PSR-MC45

Safety relay for emergency stop, safety door and light grid monitoring

Data sheet
108951_en_03

 2025-11-03

1 Description

Intended Use

The safety relay is used to monitor 1- or 2-channel signal generators and to control actuators.

When the sensor circuit is interrupted, the safety relay initiates the safe state.

The safety relay interrupts circuits in a safety-related way.

Possible signal generators

- Emergency stop button
- Door locking mechanisms
- Light grids

Contact switching type

- 3 undelayed enabling current paths
- 1 digital signal output

The enabling current paths drop out without delay as per stop category 0 in accordance with EN 60204-1.

Control

- 1- or 2-channel
- Automatic or manual, monitored start

Achievable safety integrity

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

Additional features

- Cross circuiting detection
- Optional pluggable screw or Push-in terminal blocks
- 22.5 mm housing width

Approvals

Observe these notes

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.com/products.

This document is valid for the products listed in the “Ordering data” chapter.
This document meets the same requirements as the original operating instructions with respect to the contents.

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3 Ordering data

Description	Type	Item no.	Pcs./Pkt.
Safety relay for emergency stop, safety doors, and light grids up to SIL 3, Cat. 4, PL e, 1 or 2-channel operation, automatic or manual, monitored start, 3 enabling current paths, U_S = 24 V DC, plug-in screw terminal block	PSR-MC45-3NO-1DO-24DC-SC	1082024	1
Safety relay for emergency stop, safety doors and light grids up to SIL 3, Cat. 4, PL e, 1 or 2-channel operation, automatic or manual, monitored start, 3 enabling current paths, U_S = 24 V DC, pluggable Push-in terminal block	PSR-MC45-3NO-1DO-24DC-SP	1082029	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 mm² ... 6.0 mm², lateral entry, trapezoidal crimp	CRIMPFOX 6	1212034	1
Actuator with anti-lock collar for modular emergency stop switches, for combination with module holder and contact module as a functional unit, panel installation, bayonet lock	PSR-ESS-M0-H110	1221757	1
Module holder for modular emergency stop switches, connects the contact block and actuator with bayonet lock, suitable for 3 elements	PSR-ESS-ACC-CB1-C3	1221747	1
Contact module for modular emergency stop switches with force-guided N/C contact for safety-related shutdown, in conjunction with appropriate evaluation unit suitable for use up to PL e (EN ISO 13849-1), SIL 3 (EN IEC 62061)	PSR-ESS-ACC-CB1-NC-SC	1221752	1

4 Technical data

Hardware/firmware version	
Hardware/firmware version (1082024)	≥ 01/--
Hardware/firmware version (1082029)	≥ 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. 75 mA
Power consumption at U_S	typ. 1.8 W
Inrush current	typ. 2.2 A (Δt = 300 µs at U_s)
Filter time	1 ms (at A1 in the event of voltage dips at U_s)
Protective circuit	Serial protection against polarity reversal Suppressor diode 33 V

Digital inputs: Sensor circuit (S10, S12, S22)	
Number of inputs	3
Description of the input	safety-related sensor inputs NPN (S10, S12), PNP (S22)
Input voltage range "0" signal	0 V ... 5 V (S10, S12)
Input current range "0" signal	0 mA ... 2 mA (S10, S12)
Input voltage range "1" signal	19.2 V ... 30 V
Inrush current	< 5 mA (typ. with U_S at S10/S12, Δt = 500 µs) > -5 mA (typ. with U_S at S22/0 V, Δt = 500 µs)
Current consumption	< 4 mA (typ. with U_S at S10/S12) > -15 mA (typ. with U_S at S22/0 V)
Filter time	max. 3 ms (Test pulse width of low test pulses) > 1 s (Test pulse rate for low test pulse) Where test pulse width < 1 ms: test pulse rate = 5 x test pulse width max. 1 ms (Test pulse width, high test pulse) > 100 ms (Test pulse rate, high test pulse) Unless test pulses are safety-related, they should be disabled.
Max. permissible overall conductor resistance	150 Ω
Concurrence	∞
Protective circuit	Suppressor diode 38.6 V

Digital inputs: Start circuit (S34, S35)	
Number of inputs	2
Description of the input	non-safety-related NPN
Input voltage range "1" signal	19.2 V DC ... 30 V DC
Inrush current	< 10 mA (typ. with U_S, Δt = 500 µs)
Current consumption	2.5 mA (typ. with U_S at S34) 1 mA (typ. with U_S at S35)
Max. permissible overall conductor resistance	150 Ω
Protective circuit	Suppressor diode 38.6 V

Relay outputs: Enabling current paths (13/14, 23/24, 33/34)	
Number of outputs	3
Output description	2 N/O contacts each in series, safety-related, floating
Contact material	$AgSnO_2$
Switching voltage (see section “Relay data”)	min. 5 V AC/DC max. 250 V AC/DC (Observe the load curve)
Limiting continuous current (see section “Relay data”)	6 A
Inrush current	min. 10 mA AC/DC max. 6 A
Sq. Total current $I_{TH}^2 = I_1^2 + I_2^2 + ... + I_N^2$	72 A^2 (observe derating)
Switching frequency	0.5 Hz
Mechanical service life	10x 10^6 cycles
Switching power	min. 50 mW
Switching capacity	5 A (24 V (DC13)) 5 A (250 V (AC15))
Output fuse	6 A gL/gG

Alarm outputs: M1	
Number of outputs	1
Output description	PNP non-safety-related
Voltage	approx. 23 V DC (U_s - 1 V)
Current	max. 100 mA
Maximum inrush current	1 A (Δt = 5 ms at U_s)
Switching frequency	0.5 Hz (ohmic)
Protective circuit	33 V suppressor diode
Short-circuit protection	Yes

Times	
Typical starting time with U_s	< 100 ms (when controlled via A1)
Typical response time at U_s	< 100 ms (automatic start) < 100 ms (manual, monitored start)
Typical release time with U_s	< 20 ms (on demand via the sensor circuit) < 20 ms (when controlled via A1; applicative deactivation via A1/A2 is not permitted)
Restart time	< 1 s (Boot time)
Recovery time	500 ms (following demand of the safety function)

General data	
Relay type	Electromechanical relay with force-guided contacts in accordance with IEC/EN 61810-3
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 note	See derating curve
Type of housing	PA zinc yellow (RAL 1018)
Operating voltage display	1 x LED (green)
Status display	2 x LED (green)
Rated insulation voltage	250 V AC
Rated surge voltage/insulation	See “Insulation coordination”
Degree of pollution	2
Overvoltage category	II
Maximum power dissipation for nominal condition	17.21 W (at U_B = 30 V , I_L^2 = 72 A²)
Note on power dissipation	See “Calculating the power dissipation”

Dimensions	Screw connection	Push-in connection
W x H x D	22.5 x 112.4 x 114.5 mm	22.5 x 117.4 x 114.5 mm

Connection data	Screw connection	Push-in connection
Conductor cross-section rigid	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)
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	-
Tightening torque	0.5 Nm … 0.6 Nm	-

Ambient conditions	
Ambient temperature (operation)	-40 °C … 60 °C (observe derating)
Ambient temperature (storage/transport)	-40 °C … 85 °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	15g for Δt = 11 ms (continuous shock: 10g for Δt = 16 ms)
Vibration (operation)	10 Hz … 150 Hz, 2g

Conformance/Approvals

Content of the EU Declaration of Conformity:
The product conforms with the most important requirements of the following directive(s) and their modification directives:
- 2006/42/EC Machinery Directive
- 2014/30/EU Electromagnetic Compatibility Directive (EMC)

The full EU Declaration of Conformity can be downloaded from the product page at www.phoenixcontact.com/products.

The latest approvals can be downloaded from the product page at www.phoenixcontact.com/products.

Safety data	
Stop category according to IEC 60204	0

Safety parameters in accordance to IEC 61508 - high demand	
IEC 61508 - High demand	
Equipment type	Type A
HFT	1
SIL	3
PFH_D	1.00×10^{-9} (5 A DC13; 8760 switching cycles/year or 5 A DC13; 5 A AC15; 2190 switching cycles/year)
Demand rate	< 12 Months
Proof test interval	240 Months
Mission time	240 Months

Safety parameters according to IEC 61508 - low demand	
Equipment type	Type A
HFT	1
SIL	3
PFD_{avg}	1.16×10^{-4}
Proof test interval	56 Months
Mission time	240 Months

Safety parameters according to EN ISO 13849-1	
Category	4
Performance level	e (5 A DC13; 8760 switching cycles/year or 5 A AC15; 2190 switching cycles/year)
For applications in PL e, the required demand rate for the safety function is once per month.	

Safety parameters according to EN IEC 62061	
SIL	3
For applications in SIL 3 the required demand rate for the safety function is once per month.	

5 Interface type (ZVEI classification)

Digital inputs : Sensor circuit (S10, S12, S22)				
Source/destination	**Interface type**	**Additional measure**	**Source/destination**	**Suitable interface type**
Destination	A	M	Source	A
Destination	C0	M	Source	C1, C2, C3

Interface type A - Destination			
Parameter	**min.**	**typ.**	**max.**
Input current I_i (in the ON-state)	> 2 mA	-	5 mA
Output voltage U_i	20 V	-	30 V
Input capacitance C_i	-	-	-
Additional measure M	- The inputs are not types in accordance with IEC 61131-2. - T_G is S11 for S10/S12 (24 V without cycle) - T_G is S21 for S22 (0 V without cycle) - Data for type A only applies to S10/S12		

Interface type C0 - Destination			
Parameter	**min.**	**typ.**	**max.**
Test pulse duration t_i	-	-	1.5 ms
Test pulse interval T	7.5 s	-	-
Input resistance R	6 kΩ	-	-
Input capacitance C_L	-	-	-
Inductance L_L	-	-	-
Additional measure M	- Not suitable with sources containing discharge circuits. - The inputs are not types in accordance with IEC 61131-2. - Switch-on pulses should be switched off for safety applications.		

Digital inputs : Start circuit (S34, S35)				
Source/destination	**Interface type**	**Additional measure**	**Source/destination**	**Suitable interface type**
Destination	A	M	Source	A
Destination	C0	M	Source	-

Interface type A - Destination			
Parameter	**min.**	**typ.**	**max.**
Input current I_i (in the ON-state)	2 mA (S34) 0.5 mA (S35)	-	3 mA (S34) 1.5 mA (S35)
Output voltage U_i	17.2 V	-	30 V
Input capacitance C_i	-	-	-
Additional measure M	- The inputs are not types in accordance with IEC 61131-2. - T_G is S11 for S34/S35		

Interface type C0 - Destination			
Parameter	**min.**	**typ.**	**max.**
Test pulse duration t_i	-	-	-
Test pulse interval T	-	-	-
Input resistance R	9.6 kΩ (S34) 24 kΩ (S35)	-	-
Input capacitance C_L	-	-	-
Inductance L_L	-	-	-
Additional measure M	- The inputs are not types in accordance with IEC 61131-2. - No test pulses are allowed when controlling with a source.		

Relay outputs : Enabling current paths 13/14, 23/24, 33/34				
Source/destination	**Interface type**	**Additional measure**	**Source/destination**	**Suitable interface type**
Source	A	M	Destination	A
Source	C0	M	Destination	-

Interface type A - Source			
Parameter	**min.**	**typ.**	**max.**
Switching current I_i	10 mA	-	6 A
Switching voltage U_i	5 V AC/DC	-	250 V AC/DC
Internal resistance R_i (in the switched state)	Load ≥ 1 A/24 V < 200 mΩ	-	Load ≥ 10 mA/5 V < 40 Ω
Load capacitance C_L	-	-	see switching capacity
Inductive load L_L	-	-	see switching capacity
Electrical isolation	yes		
Additional measure M	- The outputs are not types in accordance with IEC 61131-2.		

Interface type C0 - Source			
Parameter	**min.**	**typ.**	**max.**
Test pulse duration t_i	-	-	-
Test pulse interval T	-	-	-
Nominal current I_N	-	-	6 A
Load capacitance C_L	-	-	see switching capacity
Inductive load L_L	-	-	see switching capacity
Additional measure M	- The outputs are not types in accordance with IEC 61131-2. - No test pulses are emitted at the output.		

Alarm outputs : M1				
Source/destination	**Interface type**	**Additional measure**	**Source/destination**	**Suitable interface type**
Source	C0	M	Destination	-

Interface type C0 - Source			
Parameter	**min.**	**typ.**	**max.**
Test pulse duration t_i	-	-	-
Test pulse interval T	-	-	-
Nominal current I_N	-	-	100 mA
Leakage current $I_{Leakage}$	-	-	-
Load capacitance C_L	-	-	-
Inductive load L_L	-	-	-
Additional measure M	- The output is not a type in accordance with IEC 61131-2. - No test pulses are emitted at M1.		

6 Notes regarding documentation

6.1 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.

6.2 Validity

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

6.3 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

7 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.

Safety notes for installation and mounting in other languages:
PACKB.SAFETY NOTES INSTALLATION MOUNTING
They can be downloaded from the product page at www.phoenixcontact.com/products.

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

- Only use power supply units with safe isolation and SELV/PELV.
- Protect the 24 V area with a suitable external 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.
- Make sure that the output voltage of the voltage supply does not exceed 32 V even in the event of 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.
- Ensure that the device is disconnected from the power supply.
- 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.

Inductive loads can lead to welded relay contacts.

- Connect a suitable and effective protective circuit to inductive loads.
- Implement the protective circuit parallel to the load and not parallel to the switch contact.

Magnetic fields can influence the device. The magnetic field strength of the environment must not exceed 30 A/m.

- Do not use the device in the vicinity of strong magnetic fields (e.g., caused by transformers or magnetic iron).

EMC notes

Noise emission may occur when operating relay modules. Wireless reception may be disrupted in residential areas.

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.

Surge voltages can destroy the device.

- Take measures outside the device to limit transient surge voltages to the respective value for overvoltage category II.

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

Replacing the device

- Dispose of the device in the following circumstances:

– At the end of its mission time

See “Technical data” section.

– At the end of its electrical service life

See section “Electrical service life”.

– In the event of a fault

7.1 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.

8 Transport, storage, and unpacking

8.1 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 humidity and air pressure specifications, and the temperature range.
  See Section “Technical data”.

8.2 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 humidity and air pressure specifications, and the temperature range.
  See Section “Technical data”.

8.3 Unpacking

The device is delivered in packaging together with a packing slip.

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 Section “Ordering data”.

9 Function description

9.1 Single-channel sensor circuit

The sensor circuit is not designed with redundancy.

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

9.2 Two-channel sensor circuit

The connection of the 2-channel sensor circuit is equivalent.

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

See “Signal generator connection versions” section.

9.3 Automatic start

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

9.4 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.

See “Start and feedback circuit connection versions” section.

See “Function and time diagrams”.

9.5 Safe shutdown

When the sensor circuit opens, the enabling current paths open without delay.

When the enabling current paths are open, the device is in the safe state.

Signal output M1 - not safety-related

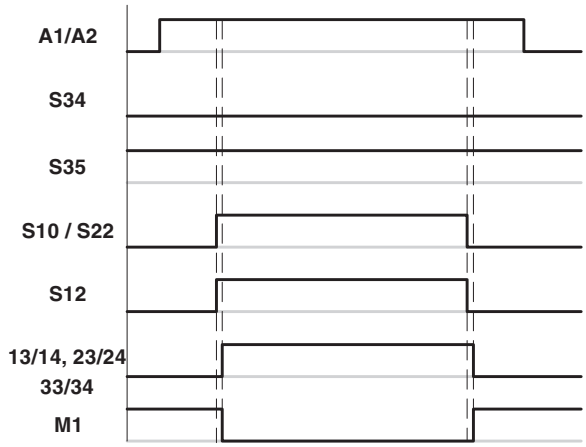
The signal output transmits non-safety-related status information.

The signal output is active when the enabling current paths are open.

10 Function and time diagrams

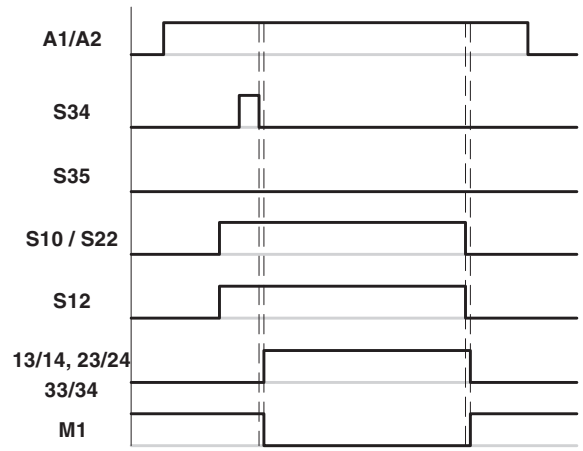
10.1 Time diagram for automatic start

Figure 1 Time diagram for automatic start



10.2 Time diagram for manual, monitored start

Figure 2 Time diagram for manual, monitored start

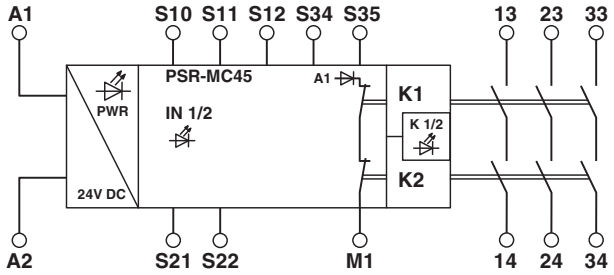


Key:

A1/A2	Power supply
S34	Manual, monitored start
S35	Automatic start
S10	Input sensor circuit (channel 2) for equivalent wiring without cross-circuit detection
S11	Output 24 V
S12	Input sensor circuit (channel 1)
S21	Output 0 V
S22	Input sensor circuit (channel 2) for equivalent wiring with cross-circuit detection
13/14, 23/24, 33/34	Undelayed enabling current paths
M1	Digital alarm output

11 Block diagram

Figure 3 Block diagram



Key:

A1	24 V DC power supply
A2	0 V power supply
S10	Input sensor circuit (channel 2) for equivalent wiring without cross-circuit detection
S11	Output 24 V
S12	Input sensor circuit (channel 1)
S21	Output 0 V
S22	Input sensor circuit (channel 2) for equivalent wiring with cross-circuit detection
S34	Manual, monitored start
S35	Automatic start
M1	Digital alarm output
13/14, 23/24, 33/34	Undelayed enabling current paths

11.1 Insulation coordination

	A1/A2 30 V	Logic 30 V	M1 30 V	13/14 250 V	23/24 250 V	33/34 250 V
A1/A2 30 V	-	-	-	4 kV BI	4 kV BI	4 kV BI
Logic 30 V	-	-	-	4 kV BI	4 kV BI	4 kV BI
M1 30 V	-	-	-	4 kV BI	4 kV BI	4 kV BI
13/14 250 V	4 kV BI	4 kV BI	4 kV BI	-	4 kV BI	4 kV BI
23/24 250 V	4 kV BI	4 kV BI	4 kV BI	4 kV BI	-	4 kV BI
33/34 250 V	4 kV BI	4 kV BI	4 kV BI	4 kV BI	4 kV BI	-

Key:

BI	Basic insulation

WARNING: Loss of electrical safety

Take measures outside the device to limit transient surge voltages to the respective value for overvoltage category II.

Basic insulation

(rated surge voltage of 4 kV)

A mixture of SELV and PELV is strictly prohibited. Only switch 250 V AC at one of the enable contacts if the adjacent contact/enabling current path carries the same potential.

12 Derating

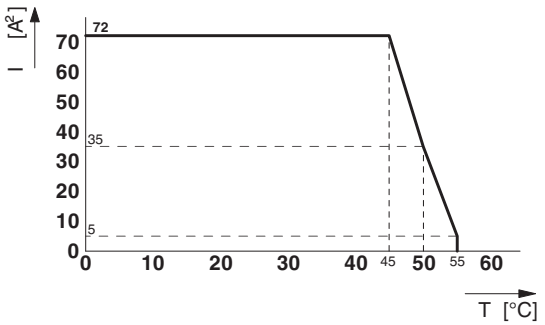
The temperature is measured at a 5 cm clearance below or to the side of the device.

12.1 Vertical or horizontal mounting position without spacing

The derating curve applies for the following conditions:

– Mounting on a vertical or horizontal DIN rail
– Devices mounted next to each other without spacing
– at U_S up to max. 30 V DC

Figure 4 Derating curve - vertical or horizontal mounting position, without spacing



12.2 Vertical or horizontal mounting position with spacing

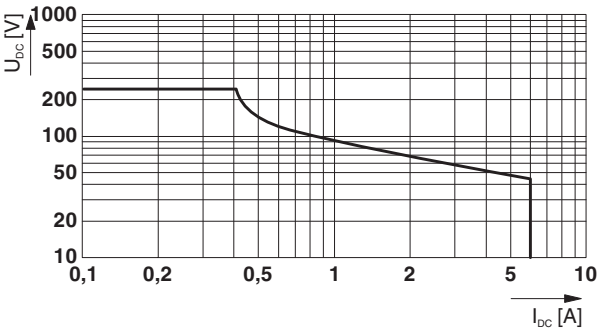
If the devices are mounted with a clearance of ≥10 mm between one another, derating is not required.

13 Relay data

13.1 Load limit curve

Ohmic load

Figure 5 Relay load limit curve – resistive load



13.2 Electrical service life

Figure 6 Number of switching cycles for AC-1

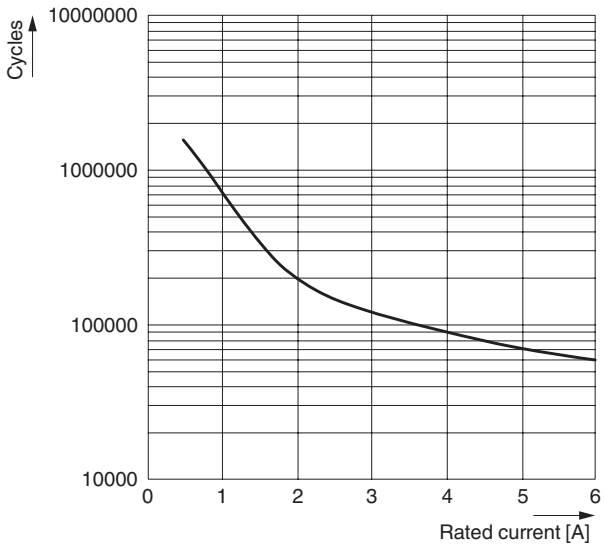


Figure 7 Number of switching cycles for AC-15

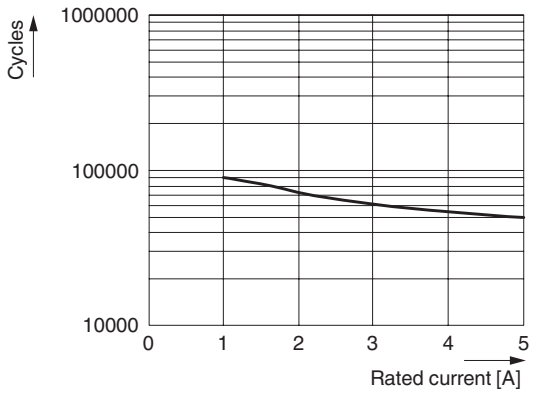


Figure 8 Number of switching cycles for DC-1

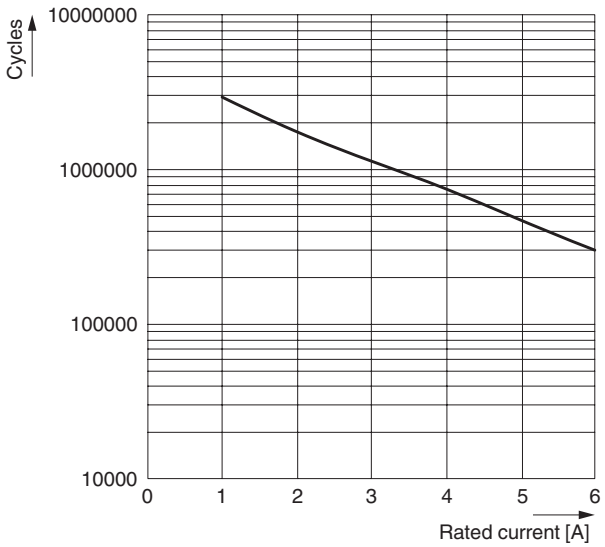
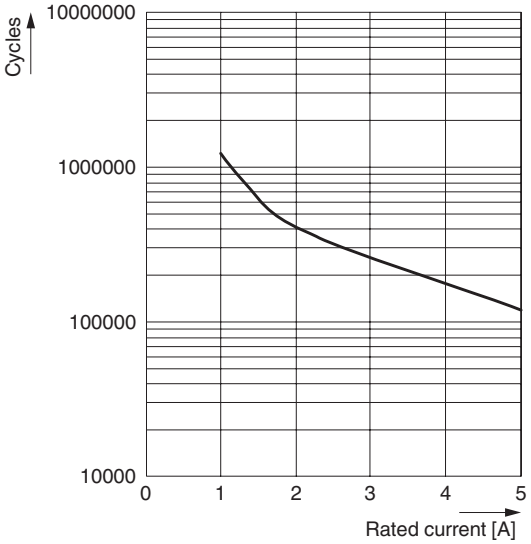


Figure 9 Number of switching cycles for DC-13



Behavior of the electrical service life

The service life curves indicate the number of switching cycles after which wear-related failures must be expected.

They depend on the utilization category and the expected load current.

Example:

Let's assume:

– Inductive load = 1 A
– Utilization category = AC15

This results in a contact service life of 90000 switching cycles.

WARNING: Loss of functional safety

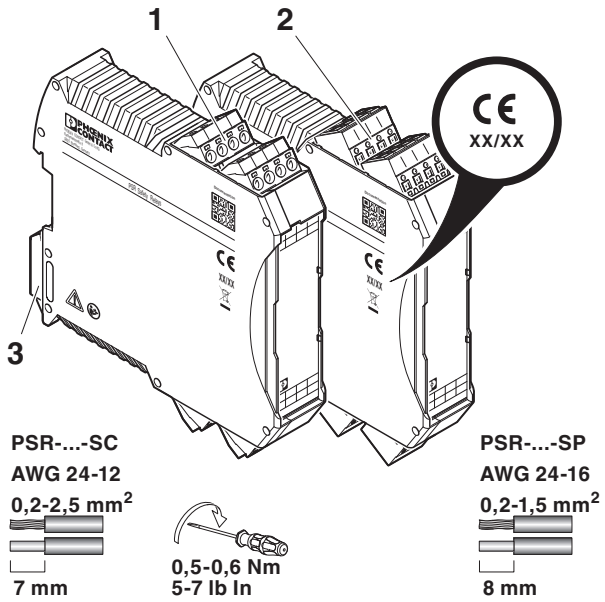
At the end of the electrical service life, there is an increased risk of loss of functional safety.

- Replace the device in good time before the end of the electrical service life.

14 Operating and indication elements

14.1 Connection versions

Figure 10 Connection versions



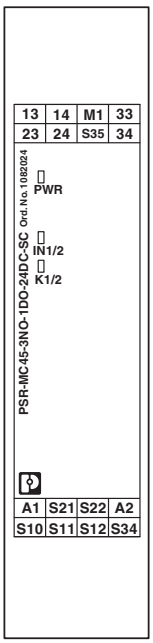
1 COMBICON plug-in screw terminal block
2 Pluggable COMBICON Push-in terminal block
3 Metal lock for fixing to DIN rail

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

14.2 Connection assignment



13/14	
23/24	Undelayed enabling current paths
33/34	
M1	Digital alarm output
S35	Automatic start
PWR	Power, LED (green)
IN1/2	Status indicator sensor circuit; LED (green)
K1/2	Status indicator safety circuit, LED (green)
A1	24 V DC power supply
A2	0 V power supply
S21	Output 0 V
S22	Input sensor circuit (channel 2) for equivalent wiring with cross-circuit detection
S10	Input sensor circuit (channel 2) for equivalent wiring without cross-circuit detection
S11	Output 24 V
S12	Input sensor circuit (channel 1)
S34	Manual, monitored start

14.3 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.

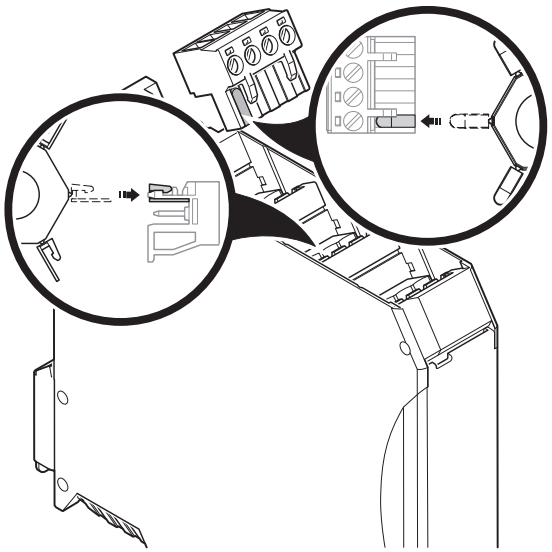
Coding profiles are plugged into the groove of the pluggable terminal block.

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.

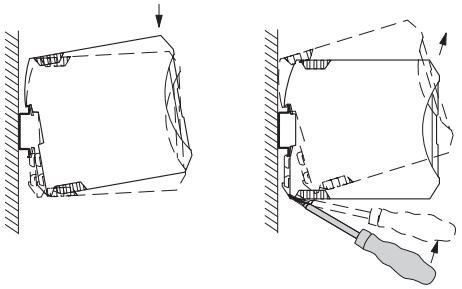
Figure 11 Attach coding elements



15 Mounting and removing

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

Figure 12 Mounting and removing



16 Wiring

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

Figure 13 Connecting the cables for PSR-...-SC (screw terminal block)

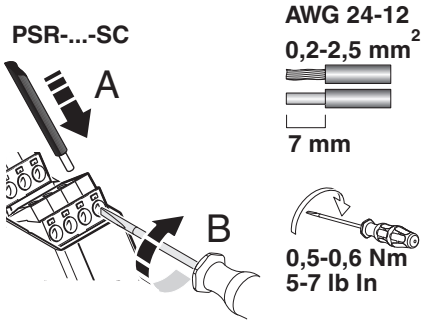
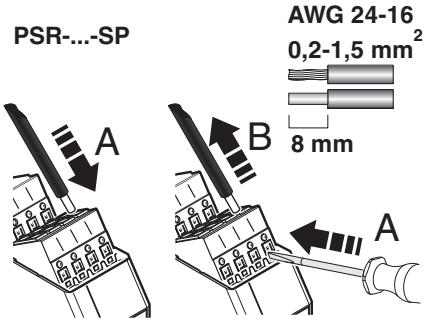


Figure 14 Connecting the cables for PSR-...-SP (Push-in terminal block)



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

Use the CRIMPFOX 6 crimping tool from Phoenix Contact.

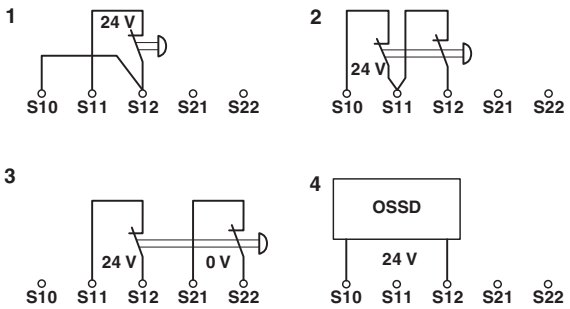
The tool enables the reliable processing of ferrules and easy removal of conductors with ferrules from the connection terminal blocks.

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

16.1 Signal generator connection versions

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

Figure 15 Signal generator connection versions



1 1-channel connection

2 2-channel connection without cross-circuit monitoring

3 2-channel connection with cross-circuit monitoring

4 2-channel connection with **external** cross-circuit detection by the signal generator

If control is 1-channel via a PLC, the digital output of the PLC must satisfy the requirements in accordance with the required safety integrity.

16.2 Start and feedback circuit connection variants

Automatic start

- Bridge the contacts A1/S35.

Manual, monitored start

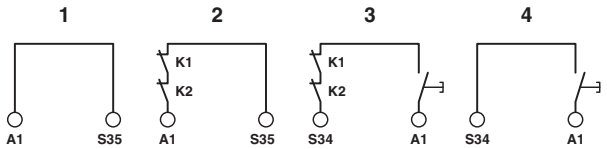
- Connect a reset button to contacts A1/S34.

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 16 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

WARNING: Risk of automatic machine restart

If the manual reset function with monitored start is used, a cross-circuit between A2/S21/0 V and the cable from the reset button to S34 can result in automatic machine startup.

- Prevent a cross-circuit between A2/S21/0 V and the cable from the reset button to S34 by means of design measures (see error prevention in accordance with EN ISO 13849-2).

17 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 IN1/2 LED lights up.

Signal output M1 is active.

Automatic start

The enabling current paths 13/14, 23/24 and 33/34 close.

The K1/2 LED lights up.

Signal output M1 is not active.

Manual, monitored start

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

The enabling current paths 13/14, 23/24 and 33/34 close.

The K1/2 LED lights up.

Signal output M1 is not active.

18 Calculating the power dissipation

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

Input power dissipation

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

Contact power dissipation

$P_{Contact} = (I_{L1}^2 + I_{L2}^2 + ... + I_{Ln}^2) \bullet 200\ m\Omega$

Total power dissipation

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

$P_{Total} = U_B^2 / (U_S/I_S) + (I_{L1}^2 + I_{L2}^2 + ... + I_{Ln}^2) \bullet 200\ m\Omega$

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	Contact load current

19 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.

WARNING: Loss of functional safety due to malfunction

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

- Replace the device.

20 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.

20.1 General states

Key:

○ LED OFF
● LED ON

LED			State	Notes
PWR	IN1/2	K1/2		
●	○	○	No relays are activated. The sensor circuit is inactive.	Possible error see error messages
●	●	○	The sensor circuit is active. Relays K1 and K2 are ready to start and are waiting fo a manual (S34) or automatic (S35) start command.	
●	●	●	The sensor circuit is active. All relays are picked up.	-

20.2 Error messages

Key:

○ LED OFF
● LED ON

LED			State	Possible cause	Corrective
PWR	IN1/2	K1/2			
●	○	○	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. The reset/start circuit (S34 or S35) is/was activated. The safety circuit (K1 and K2) is not picking up.	External error: the readback contact (external actuator) is open in the reset circuit. Internal error: 1. The diagnostic contact is not working correctly. 2. An N/O contact is welded.	External error: check the actuator. Internal error: 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. The reset/start circuit (S34 or S35) is/was activated. The safety circuit (K1) is not picking up.	External error: sensor circuit channel 1 was opened and reactivated. Internal error: diagnostics active.	External error: check the sensor circuit. Internal error: 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. The reset/start circuit (S34 or S35) is/was activated. The safety circuit (K2) is not picking up.	External error: sensor circuit channel 2 was opened and reactivated. Internal error: diagnostics active.	External error: check the sensor circuit. Internal error: 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.

21 Application examples

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

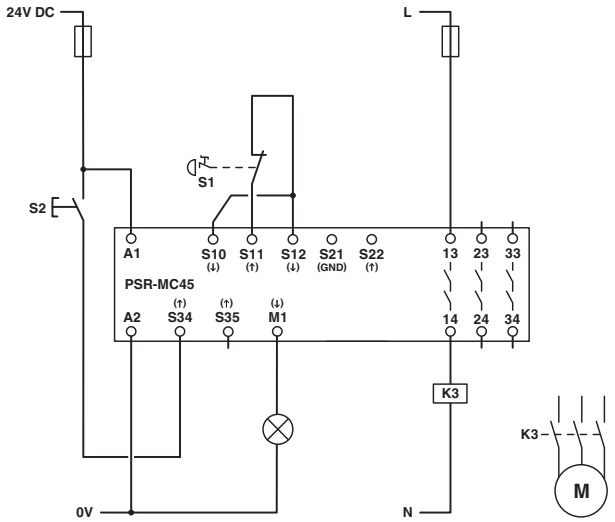
Application description:

- 1-channel emergency stop monitoring
- Manual, monitored start
- No cross-circuit detection in the sensor circuit
- Monitoring of external, force-guided contactors

Achievable safety integrity:

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

Figure 17 1-channel emergency stop monitoring/manual, monitored start



Key:

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

21.2 Emergency stop monitoring / manual, monitored start / without cross-circuit detection

Application description:

- 2-channel emergency stop monitoring
- No cross-circuit detection in the sensor circuit
- Monitoring of external, force-guided contactors
- It is assumed that errors in the cable installation for triggering the actuator and in the sensor circuit have been eliminated

Notes:

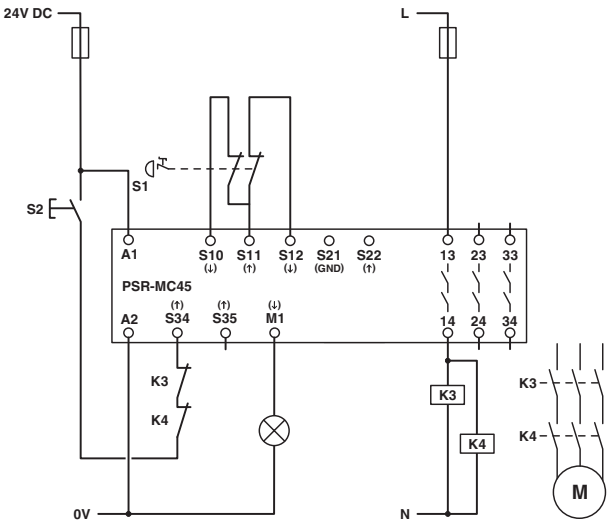
Cross-circuits in the cable installation can be ruled out in the same electrical installation space or through mechanically protected cable installation.

For sensor circuits in the field, prevent cross-circuits by using a cable installation that is protected mechanically.

Achievable safety integrity:

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

Figure 18 Emergency stop monitoring / manual, monitored start / without cross-circuit detection



Key:

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

21.3 Emergency stop monitoring/manual, monitored start

Application description:

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

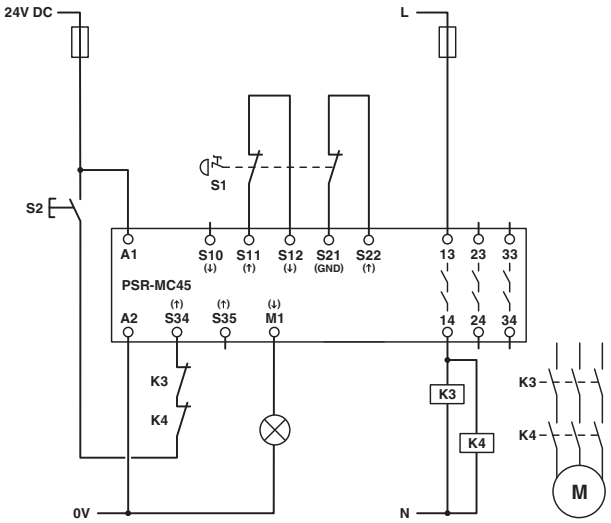
Notes:

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 IEC 62061)

Figure 19 Emergency stop monitoring/manual, monitored start



Key:

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

21.4 Light grid monitoring/manual, monitored start

Application description:

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

Notes:

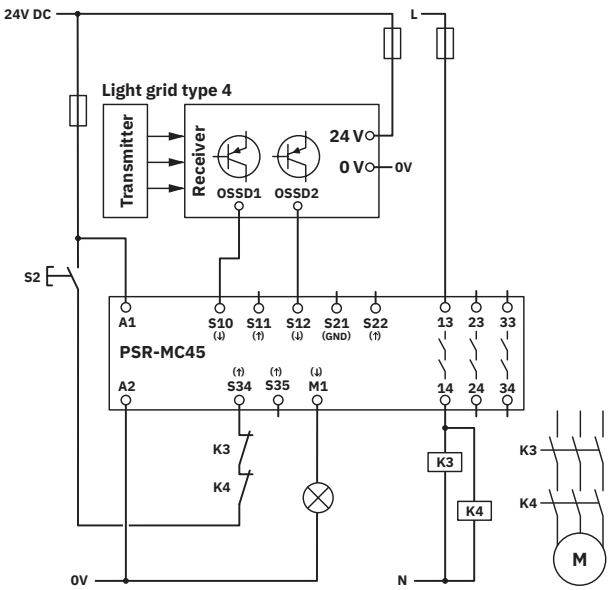
WARNING: Loss of functional safety
Make sure that the signal generator and the safety relay have the same ground potential.

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 IEC 62061)

Figure 20 Light grid monitoring/manual, monitored start



Key:

S2	Manual reset device
K1/K2	Force-guided contactors

21.5 Non-contact safety door switch monitoring / manual, monitored start

Application description:

- 2-channel safety door switch monitoring
- Manual, monitored start
- Cross-circuit detection in the sensor circuit using PSR-CT safety switch
- Monitoring of external, force-guided contactors
- It is assumed that errors in the cable installation for triggering the actuator have been eliminated

Notes:

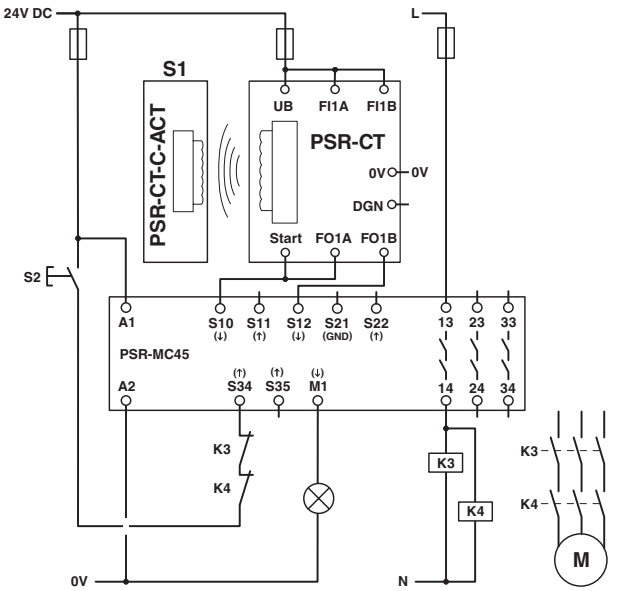
WARNING: Loss of functional safety
Make sure that the signal generator and the safety relay have the same ground potential.

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 IEC 62061)

Figure 21 Non-contact safety door monitoring / manual, monitored start



Key:

S2	Manual reset device
K1/K2	Force-guided contactors

22 Device replacement, device defect, and repair

22.1 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

22.2 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.

23 Maintenance, decommissioning, and disposal

23.1 Maintenance

The device requires no maintenance during the permissible mission time. Refer to the technical data for the mission time 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.

23.2 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 symbol with the crossed-out trash can indicates that this item must be collected and disposed of separately from other waste.
Phoenix Contact or public collection sites will take the item back for free disposal. For information on the available disposal options, visit www.phoenixcontact.com.

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.

24 Attachment

24.1 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 **> 2000 m amsl up to max. 4500 m amsl** 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

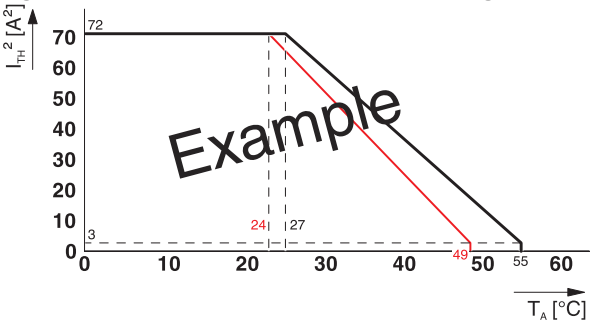
Example calculation for 3000 m

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)



24.2 Revision history

Version	Date	Contents
00	2019-08-09	First publication
01	2019-09-05	Section Technical Data: Filter time edited
02	2022-03-02	New product photo on cover page Safety regulations and installation notes section: General note removed, notes concerning decommissioning and disposal removed New sections added: Transport, storage, and unpacking; Device replacement, device defects, and repairs; Maintenance, decommissioning, and disposal Operating and indication elements section: Figures changed Block diagram section: figure changed
03	2025-11-03	Section "Technical data": Air clearance and creepage distance attribute removed; section “Interface type (ZVEI classification)” added; "Safety regulations and installation notes" section: Reference to safety notes for installation and mounting inserted in other languages