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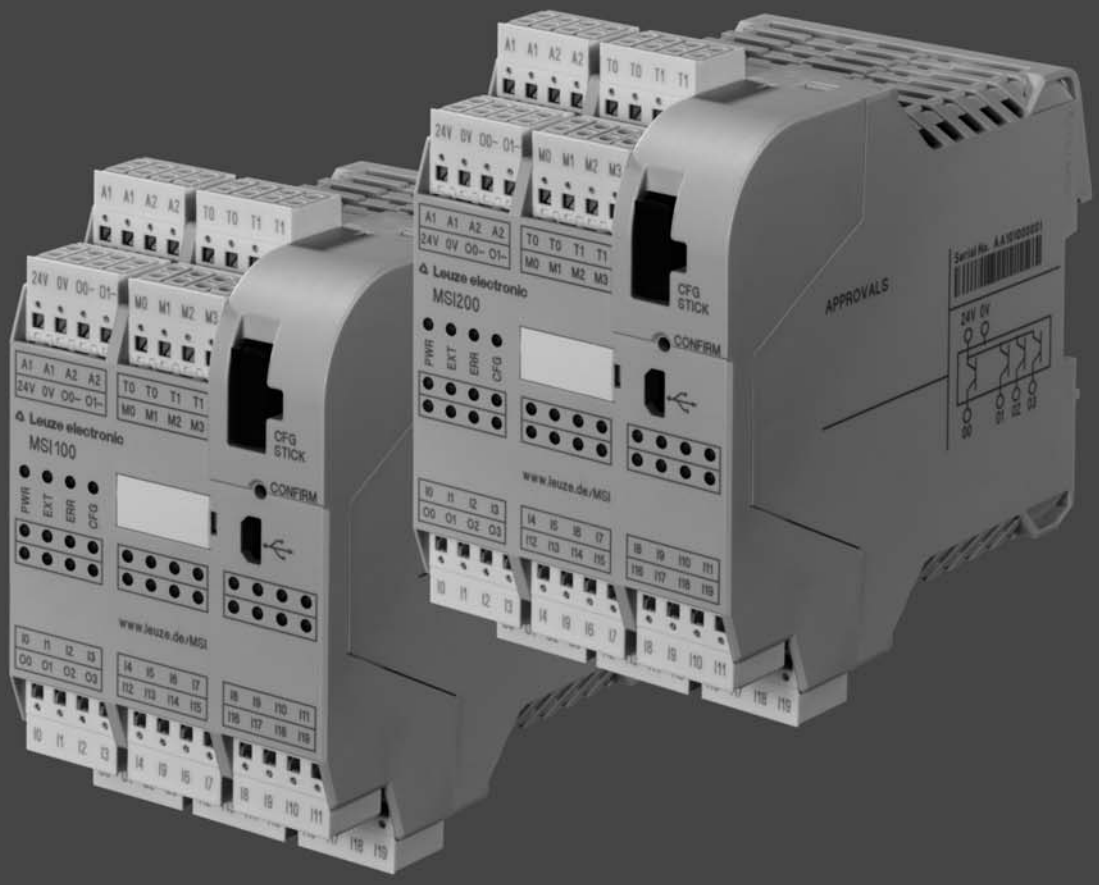
SMART SENSOR BUSINESS

MSI 100/200

Configurable safety modules and safe extension modules



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USER MANUAL

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User Manual

MSI 100/200: Configurable safety modules and safe extension modules

UM MSI 100/200, Revision 01 2018-02-01

This user manual is valid for:

	Designation	Revision from HW/FW	Part no.
MSI 100	MSI101	10/1636	547802
	MSI102	10/1636	547812
MSI 200	MSI201	10/2033	547803
	MSI202	10/2033	547813
MSI-EM200-8I4IO	MSI-EM201-8I4IO	10/1021	547804
	MSI-EM202-8I4IO	10/1021	547814
MSI-EM200-4RO	MSI-EM201-4RO	02/1002	547805
	MSI-EM202-4RO	02/1002	547815

The following designations are used in this manual:

Safety modules:
designation for modules MSI 100 and MSI 200

Safe extension modules:
designation for modules MSI-EM200-8I4IO and MSI-EM200-4RO

Table of contents

1 For your safety

Read this manual thoroughly and store it for future reference.

1.1 Labeling of the warning notices

This is the safety alert symbol. It is used to alert you to potential personal injury hazards.
There are three signal words for the severity of the possible injury.

DANGER
This indicates a danger with high degree of risk. If the danger is not avoided, it will result in death or a severe injury.

WARNING
This indicates a danger with moderate degree of risk. If the danger is not avoided, it may result in death or a severe injury.

CAUTION
This indicates a danger with low degree of risk. If the danger is not avoided, it may result in a minor or moderate injury.

This icon with the **ATTENTION** signal word warns of actions that could result in property damage or a malfunction.

Here, you can find additional information or other sources of information.

1.2 Qualification of the users

The use of products described in this manual is oriented exclusively to

– Certified electricians or persons instructed by certified electricians. The users must be familiar with the relevant safety concepts of automation technology as well as with the applicable standards and other regulations.
– Qualified application programmers and software engineers. The users must be familiar with the relevant safety concepts of automation technology as well as with the applicable standards and other regulations.

1.3 Range of application of the product

Only use the MSI 100/200 system in accordance with the range of application described in this chapter.

1.3.1 Intended use

Only use the safety modules and safe extension modules of the MSI 100/200 system according to the information provided in this section.

MSI 100/200 system

The intended use of the MSI 100/200 system is safe shutdowns. Safe switch-on is **not** an intended use.

All modules of the MSI 100/200 system are intended for use in the industrial sector.

The safety modules and safe extension modules can only perform their safety-relevant tasks if they have been integrated in the execution process correctly and in such a way as to avoid errors.

You must observe all information in this user manual as well as in the user manuals and online help listed in "Documentation" on page 14.

Only use the modules of the MSI 100/200 system according to the provided technical data. See chapter 14 „Technical data and ordering data“ from page 101.

You can find further information on the use of the MSI 100/200 system under "Using the system" on page 18.

MSI 100 and MSI 200

The MSI 100 and MSI 200 modules are configurable safety modules with 20 safe inputs and four safe outputs. The inputs are used for the evaluation of safety-relevant transducers, such as E-Stop buttons or safety doors. The circuits are interrupted in a safe manner via the outputs. In addition, four signal outputs, two clock outputs and two ground-switching outputs are available.

The MSI 100 safety module is a stand-alone device and cannot be extended with safe extension modules.

The MSI 200 safety module can be extended with safe inputs and outputs using safe extension modules of the MSI 100/200 system.

You can connect one gateway to both safety modules for transferring diagnostic data.

MSI-EM200-8I4IO

The MSI-EM200-8I4IO safe extension module is an extension to the MSI 200 safety module. An additional four configurable inputs or outputs, two configurable clock or signal outputs as well as eight safe inputs are thereby made available.

MSI-EM200-4RO

The MSI-EM200-4RO safe extension module is an extension to the MSI 200 safety module. An additional four safe relay outputs and four signal outputs are thereby made available.

MSIsafesoft

The MSIsafesoft safe configuration software is designed for the configuration of the safety modules as well as connected extension modules.

Safe function blocks and functions in MSIsafesoft

The MSIsafesoft configuration software provides safe function blocks and functions for creating the safety logic. These are designed solely for use within the safety module and support specific safety functions here.

The safe function blocks and functions can only perform their safety-related tasks within the safe control system if they have been integrated into the execution process correctly and in such a way as to avoid errors.

1.3.2 Changes to the product

Modifications to the hardware and firmware of the device are not permitted.

Improper work or changes to the device could endanger your safety or damage the device. You may not repair the device. If the device is defective, contact Leuze electronic.

1.4 Safety notices

1.4.1 General safety notices

WARNING: Serious danger through improper use

Depending on the application, improper use of the MSI 100/200 system can place the user in serious danger.

- Observe the safety notices in this chapter.
- Observe the warning notices at other locations in this document.

Documentation

You must observe all information in this manual and other applicable documents.
See chapter "Documentation" on page 14.

Safety of personnel and equipment

The safety of personnel and equipment can only be assured if the modules and safe function blocks are used correctly.
See chapter "Intended use" on page 8.

Qualified personnel

Qualified personnel are, in the context of this manual, persons who, because of their education, experience, and instruction, and their knowledge of relevant standards, regulations, accident prevention, and service conditions, have been authorized to carry out any required operations, and who are able to recognize and avoid any possible dangers.

In the context of the use of the MSI 100/200 system with the MSIsafesoft configuration software and safe function blocks, the following operations may only be carried out by qualified personnel:

– Planning, configuration (development of safety logic)
– Installation, commissioning, servicing
– Maintenance, decommissioning

Requirements

Knowledge of the following topics and products is required:

– The safety and safe extension modules used in the MSI 100/200 system
– The used peripherals (extension devices, sensors, actuators)
– Operating the MSIsafesoft configuration software
– Standards of safety technology
– Safety regulations in the area of application

Error detection

Depending on the wiring and the configuration, the safety modules and safe extension modules of the MSI 100/200 system detect errors within the safety-related equipment.

Do not open the housing

It is prohibited to open the housing of the modules. If the housing is opened, the function of the MSI 100/200 modules is no longer guaranteed.

Misconnection and incorrect polarity of the connections

Take measures to protect against misconnection, polarity reversal and tampering at the connections.

The individual terminal blocks of all MSI 100/200 modules are mechanically coded to prevent incorrect connection.

1.4.2 Electrical safety

WARNING: Loss of the safety function / hazardous body currents

Incorrect installation can result in loss of the safety function as well as in hazardous body currents. Depending on the application, the user may be exposed to severe dangers.

- Observe the notices for electrical safety.
- Observe the warning notices at other locations in this document.
- Dimension the used devices and design their installation in the system according to the specific requirements.
- Retest the equipment and systems that are retrofitted with the safety relay.
- Observe the information in the user documentation for other used devices (e.g., sensors, actuators or extension devices).

Direct / indirect contact

Protection against direct and indirect contact according to VDE 100 part 410 must be ensured for all components connected to the system. In the event of an error, no hazardous parasitic voltages may occur (single-fault tolerance).

Mandatory measures:

– Use power supply units with safe insulation (PELV)
– Decoupling of circuits that are not PELV systems
With the following components: optical couplers, relays or other components that satisfy the requirements for safe insulation

Safe insulation

Only use devices with safe insulation if hazardous contact voltages can occur at their connections.

Power supply units for 24-V supply

Only use power supply units with safe insulation and PELV in accordance with EN 50178 / VDE 0160. These units prevent short circuits between primary and secondary sides.

Connect the output-side GND connection of the power supply unit to the functional earth (FE) of the system.

Ground connection

Ensure that all inputs and outputs of the system are connected to the same ground.

Insulation dimensioning

When selecting the equipment, take into account the contamination and overvoltages that occur during operation. If necessary, take appropriate measures for voltage limitation.

Installation space and installation position

Observe the requirements listed in the technical data regarding the installation space and the installation position.

ESD note

ATTENTION: Electrostatic discharge

Electrostatic discharge can damage or destroy components. When handling, take the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and IEC 61340-5-1.

1.4.3 Safety of machines or systems

The safety of the machine or system and of the application in which the machine or system is used is the responsibility of the machine/system manufacturer and of the operating company.

Draw up and implement a safety concept

In order to use the system described in this document with the associated safe function blocks, you must have drawn up an appropriate safety concept for your machine or system. This includes the hazard and risk analysis, among others, according to the directives and standards listed in chapter "Directives and standards" on page 13.

The target safety integrity level is ascertained on the basis of the risk analysis.

– SIL acc. to IEC 61508
– SILCL acc. to EN 62061
– Cat./PL acc. to EN ISO 13849-1

The following are dependent on the ascertained safety integrity:

– The wiring of safe sensors, command devices and actuators within the overall safety function
– The use of safe function blocks in the safety logic.
  The safety logic is created using the MSIsafesoft configuration software.

Safety-related equipment

For the sensible use of the MSI 100/200 system, provide the machine with safety-related equipment.

This includes, for example:

– E-Stop buttons
– Protection hood switches
– Enabling switches
– Light barriers

Testing hardware and configuration

Carry out a validation every time you make a safety-related modification to your overall system.

Use the relevant checklists when carrying out the validation. Enter the details requested in the "Project Information" dialog box in the MSIsafesoft safe configuration software.

Use your test report to satisfy yourself that:

– The safe sensors and actuators are connected correctly in the MSI 100/200 safety application. To do this, use the "Wiring check" function in the MSIsafesoft configuration software.
– The inputs and outputs of the safety modules and the safe extension modules are correctly configured.
– The signals have been connected to the safe sensors and actuators correctly (single-channel or two-channel).
– Cross-circuit detection is implemented in your application, if required (see page 22).
– All safe function blocks and functions in the MSIsafesoft configuration software are connected correctly.

Disconnecting the USB connection

For the safe operation of the machine or system, there must be no USB connection to the safety modules.

For further information, refer to Chapter "USB interface" on page 28.

1.4.4 Safety when starting applications

Take the following into account when defining the start conditions for your machine or system:

– The machine or system may only be started if it is ensured that no persons are located in the danger zone.
– Comply with the requirements of EN ISO 13849-1 with regard to the manual reset function.

This applies for:

– The switching on of safe participants
– The acknowledgment of device error messages
– The canceling of start interlocks for safety functions

Observe start-up behavior

Some of the safe function blocks in the MSIsafesoft configuration software have parameters for specifying a start interlock and/or a restart interlock.

For further information, refer to Chapter "System start-up and restart behavior" on page 19.

1.5 Directives and standards

The standards with which the MSI 100/200 system complies can be found in the certificate of the approval body and the EC Declaration of Conformity.

You can find these documents on the Internet.
See www.leuze.com.

1.6 Documentation

Latest documentation

Always use the latest documentation. You can find changes or additions on the Internet. See www.leuze.com.

You must observe all information from the following sources:

– Technical description of the safety modules
– Technical description of the safe extension modules
– User documentation for peripheral devices (e.g., sensors/actuators) that are connected to the MSI 100/200 modules and are connected to safe function blocks in the safety logic (MSIsafesoft configuration software)
– Documentation for the supplementary standard technology
– Help system for the MSIsafesoft safe configuration software and for each of the safe function blocks (see "Opening the software help system" on page 76)

Additional information and detailed step-by-step instructions for the MSIsafesoft configuration software can be found in the help system of the software.

1.7 Safety hotline

If you have technical questions, please use our 24-hour hotline.

Phone: +49 7021 573-123
E-mail: service.protect@leuze.de

2 System description

2.1 MSI 100/200 safety system: design and functionality

Overall system: Hardware and software

The MSI 100/200 safety system consists of the following components:

When using the MSI 100 safety module:

– MSI 100 safety module
– MSIsafesoft configuration software
– Safe command devices, sensors, and actuators (depending on the application)

When using the MSI 200 safety module:

– MSI 200 safety module
– Optional safe extension modules MSI-EM200-8I4IO / MSI-EM200-4RO
– MSIsafesoft configuration software
– Safe command devices, sensors, and actuators (depending on the application)

The diagram below illustrates the overall system in an application example with the MSI 200.

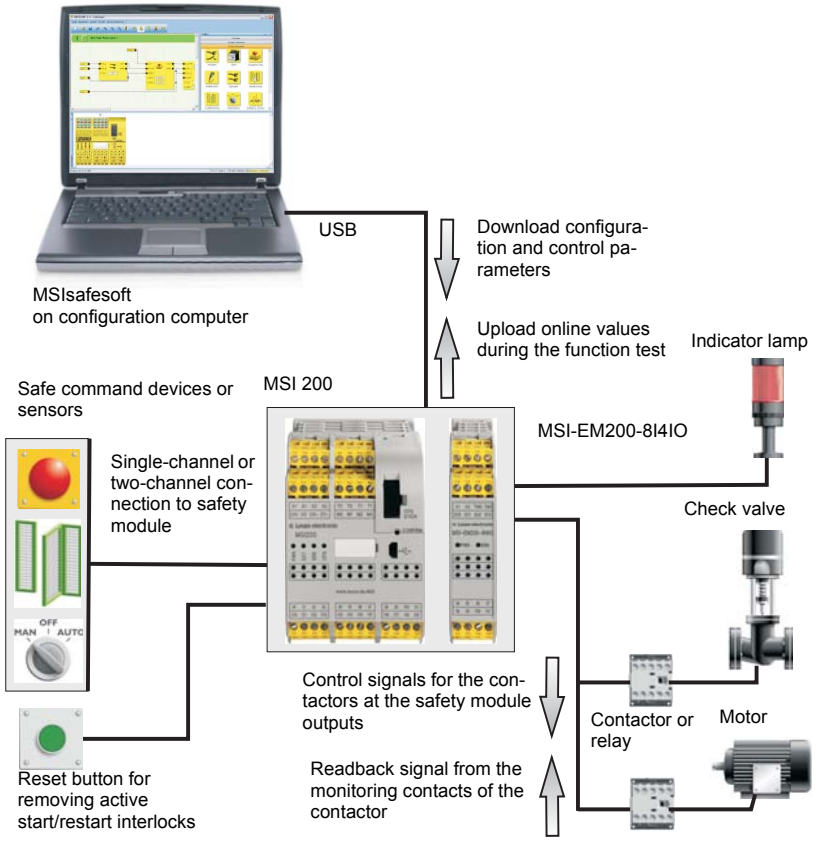


Figure 2-1 Typical structure of a safety system with MSI 200

Communication via USB

Communication between the MSI 100 or MSI 200 safety modules and the configuration software takes place via a USB interface.

WARNING: Non-safe operation

The USB interface is not protected against ESD. If a there is a USB connection in place, the safety module is in non-safe operation. The safety function cannot be properly executed.

- Only use the USB connection for commissioning.
- Disconnect the USB connection for regular operation.

Communication between the safety module and the configuration software on the PC takes place in both directions:

PC → safety module

The configuration data and device parameters are downloaded from the configuration PC to the safety module. Configuration data refers to the application logic, which you created using the MSIsafesoft configuration software.

The configuration can also be downloaded using the AC-MSI-CFG1 pluggable memory module. Please refer to "Downloading configuration from the MSIsafesoft configuration software" on page 80 and "Loading the configuration using the AC-MSI-CFG1 memory module" on page 84.

Safety module → PC

For diagnostic purposes, online values can be read from the safety module via the USB interface and displayed "live" in the software. For more detailed information, please refer to "Function Test" on page 87.

Communication via the DIN rail connector

The MSI 100 safety module is equipped with an interface for the yellow MSI-TBUS DIN rail connector. The MSI 200 safety module is equipped with two interfaces for the yellow MSI-TBUS.

In combination with the green TBUS DIN rail connector, connect a maximum of one non-safe extension device (gateway) to the MSI 100 or MSI 200 safety module.

Use additional yellow MSI-TBUS DIN rail connectors to connect up to ten safe extension modules to the MSI 200 safety module.

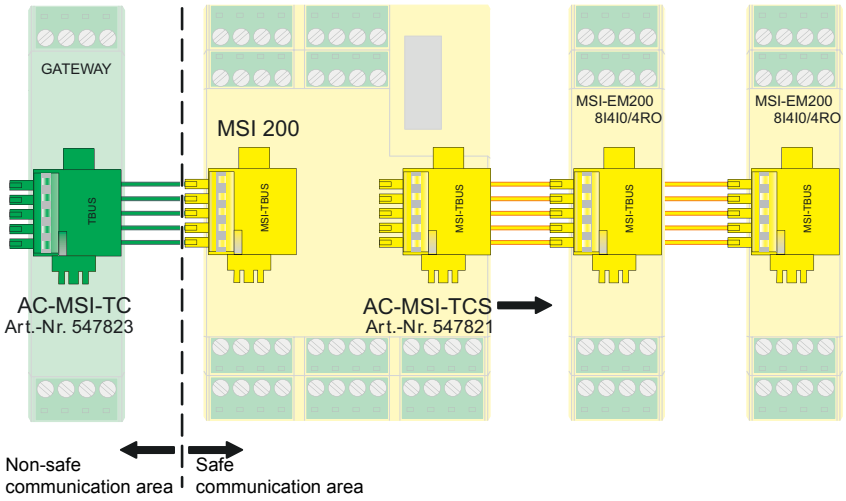


Figure 2-2 Extension of the MSI 200 safety module

Other standard bus participants are possible. For further information, refer to the user documentation of the used gateway at www.leuze.com.

Communication between the safe modules and the non-safe or safe extension modules takes place automatically via the connectors of the DIN rail connectors.
See also chapter "Mounting" on page 63.

ATTENTION: Connector wear
The modules may be connected to the DIN rail connectors a maximum of eight mating cycles.

Note the maximum permissible continuous current for extension modules supplied via the MSI-TBUS as well as the technical data of the MSI 100/200 system.
See Chapter "Technical data and ordering data" on page 101.

2.2 Using the system

Safety circuits

The safety modules of the MSI 100/200 system can be flexibly configured. For the creation of the safety logic, the system is equipped with safe function blocks. You can thereby use the MSI 100/200 system to implement various safety functions in different safety circuits. Just some of the most important options are listed below:

– E-Stop monitoring
– Safety door monitoring (with and without locking device)
– Two-hand control units (types II and III)
– External device monitoring (EDM)
– Monitoring and checking electro-sensitive protective equipment
– Operating mode selector switch (evaluation of an operating mode selector switch and an enabling switch)
– Muting applications (light grid monitoring with parallel muting)

Application examples:

In the help system of the MSIsafesoft configuration software, you can find application examples for the safe function blocks with typical application for each function block.

The safety logic configured in the configuration software as well as the wiring of the safety modules and the safe extension modules is displayed in the form of schematic views.

The online help also includes typical signal sequence diagrams, which illustrate the behavior of each function block.

The following application examples are included in the online help for the function blocks:

– Single-channel and two-channel E-Stop circuits
– Single-channel and two-channel safety door monitoring, with and without locking
– Operating mode selection with locking of the set operating mode and manual operating mode acknowledgment
– Evaluation of a three-position enabling switch with confirmation of the selected safe operating mode
– Parallel muting with two sensors
– Evaluation of a light curtain connected via a single channel
– Type II and type III two-hand control devices

2.3 Safe state

The safe state of an output terminal block is defined as the power off mode (signal value "0").

The safe state can be assumed by the MSI 100/200 system in the following cases:

1. Operating state (by triggering the safety function)
2. Error detection in the peripherals
3. Device error
4. Configuration error
5. Error detection in safe communication

2.4 System start-up and restart behavior

WARNING: Unintended machine start-up

Start/restart after switching on voltage as well as the discontinued demand for the safety function can result in undesired machine start-up.

- Note the following:
  - The module starts up immediately after completing the configuration.
  - The module restarts immediately if the trigger of the safety function is reset.
- If automatic start/restart is not desired, configure automatic start/restart accordingly in the safety logic.

Start-up

Start-up refers to the behavior of the MSI 100 and MSI 200 safety modules and the optional safe extension modules after switching on (or applying the supply voltage) and after configuring via USB interface or AC-MSI-CFG1.

Unless a start interlock is configured, the safety module starts up immediately following successful configuration (i.e., after pressing the "Confirm" button). The safe inputs are evaluated and the outputs controlled accordingly.

Restart

Restart refers to the behavior of the safety modules and the optional safe extension modules after the safety function is triggered and the subsequent return to normal operation. Normal operation is restored, e.g., by unlocking the E-Stop command device, after which safe operation is again possible.

With an active start/restart interlock, the corresponding safe module output remains in the safe state. This prevents an undesired start/restart of a machine controlled by the relevant output.

Reset button

WARNING: Unintended machine start-up

Acknowledgment of an error results in the safe input or output being immediately returned to the operating state.

- Before acknowledging an error, make certain that acknowledgment cannot result in a dangerous machine state.
- When planning the machine or system, make certain that acknowledgment is possible only if the danger zone is visible.

In accordance with EN ISO 13849-1, the manual reset function must not trigger a machine start.

An active start/restart interlock can be released by actuating a reset button that is connected and appropriately wired to the safety module or to the safe extension modules.

The reset signal is used at the same time to exit the error state once the error cause has been removed.

Implementation using safe function blocks

To implement a start/restart interlock, use the safe function blocks in the MSIsafesoft configuration software which have the relevant parameters for activating the start/restart interlock.

To configure a start interlock for a specific safe output, for example, this output must be **directly** connected in the safety logic to the output of a safe function block, for which a start interlock is set via the parameters.

You can find further information on the implementation of a start/restart interlock in the help system of the MSIsafesoft configuration software.

2.5 Error detection

Depending on the wiring and the configuration, the safety modules and safe extension modules of the MSI 100/200 system detect the following errors at the safe inputs and outputs:

– Short circuit of the outputs
– Cross-circuit of the inputs or outputs
– Overload at the outputs

2.6 Error state

Stop category 1 only in the error-free state

ATTENTION: Property damage through immediate shutdown

The device ensures stop category 1 only in **error free** operation. If the supply voltage is lost or in the case of an internal error, the device behaves acc. to stop category 0.

- Do **not** use the device in applications in which stop category 1 must be maintained even in case of failure.

Operating duration in faulty state

WARNING: Loss of the safe state in the error state

While in the error state, no module-internal tests run and, due to an accumulation of errors, the safe state may be exited.

- If the module takes on a faulty state, examine, acknowledge or rectify the error within 72 hours.

2.7 Diagnostic tools

MSIsafesoft diagnosis

Depending on the device, the modules of the MSI 100/200 system together with the MSIsafesoft configuration software provide various tools that can be used to diagnose the current configuration on the safety module:

– Hardware diagnosis in the event of a safe function block error
– Wiring check
– Tool tips in the connection editor
– Diagnostic and status indicators on the module
– Further diagnostic options via gateways

Information on hardware diagnosis, wiring checks and tool tips can be found in the help system of the MSIsafesoft configuration software.

Diagnostic and status indicators

An overview of the diagnosis and status displays of the individual modules can be found in the respective chapter.

– MSI 100 and MSI 200: see "Diagnostic and status indicators" on page 27.
– MSI-EM200-8I4IO: see "Diagnostic and status indicators" on page 37.
– MSI-EM200-4RO: see "Diagnostic and status indicators" on page 44.

Diagnosis via gateways

You can connect your MSI 100/200 system with gateways to a primary control. The reading out of the diagnosis is bus-specific.

Information on diagnosis via gateways can be found in the respective user manuals of the gateway.
See www.leuze.com.

You can find suitable gateways for use with the MSI 100/200 system in the accessories chapter "Gateways" on page 118.

2.8 Password protection

The MSI 100/200 system and MSIsafesoft use two passwords to offer dual protection against unauthorized modifications to the configuration and the project in the configuration software.

You can find further information on password protection in the help system of the MSIsafesoft configuration software.

3 MSI 100 and MSI 200 safety modules

The MSI 100 and MSI 200 safety modules are, with respect to their functionality and basic design, largely identical.

Both of the safety modules are described together in this chapter.
Also note the additional information provided for the MSI 200 and the safe extension modules.

Difference between MSI 100 and MSI 200

The difference between the two safety modules lies in the following properties:
– MSIsafesoft diagnosis
– Connection option for safe extension modules of the MSI 100/200 system

3.1 Product description

Observe the technical data for the safety modules.
See "Technical data and ordering data" on page 101.

Safe digital inputs

MSI 100 and MSI 200 are configurable safety modules with 20 safe digital inputs. The inputs are used to connect safe sensors or command devices. The maximum number of sensors/command devices is dependent on the wiring:
– Single-channel wiring: maximum 20 safe sensors/command devices
– Two-channel wiring: maximum 10 safe sensors/command devices

Safe digital outputs

The safety modules have four safe digital outputs. The outputs are actuated after evaluating the incoming signals according to the configuration.

Ground-switching outputs

The safety modules have two ground-switching outputs. The ground-switching outputs are used, for example, to switch off a contactor that is connected to the safety module. The contactor can be switched off here via either the safe 24 V output or via ground. Use of the ground-switching outputs increases the shutdown protection and cross-circuit protection of the safety circuit.

Digital signal outputs

The safety modules have four non-safe digital signal outputs. The signal outputs are used to control, e.g., a non-safe PLC or signal units.

Safe clock outputs

The safety modules have two clock outputs. The asynchronous test pulses enable safe cross-circuit detection at the inputs of the safety modules that is dependent on the configuration.

Connection technology

The safety modules are available with either screw connections or with spring-cage connections. All connection terminals are pluggable. The individual terminal blocks are mechanically coded to prevent swapping or skewed plug in.

Connection variants

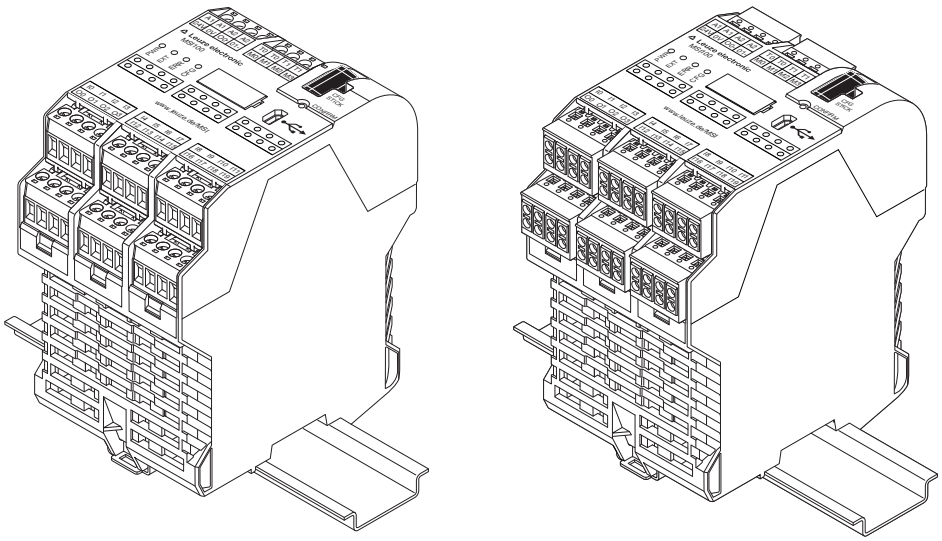


Figure 3-1 Screw terminals (left) and spring-cage terminals (right)

Block diagrams

MSI 100:

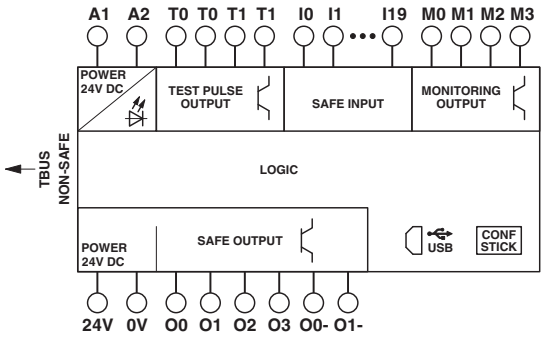


Figure 3-2 MSI 100 block diagram

MSI 200:

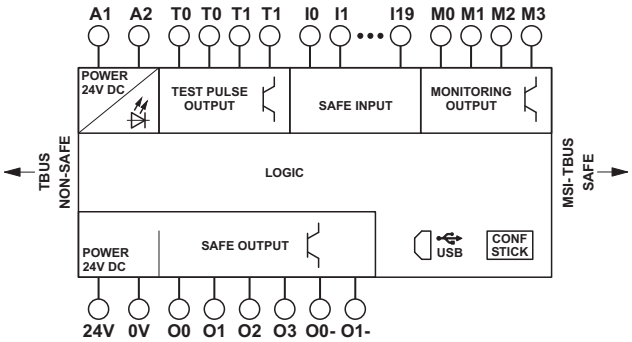


Figure 3-3 MSI 200 block diagram

Configuration

The configuration of the safety modules is created with the MSIsafesoft configuration software. You then load the configuration into the safety module via the USB interface.

WARNING: Non-safe operation

The USB interface is not protected against ESD. If a there is a USB connection in place, the safety module is in non-safe operation. The safety function cannot be properly executed.

- Only use the USB connection for commissioning.
- Disconnect the USB connection for regular operation.

Difference in MSIsafesoft

For the MSI 100 safety module, there are 16 external signals available in the MSIsafesoft configuration software.

For the MSI 200 safety module, there are 64 external signals available. The use of diagnostic addresses is also possible for function block diagnosis.

Further information on the MSIsafesoft configuration software can be found in Chapter "MSIsafesoft configuration software" on page 75 or the help system of the software.

3.1.1 Connection of extension devices

Also read "Communication via the DIN rail connector" on page 16.

Connection of non-safe extension devices (gateways):

Non-safe extension:
MSI 100/200

You can connect a maximum of one gateway to both safety modules for transferring diagnostic data. Install the gateway to the left of the safety module.

Information on diagnosis via gateways can be found in the respective user manual of the gateway.
See www.leuze.com.

You can find suitable gateways for use with the MSI 100/200 system in the accessories chapter "Gateways" on page 118.

Connection of safe extension modules:

Safe extension:
only MSI 200

Only the MSI 200 safety module can be extended with the safe extension modules of the MSI 100/200 system. Install a maximum of ten safe extension modules to the right of the MSI 200 safety module.

Additional information on the safe extension modules can be found in chapters "MSI-EM200-8I4IO safe extension module" on page 36 and "MSI-EM200-4RO safe extension module" on page 42.

3.2 Operating modes (status) of the safety modules

The following diagram illustrates the possible operating modes (status) of the MSI 100 and MSI 200 safety modules as well as the possible status transitions. When there is a USB connection to the PC, the module status is indicated on the far right in the status line of the MSIsafesoft configuration software.

WARNING: Non-safe operation

The USB interface is not protected against ESD. If a there is a USB connection in place, the safety module is in non-safe operation. The safety function cannot be properly executed.

- Only use the USB connection for commissioning.
- Disconnect the USB connection for regular operation.

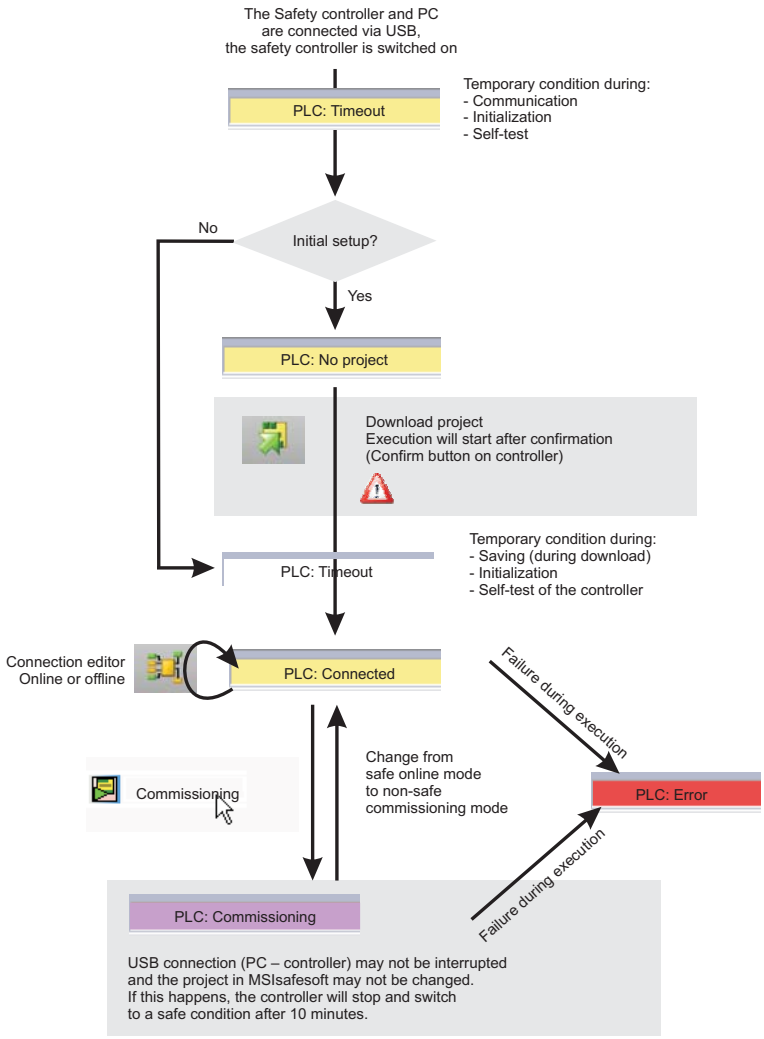


Figure 3-4 Possible operating modes (status) of MSI 100/200

3.3 Operating and indication elements

All controls and indicators for the MSI 100 and MSI 200 safety modules are located on the front side of the device.

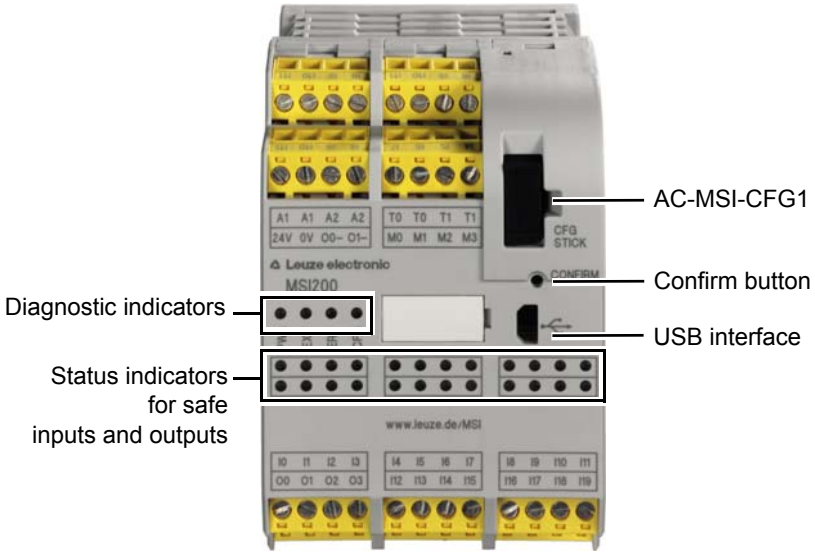


Figure 3-5 MSI 100/200 operating and display elements

3.3.1 Diagnostic and status indicators

Diagnostic indicators

The four diagnostic indicators on the front side show the operating status of the safety modules. The following LEDs are present on the devices (from left to right).

Table 3-1 MSI 100/200 LED diagnostic indicators

LED	Color	Description
PWR	Green	Indicator for the voltage supply of the safety module
DATA	Green	**Only MSI 200:** Indicator for communication with safe extension modules via MSI-TBUS. This LED is only on if an MSI-TBUS participant is connected.
ERR	Red	Error display / indicator for safety-critical system errors
CONF	Green	Indicator for the configuration status and communication via the USB interface / AC-MSI-CFG1

Status indicators

The state of each of the 20 safe digital inputs and four safe digital outputs is indicated by one LED for each on the front side of the device. The display corresponds to the actually applied signal at the terminals (not the process image).

A detailed list of possible indicator combinations for diagnostic and status indicators and their meanings can be found in Chapter "Diagnosis" on page 89.

3.3.2 Confirm button

Confirming the new configuration

The "Confirm" button is on the right-hand side on the front of the safety modules, above the USB interface. Briefly press this button using a pen to confirm a new configuration loaded via the USB interface. It is then accepted by the safety module.

See also "Downloading configuration from the MSIsafesoft configuration software" on page 80.

Resetting errors

Use the "Confirm" button to reset displayed errors. Depending on the error type, the "Confirm" button must be pressed briefly (3 s) or for a prolonged period of time (min. 15 s).

Restart

To initiate a restart of the device, press the "Confirm" button on the device for at least 15 seconds. As part of the warm start process, all outputs are initially set to the safe state. Pending error messages are now reset as long as the cause of the error no longer exists. The device then enters the initialization phase.

Replacing AC-MSI-CFG1

If you load a new configuration by replacing the AC-MSI-CFG1, press and hold down the "Confirm" button while removing and inserting the AC-MSI-CFG1 according to the specified procedure.

For the precise procedure, please refer to Chapter "Loading the configuration using the AC-MSI-CFG1 memory module" on page 84.

3.3.3 USB interface

WARNING: Non-safe operation

The USB interface is not protected against ESD. If a there is a USB connection in place, the safety module is in non-safe operation. The safety function cannot be properly executed.

- Only use the USB connection for commissioning.
- Disconnect the USB connection for regular operation.

ATTENTION: Electrostatic discharge

The safety modules contain components that can be damaged or destroyed by electrostatic discharge. When handling the USB interface, observe the necessary safety measures against electrostatic discharge (ESD) according to EN 61340-5-1 and EN 61340-5-1.

Communication between the safety module and the MSIsafesoft configuration software takes place via the USB interface (standard USB 2.0). The communication includes the following events:

– Downloading of the configuration data (i.e., for the MSIsafesoft project)
– Optional: uploading of the configuration to open it as a project in MSIsafesoft and edit it as required
– Reading of values from the safety module during operation and "live" display in the connection editor of MSIsafesoft (online mode)
– Forcing of signals on the running safety module for commissioning purposes (non-safe commissioning mode)

Before connecting the safety module to the configuration PC, install the MSIsafesoft configuration software along with the associated USB drivers for the module.

Installing the USB drivers:

The first time a MSI 100/200 safety module is connected to the configuration PC, the "Found New Hardware Wizard" appears. To install the drivers, proceed as follows:

1. When asked "Do you want to establish a connection with Windows Update?", select the "No, not this time" option.
2. Now follow the USB driver installation for MSI 100/200: confirm with "Next".
   a) When asked "Do you want to install this device software?", confirm your trust in the software manufacturer by selecting the "Install" button.
3. In the "Completing the Found New Hardware Wizard" window, complete the process by pressing the Finish button.

If the USB drivers are already installed, the appropriately configured PC detects the safety module automatically after the USB connection cable is connected.

If the MSIsafesoft configuration software is already running, the software detects the status of the safety module and indicates it at the bottom right in the status line.

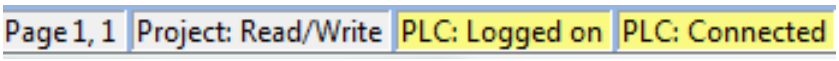


Figure 3-6 Status line in the MSIsafesoft safe configuration software (safety module already contains a configuration project)

3.3.4 AC-MSI-CFG1

The safety modules are equipped with a pluggable AC-MSI-CFG1 memory module.

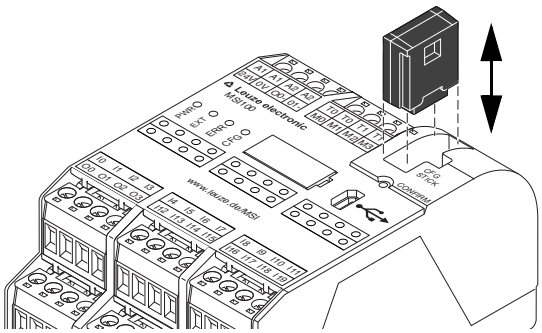


Figure 3-7 AC-MSI-CFG1 with MSI 100/200 safety module

After downloading the configuration from MSIsafesoft to the safety module, the configuration is stored in the AC-MSI-CFG1 memory module.

The AC-MSI-CFG1 **must** be inserted in the safety module both during normal operation and for downloading configuration data from MSIsafesoft via the USB interface.

As an alternative to downloading the configuration via the USB interface, it can also be loaded on the safety module using the AC-MSI-CFG1.
See "Loading the configuration using the AC-MSI-CFG1 memory module" on page 84.

Behavior without AC-MSI-CFG1

If no AC-MSI-CFG1 is plugged into the safety module or if it is pulled out, the safety module behaves as follows.

Table 3-2 Module behavior in case of missing AC-MSI-CFG1

AC-MSI-CFG1 status	Module behavior
Stick is not plugged in while downloading the configuration data.	Configuration cannot be loaded. MSIsafesoft outputs an error message.
Stick is not plugged in when the safety module is started.	All outputs remain switched off. Safety module outputs an error state. Safety module performs no functions.
Stick is pulled out during running operation.	Safety module switches off all outputs and outputs an error state. Safety module executes no further functions.
Stick is pulled out and plugged in according to the instructions for loading the configuration. See "Loading the configuration using the AC-MSI-CFG1 memory module" on page 84	The safety module switches off all outputs and executes no functions until the stick is plugged in again correctly. The safety module **does not indicate an error state**

3.4 Signal connections

All input and output connections, with the exception of the USB interface, are made via pluggable and coded connection terminals.

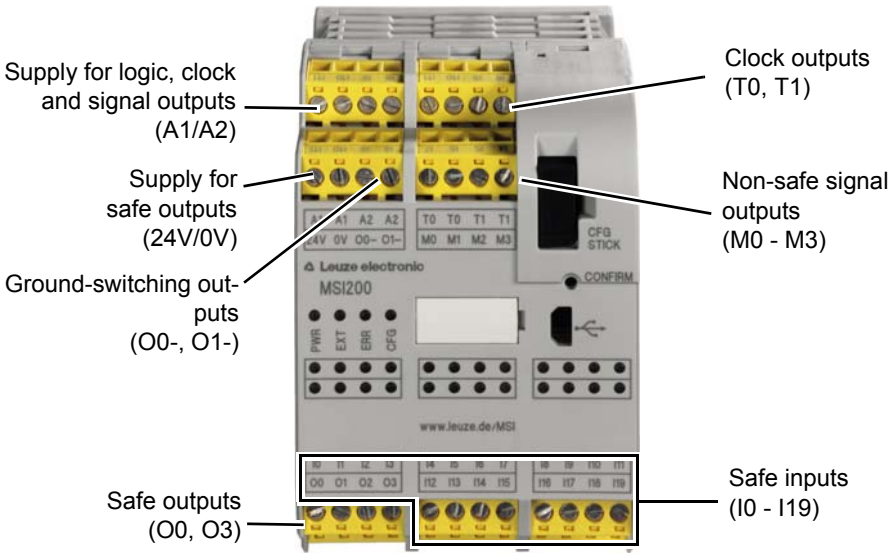


Figure 3-8 Signal connections MSI 100/200

3.4.1 Safe inputs

I0 to I19

The 20 safe digital inputs I0 to I19 are used for the direct connection of safe command devices or safety sensors.

The safe inputs are linked to the safety logic in the connection editor of the MSIsafesoft configuration software.

You can find further information on linking the safe inputs in the connection editor in the help system of the MSIsafesoft configuration software.

There, you will also find information on the topics of signal redundancy due to dual signals, two-channel sensors and cross-circuit detection.

3.4.2 Safe outputs

O0 to O3

The safety-related outputs O0 to O3 are designed as digital semiconductor outputs.

ATTENTION: Module defect

Inductive loads can destroy the outputs.

- Use a suitable and effective protective circuit.
- The protective circuit is to be parallel to the load, not parallel to the switching contact.
- Prevent feedback to the outputs.

The outputs are controlled according to the configured safety logic.

The safe outputs are linked to the safety logic in the connection editor of the MSIsafesoft configuration software.

You can find further information on linking the safe outputs in the connection editor in the help system of the MSIsafesoft configuration software.

Increasing cross-circuit protection (optional)

To increase shutdown protection and cross-circuit protection, use outputs O0 and O1 in combination with ground-switching outputs O0- and O1-.
See chapter "Ground-switching outputs" on page 34.

Test pulses

The safe output signals are clocked with a test pulse.

Reduced availability through test pulses

Test pulses can reduce the availability of the machine or system.

- Make certain that the connected load does not react to the test pulses.
- Use an appropriate filter terminal block if necessary.

Test behavior at the ground-switching output

The first dynamic test on the ground-switching output occurs up to 60 s after system restart. Not all errors in the peripherals or in the internal electronics of the outputs are therefore detected at the switch-on time.

If the switch-on time of the ground-switching outputs is < 60 s, the test takes place after an accumulated switch-on time of 60 s.

3.4.3 Signal outputs

M0 to M3

The non-safety-relevant signal outputs M0 to M3 are designed as digital semiconductor outputs.

ATTENTION: Module defect

The signal outputs can be destroyed by incorrect wiring.

- Do not connect the signal outputs in parallel.
- Prevent feedback to the signal outputs.

The signal outputs are used to control, e.g., a non-safe PLC or signal units.

Make certain that the GND potential of the signal receiver is the same as the GND potential of the safety module.

The signal outputs are linked in the connection editor of the MSIsafesoft configuration software.

You can find further information on linking the signal outputs in the connection editor in the help system of the MSIsafesoft configuration software.

3.4.4 Clock outputs

T0 and T1

The test pulses output at outputs T0 and T1 are used for cross-circuit detection at the inputs. Each output is available twice. The output test pulses T0 and T1 are phase-shifted.

The clock outputs are permanently assigned to the inputs. If this assignment is violated, the safety module detects a cross-circuit.

Cross-circuit detection can take place between T0 and T1 as well as between a test pulse and 24 V.

No cross-circuit detection takes place between inputs with the same test pulse.

Cross-circuit detection with MSIsafesoft

To implement cross-circuit detection, the relevant safe inputs must be configured accordingly using the configuration editor in MSIsafesoft.

The MSIsafesoft configuration software specifies the clock signals to be used as follows:

– For the "even" inputs (I0, I2, I4 … I18), cross-circuit detection is realized with the test pulse on T0.
– For the "odd" inputs (I1, I3, I5 … I19), cross-circuit detection is realized with the test pulse on T1.

To use cross-circuit detection for two-channel sensors, "even" inputs must therefore always be combined with "odd" inputs.

Further information on configuring cross-circuit detection via the clock outputs can be found in the help system of the MSIsafesoft configuration software.

3.4.5 Ground-switching outputs

O0- and O1-

The ground-switching outputs O0- and O1- increase the shutdown protection and cross-circuit protection of the safety system. For example, these outputs can be used to disconnect a contactor connected to the safety module both via the safe 24 V output and via ground.

The ground-switching outputs are assigned to the safe outputs as follows and can only be used in the respective combination:

– Ground-switching output O0- to output O0
– Ground-switching output O1- to output O1

In order to use the ground-switching outputs, perform the corresponding configuration for outputs O0 and O1 in the MSIsafesoft configuration software.

For more detailed information, please see topic "Configuring the I/Os of the safety module" in the help system.

3.4.6 Supply connections

WARNING: Loss of the safety function

The use of unsuitable voltage supplies and the incorrect connection of the voltage supply can result in the loss of the safety function.

- Only supply the supply voltage at connections A1/A2 and 24/0V on the base device of a MSI 100/200 system via the same voltage supply.
- Likewise, supply the supply voltage for all other devices participating in the system via the same voltage supply.
- Only use power supply units with safe insulation and SELV/PELV in accordance with EN 50178 / VDE 0160.

WARNING: Loss of the safety function through interference

EMC interference can lead to the loss of the safety function.

- Connect the output-side GND connection of the power supply unit to the functional earth (FE) of the system.

Connect the two supply connections (A1/A2 and 24V/0V) for an intended function of the safety module.

24V/0V

The 24V/0V supply connection is used to supply the safe outputs of the safety module as well as the ground-switching outputs with voltage.

A1/A2

Supply connection A1/A2 is used to supply the logic of the safety module as well as the clock and signal outputs with voltage.

Double terminal contacts A1/A1 and A2/A2

The double terminal contacts A1/A1 and A2/A2 are looped through and can be used to supply other modules or sensors.

ATTENTION: Module defect

The module can be permanently destroyed by an excessive current load.

- Observe the maximum permissible continuous current for devices connected to terminals A1 and A2

Limiting continuous current for looped-through current paths A1/A1 and A2/A2: see "Limiting continuous current" on page 101.

At the double terminal contacts, 2 and 3-conductor sensors and command devices can be supplied directly by the safety module (U_N = 24 V DC).

WARNING: Loss of the safety function through parasitic voltages

With 3-conductor sensors, make certain that the GND potential of the sensor/command device is the same as the GND potential of the safety module.

4 MSI-EM200-8I4IO safe extension module

4.1 Product description

Observe the technical data of the safe extension module.
See "Technical data MSI-EM200-8I4IO" on page 107.

Extension module for MSI 200

The MSI-EM200-8I4IO safe extension module makes additional configurable inputs and outputs available for the MSI 200 safety module. Depending on the configuration, the inputs and outputs are used for connecting safe command devices and sensors or actuators.

Safe digital inputs/outputs

The extension module has eight safe digital inputs.

You can configure another four signals as either safe digital inputs or outputs. The signal direction (input or output) can only be changed over block by block, i.e., for all four signals at once.

The outputs are actuated depending on the safety logic, which is executed in the MSI 200 safety module.

Digital clock/signal outputs (configurable)

The extension module has two digital clock/signal outputs, which are configurable.

If you configure the outputs as clock outputs, they will support cross-circuit detection at the inputs of the safe extension module.

If you configure the outputs as signal outputs, you thereby control, e.g., a non-safe PLC or signal units. The signal outputs are not safety-oriented.

Connection technology

The extension module is available with either screw connections or with spring-cage connections. All connection terminals are pluggable. The individual terminal blocks are mechanically coded to prevent swapping or skewed plug in.

Connection variants

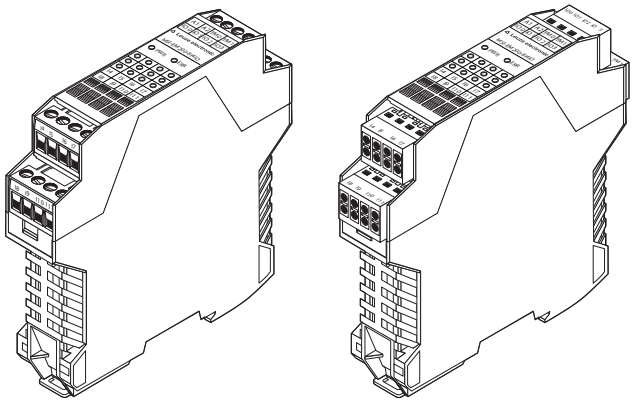


Figure 4-1 Screw terminals (left) and spring-cage terminals (right)

Block diagram

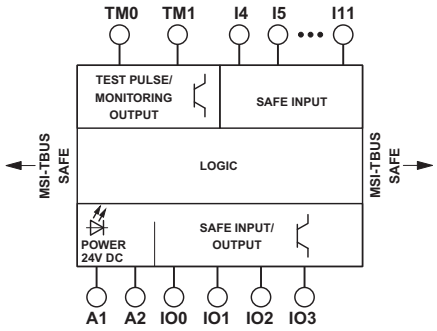


Figure 4-2 MSI-EM200-8I4IO block diagram

4.2 Diagnostic and status indicators

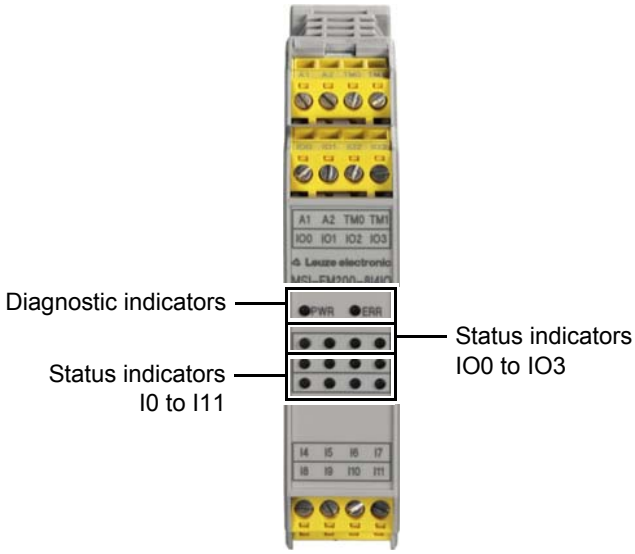


Figure 4-3 Diagnostic and status indicators MSI-EM200-8I4IO

Diagnostic indicators

The two diagnostic indicators on the front side display the operating status of the extension module.

Table 4-1 MSI-EM200-8I4IO LED diagnostic indicators

LED	Color	Description
PWR	Green	Indicator for the voltage supply of the extension module
ERR	Red	Error display

Status indicators

The state of each of the eight safe inputs and the four configurable safe inputs/outputs is indicated by a separate LED on the front side of the device.

A detailed list of possible indicator combinations for diagnostic and status indicators and their meanings can be found in Chapter "Diagnosis" on page 89.

4.3 Signal connections

All of the inputs and outputs are connected using pluggable and coded connection terminals.

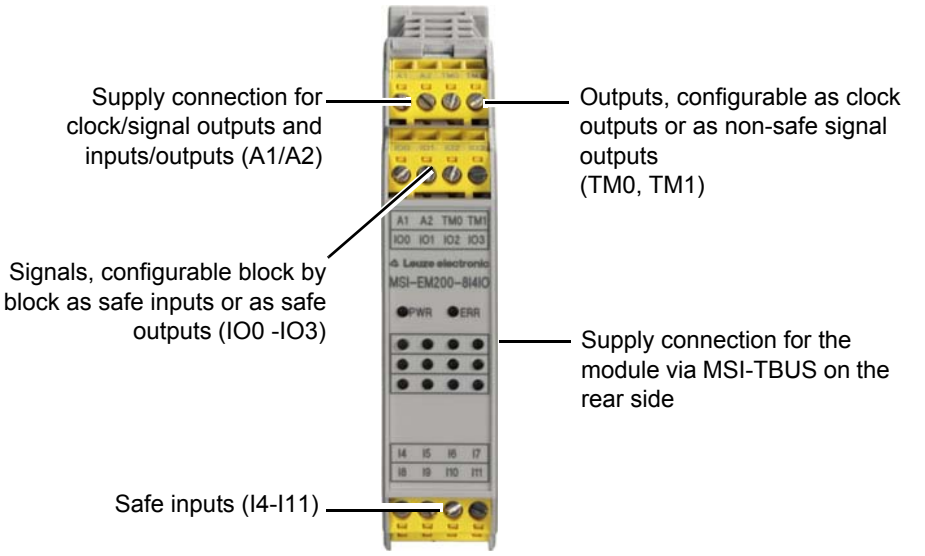


Figure 4-4 Signal connections MSI-EM200-8I4IO

4.3.1 Safe inputs

The safe digital inputs are used for the direct connection of safe command devices or safety sensors.

I4 to I11
IO0 to IO3 as inputs

The safe extension module has eight permanent safe digital inputs I4 to I11. Another four safe digital inputs IO0 to IO3 can be obtained through appropriate configuration.

The inputs/outputs are configured with the help of the configuration editor of the MSIsafesoft configuration software. The safe inputs are linked to the safety logic in the connection editor of the configuration software.

The signal direction (input or output) can only be selected for IO0 to IO3 block by block, i.e., for all four signals at once.

Conditions for IO0 to IO3 as inputs:

If you use configurable inputs/outputs IO0 to IO3 as inputs, it is mandatory that cross-circuit detection be implemented with the extension module. To do this, power the affected inputs via clock outputs TM0 or TM1 of the extension module.
See also chapter "Clock/signal outputs" on page 39.

You can find further information on configuring and linking the safe inputs in the help system of the MSIsafesoft configuration software.

There, you will also find information on the topics relevant to the safe inputs: signal redundancy due to dual signals, two-channel sensors and cross-circuit detection.

4.3.2 Safe outputs

IO0 to IO3 as outputs

Signals IO0 to IO3 can be configured as safety-related outputs and implemented as digital semiconductor outputs.

ATTENTION: Module defect

Inductive loads can destroy the outputs.

- Use a suitable and effective protective circuit.
- The protective circuit is to be parallel to the load, not parallel to the switching contact.
- Prevent feedback to the outputs.

The outputs are actuated depending on the safety logic, which is executed in the MSI 200 safety module.

The safe outputs are linked to the safety logic in the connection editor of the MSIsafesoft configuration software.

You can find further information on configuring and linking the safe outputs in the help system of the MSIsafesoft configuration software.

Test pulses

The safe output signals are clocked with a test pulse.

Reduced availability through test pulses

Test pulses can reduce the availability of the machine or system.

- Make certain that the connected load does not react to the test pulses.
- Use an appropriate filter terminal block if necessary.

4.3.3 Clock/signal outputs

TM0 and TM1

You can configure outputs TM0 and TM1 of the extension module as either non-safety-relevant digital signal outputs or as safe clock outputs.

The outputs are configured with the help of the configuration editor of the MSIsafesoft configuration software.

You can find further information on configuring and linking the clock/signal outputs in the configuration editor in the help system of the MSIsafesoft configuration software.

TM0 and TM1 as signal outputs

If you configure outputs TM0 and TM1 as signal outputs, you thereby control, e.g., a non-safe PLC or signal units.

Make certain that the GND potential of the signal receiver is the same as the GND potential of the safety module.

The non-safety-relevant signal outputs are designed as digital semiconductor outputs.

ATTENTION: Module defect

The signal outputs can be destroyed by incorrect wiring.

- Do not connect the signal outputs in parallel.
- Prevent feedback to the signal outputs.

Configure the two outputs TM0 and TM1 as signal outputs by making the following settings in the configuration editor in MSIsafesoft. The signal outputs can only be configured together.

- For TM0 to TM1, set the "Configuration" parameter to the value "Signal output - M0 to M1".

The signal outputs are linked in the connection editor of the MSIsafesoft configuration software.

You can find further information on linking the signal outputs in the connection editor in the help system of the MSIsafesoft configuration software.

TM0 and TM1 as clock outputs

If you configure outputs TM0 and TM1 as clock outputs, they will support cross-circuit detection at the inputs of the safe extension module.
See chapter "Error detection" on page 21.

If you use configurable inputs/outputs IO0 to IO3 as inputs, it is mandatory that cross-circuit detection be implemented with the extension module, i.e., the affected inputs must be supplied via clock outputs TM0 or TM1 of the extension module.
See Chapter "Safe inputs" on page 38.

If you use configurable inputs/outputs IO0 to IO3 as outputs, configuring TM0 and TM1 as clock outputs results in an error.

Configure the two outputs TM0 or TM1 as clock outputs by making the following settings in the safe configuration editor. The clock outputs can only be configured together.

- For IO0 to IO3, set the "Signal configuration" parameter to the value "Configured as safe inputs with test pulse"
- For TM0 to TM1, set the "Configuration" parameter to the value "Clock T0 to T1"

The test pulses output at outputs TM0 and TM1 (if the configuration settings have been made accordingly) are used for cross-circuit detection at the inputs of the extension module. The output test pulses T0 and T1 are phase-shifted with respect to one another.

To implement cross-circuit detection, the relevant safe inputs must be configured accordingly using the configuration editor in MSIsafesoft.

The MSIsafesoft configuration software specifies the clock signals to be used as follows:

– For the "even" inputs (IO0 and IO2 as well as I4 … I10), cross-circuit detection is realized with the test pulse on TM0.
– For the "odd" inputs (IO1 and IO3 as well as I5 … I11), cross-circuit detection is realized with the test pulse on TM1.

4.3.4 Supply connections

WARNING: Loss of the safety function

The use of unsuitable voltage supplies and the incorrect connection of the voltage supply can result in the loss of the safety function.

- Only supply the supply voltage at connections A1/A2 and 24/0V on the base device of a MSI 100/200 system via the same voltage supply.
- Likewise, supply the supply voltage for all other devices participating in the system via the same voltage supply.
- Only use power supply units with safe insulation and SELV/PELV in accordance with EN 50178 / VDE 0160.

WARNING: Loss of the safety function through interference

EMC interference can lead to the loss of the safety function.

- Connect the output-side GND connection of the power supply unit to the functional earth (FE) of the system.

Connect the two supply connections (A1/A2 and MSI-TBUS) for an intended function of the safe extension module.

Yellow MSI-TBUS

The logic of the MSI-EM200-8I4IO safe extension module is supplied with voltage via the yellow MSI-TBUS DIN rail connector.

ATTENTION: Module defect

The use of an incorrect DIN rail connector or of a terminating plug can result in a module defect.

- Only use the yellow MSI-TBUS DIN rail connector.
- **Never** use the green TBUS DIN rail connector.

A1/A2

Supply connection A1/A2 is used to supply the configurable inputs/outputs as well as the configurable clock/signal outputs with voltage.

5 MSI-EM200-4RO safe extension module

5.1 Product description

Observe the technical data of the safe extension module, see "Technical data and ordering data" on page 101.

Extension module for MSI 200

The MSI-EM200-4RO safe extension module makes additional relay outputs available to the MSI 200 safety module that you can connect to the actuator.

Safe relay outputs

The extension module has four safe relay outputs. The outputs are actuated depending on the safety logic, which is executed in the MSI 200 safety module.

Digital signal outputs

The extension module has four non-safe digital signal outputs. The signal outputs are used to control, e.g., a non-safe PLC or signal units.

Connection technology

The extension module is available with either screw connections or with spring-cage connections. All connection terminals are pluggable. The individual terminal blocks are mechanically coded to prevent swapping or skewed plug in.

Connection variants

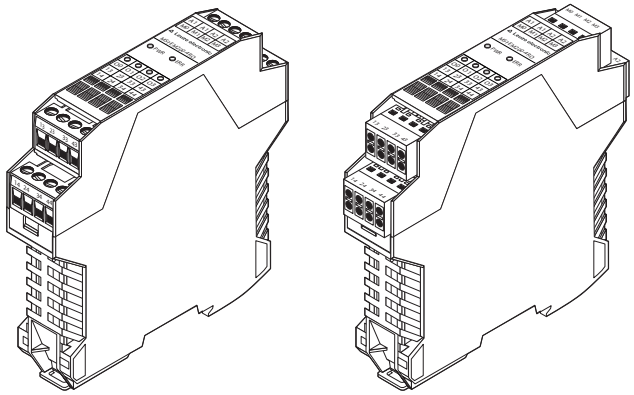


Figure 5-1 Screw terminals (left) and spring-cage terminals (right)

Block diagram

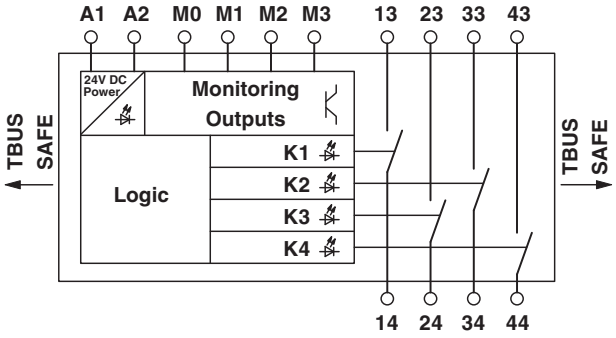


Figure 5-2 MSI-EM200-4RO block diagram

Insulation coordination

The following table shows the insulation of the relay outputs between one another and for the logic area of the device.

Table 5-1 Insulation coordination

	A1A2 24V/0V	13/14	23/24	33/34	43/44
A1A2 24V/0V	-	6 kV ST	6 kV ST	6 kV ST	6 kV ST
13/14	-	-	4 kV BI	4 kV BI	4 kV BI
23/24	-	-	-	4 kV BI	4 kV BI
33/34	-	-	-	-	4 kV BI
43/44	-	-	-	-	-

Legend:

BI	Basic insulation
ST	Safe insulation

Basic insulation

(Rated surge voltage 4 kV)

A mix of safe extra-low voltage and low voltage is not permitted.

Safe insulation / reinforced insulation

(Rated surge voltage 6 kV)

Reinforced insulation (e.g., through larger clearances and creepage distances of the conductor tracks) is designed to a higher overvoltage category than the basic insulation. It is, therefore, not possible to mix safe extra-low voltage circuits U ≤ 25 V AC or U ≤ 60 V DC and circuits with higher voltage.

5.2 Diagnostic and status indicators

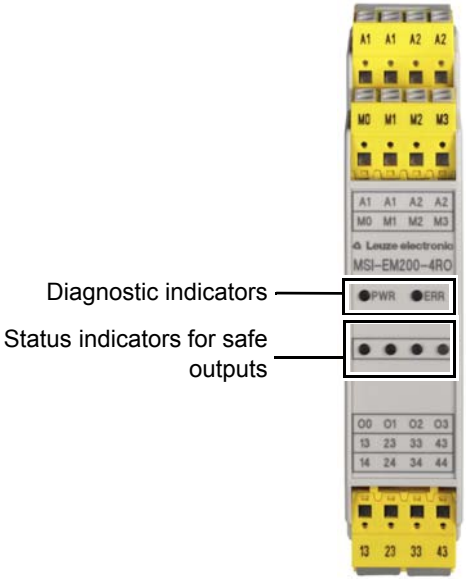


Figure 5-3 Diagnostic and status indicators MSI-EM200-4RO

Diagnostic indicators

The two diagnostic indicators on the front side display the operating status of the extension module.

Table 5-2 MSI-EM200-4RO LED diagnostic indicators

LED	Color	Description
PWR	Green	Indicator for the voltage supply of the extension module
ERR	Red	Error display

Status indicators

The state of each of the four safe relay outputs is indicated by a separate LED on the front side of the device.

A detailed list of possible indicator combinations for diagnostic and status indicators and their meanings can be found in Chapter "Diagnosis" on page 89.

5.3 Signal connections

All of the outputs are connected using pluggable and coded connection terminals.

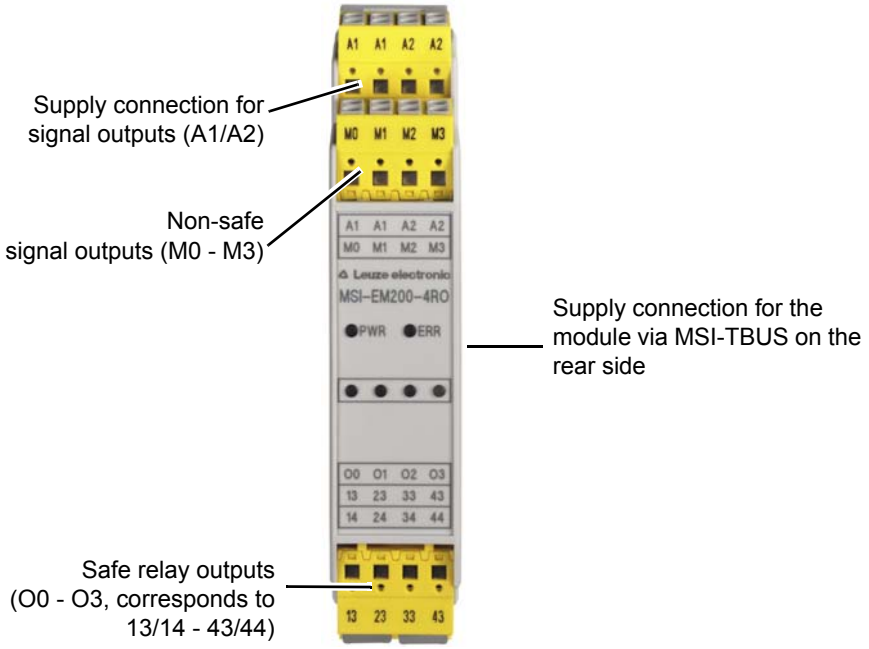


Figure 5-4 Signal connections MSI-EM200-4RO

5.3.1 Safe relay outputs

O0 to O3

Outputs O0 to O3 are designed as safety-related relay outputs.

Table 5-3 Relay outputs

Output	Relay contacts	Output	Relay contacts
O0	13/14	O2	33/34
O1	23/24	O3	43/44

WARNING: Loss of the safety function / hazardous body currents

Mixing different voltages (e.g., SELV/PELV with mains voltage) can destroy the relay contacts. The safety function can be lost and dangerous body currents may occur.

- Observe the information in Table 5-1 „Insulation coordination“ on page 43.

ATTENTION: Module defect

Inductive loads can destroy the outputs.

- Use a suitable and effective protective circuit.
- The protective circuit is to be parallel to the load, not parallel to the switching contact.
- Prevent feedback to the outputs.

You can use the relay outputs as follows:
– Single-channel assignment
– Two-channel assignment

More detailed information on the assignment can be found in the following table.

Table 5-4 Assignment of the relay outputs

Assignment	Number of outputs	Comment
Two-channel	2 two-channel relay outputs (wired in pairs) **Pair 1:** 13/14 and 23/24 (bridge between contacts 13/23) **Pair 2:** 33/34 and 43/44 (bridge between contacts 33/43)	**Prerequisite:** The bridges between contacts 13/23 and 33/43 are plugged-in and the configuration has been performed accordingly. **Info:** The pairwise wiring of the relay outputs corresponds to the factory settings.
One-channel	4 single-channel relay outputs – 13/14 – 23/24 – 33/34 – 43/44	**Prerequisite:** The bridges between contacts 13/23 and 33/43 are removed and the configuration has been performed accordingly.

Note for cat. 4 applications:
To achieve cat. 4 acc. to EN ISO 13849-1, wire the relay outputs in pairs (two-channel assignment).

The outputs are actuated depending on the safety logic, which is executed in the MSI 200 safety module.

The safe relay outputs are linked to the safety logic in the connection editor of the MSIsafesoft configuration software.

You can find further information on configuring and linking the safe outputs in the help system of the MSIsafesoft configuration software.

5.3.2 Signal outputs

M0 to M3

The non-safety-relevant signal outputs M0 to M3 are designed as digital semiconductor outputs.

ATTENTION: Module defect

The signal outputs can be destroyed by incorrect wiring.

- Do not connect the signal outputs in parallel.
- Prevent feedback to the signal outputs.

The signal outputs are used to control, e.g., a non-safe PLC or signal units.

Make certain that the GND potential of the signal receiver is the same as the GND potential of the safety module.

The signal outputs are linked in the connection editor of the MSIsafesoft configuration software.

You can find further information on linking the signal outputs in the connection editor in the help system of the MSIsafesoft configuration software.

5.3.3 Supply connections

WARNING: Loss of the safety function

The use of unsuitable voltage supplies and the incorrect connection of the voltage supply can result in the loss of the safety function.

- Only supply the supply voltage at connections A1/A2 and 24/0V on the base device of a MSI 100/200 system via the same voltage supply.
- Likewise, supply the supply voltage for all other devices participating in the system via the same voltage supply.
- Only use power supply units with safe insulation and SELV/PELV in accordance with EN 50178 / VDE 0160.

Connect the two supply connections (A1/A2 and MSI-TBUS) for an intended function of the safe extension module.

Yellow MSI-TBUS

The logic of the MSI-EM200-4RO safe extension module is supplied with voltage via the yellow MSI-TBUS DIN rail connector.

ATTENTION: Module defect

The use of an incorrect DIN rail connector or of a terminating plug can result in a module defect.

- Only use the yellow MSI-TBUS DIN rail connector.
- **Never** use the green TBUS DIN rail connector.

A1/A2

Supply connection A1/A2 is used to supply the signal outputs of the safe extension module with power.

Double terminal contacts A1/A1 and A2/A2

The double terminal contacts A1/A1 and A2/A2 are looped through and can be used to supply other modules or sensors.

ATTENTION: Module defect

The module can be permanently destroyed by an excessive current load.

- Observe the maximum permissible continuous current for devices connected to terminals A1 and A2

Limiting continuous current for looped-through current paths A1/A1 and A2/A2: see "Limiting continuous current" on page 101.

At the double terminal contacts, 2 and 3-conductor sensors and command devices can be supplied directly by the safety module (U_N = 24 V DC).

WARNING: Loss of the safety function through parasitic voltages

With 3-conductor sensors, make certain that the GND potential of the sensor/command device is the same as the GND potential of the safety module.

6 Wiring examples

6.1 Information on the wiring examples

In the following examples, clock outputs T0 and T1 are used.

With safe extension module MSI-EM200-8I4IO, these correspond to clock outputs TM0 and TM1 if they are configured as clock outputs.

Terminals IO0 to IO3 of safe extension module MSI-EM200-8I4IO function as inputs if they are appropriately configured as inputs.

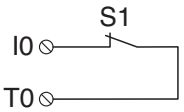
6.2 Single-channel assignment of the safe digital inputs

With the single-channel assignment of the safe digital inputs, the inputs function independent of one another.

6.2.1 Cross circuit monitoring switched on

If an input pair is configured single-channel with cross circuit monitoring, the following permanent assignment applies:

– – All "even" inputs I0, I2, … are permanently assigned to clock output T0.
– – All "odd" inputs I1, I3, … are permanently assigned to clock output T1.



Legend:

S1	Safety switches
I0	Input
T0	Clock output

Figure 6-1 Single-channel assignment of the inputs

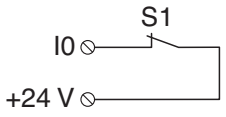
Key dates

Sensor	One-channel
Sensor supply	Internally through clock output T0 (clocked) or T1 (clocked)
Attainable safety integrity	SIL 1/SILCL 1/Cat. 1/PL c

Example configuration

Configuration	**Configured as**
Input xx channel 1/channel 2	
Cross circuit monitoring	Yes, with test pulse T0 for all "even" inputs I0, I2, … Yes, with test pulse T1 for all "odd" inputs I1, I3, …

6.2.2 Cross circuit monitoring switched off, external supply



Legend:

S1	Safety switches
I0	Input
+24 V	Supplied by external 24 V (note potential reference)

Figure 6-2 Single-channel assignment of the inputs: external supply

Key dates

Sensor	Single-channel switch
Sensor supply	External (24 V, note potential reference)
Attainable safety integrity	SIL 1/SILCL 1/Cat. 1/PL c

WARNING: Loss of the safety function

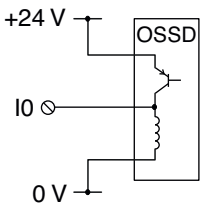
Cross circuits can lead to the loss of the safety function.

- Exclude the possibility of cross circuits in order to be able to achieve the specified safety integrity.

Example configuration

Configuration	Configured as
Input xx channel 1/channel 2	
Cross circuit monitoring	No

6.2.3 External supply (OSSD)



Legend:

OSSD	OSSD sensor
I0	Input
+24 V	Supplied by external 24 V
0 V	External 0 V (note potential reference)

Figure 6-3 Single-channel assignment of the inputs: external supply (OSSD)

WARNING: Loss of the safety function
Parasitic voltages can lead to the loss of the safety function.
- Exclude the possibility of parasitic voltages through appropriate wiring.

Key dates

Sensor	Single-channel OSSD output (with internal testing)
Sensor supply	External (OSSD sensor)
Attainable safety integrity	SIL 1/SILCL 1/Cat. 1/PL c

WARNING: Loss of the safety function
Cross circuits can lead to the loss of the safety function.
- Exclude the possibility of cross circuits in order to be able to achieve the specified safety integrity.

Example configuration

Configuration	Configured as
Input xx channel 1/channel 2	
Cross circuit monitoring	No

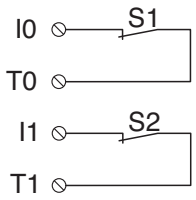
6.3 Two-channel equivalent assignment of the safe digital inputs

With the two-channel assignment of the inputs, two adjacent inputs of the same connector are used.

For two-channel equivalent assignment of the inputs, use the "equivalent" function module in the MSIsafesoft configuration software.
The function description of the module can be found in the help system of the software.

6.3.1 Cross circuit monitoring switched on, supplied by T0 and T1

Possible wiring variants:



Legend:

S1, S2	Switching elements
I0, I1	Inputs
T0, T1	Supplied by T0 and T1

Figure 6-4 Two-channel equivalent assignment of the inputs, supplied by T0 and T1 (both clocked)

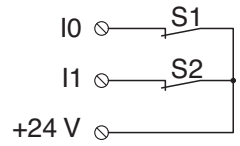
Key dates

Sensor	Two-channel equivalent with cross circuit monitoring
Sensor supply	Internal by clock outputs T0 and T1 (both clocked)
Attainable safety integrity	SIL 3/SILCL 3/Cat. 4/PL e

Example configuration

Configuration	**Configured as**
Input xx channel 1/channel 2	
Cross circuit monitoring	Yes, with test pulse T0 at I0 Yes, with test pulse T1 at I1

6.3.2 Cross circuit monitoring switched off, external supply



Legend:

S1, S2	Switching elements
I0, I1	Inputs
+24 V	Supplied by external 24 V (note potential reference)

Figure 6-5 Two-channel equivalent assignment of the inputs, external supply, cross circuit monitoring switched off

Key dates

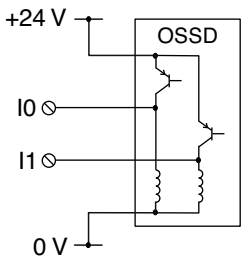
Sensor	Two-channel equivalent
Sensor supply	External (24 V, note potential reference)
Attainable safety integrity	SIL 3/SILCL 3/Cat. 3/PL d

WARNING: Loss of the safety function
An accumulation of errors can lead to the loss of the safety function.
- Test the safety function at appropriate time intervals to detect errors in good time.

Example configuration

Configuration	Configured as
Input xx channel 1/channel 2	
Cross circuit monitoring	No

6.3.3 External supply (OSSD)



Legend:

OSSD	OSSD sensor
I0, I1	Inputs
+24 V	Supplied by external 24 V
0 V	External 0 V (note potential reference)

Figure 6-6 Two-channel equivalent assignment of the inputs, external supply (OSSD)

WARNING: Loss of the safety function
Parasitic voltages can lead to the loss of the safety function.
- Exclude the possibility of parasitic voltages through appropriate wiring.

Key dates

Sensor	Two-channel OSSD output (with internal testing)
Sensor supply	External (OSSD sensor)
Attainable safety integrity	SIL 3/SILCL 3/Cat. 4/PL e

Example configuration

Configuration	**Configured as**
Input xx channel 1/channel 2	
Cross circuit monitoring	No

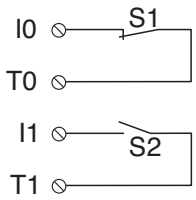
6.4 Two-channel antivalent assignment of the safe digital inputs

With the two-channel assignment of the inputs, two adjacent inputs of the same connector are used.

For two-channel antivalent assignment of the inputs, use the "antivalent" function module in the MSIsafesoft configuration software.
The function description of the module can be found in the help system of the software.

6.4.1 Cross circuit monitoring switched on, supplied by T0 and T1

Possible wiring variants:



Legend:

S1, S2	Switching elements
I0, I1	Inputs
T0, T1	Supplied by T0 and T1

Figure 6-7 Two-channel antivalent assignment of the inputs, supplied by T0 and T1, cross circuit monitoring switched on

Key dates

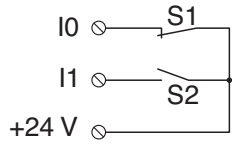
Sensor	Two-channel antivalent
Sensor supply	Internal by clock output T0 and T1, cross circuit monitoring switched on
Attainable safety integrity	SIL 3/SILCL 3/Cat. 4/PL e

WARNING: Loss of the safety function
An accumulation of errors can lead to the loss of the safety function.
- Test the safety function at appropriate time intervals to detect errors in good time.

Example configuration

Configuration	Configured as
Input xx channel 1/channel 2	
Cross circuit monitoring	Yes, with test pulse T0 at I0 Yes, with test pulse T1 at I1

6.4.2 Cross circuit monitoring switched off, external supply



Legend:

S1, S2	Switching elements
I0, I1	Inputs
+24 V	Supplied by external 24 V (note potential reference)

Figure 6-8 Two-channel antivalent assignment of the inputs, external supply

Key dates

Sensor	Two-channel antivalent
Sensor supply	External (24 V, note potential reference)
Attainable safety integrity	SIL 3/SILCL 3/Cat. 3/PL d

WARNING: Loss of the safety function
An accumulation of errors can lead to the loss of the safety function.
- Test the safety function at appropriate time intervals to detect errors in good time.

Example configuration

Configuration	Configured as
Input xx channel 1/channel 2	
Cross circuit monitoring	No

6.5 Safe digital outputs

6.5.1 Information on the protective circuitry of external relays/contactors (freewheeling circuit)

Possible wiring variants:

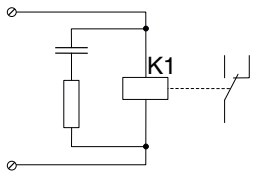
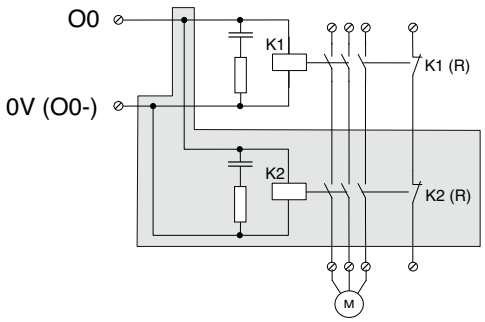


Figure 6-9 Example for the freewheeling circuit of an external relay

Observe the following measures:

- Limit the inductive cut-off voltage to < –15 V (e.g, with RC elements, suppressor diodes or varistors).
- Note that the freewheeling circuit affects the decay time and the life expectancy of the contactor.
- When dimensioning the protective circuit of the relay, take into account the information provided by the relay manufacturer.

6.5.2 Single-channel assignment of the safe digital outputs



Legend:

O0, 0V, O0-	Outputs
K1, K2	External relays/contactors
K1(R), K2(R)	Forced normally closed contacts

Figure 6-10 Single-channel assignment of the outputs

K1 (R) and, where applicable, K2 (R) represent the forced normally closed contacts for state monitoring of the relays (readback contacts).

- Connect these contacts via safe digital inputs.
- Evaluate the readback and, thus, the state of the switching elements in the safe application program.

WARNING: Loss of the safety function

Parasitic voltages can lead to the loss of the safety function.

- Exclude the possibility of parasitic voltages through appropriate wiring.

Key dates

Actuator	One-channel	Two-channel
Attainable safety integrity	SIL 1/SILCL 1/Cat. 1/PL c	SIL 3/SILCL 3/Cat. 4/PL e

6.5.3 Two-channel assignment of the safe digital outputs

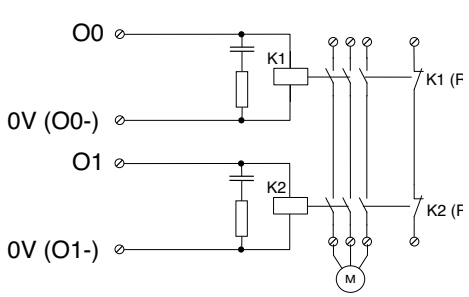


Figure 6-11 Two-channel assignment of the outputs

K1 (R) and K2 (R) represent the forced normally closed contacts for state monitoring of the relays (readback contacts).

- Connect these contacts via safe digital inputs.
- Evaluate the readback and, thus, the state of the switching elements in the safe application program.

WARNING: Loss of the safety function

Parasitic voltages can lead to the loss of the safety function.

- Exclude the possibility of parasitic voltages through appropriate wiring.

Key dates

Actuator	Two-channel
Attainable safety integrity	SIL 3/SILCL 3/Cat. 4/PL e

6.6 Safe relay outputs

6.6.1 Information on the protective circuitry of external relays/contactors (freewheeling circuit)

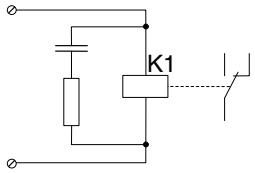
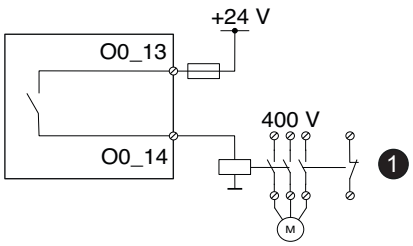


Figure 6-12 Example for the freewheeling circuit of an external relay

A protective circuit via the relay contacts is not permissible.

6.6.2 Single-channel assignment of the safe relay outputs

With single-channel assignment, the safety relays operate independent of one another. They are actuated individually.



Legend:

O0_xx	Relay outputs
+24 V	Switching voltage (external)
400 V	Actuator voltage
1	Possible readback

Figure 6-13 Single-channel assignment of the relay outputs

Optional readback of the actuator is possible via the safe inputs of the MSI 100/200 system.

Information on switching other voltages: see chapter 14 „Technical data and ordering data“.

Key dates

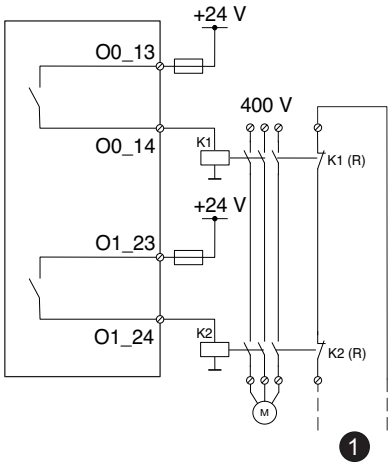
Actuator	One-channel
Attainable safety integrity	SILCL 1/Cat. 1/PL c

Example configuration

Configuration	**Configured as**
Signal configuration	Single-channel (O0 and O1 switch independently)

6.6.3 Single-channel assignment of the safe relay outputs

With two-channel assignment, the safety relays of both channels work together. This assignment is permanent and cannot be configured.



Legend:

O0_xx, O1_xx	Relay outputs
+24 V	Switching voltage (external)
400 V	Actuator voltage
K1, K2	External relays/contactors
K1(R), K2(R)	Forced normally closed contacts
1	Possible readback

Figure 6-14 Two-channel assignment of the relay outputs

A possible readback of the actuator is possible via the safe inputs of the MSI 100/200 system.

Information on switching other voltages: see chapter 14.3 „Technical data MSI-EM200-4RO“.

7 Mounting, removal and electrical installation

7.1 Safety notices for mounting, removal and electrical installation

Qualified personnel

Mounting, removal and electrical installation of the MSI 100/200 system may only be performed by qualified personnel.
See "Qualified personnel" on page 10.

WARNING: Serious personal injury or material damage
Disregarding this warning may result in damage to equipment and/or serious personal injury.

WARNING: Dangerous voltage
Mounting, removal and electrical installation without ensuring that the system is free of voltage can result in dangerous electric shocks.
- Perform mounting, removal and electrical installation of the safety modules and safe extension modules only in a voltage-free state.
- De-energize the entire system before performing installation work and secure the system against unintentional switching-on of the voltage.
- Only switch voltage on after completing the setting and the system can no longer pose a hazard.

WARNING: Unintended machine start-up
Mounting, removal and electrical installation without ensuring that the system is free of voltage can result in unintended machine start-up.
- Perform mounting, removal and electrical installation of the safety modules and safe extension modules only in a voltage-free state.
- De-energize the entire system before performing installation work and secure the system against unintentional switching-on of the voltage.
- Only switch voltage on after completing the setting and the system can no longer pose a hazard.

ATTENTION: Electrostatic discharge
The modules contain components that can be damaged or destroyed by electrostatic discharge. When handling the modules, take the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and IEC 61340-5-1.

7.2 Mounting

7.2.1 Mounting instructions

ATTENTION: Property damage
Improper mounting can result in property damage.
- When mounting the MSI 100/200 system, observe the following instructions.

Table 7-1 Important mounting instructions

Connection via DIN rail connectors	
MSI-TBUS	To connect the MSI 100 and MSI 200 safety modules as well as the MSI-EM200-8I4IO and MSI-EM200-4RO safe extension modules, use only the yellow MSI-TBUS DIN rail connector. **Connection with another DIN rail connector is not permitted.**
TBUS	For the connection of non-safe extension devices (gateways), use only the green TBUS DIN rail connector. **Connection with another DIN rail connector is not permitted.**
Mounting direction for extensions	
Non-safe extension: left	Mount a non-safe extension module (gateway) to the left of the MSI 100 or MSI 200 safety module.
Safe extension: right	Mount the MSI-EM200-8I4IO and/or MSI-EM200-4RO safe extension modules to the right of the MSI 200 safety module.
Maximum number of extension devices	
Non-safe extension	Connect a maximum of one non-safe extension device (gateway) to the MSI 100 or MSI 200 safety module.
Safe extension	Connect a maximum of ten safe extension modules to the MSI 200 safety module.

You can find a graphical depiction of an MSI 100/200 system extended with MSI-TBUS and TBUS in Figure 2-2 on page 17.

7.2.2 Mounting location

- Mount the module in a dust- and humidity-protected switch cabinet or terminal box (IP54 or higher).
- Secure the switch cabinet/terminal box against opening by unauthorized persons.

7.2.3 Mounting

35 mm DIN rail

The modules of the MSI 100/200 system are intended only for mounting on 35 mm DIN rails acc. to EN 60715. To avoid contact resistance, only use clean and corrosion-free DIN rails.

TBUS / MSI-TBUS DIN rail connectors (optional)

1. **Optional:** If you would like to use the DIN rail connectors to create a connection station with extension units, proceed as follows.
   b) Connect the required number of DIN rail connectors for the connection station (see Figure 7-1, A).
   c) Snap this group of DIN rail connectors onto the DIN rail (see steps B and C).

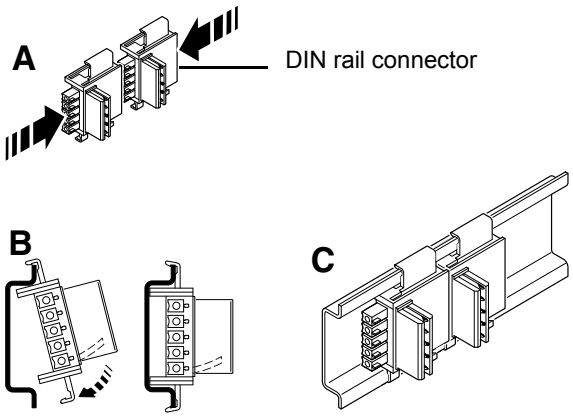


Figure 7-1 Mounting DIN rail connectors

Mounting the MSI 100/200 module

2. Place the module onto the DIN rail from above so that the upper retaining groove of the module is hooked onto the top edge of the DIN rail (see Figure 7-2).

ATTENTION: Module defect

The use of an incorrect DIN rail connector or of a terminating plug can result in a module defect.

- Use only the yellow MSI-TBUS DIN rail connector for safe extension modules.
- For non-safe extension devices, use the green TBUS DIN rail connector.

ATTENTION: Damage to the connectors

When using DIN rail connectors, ensure that the contact opening in the base of the module is aligned correctly over the contact block of the DIN rail connector.

ATTENTION: Connector wear

The modules may be connected to the DIN rail connectors a maximum of eight mating cycles.

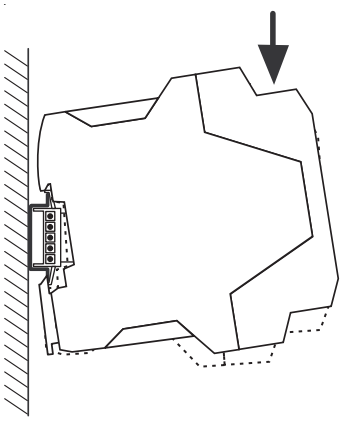


Figure 7-2 Mounting a MSI 100/200 module on the DIN rail

3. Push the lower part of the module that is furthest from the DIN rail towards the DIN rail until it engages with a click.
4. Check that the module is fixed securely on the DIN rail.
5. When mounting additional modules on the DIN rail (e.g., gateways or power supply units), place them on the DIN rail with no spacing, i.e., in direct contact with the sides of the housing.
6. Mount a standard end clamp for 35 mm DIN rails (TS 35) on both sides of the module or module group. This prevents the modules from sliding and protects against faulty connection with other modules on the DIN rail. You thereby also avoid an accidental connection of other DIN rail connectors.

7.3 Removal

1. Pull the locking latch on the bottom of the module down using a screwdriver, for example, to release the module from the DIN rail.
2. Slightly lift the bottom of the module away from the DIN rail.
3. Pull the module diagonally upwards away from the DIN rail.

7.4 Electrical installation

For reliable and touch-safe contacts, isolate the connection ends for all modules of the MSI 100/200 system as follows:

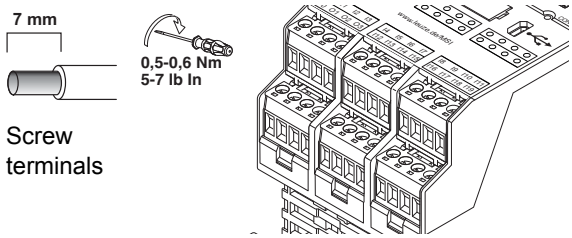


Figure 7-3 Connecting to screw terminals

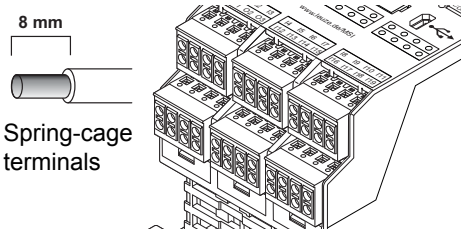


Figure 7-4 Connecting to spring-cage terminals

Wire-end sleeves are recommended when using flexible cables.

To maintain UL approval, use copper cables that are designed for operating temperatures of > 75 °C.

7.4.1 Connecting signal lines

Observe manufacturer's specifications

Connect the sensors and actuators according to your safety requirements and the respective manufacturer specifications.

Ensure signal redundancy

Ensure signal redundancy when connecting the signal lines of two-channel command devices and sensors to the inputs of the safety modules.

WARNING: Loss of the safety function through cross circuits and short circuits

Cross circuits and short circuits can lead to the loss of the safety function.

- Prevent cross circuits and short circuits by using a suitable cable installation.
- Implement cross-circuit detection.

You can find further information on the topics of signal redundancy through dual signals, two-channel sensors and cross-circuit detection in the help system of the MSIsafesoft configuration software.

Cable lengths

Many applications use large numbers of sensors or command devices. Depending on the size of the machine or system, a considerable amount of cabling may be required to wire the sensors.

WARNING: Loss of the safety function through interference

To avoid interference, always cover both cable ends at the inputs as well as the outputs.

ATTENTION: Reduced availability through excessively long cables

If the maximum permissible cable lengths are exceeded, the safety modules automatically trigger the safety function, even if it was not requested. Your system thereby suffers an unwanted reduction in availability.

- Do not exceed the maximum permissible cable lengths.

See "Maximum cable lengths" for the safe inputs of the MSI 100/200 modules on pages 101 and 101.

MSI 100 and MSI 200

Connecting signal lines for the safety modules:

1. Connect the sensors to safe inputs **I0** to **I19**.
2. Connect the actuators to safe outputs **O0** to **O3**.
3. **Optional:** Also connect the actuators to ground-switching outputs **O0-** (assigned to O0) and **O1-** (assigned to O1) to increase the shutdown protection and cross-circuit protection.
4. **Optional:** Implement a signaling function by, e.g., connecting a non-safe PLC or a signal unit to signal outputs **M0** to **M3**.
5. **Optional:** Implement cross-circuit detection for the "even" inputs **I0, I2, I4, … I18** by wiring these to clock output **T0**.
   For the "odd" inputs **I1, I3, I5, … I19**, use clock output **T1**.

Connecting signal lines for the MSI-EM200-8I4IO safe extension module:

MSI-EM200-8I4IO

IO0 to IO3 as inputs:

1. Connect the sensors to safe inputs **I4** to **I11**.
2. Connect the sensors to safe inputs **IO0** to **IO3**.
3. **Mandatory:** Implement cross-circuit detection for inputs **IO0** to **IO3** by wiring these to clock outputs **TM0** and **TM1**.

IO0 to IO3 as outputs:

1. Connect the sensors to safe inputs **I4** to **I11**.
2. Connect the actuators to safe outputs **IO0** to **IO3**.
3. **Optional:** Implement a signaling function by, e.g., connecting a non-safe PLC or a signal unit to the outputs configured as signal outputs **TM0** and **TM1**.
4. **Optional:** Implement cross-circuit detection for inputs **I4** to **I11** by wiring these to the outputs configured as clock outputs **TM0** and **TM1**.

Connecting signal lines for the MSI-EM200-4RO safe extension module:

MSI-EM200-4RO

1. Connect the actuators to safe relay outputs **O0** to **O3**.
2. **Optional:** Implement a signaling function by, e.g., connecting a non-safe PLC or a signal unit to signal outputs **M0** to **M3**.

7.4.2 Connecting the supply voltage

Switching on

The modules of the MSI 100/200 system have no main switch. You switch them on by applying the supply voltage.

Once the supply voltage has been applied, the modules execute an initialization routine (all LEDs illuminate). Once the "PWR" status indicator lights up permanently, the respective MSI 100/200 module is ready to operate.

MSI 100 and MSI 200

Connecting the supply voltage for the safety modules:

1. Connect the supply voltage to terminal points **A1** (24 V DC) and **A2** (0 V).

Connections A1/A2 supply the logic as well as the clock and signal outputs of the safety modules.

2. Connect the supply voltage to terminal points **24V** and **0V**.

Connections 24V/0V supply the safe outputs and the ground-switching outputs of the safety modules.

WARNING: Loss of the safety function

The use of unsuitable voltage supplies and the incorrect connection of the voltage supply can result in the loss of the safety function.

- Only supply the supply voltage at connections A1/A2 and 24/0V on the base device of a MSI 100/200 system via the same voltage supply.
- Likewise, supply the supply voltage for all other devices participating in the system via the same voltage supply.
- Only use power supply units with safe insulation and SELV/PELV in accordance with EN 50178 / VDE 0160.

Connect the two supply connections (A1/A2 and 24V/0V) for an intended function of the safety module.

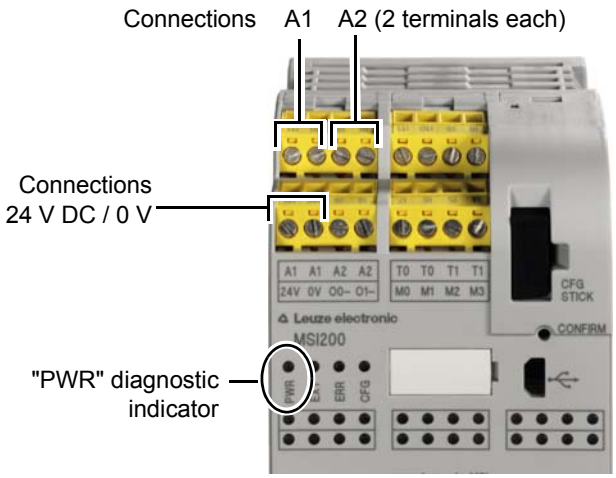


Figure 7-5 Connecting the MSI 100/200 supply voltage

Double terminal contacts A1 and A2 provide the supply voltage for supplying other sensors and command devices.

Also read chapter "Ground-switching outputs" on page 34.

MSI-EM200-8I4IO and MSI-EM200-4RO

Connecting the supply voltage for the safe extension modules:

1. Connect the supply voltage to terminal points **A1** (24 V DC) and **A2** (0 V) of the respective safe extension module.

Connections A1/A2 supply the clock/signal outputs as well as the inputs and outputs (MSI-EM200-8I4IO) or the signal outputs (MSI-EM200-4RO).

The logic of the safe extension modules is supplied with voltage via the yellow MSI-TBUS DIN rail connector.

WARNING: Loss of the safety function

The use of unsuitable voltage supplies and the incorrect connection of the voltage supply can result in the loss of the safety function.

- Only supply the supply voltage at connections A1/A2 and 24/0V on the base device of a MSI 100/200 system via the same voltage supply.
- Likewise, supply the supply voltage for all other devices participating in the system via the same voltage supply.
- Only use power supply units with safe insulation and SELV/PELV in accordance with EN 50178 / VDE 0160.

Connect the two supply connections (A1/A2 and MSI-TBUS) for an intended function of the safe extension modules.

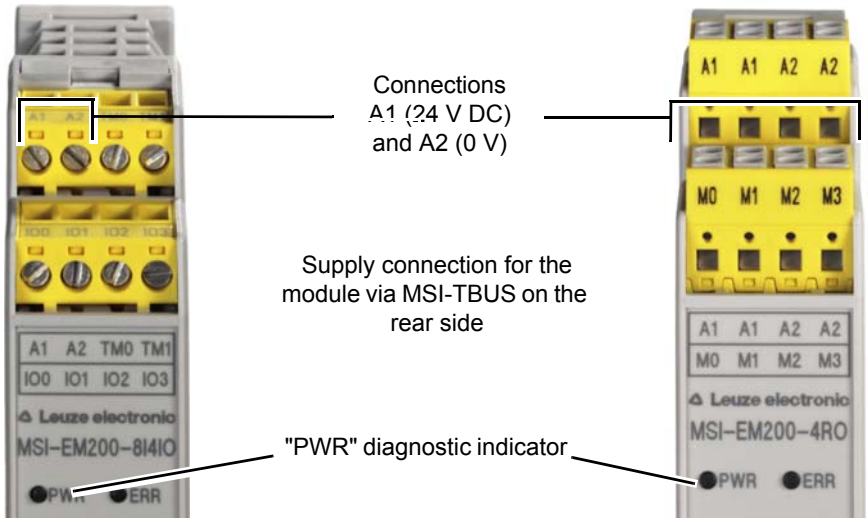


Figure 7-6 Connecting the supply voltage MSI-EM200-8I4IO and MSI-EM200-4RO

Also read:

– MSI-EM200-8I4IO: "Supply connections" on page 41
– MSI-EM200-4RO: "Supply connections" on page 47

7.4.3 Example connection of an MSI 100/200 system

Note the following points when connecting your MSI 100/200 system to the various participants:

Voltage supply and ground reference

- Supply the supply voltage for all other devices participating in the system via the same voltage supply.
- Only use power supply units with safe insulation and SELV/PELV in accordance with EN 50178 / VDE 0160.
- Safeguard the voltage supply externally with a suitable fuse.
- Connect the output-side GND connection of the power supply unit to the functional earth (FE) of the system.
- Ensure that all inputs and outputs of the system are connected to the same ground.

Other participants

- For the connection of safe extension modules, use only the yellow MSI-TBUS DIN rail connector.
- For the connection of non-safe extension devices (gateways), use only the green TBUS DIN rail connector.

The following figure shows the correct connection of the voltage supply for an MSI 100/200 system with various participants.

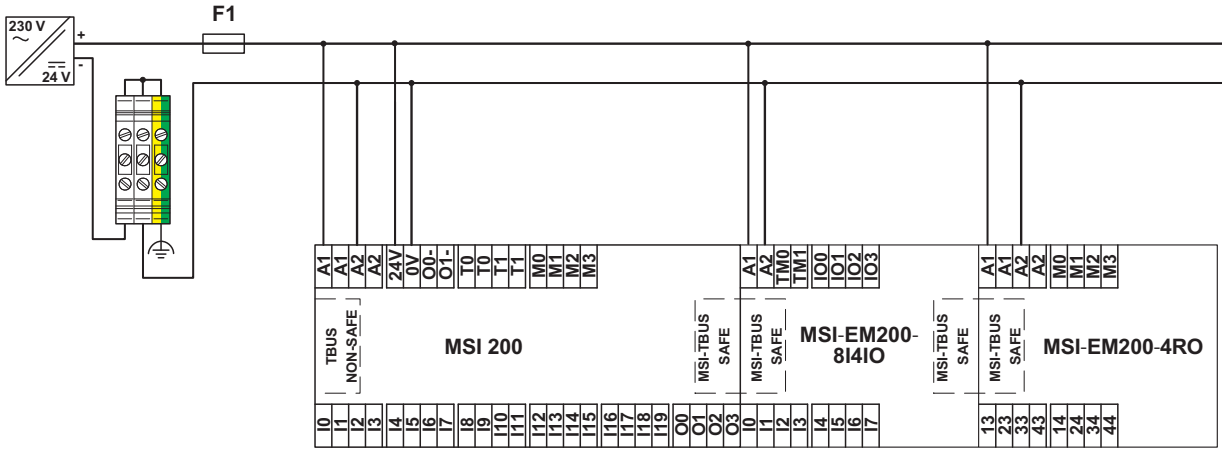


Figure 7-7 MSI 100/200 system voltage supply

Legend:

F1	External fuse
⏚	Functional earth (FE)

8 Firmware update

Update the firmware of the MSI 100/200 system with the help of the MSIsafesoft safe configuration software.

8.1 Safety notices for the firmware update

The following safety notices must be observed during and after the firmware update:

WARNING: Non-safe operation

While the firmware update is running, the MSI 100/200 operates in the non-safe mode. Reliable detection of the safety demand is not guaranteed while in this operating state.

- Therefore, make sure that running the firmware update will not lead to any hazardous situations.
- Take action to prevent the machine from being started up unintentionally (by, e.g., disconnecting the terminals on the output side from the MSI 100/200 system, and disconnecting the drives from the power supply).

ATTENTION: Module defect

Interrupting the connection between the PC and safety module during the firmware update can damage the device.

A faulty or incomplete firmware installation can render communication between the PC and safety module impossible. In this case, the faulty installation cannot be corrected with the assistance of MSIsafesoft.

- Do **not** disconnect the USB cable during the update process.
- Do **not** switch off the safety module during the update process.

Validation / verification

Once the firmware update has concluded, validate and verify the safety application.

8.2 Requirement for firmware update

Before running the firmware-update, ensure the following points:

– The MSI 100 or MSI 200 safety module is connected to the PC via the USB cable and switched on.
– The AC-MSI-CFG1 memory module is plugged into the safety module.
– A project for the safety module is loaded in the MSIsafesoft configuration software.
– Simulation mode for the MSIsafesoft configuration software is switched off.
– Displayed in the status line of the MSIsafesoft configuration software is: "Control: Connected" and "Control: Logged off".
– Displayed in the status line of the MSIsafesoft configuration software is: "Project: Write protected".

8.3 Running a firmware update

1. To start the firmware update in the MSIsafesoft configuration software, select the "Safe control > Firmware update" menu item.

The wizard, which will guide you through the update, is displayed.

2. Proceed as described **in detail in the help system**.

You will find the topic "Firmware update" listed in the contents of the MSIsafesoft configuration software help system.
See also "Opening the software help system" on page 9-76.

9 MSIsafesoft configuration software

9.1 Installing software

Installation

The installation routine for the configuration software includes the installation of the driver for the USB interface. The driver enables communication between the PC and the modules of the MSI 100/200 system.

To ensure that the safety modules are automatically and correctly detected by the configuration software, the software must be fully installed **before** the device is connected to the PC the first time.

Proceed as follows:

1. **If you have downloaded the configuration software:**
   Extract the downloaded file and start the installation program (setup file).
   If you purchased the configuration software on CD:
   Insert the CD in the drive. A menu opens automatically. Start the installation program via menu item "Install software".

If you have deactivated the auto start option on your computer, open the "MSIsafesoft" folder on the CD-ROM and execute the setup file.

2. Select the desired language for the installation routine.

This selection also sets the language for the MSIsafesoft user interface, which is set when the software is started for the first time.

The installation program now guides you through the installation step by step.

3. Follow the instructions on the screen.

Once MSIsafesoft is installed, you will be prompted to install the drivers for the safety module.

4. Follow the instructions on the screen.
5. In the Windows dialog box for driver installation, select "Install the software automatically (recommended)".

Finally, a message appears indicating that the configuration software and drivers for the safety module have been fully installed.

9.2 Opening the software help system

You will find a description of the comprehensive functions of MSIsafesoft in the help system for the software.

There are various ways to open the help system:

a) In the "?" menu, select "Help topics".
The table of contents for the help system appears.
Search for a help topic as described below.

b) In an active dialog box or window, press <F1>.
The context-sensitive help for the active dialog box or window appears.

c) In the connection editor, select an object and press <F1> in order to view information relating to that object.
For safe functions and function blocks, general information about the objects can be accessed in this way.

d) Use the "Help" context menu item of an applicable module or function to open the relevant module information.

The diagram below illustrates the various options for opening the help system and searching for information via context-sensitive help or via the contents or index.

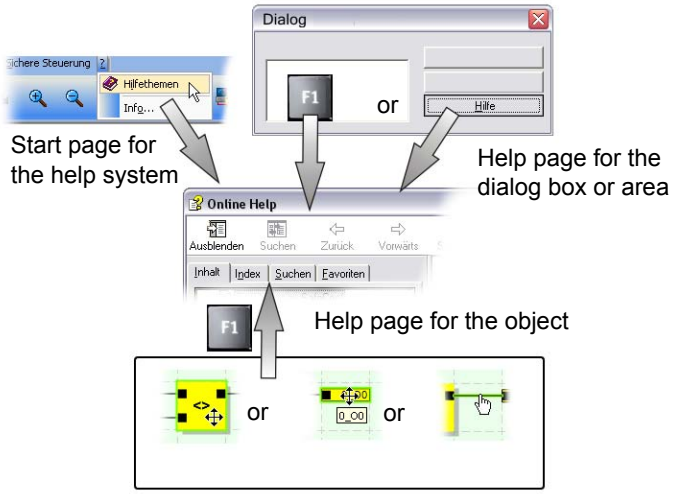


Figure 9-1 Opening the help system in the MSIsafesoft configuration software

10 Configuration and commissioning

Qualified personnel

The MSI 100/200 system may only be configured and commissioned by qualified personnel.
See "Qualified personnel" on page 10.

10.1 Example for configuration and commissioning

For detailed information, please refer to the sections cited and the help system of the MSIsafesoft configuration software.

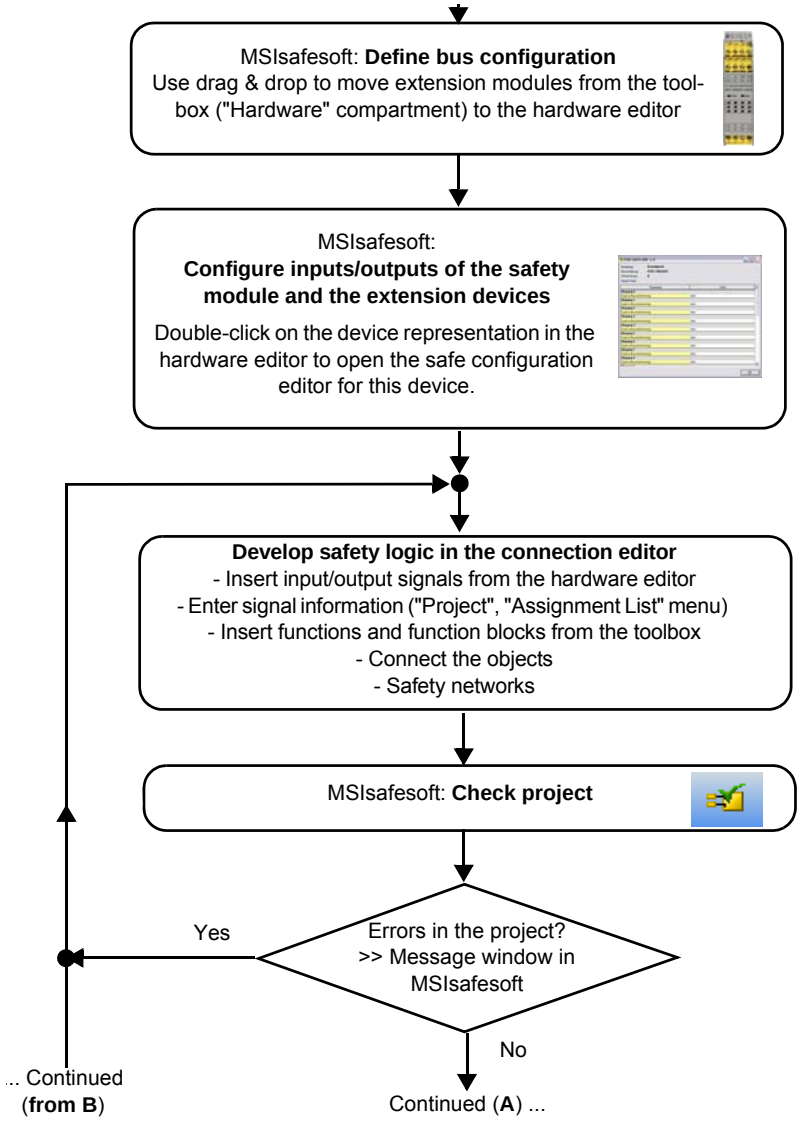


Figure 10-1 Flow chart: Example configuration and commissioning (1 of 3)

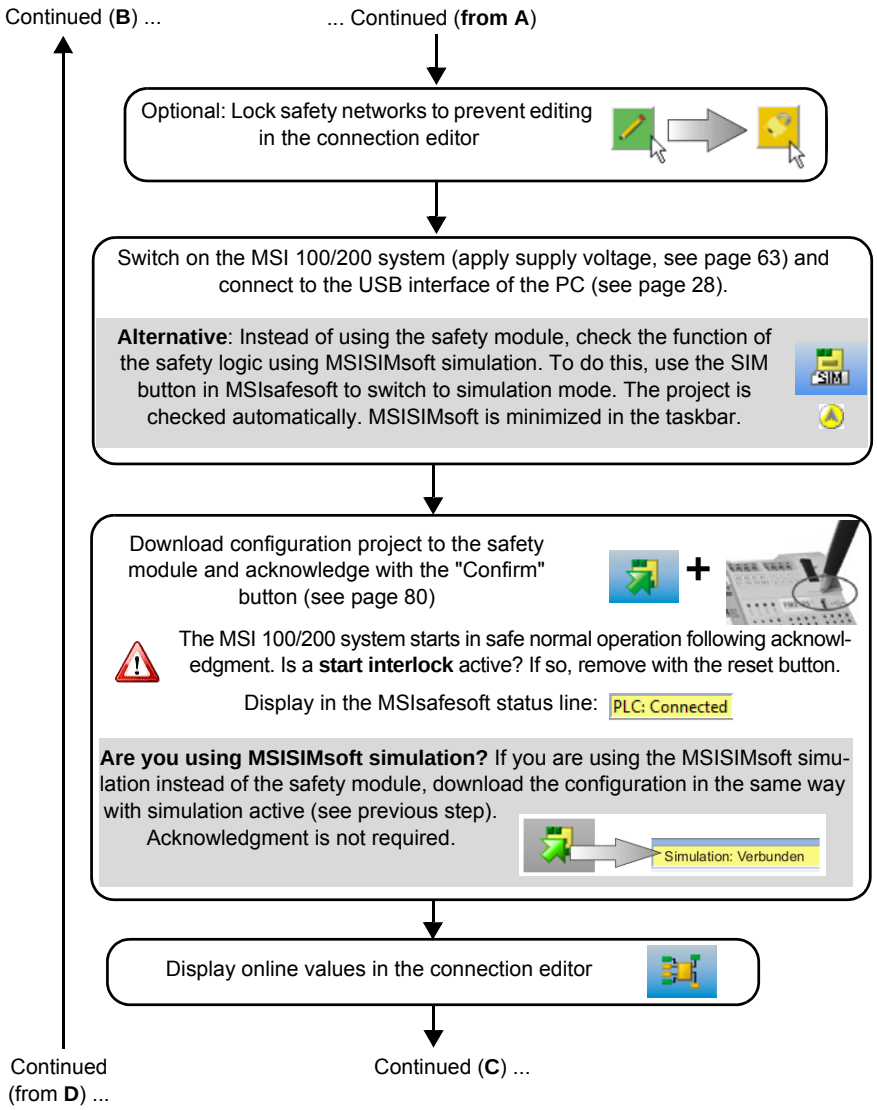


Figure 10-2 Flow chart: Example configuration and commissioning (2 of 3)

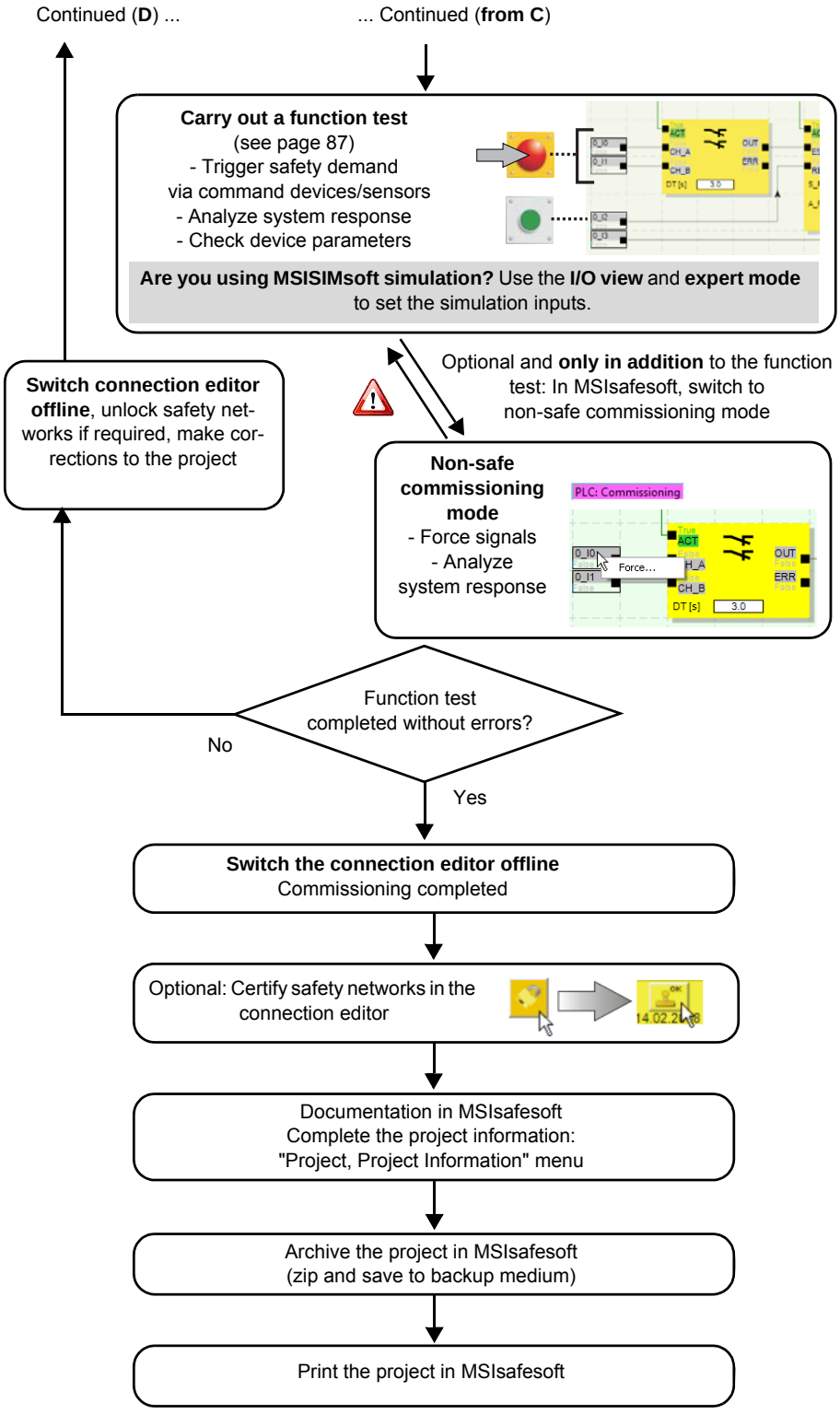


Figure 10-3 Flow chart: Example configuration and commissioning (3 of 3)

10.2 Downloading configuration from the MSIsafesoft configuration software

WARNING: Risk of injury or damage to equipment due to unintentional system states or incorrect responses

The safety module is in the commissioning phase, i.e., unintentional system states or incorrect responses cannot be ruled out. Operation is not safe.

- Make sure that the act of triggering the safety demand will not pose a risk for people or materials.
- Do not enter any hazardous areas and ensure that no other persons can access the danger zone either.

The configuration, including the device configuration, is created in the MSIsafesoft configuration software as a project. Once finished, load the configuration in the MSI 100 or MSI 200 safety module. This data is usually transmitted via the USB interface of the safety module.

Alternatively, the configuration can also be loaded by inserting a AC-MSI-CFG1 memory module that contains the relevant data.

For further information, please refer to "Loading the configuration using the AC-MSI-CFG1 memory module" on page 84.

The memory requirements of the MSI100/200 system are influenced mainly by the following factors:

- The number of digital I/O extension modules used
- The number of function modules used
- The type of function modules used
- The number of flags used
- The extent of user comments in the program

In the case of very complex logic programs, our service department can provide you with support in optimizing memory use (see "Safety hotline" on page 14).

To download the configuration, proceed as follows:

1. Ensure the following:
   – The safety module is switched on.
   – The MSIsafesoft configuration software is installed on the configuration computer (this installation also includes the required drivers).
   – The MSIsafesoft configuration software is started.
   – A AC-MSI-CFG1 memory module is plugged into the safety module. The configuration cannot otherwise be loaded.
2. Connect the USB cable to the safety module (Mini-USB connector, 5-pin, maximum cable length 3 m) and to a USB port on the PC.

ATTENTION: Electrostatic discharge

The safety modules contain components that can be damaged or destroyed by electrostatic discharge. When handling the USB interface, observe the necessary safety measures against electrostatic discharge (ESD) according to EN 61340-5-1 and EN 61340-5-1.

Once the interconnection cable has been connected, the correspondingly configured PC automatically detects the safety module and indicates its status at the bottom right of the status line.

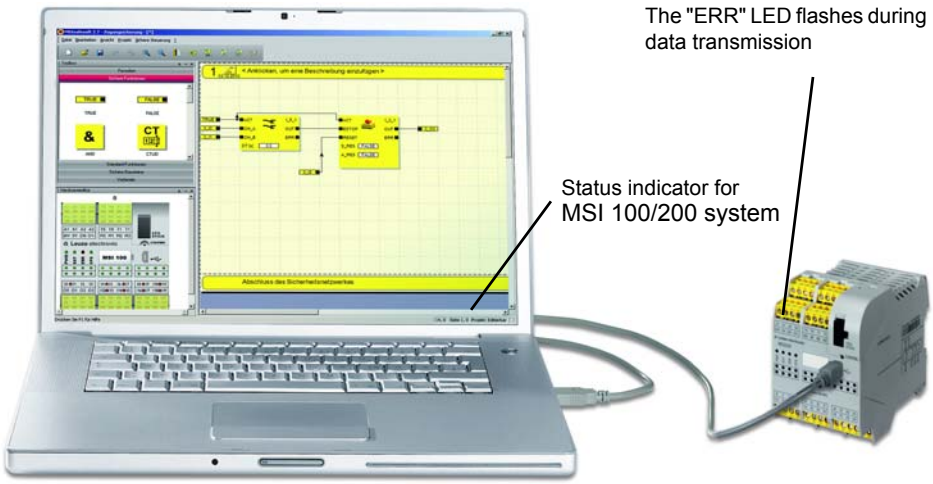


Figure 10-4 USB connection between PC and safety module

Logging on with control password

The project can only be downloaded to the safety module if you have logged on in MSIsafesoft with the correct **control password**.

3. In the "Safe control" menu, select "Log on", enter the control password in the dialog box, and click "OK".
4. Download the project created in MSIsafesoft to the safety module by clicking on the depicted icon in the toolbar.

Prerequisite for this is that the current project was first **checked and determined to be free of errors** (see MSIsafesoft help system).

Is there already a project on the safety module?

If the status line on the right has the yellow entry "Control: No project", the project is transmitted to the safety module without any further prompts.

If another project or another version of the same project is already available on the safety module and is being executed, a corresponding dialog box appears, indicating this fact.

- Click "Yes" in this dialog box to overwrite the current control configuration on the safety module.

Data transmission

During data transmission

– A progress indicator is displayed in the status line of MSIsafesoft.
– The "CONF" status display flashes quickly on the safety module (approximately 6 Hz).

If data transmission is interrupted during the download, you can find assistance in chapter "Problems and solutions" starting on page 95.

Following successful data transmission

– The "CONF" status display flashes slowly on the safety module (approx. 1.5 Hz).
– A corresponding dialog
"Sending successful" appears in the configuration software.

If the "Sending successful" dialog is displayed, perform the next steps in the following order.

Please note:

First acknowledge the configuration on the safety module (see step 5).

... before clicking "OK".

Figure 10-5 Dialog box following successful data transmission

5. Confirm the new configuration by pressing the "Confirm" button using a pen (see Figure 10-6).

WARNING: Danger due to activated outputs

Following acknowledgment, the safety module starts running immediately. Provided that no start interlock is active, which must be canceled manually, outputs may be activated immediately after start-up.

- Make sure that the start-up of the safety module cannot lead to any hazardous situations.

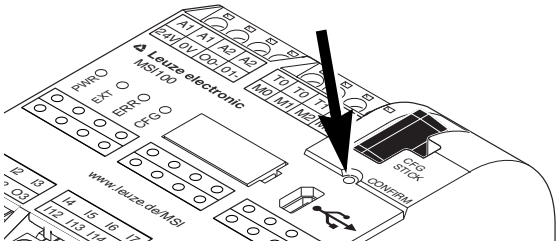


Figure 10-6 Confirming the configuration with the "Confirm" button

Initialization

The safety module is then reinitialized (all diagnostic indicators illuminate briefly) and then switches to safe normal operation (only "PWR" LED on).

Ending data transmission

6. Exit the dialog in the configuration software and click on "OK".

Start interlock

Start interlock active?

WARNING: Unintended machine start-up

Canceling the start interlock can result in unintended machine start-up.

- Before canceling the start interlock, make certain that canceling cannot result in a dangerous machine state.
- When planning the machine or system, make certain that canceling the start interlock is possible only if the danger zone is visible.

If a start interlock has been predefined in the configuration, it will be active following start-up. An active start interlock must be canceled by pressing a reset button which is connected to the safety module according to the configuration.

For further information, please refer to "System start-up and restart behavior" on page 19.

If the safety module is not initialized correctly, proceed as described in chapter "Problems and solutions" on page 95.

Next steps

Next, continue with the function test.
See chapter "Function Test" on page 87.

Check values (CRC)

Check values (CRC)

To ensure that any distortions to the configuration data during transmission to the safety module can be reliably detected, a check value (CRC) is calculated in the configuration software when the project is checked.

The safety module also determines the check value for the downloaded data.

If the check values on the safety module and in the configuration software are identical, all data has been saved on the safety module without distortion. If the check values differ, a corresponding error message is output.

Deviating check values through subsequent changes

The check value (CRC) will also differ if subsequent modifications have been made to the project in the configuration software, but have not yet been downloaded to the safety module.

Note

For example, the following tasks are evaluated as changes in the project:

– Moving an object
– Making a change to the project documentation

Recommendation

Record the check value (CRC) after commissioning and subsequent validation in the machine protocol to understand subsequent project changes.

10.3 Loading the configuration using the AC-MSI-CFG1 memory module

WARNING: Risk of injury or damage to equipment due to unintentional system states or incorrect responses

The safety module is in the commissioning phase, i.e., unintentional system states or incorrect responses cannot be ruled out. Operation is not safe.

- Make sure that the act of triggering the safety demand will not pose a risk for people or materials.
- Do not enter any hazardous areas and ensure that no other persons can access the danger zone either.

Configurations can be downloaded not only via the USB interface but also with the help of the AC-MSI-CFG1 memory module. In this way, the configuration of one device can be transferred to other safety modules. This is useful if no configuration computer is available at an installation location or for transferring the configuration to a new device on device replacement.

To replace the AC-MSI-CFG1 memory module, proceed as follows. This sequence ensures that the active configuration is not overwritten by accidental insertion of an AC-MSI-CFG1.

Removing the AC-MSI-CFG1

1. It is not permissible to replace the AC-MSI-CFG1 during running operation. If the safety module is already in operation, perform the following steps.
   a) First, shut down the machine.
   b) Switch off the safety module.
   c) Remove the current AC-MSI-CFG1.

After the AC-MSI-CFG1 has been removed correctly, all outputs of the safety module are in a safe, de-energized state (FALSE). As long as the AC-MSI-CFG1 is removed, the safety module has no function.

If the AC-MSI-CFG1 is not removed correctly, the safety module also displays an error message.

Inserting the new AC-MSI-CFG1

WARNING: Danger due to activated outputs

After you have loaded the configuration by replacing the AC-MSI-CFG1, the safety module starts with program execution. Provided that no start interlock which must be cancelled manually is active, outputs may be activated immediately.

- Make sure that the start-up of the safety module cannot lead to any hazardous situations.

2. Insert the new AC-MSI-CFG1 in the safety module, which is switched off.
   The AC-MSI-CFG1 is mechanically coded and cannot be inserted in the device incorrectly.
3. Switch the safety module on and wait until it has initialized.
   All four diagnostic indicators light up once during initialization.
   The safety module now detects the previously unknown AC-MSI-CFG1 and indicates this with a flashing "CONF" diagnostic indicator.
4. Remove the AC-MSI-CFG1 again.

5. Press the "Confirm" button on the device and **hold** it down.
6. Reinsert the AC-MSI-CFG1 **while** holding down the "Confirm" button.

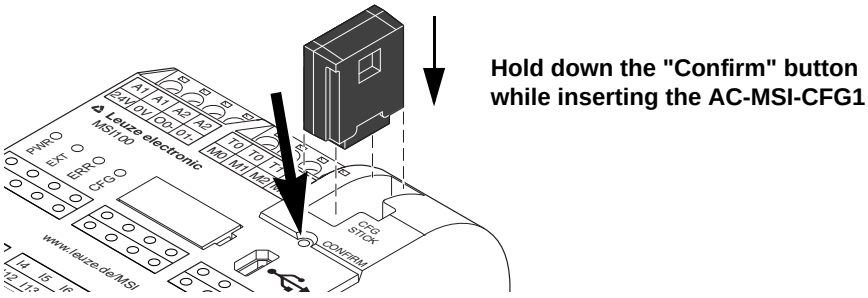


Figure 10-7 Insert AC-MSI-CFG1

7. Release the "Confirm" button once the AC-MSI-CFG1 is inserted correctly.
   The safety module now initializes with the new configuration.

Start interlock

Start interlock active?

WARNING: Unintended machine start-up

Canceling the start interlock can result in unintended machine start-up.

- Before canceling the start interlock, make certain that canceling cannot result in a dangerous machine state.
- When planning the machine or system, make certain that canceling the start interlock is possible only if the danger zone is visible.

If a start interlock has been predefined in the configuration, it will be active following start-up. An active start interlock must be canceled by pressing a reset button which is connected to the safety module according to the configuration.

For further information, please refer to "System start-up and restart behavior" on page 19.

If the safety module is not initialized correctly, proceed as described in chapter "Problems and solutions" on page 95.

10.4 Uploading the configuration from the safety module

Projects downloaded to the safety module are saved there and can be uploaded to the PC and the configuration software again if required.

This may be required, for example, if a project has to be read from the safety module for diagnostic purposes.

It is possible to upload a project from the safety module to the configuration software without the control password. However, to edit the uploaded project you will need the correct project password.

To upload the project, proceed as follows:

1. If a project is currently open in the configuration software, save it before uploading the required project from the safety module.
2. Exit commissioning mode and the online mode of the configuration software.

The "Online values" icon must not be selected prior to starting the upload and the status line must show the control status "Control: Connected".

3. Click on the "Upload" icon in the toolbar.

4. Click "Yes" in the dialog box to confirm the upload.
   Transmission from the safety module to the PC starts and a progress indicator is displayed in the MSIsafesoft configuration software status line.
5. If a project with the same name already exists on the PC, a prompt will appear where you must decide whether you want to overwrite the project which is already loaded or not.
   In this dialog box, click on the corresponding buttons:
   – **"Yes"** to overwrite the data of the existing project with that of the project which has just been uploaded.
     Overwriting means that the current data will be lost and cannot be recovered.
   – **"No"** to save the uploaded project under a different name or in a different directory.
     The "Save Project As" dialog box appears.
     Here, select a directory, enter a file name, and click "Save".
6. You are now asked to enter the project password.
   Once you have entered the password you can edit and check the project, load it to the safety module, and start it up there as usual.

10.5 Function Test

WARNING: Risk of injury or damage to equipment due to unintentional system states or incorrect responses

The safety module is in the commissioning phase, i.e., unintentional system states or incorrect responses cannot be ruled out. Operation is not safe.

- Make sure that the act of triggering the safety demand will not pose a risk for people or materials.
- Do not enter any hazardous areas and ensure that no other persons can access the danger zone either.

Validation

Once the project has been uploaded to the safety module, it is executed there following manual acknowledgment. You must perform a function test to ensure that the safety module and, thus, the safety logic and the entire wiring are functioning correctly.

Online mode in MSIsafesoft

You can switch the MSIsafesoft configuration software to online mode for the function test. The online values are thereby read cyclically from the safety module and displayed in the connection editor and the hardware editor.

Safety demand / monitoring signals

By activating the safe command devices, e.g., by pressing the E-Stop command device or opening the safety door, you trigger the safety demand. The behavior of the safety logic can now be analyzed precisely in the configuration software, as the connection editor displays the value of every signal "live" in online mode.

10.5.1 Performing function test with the help of online mode

Connecting / logging in

1. Connect the switched-on safety module to the configuration computer via the USB interface.
2. Start the MSIsafesoft configuration software and log in to the safety module.
   The status line in the MSIsafesoft configuration software now displays the following entry on the right-hand side.
   PLC: Logged on | PLC: Connected

The system can only display online values if the project in the safety module and the project in the configuration system are identical.

If you have made a change to a project after commissioning, you must check the project and download it to the safety module again.

Only then can you display online values.

Note

For example, the following tasks are evaluated as changes in the project:

– Moving an object
– Making a change to the project documentation

3. Switch the MSIsafesoft configuration software to online mode by clicking on the "Display online values" icon in the toolbar.

Signal lines and function block connections are now displayed in the connection editor in different colors, according to their state (TRUE/FALSE), and together with the current values. The hardware editor also supports the function test through "lit" LEDs.

4. Trigger a safety demand via the safe command devices.
5. Monitor the response of the machine and the configuration via the online values in the connection editor.

Example:

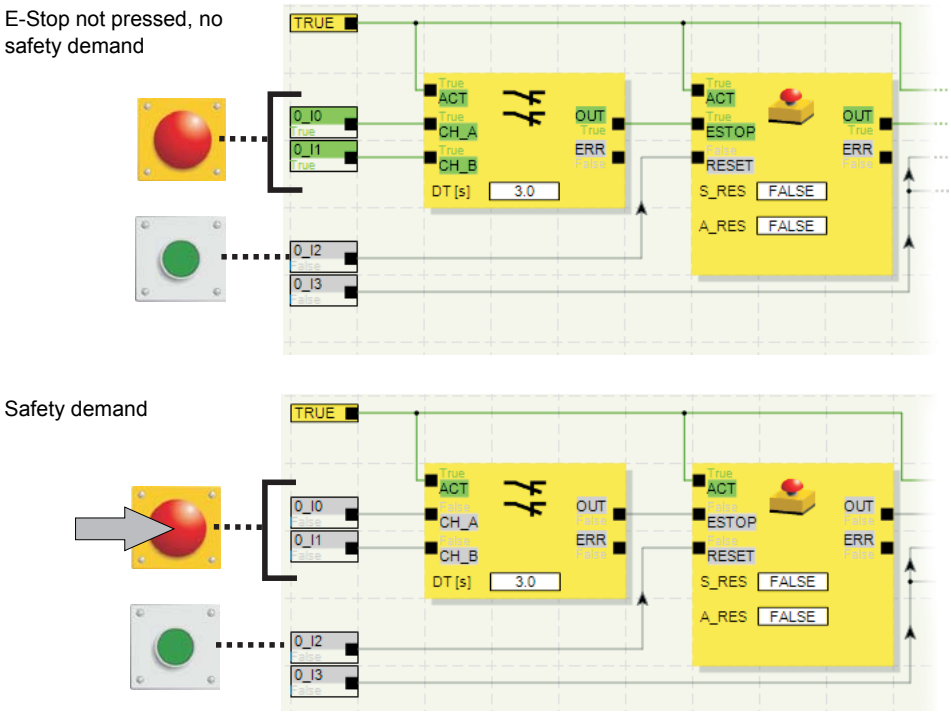


Figure 10-8 Example of a function test for the safety system using the online mode of MSIsafesoft

11 Diagnosis

MSIsafesoft diagnosis

Information on hardware diagnosis, wiring checks and tool tips can be found in the help system of the MSIsafesoft configuration software.

Diagnosis via gateways

You can connect your MSI 100/200 system with gateways to a primary control. The reading out of the diagnosis is bus-specific.

Information on diagnosis via gateways can be found in the respective user manual of the gateway.
See www.leuze.com.

You can find suitable gateways for use with the MSI 100/200 system in the accessories chapter "Gateways" on page 118.

11.1 Diagnosis via LED indicators on the module

The following tables list the possible indicator combinations for the diagnostic and status indicators and their meanings. A distinction is made between slow flashing and fast flashing LEDs.

The LED symbols in the tables mean:

●	LED is off
☼	LED is on
☼	LED flashes: slowly ≈ 2 Hz / quickly ≈ 6 Hz
S	If there is an **S** below an LED symbol, this LED indicator applies only for the MSI 100.
M	If there is an **M** below an LED symbol , this LED indicator applies only for the MSI 200.

11.1.1 MSI 100 and MSI 200

Table 11-1 Diagnostic indicators for MSI 100 and MSI 200

PWR (green)	DATA (green)	ERR (red)	CONF (green)	I0 … I19	O0 … O3	Meaning
●	●	●	●			Device is switched off No voltage supply at A1 and A2
☼	☼	☼	☼			Initialization phase after switching on or after restarting after the "Confirm" button has been pressed (maximum duration: 4 s)
☼	●	●	☼			Initial commissioning state No configuration data present on the AC-MSI-CFG1 • Download project with MSIsafesoft
☼	●	☼	☼			AC-MSI-CFG1 not present • Insert AC-MSI-CFG1 and apply voltage supply
☼	●	●	☼ ≈ 2 Hz			Acknowledgment of new configuration required after download • Press the "Confirm" button on the device
☼	●	●	☼ ≈ 6 Hz			Acknowledgment of a new configuration required after transfer via AC-MSI-CFG1 →For sequence, see chapter 10.3 on page 84
☼	☼	●	☼ ≈ 2 Hz			Acknowledgment required after changing an extension device • Press the "Confirm" button on the device
☼	●	●	●			**MSI 100:** Normal operation Configuration data present on the AC-MSI-CFG1 **MSI 200:** Normal operation without connected extension devices (TBUS communication) Configuration data present on the **AC-MSI-CFG1**
☼	☼	●	●			**MSI 200:** Normal operation with connected extension units (TBUS communication)
☼	● S ☼ M	☼	●			Limited operation with error on at least one input/output • Rectify the error • Deactivate input/output • Press the "Confirm" button on the device (duration: min. 15 s)
☼	●	☼ ≈ 6 Hz	●			Error has occurred • Read out error code with MSIsafesoft

Table 11-1 Diagnostic indicators for MSI 100 and MSI 200

PWR (green)	DATA (green)	ERR (red)	CONF (green)	I0 … I19	O0 … O3	Meaning
☼	● S ☼ M	☼	●	☼ ≈ 6 Hz	●	Cross-circuit has occurred • Check wiring of the peripherals • Press the "Confirm" button (duration: 3 s) **MSI 200:** Only in combination with safe extension module.
☼	● S ☼ M	☼	●	●	☼ ≈ 6 Hz	Short-circuit at safe output (GND was connected to a safe output) • Press the "Confirm" button on the device (duration: min. 15 s) **MSI 200:** Only in combination with safe extension module.
☼	● S ☼ M	☼	●	☼ ≈ 6 Hz	●	Short-circuit at clock output (GND was connected to a clock output). • Rectify short circuit at clock output • Press the "Confirm" button on the device (duration: min. 15 s) **MSI 200:** Only in combination with safe extension module.

Table 11-2 Status indicators of the safe inputs and outputs for MSI 100 and MSI 200

LED	State	Meaning
For each input ("I0" to "I19")	●	**No** switching signal at the relevant input
	☼	Switching signal active at the input
	☼ Long ON Short OFF	Wiring check at an active input or antivalent input
	☼ Long OFF Short ON	Wiring check at an inactive input or antivalent input
For each output ("O0" to "O3")	●	Output is not active
	☼	Output is active
	☼ Long ON Short OFF	Wiring check at an active output
	☼ Long OFF Short ON	Wiring check at an inactive output

11.1.2 MSI-EM200-8I4IO

Table 11-3 Diagnostic indicators for MSI-EM200-8I4IO

PWR (green)	ERR (red)	Meaning
●	●	Device is switched off, no voltage supply at 24 V/0 V or MSI-TBUS
☼	☼	Initialization phase after power up (maximum duration: 4 s).
☼	●	Normal operation
☼	☼	Limited operation with error on at least one input/output • Rectify the error • Deactivate input/output • Press the "Confirm" button on the MSI 200 base device (duration: min. 15 s) A flashing LED at an input or output signals an error affecting the corresponding signal (see Table 11-4).
☼	☼ ≈ 6 Hz	Error has occurred • Read out error code with MSIsafesoft

Table 11-4 Status indicators for MSI-EM200-8I4IO safe inputs and outputs

LED	State	Meaning
For each input ("I4" to "I11") and for "IO0" to "IO3", if these are configured as safe inputs	●	No switching signal at the relevant input
	☼	Switching signal active at the input
	☼ Long ON Short OFF	Wiring check at an input or antivalent input
For "IO0" to "IO3", if these are configured as safe outputs	●	Output is not active
	☼	Output is active
	☼ Long ON Short OFF	Wiring check at an output

11.1.3 MSI-EM200-4RO

Table 11-5 Diagnostic indicators for MSI-EM200-4RO

PWR (green)	ERR (red)	Meaning
●	●	Device is switched off, no voltage supply at 24 V/0 V or MSI-TBUS
☼	☼	Initialization phase after power up (maximum duration: 4 s).
☼	●	Normal operation
☼	☼	Limited operation with error on at least one output • Rectify the error • Deactivate output • Press the "Confirm" button on the MSI 200 base device (duration: min. 15 s) A flashing LED at an output signals an error (see Table 11-6).
☼	☼ ≈ 6 Hz	Error has occurred • Read out error code with MSIsafesoft

Table 11-6 Status indicators of the safe outputs for MSI-EM200-4RO

LED	State	Meaning
For "O0" to "O3"	●	Output is not active
	☼	Output is active
	☼ Long ON Short OFF	Wiring check at an output

12 Problems and solutions

This chapter contains a list of possible problems that may occur when working with the configuration software and the safety modules (MSI 100 and MSI 200) as well as with the safe extension modules (MSI-EM200-8I4IO and MSI-EM200-4RO). The following descriptions are divided into categories corresponding to the different sections of the configuration software.

12.1 General

Table 12-1 Solutions for general problems

Problem	Solution
The user program cannot be downloaded from the configuration software to the control / the control hangs, whereby a system utilization < 100% is simultaneously displayed in the status bar in the lower right.	Please contact Leuze electronic technical support. We can support you with the optimization of memory usage. See also "Downloading configuration from the MSIsafesoft configuration software" on page 80.
When the MSIsafesoft safe configuration software was launched, the installation check identified a faulty system file. A corresponding message window is displayed.	Uninstall the safe configuration software, then reinstall it by running the setup program from the installation CD.
The test routine for the operating system has determined that you are trying to launch the MSIsafesoft configuration software on an operating system that is not supported.	Install an operating system supported by the MSIsafesoft configuration software (see "System requirements for the MSIsafesoft configuration software" on page 117) or consult with technical support to determine whether a newer version of MSIsafesoft is available that supports your current operating system.
An error has occurred (accompanied by a corresponding message), which cannot be removed using any of the measures described here.	Please contact Leuze electronic technical support.
The safe MSIsafesoft configuration software or one of its functions is not behaving as described in the user documentation or the help system.	Please contact Leuze electronic technical support.

12.2 Graphical connection editor

Table 12-2 Solutions for problems with the graphical connection editor

Problem	Solution
You have attempted to open a project, but the safety logic could not be loaded due to a checksum error. A corresponding message window is displayed.	The project concerned is damaged and can no longer be used. Use the latest backup copy of the project (as described in the help system under "Zipping and extracting projects"). If the problem persists, please contact Leuze electronic technical support.
During editing, a message window appears where the connection editor reports damaged data, a sporadic error or a systematic error.	The project is closed automatically. You do not have the opportunity to save the most recently made changes. If the problem persists when the project is reopened, please contact Leuze electronic technical support.

12.3 Configuration editor

Table 12-3 Solutions for problems with the configuration editor

Problem	Solution
You have attempted to open the configuration editor, but the data could not be loaded due to a checksum error. A corresponding message window is displayed.	The project can no longer be used, as the configuration data cannot be deleted. Use the latest backup copy of the project (as described in the help system under "Zipping and extracting projects").
The configuration editor responds unexpectedly to an entry in the parameter table, e.g., by displaying something other than what has been entered or selected. This may be traced back to a sporadic error or a systematic error.	Undo the last entry (by pressing <Ctrl>+<Z>), then repeat the entry. If the result is still incorrect, please contact Leuze electronic technical support.
During editing, a message window appears in which the configuration editor reports damaged data, a sporadic error or a systematic error.	The project is closed automatically. You do not have the opportunity to save the most recently made changes. If the problem persists when the project is reopened, please contact Leuze electronic technical support.

12.4 Online communication between MSIsafesoft and the safety module

Table 12-4 Solutions for communication problems between MSIsafesoft and the safety module

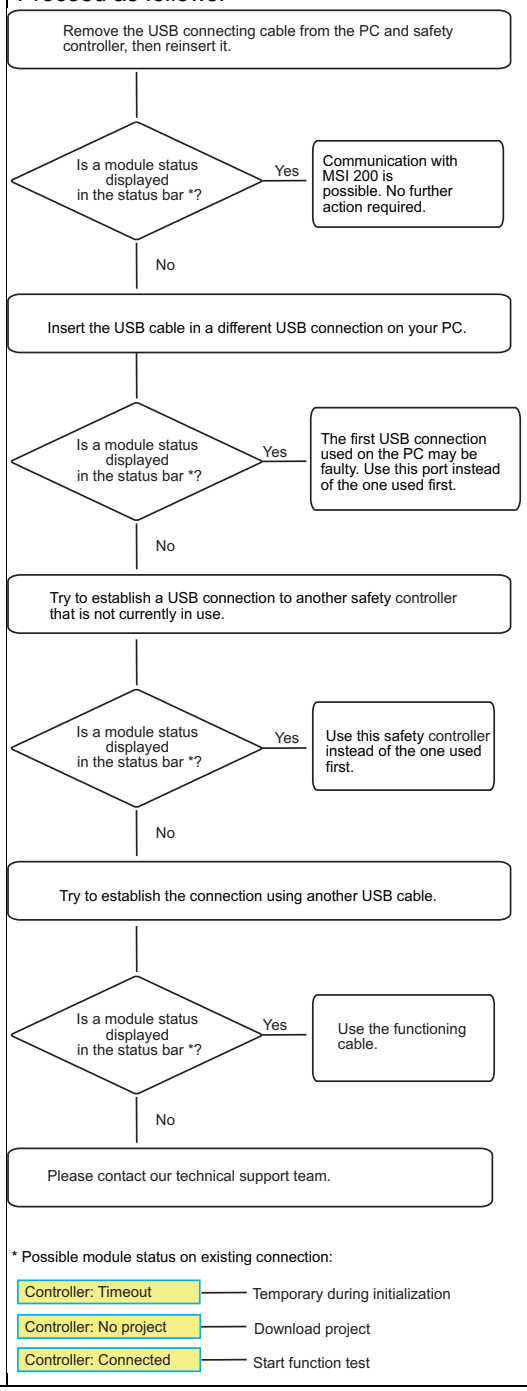
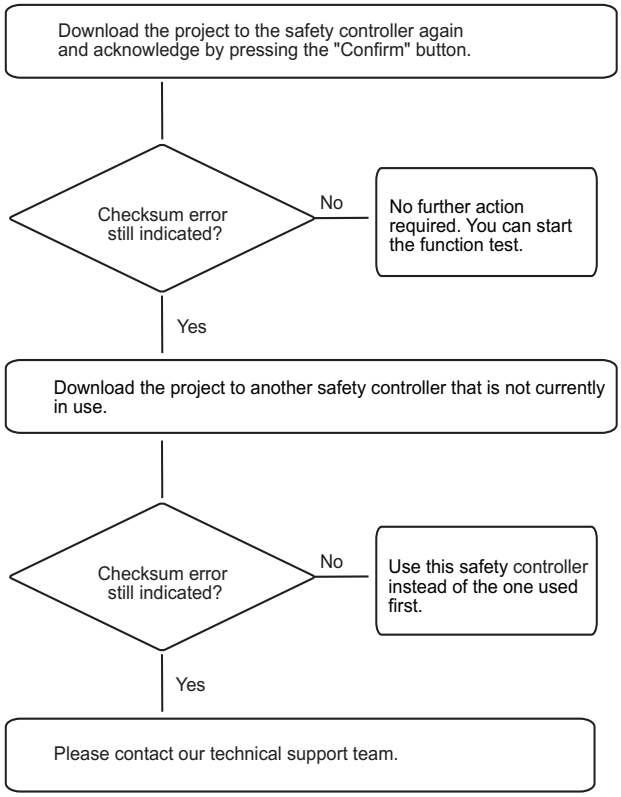
Problem	Solution
A connection cannot be established to the safety module. The status line does not display a status for the safety module ("Timeout", "No project" or "Connected"; see information under the diagram below). The status line looks like this, for example: 	Proceed as follows:  * Possible module status on existing connection: Controller: Timeout — Temporary during initialization Controller: No project — Download project Controller: Connected — Start function test

Table 12-4 Solutions for communication problems between MSIsafesoft and the safety module

Problem	Solution
Transmission has been interrupted during the download procedure.	1. Start transmission again. 2. If the download fails once more, remove the USB connecting cable from the interface on the configuration computer and reinsert it. 3. Once the safety module has been detected correctly (see display in the status line), restart the download procedure.
Following successful project download, the MSIsafesoft safe configuration software identifies that the checksum of the project on the safety module does not match that of the project on the PC. A corresponding message window is displayed.	Proceed as follows: 

12.5 Communication between the safety module and the safe extension module

Table 12-5 Solutions for communication problems between safety module and safe extension module

Problem	Solution
Communication between the safety module and the safe extension module via the DIN rail connector (MSI-TBUS) has been interrupted. The "Data" LED on the safety module does not illuminate.	Check whether all safe extension modules are correctly connected to the safety module. A connection is correct if there is a MSI-TBUS male connector under each extension module and the plug-in connection has been made properly (the module must snap into place). Check whether the power supply at each extension module has been connected and switched on correctly.

12.6 Safety module messages

Table 12-6 Solutions for messages from the safety module

Problem	Solution
Following acknowledgment of the newly loaded configuration, the safety module is not initialized correctly ("Control: Error" is displayed in the status line and flashing "ERR" status indicator on the safety module).	1. Switch the safety module off and on again. 2. Download the project to the safety module again and acknowledge the new configuration by pressing the "Confirm" button on the device. 3. If the problem persists, please contact our technical support team
The safety module reports an internal error.	Please contact Leuze electronic technical support.

13 Maintenance, repair, decommissioning and disposal

13.1 Maintenance

The modules of the MSI 100/200 system are maintenance-free. Depending on the application and the connected peripherals, the function of the peripheral devices and the safety chain may need to be tested periodically.

Service the connected peripheral devices (e.g., light barriers) acc. to manufacturer's specifications.

The mission time and the proof test interval at high or low demand rate for the modules of the MSI 100/200 system can be found in the technical data.
See "Technical data and ordering data" on page 101.

13.2 Repair

Repair work or changes by the user to the module are prohibited. The housing must not be opened. If the housing is opened, the function of the MSI 100/200 modules is no longer guaranteed.

In case of failure, send the module to Leuze electronic or immediately contact
Leuze electronicand request a member of service staff.

13.3 Decommissioning and disposal

Decommission according to the requirements of the machine or system manufacturer.

When decommissioning the MSI 100/200 system or parts of the system, handle the used modules as follows:

Further use of the module	Measure
The modules are still used as intended.	Observe requirements on storage and transport according to the technical data: see chapter 14 "Technical data and ordering data" on page 101.
Modules are no longer used.	Dispose of the modules in accordance with environmental regulations. Ensure that the modules cannot be used again.

14 Technical data and ordering data

14.1 Technical data MSI 100 and MSI 200

Logic / supply A1/A2	
Rated control circuit supply voltage U_S	24 V DC (A1/A2)
Permissible range	18 V DC … 30 V DC (incl. all tolerances, incl. residual ripple)
Rated control supply current I_S	Typ. 110 mA
Limiting continuous current	Max. 6 A (for looped-through current paths A1/A1 and A2/A2, see "Double terminal contacts A1/A1 and A2/A2" on page 35)
Filter time	Typ. 20 ms (load-dependent, on voltage dips for U_S)
Status indicator	3 x green LEDs 1 x red LED
Protective circuit	Yes, within the scope of the operating voltage limits
Safe digital inputs I0 to I19	
Quantity	10 (two-channel, up to SIL 3) 20 (one-channel, up to SIL 2)
Type	digital, type HTL
Input voltage range "0" signal	0 V DC … 5 V DC (for safe off)
Input voltage range "1" signal	11 V DC … 30 V DC
Typical current consumption at U_S	4 mA
Maximum total cable length	2000 m
Status indicator	20 x green LEDs (1 LED per input)
Safe digital outputs O0 to O3 and ground-switching outputs O0- and O1-	
Quantity (type)	4 (safe semiconductor outputs, up to Cat. 4 in accordance with EN ISO 13849-1) 2 (ground-switching outputs)
Nominal voltage	24 V DC (supply via 24V/0V)
Permissible range	18 V DC … 30 V DC (incl. all tolerances, incl. residual ripple)

WARNING: Loss of the safety function

The use of unsuitable voltage supplies and the incorrect connection of the voltage supply can result in the loss of the safety function.

- Only use power supply units with safe insulation and SELV/PELV in accordance with EN 50178 / VDE 0160.
- Connect the output-side GND connection of the power supply unit to the functional earth (FE) of the system.

Safe digital outputs O0 to O3 and ground-switching outputs O0- and O1-	
Limiting continuous current	2 A (each channel, see Derating) 2 A (total current of all outputs)
Maximum output voltage in low state	< 5 V
Maximum leakage current in low state	2 mA

WARNING: Loss of the safety function

Switching of the load at maximum leakage current can lead to the loss of the safety function.

- Note that the load does not switch at this current and must not remain in the switched-on state.
- Take this into account when selecting the actuator.

Load	
Capacitive[1]	Max. 1 µF (electronic components)
Inductive[2]	- (see protective circuit)
Test pulses	< 1 ms
Protective circuit	Yes, within the scope of the operating voltage limits
Short circuit protected	Yes
Status indicator	4 x green LEDs (1 LED per output)

1 When using electromechanical components (e.g., contactors), the capacitive load can be disregarded.

2 Use a suitable and effective protective circuit on inductive loads.

Clock outputs T0 and T1	
Quantity	2
Type	Digital
Voltage	24 V DC (supply via 24V/0V)
Limiting continuous current	100 mA
Test pulses	< 1 ms
Short circuit protected	Yes

Signal outputs M0 to M3	
Quantity	4
Type	Digital
Voltage	24 V DC (supply via 24V/0V)
Limiting continuous current	100 mA
Short circuit protected	Yes

Times	
Reaction time	Max. 30 ms (plus reaction time of MSI-EM200-4RO) See appendix "Switch-off time of the MSI 100/200 system" on page 124.
Recovery time	< 10 s

General specifications

Nominal operating mode	100% ED
Degree of protection in accordance with VDE 0470 part 1	
Housing	IP20
Connection terminals	IP20
Installation location	Min. IP54
Mounting type	DIN rail mounting
Installation position	On horizontal DIN rail
Design of housing	Unreinforced polyamide PA, yellow
Air and creepage distances between the circuits	Acc. to EN 50178
Degree of contamination	2
Overvoltage category	III
Maximum power loss at rated conditions	6372 mW (at a = 20, b = 2, c = 4, d = 2, e = 2, I_{Clock} = 100 mA, I_{Signal} = 100 mA, $I_{Out/GND}$ = 2 A, $I_{Out/Out}$ = 2 A) See appendix "Calculation of the power loss" on page 120
Maximum number of safe extension modules	10
Maximum number of non-safe extension devices (gateways) in the MSI 100/200 system	1
Maximum continuous current via MSI-TBUS	4 A

Dimensions and weight

	Screw connection	Spring-cage connection
Width / height / depth	67.5 mm / 114.5 mm / 99 mm	67.5 mm / 114.5 mm / 112 mm
Weight with plugs	Approx. 154 g	Approx. 154 g

Connection data

	Screw connection	Spring-cage connection
Conductor cross-section (rigid/flexible)	0.2 mm² … 2.5 mm² AWG 24 … 12	0.2 mm² … 1.5 mm² AWG 24 … 16
Stripped length	7 mm	8 mm
Screw thread	M3	-
Tightening torque	0.5 Nm … 0.6 Nm 5 lb in … 7 lb in	-

UL note:
To maintain UL approval, use copper cables that are designed for operating temperatures of > 75 °C.

Environmental conditions

Ambient temperature	
Operation	- 20 °C … + 55 °C (see Derating)
Storage/transport	- 20 °C … + 70 °C
Air humidity	
Operation	75% (average, 85% occasionally)
Storage/transport	75% (average, 85% occasionally)
Air pressure	
Operation	70 kPa … 108 kPa (up to 3000 m above sea level)
Storage/transport	66 kPa … 108 kPa (up to 3500 m above sea level)
Operation altitude	Max. 2000 m above sea level See appendix "Use of MSI 100/200 modules at altitudes above 2000 m above sea level" on page 125
Shock	10g Δt = 11 ms (three shocks in each spatial direction) 10g Δt = 16 ms (continuous shock; 1000 shocks in each spatial direction)
Vibration (operation)	2g

Safety-related characteristic parameters – high demand		
	With one-channel configuration	**With two-channel configuration**
Stop category acc. to IEC 60204	0	0
Category in accordance with EN ISO 13849-1	2	4
Performance Level (PL) in accordance with EN ISO 13849-1	d	e
SILCL according to EN 62061	2	3
Mission time	240 months	240 months

Safety-related characteristic parameters for IEC 61508 – high demand		
	With one-channel configuration	**With two-channel configuration**
Device type	B	
HFT	0	1
SIL	2	3
PFH_D	16.1×10^{-9} (MSI 100) 17.1×10^{-9} (MSI 200)	16.1×10^{-9} (MSI 100) 17.1×10^{-9} (MSI 200)
Request rate	< 12 months	< 12 months
Proof test interval	240 months	240 months
Mission time	240 months	240 months

Substitute depiction as 1oo1 structure for IEC 61508 – high demand (relevant characteristic values for the process industry)		
	With one-channel configuration	**With two-channel configuration**
Device type	B	B
HFT	0	0
SIL	2	3
Safe failure fraction (SFF)	99.81 %	99.81 %
λSD	0 FIT	0 FIT
λSU	1282 FIT	1282 FIT
λDD	459 FIT	459 FIT
λDU	3.39 FIT	3.39 FIT
λtotal	1745 FIT	1745 FIT
MTBF	64.78 years (for MTTR = 8 h)	64.78 years (for MTTR = 8 h)
PFH_D	3.39×10^{-9}	3.39×10^{-9}

Safety-related characteristic parameters for IEC 61508 – low demand		
	With one-channel configuration	**With two-channel configuration**
Device type	B	
HFT	0	1
SIL	2	3
PFD_{avg}	2.99×10^{-4}	2.99×10^{-4}
Proof test interval	240 months	240 months
Mission time	240 months	240 months

Substitute depiction as 1oo1 structure for IEC 61508 – low demand (relevant characteristic values for the process industry)		
	With one-channel configuration	**With two-channel configuration**
Device type	B	B
HFT	0	0
SIL	2	3
Safe failure fraction (SFF)	99.84 %	99.84 %
λSD	0 FIT	0 FIT
λSU	1638 FIT	1638 FIT
λDD	505 FIT	505 FIT
λDU	3.39 FIT	3.39 FIT
λtotal	2146 FIT	2146 FIT
MTBF	64.36 years (for MTTR = 8 h)	64.36 years (for MTTR = 8 h)
PFD_{avg}	1.49×10^{-5} (for T1 = 1 year)	1.49×10^{-5} (for T1 = 1 year)

Safety-related characteristic parameters for EN 50156-2	
SIL	Max. 3 (ref. IEC 61508)

Derating

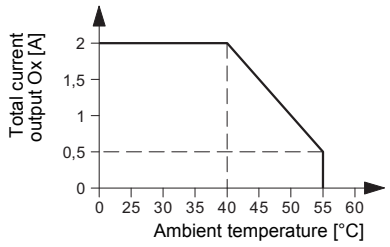


Figure 14-1 Derating curve MSI 100 and MSI 200

14.2 Technical data MSI-EM200-8I4IO

Logic / supply	
Rated control circuit supply voltage U_S	24 V DC (supply via MSI-TBUS)
Permissible range	18 V DC … 30 V DC (incl. all tolerances, incl. residual ripple)
Rated control supply current I_S	(supply via MSI-TBUS) Typ. 51.6 mA (no inputs and outputs set, A1/A2 open) Typ. 66 mA (all inputs and safe outputs set)
Filter time	Typ. 20 ms (load-dependent, on voltage dips for U_S)
Status indicator	1 x green LED 1 x red LED
Protective circuit	Yes, within the scope of the operating voltage limits

Safe digital inputs IO0 to IO3 (if configured) and I4 to I11	
Quantity	12 (4 of which are configurable as input or output)
Type	Digital
Input voltage range "0" signal	0 V DC … 5 V DC (for safe off)
Input voltage range "1" signal	11 V DC … 30 V DC
Typical current consumption at U_S	4 mA
Maximum total cable length	2000 m
Error detection time with 1-channel structure	< 1 s
Status indicator	12 x green LEDs

Safe digital outputs IO0 to IO3 (if configured)	
Quantity	4 (if the configurable inputs/outputs are used as outputs)
Type	Digital
Nominal voltage	24 V DC (supply via A1/A2)
Permissible range	18 V DC … 30 V DC (incl. all tolerances, incl. residual ripple)

WARNING: Loss of the safety function

The use of unsuitable voltage supplies and the incorrect connection of the voltage supply can result in the loss of the safety function.

- Only use power supply units with safe insulation and SELV/PELV in accordance with EN 50178 / VDE 0160.
- Connect the output-side GND connection of the power supply unit to the functional earth (FE) of the system.

Safe digital outputs IO0 to IO3 (if configured)	
Limiting continuous current	4 x 0.5 A (see Derating)
Load	
Capacitive[1]	Max. 1 µF (electronic components)
Inductive[2]	- (see protective circuit)
Test pulses	< 1 ms
Protective circuit	Yes, within the scope of the operating voltage limits
Short circuit protected	Yes
Status indicator	4 x green LEDs

1 When using electromechanical components (e.g., contactors), the capacitive load can be disregarded.

2 Use a suitable and effective protective circuit on inductive loads.

Clock/signal outputs TM0 and TM1	
Quantity	2
Type	Digital
Nominal voltage	24 V DC (supply via A1/A2)
Limiting continuous current	50 mA
Test pulses	~ 1 ms
Short circuit protected	Yes

Times	
Reaction time	Max. 30 ms (plus reaction time MSI-EM200-4RO) See appendix "Switch-off time of the MSI 100/200 system" on page 124.
Recovery time	< 10 s

General specifications	
Nominal operating mode	100% ED
Degree of protection in accordance with VDE 0470 part 1	
Housing	IP20
Connection terminals	IP20
Installation location	Min. IP54
Mounting type	DIN rail mounting
Installation position	On horizontal DIN rail
Housing material	Unreinforced polyamide PA, yellow
Air and creepage distances between the circuits	Acc. to EN 50178
Degree of contamination	2
Overvoltage category	III
Maximum power loss at rated conditions	2323 mW (with f = 8, g = 2, h = 4, I_{Clock} = 50 mA, $I_{Out/GND}$ = 500 mA) See appendix "Calculation of the power loss" on page 120

General specifications

Maximum number of safe extension modules in the MSI 100/200 system	10
Maximum number of non-safe extension devices (gateways) in the MSI 100/200 system	1
Maximum continuous current via MSI-TBUS	4 A

Dimensions and weight

	Screw connection	Spring-cage connection
Width / height / depth	22.5 mm / 99 mm / 114.5 mm	22.5 mm / 112 mm / 114.5 mm
Weight with plugs	Approx. 130 g	Approx. 130 g

Dimensions and connection data

	Screw connection	Spring-cage connection
Conductor cross-section (rigid/flexible)	0.2 mm² … 2.5 mm² AWG 24 … 12	0.2 mm² … 1.5 mm² AWG 24 … 16
Stripped length	7 mm	8 mm
Screw thread	M3	-
Tightening torque	0.5 Nm … 0.6 Nm 5 lb in … 7 lb in	-

UL note:
To maintain UL approval, use copper cables that are designed for operating temperatures of > 75 °C.

Environmental conditions

Ambient temperature	
Operation	- 20 °C … + 55 °C (see Derating)
Storage/transport	- 20 °C … + 70 °C
Air humidity	
Operation	75% (average, 85% occasionally)
Storage/transport	75% (average, 85% occasionally)
Air pressure	
Operation	70 kPa … 108 kPa (up to 3000 m above sea level)
Storage/transport	66 kPa … 108 kPa (up to 3500 m above sea level)
Operation altitude	Max. 2000 m above sea level See appendix "Use of MSI 100/200 modules at altitudes above 2000 m above sea level" on page 125
Shock	10g Δt = 11 ms (three shocks in each spatial direction) 10g Δt = 16 ms (continuous shock; 1000 shocks in each spatial direction)
Vibration (operation)	2g

Safety-related characteristic parameters – high demand		
	With one-channel configuration	**With two-channel configuration**
Stop category acc. to IEC 60204	0	0
Category in accordance with EN ISO 13849-1	2	4
Performance Level (PL) in accordance with EN ISO 13849-1	d	e
SILCL according to EN 62061	2	3
Mission time	240 months	240 months

Safety-related characteristic parameters for IEC 61508 – high demand		
	With one-channel configuration	**With two-channel configuration**
Device type	B	B
HFT	0	1
SIL	2	3
PFH_D	3.94×10^{-9}	3.94×10^{-9}
Request rate	< 12 months	< 12 months
Proof test interval	240 months	240 months
Mission time	240 months	240 months

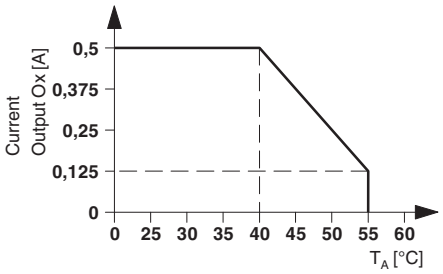
Substitute depiction as 1oo1 structure for IEC 61508 – high demand (relevant characteristic values for the process industry)		
	With one-channel configuration	**With two-channel configuration**
Basis of calculation	For the configuration of up to 8 inputs and up to 4 outputs	
Device type	B	B
HFT	0	0
SIL	2	3
Safe failure fraction (SFF)	99.88 %	99.88 %
λSD	0 FIT	0 FIT
λSU	1253 FIT	1253 FIT
λDD	317 FIT	317 FIT
λDU	1.91 FIT	1.91 FIT
λtotal	1572 FIT	1572 FIT
MTBF	71.91 years (for MTTR = 8 h)	71.91 years (for MTTR = 8 h)
PFH_D	1.91×10^{-9}	1.91×10^{-9}

Safety-related characteristic parameters for IEC 61508 – low demand		
	With one-channel configuration	**With two-channel configuration**
Device type	B	B
HFT	0	1
SIL	2	3
PFD_{avg}	2.1×10^{-4}	2.1×10^{-4}
Proof test interval	240 months	240 months
Mission time	240 months	240 months

Substitute depiction as 1oo1 structure for IEC 61508 – low demand (relevant characteristic values for the process industry)		
	With one-channel configuration	**With two-channel configuration**
Basis of calculation	For the configuration of up to 8 inputs and up to 4 outputs	
Device type	B	B
HFT	0	0
SIL	2	3
Safe failure fraction (SFF)	99.91 %	99.91 %
λSD	0 FIT	0 FIT
λSU	1729 FIT	1729 FIT
λDD	349 FIT	349 FIT
λDU	1.91 FIT	1.91 FIT
λtotal	2080 FIT	2080 FIT
MTBF	66.41 years (for MTTR = 8 h)	66.41 years (for MTTR = 8 h)
PFD_{avg}	8.38×10^{-6} (for T1 = 1 year)	8.38×10^{-6} (for T1 = 1 year)

Safety-related characteristic parameters for EN 50156-2	
SIL	Max. 3 (ref. IEC 61508)

Derating



Legend:

T_A = ambient temperature

Current output Ox

Figure 14-2 Derating curve MSI-EM200-8I4IO

14.3 Technical data MSI-EM200-4RO

Logic / supply	
Rated control circuit supply voltage U_S	24 V DC (supply via MSI-TBUS)
Permissible range	18 V DC … 30 V DC (incl. all tolerances, incl. residual ripple)
Rated control supply current I_S	(Supply via MSI-TBUS) 74 mA (at 24 V DC, relay outputs set) 54 mA (at 24 V DC, relay outputs **not** set)
Status indicator	1 x green LED 1 x red LED
Protective circuit	Yes, within the scope of the operating voltage limits
Safe relay outputs O0 to O3	
Quantity	4 (one-channel) 2 (two-channel, pairwise wiring)
Info: The pairwise wiring of the relay outputs corresponds to the factory settings. **Pair 1:** 13/14 and 23/24 (bridge between contacts 13/23) **Pair 2:** 33/34 and 43/44 (bridge between contacts 33/43)	
Type	Relay contacts, safety-related normally open contacts
Contact material	$AgSnO_2$ (from HW03) AgCuNi + 0.2 - 0.4 µm Au (up to HW02)
Switching voltage	Min. 12 V AC/DC (from HW03) Min. 5 V AC/DC (up to HW02) Max. 250 V AC/DC
Limiting continuous current	4 A (see derating)
Switching current	Min. 3 mA (from HW03) Min. 5 mA (up to HW02)
Switching power	Min. 60 mW
Life expectancy, mechanical	10 x 10^6 switching cycles
Output guarding	6 A gL/gG 4 A gL/gG (for low-demand applications)
Status indicator	4 x green LEDs
Signal outputs M0 to M3	
Quantity	4
Type	Digital
Nominal voltage	24 V DC (supply via A1/A2)

Signal outputs M0 to M3	
Limiting continuous current	50 mA
Protective circuit	Yes, within the scope of the operating voltage limits
Short circuit protected	Yes
Times	
Reaction time	Max. 50 ms See appendix "Switch-off time of the MSI 100/200 system" on page 124.
Recovery time	< 10 s
General specifications	
Nominal operating mode	100% ED
Degree of protection in accordance with VDE 0470 part 1 Housing Connection terminals Installation location	 IP20 IP20 Min. IP54
Mounting type	DIN rail mounting
Installation position	On horizontal DIN rail
Housing material	Unreinforced polyamide PA
Air and creepage distances between the circuits	Acc. to DIN EN 50178
Rated insulation voltage	250 V AC
Rated surge voltage / insulation	4 kV / basic insulation of the output contact current paths (13/14, 23/24, 33/34, 43/44) between one another 6 kV / safe insulation, reinforced insulation of the output contact current paths (13/14, 23/24, 33/34, 43/44) from the other circuits
Degree of contamination	2
Overvoltage category	III
Maximum power loss at rated conditions	**Ambient temperature of up to 40°C:** 3932 mW (with m = 4, n = 4, I_{Load} = 4 A, I_{Signal} = 50 mA) **Ambient temperature of up to 55°C (derating observed):** 1532 mW (with m = 4, n = 4, I_{Load} = 1 A, I_{Signal} = 50 mA) See appendix "Calculation of the power loss" on page 120
Maximum number of safe extension modules with MSI 200	10
Maximum number of non-safe extension devices (gateways) in the MSI 100/200 system	1
Maximum continuous current via MSI-TBUS	4 A

Dimensions and weight

	Screw connection	Spring-cage connection
Width / height / depth	22.5 mm / 99 mm / 114.5 mm	22.5 mm / 112 mm / 114.5 mm
Weight with plugs	Approx. 140 g	Approx. 140 g

Dimensions and connection data

	Screw connection	Spring-cage connection
Conductor cross-section (rigid/flexible)	0.2 mm² … 2.5 mm² AWG 24 … 12	0.2 mm² … 1.5 mm² AWG 24 … 16
Stripped length	7 mm	8 mm
Screw thread	M3	-
Tightening torque	0.5 Nm … 0.6 Nm 5 lb in … 7 lb in	-

UL note:
To maintain UL approval, use copper cables that are designed for operating temperatures of > 75 °C.

Environmental conditions

Ambient temperature	
Operation	- 20 °C … + 55 °C (see Derating)
Storage/transport	- 20 °C … + 70 °C
Air humidity	
Operation	75% (average, 85% occasionally)
Storage/transport	75% (average, 85% occasionally)
Air pressure	
Operation	70 kPa … 108 kPa (up to 3000 m above sea level)
Storage/transport	66 kPa … 108 kPa (up to 3500 m above sea level)
Operation altitude	Max. 2000 m above sea level See appendix "Use of MSI 100/200 modules at altitudes above 2000 m above sea level" on page 125
Shock	10g Δt = 11 ms (three shocks in each spatial direction) 10g Δt = 16 ms (continuous shock; 1000 shocks in each spatial direction)
Vibration (operation)	2g

Safety-related characteristic parameters – high demand				
	With one-channel configuration		With two-channel configuration	
	From HW03	Up to HW02	From HW03	Up to HW02
Stop category acc. to IEC 60204	0	0	0	0
Category in accordance with EN ISO 13849-1	1	1	4	4
Performance Level (PL) in accordance with EN ISO 13849-1	c	c	e[1]	e[1]
SILCL according to EN 62061	1	1	3	3
Mission time	240 months	240 months	240 months	240 months

[1] For applications with PL e, it is necessary that the safety function be requested once per month.

Safety-related characteristic parameters for IEC 61508 – high demand						
	With one-channel configuration				With two-channel configuration	
	From HW03		Up to HW02		From HW03	Up to HW02
HFT	0	0	0	0	1	1
SIL	1	1	1	1	3	3
PFH_D	3.67×10^{-7} (4 A DC13; 8760 switching cycles/year)	5.5×10^{-7} (5 A AC15; 8760 switching cycles/year)	1.41×10^{-7} (5 A DC13; 8760 switching cycles/year)	1.0×10^{-7} (3 A AC15; 8760 switching cycles/year)	7.3×10^{-10} (4 A DC13; 5 A AC15; 8760 switching cycles/year)	7.3×10^{-10} (5 A DC13; 3 A AC15; 8760 switching cycles/year)
Request rate	< 12 months	< 12 months	< 12 months	< 12 months	< 12 months	< 12 months
Proof test interval	240 months	240 months	240 months	240 months	240 months	240 months
Mission time	240 months	240 months	240 months	240 months	240 months	240 months

Substitute depiction as 1oo1 structure for IEC 61508 – high demand (relevant characteristic values for the process industry)				
	With one-channel configuration		With two-channel configuration	
	From HW03	Up to HW02	From HW03	Up to HW02
Calculated with	4 A DC13	5 A DC13	4 A DC13	5 A DC13
HFT	0	0	0	0
SIL	1	1	3	3
Safe failure fraction (SFF)	83.79 %	93.88 %	99.99 %	99.99 %
λSD	873 FIT	873 FIT	910 FIT	910 FIT
λSU	990 FIT	1259 FIT	2681 FIT	1781 FIT
λDD	33 FIT	33 FIT	23.75 FIT	21.51 FIT
λDU	367 FIT	141 FIT	0.17 FIT	0.13 FIT
λtotal	2263 FIT	2305 FIT	3615 FIT	2712 FIT
MTBF	49.94 years (for MTTR = 8 h)	49.02 years (for MTTR = 8 h)	31.26 years (for MTTR = 8 h)	41.67 years (for MTTR = 8 h)
PFH_D	3.67×10^{-7}	1.41×10^{-7}	1.72×10^{-10}	1.27×10^{-10}

Safety-related characteristic parameters for IEC 61508 – low demand				
	With one-channel configuration		With two-channel configuration	
	From HW03	Up to HW02	From HW03	Up to HW02
HFT	0	0	1	1
SIL	1	1	3	3
PFD_{avg}	4.35×10^{-3}	4.35×10^{-3}	1.18×10^{-4}	1.18×10^{-4}
Proof test interval	60 months	60 months	60 months	60 months
Mission time	240 months	240 months	240 months	240 months

Substitute depiction as 1oo1 structure for IEC 61508 – low demand (relevant characteristic values for the process industry)				
	With one-channel configuration		With two-channel configuration	
	From HW03	Up to HW02	From HW03	Up to HW02
HFT	0	0	0	0
SIL	1	1	3	3
Safe failure fraction (SFF)	94.26 %	94.26 %	99.88 %	99.88 %
λSD	873 FIT	873 FIT	910 FIT	910 FIT
λSU	2379 FIT	2379 FIT	3700 FIT	3700 FIT
λDD	32 FIT	32 FIT	21.18 FIT	21.18 FIT
λDU	200 FIT	200 FIT	5.45 FIT	5.45 FIT
λtotal	3484 FIT	3484 FIT	4637 FIT	4637 FIT
MTBF	32.44 years (for MTTR = 8 h)	32.44 years (for MTTR = 8 h)	24.37 years (for MTTR = 8 h)	24.37 years (for MTTR = 8 h)
PFD_{avg}	9.69×10^{-5} (for T1 = 1 year)	9.69×10^{-5} (for T1 = 1 year)	1.23×10^{-4} (for T1 = 1 year)	1.23×10^{-4} (for T1 = 1 year)

Safety-related characteristic parameters for EN 50156-2	
SIL	Max. 3 (ref. IEC 61508)

Derating

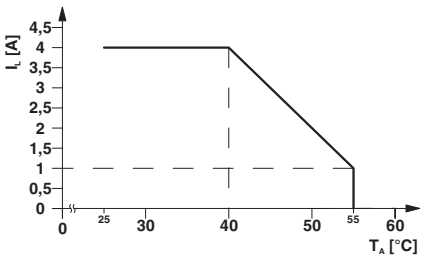


Figure 14-3 Derating curve MSI-EM200-4RO

Legend:

T_A = ambient temperature

I_L = current output O_x

Each contact can be loaded with up to 4 A at an ambient temperature of up to 40 °C.

At an ambient temperature of 55 °C, every contact can be loaded with 1 A, two contacts can be loaded with 1.4 A or one contact can be loaded with 2 A.

14.4 Certifications

For the current certifications, go to www.leuze.com.

14.5 Conformity with EMC directive

Conformity with EMC directive 2014/30/EU		
Testing of interference rejection in acc. with DIN EN 61000-6-2		
Electrostatic discharge (ESD)	EN 61000-4-2 (IEC 61000-4-2)	Criterion B 4 kV contact discharge, 8 kV air discharge
Electromagnetic fields	EN 61000-4-3 (IEC 61000-4-3)	Criterion A, field strength 10 V/m
Fast transients (burst)	EN 61000-4-4 (IEC 61000-4-4)	Criterion B, test voltage 2 kV
Transient overvoltage (surge)	EN 61000-4-5 (IEC 61000-4-5)	Criterion B DC voltage supply lines: 1 kV (asymmetric) Signal lines: 1 kV (asymmetric)
Conducted disturbances	EN 61000-4-6 (IEC 61000-4-6)	Criterion A, test voltage 10 V
Testing of the interference emission in accordance with DIN EN 61000-6-4		
Interference emission	EN 55016-1-2 EN 55016-2-1 EN 55016-2-3	Class A, industrial sector

14.6 System requirements for the MSIsafesoft configuration software

Software prerequisites		
Supported operating systems	Windows 8 (32 or 64 bit) Windows 7 (32 or 64 bit) SP1 Windows XP SP3	
Supported browsers	Internet Explorer version 6 or higher	
Hardware prerequisites		
CPU	Pentium	2 GHz (recommended) / 1 GHz (minimum)
Main memory	Windows 7 / Windows 8 Windows XP	2 GB (recommended) / 1 GB (minimum) 1 GB (recommended) / 512 MB (minimum)
Hard disk	At least 250 MB free hard disk memory	
Drive	CD-ROM	
Operating units	Keyboard, mouse	
Monitor resolution	Minimum 800 x 600	
Other		
Basic functionality	Configuration of the MSI 100/200 safety modules	
Supported languages	German, English, Spanish, French, Italian	

14.7 Ordering data

14.7.1 MSI 100/200 modules

Description	Type	Part no.	Unit
Safety modules			
Configurable safety module, **non-expandable**, 1x AC-MSI-CFG1 memory module included			
Module with screw connections	MSI101	547802	1
Module with spring-cage connections	MSI102	547812	1
Configurable safety module, **expandable**, DIN rail connector and 1x AC-MSI-CFG1 memory module included			
Module with screw connections	MSI201	547803	1
Module with spring-cage connections	MSI202	547813	1
Safe extension modules			
Configurable safe extension module with **configurable inputs/outputs**, DIN rail connector included			
Module with screw connections	MSI-EM201-8I4IO	547804	1
Module with spring-cage connections	MSI-EM202-8I4IO	547814	1
Configurable safe extension module with **relay outputs**, DIN rail connector included			
Module with screw connections	MSI-EM201-4RO	547805	1
Module with spring-cage connections	MSI-EM202-4RO	547815	1

14.7.2 Software

Make sure that you always use the latest software.
The software is available for download free of charge on the Internet at www.leuze.com.

Description	Type	Part no.
Configuration software for MSI 100/200 modules	MSIsafesoft	

14.7.3 Accessories

Description	Type	Part no.	Unit
MSI 100/200 configuration package incl. MSIsafesoft configuration software, configuration cable (USB) and quick start guide	MSI-SWC1	547825	1
Memory module for MSI 100/200 system (included in the scope of delivery of the safety modules)	AC-MSI-CFG1	547820	10
USB connection cable, USB connector type A to USB connector type Mini-B; length: 1.5 m	KB USB A - USB miniB	50117011	1
DIN rail connector for safety relays, for supply / actuation / monitoring (depending on module)	AC-MSI-TCS	547821	10
DIN rail connector for connection with electronics housings	AC-MSI-TC	547823	10

14.7.4 Gateways

The following gateways are suitable for use with the MSI 100/200 system.

Description	Bus system	Type	Part no.	Unit
Gateway for the connection of up to 32 INTERFACE system participants to a primary control, DIN rail connector included	PROFIBUS DP	MSI-FB-PB101	547806	1

14.8 Documentation

Make sure that you always use the latest documentation
This is available for download on the Internet at www.leuze.com.

A Technical appendix

A 1 Calculation of the power loss

The total power loss of a MSI 100/200 system is determined from the power loss of the logic, the power loss per connected input and per used clock or signal output as well as the power loss per used output.

If you use the MSI 200 safety module in combination with extension devices, the power loss of all connected extension devices is added as well.

Calculate the total power loss using the following formulas. The contact resistances of the connection terminals are ignored here.

A 1.1 Power loss for MSI 200 and MSI 100

Power loss of the logic

– for $U_{S(24V/0V)} = U_{S(A1/A2)} = 24$ V DC

$\mathbf{P_{Logic}} = P_{24V/0V} + P_{A1/A2} = 310$ mW + 770 mW = 1080 mW

Power loss per connected input

– for $U_{S(24V/0V)} = 24$ V DC

$\mathbf{P_{Input}} = 134$ mW

Power loss per clock output

– for $U_{S(A1/A2)} = 24$ V DC

$\mathbf{P_{Clock}} = I_{Clock}^2 * 60$ mΩ

Power loss per signal output

– for $U_{S(A1/A2)} = 24$ V DC

$\mathbf{P_{Signal}} = I_{Signal}^2 * 60$ mΩ

Power loss per output Out / GND

– for $U_{S(24V/0V)} = 24$ V DC

$\mathbf{P_{Out/GND}} = I_{Out/GND}^2 * 138$ mΩ

Power loss per output Out / Out

– for $U_{S(24V/0V)} = 24$ V DC

$\mathbf{P_{Out/Out}} = I_{Out/Out}^2 * 188$ mΩ

Total power loss

$P_{Total} = P_{Logic} + a * P_{Input} + b * P_{Clock} + c * P_{Signal} + d * P_{Out/GND} + e * P_{Out/Out} + P_{Extensions}$

i.e.

$P_{Total} = 1080\ mW + a * 134\ mW + b * I_{Clock}^2 * 60\ m\Omega + c * I_{Signal}^2 * 60\ m\Omega + d * I_{Out/GND}^2 * 138\ m\Omega + e * I_{Out/Out}^2 * 188\ m\Omega + P_{Extensions}$

Legend:

P	Power loss in mW
U_S	Rated control circuit supply voltage assigned to the connections
I_{Clock}	Current drawn at a clock output
I_{Signal}	Current drawn at a signal output
$I_{Out/GND}$	Current drawn from an output with GND reference point of the load
$I_{Out/Out}$	Current drawn from an output with OUT reference point of the load
a	Number of used inputs
b	Number of used clock outputs
c	Number of used signal outputs
d	Number of used outputs with GND reference point of the load
e	Number of used outputs with OUT reference point of the load
$P_{Extensions}$	Sum of the power consumption of the extension devices with $U_{S(24V/0V)}$ from the TBUS (only relevant with MSI 200)

A 1.2 Power loss for MSI-EM200-8I4IO

Power loss of the logic

– for $U_{S(24V/0V)} = U_{S(A1/A2)} = 24$ V DC (via MSI-TBUS)

$\mathbf{P_{Logic}} = P_{24V/0V} + P_{A1/A2} = 450$ mW + 77 mW = 617 mW

Power loss per connected input

– for $U_{S(A1/A2)} = 24$ V DC

$\mathbf{P_{Input}} = 134$ mW

Power loss per clock / signal output

– for $U_{S(24V/0V)} = 24$ V DC

$\mathbf{P_{Clock}} = I_{Clock}^2 * 350$ mΩ

Power loss per output Out / GND

– for $U_{S(A1/A2)} = 24$ V DC

$\mathbf{P_{Out/GND}} = I_{Out/GND}^2 * 96$ mΩ + 134 mW

Total power loss

$\mathbf{P_{Total}} = P_{Logic} + f * P_{Input} + g * P_{Clock} + h * P_{Out/GND}$

i.e.

$\mathbf{P_{Total}} = 617$ mW + f * 134 mW + g * $I_{Clock}^2 * 350$ mΩ
+ h * ($I_{Out/GND}^2 * 96$ mΩ + 134 mW)

Legend:

P	Power loss in mW
U_S	Rated control circuit supply voltage assigned to the connections
I_{Clock}	Current drawn at a clock output
$I_{Out/GND}$	Current drawn from an output with GND reference point
f	Number of used inputs
g	Number of used clock/signal outputs
h	Number of used outputs with GND reference point

A 1.3 Power loss for MSI-EM200-4RO

Power loss of the logic

– for $U_{S(24V/0V)} = U_{S(A1/A2)}$ = 24 V DC (via MSI-TBUS)

$\mathbf{P_{Logic}} = P_{24V/0V} + P_{A1/A2}$ = 480 mW + 30 mW = 510 mW

Power loss per signal output

– for $U_{S(A1/A2)}$ = 24 V DC
– $\mathbf{P_{Signal}} = I_{Signal}^2 * 100\ m\Omega$

Power loss per relay output

– for $U_{S(24V/0V)}$ = 24 V DC

$\mathbf{P_{Load1}}$ = 55 mW

Power loss per relay output

– for $U_{X3/X4}$ = 24 V DC

$\mathbf{P_{Load2}} = I_{Load} * 200\ mV$

Total power loss

$\mathbf{P_{Total}} = P_{Logic} + m * P_{Signal} + n * (P_{Load1} + P_{Load2})$

i.e.

$\mathbf{P_{Total}} = 510\ mW + I_{Signal}^2 * 100\ m\Omega + n * (55\ mW + I_{Load} * 200\ mV)$

Legend:

P	Power loss in mW
U_S	Rated control circuit supply voltage assigned to the connections
I_{Signal}	Current drawn at a signal output
I_{Load}	Load current switched at the relay output
m	Number of used signal outputs
n	Number of used relay outputs

A 2 Switch-off time of the MSI 100/200 system

Required switch-off time

The required switch-off time is dependent on your safety application.

Actual switch-off time

The actual switch-off time for the safety function must always be less than the required switch-off time.

The actual switch-off time for the safety function (t_{SF}) is determined using the following formula:

$$\mathbf{t_{SF}} = t_S + t_{MSI200} (+ t_{4RO}) + t_A + t_{STOP}$$

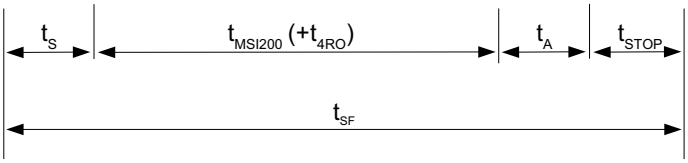


Figure A-1 Switch-off time for the safety function

Legend:

$\mathbf{t_S}$	Reaction time of the sensor/transducer
$\mathbf{t_{MSI200}}$	Max. reaction time of the MSI 100/200 system
$\mathbf{t_{4RO}}$	Max. reaction time of the MSI-EM200-4RO module
$\mathbf{t_A}$	Reaction time of the actuator
$\mathbf{t_{STOP}}$	Stopping time of the machine

Maximum response time

The maximum guaranteed reaction time (t_{MSI200}) of the MSI 100/200 system is 30 ms. The maximum reaction time t_{MSI200} applies independent of the number of used safe extension modules. An exception here is the MSI-EM200-4RO relay module.

When using one or more relay modules, the maximum reaction time of the MSI-EM200-4RO module (t_{4RO}) must be added once due to the mechanical release time of the relay. The maximum reaction time t_{4RO} is 50 ms.

A 3 Use of MSI 100/200 modules at altitudes above 2000 m above sea level

The following chapter describes the conditions for using modules of the MSI 100/200 system at altitudes above 2000 m above sea level.

Observe the respective, specific data (technical data, derating, etc.) of the used module.
See "Technical data and ordering data" on page 101.

Use of the module at altitudes **above 2000 m above sea level to max. 4500 m above sea level** is possible under the following conditions:

Maximum ambient temperature

1. Determine the maximum ambient temperature for operation with the corresponding factor acc. to the following table.

Derating curve

2. If a derating is specified, shift all points of the derating curve by the corresponding factor according to the following table.

Operation altitude above sea level	Temperature derating factor
2000 m	1
2500 m	0.953
3000 m	0.906
3500 m	0.859
4000 m	0.813
4500 m	0.766

Switching voltage for relay outputs

3. Limit the maximum switching voltage for relay outputs acc. to the following table. Note the technical data of the device here.

Max. switching voltage acc. to the technical data of the device	Max. switching voltage when used at altitudes above 2000 m above sea level
< 150 V AC/DC	Max. switching voltage acc. to the technical data of the device remains valid
> 150 V AC/DC	Limited to max 150 V AC/DC

A 3.1 Example calculation

The following calculation and the depicted derating curve are an example for the use of an MSI 100/200 module at an altitude of 3,000 m above sea level.

Perform the actual calculation and the shift of the derating curve for the module you are using according to the technical data.

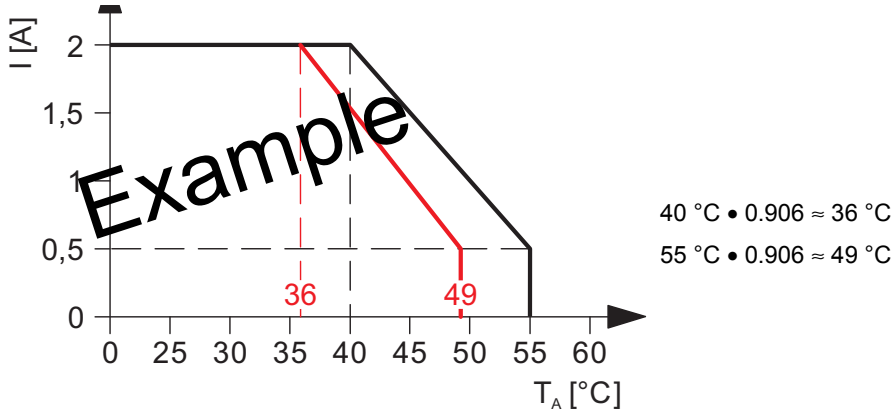


Figure 14-4 Example of a shifted derating curve (red)

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C Revision history

Revision	Date	Contents
01	2018-02-01	First publication Combination and revision of the MSI 100 (Part No. 700921) and MSI 200 (Part No. 700931) manuals

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