PSR-MC31

Safety relay module with safe digital outputs

Data sheet
108785_en_03

1 Description

Intended Use

The safety relay module is designed to monitor 4-wire switching strips and safety shut-off mats and is operated based on the short circuit principle in accordance with EN ISO 13856-1.

The safety relay module is also suitable for monitoring emergency stop switches, safety doors and light grids.

The safety relay module safely interrupts circuits under the following conditions:

- Interrupting the senor circuit
- Interrupting the external enable signal
- Cross-circuit in the sensor circuit

Possible signal generators

- 4-wire control strips or safety shut-off mats in accordance with EN ISO 13856-1
- Emergency stop button
- Door locking mechanisms
- Light grids

Contact type

- 1 sensor circuit
- 2 safe digital outputs
- 1 digital signal output

The safe digital outputs switch without delay according to stop category 0 in accordance with EN 60204-1.

Control

- Single or two channel
- Automatic or manual, monitored start

Achievable safety integrity

- Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (EN 62061)

Additional features

- Several modules can be cascaded
- Optional pluggable screw or Push-in terminal blocks
- 12.5 mm housing width

Approvals

WARNING: Risk of electric shock

Observe the safety regulations and installation notes in the corresponding section.

Make sure you always use the latest documentation.
It can be downloaded from the product at phoenixcontact.net/products.

This document is valid for the products listed in the “Ordering data”.

This document meets the same requirements as the original operating instructions with respect to the contents.

2 Table of contents

1 Description 1
2 Table of contents 2
3 Ordering data 3
4 Technical data 4
5 Notes regarding documentation 8
6 Safety regulations and installation notes 9
7 Transport, storage, and unpacking 10
8 Function description 11
9 Function and time diagrams 12
10 Block diagram 13
11 Derating 14
12 Operating and indication elements 15
13 Mounting and removing 16
14 Wiring 17
15 Startup 18
16 Calculating the power dissipation 19
17 Function test/proof test 19
18 Diagnostics 20
19 Application examples 22
20 Device replacement, device defect, and repair 27
21 Maintenance, decommissioning, and disposal 27
22 Attachment 28

3 Ordering data

Description	Type	Item no.	Pcs./Pkt.
Safety relay module for safety shut-off mats, switching strips, emergency stop, safety doors, and light grids up to SIL 3, Cat. 4, PL e, 1 or 2-channel operation, automatic or manual start, 2 safe HL outputs, 1 signal output, U_S = 24 V DC, plug-in screw terminal block	PSR-MC31-2SDO-1DO-24DC-SC	1015520	1
Safety relay module for safety shut-off mats, switching strips, emergency stop, safety doors, and light grids up to SIL 3, Cat. 4, PL e, 1 or 2-channel operation, automatic or manual start, 2 safe HL outputs, 1 signal output, U_S = 24 V DC, pluggable Push-in terminal block	PSR-MC31-2SDO-1DO-24DC-SP	1015503	1

Accessories	Type	Item no.	Pcs./Pkt.
Coding profile, is inserted into the slot on the plug or inverted header, red insulating material	CP-MSTB	1734634	100
Coding section, inserted into the recess in the header or the inverted plug, red insulating material	CR-MSTB	1734401	100
Crimping pliers, for ferrules without insulating collar according to DIN 46228 Part 1 and ferrules with insulating collar according to DIN 46228 Part 4, 0.25 mm^2 ... 6.0 mm^2, lateral entry, trapezoidal crimp	CRIMPFOX 6	1212034	1

4 Technical data

Hardware/firmware version	
HW/FW	≥ 01/--
The technical data and safety characteristics are valid as of the specified HW/FW version.	

Supply: A1/A2	
Rated control circuit supply voltage U_S	24 V DC -20 % / +25 % (provide external protection)
Rated control circuit supply voltage U_S	19.2 V DC ... 30 V DC
Rated control supply current I_S	typ. 54 mA (No load)
Power consumption at U_S	typ. 1.3 W
Inrush current	< 5 A (Δt = 200 µs at U_s)
Filter time	1 ms (For the logic. At A1 in the event of voltage dips at U_s)
Protective circuit	Parallel protection against polarity reversal, Suppressor diode, Provide external protection, see safety notes. Fuse type: 5 A FF

Digital inputs: Sensor circuit S10, S12, S22	
Number of inputs	3
Description of the input	safety-related sensor inputs IEC 61131-2 type 3 (S10, S12) PNP (S22)
Input voltage range "0" signal	0 V DC ... 5 V DC (S10, S12) S22 open
Input current range "0" signal	0 mA ... 2 mA (S10, S12)
Input voltage range "1" signal	11 V DC ... 30 V DC (S10, S12) 0 V ... 0 V (S22)
Inrush current	< 10 mA (Typically with U_S at S10/S12, Δt = 500 µs) > -5 mA (typ. with U_S at S22, Δt = 500 µs)
Current consumption	4 mA (S10, S12) -4 mA (S22)
Filter time	max. 1.5 ms (Test pulse width of low test pulses) Test pulse rate = 5 x Test pulse width Does not apply for S22 Deactivate the switch-on pulses for safety applications.
Max. permissible overall conductor resistance	150 Ω
Concurrence	∞
Protective circuit	Suppressor diode

Digital inputs: Start circuit S34, S35	
Number of inputs	2
Description of the input	non-safety-related
Input voltage range "1" signal	19.2 V DC ... 30 V DC
Inrush current	< 10 mA (Typically with U_S, Δt < 100 ms)
Current consumption	< 7 mA (Typically with U_S at S34) < 5 mA (Typically with U_S at S35)

Digital inputs: Start circuit S34, S35	
Max. permissible overall conductor resistance	150 Ω
Cable length	100 m
Protective circuit	Suppressor diode

Digital inputs: External release S36	
Number of inputs	1
Description of the input	safety-related IEC 61131-2 type 3
Input voltage range "0" signal	0 V DC ... 5 V DC
Input current range "0" signal	0 mA ... 2 mA
Input voltage range "1" signal	11 V DC ... 30 V DC
Inrush current	< 10 mA (Δt = 500 µs)
Current consumption	7 mA
Filter time	max. 1.5 ms (Test pulse width of low test pulses) Test pulse rate = 5 x Test pulse width
Max. permissible overall conductor resistance	150 Ω
Protective circuit	Suppressor diode

Digital outputs: 14, 24	
Number of outputs	2
Output description	Safety-related digital outputs PNP, IEC 61131-2 Type 2
Output voltage	≥ 23 V DC (U_s - 1 V)
Output voltage when switched off	< 5 V DC (in the safe state)
Output current	max. 2.4 A
Inrush current	max. 4.8 A (Δt = 10 ms)
Leakage current	max. 1 mA (in the safe state)
Ohmic load	min. 12 Ω
Max. capacitive load	max. 10 µF (2.4 A load) max. 4.7 µF (1 A load)
Max. inductive load	max. 1 H
Min. load current	2 mA
Switching frequency	1 Hz (Resistive, inductive, capacitive)
Test pulses	< 1 ms (Test pulse width of low test pulses)
Protective circuit	Freewheeling circuit for inductive loads
Limitation of the voltage induced on circuit interruption	max. 50 V

Alarm outputs: M1	
Number of outputs	1
Output description	PNP non-safety-related
Voltage	approx. 22 V DC (U_s - 2 V)
Current	max. 100 mA

Alarm outputs: M1	
Maximum inrush current	500 mA (Δt = 1 ms at U_s)
Protective circuit	Suppressor diode
Short-circuit protection	Yes

Times	
Typical starting time with U_s	< 200 ms (with U_s when controlled via A1)
Typical response time at U_s	< 200 ms (automatic start) < 175 ms (manual, monitored start)
Response time	< 10 ms (Take the extension of the response time into consideration if you switch several devices in sequence.)
Restart time	< 250 ms (Boot time)
Recovery time	250 ms (following demand of the safety function)

General data	
Nominal operating mode	100% operating factor
Degree of protection	IP20
Min. degree of protection of inst. location	IP54
Mounting type	DIN rail mounting
Mounting position	vertical or horizontal
Assembly instructions	See derating curve
Type of housing	Polyamide yellow
Operating voltage display	1 x green LED
Status display	3 x green LED
Indication	1 x red LED
Air clearances and creepage distances between the power circuits	according to DIN EN 50178, EN 60947-5-1
Rated insulation voltage	50 V
Rated surge voltage/insulation See “Insulation coordination”	Basic insulation 4 kV between all current paths and housing
Protection class	II (EN 50178)
Degree of pollution	2
Overvoltage category	III
Maximum power dissipation for nominal condition	3.1 W (U_B = 30 V , I_{L1} = I_{L2} = 2.4 A)
Note on power dissipation	See “Calculating the power dissipation”

Dimensions	Screw connection	Push-in connection
W x H x D	12.5 x 112.2 x 114.5 mm	12.5 x 116.6 x 114.5 mm

Connection data	Screw connection	Push-in connection
Conductor cross section solid	0.2 mm² ... 2.5 mm²	0.2 mm² ... 1.5 mm²
Conductor cross section flexible	0.2 mm² ... 2.5 mm²	0.2 mm² ... 1.5 mm²
Conductor cross-section AWG	24 ... 12	24 ... 16
Conductor cross section flexible, with ferrule without plastic sleeve		0.25 mm² ... 1.5 mm² (only together with CRIMPFOX 6)

Connection data	Screw connection	Push-in connection
Conductor cross section flexible, with ferrule with plastic sleeve		0.25 mm² ... 1.5 mm² (only together with CRIMPFOX 6)
Stripping length	7 mm	8 mm
Screw thread	M3	
Torque	0.5 Nm ... 0.6 Nm	

Ambient conditions	
Ambient temperature (operation)	-40 °C ... 70 °C (observe derating)
Ambient temperature (storage/transport)	-40 °C ... 70 °C
Max. permissible relative humidity (operation)	75 % (on average, 85% infrequently, non-condensing)
Max. permissible humidity (storage/transport)	75 % (on average, 85% infrequently, non-condensing)
Maximum altitude	≤ 2000 m (Above sea level)
Information on operating height	See the “Using PSR devices at altitudes greater than 2000 m above sea level” section
Shock	30g
Vibration (operation)	10 Hz ... 150 Hz, 5g

Conformance/Approvals	
CE	CE-compliant
Approvals	

Safety data	
Stop category according to IEC 60204	0

Safety parameters in accordance with IEC 61508 - high demand	
IEC 61508 - High demand	
Equipment type	Type A
HFT	1
SIL	3
PFH_D	1.00×10^{-9}
Demand rate	< 12 Months
Proof test interval	240 Months
Duration of use	240 Months

Safety characteristic data according to EN ISO 13849-1	
Category	4
Performance level	e

For applications in PL e, the required demand rate for the safety function is once per month.

Safety technology parameters in accordance with EN 62061	
SIL	3

For applications in SIL 3 the required demand rate for the safety function is once per month.

5 Notes regarding documentation

5.1 Identification of warning notes

This symbol indicates hazards that could lead to personal injury.

There are three signal words indicating the severity of a potential injury.

DANGER Indicates a hazard with a high risk level. If this hazardous situation is not avoided, it will result in death or serious injury.

WARNING Indicates a hazard with a medium risk level. If this hazardous situation is not avoided, it could result in death or serious injury.

CAUTION Indicates a hazard with a low risk level. If this hazardous situation is not avoided, it could result in minor or moderate injury.

This symbol together with the **NOTE** signal word warns the reader of actions that might cause property damage or a malfunction.

Here you will find additional information or detailed sources of information.

5.2 Validity

This data sheet is valid for the described product(s) from the hardware/firmware version specified in the technical data.

5.3 Target group

This data sheet is therefore aimed at:

– Qualified personnel who plan and design safety equipment for machines and systems and are familiar with regulations governing occupational safety and accident prevention.
– Qualified personnel who install and operate safety equipment in machines and systems.

Qualified personnel:

Qualified personnel are people who, because of their education, experience, and instruction and their knowledge of relevant standards, regulations, accident prevention, and service conditions, have been authorized by those responsible for the safety of the system to carry out any required operations and who are able to recognize and avoid any possible dangers.

Requirements:

Knowledge of the following topics is required:

– Handling safety components
– Valid EMC regulations
– Valid regulations governing occupational safety and accident prevention

6 Safety regulations and installation notes

WARNING: Death, serious personal injury or damage to equipment

Depending on the application, incorrect handling of the device may pose serious risks for the user or cause damage to equipment.

- Observe all the safety notes and warning instructions provided in this chapter and elsewhere in this document.

Direct/indirect contact

- Protection against direct and indirect contact according to VDE 0100 Part 410 must be ensured for all components connected to the system.

In the event of an error, parasitic voltages must not occur (single-fault tolerance).

Power supply units for 24 V supply

Parallel protection against polarity reversal is only implemented in the device for a limited period. The following measures must be implemented to prevent damage to the device:

- Only use power supply units with safe isolation and SELV/PELV.
- Secure the supply voltage externally with a 5 A FF fuse.
- Make sure that the power supply unit is able to supply **four times** the nominal current of the external fuse, to ensure that it trips in the event of an error.

Startup, mounting, and modifications

Startup, mounting, modifications, and upgrades may only be carried out by qualified personnel.

- Before working on the device, disconnect the power.
- Carry out wiring according to the application. Refer to the “Application examples” section for this.

Reliable operation is only ensured if the device is installed in housing protected from dust and humidity.

- Install the device in housing protected from dust and humidity (min. IP54).

Mismatching and polarity reversal of connections

- Take measures to prevent mismatching, polarity reversal, and manipulation of connections.

In operation

During operation, parts of electrical switching devices carry hazardous voltages.

- Protective covers must not be removed when operating electrical switching devices.

For emergency stop applications, automatic startup of the machine can pose serious risks for the user.

- The machine must be prevented from restarting automatically by a higher-level controller.

With the manual, monitored reset device, a machine start may not be triggered in accordance with EN ISO 13849-1.

Observe the following measures for inductive loads:

- Connect a suitable and effective protective circuit to inductive loads.
- Implement the protective circuit in parallel to the load.
- Limit the inductive interrupting voltage in accordance with the specifications in the technical data. Use suppressor diodes or varistors, for example.
- Please observe the specifications of the manufacturer when sizing the protective circuit for relay or contactor.
- Please note that the freewheeling circuit affects the fall time and the service life of the relay or contactor.

The device is a Class A product.

- Observe the requirements for noise emission for electrical and electronic equipment (EN 61000-6-4).
- Implement appropriate precautions against noise emission.

Faulty devices

The devices may be damaged following an error. Correct operation can no longer be ensured.

- Replace any defective devices.

Only the manufacturer or their authorized representative may perform the following activities. Otherwise the warranty is invalidated.

– Repairs to the device
– Opening the housing

6.1 Safety of machines or systems

Draw up and implement a safety concept

The machine or system manufacturer and the operator are responsible for the safety of the machine or system and the application in which the machine or system is used. In order to use the device described in this document, you must have drawn up an appropriate safety concept for your machine or system. This includes a risk assessment in accordance with the directives and standards specified in the EC Declaration of Conformity, as well as other standards.

Risk assessment, validation and function test

- Before using the device, perform a risk assessment on the machine or system.
- Validate your entire safety system.
- Carry out a new validation every time you make a safety-related modification.
- Perform a function test on a regular basis.

Achievable safety integrity

The functional safety is ensured for the device as a single component. However, this does not guarantee functional safety for the entire machine or system. In order to be able to achieve the desired safety level for the entire machine or system, define the safety requirements for the machine or system as well as how to implement them from both a technological and an organizational perspective.

7 Transport, storage, and unpacking

7.1 Transport

The device is delivered in cardboard packaging.

- Observe the instructions on how to handle the package indicated on the packaging.

Suitable transport packaging

- Only transport the device in its original packaging or in packaging suitable for transport.

Technical data and environmental conditions

- For transport, observe the specifications regarding the temperature range, humidity, and air pressure.

See “Technical data” section.

7.2 Storage

Suitable storage location

The storage location must meet the following requirements:

– Dry
– Protected against unauthorized access
– Protected against harmful environmental influences such as UV light

Technical data and environmental conditions

- For storage, observe the specifications regarding the temperature range, humidity, and air pressure.

See “Technical data” section.

7.3 Unpacking

The device is delivered in packaging together with a packing slip that provides installation instructions.

Observing the packing slip

- Read the entire packing slip carefully.
- Retain the packing slip.

Checking the delivery

- Check the delivery for damage and completeness.
- Submit any claims for transport damage immediately.

Scope of supply

Refer to the ordering data for the standard scope of supply for the product.

See “Ordering data” section.

8 Function description

8.1 Single-channel sensor circuit

The sensor circuit is not designed with redundancy.

The safety relay module does not detect short circuits and cross-circuits in the sensor circuit.

8.2 Two-channel sensor circuit

The connection of the two-channel sensor circuit is equivalent.

With the corresponding wiring, the safety relay module detects short circuits and cross-circuits in the sensor circuit.

When using 4-wire switching strips or safety shut-off mats, a cross-circuit is formed between the outputs and the internal fault detection is triggered.

See “Signal generator connection versions” section.

8.3 External enable signal

Input S36 of the safety relay module is designed to interlink several PSR-MC31 devices or to be controlled via an external, safe signal.

If the external enable signal is reset, the safety relay module initiates the safe state.

See “External enable signal connection versions” section.

8.4 Automatic start

The device starts automatically after the sensor circuit has been closed.

The external enable signal at S36 must be active for the start.

8.5 Manual, monitored start

When the sensor circuit is closed, the device starts once the start circuit has been closed and opened again by pressing and releasing the reset button.

A connected reset button is monitored.

The external enable signal at S36 must be active for the start.

See “Start and feedback circuit connection versions” section.

See “Function and time diagrams”.

8.6 Safe shutdown

The safety relay module safely interrupts circuits under the following conditions:

– Interrupting the senor circuit
– Interrupting the external enable signal
– Cross-circuit in the sensor circuit

Digital outputs 14 and 24 are switched off in the safe state.

The safe digital outputs switch without delay according to stop category 0 in accordance with EN 60204-1.

Monitor the leakage current and remaining voltage at the outputs in the switched off condition. See technical data.

Signal output M1 - not safety-related

The signal output transmits non-safety-related status information.

The signal output is active when the safe digital outputs are switched off.

9 Function and time diagrams

Key:

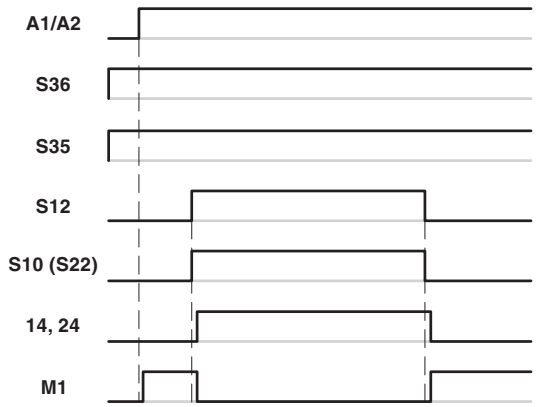
A1/A2	Power supply
S36	External enable signal input
S35	Input automatic start
S34	Input manual, monitored start
S12	Sensor circuit channel 1
S10 (S22)	Sensor circuit channel 2
14, 24	Safe digital outputs
M1	Digital alarm output

9.1 Time diagram for automatic start

9.1.1 Continuous autostart

– Permanent high signal at S35

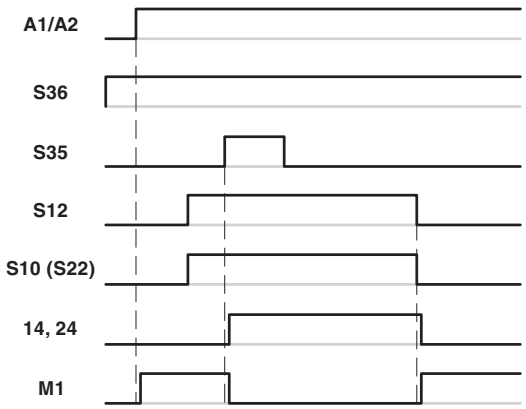
Figure 1 Time diagram for automatic start



9.1.2 Autostart pulse

– Start on rising edge at S35
– Not monitored

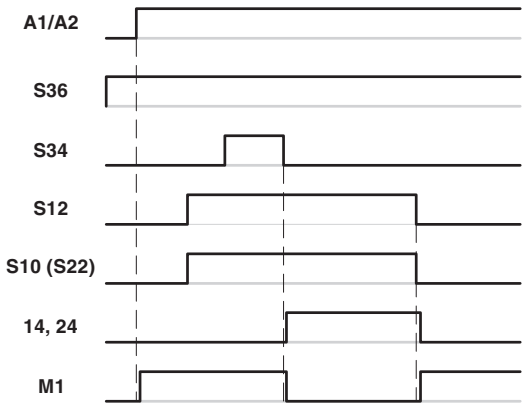
Figure 2 Time diagram for automatic start



9.2 Time diagram for manual, monitored start

– Start on falling edge at S34
– Monitored

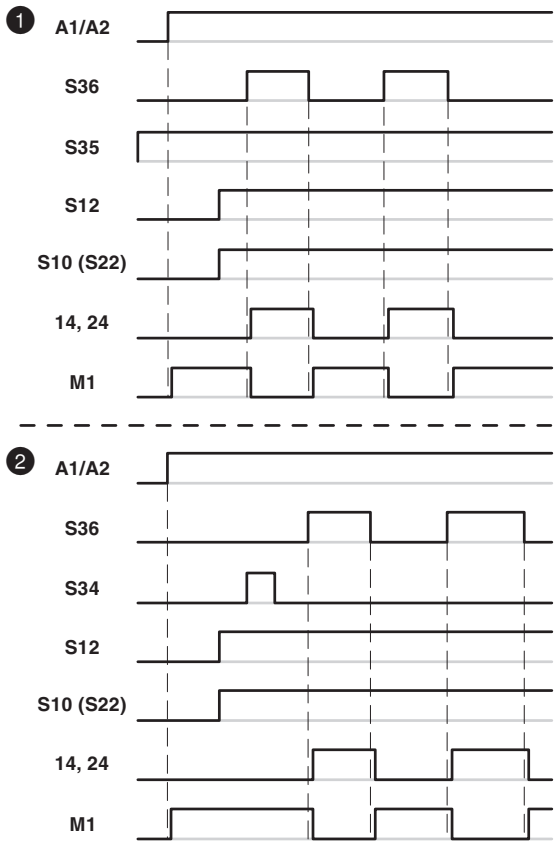
Figure 3 Time diagram for manual, monitored start



9.3 Time diagram for start via external release

– External enable signal to S36
– Monitored

Figure 4 Time diagram for start via external release

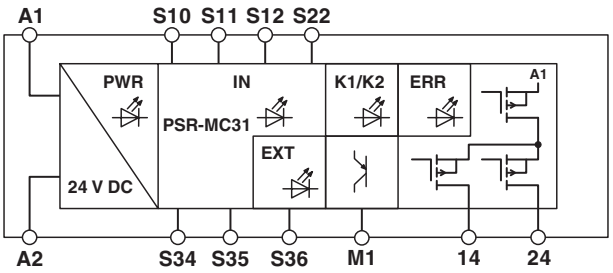


Key:

A1/A2	Power supply
S36	External enable signal input
S35	Input automatic start
S34	Input manual, monitored start
S12	Sensor circuit channel 1
S10 (S22)	Sensor circuit channel 2
14, 24	Safe digital outputs
M1	Digital alarm output
❶	External release on autostart
❷	External release on manual start

10 Block diagram

Figure 5 Block diagram



Key:

A1	24 V DC power supply
A2	0 V power supply
S10	Input sensor circuit channel 2 (24 V)
S11	Output 24 V (protected)
S12	Input sensor circuit channel 1 (24 V)
S22	Input sensor circuit channel 2 (0 V)
S34	Input manual, monitored start
S35	Input automatic start
S36	External enable signal input
M1	Digital alarm output
14, 24	Safe digital outputs

11 Derating

The load current I_L relates to the individual output, i. e. the specified current can be applied to both of the outputs on the device at the same time.

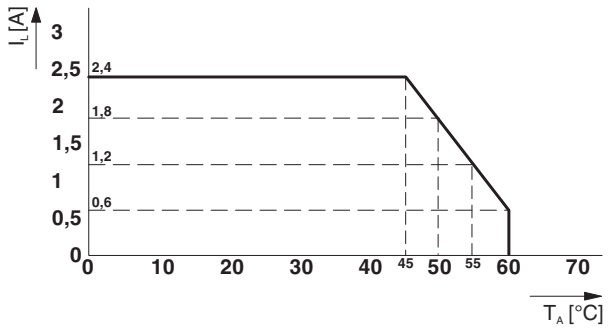
11.1 Vertical or horizontal mounting position without spacing

The derating curve represents the max. current per output.

The derating curve applies for the following conditions:

– Mounting on a vertical or horizontal DIN rail
– Devices mounted next to each other without spacing

Figure 6 Derating curve - vertical or horizontal mounting position, without spacing



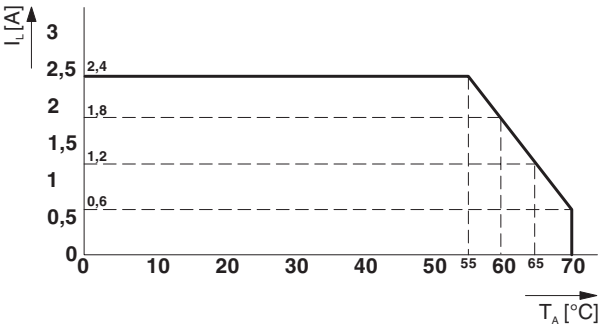
11.2 Vertical mounting position with spacing

The derating curve represents the max. current per output.

The derating curve applies for the following conditions:

– Mounting on a vertical DIN rail
– Devices mounted next to each other with ≥ 10 mm spacing

Figure 7 Derating curve - vertical mounting position, with spacing



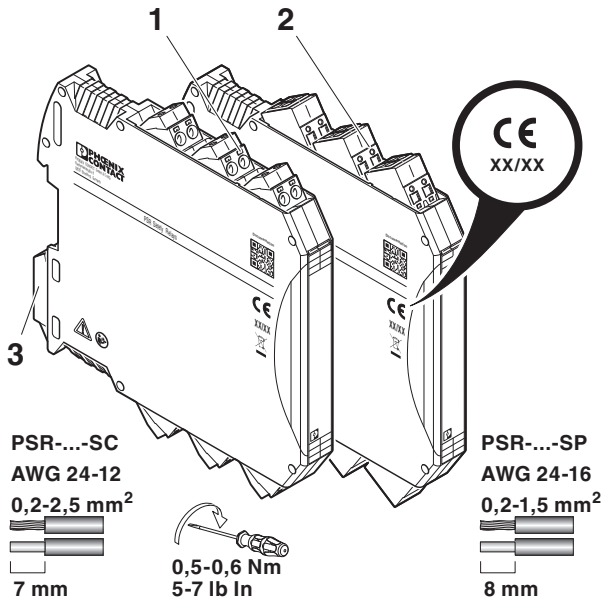
11.3 Horizontal mounting position with spacing

If the devices are mounted in the **horizontal** mounting position with ≥10 mm spacing between one another, no derating is required.

12 Operating and indication elements

12.1 Connection versions

Figure 8 Connection versions

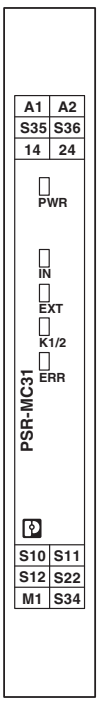


1 COMBICON plug-in screw terminal block
2 Pluggable COMBICON Push-in terminal block
3 Metal lock for fixing to DIN rail

See section "Optional terminal coding".

The year the device was constructed can be found underneath the CE designation on the housing.
XX/XX = Calendar week / year

12.2 Connection assignment



A1	24 V DC power supply
A2	0 V power supply
S35	Input automatic start
S36	External enable signal input
14, 24	Safe digital outputs
PWR	Power, LED (green)
IN	Status indicator sensor circuit; LED (green)
EXT	Status indicator of external release; LED (green)
K1/2	Status indicator safety circuit, LED (green)
ERR	Diagnostic indicator; LED (red)
S10	Input sensor circuit channel 2 (24 V)
S11	Output 24 V (protected)
S12	Input sensor circuit channel 1 (24 V)
S22	Input sensor circuit channel 2 (0 V)
M1	Digital alarm output
S34	Input manual, monitored start

12.3 Optional terminal coding

The device connection terminal blocks are **not** coded as standard.

The optional coding accessories can provide you with increased safety against connection mismatching and reverse polarity.
See section “Ordering data”.

If you do not use the coding accessories, ensure that alternative validation measures are taken.

Coding system

The terminal blocks can be coded by using coding sections and coding profiles.

Coding sections are plugged onto the terminal block header in the device housing.

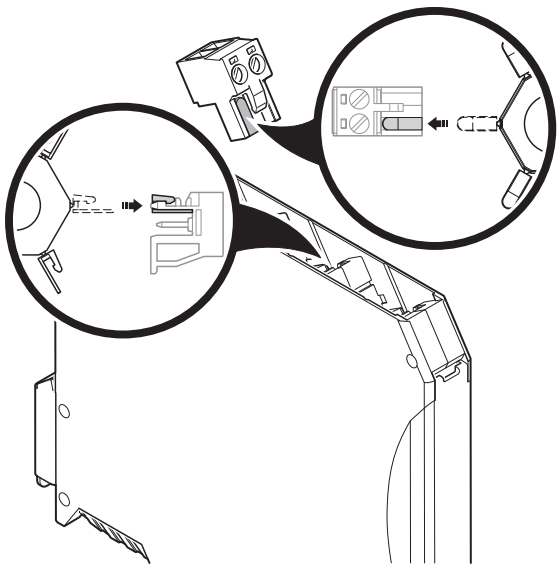
Coding profiles are plugged into the groove of the pluggable terminal block.

Various combinations can be used to create a coding system for the device terminal blocks.

Attaching coding elements

1. Push a coding section onto the terminal block header in the device housing.
   Remove the coding section from the coding star.
2. Push a coding profile into the groove of the terminal block.
   Remove the coding profile from the coding star.

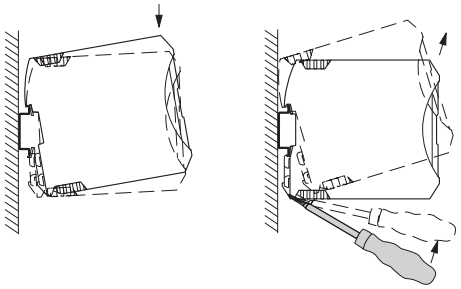
Figure 9 Attach coding elements



13 Mounting and removing

- Mount the device on a 35 mm DIN rail according to EN 60715.
- To remove the device, use a screwdriver to release the snap-on foot.

Figure 10 Mounting and removing



14 Wiring

- Connect the cables to the connection terminal blocks using a screwdriver.

Figure 11 Connecting the cables for PSR-...-SC (screw terminal block)

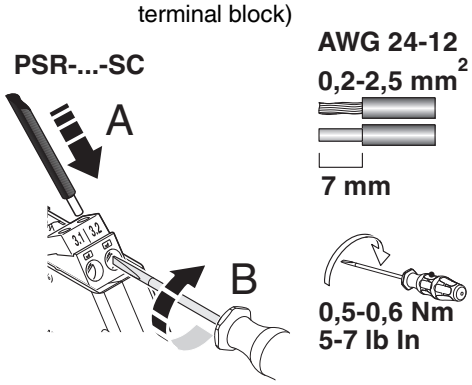
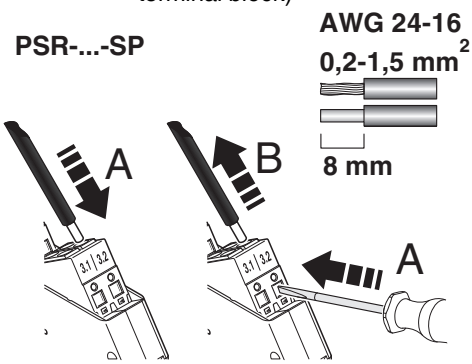


Figure 12 Connecting the cables for PSR-...-SP (Push-in terminal block)



It is recommended that ferrules are used to connect stranded cables.

Use the CRIMPFOX 6 crimping tool from PHOENIX CONTACT.

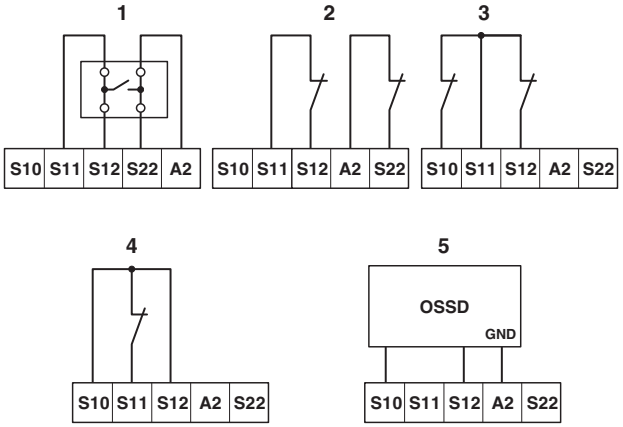
The tool enables the reliable processing of ferrules and easy removal of conductors with ferrules from the connection terminal blocks.

For compliance with UL approval, use copper wire that is approved up to 60°C/75°C.

14.1 Signal generator connection versions

- Connect suitable signal generators to S10/S11/S12 and S22/A2.

Figure 13 Signal generator connection versions



1 Connection of safety shut-off mats

2 Two-channel connection with cross-circuit monitoring

3 Two-channel connection without cross-circuit monitoring

4 Single-channel connection

5 Two-channel connection with **external** cross-circuit detection by the signal generator

If control is single-channel via a PLC, the digital output of the PLC must satisfy the requirements in accordance with the required safety integrity.

14.2 Start and feedback circuit connection variants

Automatic start

- Bridge the contacts A1/S35.

Manual, monitored start

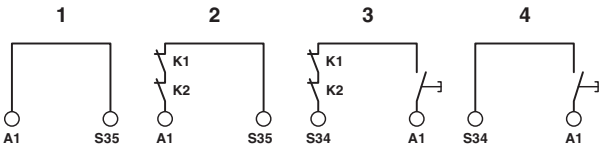
- Connect a reset button to contacts A1/S34.

A connected reset button is monitored.

Start and feedback circuit

- Place the relevant N/C contacts in path A1/S34 or A1/S35 to monitor external contactors or extension devices with force-guided contacts.

Figure 14 Start and feedback circuit connection variants



1 Automatic start

2 Automatic start with monitored contact extension

3 Manual, monitored start with monitored contact extension

4 Manual, monitored start

14.3 External enable signal connection versions

Refer to the “Application examples” section for this.

Interlinking of several PSR-MC31

- Connect a safe digital output of the preceding PSR-MC31 and connection S36 of the following PSR-MC31.
- Bridge connections S36/A1 of the first PSR-MC31.

Take the extension of the response time into consideration if you switch several devices in sequence.

Controlled by an external, safe signal

- Connect an external, safe signal to connection S36 of the safety relay module, e. g. a safe PLC output.

No external enable signal

If you do not require an external enable signal, bridge connections S36/A1 of the safety relay module.

15 Startup

- Apply the rated control circuit supply voltage (24 V DC) at terminal blocks A1/A2.

The Power LED lights up.

- Close sensor circuit.
  See “Signal generator connection versions” section.

The IN LED lights up.

- Ensure that the external enable signal is active.
  See “External enable signal connection versions” section.

The EXT LED lights up.

Automatic start

Safe digital outputs 14 and 24 switch on.

The K1/2 LED lights up.

Signal output M1 is not active.

Manual, monitored start

- Press the reset button.
- Release the reset button.

Safe digital outputs 14 and 24 switch on.

The K1/2 LED lights up.

Signal output M1 is not active.

16 Calculating the power dissipation

The total power dissipation of the safety relay module is based on the input power dissipation and the output power dissipation for the same or for different load currents.

Input power dissipation

$P_{Input} = U_B^2 / (U_S/I_S)$

Output power dissipation

$P_{Output} = (I_{L1} + I_{L2})^2 * 24\ m\Omega + 40\ m\Omega * (I_{L1}^2 + I_{L2}^2)$

Total power dissipation

$P_{Total} = P_{Input} + P_{Output}$

therefore

$P_{total} = U_B^2 / (U_S/I_S) + (I_{L1} + I_{L2})^2 * 24\ m\Omega + 40\ m\Omega * (I_{L1}^2 + I_{L2}^2)$

Key:

P	Power dissipation in mW
U_B	Applied operating voltage
U_S	Rated control circuit supply voltage
I_S	Rated control supply current
I_L	Output load current

17 Function test/proof test

To verify the device function, proceed as follows:

- Demand the safety function by actuating the corresponding safety equipment.
- Check whether the safety function was executed correctly by switching the device on again.

If the device does not switch on again, the proof test failed.

The ERR LED flashing red indicates a faulty proof test.

If the proof test contains errors, the device no longer functions correctly.

- Replace the device.

18 Diagnostics

Plausibility errors are deleted when the supply voltage is switched off (power down reset).

In the event of an error or fault that is not listed, please contact Phoenix Contact.

18.1 General states

Key:

○ LED OFF
● LED ON

LED					State	Notes
PWR	IN	EXT	K1/2	ERR		
●	●	●	●	○	The sensor circuit is active. All of the safe outputs are active.	-
●	●	○	○	○	The sensor circuit is active. All of the safe outputs are deactivated.	External enable signal is not connected or interrupted.
●	○	○	○	○	The sensor circuit is not active. The external release is not active. All of the safe outputs are deactivated.	Possible error see error messages
●	○	●	○	○	The sensor circuit is not active. The external release is active. All of the safe outputs are deactivated.	
●	●	●	○	○	The sensor circuit is active. The safe outputs are ready to start and await reset/ start command (S34 or S35).	

18.2 Error messages

Key:

○ LED OFF
● LED ON

LED					State	Possible cause	Corrective
PWR	IN	EXT	K1/2	ERR			
●	○	●	○	○	The sensor circuit is actively controlled, but no input LEDs are lit up.	Internal cross-circuit detection is active: potential cross-circuit in the sensor circuit.	Switch off the operating voltage and rectify the cross-circuit. Then perform a function test.
●	●	○	○	○	The sensor circuit is active. All of the safe outputs are deactivated.	External enable signal is not connected or interrupted.	Check the external enable signal/enable circuit.
●	●	●	○	●	The sensor circuit is active. The reset/start circuit (S34) was activated. All of the safe outputs are deactivated.	Error during manual reset S34 (stuck-at at the input). External error: sensor circuit channel 1 or channel 2 was opened and reactivated.	Remove the error in the reset/start circuit. Then perform a function test. External error: check the sensor circuit.
●	○ / ●	○ / ●	○	●		Internal error: diagnostics active.	Perform a power down reset with subsequent function test. **If the error occurs again after the function test, replace the device.**
○	○	○ / ●	○	○	The sensor circuit is active.	1. No supply voltage at A1/ A 2. Over- or undervoltage at A1	Check the supply voltage.

19 Application examples

19.1 Single-channel emergency stop monitoring/ manual, monitored start

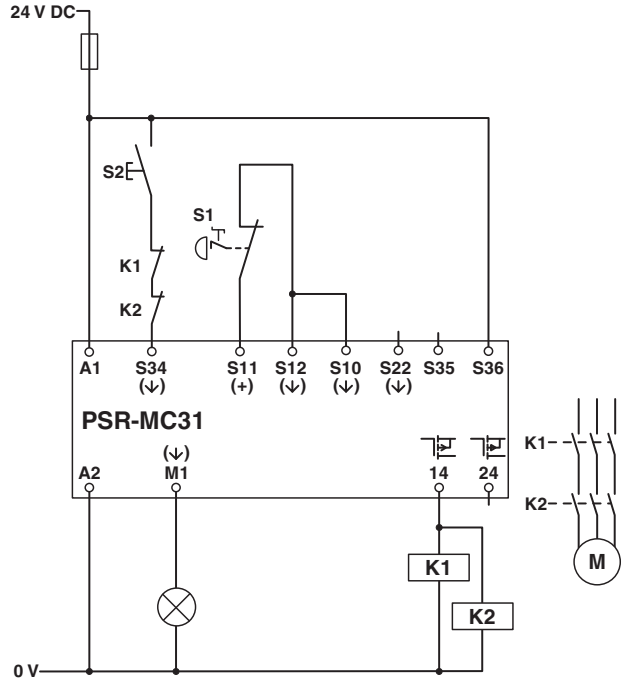
Application description:

- Single-channel emergency stop monitoring
- Manual, monitored start
- Monitoring of external, force-guided contactors

Achievable safety integrity:

- Suitable up to category 1, PL c (EN ISO 13849-1), SIL 1 (EN 62061)

Figure 15 Single-channel emergency stop monitoring/ manual, monitored start



Key:

S1	Emergency stop button
S2	Manual reset device
K1/K2	Force-guided contactors

19.2 Emergency stop monitoring/manual, monitored start

Application description:

- Two-channel emergency stop monitoring
- Manual, monitored start
- Monitoring of external, force-guided contactors
- It is assumed that errors in the cable installation for triggering the actuator have been eliminated

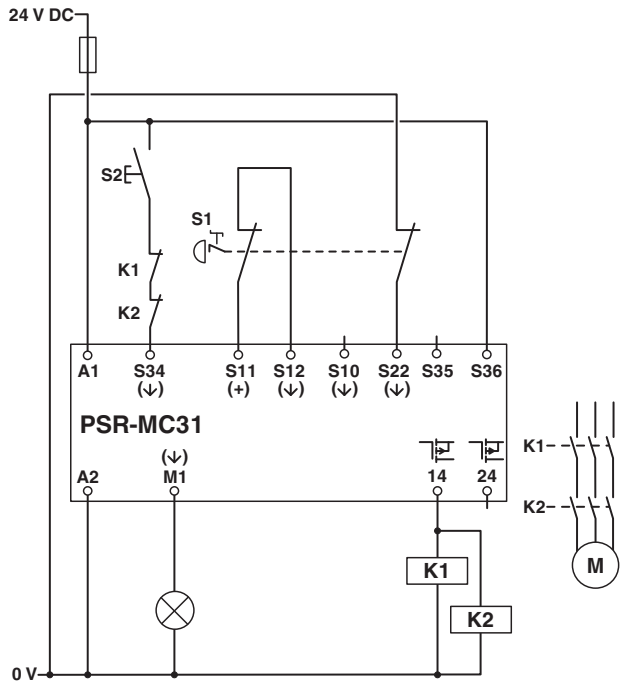
Notes:

Cross-circuits in the cable installation can be ruled out in the same electrical installation space or through mechanically protected cable installation.

Achievable safety integrity:

- Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (EN 62061)

Figure 16 Emergency stop monitoring/manual, monitored start



Key:

S1	Emergency stop button
S2	Manual reset device
K1/K2	Force-guided contactors

19.3 Light grid monitoring/manual, monitored start

Application description:

- Two-channel light grid monitoring
- Manual, monitored start
- Monitoring of external, force-guided contactors
- It is assumed that errors in the cable installation for triggering the actuator have been eliminated

Notes:

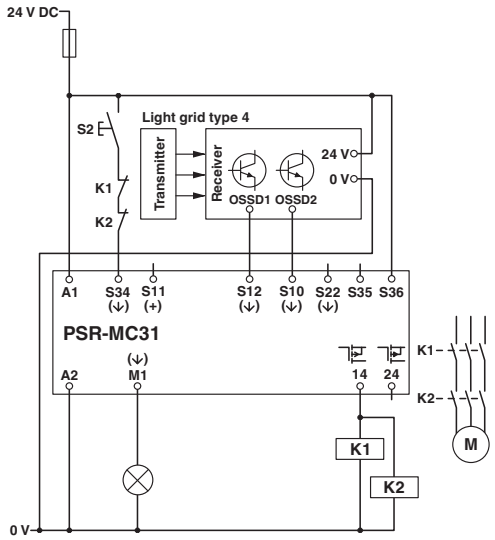
WARNING: Loss of functional safety
Make sure that the signal generator and the safety relay have the same ground potential.

Cross-circuits in the cable installation can be ruled out in the same electrical installation space or through mechanically protected cable installation.

Achievable safety integrity:

- Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (EN 62061)

Figure 17 Light grid monitoring/manual, monitored start



Key:

S2	Manual reset device
K1/K2	Force-guided contactors

19.4 Magnetic switch monitoring/manual, monitored start

Application description:

- Two-channel magnetic switch monitoring
- Manual, monitored start
- Monitoring of external, force-guided contactors
- It is assumed that errors in the cable installation for triggering the actuator have been eliminated

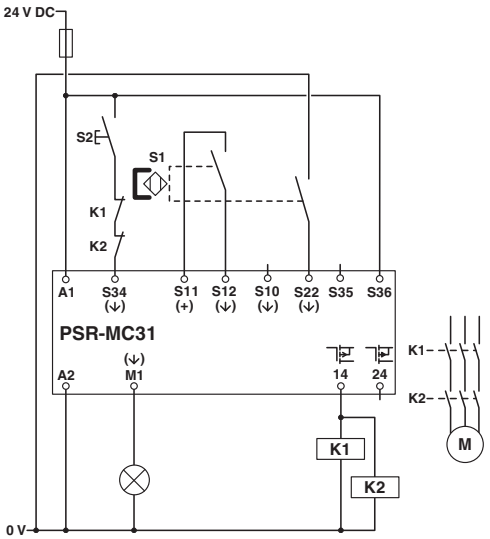
Notes:

Cross-circuits in the cable installation can be ruled out in the same electrical installation space or through mechanically protected cable installation.

Achievable safety integrity:

- Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (EN 62061)

Figure 18 Magnetic switch monitoring/manual, monitored start



Key:

S1	Solenoid switch
S2	Manual reset device
K1/K2	Force-guided contactors

19.5 Switching strip monitoring/manual, monitored start

Application description:

- Two-channel switching strip monitoring
- Manual, monitored start
- Monitoring of external, force-guided contactors
- It is assumed that errors in the cable installation for triggering the actuator have been eliminated
- Switching strips or safety shut-off mats in accordance with EN ISO 13856-1 (short circuit principle)

Notes:

WARNING: Danger caused by incorrectly implemented safety or overtravel distances

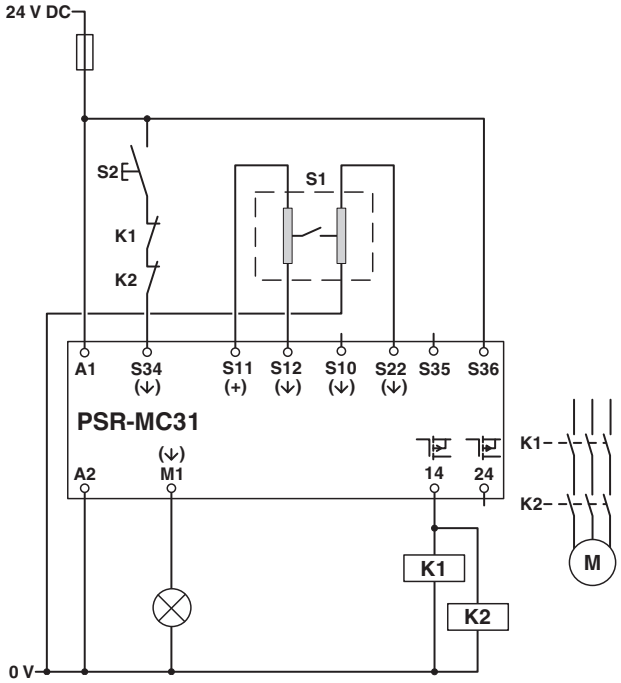
Observe the requirements for determining the safety and overtravel distances in accordance with EN ISO 13856-1.

Cross-circuits in the cable installation can be ruled out in the same electrical installation space or through mechanically protected cable installation.

Achievable safety integrity:

- Suitable up to PL d (EN ISO 13849-1), SIL 2 (EN 62061)

Figure 19 Control strip monitoring/manual, monitored start



Key:

S1	Switching strips or safety shut-off mats
S2	Manual reset device
K1/K2	Force-guided contactors

19.6 Switching strip monitoring/autostart

Application description:

- Two-channel switching strip monitoring
- Automatic start
- Monitoring of external, force-guided contactors
- It is assumed that errors in the cable installation for triggering the actuator have been eliminated
- Switching strips or safety shut-off mats in accordance with EN ISO 13856-1 (short circuit principle)

Notes:

WARNING: Danger caused by incorrectly implemented safety or overtravel distances

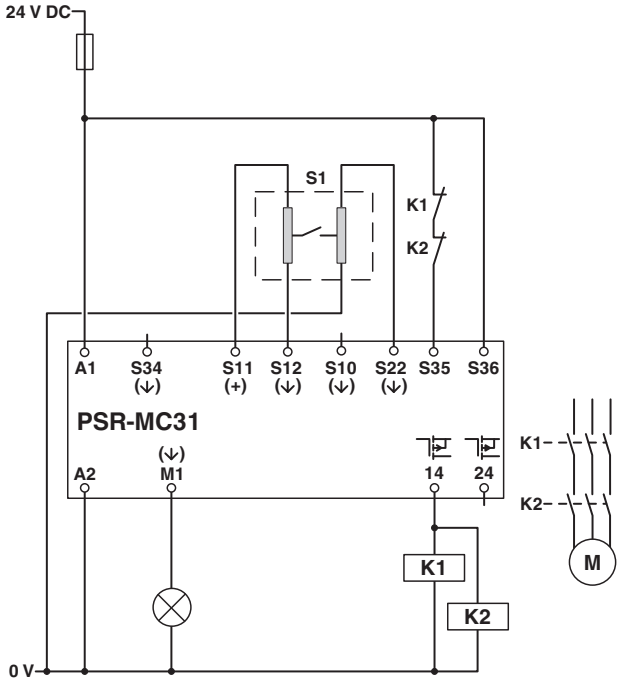
Observe the requirements for determining the safety and overtravel distances in accordance with EN ISO 13856-1.

Cross-circuits in the cable installation can be ruled out in the same electrical installation space or through mechanically protected cable installation.

Achievable safety integrity:

- Suitable up to PL d (EN ISO 13849-1), SIL 2 (EN 62061)

Figure 20 Control strip monitoring/autostart



Key:

S1	Switching strips or safety shut-off mats
K1/K2	Force-guided contactors

19.7 Emergency stop monitoring concatenation with switching strip monitoring

Application description:

- Two-channel emergency stop monitoring with manual, monitored start on first safety relay module
- Two-channel switching strip monitoring with autostart on second safety relay module
- Monitoring of external, force-guided contactors
- It is assumed that errors in the cable installation for triggering the actuator and the cable to S36 on the second safety switching device have been eliminated
- Switching strips or safety shut-off mats in accordance with EN ISO 13856-1 (short circuit principle)

Notes:

WARNING: Danger caused by incorrectly implemented safety or overtravel distances

Observe the requirements for determining the safety and overtravel distances in accordance with EN ISO 13856-1.

WARNING: Loss of functional safety

Make sure that both of the safety relay modules have the same ground potential.

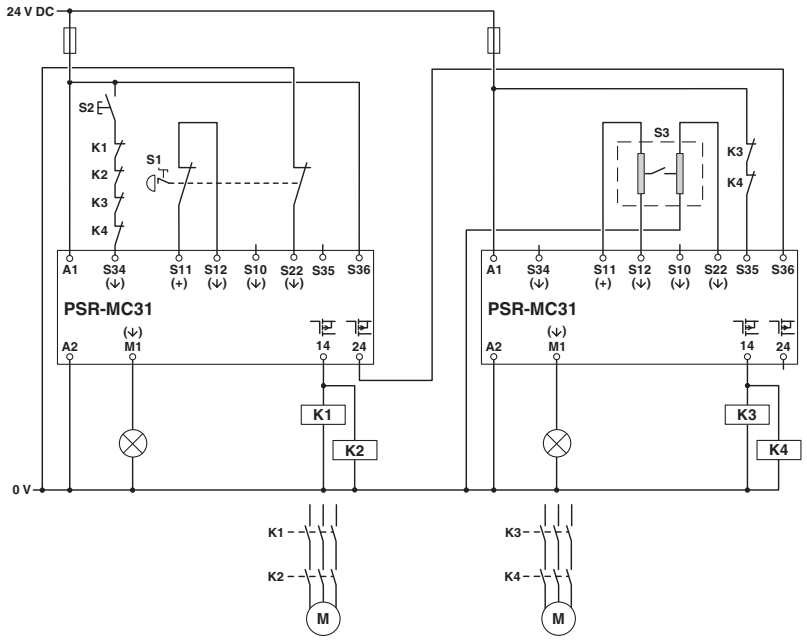
Cross-circuits in the cable installation can be ruled out in the same electrical installation space or through mechanically protected cable installation.

Both safety relay modules and all of the contactors must be located in the same installation area.

Achievable safety integrity:

- **Emergency stop monitoring:** Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (EN 62061)
- **Switching strip monitoring:** Suitable up to PL d (EN ISO 13849-1), SIL 2 (EN 62061)

Figure 21 Emergency stop monitoring concatenation with control strip monitoring



Key:

S1	Emergency stop button
S2	Manual reset device
S3	Switching strips or safety shut-off mats
K1/K2/ K3/K4	Force-guided contactors

20 Device replacement, device defect, and repair

20.1 Device replacement

The device can be replaced, if necessary.

If you need to replace the device, proceed as described in the following section:

– Mounting and removal
– Wiring

Observe the device type and version

The new device must meet the following requirements:

– Same device type
– Same or later version

20.2 Device defect and repair

Do not open the housing

Repairs may only be carried out by Phoenix Contact. Do not open the housing. If the housing is opened, the function of the device can no longer be ensured.

Faulty devices

- Please contact Phoenix Contact.

21 Maintenance, decommissioning, and disposal

21.1 Maintenance

The device requires no maintenance during the permissible duration of use. Refer to the technical data for the duration of use of the device.

If necessary, carry out proof tests within the specified proof test interval.

See “Technical data” section.

Depending on the application and connected I/O devices, you should test the function of the I/O devices and the safety chain regularly.

Observe the relevant manufacturer specifications for carrying out maintenance on connected I/O devices.

21.2 Decommissioning and disposal

Carry out decommissioning according to the requirements of the machine or system manufacturer.

When decommissioning the system or parts of the system, ensure the following for the devices used.

The device continues to be used only as intended:

- Observe the storage and transport requirements.

See “Transport, storage, and unpacking” section.

The device is not used any more:

The device contains valuable recyclable materials, which should be utilized.

Device disposal

- Do not dispose of the device with household waste; it should instead be disposed of in accordance with the currently applicable national regulations.

Packaging disposal

- Dispose of packaging materials that are no longer needed (cardboard packaging, paper, bubble wrap sheets, pillow bags, etc.) with household waste in accordance with the currently applicable national regulations.

22 Attachment

22.1 Using PSR devices at altitudes greater than 2000 m above sea level

The following section describes the special conditions for using PSR devices at altitudes greater than 2000 m above sea level. Observe the relevant device-specific data (technical data, derating, etc.) according to the product documentation for the individual device.

Using the device at altitudes **greater than 2000 m above sea level up to max. 4500 m above sea level** is possible under the following conditions:

1. Limit the rated control circuit supply voltage (U_S) in accordance with the table below. Observe the technical data for the device.

U_S according to the technical data for the device	U_S when used at altitudes greater than 2000 m above sea level
< 150 V AC/DC	U_S according to the technical data for the device still valid
> 150 V AC/DC	Limited to max. 150 V AC/DC

2. Limit the maximum switching voltage in accordance with the table below. Observe the technical data for the device.

Max. switching voltage according to the technical data for the device	Max. switching voltage when used at altitudes greater than 2000 m above sea level
< 150 V AC/DC	Max. switching voltage according to the technical data for the device still valid
> 150 V AC/DC	Limited to max. 150 V AC/DC

3. Reduce the maximum ambient temperature for operation by the corresponding factor in accordance with the table below.
4. If derating is specified, offset all the points of the derating curve by the corresponding factor in accordance with the table below.

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

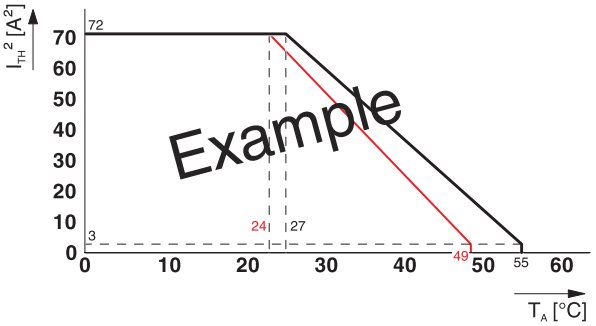
Example calculation for 3000 m

The following calculation and the illustrated derating curve are provided as examples. Perform the actual calculation and offset the derating curve for the device used according to the technical data and the “Derating” section.

27 °C • 0.906 ≈ 24 °C

55 °C • 0.906 ≈ 49 °C

Figure 22 Example of a suspended derating curve (red)



22.2 Revision history

Version	Date	Contents
00	2019-05-15	First publication
01	2019-06-19	Technical data: Device fuse protection changed; safety notes on the fuse protection for the supply voltage changed
02	2022-02-04	HW/FW status adjusted; technical data amended: digital output short-circuit protection, protection class, conductor cross-section with ferrules; Section Safety notes revised; Note EC declaration of conformity removed from section Safety of machinery or systems; Section Transporting, storage, and unpacking added; Figures on connection versions and connection assignment changed; Information on CRIMPFOX 6 in section Wiring added; Section Device replacement, device defects, and repairs added; Section Maintenance, decommissioning, and disposal added, change in COMPLETE line
03	2022-07-12	Technical data: Test pulses corrected to < 1 ms.