

Line voltage

Below, everything you need to consider in terms of line voltage is described (refer to section Insulation, protection class, degree of protection and rated voltage (Page 333)):

- For fixed plants or systems without an all-pole mains disconnection switch, a mains disconnection device (all-pole) must be available in the building installation.
- For load power supplies, the configured rated voltage range must correspond to the local line voltage.
- For all power circuits of the ET 200SP distributed I/O system, the fluctuation/deviation of the line voltage from the rated value must be within the permitted tolerance.

24 V DC supply

Below you will find a description of what you need to pay attention to with 24 V DC supply:

- In the event of danger through overload, you must provide lightning protection measures:
 - For external lightning protection
 - For internal lightning protection: Only if greater values (phase - ground) or (phase - phase) are required for the power surge than those specified in the section Electromagnetic compatibility (Page 333).
- For 24 V DC supply: Ensure protection by electrical separation and separate cable routing or increased insulation of circuits with dangerous potentials from extra low voltage (SELV/PELV) in accordance with IEC 61131-2 / IEC 61010-2-201.

Requirements for power supplies in the event of voltage interruption

NOTE

To ensure adherence to IEC 61131-2, only use power packs/power supply units (e.g. 230/400 V AC → 24 V DC) with a mains buffering time of at least 10 ms. Observe the relevant requirements in your application (e.g. product standard for "burners" 30 ms according to EN 298 or 20 ms according to NAMUR recommendation NE 21) with respect to possible voltage interruptions. The latest up-to-date information on PS components is available on the Internet (<https://mall.industry.siemens.com>).

Of course, these requirements also apply to power packs/power supply units not constructed using ET 200SP or S7-1500/S7-300-/S7-400 design.

Protection against outside electrical influences

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

- Make sure that the system for discharging electromagnetic interference is connected to a functional earth or to protective conductor with a sufficient cross-section for all plants with an ET 200SP distributed I/O system.
- For supply, signal and bus lines, you must ensure that the laying of the lines and the installation is correct.
- For signal and bus lines, you must ensure that a wire/cable break or a cross-circuit does not lead to undefined states of the plant or system.

Reference

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

8.2 Additional rules and regulations for the operation of the ET 200SP with fail-safe modules

8.2.1 Safety extra-low voltage (SELV, PELV) for failsafe modules and failsafe motor starters

WARNING

The failsafe modules must be operated with safety extra-low voltage (SELV, PELV).

You can find more information on safety extra-low voltage (SELV, PELV) in the data sheets of the applicable power supplies, for example.

The fail-safe modules operate with the 24 V DC rated voltage. The tolerance range is 19.2 V DC to 28.8 V DC.

The fail-safe motor starters operate with the 24 V DC rated voltage. The tolerance range is 20.4 V DC to 28.8 V DC.

Within the overvoltage range from 32 V DC to 36 V DC, the F-modules react in a fail-safe manner and the inputs and outputs are passivated. For overvoltages greater than 36 V DC, the F-modules are permanently de-energized.

Use a power supply unit that does not exceed $U_m = 36$ V DC even in the event of a fault. For more on this, refer to the information in the data sheet on overvoltage protection in the case of an internal error. Or implement appropriate measures to limit the voltage, e.g. use of an overvoltage protector.

All system components that can supply electrical energy in any form whatsoever must fulfill this condition.

Each additional circuit (24 V DC) used in the system must have a safety extra-low voltage (SELV, PELV). Refer to the relevant data sheets or contact the manufacturer.

Sensors and actuators with an external power supply can also be connected to F-modules. Make sure that power is supplied to these components from safety extra-low voltage (SELV, PELV) as well. The process signal of a 24 V DC digital module may not exceed a fault voltage U_m in the event of a fault.

WARNING

Even when a fault occurs, the permissible potential difference between the supply of the interface module (bus voltage) and the load voltage must not be exceeded.

An external direct electrical connection is one way to meet this requirement. This also prevents potential differences from causing voltage additions at the individual voltage sources, which would cause the fault voltage U_m to be exceeded.

8.2.2 Requirements for sensors and actuators for fail-safe modules and fail-safe motor starters

General requirements for sensors and actuators

Note the following important warning regarding safety-related use of sensors and actuators:

WARNING

Note that instrumentation with sensors and actuators bears a considerable **safety responsibility**. Also bear in mind that sensors and actuators generally do not have proof-test intervals of 20 years as defined in IEC 61508:2010 without considerable loss of safety.

The probability of hazardous faults and the rate of hazardous faults of safety functions must comply with an SIL-defined high limit. A listing of values achieved by F-modules in the technical specifications of the F-modules is available under "Fail-safe performance characteristics".

To achieve the required safety class, suitably qualified sensors and actuators are necessary.

Additional sensor requirements

General rule: To achieve SIL3/Cat. 3/PLe, a single-channel sensor is adequate. However, to achieve SIL3/Cat. 3/PLe with a single-channel sensor, the sensor itself must be SIL3/Cat. 3/PLe-capable; otherwise the sensor must be connected by two channels to achieve this safety level.

To achieve SIL3/Cat. 4/PLe, sensors must be connected by two channels.

WARNING

In the case of fail-safe input modules, the value "0" is output to the F-CPU after detection of faults. You therefore need to make sure that the sensors are implemented in such a way as to ensure the reliable reaction of the safety program when the sensor is in the "0" state.

Example: In its safety program, an EMERGENCY-STOP sensor must achieve the shutdown of the relevant actuator when it is in the "0" state (EMERGENCY-STOP button pressed).

Additional requirements for sensors for fail-safe motor starters

Only single-channel sensors that fulfill the required safety category themselves may be connected to the fail-safe motor starter's F-DI. Fail-safe laying must be observed in accordance with the required safety category.

WARNING

Safety-related shutdown using the F-DI

Depending on the I/O used, the shutdown takes place via one or two output channels (terminals):

- PM-switching: The shutdown takes place via two output channels.
- PP-switching: The shutdown takes place via one output channel.

Shutdown via only one output channel (PP-switching) achieves SIL 3 according to ISO 62061 and PLe/Cat.4 according to EN ISO 13849-1, if it is ensured that the cabling is installed in a cross-circuit-proof/P-short-circuit-proof manner.

Duration requirements for sensor signals

WARNING

Observe the following requirements for sensor signals:

- To ensure the correct detection of the sensor signals via fail-safe modules with inputs, you need to make sure that the sensor signals are output for a minimum duration.
- For pulses to be detected with certainty, the time between two signal changes (pulse duration) must be greater than the PROFIsafe monitoring time.

Reliable detection by F-modules with inputs

The minimum duration of sensor signals for F-modules with inputs depends on the configured input delay, the parameters of the short circuit test of the sensor supplies, and the configured discrepancy behavior for 1oo2 evaluation. The signal must be greater than the maximum response time of the configured application. Information on calculating the maximum response time can be found in the section "Response times" of the relevant F-module.

The maximum permitted switching frequency of the sensor signals results from the minimum duration.

Additional requirements for actuators

The fail-safe output modules test the outputs at regular intervals. The F-module briefly switches off the activated outputs and, if necessary, switches on the deactivated outputs. You can assign the maximum duration of the test pulses (dark and light period) with parameters. Fast reacting actuators may briefly drop out or be activated during the test. If your process does not tolerate this, set the pulse duration of the light or dark test correspondingly or use actuators that have sufficient lag.

WARNING

If the actuators switch voltages greater than 24 V DC (e.g. 230 V AC), the outputs of a fail-safe output module and the parts carrying a higher voltage must be electrically isolated (in accordance with IEC 60664-1).

This is generally the case for relays and contactors. Particular attention must be paid to this with semiconductor switching devices.

Technical specifications of sensors and actuators

Refer to the manuals of the fail-safe modules for technical specifications to assist you in selecting sensors and actuators.

8.2.3 Crosstalk of digital input/output signals

When fail-safe digital output and input signals are in a single cable, F-DQ modules and F-PM-E modules may experience readback errors.

Cause: capacitive crosstalk

During the bit pattern test of the outputs or the sensor supply of the inputs, the steep switching edge of the output drivers caused by the coupling capacitance of the line may result in crosstalk to other non-activated output or input channels. This may then lead to a response of the readback circuit in these channels. A cross circuit/short-circuit is detected, which leads to safety-related tripping.

Remedy:

- Separate cables for F-DI modules, F-DQ modules, and F-PM-E modules or non-fail-safe DQ modules
- Separate cables for F-DQ channel and F-DI channels for the F-PM-E module
- Coupling relay or diodes in the outputs
- Disable the sensor supply test if safety class requirements allow it.

Cause: magnetic crosstalk

Note that an inductive load connected to the F-DQ channels can induce coupling of a strong magnetic field.

Remedy:

- Separate the inductive loads spatially or shield against the magnetic field.
- Configure the readback time to 50 ms or higher.

8.3 Additional rules and regulations for operation of an Ex module group

Ex module group

You can find the rules and regulations for operation of an Ex module group 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>)

8.4 Additional rules and instructions for operation with motor starters

8.4.1 Protection against short circuit

The motor starter complies with type of coordination 1. Secure the feeder cable for the infeed bus according to current, country-specific rules for conductor protection.



WARNING

**Hazardous Voltage at the Motor
Can Cause Death, Serious Injury, or Property Damage.**

Following a short-circuit, the SIMATIC ET 200SP motor starter is defective. Replace the motor starter following a short-circuit.

8.5 Operating the ET 200SP on grounded incoming supply

Introduction

Below you will find information on the overall configuration of an ET 200SP distributed I/O system on a grounded incoming supply (e.g. TN-S network). The specific subjects discussed are:

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

Grounded incoming supply

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

Safe electrical separation (SELV in accordance with IEC 61131-2 or IEC 61010-2-201)

Load power supplies/power supply modules with 24 V DC output voltage require safe electrical separation and voltage limiting (extra low voltage). Load power supplies/power supply modules with 24 V DC output voltage are not connected to the protective conductor. According to IEC 61131-2 and IEC 61010-2-201, this protection is referred to as SELV (Safety Extra Low Voltage).

The wiring of SELV circuits must be safely separated from the wiring of other circuits that are not SELV, or the insulation of all conductors must be dimensioned for the higher voltage.

Grounded extra-low voltage (PELV in accordance with IEC 61131-2 or IEC 61010-2-201)

Load power supplies/power supply modules with grounded 24 V DC output voltage require safe connection to the protective conductor and voltage limiting (extra low voltage).

According to IEC 61131-2 and IEC 61010-2-201, this protection is referred to as PELV (Protective Extra Low Voltage).

The wiring of PELV circuits must be safely separated from the wiring of other circuits that are not PELV, or the insulation of all conductors must be dimensioned for the higher voltage.

Configuration of ET 200SP with ungrounded reference potential

To conduct interference currents, the reference potential of the CPU/interface module and the BaseUnits BU15...D is connected internally via an RC combination (IM/CPU: $R = 10\text{ M}\Omega$ / $C = 100\text{ nF}$, BU15...D: $R = 10\text{ M}\Omega$ / $C = 4\text{ nF}$) with the mounting rail (functional grounding).

- This configuration conducts high-frequency interference currents and prevents static charges.
- It is always possible to configure an ungrounded setup of the ET 200SP distributed I/O system as the ET 200SP distributed I/O system has no fixed ground connection. The power pack/power supply module for 24 V DC must also be ungrounded and electrically isolated.

If you want to configure the ET 200SP distributed I/O system with grounded reference potential, connect the 1M connection of the CPU/interface module electrically with the protective conductor.

Short-circuit / overload protection

Various measures as protection against short-circuits and overloads are required for setting up a full installation. The type of components and the binding protective measures depend on which IEC (DIN VDE) regulation applies to your system configuration. The table refers to the figure below and compares the IEC (DIN VDE) regulations.

Table 8-1 Components and protective measures

	Refer to figure	IEC 60364 (DIN VDE 0100)	IEC 60204 (DIN VDE 0113)
Disconnecting device for controller, sensors, and actuators	①	Main switch	Disconnecter
Short-circuit / overload protection: In groups for sensors and actuators	② ③	Single-pole protection of circuits	With grounded secondary circuit: single-pole protection otherwise: all-pole protection
Load current supply for AC load circuits with more than five items of electro-magnetic equipment	②	Galvanic isolation by transformer recommended	Galvanic isolation by transformer recommended

Cable temperature measurement threshold

NOTE

Cable temperature measurement threshold

When choosing a cable, remember that the cable temperature in operation can be up to 30 °C higher than the ambient temperature of the ET200SP system (example: at an ambient temperature of 60 °C, a connection conductor must be dimensioned for a temperature range of at least 90 °C).

You should specify other connection types and material requirements based on the electrical characteristics of the circuits you use and the installation environment.

ET 200SP in the overall configuration

The figure below shows the overall configuration of the ET 200SP distributed I/O system (load current supply and grounding concept) with supply from a TN-S network.

Own distribution/Zone B

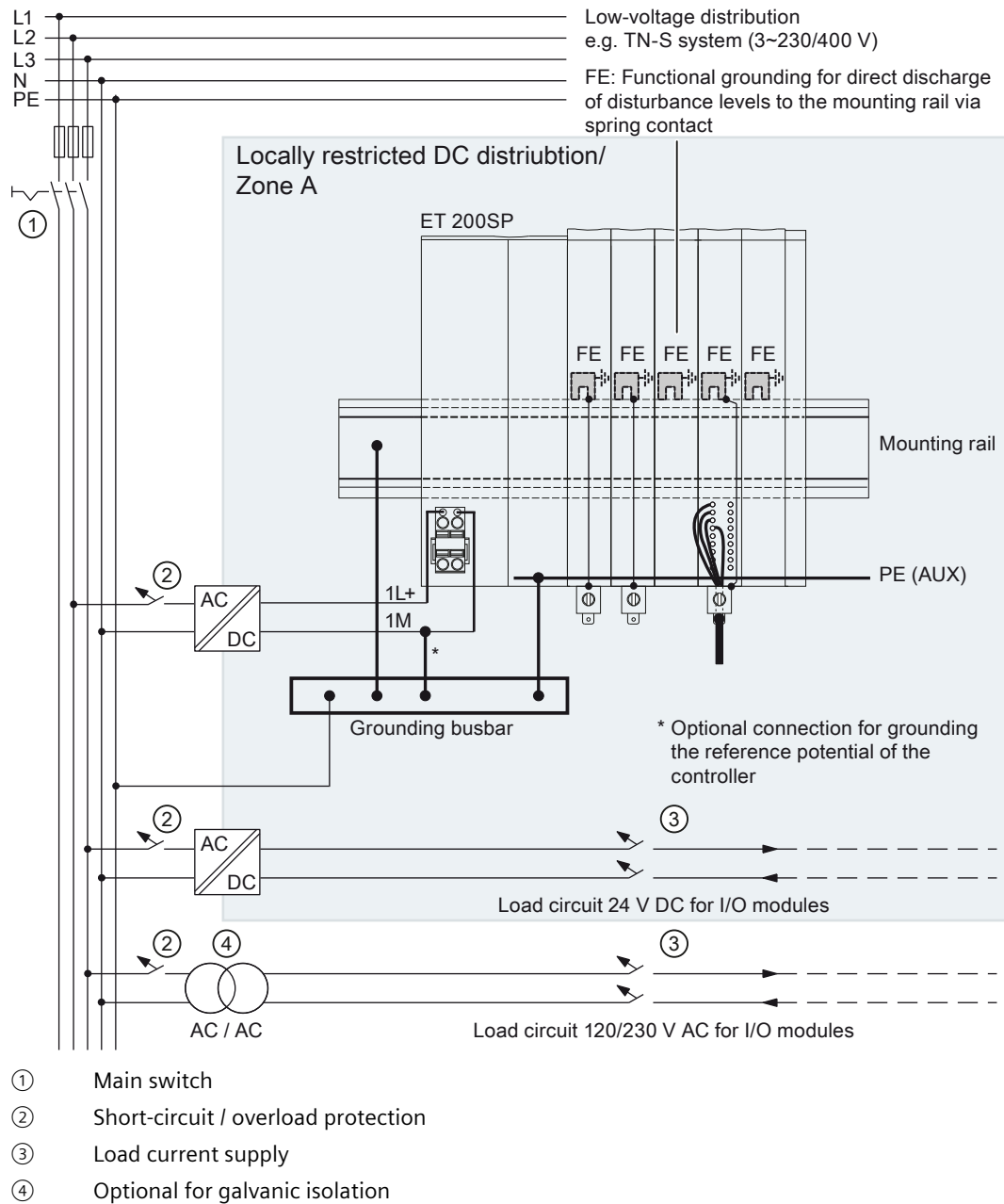


Figure 8-1 ET 200SP in the total configuration