

# PSR-MS40 / PSR-MS45

PL  
EN ISO 13849

SILCL  
IEC 62061

## Safety relay for emergency stop and safety door monitoring



Data sheet  
106169\_en\_01

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## 1 Description

### Intended Use

The **PSR-MS40** and **PSR-MS45** safety relays can be used to monitor two-channel signal generators, e.g., emergency stop buttons and safety door locking mechanisms, as well as to control actuators.

The safety relays are equipped with an enabling current path that drops out without delay according to stop category 0 in accordance with EN 60204-1.

In the case of the **PSR-MS40** safety relay, the enabling current path is controlled automatically once the sensor circuit has been closed.

In the case of the **PSR-MS45** safety relay, the enabling current path is controlled once the sensor circuit has been closed and the manual reset device (reset button) has first been pressed and released again (manual, monitored start).

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

### Features

- Safety relay for emergency stop and safety door monitoring
- Suitable up to category 4, PL e (EN ISO 13849-1), SILCL 3 (EN 62061)
- 1 two-channel sensor circuit
- 1 undelayed enabling current path
- 1 digital signal output
- Fixed screw connection
- 6.8 mm housing width



#### **WARNING: Risk of electric shock**

Observe the safety instructions in the corresponding section!



Make sure you always use the latest documentation.

It can be downloaded from the product at [phoenixcontact.net/products](http://phoenixcontact.net/products).



This data sheet meets the same requirements as the original operating instructions in terms of contents and is valid for all products listed on the following pages.

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### 3 Ordering data

Description	Type	Order No.	Pcs. / Pkt.
Safety relay for emergency stop and safety doors up to SIL 3, SILCL 3, Cat. 4, PL e, 2-channel operation, automatic start, 1 enabling current path, $U_S = 24$ V DC, fixed screw terminal block	PSR-MS40-1NO-1DO-24DC-SC	2904954	1
Safety relay for emergency stop and safety doors up to SIL 3, SILCL 3, Cat. 4, PL e, 2-channel operation, manual, monitored start, 1 enabling current path, $U_S = 24$ V DC, fixed screw terminal block	PSR-MS45-1NO-1DO-24DC-SC	2904955	1

### 4 Technical data

Hardware/firmware version	
HW/FW	≥ 00/-- (The technical data and safety characteristics are valid as of the specified HW/FW version.)
Input data	
Rated control supply voltage $U_S$	24 V DC -15 % / +10 %
Rated control supply current $I_S$	typ. 42 mA
Typical inrush current	4.5 A ( $\Delta t = 120 \mu s$ at $U_S$ ) < 20 mA (with $U_S/I_x$ to S12) < 10 mA (with $U_S/I_x$ at the start circuit) < 5 mA (with $U_S/I_x$ to S22/ $U_S$ ) > -15 mA (with $U_S/I_x$ to S22/0V)
Current consumption	< 5 mA (with $U_S/I_x$ to S12) < 5 mA (with $U_S/I_x$ to S22/ $U_S$ ) < 10 mA (with $U_S/I_x$ at the start circuit) > -5 mA (with $U_S/I_x$ to S22/0V)
Power consumption at $U_S$	typ. 1 W
Voltage at input/start and feedback circuit	24 V DC -15 % / +10 %
Filter time	1 ms (at A1 in the event of voltage dips at $U_S$ ) max. 1.5 ms (at S12, S22; test pulse width) min. 7.5 ms (at S12, S22; test pulse rate) Test pulse rate = 5 x Test pulse width
Max. permissible overall conductor resistance (Input and reset circuit at $U_S$ )	150 $\Omega$
Typical response time at $U_S$	< 175 ms
Typical starting time with $U_S$	< 250 ms (when controlled via A1)
Typical release time with $U_S$	< 20 ms (when controlled via A1 or S12 and S22.)
Recovery time	< 500 ms
Maximum switching frequency	0.5 Hz
Operating voltage display	1 x green LED
Status display	2 x green LEDs
Protective circuit	Surge protection Suppressor diode Reverse polarity protection for rated control supply voltage
Output data	
Contact type	1 enabling current path
Contact material	AgSnO <sub>2</sub>
Minimum switching voltage	20 V AC/DC
Maximum switching voltage	250 V AC/DC
Limiting continuous current	6 A (N/O contact)
Maximum inrush current	6 A
Inrush current, minimum	3 mA
Sq. Total current	36 A <sup>2</sup> (see to derating)

**Output data**

Switching capacity min.	60 mW
Mechanical service life	10 x 10 <sup>6</sup> cycles
Output fuse	6 A gL/gG (N/O contact) 4 A gL/gG (for low-demand applications)

**Alarm outputs**

Number of outputs	1 (digital, PNP)
Voltage	22 V DC (U <sub>S</sub> - 2 V)
Current	max. 100 mA
Maximum inrush current	500 mA (Δt = 1 ms at U <sub>S</sub> )
Short-circuit protection	no

**General data**

Relay type	Electromechanically forcibly guided, dust-proof relay.
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
Dimensions (W/H/D)	6.8 x 93.1 x 102.5 mm
Type of housing	PBT yellow
Clearances and creepage distances between the power circuits	DIN EN 50178
Rated insulation voltage	250 V AC
Rated surge voltage/insulation	Safe isolation, reinforced insulation 6 kV between input circuit and enabling current path Basic insulation 4 kV between all current paths and housing
Pollution degree	2
Surge voltage category	III

**Connection data**

Connection method	Screw connection
Conductor cross section, solid	0.2 mm <sup>2</sup> ... 2.5 mm <sup>2</sup>
Conductor cross section, stranded	0.2 mm <sup>2</sup> ... 2.5 mm <sup>2</sup>
Conductor cross section AWG/kcmil	26 ... 12
Stripping length	12 mm
Screw thread	M3

**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	max. 2000 m (Above sea level)
Shock	15g
Vibration (operation)	10 Hz ...150 Hz, 2g

**Conformance / approvals**

Conformance	CE-compliant
Approvals	

**Safety data**

Stop category according to IEC 60204 0

**Safety parameters for IEC 61508 - High demand**

SIL 3

PFH<sub>d</sub>  $1.5 \times 10^{-9}$  (4 A DC13; 5 A AC15; 8760 switching cycles/year)

Demand rate < 12 Months

Proof test interval 240 Months

Duration of use 240 Months

**Safety parameters for IEC 61508 - Low demand**

SIL 3

PFD<sub>avg</sub>  $1.47 \times 10^{-4}$

Proof test interval 60 Months

Duration of use 240 Months

**Safety parameters for EN 62061**

SIL CL 3

**Safety characteristic data according to EN ISO 13849**

Category 4

Performance level e (4 A DC13; 5 A AC15; 8760 switching cycles/year)

Duration of use 240 Months

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

## 5 Safety notes



### **WARNING: Risk of electric shock**

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

Before working on the switching device, disconnect the power.

Please observe the safety regulations of electrical engineering and industrial safety and liability associations!

Disregarding these safety regulations may result in death, serious personal injury or damage to equipment.

Startup, mounting, modifications, and upgrades should only be carried out by a skilled electrical engineer!



### **WARNING: Risk of automatic machine restart!**

For emergency stop applications, the machine must be prevented from restarting automatically by a higher-level control system.

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



### **WARNING: Danger due to faulty devices!**

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

In the event of an error, replace the device immediately.

Repairs to the device, especially if the housing must be opened, may only be carried out by the manufacturer or authorized persons. Otherwise the warranty is invalidated.



### **WARNING: Risk due to incorrect installation**

For reliable operation, the safety relay must be installed in housing protected from dust and humidity (IP54).

Carry out wiring according to the application. Refer to the "Application examples" section for this.



### **WARNING: Risk due to welded relay contacts**

A suitable and effective protective circuit is to be provided for inductive loads. This is to be implemented parallel to the load and not parallel to the switch contact.



### **WARNING: danger due to magnetic interference!**

Do not use the device in the vicinity of strong magnetic fields (e.g., caused by transformers or magnetic iron). The magnetic field strength of the environment must not exceed 30 A/m.



### **NOTE: Risk of damage to equipment due to noise emissions**

When operating relay modules the operator must meet the requirements for noise emission for electrical and electronic equipment (EN 61000-6-4) on the contact side and, if required, take appropriate measures.



### **NOTE: Risk of damage to equipment due to noise emissions**

This is a Class A product. In a domestic environment it may cause radio interference, in which case the user may be required to take adequate measures.



Only use power supply units with safe isolation and SELV / PELV in accordance with EN 50178/VDE 0160 (SELV / PELV).



### **NOTE: Electrostatic discharge!**

The device contains components that can be damaged or destroyed by electrostatic discharge. When handling the device, observe the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and EN 61340-5-2.

## 6 Basic circuit diagram

Key:

Designation	Explanation
A1	+24 V power supply
A2	0 V power supply
S12	Input sensor circuit (channel 1)
S22	Input sensor circuit (channel 2)
S35 (PSR-MS40 only)	Automatic start
S34 (PSR-MS45 only)	Manual, monitored start
13/14	Enabling current path, undelayed
M1	Signal output (PNP)

### 6.1 Block diagram PSR-MS40

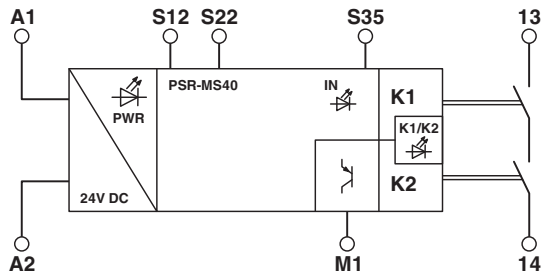


Figure 1 Block diagram PSR-MS40

### 6.2 Block diagram PSR-MS45

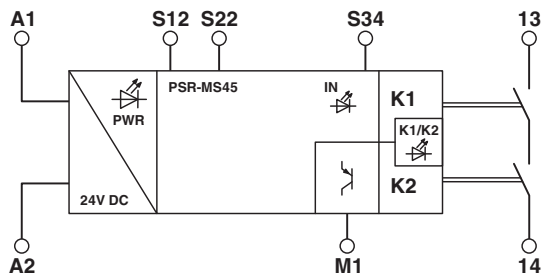


Figure 2 Block diagram PSR-MS45

## 7 Derating

### 7.1 Vertical or horizontal mounting position

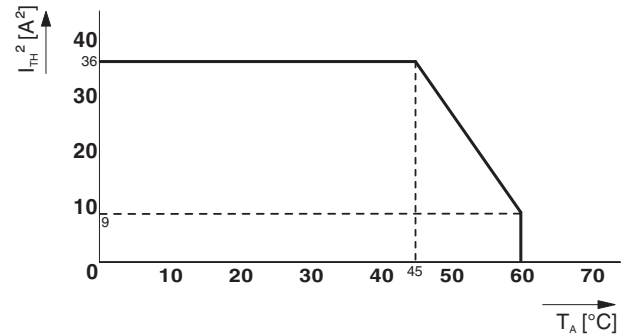


Figure 3 Derating curve - vertical or horizontal mounting position with connected modules

## 8 Load curve

### 8.1 Ohmic load

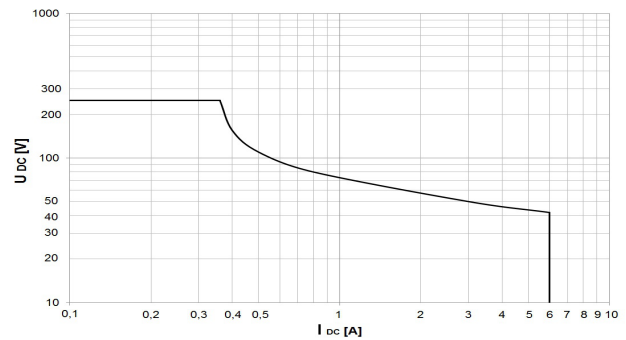


Figure 4 Relay load curve - ohmic load

## 9 Function/time diagrams

Key:

Designation	Explanation
A1/A2	Power supply
S35 (PSR-MS40 only)	Automatic start
S34 (PSR-MS45 only)	Manual, monitored start
S12	Input sensor circuit (channel 1)
S22	Input sensor circuit (channel 2)
13/14	Enabling current path, undelayed
M1	Signal output (PNP)

### 9.1 Time diagram PSR-MS40

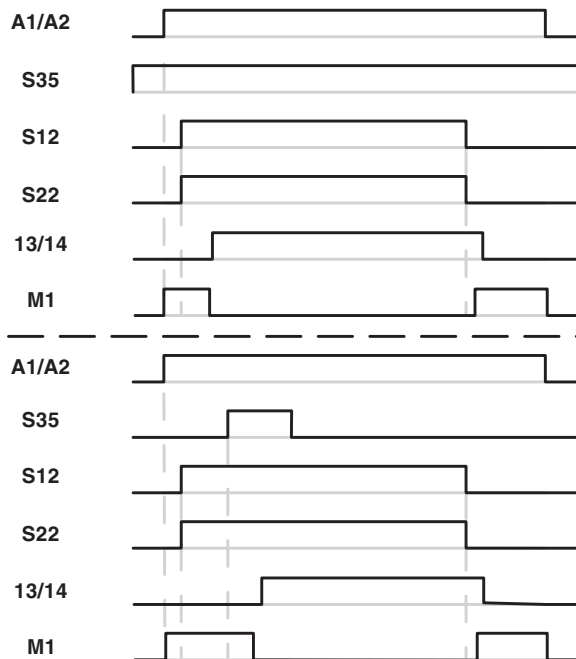


Figure 5 Time diagram PSR-MS40

### 9.2 Time diagram PSR-MS45

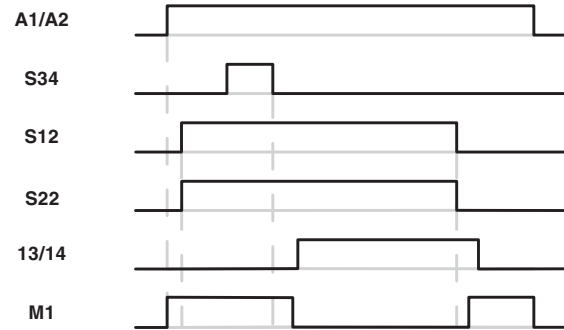


Figure 6 Time diagram PSR-MS45

## 10 Operating and indication elements

### 10.1 Connection versions

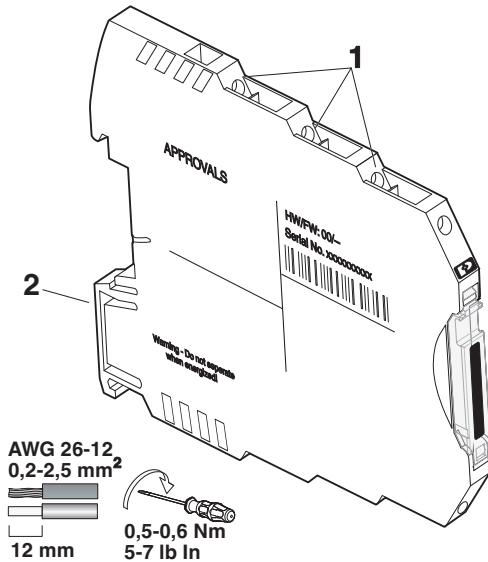


Figure 7 Connection versions

- 1 Fixed screw connection
- 2 Snap-on foot for DIN rail mounting



The year the device was constructed can be found underneath the CE designation on the housing.

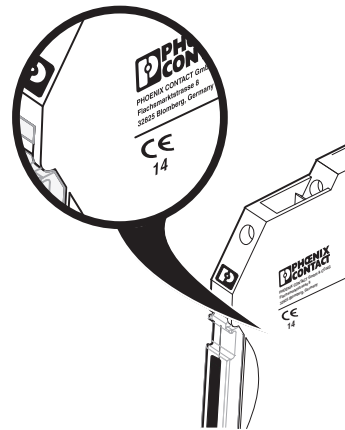


Figure 8 Year of manufacture of the device

### 10.2 Connection assignment

**Figure**

**Designation**

**Explanation**



A 1	A 1	+24 V power supply
A 2	A 2	0 V power supply
S 22	S 22	Input sensor circuit (channel 2)
S 12	S 12	Input sensor circuit (channel 1)
PWR	PWR	Power LED (green)
IN	IN	Status indicator sensor circuit; LED (green)
K1/K2	K1/K2	Status indicator safety circuit; LED (green)
S 35 (PSR-MS40 only)	S 35 (PSR-MS40 only)	Automatic start
S 34 (PSR-MS45 only)	S 34 (PSR-MS45 only)	Manual, monitored start
1 4	1 4	Enabling current path, undelayed
1 3	1 3	Enabling current path, undelayed
M 1	M 1	Signal output (PNP)

## 11 Mounting and connection

Mount the module on a 35 mm DIN rail according to EN 60715.

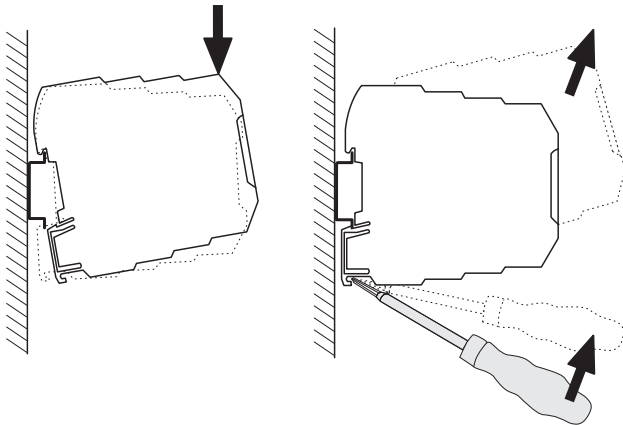


Figure 9 Mounting and removing

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

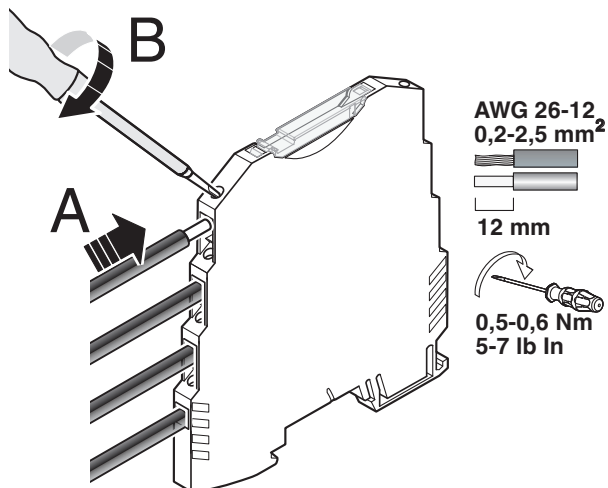


Figure 10 Connection of the cables



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

## 12 Startup

Apply the rated control supply voltage (24 V DC) at terminal blocks A1/A2. The PWR LED lights up.

Close sensor circuit 24 V/S12 and 24 V/S22. The IN LED lights up.

### Automatic start (PSR-MS40 only):

Close contacts 24 V/S35. The enabling current path closes.

### Manual, monitored start (PSR-MS45 only):

Close contacts 24 V/S34. When the start circuit is then opened, the enabling current path is closed.

The K1/K2 LED lights up.

If the rated control supply voltage drops or the sensor circuit (24 V/S12 or 24 V/S22) is opened, the enabling current path of the output circuit (13/14) opens and the contacts enter the safe state.

## 13 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

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

### Contact power dissipation

With the same load currents:

$$P_{\text{Contact}} = n \cdot I_L^2 \cdot 50 \text{ m}\Omega$$

With different load currents:

$$P_{\text{Contact}} = (I_{L1}^2 + I_{L2}^2 + \dots + I_{Ln}^2) \cdot 50 \text{ m}\Omega$$

### Total power dissipation

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

therefore

$$P_{\text{Total}} = U_B^2 / (U_S / I_S) + n \cdot I_L^2 \cdot 50 \text{ m}\Omega$$

or

$$P_{\text{Total}} = U_B^2 / (U_S / I_S) + (I_{L1}^2 + I_{L2}^2 + \dots + I_{Ln}^2) \cdot 50 \text{ m}\Omega$$

### Key:

Designation	Explanation
P	Power dissipation in mW
$U_B$	Applied operating voltage
$U_S$	Rated control supply voltage
$I_S$	Rated control supply current
n	Number of enabling current paths used
$I_L$	Contact load current

## 14 Diagnostics

### Function test/proof test

The following section describes the LED indicators for general states and error messages as well as possible causes and remedies.



Use the function test to check the safety function. To do this, request the safety function once by pressing the emergency stop button, for example. Check whether the safety function is running correctly by switching the device on again via the sensor circuits.

#### 14.1 General states

PWR LED	IN LED	K1/K2 LED	State	Notes
ON	OFF	OFF	All relays are not activated. The sensor circuit is off.	Possible error see error messages
ON	ON	OFF	The sensor circuit is active. Relays K1 and K2 are ready to start and await reset/start command (S34 or S35).	-
ON	ON	ON	The sensor circuit is active. All relays are picked up.	-

#### 14.2 Error Messages

PWR LED	IN LED	K1/K2 LED	State	Possible cause	Remedy
ON	OFF	OFF	The sensor circuit is actively controlled, but no input LEDs are lit up.	Interrupt in the sensor circuit or faulty signal generator.	Check the sensor circuit/signal generator. Then perform a function test.
ON	ON	OFF	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. <b>If the error occurs again after the function test, replace the device.</b>
ON	ON	OFF	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.	Error in the sensor circuit.	Check the sensor circuit. Then perform a function test. <b>If the error occurs again after the function test, replace the device.</b>
ON	ON	OFF	The sensor circuit is active. The reset/start circuit (S34) is/was activated. The safety circuit (K1 and K2) is not picking up.	Error during manual reset S34 (stuck-at at the input).	Remove the error in the reset/start circuit. Then perform a function test.
OFF	OFF	OFF	The sensor circuit is active.	1. No supply voltage at A1/A 2. Over- or undervoltage at A1	Check the supply voltage.

## 15 Application examples

### Key:

- S1 = Emergency stop button
- S2 = Manual reset device
- S3 = Solenoid switch
- B1/B2 = Mechanical safety door switches
- K1/K2 = Contactors



Cross-circuits in the cable installation can be excluded if the safety relay and external contactors K1 and K2 are located in the same electrical installation space.

### Applications with the PSR-MS40

#### 15.1 Emergency stop monitoring/automatic start

- Two-channel emergency stop monitoring
- Automatic start
- No cross-circuit detection in the sensor circuit
- Suitable up to category 4, PL e (EN ISO 13849-1), SILCL 3 (EN 62061), if cross-circuits in the control to the actuator and the sensor circuit can be ruled out

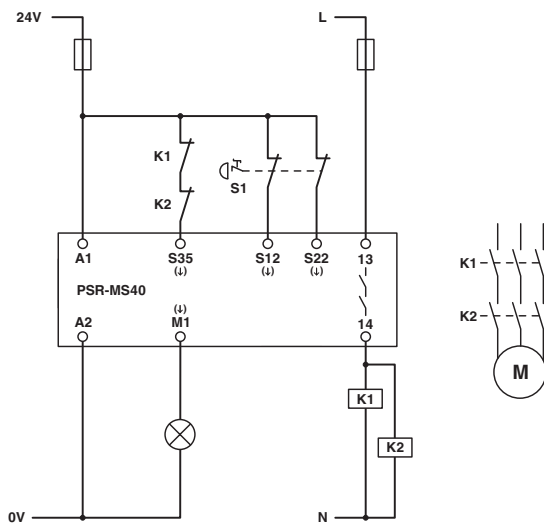


Figure 11 Emergency stop monitoring/automatic start

#### 15.2 Safety door monitoring/automatic start

- Two-channel safety door monitoring
- Automatic start
- No cross-circuit detection in the sensor circuit
- Suitable up to category 4, PL e (EN ISO 13849-1), SILCL 3 (EN 62061), if cross-circuits in the control to the actuator and the sensor circuit can be ruled out

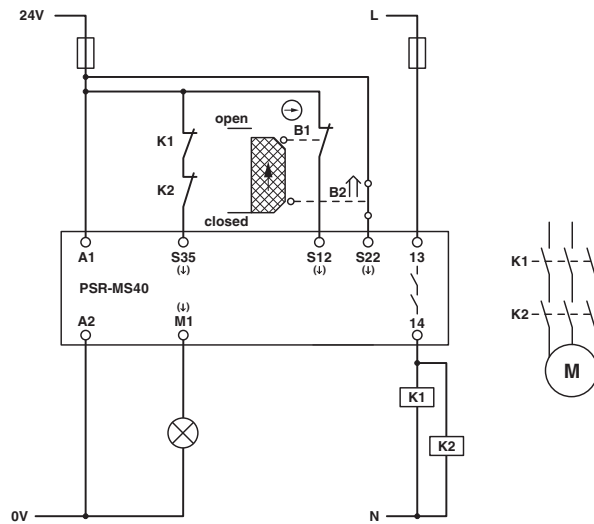


Figure 12 Safety door monitoring/automatic start

### 15.3 Magnetic switch monitoring/automatic start

- Two-channel magnetic switch monitoring
- Automatic start
- No cross-circuit detection in the sensor circuit
- Suitable up to category 4, PL e (EN ISO 13849-1), SILCL 3 (EN 62061), if cross-circuits in the control to the actuator and the sensor circuit can be ruled out

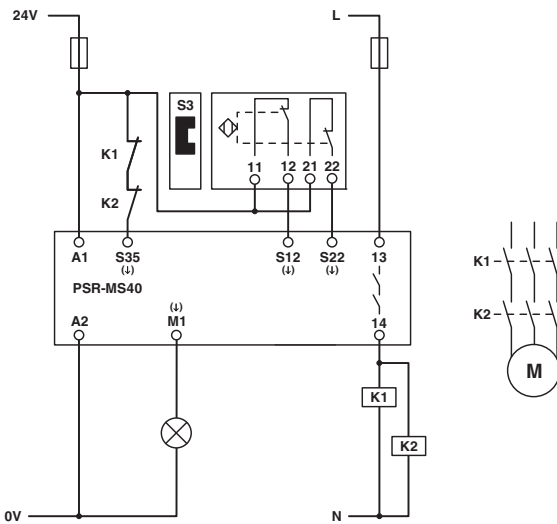


Figure 13 Magnetic switch monitoring/automatic start

### Applications with the PSR-MS45

#### 15.4 Emergency stop monitoring/manual, monitored start

- Two-channel emergency stop monitoring
- Manual, monitored start
- No cross-circuit detection in the sensor circuit
- Suitable up to category 4, PL e (EN ISO 13849-1), SILCL 3 (EN 62061), if cross-circuits in the control to the actuator and the sensor circuit can be ruled out

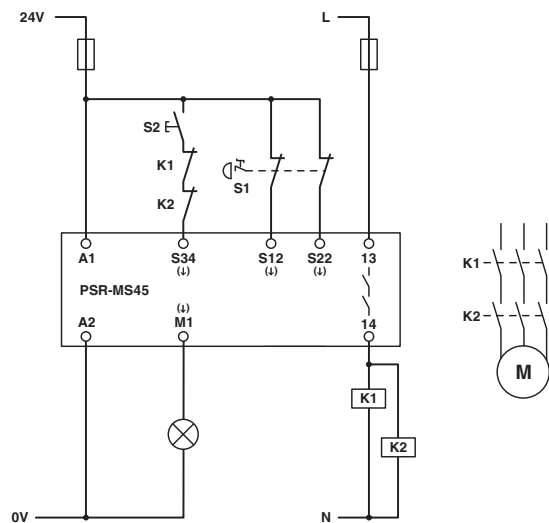


Figure 14 Emergency stop monitoring/manual, monitored start

### 15.5 Safety door monitoring/manual, monitored start

- Two-channel safety door monitoring
- Manual, monitored start
- No cross-circuit detection in the sensor circuit
- Suitable up to category 4, PL e (EN ISO 13849-1), SILCL 3 (EN 62061), if cross-circuits in the control to the actuator and the sensor circuit can be ruled out

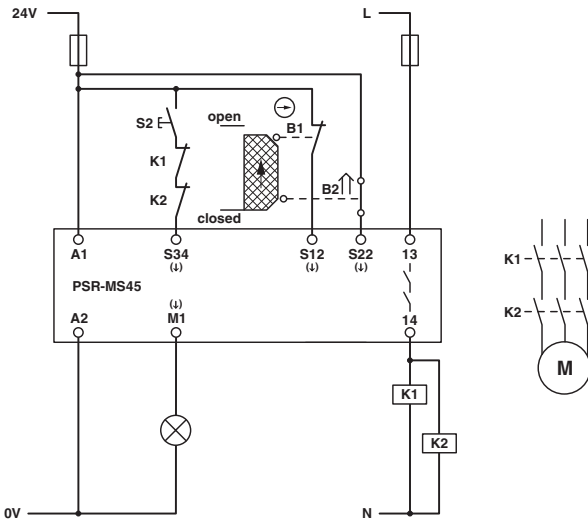


Figure 15 Safety door monitoring/manual, monitored start

### 15.6 Magnetic switch monitoring/manual, monitored start

- Two-channel magnetic switch monitoring
- Manual, monitored start
- No cross-circuit detection in the sensor circuit
- Suitable up to category 4, PL e (EN ISO 13849-1), SILCL 3 (EN 62061), if cross-circuits in the control to the actuator and the sensor circuit can be ruled out

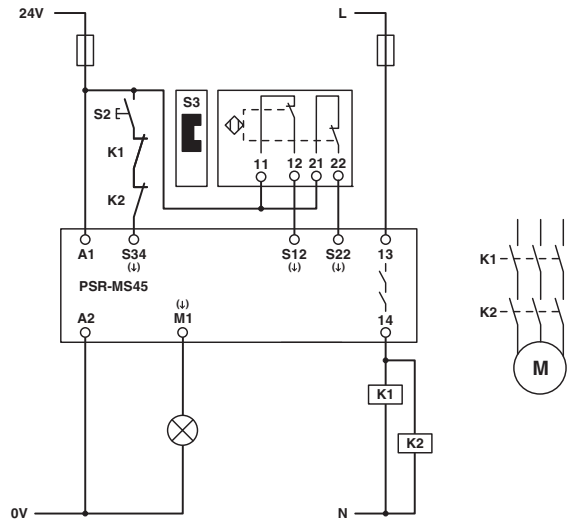


Figure 16 Magnetic switch monitoring/manual, monitored start

## 16 Revision history

Version	Date	Contents
00	2014-12-03	First publication
01	2015-03-05	Reverse polarity protection extended; relay type extended; dimensions updated; load curve extended
01_c00	2015-05-19	Caption of figure 4 corrected (translation error)