PSR-MS60

PL
EN ISO 13849

SILCL
IEC 62061



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

Data sheet
106171_en_02

© PHOENIX CONTACT 2015-08-21

1 Description

Intended Use

The **PSR-MS60** safety relay can be used to monitor two-channel signal generators, e.g., emergency stop buttons, safety door locking mechanisms, and light grids, as well as to control actuators.

The safety relay is equipped with two single-channel enabling current paths that drop out without delay according to stop category 0 and EN 60204-1.

The enabling current paths are controlled automatically once the sensor circuit has been closed.

Features

- Safety relay for emergency stop, safety door, and light grid monitoring
- Suitable up to category 4, PL e (EN ISO 13849-1), SILCL 3 (EN 62061)
- 1 two-channel sensor circuit
- 2 undelayed single-channel enabling current paths
- 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.

This document meets the same requirements as the original operating instructions in terms of contents and is valid for all products listed in the “Ordering data” section.

2 Table of contents

1 Description ... 1
2 Table of contents ... 2
3 Ordering data ... 3
4 Technical data ... 3
5 Safety notes ... 6
6 Basic circuit diagram ... 7
7 Derating ... 7
7.1 Vertical or horizontal mounting position ... 7
8 Load curve ... 7
8.1 Ohmic load ... 7
9 Function/time diagrams ... 7
10 Operating and indication elements ... 8
10.1 Connection versions ... 8
10.2 Connection assignment ... 8
11 Mounting and connection ... 9
12 Startup ... 9
13 Calculating the power dissipation ... 10
14 Diagnostics ... 11
14.1 General states ... 11
14.2 Error Messages ... 11
15 Application examples ... 12
15.1 Light grid monitoring/automatic start ... 12
15.2 Two-channel control via LPSDO module ... 12
15.3 Single-channel control via failsafe controller ... 13
16 Revision history ... 14

3 Ordering data

Description	Type	Order No.	Pcs. / Pkt.
Safety relay for emergency stop, safety doors, and light grids up to SIL 3, SILCL 3, Cat. 4, PL e, 2-channel operation, automatic start, 2 enabling current paths (1-channel), U_S = 24 V DC, fixed screw terminal block	PSR-MS60-2NO-24DC-SC	2904958	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. 40 mA
Input voltage range "0"-signal	0 V DC ... 5 V DC (for safe off)
Typical inrush current	4.5 A (Δt = 120 µs at U_s) < 20 mA (with U_s/I_x to S12) < 20 mA (with U_s/I_x to S22)
Current consumption	< 5 mA (with U_s/I_x to S12) < 5 mA (with U_s/I_x to S22)
Power consumption at U_S	typ. 0.96 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 (Test pulse duration) min. 7.5 ms (Test pulse rate) Test pulse rate = 5 x Test pulse width
Max. permissible overall conductor resistance (Input and reset circuit at U_S)	150 Ω
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	2 enabling current paths
Contact material	$AgSnO_2$
Minimum switching voltage	10 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	72 A^2 (see to derating)
Switching capacity min.	30 mW
Mechanical service life	10 x 10^6 cycles
Output fuse	6 A gL/gG (N/O contact) 4 A gL/gG (for low-demand applications)

General data

Relay type	Electromechanical relay with forcibly guided contacts in accordance with IEC/EN 61810-3 (EN 50205)
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 (13/14) and enabling current path (23/24) 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 mm² ... 2.5 mm²
Conductor cross section, stranded	0.2 mm² ... 2.5 mm²
Conductor cross section AWG/kcmil	26 ... 12
Stripping length	12 mm
Screw thread	M3

Ambient conditions

Ambient temperature (operation)	-40 °C ... 55 °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_d	1.5×10^{-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_{avg}	1.47×10^{-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 radion inteference, 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

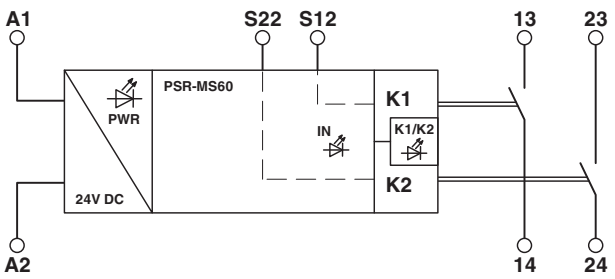


Figure 1 Block diagram

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)
13/14	Enabling current path (channel 1), undelayed
23/24	Enabling current path (channel 2), undelayed

7 Derating

7.1 Vertical or horizontal mounting position

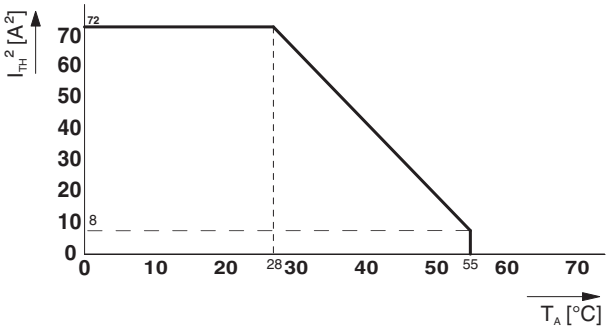


Figure 2 Derating curve - vertical or horizontal mounting position with connected modules

8 Load curve

8.1 Ohmic load

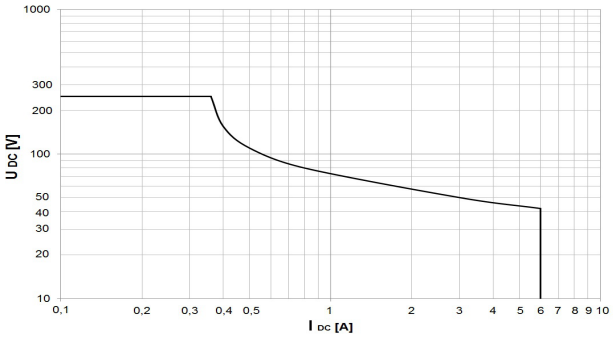


Figure 3 Relay load curve - ohmic load

9 Function/time diagrams

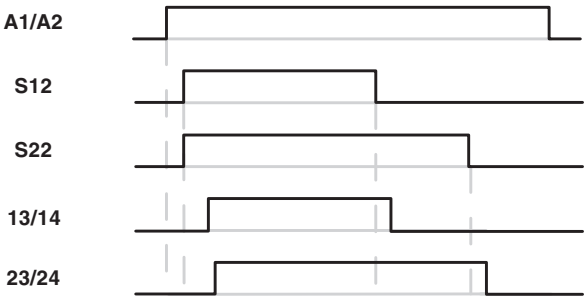


Figure 4 Time diagram

Key:

Designation	Explanation
A1/A2	Power supply
S12	Input sensor circuit (channel 1)
S22	Input sensor circuit (channel 2)
13/14	Enabling current path (channel 1), undelayed
23/24	Enabling current path (channel 2), undelayed

10 Operating and indication elements

10.1 Connection versions

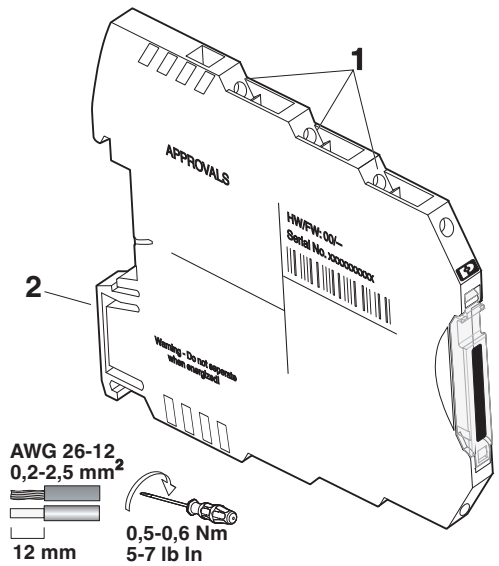


Figure 5 Connection versions

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.

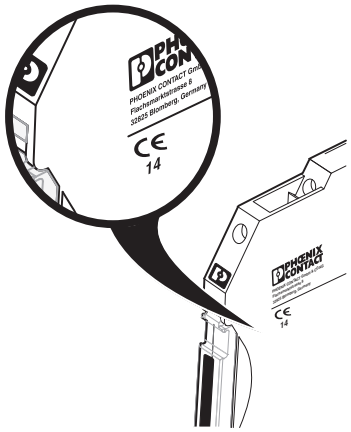


Figure 6 Year of manufacture of the device

10.2 Connection assignment

Figure	Designation	Explanation
	A1	+24 V power supply
	A2	0 V power supply
	S22	Input sensor circuit (channel 2)
	S12	Input sensor circuit (channel 1)
	PWR	Power LED (green)
	IN	Status indicator sensor circuit; LED (green)
	K1/K2	Status indicator safety circuit; LED (green)
	23/24	Enabling current path (channel 2), undelayed
	13/14	Enabling current path (channel 1), undelayed

11 Mounting and connection

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

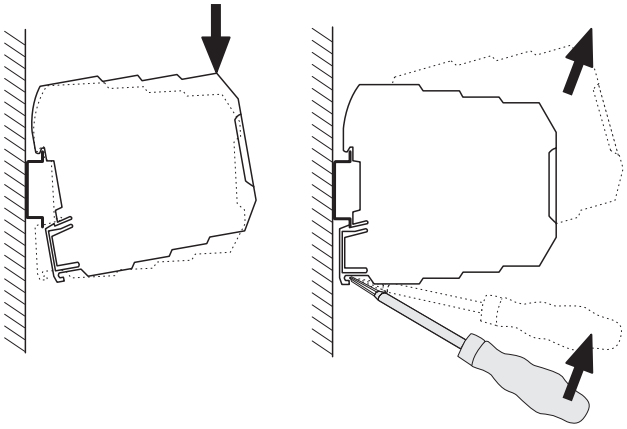


Figure 7 Mounting and removing

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

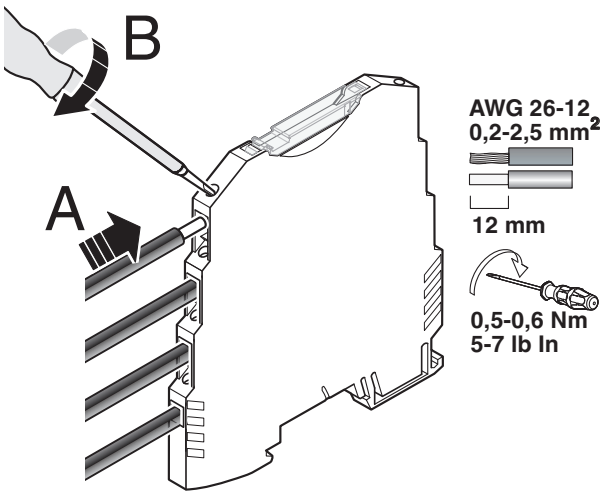


Figure 8 Connection of the cables

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.

The K1/K2 LED lights up.

If the rated control supply voltage drops, the enabling current paths of the output circuits (13/14 and 23/24) open and the contacts enter the safe state.

If a channel to the sensor circuit is opened (24 V/S12 or 24 V/S22) the corresponding enabling current path opens (13/14 or 23/24).

The sensor circuits are assigned to the enabling current paths as follows:
S12 to 13/14 and **S22 to 23/24**
(see block diagram).
This means:
If only sensor circuit S12 opens, only enabling current path 13/14 is opened.
If sensor circuit S22 also opens, enabling current path 23/24 is also opened.

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

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

Contact power dissipation

With the same load currents:

$P_{Contact} = n \bullet I_L^2 \bullet 25\ m\Omega$

With different load currents:

$P_{Contact} = (I_{L1}^2 + I_{L2}^2 + ... + I_{Ln}^2) \bullet 25\ m\Omega$

Total power dissipation

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

therefore

$P_{Total} = U_B^2 / (U_S/I_S) + n \bullet I_L^2 \bullet 25\ m\Omega$

or

$P_{Total} = U_B^2 / (U_S/I_S) + (I_{L1}^2 + I_{L2}^2 + ... + I_{Ln}^2) \bullet 25\ m\Omega$

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

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

Function test/proof test



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	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 safety circuit (K1 and K2) is not picking up.	Internal error: 1. The diagnostic contact is not working correctly. 2. An N/O contact is welded.	Internal error: perform a power down reset with subsequent function test. **If the error occurs again after the function test, replace the device.**
ON	ON	OFF	The sensor circuit is active. The safety circuit (K1 and K2) is not picking up.	Error in the sensor circuit.	Check the sensor circuit. Then perform a function test. **If the error occurs again after the function test, replace the device.**
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:

K1/K2 = Contactors

Applications with the PSR-MS60

15.1 Light grid monitoring/automatic start

- Two-channel light grid monitoring
- Automatic start
- Monitoring of external contactors
- Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (EN 62061)

WARNING: Loss of functional safety!

Make sure that the signal generator (e.g., PLC output card or light grid) and the safety relay have the same ground potential.

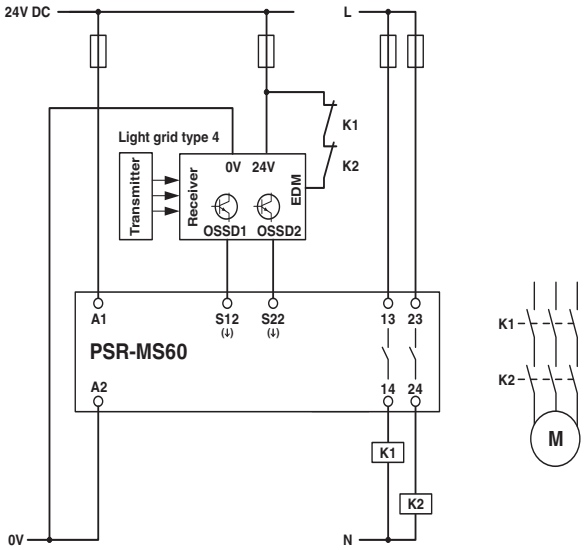


Figure 9 Light grid monitoring/automatic start

15.2 Two-channel control via LPSDO module

- Two-channel control
- Cross-circuit detection by means of LPSDO module
- Automatic start
- Monitoring of external contactors
- Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (EN 62061)

WARNING: Loss of functional safety!

Make sure that the signal generator (e.g., PLC output card or light grid) and the safety relay have the same ground potential.

The bright pulses (test pulses generated by switching on briefly) sent by the controller can lead to the brief, unwanted activation of the safety relay. You should therefore deactivate the bright pulses of the failsafe controller.

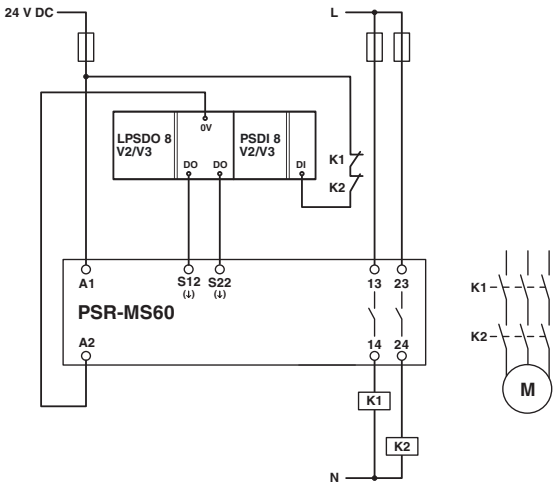


Figure 10 Two-channel control via LPSDO module

15.3 Single-channel control via failsafe controller

– Single-channel control
– Automatic start
– Monitoring of external contactors
– Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (EN 62061) if the digital output of the safety-related controller meets PL e, SIL 3 and cross-circuits can be ruled out

WARNING: Loss of functional safety!

Make sure that the signal generator (e.g., PLC output card or light grid) and the safety relay have the same ground potential.

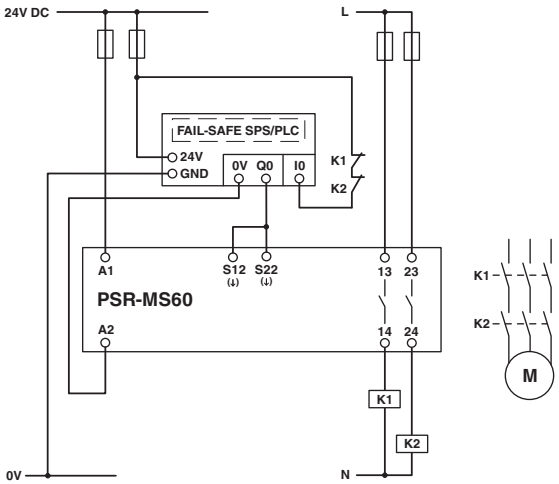


Figure 11 Single-channel control via failsafe PLC

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
02	2015-08-21	Input voltage range "0"-signal added; relay type changed; application examples and notes for the examples revised