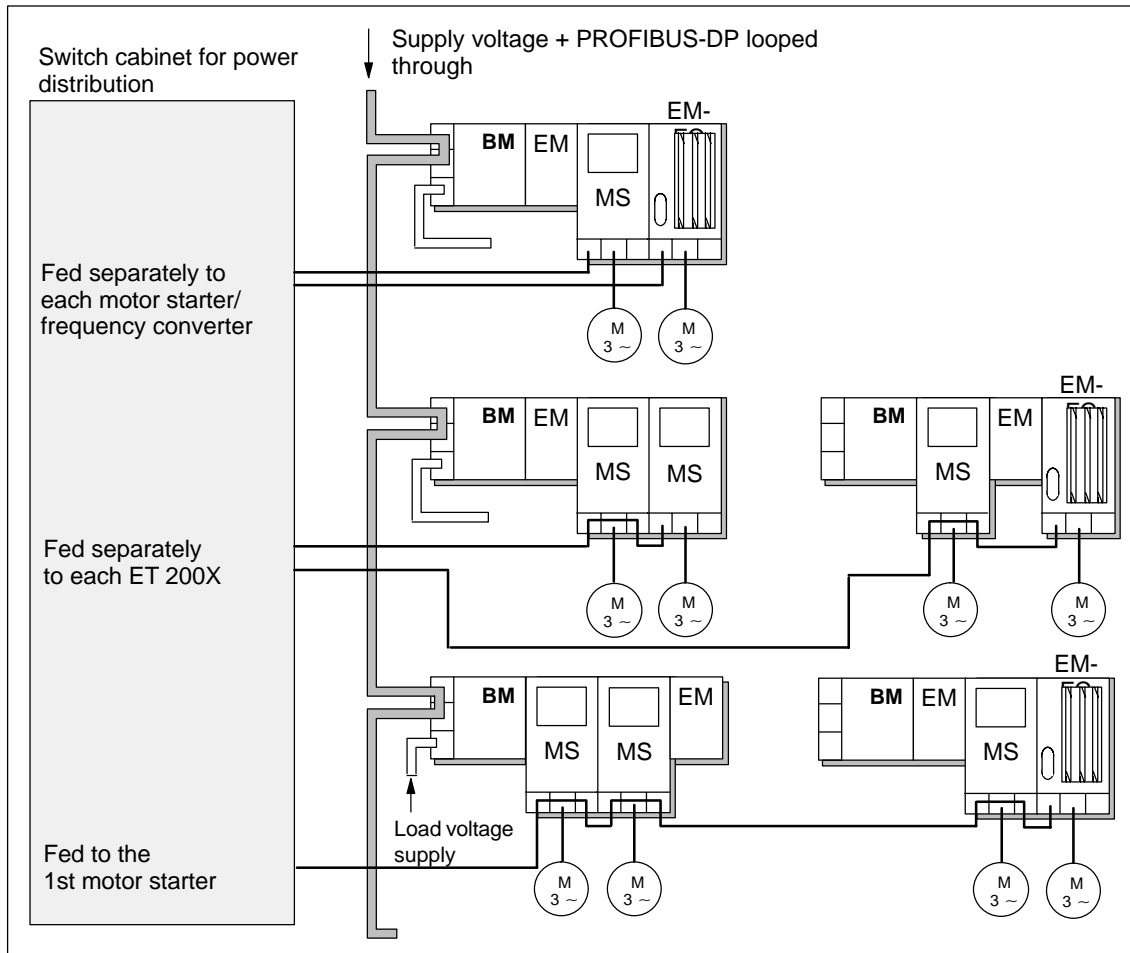
Figure 2-6   Connecting and looping through the load supply voltage

Cables

Please refer to Section 4.4 for a list of suitable cable types.

2.5 Connecting and looping through the load voltage

Necessity

A load voltage is only necessary if you wish to use a basic module/expansion module(s) with outputs (e. g. DO) and/or motor starters/frequency converters.

In the case of the ET 200X-DESINA and ET 200X-ECOFAST, the load voltage is carried by the DESINA hybrid cable.

Connection

You can hook up the load voltage by means of a connector on the basic module of the ET 200X. Power can also be supplied from a power module or a SITOP power.

Configuration example

The diagrams below show you a configuration with basic/expansion modules that have digital outputs (DO). Please refer to Section 7.1 for a list of the modules that can be used.
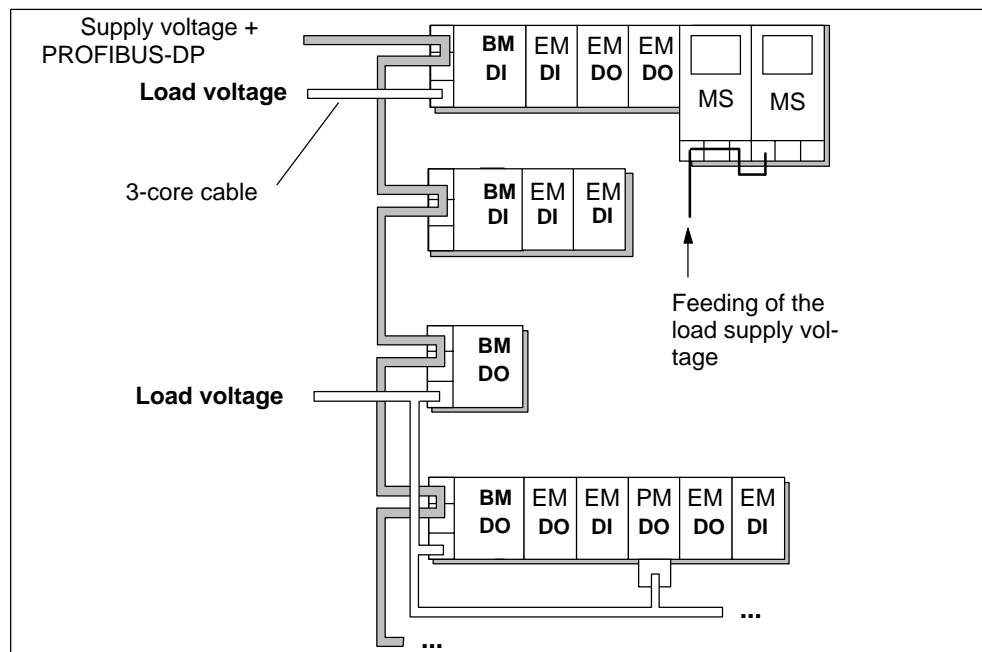
Figure 2-7   Connecting and looping through the load voltage

Looping through

The load voltage can be looped through from one ET 200X to the next by wiring the load voltage connector accordingly (see Section 4.4.2).

Cables

Please refer to Section 4.4 for a list of suitable cable types.

2.6 Use of the SITOP power power supply unit

The SITOP power 24V/10A power supply unit can provide the ET 200X with the supply voltage for electronics/sensors and/or the load voltage.

Configuration example

The diagrams below show you some configuration examples.
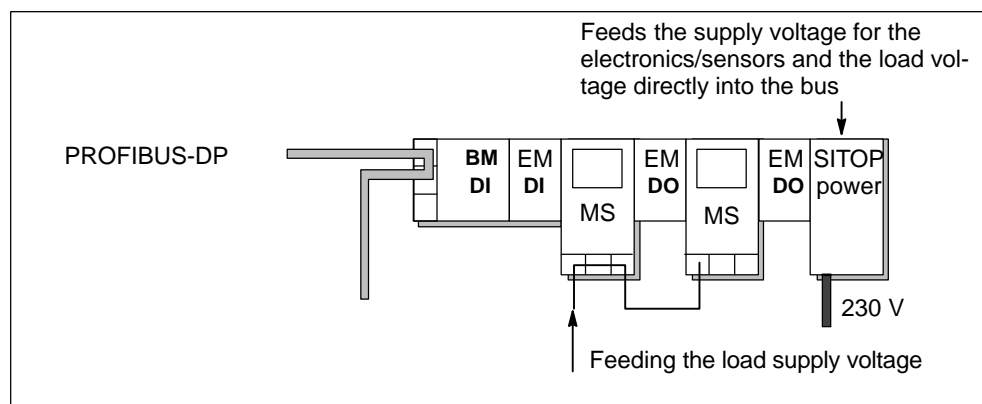
Figure 2-8   ET 200X with SITOP power 24V/10A

2.7 Connecting and looping through load voltages and PROFIBUS-DP to ET 200X-DESINA / ET 200X-ECOFAST

Non-switched and switched load voltage and PROFIBUS-DP are fed to the first ET 200X-DESINA/ET 200X-ECOFAST in a shared DESINA hybrid cable and looped through to the downstream ET 200X-DESINA/ ET 200X-ECOFAST.
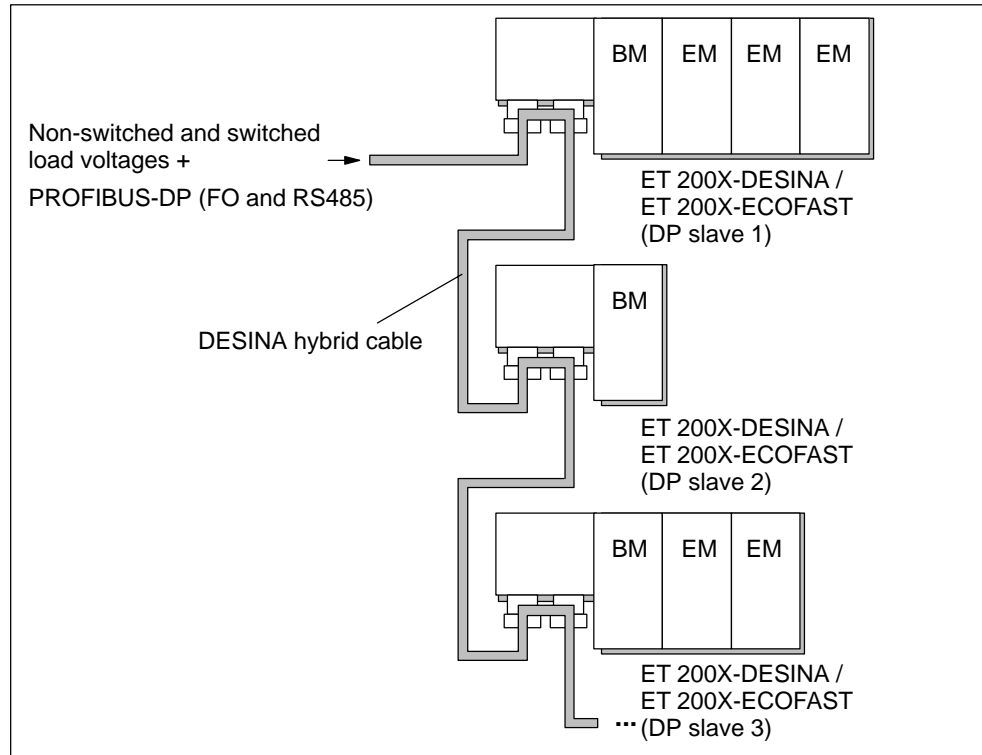
Figure 2-9   Supply voltage and PROFIBUS-DP supplied and looped through with a DESINA hybrid cable

For the connection with controller or power supply on the DESINA hybrid cable, we recommend the MCP12P media converter manufactured by Harting. See ordering data in Appendix A.

2.8 Restrictions on the number of modules

Maximum configuration

Every ET 200X consists of a basic module and up to seven expansion modules.

Motor starter, frequency converter: A maximum of 6 motor starters or frequency converters can be connected for each basic module (EM 300..., EM 148-FC). They can be inserted anywhere in the ET 200X but frequency converters must always be to the right of the motor starters.

Pneumatic interface modules: A maximum of 6 pneumatic interface modules (EM 148-P DO 16 × P/CPV...) can be connected in the ET 200X configuration.

CP 142-2 communication processor: A maximum of 6 CP 142-2 communication processors can be connected to each basic module (except BM 147/CPU). Up to seven CP 142-2 processors can be connected to the BM 147/CPU.

Restrictions imposed by power input

The maximum configuration is dependent on the power input of the individual modules. The table below shows you all the possible configurations (described in the previous sections) and specifies the restrictions imposed on them. It also indicates ways of overcoming these restrictions.

Note

The PM 148 DO 4 × DC 24V/2A power module interrupts the supply of load voltage to the downline expansion modules of an ET 200X. It has a separate load-voltage feed, which it uses to supply the downline expansion modules (see Section 2.9).

Table 2-2   Restrictions imposed on the maximum configuration by the power input

Configuration options	Restrictions	Calculation/overcoming the restrictions
Supply voltage and PROFIBUS-DP fed and looped through via a common cable ① Supply voltage and PROFIBUS-DP fed via separate cables and looped through via a common cable ②	Power input of the whole configuration: • Up to 40 °C ≤ 6 A • Up to 55 °C ≤ 4 A Maximum cable length: • 25 m if the power input of the whole configuration is as follows: Up to 40 °C ≤ 6 A Up to 55 °C ≤ 4 A • 120 m if the power input of the whole configuration is as follows: Up to 40 °C ≤ 1 A Up to 55 °C ≤ 0.8 A	1. Calculate the power input of each module (see the technical specifications as of Section 7.1). 2. Add up the power input of all the modules in the whole configuration. 3. If the current input > 6 A (4 A), then feed the supply voltage to a few ET 200Xs from the power system again (permissible power input per ET 200X ≤ 1 A or ≤ 0.8 A as a function of temperature).
Supply voltage and PROFIBUS-DP fed and looped through via separate cables ③	Power input of one ET 200X: • Up to 40 °C ≤ 1 A • Up to 55 °C ≤ 0.8 A The maximum cable length for the supply voltage is dependent on the cable core cross-section and on the power input of the whole configuration: • Cable core cross-section 0.75 mm^2 and power input 1 A (0.8 A): cable length 120 m • Cable core cross-section 0.75 mm^2 and power input 6 A (4 A): cable length 12 m • Cable core cross-section 1.5 mm^2 and power input 1 A (0.8 A): cable length 240 m • Cable core cross-section 1.5 mm^2 and power input 6 A (4 A): cable length 24 m The length of the bus cable is dependent on the transmission rate of the PROFIBUS-DP network (see the manual for the DP master)	1. Calculate the power input of each module (see the technical specifications as of Section 7.1). 2. Add up the power input of the modules of each ET 200X. 3. If the power input > 1 A (0.8 A), reduce the number of expansion modules per ET 200X. To calculate the cable length: 1. Add up the power input of all the modules in the whole configuration. 2. Increase the cable length, if necessary, by feeding the supply voltage for a few ET 200Xs from the power system again.

Table 2-2   Restrictions imposed on the maximum configuration by the power input, continued

Configuration options	Restrictions	Calculation/overcoming the restrictions
Supply voltage fed to each ET 200X from the power system and PROFIBUS–DP looped through via a separate cable ④	Power input of one ET 200X: • Up to 40 °C ≤ 1 A • Up to 55 °C ≤ 0.8 A The length of the bus cable is dependent on the transmission rate of the PROFIBUS-DP network (see the manual for the DP master)	1. Calculate the power input of each module (see the technical specifications as of Section 7.1). 2. Add up the power input of the modules of each ET 200X. 3. If the power input > 1 A (0.8 A), reduce the number of expansion modules per ET 200X.
Load voltage connected and looped through to the basic module (see Figure 2-7)	Power input from the load of one ET 200X: • Up to 40 °C ≤ 10 A • Up to 55 °C ≤ 8 A Power input from the load of the whole configuration if the load voltage is looped through: • Up to 40 °C ≤ 16 A • Up to 55 °C ≤ 12 A	1. Calculate the power input from the load of each module (see the technical specifications as of Section 7.1). 2. Add up the power inputs of all the modules of an ET 200X or of the whole configuration. 3. If the power input from the load of an ET 200X > 10 A (8 A), you have two options: – Reduce the number of expansion module(s) with DOs and/or motor starters/frequency converters on the ET 200X – Feed in the load voltage using a power module (see Figure 2-10) If the power input from the load of the whole configuration > 16 A (12 A), feed the load voltage to a few ET 200Xs from the power system again.

⚠ **Caution**

If you ignore the restrictions on the maximum system configuration specified in Table 2-2, the cable insulation and the contacts may be overheated and the device damaged as a result.

Currents of motor starters

You will find the power input and aggregate current of motor starters in the manual *EM 300* motor starters.

Currents of frequency converters

You will find the power input and aggregate current of frequency converters in the manual *EM 148-FC frequency converters.*

2.9 Maximum configuration and configuration options with power modules

Maximum configuration

Every ET 200X consists of a basic module and up to seven expansion modules, of which a maximum of seven expansion modules can be
PM 148 DO 4 × DC 24V/2A power modules.

Restrictions imposed by power input

The maximum system configuration is limited amongst other things by the power input of the load of the digital output modules in the configuration (see Section 2.7).

Limits for current consumption by load **without** use of power modules:

Limits for one ET 200X	Limits for ET 200X overall configuration (load voltage looped through)
Up to 40 °C: ≤ 10 A	Up to 40 °C: ≤ 16 A
Up to 55 °C: ≤ 8 A	Up to 55 °C: ≤ 12 A

Raising the limit

If the power input from the load exceeds the above limits, use power modules that correspond to the load power consumption of your configuration. A power module provides 10 A of load current for the downline digital-output modules.

Configuration examples

The illustration below shows a number of ET 200X configurations with power modules. The load voltage can be:

- fed separately to each basic module and each power module ①
- looped through from basic module to power module ②
- looped through from power module to power module ③
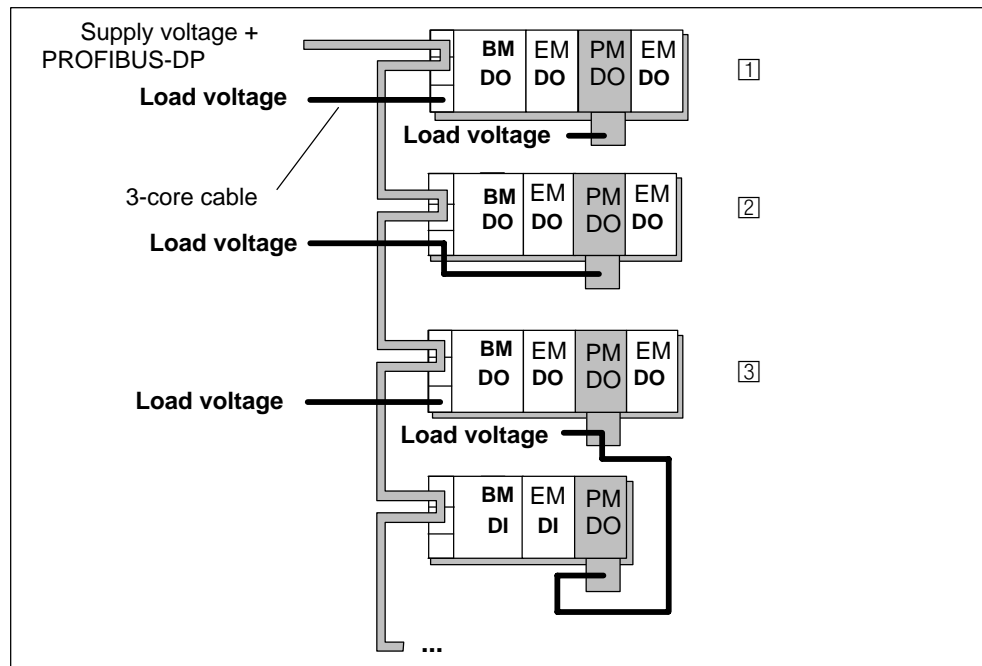
Figure 2-10   Configuration examples with power modules

Note

Load voltage cannot be supplied to power modules from the basic module via the ET 200X backplane bus. The load voltage must always be supplied via the power module's connector plug.

Installation

<div style="text-align: right; font-size: 3em; font-weight: bold;">3</div>

Structure of the ET 200X

> The ET 200X distributed I/O device is a modular DP slave. An ET 200X consists of a basic module and up to 7 expansion modules.

Installation procedure

> You have to install the ET 200X distributed I/O device in several stages. See Chapter 3.1 and 3.2.

Required settings

> You can set the PROFIBUS address between with the 7 DIL switches in the basic module or by means of the configuration connector (BM 143-DESINA and BM 141-ECOFAST).

> If the ET 200X distributed I/O device is the first or last DP slave in a PROFIBUS-DP network with copper conductors (RS 485), you must terminate the bus on the basic module with a terminating resistor (not required with BM 143-DESINA FO).

Contents of Chapter

Section	Subject	Page
3.1	Installing/deinstalling the ET 200X	3-2
3.2	Installing/disassembling pneumatic components	3-11
3.3	Setting/modifying the PROFIBUS address	3-16
3.4	Terminating PROFIBUS with a terminating resistor	3-20

3.1 Installing/deinstalling the ET 200X

Installation Position

The ET 200X with no motor starters or frequency converters can be installed in any position.

An ET 200X with motor starters or frequency converters can be installed on a vertical wall in the following positions:

- ET 200X tilted up to 22.5 to the front or the rear, and/or
- ET 200X rotated up to 90 to the right or the left.

DIN rail

As a preference, the ET 200X modules must be installed on a DIN rail. Five types are available (see Table 3-1 and Figures 3-1 and 3-2).

Table 3-1   DIN rails for installing an ET 200X

Description	Order No.
DIN rail, narrow, length 400 mm for ET 200X electronic module	6ES7 194-1GA00-0XA0
DIN rail, narrow, length 640 mm for ET 200X electronic module	6ES7 194-1GA10-0XA0
DIN rail, narrow, length 2000 mm for ET 200X electronic module	6ES7 194-1GA20-0XA0
DIN rail, wide, length 520 mm for ET 200X electronic module and motor starter/frequency converter/pneumatic interface module	6ES7 194-1GB00-0XA0
DIN rail, wide, length 1000 mm for ET 200X electronic module and motor starter/frequency converter/pneumatic interface module	6ES7 194-1GB10-0XA0
Screws with washer assemblies (100 screws M5 x 20, crossed recessed head with washer) for fitting ET 200X modules onto DIN rail	6ES7 194-1KC00-0XA0
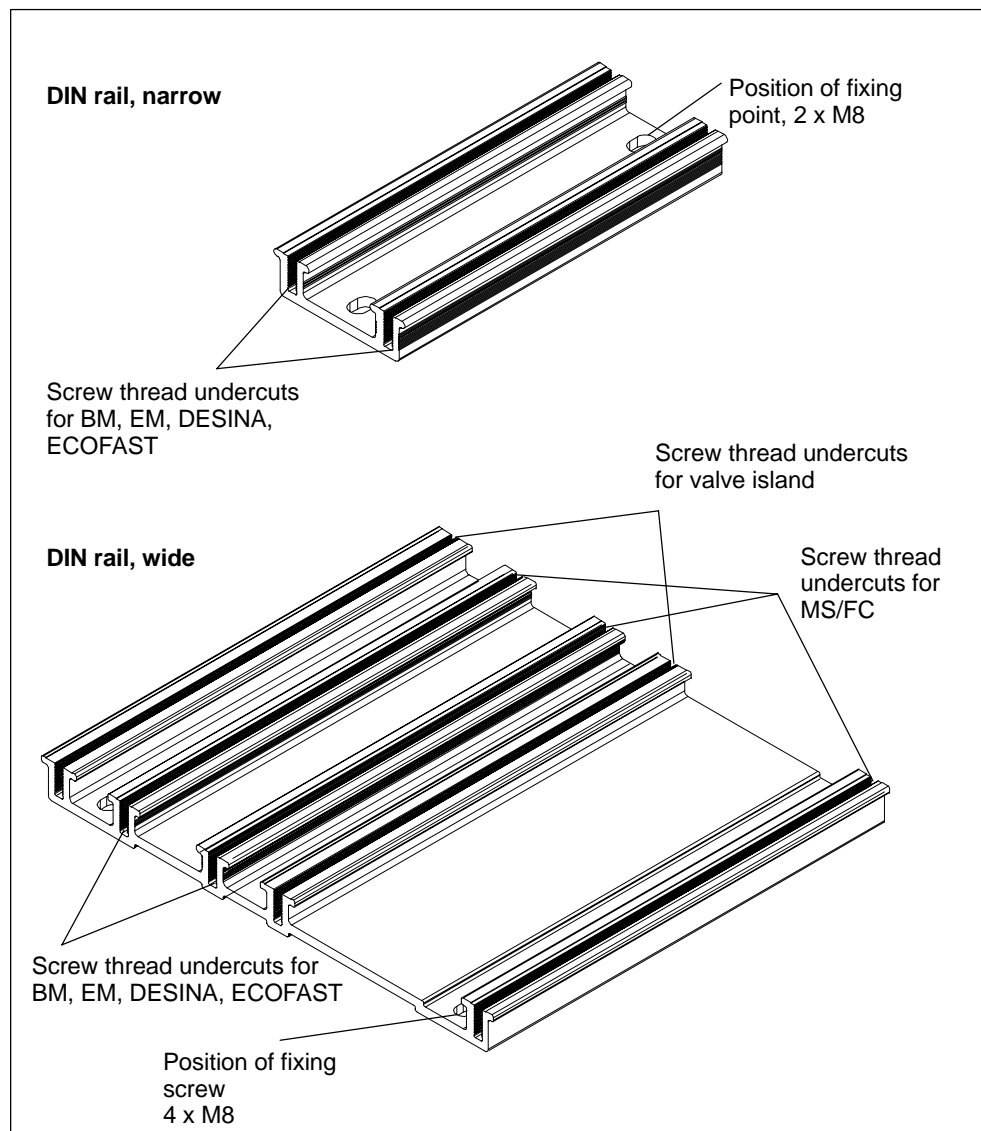
Figure 3-1   DIN rail for installing the ET 200X modules

Cross recessed head screws M5 x 20 8.8 Z4-1 as per DIN 7985 and a lock ring and washer should be used to fasten the module to the DIN rail. The screw length of 20 mm is absolutely essential.

Figure 3-2 shows dimensioned drawings for the narrow DIN rails.

Figure 3-3 shows dimensioned drawings for the wide DIN rails.
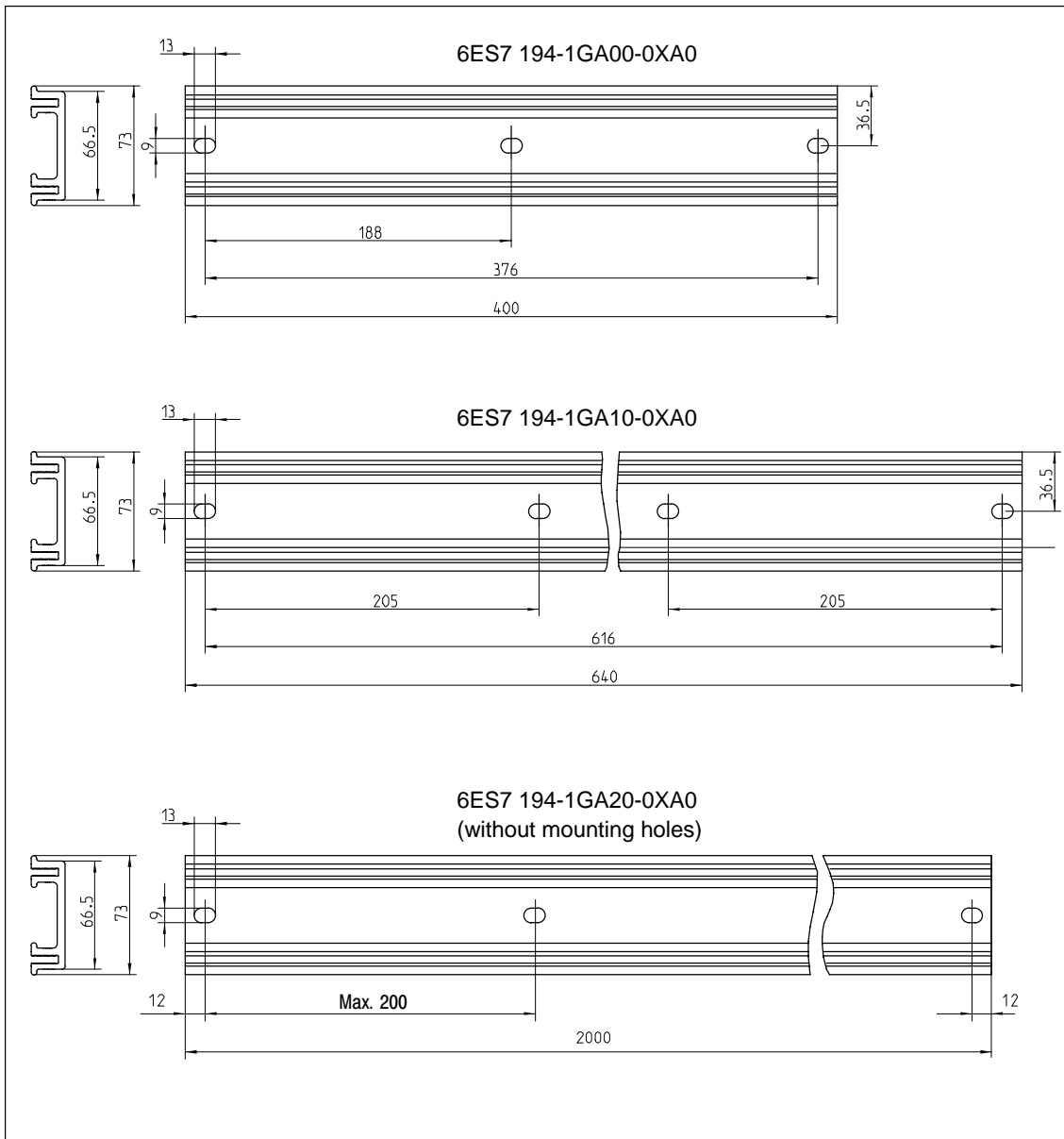
Figure 3-2   Dimensioned drawings of the narrow DIN rails

Note

You must cut the narrow DIN rail (with a length of 2000) to suit your requirements and drill the mounting holes for M8 screws.

To ensure that all the ET 200X modules have the specified vibration resistance, the mounting holes should be spaced at even intervals of a maximum 200 mm after initial spacing of 12 mm.
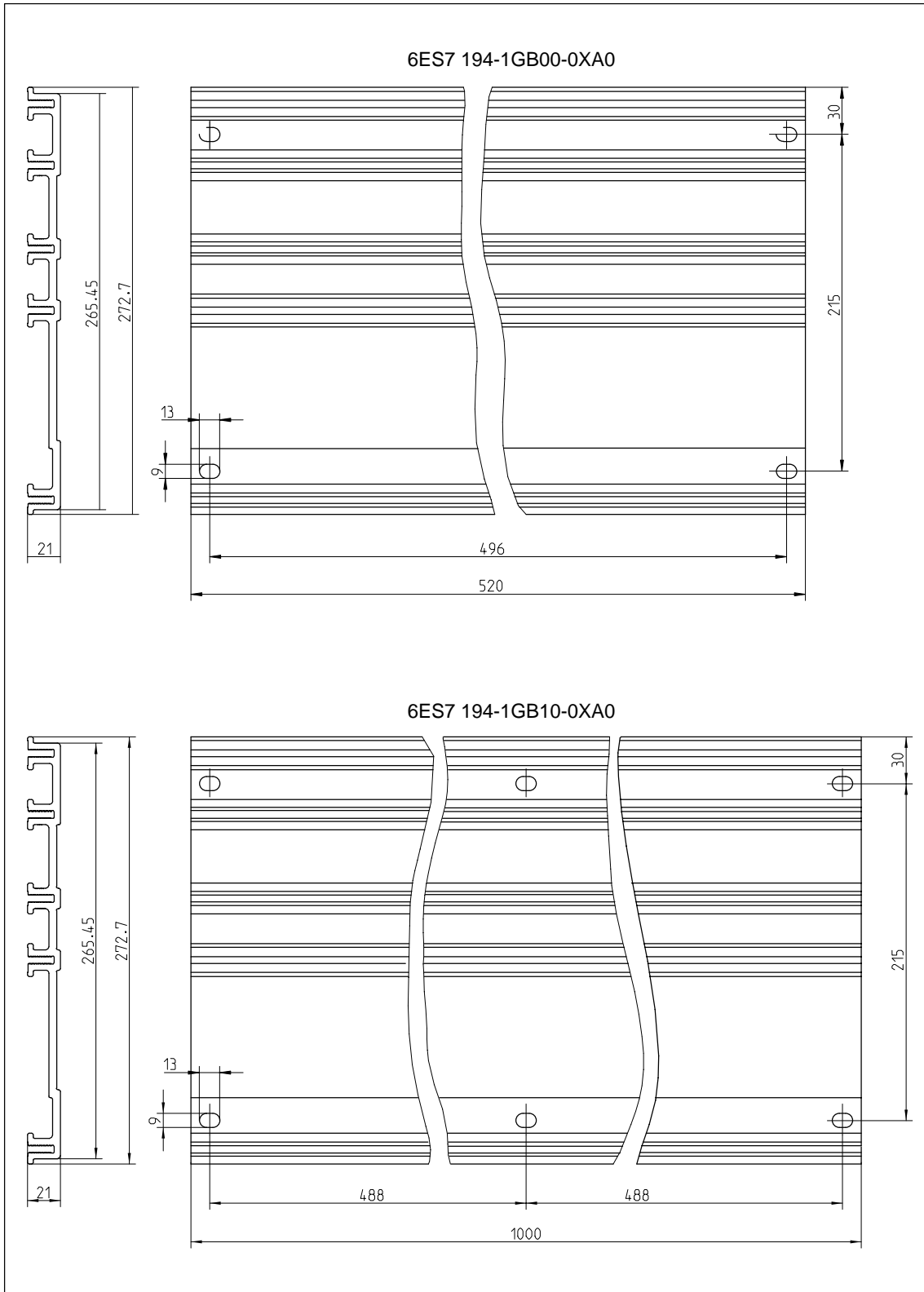
Figure 3-3   Dimensioned drawings of the wide DIN rails

Installing the ET 200X

1. Use M8 screws to secure the DIN rail to the substrate at all the fixing points provided.

2. Remove the cover panel from the expansion port of the basic module.

3. Screw the basic module to the DIN rail at the 4 fixing points using cross-recess M5 x 20 screws
   Tightening torque: 2 Nm (max. 3 Nm)

4. Plug the expansion module into the expansion interface of the basic module and fasten the modules using two M3.5 x 25 screws.

Note

- If both frequency converters and motor starters are to be fitted in an ET 200X, you must always fit the **frequency converters to the right of the motor starters** (because the connector pin assignment of the motor starters is different from the assignment on the DESINA).

- SITOP power 24V/10A must always be fitted in the extreme right position in the ET 200X and the lid fitted to seal the expansion interface.

5. Use M5 x 20 cross-recess screws to screw the expansion module to the DIN rail at the two or three fixing points.
   Tightening torque: 2 Nm (max. 3 Nm)

6. Plug the next expansion module into the interface of the previous expansion module and fasten the module using two or three M3.5 x 25 screws.

7. Use M5 x 20 cross-recess screws to screw the expansion module to the DIN rail at the two or three fixing points.
   Tightening torque: 2 Nm (max. 3 Nm)

8. Repeat steps 6 and 7 until the ET 200X is completely installed on the DIN rail.

9. Fix the cover panel for the expansion port onto the last expansion module of the ET200X.
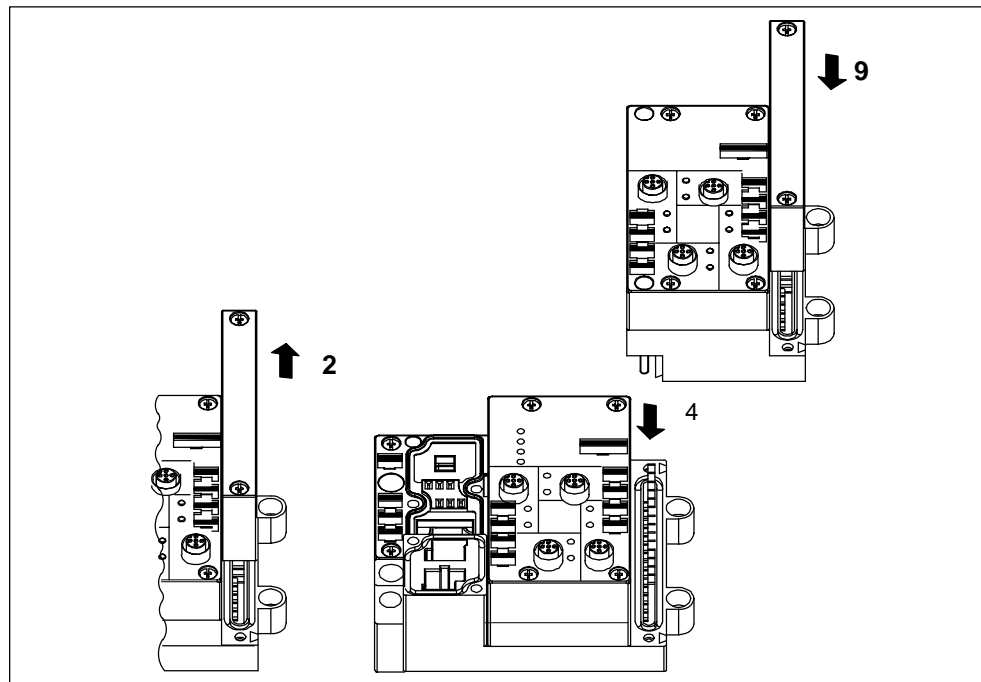
Figure 3-4   Installing expansion modules

Deinstalling the ET 200X

Note the following before deinstalling the ET 200X:

Caution

Before you deinstall expansion modules, you must switch off all the supply voltages for the ET 200X (i.e. the ET 200X must be deenergized).

If you do not do this, when you remove the expansion modules their electronic components can get damaged.

Note

If servicing is required, it is possible to eliminate a module fault by replacing the upper section (the ET 200X must be in a deenergized state). In this case, disassemble the replacement module and use the upper section.
This renders complete disassembly of the ET 200X unnecessary.

Dimensioned drawing for fixing holes

The diagrams below show you the positions of the fixing screw holes for one basic module, one expansion module and one motor starter or frequency converter. Use the specified screws.

Note

The ET 200X must be installed on the rail, and screws must be affixed at all the fixing points.
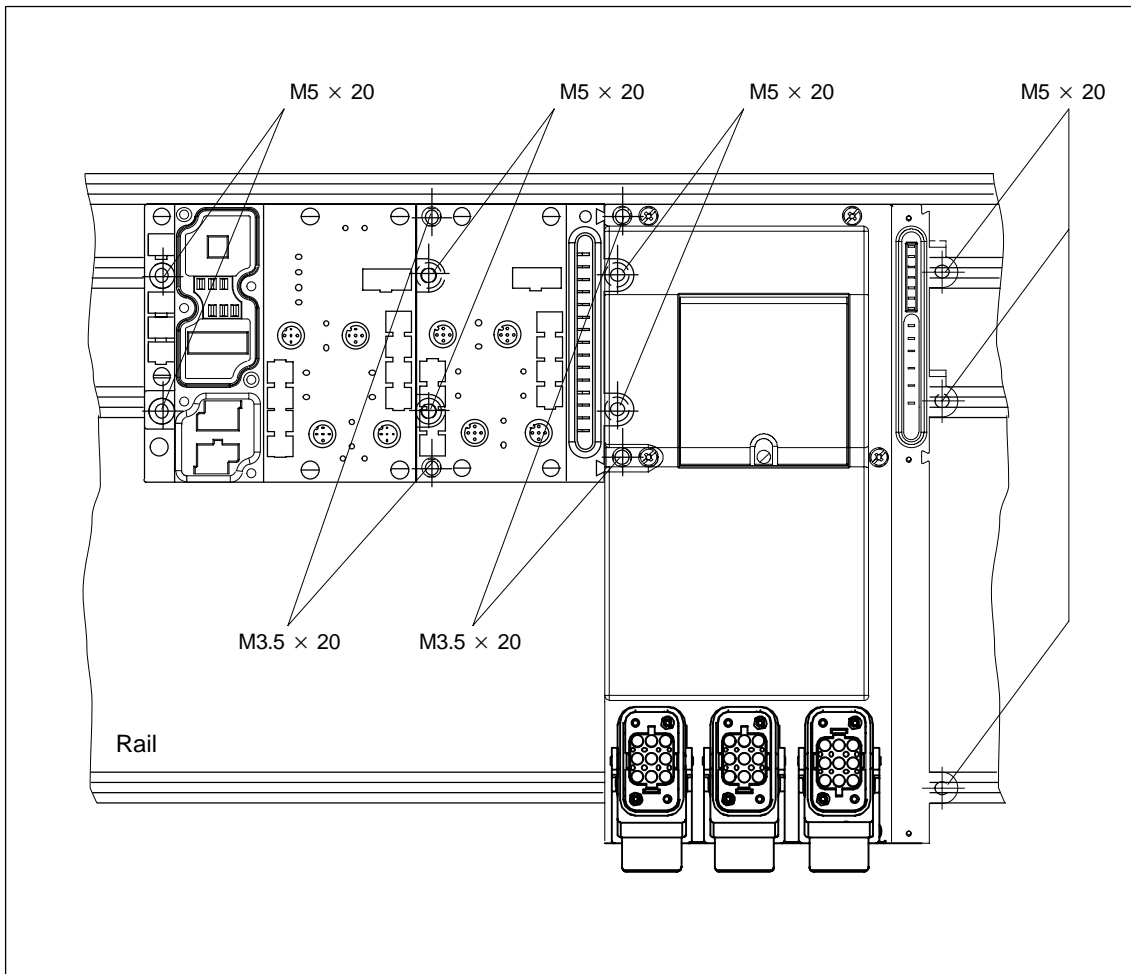
Figure 3-5   Fixing screws for basic and expansion modules
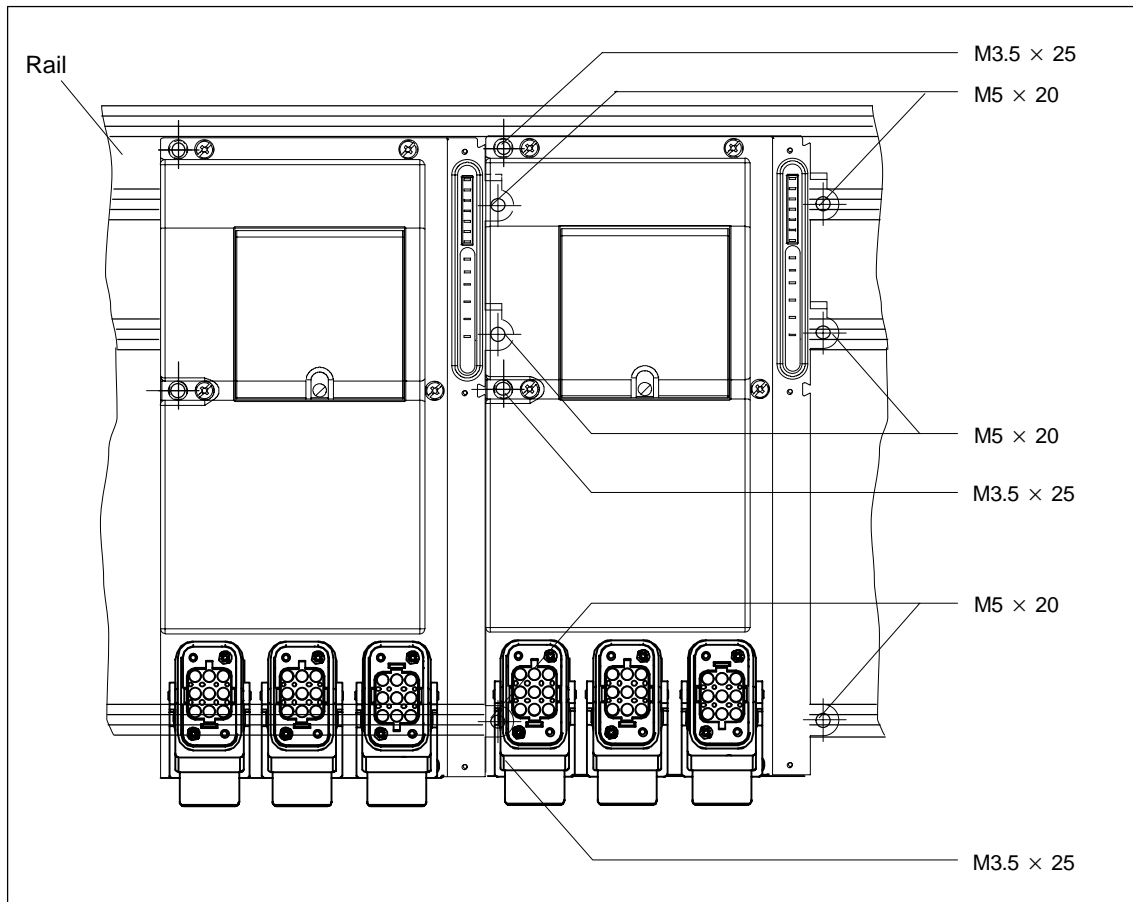
Figure 3-6   Fixing screws for motor starters and frequency converters

3.2   Installing/disassembling pneumatic components

Supply and service line connections to the pneumatic module
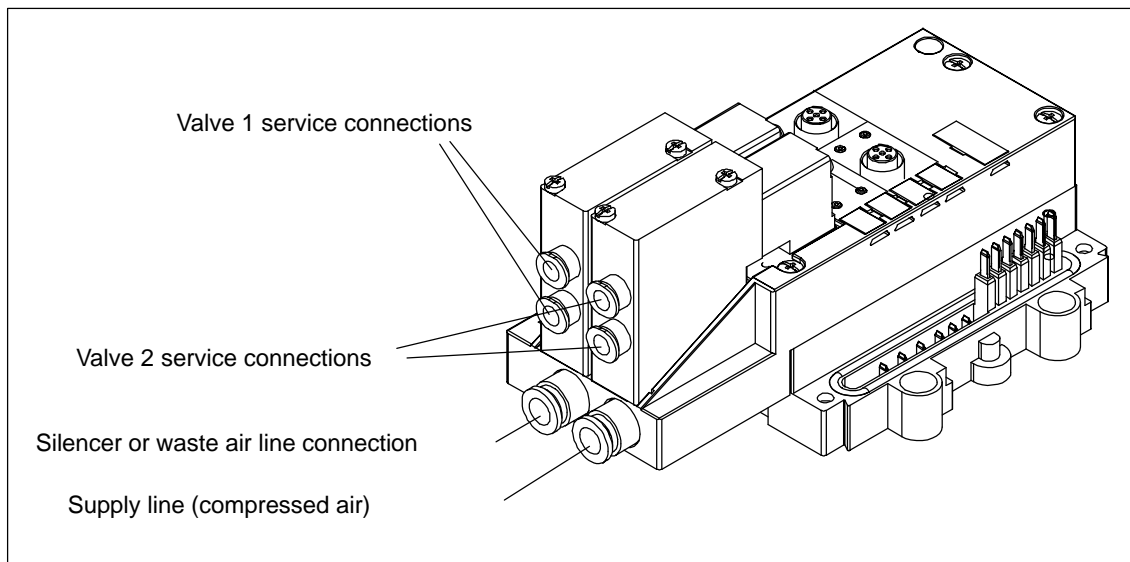
Figure 3-7   Supply and service lines on pneumatic module EM 148-P DI 4 x DC 24V/DO 2 x P

Diameters of tubing for pneumatic connection

Table 3-2   Outer diameters of pneumatic tubing

Tubing	Outside diameter
Supply and waste air connections	8 mm each
Service connections per valve	6 mm each

Supply, waste air and service line connection to pneumatic module

Prerequisite: You have installed the ET 200X (see Section 3.1).

1. Use tubing exhibiting outside tolerance from FESTO for example, type PUN ... or type PAN .... Push the tubing having an outer diameter complying with Table 3-2 as far as the stop over the appropriate connection on the module (refer to Figure 3-7).

2. Close unused service connections with plugs. (2 plugs are included with the pneumatic module.)

Note

Bundle laid tubing with hose band clips for the sake of tidiness on your system.

Directing waste air into the environment

If you want to direct the waste air from the module into the environment, you can leave the waste air connection on the module open (refer to Figure 3-7). We recommend you to place a silencer on the waste air connection to reduce noise.

You will find the order number for the silencer in Appendix A.

Containing waste air

If you place tubing on the waste air connection of the module, you can then guide the waste air away or collect it. Collection is practical, for instance, the pneumatic system is enriched with oil and you would like to dissipate the oily air.

In the case of contained air, the tubing has to be run by the shortest possible route to a large-volume waste air line or outdoors. Please note that the operating pressure must not rise with hose length. Waste air must not be impeded at the waste air connection of the module.

Note

When the waste air from several modules is funneled, the resulting back pressure in the common waste air line my be too high – for example, with a long waste air tube length or a small tube diameter. In this case we recommend you to install a non-return valve between the waste air line of the pneumatic module and the common waste air line – for example, type H-QS-8 from FESTO.

Central supply of compressed air to pneumatic modules

There is no pneumatic connection between several pneumatic modules of the ET 200X. This means that you must supply compressed air to each pneumatic module separately.

In order to feed the pneumatic modules **centrally** with air all the same, there is a simple solution. You interconnect the compressed air lines by means of T plug connections – for example, type QST-10-8 from FESTO, as basically shown in the figure below.
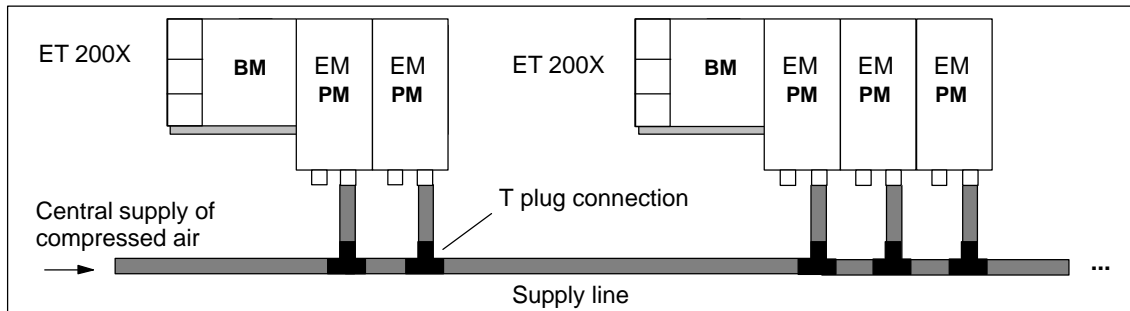
Figure 3-8   Central supply of compressed air to pneumatic modules

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Note

The rate of air flow is lower when T plug connections are used.

Note on starting up and operating pneumatic components

Note

Please note that the permissible operating pressure is reached before the valve is switched electrically.

FESTO valve island for ET 200X

The pneumatic interface modules are expansion modules for connecting two Regular FESTO valve islands:

- EM 148-P DO 16 $\times$ P/CPV10 for FESTO valve island CPV10

- EM 148-P DO 16 $\times$ P/CPV14 for FESTO valve island CPV14

You can obtain valve islands from FESTO. The valve islands are described in separate documents.

Installing a FESTO valve island and pneumatic interface module

Prerequisite: You have installed the ET 200X (see Chapter 3.1).

If you want to install a pneumatic interface module or a PM 148 DO 4 × DC 24V/2A power module directly next to a motor starter, the motor starter must be version ≥ 02.

A maximum of six pneumatic interface modules can be plugged into an ET 200X.

To install, perform the followings steps:

1. Slide the pneumatic interface module into the expansion interface of the preceding module.

2. Tighten the securing screws of the extension interface.

3. Plug the valve island in the interface module.

4. Screw the valve island and the interface module tightly to the rail (see Section 3.1).
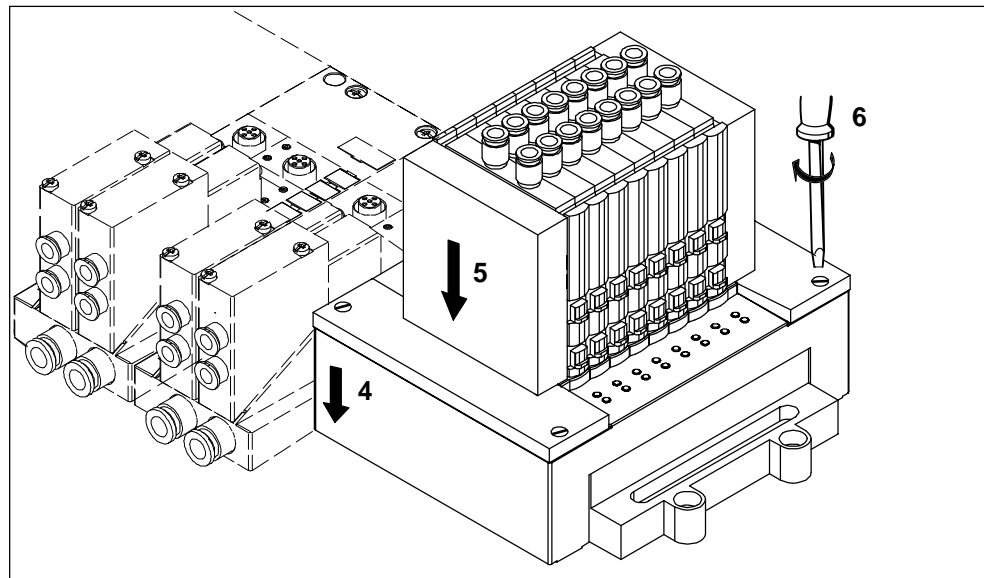
Figure 3-9   Installing a valve island with an interface module

Dimensioned drawing for installation holes on the pneumatic interface module

The diagram below contains the dimensions and positions of the mounting screw holes for one basic module and a pneumatic interface module.
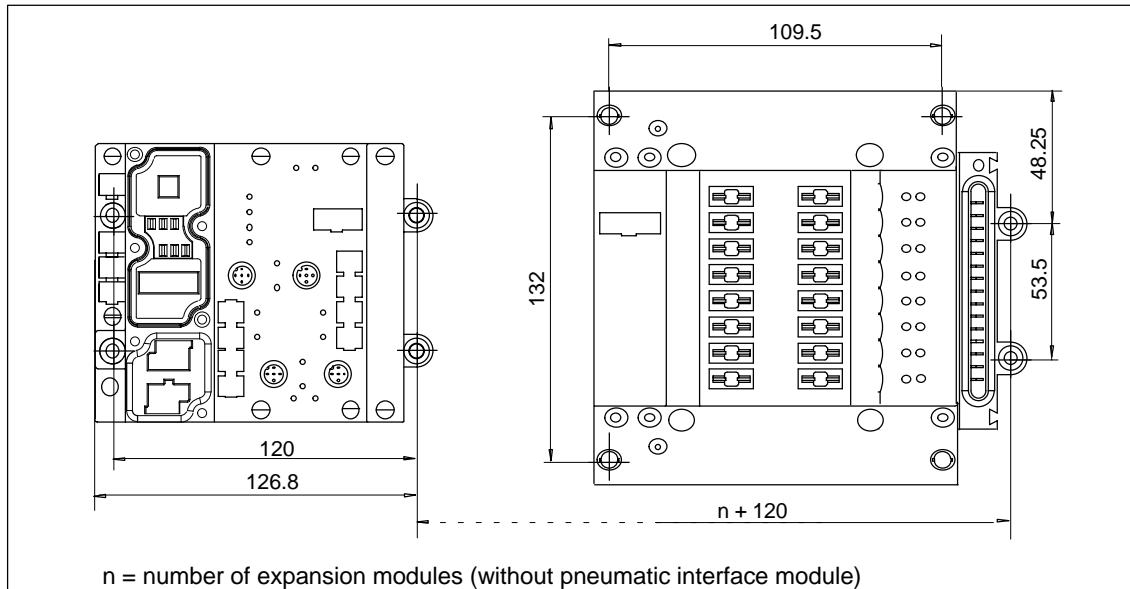
Figure 3-10   Dimensions of installation holes on the pneumatic interface module

Disassembling modules featuring pneumatic functionality

Please take the following important note into account before disassembling pneumatic and pneumatic interface modules:

⚠️ **Caution**

Before disassembling expansion modules featuring pneumatics, you must:

- disconnect all supply voltages for the ET 200X
- disconnect the supply of compressed air

If you fail to comply with these rules, the following effects are possible:

- damage to module electronics
- uncontrollable motions of detached tubing
- unwanted motions of the actuators connected

3.3 Setting/modifying the PROFIBUS address

The PROFIBUS address defines the address of the ET 200X distributed I/O device on PROFIBUS-DP which is used by the DP master.

Set the PROFIBUS address using the DIP switches on the basic module.

Valid PROFIBUS addresses

The PROFIBUS address can be anything from 1 to 125. The PROFIBUS address 0, which is set when the ET 200 distributed I/O system leaves the factory, is reserved for a programming device/PC.

Location of the DIP switches on the BM 141, BM 142 and BM 147/CPU

The DIP switches for setting the PROFIBUS address are inside the basic module underneath the connector plate for the connectors for PROFIBUS-DP and the supply voltage.

Location of the DIP Switches on the BM 143-DESINA and BM 141-ECOFAST

The DIL switches for setting the PROFIBUS address are in a removable configuration connector.

The configuration connector is secured to the basic module by an 8-pin M12 round plug.

This means that if the basic module has to be replaced it is not necessary to reset the PROFIBUS address.

Procedure for BM 141, BM 142 and BM 147/CPU

1. Remove the connector plate from the basic module before you set the PROFIBUS address. The DIL switches are concealed by the connector plate.

2. Set the PROFIBUS address using the DIL switches.

The diagram below shows the location of the DIL switches in the basic module as well as an example of the switch settings.

Example: PROFIBUS address 78

$2^1 + 2^2 + 2^3 + 2^6 = 2 + 4 + 8 + 64 = 78$

ON

1 2 3 4 5 6 7 8*

* Switch 8 must be OFF!
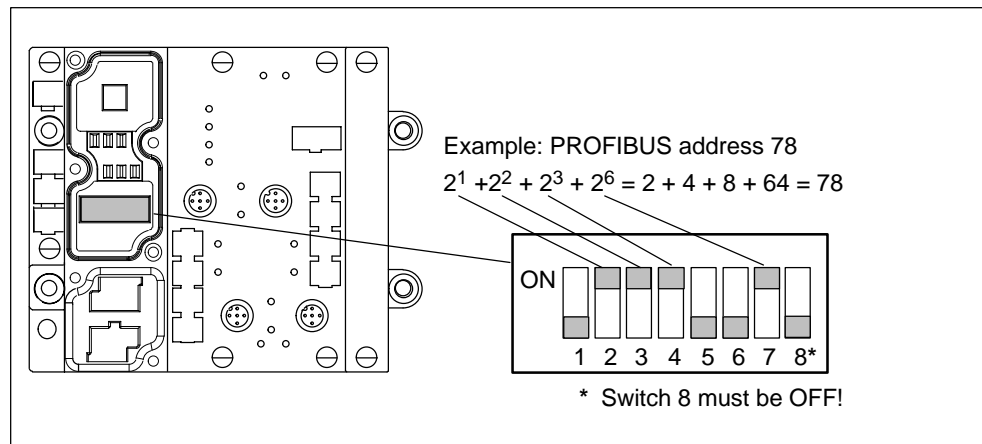
Figure 3-11   Setting the PROFIBUS address

Note: The PROFIBUS address in the basic module must always correspond to the PROFIBUS address specified in the configuration software for this ET 200X.

Procedure for BM 143-DESINA and BM 141-ECOFAST

1. Unscrew the configuration connector from the basic module and disconnect the plug (see Figure 3-12).
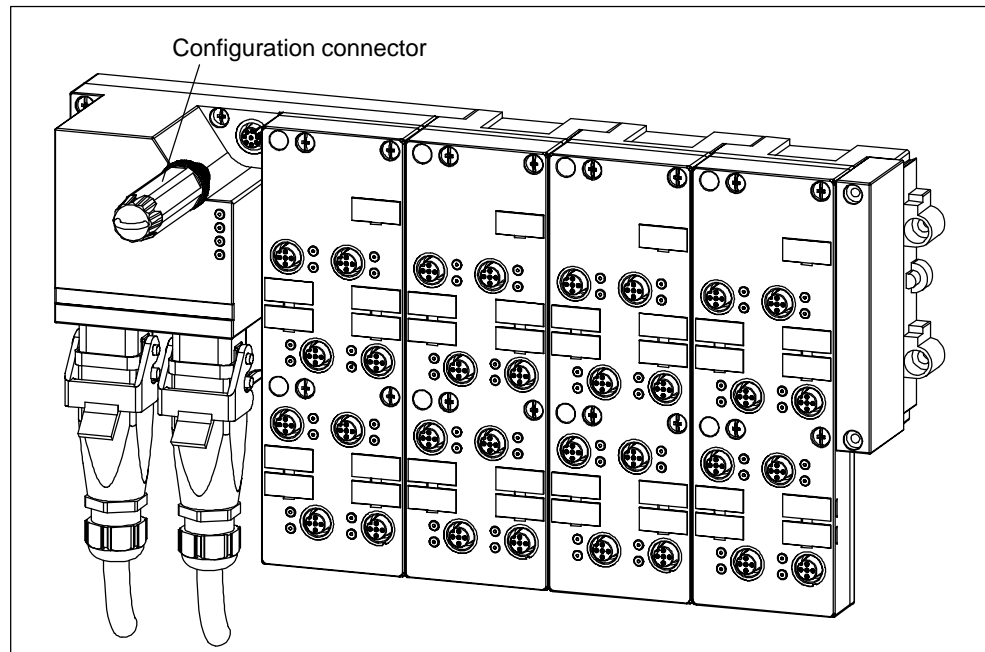
Figure 3-12   Position of the configuration connector on the
ET 200X-DESINA/ET 200X-ECOFAST

2. On the configuration connector, slacken the screw securing the cover and remove the cover.

3. Set the PROFIBUS address using the DIL switches.

The diagram below shows the configuration connector with the cover removed, as well as an example of the switch settings.

Example: PROFIBUS address 92

$$2^2 + 2^3 + 2^4 + 2^6 = 4 + 8 + 16 + 64 = 92$$
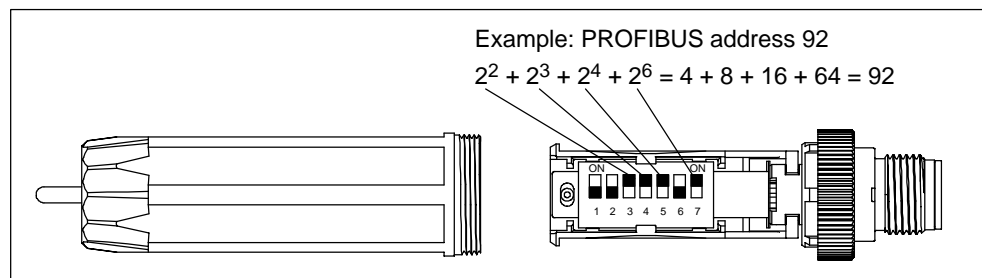
Figure 3-13   Setting the PROFIBUS address at the configuration connector

Note: The PROFIBUS address in the basic module must always correspond to the PROFIBUS address specified in the configuration software for this ET 200X-DESINA/ET 200X-ECOFAST.

4. Reinstall the cover and plug the configuration connector back into the basic module. Secure the configuration connector to the basic module.

Modifying the PROFIBUS address

You can modify the PROFIBUS address in exactly the same way as you set it. Any change made to the PROFIBUS address takes effect when the supply voltage is turned on the ET 200X.

3.4   Terminating PROFIBUS with a terminating resistor

Purpose of the terminating resistor

A bus cable must be connected at both ends (i.e. at the first and last node in the network) with its characteristic impedance.

Note

The terminating resistor is only necessary with copper conductors with an RS-optic cables (FO).

Because the BM 143–DESINA FO basic module is connected to the PROFIBUS–DP by means of fiber-optic cables there is no terminating resistor there.

How to proceed with the ET 200X

In the case of the ET 200X you switch the terminating resistor using two DIP switches. The two DIP switches are inside the basic module of the ET 200X, under the connector plate for the connector for PROFIBUS-DP and the supply voltage for electronic components/sensors.

1. Remove the connector plate from the basic module before you connect the terminating resistor. The DIL switches are concealed by the connector plate.

2. Connect the terminating resistor using the DIL switches.

The diagram below shows the location of the DIL switches in the basic module as well as an example of the switch settings.

Note

The terminating resistor will not function correctly unless **both** DIP switches of the terminating resistor are set to "on" or "off".
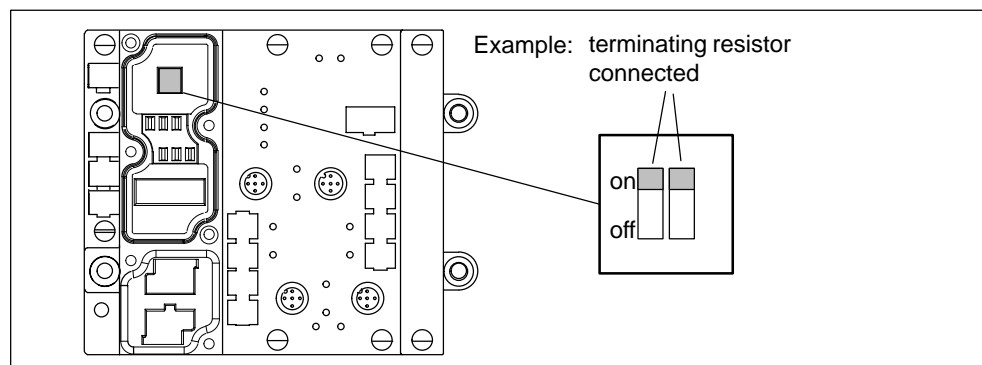
Figure 3-14   Connecting the terminating resistor

How to proceed with the ET 200X-DESINA and ET 200X-ECOFAST with RS 485 Interface

Connect these bus nodes using DESINA hybrid cables with copper conductors (RS 485).

Attach the terminating resistor for the first and last bus node on the right-hand DESINA connector of the relevant BM 141-ECOFAST or BM 143-DESINA RS485 basic module.

You can find the order numbers for the terminating resistor in Appendix A.

PROFIBUS-DP with
RS 485 interface

Terminating resistor
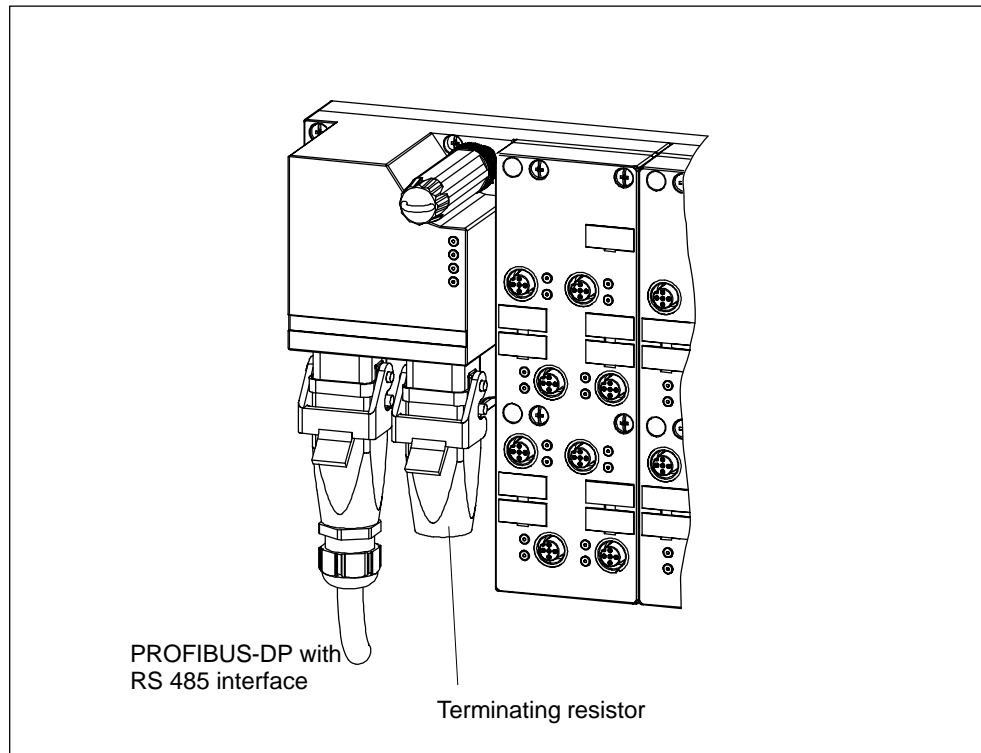
Figure 3-15   Attaching the terminating resistor

Note

The terminating resistor is supplied by the non-switched DC 24 V-NS load voltage.

The terminating resistor can only be guaranteed to function without problems if the non-switched DC 24 V-NS load voltage has a tolerance range of ±10%.

Wiring

4

In this Chapter

This chapter provides an overview of the rules and regulations for operating the ET 200X distributed I/O device.

It also shows you how you have to wire the ET 200X distributed I/O device.

Contents of Chapter

Grounding

You can set up a grounded or ungrounded configuration for the ET 200X distributed I/O device.

For reasons of electromagnetic compatibility, the ET 200X and ET 200X-DESINA/ET 200X-ECOFAST distributed I/O devices must always be non-isolated (connect PE terminal to protective ground!).

4.1   General rules and regulations for operating an ET 200X

As a component part of a plant or system, the ET 200X distributed I/O device necessitates observance of special rules and regulations, depending on where it is to be used.

This chapter provides an overview of the most important rules which you have to observe for integrating the ET 200X distributed I/O device in a plant or system.

Specific application

Observe the safety and accident prevention regulations that apply to specific applications, e.g. the directive on machinery 89/392/EEC.

EMERGENCY STOP devices

EMERGENCY STOP devices conforming with IEC 204 (corresponds to DIN VDE 113) must remain effective in all the operating modes of the plant or system.

Plant Start-up after certain events

The following table shows the points you have to take into account upon start-up of a plant following certain events.

If ...	Then ...
Start-up follows a voltage drop or failure Start-up of the ET 200X follows an interruption of bus communications	No dangerous operating states may occur. If they do, an emergency stop must be triggered.
Start-up follows unlocking of the EMERGENCY STOP device	There must not be an uncontrolled or undefined start-up.

24 VDC supply

The following table shows you the items you have to take into account in respect of the 24 VDC supply.

With ...	Pay attention to ...	
Buildings	Outdoor lightning protection	Take lightning protection precautions
24 VDC supply lines, signal lines	Indoor lightning protection	– for example, lightning conductors
24 VDC supply	Safe (electrical) isolation of extra-low voltage	

Protection against external electrical phenomena

The following table shows you the items you have to take into account in respect of protection against electrical phenomena or faults.

With ...	Make sure that ...
Any plant or system in which the ET 200X is installed	The plant or system is connected to a protective ground for diverting electromagnetic interference.
Supply, signal and bus lines	The wiring arrangement and installation are correct.
Signal and bus lines	Any break of a line or conductor does not result in undefined states of the plant or system.

4.2 Operating the ET 200X on a grounded supply

In this section, you will find information on the overall configuration of an ET 200X distributed I/O device on a grounded supply (TN-S system). The specific subjects discussed are:

- Circuit-breaking devices, short-circuit and overload protection in accordance with DIN VDE 0100 and DIN VDE 0113
- Load power supplies and load circuits

Definition: Grounded supply

With grounded supplies, the neutral conductor of the system is grounded. A simple ground fault between a live conductor and ground or a grounded section of the plant causes the protective devices to trip.

Components and protective measures

Different components and protective measures are specified for erecting a complete plant. The types of component and the degree to which the protective measures are binding depend on the DIN VDE regulation that applies to the configuration of your plant. The following table refers to Figure 4-1.

Compare ...	Ref. to Fig. 4-1	DIN VDE 0100	DIN VDE 0113
Circuit-breaking device for PLC, sensors and signal control elements	①	... Part 460: Main switch	... Part 1: Disconnector
Short-circuit and overload protection: Grouped for sensors and signal control elements	② ③	... Part 725: Single-pole protection of circuits	... Part 1: • In the case of a grounded secondary circuit: provide **single-pole** protection • Otherwise: Provide **all-pole** protection

Safe electrical isolation

Safe electrical isolation must be provided for:

- Modules that must be supplied with voltages $\leq$ 60 VDC or $\leq$ 25 VAC
- 24 VDC load circuits

Configuring the ET 200X with grounded reference potential

When the ET 200X is configured with grounded reference potential, any interference currents are diverted to the protective ground. The connections must be connected externally or in the connector (see Figure 4-1).

Configuring the ET 200X with ungrounded reference potential

When the ET 200X is configured with ungrounded reference potential, any interference currents that occur are diverted to the protective ground via an RC network in the basic module.

Insulation monitor

You must set up an insulation monitor in the following cases:

- Ungrounded configuration of the ET 200X
- When dangerous system states can occur as a result of double faults

ET 200X in overall configuration

Figure 4-1 shows the location of the ET 200X distributed I/O device in the overall system (load power supply and grounding philosophy) for supply from a TN-S system.
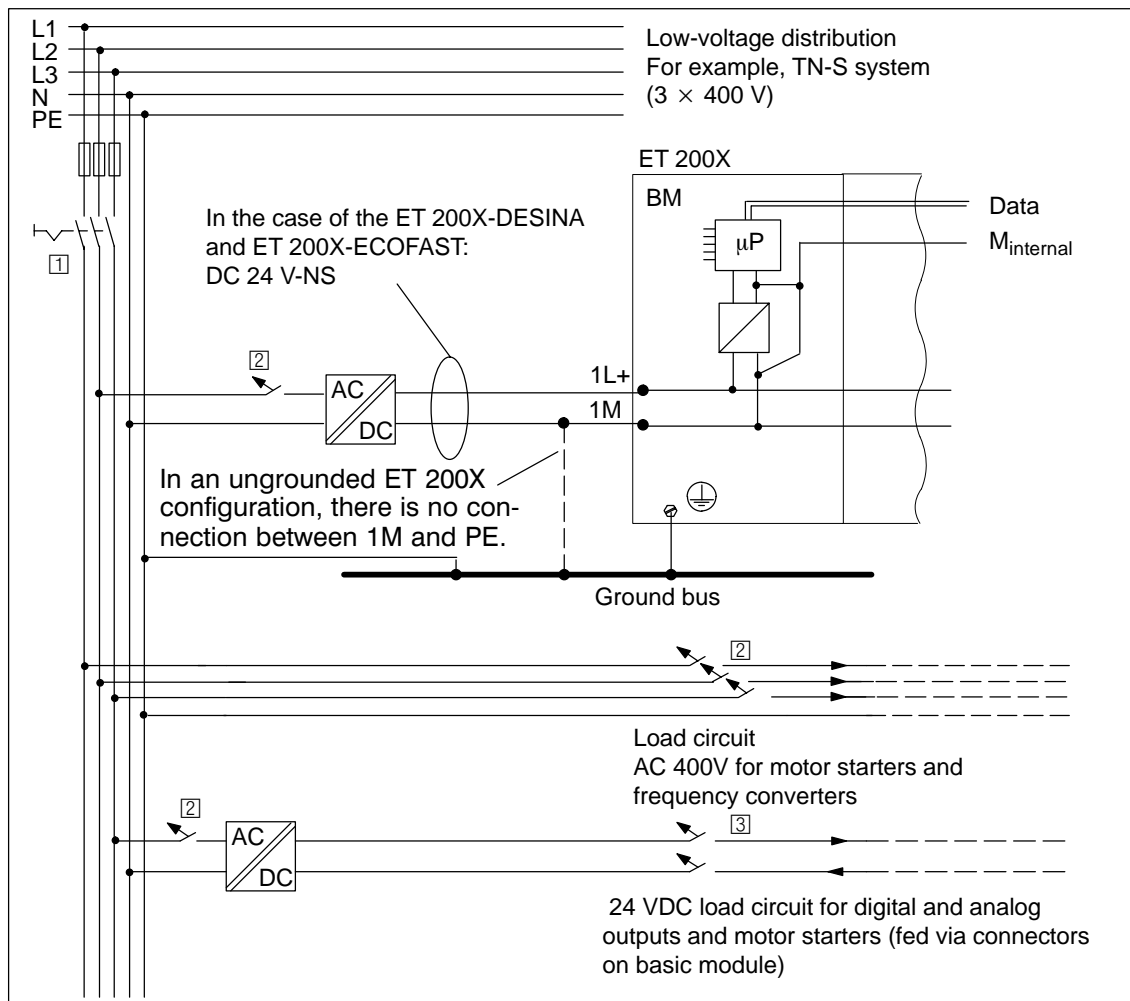
Figure 4-1   Operating the ET 200X with reference potential

4.3 Electrical design of the ET 200X

Electrical isolation between ...

The electrical design of the ET 200X includes isolation between:

- The load circuits and all the other circuit components of the ET 200X
- The PROFIBUS-DP port in the basic module and circuit components

ET 200X configuration

The diagrams below show the potentials in an ET 200X configuration.

Note: The potentials of the analog modules EM AI and EM AO correspond to those of the EM DI expansion modules.
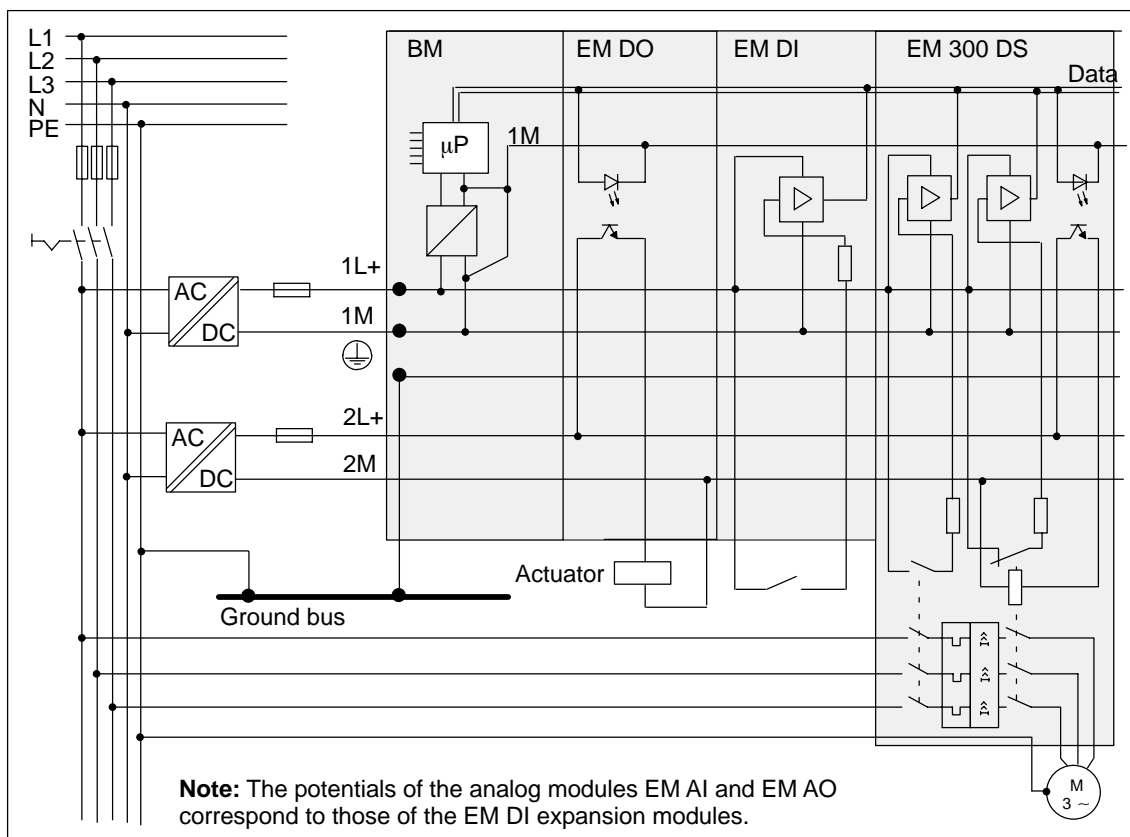
Figure 4-2   Potentials present in an ET 200X configuration with motor starter
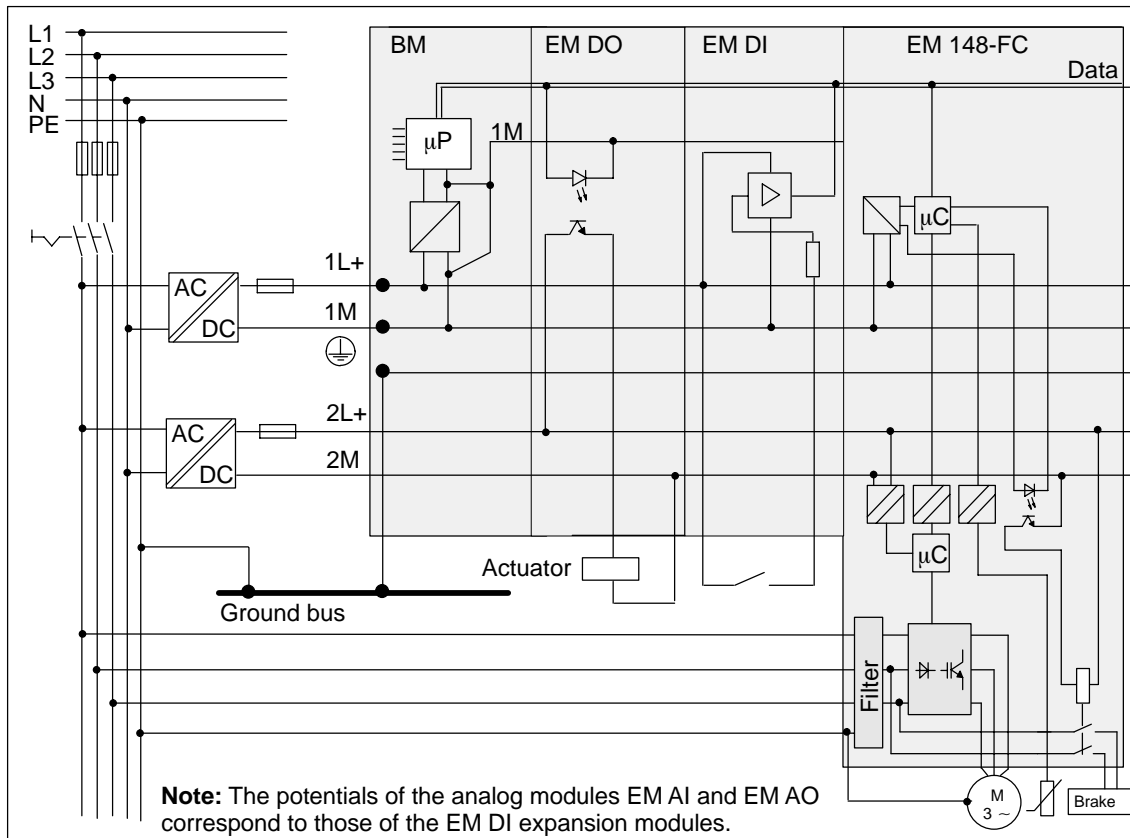
Figure 4-3   Potentials present in an ET 200X configuration with frequency converter
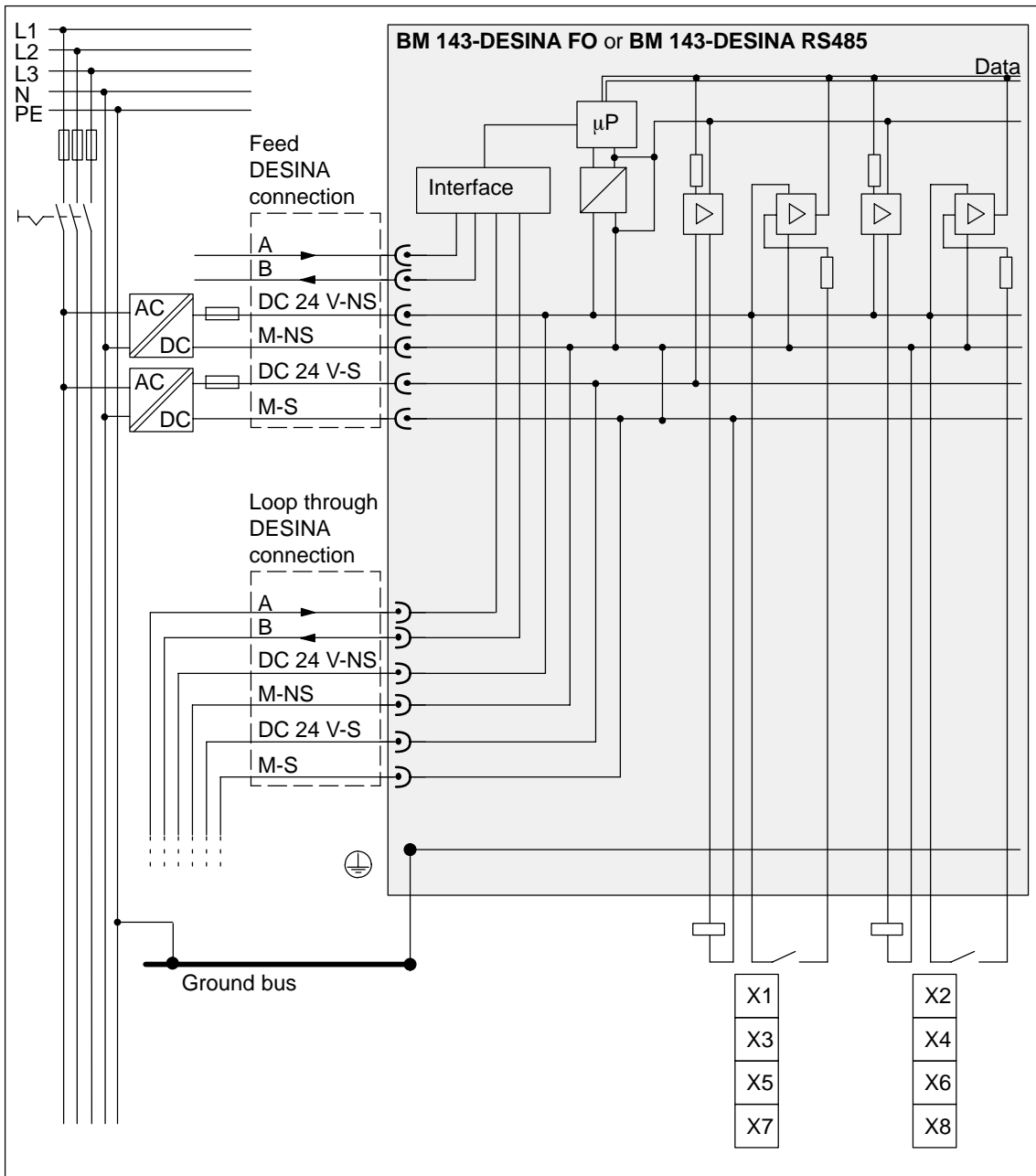
Figure 4-4   Potentials present in an ET 200X-DESINA configuration
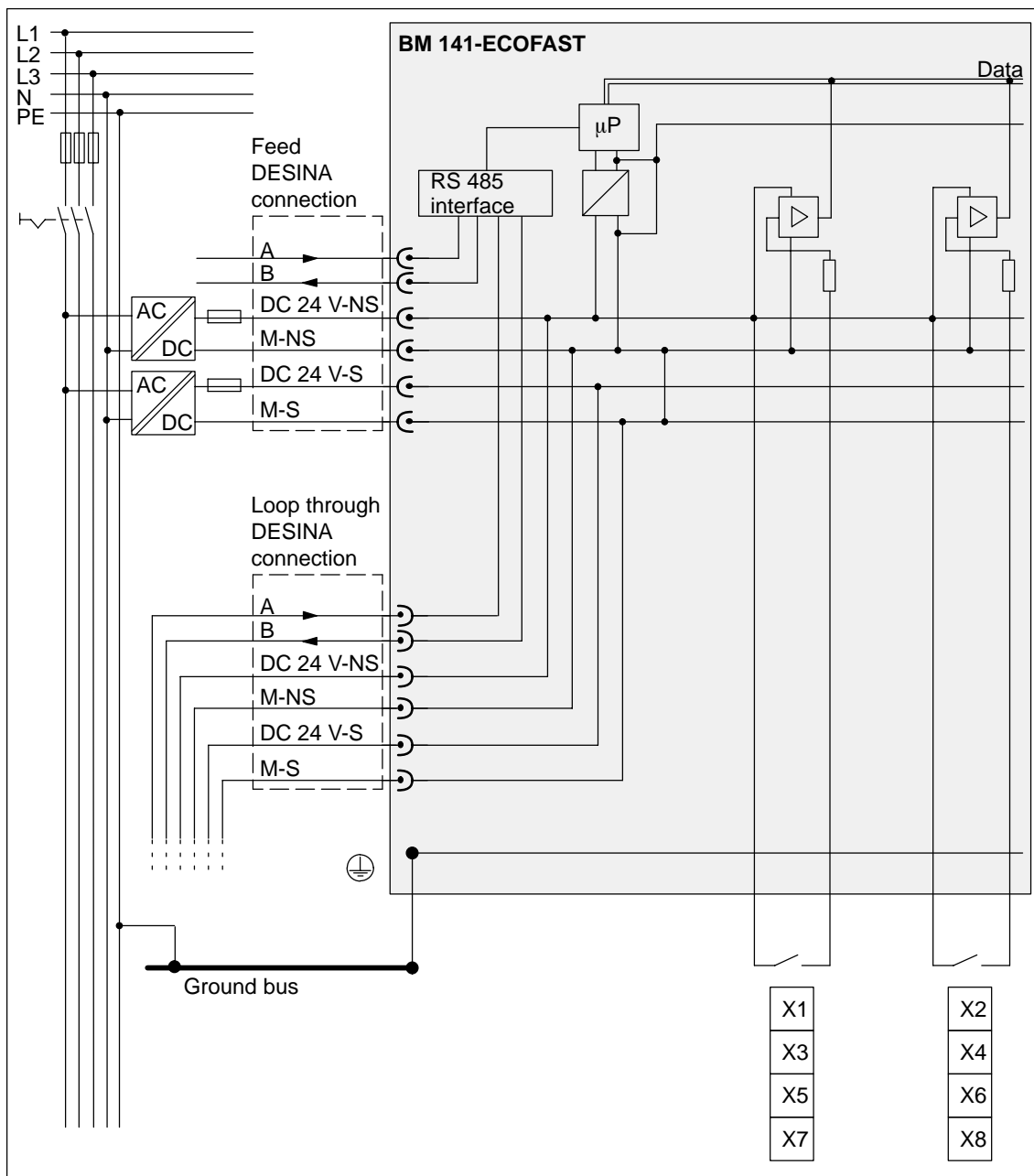
Figure 4-5   Potentials present in an ET 200X-ECOFAST configuration

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Note

In the case of the ET 200X-DESINA/ET 200X-ECOFAST distributed I/O device, the frame potentials of the switched and non-switched load voltage are connected to each other.

> **Note**
>
> The following applies to the BM 143-DESINA FO, BM 143-DESINA RS485, and EM 143-DESINA modules:
> - All inputs receive the non-switched load voltage.
> - Outputs (if present) of sockets X1, X3, X5, X7 are supplied by the switched load voltage.
> - Outputs (if present) of sockets X2, X4, X6, X8 are supplied by the non-switched load voltage.
>
> The outputs of all other expansion modules receive the switched load voltage.

Protection against destruction of components

In order to prevent the components of the ET 200X from being destroyed, you must always protect the supply voltage lines to the electronics/sensors and the load voltage with an external circuit–breaker – for example, Siemens Series 5SN1 that has the following characteristics:

- Protection of the supply voltage for the electronic components/sensors: 230 VAC (with rated current)/max. 6 A: tripping characteristic (type) B or C

- Protection of the load voltage: 230 VAC (with rated current)/max. 16 A: tripping characteristic (type) B or C

4.4   Wiring the ET 200X

Wiring procedure

You have to wire the ET 200X distributed I/O device in several steps. We recommend you adopt the following procedure:

Table 4-1   Order of steps for wiring the ET 200X

Step	Procedure	See ...
1.	Install the connectors for PROFIBUS-DP, supply and load voltage, if required.	Section 4.4.1
2.	Wire the above connectors.	Section 4.4.2
3.	Wire the connectors for connection to the inputs and outputs on the modules.	Section 4.4.4
4.	Connect the protective ground to the basic module.	Section 4.4.5
5.	Connect the protective ground to expansion modules with analog inputs and outputs.	Section 4.4.6
6.	Install the connectors and the plugs for the inputs and outputs on the modules.	Section 4.4.7
7.	Seal unused sockets with M12 plugs.	

Note

Steps 1 and 2 do not apply to ET 200X-DESINA, because the cables used are of the ready-to-use DESINA hybrid type.

Suitable cable types

The table below shows the suitable cable types and their applications. You can find a list of cables and their order numbers in Appendix
A. If cables other those listed in Appendix A are used for connecting and looping through PROFIBUS-DP, these cables must meet the specification for cable type A as per PROFIBUS-DP.

Table 4-2   Cable types

Cable type	Application
5-core cable, shielded	Connecting and looping through PROFIBUS-DP and supply voltage to electronics/sensors via a common cable
3-core copper cable, flexible	Connecting supply voltage to electronics/sensors or load voltage[1]
2-core cable, shielded (bus cable)	Connecting and looping through PROFIBUS-DP
DESINA hybrid cable (fiber-optic cable or RS 485, prepared with a DESINA connector)	Connecting and looping through PROFIBUS-DP and non-switched and switched supply voltages via a common cable The DESINA hybrid cable is supplied ready for use (wired) with DESINA connectors in various lengths. See Appendix A.
3-, 4- or 5-core copper cable, flexible	Connecting the actuators and sensors to the digital inputs/outputs[2]
4-core copper cable, shielded	Connecting the actuators and sensors to the analog inputs/outputs[2]
4 or 6-core copper cable, flexible	Connecting the motor starter[3]: • The load and brake supply voltage (with looping through) • A load (with brake, only a 6-core cable can be used; see the *EM 300* Motor Starters manual for order number)
4-, or 8-core copper cable, flexible, shielded	Connecting the frequency converter[4]: • The load supply voltage (with looping through) • A load with brake and thermistor (only an 8-core cable) For order number see *EM 148-FC frequency converter* Manual

[1]   Core cross-section must be $\leq$ 2.5 mm^2
[2]   Core cross-section must be $\leq$ 0.75 mm^2
[3]   Core cross-section must be = 1.5 or 2.5 mm^2
[4]   Core cross-section must be = 1.5, 2.5 or 4 mm^2

Table 4-3   Technical specifications of the 5-core cable

Parameters	Value
Type of cable • With PVC sheath • With PUR sheath, suitable for drum use	02Y(ST)C 1×2×0.65/2.56-150 LI LIY-J Y 3×1×0.75 VI KF30 02Y(ST)C 1×2×0.65/2.56-150 LI LIY-J Y 11 3×1×0.75 PETROL

Cable structure
a) Core LIY 0.75/1.70
   Copper strands 24 × 0.2 BLW
   Polyvinylchloride sheathing (PVC)
   Section thickness
b) Core 02Y 0.65/2.56 LI
   Copper strands 19 × 0.13 BLW
   Celled polyethylene sheathing
c) Pair LI02Y(ST)C 1×2×0.25/2.6
   2 cores to b) RD, GN braided
   Aluminum coated foil, overlapped
   Braided shield made of Cu wires
   Outer sheath
	
	∅ 1.23 mm
	∅ 1.7 mm
	approx. 0.23 mm
	
	∅ 0.65 mm
	∅ 2.56 mm
	
	0.15 mm ∅ VZN
	approx. 65 %

Core 1 bundle to c), 3 cores to a) GNYE, BK, BL Filler Plastic foil, overlapped	 ∅ 7.9 mm
Sheath Section thickness	PVC or PUR approx. 0.8 mm
Outside diameter	(9.5 ±0.5) mm
Permissible minimum bending radius • recurrent bending • once-only bending	 ≥ 70 mm ≥ 35 mm
Operating temperature	–30 °C to +60 °C
Weight	approx. 105 kg/km

Table 4-3   Technical specifications of the 5-core cable, continued

Parameters	Value
Electrical properties at 20 °C Tests in accordance with DIN VDE 0472	
• Conductor resistance of cores to a)	≤ 26 Ω/km
• Conductor resistance of cores to b)	≤ 84 Ω/km
• Insulation resistance	≥ 20 MΩ/km
• Operating capacity [1]	≈ 30 pF/m
• Surge impedance at 3 to 20 MHz [1]	135 to 165 Ω
• Wave attenuation at 0.2 MHz [1]	≤ 0.6 dB/100 m
• Operating voltage (peak voltage)	35 V
• Test voltage (core/core eff. 50 Hz 1 min)	500 V
• Test voltage (core/shield eff. 50 Hz 1 min)	500 V
Flame test	to VDE 0472, Part 804, test type B
only cables with PUR sheath	
• Oil resistance	to VDE 0471, Part 804, test type B
• Suitable for drum use	Yes

1   Values for pair to c)

4.4.1   Installing/removing connectors

To affix the cables and provide IP 65, IP 66, and IP 67 protection, the connectors for PROFIBUS-DP, the supply voltage, and load voltage are supplied with M16 cable glands.

A connector assembly consists of a protective shell, a 6-pin connector, 1(2) M16 cable gland(s) and 1(2) lock nut(s). You can find the order numbers for the connectors in Appendix A.

Shell

1st M16 cable gland

2nd M16 cable gland can be attached
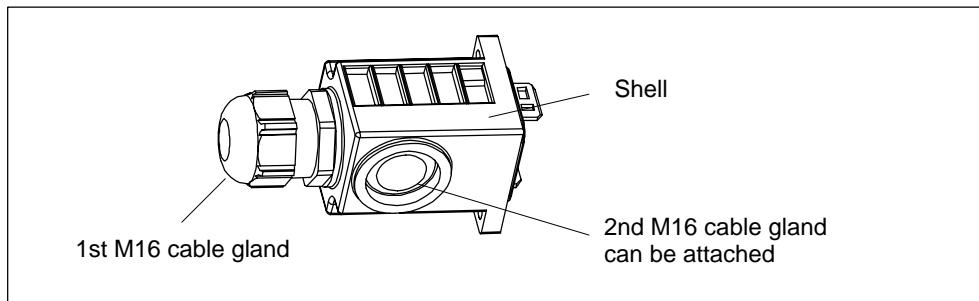
Figure 4-6   Connector: protective shell with an M16 cable gland

Installing connectors

Proceed as follows to install a connector:

1. Pierce the shell of the connector with a screwdriver at the point at which you want to feed through the cable.
   Risk of injury. Watch your fingers.

2. Place the lock nut in the shell over the pierced hole.

3. Screw the M16 cable gland tightly onto the protective shell.

   Note: If you feed PROFIBUS-DP and the supply voltage for the electronic components/sensors to the basic module via 2 separate cables, you must install two M16 cable glands on the protective shell.

4. Feed the cable through the installed M16 cable gland.

5. Wire the 6-pin plug connector (see Section 4.4.2). In doing so, comply with the wiring rules listed in Table 4-4.

6. Withdraw the cable until the start of the sheath is roughly level with the start of the M16 cable gland, then screw the M16 cable gland tight (the sheath is clamped).

7. Feed the wired plug connector back into the shell until it snaps into place. This is shown in the diagram below (apart from the wiring).
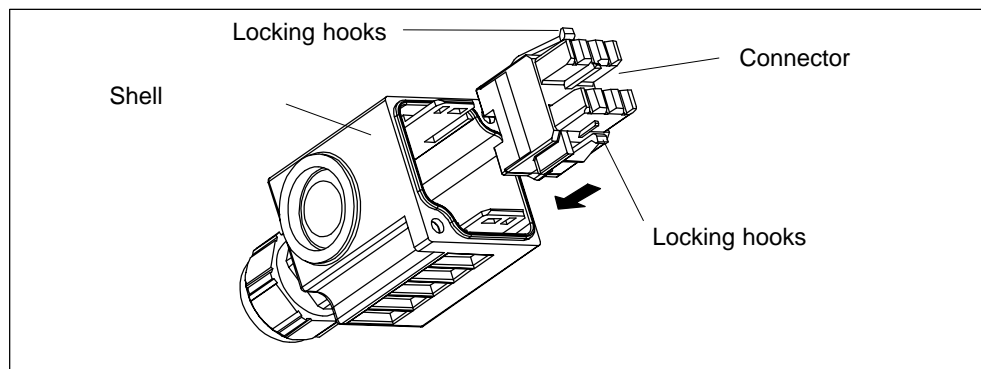
Figure 4-7   Snapping the connector into place in the shell

Removing connectors

If you want to remove a connector, proceed as follows

1. Release the two locking hooks as illustrated in Figure 4-8 using a pointed implement.

2. Remove the connector from the shell.
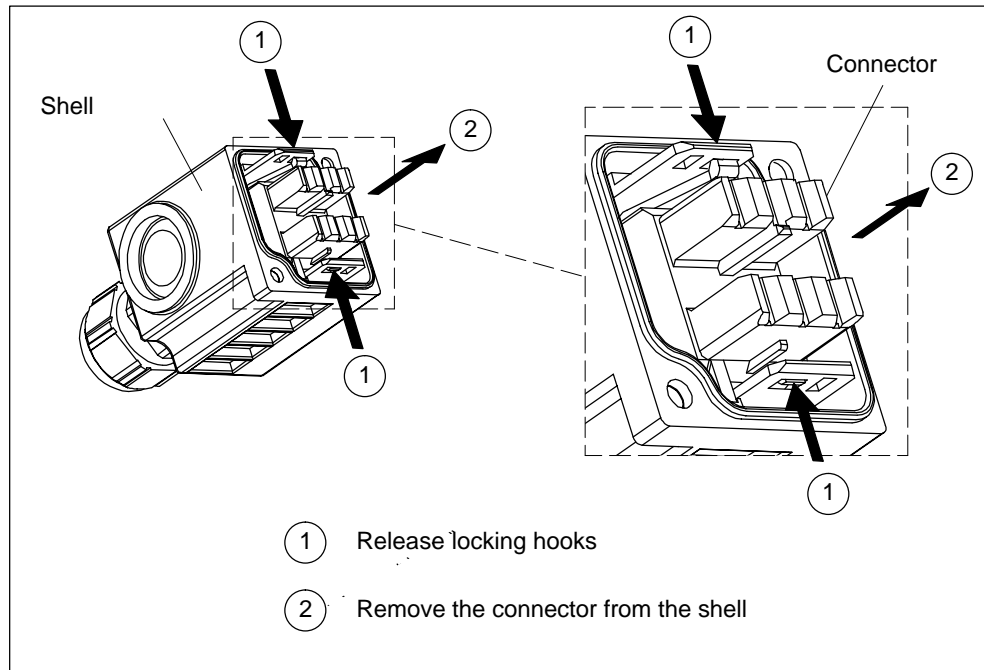
Figure 4-8   Removing the connector from the shell

4.4.2 Wiring connectors

Rules for wiring connectors

The following table shows you the rules you have to take into account in respect of the wiring of the connectors.

Table 4-4   Wiring rules for connectors

Rules for ...	Wiring connectors
Connectable core cross-sections:	
Solid conductors	Options for PROFIBUS-DP connection:
	• 2-core cable, shielded (bus cable)
	• Direct-buried cable
Flexible conductors	
• with wire end ferrule	0.25 to 1.5 mm^2
• without wire end ferrule	0.25 to 2.5 mm^2
Number of cores per terminal connection	1 or combination of 2 cores up to 1.5 mm^2 (sum) in a common wire end ferrule
Permissible outside diameter of cable	$\varnothing$ 4 to 10 mm
Bared length of cores (with or without insulation collar)	6 mm
Bared length of cable sheath	45 mm
Wire end ferrules to DIN 46228	
• without insulation collar	Form A up to 7 mm long
• with insulation collar	Form E up to 8 mm long

Bared Lengths: Example

The diagram below shows an example of bared lengths. These lengths apply to all cables that are suitable for use with the connector assembly. Braided shields must be twisted and inserted into wire end ferrules, and the projecting lengths cut off. The shield around the PROFIBUS cores must be brought as close as possible to the connectors.
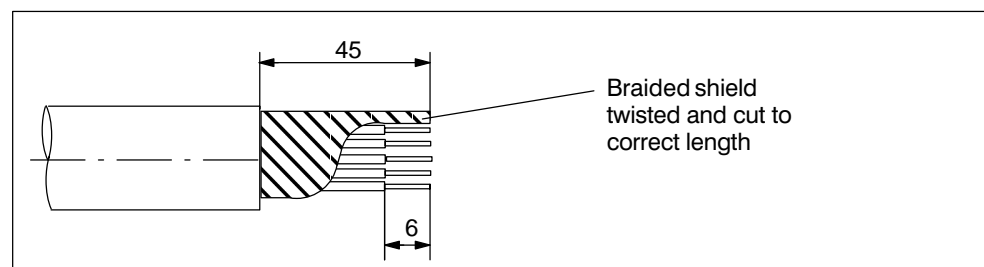
Figure 4-9   Bared length of a 5-core cable

Connection alternatives

The following connection alternatives are available for the ET 200X in accordance with the configuration options:

- Supply voltage for the electronics/sensors and PROFIBUS-DP fed via a common cable

- Supply voltage for the electronics/sensors and PROFIBUS-DP fed via separate cables

The load voltage must either be fed separately to each ET 200X or looped through.

Wiring of PROFIBUS-DP and supply voltage

If you want to feed PROFIBUS-DP and the supply voltage for the electronics/sensors to the basic module separately, you will need:

- A connector

- A 2-core cable, shielded for the PROFIBUS-DP terminal connection (the braided shield must be twisted, inserted in a wire end ferrule and connected to pin 2 of the shield; see Figure 4-10)

- A 3-core, flexible copper cable for the supply voltage connection

If you want to feed PROFIBUS-DP and the supply voltage for the electronics/sensors to the basic module via a common cable, you will need a 5-core, shielded cable in addition to the connector (6ES7 194-1LY00-0AA0-Z).

Connector pinout

You must always wire the connector as shown in the diagram below, irrespective of whether you are using one or two cables. The pins for the PROFIBUS-DP terminal connection are highlighted in bold type.
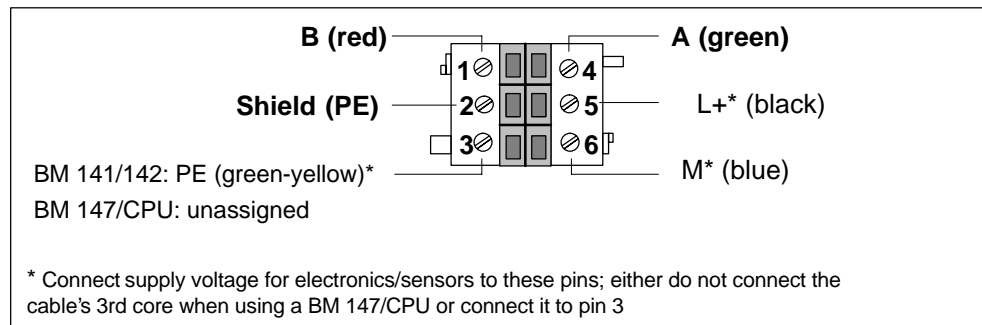
Figure 4-10   Pinout of the connector for wiring PROFIBUS-DP and the supply voltage for the electronics/sensors

Looping through PROFIBUS-DP and supply voltage

If you want to loop PROFIBUS-DP and/or the supply voltage for the electronics/sensors through to the next ET 200X, you have to wire the second connector. This connector must be wired in exactly the same way as the connector for feeding the first ET 200X (see Figure 4-10).

Wiring of load power supply

If you want to connect a load power supply (24 VDC), you will need:

* A connector

* A 3-core, flexible Cu cable

Wire the connector to pins 1, 2 and 3 as shown in the diagram below. Terminals 1 and 4; 2 and 5; 3 and 6 are internally jumpered.
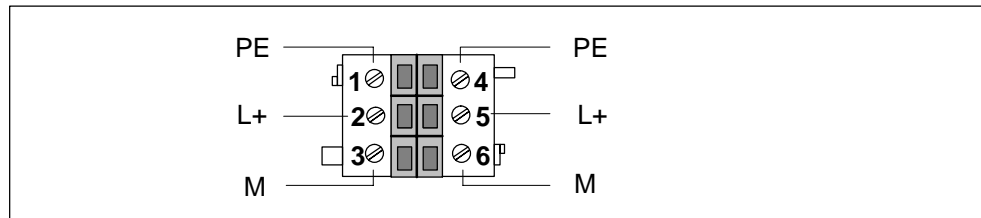
Figure 4-11   Pinout of the load voltage connector

⚠ **Caution**

If you wire the connectors incorrectly, the device or its components may be damaged beyond repair!

Looping through load voltage

If you want to loop a load voltage (24 VDC) through to the next ET 200X, you must wire a 3-core, flexible, copper cable to the connector (pins 4, 5 and 6) in addition to the wiring arrangement shown in Figure 4-11. Then wire the other end of the cable to pins 1, 2 and 3 of the next load voltage connector.

Always use the same core colors for the same signals.

Note

The load voltage can be looped through from the power module only when the connector is plugged into the power module.

Looping through the load voltage from the power module

If you want to loop the load voltage through to the next power module or ET 200X, you must install a second M16 cable gland on the connector (see wiring in Figure 4-11).
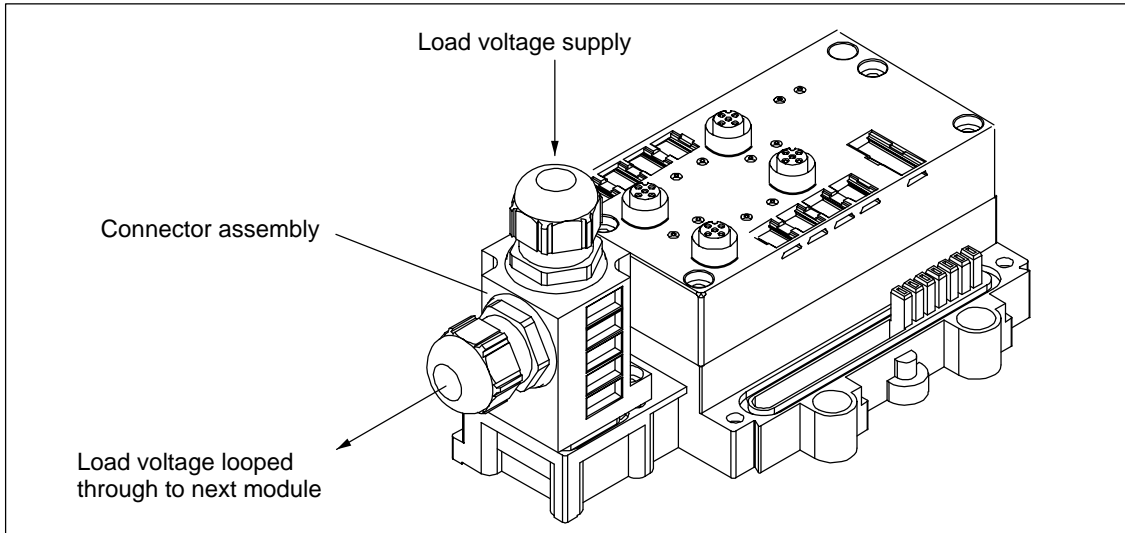
Figure 4-12   Power module with connector and 2 M16 cable glands

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Note

The load voltage can be looped through from the power module only when the connector is plugged into the power module.

Using a common power supply

You can feed the supply voltage for the electronics/sensors and for loads from a single power supply, providing no electrical isolation is necessary between the sensor and the load supply. You simply need to wire the two connectors together externally (L+, M and PE). Note the restrictions imposed by the current consumption (see Section 2.8)! If necessary, use a power module or a SITOP power 24V/10A.

Always plug in 3 connectors

Note

You must always plug all three connectors into the basic module, irrespective of whether or not they are wired, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

An alternative is to close unused connectors with covers. You can find the order numbers for the covers in Appendix A.

4.4.3 Pinout of the ET 200X-DESINA / ET 200X-ECOFAST

Figure 4-13 shows the pinout of the connector for the BM 143-DESINA FO basic module.

Socket	Pinout
X01 Supply (Supply voltage for electronics/ sensors, actuators PROFIBUS-DP)	1 L+ (NS) 2 M (NS) 3 M (S) 4 L+ (S) 5 Signal A (RD) 6 Signal B (TD)
X02 Loop through	1 L+ (NS) 2 M (NS) 3 M (S) 4 L+ (S) 5 Signal A (RD) 6 Signal B (TD)
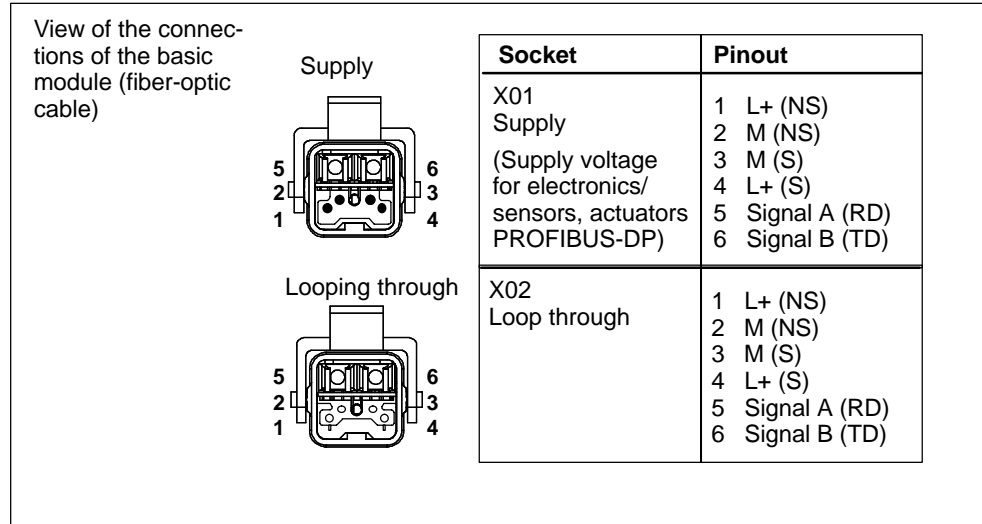
Figure 4-13   Pinout of the connector for the BM 143-DESINA FO

Figure 4-14 shows the pinout of the connector for the BM 141-ECOFAST and BM 143-DESINA RS485 basic modules.

Socket	Pinout
X01 Supply (Supply voltage for electronics/ sensors, actuators PROFIBUS-DP)	1 L+ (NS) 2 M (NS) 3 M (S) 4 L+ (S) 5 Signal A 6 Signal B
X02 Loop through	1 L+ (NS) 2 M (NS) 3 M (S) 4 L+ (S) 5 Signal A 6 Signal B
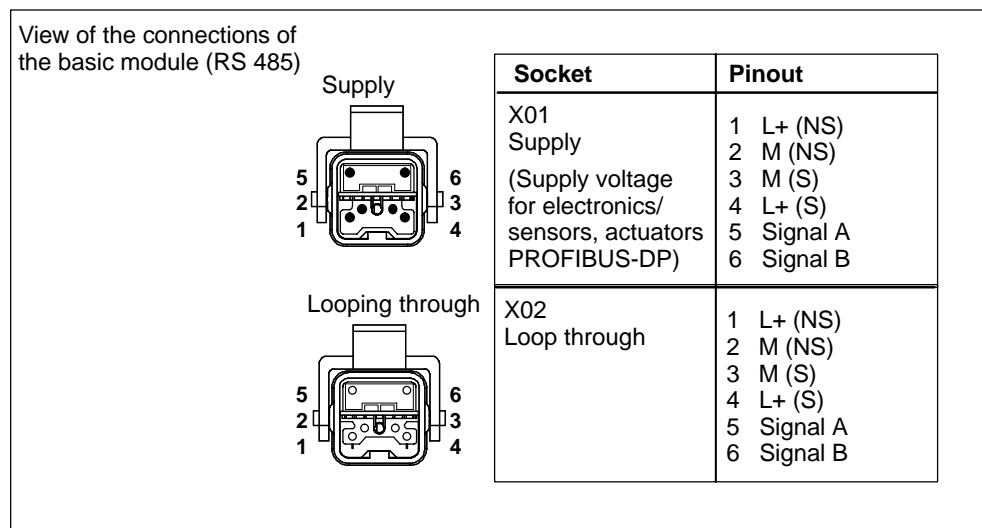
Figure 4-14   Pinout of the connector for the BM 141-ECOFAST and
BM 143-DESINA RS485 basic modules

4.4.4   Wiring the connectors for inputs and outputs

Connectors for digital inputs and outputs

You can connect digital inputs and outputs to the round, 5-pin M12 sockets on the front of the basic/expansion modules. Alternatively, you can use 5-pin M12 coupler plugs or Y connectors. Please refer to Appendix A for the order numbers.

Connectors for analog inputs and outputs

You connect analog inputs and outputs to the round, 5-pin M12 sockets on the front of the expansion module. You use 4- or 5-pin M12 coupler plugs. You can obtain further information on the connectors on request:

- 4-pin   Outgoing cable unit PG 7   99-1429-814-04
- 4-pin   Outgoing cable unit PG 9   99-1429-812-04
- 5-pin   Outgoing cable unit PG 7   99-1437-814-05
- 5-pin   Outgoing cable unit PG 9   99-1437-812-05

Address for ordering:

Franz Binder GmbH + Co.
Elektrische Bauelemente KG
Rötelstraße 27
D-74172 Neckarsulm

Wiring of M12 coupler plug for digital inputs

To connect the digital inputs, you require:

- A 5-pin, M12 coupler plug, possibly integrally molded

- A flexible 3-, 4- or 5-core copper cable with a core cross-section of ≤ 0.75 mm^2

Wire the coupler plug in accordance with the pinout table below. The pinout of the sockets X1 to X4/X8, which are used for the inputs on the ET 200X, is shown together with the data for the individual modules in Section 7.1 ff.

Table 4-5   Pinout of the coupler plug for digital inputs

Pin	Assignment	View of coupler plug (wiring side)
1	24 V power supply for sensor*	
2**	Input signal	
3	Chassis ground, power supply	
4	Input signal	
5	PE	

*   Made available by the ET 200X for the connected sensor
**   Only relevant if socket has 2 assigned channels

Note

If a sensor has a normally-closed contact and a normally-open contact, the normally-closed contact is automatically wired to pin 2. The channel assigned to pin 2 can thus no longer be used for the adjacent socket.

Wiring of M12 coupler plug for digital inputs (DESINA/ECOFAST)

To connect the digital inputs, you require:

- A 5-pin, M12 coupler plug, possibly integrally molded

- A flexible 4- or 5-core copper cable with a core cross-section of ≤ 0.75 mm^2

Wire the coupler plug in accordance with the pinout table below. The pinout of sockets X1 to X8, which are used for the inputs on the ET 200X-DESINA/ECOFAST, is shown together with the data for the individual modules in Section 7.5 ff.

Connecting digital inputs (DESINA):

You have set the following parameters:
Pin 2 as diagnostic input and pin 4 as digital input.

- Channel type (pin 4): digital input

- Input functionality (pin 2): diagnostic input

Table 4-6   Pinout of the coupler plug for digital inputs (DESINA)

Pin	Assignment for digital input (DESINA)	View of coupler plug (wiring side)
1	24 V power supply for sensor*	Digital input (DESINA)
2	Diagnostic input of DESINA sensor	
3	Chassis ground, power supply	
4	Input signal from DESINA sensor	
5	not assigned	

*   Made available by the ET 200X-DESINA/ET 200X-ECOFAST for the connected sensor

Connecting digital inputs (standard):

You have set the following parameters:
Pin 2 as input with NC function and pin 4 as digital input.

- Channel type (pin 4): digital input

- Input functionality (pin 2): input with NC function

Table 4-7   Pinout of the coupler plug for digital inputs (standard)

Pin	Assignment for digital input (standard)	View of coupler plug (wiring side)
1	24 V power supply for sensor*	Digital inputs (standard)
2	Input signal** (NC function)	
3	Chassis ground, power supply	
4	Input signal	
5	not assigned	

*   Made available by the ET 200X-DESINA/ET 200X-ECOFAST for the connected sensor
**   NC function:
    Non-switched means: To the process when status is "1", in PII status "0";
    switched means: To the process when status is "0", in PII status "1"

Wiring of M12 coupler plug for digital outputs

To connect the digital inputs, you require:

- A 5-pin, M12 coupler plug, possibly integrally molded

- A flexible, 3- or 4-core copper cable with a core cross-section of ≤ 0.75 mm^2

Wire the coupler plug in accordance with the pinout table below. The pinout of sockets X1 to X4/X8, which are used for the outputs on the ET 200X, is shown in Section 7.4 ff.

Table 4-8   Pinout of the coupler plug for digital outputs

Pin	Assignment	View of coupler plug (wiring side)
1	–	
2*	Output signal	
3	Chassis ground, load voltage	
4	Output signal	
5	PE	

*   Only relevant if socket has 2 assigned channels

Wiring of M12 coupler plug for digital inputs (DESINA/ECOFAST)

To connect the digital inputs, you require:

- A 5-pin, M12 coupler plug, possibly integrally molded
- A flexible 4- or 5-core copper cable with a core cross-section of ≤ 0.75 mm^2

Wire the coupler plug in accordance with the pinout table below. You can find the pinout of sockets X1 to X8 which are used for the outputs on the ET 200X-DESINA/ET 200X-ECOFAST as of Section 7.5.

Connecting digital outputs (DESINA):

Your parameter settings are as follows:

- Channel type (pin 4): digital output
- Input functionality (pin 2): diagnostic input

Table 4-9   Pinout of the coupler plug for digital outputs (DESINA)

Pin	Assignment for digital output (DESINA)	View of coupler plug (wiring side)
1	24 V power supply for diagnostics input*	Digital output (DE-SINA)
2	Diagnostic input	
3	Chassis ground, load supply	
4	Output signal to DESINA actuator	
5	not assigned	

*   Made available by the ET 200X-DESINA for the diagnostics input

Connecting digital outputs (standard):

Your parameter settings are as follows:

- Channel type (pin 4): digital output

- Input functionality (pin 2): diagnostic input

Table 4-10   Pinout of the coupler plug for digital outputs (standard)

Pin	Assignment for digital output (standard)	View of coupler plug (wiring side)
1	24 V power supply for diagnostics input*	
2	Diagnostic input	
3	Chassis ground, load supply	
4	Output signal to actuator	
5	not assigned	

*   Made available by the ET 200X-DESINA/ET 200X-ECOFAST for the diagnostic input

Y connector

The Y connector permits double wiring of actuators and sensors at the inputs or outputs of the ET 200X.

It is advisable to use the Y connector if each socket of a module has two assigned channels. The Y connector divides the two channels between two coupler plugs (see Tables 4-11 and 4-12 for pinout).

Note: You cannot use the Y connector in conjunction with the M12, 5-pin angular coupler plug.
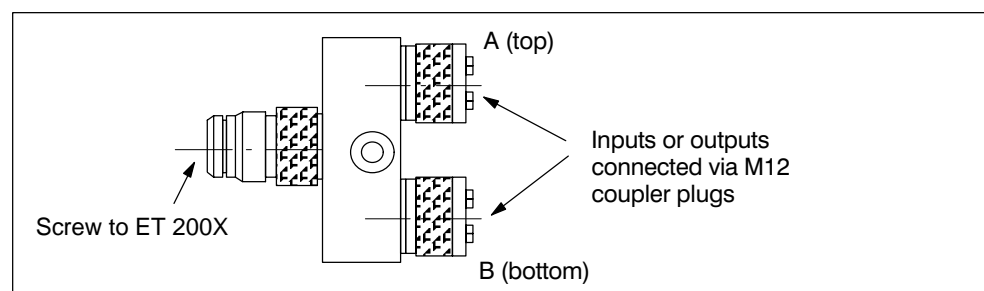
Figure 4-15   Y connector

Note

The Y connector **cannot** be used on the expansion modules EM 141 DI 8 x DC 24V (long type of construction) and EM 142 DO 8 x DC 24V/1.2A.

Wiring of coupler plugs (DI) for Y connector

To connect the digital inputs using a Y connector, you require:

- A Y connector and 2 M12 coupler plugs
- A flexible, 3- or 4-core copper cable with a core cross-section of ≤ 0.75 mm^2

Wire the two M12 coupler plugs for the Y connector in accordance with the pinout table below. The assignment of pin 4 depends on the socket of the ET 200X to which you screw the Y connector.

Table 4-11   Pinout of the coupler plugs for digital inputs when a Y connector is used

Pin	Coupler plug assignment ...		View of
	A (top)	B (bottom)	**Y connector**
1	24 V power supply for sensor*		
2	–	–	
3	Chassis ground, power supply		
4	Input signal on socket X1: channel 0 socket X2: channel 1 socket X3: channel 2 socket X4: channel 3	Input signal on so. X1: channel 4/1** so. X2: channel 5/–** so. X3: channel 6/3** so. X4: channel 7/–**	
5	PE		

*   Made available by the ET 200X for the connected sensor
**   Channel specified after the "/" valid if the BM/EM has four channels
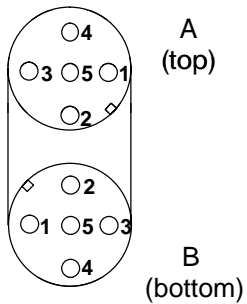
Wiring of coupler plugs (DO) for Y connector

To connect the digital outputs using a Y connector, you require:

- A Y connector

- Two M12 coupler plugs

- A flexible, 3- or 4-core copper cable with a core cross-section of ≤ 0.75 mm^2

Wire the two M12 coupler plugs for the Y connector in accordance with the pinout table below. The assignment of pin 4 depends on the socket of the ET 200X to which you screw the Y connector.

Table 4-12   Pinout of the coupler plugs for digital outputs when a Y connector is used

Pin	Coupler plug assignment ...		View of
	A (top)	**B (bottom)**	**Y connector**
1	–		
2	–	–	
3	Chassis ground, load voltage		
4	Output signal on socket X1: channel 0 socket X2: channel 1 socket X3: channel 2 socket X4: channel 3	Output signal on socket X1: channel 1 socket X2: – socket X3: channel 3 socket X4: –	
5	PE		

Pinout of the sockets for inputs/outputs

The pinout of the sockets for inputs/outputs is shown together with the data for the individual modules in Section 7.1 ff.

Wiring the M12 coupler plug for analog inputs and outputs

To connect the analog inputs and analog outputs, you require:

- A 4- or 5-pin, M12 coupler plug

- A shielded 4-core copper cable with a core cross-section of ≤ 0.75 mm^2

Wire the coupler plug in accordance with the pinout of the sockets on the expansion module. You will find the pinout in the information on the various modules as of Section 7.21.9. You may have to connect the expansion module to the protective ground (see Section 4.4.6).

4.4.5 Connecting the protective ground to the basic module

Protective ground connection

You must connect the protective ground to the basic module. A grounding screw is provided on the basic module for this purpose.

Minimum cross-section from the conductor to the protective ground: 4 mm^2.

The connection to the protective ground is also required to divert the interference currents and for EMC resistance. To improve the EMC performance, it is advisable to select the largest possible cross-section for the wire to the protective ground (e.g. copper braided cable).

Note

Make sure that the protective ground connection always has a low impedance.

Figure 4-16 shows how the protective ground connects to the BM 141, BM 142 and BM 147/CPU basic modules. The fixing screw M5 is enclosed with the basic module as standard.
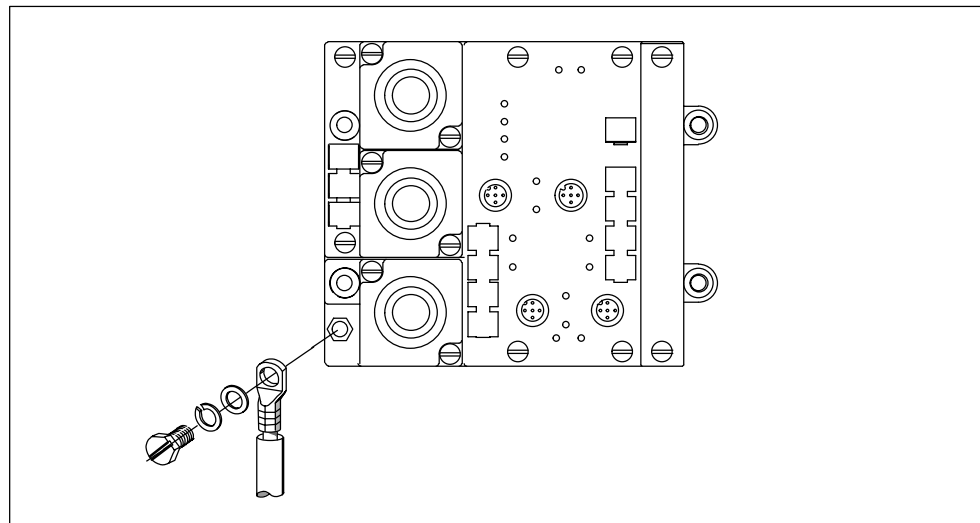
Figure 4-16   Connecting the protective ground to the BM 141, 142 and 147/CPU basic modules

Figure 4-17 shows how the basic modules BM 143-DESINA FO, BM 143-DESINA RS485, and BM 141 DI 8 × DC 24V ECOFAST must be connected to protective ground.
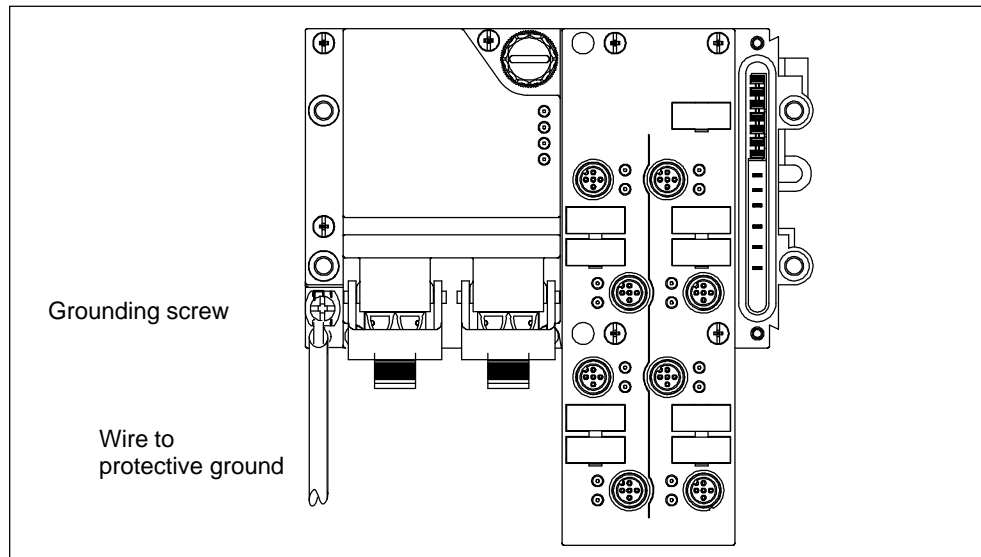
Figure 4-17   Connecting the basic modules BM 143-DESINA FO, BM 143-DESINA RS485, and BM 141 DI 8 × DC 24V ECOFAST to protective ground

EMC

You will find additional notes on EMC installation and wiring in the manual for the DP master you are using or for the host system.

4.4.6   Connecting a protective ground to expansion modules with analog inputs and outputs

Grounding expansion modules with AI/IO

To ensure the ET 200X remains operative even when subject to interference (especially RF coupling in accordance with ENV 50141), you must ground every expansion module with analog inputs or outputs **separately**.

Connection to protective ground

You must connect the protective ground to the expansion module. A grounding screw is provided on the expansion module for this purpose. You either connect the protective ground to the PE screw of the basic module (see Section 4.4.5) or directly to protective ground. Minimum cross-section from the conductor to the protective ground: 4 mm^2.

Note

Make sure that the protective ground has a low impedance (Figure 4-18).

Figure4-18 shows you how to connect the protective earth to the analog module. The M5 fixing screw is attached to the analog module such that it cannot get lost.
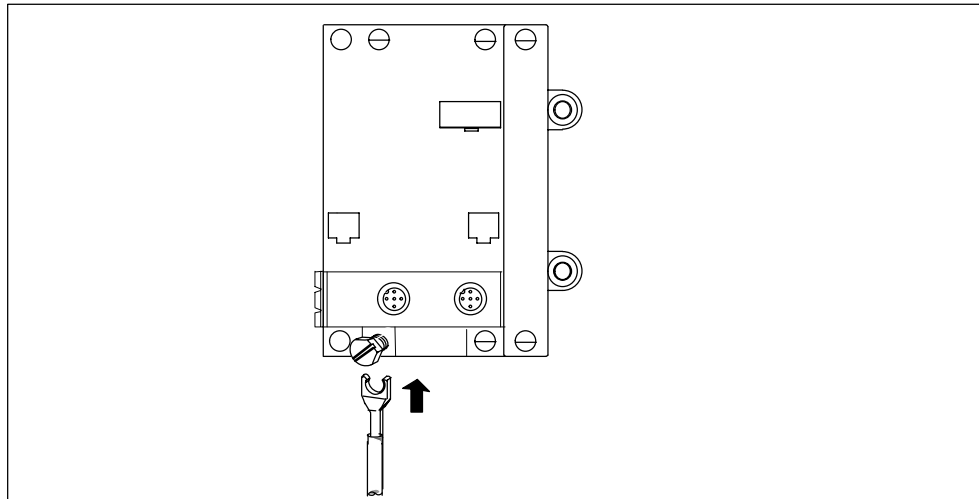
Figure 4-18   Connecting the protective ground to the analog module

EMC

You will find additional notes on EMC installation and wiring in the manual for the DP master you are using or for the host system.

4.4.7 Plugging the connectors into the ET 200X

Requirements for plugging in connectors

You must have wired the cables to the connectors. In addition, you must have set the PROFIBUS address (in accordance with your configuration) and if necessary connected the terminating resistance.

Plugging connectors into the ET 200X

Proceed as follows after you have completed the wiring:

1. Press two fixing screws into each connector and plug the connectors into the plate.

2. Plug the plate with the two connectors and the connector for the load voltage into the basic module. Note the mechanical polarization of the connector plate.

   Note: You must always plug all three connectors into the basic module irrespective of whether or not they are wired in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved. An alternative is to close unused connectors with covers.

3. Screw the connectors tightly onto the basic module with a torque of max. 0.8 Nm.

4. Plug all the other connectors into the appropriate sockets on the front of the basic module/expansion modules.

⚠ **Caution**

The connector for the load voltage, the coupler plugs and the Y connectors must not be removed from the sockets for the inputs/outputs while the ET 200X is operating, nor must the power connectors be removed from the motor starters or frequency converters.

You should therefore always either disconnect the ET 200X from PROFIBUS-DP (by removing the PROFIBUS-DP connector) or switch off the supply voltage to the electronics/sensors, the load voltage and the load before you remove the above connectors!

Installing the connector on the ET 200X-DESINA/ET 200X-ECOFAST

Proceed as follows after you have completed the wiring of the sensors and actuators:

1. Push up the latch for the DESINA connectors on the basic module.

2. Plug the DESINA connectors (non-switched and switched load voltages and PROFIBUS-DP via fiber-optic or copper cables) into the sockets on the basic module. Note the mechanical coding of the connectors for feed and loop-through.

   Note: You must always plug both DESINA connectors into the basic module in order to ensure that the degree of protection (IP 65, IP 66, or IP 67) is achieved. Fit a cover if a DESINA socket remains unused. You can find the order numbers for the covers in Appendix A.

3. Push down the latch for the DESINA connectors.
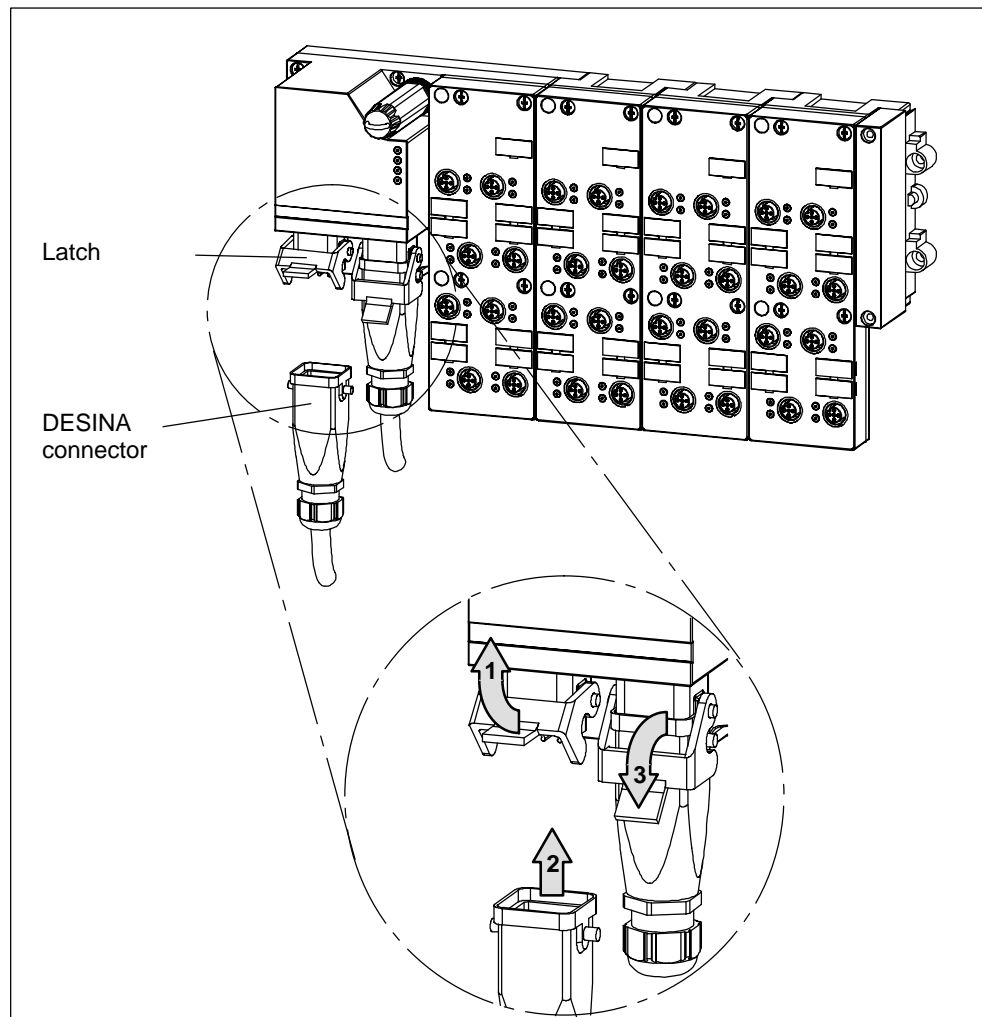
Figure 4-19   Plugging connectors into the ET 200X-DESINA/ET 200X-ECOFAST

4. Plug all the other connectors into the appropriate sockets on the front of the basic module/expansion modules.

⚠ **Caution**

Do not unplug the DESINA connectors or the coupler plugs for the inputs/outputs or the power connector for the motor starters or frequency converters while the ET 200X-DESINA/ET 200X-ECOFAST is operating, or the modules may be damaged or possibly even destroyed.

Always switch off the non-switched and switched load voltages and loads before unplugging the connectors.

Installing connectors on analog modules

Note

You must push the M12 coupler plug securely into the analog socket (against the resistance of the shield plate) so that the thread of the coupler plug is engaged. When doing this, watch the mechanical coding on the connector.

Installing connectors on power modules

Install the connector with the two **short** screws on the power module. The short screws are enclosed with the power module as standard.

Covering up unused sockets

You must seal off any sockets which are not required with M12 screw caps in order to ensure the degree of protection (IP 65, IP 66 or IP 67) is maintained. You can find the order numbers for the M12 screw caps in Appendix A.

Wired ET 200X

The diagram below shows a wired ET 200X. (The power connectors for the load supply voltage and the load on the motor starter are not featured here.)
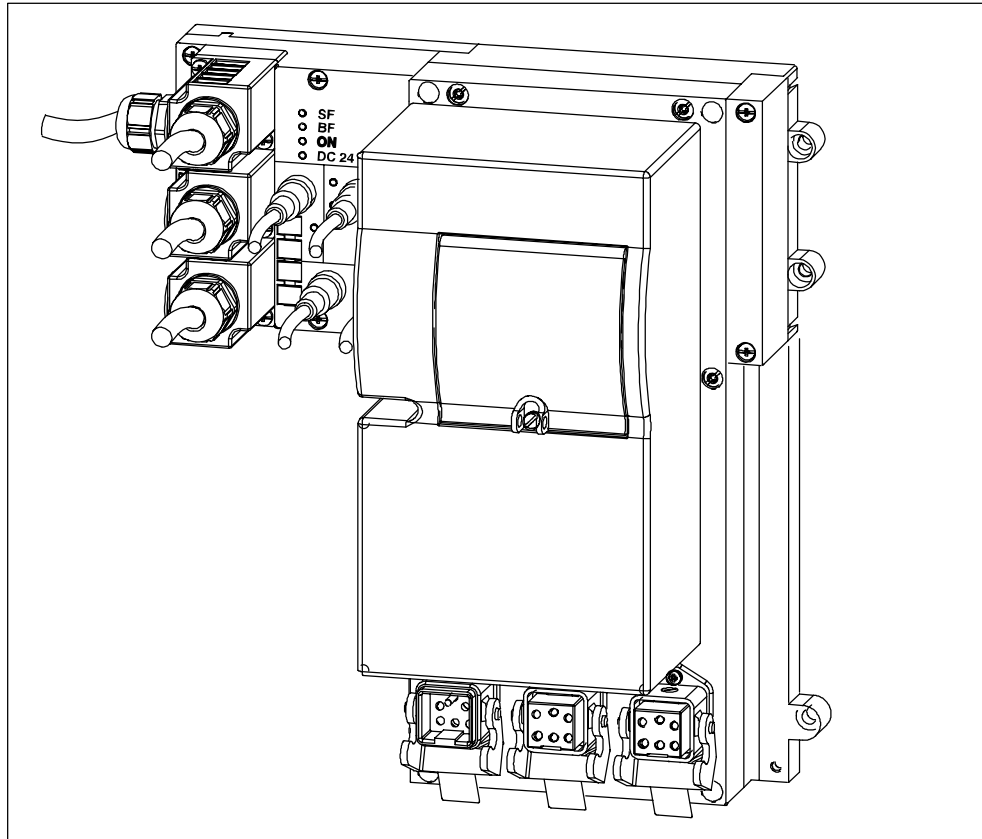
Figure 4-20   Wired ET 200X

4.4.8   **Wiring the SITOP power power supply and adapting It to deployment conditions**

Only very little wiring work is required to integrate the SITOP power 24V/10A power supply into the ET 200X. The output voltage can either be used as supply voltage for electronics/sensors and/or load voltage. The power supply response in the event of a fault can be parameterized.

Wiring

⚠ **Warning**

Before starting the installation work, the main switch on the system is to be switched off and secured to prevent it from being turned on again. If this point is not observed, death or severe physical injury may be caused through touching live components.

Proceed as follows to wire the SITOP power:

1. The connections for the incoming voltage are accessible once the terminal cover has been removed. Undo the four screws to gain access ❶.

⚠ **Caution**

Only qualified personnel may open the device. They must know how to handle electrostatic sensitive devices (ESD).
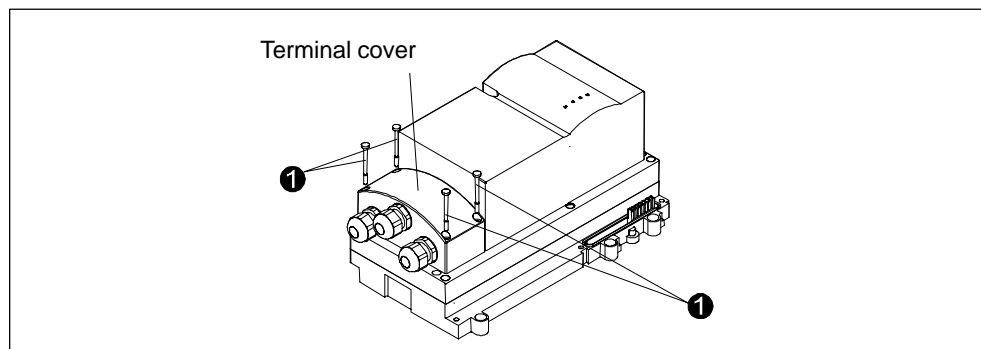
Figure 4-21   Removing the terminal cover

2. Take off the terminal cover. When doing this, make sure that the seal is not damaged.

3. Feed the power cable through the M16 cable gland. The outside diameter of the mains power supply cable must be between 4 mm and 10 mm and be suitable for special operating conditions (environmental influences).

4. Connect the mains power supply cable to supply terminals L1, N and PE ⏚. Conductor cross-sections between 0.5 mm^2 and 2.5 mm^2 can be clamped.

Note

The screw-type terminals can be plugged in as a unit.
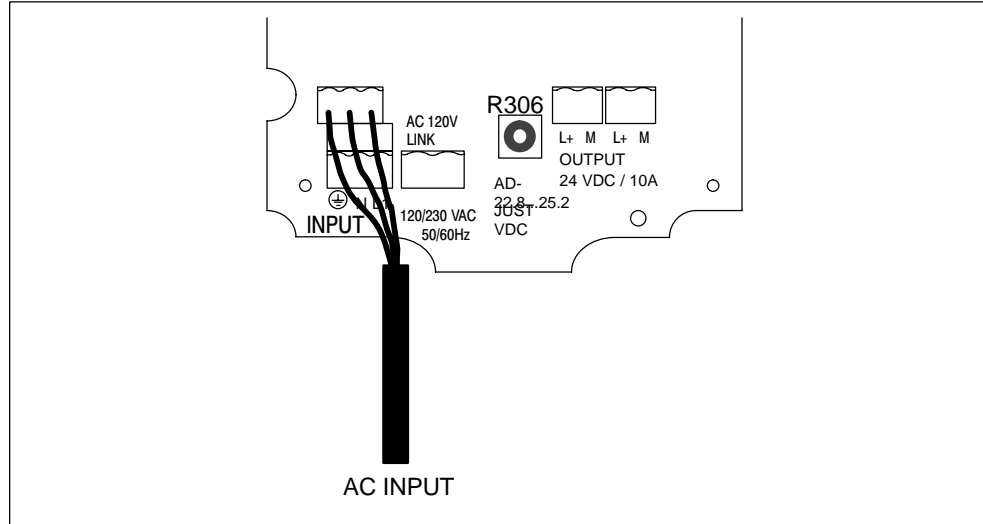
Figure 4-22   Connecting the mains power supply cable

Note

When installing the SITOP power 24V/10A power supply, the relevant DIN/VDE regulations or the regulations specific to the country are to be observed.

The supply voltage (120/230 VAC) must be in accordance with VDE 0100 and VDE 0160. A protective device (fuse) and disconnecting device to isolate the power supply must be provided.

Operation on 120 VAC

When operating on a 120 VAC power supply, a bridge must be wired between the two "AC 120V LINK" terminals. The bridge must have the same cross-section and insulation as the mains power supply cable. The length must not exceed 100 mm.

Warning

Even the optional bridge carries dangerous electrical voltage!

5. Install the M16 cable gland(s).

6. If required, make the following settings:

Setting the output voltage

The output voltage can be set in the range from 22.8 V to 25.2 V using
potentiometer R306.
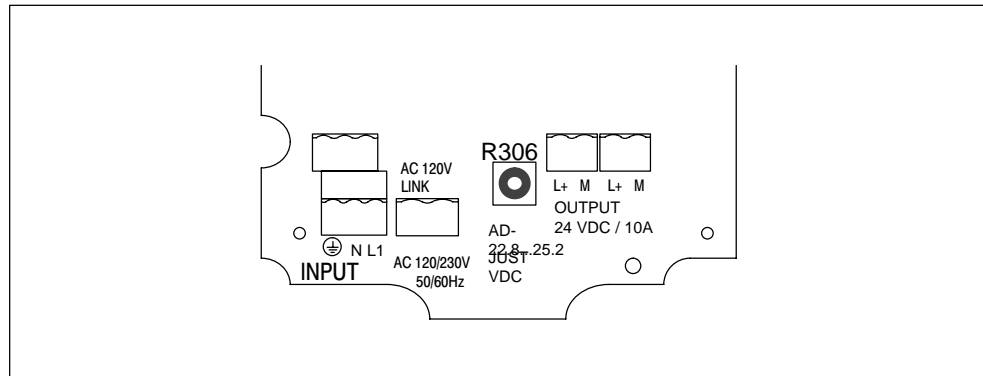
Figure 4-23   Potentiometer R306 for setting the output voltage

⚠️ **Warning**

Potentiometer R306 may only be operated with an insulated screwdriver in
accordance with DIN 7437, because components carrying dangerous electrical
voltage may be touched unintentionally.

Switching the output voltage to the bus segment of the ET 200X

The top section of the SITOP power must be removed to make the following settings.

⚠ **Warning**

The top section may only be removed when the mains voltage has been switched off and measures put in place to ensure that it cannot be turned on again.

Undo the six screws ❷ and remove the top section. When doing this, make sure that the seal is not damaged.
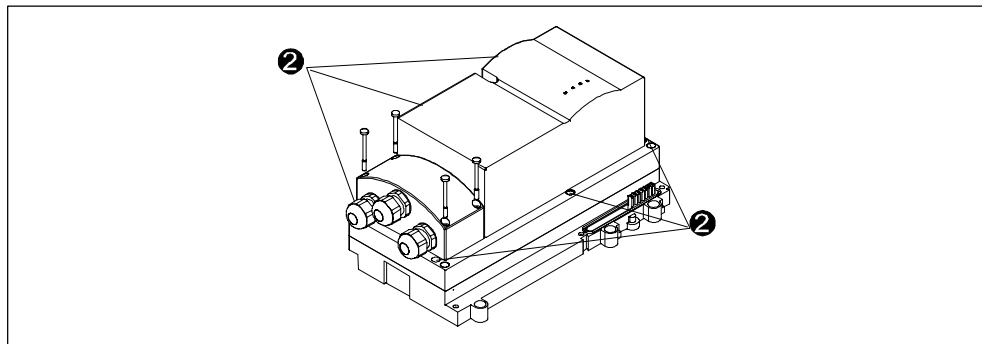
Figure 4-24   Removing the top section

The output voltage can be switched on the underside of the top section by rearranging adapter plate A1 on the various bus segments of the ET 200X. For this, the combinations listed in Table 4-13 are possible. In the case of adapter position IV, basic insulation is provided between the bus segments and the output terminals (for an insulation rating voltage of 400 VAC).

The reference potential of the supply voltage for electronics/sensor 1L+ and load voltage supply 2L+ are not floating.

Table 4-13   Switching the output voltage to the bus segment of the ET 200X

Position of adapter plate A1	Supply voltage for electronics/ sensor 1L+	Load voltage supply 2L+	Output terminals	
I	x	–	x	
II	x	x	x	
III	–	x	x	"As delivered" condition
IV	–	–	x	

x: Voltage present
–: No voltage present
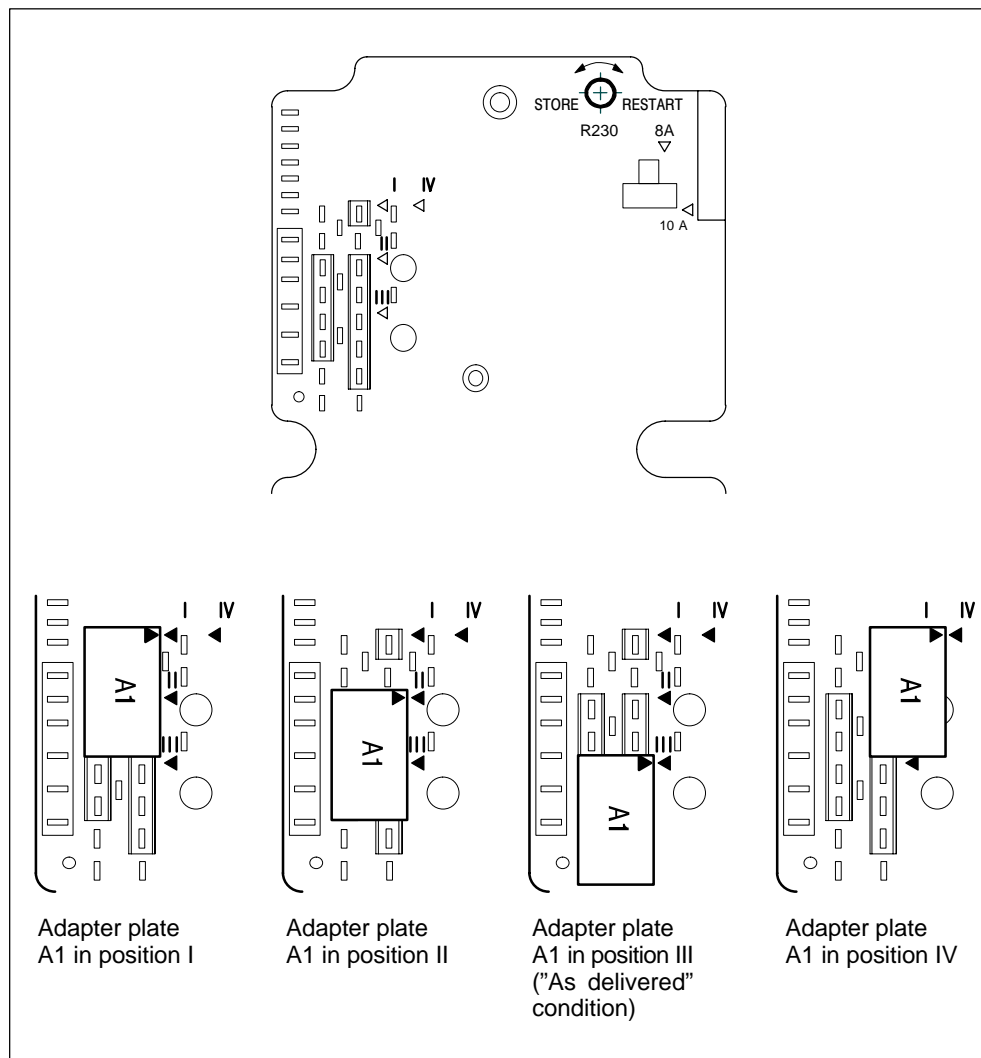
Figure 4-25   Positions of adapter plate A1

Switching over the short circuit response

The SITOP power response in the event of a short circuit on the output side can be switched over using potentiometer R230.

Table 4-14 Switching over the short circuit response

Position of potentiometers R230	Response in the event of a short circuit	
Right-hand stop "RESTART"	Automatic attempts to start up	"As delivered" condition
Left-hand stop "STORE"	Stored shutdown. RESET by switching off the mains voltage for at least 5 minutes.	
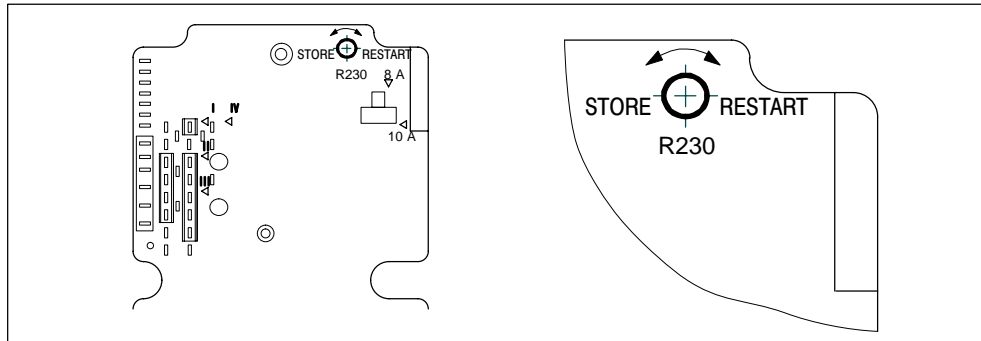
Figure 4-26   Position of the R230 potentiometer

Switching over the power supply

Output current limitation can be changed by rearranging adapter plate A2.

Note

Switching over to 10 A is only permissible at ambient temperature < 40 °C.

Table 4-15   Switching over current limiting

Position of adapter plate A2	Application of current limiting at approx.	
8 A	9.5 A	”As delivered” condition
10 A	11 A	
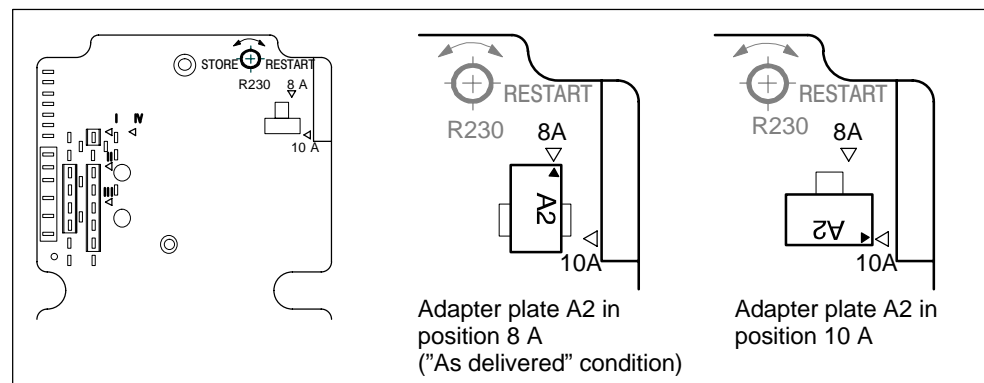
Figure 4-27   Positions of the adapter plate A2

7. Refit the top section and the terminal cover and screw down both units securely.

Note

In order to ensure that IP 65 degree of protection is maintained, once the wiring and setting is complete, all M16 cable glands and covers must be screwed together correctly.

Tightening torque

- For casing screws: 0.5 Nm

- For M16 cable glands: tighten the cap nut until the rubber seal lies on the cable. Then tighten for a further $^1/_2$ turn.

Commissioning and Diagnostics

5

Contents of Chapter

5.1 Configuring ET 200X-DESINA

Introduction

An ET 200X-DESINA channel assumes the functionality determined by the settings sent to it on parameterization.

The possibilities are:

- Digital input
- Digital output } pin 4
- Diagnostic input
- Diagnostics input with diagnostics frame } pin 2
- Input with NC function

Parameterization for the functional input (Pin 2) is displayed and analyzed in accordance with Table5-1.

Table 5-1   Display and analysis of the parameters for the DESINA functional input

Pin 2 is "1" (+24 V) Process image is always "0"	LEDs	Analysis
Diagnostics input (default)	Red⇒off	Process image
Diagnostics input with diagnostics frame	Red⇒off	Process image and SFC 13, for example (see Section 5.6.1)
Input with NC function	Yellow⇒on	Process image

Pin 2 is "0" Process image is always "1"	LEDs	Analysis
Diagnostics input (default)	Red⇒on	Process image
Diagnostics input with diagnostics frame	Red⇒on	Process image and SFC 13, for example (see Section 5.6.1)
Input with NC function	Yellow⇒off	Process image

Configuration

2 bytes for inputs and 2 bytes for outputs are reserved for data transfer in the process image (PI). In the process image the input and output ranges must not be at the same address.

Figure 5-1 shows the arrangement of the digital inputs and outputs on the BM 143-DESINA and EM 143-DESINA in relation to the bits of the inputs and outputs in the PI.
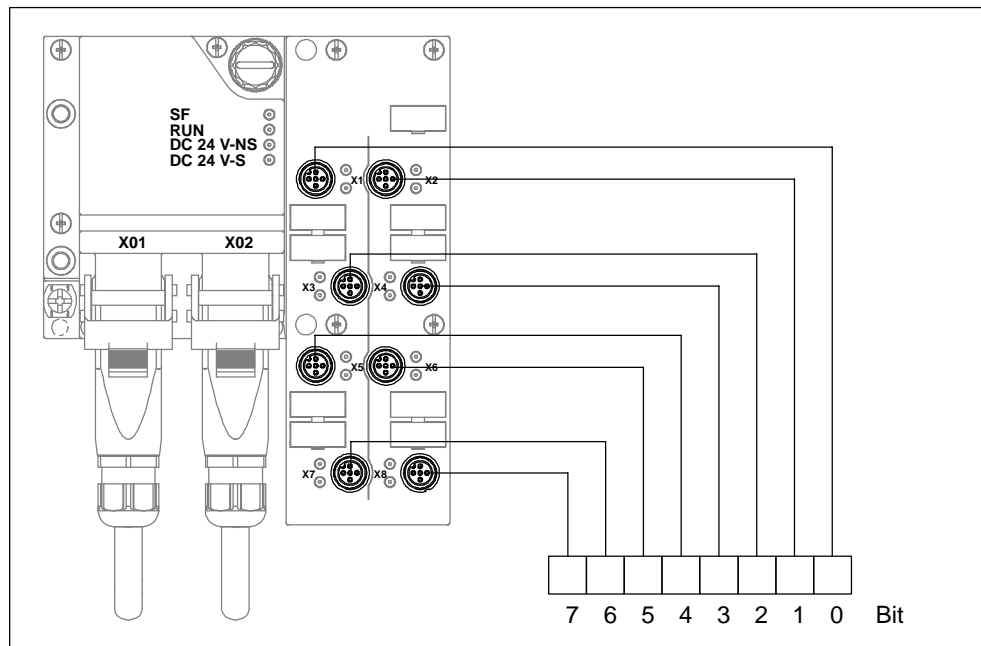
Figure 5-1   Correlation of DIs/DOs on BM 143-DESINA/EM 143-DESINA with bits of inputs/outputs in the PI

Signals (user data) and diagnostics data are mutually independent. The diagnostics input merely shows the state of the sensor or actuator; there is no defined effect on the signal. The necessary or desired reaction can only be derived from the application.

The examples below illustrate the relationship between the individual signals and the diagnostic inputs.

Bit assignment of the inputs

In the PI, inputs are assigned as shown in Figure 5-2.

	7	6	5	4	3	2	1	0	Bit
Byte 0	ND7	ND6	ND5	ND4	ND3	ND2	ND1	ND0	
Byte 1	FI7	FI6	FI5	FI4	FI3	FI2	FI1	FI0	

ND0 ... ND7:   Signal (user datum, digital)
                          channel 0 to channel 7

FI0 ... FI7:   Functional input (diagnostics datum)
                          channel 0 to channel 7
                          Each functional input can be parameterized
                          – as a diagnostics input or
                          – as an input with NC function.

                          Default: diagnostic input

Figure 5-2   Assignment of the inputs in the process image (PI)

Bit assignment of the outputs

In the PI, outputs are assigned as shown in Figure 5-3.

	7	6	5	4	3	2	1	0	Bit
Byte 0	ND7	ND6	ND5	ND4	ND3	ND2	ND1	ND0	
Byte 1	0	0	0	0	0	0	0	0	

ND0 ... ND7:   Signal (user datum, digital)
                          channel 0 to channel 7

Byte 1 is not used (= 0)

Figure 5-3   Assignment of the outputs in the process image (PI)

Examples of assignment

1. The 8 channels of a BM 143-DESINA are to be parameterized as $5 \times$ DIs + $3 \times$ DOs. The functional inputs are parameterized as diagnostics inputs.

Channel 7	Channel 6	Channel 5	Channel 4	channel 3	Channel 2	Channel 1	Channel 0
DI	DI	DO	DI	DO	DI	DO	DI

The input/output assignment in the process image is thus:

PII:

	7	6	5	4	3	2	1	0	Bit
Byte 0	ND7	ND6	0	ND4	0	ND2	0	ND0	

Byte 1	FI7 (D)	FI6 (D)	FI5 (D)	FI4 (D)	FI3 (D)	FI2 (D)	FI1 (D)	FI0 (D)

PIO:

Byte 0	0	0	ND5	0	ND3	0	ND1	0
Byte 1	0	0	0	0	0	0	0	0
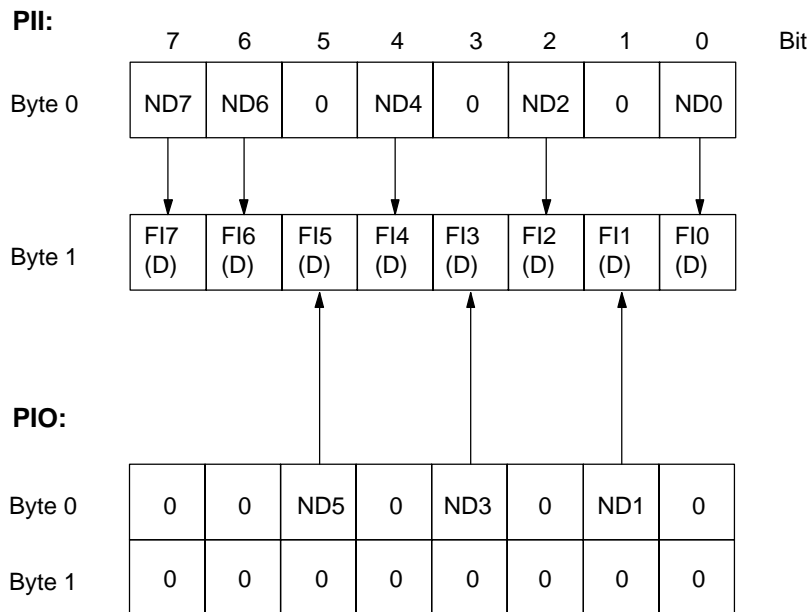
FEn (D): Diagnostics input n

The arrows indicate the permanent relationship between signal and diagnostics input.

The following applies in the example:
Diagnosis for channel 0 (DI) is in bit 0 of byte 1 of the PII
Diagnosis for channel 1 (DO) is in bit 1 of byte 1 of the PII
Diagnosis for channel 2 (DI) is in bit 2 of byte 1 of the PII
.
.
.

This assignment has to be taken into account when the application is programmed.

2. The 8 channels of a EM 143-DESINA are to be parameterized as $5 \times$ DIs + $3 \times$ DOs. Of these, two DIs should have NC functionality. The remaining six functional inputs are parameterized as diagnostics inputs.

Channel 7	Channel 6	Channel 5	Channel 4	channel 3	Channel 2	Channel 1	Channel 0
DI (NC contact)	DI	DI (NC contact)	DI	DI	DO	DO	DO

The input/output assignment in the process image is thus:

PII:

	7	6	5	4	3	2	1	0	Bit
Byte 0	ND7	ND6	ND5	ND4	ND3	0	0	0	

Byte 1	FI7 (NC)	FI6 (D)	FI5 (NC)	FI4 (D)	FI3 (D)	FI2 (D)	FI1 (D)	FI0 (D)

PIO:

Byte 0	0	0	0	0	0	ND2	ND1	ND0
Byte 1	0	0	0	0	0	0	0	0
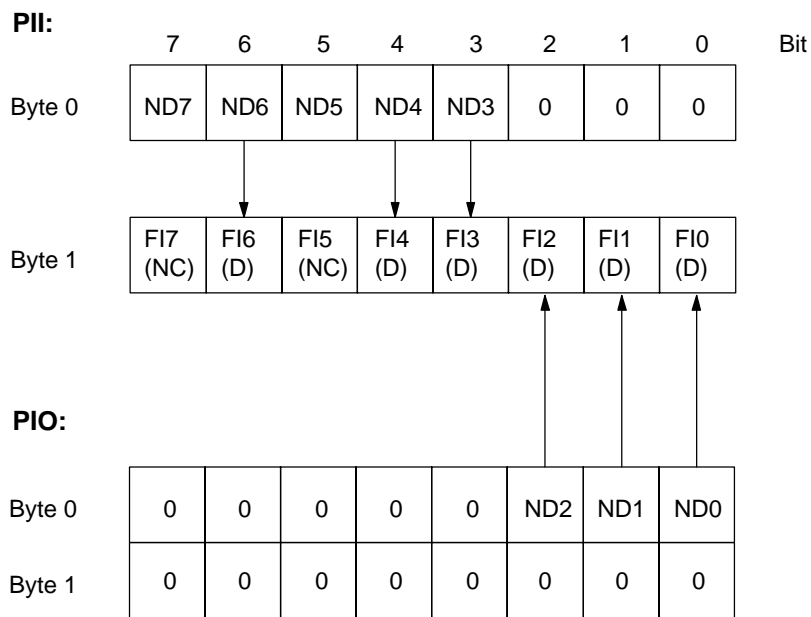
FEn (D): Diagnostics input n
FEn (Ö): Input with NC functionality

The arrows indicate the permanent relationship between signal and diagnostics input. This assignment has to be taken into account when the application is programmed.

5.2 Commissioning and starting up the DP slave 5-7

Software requirements

Table 5-2   Software requirements for commissioning an ET 200X (except DESINA)

Project software used	Version	Explanations
STEP 7	≤ Version 3.1	The type file of the DP slave is integrated in *STEP 7*.
	> Version 3.1	Included in *STEP 7* or new modules to be embedded with OM or type file
COM PROFIBUS	≥ Version 2.1	You have embedded the type file of the DP slave in *COM PROFIBUS*.
Configuration software for a different DP master being used		You require the device master file and the contents of the configuration frame and parameter assignment frame for the DP slave (refer to Appendix B and the *configuration and parameter assignment frame for ET 200X* at http://www.ad.siemens.de/simatic-cs).

Table 5-3   Software requirements for commissioning an ET 200X-DESINA

Project software used	Version	Explanations
	ET 200X with BM 143-DESINA FO	
STEP 7	≥ Version 5.0 and Service Pack 3	You have embedded the device master file of the DP slave in *STEP 7* or You use HWCONFIG. As of Service Pack 3, the ET 200X-DESINA with fiber-optic cable is included in the hardware catalog.
	ET 200X with BM 143-DESINA RS485/ BM 141 DI 8 × DC 24V ECOFAST	
STEP 7	≥ Version 5.1 and Service Pack 2	You have embedded the device master file of the DP slave in *STEP 7* or You use HWCONFIG. As of Service Pack 2, the ET 200X with RS 485 is included in the hardware catalog.
	ET 200X with BM 141 DI 8 × DC 24V ECOFAST DIAG	
STEP 7	≥ Version 5.1 and Service Pack 4	You have embedded the device master file of the DP slave in *STEP 7* or You use HWCONFIG. As of Service Pack 4, the ET 200X with RS 485 is included in the hardware catalog.
COM PROFIBUS	≥ Version 2.1	You have embedded the device master file of the DP slave in *COM PROFIBUS* (refer to Appendix B).
Configuration software for a different DP master being used		You require the device master file and the contents of the configuration frame and parameter assignment frame for the DP slave (refer to Appendix B and *configuration and parameter assignment frame for ET 200X* at http://www.ad.siemens.de/simatic-cs).

Device master file

You can download the DDB file

- From the Internet at http://www.ad.siemens.de/csi_e/gsd

Integrating the DDB file in the configuration software

The following table 5-4 tells you how to integrate the type file in SIMATIC S7 or SIMATIC S5 (COM PROFIBUS).

Table 5-4   Integrating the DDB file in the configuration software

Step	STEP 7, as of V3.1	COM PROFIBUS, as of V2.1[1]
1	Start STEP 7 and in HWCONFIG call the **Options ▶ Install New GSD** menu command.	Copy the DDB file from the ET 200X to the COM PROFIBUS directory: **...CPBV..\GSD** (default) Copy the bitmap file to the directory: **...CPBV..\BITMAPS**
2	Select the DBB file you want to install from the following dialog box and confirm with OK. Result: The ET 200X is displayed in the hard- ware catalog in the PROFIBUS-DP directory.	Start COM PROFIBUS, and choose the **File ▶ Read GSD File** menu command. Result: The ET 200X is displayed in the hardware catalog at slave configuration.
3	Configure the ET 200X with STEP 7 (see the integrated help system in STEP 7).	Configure the ET 200X with COM PROFIBUS (see the integrated help system in COM PROFIBUS).

[1] If you are using a different configuration software package, refer to its software documentation

Function: Direct communication between basic modules

In *STEP 7* V5.0 and later, you can configure direct communication for PROFIBUS nodes. The following basic modules can participate in direct communication as the sender (publisher):

- BM 141 DI 8 × DC 24V, 6ES7 141-1BF01-0XB0, from product version 08
  6ES7 141-1BF11-0XB0, from product version 01
  6ES7 141-1BF12-0XB0, from product version 01

- BM 141 DI 8 × DC 24V
  ECOFAST, 6ES7 141-1BF00-0AB0, from product version 01
  6ES7 141-1BF01-0AB0, from product version 01

- BM 141 DI 8 × DC 24V
  ECOFAST DIAG, 6ES7 141-1BF40-0AB0, from product version 01

- BM 142 DO 4 × DC 24V/2A, 6ES7 142-1BD11-0XB0, from product version 08
  6ES7 142-1BD21-0XB0, from product version 01
  6ES7 142-1BD22-0XB0, from product version 01

- BM 143-DESINA FO, 6ES7 143-1BF00-0XB0, from product version 01

- BM 143-DESINA RS485, 6ES7 143-1BF00-0AB0, from product version 01

You will find a detailed description of direct communication in the *STEP 7* Online Help.

Requirements for commissioning

Table 5-5   Requirements for commissioning the DP slave

Presumed activity	See ...
1. DP slave installed	Section 3.1
2. PROFIBUS address set on DP slave	Section 3.3
3. If the bus signals are transferred using copper conductors and the DP slave is at the end of the segment, the terminating resistor must be activated on the DP slave: – In the case of the BM 141, BM 142 and BM 147/CPU by bringing it into the circuit – In the case of the BM 141-ECOFAST and BM 143-DESINA RS485 by mounting the terminating resistor on the right-hand DESINA connector	Section 3.4
4. DP slave wired	Section 4.4
5. DP slave configured	Online Help/configuration software manual
6. Supply voltage turned on for DP master	Manual for DP master
7. DP master set to RUN mode	Manual for DP master

Commissioning the DP slave

Table 5-6   Order of steps for commissioning the DP slave

Step	Procedure
1.	Turn on the supply voltage to the DP slave.
2.	Turn on the supply voltage to the load as necessary.

Starting up the ET 200X
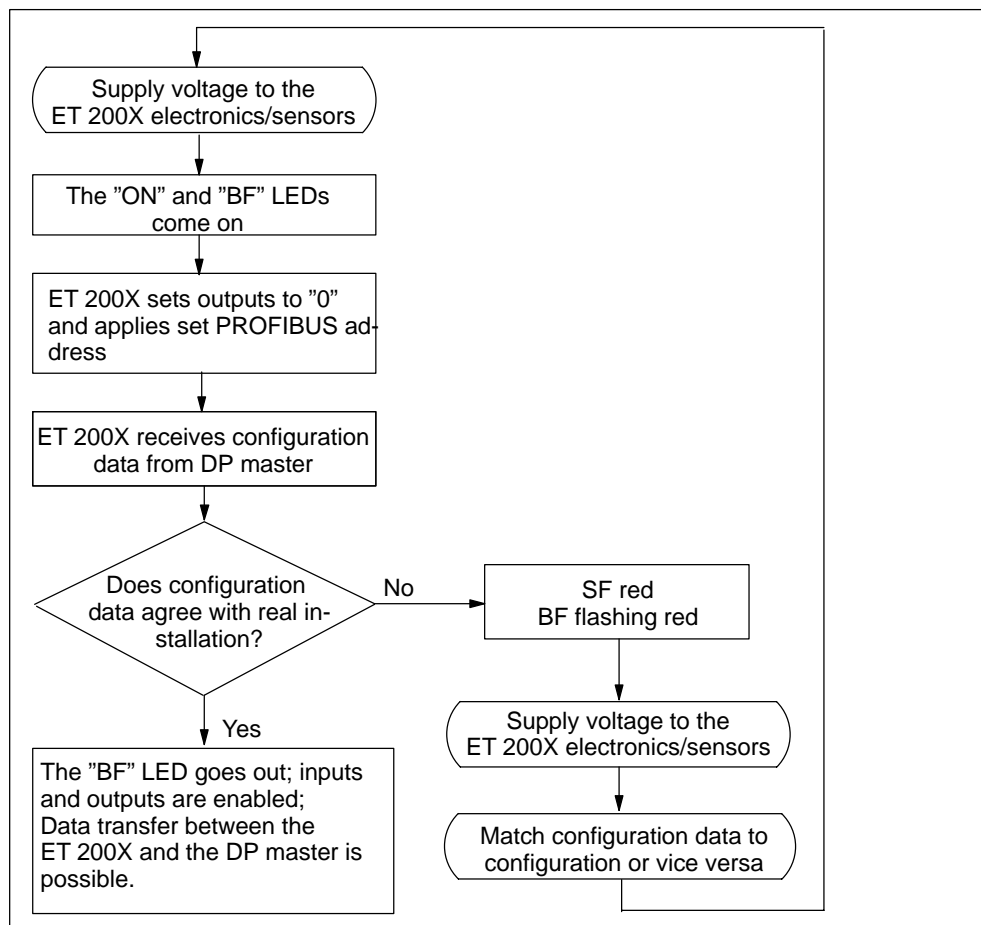
Figure 5-4   Start-up of the ET 200X

Starting up the ET 200X-DESINA
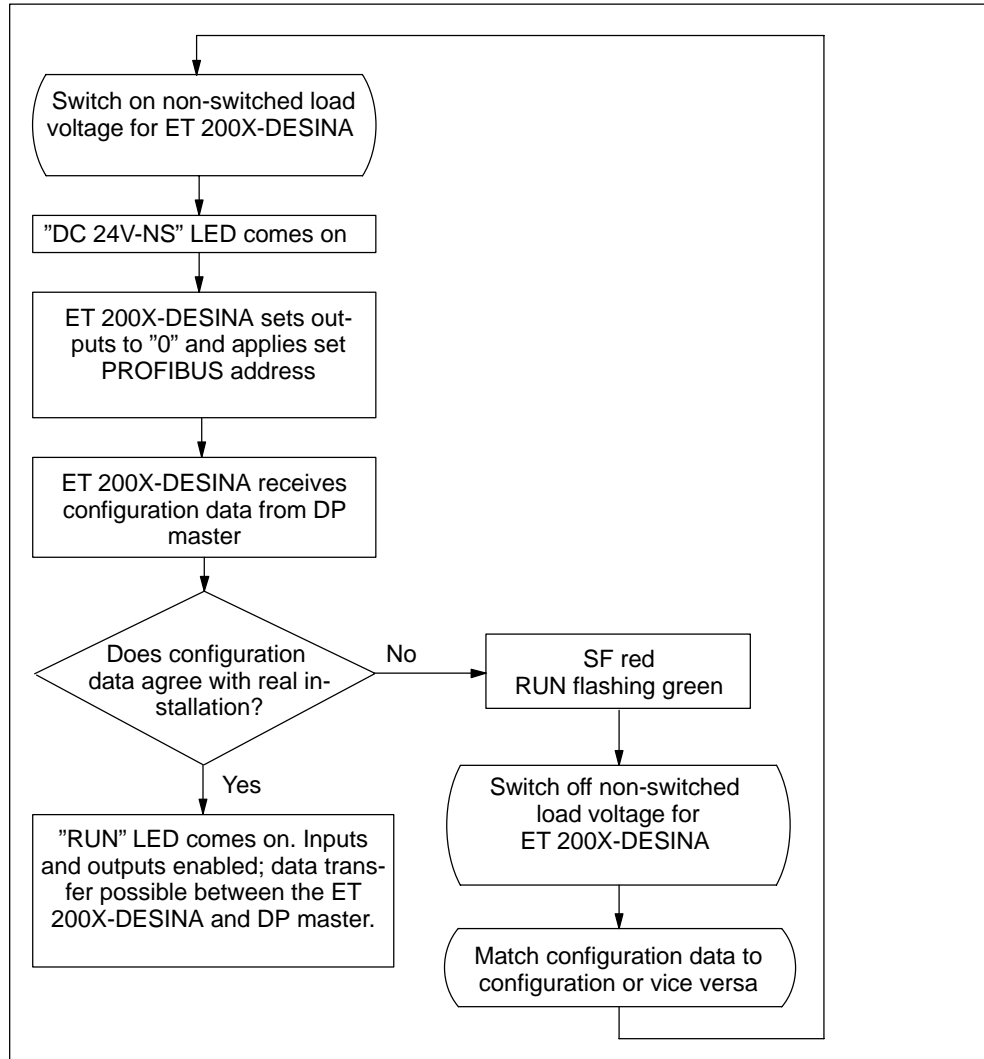
Figure 5-5   Start-up of the ET 200X-DESINA

5.3 Diagnostics using LEDs

All the basic and some of the ET 200X expansion modules have LEDs for
displaying the status and errors.

5.3.1 LEDs on BM 141 and BM 142 basic modules

Table 5-7   Status and error display by means of LEDs on the BM 141 and BM 142 basic modules

⬤ SF	(system fault):	red
⬤ BF	(bus fault):	red
◯ ON	(supply voltage):	green
◯ 24 VDC	(load supply voltage):	green

LEDs			Meaning	Action
SF	BF	ON		
Off	Off	Off	• There is either no supply voltage to the electronics/sensors on the DP slave or it is too low.	• Turn on the supply voltage to the DP slave.
			• A hardware fault has occurred.	• Replace the basic module.
*	*	On	Supply voltage is applied to the DP slave.	–
*	On	On	• The DP slave is starting up.	–
			• The connection to the DP master has failed.	• Check the PROFIBUS-DP connection.
			• The DP slave does not detect a baud rate.	• Check the DP master.
			• Bus interrupt	• Check all the cables in your PROFIBUS-DP network.
			• The DP master is not operating	• Check whether the cable connectors for PROFIBUS-DP are firmly attached to the basic module.
On	Off	On	• Diagnostic message has been issued.	• Evaluate the diagnosis.
			• The PROFIBUS address set on the DP slave is not allowed.	• Change the PROFIBUS address set on the basic module.
			• A DP slave hardware fault has occurred.	• Check whether the modules are securely connected together.
On	Flash.	On	• The configuration data sent by the DP master to the DP slave does not agree with the configuration of the DP slave.	• Check the configuration of the DP slave (input/output, PROFIBUS address).

Table 5-7   Status and error displays by means of LEDs on the basic module, continued

⬤	SF	(system fault):		red	
⬤	BF	(bus fault):		red	
◯	ON	(supply voltage):		green	
◯	24 VDC	(load supply voltage):		green	

LEDs			Meaning	Action
SF	**BF**	**ON**		
Off	Flash.	On	• The DP slave has detected the baud rate but is not being addressed by the DP master. • The DP slave has not been configured.	• Check the PROFIBUS address set in the DP slave or in the configuration software. • Check the configuration of the DP slave (station type).
Flash.	On	On	• A basic module hardware fault has occurred.	• Replace the basic module.

*   Not applicable

SF LED

On the BM 141 and BM 142 basic modules, version 06 or later, the red system fault LED (SF) comes on as soon as a diagnostic event is registered. The SF LED goes not go out unless all diagnostic events have been acknowledged.

24 VDC LED

The 24 VDC LED is on when the ET 200X is connected to a load power supply.

5.3.2 LEDs on basic modules

- BM 143-DESINA FO,
- BM 143-DESINA RS485
- BM 141 DI 8 × DC 24V ECOFAST
- BM 141 DI 8 × DC 24V ECOFAST DIAG
- BM 141 DI 8 × DC 24V DIAG

Table 5-8   Status and fault displays using LEDs on the basic modules

●	SF	(system fault):	red
○	RUN	(status indicator):	green
○	DC 24 V-NS	(non-switched load voltage):	green
○	DC 24 V-S	(switched load voltage):	green

LEDs				Meaning	Action
SF	RUN	DC 24 V-NS	DC 24 V-S		
On	*	*	*	• Diagnostic message has been issued. • The PROFIBUS address set on the DP slave is not allowed. • A DP slave hardware fault has occurred.	• Evaluate the diagnosis. • Change the PROFIBUS address for the basic module as set by means of the configuration connector. • Check whether the modules are securely connected together.
On	Flash.	On	On	• The configuration data sent by the DP master to the DP slave does not agree with the configuration of the DP slave.	• Check the configuration of the DP slave (input/output, PROFIBUS address).
Off	Flash.	On	On	• PROFIBUS address is incorrect • Bus interruption at PROFIBUS-DP	• Correct the PROFIBUS address • Rectify the bus interruption

* Not applicable

RUN LED

The RUN LED lights up when the DP slave is in the process of exchanging data with the DP master.

DC 24-NS LED

The DC 24V-NS LED is on when the DC 24V-NS non-switched supply voltage is applied.

DC 24V-S LED

The DC 24V-S LED is on when the switched DC 24V-S supply voltage is available along with the DC 24V-NS supply voltage.

BM 143-DESINA FO and BM 143-DESINA RS485 status display

The ET 200X-DESINA has two LEDs per channel (X1 to X8) 2 LEDs for status indication:

- "Yellow" LED (for digital input or output, pin 4)

    The LED is yellow when the input or output is active.

- LED "red/yellow" (for pin 2 input functionality, see Table 5-1)

    The LED is red when

    – the functional input is parameterized as a diagnostics input for DESINA and

    – a DESINA fault (status "0") is registered for the sensor/actuator.

    The LED is yellow when

    – the functional input is parameterized as an input with NC function and

    – The status of the sensor connected to the input is non-switched ("1").

Status display of the BM 141 DI 8 × DC 24V ECOFAST

In the case of the BM 141 DI 8 × DC 24V ECOFAST basic module there is one LED for each channel (X1 to X8) for status display:

- Green LED (for digital input)

    The LED is green when the input is active.

Status display of the BM 141 DI 8 × DC 24V ECOFAST DIAG

In the case of the BM 141 DI 8 × DC 24V ECOFAST DIAG basic module there are two LEDs for each channel (X1 to X8) for status display:

- Green LED

    The LED is green when the input is active.

- Red LED

    The LED is red if there is a fault on the channel:

    – Short circuit of the 24 V sensor power supply

    – Digital input wire break

5.3.3 LEDs on expansion modules (except DESINA)

SF LED (system fault display)

Some ET 200X expansion modules have an "SF" LED:

- EM 142 DO 4 × DC 24V/2A expansion module with digital outputs (6ES7 142-1BD40-0XB0)

- PM 148 DO 4 × DC 24V/2A power module

- All expansion modules with analog inputs

- All expansion modules with analog outputs

Parameterizable and non-parameterizable diagnostic messages

There are parameterizable and non-parameterizable diagnostic messages.

Non-parameterizable diagnostic messages are issued without you having to take any action. You have to set parameterizable diagnostic messages in the configuration software for them to be issued (refer to Table 5-10 onwards).

SF LED On

The SF LED on the expansion module is turned on as soon as a diagnostic message is triggered by the expansion module.

Status display

In addition, all the ET 200X modules have a status display for every input and output. The LEDs are lit when the inputs and outputs are active.

Status display of the EM 141 DI 8 × DC 24V DIAG (6ES7 141-1BF40-0AB0)

In the case of the expansion module there are 2 LEDs for each channel (X1 to X8) for status display:

- Green LED

  The LED is green when the input is active.

- Red LED

  The LED is red when there is a fault on the channel:

  – Short circuit of the 24 V sensor power supply

  – Digital input wire break

Status display of the EM 141 DI 8 $\times$ DC 24V DIAG (6ES7 141-1BF30-0AB0)

In the case of the expansion module there is 1 LED (with two colors) for each channel (X1 to X4) for status display:

- Green/red LED

  The LED is green when the input is active.

  The LED is red when there is a fault on the channel:

  – Short circuit of the 24 V sensor power supply

  – Digital input wire break

24 VDC LED

The power module also has a 24 VDC LED. The 24 VDC LED is on when the power module is connected to a load-voltage supply.

If no load voltage is available:

- the SF LED on the power module is on
- the 24 VDC LED on the power module is off

5.3.4 LEDs on EM 143-DESINA expansion modules

Status display

The ET 200X-DESINA has two LEDs per channel (X1 to X8) 2 LEDs for status indication:

- "Yellow" LED (for digital input or output, pin 4)

  The LED is yellow when the input or output is active.

- Red/yellow LED (for pin 2 input functionality, see Table 5-1)

  The LED is red when

  – the functional input is parameterized as a diagnostics input for DESINA and

  – a DESINA fault (status "0") is registered for the sensor/actuator.

  The LED is yellow when

  – the functional input is parameterized as an input with NC function and

  – the status of the sensor connected to the input is non-switched ("1").

5.3.5 LED on SITOP power

Table 5-9   Status and error displays by means of LEDs on SITOP power

○	24 VDC (24 V at output terminals):	green
○	ELECTRONIC/SENSOR 1L+ (supply voltage for electronic components/sensors):	green
○	LOAD 2L+ (load voltage supply):	green
●	TEMP > (temperature rise):	red

LEDs				Meaning	Action
24 VDC	**ELECTRONIC/ SENSOR 1L+**	**LOAD 2L+**	**TEMP >**		
Off	Off	Off	*	• No supply voltage • Short circuit at output[1]	• Switch on the mains voltage. • Repair the short circuit.
Flash.	Flash.	Flash.	*	• Overload in RESTART mode • Short circuit at output [1]	• Check the current consumption and reduce, if appropriate, the number of modules (see Section 2.7) • Repair the short circuit.
On	*	*	*	• 24 V is applied to the output terminals.	–
*	On	On	*	• Associated bus segment is supplied with 24 V	–
*	*	*	Flash.	• Switch off as maximum temperature exceeded	• Check environmental and load conditions

*   Not applicable
1) Depends on parameterized short-circuit response

5.4 Parameterizable diagnostic messages

You can assign parameters to diagnostic messages for the following modules with *STEP 7* or *COM PROFIBUS*:

- EM 142 DO 4 × DC 24V/2A expansion module with digital outputs
  (6ES7 142-1BD40-0XB0)

- PM 148 DO 4 × DC 24V/2A power module

- All expansion modules with analog inputs

- All expansion modules with analog outputs

Diagnostics messages of the EM 142 DO 4 × DC 24V/2A (6ES7 142-1BD40-0XB0) and the PM 148 DO 4 × DC 24V/2A

Table 5-10   Diagnostics messages of the EM 142 DO 4 x DC 24V/2A and
             PM 148 DO 4 x DC 24V/2A

Diagnostic message	Area affected by diagnostics	Configurable
Configuration or parameter assignment error	Expansion module	Not configurable
Wire break	Channel	Configurable
Short-circuit to M	Channel	Configurable
Short circuit to L+	Channel	Configurable

*   The broken wire signal is triggered at a current value of < 6 mA and only if the corresponding channel has been set.

Diagnostic messages of expansion modules with analog inputs

When a fault is detected, modules with analog inputs supply a signal value of "7FFF$_H$", irrespective of parameter assignment.

Table 5-11   Diagnostic messages for modules with AI

Diagnostic message	Area affected by diagnostics	Configurable
Configuration or parameter assignment error	Expansion module	Not configurable
Wire break (only with current inputs and over the measuring ranges 4 to 20 mA)[1]	Channel	Configurable
Upper limit violation	Channel	Parameterizable[2]
Lower limit violation	Channel	Parameterizable[2]

[1]   The broken wire signal is triggered at a current value of $\leq$ 3.6 mA.
[2]   Perform the setting by activating the "group diagnosis" parameter in the configuration software.

Diagnostic messages of expansion modules with analog outputs

Table 5-12   Diagnostic messages for modules with AO

Diagnostic message	Area affected by diagnostics	Configurable
Configuration or parameter assignment error	Expansion module	Not configurable
Wire break (with current outputs only)[1]	Channel	Parameterizable[2]
Short-circuit to M (with voltage outputs only)[3]	Channel	Parameterizable[2]

[1]   In the case of EM 145 AO 2 $\times$ I (6ES7 145-1GB31-0XB0) the broken wire signal is triggered at a current value of $\leq$ −2 mA or $\geq$ +2 mA.
[2]   Perform the setting by activating the "group diagnosis" parameter in the configuration software.
[3]   In the case of EM-circuit signal is triggered at a voltage value of $\leq$ −750 mV or $\geq$ +750 mV.

Action following diagnostic message in *STEP 7*

Every diagnostic message results in the following action:

- If you have selected the "enable diagnostic interrupt" parameter, a diagnostic interrupt is triggered (refer to Section 5.5.1).

- A diagnostic interrupt is followed by the diagnostic message being entered in the diagnostic buffer of the master CPU or – if you are using the BM 147/CPU on the ET 200X – in the diagnostic buffer of the BM 147/CPU.

- The SF LED on the expansion module goes on.

- The OB 82 is called. If it is not present, the CPU then switches to STOP mode (either the master CPU or, if the BM 147/CPU is being used on the ET 200X, the CPU of the BM 147/CPU).

Action following diagnostic message in *COM PROFIBUS*

If you have enabled diagnostic interrupts with *COM PROFIBUS*, diagnostic interrupts are shown in the device-specific diagnosis of the ET 200X. In other words, the module that triggered the interrupt and the cause of the interrupt are entered in the device-specific diagnosis (see Section 5.6.9).

The SF LED on the expansion module goes on.

Causes and action

The following table shows all the diagnostic messages possible for expansion modules, together with their causes and remedial action.

Table 5-13   Diagnostic messages – causes and remedial action

Diagnostic message	Possible cause	Remedial action
Configuration/parameter assignment error	You have assigned different parameters to the module in the user program (possible in *STEP 7* SFC call). The new values are not within the permissible range or are not consistent.	Assign new parameters to module
Wire break	Resistance of sensor/actuator wiring too high	Use a different sensor/actuator type or wire differently – for example, use wires having a larger cross-section
	Interruption of the cable between the module and the sensor/actuator	Establish cable connection
	Channel not wired (open)	Deactivate channel at AI (by means of "measurement type" parameter)
		Wire up channel
Short-circuit to M (error detection only when output at "1")	• Output overloaded • Output short-circuited to M	• Clear overloading • Clear short-circuit
Short-circuit to L+	Output short-circuited to L+ of module supply	Replace module
Lower limit violation	Input value below underrange, fault possibly caused by: • Sensor connected with reverse polarity • Incorrect measuring range set	Check connections Assign parameters to other range
Lower limit violation	Input value higher than overrange	Assign parameters to other range

Parameters

The parameters you can set and their ranges can be found in the technical data applicable to expansion modules:

- for EM 142 DO 4 × DC 24V/2A (6ES7 142-1BD40-0XB0) in Table 7-28
- for PM 148 DO 4 × DC 24V/2A in Table 7-37
- for the expansion modules with analog inputs in Table 7-41
- for the expansion modules with analog outputs in Table 7-42

5.5 Evaluating ET 200X interrupts

With certain faults, interrupts are triggered by the DP slave. Interrupts are evaluated differently from each other, depending on the DP master being used.

Evaluating interrupts with S7 DP master

Prerequisite: You have configured the ET 200X with *STEP 7* as of version 3.1.

When an interrupt occurs, interrupt OBs are processed automatically in the CPU of the DP master if you have programmed them (refer to the *System Software for S7-300/S7-400, Program Design* programming manual).

Evaluating interrupts with a different DP master

If you are operating the ET 200X with a different DP master, the alarms are simulated within the extended diagnosis of the ET 200X (see Section 5.6.7 onwards). You must continue processing the results of the diagnosis in the application of the DP master.

Note

In order to be able to evaluate alarms by means of the extended diagnosis with a different DP-master, take note of the following:

- The DP master must be able to save the diagnostic messages; it might store the diagnostic messages in a ring buffer, for example. If the DP master cannot store diagnostic messages, only the latest diagnostic message to be received is stored, for instance.
- You have to poll regularly in your user program the corresponding bits in the extended diagnosis. Take into account the bus transit time with PROFIBUS-DP so that you can retrieve the bits at least in synchronism with the bus transit time, for example.
- With an IM 308-C as a DP master you cannot use process alarms and cycle end alarms within the extended diagnosis.

5.5.1   Module interrupts *(STEP 7)*

You can assign parameters to diagnostic and hardware interrupts for modules having analog inputs with *STEP 7*.

For

- modules with analog outputs

- EM 142 DO 4 × DC 24V/2A (6ES7 142-1BD40-0XB0)

- PM 148 DO 4 × DC 24V/2A

- BM 143-DESINA and EM 143-DESINA

- BM 141 DI 8 × DC 24V ECOFAST DIAG and EM 141 DI 8 × DC 24V DIAG

it is possible to configure diagnostic interrupts.

Triggering a diagnostic interrupt

With a coming or going event – for example, wire break fault – the module triggers a diagnostic interrupt if the "enable diagnostic interrupt" parameter has been assigned.

Table 5-14   Events that can trigger diagnostic interrupt

Event	EM 142 DO 4 × DC 24V/2A PM 148 DO 4 × DC 24V/2A	Module with analog inputs	Module with analog outputs	BM 143-DE-SINA EM 143-DE-SINA	BM 141 DI 8×DC 24V ECOFAST DIAG EM 141 DI 8×DC 24V DIAG
Configuration/ parameter assignment error*	Yes	Yes	Yes	Yes	Yes
Wire break	Yes	Yes	Yes	Yes	Yes
Short-circuit to M	Yes	Yes	Yes	No	Yes
Short circuit to L+	Yes	No	No	No	No
Lower limit violation	No	Yes	No	No	No
Upper limit violation	No	Yes	No	No	No
Rising edge	No	No	No	No	Yes
Falling edge	No	No	No	No	Yes

*   MAINS OFF/MAINS ON for the ET 200X is required following rectification of the configuration/parameter-assignment error.

The CPU interrupts the processing of the user program and processes the diagnostic interrupt block (OB 82). The event that led to the interrupt is entered in the start information of OB 82.

Triggering a hardware interrupt from modules with analog inputs

You define a work area by assigning parameters to an upper and lower limit value. If the process signal – for example, the ignition temperature – of a module leaves this work area, the module triggers a hardware interrupt the "enable hardware interrupt upon limit exceeded" parameter has been assigned. The CPU interrupts the processing of the user program and processes the hardware interrupt block OB 40.

The channels violating a limit value and the limit value concerned are entered in the start information of the OB 40 in tag OB40_POINT_ADDR. You will find an assignment of the bits to local data double word 8 in the figure below.
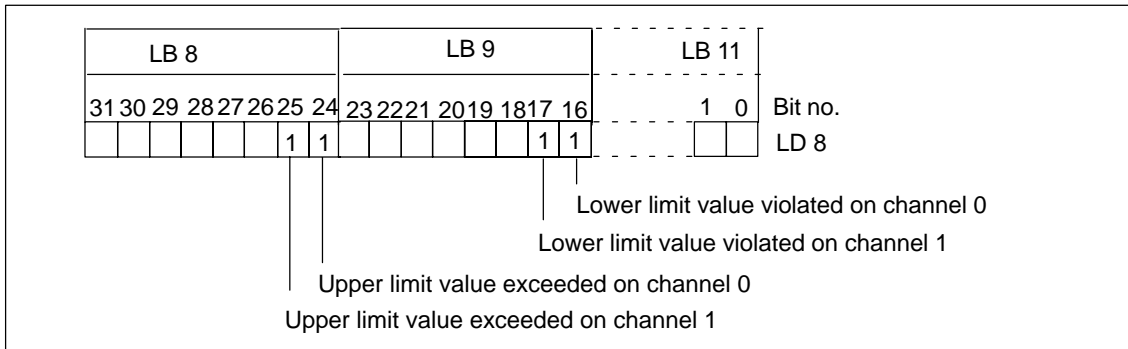
Figure 5-6   Start information of OB 40: modules with analog inputs

Triggering of a hardware interrupt in the case of the BM 141 DI 8 DC 24V ECOFAST DIAG and EM 141 DI 8 DC 24V DIAG

The channel that triggered the hardware interrupt is entered in the start information of the OB 40 in the variable OB40_POINT_ADDR. You will find an assignment of the bits to local data double word 8 in the figure below.
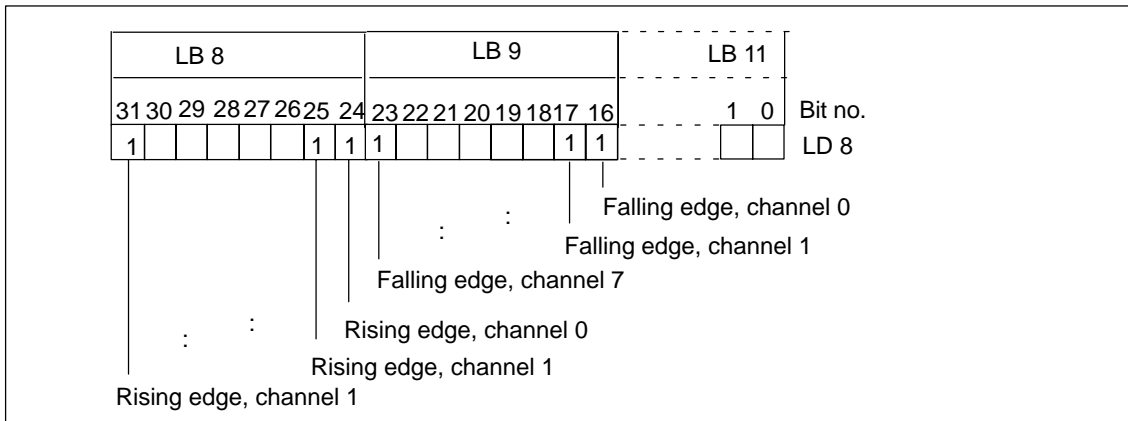
Figure 5-7   Start information of OB 40: BM 141 DI 8 DC 24V ECOFAST DIAG and
EM 141 DI 8 DC 24V DIAG

Note

You will find a description of OBs 40 and 82 in the *System and Standard Functions* reference manual.

5.5.2   Module interrupts *(COM PROFIBUS)*

You can assign parameters to diagnostic and hardware interrupts for modules having analog inputs with *COM PROFIBUS*.

For

- modules with analog outputs
- EM 142 DO 4 × DC 24V/2A (6ES7 142-1BD40-0XB0)
- PM 148 DO 4 × DC 24V/2A
- BM 143-DESINA and EM 143-DESINA
- BM 141 DI 8 × DC 24V ECOFAST DIAG
- EM 141 DI 8 × DC 24V DIAG

it is possible to configure diagnostic interrupts.

The alarms are simulated in the extended diagnosis of the ET 200X (see Section 5.6.9). You can continue processing the interrupt messages in the user program of the DP master.

5.6   ET 200X diagnostics with *STEP 7* and *STEP 5*

Slave diagnosis

The slave diagnosis behaves in accordance with the IEC 61784-1:2002 Ed1 CP 3/1 standard. Depending on the DP master, It can be read using *STEP 7* or *STEP 5* for all DP slaves that comply with the standard.

Displaying and structuring the slave diagnostics is described in the following sections.

BM 141, BM 141-ECOFAST, BM 142 and BM 143-DESINA provide the slave diagnosis that complies with the Standard. Note the differences in the diagnostic frame depending on which version and which release you have.

The basic modules provide an extended diagnosis, depending on the DP master and the parameterization.

Note

- The extended diagnosis can only be used in the slave mode that complies with the Standard (not in S7 slave operation).
- Diagnosis as per the Standard and module diagnosis will always be signaled, even if no alarm is enabled during parameterization of the basic module.

S7 diagnostics

S7 diagnosis can be requested for all modules in the
SIMATIC S7/M7 range of modules. The structure of the S7 diagnosis is identical
for base unit and distributed modules.

The diagnosis data of a module is in data records 0 and 1 of the system data part
of the module. Data record 0 contains 4 bytes of diagnostic data describing the
current state of a module. Data record 1 contains module diagnostics data in
addition.

Data records 0 and 1 are contained in the slave diagnosis (refer to Section for its
structure 5.6.2).

5.6.1 Reading out the diagnosis

Options for reading out the diagnosis

Table 5-15 Reading out the diagnosis of ET 200X with *STEP 7* and *STEP 5*

Programmable logic controller with DP master	Block or register in STEP 7	Application	See ...
SIMATICS7/M7	"DP slave diagnosis" register	Display slave diagnostics as plain text on the *STEP 7* user interface	The section on hardware diagnostics in the *STEP 7* online help system
	SFC 13 "DP NRM_DG"	Display slave diagnosis (store in data area of the user program)	Configuration, see Section 5.6.2; for the SFC see *System and Standard Functions* reference manual
	SFC 59 "RD_REC"	Read out data records of S7 diagnosis (store in data area of the user program)	
	FB 125/FC 125	Evaluate slave diagnostics	On the Internet at http://www.ad.siemens.de/ simatic-cs under the ID 387 257
	SFB 52	Read data record from a DP slave	See online help system in *STEP 7*
	SFB 54	Receive interrupts from the interrupt OBs	
SIMATIC S5 with the IM 308-C as DP master	FB192 "IM308C"	Display slave diagnosis (store in data area of the user program)	Configuration, see Section 5.6.2; for the FB see the *ET200 Distributed I/O Device* manual
SIMATIC S5 with S5-95U as DP master	FB 230 "S_DIAG"	**Note:** not for enhanced diagnosis	

Example of reading out the slave diagnosis with SFC 13 "DPNRM_DG"

Here you will find an example of how to use SFC 13 to display the slave diagnosis for a DP slave in the STEP *7* user program.

Assumptions

The following assumptions apply to this STEP *7* user program:

- The diagnosis address of the ET 200X is 1022 (3FE$_H$).

- The slave diagnosis should be stored in DB 82: as of address 0.0, length 64 bytes.

- The slave diagnosis consists of 64 bytes.

STEP 7 user program

STL	Description
CALL SFC 13	
REQ :=TRUE	Read request
LADDR :=W#16#3FE	Diagnosis address of the ET 200X
RET_VAL :=MW 0	RET_VAL of SFC 13
RECORD :=P#DB82.DBX 0.0 BYTE 64	Data mailbox for the diagnosis in DB 82
BUSY :=M2.0	Read operation runs over several OB1 cycles

Example of displaying the slave diagnosis with FB 192 "IM308C"

Here you will find an example of how you use FB 192 to read out the slave diagnosis for a DP slave in the *STEP 5* user program.

Assumptions

The following assumptions apply to this *STEP 5* user program:

- The IM 308-C is assigned pages 0 to 15 (number 0 of the IM 308-C) as the DP master.

- The DP slave has PROFIBUS address 3.

- The slave diagnosis is required to be stored in DB 20. However, you can also use any other data block for this.

- The slave diagnosis consists of 26 bytes.

STEP 5 user program

```
STL                                Description

     :A     DB 30
     :JU    FB 192
Name :IM308C
DPAD :      KH F800                 Default address area of the IM 308-C
IMST :      KY 0, 3                 IM No. = 0, PROFIBUS address of DP slave = 3
FCT  :      KC SD                   Function: Read slave diagnosis
GCGR :      KM 0                    Not evaluated
TYPE :      KY 0, 20                S5 data area: DB 20
STAD :      KF +1                   Diagnostic data from data word 1
LENG :      KF –1                   Diagnosis length = joker length (all permissible
                                    bytes)
ERR  :      DW 0                    Error code stored in DW 0 of DB 30
```

5.6.2 Structure of the slave diagnosis, ET 200X

Structure of slave diagnosis, ET 200X
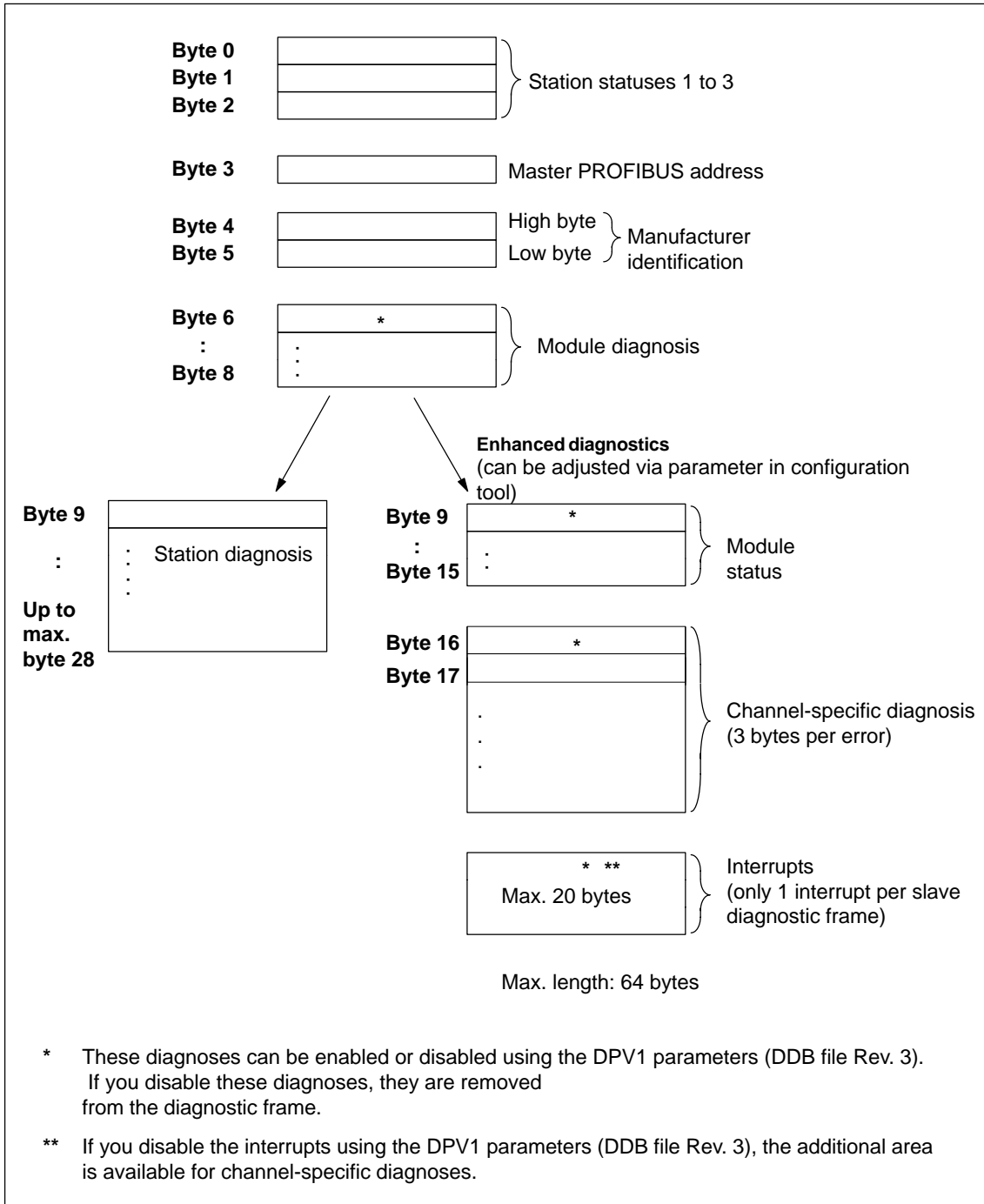
Figure 5-8   Structure of the slave diagnosis, ET 200X

Data records of the S7 diagnosis contained in the station diagnosis

Bytes 13 to 16 of the device-specific diagnosis correspond to data record 0 of the S7 diagnosis. Bytes 13 to 28 of the station diagnosis correspond to data record 1 of the S7 diagnosis. (Data record 1 contains data record 0 in the first 4 bytes.)

5.6.3 Station statuses 1 to 3

Definition

Station statuses 1 to 3 provide an overview of the status of a DP slave.

Station status 1

Table 5-16 Structure of station status 1 (Byte 0) ET 200X

Bit	Meaning	Cause/remedy
0	1: The DP slave cannot be addressed by the DP master. The bit in the DP slave is always 0.	• Correct PROFIBUS address set on the DP slave? • Bus connector/fiber-optic cable connected? • Voltage at DP slave? • RS 485 repeater set correctly? • Reset on the DP slave executed (switch on/off)
1	1: The DP slave is not yet ready to exchange data.	• Wait while the DP slave starts up.
2	1: The configuration data sent by the DP master to the DP slave does not agree with the configuration of the DP slave.	• Correct station type or correct configuration of the DP slave entered in the configuration software?
3	1: External diagnosis available.	• Evaluate the module diagnostics, the module status and/or the channel-specific diagnostics. Bit 3 is reset as soon as all the faults have been rectified. The bit is reset when there is a new diagnostic message in bytes of the above-mentioned diagnostics.
4	1: The requested function is not supported by the DP slave (e.g. SYNC/FREEZE).	• Check the configuration.
5	1: The bit is always "0".	Note: When reading the station status from the DP master, is the bit at "1"? The DP master cannot interpret the response of the DP slave.

Table 5-16   Structure of station status 1 (Byte 0) ET 200X

Bit	Meaning	Cause/remedy
6	1: The DP slave type does not agree with the software configuration.	• Compare the desired configuration with the actual configuration.
7	1: Parameters have been assigned to the DP slave by a different DP master (not that which currently has access to the DP slave).	• The bit is always "1" when you are accessing the DP slave with the programmer or another DP master, for example. The PROFIBUS address of the DP master which assigned parameters to the DP slave is located in the "master PROFIBUS address" diagnostic byte.

Station status 2

Table 5-17   Structure of station status 2 (Byte 1) ET 200X

Bit	Meaning
0	1: New parameters have to be assigned to the DP slave.
1	1: A diagnostic message has been issued. The DP slave will not work until the fault has been corrected (static diagnostic message).
2	1: The bit is always "1" in the DP slave.
3	1: Response monitoring has been enabled for this DP slave.
4	1: The DP slave has received the "FREEZE" control command.
5	1: The DP slave has received the "SYNC" control command.
6	0: The bit is always at 0.
7	1: The bit is always at 0. Note: When the station status is read by the DP master, the bit is at "1" if the DP slave in the DP master has been deactivated. The DP slave is deactivated – that is, it has been removed from current processing.

Station Status 3

Table 5-18   Structure of Station Status 3 (Byte 2) ET 200X

Bit	Meaning
0 to 6	0: The bits are always at "0".
7	1: There are more channel-specific diagnostic messages than can be represented in the diagnostic frame.

5.6.4 Master PROFIBUS address

Definition

The PROFIBUS address of the DP master is stored in diagnostics byte 3: this is the master

- which assigned parameters to the DP slave

- which has read and write access to the DP slave

FF_H in byte 3

If the value FF_H is defined as the master PROFIBUS address in byte 3, the DP slave has not been parameterized by the DP master.

5.6.5 Manufacturer identification

Definition

A code is stored in the manufacturer ID that describes the type of the DP slave.

Manufacturer identification

Table 5-19 Structure of the manufacturer ID (Byte 4, 5) ET 200X

Byte 4	Byte 5	Manufacturer ID for
80_H	$3D_H$	BM 141 DI 8 x DC 24V
80_H	$D2_H$	BM 141 DI 8 x DC 24V ECOFAST
80_H	$D3_H$	BM 141 DI 8 x DC 24V EDOFAST DIAG
80_H	$3C_H$	BM 142 DO 4 x DC 24V/2A
80_H	$9A_H$	BM 143-DESINA FO
80_H	$9A_H$	BM 143-DESINA RS485

5.6.6   ID-specific diagnosis

Definition

The ID-specific diagnosis states whether or not the modules of the ET 200X are defective. The module diagnosis begins as of byte 6 and comprises 3 bytes.

Module diagnosis

The module diagnosis for the ET 200X is structured as follows:
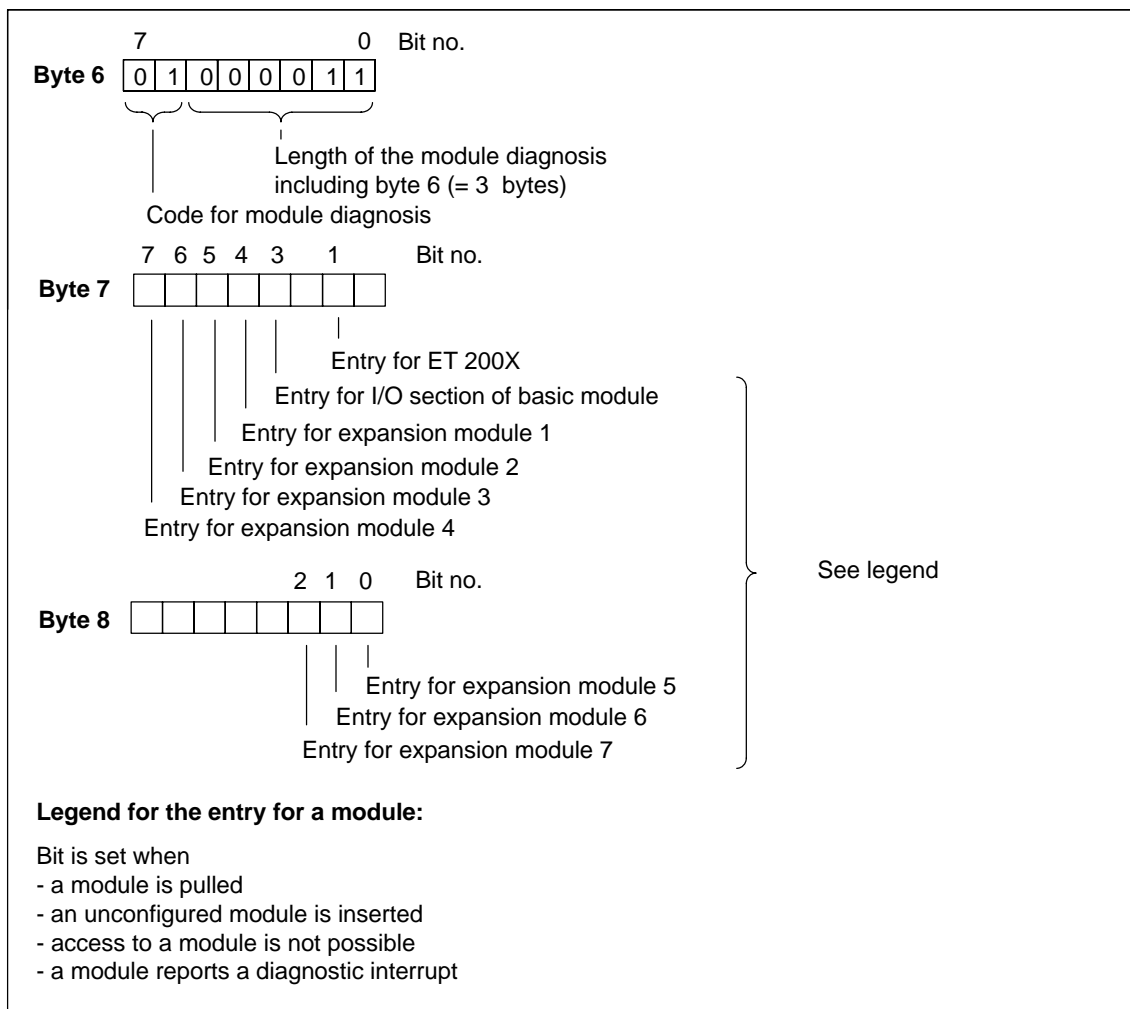
Figure 5-9   Structure of ID-specific diagnosis for ET 200X

5.6.7   Module status

Definition

The module status indicates the status of the configured modules and provides details of the ID-specific diagnosis in respect of the configuration. The module status begins after the module diagnosis and comprises 7 bytes.

The module is only contained in the diagnosis frame if you have activated "extended diagnosis" during parameterization.

Module status

The module status for ET 200X is configured as follows:
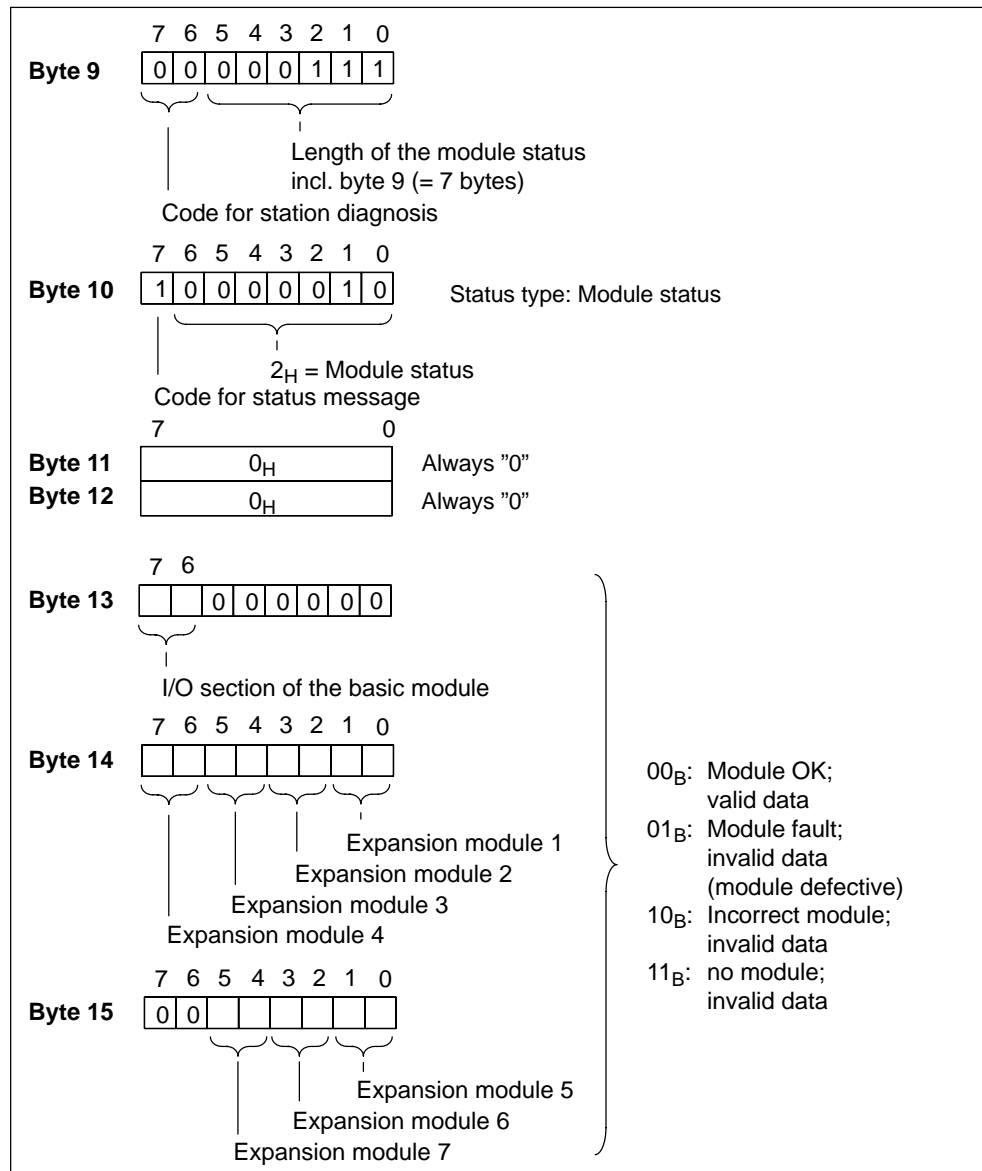
Figure 5-10   Configuration of the module status for ET 200X

5.6.8   Channel-specific diagnosis

Definition

The channel-specific diagnosis gives information on channel errors of modules and expands on the module diagnosis. Channel-specific diagnosis begins after the module status. Channel-specific diagnosis does not affect the module status.

Channel-specific diagnosis

Important: The diagnostic interrupt must be switched on for each module!

The channel-specific diagnosis is only contained in the diagnosis frame if have activated the "extended diagnosis" during parameterization.
The maximum number of channel-specific diagnoses is limited by the maximum overall length of the slave diagnosis of 64 Bytes. The length of the slave diagnosis is dependent on the number of the channel-specific diagnoses currently present. If more channel-specific diagnoses are present than can be shown in the slave diagnosis, bit 7 "diagnosis overrun" is set in the station status 3.

Tip: If you disable the interrupts for the ET 200M during parameter assignment, there are still up to 20 additional bytes available in the interrupt section for the channel-specific diagnosis (see also Figure 5-8).
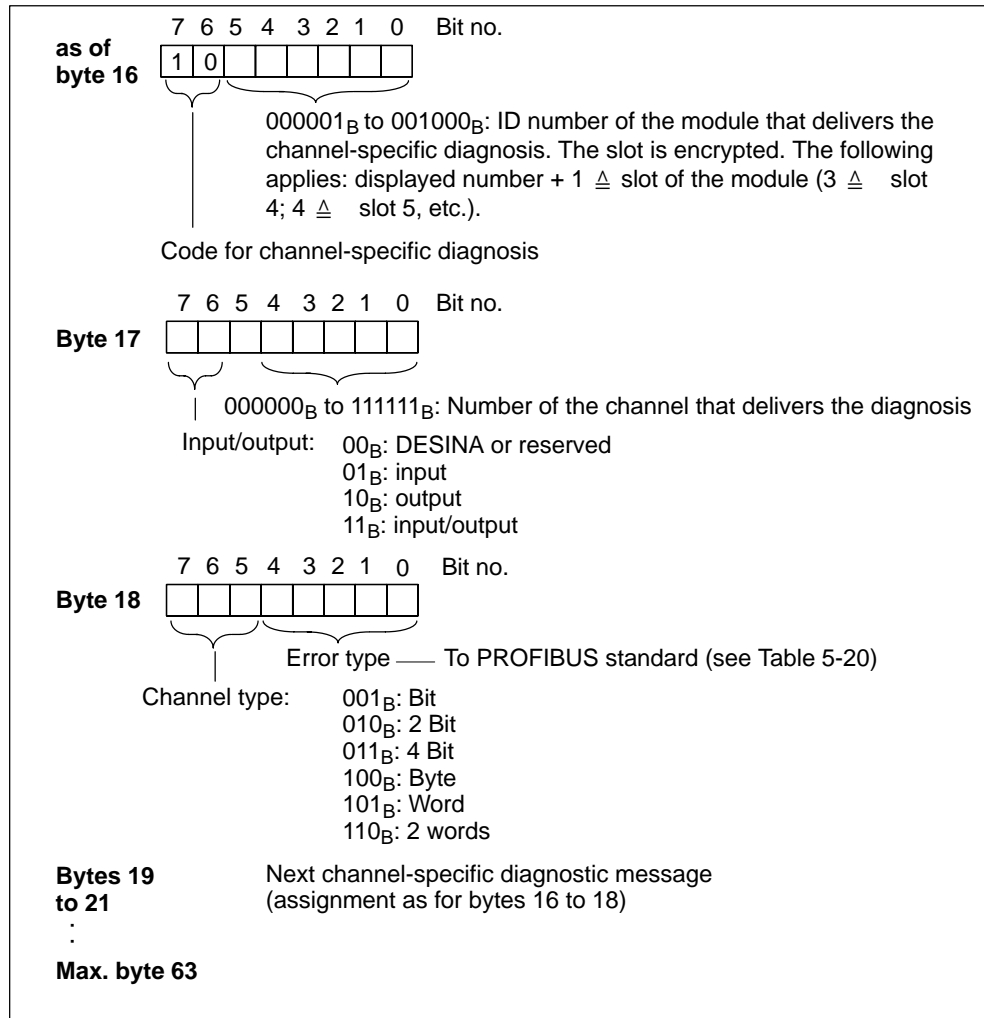
Figure 5-11   Configuration of channel-specific diagnosis, ET 200X

Channel-specific error messages

Table 5-20   Channel-specific error messages to PROFIBUS standard

Error type		Error text	Meaning	Action
00001_B	1_D	Short circuit	Short circuit because, for example: • Sensor wiring to P potential short-circuited • Sensor wiring to M potential short-circuited • Output wiring to P potential short-circuited • Output wiring to ground short-circuited	Correct the process wiring.
00010_B	2_D	Undervoltage	Main voltage failed or too low	Correct mains voltage
00011_B	3_D	Overvoltage	Mains voltage too high	Correct mains voltage
			Braking power too high	Increase **ramp-down time** parameter on EM 148-FC
00100_B	4_D	Overload	The output level is overloaded	Correct the module/actuator match.
00101_B	5_D	Temperature rise	The output level is overloaded and is too hot	Correct the module/actuator match.
00110_B	6_D	Open circuit	Wire break because, for example: • The signal line to a sensor is interrupted • The signal line from an actuator is interrupted • Power cable of the sensor interrupted	Correct the process wiring
00111_B	7_D	Upper limit violation	Value is above the overrange.	Correct the module/actuator match.
01000_B	8_D	Lower limit violation	Value is below the underrange.	Correct the module/actuator match.
01001_B	9_D	Error	Internal module fault	Exchange the frequency converter

Table 5-21   Channel-specific error messages – manufacturer-specific

Error type		Error text	Meaning	Action
10000_B	16_D	Parameterization error	Parameter assignment error, for example, because: • The module cannot use the parameter (unknown, impermissible combination...) • Module is not parameterized.	Correct the parameter assignment.
10001_B	17_D	Load voltage is missing	The following voltages may be missing: • Load voltage at BM 141/BM 142 • Switched load voltage in the case of BM 143 DESINA and BM 141-ECOFAST 8DI	Correct the process wiring
10110_B	22_D	Hardware interrupt lost	Hardware interrupt lost	Correction, coordination of program, process, module
11000_B	24_D	Actuator fault	Excess temperature on motor	Check mechanical loading of motor
			Thermistor not connected	Connect thermistor or deactivate **thermistor monitoring, motor** parameter on EM 148-FC
11010_B	26_D	External fault	External (process-related) error, for example: • Sensor error • Actuator error • Sensor data is not correct • Break in wire to EM	Replace the sensor/actuator; correct the process wiring.

5.6.9   Interrupts

Definition

The interrupts section of the slave diagnosis provides information on the type of interrupt and the cause that triggered the interrupt.
The interrupt section has a maximum of 20 bytes.
A maximum of one interrupt can be used per slave diagnosis.

Position in the diagnostic frame

The position of the interrupt section in the slave diagnosis depends on the structure of the diagnostic frame and on the number of channel-specific diagnoses (see also Figure 5-8):

- No enhanced diagnosis: always as of byte 9 after the module diagnosis

- Enhanced diagnosis: after the channel-specific diagnoses.

  For example: if there are 3 channel-specific diagnoses, the interrupt section begins as of byte 25.

More than one interrupt

Interrupt information in the slave diagnosis is overwritten by the interrupt information of the next interrupt to be triggered.

Contents

The contents of the interrupt information depend on the type of interrupt:

In the case of **diagnostic interrupts**, the diagnostic data record 1 for SIMATIC S7 (16 bytes) is sent as interrupt information (as of byte x+4). You can find out what these bytes mean for digital and analog modules in Figures 5-14 to 5-17.
In the case of **hardware interrupts**, the additional interrupt information is 4 bytes long. You can find out what these bytes mean in Figure 5-18.

Alarms

The alarm unit for ET 200X is configured as follows.

Figure 5-12   Structure of the ET 200X alarm unit

Diagnostic interrupt of modules with digital inputs

Byte x+4

7 6 5 4 3 2 1 0
| | |0|0| | | | |

Module malfunction, i. e. a problem has been detected
Internal fault in module
External error: Module no longer addressable
Channel fault in module
Parameters not assigned to module
Parameterization error

Byte x+5

7   0

$1F_H$: Module class, digital module

Bytes x+6 to x+7: Are not used

Byte x+8

7   0

70_H: Module with digital inputs

Byte x+9

7   0

08_H: Length of channel-specific diagnosis

Byte x+10

7   0

08_H: Number of channels per module

Byte x+11

7 6 5 4 3 2 1 0

Diagnostic event on channel 0 of module
Diagnostic event on channel 1 of module
:
:
Diagnostic event on channel 7 of module

Byte x+12
Channel 0

7 6 5 4 3 2 1 0
|0|0|0| | | |0| |

Diagnostic events for channel 0

Configuration or parameter assignment error
Short circuit to M (in the event of an error, bit 2 **or** Bit 3 is set)
Wire break

Byte x+13: Assignment for channel 1 as for byte x+12
Byte x+14: Assignment for channel 2 as for byte x+12
:
Byte x+19: Assignment for channel 7 as for byte x+12

Figure 5-13   Structure as of byte x+4 for diagnostic interrupt (digital input)

Diagnostic interrupt of modules with digital outputs

Byte x+4

```
7 6 5 4 3 2 1 0
```

Module malfunction, i. e. a problem has been detected
Internal fault in module
External error: Module no longer addressable
Channel fault in module
External auxiliary supply is missing, i. e.:
Load power supply is missing or is too low
Parameters not assigned to module
Parameterization error

Byte x+5

```
7          0
```

$1F_H$: Module class, digital module

Bytes x+6 to x+7: Are not used

Byte x+8

```
7          0
```

72_H: Module with digital outputs

Byte x+9

```
7          0
```

Length of channel-specific diagnosis

Byte x+10

```
7          0
```

Number of channels per module

Byte x+11

```
7 6 5 4 3 2 1 0
```

Diagnostic event on channel 0 of module
Diagnostic event on channel 1 of module
:
:
Diagnostic event on channel 7 of module

Byte x+12
Channel 0

```
7 6 5 4 3 2 1 0
```

Diagnostic events for channel 0

Configuration or parameter assignment error
Short circuit to L+
Short-circuit to M
Wire break
Temperature rise

Byte x+13: Assignment for channel 1 as for byte x+12
Byte x+14: Assignment for channel 2 as for byte x+12
    :
Byte x+19: Assignment for channel 7 as for byte x+12

Figure 5-14   Structure as of byte x+4 for diagnostic interrupt (digital outputs)

Diagnosis alarm from EM 143-DESINA modules

Figure 5-15   Structure from Byte x+4 for diagnosis alarm of EM 143-DESINA modules

In channel-specific diagnostics, a diagnostic interrupt from the EM 143-DESINA expansion module leads to error type 11010_B (see Table 5-20).

Diagnostic interrupt of modules with analog inputs

7 6 5 4 3 2 1 0

Byte x+4 ☐ ☐ 0 0 ☐ ☐ ☐ ☐

Module malfunction, i. e. a problem has been detected
Internal fault in module
External error: Module no longer addressable
Channel fault in module
Parameters not assigned to module
Parameterization error

7   0

Byte x+5 ☐☐☐☐☐☐☐☐ 15_H: Module class, analog module

7   2   0

Byte x+6 ☐☐☐☐☐☐☐☐

Coding key incorrect or missing
Module in STOP mode

7   4   0

Byte x+7 ☐☐☐☐☐☐☐☐

Error during analog/digital conversion in module

Byte x+8 ☐☐☐☐☐☐☐☐ 71_H: Module with analog inputs

Byte x+9 ☐☐☐☐☐☐☐☐ Length of channel-specific diagnosis

Byte x+10 ☐☐☐☐☐☐☐☐ Number of channels per module

7 6 5 4 3 2 1 0

Byte x+11 ☐☐☐☐☐☐☐☐

Diagnostic event on channel 0 of module
Diagnostic event on channel 1 of module
:
Diagnostic event on channel 7 of module

7 6 5 4 3 2 1 0

Byte x+12 ☐ ☐ 0 ☐ ☐ 0 0 ☐ Diagnostic events for channel 0

Configuration or parameter assignment error
Short-circuit to M
Wire break
Lower limit violation
Upper limit violation

Byte x+13: Assignment for channel 1 as for byte x+12

:

Byte x+19: Assignment for channel 7 as for byte x+12

Figure 5-16   Structure as of byte x+4 for diagnostic interrupt (analog inputs)

Diagnostic interrupt of modules with analog outputs

7 6 5 4 3 2 1 0

Byte x+4

| Module malfunction, i. e. a problem has been detected
| Internal fault in module
| External error: Module no longer addressable
| Channel fault in module
| Parameters not assigned to module
| Parameterization error

7   0

Byte x+5   15$_H$: Module class, analog module

7   2   0

Byte x+6

| Module in STOP mode

Byte x+7: Is not used

Byte x+8   73$_H$: Module with analog outputs

Byte x+9   Length of channel-specific diagnosis

Byte x+10   Number of channels per module

7 6 5 4 3 2 1 0

Byte x+11

| Diagnostic event on channel 0 of module
| Diagnostic event on channel 1 of module
| :
| Diagnostic event on channel 3 of module

7 6 5 4 3 2 1 0

Byte x+12   0 0 0   0 0   Diagnostic events for channel 0

| Configuration or parameter assignment error
| Short-circuit to M
| Wire break

Byte x+13: Assignment for channel 1 as for byte 12

Byte x+14: Assignment for channel 2 as for byte 12

Byte x+13: Assignment for channel 3 as for byte 12

Bytes x+14 to x+19: Are always 00$_H$

Figure 5-17   Configuration as of byte x+4 for diagnostic interrupt (analog outputs)

Hardware interrupt of analog input modules

Figure 5-18   Structure as of byte x+4 for hardware interrupt (analog inputs)

Hardware interrupt of digital input modules

Figure 5-19   Structure as of byte x+4 for hardware interrupt (digital inputs)

Byte x+4 to x+7 (x+10) for diagnosis of ET 200X

If byte x+2 contains the slot number 02, this indicates that a basic module is generating diagnostic messages. These diagnostic messages are contained in bytes x+4 to x+7 (x+10).

Table 5-22 gives you the meaning of bytes x+4 to x+7 (x+10) when the following basic modules are used:

Basic module	MLFB
BM 141 DI 8 × DC 24V	6ES7 141-1BF11-0XB0 6ES7 141-1BF12-0XB0
BM 141 DI 8 × DC 2 ECOFAST	6ES7 141-1BF00-0AB0 6ES7 141-1BF01-0AB0
BM 141 DI 8 × DC 24V ECOFAST DIAG	6ES7 141-1BF40-0AB0
BM 142 DO 4 × DC 24V/2A	6ES7 142-1BD21-0XB0 6ES7 142-1BD22-0XB0
BM 143-DESINA FO	6ES7 143-1BF00-0XB0
BM 143-DESINA RS485	6ES7 143-1BF00-0AB0

Table 5-22   Bytes x+4 to x+10 in the diagnosis of ET 200X

Byte	Bit	Meaning	Remarks	
x+4	0	Error	1: 0:	Error No error
	1	Internal error	Cause of fault is in BM	
	2	External error	Cause of fault is in configuration of ET 200X	
	3	Module fault	BM cannot access one or more plugged-in modules	
	4	Load voltage	1: 0:	Error No error
	5	not assigned	–	
	6	Parameters not assigned to module	–	
	7	Parameter assignment	1: 0:	Error No error
x+5	0 to 7	$1B_H$	Fixed	
x+6	0 to 7	not assigned	–	
x+7	0 to 7	not assigned	–	
x+8	0 to 7	Module ID	55_H for basic module	
x+9	0 to 7	08_H	Length of channel-specific diagnosis	
x+10	0 to 7	08_H	Fixed	
x+11 to x+19	0 to 7	not assigned	–	

Table 5-23 gives you the meaning of bytes x+4 to x+7 (x+10) when the following basic modules are used:

Basic module	MLFB
BM 141	6ES7 141-1BF01-0XB0
BM 142	6ES7 142-1BD11-0XB0

Table 5-23 Bytes x+4 to x+7 in the diagnosis of ET 200X

Byte	Bit	Meaning	Remarks	
x+4	0	Module malfunction (power supply for sensor/logic too low or Bits 2 and 4 are set)	1: 0:	Error No error
	1	not assigned	–	
	2	External error	Cause of fault is configuration if ET 200X (EM can no longer be addressed)	
	3	not assigned	–	
	4	No external auxiliary voltage (no load voltage supply or it is too low)	1: 0:	Error No error
	5	not assigned	–	
	6	not assigned	–	
	7	Parameter assignment	1: 0:	Error No error
x+5	0 to 3	1011	Fixed (Module class: Basic module)	
	4 to 7	not assigned	–	
x+6	0 to 7	not assigned	–	
x+7	0 to 7	not assigned	–	

5.6.10   Analyzing interrupts from station diagnosis

The structure of the station diagnosis is the same as the structure of the interrupt section, as described in Section 5.6.9.

Interrupts with S7 DP master

The ET 200X supports the following alarms:

- Diagnostic interrupt
- Hardware interrupt

You can evaluate these interrupts with an S7 DP master. In the case of an interrupt, interrupt OBs run automatically in the CPU (see the *System Software for S7-300/S7-400, Program Design* programming manual).

Interrupts with another DP master

If you operate the ET 200X with another DP master, these alarms will be simulated as device-specific diagnosis of the ET 200X. You must postprocess the relevant diagnostic events in the DP master's user program.

Saving the diagnosis

Depending on byte x+1, transfer the contents of the station diagnosis to a data block because:

- The interrupts are updated cyclically.

- The contents of the diagnosis as of byte x+3 depend on whether the S7 diagnosis or S7 hardware interrupt is reported.

Note

The following points are important in evaluating diagnostic interrupts and hardware interrupts with a different DP master by means of the station diagnosis:

- The DP master should be able to store the diagnostic messages, that is, the DP master should have a ring buffer in which to place these messages. If the DP master cannot store diagnostic messages, only the latest diagnostic message to be received is stored, for instance.

- You have to poll regularly in your user program the corresponding bits in the station diagnosis. You must also take PROFIBUS-DP's bus cycle time into consideration so that you can scan the bits at least once in sync with the bus cycle time, for example.

- You cannot use hardware interrupts in the station diagnosis in an IM 308-C as DP master, because only coming – and not going – interrupts are reported. For example, the "upper limit violation" bit is only reset when the "lower limit violation" bit is set.

General Technical Specifications

6

What are general technical specifications?

The general technical specifications contain the standards and test values with which the ET 200X conforms and which it fulfills, and the test criteria by which the ET 200X distributed I/O device was tested.

In this Chapter

Section	Subject	Page
6.1	Standards, certificates and approvals	6-2
6.2	Electromagnetic compatibility	6-4
6.3	Mechanical and climatic environmental conditions	6-6
6.4	Details of insulation testing, safety class, degree of protection and rated voltage of the ET 200X	6-9

6.1 Standards, certificates and approvals

This chapter contains the following information about the components of the ET 200X:

- The most important standards for which the ET 200X satisfies the criteria
- The certificates and approvals available for the ET 200X

PROFIBUS standard

The ET 200X distributed I/O device is based on IEC 61784-1:2002 Ed1 CP 3/1.

Identification code for Australia

The ET 200X distributed I/O device complies with AS/NZS 2064 (Class A).

IEC 61131

The ET 200X distributed I/O device meets the requirements and criteria of IEC 61131-2, (programmable controllers, part 2 on equipment requirements and tests).

CE certification

The ET 200X distributed I/O device meets the requirements and protection objectives of the following EC directives and complies with the harmonized European standards (ENs) that have been published in the Official Gazettes of the European Community for programmable logic controllers:

- 73/23/EEC "Electrical equipment for use within fixed voltage ranges" (low-voltage directive)
- 89/336/EEC "Electromagnetic compatibility" (EMC directive)

The EC declarations of conformity are being kept available for the cognizant authorities at:

Siemens Aktiengesellschaft
Bereich Automatisierungs- und Antriebstechnik
A&D AS RD42
Postfach 1963
D-92209 Amberg

UL Recognition

UL Recognition Mark
Underwriters Laboratories (UL) as per
Standard UL 508, File No. 116536

CSA Certification

CSA Certification Mark
Canadian Standard Association (CSA) to
 Standard C22.2 No. 142, File No. LR 48323

The SITOP power power supply has cUL certification.

DESINA

The ET 200X-DESINA fulfills the requirements of the DESINA specification.

6.2 Electromagnetic compatibility

Definition

Electromagnetic compatibility is the ability of an electric device to function satisfactorily in its electromagnetic environment without interfering with this environment.

The ET 200X distributed I/O device complies with the requirements of the EMC legislation of the European internal market. A requirement for this is that the ET 200 distributed I/O system meets the specifications and directives concerning electrical installation.

Bus parameter settings for the *PROFIBUS-DP*

Note

To maintain the EMC values, you must increase the "Retry Limit" bus parameter to at leas "3" in your configuration software (e.g. *COM PROFIBUS* or *STEP 7*) **for transmission rates of 500 kbps and 1.5 Mbps**. Leave all the other bus parameters as they are, in accordance with your selected bus profile.

Pulse-shaped interference

The following table shows the electromagnetic compatibility of the ET 200X distributed I/O device with regard to pulse-shaped interference.

Pulse-shaped interference	Tested with	Corresponds to severity
Electrostatic discharge to IEC 61000-4-2.	8 kV 4kV	3 (air discharge) 2 (contact discharge)
Burst pulses (fast transient interference) in accordance with IEC 61000-4-4.	2 kV (supply line) 1 kV (signal line)	3 2
Surge in accordance with IEC 61000-4-5 Only with lightning protection elements (refer to DP master manual) • Asymmetrical connection • Symmetrical connection	 2 kV (supply line) 2 kV (signal line/ data line) 1 kV (supply line) 1 kV (signal line/ data line)	 3

Sine-shaped interference

The following table shows the electromagnetic compatibility of the ET 200X distributed I/O device with regard to sine-shaped interference.

RF radiation in accordance with IEC 61000-4-3 Electromagnetic RF field		RF coupling in accordance with IEC 61000-4-6
Amplitude-modulated	**Pulse-modulated**	
80 to 1000 MHz	900 MHz $\pm$ 5 MHz	0.15 to 80 MHz
10 V/m		10 V_{rms} unmodulated
80 % AM (1 kHz)	50 % ED	80 % AM (1 kHz)
	200 Hz repetition frequency	150 Ω source impedance

Emission of radio interference

Emitted interference of electromagnetic fields in accordance with EN 55011: limit value class A, group 1 (measured at a distance of 30 m).

Frequency	Emitted interference
From 30 to 230 MHz	< 30 dB (μV/m)Q
From 230 to 1000 MHz	< 37 dB (μV/m)Q

6.3 Mechanical and climatic environmental conditions

Shipping and storage conditions

The ET 200X distributed I/O device exceeds the requirements of EC 61131-2 with regard to transport and storage conditions. The following figures are valid for modules that have been transported or stored in their original packaging.

Type of condition	Permissible range
Free fall	BM/EM/frequency converter: ≤ 1 m Motor starter: ≤ 0.35 m
Temperature	BM/EM, except the pneumatic module: from –40 °C to +70 °C
	Pneumatic module: from –30 °C to +70 °C
Temperature variation	20 K/h
Air pressure	From 1080 to 660 hPa (corresponds to an altitude of -1000 to 3500 m)
Relative humidity	From 5 to 95 %, without condensation

Climatic environmental conditions

The following climatic environmental conditions apply:

Environmental conditions	Operating ranges	Remarks
Temperature	From 0 to 55 °C	For horizontal installation; not for pneumatic components
	From 0 to 50 °C	For horizontal installation of pneumatic components
	From 0 to 40 °C	For all other installation positions
Temperature variation	10 K/h	
Relative humidity	From 5 to 100 %	
Air pressure	From 1080 to 795 hPa	Corresponds to an altitude of -1000 to 2000 m
Contaminant concentration	SO_2: < 0.5 ppm; rel. humidity < 60 %, no moisture condensation H_2S: < 0.1 ppm; rel. humidity < 60 %, no moisture condensation	Test: 10 ppm; 4 days 1 ppm; 4 days

Mechanical environmental conditions

The mechanical environmental conditions are shown in the following table in the form of sinusoidal oscillations. For this, each module of the ET 200X is secured to the substrate.

Basic and expansion modules	Frequency range	Permanent	Tested with ...
All except motor starters/frequency converters and pneumatic components	$5 \leq f \leq 8$ Hz	0.35 mm amplitude	0.75 mm amplitude
	$8 \leq f \leq 150$ Hz	5 g constant acceleration	10 g constant acceleration
Motor starters/frequency converters and pneumatic components	$5 \leq f \leq 8$ Hz	0.15 mm amplitude	0.15 mm amplitude
	$8 \leq f \leq 150$ Hz	2 g constant acceleration	2 g constant acceleration

Testing mechanical environmental conditions

The following tables provide information about the type and scope of tests for mechanical ambient conditions. For this, each module of the ET 200X is secured to the substrate.

Test for ...	Test standard	Basic and expansion modules without motor starter/ frequency converter and pneumatic components
Oscillations	Oscillation test to IEC 60068-2-8	Type of oscillation: frequency sweeps with a rate of change of 1 octave per minute. 5 Hz $\leq$ f $\leq$ 8 Hz, constant amplitude of 0.75 mm 8 Hz $\leq$ f $\leq$ 150 Hz, constant acceleration of 10 g Duration of oscillation: 10 frequency sweeps per axis in each of the three perpendicular axes
Shock	Shock test to IEC 60068-2-27	Type of shock: half-sine Shock strength: 30 g peak value, 18 ms duration Direction of the shock: 3 shocks per +/– direction in each of the three perpendicular axes
Repetitive shock	Shock test to IEC 60068-29	Type of shock: half-sine Shock strength: 25 g peak value, 6 ms duration Direction of the shock: 1000 shocks per +/– direction in each of the three perpendicular axes
Test for ...	Test standard	Motor starters/frequency converters and pneumatic components
Oscillations	Oscillation test to IEC 60068-2-8	Type of oscillation: frequency sweeps with a rate of change of 1 octave per minute. 5 Hz $\leq$ f $\leq$ 8 Hz, constant amplitude of 0.15 mm 8 Hz $\leq$ f $\leq$ 150 Hz, constant acceleration of 2 g Duration of oscillation: 10 frequency sweeps per axis in each of the three perpendicular axes
Shock	Shock test to IEC 60068-2-27	Type of shock: half-sine Shock strength: 15 g peak value, 11 ms duration Direction of the shock: 3 shocks per +/– direction in each of the three perpendicular axes

6.4 Details of insulation testing, safety class, degree of protection and rated voltage of the ET 200X

Test voltage

Insulation strength is demonstrated in the routine test with the following test voltage in accordance with IEC 61131-2:

Circuits with rated voltage U_e to other circuits and ground	Test voltage
$0\ V < U_e \leq 50\ V$	500 VDC
$300\ V < U_e \leq 600\ V$	2.6 kVDC to ground 4 kVDC to backplane bus

Pollution severity

Pollution severity 3 in accordance with IEC 61131

Safety class

Safety class I in accordance with IEC 60536

IP 65 degree of protection

Degree of protection IP 65 in accordance with IEC 60529 for all basic and expansion modules, EM 148-FC frequency converters, motor starters and pneumatic components of the ET 200X. This means:

- Protection against the ingress of dust and complete protection against electric shock
- Protection against water jets from nozzles which are aimed at the casing from all directions. (There must be no harmful effects from the water.)

IP 66 and IP 67 degrees of protection

Degree of protection IP 66 and IP 67 in accordance with IEC 60529 for all basic and expansion modules (except motor starters, EM 148-FC frequency converters and pneumatic components):

- Protection against the ingress of dust and complete protection against electric shock
- IP 66: Protection against heavy seas or strong water jets. (There must be no ingress of harmful quantities of water into the casing.)
- IP 67: Protection against water when the casing is immersed in it under defined pressure and time conditions. (There must be no ingress of harmful quantities of water into the casing.)

Note

The above-mentioned degrees of protection are only warranted when the ET 200X is completely closed. Therefore:

- Always plug all connectors for PROFIBUS-DP and the supply voltage for the electronics/sensors and the load into the basic module (BM 141, BM 142, BM 147/CPU), irrespective of whether or not they are all wired. An alternative is to close unused connectors with covers.
- Plug all the DESINA connectors into the BM 141-ECOFAST or BM 143-DESINA basic modules. Fit a cover if a DESINA socket remains unused.
- Seal off any terminal connections which are not required with screw caps.

NEMA classification of the ET 200X (for the US market)

All the basic and expansion modules of the ET 200X (except motor starters, EM 148-FC frequency converters, CPV 10 and CPV 40 valve terminals, and pneumatic modules) meet the requirements of NEMA: Enclosure rating Type: 4X – indoor use only.

Rated voltage for operation

The ET 200X distributed I/O device operates with the rated voltage and corresponding tolerances shown in the following table.

Rated voltage	Tolerance range
24 VDC	20.4 to 28.8 VDC

Technical Specifications

7

The ET 200X consists of different components that are connected together to form the ET 200X distributed I/O device. In this chapter, we have summarized the technical specifications relating to the different types of component.

Contents of Chapter

7.1 BM 141 DI 8 × DC 24V basic module (6ES7 141-1BF12-0XB0)

Features

The basic module BM 141 DI 8 × DC 24V with the order number 6ES7 141-1BF12-0XB0 has the following features:

- 8 digital inputs
- Rated input voltage of 24 VDC
- Suitable for switches and proximity switches (BEROs)

Pinout of the sockets for DI

The following table shows the pinout of the four sockets used to connect the digital inputs. The connector wiring is described in Section 4.4.4. You can find the layout of the sockets 1 to 4 on the module in Appendix C.

Table 7-1   Pinout of the sockets for 8-channel digital inputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket (Front view)
1	Sensor supply output 1L+				
2	Input signal, channel 4	Input signal, channel 5	Input signal, channel 6	Input signal, channel 7	
3	Chassis ground, power supply				
4	Input signal, channel 0	Input signal, channel 1	Input signal, channel 2	Input signal, channel 3	
5	PE				

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

The basic circuit diagram of the basic module is shown below.

Figure 7-1   Basic circuit diagram of the BM 141 DI 8 x DC 24V basic module

Parameters

The following tables provide an overview of the parameters on the basic module that can be set.

Table 7-2   Parameters of the BM 141 DI 8 × DC 24V

Parameters			Range	Default	Area affected
S7 slave with HWCONFIG	**Standard slave with DDB file SIEM803D.GSG[1]**	**Standard slave with DDB file SI03803D.GSG[1]**			
——	——	DP interrupt mode	DPV0/DPV1	DPV1	ET 200X
Diagnostic interrupt			Yes/no	Yes	ET 200X
Hardware interrupt			Yes/no	Yes	ET 200X
——	Enhanced diagnostics[2]	——	Yes/no	Yes	ET 200X
——	——	Startup when expected/actual config. differ	Yes/no	No	ET 200X
Diagnosis: no load voltage (S)			Yes/no	Yes	ET 200X
——	——	Module diagnosis	Yes/no	Yes	ET 200X
——	——	Module status	Yes/no	Yes	ET 200X
——	——	Channel-specific diagnosis	Yes/no	Yes	ET 200X

[1]   As of basic module 6ES7 141-1BF12-0XB0, version 1

[2]   The length of the diagnostic frame is $\geq$ 32 bytes

Dimensions and weight	
Dimensions W × H × D (mm)	134 × 110 × 55
Weight	Approx. 500 g
Module-specific data	
Baud rate	9.6/19.2/93.75/187.5 /500 kbps 1.5/3/6/12 Mbps
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of inputs	8
Cable length	
• Unshielded	Max. 30 m
Manufacturer identification	803D$_H$
Voltages, currents, potentials	
Rated supply voltage for electronic components and sensors 1L+	24 VDC
• Max. perm. current for electronic components and sensors	Up to 40 °C 1 A; Up to 55 °C 0.8 A
• Reverse polarity protection	Yes
• Short circuit protection	Yes, electronic
Rated load voltage 2L +	24 VDC
• Reverse polarity protection	No
Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
Maximum number of inputs driven simultaneously	
• All installation positions To 55 °C	8

Electrical isolation	
• Between channels	No
• Between load voltage and all other circuit components	Yes
• Between PROFIBUS-DP and all other circuit components	Yes
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From supply voltage 1L+	Max. 180 mA
Power loss of module	Typ. 3.5 W
Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	Diagnostic interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)
• PROFIBUS-DP bus monitoring	Red LED (BF)
• Monitoring of the electronics power supply	Green LED (ON)
• Load voltage monitor	Green LED (24VDC)
• Reading diagnostic information	Possible
Sensor supply outputs	
Outputs	4
Output current*	Up to 40 °C max. 0.9A; Up to 55 °C max. 0.7A
Short circuit protection	Yes, electronic

Sensor selection data	
Input voltage	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	–3 to 5 V
Input current	
• With signal "1"	Typ. 7 mA
Input delay	
• From "0" to "1"	1.2 to 4.8 ms
• From "1" to "0"	1.2 to 4.8 ms

Input characteristic	To IEC 61131, Type 1
Connection of two-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

*   Please note the total current per ET 200X.

7.2 BM 141 DI 8 × DC 24V ECOFAST basic module (6ES7 141-1BF01-0AB0)

Features
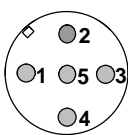
The BM 141 DI 8 × DC 24V ECOFAST basic module with the order number 6ES7 141-1BF01-0AB0 has the following features:

- PROFIBUS-DP connection via copper conductors (RS 485)

- 8 digital inputs

- Rated input voltage of 24 VDC

- Suitable for switches and proximity switches (BEROs)

Pinout of the sockets for DI

The following table shows the pinout of the eight sockets used to connect the digital inputs. The connector wiring is described in Section 4.4.4. You can find the layout of the sockets in Appendix C.

Table 7-3   Pinout of sockets X1 to X8 for digital inputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket
1	Sensor supply output 1L+				
2	not assigned				
3	Chassis ground, power supply				
4	Input signal, channel 0	Input signal, channel 1	Input signal, channel 2	Input signal, channel 3	
5	PE				
Pin	**Assignment of socket X5**	**Assignment of socket X6**	**Assignment of socket X7**	**Assignment of socket X8**	
1	Sensor supply output 1L+				
2	not assigned				
3	Chassis ground, power supply				
4	Input signal, channel 4	Input signal, channel 5	Input signal, channel 6	Input signal, channel 7	
5	PE				

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

The basic circuit diagram of the basic module is show below.

Figure 7-2   Basic circuit diagram for the BM 141 DI 8 × DC 24V ECOFAST basic module
             (6ES7 141-1BF01-0AB0)

Parameters

The following tables provide an overview of the parameters on the basic module that can be set.

Table 7-4   Parameters of the BM 141 DI 8 × DC 24V ECOFAST

Parameters			Range	Default	Area affected
S7 slave with HWCONFIG	**Standard slave with DDB file SIEM80D2.GSG[1]**	**Standard slave with DDB file SI0380D2.GSG[1]**			
——	——	DP interrupt mode	DPV0/DPV1	DPV1	ET 200X
Diagnostic interrupt			Yes/no	Yes	ET 200X
Hardware interrupt			Yes/no	Yes	ET 200X
——	Enhanced diagnostics[2]	——	Yes/no	Yes	ET 200X
——	——	Startup when expected/actual config. differ	Yes/no	No	ET 200X
Diagnosis: no load voltage (S)			Yes/no	Yes	ET 200X
——	——	Module diagnosis	Yes/no	Yes	ET 200X
——	——	Module status	Yes/no	Yes	ET 200X
——	——	Channel-specific diagnosis	Yes/no	Yes	ET 200X

[1]   As of basic module 6ES7 141-1BF01-0AB0, version 1

[2]   The length of the diagnostic frame is ≥ 32 bytes

Dimensions and weight	
Dimensions W × H × D (mm)	175 × 180 × 110
Weight	Approx. 650 g
Module-specific data	
Baud rate	9.6/19.2/45.45/93.75/187.5/500 kbps 1.5/3/6/12 Mbps
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of channels	8 digital inputs
Cable length	
• Unshielded	Max. 30 m
Manufacturer identification	80D2$_H$
Voltages, currents, potentials	
Non-switched rated load voltage (NS)	24 VDC
• Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
• Reverse polarity protection	No
• Short circuit protection	No
Switched rated load voltage (NS)	24 VDC
• Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
• Reverse polarity protection	No
Maximum number of inputs driven simultaneously	
• all installed positions to max. 55 °C	8
Electrical isolation	
• Between channels and backplane bus	No

•	Between channels	No
•	Between load voltages	No
•	Between load voltage and all other circuitry	No
•	Between PROFIBUS-DP and all other circuitry	Yes
Permissible potential difference		
•	Between different circuits	75 VDC, 60 VAC
Insulation tested with		500 VDC
Power input		
•	From backplane bus (1L+)	Max. 180 mA
Power loss of module		Typ. 3.5 W
Status, alarms, diagnostics		
Status display		Green LED per channel
Alarms		Diagnostic interrupt
Diagnostic functions		Configurable
•	Group error	Red LED (SF)
•	Status indicator	Green LED (RUN)
•	Indicator for non-switched load voltage	Green LED (DC 24V-NS)
•	Indicator for switched load voltage	Green LED (DC 24V-S)
•	Reading diagnostic information	Possible
Sensor supply outputs		
Outputs		8
Output current*		Up to 40 °C max. 1A; to 55 °C max. 0.8A
Short circuit protection		Yes, electronic

Sensor selection data	
Input voltage	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	– 3 to 5 V
Input current	
• With signal "1"	Typ. 7 mA
Input delay	
• From "0" to "1"	1.2 to 4.8 ms
• From "1" to "0"	1.2 to 4.8 ms

Input characteristic	To IEC 61131, Type 1
Connection of two-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

* Please note the total current per ET 200X.

7.3 BM 141 DI 8 × DC 24V ECOFAST DIAG basic module (6ES7 141-1BF40-0AB0)

Features

The BM 141 DI 8 × DC 24V ECOFAST DIAG with the order number 6ES7 141-1BF40-0AB0 has the following features:

- PROFIBUS-DP connection via copper conductors (RS 485)

- 8 digital inputs

- Rated input voltage of 24 VDC

- Suitable for switches and proximity switches (BEROs)

- Diagnostic interrupt for short circuit and wire break for each channel (I/O component of the basic module)

- Hardware interrupt at rising and falling edges for each channel (I/O component of the basic module)

- Direct communication

- Parameterizable input delays

Pinout of the sockets for DI

The following table shows the pinout of the eight sockets used to connect the digital inputs. You can find the wiring of the connector in the ET 200X manual, Section 4.4.4. You can find the layout of the sockets in the ET 200X manual, Appendix C.

Table 7-5   Pinout of sockets X1 to X8 for digital inputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket
1	Sensor supply output 1L+				
2	not assigned				
3	Chassis ground, power supply				
4	Input signal, channel 0	Input signal, channel 1	Input signal, channel 2	Input signal, channel 3	
5	PE				
Pin	**Assignment of socket X5**	**Assignment of socket X6**	**Assignment of socket X7**	**Assignment of socket X8**	
1	Sensor supply output 1L+				
2	not assigned				
3	Chassis ground, power supply				
4	Input signal, channel 4	Input signal, channel 5	Input signal, channel 6	Input signal, channel 7	
5	PE				

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

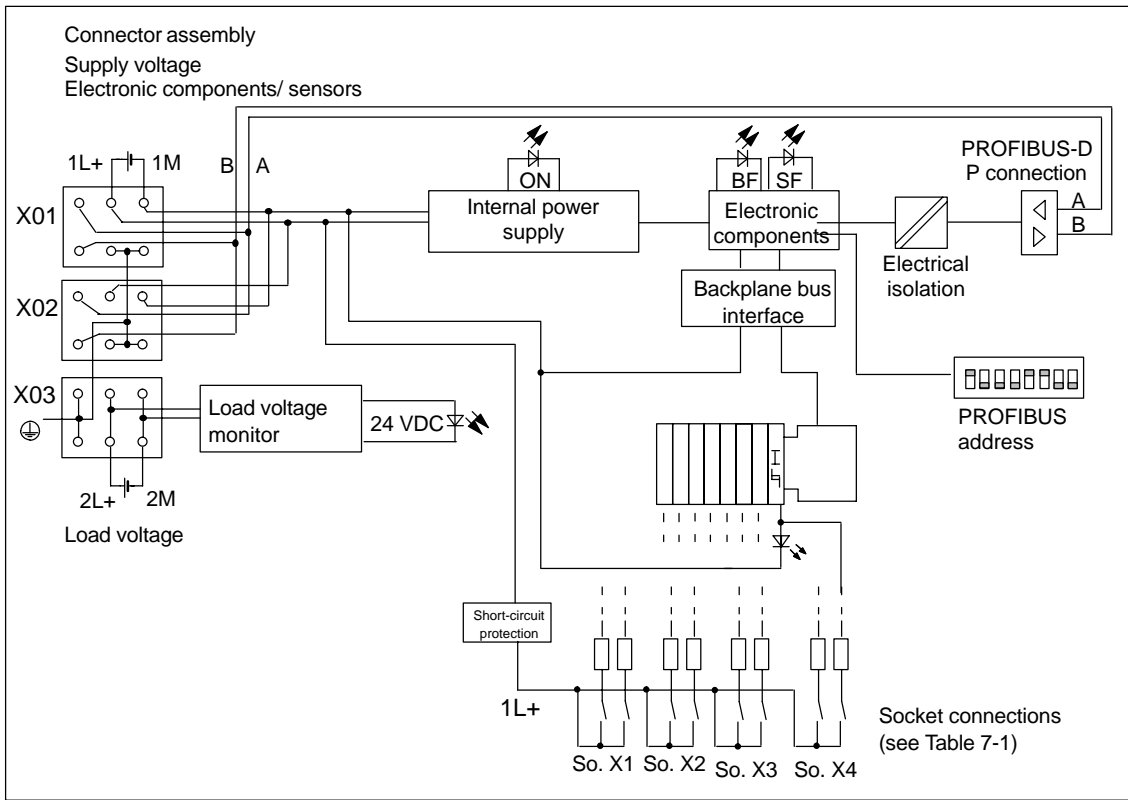The basic circuit diagram of the basic module is show below.

Figure 7-3   Basic circuit diagram for the BM 141 DI 8 × DC 24V ECOFAST DIAG basic module
(6ES7 141-1BF40-0AB0)

Parameters

The following tables provide an overview of the parameters on the basic module that can be set.

Table 7-6   Parameters of the BM 141 DI 8 × DC 24V ECOFAST DIAG

Parameters			Range	Default	Area affected
S7 slave with HWCONFIG	**Standard slave with DDB file SIEM80D3.GSG[1]**	**Standard slave with DDB file SI0380D3.GSG[1]**			
——	——	DP interrupt mode	DPV0/DPV1	DPV1	ET 200X
Diagnostic interrupt			Yes/no	Yes	ET 200X
Hardware interrupt			Yes/no	Yes	ET 200X
——	Enhanced diagnostics[2]	——	Yes/no	Yes	ET 200X
——	——	Startup when expected/actual config. differ	Yes/no	No	ET 200X
Diagnosis: no load voltage (S)			Yes/no	Yes	ET 200X
——	——	Module diagnosis	Yes/no	Yes	ET 200X
——	——	Module status	Yes/no	Yes	ET 200X
——	——	Channel-specific diagnosis	Yes/no	Yes	ET 200X

[1]   As of basic module 6ES7 141-1BF40-0AB0, version 2

[2]   The length of the diagnostic frame is ≥ 32 bytes

Table 7-7   Parameters of the BM 141 DI 8 × DC 24V ECOFAST DIAG for digital inputs

Parameters	Range	Default	Area affected
Input delay[1]	0.5 ms/ 3 ms/ 15 ms/ 20 ms	3 ms	Module
Diagnosis: short circuit to M	Yes/no	No	Channel
Diagnosis: wire break	Yes/no	No	Channel
Diagnostic interrupt	Yes/no	No	Module
Hardware interrupt	Yes/no	No	Module
Hardware interrupt on rising edge[2]	Yes/no	No	Channel
Hardware interrupt on falling edge[2]	Yes/no	No	Channel

[1]   The input delay applies at "0" to "1" and at "1" to "0".

[2]   These parameters can only be set if you enable the hardware interrupt parameter.

Technical data

Dimensions and weight	
Dimensions W $\times$ H $\times$ D (mm)	175 $\times$ 180 $\times$ 110
Weight	Approx. 650 g
Module-specific data	
Baud rate	9.6/19.2/45.45/93.75/187.5/500 kbps 1.5/3/6/12 Mbps
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of channels	8 digital inputs
Cable length	
• Unshielded	Max. 30 m
Manufacturer identification	80D3$_H$
Voltages, currents, potentials	
Non-switched rated load voltage (NS)	24 VDC
• Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
• Reverse polarity protection	No
• Short-circuit protection	No
Switched rated load voltage (NS)	24 VDC
• Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
• Reverse polarity protection	No
Maximum number of inputs driven simultaneously	
• all installed positions max. 55 °C	8
Electrical isolation	
• Between channels and backplane bus	No
• Between channels	No
• Between load voltages	No
• Between load voltage and all other circuitry	No
• Between PROFIBUS-DP and all other circuitry	Yes

Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 180 mA
Power loss of the module	Typ. 3.5 W
Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	Hardware interrupt Diagnostic interrupt
• Hardware interrupt	Configurable
• Diagnostic interrupt	Configurable
Diagnostic functions	Configurable
• Group error	Red LED (SF)
• Status indicator	Green LED (RUN)
• Indicator for non-switched load voltage	Green LED (DC 24V-NS)
• Indicator for switched load voltage	Green LED (DC 24V-S)
• Channel error display	red LED per channel
• Reading diagnostic information	Possible

Sensor supply outputs	
Outputs	8
Output current*	Up to 40 °C max. 1A; to 55 °C max. 0.8A
Short-circuit protection	Yes, electronic
Sensor selection data	
Input voltage	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	– 3 to 5 V
Input current	
• With signal "1"	Typ. 10 mA
Input delay (parameterizable)	

At "0" to "1" and at "1" to "0"	Typ. 0.5 ms
	Typ. 3 ms
	Typ. 15 ms
	Typ. 20 ms
Input characteristic	To IEC 61131, Type 2
Connection of two-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA **

* Please note the total current per ET 200X.
** The required closed-circuit current for wire break detection is 0.6 mA $<$ I $<$ 1.5 mA

7.4   BM 142 DO 4 x DC 24V/2A basic module (6ES7 142-1BD22-0XB0)

Features

The BM 142 DO 4 x DC 24V/2A basic module, order number 6ES7 142-1BD22-0XB0, has the following features:

- 4 digital outputs

- Output current 2 A per output

- Rated load voltage 24 VDC

- Suitable for solenoids, DC contactors and indicator lights

Pinout of the sockets for DO

The following table shows the pinout of the four sockets used to connect the digital outputs. The connector wiring is described in Section 4.4.4. You can find the layout of the sockets X1 to X4 on the module in Appendix C.

Table 7-8   Pinout of the sockets for 4-channel digital outputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket (Front)
1	–				
2	Output signal, channel 1*	–	Output signal, channel 3*	–	
3	Chassis ground, load power supply				
4	Output signal, channel 0	Output signal, channel 1*	Output signal, channel 2	Output signal, channel 3*	
5	PE				

* **Note:** Channel 1 and channel 3 are only allowed to be used at one socket (X1/X2 or X3/X4).

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

The basic circuit diagram of the basic module is shown below.

Figure 7-4   Basic circuit diagram of the BM 142 DO 4 x DC 24V/2A basic module

Parameters

The following table provides an overview of the parameters that can be set on the basic module.

Table 7-9   Parameters of the BM 142 DO 4 $\times$ DC 24V/2A

Parameters			Range	Default	Area affected
S7 slave with HWCONFIG	**Standard slave with DDB file SIEM803C.GSG**[1]	**Standard slave with DDB file SI03803C.GSG**[1]			
⎯⎯	⎯⎯	DP interrupt mode	DPV0/DPV1	DPV1	ET 200X
Diagnostic interrupt			Yes/no	Yes	ET 200X
Hardware interrupt			Yes/no	Yes	ET 200X
⎯⎯	Enhanced diagnostics[2]	⎯⎯	Yes/no	Yes	ET 200X
⎯⎯	⎯⎯	Startup when expected/actual config. differ	Yes/no	No	ET 200X
Diagnosis: no load voltage (S)			Yes/no	Yes	ET 200X
⎯⎯	⎯⎯	Module diagnosis	Yes/no	Yes	ET 200X
⎯⎯	⎯⎯	Module status	Yes/no	Yes	ET 200X
⎯⎯	⎯⎯	Channel-specific diagnosis	Yes/no	Yes	ET 200X

[1]   As of basic module 6ES7 142-1BD22-0XB0, version 3

[2]   The length of the diagnostic frame is $\geq$ 32 bytes.

Dimensions and weight	
Dimensions W $\times$ H $\times$ D (mm)	134 $\times$ 110 $\times$ 55
Weight	Approx. 500 g
Module-specific data	
Baud rate	9.6/19.2/93.75/187.5 /500 kbps 1.5/3/6/12 Mbps

Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of outputs	4
Cable length	
• Unshielded	Max. 30 m
Manufacturer identification	803C$_H$

Voltages, currents, potentials	
Rated supply voltage for electronic components and sensors 1L+	24 VDC
• Max. perm. current for electronic components and sensors	Up to 40 °C 1 A; Up to 55 °C 0.8 A Yes
• Reverse polarity protection	Yes, electronic
• Short-circuit protection	
Rated load voltage 2L +	24 VDC
• Reverse polarity protection	No
Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
Aggregate current of outputs	
• All installation positions	
Up to 20 °C	Max. 6 A
Up to 55 °C	Max. 4 A
Electrical isolation	
• Between channels and backplane bus	Yes
• Between channels and supply voltage for electronic components	Yes
• Between channels	No
• Between load power supply and all other circuit components	Yes
• Between PROFIBUS-DP and all other circuit components	Yes
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From supply voltage 1L+	Max. 180 mA
• From load voltage 2L+ (without load)	Max. 12 mA
Power loss of module	Typ. 4 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	Diagnostic interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)
• PROFIBUS-DP bus monitoring	Red LED (BF)
• Monitoring of the electronics power supply	Green LED (ON)
• Load voltage monitor	Green LED (DC24V)
• Reading diagnostic information	Possible

Actuator selection data	
Output voltage	
• With signal "1"	Min. of 2L+ (− 0.8 V)
Output current	
• With signal "1"	
Rated value	2 A
Permissible range	5 mA to 2.4 A
• With signal "0" (residual current)	Max. 0.5 mA
Load resistance range	12 Ω to 4 kΩ
Lamp load	Max. 10 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs of same basic module only)
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Limitation (internal) of voltage induced on circuit interruption	Typ. 2L+ (− 47 V)
Short-circuit protection for output	Yes, electronic
• Response threshold	Typ. 3 A

7.5 BM 143-DESINA FO basic module (6ES7 143-1BF00-0XB0)

Features

The BM 143-DESINA FO basic module (order number 6ES7 143-1BF00-0XB0) has the following features:

- PROFIBUS-DP connection via fiber-optic cables

- 8 digital inputs or outputs (individually parameterizable as input or output) plus 8 diagnostic inputs or inputs with NC functionality (individually parameterizable).

- Rated input voltage of 24 VDC

- Digital inputs are suitable for switches and proximity switches (BERO switches)

- Digital outputs are suitable for solenoid valves, DC contactors and indicator lights

Pinout of the sockets for DI/DO

The tables below show the pinouts of the 8 sockets for connecting digital inputs and outputs. The connector wiring is described in Section 4.4.4. The arrangement of sockets X1 to X8 on the module in Appendix C.

Table 7-10 Pinout of sockets X1, X3, X5 and X7 for digital inputs or outputs

Pin	Assignment of socket X1	Assignment of socket X3	Assignment of socket X5	Assignment of socket X7	Front view of socket (Front view)
1	Non-switched supply voltage DC 24V-NS				
2	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	
3	Chassis ground, power supply				
4*	Digital input or output (DESINA) channel 0	Digital input or output (DESINA) channel 2	Digital input or output (DESINA) channel 4	Digital input or output (DESINA) channel 6	
5	not assigned				

*   If it is parameterized as a digital output, pin 4 is fed by the DC 24V-S switched supply voltage.

Table 7-11   Pinout of sockets X2, X4, X6 and X8 for digital inputs or outputs

Pin	Assignment of socket X2	Assignment of socket X4	Assignment of socket X6	Assignment of socket X8	Front view of socket (Front view)
1	Non-switched supply voltage DC 24V-NS				
2	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	
3	Chassis ground, power supply				
4*	Digital input or output (DESINA) channel 1	Digital input or output (DESINA) channel 3	Digital input or output (DESINA) channel 5	Digital input or output (DESINA) channel 7	
5	not assigned				

*   If it is parameterized as a digital output, pin 4 is fed by the DC 24V-NS non-switched supply voltage.

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

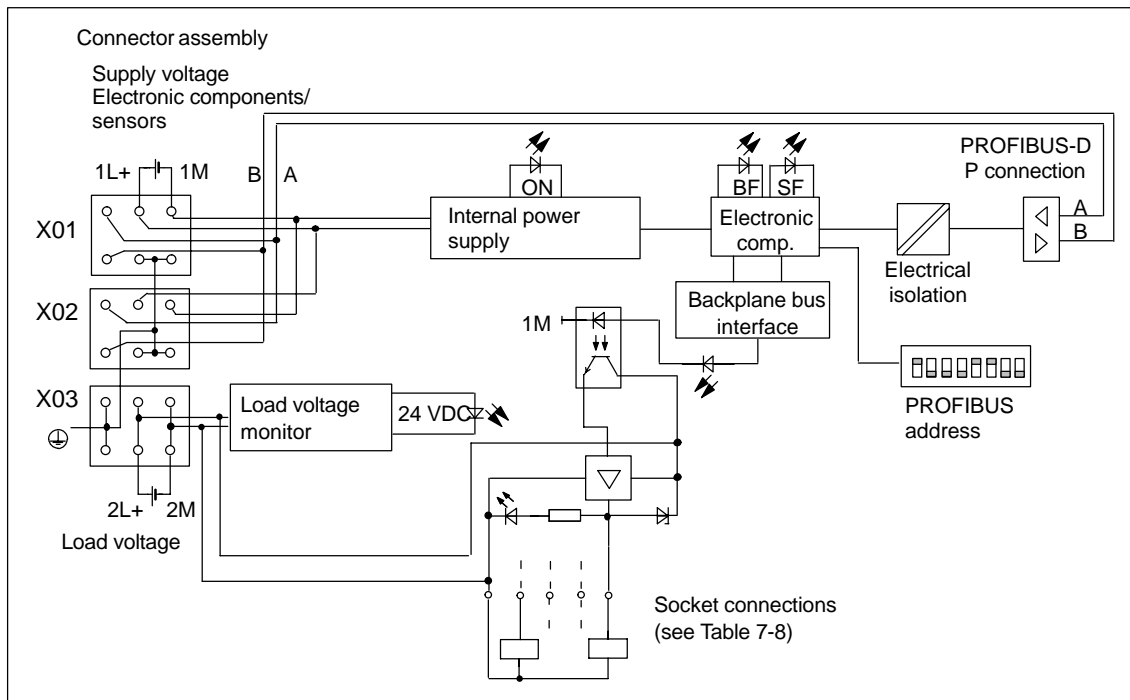The basic circuit diagram of the basic module is shown below.

Figure 7-5   Basic circuit diagram of the BM 143-DESINA FO basic module

Parameters

The following table provides an overview of the parameters you can set for the basic module.

Table 7-12   Parameters of the BM 143-DESINA FO

Parameters			Range	Default	Area affected
S7 slave with HWCONFIG	**Standard slave with DDB file SIEM809A.GSG[1]**	**Standard slave with DDB file SI03809A.GSG[1]**			
⎯⎯	⎯⎯	DP interrupt mode	DPV0/DPV1	DPV1	ET 200X
Diagnostic interrupt			Yes/no	Yes	ET 200X
Hardware interrupt			Yes/no	Yes	ET 200X
⎯⎯	Enhanced diagnostics[2]	⎯⎯	Yes/no	Yes	ET 200X
⎯⎯	⎯⎯	Startup when expected/actual config. differ	Yes/no	No	ET 200X
Diagnosis: no load voltage (S)			Yes/no	Yes	ET 200X
⎯⎯	⎯⎯	Module diagnosis	Yes/no	Yes	ET 200X
⎯⎯	⎯⎯	Module status	Yes/no	Yes	ET 200X
⎯⎯	⎯⎯	Channel-specific diagnosis	Yes/no	Yes	ET 200X

[1]   As of basic module 6ES7 143-1BF00-0XB0, version 5

[2]   The length of the diagnostic frame is $\geq$ 32 bytes.

Table 7-13 Parameters of the BM 143-DESINA FO for digital inputs and outputs

Parameters	Range	Default	Area affected
Channel type for I/On (n= 0...7)	Digital input/ digital output	Digital output (Channel K0, K2, K4, K6) Digital input (Channel K1, K3, K5, K7)	Channel
Functional input In (n=8...15)	Diagnostic input/ diagnostic input with diagnostic frame/ Input with NC function	Diagnostic input	Channel
Response to CPU/master STOP	Output No current or voltage hold last value/ Apply substitute value/	Output No current or voltage	Channel
Substitute value On (n=0...7)	0/1	0	Channel
Diagnostic interrupt	Yes/no	No	Module

Dimensions and weight	
Dimensions W × H × D (mm)	175 × 180 × 110
Weight	Approx. 650 g
Module-specific data	
Baud rate	9.6/19.2/45.45/93.75/ 187.5/500 kbps 1.5/3/6/12 Mbps
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of channels	8 digital inputs and outputs
	8 functional inputs (diagnostics inputs or inputs with NC functionality)
Cable length	
• Unshielded	Max. 30 m
Manufacturer identification	809A$_H$
Voltages, currents, potentials	
Non-switched rated load voltage (NS)	24 VDC
• Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
• Reverse polarity protection	No
• Short-circuit protection	No
Switched rated load voltage (NS)	24 VDC
• Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
• Reverse polarity protection	No
Maximum number of inputs driven simultaneously	
• all installed positions max. 55 °C	8
Aggregate current of outputs	
• All installation positions	
To 20 °C	Max. 10 A
To 50 °C	Max. 6 A
To 55 °C	Max. 5 A
Electrical isolation	
• Between channels and backplane bus	No

•	Between channels	No
•	Between load voltages	No
•	Between load voltage and all other circuitry	No
•	Between PROFIBUS-DP and all other circuitry	Yes
Permissible potential difference		
•	Between different circuits	75 VDC, 60 VAC
Insulation tested with		500 VDC
Power loss of module		Typ. 3.5 W
Status, alarms, diagnostics		
Status display		Yellow LED per channel
Indicator for functional input		Yellow/red LED per channel
Alarms		Diagnostic interrupt
Diagnostic functions		Configurable
•	Group error	Red LED (SF)
•	Status indicator	Green LED (RUN)
•	Indicator for non-switched load voltage	Green LED (DC 24V-NS)
•	Indicator for switched load voltage	Green LED (DC 24V-S)
•	Reading diagnostic information	Possible
Sensor supply outputs		
Outputs		8
Output current		Up to 40 °C max. 1 A; Up to 55 °C max. 0.8 A
Short-circuit protection		Yes, electronic

Sensor selection data	
Input voltage for parameterized DI (pin 4)	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	–30 to 5V
Input voltage for functional input (pin 2)	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	–30 to 2 V
Input current	
• With signal "1"	Typ. 5 mA
Input delay	
• From "0" to "1"	1.2 to 4.8 ms
• From "1" to "0"	1.2 to 4.8 ms
Input characteristic	To IEC 61131, Type 2
Connection of two-wire BE-ROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

Actuator selection data	
Output voltage	
• With signal "1"	Min. NS/S (– 0.8 V)
Output current	
• With signal "1"	
Rated value	1.2 A
Permissible range	7 mA to 1.3 A
• With signal "0" (residual current)	Max. 0.5 mA
Load resistance range	21 ohms to 4 kohms
Lamp load	Max. 10 W
Parallel connection of two outputs	No
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 2 Hz
• Lamp load	Max. 1 Hz
Limitation (internal) of voltage induced on circuit interruption	Typ. NS/S (– 47 V)
Short-circuit protection for output	Yes, electronic
• Response threshold	Typ. 1.8 A

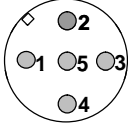## 7.6 BM 143-DESINA RS485 basic module (6ES7 143-1BF00-0AB0)

Features
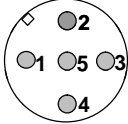
The BM 143-DESINA RS485 basic module with the order number
6ES7 143-1BF00-0AB0 has the following features:

- PROFIBUS-DP connection via copper conductors (RS 485)

- 8 digital inputs or outputs (individually parameterizable as input or output) plus 8 diagnostic inputs or inputs with NC functionality (individually parameterizable).

- Rated input voltage of 24 VDC

- Digital inputs are suitable for switches and proximity switches (BERO switches)

- Digital outputs are suitable for solenoid valves, DC contactors and indicator lights

Pinout of the sockets for DI/DO

The following tables show the pinouts of the eight sockets used to connect the digital inputs or outputs. The connector wiring is described in Section 4.4.4. The arrangement of sockets X1 to X8 on the module in Appendix C.

Table 7-14 Pinout of sockets X1, X3, X5 and X7 for digital inputs or outputs

Pin	Assignment of socket X1	Assignment of socket X3	Assignment of socket X5	Assignment of socket X7	Front view of socket (Front view)
1	Non-switched supply voltage DC 24V-NS				
2	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	
3	Chassis ground, power supply				
4*	Digital input or output (DESINA) channel 0	Digital input or output (DESINA) channel 2	Digital input or output (DESINA) channel 4	Digital input or output (DESINA) channel 6	
5	not assigned				

* If it is parameterized as a digital output, pin 4 is fed by the DC 24V-S switched supply voltage.

Table 7-15 Pinout of sockets X2, X4, X6 and X8 for digital inputs or outputs

Pin	Assignment of socket X2	Assignment of socket X4	Assignment of socket X6	Assignment of socket X8	Front view of socket (Front view)
1	Non-switched supply voltage DC 24V-NS				
2	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	
3	Chassis ground, power supply				
4*	Digital input or output (DESINA) channel 1	Digital input or output (DESINA) channel 3	Digital input or output (DESINA) channel 5	Digital input or output (DESINA) channel 7	
5	not assigned				

*   If it is parameterized as a digital output, pin 4 is fed by the DC 24V-NS non-switched supply voltage.

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

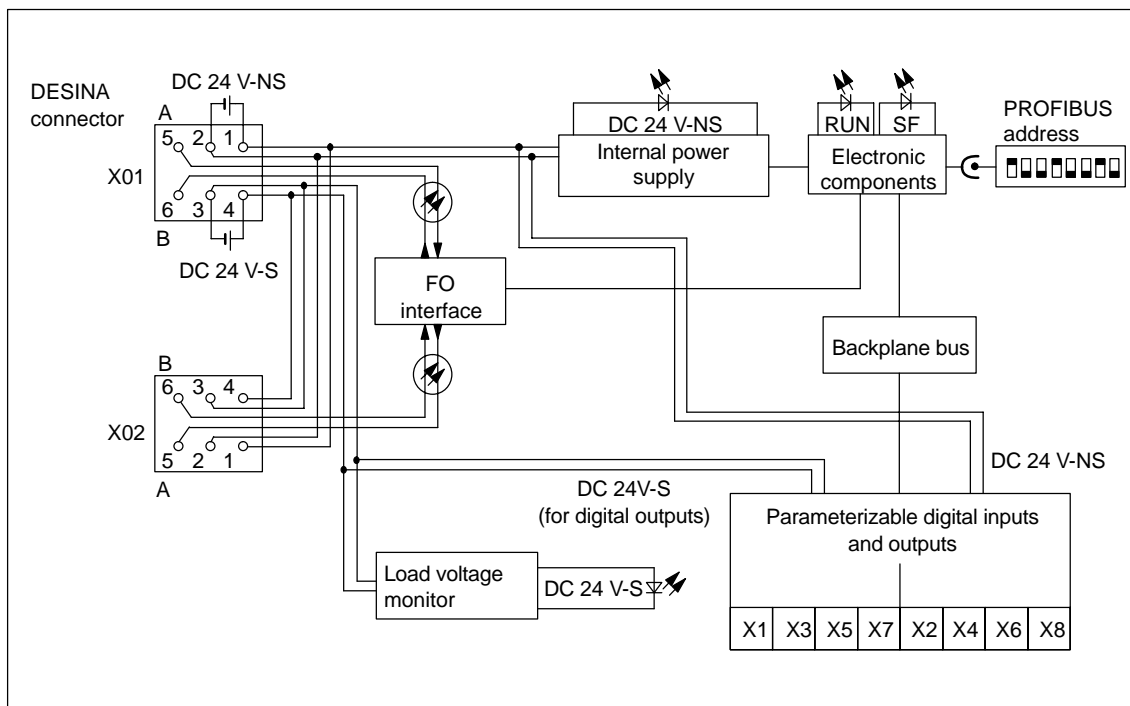The basic circuit diagram of the basic module is shown below.

Figure 7-6   Basic circuit diagram of the BM 143-DESINA RS485 basic module

Parameters

The following table provides an overview of the parameters you can set for the basic module.

Table 7-16   Parameters of the BM 143-DESINA RS485

Parameters			Range	Default	Area affected
S7 slave with HWCONFIG	**Standard slave with DDB file SIEM809A.GSG[1]**	**Standard slave with DDB file SI03809A.GSG[1]**			
——	——	DP interrupt mode	DPV0/DPV1	DPV1	ET 200X
Diagnostic interrupt			Yes/no	Yes	ET 200X
Hardware interrupt			Yes/no	Yes	ET 200X
——	Enhanced diagnostics[2]	——	Yes/no	Yes	ET 200X
——	——	Startup when expected/actual config. differ	Yes/no	No	ET 200X
Diagnosis: no load voltage (S)			Yes/no	Yes	ET 200X
——	——	Module diagnosis	Yes/no	Yes	ET 200X
——	——	Module status	Yes/no	Yes	ET 200X
——	——	Channel-specific diagnosis	Yes/no	Yes	ET 200X

[1]   As of basic module 6ES7 143-1BF00-0AB0, version 2

[2]   The length of the diagnostic frame is $\geq$ 32 bytes.

Table 7-17 Parameters of the BM 143-DESINA RS485 for digital inputs and outputs

Parameters	Range	Default	Area affected
Channel type for I/On (n= 0...7)	Digital input/ digital output	Digital output (Channel K0, K2, K4, K6) Digital input (Channel K1, K3, K5, K7)	Channel
Functional input In (n=8...15)	Diagnostic input/ diagnostic input with diagnostic frame/ Input with NC function	Diagnostic input	Channel
Response to CPU/master STOP	Output No current or voltage hold last value/ Apply substitute value/	Output No current or voltage	Channel
Substitute value On (n=0...7)	0/1	0	Channel
Diagnostic interrupt	Yes/no	No	Module

Dimensions and Weight	
Dimensions W × H × D (mm)	175 × 180 × 110
Weight	Approx. 650 g
Module-specific data	
Baud rate	9.6/19.2/45.45/93.75/ 187.5/500 kbps 1.5/3/6/12 Mbps
Bus protocol	PROFIBUS-DP
FREEZE compatibility	Yes
SYNC compatibility	Yes
Number of channels	8 digital inputs and outputs
	8 functional inputs (diagnostics inputs or inputs with NC functionality)
Cable length	
• Unshielded	Max. 30 m
Manufacturer identification	809A$_H$
Voltages, currents, potentials	
Non-switched rated load voltage (NS)	24 VDC
• Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
• Reverse polarity protection	No
• Short-circuit protection	No
Switched rated load voltage (NS)	24 VDC
• Max. perm. power input from load	Up to 40 °C 10 A; Up to 55 °C 8 A
• Reverse polarity protection	No
Maximum number of inputs driven simultaneously	
• all installed positions max. 55 °C	8
Aggregate current of outputs	
• All installation positions	
To 20 °C	Max. 10 A
To 50 °C	Max. 6 A
To 55 °C	Max. 5 A

Electrical isolation	
• Between channels and backplane bus	No
• Between channels	No
• Between load voltages	No
• Between load voltage and all other circuitry	No
• Between PROFIBUS-DP and all other circuitry	Yes
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power loss of module	Typ. 3.5 W
Status, alarms, diagnostics	
Status display	Yellow LED per channel
Indicator for functional input	Yellow/red LED per channel
Alarms	Diagnostic interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)
• Status indicator	Green LED (RUN)
• Indicator for non-switched load voltage	Green LED (DC 24V-NS)
• Indicator for switched load voltage	Green LED (DC 24V-S)
• Reading diagnostic information	Possible
Sensor supply outputs	
Outputs	8
Output current	Up to 40 °C max. 1 A; Up to 55 °C max. 0.8 A
Short-circuit protection	Yes, electronic

Sensor selection data		Actuator selection data	
Input voltage for parameterized DI (pin 4)		Output voltage	
• Rated value	24 VDC	• With signal "1"	Min. NS/S (– 0.8 V)
• With signal "1"	13 to 30 V	Output current	
• With signal "0"	–30 to 5V	• With signal "1"	
Input voltage for functional input (pin 2)		Rated value	1.2 A
• Rated value	24 VDC	Permissible range	7 mA to 1.3 A
• With signal "1"	13 to 30 V	• With signal "0" (residual current)	Max. 0.5 mA
• With signal "0"	–30 to 2 V	Load resistance range	21 ohms to 4 kohms
Input current		Lamp load	Max. 10 W
• With signal "1"	Typ. 5 mA	Parallel connection of two outputs	No
Input delay		Driving a digital input	Possible
• From "0" to "1"	1.2 to 4.8 ms	Switching frequency	
• From "1" to "0"	1.2 to 4.8 ms	• Resistive load	Max. 100 Hz
Input characteristic	To IEC 61131, Type 2	• Inductive load to IEC 947-5-1, DC13	Max. 2 Hz
Connection of two-wire BE-ROs	Possible	• Lamp load	Max. 1 Hz
• Permissible closed-circuit current	Max. 1.5 mA	Limitation (internal) of voltage induced on circuit interruption	Typ. NS/S (– 47 V)
		Short-circuit protection for output	Yes, electronic
		• Response threshold	Typ. 1.8 A

7.7 EM 141 DI 4 × DC 24V expansion module (6ES7 141-1BD31-0XA0)

Features

The EM 141 DI 4 × DC 24V expansion module; order number 6ES7 141-1BD31-0XA0 has the following features:

- 4 digital inputs
- Rated input voltage of 24 VDC
- Suitable for switches and proximity switches (BEROs)

Pinout of the sockets for DI

The following table shows the pinout of the four sockets used to connect the digital inputs. You can find the wiring of the connector in Section 4.4.3. You can find the layout of the sockets in Appendix C.

Table 7-18   Pinout of the sockets for 4-channel digital inputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket
1	Sensor supply output 1L+				
2	Input signal, channel 1*	–	Input signal, channel 3*	–	
3	Chassis ground, power supply				
4	Input signal, channel 0	Input signal, channel 1*	Input signal, channel 2	Input signal, channel 3*	
5	PE				

*   **Note:** Channel 1 and channel 3 are only allowed to be used at one socket (X1/X2 or X3/X4).

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

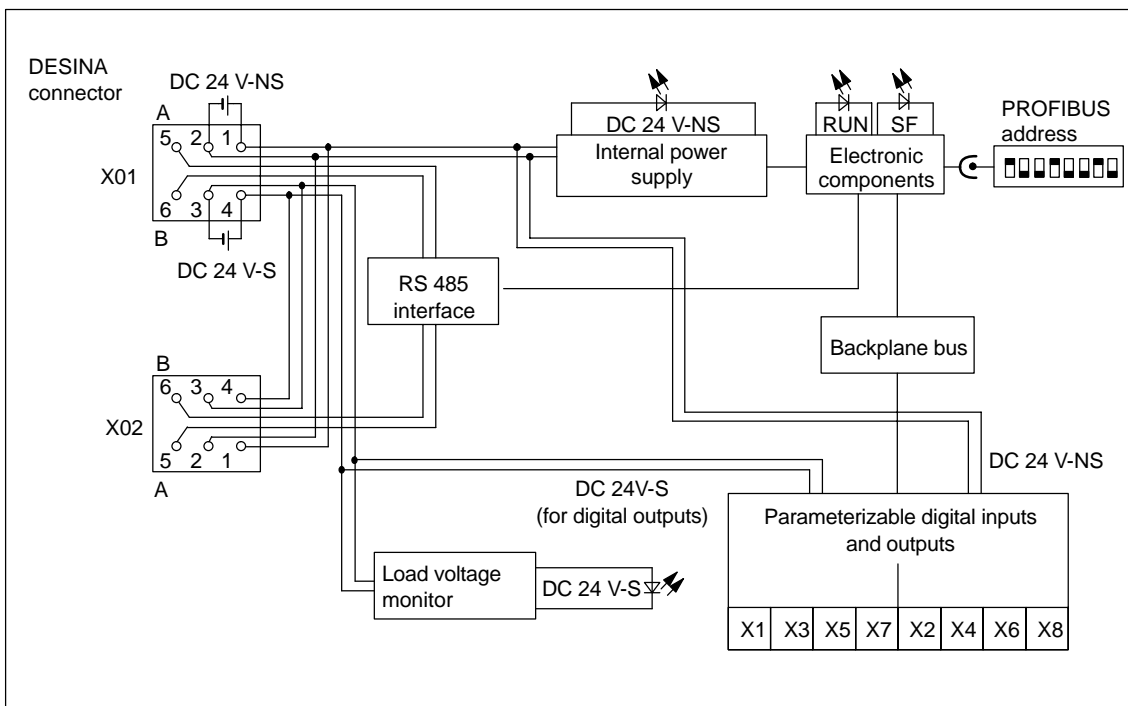The basic circuit diagram of the expansion module is shown below.

Figure 7-7   Basic circuit diagram of expansion module EM 141 DO 4 x DC 24V

Dimensions and weight	
Dimensions W × H × D (mm)	87 × ×110 × ×55
Weight	Approx. 250 g

Module-specific data	
Number of inputs	4
Cable length	
• Unshielded	Max. 30 m

Voltages, currents, potentials	
Maximum number of inputs driven simultaneously	
• All installation positions Up to 55 °C	4
Electrical isolation	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 16 mA
Power loss of module	Typ. 1.5 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	None

Sensor supply outputs	
Outputs	4
Output current*	Up to 40 °C max. 0.9A; Up to 55 °C max. 0.7A
Short-circuit protection	Yes, electronic

Sensor selection data	
Input voltage	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	- 3 to 5 V
Input current	
• With signal "1"	Typ. 7 mA
Input delay	
• From "0" to "1"	1.2 to 4.8 ms
• From "1" to "0"	1.2 to 4.8 ms
Input characteristic	To IEC 61131, Type 1
Connection of two-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

* Please note the total current per ET 200X.

7.8 EM 141 DI 8 × DC 24V expansion module (6ES7 141-1BF31-0XA0)

Features

The EM 141 DI 8 x DC 24V expansion module with the order number 6ES7 141-1BF31-0XA0 has the following features:

- 8 digital inputs
- Rated input voltage of 24 VDC
- Suitable for switches and proximity switches (BEROs)

Pinout of the sockets for DI

The following table shows the pinout of the four sockets used to connect the digital inputs. The connector wiring is described in Section 4.4.4. You can find the layout of the sockets in Appendix C.

Table 7-19 Pin assignment of sockets for 8-channel digital inputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket
1	Sensor supply output 1L+				
2	Input signal, channel 4	Input signal, channel 5	Input signal, channel 6	Input signal, channel 7	
3	Chassis ground, power supply				
4	Input signal, channel 0	Input signal, channel 1	Input signal, channel 2	Input signal, channel 3	
5	PE				

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

The basic circuit diagram of the expansion module is shown below.

Figure 7-8   Basic circuit diagram for expansion module EM 141 DI 8 x DC 24V
(6ES7 141-1BF31-0XA0)

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 110 × 55
Weight	Approx. 250 g
Module-specific data	
Number of inputs	8
Cable length	
• Unshielded	Max. 30 m
Voltages, currents, potentials	
Maximum number of inputs driven simultaneously	
• All installed positions max. 55 °C	8
Electrical isolation	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 16 mA
Power loss of module	Typ. 1.5 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	None
Sensor supply outputs	
Outputs	4
Output current*	Up to 40 °C max. 0.9A; Up to 55 °C max. 0.7A
Short-circuit protection	Yes, electronic

Sensor selection data	
Input voltage	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	– 3 to 5 V
Input current	
• With signal "1"	typ. 7 mA
Input delay	
• From "0" to "1"	1.2 to 4.8 ms
• From "1" to "0"	1.2 to 4.8 ms

Input characteristic	To IEC 61131, Type 1
Connection of two-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

*   Please note the total current per ET 200X.

7.9   EM 141 DI 8 × DC 24V DIAG expansion module (6ES7 141-1BF30-0XB0)

Hardware

The expansion module can be used together with the following basic modules:

- BM 141 DI 8×DC 24V,   6ES7 141-1BF01-0XB0, from product version 05
  6ES7 141-1BF11-0XB0, from product version 01
  6ES7 141-1BF12-0XB0, from product version 01

- BM 141 DI 8×DC 24V ECOFAST,
  6ES7 141-1BF00-0AB0, from product version 01
  6ES7 141-1BF01-0AB0, from product version 01

- BM 141 DI 8×DC 24V ECOFAST DIAG,
  6ES7 141-1BF40-0AB0, from product version 01

- BM 142 DO 4×DC 24V/2A, 6ES7 142-1BD11-0XB0, from product version 05
  6ES7 142-1BD21-0XB0, from product version 01
  6ES7 142-1BD22-0XB0, from product version 01

- BM 143-DESINA FO,   6ES7 143-1BF00-0XB0, from product version 01

- BM 143-DESINA RS485,   6ES7 143-1BF00-0AB0, from product version 01

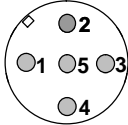- BM 147/CPU,   6ES7 147-1AA00-0XB0, from product version 01

Features

The EM 141 DI 8 x DC 24V DIAG expansion module with the order number 6ES7 141-1BF30-0XB0 has the following features:

- 8 digital inputs

- Rated input voltage of 24 VDC

- Suitable for switches and proximity switches (BEROs)

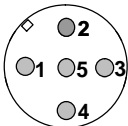- Diagnostic interrupt for short circuit and wire break for each channel

- Hardware interrupt for rising and falling pulse edge for each channel

- Short type (110 mm)

- Parameterizable input delays

Pinout of the sockets for DI

The following table shows the pinout of the four sockets used to connect the digital inputs. You can find the wiring of the connector in the ET 200X manual, Section 4.4.4. You can find the layout of the sockets in the ET 200X manual, Appendix C.

Table 7-20   Pinout of socket X1 to X4 for digital inputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket
1	Sensor supply output 1L+				
2	Input signal, channel 4	Input signal, channel 5	Input signal, channel 6	Input signal, channel 7	
3	Chassis ground, power supply				
4	Input signal, channel 0	Input signal, channel 1	Input signal, channel 2	Input signal, channel 3	
5	PE				

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

The basic circuit diagram of the expansion module is show below.

Figure 7-9   Basic circuit diagram for expansion module EM 141 DI 8 x DC 24V DIAG (6ES7 141-1BF30-0XB0)

Parameters

The following table summarizes the parameters that you can set for the expansion module.

Table 7-21   Parameters of the EM 141 DI 8 $\times$ DC 24V DIAG

Parameters	Range	Default	Area affected
Input delay[1]	0.5 ms/ 3 ms/ 15 ms/ 20 ms	3 ms	Module
Diagnosis: short circuit to M	Yes/no	No	Channel
Diagnosis: wire break	Yes/no	No	Channel
Diagnostic interrupt	Yes/no	No	Module
Hardware interrupt	Yes/no	No	Module
Hardware interrupt on rising edge[2]	Yes/no	No	Channel
Hardware interrupt on falling edge[2]	Yes/no	No	Channel

[1]   The input delay applies at "0" to "1" and at "1" to "0".
[2]   These parameters can only be set if you enable the hardware interrupt parameter.

Technical data

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 110 × 55
Weight	Approx. 250 g
Module-specific data	
Number of inputs	8
Cable length	
• Unshielded	Max. 30 m
Voltages, currents, potentials	
Maximum number of inputs driven simultaneously	
• All installed positions max. 55 °C	8
Electrical isolation	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 30 mA
Power loss of module	Typ. 1.5 W
Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	Hardware interrupt Diagnostic interrupt
• Hardware interrupt	Configurable
• Diagnostic interrupt	Configurable
Diagnostic functions	Configurable
• Group error	Red LED (SF)
• Channel error display	Red LED per channel
• Reading diagnostic information	Possible

Sensor supply outputs	
Outputs	4
Output current*	Up to 40 °C max. 0.5A; Up to 55 °C max. 0.4A
Aggregate current	Up to 40 °C max. 0.9A; Up to 55 °C max. 0.7A
Short-circuit protection	Yes, electronic
Sensor selection data	
Input voltage	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	– 3 to 5 V
Input current	
• With signal "1"	Typ. 10 mA
Input delay (parameterizable)	
At "0" to "1" and at "1" to "0"	Typ. 0.5 ms
	Typ. 3 ms
	Typ. 15 ms
	Typ. 20 ms
Input characteristic	To IEC 61131, Type 2
Connection of two-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA **

*   Please note the total current per ET 200X.
**   The required closed-circuit current for wire break detection is 0.6 mA < I < 1.5 mA

7.10 EM 141 DI 8 × DC 24V expansion module (6ES7 141-1BF41-0XA0)

Features

The EM 141 DI 8 x DC 24V expansion module with the order number 6ES7 141-1BF41-0XA0 has the following features:

- 8 digital inputs
- Rated input voltage of 24 VDC
- Suitable for switches and proximity switches (BEROs)

Pinout of the sockets for DI

The following table shows the pinout of the eight sockets used to connect the digital inputs. The connector wiring is described in Section 4.4.4. You can find the layout of the sockets in Appendix C.

Table 7-22 Pinout of socket X1 to X8 for digital inputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket
1	Sensor supply output 1L+				
2	not assigned				
3	Chassis ground, power supply				
4	Input signal, channel 0	Input signal, channel 1	Input signal, channel 2	Input signal, channel 3	
5	PE				
Pin	**Assignment of socket X5**	**Assignment of socket X6**	**Assignment of socket X7**	**Assignment of socket X8**	
1	Sensor supply output L+				
2	not assigned				
3	Chassis ground, power supply				
4	Input signal, channel 4	Input signal, channel 5	Input signal, channel 6	Input signal, channel 7	
5	PE				

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

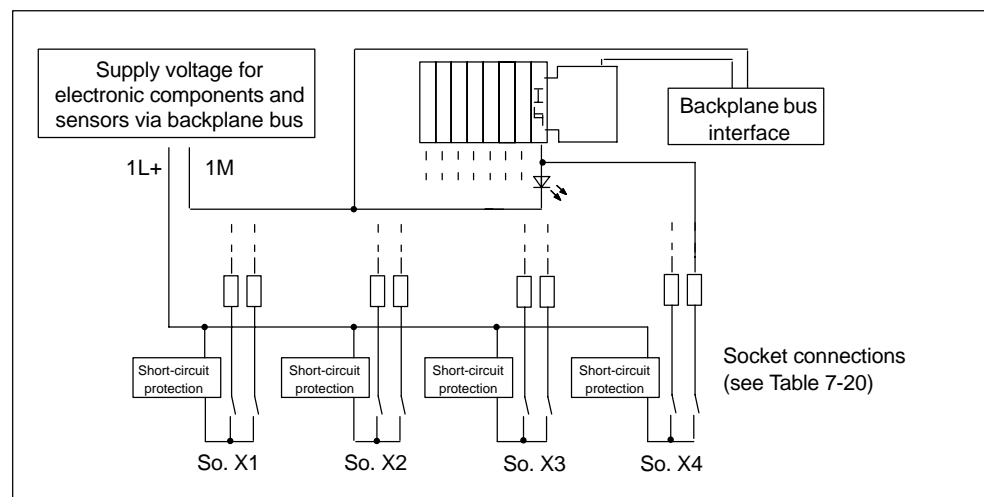The basic circuit diagram of the expansion module is show below.

Figure 7-10   Basic circuit diagram of expansion module EM 141 DI 8 x DC 24V
(6ES7 141-1BF41-0XA0)

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 180 × ≡ ≡
Weight	Approx. 350 g
Module-specific data	
Number of inputs	8
Cable length	
• Unshielded	Max. 30 m
Voltages, currents, potentials	
Maximum number of inputs driven simultaneously	8
• All installed positions max. 55 °C	
Electrical isolation	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 10 mA
Power loss of module	Typ. 1.5 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	None
Sensor supply outputs	
Outputs	8
Output current*	Up to 40 °C max. 1A; Up to 55 °C max. 0.8A
Short-circuit protection	Yes, electronic
Sensor selection data	
Input voltage	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	– 3 to 5 V
Input current	
• With signal "1"	Typ. 7 mA
Input delay	
• From "0" to "1"	1.2 to 4.8 ms
• From "1" to "0"	1.2 to 4.8 ms
Input characteristic	To IEC 61131, Type 1
Connection of two-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

*   Please note the total current per ET 200X.

7.11   EM 141 DI 8 × DC 24V DIAG expansion module (6ES7 141-1BF40-0XB0)

Hardware

The expansion module can be used together with the following basic modules:

- BM 141 DI 8×DC 24V,   6ES7 141-1BF01-0XB0, from product version 05
                                                6ES7 141-1BF11-0XB0, from product version 01
                                                6ES7 141-1BF12-0XB0, from product version 01

- BM 141 DI 8×DC 24V ECOFAST,
                                                6ES7 141-1BF00-0AB0, from product version 01
                                                6ES7 141-1BF01-0AB0, from product version 01

- BM 141 DI 8×DC 24V ECOFAST DIAG,
                                                6ES7 141-1BF40-0AB0, from product version 01

- BM 142 DO 4×DC 24V/2A, 6ES7 142-1BD11-0XB0, from product version 05
                                                6ES7 142-1BD21-0XB0, from product version 01
                                                6ES7 142-1BD22-0XB0, from product version 01

- BM 143-DESINA FO,   6ES7 143-1BF00-0XB0, from product version 01

- BM 143-DESINA RS485,   6ES7 143-1BF00-0AB0, from product version 01

- BM 147/CPU,   6ES7 147-1AA00-0XB0, from product version 01
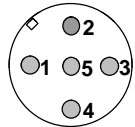
Features

The EM 141 DI 8 x DC 24V DIAG expansion module with the order number 6ES7 141-1BF40-0XB0 has the following features:

- 8 digital inputs

- Rated input voltage of 24 VDC

- Suitable for switches and proximity switches (BEROs)

- Diagnostic interrupt for short circuit and wire break for each channel

- Hardware interrupt for rising and falling pulse edge for each channel

- Long type (180 mm)

- Parameterizable input delays

Pinout of the sockets for DI

The following table shows the pinout of the eight sockets used to connect the digital inputs. You can find the wiring of the connector in the ET 200X manual, Section 4.4.4. You can find the layout of the sockets in the ET 200X manual, Appendix C.

Table 7-23   Pinout of sockets X1 to X8 for digital inputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket
1	Sensor supply output 1L+				
2	not assigned				
3	Chassis ground, power supply				
4	Input signal, channel 0	Input signal, channel 1	Input signal, channel 2	Input signal, channel 3	
5	PE				
Pin	**Assignment of socket X5**	**Assignment of socket X6**	**Assignment of socket X7**	**Assignment of socket X8**	
1	Sensor supply output 1L+				
2	not assigned				
3	Chassis ground, power supply				
4	Input signal, channel 4	Input signal, channel 5	Input signal, channel 6	Input signal, channel 7	
5	PE				

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

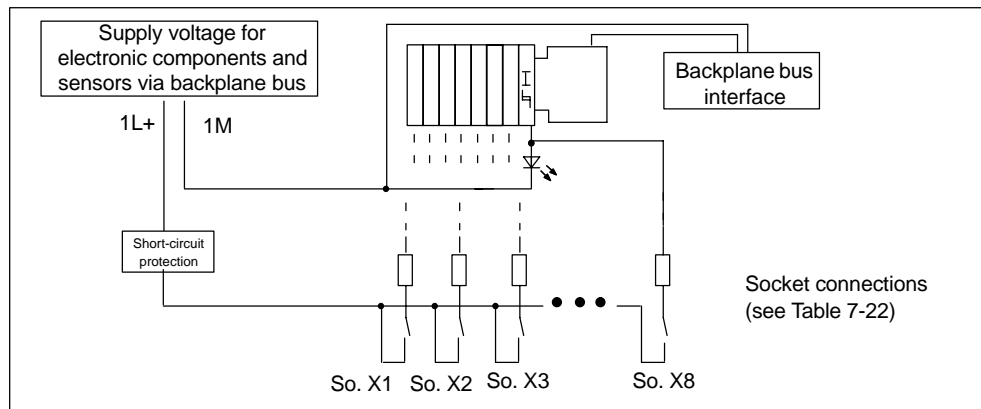The basic circuit diagram of the expansion module is show below.

Figure 7-11   Basic circuit diagram of expansion module EM 141 DI 8 x DC 24V DIAG (6ES7 141-1BF40-0XB0)

Parameters

The following table summarizes the parameters that you can set for the expansion module.

Table 7-24 Parameters of the EM 141 DI 8 $\times$ DC 24V DIAG

Parameters	Range	Default	Area affected
Input delay[1]	0.5 ms/ 3 ms/ 15 ms/ 20 ms	3 ms	Module
Diagnosis: short circuit to M	Yes/no	No	Channel
Diagnosis: wire break	Yes/no	No	Channel
Diagnostic interrupt	Yes/no	No	Module
Hardware interrupt	Yes/no	No	Module
Hardware interrupt on rising edge[2]	Yes/no	No	Channel
Hardware interrupt on falling edge[2]	Yes/no	No	Channel

[1] The input delay applies at "0" to "1" and at "1" to "0".
[2] These parameters can only be set if you enable the hardware interrupt parameter.

Technical data

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 180 × 55
Weight	Approx. 350 g

Module-specific data	
Number of inputs	8
Cable length	
• Unshielded	Max. 30 m

Voltages, currents, potentials	
Maximum number of inputs driven simultaneously	8
• All installed positions max. 55 °C	
Electrical isolation	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 30 mA
Power loss of module	Typ. 1.5 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	Hardware interrupt Diagnostic interrupt
• Hardware interrupt	Configurable
• Diagnostic interrupt	Configurable
Diagnostic functions	Configurable
• Group error	Red LED (SF)
• Channel error display	red LED per channel
• Reading diagnostic information	Possible

Sensor supply outputs	
Outputs	8
Output current*	Up to 40 °C max. 0.5A; Up to 55 °C max. 0.4A
Aggregate current	Up to 40 °C max. 1A; Up to 55 °C max. 0.8A
Short-circuit protection	Yes, electronic

Sensor selection data	
Input voltage	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	– 3 to 5 V
Input current	
• With signal "1"	Typ. 10 mA
Input delay (parameterizable)	
At "0" to "1" and at "1" to "0"	Typ. 0.5 ms
	Typ. 3 ms
	Typ. 15 ms
	Typ. 20 ms
Input characteristic	To IEC 61131, Type 2
Connection of two-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA **

* Please note the total current per ET 200X.
** The required closed-circuit current for wire break detection is 0.6 mA < I < 1.5 mA

7.12 EM 142 DO 4 x DC 24V/0.5A expansion module (6ES7 142-1BD30-0XA0)

Features

The EM 142 DO 4 $\times$ DC 24V/0.5A expansion module; order number 6ES7 142-1BD30-0XA0 has the following features:

- 4 digital outputs
- Output current 0.5 A per output
- Rated load voltage 24 VDC
- Suitable for solenoids, DC contactors and indicator lights

Pinout of the sockets for DO

The following table shows the pinout of the four sockets used to connect the digital outputs. You can find the layout of the sockets in Appendix C. The connector wiring is described in Section 4.4.3.

Table 7-25   Pinout of the sockets for 4-channel digital outputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket (Front)
1	–				
2	Output signal, channel 1*	–	Output signal, channel 3*	–	
3	Chassis ground, load power supply				
4	Output signal, channel 0	Output signal, channel 1*	Output signal, channel 2	Output signal, channel 3*	
5	PE				

*   **Note:** Channel 1 and channel 3 are only allowed to be used at one socket (X1/X2 or X3/X4).

Basic circuit diagram

The basic circuit diagram of the expansion module is shown below.

Figure 7-12   Basic circuit diagram of expansion module EM 142 DO 4 x DC 24V/0.5A

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 110 × 55
Weight	Approx. 250 g

Module-specific data	
Number of outputs	4
Cable length	
• Unshielded	Max. 30 m

Voltages, currents, potentials	
Aggregate current of outputs	
• All installation positions To 55 °C	Max. 2 A
Electrical isolation	
• Between backplane bus and all other circuit components	Yes
• Between channels	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 28.5 mA
• From load voltage 2L+ (without load)	Max. 6 mA
Power loss of module	Typ. 1.2 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	None

Actuator selection data	
Output voltage	
• With signal "1"	Min. of 2L+ (−0.8 V)
Output current	
• With signal "1"	
Rated value	0.5 A
Permissible range	5 mA to 0.6 A
• With signal "0" (residual current)	Max. 0.1 mA
Load resistance range	48 Ω to 4 kΩ
Lamp load	Max. 5 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Limitation (internal) of voltage induced on circuit interruption	Typ. 2L+ (− 47 V)
Short-circuit protection for output	Yes, electronic
• Response threshold	Typ. 1 A

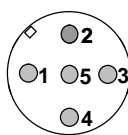## 7.13 EM 142 DO 4 × DC 24V/2A expansion module (6ES7 142-1BD40-0XA0)

Features
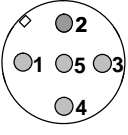
The EM 142 DO 4 × DC 24V/2A expansion module; order number
6ES7 142-1BD40-0XA0 has the following features:

- 4 digital outputs
- Output current 2 A per output
- Rated load voltage 24 VDC
- Suitable for solenoids, DC contactors and indicator lights

Pinout of the sockets for DO

The following table shows the pinout of the four sockets used to connect the digital
outputs. You can find the layout of the sockets in Appendix C The connector wiring
is described in Section 4.4.3.

Table 7-26 Pinout of the sockets for 4-channel digital outputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket (Front)
1	–				
2	Output signal, channel 1*	–	Output signal, channel 3*	–	
3	Chassis ground, load power supply				
4	Output signal, channel 0	Output signal, channel 1*	Output signal, channel 2	Output signal, channel 3*	
5	PE				

*   **Note:** Channel 1 and channel 3 are only allowed to be used at one socket (X1/X2 or X3/X4).

Basic circuit diagram

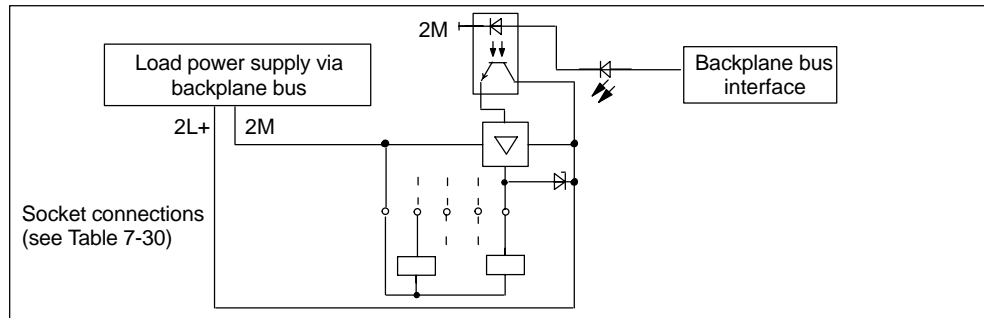The basic circuit diagram of the expansion module is shown below.

Figure 7-13   Basic circuit diagram of expansion module EM 142 DO 4 x DC 24V/2A

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 110 × 55
Weight	Approx. 250 g
Module-specific data	
Number of outputs	4
Cable length	
• Unshielded	Max. 30 m
Voltages, currents, potentials	
Aggregate current of outputs	
• All installation positions	
To 20 °C	Max. 6 A
To 55 °C	Max. 4 A
Electrical isolation	
• Between backplane bus and all other circuit components	Yes
• Between channels	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 28.5 mA
• From load voltage 2L+ (without load)	Max. 12 mA
Power loss of module	Typ. 2.1 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	None
Actuator selection data	
Output voltage	
• With signal "1"	Min. of 2L+ (−0.8 V)
Output current	
• With signal "1"	
Rated value	2 A
Permissible range	5 mA to 2.4 A
• With signal "0" (residual current)	Max. 0.5 mA
Load resistance range	12 Ω to 4 kΩ
Lamp load	Max. 10 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Limitation (internal) of voltage induced on circuit interruption	Typ. 2L+ (− 47 V)
Short-circuit protection for output	Yes, electronic
• Response threshold	Typ. 3 A

7.14   EM 142 DO 4 x DC 24V/2A expansion module (6ES7 142-1BD40-0XB0)

Hardware

The expansion module can be used together with the following basic modules:

- BM 141 DI 8 × DC 24V,   6ES7 141-1BF01-0XB0, from product version 05
  6ES7 141-1BF11-0XB0, from product version 01
  6ES7 141-1BF12-0XB0, from product version 01

- BM 141 DI 8 × DC 24V ECOFAST,
  6ES7 141-1BF00-0AB0, from product version 01
  6ES7 141-1BF01-0AB0, from product version 01

- BM 141 DI 8 × DC 24V ECOFAST DIAG,
  6ES7 141-1BF40-0AB0, from product version 01

- BM 142 DO 4 × DC 24V/2A, 6ES7 142-1BD11-0XB0, from product version 05
  6ES7 142-1BD21-0XB0, from product version 01
  6ES7 142-1BD22-0XB0, from product version 01

- BM 143-DESINA FO,   6ES7 143-1BF00-0XB0, from product version 01

- BM 143-DESINA RS485,   6ES7 143-1BF00-0AB0, from product version 01

- BM 147/CPU,   6ES7 147-1AA00-0XB0, from product version 01

Features

The EM 142 DO 4 x DC 24V/2A expansion module, order number
6ES7 142-1BD40-0XB0, has the following features:

- 4 digital outputs

- Output current 2 A per output

- Rated load voltage 24 VDC

- Suitable for solenoids, DC contactors and indicator lights

- Parameterizable diagnostic interrupt

- Parameterizable diagnostics

- Parameterizable substitute value output

- SF LED

Pinout of the sockets for DO

The following table shows the pinout of the four sockets used to connect the digital outputs. You can find the layout of the sockets in Appendix C. The connector wiring is described in Section 4.4.4.

Table 7-27   Pinout of the sockets for 4-channel digital outputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket (Front)
1	–				
2	Output signal, channel 1*	–	Output signal, channel 3*	–	
3	Chassis ground, load power supply				
4	Output signal, channel 0	Output signal, channel 1*	Output signal, channel 2	Output signal, channel 3*	
5	PE				

*   **Note:** Channel 1 and channel 3 are only allowed to be used at one socket (X1/X2 or X3/X4).

Basic circuit diagram

The basic circuit diagram of the expansion module is shown below.
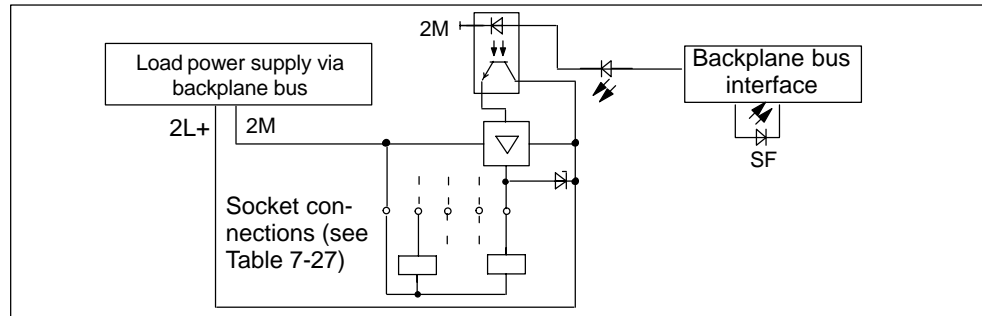

Figure 7-14   Basic circuit diagram of expansion module EM 142 DO 4 x DC 24V/2A

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Parameters

The following table summarizes the parameters that you can set for the expansion module.

In Section 5.4 you will find the parameterizable diagnostics and in Section 5.5 you will find an in-depth description of diagnostic and hardware interrupt handling. You can find the layout of the parameter assignment frame and the assignment of the bits including the parameters of the digital outputs in the *configuration and parameter assignment frame for the ET 200X* at http://www.ad.siemens.de/simatic-cs.

Table 7-28   Parameters of the EM 142 DO 4 x DC 24V/2A

Parameters	Range	Default	Area affected
Enable • Diagnostic interrupt	 Yes/no	 No	Expansion module
Diagnosis • Wire break • Short-circuit to M • Short-circuit to L+	 Yes/no Yes/no Yes/no	 No No No	Channel
Behavior upon CPU STOP	Set substitute value/ maintain last value/no current or voltage	No current or voltage	Channel
Substitute value*	0/1	0	Channel

*   Substitute values are current or voltage values that are output upon STOP of the master CPU by the expansion module to the process.

Effect of the supply voltage and the operating mode

The output values of the module are dependent on the supply voltage for the electronics/sensors and on the operating status of the PLC (CPU of the DP master).

Table 7-29 Dependencies of digital output values on the operating status of the PLC (CPU of DP master) and L + supply voltage

Operating mode of the PLC (CPU of the DP master)		Supply voltage L + to ET 200X	Output value of expansion module
Power on	RUN	L + applied	PLC value
		L + not applied	0 V
Power on	STOP	L + applied	Substitute value/last value (default:0 V)
		L + not applied	0 V
Power off	–	L + applied	• After current operation: substitute value/last value (default: 0 V) • Upon commissioning the DP slave: 0 V
		L + not applied	0 V

Supply voltage on/off

A failure of the supply voltage to the electronics/sensors on the ET 200X is always displayed by the "ON" LED on the basic module and also entered in the diagnostic data area of the basic module.

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 110 × 55
Weight	Approx. 250 g
Module-specific data	
Number of outputs	4
Cable length	
• Unshielded	Max. 30 m
Voltages, currents, potentials	
Aggregate current of outputs	
• All installation positions	
To 20 °C	Max. 6 A
To 55 °C	Max. 4 A
Electrical isolation	
• Between backplane bus and all other circuit components	Yes
• Between channels	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 40 mA
• From load voltage 2L+ (without load)	Max. 60 mA
Power loss of module	Typ. 2.5 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	Diagnostic interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)
Actuator selection data	
Output voltage	
• With signal "1"	Min. of 2L+ (−0.8 V)
Output current	
• With signal "1"	
Rated value	2 A
Permissible range	6 mA to 2.4 A
• With signal "0" (residual current)	Max. 0.5 mA
Load resistance range	12 Ω to 4 kΩ
Lamp load	Max. 10 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible at minimum current of 6 mA
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Limitation (internal) of voltage induced on circuit interruption	Typ. 2L+ (− 53 V)
Short-circuit protection for output	Yes, electronic
• Response threshold	Typ. 3.5 A

7.15 EM 142 DO 8 x DC 24V/1.2A expansion module (6ES7 142-1BF30-0XA0)
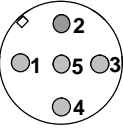
Features

The expansion module EM 142 DO 8 x DC 24V/1.2A; order number 6ES7 142-1BF30-0XA0, has the following features:

- 8 digital outputs
- Output current 1.2 A per output
- Rated load voltage 24 VDC
- Suitable for solenoids, DC contactors and indicator lights

Pinout of the sockets for DO

The following table shows the pinout of the four sockets used to connect the digital outputs. You can find the layout of the sockets in Appendix C. The connector wiring is described in Section 4.4.4.

Table 7-30 Pin assignment of sockets for 8-channel digital outputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket (Front)
1	not assigned				
2	not assigned				
3	Chassis ground, load power supply				
4	Output signal, channel 0	Output signal, channel 1	Output signal, channel 2	Output signal, channel 3	
5	PE				
Pin	**Assignment of socket X5**	**Assignment of socket X6**	**Assignment of socket X7**	**Assignment of socket X8**	
1	not assigned				
2	not assigned				
3	Chassis ground, load power supply				
4	Output signal, channel 4	Output signal, channel 5	Output signal, channel 6	Output signal, channel 7	
5	PE				

Basic circuit diagram

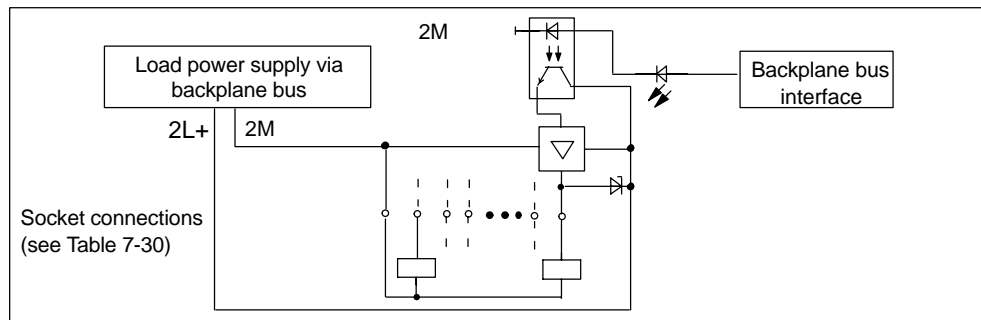The following Figure shows the basic circuit diagram for the expansion module.

Figure 7-15   Basic circuit diagram for expansion module EM 142 DO 8 x DC 24V/1.2A

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 180 × 55
Weight	Approx. 350 g
Module-specific data	
Number of outputs	8
Cable length	
• Unshielded	Max. 30 m
Voltages, currents, potentials	
Aggregate current of outputs	
• All installation positions	
to 20 °C	max. 7 A
to 50 °C	max. 5 A
Electrical isolation	
• Between backplane bus and all other circuit components	Yes
• Between channels	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 35 mA
• From load voltage 2L+ (without load)	Max. 12 mA
Power loss of module	Typ. 1.5 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	None
Actuator selection data	
Output voltage	
• With signal "1"	min. 2L+ (−1.2 V)
Output current	
• With signal "1"	
Rated value	1.2 A
Permissible range	5 mA to 13 A
• With signal "0" (residual current)	Max. 0.5 mA
Load resistance range	21 Ω to 4 kΩ
Lamp load	Max. 10 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Limitation (internal) of voltage induced on circuit interruption	Typ. 2L+ (− 47 V)
Short-circuit protection for output	Yes, electronic
• Response threshold	Typ. 1.8 A

7.16   EM 143-DESINA expansion module (6ES7 143-1BF30-0XB0)

Features

The EM 143-DESINA expansion module (order number 6ES7 143-1BF30-0XB0) has the following features:

- 8 digital inputs or outputs (individually parameterizable as input or output) plus 8 diagnostic inputs or inputs with NC functionality (individually parameterizable).

- Rated input voltage of 24 VDC

- Digital inputs are suitable for switches and proximity switches (BERO switches)

- Digital outputs are suitable for solenoid valves, DC contactors and indicator lights

Pinout of the sockets for DI/DO

The tables below show the pinouts of the 8 sockets for connecting digital inputs and outputs. The connector wiring is described in Section 4.4.4. The arrangement of sockets X1 to X8 on the module in Appendix C.

Table 7-31   Pinout of sockets X1, X3, X5 and X7 for digital inputs or outputs

Pin	Assignment of socket X1	Assignment of socket X3	Assignment of socket X5	Assignment of socket X7	Front view of socket (Front view)
1	Non-switched supply voltage DC 24V-NS				
2	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	
3	Chassis ground, power supply				
4*	Digital input or output (DESINA) channel 0	Digital input or output (DESINA) channel 2	Digital input or output (DESINA) channel 4	Digital input or output (DESINA) channel 6	
5	not assigned				

*   If it is parameterized as a digital output, pin 4 is fed by the DC 24V-S switched supply voltage.

Table 7-32   Pinout of sockets X2, X4, X6 and X8 for digital inputs or outputs

Pin	Assignment of socket X2	Assignment of socket X4	Assignment of socket X6	Assignment of socket X8	Front view of socket (Front view)
1	Non-switched supply voltage DC 24V-NS				
2	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	Diagnostics input or input with NC functionality	
3	Chassis ground, power supply				
4*	Digital input or output (DESINA) channel 1	Digital input or output (DESINA) channel 3	Digital input or output (DESINA) channel 5	Digital input or output (DESINA) channel 7	
5	not assigned				

*   If it is parameterized as a digital output, pin 4 is fed by the DC 24V-NS non-switched supply voltage.

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Basic circuit diagram

The basic circuit diagram of the expansion module is shown below.
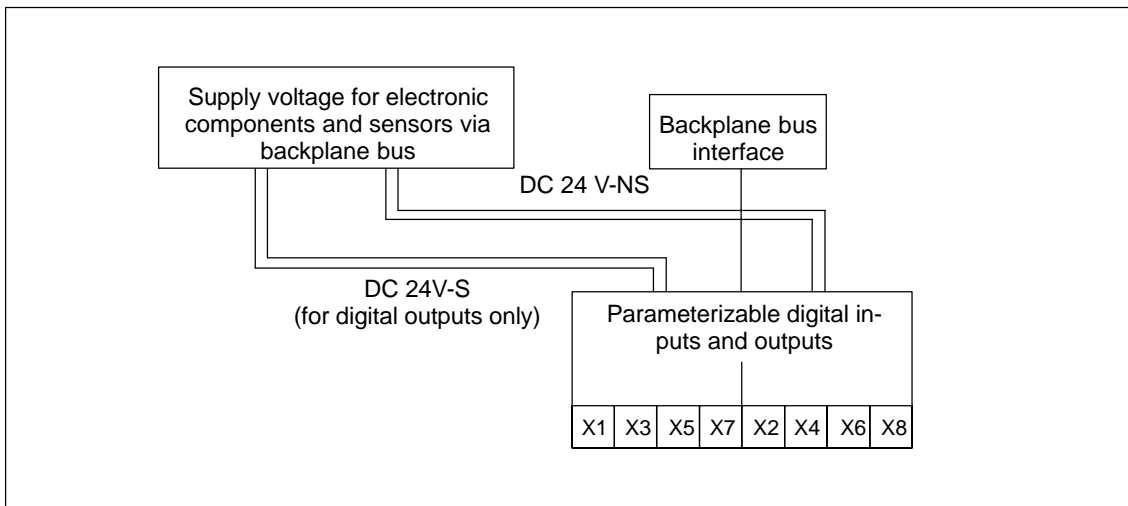

Figure 7-16   Basic circuit diagram of expansion module EM 143-DESINA

Parameters

The following table summarizes the parameters that you can set for the expansion module.

Table 7-33 Parameters of the EM 143-DESINA for digital inputs and outputs

Parameters	Range	Default	Area affected
Channel type for I/On (n= 0...7)	Digital input/ digital output	Digital output (Channel K0, K2, K4, K6) Digital input (Channel K1, K3, K5, K7)	Channel
Functional input In (n=8...15)	Diagnostic input/ diagnostic input with diagnostic frame/ Input with NC function	Diagnostic input	Channel
Response to CPU/master STOP	Output No current or voltage hold last value/ Apply substitute value/	Output No current or voltage	Channel
Substitute value On (n=0...7)	0/1	0	Channel
Diagnostic interrupt	Yes/no	No	Module

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 180 × 55
Weight	Approx. 350 g
Module-specific data	
Number of channels	8 digital inputs and outputs
	8 functional inputs (diagnostics inputs or inputs with NC functionality)
Cable length	
• Unshielded	Max. 30 m
Voltages, currents, potentials	
Maximum number of inputs driven simultaneously	
• All installed positions max. 55 °C	8
Aggregate current of outputs	
• All installation positions	
To 20 °C	Max. 10 A
To 50 °C	Max. 6 A
Electrical isolation	
• Between channels and backplane bus	No
• Between channels	No
• Between load voltages	No
• Between load voltage and all other circuitry	No
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power loss of module	Typ. 1.5 W

Status, alarms, diagnostics	
Status display	Yellow LED per channel
Indicator for functional input	Yellow/red LED per channel
Alarms	Diagnostic interrupt
Diagnostic functions	Configurable
• Reading diagnostic information	Possible
Sensor supply outputs	
Outputs	8
Output current	Up to 40 °C max. 1 A; Up to 55 °C max. 0.8 A
Short-circuit protection	Yes, electronic
Sensor selection data	
Input voltage for parameterized DI (pin 4)	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	−30 to 5V
Input voltage for functional input (pin 2)	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	−30 to 2 V
Input current	
• With signal "1"	Typ. 5 mA
Input delay	
• From "0" to "1"	1.2 to 4.8 ms
• From "1" to "0"	1.2 to 4.8 ms
Input characteristic	To IEC 61131, Type 2
Connection of two-wire BEROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA

Actuator selection data	
Output voltage	
• With signal "1"	Min. NS/S (– 0.8 V)
Output current	
• With signal "1" Nominal value Permissible range	 1.2 A 7 mA to 1.3 A
• With signal "0" (residual current)	Max. 0.5 mA
Load resistance range	21 ohms to 4 kohms
Lamp load	Max. 10 W
Parallel connection of two outputs	No

Driving a digital input	Possible
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 2 Hz
• Lamp load	Max. 1 Hz
Limitation (internal) of voltage induced on circuit interruption	Typ. NS/S (– 47 V)
Output short-circuit protection	Yes, electronic
• Response threshold	Typ. 1.8 A

7.17 EM 148-P DI 4 × DC 24V/DO 2 × P expansion module (pneumatic module) (6ES7 148-1DA00-0XA0)

Features

The EM 148-P DI 4 x DC 24V/DO 2 x P expansion module, order number 6ES7 148-1DA00-0XA0, has the following features:

- 4 digital inputs

- Rated input voltage of 24 VDC

- Suitable for switches and proximity switches (BEROs)

- 2 digital outputs with 2 integrated 4/2-way valves

- Permissible pressure range of 3 to 8 bars

Pinout of the sockets for DI

The following table shows the pinout of the two sockets used to connect the digital inputs. The connector wiring is described in Section 4.4.4. You can find the layout of the sockets in Appendix C.

Table 7-34   Pinout of the sockets for 2-channel digital inputs (pneumatic module)

Pin	Assignment of socket X1	Assignment of socket X2	Front view of socket
1	Sensor supply output 1L+		
2	Input signal, channel 1	Input signal, channel 3	
3	Chassis ground, power supply		
4	Input signal, channel 0	Input signal, channel 2	
5	PE		

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65) is achieved.

Switch-on sequence

The 4/2-way valve is not of the contention-free type.

Consequently, it is important to switch on the compressed air supply first, and then switch on the voltage.

Basic circuit diagram

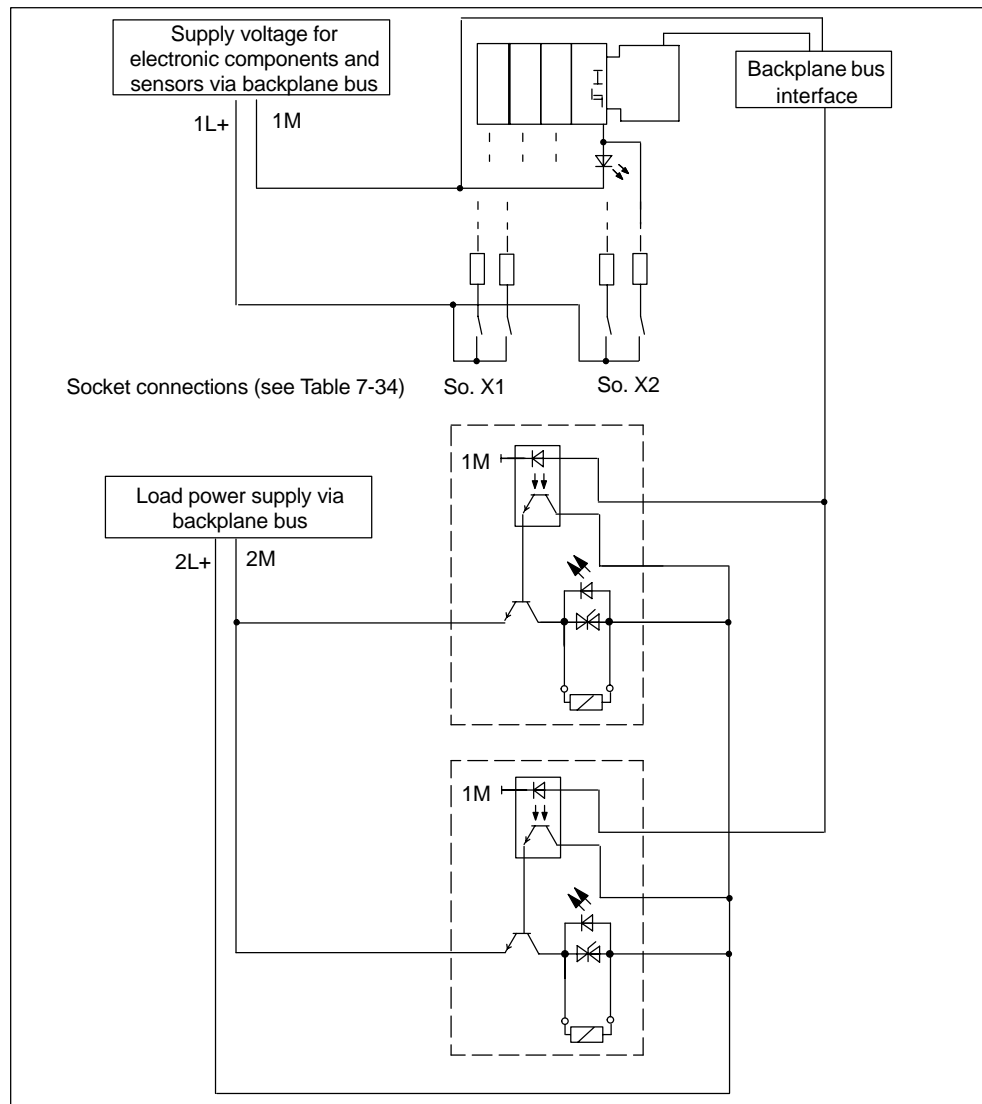The basic circuit diagram of the expansion module is shown below.

Figure 7-17   Basic circuit diagram for EM 148-P DI 4 x DC 24V/DO 2 x P expansion module

Pneumatic connection diagram

The pneumatic connection diagram of a 4/2-way valve is shown below.
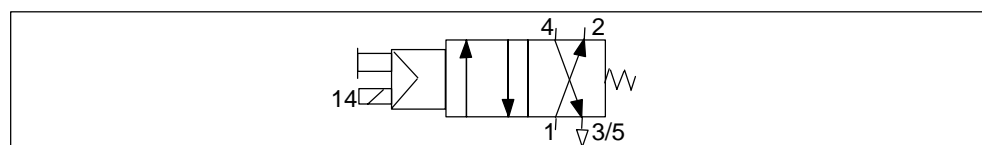

Figure 7-18   Pneumatic connection diagram of a 4/2-way valve

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 173 × 88
Weight	Approx. 500 g
Module-specific data	
Number of inputs	4 (electrical)
Number of outputs	4 (pneumatic)
Length of cable (inputs)	
• Unshielded	Max. 30 m
Voltages, currents, potentials	
Maximum number of inputs driven simultaneously	
• All installation positions To 55 °C	4
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 40 mA
• From 2L+ load voltage (incl. valves)	Max. 130 mA
Power loss of module	Typ. 3 W
Status, alarms, diagnostics	
Status display	Green LED per channel Green LED per valve
Alarms	None

Sensor supply outputs	
Outputs	2
Output current*	Up to 40 °C max. 0.9A; Up to 55 °C max. 0.7A
Short-circuit protection	Yes, electronic
Sensor selection data	
Input voltage	
• Rated value	24 VDC
• With signal "1"	13 to 30 V
• With signal "0"	– 3 to 5 V
Input current	
• With signal "1"	Typ. 7 mA
Input delay	
• From "0" to "1"	1.2 to 4.8 ms
• From "1" to "0"	1.2 to 4.8 ms
Input characteristic	To IEC 61131, Type 2
Connection of two-wire BE-ROs	Possible
• Permissible closed-circuit current	Max. 1.5 mA
Valve outlets	
Medium	Compressed air (for properties refer to paragraph below)
Pressure range	3 to 8 bars
Rated flow	300 l/min
Valve switching times	
• On, change	20 ms
• Off	20 ms
Current input per valve	50 mA

* Please note the total current per ET 200X.

Compressed air for valve outlets

You should operate the valves with filtered (40 μm), dried and oil-free compressed air of Class 5 4 3 in accordance with ISO 8573-1.

Operation with filtered, dried and oiled compressed air of Class 5 4 5 is similarly possible. For this purpose, use an oil that is included on FESTO's list of proposed oils:

Table 7-35   Suitable types of oil for compressed air

Suitable oils	Features
• FESTO OFSW-32 Special Oil • ARAL Vitam GF 32 • Esso Nuto H 32 • Mobil DTE 24 • BP Energol HLP-HM 32	DIN 51 524, Part 2 hydraulic oil, viscosity 32 mm^2/s at 40 °C (HLP 32)

Example of retrieving the 2 limits of travel of a pneumatic cylinder

In the table below you will find an excerpt from a *STEP 7* user program for retrieving the two limits of travel of a pneumatic cylinder.

Assumptions

The following assumptions apply to this *STEP 7* user program:

• In the example the pneumatic module is inserted directly adjacent to the basic module. Its address is therefore 0.

• The pneumatic cylinder is controlled by means of a valve on the pneumatic module.

• The inputs I 0.0 "cylinder down" and I 0.1 "cylinder up" are used for the pneumatic cylinder limits of travel.

• The pneumatic cylinder is controlled by means of output O 0.0.

STEP 7 user program

STL	Description
U I 0.0	When cylinder at limit of travel "down"
U M 0.0	and instruction "cylinder up" queued
S O 0.0	the output is set, i.e. cylinder moves upwards
U I 0.1	When cylinder at limit of travel "up"
U M 0.1	and instruction "cylinder down" queued
R O 0.0	the output is reset, i.e. cylinder moves downwards

7.18   EM 148-P DO 16 × P/CPV10 expansion module (pneumatic interface module for CPV10) (6ES7 148-1EH00-0XA0)

Installation next to motor starter (EM 300...)

You can install the expansion module immediately next to a motor starter, product version ≥ 02.

Features

The EM 148-P DO 16 x P/CPV10 expansion module, order number 6ES7 148-1EH00-0XA0, has the following features:

- 16 digital outputs

- Rated load voltage 24 VDC

- Suitable for connecting a FESTO CPV10 valve island with up to 16 valves

Basic circuit diagram

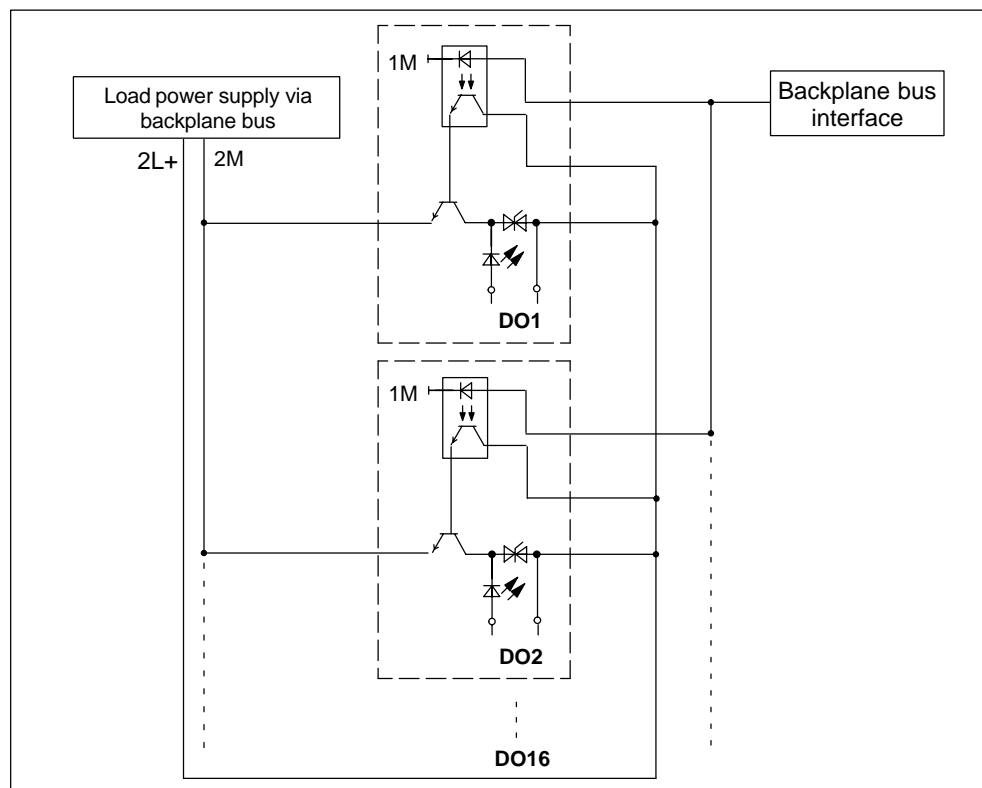The basic circuit diagram of the expansion module is shown below.
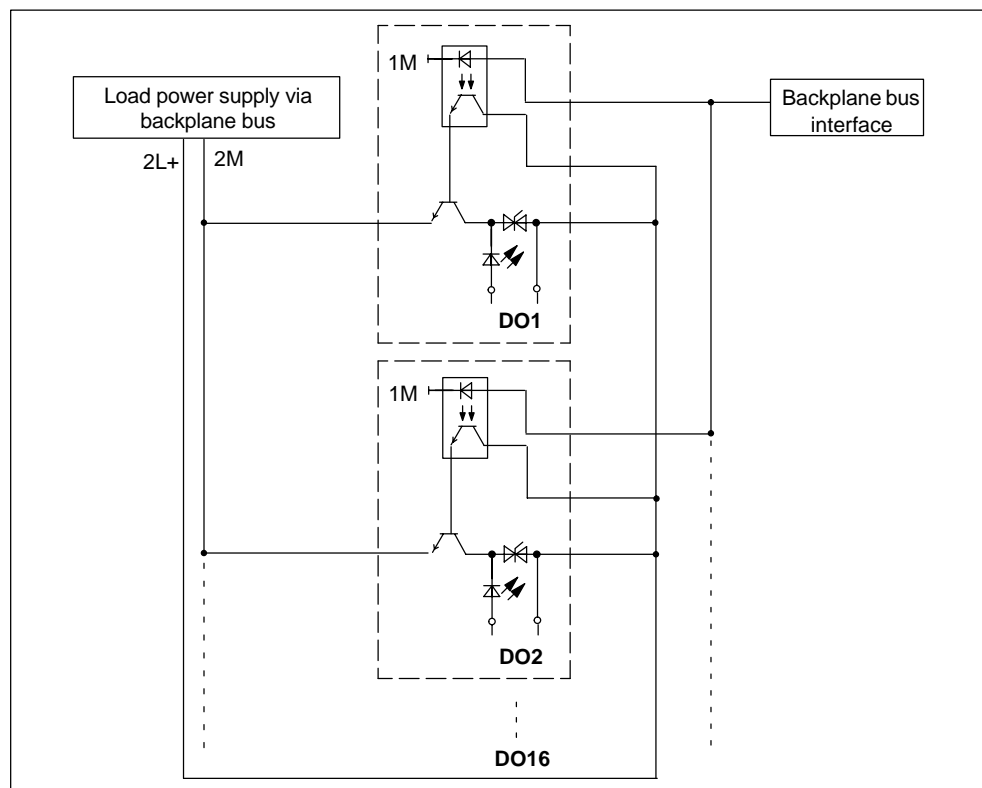
Figure 7-19   Basic circuit diagram of the EM 148-P DO 16 x P/CPV10 expansion module

Assigning addresses to the pneumatic interface module for the CPV10

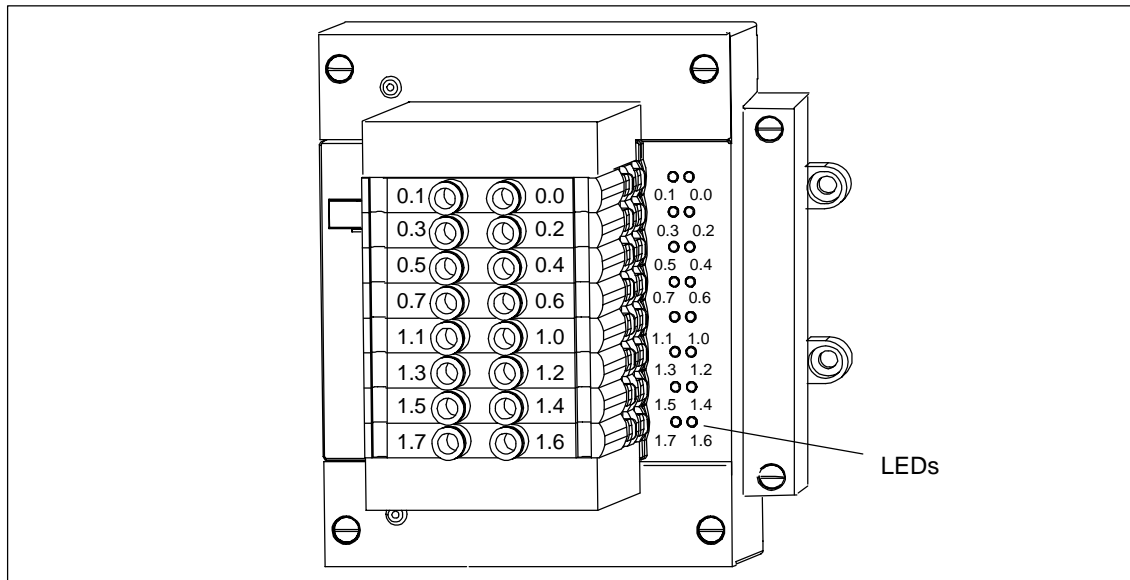The figure below shows the pneumatic interface module with FESTO CPV10 valve island and addresses.
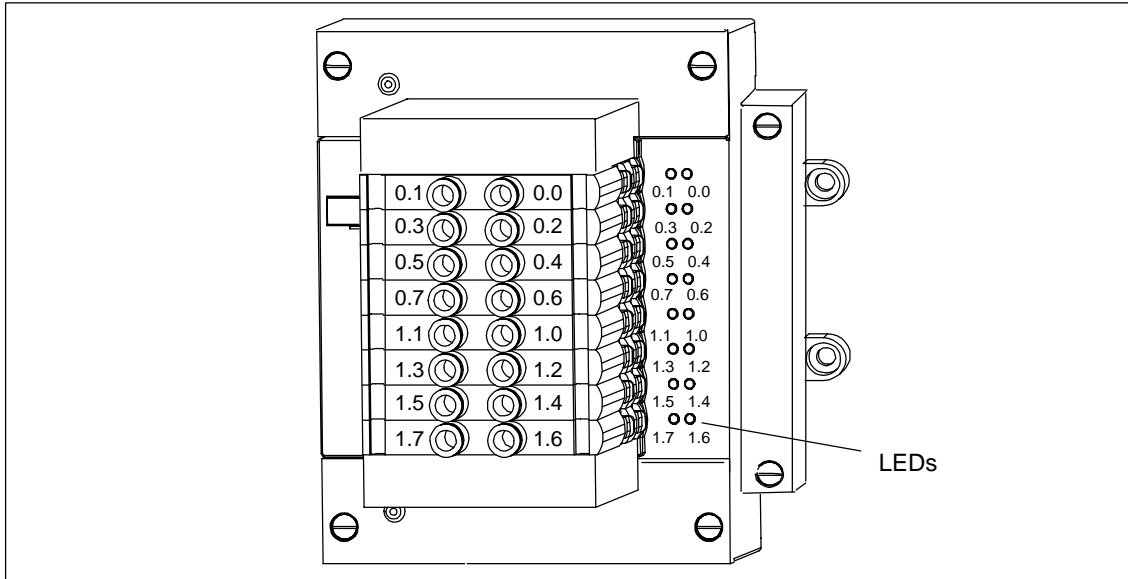
Figure 7-20   Assigning addresses to the pneumatic interface module

Dimensions and weight	
Dimensions W × H × D (mm)	147 × 152 × 55
Weight	Approx. 450 g
Module-specific data	
Number of outputs	16
Voltages, currents, potentials	
Electrical isolation	
• Between extension interface and channels	Yes, optocouplers
• Between channels	No
In groups of	16
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 35 mA
• From 2L+ load voltage (incl. CPV10 valves)	Max. 320 mA
Power loss of module (incl. valves)	Typ. 6 W

Status, alarms, diagnostics	
Status display	Green LED per digital output
Alarms	None
Valve island for connection meets following conditions*	
Medium	Compressed air filtered (40 μm) Oiled (oil: VG 32) Unoiled/vacuum
Pressure range	3 to 8 bars
Rated flow	400 l/min
Valve switching times	
• On, change	17 ms
• Off	25 ms
Current input per valve	20 mA

*   Further details on valve islands will be found in the FESTO documentation on valve islands.

7.19 EM 148-P DO 16 × P/CPV14 expansion module (pneumatic interface module for CPV14) (6ES7 148-1EH10-0XA0)

Installation next to motor starter (EM 300...)

You can install the expansion module immediately next to a motor starter, product version ≥ 02.

Features

The EM 148-P DO 16 x P/CPV14 expansion module, order number 6ES7 148-1EH10-0XA0, has the following features:

- 16 digital outputs

- Rated load voltage 24 VDC

- Suitable for connecting a FESTO CPV14 valve island with up to 16 valves

Basic circuit diagram

The basic circuit diagram of the expansion module is shown below.

Figure 7-21   Basic circuit diagram for EM 148-P DO 16 x P/CPV14 expansion module

Address assignment for pneumatic interface module for CPV14

The figure below shows the pneumatic interface module with FESTO CPV 14 valve island and addresses.

Figure 7-22   Assigning addresses to the pneumatic interface module

Dimensions and weight	
Dimensions W × H × D (mm)	147 × 152 × 55
Weight	Approx. 450 g
Module-specific data	
Number of outputs	16
Voltages, currents, potentials	
Electrical isolation	
• Between extension interface and channels	Yes, optocouplers
• Between channels	No
In groups of	16
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 45 mA
• From 2L+ load voltage (incl. CPV14 valves)	Max. 520 mA
Power loss of module (incl. valves)	Typ. 9 W

Status, alarms, diagnostics	
Status display	Green LED per digital output
Alarms	None
Valve island for connection meets following conditions*	
Medium	Compressed air filtered (40 μm) Oiled (oil: VG 32) Unoiled/vacuum
Pressure range	3 to 8 bars
Rated flow	800 l/min
Valve switching times • On, change • Off	24 msec 30 msec
Current input per valve	32 mA

*   Further details on valve islands will be found in the FESTO documentation on valve islands.

7.20   PM 148 DO 4 × DC 24V/2A power module (6ES7 148-1CA00-0XB0)

Hardware

The power module can be used together with the following basic modules:

- BM 141 DI 8 × DC 24V,   6ES7 141-1BF01-0XB0, from product version 05
6ES7 141-1BF11-0XB0, from product version 01
6ES7 141-1BF12-0XB0, from product version 01

- BM 141 DI 8 × DC 24V ECOFAST,
6ES7 141-1BF00-0AB0, from product version 01
6ES7 141-1BF01-0AB0, from product version 01

- BM 141 DI 8 × DC 24V ECOFAST DIAG,
6ES7 141-1BF40-0AB0, from product version 01

- BM 142 DO 4 × DC 24V/2A, 6ES7 142-1BD11-0XB0, from product version 05
6ES7 142-1BD21-0XB0, from product version 01
6ES7 142-1BD22-0XB0, from product version 01

- BM 143-DESINA FO,   6ES7 143-1BF00-0XB0, version 01 or later

- BM 143-DESINA RS485,   6ES7 143-1BF00-0AB0, version 01 or later

- BM 147/CPU,   6ES7 147-1AA00-0XB0, version 01 or later

Features

The PM 148 DO 4 x DC 24V/2A power module, order number
6ES7 148-1CA00-0XB0, has the following features:

- Connection for load voltage supply

- 4 digital outputs

- Output current 2 A per output

- Rated load voltage 24 VDC

- Suitable for solenoids, DC contactors and indicator lights

- Parameterizable diagnostic interrupt

- Parameterizable diagnostics

- Parameterizable substitute value output

- Indicator for system fault (SF LED)

- Indicator for load voltage (DC 24V LED)

Pinout of sockets for DO

The following table shows the pinout of the four sockets used to connect the digital outputs. You can find the layout of the sockets in Appendix C. The connector wiring is described in Section 4.4.4.

Table 7-36 Pin assignment of sockets for 4-channel digital outputs

Pin	Assignment of socket X1	Assignment of socket X2	Assignment of socket X3	Assignment of socket X4	Front view of socket (Front)
1	–				
2	Output signal, channel 1*	–	Output signal, channel 3*	–	
3	Chassis ground, load power supply				
4	Output signal, channel 0	Output signal, channel 1*	Output signal, channel 2	Output signal, channel 3*	
5	PE				

* **Note:** Channel 1 and channel 3 are only allowed to be used at one socket (X1/X2 or X3/X4).

Basic circuit diagram

The basic circuit diagram of the power module is shown below.
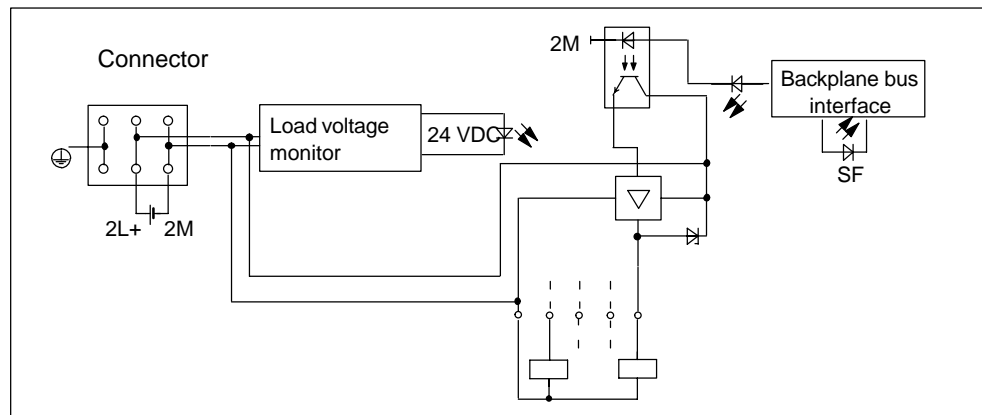
Figure 7-23   Basic circuit diagram of power module PM 148 DO 4 x DC 24V/2A
(6ES7 148-1CA00-0XB0)

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Parameters

The following table summarizes the parameters that you can set for the power module.

In Section 5.4 you will find the parameterizable diagnostics and in Section 5.5 you will find an in-depth description of diagnostic and hardware interrupt handling. You can find the layout of the parameter assignment frame and the assignment of the bits including the parameters of the digital outputs in the *configuration and parameter assignment frame for the ET 200X* at http://www.ad.siemens.de/simatic-cs.

Table 7-37   Parameters of the PM 148 DO 4 x DC 24V/2A

Parameters	Range	Default	Area affected
Enable • Diagnostic interrupt	 Yes/no	 No	Expansion module
Diagnosis • Wire break • Short-circuit to M • Short-circuit to L+	 Yes/no Yes/no Yes/no	 No No No	Channel
Behavior upon CPU STOP	Set substitute value/ maintain last value/no current or voltage	No current or voltage	Channel
Substitute value*	0/1	0	Channel

*   Substitute values are current or voltage values that are output upon STOP of the master CPU by the expansion module to the process.

Effect of the supply voltage and the operating mode

The output values of the module are dependent on the supply voltage for the electronics/sensors and on the operating status of the PLC (CPU of the DP master).

Table 7-38 Dependencies of digital output values on the operating status of the PLC (CPU of DP master) and L + supply voltage

Operating mode of the PLC (CPU of the DP master)		Supply voltage L + to ET 200X	Output value of power module
Power on	RUN	L + applied	PLC value
		L + not applied	0 V
Power on	STOP	L + applied	Substitute value/last value (default:0 V)
		L + not applied	0 V
Power off	–	L + applied	• After current operation: substitute value/last value (default: 0 V) • Upon commissioning the DP slave: 0 V
		L + not applied	0 V

Supply voltage On/Off

A failure of the supply voltage to the electronics/sensors on the ET 200X is always displayed by the "ON" LED on the basic module and also entered in the diagnostic data area of the basic module.

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 165 × 67
Weight	Approx. 250 g
Module-specific data	
Number of outputs	4
Cable length	
• Unshielded	Max. 30 m
Voltages, currents, potentials	
Rated load voltage 2L +	24 VDC
Max. perm. power input from load	Up to 40 °C 10 A Up to 55 °C 8 A
Aggregate current of outputs	
• All installation positions	
Up to 20 °C	Max. 6 A
Up to 55 °C	Max. 4 A
Electrical isolation	
• Between backplane bus and all other circuit components	Yes
• Between channels	No
• Between load power supply and all other circuit components	Yes
Permissible potential difference	
• Between different circuits	75 VDC, 60 VAC
Insulation tested with	500 VDC
Power input	
• From backplane bus (1L+)	Max. 40 mA
• From load voltage 2L+ (without load)	Max. 60 mA
Power loss of module	Typ. 2.5 W

Status, alarms, diagnostics	
Status display	Green LED per channel
Alarms	Diagnostic interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)
• Load voltage monitor	Green LED (DC 24V)
Actuator selection data	
Output voltage	
• With signal "1"	Min. of 2L+ (−0.8 V)
Output current	
• With signal "1"	
Rated value	2 A
Permissible range	6 mA to 2.4 A
• With signal "0" (residual current)	Max. 0.5 mA
Load resistance range	12 Ω to 4 kΩ
Lamp load	Max. 10 W
Parallel connection of two outputs	
• For redundant control of load	Possible (outputs in same group only)
• For performance improvement	Not possible
Driving a digital input	Possible at minimum current of 6 mA
Switching frequency	
• Resistive load	Max. 100 Hz
• Inductive load to IEC 947-5-1, DC13	Max. 0.5 Hz
• Lamp load	Max. 1 Hz
Limitation (internal) of voltage induced on circuit interruption	Typ. 2L+ (− 53 V)
Short-circuit protection for output	Yes, electronic
• Response threshold	Typ. 3.5 A

7.21 Expansion modules with analog inputs and outputs

Hardware

The expansion module can be used together with the following basic modules:

- BM 141 DI 8 × DC 24V,   6ES7 141-1BF01-0XB0, from product version 05
  6ES7 141-1BF11-0XB0, from product version 01
  6ES7 141-1BF12-0XB0, from product version 01

- BM 141 DI 8 × DC 24V ECOFAST,
  6ES7 141-1BF00-0AB0, from product version 01
  6ES7 141-1BF01-0AB0, from product version 01

- BM 141 DI 8 × DC 24V ECOFAST DIAG,
  6ES7 141-1BF40-0AB0, from product version 01

- BM 142 DO 4 × DC 24V/2A, 6ES7 142-1BD11-0XB0, from product version 05
  6ES7 142-1BD21-0XB0, from product version 01
  6ES7 142-1BD22-0XB0, from product version 01

- BM 143-DESINA FO,   6ES7 143-1BF00-0XB0, version 01 or later

- BM 143-DESINA RS485,   6ES7 143-1BF00-0AB0, from product version 01

- BM 147/CPU,   6ES7 147-1AA00-0XB0, from product version 01

EM with analog inputs

By means of expansion modules with analog inputs, continuously changing signals, such as those that occur when measuring temperature or pressure, can be recorded, evaluated and converted to digital values for further processing.

Features of the analog inputs

The expansion modules with analog inputs have the following features:

- Different measuring ranges:
  - ± 10 V
  - ± 20 mA, 4 to 20 mA (four-wire measuring transducer, parameterizable)
  - 4 to 20-wire measuring transducer)
  - Pt100 resistance thermometer (two-, three- or four-conductor connection possible)
- SIMATIC S7 and SIMATIC S5 data format (parameterizable)
- Resolution of 12 bits plus sign
- 2 channels (same measuring range and data format for both channels of an expansion module)
- 24 VDC supply voltage for expansion module and sensor via backplane bus
- Analog inputs not isolated from the internal electronic components
- Integration time 16.7 ms/20 ms (parameterizable)

EM with analog outputs

The expansion modules with analog outputs allow digital values inputted by means of a controller to be converted in an expansion module to corresponding analog signals (current or voltage) that control actuators (setpoint input for speed controllers, temperature controllers, etc.).

Features of the analog outputs

The expansion modules with analog outputs have the following features:

- Different measuring ranges:
  - $\pm$ 10 V
  - $\pm$ 20 mA, 4 to 20 mA (parameterizable)
- SIMATIC S7 and SIMATIC S5 data format (parameterizable)
- Resolution of 11 bits plus sign
- 2 channels (same measuring range and data format for both channels of an expansion module)
- 24 VDC supply voltage
- Analog outputs not isolated from the internal electronic components

Measuring ranges in SIMATIC S7 and S5 format

The following table compares the measuring ranges (rated ranges) in SIMATIC S7 and SIMATIC S5 format:

Table 7-39   Representation of measuring ranges for analog inputs

Measuring range	Representation of the rated ranges in SIMATIC S7 format	Representation of the rated ranges in SIMATIC S5 format
$\pm$ 10 V $\pm$ 20 mA	−27648 to +27648	−2048 to +2048
4 to 20 mA	0 to +27648	512 to +2560
PT100 Standard −100 to +850 ºC	**0.1 ºC/digit**	0.5 ºC/digit −200 to +1700
−200 to +850 ºC	−2000 to +8500	

Table 7-40   Representation of measuring ranges for analog outputs

Output range	Representation of the rated ranges in SIMATIC S7 format	Representation of the rated ranges in SIMATIC S5 format
$\pm$ 10 V $\pm$ 20 mA	−27648 to +27648	−1024 to +1024
4 to 20 mA	0 to +27648	0 to +1024

7.21.1   Parameters of the analog inputs and outputs

Parameter assignment

You set the parameters of the analog inputs/outputs using either the *STEP 7* or *COM PROFIBUS* parameter assignment software.

Parameters

The tables below give an overview of the of the parameters that you can set for the analog inputs and analog outputs.

You can find the layout of the parameter assignment frame and the assignment of the bits including the parameters of the analog inputs and outputs in the **configuration and parameter assignment frame of the ET 200X** at http://www.ad.siemens.de/simatic-cs. In Section 5.4 you will find the parameterizable diagnostics and in Section 5.5 you will find an in-depth description of diagnostic and hardware interrupt handling.

Table 7-41   Parameters of analog inputs

Expansion modules with	Parameters	Range	Default	Area affected
All	Format	SIMATIC S7 format/ SIMATIC S5 format	SIMATIC S7 format	Expansion Module
All	Enable • Diagnostic interrupt • Hardware interrupt upon limit value violation	Yes/no Yes/no	No No	Expansion module
All	Diagnosis • Group diagnosis	Yes/no	No	Channel
EM 144 AI 2 × I (6ES7 144-1GB31-0XB0 and 6ES7 144-1GB41-0XB0) EM 144 AI 2 × RTD (6ES7 144-1JB31-0XB0)	Diagnosis • With wire break check	Yes/no	No	Channel
EM 144 AI 2 × I (6ES7 144-1GB31-0XB0)	Measuring range	20 mA/4 to 20 mA	4 to 20 mA	Channel
EM 145 AO 2 × I (6ES7 145-1GB31-0XB0)	Measuring range	20 mA/4 to 20 mA	4 to 20 mA	Channel
All	Reset time[1]	16.7 ms/20 ms	20 ms	Channel (module channels must be identically set)

Table 7-41 Parameters of analog inputs, Fortsetzung

Expansion modules with	Parameters	Range	Default	Area affected
All	Trigger for hardware interrupt			Channel
	• Upper limit value	From 32511 to −32512	–	
	• Lower limit value	From −32512 to 32511	–	

[1] For optimum interference suppression of the analog modules as a function of the system frequency (at 50 Hz, 20 msec reset time; at 60 Hz, 16.7 msec reset time)

Table 7-42 Parameters of analog outputs

Expansion modules with AOs	Parameters	Range	Default	Area affected
All	Format	SIMATIC S7 format/ SIMATIC S5 format	SIMATIC S7 format	Expansion module
All	Enable • Diagnostic interrupt	Yes/no	No	Expansion module
All	Diagnosis • Group diagnosis	Yes/no	No	Channel
All	Behavior upon CPU STOP	Set substitute value/ maintain last value/no current or voltage	No current or voltage	Channel
All	Substitute value*	0/1	0	Channel

* Substitute values are current or voltage values that are output upon STOP of the master CPU by the module with analog outputs to the process.

7.21.2 Analog value representation for measuring ranges with SIMATIC S7

Analog value representation

The digitized analog value for input and output values in the same rated range is the same.

The analog values are represented in the form of a twos complement.

The following table shows the analog value representation of the expansion modules with analog inputs and outputs:

Table 7-43 Analog value representation (SIMATIC S7 format)

Resolution	Analog value															
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Significance of the bits	$+/-$	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" $\rightarrow$ +
- "1" $\rightarrow$ −

Measured-value resolution

In the table below you will find the representation of the binary analog values and the associated decimal and hexadecimal representation of the units of the analog values.

The analog inputs have a resolution of 12 bits + plus/minus sign, whereas the analog outputs have a resolution of 11 bits + plus/minus sign. Each analog value is entered in the accumulator with left justification. The bits marked "x" are set to "0".

Note: This resolution does not apply to temperature values. The converted temperature values are the result of a conversion in the expansion module (see Table 7-47).

Table 7-44 Measured-value resolution of the analog values (SIMATIC S7 format)

Resolution in bits (plus +/–)	Units		Analog value	
	Decimal	Hexadecimal	High byte	Low byte
11	16	10_H	+/– 0 0 0 0 0 0 0	0 0 0 1 x x x x
12	8	8_H	+/– 0 0 0 0 0 0 0	0 0 0 0 1 x x x

7.21.3 Analog value representation for the measuring ranges of the analog inputs and outputs (SIMATIC S7 Format)

The tables in this chapter contain the digitized analog values for the measuring ranges of the expansion modules with analog inputs and outputs.

The binary representation of the analog values is always the same, so these tables only compare the measuring ranges and the units.

Input ranges $\pm$ 10 V $\pm$ 20 mA

The following table contains the representation of the digitized measured value for the:

- For the voltage measuring range $\pm$ 10 V and

- For the current measuring range $\pm$ 20 mA.

Table 7-45 SIMATIC S7 format: representation of the digitized measured value +/–10 V; +/–20 mA (expansion modules with analog inputs)

Measuring range $\pm$ 10 V	Measuring range $\pm$ 20 mA	Units		Range
		Decimal	Hexadecimal	
> 11.7589	> 23.515	32767	7FFF$_H$	Overflow
11.7589	23.515	32511	7EFF$_H$	Overrange
:	:	:	:	
10.0004	20.0007	27649	6C01$_H$	
10.00	20.000	27648	6C00$_H$	Rated range
7.50	14.998	20736	5100$_H$	
:	:	:	:	
$-$ 7.50	$-$ 14.998	–20736	AF00$_H$	
$-$ 10.00	$-$ 20.000	–27648	9400$_H$	
$-$ 10.0004	$-$ 20.0007	–27649	93FF$_H$	Underrange
:	:	:	:	
$-$ 11.759	$-$ 23.516	–32512	8100$_H$	
<$-$ 11.759	<$-$ 23.516	–32768	8000$_H$	Underflow

Input range 4 to 20 mA

The following table contains the representation of the digitized measured value for the:

- Current measuring range 4 to 20 mA

Table 7-46   SIMATIC S7 format: representation of the digitized measured value 4 to 20 mA (expansion module with analog inputs)

Measuring range from 4 to 20 mA	Units		Range
	Decimal	**Hexadecimal**	
>22.810	32767	7FFF$_H$	Overflow
22.810	32511	7EFF$_H$	Overrange
:	:	:	
20.0005	27649	6C01$_H$	
20.000	27648	6C00$_H$	Rated range
16.000	20736	5100$_H$	
:	:	:	
4.000	0	0$_H$	
3.9995	−1	FFFF$_H$	Underrange
:	:	:	
1.1852	−4864	ED00$_H$	
1.1852	−32768	8000$_H$	Underflow

Relationship between "Wire break" and measuring range

If the "wire break" parameter is deactivated in the configuration software and the measuring range $\leq$ 1.1 mA, then "8000$_H$" is output and bit 6 "measuring range underflow" is set in byte 21 of the station diagnosis.

If the "wire break" parameter is activated and the measuring range $\leq$ 3.6 mA, then "8000$_H$" is output and bit 4 "wire break" is set in byte 21 of the station diagnosis.

Standard temperature range, Pt 100

In the following table you will find the representation of the digitized measured value for the standard temperature range of the Pt 100 sensor. The characteristic linearization applies to the following temperature ranges: – 200 °C to + 850 °C (in increments of 0.1 °C).

Table 7-47   SIMATIC S7 format: representation of the digitized measured value for the standard temperature range, Pt 100 (expansion module with analog inputs)

Measured va-lue in °C	Decimal	Hexadeci-mal	Range
> 1000.0	32767	7FFF$_H$	Overflow
1000.0 : 850.1	10000 : 8501	2710$_H$: 2135$_H$	Overrange
850.0 : −200.0	8500 : −2000	2134$_H$: F830$_H$	Rated range
−200.1 : −243.0	−2001 : −2430	F82F$_H$: F682$_H$	Underrange
<− 243.0	−32768	8000$_H$	Underflow

Tables for output ranges

As of Table 7-48 you will find the analog output ranges of the expansion modules with analog outputs.

Output ranges $\pm$ 10 V $\pm$ 20 mA

The following table contains the representation of the output ranges for the:

- For the voltage output range $\pm$ 10 V and

- For the current output range $\pm$ 20 mA.

Table 7-48   SIMATIC S7 format: representation of the analog output range +/–10 V; +/–20 mA

Output range $\pm$ 10 V	Output range $\pm$ 20 mA	Units		Range
		Decimal	Hexadecimal	
0	0	>32511	>7EFF$_H$	Overflow
11.7589	23.515	32511	7EFF$_H$	
:	:	:	:	Overrange
10.0004	20.0007	27649	6C01$_H$	
10.00	20.000	27648	6C00$_H$	
7.50	14.998	20736	5100$_H$	
:	:	:	:	Rated range
– 7.50	– 14.998	–20736	AF00$_H$	
– 10.00	– 20.000	–27648	9400$_H$	
– 10.0004	–20.0007	–27649	93FF$_H$	
:	:	:	:	Underrange
– 11.7589	– 23.515	–32512	8100$_H$	
0	0	<–32512	<8100$_H$	Underflow

Output range 4 to 20 mA

The following table contains the representation of the current output range 4 to 20 mA.

Table 7-49 SIMATIC S7 format: representation of the analog current output range 4 to 20 mA

Output range 4 to 20 mA	Units		Range
	Decimal	**Hexadecimal**	
0	>32511	>7EFF$_H$	Overflow
22.8142 : 20.0005	32511 : 27649	7EFF$_H$: 6C01$_H$	Overrange
20.000 : 4.000	27648 : 0	6C00$_H$: 0$_H$	Rated range
3.9995 : 0	−1 : − 6912	FFFF$_H$: E500$_H$	Underrange
0	<−6913	<E4FF$_H$	Underflow

7.21.4 Analog value representation for measuring ranges with SIMATIC S5

Analog value representation

The analog inputs have a resolution of 12 bits + plus/minus sign, whereas the analog outputs have a resolution of 11 bits + plus/minus sign. Each analog value is entered in the accumulator with left justification.

The analog values are represented in the form of a twos complement.

Analog inputs

The following table shows the analog value representation of the expansion modules with analog inputs:

Table 7-50   Analog value representation of the analog inputs (SIMATIC S5 format)

Resolution	Analog value															
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Significance of the bits	+/−	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	x	F	Ü

Sign

The sign (+/−) of the analog value is always in bit number 15:

- "0" → +
- "1" → −

Irrelevant bits

Irrelevant bits are marked "x".

Diagnostic bits

Bit numbers 0 and 1 are reserved for diagnostic functions, whereas bit number 2 does not have a function.

- E = error bit (0 = no wire break; 1 = wire break)
- O = overflow bit

Analog outputs

The following table shows the analog value representation of the expansion modules with analog outputs:

Table 7-51   Analog value representation of the analog outputs (SIMATIC S5 format)

Resolution	Analog value															
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Significance of the bits	+/−	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	x	x	x	x

7.21.5   Analog value representation for the measuring ranges of the analog inputs and outputs (SIMATIC S5 format)

The tables in this chapter contain the digitized analog values for the measuring ranges of the expansion modules with analog inputs and outputs.

Format calculation

The SIMATIC S5 format is calculated in the analog module from the SIMATIC S7 format. The overrange in the two formats is therefore the same size (approx. 17.6 %).

Input ranges $\pm$ 10 V

The following table contains the representation of the digitized measured value for the:

- For the voltage measuring range $\pm$ 10 V

Table 7-52 SIMATIC S5 format: representation of the digitized measured value +/–10 V (expansion module with analog inputs)

Measuring range $\pm$ 10 V	Units (dec.)	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	x	F	Ü	Range
>11.7578	2409	0	1	0	0	1	0	1	1	0	1	0	0	1	0	0	1	Overflow
11.7589	2408	0	1	0	0	1	0	1	1	0	1	0	0	0	0	0	0	Overrange
10.005	2049	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
10.00	2048	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5	1024	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Rated range
−5	−1024	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
−10.00	−2048	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
−10.005	−2049	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	Under-range
−11.7578	−2408	1	0	1	1	0	1	0	0	1	1	0	0	0	0	0	0	
<−11.7578	−2409	1	0	1	1	0	1	0	0	1	0	1	1	1	0	0	1	Underflow

Input range ± 20 mA

The following table contains the representation of the digitized measured value for the:

- For the current measuring range ± 20 mA.

Table 7-53   SIMATIC S5 format: representation of the digitized measured value +/–20 mA (expansion module with analog inputs)

Measuring range ± 20 mA	Units (dec.)	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	x	F	Ü	Range
>23.5156	2409	0	1	0	0	1	0	1	1	0	1	0	0	1	0	0	1	Overflow
23.5156	2408	0	1	0	0	1	0	1	1	0	1	0	0	0	0	0	0	Overrange
20.0097	2049	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
20.000	2048	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0.0097	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Rated range
−0.0097	−1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	
−20.000	−2048	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
−20.0097	−2049	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	Under-range
−23.5156	−2408	1	0	1	1	0	1	0	0	1	1	0	0	0	0	0	0	
<−23.5156	−2409	1	0	1	1	0	1	0	0	1	0	1	1	1	0	0	1	Underflow

Input range 4 to 20 mA

The following table contains the representation of the digitized measured value for the:

* Current measuring range 4 to 20 mA

Table 7-54 SIMATIC S5 format: representation of the digitized measured value 4 to 20 mA (expansion module with analog inputs)

Measuring range 4 to 20 mA	Units (dec.)	Data word															Range
		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}	x	F	Ü	
>22.8125	2921	0	1	0	1	1	0	1	1	0	1	0	0	1	0	0	1	Overflow
22.8125	2920	0	1	0	1	1	0	1	1	0	1	0	0	0	0	0	0	Overrange
20.0078	2561	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	
20.000	2560	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
4.0078	513	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	Rated range
4.000	512	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
3.9922	511	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	Under-range
1.1852	151	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	
<1.1797	4095	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	Underflow

Relationship between "Wire break" and measuring range

The $\leq$ 3.6 mA measuring range according to Table 7-54 can be used only if the "wire break" parameter has been deactivated in the software.

When "wire break" has been activated and the measuring range is $\leq$ 3.6 mA, then "4095" is output and the error and overflow bits are set.

Standard temperature range, Pt 100

In the following table you will find the representation of the digitized measured value for the standard temperature range of the Pt 100 sensor. The characteristic linearization applies to the following temperature ranges: – 200 °C to + 850 °C (in increments of 0.5 °C).

Table 7-55 SIMATIC S5 format: representation of the digitized measured value for the standard temperature range, Pt 100 (expansion module with analog inputs)

Measured value in °C	Units (dec.)	Data word															Range
		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	x	F	Ü	
> 1000.0	2001	0	0	1	1	1	1	1	0	1	0	0	0	1	0	0	1	Overflow
1000.0	2000	0	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	Over-range*
851.0	1702	0	0	1	1	0	1	0	1	0	0	1	1	0	0	0	0	
850.0	1700	0	0	1	1	0	1	0	1	0	0	1	0	0	0	0	0	
100	200	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Rated range
−20	− 40	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	
−100.0	− 200	1	1	1	1	1	0	0	1	1	1	0	0	0	0	0	0	
−101.0	− 202	1	1	1	1	1	0	0	1	1	0	1	1	0	0	0	0	Under-range
−243.0	− 486	1	1	1	1	0	0	0	0	1	1	0	1	0	0	0	0	
< −243.0	− 487	1	1	1	1	0	0	0	0	1	1	0	0	1	0	0	1	Under-flow*

*   In the overrange and underrange, the gradient of the characteristic curve at the point where the linearized rated range is left is retained.

Tables for output ranges

As of Table 7-56 you will find the analog output ranges of the expansion modules with analog outputs.

Output range ± 10 V

The following table contains the representation of the voltage output range ± 10 V.

Table 7-56 SIMATIC S5 format: representation of the analog voltage output range +/–10 V

Output range ± 10 V	Units (dec.)	Data word																Range
		2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	x	x	x	x	
0	≥ 1205	0	1	0	0	1	0	1	1	0	1	0	1	x	x	x	x	Overflow
11.7578	1204	0	1	0	0	1	0	1	1	0	1	0	0	x	x	x	x	Overrange
10.0098	1025	0	1	0	0	0	0	0	0	0	0	0	1	x	x	x	x	
10.0000	1024	0	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	
0.0098	1	0	0	0	0	0	0	0	0	0	0	0	1	x	x	x	x	
0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	x	x	x	x	Rated range
−0.0098	−1	1	1	1	1	1	1	1	1	1	1	1	1	x	x	x	x	
−10.0000	−1024	1	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	
−10.0098	−1025	1	0	1	1	1	1	1	1	1	1	1	1	x	x	x	x	Under-range
−11.7578	−1204	1	0	1	1	0	1	0	0	1	1	0	0	x	x	x	x	
0	≤ 1205	1	0	1	1	0	1	0	0	1	0	1	1	x	x	x	x	Underflow

Output range ± 20 mA

The following table contains the representation of the current output range ± 20 mA.

Table 7-57 SIMATIC S5 format: representation of the analog current output range +/–20 mA

Output range ± 20 mA	Units (dec.)	Data word																Range
		2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	x	x	x	x	
0	≥ 1205	0	1	0	0	1	0	1	1	0	1	0	1	x	x	x	x	Overflow
23.5156	1204	0	1	0	0	1	0	1	1	0	1	0	0	x	x	x	x	Overrange
20.0195	1025	0	1	0	0	0	0	0	0	0	0	0	1	x	x	x	x	
20.000	1024	0	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	
0.0195	1	0	0	0	0	0	0	0	0	0	0	0	1	x	x	x	x	
0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	x	x	x	x	Rated range
−0.0195	−1	1	1	1	1	1	1	1	1	1	1	1	1	x	x	x	x	
−20.000	−1024	1	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	
−20.0195	−1025	1	0	1	1	1	1	1	1	1	1	1	1	x	x	x	x	
−23.5156	−1204	1	0	1	1	0	1	0	0	1	1	0	0	x	x	x	x	Under-range
0	≤ −1205	1	0	1	1	0	1	0	0	1	0	1	1	x	x	x	x	Underflow

Output range 4 to 20 mA

The following table contains the representation of the current output range 4 to 20 mA.

Table 7-58   SIMATIC S5 format: representation of the analog current output range 4 to 20 mA

Output range 4 to 20 mA	Units (dec.)	Data word																Range
		2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	x	x	x	x	
0	≥ 1205	0	1	0	0	1	0	1	1	0	1	0	1	x	x	x	x	Overflow
22.8125	1204	0	1	0	0	1	0	1	1	0	1	0	0	x	x	x	x	Overrange
20.0156	1025	0	1	0	0	0	0	0	0	0	0	0	1	x	x	x	x	
20.000	1024	0	1	0	0	0	0	0	0	0	0	0	0	x	x	x	x	
4.0156	1	0	0	0	0	0	0	0	0	0	0	0	1	x	x	x	x	Rated range
4.000	0	0	0	0	0	0	0	0	0	0	0	0	0	x	x	x	x	
3.9844	−1	1	1	1	1	1	1	1	1	1	1	1	1	x	x	x	x	Underrange
0	−256	1	1	1	1	0	0	0	0	0	0	0	0	x	x	x	x	
0	−257	1	1	1	0	1	1	1	1	1	1	1	1	x	x	x	x	Underflow
0	≤ −1205	1	0	1	1	0	1	0	0	1	0	1	1	x	x	x	x	

7.21.6 Behavior of the analog inputs and outputs during operation and in the event of faults

This chapter deals with the following topics:

- The dependency of the analog input and output values on the supply voltage of the expansion module and the operating modes of the PLC

- The behavior of the analog expansion modules as a function of the position of the analog values in the relevant value range

- The effect of errors on the analog inputs/outputs

Effect of the supply voltage and the operating mode

The input and output values of the analog modules are dependent on the supply voltage for electronic components/sensors and on the operating mode of the PLC (CPU of the DP master).

Table 7-59 How the analog input/output values depend on the operating mode of the PLC (CPU of the DP master) and the supply voltage L +

Operating mode of the PLC (CPU of the DP master)		Supply voltage L + to ET 200X	Input value of the expansion module with analog inputs and (evaluation possible in the CPU of the DP master)	Output value of the expansion module with analog outputs
Power on	RUN	L + applied	Process value	PLC value
			$7FFF_H$ until the first conversion after the module is switched on or after the module is parameterized	Until the first conversion ... • **after the module is switched on**, a signal of 0 mA or 0 V is output. • **after the module is parameterized**, the previous value is output.
		L + not applied	0 mA/0 V	0 mA/0 V
Power on	STOP	L + applied	0 mA/0 V	Substitute value/last value (default: 0 mA/0 V)
		L + not applied	0 mA/0 V	0 mA/0 V
Power off	–	L + applied	–	0 mA/0 V
		L + not applied	–	0 mA/0 V

Supply voltage On/Off

A failure of the supply voltage to the electronics/sensors on the ET 200X is always displayed by the "ON" LED on the basic module and also entered in the diagnostic data area of the basic module.

⚠️ **Caution**

When the supply voltage for electronic components/sensors on the ET 200X is switched on/off, incorrect interim values may be obtained temporarily at the analog outputs.

Effect of the value range for the analog input

The behavior of the expansion modules with analog inputs depends on where the input values are in the value range. The following table indicates this:

Table 7-60 Behavior of the analog modules as a function of the position of the analog output value

Measured value in	Input value in SIMATIC S7 format	Input value in SIMATIC S5 format	SF LED	Diagnostic data area of the module	Interrupt
in the rated range	Measured value	Measured value	–	–	–
in the over-range/under-range	Measured value	Measured value	–	–	–
in the overflow	$7FFF_H$	End of the overrange +1 plus overflow bit	On*	Entry performed*	Diagnostic interrupt**
in the underflow	8000_H	End of the underrange −1 plus overflow bit	On*	Entry performed*	Diagnostic interrupt**
Outside the upper or lower limit value	Measured value	Measured value	–	–	Hardware interrupt**
Before parameterization or in the event of incorrect parameterization	$7FFF_H$	$7FFF_H$	On*	–	–

*   When the "group diagnosis" parameter has been enabled in the configuration software
** When the diagnostic or hardware interrupt has been enabled in the configuration software

EM 144 AI 2 x RTD, response in the event of a wire break

If a wire break occurs on one of the EM 144 AI 2 x RTD expansion module's channels, the measured values on the expansion module's other channel may be corrupted. When this happens in S5 format, the overflow bit is set and the value $06E6_H$ is loaded; in S7 format the value $7FFF_H$ is loaded.

Effect of the value range for the analog output

The behavior of the expansion modules with analog outputs depends on where the output values are in the value range. The following table indicates this:

Table 7-61   Behavior of the analog modules depending on the position of the analog output value in the value range

Output value in	Output value in SIMATIC S 5/S7 format	SF LED	Diagnostic data area of the module	Interrupt
Rated range	Value from DP master	–	–	–
Overrange/underrange	Value from DP master	–	–	–
Overflow	0 signal	–	–	–
Underflow	0 signal	–	–	–
Before parameterization or in the event of incorrect parameterization	0 signal	On*	–	–

7.21.7 Connecting measuring sensors to the analog inputs

You can connect different measuring sensors to the analog inputs depending on the type of measurement involved:

- Voltage sensors
- Current sensors as:
  - Two-wire measuring transducers
  - Four-wire measuring transducers
- Resistance thermometers

Abbreviations used

The following abbreviations are used in the figures in this section:

I_{C+}:   Constant-current line (positive)

I_{C-}:   Constant-current line (negative)

M_+:   Measuring line (positive)

M_-:   Measuring line (negative)

1M: Frame connection for sensor

$1L_+$:   Supply voltage connection for DC 24 V sensor

Connecting voltage sensors

The figure below shows how voltage sensors are connected to an expansion module with analog inputs.
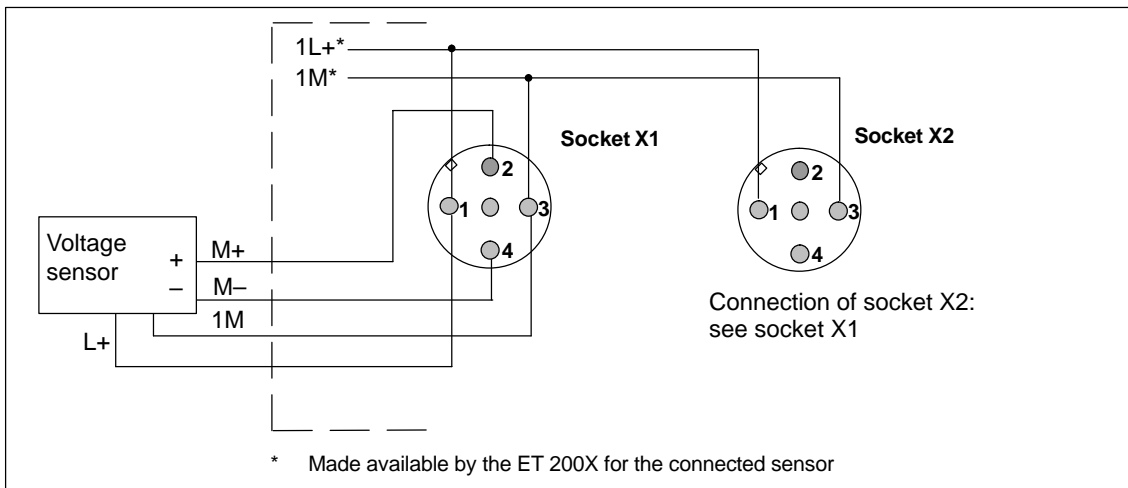
Figure 7-24   Connection of voltage sensors to analog inputs (EM with order number 6ES7 144-1FB31-0XB0)

Connecting current sensors as two- and four-wire measuring transducers

The supply voltage is fed to the two-wire measuring transducer and is inherently short circuit-proof. The two-wire measuring transducer then converts the fed measured value into a current. Four-wire measuring transducers have a separate supply voltage connection.

The two-wire measuring transducers must be insulated measuring sensors.

The figure below shows how current sensors are connected as two-wire measuring transducers to an EM 144 AI 2 $\times$ I expansion module (4 to 20 mA).
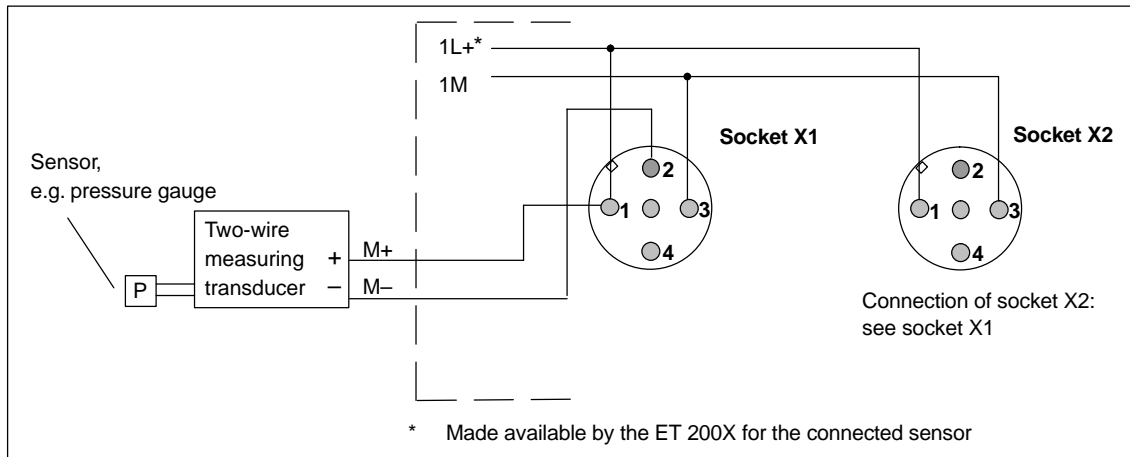
Figure 7-25   Connection of current sensors (two-wire measuring transducers) to analog inputs (EM with order number 6ES7 144-1GB41-0XB0)

Four-wire measuring transducer at the EM 144 AI 2 $\times$ I ($\pm$ 20 mA)

The figure below shows how current sensors are connected as four-wire measuring transducers to an EM 144 AI 2 $\times$ I expansion module ($\pm$ 20 mA).

* Made available by the ET 200X for the connected sensor;
1L+ of module must be used since a possible broken wire signal is possible
only with the sensor supply made available by the module.
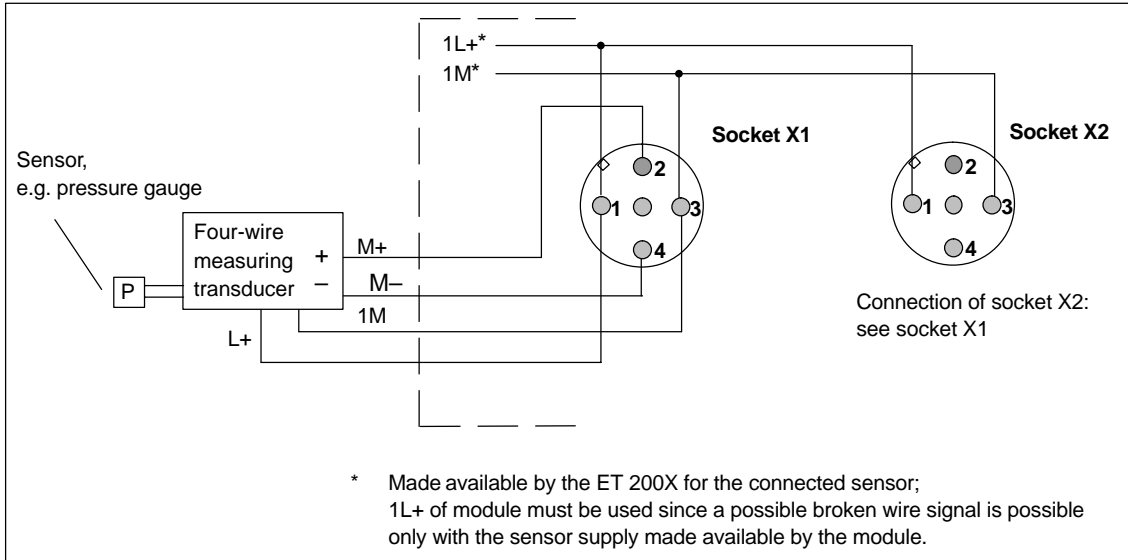
Figure 7-26   Connection of current sensors (four-wire measuring transducers) to analog inputs (EM with order number 6ES7 144-1GB31-0XB0)

Four-wire measuring transducer to EM 144 AI 2 $\times$ I (4 to 20 mA)

The figure below shows how current sensors are connected as four-wire measuring transducers to an EM 144 AI 2 $\times$ I expansion module (4 to 20 mA).
Note: There is no L+ available at pin 1 on the expansion module. You therefore have to feed the supply voltage for the current sensor from an external source.
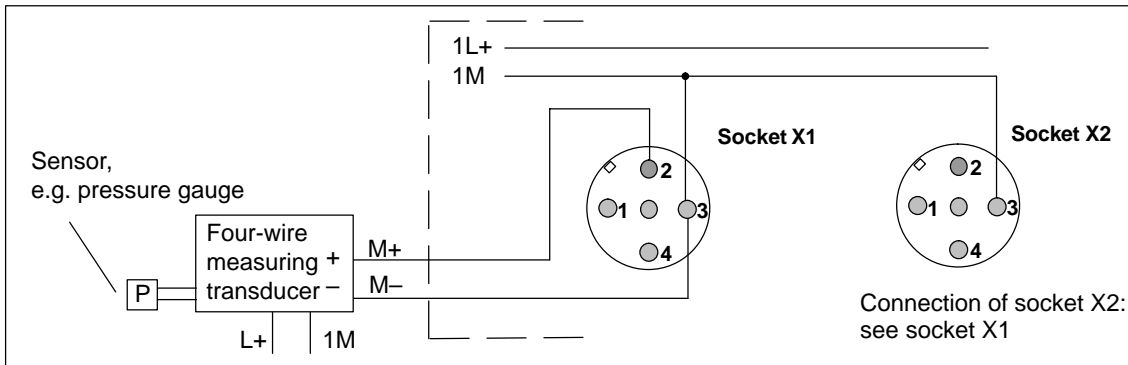
Figure 7-27   Connection of current sensors (four-wire measuring transducers) to analog inputs (EM with order number 6ES7 144-1GB41-0XB0)

Connecting Pt 100 resistance thermometers

The resistance thermometers are measured in a four-conductor connection. Constant current is fed to the resistance thermometers via connections I_{C+} and I_{C-}. The voltage generated at the resistance thermometer is measured via connections M_+ and M_-. This ensures highly accurate measurement results with the four-conductor connection. The figure below shows how resistance thermometers are connected to an EM 144 AI 2 × RTD expansion module.
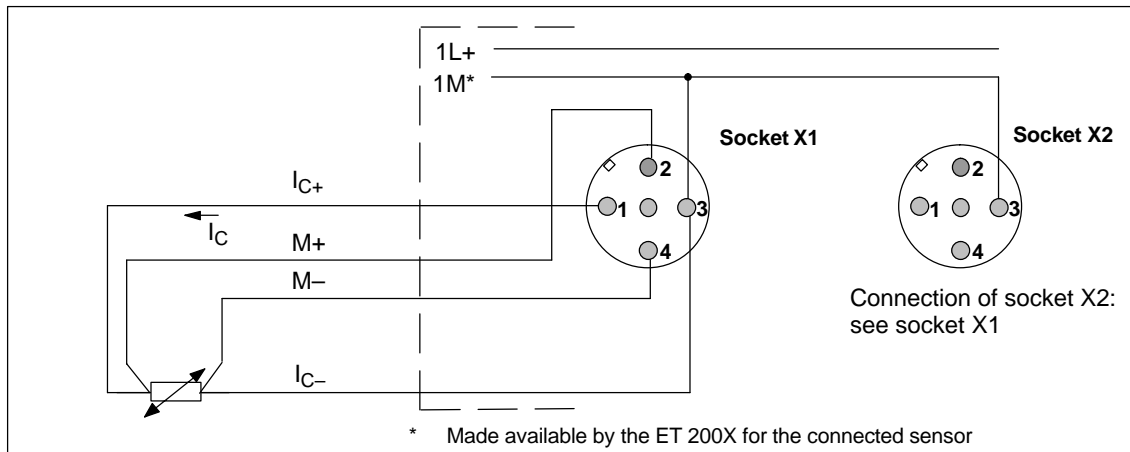
Figure 7-28   Connection of resistance thermometers to EM 144 AI 2 x RTD (EM with order number 6ES7 144-1JB31-0XB0)

In the case of a two- or three-wire connection, you have to create appropriate bridges in the connector to form connections between M_+ and I_{C+} and M_- and I_{C-} on the expansion module. However, you must reckon with a lost of accuracy in the measurement results.

7.21.8   Connecting loads to the analog outputs

When you use expansion modules with analog outputs, you can supply loads/actuators with current or voltage.

Abbreviations used

The following abbreviations are used in the figures in this section:

Q_I: Analog output current

Q_V: Analog output voltage

1M: Frame connection/reference potential of the analog circuit

R_L: Load/actuator

Connecting loads to a voltage output

You have to connect loads to a current output at Q_V and the reference point of the analog circuit 1M (see Figure 7-29).

Four-conductor connection

If you connect a load with a 4-core cable to a voltage output, use only 2 of the cable's cores and connect them to pins 1 and 3.

Connecting loads to a current output

You have to connect loads to a current output at Q_I and the reference point of the analog circuit 1M.

The figure below shows how loads are connected to a voltage or current output of an expansion module with analog outputs.
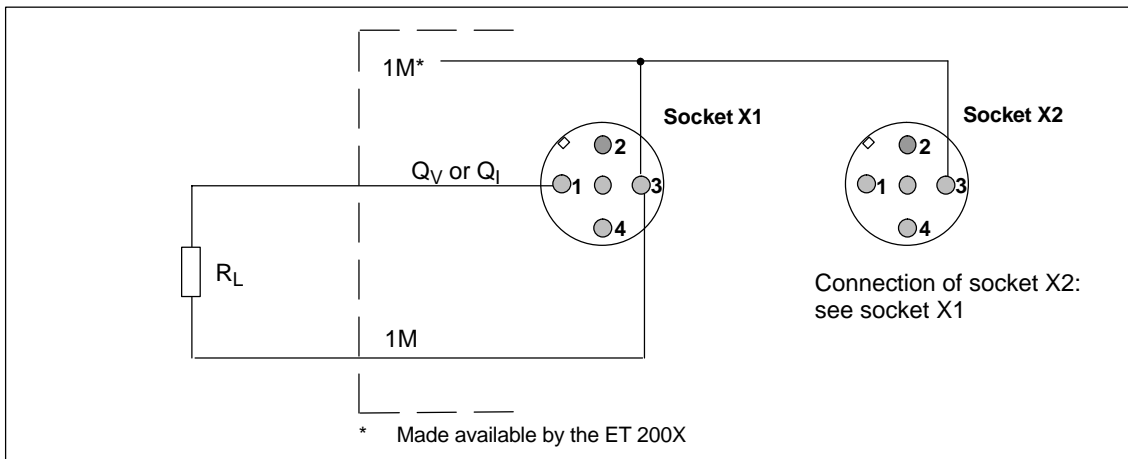
Figure 7-29   Connection of loads to a voltage or current output (analog output; EM with order number 6ES7 145-1FB31-0XB0; 6ES7 145-1GB31-0XB0)

7.21.9 EM 144 AI 2 x U expansion module (6ES7 144-1FB31-0XB0)

Features
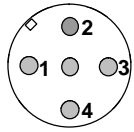
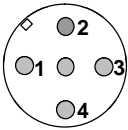The EM 144 AI 2 × U expansion module with the order number
6ES7 144-1FB31-0XB0 has the following features:

- 2 inputs for voltage measurement (2 channels with the same measuring range and data format)
- Input range ± 10 V
- Resolution of 12 bits plus sign
- 24 VDC supply voltage
- Non-isolated
- Parameterizable diagnostic interrupt
- Parameterizable hardware interrupt
- Parameterizable diagnostics
- SF LED

Pinout of the sockets for AI

The following table shows the pinout of the two sockets used to connect the analog inputs. You can find the layout of the sockets in Appendix C.

Table 7-62 Pinout of the sockets for 2-channel analog inputs (voltage)

Pin	Assignment of socket X1	Assignment of socket X2	Front view of socket (Front view)
1	Sensor supply output 1L+		
2	Input signal "+", channel 0	Input signal "+", channel 1	
3	Chassis ground, power supply		
4	Input signal "–", channel 0	Input signal "–", channel 1	

Basic circuit diagram

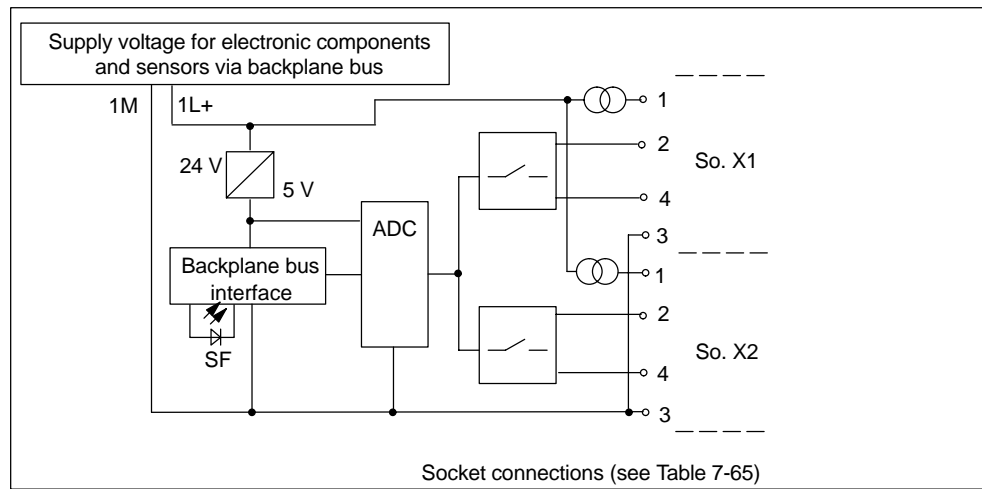The basic circuit diagram of the expansion module is shown below.

Figure 7-30   Basic circuit diagram of expansion module EM 144 AI 2 x U

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 110 × 55
Weight	Approx. 250 g
Module-specific data	
Number of inputs	2
Cable length	
• Shielded	Max. 30 m

Voltages, currents, potentials	
Electrical isolation	No
Permissible potential difference	2.0 VDC; AC$_{SS}$
• Between input (frame connection) and M$_{ANA}$ (U$_{CM}$)	
• Between M$_{ANA}$ and centralized grounding point (U$_{ISO}$)	0 VAC; DC
Power input	Max. 40 mA
• From supply voltage L+	Typ. 0.9 W
Power loss of the module	

Analog value formation	
Measurement principle	Integrative
Integration and cycle time/ resolution per channel:	
• Integration time parameterizable	Yes
• Integration time in ms	16.7 20
• Cycle time in ms (all channels)	134 160
• Interference voltage suppression for interference frequency f1 in Hz	60 50
• Resolution (including overrange)	12 bits plus sign
• Rated value in units:	
– SIMATIC S7 format:	6912
– SIMATIC S5 format:	4096

Interference suppression, error limits	
Interference voltage suppression	
• Common-mode interference	> 60 dB
• Series-mode interference (peak interference value < rated value of input range)	> 40 dB
Operational limit (entire temperature range with reference to input range)	± 1.2 %
Basic error (operational limit at 25 °C with reference to input range)	± 1.0 %

Temperature error (with reference to input range)	± 0.01 %/K
Crosstalk between inputs	> 45 dB
Linearity error (with reference to input range)	± 0.05 %
Repeat accuracy (steady state at 25 °C with reference to input range)	± 0.05 %

Status, alarms, diagnostics	
Alarms	• Diagnostic interrupt
	• Hardware interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)

Sensor supply outputs	
Outputs	2
Output current*	Up to 40 °C max. 0.9A; Up to 55 °C max. 0.7A
Short circuit protection	Yes, electronic

Sensor selection data	
Input range (rated value)/input resistance	± 10 V/100 kΩ
Permissible input voltage (destruction limit)	30 V
Sensor connection	
• For voltage measurement	Possible

*   Please note the total current per ET 200X.

7.21.10   EM 144 AI 2 x I expansion module (+/–20 mA) (6ES7 144-1GB31-0XB0)

Features
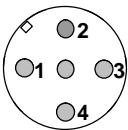
The EM 144 AI 2 $\times$ I expansion module with the order number
6ES7 144-1FB31-0XB0 has the following features:

- 2 inputs for current measurement (2 channels with the same measuring range and data format)
- Parameterizable input range, $\pm$ 20 mA or 4 to 20 mA
- Connection of sensors as four-wire measuring transducers
- Resolution of 12 bits plus sign
- 24 VDC supply voltage
- Non-isolated
- Parameterizable diagnostic interrupt
- Parameterizable hardware interrupt
- Parameterizable diagnostics
- SF LED

Pinout of the sockets for AI

The following table shows the pinout of the two sockets used to connect the analog inputs. You can find the layout of the sockets in Appendix C.

Table 7-63   Pinout of the sockets for 2-channel analog inputs (EM 144 AI 2 x I)

Pin	Assignment of socket X1	Assignment of socket X2	Front view of socket (Front view)
1	Sensor supply output 1L+		
2	Input signal ”+”, channel 0	Input signal ”+”, channel 1	
3	Chassis ground, power supply		
4	Input signal ”–”, channel 0	Input signal ”–”, channel 1	

Basic circuit diagram

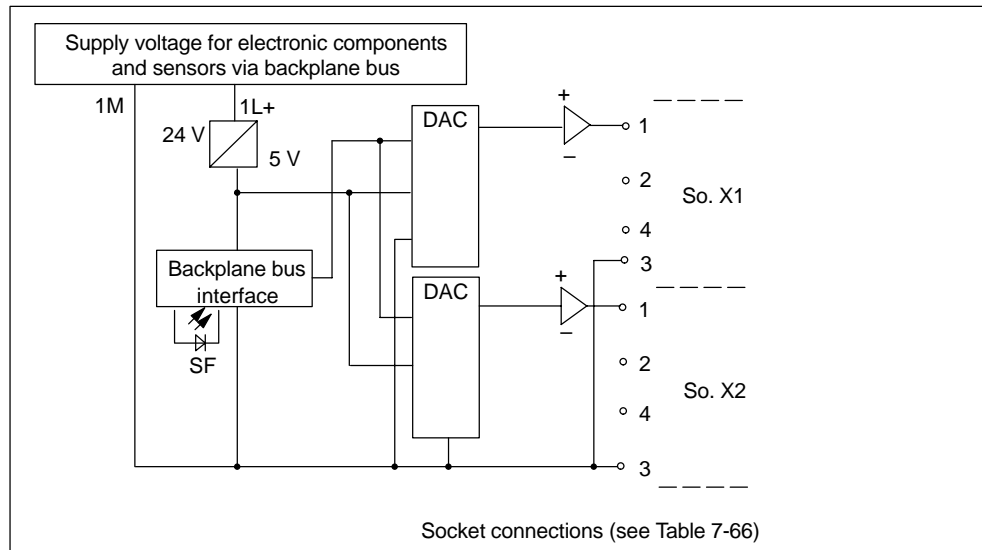The basic circuit diagram of the expansion module is shown below.

Figure 7-31   Basic circuit diagram of expansion module EM 144 AI 2 x I

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Dimensions and weight	
Dimensions W $\times$ H $\times$ D (mm)	87 $\times$ 110 $\times$ 55
Weight	Approx. 250 g
Module-specific data	
Number of inputs	2
Cable length	
• Shielded	Max. 30 m

Voltages, currents, potentials	
Electrical isolation	No
Permissible potential difference	2.0 VDC; AC_{SS}
• Between input (frame connection) and M_{ANA} (U_{CM})	
• Between M_{ANA} and centralized grounding point (U_{ISO})	0 VAC; DC
Power input	
• From supply voltage L+	Max. 40 mA
Power loss of the module	Typ. 0.9 W

Analog value formation		
Measurement principle	Integrative	
Integration and cycle time/ resolution per channel:		
• Integration time parameterizable	Yes	
• Integration time in ms	16.7	20
• Cycle time in ms (all channels)	134	160
• Interference voltage suppression for interference frequency f1 in Hz	60	50
• Resolution (including overrange)	12 bits plus sign	
• Rated value in units:		
– SIMATIC S7 format:	6912	
– SIMATIC S5 format:	4096	

Interference suppression, error limits	
Interference voltage sup- pression	
• Common-mode interference	> 60 dB
• Series-mode interference (peak interference value < rated value of input range)	> 40 dB
Operational limit (entire temperature range with re- ference to input range)	± 1.2 %
Basic error (operational limit at 25 °C with reference to input range)	± 1.0 %
Temperature error (with re- ference to input range)	± 0.01 %/K

Crosstalk between inputs	> 45 dB
Linearity error (with refe- rence to input range)	± 0.05 %
Repeat accuracy (steady state at 25 °C with reference to input range)	± 0.05 %

Status, alarms, diagnostics	
Alarms	• Diagnostic interrupt
	• Hardware interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)

Sensor supply outputs	
Outputs	2
Output current*	Up to 40 °C max. 0.9A; Up to 55 °C max. 0.7A
Short circuit protection	Yes, electronic

Sensor selection data	
Input range (rated range)/input resistance parameterizable	± 20 mA/25 Ω
	4 to 20 mA
Permissible input voltage (destruction limit)	40 mA
Sensor connection	
• For current measurement:-wire measuring transducer**	Not possible Possible

* Please note the total current per ET 200X.
** 1L+ of module must be used since a possible broken wire signal is possible only with the sensor supply made available by the module.

7.21.11 EM 144 AI 2 x I expansion module (4 to 20 mA) (6ES7 144-1GB41-0XB0)

Features

The EM 144 AI 2 × I expansion module with the order number
6ES7 144-1GB41-0XB0 has the following features:

- 2 inputs for current measurement (2 channels with the same measuring range and data format)
- Input range 4 to 20 mA
- Connection of sensors as two- or four-wire measuring transducers
- Resolution of 12 bits plus sign
- 24 VDC supply voltage
- Non-isolated
- Parameterizable diagnostic interrupt
- Parameterizable hardware interrupt
- Parameterizable diagnostics
- SF LED

Pinout of the sockets for AI

The following table shows the pinout of the two sockets used to connect the analog inputs. You can find the layout of the sockets in Appendix C.

Table 7-64 Pinout of the sockets for 2-channel analog inputs (EM 144 AI 2 x I, 4 to 20 mA)

Pin	Assignment of socket X1	Assignment of socket X2	Front view of socket (Front view)
1	Sensor supply output 1L+*; Input signal "+", channel 0	Sensor supply output 1L+*; Input signal "+", channel 1	
2	Input signal "–", channel 0	Input signal "–", channel 1	
3	Chassis ground, power supply		
4	–		

*   L+ is not available at pin 1 for connecting **four-wire measuring transducers**. You therefore have to feed the sensor supply voltage from an external source (see also Section 7.21.7).

Basic circuit diagram

The basic circuit diagram of the expansion module is shown below.
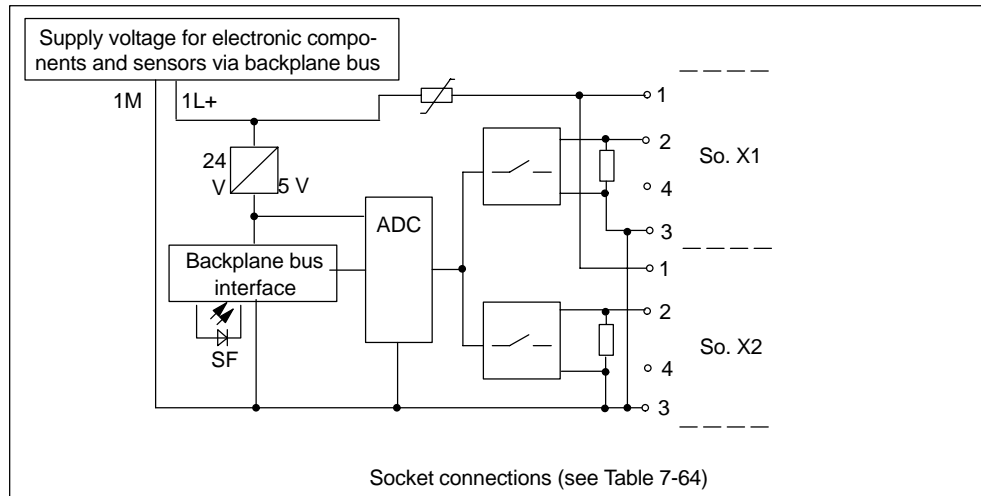
Figure 7-32   Basic circuit diagram of Expansion module EM 144 AI 2 x I (4 to 20 mA)

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Dimensions and weight	
Dimensions W $\times$ H $\times$ D (mm)	87 $\times$ 110 $\times$ 55
Weight	Approx. 250 g
Module-specific data	
Number of inputs	2
Cable length	
• Shielded	Max. 30 m
Voltages, currents, potentials	
Electrical isolation	No
Permissible potential difference	
• Between input (frame connection) and M_{ANA} (U_{CM})	2.0 VDC; AC_{SS}
• Between M_{ANA} and centralized grounding point (U_{ISO})	0 VAC; DC
Power input	
• From supply voltage L+	Max. 80 mA
Power loss of the module	Typ. 1W
Analog value formation		
---	---	---
Measurement principle	Integrative	
Integration and cycle time/ resolution per channel:		
• Integration time parameterizable	Yes	
• Integration time in ms	16.7	20
• Cycle time in ms (all channels)	134	160
• Interference voltage suppression for interference frequency f1 in Hz	60	50
• Resolution (including overrange)	12 bits plus sign	
• Rated value in units:		
– SIMATIC S7 format:	6912	
– SIMATIC S5 format:	4096	

Interference suppression, error limits	
Interference voltage suppression	
• Common-mode interference	> 60 dB
• Series-mode interference (peak interference value < rated value of input range)	> 40 dB
Operational limit (entire temperature range with reference to input range)	$\pm$ 1.2 %
Basic error (operational limit at 25 °C with reference to input range)	$\pm$ 1.0 %
Temperature error (with reference to input range)	$\pm$ 0.01 %/K
Crosstalk between inputs	> 45 dB
Linearity error (with reference to input range)	$\pm$ 0.05 %
Repeat accuracy (steady state at 25 °C with reference to input range)	$\pm$ 0.05 %
Status, alarms, diagnostics	
Alarms	• Diagnostic interrupt
	• Hardware interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)
Sensor selection data	
Input range (rated value)/input resistance	4 to 20 mA/25 Ω
Permissible input voltage (destruction limit)	40 mA
• Short circuit protection	Yes
• Short-circuit current	Approx. 65 mA
Sensor load	Max. 750 Ω
Sensor connection	
• For current measurement: As 2-wire measuring transducer	Possible
As 4-wire measuring transducer	Possible

7.21.12 EM 144 AI 2 × RTD expansion module (6ES7 144-1JB31-0XB0)

Features

The EM 144 AI 2 × RTD expansion module with the order number
6ES7 144-1JB31-0XB0 has the following features:

- 2 inputs for Pt 100 resistance thermometer (2 channels with the same measuring range and data format)

- Input range for Pt 100

- Resolution of 12 bits plus sign

- 24 VDC supply voltage

- Non-isolated

- Parameterizable diagnostic interrupt

- Parameterizable hardware interrupt

- Parameterizable diagnostics

- SF LED

Pinout of the sockets for AI

The following table shows the pinout of the two sockets used to connect the analog inputs. You can find the layout of the sockets in Appendix C.

Table 7-65   Pinout of the sockets for 2-channel analog inputs (Pt 100)

Pin	Assignment of socket X1	Assignment of socket X2	Front view of socket (Front view)
1	Sensor supply output current (approx. 1 mA)		
2	Input signal ”+”, channel 0	Input signal ”+”, channel 1	
3	Chassis ground, power supply		
4	Input signal ”–”, channel 0	Input signal ”–”, channel 1	

Basic circuit diagram

The basic circuit diagram of the expansion module is shown below.

Figure 7-33   Basic circuit diagram of expansion module EM 144 AI 2 x RTD

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 110 × 55
Weight	Approx. 250 g
Module-specific data	
Number of inputs	2
Cable length	
• Shielded	Max. 30 m
Voltages, currents, potentials	
Electrical isolation	No
Permissible potential difference	
• Between input (frame connection) and M_{ANA} (U_{CM})	2.0 VDC; AC_{SS}
• Between M_{ANA} and centralized grounding point (U_{ISO})	0 VAC; DC
Power input	
• From supply voltage L+	Max. 40 mA
Power loss of the module	Typ. 0.9 W
Analog value formation	
Measurement principle	Integrative
Integration and cycle time/ resolution per channel:	
• Integration time parameterizable	Yes
• Integration time in ms	16.7 20
• Cycle time in ms (all channels)	134 160
• Interference voltage suppression for interference frequency f1 in Hz	60 50
• Resolution (including overrange)	12 bits plus sign
• Rated value in units:	
– SIMATIC S7 format:	6912
– SIMATIC S5 format:	4096

Interference suppression, error limits	
Interference voltage suppression	
• Common-mode interference	> 60 dB
• Series-mode interference (peak interference value < rated value of input range)	> 40 dB
Operational limit (entire temperature range with reference to input range)	± 1.2 %
Basic error (operational limit at 25 °C with reference to input range)	± 1.0 %
Temperature error (with reference to input range)	± 0.01 %/K
Crosstalk between inputs	> 45 dB
Linearity error (with reference to input range)	± 0.05 %
Repeat accuracy (steady state at 25 °C with reference to input range)	± 0.05 %
Status, alarms, diagnostics	
Alarms	• Diagnostic interrupt
	• Hardware interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)
Sensor selection data	
Input range (rated value)/input resistance	Pt 100/10 MΩ
Characteristic curve linearization	Yes
Permissible input voltage (destruction limit)	30 V
Measurement current I_{C+}	Max. 1.5 mA
Sensor connection	
• Two-conductor connection	Possible
• Three-conductor connection	Possible
• Four-conductor connection	Possible

7.21.13 EM 145 AO 2 × U expansion module (6ES7 145-1FB31-0XB0)

Features
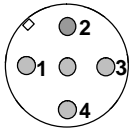
The EM 145 AO 2 × U expansion module with the order number
6ES7 145-1FB31-0XB0 has the following features:

- 2 outputs for voltage output (2 channels with the same measuring range and data format)
- Output range ± 10 V
- Resolution of 11 bits plus sign
- 24 VDC supply voltage
- Non-isolated
- Parameterizable diagnostic interrupt
- Parameterizable diagnostics
- Parameterizable substitute value output
- SF LED

Pinout of sockets for AO

The following table shows the pinout of the two sockets used to connect the analog outputs. You can find the layout of the sockets in Appendix C.

Table 7-66 Pinout of the sockets for 2-channel analog outputs (voltage)

Pin	Assignment of socket X1	Assignment of socket X2	Front view of socket (Front view)
1	Output signal Q_V, channel 0	Output signal Q_V, channel 1	
2	–	–	
3	Chassis ground, power supply		
4	–	–	

Basic circuit diagram

The basic circuit diagram of the expansion module is shown below.

Figure 7-34   Basic circuit diagram of expansion module EM 145 AO 2 x U

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 110 × 55
Weight	Approx. 250 g
Module-specific data	
Number of outputs	2
Cable length	
• Shielded	Max. 30 m
Voltages, currents, potentials	
Electrical isolation	No
Permissible potential difference	
• Between coil (frame connection) and centralized grounding point (U$_{ISO}$)	0 VAC; DC
Power input	
• From supply voltage L+	Max. 75 mA
Power loss of the module	Typ. 1.5 W
Analog value formation	
Resolution (including over-range)	11 bits plus sign
• Rated value in units:	
– SIMATIC S7 format:	1728
– SIMATIC S5 format:	1024
Cycle time (all channels)	1 ms
Settling time	
• For resistive load	0.6 ms
• For capacitive load	6.0 ms
Replacement values can be applied	No

Interference suppression, error limits	
Operational limit (entire temperature range with reference to output range)	± 1 %
Basic error (operational limit at 25 °C with reference to output range)	± 0.9 %
Temperature error (with reference to output range)	± 0.01 %/K
Crosstalk between outputs	> 45 dB
Linearity error (with reference to output range)	± 0.08 %
Repeat accuracy (steady state at 25 °C with reference to output range)	± 0.05 %
Output ripple (with reference to output range, bandwidth 0 to 50 kHz)	± 0.05 %
Status, alarms, diagnostics	
Alarms	Diagnostic interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)
Actuator selection data	
Output range (rated value)	−10 to 10 V
Load resistance	Min. 1.0 kΩ
• With capacitive load	Max. 0.1 μF
• Short circuit protection	Yes
• Short-circuit current	Max. 30 mA
Permissible input voltage for voltage output (destruction limit)	15 V
Actuator connection	
• Two-conductor connection	Possible
• Four-conductor connection	Possible

7.21.14 EM 145 AO 2×I expansion module (6ES7 145-1GB31-0XB0)

Features

The EM 145 AO 2 × I expansion module with the order number
6ES7 145-1GB31-0XB0 has the following features:

- 2 outputs for current measurement (2 channels with the same measuring range and data format)
- Parameterizable output range, ±20 mA or 4 to 20 mA
- Resolution of 11 bits plus sign
- 24 VDC supply voltage
- Non-isolated
- Parameterizable diagnostic interrupt
- Parameterizable diagnostics
- Parameterizable substitute value output
- SF LED

Pinout of sockets for AO

The following table shows the pinout of the two sockets used to connect the analog outputs. You can find the layout of the sockets in Appendix C.

Table 7-67   Pinout of the sockets for 2-channel analog outputs (current)

Pin	Assignment of socket X1	Assignment of socket X2	Front view of socket (Front view)
1	Output signal Q_I, channel 0	Output signal Q_I, channel 1	
2	–		
3	Chassis ground, power supply		
4	–		

Basic circuit diagram

The basic circuit diagram of the expansion module is shown below.
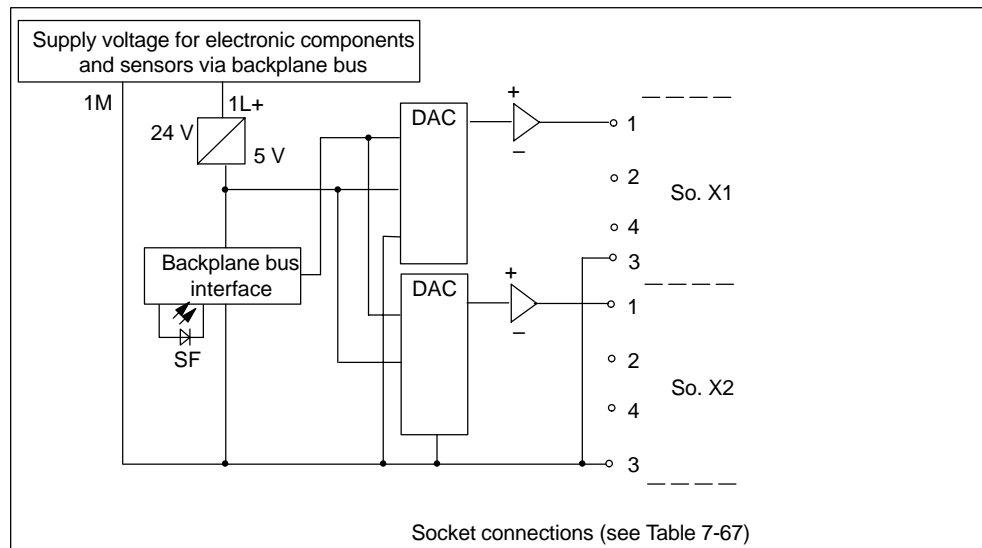
Figure 7-35   Basic circuit diagram of expansion module EM 145 AO 2 x I

Covering up unused connections

You must seal off any connections which are not required with M12 screw caps, in order to ensure that the degree of protection (IP 65, IP 66 or IP 67) is achieved.

Dimensions and weight	
Dimensions W × H × D (mm)	87 × 110 × 55
Weight	Approx. 250 g
Module-specific data	
Number of outputs	2
Cable length	
• Shielded	Max. 30 m
Voltages, currents, potentials	
Electrical isolation	No
Permissible potential difference	
• Between coil (frame connection) and centralized grounding point (U_{ISO})	0 VAC; DC
Power input	
• From supply voltage L+	Max. 110 mA
Power loss of the module	Typ. 2.3W
Analog value formation	
Resolution (including over-range)	11 bits plus sign
• Rated value in units:	
– SIMATIC S7 format:	1728
– SIMATIC S5 format:	1024
Cycle time (all channels)	1 ms
Settling time	
• For resistive load	0.6 ms
• For capacitive load	6.0 ms
Replacement values can be applied	No

Interference suppression, error limits	
Operational limit (entire temperature range with reference to output range)	± 1 %
Basic error (operational limit at 25 °C with reference to output range)	± 0.9 %
Temperature error (with reference to output range)	± 0.01 %/K
Crosstalk between outputs	> 45 dB
Linearity error (with reference to output range)	± 0.08 %
Repeat accuracy (steady state at 25 °C with reference to output range)	± 0.05 %
Output ripple (with reference to output range, bandwidth 0 to 50 kHz)	± 0.05 %
Status, alarms, diagnostics	
Alarms	Diagnostic interrupt
Diagnostic functions	Configurable
• Group error	Red LED (SF)
Actuator selection data	
Output range (rated values), parameterizable	−20 to 20 mA 4 to 20 mA
Load resistance	Max. 500 Ω
• Inductive load	Max. 0.1 mH
Current output	
• No-load voltage	Max. 15 V
Permissible input current for current output (destruction limit)	40 mA
Actuator connection	
• Two-conductor connection	Possible

7.22   SITOP power power supply 24V/10A (6EP1 334-2CA00)

Properties

The SITOP power 24V/10A power supply, order number 6EP1 334-2CA00, has the following features:

- Primary switched-mode power supply

- Rated input voltage 120/230 VAC

- Rated output voltage 24 VDC, floating, short-circuit-proof and stable at no load

- Rated output current up to 10 A

- Output voltage optionally as supply voltage for electronics/sensors and/or load voltage of ET 200X

- Parameterizable behavior in the event of an error: restart or shutdown following short circuit on the output

- LEDs for operating mode

Basic circuit diagram

The figure below shows the basic circuit diagram of the SITOP power power supply.
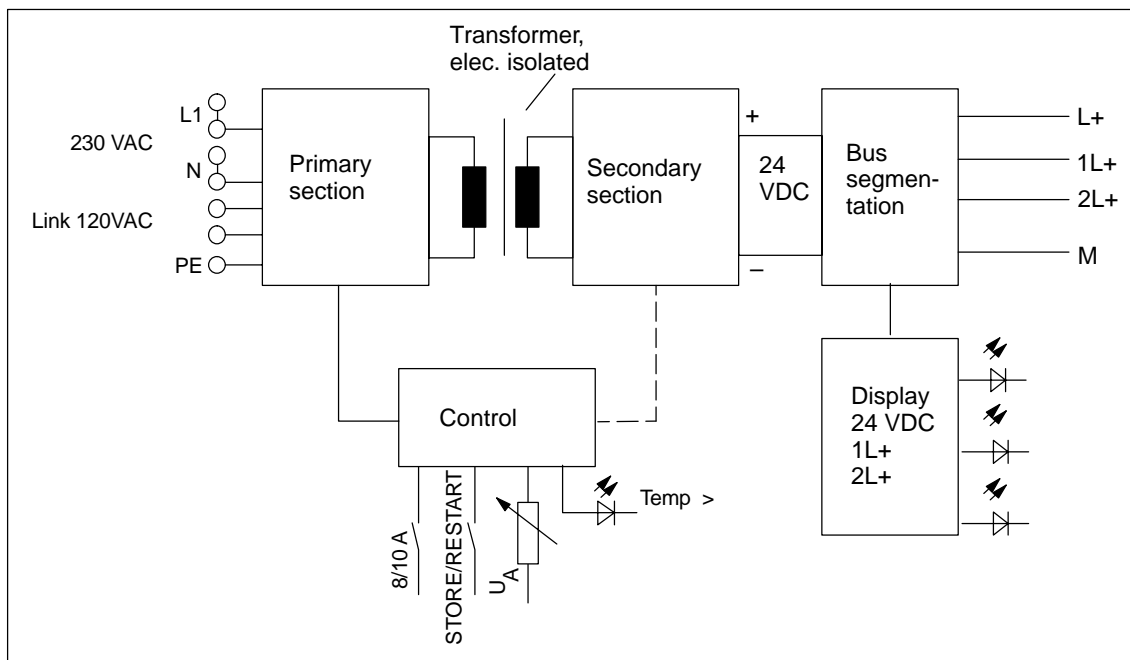
Figure 7-36   Basic circuit diagram for SITOP power supply

Dimensions and weight	
Dimensions W × H × D (mm)	146.5 x 265 x 134
Weight	Approx. 1.7 kg
Voltages, currents, potentials	
Input voltage	
• Rated value U_{EN}	120/230 VAC
• Permissible range	93 V to 132 VAC 187 V to 264 VAC
• Frequency	47 Hz to 63 Hz
• Mains buffering (at U_E= 93/187 V; I_{AN})	Min. 20 ms
Rated input current I_{EN} (at 120 V/230 V)	4.3 A/2.6 A
Current at make (at U_E = 230 V; 25 °C)	<55 A; 2.5 A^2s
Recommended circuit-breaker in the supply lead	16 A, Characteristic C
Power consumption	270W
Efficiency at full load	Approx. 89%
Device protection	Internal line-side fuse T 6.3 A/250 V

Output voltage	
• Rated value U_{AN}	24 VDC
• Overall tolerance, static	± 3%
Residual ripple	Max. 15 mV_{ss}
Setting range	22.8 V to 25.2 V
Output current	
• Rated value I_{AN}	10 A
• To 40 °C	Max. 10A
• To 55 °C	Max. 8A
Overcurrent limitation	Typ. 1.1 to 1.3 x I_{AN}
Output short-circuit protection	Yes
Outputs stable at no load	Yes
Electrical isolation	
• Primary/secondary	Yes (SELV as per EN 60950)
Status, alarms, diagnostics	
Status display	Green LEDs for • 24 V at output terminals • Supply voltage available at bus for electronics/ sensors • Load voltage available at bus Red LED for shut-down on account of excess temperature

Order Numbers

A

Should you require additional ET 200X components or PROFIBUS accessories for use with the ET 200X, you will find all the order numbers here.

Basic modules

Table A-1 Basic modules – order numbers

Designation	Order number
BM 141 DI 8 DC 24V basic module	6ES7 141-1BF12-0XB0
BM 141 DI 8 × DC 24V ECOFAST basic module with large designation labels	6ES7 141-1BF01-0AB0
BM 141 DI 8 × DC 24V ECOFAST DIAG basic module	6ES7 141-1BF40-0AB0
BM 142 DO 4 DC 24V/2A basic module	6ES7 142-1BD22-0XB0
BM 143-DESINA FO basic module with large designation labels	6ES7 143-1BF00-0XB0
BM 143-DESINA RS485 basic module with large designation labels	6ES7 143-1BF00-0AB0

Expansion modules

Table A-2   Expansion modules – order numbers

Description	Order number
EM 141 DI 4×DC 24V expansion module	6ES7 141-1BD31-0XA0
EM 141 DI 8 DC 24V expansion module	6ES7 141-1BF31-0XA0
EM 141 DI 8×DC 24V DIAG expansion module	6ES7 141-1BF30-0XB0
EM 141 DI 8×DC 24V expansion module with large designation labels	6ES7 141-1BF41-0XA0
EM 141 DI 8×DC 24V DIAG expansion module	6ES7 141-1BF40-0XB0
EM 142 DO 4×DC 24V/0.5A expansion module	6ES7 142-1BD30-0XA0
EM 142 DO 4 DC 24V/2A expansion module	6ES7 142-1BD40-0XA0
EM 142 DO 4 DC 24V/2A expansion module	6ES7 142-1BD40-0XB0
EM 142 DO 8×DC 24V/1.2A expansion module with large designation labels	6ES7 142-1BF30-0XA0
EM 143-DESINA expansion module with large designation labels	6ES7 143-1BF30-0XB0
EM 144 AI 2×U expansion module	6ES7 144-1FB31-0XB0
EM 144 AI 2×I expansion module	6ES7 144-1GB31-0XB0
EM 144 AI 2×I expansion module	6ES7 144-1GB41-0XB0
EM 144 AI 2×RTD expansion module	6ES7 144-1JB31-0XB0
EM 145 AO 2×U expansion module	6ES7 145-1FB31-0XB0
EM 145 AO 2×I expansion module	6ES7 145-1GB31-0XB0
EM 148-P DI 4×DC 24V/ DO 2 x P expansion module	6ES7 148-1DA00-0XA0
EM 148-P DO 16×P/CPV10 expansion module	6ES7 148-1EH01-0XA0
EM 148-P DO 16×P/CPV14 expansion module	6ES7 148-1EH11-0XA0
PM 148 DO 4×DC 24V/2A power module	6ES7 148-1CA00-0XB0
SITOP power 24V/10A power supply unit	6EP1 334-2CA00
CP 142-2 communication processor	6GK7 142-2AH00-0XA0

Accessories for ET 200X

Table A-3   Accessories for ET200X – order numbers

Description	Order number
Connector assembly for PROFIBUS-DP, supply voltage for electronic components/sensors and load voltage (protective shell with 6-pin connector, 2 M16 cable glands and 2 lock nuts)	6ES7 194-1AA01-0XA0
Cover plate (for sealing off unused connectors for PROFIBUS-DP and supply/load voltage; 10 units)	6ES7 194-1JB00-0XA0
M12 coupler plug, 5-pin (for connecting actuators and sensors)	On request
M12 angular coupler plug, 5-pin (for connecting actuators and sensors; cannot be used in conjunction with an M12 Y connector)	On request
M12 Y connector, 5-pin (for dual connection of actuators/sensors to digital inputs/outputs)	6ES7 194-1KA01-0XA0
AS interface, M12 screw cap (for sealing off unused inputs and outputs of the ET 200X; 10 units)	3RX9 802-0AA00
Silencer for pneumatic module	6ES7 194-1EA00-0XA0
DIN rail, narrow, length 400 mm for ET 200X electronic submodule	6ES7 194-1GA00-0XA0
DIN rail, narrow, length 640 mm for ET 200X electronic submodule	6ES7 194-1GA10-0XA0
DIN rail, narrow, length 2000 mm for ET 200X electronic submodule	6ES7 194-1GA20-0XA0
DIN rail, wide, length 520 mm for ET 200X electronic module and motor starter/frequency converter	6ES7 194-1GB00-0XA0
DIN rail, wide, length 1000 mm for ET 200X electronic submodule and motor starter/frequency converter	6ES7 194-1GB10-0XA0
Screws with washer assemblies (100 screws M5 x 20, crossed recessed head with washer) for fitting ET 200X modules onto DIN rail	6ES7 194-1KC00-0XA0

Accessories for ET 200X-DESINA / ET 200X-ECOFAST

Table A-4   Accessories for ET 200X-DESINA / ET 200X-ECOFAST – order
numbers

Description	Order number
Configuration connector	6ES7 194-1KB00-0XA0
ECOFAST hybrid cables (2 copper conductors and 2×2 copper wires) complete with ECOFAST connectors: 1.5 m 3.0 m 5.0 m 10.0 m 15.0 m 20.0 m 25.0 m 30.0 m 35.0 m 40.0 m 45.0 m 50.0 m	6XV1 830-7BH15 6XV1 830-7BH30 6XV1 830-7BH50 6XV1 830-7BN10 6XV1 830-7BN15 6XV1 830-7BN20 6XV1 830-7BN25 6XV1 830-7BN30 6XV1 830-7BN35 6XV1 830-7BN40 6XV1 830-7BN45 6XV1 830-7BN50
Unprepared ECOFAST hybrid cable (2 copper conductors and 2×2 copper wires) in various lengths: 20.0 m 50.0 m 100.0 m	6XV1 830-7AN20 6XV1 830-7AN50 6XV1 830-7AT10
ECOFAST hybrid cable, in meters (2 copper conductors and 2×2 copper wires)	6XV1 830-7AH10
ECOFAST hybrid cable, fiber-optic cable (2 fiber-optic cables and 2×2 copper wires) complete with ECOFAST connectors in various lengths: 1.5 m 3.0 m 5.0 m 10.0 m 15.0 m	6XV1 830-6DH15 6XV1 830-6DH30 6XV1 830-6DH50 6XV1 830-6DN10 6XV1 830-6DN15
Unprepared ECOFAST hybrid cable, fiber-optic cable (2 fiber-optic cables and 2×2 copper wires) in various lengths: 20.0 m 50.0 m 100.0 m	6XV1 830-6CN20 6XV1 830-6CN50 6XV1 830-6CT10
ECOFAST hybrid cable, fiber-optic cable, in metres (2 fiber-optic cables and 2×2 copper wires)	6XV1 830-6CH10
Cover plate (to seal off unused DESINA/ECOFAST connection sockets); 10 units	6ES7 194-1JB10-0XA0

Table A-4   Accessories for ET 200X-DESINA / ET 200X-ECOFAST – order
             numbers, continued

Description	Order number
DESINA/ECOFAST terminating resistor for PROFIBUS-DP with copper conductors: 1 unit 5 units	6GK1 905-0DA10 6GK1 905-0DA00
For preparing the cables: PROFIBUS ECOFAST Hybrid Plug 180 (ECOFAST Cu, 5 units) With pin insert With socket insert PROFIBUS ECOFAST Cyberoptic Hybrid Plug 180 (ECOFAST fiber-optic cable, 5 units) DESINA-compatible With pin insert With socket insert	 6GK1 905-0CA00 6GK1 905-0CB00 6GK1 905-0BA00 6GK1 905-0BB00

For the connection between controller and power supply we recommend Harting
accessories:

Description	Order number
For the link between the controller and power supply: Media Converter PROFIBUS MCP12P	20 40 004 3647

Address for ordering:

    HARTING Vertrieb für Steckverbinder und
    Systemtechnik GmbH & Co. KG
    Postfach 2451
    D-32381 Minden
    Tel.   + 49 5 71 88 96 - 0
    Fax   + 49 5 71 88 96 - 2 82
    E-mail: de.sales@HARTING.com
    Internet: http://www.HARTING.com

Connectors for AIs/AOs

To connect actuators/sensors to the analog inputs/outputs of the corresponding expansion modules, use 4- or 5-pin M12 coupler plugs. We recommend the following connectors from Binder.

Table A-5   Connectors manufactured by Binder – order numbers

Description		Order number
Connector 4-pin	Outgoing cable unit PG 7	99-1429-814-04
Connector 4-pin	Outgoing cable unit PG 9	99-1429-812-04
Connector 5-pin	Outgoing cable unit PG 7	99-1437-814-05
Connector 5-pin	Outgoing cable unit PG 9	99-1437-812-05

Address for ordering:

Franz Binder GmbH + Co.-74172 Neckarsulm

Spare parts for ET 200X

Table A-6   Spare parts for ET 200X – order numbers

Description	Order number
Labels for ET 200X (10 × 8 mm) (20 strips of 40 labels)	6ES7 194-1BA00-0XA0
Labels for ET 200X, ET 200X-DESINA and ET 200X-ECOFAST (20 × 9 mm) (19 strips of 20 labels)	3RT 1900-1SB50
Plugs for pneumatic module	6ES7 194-1JA00-0XA0
Connector plate (for BM 141, BM 142)	6ES7 194-1FC00-0XA0

Cables for the ET 200X

Table A-7 lists all the cables for the ET 200 distributed I/O system which you may require in conjunction with the ET 200X.

Table A-7   Network components for the ET 200 distributed I/O system

Network components	Order number
Cables:	
• 2-core, shielded cable (bus cable)	6XV1 830-0AH10
• 2-core, shielded cable (bus cable) halogen free	6XV1 830-0CH10
• 2-core, shielded cable (bus cable) with PUR sheath	6XV1 830-0DH10
• 2-core, shielded cable (bus cable) with PE sheath	6XV1 830-0BH10
• 2-core, shielded cable (bus cable) for festooning	6XV1 830-3CH10
• Drum cable	6XV1 830-3BH10
• Direct-buried cable	6XV1 830-3AH10
• Cable, 5-core, uncut (for bus and sensor supply; with PVC sheath)	6ES7 194-1LY00-0AA0
• Cable, 5-core, uncut; oil-resistant, drum-capable, conditionally welding-resistant (for bus and sensor supply; with PUR sheath)	6ES7 194-1LY10-0AA0

MOBY modules

The following expansion module can be used with the ET 200X.

Table A-8   MOBY modules

Network components	Order number
ASM 473 interface module for MOBY	6GT2 002-0HA10

Manuals for STEP 7 and SIMATIC S7

You require one of the manuals listed below to program and commission the ET 200X with *STEP 7*.

Table A-9   Manuals for *STEP 7* and SIMATIC S7

Manual	Contents
S7-300 Programmable Controller Hardware and Installation	etc. • Description of the PROFIBUS-DP master interface of CPU 315-2 DP • Installing a PROFIBUS-DP network • RS 485 repeater
S7-400/M7-400 Programmable Controllers Hardware and Installation	etc. • Description of the PROFIBUS-DP master interface in S7-400 and M7-400 • Installing a PROFIBUS-DP network • RS 485 repeater
System software for S7-300/400 Program design Programming Manual	etc. Description of addressing and diagnostics on SIMATIC S7
System software for S7-300/400 System and standard functions Reference Manual	Description of the SFCs in *STEP 7*

Manual for the ET 200 in SIMATIC S5

You require the manual listed below to program and commission the ET 200X with *COM PROFIBUS*.

Table A-10 Manual for ET 200 in SIMATIC S5

Manual	Order number	Contents
ET 200 distributed I/O system	6ES5 998-3ES.2	• Description of master interface IM 308-C for S5-115U/H, S5-135U and S5-155U/H • Description of the S5-95U with the PROFIBUS-DP master interface • Description of the procedure for installing a DP system and an FMS system with the CP 5412 (A2) as master • Handling *COM PROFIBUS* • Handling FB IM308C/FB 230

Technical guide to PROFIBUS-DP with SIMATIC S7 and *STEP 7*

Table A-11 Technical Guide to PROFIBUS-DP and SIMATIC S7

Technical guide	Order number	Contents
Decentralization with PROFIBUS-DP *– Architecture and Fundamentals, Configuration and Use with SIMATIC S7 –* Josef Weigmann, Gerhard Kilian Publicis MCD Verlag, 2nd Edition, 2000	In bookshops: ISBN 3-89578-123-1 From your Siemens agent: A19100-L531-B772	Instruction manual for a simple introduction to PROFIBUS-DP and implementation of automation tasks with PROFIBUS-DP and SIMATIC S7. Use of PROFIBUS-DP is illustrated for the SIMATIC-related examples.

Device Master Files

B

Device master file

A device master file contains all the slave-specific features. The structure of the DDB file is specified in IEC 61784-1:2002 Ed1 CP 3/1.

You can download the device master files from the Internet. You will find all device master files under "Downloads" on the SIMATIC Customer Supports website at http://www.ad.siemens.de/csi/gsd.

Other features

Table B-1   Other features of the modules of the ET 200X

Basic/expansion module	Order number	Manufac-turer iden-tification	Consis-tency	Ad-dress scope (bytes)	Ad-dress range
BM 141 DI 8×DC 24V	6ES7 141-1BF12-0XB0	$803D_H$	Byte	1	Digital
BM 141 DI 8×DC 24V ECOFAST	6ES7 141-1BF01-0AB0	$80D2_H$	Byte	1	Digital
BM 141 DI 8×DC 24V ECOFAST DIAG	6ES7 141-1BF40-0AB0	$80D3_H$	Byte	1	Digital
BM 142 DO 4×DC 24V/2A	6ES7 142-1BD22-0XB0	$803C_H$	Byte	1	Digital
BM 143-DESINA FO	6ES7 143-1BF00-0XB0	$809A_H$	Byte	2*	Digital
BM 143-DESINA RS485	6ES7 143-1BF00-0AB0	$809A_H$	Byte	2*	Digital
EM 141 DI 4×DC 24V	6ES7 141-1BD31-0XA0	–	Byte	1	Digital
EM 141 DI 8×DC 24V	6ES7 141-1BF31-0XA0	–	Byte	1	Digital
EM 141 DI 8×DC 24V DIAG	6ES7 141-1BF30-0XB0	–	Byte	1	Digital
EM 141 DI 8×DC 24V	6ES7 141-1BF41-0XA0	–	Byte	1	Digital
EM 141 DI 8×DC 24V DIAG	6ES7 141-1BF40-0XB0	–	Byte	1	Digital
EM 142 DO 4×DC 24V/0.5A	6ES7 142-1BD30-0XA0	–	Byte	1	Digital
EM 142 DO 4×DC 24V/2A	6ES7 142-1BD40-0XA0	–	Byte	1	Digital
EM 142 DO 4×DC 24V/2A	6ES7 142-1BD40-0XB0	–	Byte	1	Digital
EM 142 DO 8×DC 24V/1.2A	6ES7 142-1BF30-0XA0	–	Byte	1	Digital
EM 143-DESINA	6ES7 143-1BF30-0XB0	–	Byte	2*	Digital
EM 144 AI 2×U	6ES7 144-1FB31-0XB0	–	Word	4	Analog
EM 144 AI 2×I (±20 mA)	6ES7 144-1GB31-0XB0	–	Word	4	Analog
EM 144 AI 2×I (4 to 20 mA)	6ES7 144-1GB41-0XB0	–	Word	4	Analog
EM 144 AI 2×RTD	6ES7 144-1JB31-0XB0	–	Word	4	Analog
EM 145 AO 2×U	6ES7 145-1FB31-0XB0	–	Word	4	Analog
EM 145 AO 2×I	6ES7 145-1GB31-0XB0	–	Word	4	Analog
EM 148-P DI 4×DC 24V/DO 2×P expansion module	6ES7 148-1DA00-0XA0	–	Byte	1*	Digital
EM 148-P DO 16×P/CPV10 expansion module	6ES7 148-1EH01-0XA0	–	Byte	2	Digital
EM 148-P DO 16×P/CPV14 expansion module	6ES7 148-1EH11-0XA0	–	Byte	2	Digital

*   for inputs and outputs

Dimesioned Drawings and Pinouts

C

You will find dimensioned drawings of the most important components of the ET 200X below. You will also find essential pinout information for the ET 200X.

Contents of Chapter

C.1 Dimensioned drawings – basic modules

BM 141, BM 142 and BM 147/CPU basic modules

Figure C-1 below is a dimensioned drawing of a BM 141, BM 142, BM 147/CPU basic module with bus connectors. You must add the length of the M16 cable glands and the bending radius of your particular cable to the overall width and depth specified.
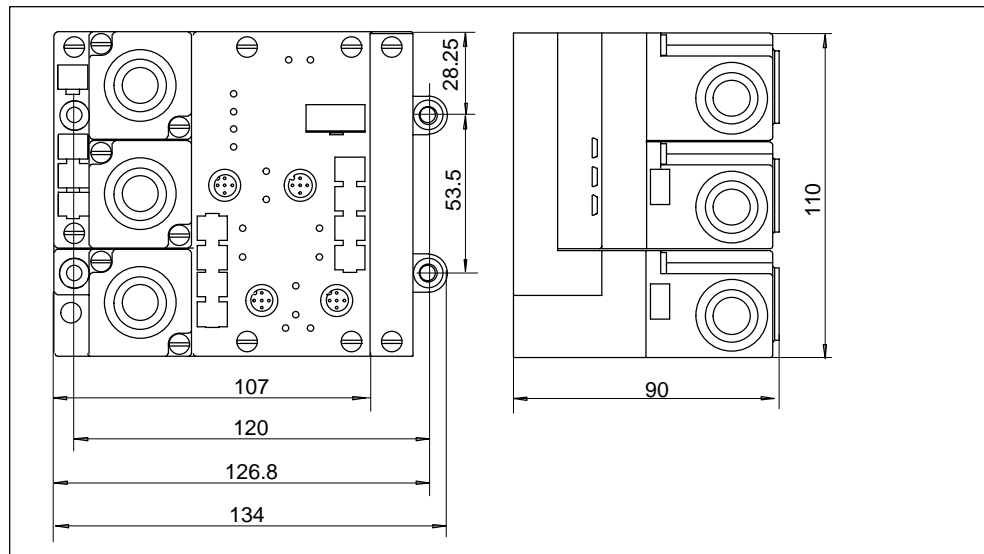
Figure C-1   Dimensioned drawing of BM 141, BM 142, BM 147/CPU basic module

DESINA and ECOFAST basic modules

The following figure C-2 shows you the dimensioned drawing of the basic modules BM 141-ECOFAST and BM 143-DESINA with DESINA connectors.

You have to add the bending radius of the DESINA hybrid cable to the specified overall height. You might have to add the length of the coupler plugs and the bending radius of your particular cable to the specified overall depth.
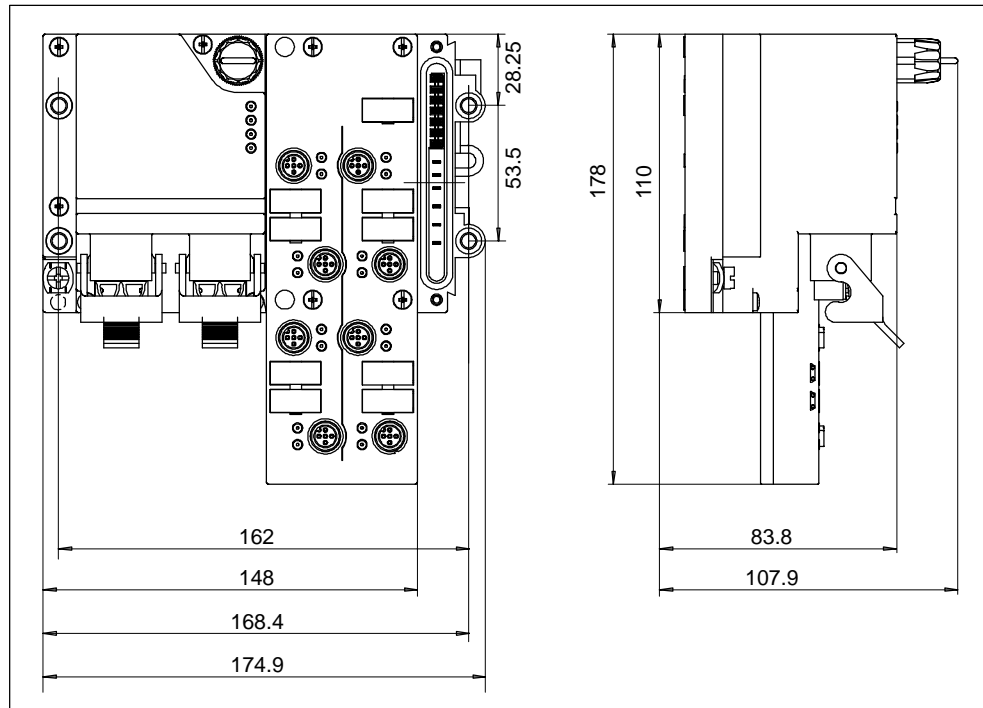
Figure C-2   Dimensioned drawing of the BM 141-ECOFAST, BM 143-DESINA basic modules

C.2 Dimensioned drawings – expansion modules

The following figure C-3 shows you the dimensioned drawing of the expansion
modules EM 141, EM 142, EM 144, and EM 145. You must add the length of the
coupler plugs/Y busbar connection pieces and the bending radius of your particular
cable to the overall depth specified.
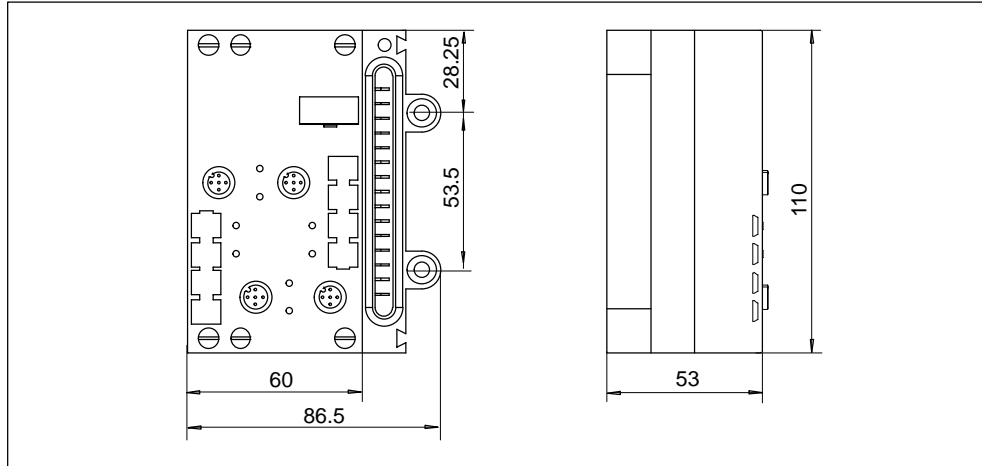
Figure C-3   Dimensioned drawing of EM 141, EM 142, EM 144, EM 145 expansion
modules

Figure C-4 below is a dimensioned drawing of EM 141 (high design),
EM 142 DO 8 x DC 24V/1.2A and EM 143-DESINA expansion modules.

You must add the length of the coupler plugs and the bending radius of your
particular cable to the specified overall depth.
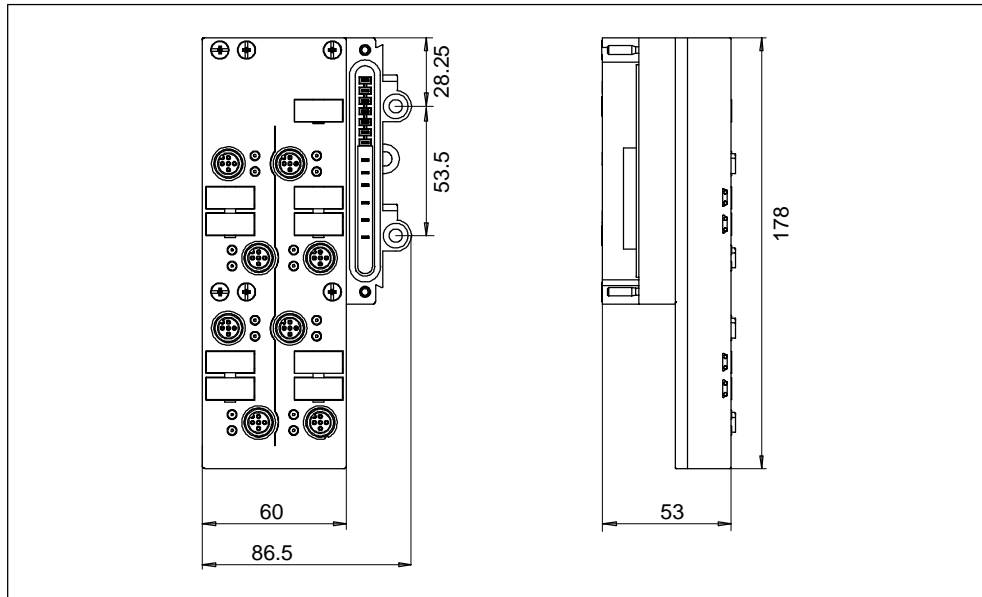
Figure C-4   Dimensioned drawing of EM 141 (high design),
              EM 142 DO 8 x DC 24V/1.2A and EM 143-DESINA expansion modules

C.3   Dimensioned drawing – pneumatic module
EM 148-P DI 4 × DC 24 V/DO 2 × P

The dimensioned drawing of the pneumatic module is shown below. You have to add the length and bending radius of the tubing to the specified overall height.
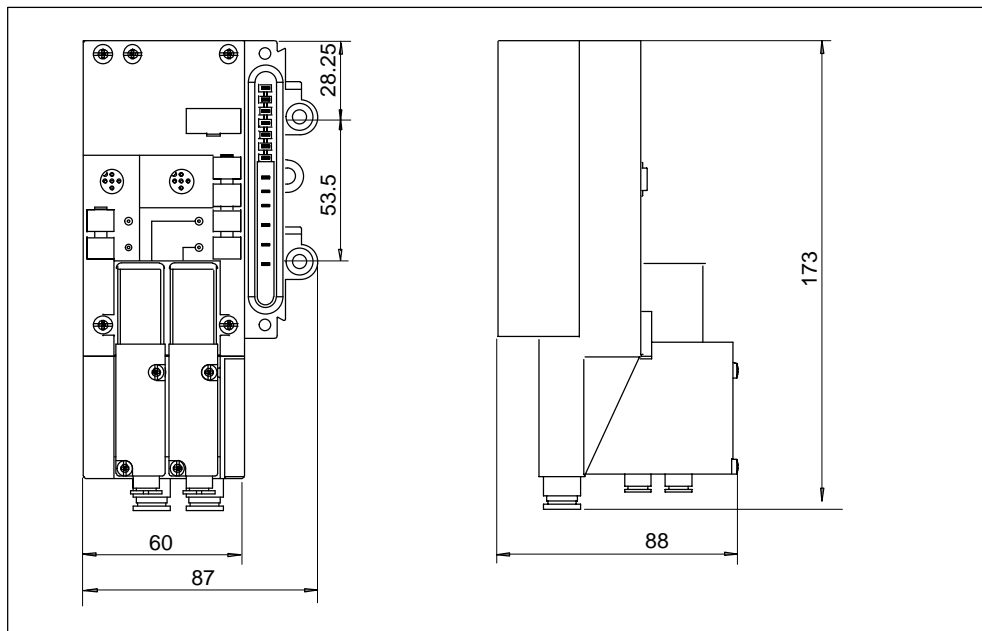
Figure C-5   Dimensioned drawing of the pneumatic module

C.4 Dimensioned drawing – pneumatic interface module EM 148-P DO 16 × P/CPV10 and ...14

The dimensioned drawing of the pneumatic interface module is shown below. You must add the depth of the FESTO valve island, and the length and bending radius of the tubing to the specified overall depth.
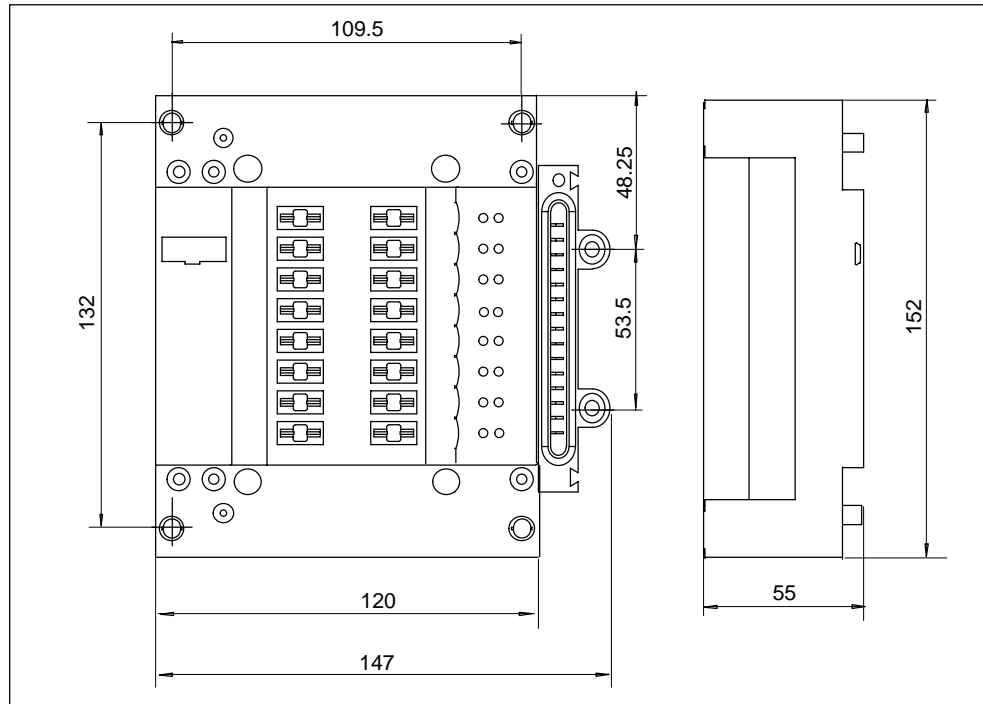
Figure C-6   Dimensioned drawing of the pneumatic interface module

C.5   Dimensioned drawing – power module

The diagram below is a dimensioned drawing of a power module. You must add the length of the coupler plugs/Y connectors and the bending radius of your particular cables to the specified overall depth. You must add the bending radius of your particular cable to the specified overall height if the load voltage is looped through.
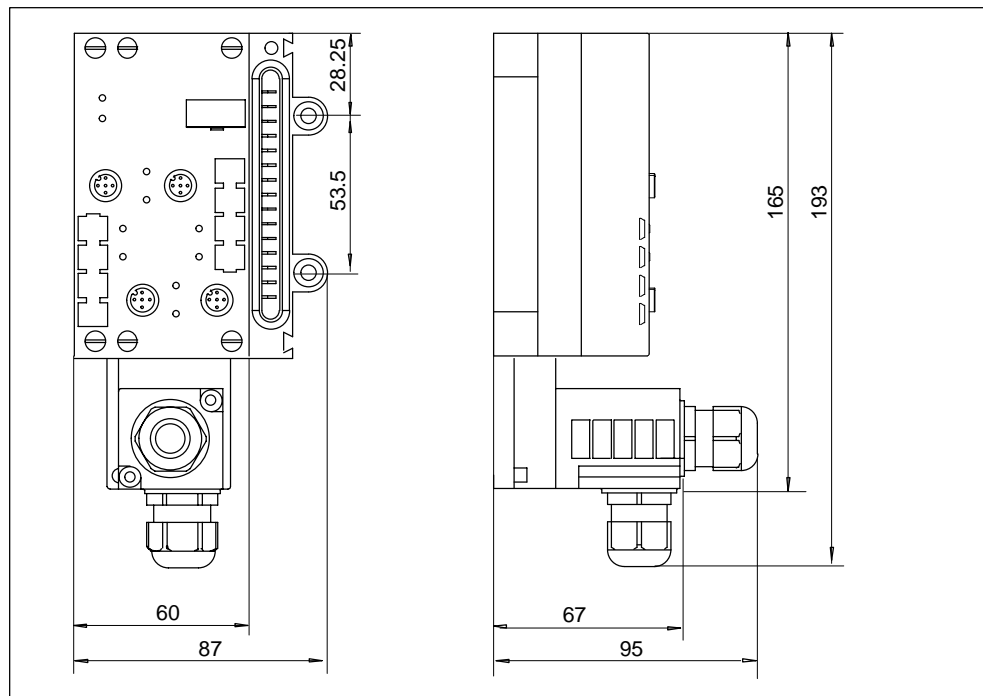
Figure C-7   Dimensioned drawing – power module

C.6 Dimensioned drawing – SITOP power supply unit

The figure below shows the dimensioned drawing of the SITOP power power supply. You must add the bending radius of your particular cable to the specified overall height.
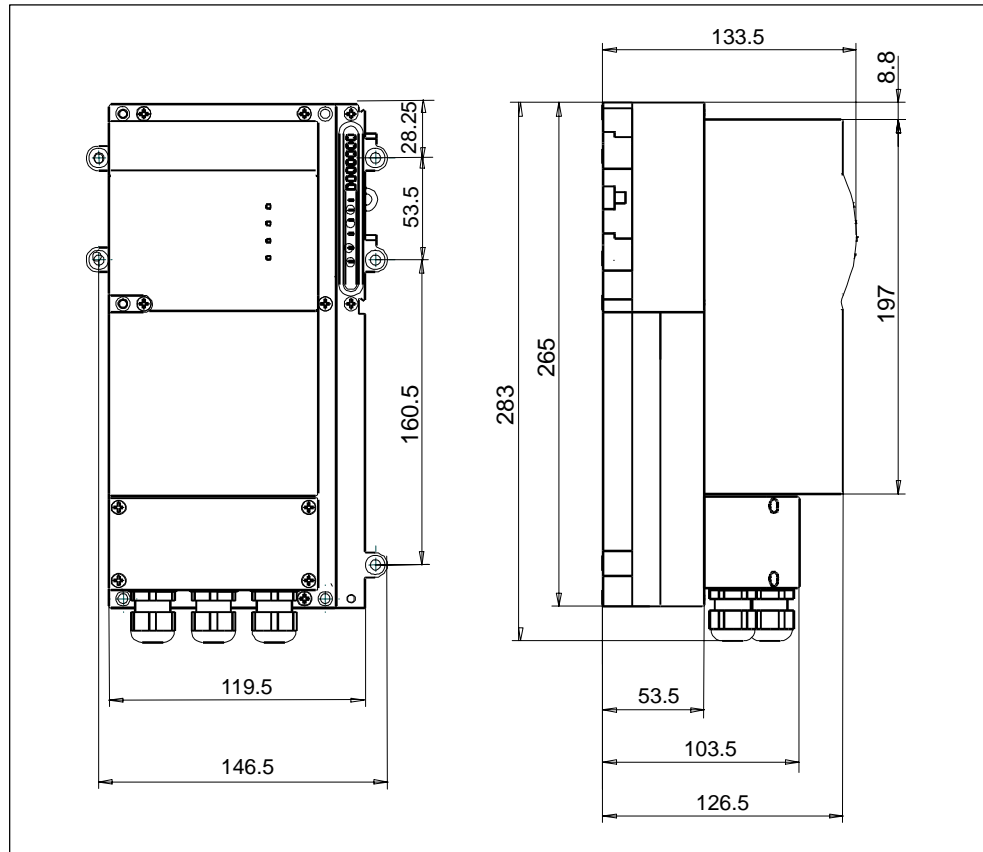
Figure C-8   Dimensioned drawing of SITOP power

C.7   Dimensioned drawings – DIN rails
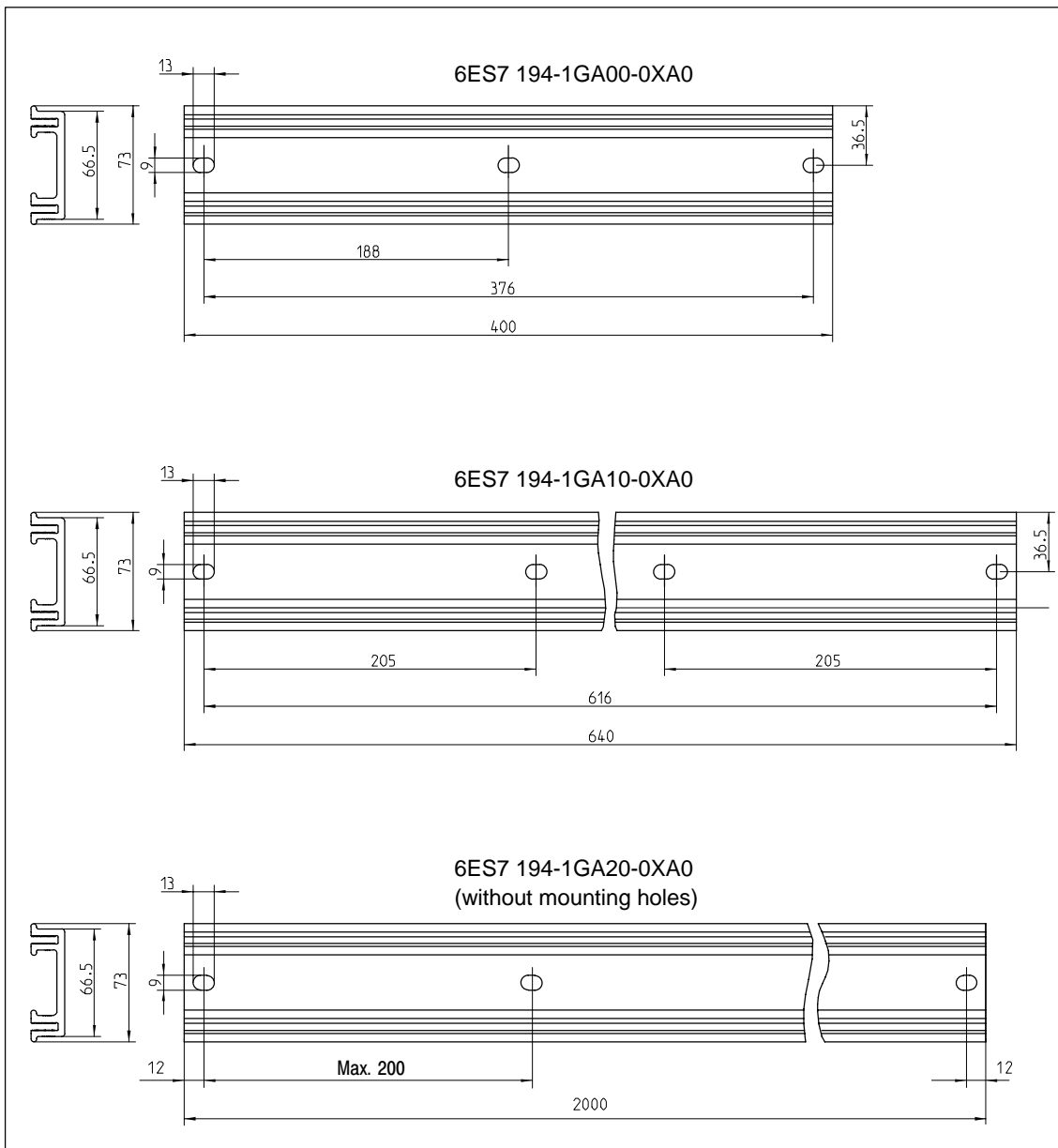
Figure C-9   Dimensioned drawings of the Narrow DIN rails

Note

You must cut the narrow DIN rail (with a length of 2000) to suit your requirements and drill the mounting holes for M8 screws.

To ensure that all the ET 200X modules have the specified vibration resistance, the mounting holes should be spaced at even intervals of a maximum 200 mm after initial spacing of 12 mm.

6ES7 194-1GB00-0XA0

6ES7 194-1GB10-0XA0
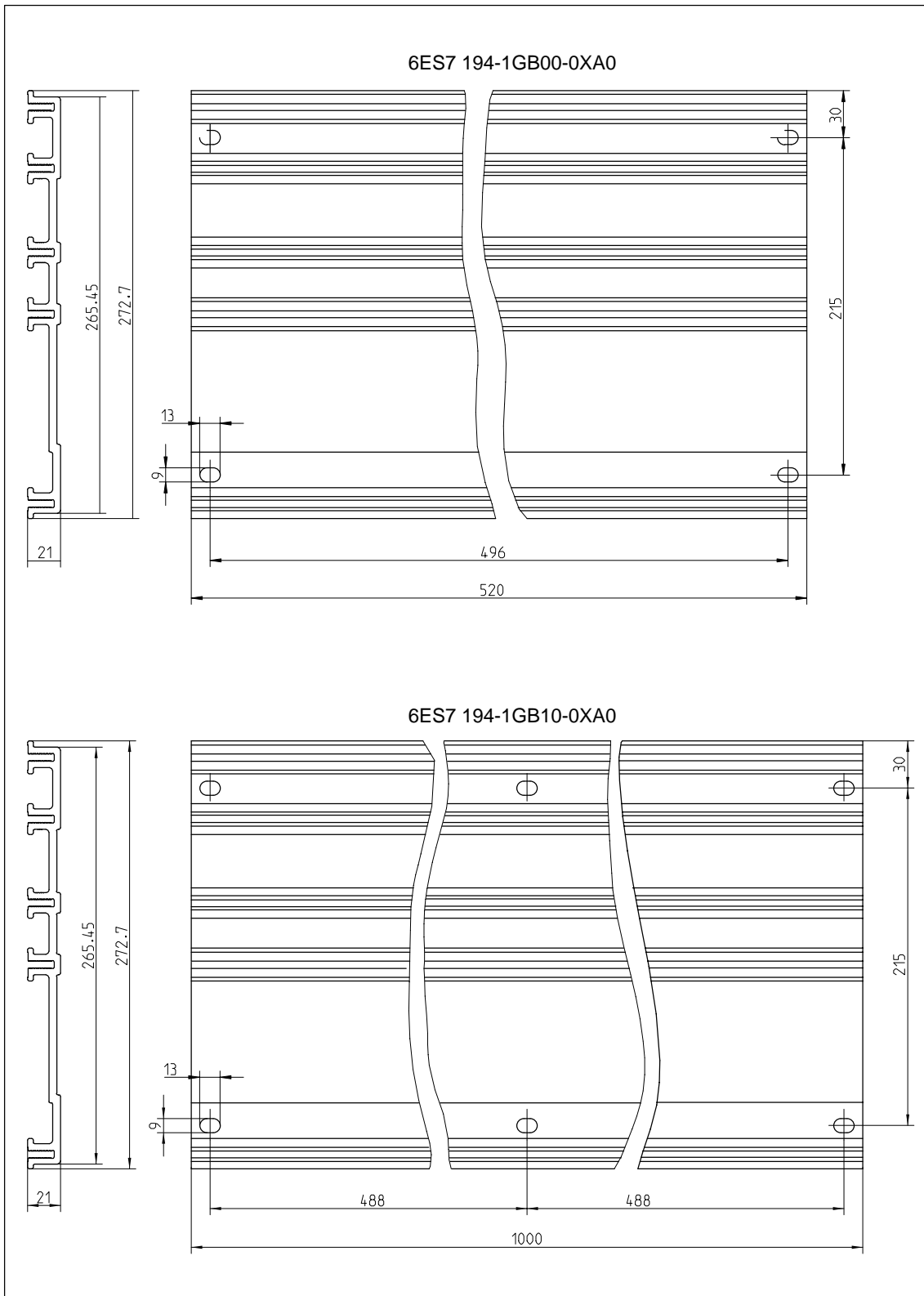
Figure C-10   Dimensioned drawings of the wide DIN rails

C.8 Pinout of the ET 200X

Figure C-11 below shows the pinout of the ET 200X on a BM 141, BM 142, BM 147/CPU basic module. The arrangement of sockets X1 to X4 is the same on all basic and expansion modules (BM 141, BM 142, EM 141, EM 142, EM 144, EM 145) with digital inputs and outputs.

Socket	Pinout	
X01 and X10 (supply voltage for electronic components/sensors, PROFIBUS-DP)	1 2 3 4 5 6	B signal PE PE/–* A signal L+ M
X03 (load voltage)	1 2 3 4 5 6	PE L+ M PE L+ M

* BM 141/142: PE
   BM 147/CPU: not assigned
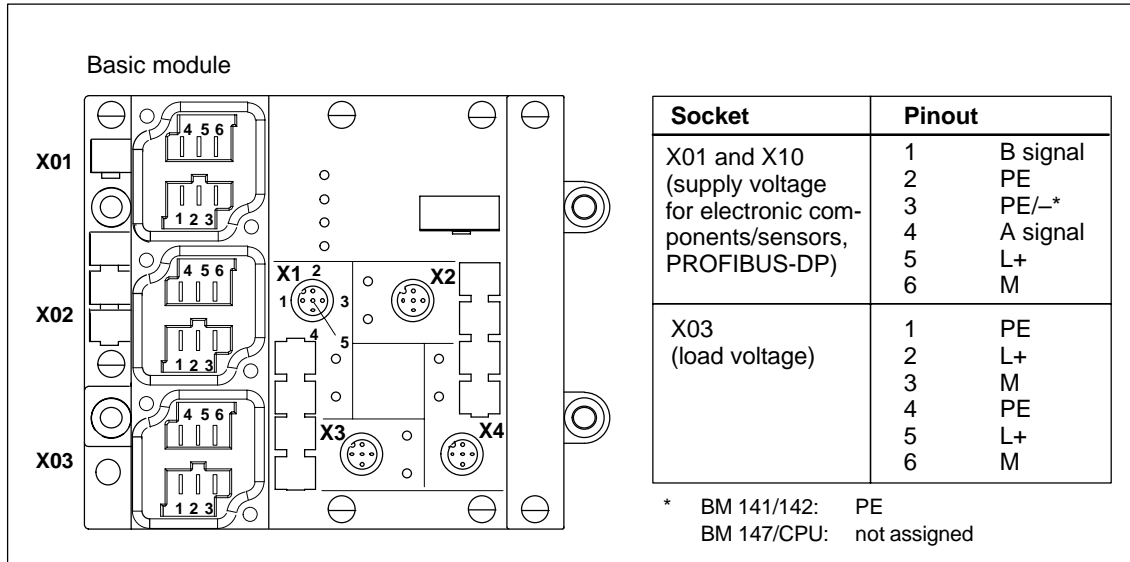
Figure C-11 Pinout of the ET 200X (BM 141, BM 142, BM 147/CPU)

Socket	Pinout of 8-channel DI	Pinout of 4-channel DI	Pinout of 4-channel DO	Pinout of pneumatic module (4-channel DI)
X1	1 Sensor supply output L+ 2 Input signal, channel 4 3 Grounding supply voltage 4 Input signal, channel 0 5 PE	1 Sensor supply output L+ 2 Input signal, channel 1 3 Grounding supply voltage 4 Input signal, channel 0 5 PE	1 – 2 Output signal, channel 1 3 Grounding Load current power supply 4 Output signal, channel 0 5 PE	1 Sensor supply output L+ 2 Input signal, channel 1 3 Grounding supply voltage 4 Input signal, channel 0 5 PE
X2	1 Sensor supply output L+ 2 Input signal, channel 5 3 Grounding supply voltage 4 Input signal, channel 1 5 PE	1 Sensor supply output L+ 2 – 3 Grounding supply voltage 4 Input signal, channel 1 5 PE	1 – 2 – 3 Grounding Load current power supply 4 Output signal, channel 1 5 PE	1 Sensor supply output L+ 2 Input signal, channel 3 3 Grounding supply voltage 4 Input signal, channel 2 5 PE

Socket	Pinout of 8-channel DI	Pinout of 4-channel DI	Pinout of 4-channel DO	Pinout of pneumatic module (4-channel DI)
X3	1 Sensor supply output L+ 2 Input signal, channel 6 3 Grounding supply voltage 4 Input signal, channel 2 5 PE	1 Sensor supply output L+ 2 Input signal, channel 3 3 Grounding supply voltage 4 Input signal, channel 2 5 PE	1 – 2 Output signal, channel 3 3 Grounding Load current power supply 4 Output signal, channel 2 5 PE	–
X4	1 Sensor supply output L+ 2 Input signal, channel 7 3 Grounding supply voltage 4 Input signal, channel 3 5 PE	1 Sensor supply output L+ 2 – 3 Grounding supply voltage 4 Input signal, channel 3 5 PE	1 – 2 – 3 Grounding Load current power supply 4 Output signal, channel 3 5 PE	–

C.9 Pinout of the 8-channel expansion modules

Figure C-12 below shows the pinout of the 8-channel DI/DO expansion modules of the ET 200X on an expansion module (high design). The arrangement of sockets X1 to X8 is the same on all expansion modules with digital inputs and outputs.
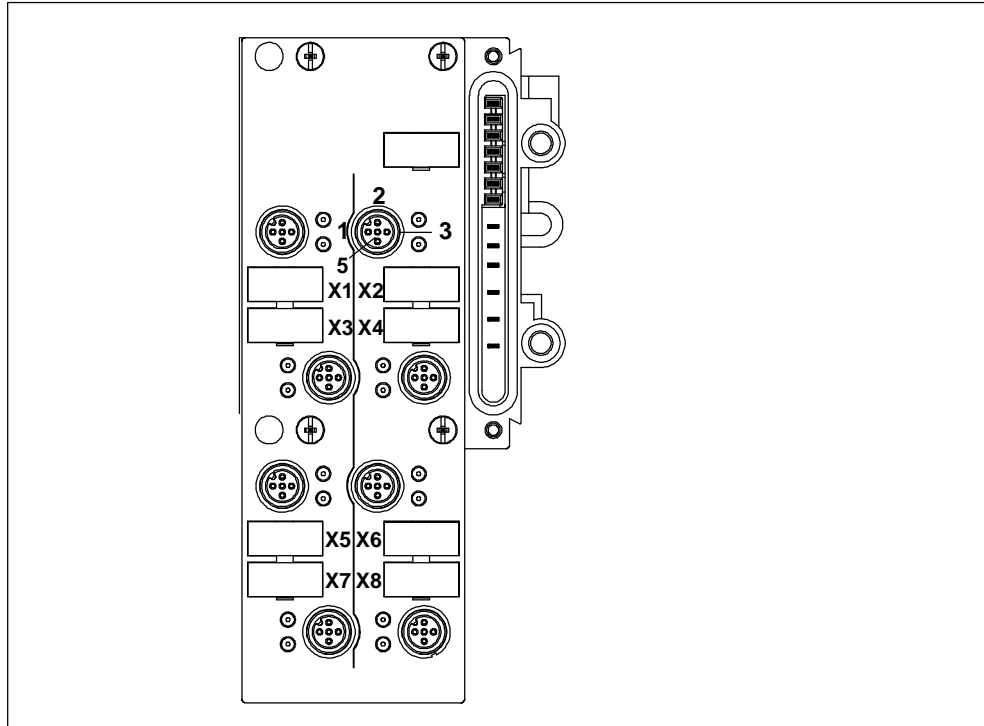
Figure C-12   Pinout of the 8-channel DI/DO expansion module

Socket	Pinout 8-channel DI	Pinout 8-channel DO
X1 to X8	1 Sensor supply output L+ 2 not assigned 3 Grounding supply voltage 4 Input signal channel n 5 PE	1 not assigned 2 not assigned 3 Grounding load current power supply 4 Output signal channel n 5 PE

C.10 Pinout of the ET 200X-DESINA

Figure C-13 shows you the pinout of the ET 200X-DESINA using the example of the BM 143-DESINA FO basic module.
The BM 143-DESINA RS485 basic module has the same pinout on the PROFIBUS-DP connection (pins 5 and 6) but has copper conductors instead of fiber-optic cables. The arrangement of sockets X1 to X8 is identical for all DESINA basic and expansion modules with digital inputs and outputs.

Socket	Pinout
X01 Supply (Supply voltage for electronics/ sensors, actuators PROFIBUS-DP)	1 L+ (NS*) 2 M (NS*) 3 M (S**) 4 L+ (S**) 5 Signal A (RD***) 6 Signal B (TD***)
X02 Loop through	1 L+ (NS*) 2 M (NS*) 3 M (S**) 4 L+ (S**) 5 Signal A (RD***) 6 Signal B (TD***)

* Non-switched supply voltage
** Switched load voltage
*** on the basis of the DESINA specification
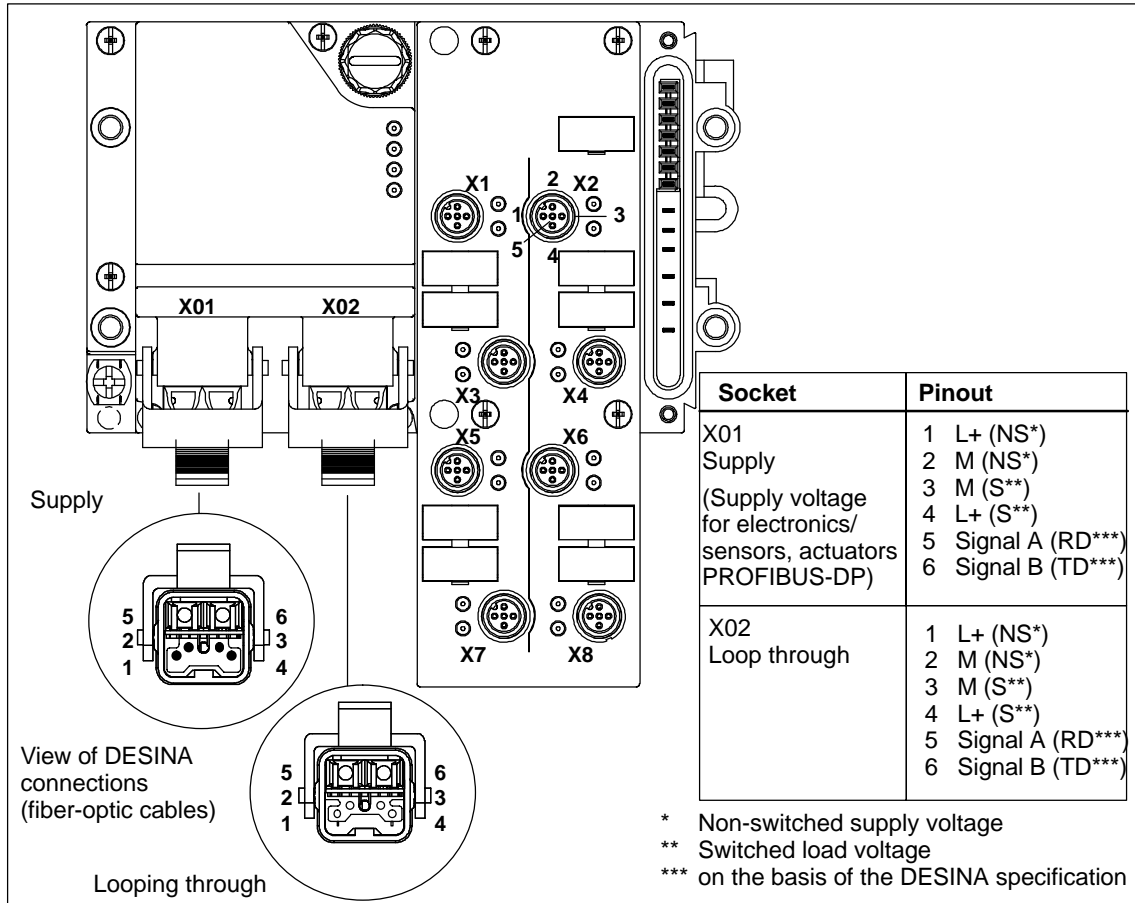
Figure C-13   Pinout of the ET 200X-DESINA

Socket	Pinout of the 8-channel DI/DO
X1 X3 X5 X7	1 Sensor supply output L+ (NS) 2 Diagnostic input or input with NC function. 3 Grounding supply voltage 4 Digital input or output (DESINA) channels 0, 2, 4 and 6 5 not assigned
X2 X4 X6 X8	1 Sensor supply output L+ (NS) 2 Diagnostic input or input with NC function. 3 Grounding supply voltage 4 Digital input or output (DESINA) channels 1, 3, 5 and 7 5 not assigned

C.11 Pinout of the ET 200X-ECOFAST

Figure C-14 shows the pinout of the BM 141-ECOFAST 8DI basic module.

The following table appears within the figure:

Socket	Pinout
X01 Supply (Supply voltage for electronics/ sensors, actuators PROFIBUS-DP)	1 L+ (NS*) 2 M (NS*) 3 M (S**) 4 L+ (S**) 5 Signal A 6 Signal B
X02 Loop through	1 L+ (NS*) 2 M (NS*) 3 M (S**) 4 L+ (S**) 5 Signal A 6 Signal B

*   Non-switched supply voltage
** Switched load voltage
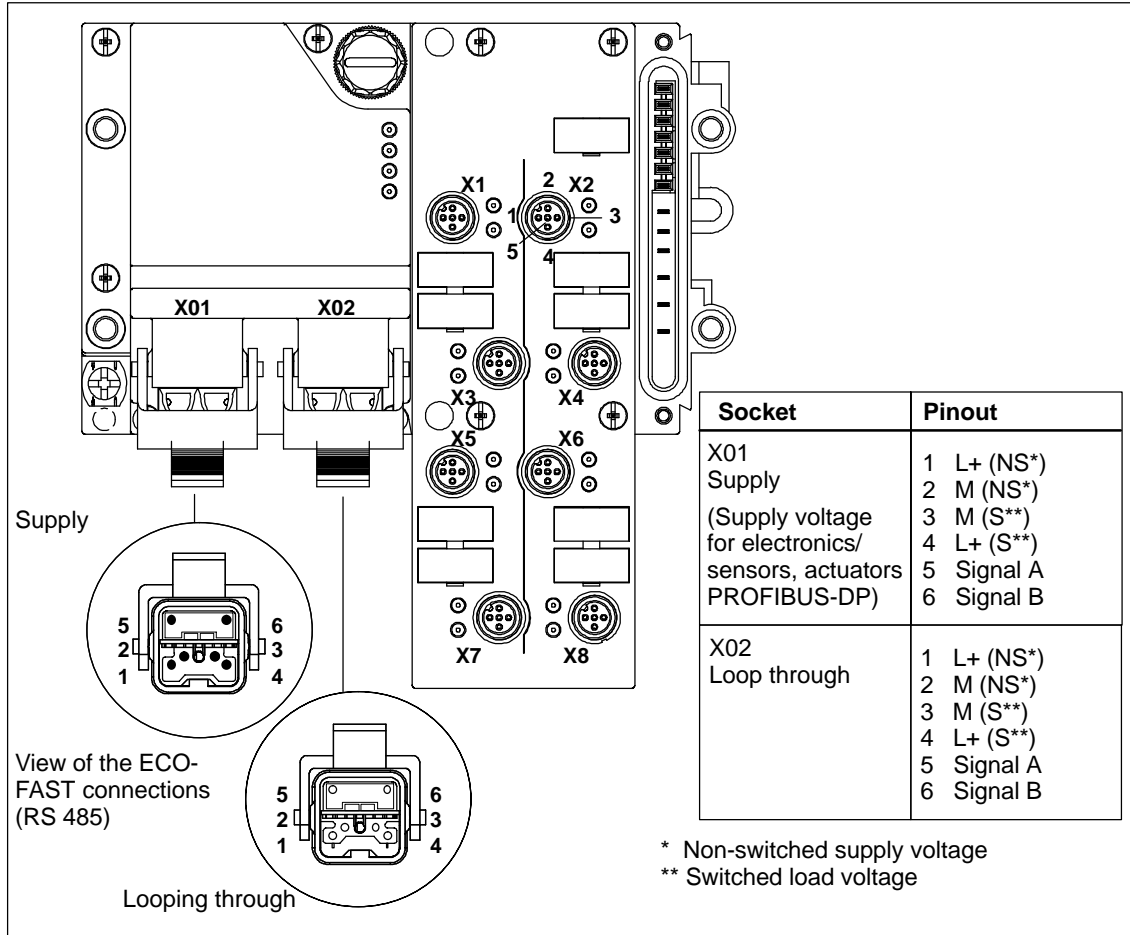
Figure C-14   Pinout of the BM 141-ECOFAST 8DI basic module

Socket	Pinout of the BM 141-ECOFAST 8DI
X1 X3 X5 X7	1 Sensor supply output L+ (NS) 2 not assigned 3 Grounding supply voltage 4 Digital input channels 0, 2, 4 and 6 5 not assigned
X2 X4 X6 X8	1 Sensor supply output L+ (NS) 2 not assigned 3 Grounding supply voltage 4 Digital input channels 1, 3, 5 and 7 5 not assigned

C.12 Pinout of analog inputs/outputs

Figure C-15 below shows the pinout of the inputs/outputs of the ET 200X on an expansion module. The arrangement of the sockets is identical for all expansion modules with analog inputs and outputs.
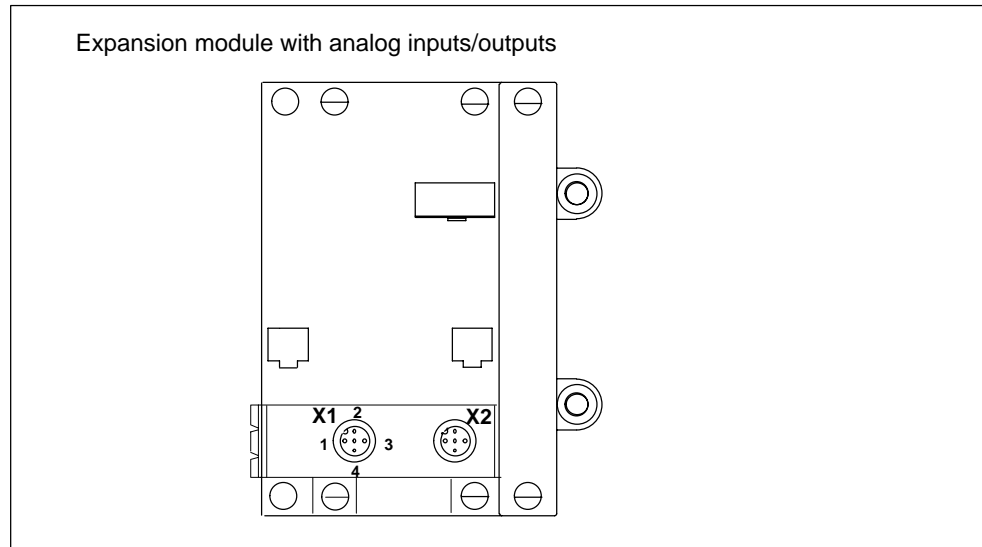
Figure C-15   Pinout of expansion module with analog inputs/outputs

Socket	Pinout of 2-channel AI		Pinout of 2-channel AO	
	Voltage/current $\pm$ 10 V $\pm$ 20 mA Pt 100	**Current** 4 to 20 mA	**Voltage** $\pm$ 10 V	**Current** $\pm$ 20 mA 4 to 20 mA
X1	1 L+ 2 Channel 0 (+) 3 Ground power supply 4 Channel 0 (–)	1 L+; channel 0 (+) 2 Channel 0 (–) 3 Ground power supply 4 –	1 Qv channel 0 2 – 3 Ground power supply 4 –	1 QI channel 0 2 – 3 Ground power supply 4 –
X2	1 L+ 2 Channel 1 (+) 3 Ground power supply 4 Channel 1 (–)	1 L+; channel 1 (+) 2 Channel 1 (–) 3 Ground power supply 4 –	1 Qv channel 1 2 – 3 Ground power supply 4 –	1 QI channel 1 2 – 3 Ground power supply 4 –

Glossary

Aggregate current

Aggregate of the currents of all output channels of a digital output module.

Automation system

An automation system is a programmable logic controller consisting of at least one CPU, various input and output modules and operator interfaces.

Bus

Common transmission channel to which all stations are connected; a bus has two defined ends.

In the case of the ET 200, the bus is a two-wire or fiber-optic cable.

Bus connector

The physical link between bus node and bus cable. There is a special bus connector for ET 200X (= connector for PROFIBUS-DP) with a degree of protection rating of IP 65.

Chassis ground

Chassis ground refers to all the interconnected inactive parts of a piece of equipment that, even in the event of a fault, cannot carry voltage that is dangerous to the touch.

Configure

Configuring means planning individual components in a distributed I/O system.

Device master file

A device master file contains all the DP-slave-specific features. The format of the DDB file is specified in *IEC 61784-1:2002 Ed1 CP 3/1*.

DESINA

Distributed and **S**tandardized **IN**st**A**llation technique for machine tools
DESINA is an all-inclusive general concept for standardization of
installation-relevant components in terms of function and connection technology.
End-to-end usage of DESINA-compliant components can produce significant
savings in the costs of system planning, implementation and operation.

Diagnostic interrupt

Diagnostics-compatible modules use diagnostic interrupts to notify the central
CPU of system errors.

In SIMATIC S7/M7: When an error is detected or disappears (e.g. wire break),
ET 200X triggers a diagnostic interrupt, provided the interrupt is enabled. The CPU
of the DP master interrupts the processing of the user program and lower priority
classes and processes the diagnostic interrupt block (OB 82).

In SIMATIC S5: The diagnostic interrupt appears in the station diagnosis. Using
cyclical querying of the diagnostic bits in the station diagnosis you can detect
errors such as a wire break.

Diagnostics

Diagnostics means the detection, localization, classification, reporting and
evaluation of faults, malfunctions and messages.

Diagnostics incorporates monitoring functions which run automatically while the
system is in operation. This enhances system availability by reducing setup
times and outages.

Direct starter

A direct starter is a → Motor starter which switches a motor on or off directly. It
consists of a power circuit-breaker and a contactor.

Distributed I/O devices

These are input/output units that are not located in the base unit; instead, they
are distributed at some distance from the CPU. The following are examples of
such units:

- ET 200M, ET 200B, ET 200C, ET 200U, ET 200X, ET 200L
- DP/AS-I Link
- S5-95U with PROFIBUS-DP slave interface
- Other DP slaves from either Siemens or other vendors

The distributed I/O devices are connected to the DP master via PROFIBUS-DP.

DP address

> → PROFIBUS address

DP master

> A → master that complies with *IEC 61784-1:2002 Ed1 CP 3/1* is described as a DP master.

DP slave

> A → slave that is operated on PROFIBUS with the PROFIBUS-DP protocol and that complies with *IEC 61784-1:2002 Ed1 CP 3/1* standard is called a DP slave.

DP standard

> The DP standard is the bus protocol of the ET 200 distributed I/O system based on *IEC 61784-1:2002 Ed1 CP 3/1*.

DPV0

> Cyclic data transfer between the DP master and DP slaves.

DPV1

> Extension of DPV0 with an acyclic data transfer between the DP master and DP slaves.

Equipotential bonding

> Electrical connection (equipotential bonding conductor) that brings the parts of electrical equipment and other conductive parts to the same or approximately the same potential in order to prevent troublesome or dangerous voltages arising between these parts.

Error handling

> → Diagnostics

External power supply

> Power supply for the ET 200X distributed I/O device and the process peripherals connected to it.

FREEZE

This is a control command of the DP master to a group of DP slaves.

When a DP slave receives the FREEZE control command, it freezes the current status of the **inputs** and transfers them cyclically to the DP master.

After each subsequent FREEZE control command, the DP slave freezes the status of the **inputs** again.

The input data is not transferred from the DP slave to the DP master again cyclically until the DP master sends the UNFREEZE control command.

Frequency converter

On the ET 200X the frequency converter is used for infinitely variable adjustment of the speed and adaptation of the power of asynchronous motors up to 1.5 kW rated power. Temperature monitoring device and motor brake are integrated.

The converter is parameterized appropriately for the connected motor. Operation of the frequency converter is controlled by the software.

Ground

The conductive mass of earth, the electrical potential of which can be set to zero at any point. In the vicinity of grounding electrodes the potential may not be zero. The term "reference ground" is often used here.

Grounding

Grounding means to connect a conductive component with the grounding electrode via a ground system.

Isolated

In the case of isolated input/output modules, the reference potentials of the control and load circuit are galvanically isolated – by means of optical isolators or relay contacts, for example. Input/output circuits can be grouped.

Master

When they are in possession of the token, masters can send data to and request data from other nodes (= active node). The CPU 315-2 DP and the IM 308-C are examples of DP masters.

Motor starter

Motor starter is the overall term for → Direct and → Reversing Starters. Motor starters determine the start-up and direction of rotation of a motor (= load).

Node

A device that can send, receive or amplify data via the bus, such as a DP master, DP slave, RS 485 repeater or active star coupler.

Node address

$\rightarrow$ PROFIBUS address

Non-isolated

In the case of non-isolated input/output modules, the reference potentials of the control and load circuit are electrically connected.

Parameterize

Parameterizing means sending slave parameters from the DP master to the DP slave.

PROFIBUS

PROcess FIeld BUS – German process and field bus standard that is defined in *IEC 61784-1:2002 Ed1 CP 3/1*. It defines the functional, electrical and mechanical properties of a bit-serial field bus system.

PROFIBUS is available with the protocols DP (the German abbreviation for distributed I/O), FMS (= field bus message specification), PA (= process automation), or TF (= technology functions).

PROFIBUS address

Each bus node must receive a PROFIBUS address to uniquely identify it on the PROFIBUS bus system.

The PC/programming device has the PROFIBUS address "0".

PROFIBUS addresses 1 to 125 are permissible for the ET 200X distributed I/O device.

Reference potential

Potential from which the voltages of the circuits involved can be observed and/or measured.

Reversing starter

A reversing starter is a $\rightarrow$ motor starter which determines a motor's direction of rotation. It consists of a power circuit-breaker and two contactors.

Segment

The bus line between two terminating resistors forms a segment. A segment contains 0 to 32 → nodes. Segments can be interconnected by means of RS 485 repeaters.

Slave

A slave can only exchange data with a → master when requested by it to do so. By slaves we mean, for example, all DP slaves, such as ET 200B, ET 200X, ET 200M etc.

Station number

→ PROFIBUS address

SYNC

This is a control command of the DP master to a group of DP slaves.

By means of the SYNC control command the DP master causes the DP slave to freeze the current statuses of the **outputs**. In the subsequent frames, the DP slave stores the output data, but the statuses of the outputs remain unchanged.

After each new SYNC control command, the DP slave sets the outputs that it has stored as output data. The outputs are not cyclically updated again until the DP master sends the UNSYNC control command.

Terminating resistor

The terminating resistor is a resistor for adjusting the power on the bus cable; terminating resistors must be used on the cable and segment ends.

The terminating resistors in the ET 200X are switched on and off in the basic module.

The ET 200X-DESINA connects to the bus by means of a fiber-optic waveguide, so no terminating resistors are required.

Transmission rate

The transmission rate of a data transfer is measured in bits transmitted per second (transmission rate = bit rate).

In the case of the ET 200X, transmission rates of 9.6 kbps to 12 Mbps are possible.

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