# SIEMENS

SYSTEM MANUAL

# SIMATIC

## ET 200SP

ET 200SP Distributed I/O System

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# System overview

**5**

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

**SIMATIC ET 200SP**

SIMATIC ET 200SP is a scalable and highly flexible distributed I/O system for connecting process signals to a higher-level controller via a fieldbus.

## Customer benefits of the system

**Compact design**
- Small size and high variability through scalability
- Maximum level of clarity through innovative labeling system in minimum space
- System-integrated load current supply

**Safety Integrated**
- Easy integration of fail-safe CPUs and modules
- All F-parameters set in software

**Easy to use**
- Compact modules, fixed wiring with single-cable and multi-cable connection
- Less time due to connection technology with push-in terminals and without tools
- Adaptation of the configuration for future expansions through integrated configuration control

**Communication standards**
- PROFINET IO
- PROFIBUS DP
- EtherNet/IP
- Modbus TCP
- ET-Connection
- AS-Interface
- IO-Link
- Point-to-point (RS232, RS485)
- DALI
- DMX

**High performance**
- Isochronous PROFINET IO with the PROFIsafe and PROFIenergy profiles

**Energy efficiency**
- PROFIenergy as integrated function

**CPU**
- PROFINET interface with 3 ports
- IO controller
- I-device
- Optional CM DP module for connection to PROFIBUS DP

**Motor starter**
- Easy integration of motor starters with overload and short-circuit protection
- Compact design with a maximum connectable motor output of up to 5.5 kW

**Powerful technology**
- Modules for Counting, Positioning, Weighing and Measuring functions of electrical parameters

**Modules for hazardous area**
- Modules for the connection of devices in hazardous areas of Zone 0 and Zone 1.

Figure 5-1  SIMATIC ET 200SP distributed I/O system - Customer benefits

## Area of application

Thanks to its multifunctionality, the SIMATIC ET 200SP distributed I/O system is suitable for a wide range of applications. Its scalable design allows you to tailor your configuration to local requirements. Various CPUs/interface modules are available for connection to PROFINET IO, PROFIBUS DP, EtherNet/IP or Modbus TCP.

SIMATIC ET 200SP with CPU allows intelligent pre-processing to relieve the higher-level controller. The CPU can also be used as standalone device.

By using fail-safe CPUs, you can implement applications for safety engineering. Configuration and programming of your safety program takes place the same way as for standard CPUs.

An extensive range of I/O modules extends the area of application of the ET 200SP system.

SIMATIC ET 200SP is designed with degree of protection IP20 and is intended for installation in a control cabinet.

With use of an ET 200SP R1, you increase the availability of the system through redundant interface modules.

## Configuration

The SIMATIC ET 200SP distributed I/O system is installed on a mounting rail. It consists of:

- CPU/interface module
- Up to 64 I/O modules, which can be plugged into BaseUnits in any combination
- Up to 31 motor starters
- A server module that completes the configuration of the ET 200SP.

## Configuration example
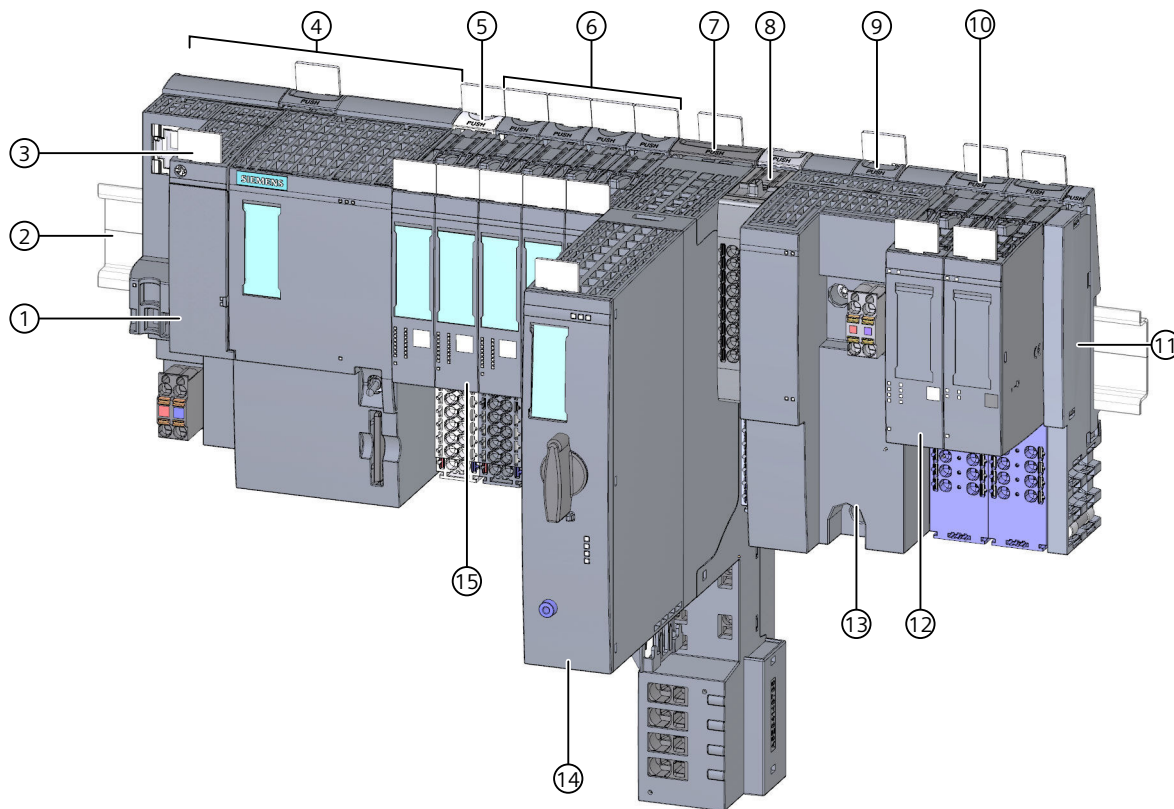


① BusAdapter

② Mounting rail

③ Reference identification label

④ CPU/interface module

⑤ Light-colored BaseUnit BU..D with infeed of supply voltage

⑥ Dark-colored BaseUnits BU..B for conducting the potential group further

⑦ BaseUnit for motor starters

⑧ Potential distributor module

⑨ Ex BaseUnit for Ex power module

⑩ Ex BaseUnit for Ex I/O module

⑪ Server module (included in the scope of supply of the CPU/interface module)

⑫ Ex I/O module

⑬ Ex power module

⑭ ET 200SP motor starter

⑮ I/O module

Figure 5-2  Configuration example of the ET 200SP

## 5.2 What are fail-safe automation systems and fail-safe modules?

### Fail-safe automation systems

Fail-safe automation systems (F-systems) are used in systems with higher safety requirements. F-systems control processes and ensure that they are in a safe state immediately after shutdown. In other words, F-systems control processes in which an immediate shutdown does not endanger persons or the environment.

### Safety Integrated

Safety Integrated is the integrated safety concept for automation and drive technology from Siemens.

Proven technologies and systems from automation technology are used for safety systems. Safety Integrated includes the complete safety sequence, ranging from sensor, actuator and fail-safe modules right through to the controller, including safety-related communication via standard fieldbuses. Drives and controllers handle safety tasks in addition to their actual functions.

### Fail-safe modules

The key difference between fail-safe modules (F-modules) and standard modules is that they have an internal two-channel design. This means the two integrated processors monitor each other, automatically test the input and output circuits, and switch the fail-safe module to a safe state in the event of a fault.

The F-CPU communicates with a fail-safe module via the safety-related PROFIsafe bus profile.

### Fail-safe motor starters

Fail-safe motor starters enable safety-related tripping of motor loads. Fail-safe motor starters are not PROFIsafe nodes. Motor starters operate together with the fail-safe modules of the ET 200SP system.

### Area of application of ET 200SP with fail-safe I/O modules

By using the ET 200SP distributed I/O system with fail-safe I/O modules, you are replacing conventional safety engineering configurations. This includes the replacement of switching devices for emergency STOP, protective door monitors, two-hand operation, etc.

## 5.3 How are SIMATIC Safety F-systems structured with ET 200SP?

### SIMATIC Safety F-system with ET 200SP

The figure below shows an example of a configuration for a SIMATIC Safety F-system with ET 200SP distributed I/O system and PROFINET IO. You can configure the PROFINET IO lines with copper cable, fiber-optic cable or WLAN.

Fail-safe I/O modules and non-fail-safe I/O modules can be combined in an ET 200SP configuration.

The fail-safe IO controller (F-CPU) exchanges safety-related and non-safety-related data with fail-safe and non-fail-safe ET 200SP modules.

ET 200SP Fe.g. CPU 1512SP F-1 PN and CM DP



PROFINET
(Industrial Ethernet)
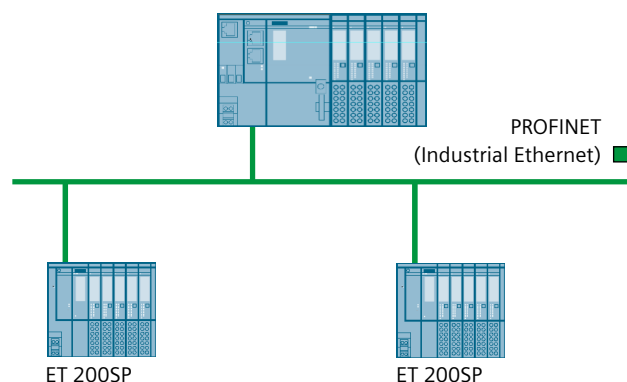
ET 200SP                    ET 200SP

Figure 5-3  Fail-safe SIMATIC Safety automation system (sample configuration)

### Fail-safe ET 200SP I/O modules

The following fail-safe I/O modules are available for the ET 200SP distributed I/O system:

- Fail-safe power modules are used to supply the potential group load voltage and for the safety-related tripping of the load voltage for non-fail-safe output modules.
- Fail-safe digital input modules detect the signal states of safety-related sensors and send the relevant safety frames to the F-CPU.
- Fail-safe digital output modules are suitable for safety-related shutdown procedures with short circuit and cross-circuit protection up to the actuator.

### ET 200SP fail-safe motor starters

Fail-safe motor starters are suitable for safety-related tripping of motor loads.

**Example of a configuration with fail-safe I/O modules**
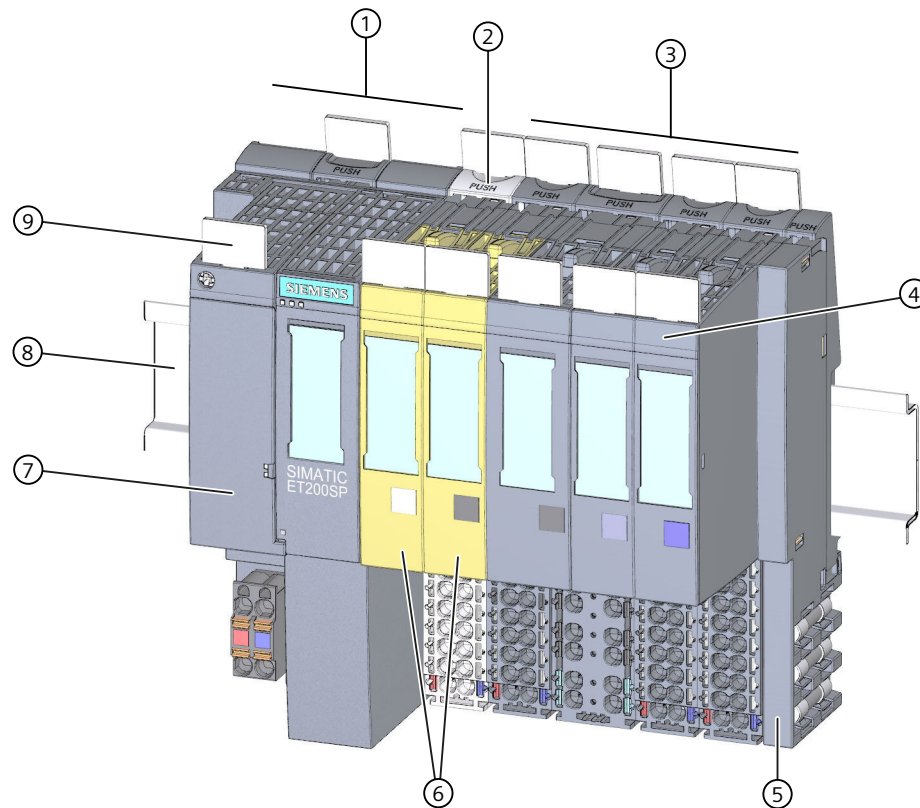


| ① | Interface module |
|---|---|
| ② | Light-colored BaseUnit BU..D with infeed of supply voltage |
| ③ | Dark-colored BaseUnits BU..B for conducting the potential group further |
| ④ | I/O module |
| ⑤ | Server module (ships with the interface module) |
| ⑥ | Fail-safe I/O modules |
| ⑦ | BusAdapter |
| ⑧ | Mounting rail |
| ⑨ | Reference identification label |

Figure 5-4  Example of a configuration of the ET 200SP with fail-safe I/O modules

## Hardware and software requirements

Fail-safe modules ET 200SP are supported by IM155-6PN ST interface modules as of firmware V1.1.1, IM155-6PN HF as of firmware V2.0, IM155-6PN HS as of firmware V4.0 and IM155-6DP HF as of firmware V1.0.

You require the STEP 7 Safety Advanced option package, V12 or higher including HSP 54, for configuration and programming of the ET 200SP fail-safe modules with the SIMATIC Safety fail-safe system.

You require the F-Configuration Pack V5.5 SP10 or later for configuring and programming the ET 200SP failsafe modules with the Distributed Safety failsafe system.

You require the F-Configuration Pack V5.5 SP12 or later for configuring and programming the ET 200SP failsafe modules with the F/FH Systems failsafe system.

ET 200SP fail-safe motor starters are supported by interface modules IM155-6PN BA, firmware V3.2 or higher, IM155-6PN ST, firmware V3.1 or higher, IM155-6PN HF, firmware V3.1 or higher and IM155-6DP HF firmware V3.0 or higher.

You require SIMATIC Step 7 V14 or higher for configuration and programming of ET 200SP fail-safe motor starters. The F-Configuration Pack is not needed for configuration and programming of the ET 200SP fail-safe motor starter.

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**NOTE**

Configuration of ET 200SP motor starters, SIMATIC Step 7 V13 or higher, is possible with a GSD file (GSDML).

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## Use in safety mode only

Safety mode is the F-I/O operating mode that allows safety-related communication using safety frames.

Safety mode of motor starters is characterized by the fail-safe digital input (F-DI) and availability of the 24 V power supply.

You can only use the ET 200SP fail-safe I/O modules in safety mode. They cannot be used in non-fail-safe mode.

### Achievable safety classes

The fail-safe modules are equipped with integrated safety functions for safety mode.
You can achieve the safety classes of the table below:

- With the appropriate parameter assignment of the safety functions in STEP 7
- With a specific combination of fail-safe and non-fail-safe I/O modules
- With a special arrangement and wiring of the sensors and actuators

Table 5-1  Safety classes that can be achieved with ET 200SP in safety mode

| Safety class in safety mode | | |
|---|---|---|
| **According to IEC 61508** | **According to ISO 13849-1** | |
| SIL2 | Category 3 | (PL) Performance Level d |
| SIL3 | Category 3 | (PL) Performance Level e |
| SIL3 | Category 4 | (PL) Performance Level e |

### More information

You will find the use cases and wiring for the relevant safety class in the manuals of the fail-safe I/Os and the fail-safe motor starters.

# 5.4 Components
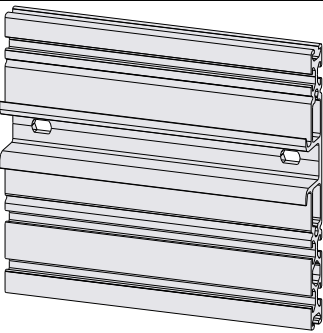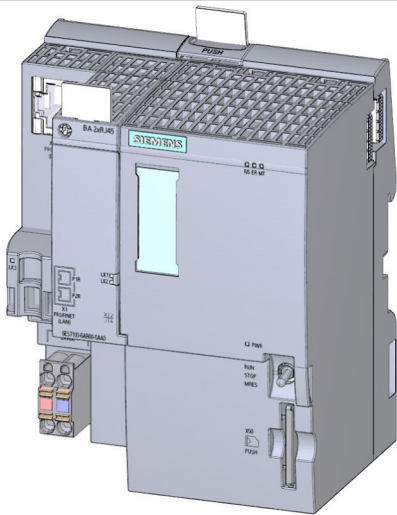
## Overview of ET 200SP modules and accessories

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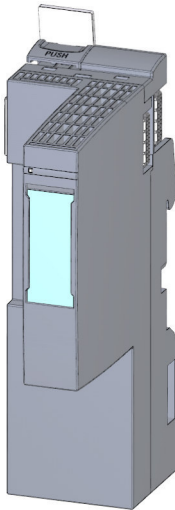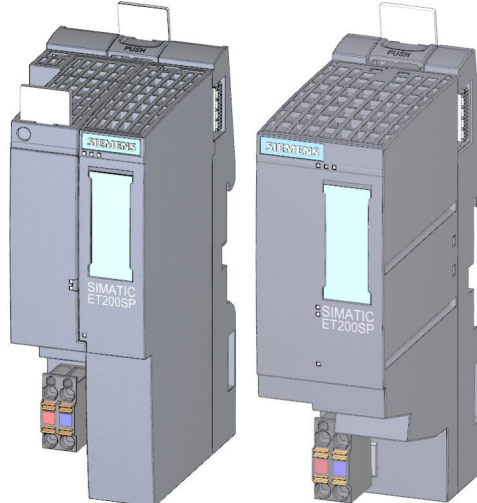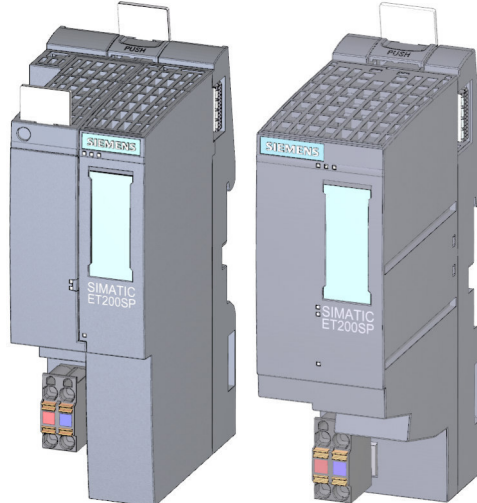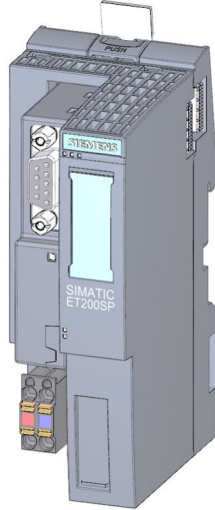
**NOTE**

A complete overview of the ET 200SP modules and accessories is available in the Product information on documentation of the ET 200SP distributed I/O system (https://support.industry.siemens.com/cs/de/de/view/73021864/en).

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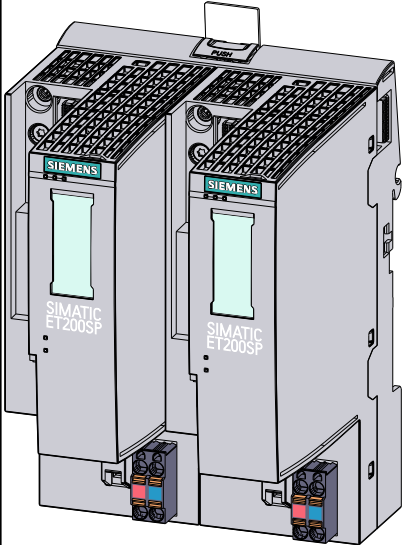
## Basic components of the ET 200SP distributed I/O system
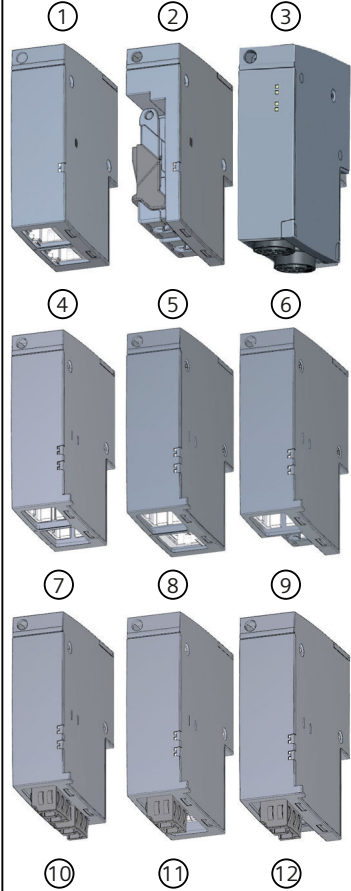
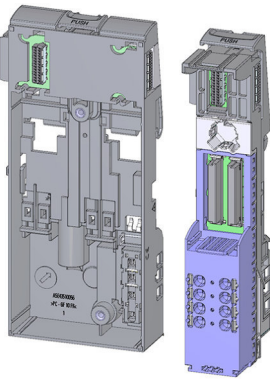Table 5-2  Basic components of the ET 200SP
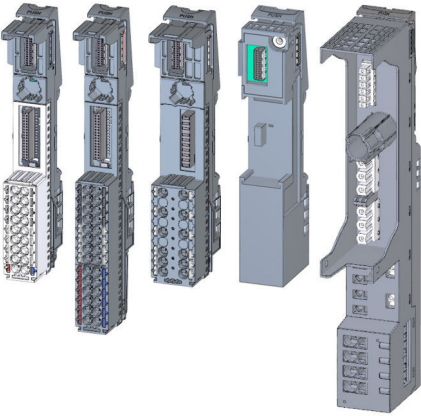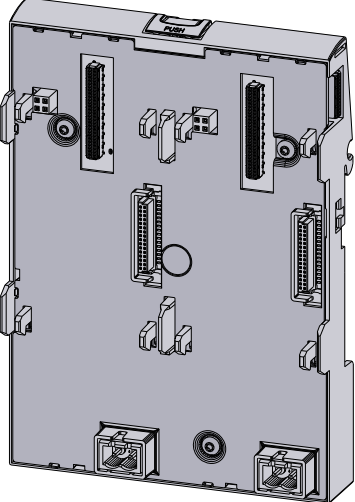
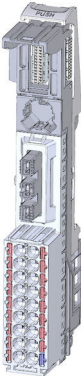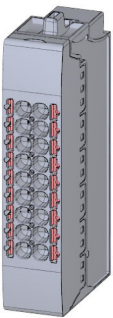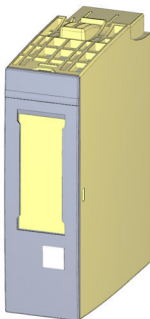| Basic component | Function | Figure |
|---|---|---|
| Mounting rail in accordance with EN 60715 | The mounting rail is the rack of the ET 200SP distributed I/O system. You install the ET 200SP system on the mounting rail. The mounting rail is 35 mm high. |  |
| SIMATIC system rail | The system rail is the mounting rack of the ET 200SP R1 distributed I/O system. The ET 200SP R1 system must be installed on the system rail. You can also mount all other interface modules on the system rail to improve the stability of the system. |  |
| CPU/Fail-safe CPU | The (F) CPU:<br>• Runs the user program. The F-CPU also runs the safety program.<br>• Can be used as an IO controller or I-Device on PROFINET IO or as a standalone CPU<br>• Links the ET 200SP to the IO devices or the IO controller<br>• Exchanges data with the I/O modules via the backplane bus.<br>Additional CPU functions:<br>• Communication via PROFIBUS DP (the CPU can be used as a DP master or DP slave in combination with the CM DP communication module)<br>• Integrated Web server<br>• Integrated technology<br>• Integrated trace functionality<br>• Integrated system diagnostics<br>• Integrated safety<br>• Safety mode (when using fail-safe CPUs) |  |

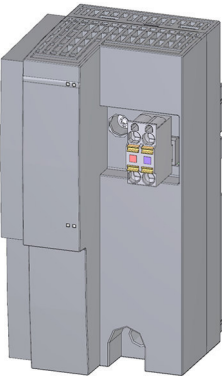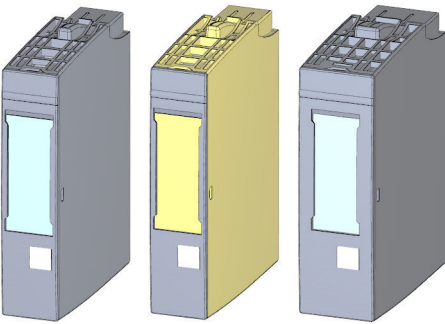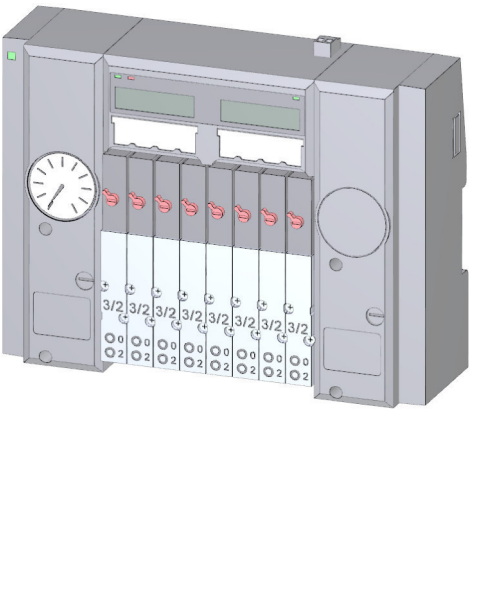| Basic component | Function | Figure |
|---|---|---|
| Communication module CM DP | The communication module CM DP<br>• Connects the CPU with PROFIBUS DP<br>• The bus connection is an RS485 interface. | |
| Interface module for PROFINET IO | The interface module:<br>• Can be used as IO device on PROFINET IO<br>• Links the ET 200SP with the IO controller<br>• Exchanges data with the I/O modules via the backplane bus. | |
| Interface module for MultiFieldbus | The interface module:<br>• Use as IO device on PROFINET IO<br>• Links the ET 200SP with the IO controller<br>• Links the ET 200SP via EtherNet/IP<br>• Links the ET 200SP via Modbus TCP<br>• Exchanges data with the I/O modules via the backplane bus<br>You can find more information about MultiField-bus in the MultiFieldbus Function Manual (https://support.industry.siemens.com/cs/ww/en/view/109773209) and in the Inter-face Module IM 155-6 MF HF Equipment Manual (https://support.industry.siemens.com/cs/ww/en/view/109773210). | |
| Interface module for PROFIBUS DP | The interface module:<br>• Can be used as DP slave on PROFIBUS DP<br>• Links the ET 200SP with the DP master<br>• Exchanges data with the I/O modules via the backplane bus. | |

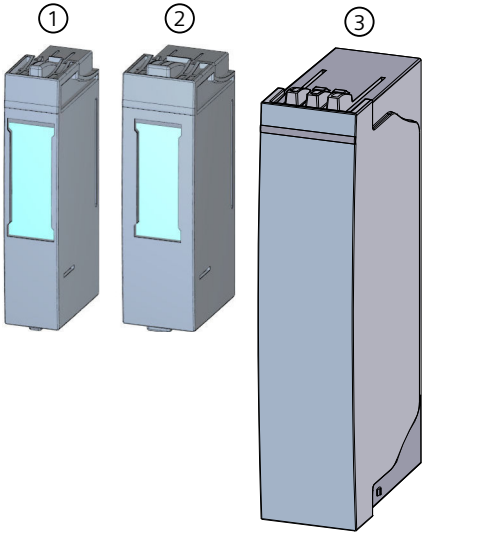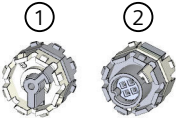| Basic component | Function | Figure |
|---|---|---|
| Interface modules and BaseUnit BU type M0 for redundant connection | The ET 200SP R1 system:<br>• Use as redundant IO device on PROFINET IO<br>• Connects the ET 200SP to the IO controller<br>• Exchanges data with the I/O modules via the backplane bus. |  |

| Basic component | Function | Figure |
|---|---|---|
| BusAdapter | The BusAdapters allow free selection of the connection technology for PROFINET IO. The following versions are available for PROFINET CPU/interface modules:<br>• For standard RJ45 connector (BA 2×RJ45) ①<br>• For direct connection of the bus cable (BA 2×FC) ②<br>• For standard M12 connector (D-coded) with screw-type terminal or plug-in push-pull version (BA 2xM12) ③<br>• For POF/PCF fiber-optic cable (BA 2xSCRJ) ④<br>• As media converter for POF/PCF fiber-optic cable ⇔ standard RJ45 plug (BA SCRJ/RJ45) ⑤<br>• As media converter for POF/PCF fiber-optic cable ⇔ direct connection of the bus cable (BA SCRJ/FC) ⑥<br>• For glass fiber-optic cable (BA 2xLC) ⑦<br>• As media converter for glass fiber-optic cable ⇔ standard RJ45 plug (BA LC/RJ45) ⑧<br>• As media converter for glass fiber-optic cable ⇔ direct connection of the bus cable (BA LC/FC) ⑨<br>• For single-mode fiber-optic cable with maximum length of 20 km (BA 2xLC-LD, long distance) ⑩<br>• As media converter for glass fiber-optic cable with an LC plug connector ⇔ standard RJ45 connector (BA LC-LD/RJ45) ⑪<br>• As media converter for glass fiber-optic cable with an LC plug connector ⇔ standard M12 plug or M12 push-pull connector (BA LC-LD/M12) ⑫ |  |
| | For mixed ET 200SP/ET 200AL configuration, you require the BusAdapter BA-Send 1xFC ① (plugged into the BaseUnit BU-Send). Connect the bus cable for ET-Connection to the BusAdapter BA-Send 1xFC. |  |

| Basic component | Function | Figure |
|---|---|---|
| BaseUnit | The BaseUnits provide the electrical and mechanical connection of the ET 200SP modules. Place the I/O modules or the motor starter onto the BaseUnits.<br>Suitable BaseUnits are available in each case for the different requirements. You can find additional information in section Selecting the BaseUnit for I/O modules (Page 84). |  |
| Ex BaseUnit | You need the following BaseUnits for an Ex module group:<br>• Ex BaseUnit for Ex power module<br>• Ex BaseUnit for Ex I/O module |  |
| BaseUnit ET 200SP R1 | Connects the IM 155-6 PN R1 redundant interface modules to the backplane bus.<br>It enables data exchange with the I/O modules.<br>Note:<br>Interface modules cannot be plugged in if the supply voltage connector is plugged in.<br>Only use BusAdapters of the same type. |  |

| Basic component | Function | Figure |
|---|---|---|
| PotDis-BaseUnit potential distributor module | You use the potential distributor module to distribute a variety of potentials (P1, P2). This allows you to implement a multi-cable connection without external terminals with 16-channel digital modules.<br>The assembly has two parts:<br>• If you need additional potential terminals, plug a PotDis-TerminalBlock in the PotDis-BaseUnit.<br>• Alternatively, plug a BU cover (15 mm) on the PotDis-BaseUnit.<br>With potential distributor modules, you may only connect to the PotDis-TB versions BR-W and n.c.-G potential, which exceed the voltage level of SELV/PELV. Other SELV/PELV potential groups should be separated with light-colored PotDis BUs. Suitable PotDis-BaseUnits are available in each case for the different requirements. You can find additional information in section Selecting a PotDis-BaseUnit (Page 90). | |
| PotDis-TerminalBlock | If you need additional potential terminals for a PotDis-BaseUnit, plug a PotDis-TerminalBlock in the PotDis-BaseUnit.<br>Voltages greater than SELV/PELV are only permitted for the PO PotDis-TBs BR (bridged) and NC (not connected). The same applies to PE. Voltages at the terminals of the PotDis modules connected to the P1/P2 rails must not be greater than SELV/PELV.<br>Suitable PotDis-TerminalBlocks are available in each case for the different requirements. You can find additional information in section Selecting a PotDis-TerminalBlock (Page 91). | |
| Fail-safe power module | The fail-safe power module allows the safety-related shutdown of digital output modules / fail-safe digital output modules. | |

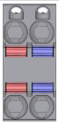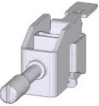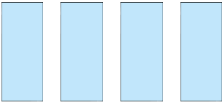| Basic component | Function | Figure |
|---|---|---|
| Ex power module | The Ex power module supplies the downstream Ex I/O modules via the power bus on the Ex BaseUnit of the Ex power module. An Ex BaseUnit is required for installing the Ex power module. |  |
| I/O module / Fail-safe I/O module/ Ex I/O module | The I/O module determines the function at the terminals. The controller detects the current process state via the connected sensors and actuators, and triggers the corresponding reactions. I/O modules are divided into the following module types:<br>• Digital input (DI, F-DI, Ex-DI)<br>• Digital output (DQ, F-DQ PM, F-DQ PP, F-RQ, Ex-DQ)<br>• Analog input (AI, F-AI, Ex-AI)<br>• Analog output (AQ, Ex-AQ)<br>• Technology module (TM, F-TM-C)<br>• Communication module (CM)<br>• Power module (F-PM-E) |  |
| Motor starter/fail-safe motor starter | The motor starter is a switching and protection device for 1-phase and 3-phase loads.<br>The motor starter is available as a direct-on-line and reversing starter. |  |

| Basic component | Function | Figure |
|---|---|---|
| Vale terminal AirLINE SP type 8647 (Bürkert GmbH & Co. KG) [1] [2] | Basic component: Valve terminal AirLINE SP type 8647 (Bürkert). For more information on the AirLINE SP, type 8647 (e.g. data sheet and operating instructions), please contact Bürkert (https://www.burkert.co.uk/en/type/8647) directly. Function: Valve terminals are common in industrial automation and are used as pilot valves for controlling pneumatic actuators, for example in areas of the food, pharmaceutical and water treatment industries. The ET 200SP in combination with the AirLINE SP, type 8647 from Bürkert provides a universal interface between process and plant control that enables the flexible, modular configuration of pilot valves and I/O modules. The valve terminal can also be fitted to the base of the control cabinet with the help of the AirLINE Quick Adapter. This further reduces the space required in the control cabinet and considerably simplifies installation of the pneumatic system. [1] [2] |  |
| BU cover | Insert the BU cover on the BaseUnits: <br>• Whose slots are not equipped with I/O modules/ motor starters//PotDis-TerminalBlocks <br>• Whose slots have been reserved for future expansion (as empty slots). <br>You can keep a reference identification label for the planned I/O module inside the BU cover. <br>There are three versions: <br>• For BaseUnits with a width of 15 mm ① <br>• For BaseUnits/Ex BaseUnits with a width of 20 mm ② <br>• For BaseUnits of motor starters with a width of 30 mm ③ |  |
| Server module | The server module completes the configuration of the ET 200SP. The server module includes holders for 3 spare fuses (5 × 20 mm). The server module ships with the CPU/interface module and is available as spare part. |  |

| Basic component | Function | Figure |
|---|---|---|
| Coding element | The coding element codes the I/O module with the BaseUnit.<br>There are two versions:<br><br>• Mechanical coding element ①: Ensures the coding<br><br>• Electronic coding element ②: This version also has an electronic, rewritable memory for module-specific configuration data (such as the F-destination address for fail-safe modules, parameter data for the IO link master). | ①     ② |

¹⁾ Note: The description contains non-binding information on supplementary products that are manufactured and marketed not by Siemens but by third-parties outside the Siemens group ("third-party firms"). These third parties organize the manufacture, sale and delivery of their products independently and their terms and conditions apply.

²⁾ Disclaimer/Use of hyperlinks: Siemens has put together this description with great care. However, Siemens is unable to check whether the data provided by third-party firms is complete, accurate and up to date. Certain items of information may therefore potentially be incorrect, incomplete or no longer up to date. Siemens shall not accept any liability should this be the case, nor shall it accept liability for the usability of the data or of the product for the user unless it has a statutory obligation to do so.
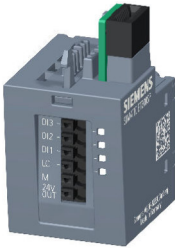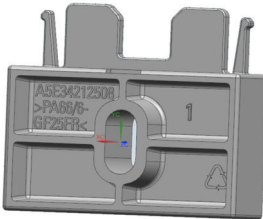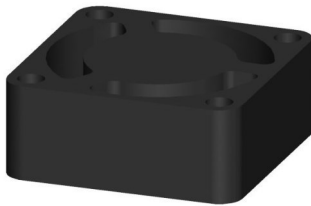
## Accessories of the ET 200SP distributed I/O system

Table 5-3  Accessories of the ET 200SP

| Accessories | Function | Figure |
|---|---|---|
| 24 V DC connector | Application of the 24 V DC supply to the connector, and connection, e.g. to the CPU/interface module/Ex power module.<br>The 24 V DC connector is available as a spare part. | |
| Shield connection | The shield connection allows the low-impedance contacting of cable shields with minimum installation times. | |
| Labeling strips | Attach the labeling strips to the modules for system-specific labeling of the ET 200SP distributed I/O system. The labeling strips can be printed.<br>The labeling strips can be ordered as accessories (Page 339) on a roll for thermal transfer printers or as DIN A4 format sheets for laser printers. | |
| Reference identification labels | The labels enable the reference identification labeling of the ET 200SP components.<br>The labels can be ordered on a mat for thermal transfer and inkjet printers as accessories (Page 339). | |
| Color identification labels | The color identification labels are module-specific and can be ordered for the process terminals, AUX terminals and additional terminals as accessories (Page 339). | |

## Accessories of the SIMATIC ET 200SP motor starters

Table 5-4  SIMATIC ET 200SP motor starter accessories

| Accessories | Function | Figure |
|---|---|---|
| 3DI/LC module | The optional 3DI/LC module has three digital inputs and one LC input. For reasons of operational safety, input LC is permanently set to manual local mode. By parameterizing the inputs DI1 - DI3 with motor CLOCKWISE or motor COUNTER-CLOCKWISE, you can control the motor in manual local mode.<br>The functions of the 3DI/LC module are not relevant to functional safety.<br>Detailed information on the functions when using a 3DI/LC module can be found in the Manual (https://support.industry.siemens.com/cs/ww/en/view/109479973). |  |
| Mechanical bracket for BaseUnit | Use the mechanical bracket for additional fixing of the motor starter. You can use the mechanical bracket on 7.5 mm and 15 mm mounting rails. |  |
| Infeed bus cover | For finger-safe termination of the infeed bus, use the cover. |  |
| Fan | You can use the motor starter at higher ambient temperatures if a fan is installed. |  |

# Application planning

# 6

## Overview

The BaseUnits (BU) are classified according to different types. Every BaseUnit type is distinguished by characteristics that match certain I/O modules and motor starters (see the following table and graphics).

You recognize the BU type for an I/O module by the last two digits of an I/O module's article number.

The BU type onto which you can plug the respective I/O module is printed on the I/O modules. You can therefore read which BU type you need straight from the I/O module (see Factory labels (Page 171) (page 122)).

Example: On the output module DQ 16x24VDC/0.5A ST with article number 6ES7132-6BH01-0B**A0** the information "BU: A0" is printed. This means you can plug this I/O module into a BaseUnit of BU type "A0", which means any BaseUnit whose article number ends in "A0". I/O modules that are suitable for two BU types are labeled accordingly, for example "BU: A0, A1".

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**NOTE**

You will find a complete module overview of the ET 200SP distributed I/O system and an overview of possibilities of combining BaseUnits and I/O modules /motor starters in the Product information for documentation of the ET 200SP distributed I/O system (https://support.industry.siemens.com/cs/de/de/view/73021864/en).

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**NOTE**

**Use of Ex modules**

If you are using Ex I/O modules for the connection of intrinsically safe devices from Zone 0 or Zone 1 in the ET 200SP configuration, observe the information for plant planning in the System Manual ET 200SP HA Distributed I/O system / ET 200SP Modules for devices used in an explosion hazardous environment (https://support.industry.siemens.com/cs/ww/de/view/109795533/en).

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Table 6-1  Selecting a suitable BaseUnit for interface modules

| Select BaseUnit | Interface module (example) | Examples of suitable interface modules for BU types | |
|---|---|---|---|
| | | Interface module (example) | BaseUnit |
| BU type **M0** | Interface module<br>• 6ES7...**M0**<br>• 24 V DC<br>• 100 mm wide | IM 155-6 PN R1 (6ES7155-6AU00-0H**M0**) | BU (6ES7193-6BR00-0H**M0**) |