PSR-...- 24DC/ESD/4X1/30

PL
EN ISO 13849

Safety relay for emergency stop, safety door and light grid monitoring with adjustable delay time

Data sheet
103840_en_04

 2023-10-19

1 Description

The **PSR-ESD-30** safety relay can be used for emergency stop and light grid/safety door monitoring as well as in safety circuits according to DIN EN 60204-1.

With this switching device, circuits are interrupted in a safety-oriented manner. Single-channel or two-channel control is available, either with an automatic or a manual start circuit. A connected reset button (connected to A1/S34) is monitored.

Depending on the external wiring, up to category 4, PL e in accordance with EN ISO 13849-1 or SIL 3 in accordance with EN IEC 62061 can be achieved.

The safety relay has two enabling current paths that drop out without delay according to stop category 0. Two other enabling current paths drop out with a delay in compliance with stop category 1.

Features

- Emergency stop, safety door and light grid monitoring
- Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (EN IEC 62061)
- Single-channel or two-channel wiring with cross-circuit detection
- Two undelayed and two off-delay enable contacts
- Delay time can be progressively preset (0.1 s ... 30 s)
- Automatic or manual start circuit
- Optional pluggable screw or Push-in terminal blocks

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.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.

2 Table of contents

3 Ordering data

Description	Type	Item no.	Pcs./Pkt.
Safety relay for emergency stop and safety door monitoring up to SIL 3 or Cat. 4, PL e in accordance with EN ISO 13849, automatic or manual activation, 2 N/O contacts with a dropout delay of 0.1 s ... 30 s, plug-in screw connection terminal block	PSR-SCP- 24DC/ESD/4X1/30	2981800	1
Safety relay for emergency stop and safety door monitoring up to SIL 3 or Cat. 4, PL e in accordance with EN ISO 13849, automatic or manual activation, 2 N/O contacts with a fixed dropout delay of 0.1 s ... 30 s, pluggable Push-in terminal block	PSR-SPP- 24DC/ESD/4X1/30	2981813	1
Set of 35 safety relays for emergency stop and safety door monitoring up to SIL 3 or Cat. 4, PL e in accordance with EN ISO 13849, automatic or manual activation, 2 N/O contacts with a dropout delay of 0.1 s to 30 s, plug-in screw connection terminal block	PSR-SCP-24DC/ESD/4X1/ 30-SET35	1217839	1

4 Technical data

Hardware/firmware version	
HW/FW	≥ 09/1800
The technical data and safety characteristics are valid as of the specified HW/FW version.	

Input data	
Nominal input voltage U_N	24 V DC
Input voltage range (factor)	0.85 ... 1.1
Typical input current	75 mA DC
Voltage at input/start and feedback circuit	approx. 24 V DC
Max. permissible overall conductor resistance (Input and reset circuit at U_N)	500 Ω (Input and reset circuit at U_N)
Typical response time	150 ms (Monitored/manual and auto-start)
Typical release time	20 ms (Undelayed contacts) 100 ms (delayed contacts)
Delay time range	0.1 s ... 30 s ±40 % (K3, K4 adjustable)
Recovery time	330 ms (Restart)
Operating voltage display	Green LED
Status display	LED K1/K2 and K3(t)/K4(t), green
Protective circuit	Suppressor diode, 33 V DC

Output data	
Contact switching type	4 enabling current paths
Contact material	$AgSnO_2$
Minimum switching voltage	15 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	25 mA
Sq. Total current $I_{TH}^2 = I_1^2 + I_2^2 + ... + I_N^2$	120 A^2 (see derating curve)
Interrupting rating (ohmic load) max.	144 W (24 V DC, τ = 0 ms) 288 W (48 V DC, τ = 0 ms) 90 W (110 V DC, τ = 0 ms) 88 W (220 V DC, τ = 0 ms) 1500 VA (250 V AC, τ = 0 ms)
Maximum interrupting rating (inductive load)	42 W (24 V DC, τ = 40 ms) 33 W (48 V DC, τ = 40 ms) 25 W (110 V DC, τ = 40 ms) 23 W (220 V DC, τ = 40 ms)
Switching capacity min.	0.4 W
Mechanical service life	approx. 10^7 cycles
Switching capacity (360/h cycles)	on request
Switching capacity (3600/h cycles)	3 A (24 V (DC13)) 3 A (230 V (AC15))
Output fuse	10 A gL/gG NEOZED (N/O contact)

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	any
Type of housing	Polyamide
Air clearances and creepage distances between the power circuits	DIN EN 60947-1
Rated insulation voltage	250 V
Rated surge voltage/insulation	4 kV / basic insulation
Degree of pollution	2
Overvoltage category	II

Dimensions	Screw connection	Push-in connection
W x H x D	22.5 x 99 x 114.5 mm	22.5 x 112 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
Stripping length	7 mm	8 mm
Screw thread	M3	

Ambient conditions	
Ambient temperature (operation)	-20 °C ... 45 °C
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)
Shock	15g
Vibration (operation)	10 Hz ... 150 Hz, 2g

Conformance/Approvals	
Approvals	

Safety data	
Stop category according to IEC 60204	0 (Undelayed contacts) 1 (delayed contacts)

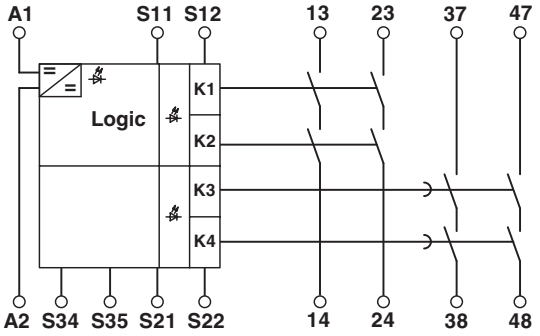
Safety parameters in accordance with IEC 61508 - high demand	
SIL	3
PFH_D	1.80×10^{-9}
Diagnostic coverage (DC)	99 %
$MTTF_D$	63311 Years
Demand rate	< 12 Months
Proof test interval	240 Months
Duration of use	240 Months
The specifications apply assuming the following calculation basis	
B_{10D}	400000 (at 3 A AC15 DC13)
d_{op}	365.25 Days
h_{op}	24 h
t_{Cycle}	3600 s

Safety parameters according to EN ISO 13849-1	
Category	4
Performance level	e
DC_{avg}	99 %
$MTTF_D$	124.23 Years
CCF	passed
Duration of use	240 Months
The specifications apply assuming the following calculation basis	
B_{10D}	400000 (at 3 A AC15 DC13)
d_{op}	365.25 Days
h_{op}	24 h
t_{Cycle}	3600 s

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

5 Block diagram

Figure 1 Block diagram

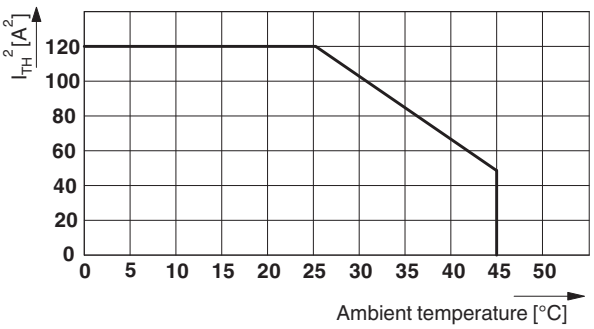


Key:

Designation	Explanation
A1/A2	Safety relay input voltage
S11/S12	Safety sensor/switch 1 input circuit
S21/S22	Safety sensor/switch 2 input circuit
S34/S35	Start circuit
13/14	Undelayed enabling current path 1
23/24	Undelayed enabling current path 2
37/38	Delayed enabling current path 1
47/48	Delayed enabling current path 2

6 Derating

Figure 2 Derating curve



7 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.

NOTE: Risk of damage to equipment 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.

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: Electronics may be damaged when overloaded

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

Taking out of service and disposal

- At the end of its service life, dispose of the product in accordance with the applicable environmental regulations.
- Make sure that the device can never be reused.

8 Operating and indication elements

8.1 Connection assignment

Figure 3 PSR-SCP-24DC/ESD/4X1/30

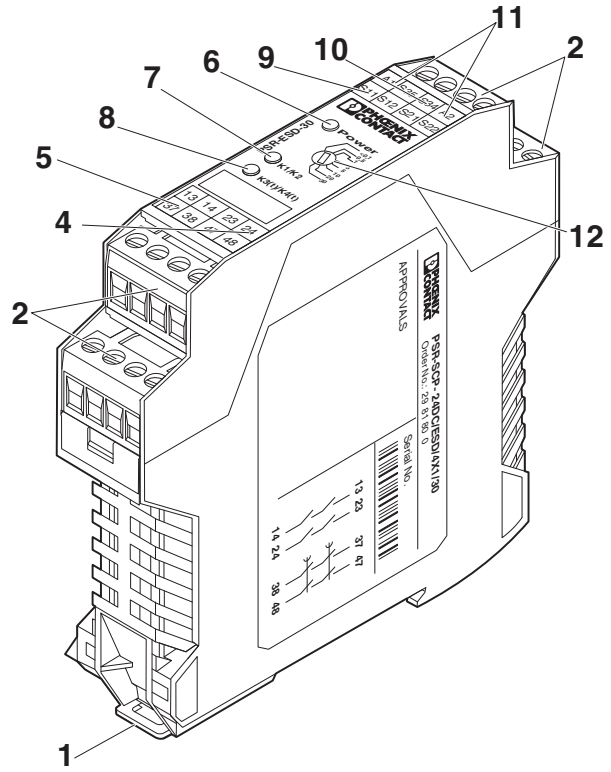
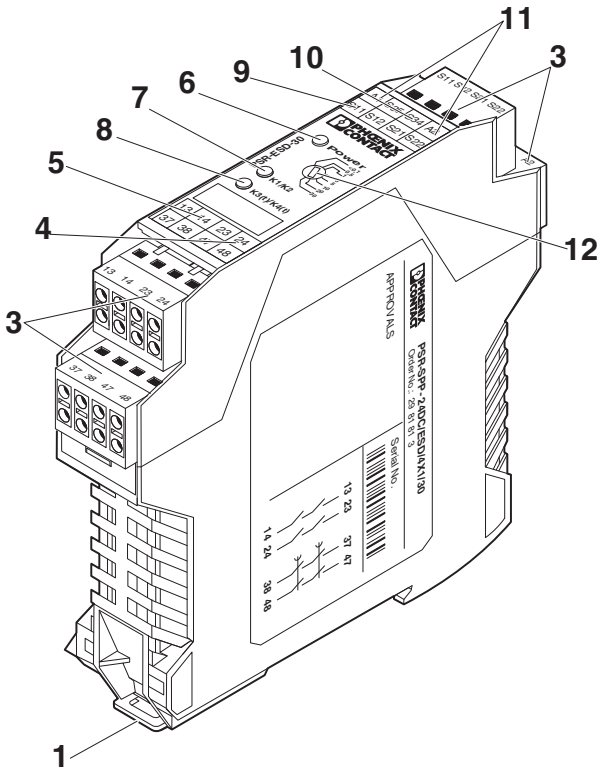


Figure 4 PSR-SPP-24DC/ESD/4X1/30



Key:

Designation	Explanation
1	Metal lock for mounting on the DIN rail
2	COMBICON plug-in screw terminal blocks
3	COMBICON plug-in spring-cage terminal blocks
4	13/14, 23/24 - undelayed enabling current paths
5	37/38, 47/48 - delayed enabling current paths
6	LED status indicator, green - Power
7	LED status indicator, green - K1/K2
8	LED status indicator, green - K3(t)/K4(t)
9	S11, S12, S21, S22 – input circuits
10	S34, S35 - start circuits
11	A1, A2 - supply voltage connection
12	Rotary switch, delay time 0.1s...30s

8.2 LED status indicators

PWR-LED	K1/K2-LED	K3(t)/K4(t) LED	Meaning	Measure/remedy in the event of an error
ON	OFF	OFF	Ready to operate	Safety relay is ready to operate
ON	ON	ON	Operating	Safety relay is active. The enabling current paths are closed.
Flashes 0.2 s	OFF	OFF	Internal error	Safety relay is faulty. Replace the safety relay.
Flashes 1 s	OFF	OFF	External error	Check the wiring and the operating voltage supply. In the case of a manual reset: Check for
Flashes 1 s	Flashes 1 s	OFF	Configuration errors	An error occurred during configuration. Check the wiring and operation. Then carry out configuration again in accordance with Section 9.
Flashes 1 s	Flashes 1 s	Flashes 1 s	Configuration required	Rotary switch has been modified. Carry out configuration again in accordance with Section 9.

For additional diagnostic descriptions, please refer to Section 7 of the application manual for PSR safety relays.

9 Configuration

Once configuration is complete, close the four enable current paths and the Power, K1/K2 and K3(t)/K4(t) LEDS are illuminated.

To configure the safety relay, proceed as follows:

1 Disconnect the safety relay from the supply voltage.
2 Set the delay time (1 s ... 30 s) at the rotary switch.
3 Restore the power supply.
4 Close the emergency stop circuits.
5 In the case of a **manual start:** press the reset button.
6 **Automatic start circuit:** wait for the configured delay time until the enabling current paths are closed and the Power LED lights up.
7 **Manual start circuit:** wait for the configured delay time and press the reset button until the enabling current paths are closed and the Power LED lights up.

WARNING: Danger due to incorrect delay time!

Check the set delay time following installation.

9.1 Setting the delay time

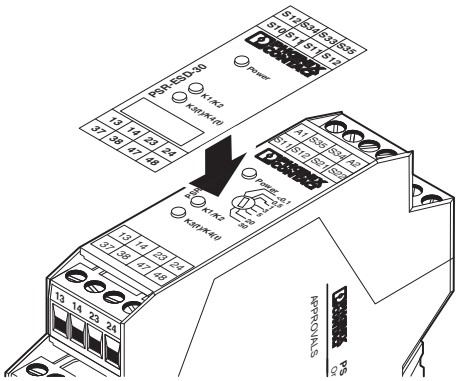
The delay time is set progressively between 0.1 s and 30 s via the rotary switch in the upper housing part.

If the rotary switch is modified during operation, the safety relay switches to configuration mode and the LEDs flash. The safety relay is only ready for operation again once the supply voltage has been switched off and on again and configuration has been carried out.

9.2 Protection against manipulation

Once the time has been set, the rotary switch can be protected against manipulation by covering with the label provided.

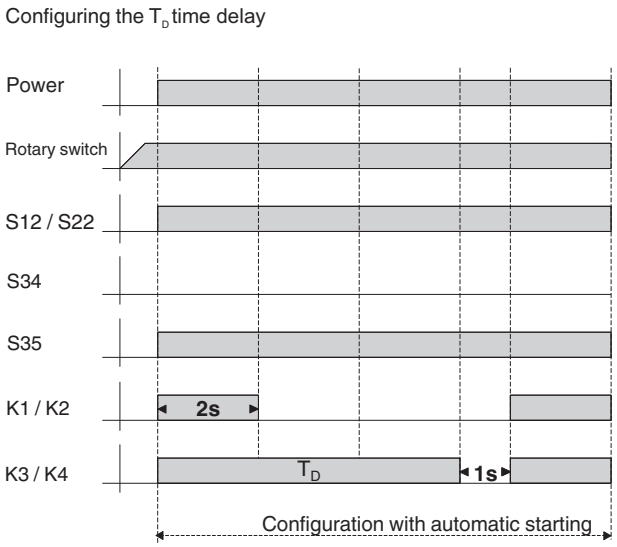
Figure 5 Applying the label



10 Timing Diagrams

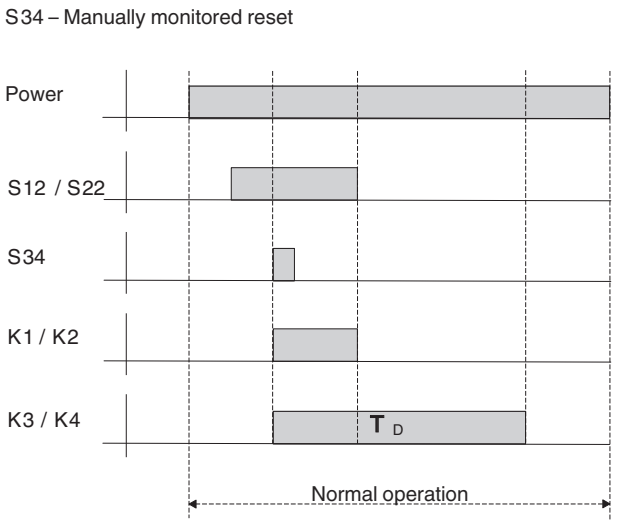
10.1 Configuring the time delay

Figure 6 Configuration of the delay time (in seconds)



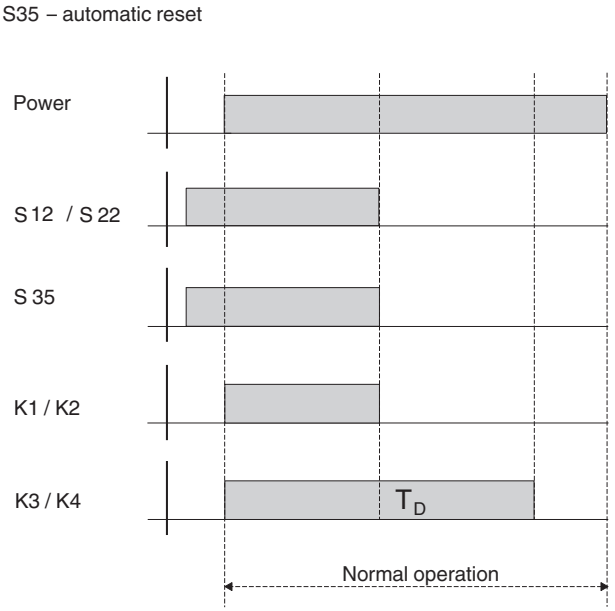
10.2 Manually monitored reset, S34

Figure 7 Manually monitored reset



10.3 Automatic reset, S35

Figure 8 Automatic reset



11 Operating modes

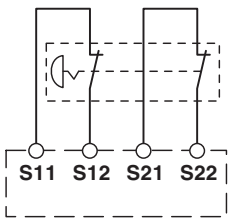
11.1 Two-channel with cross-circuit monitoring via clock outputs

If digital inputs S12 and S22 are controlled with the output signal of digital outputs S11 and S21, the emergency stop circuits are monitored for cross circuits by the safety relay.

After the safety function has been triggered by the opening of an emergency stop circuit, both emergency stop circuits must be opened once at the same time before it is possible to reset the enabling current paths.

If this condition is not met, the device signals an external error.

Figure 9 Cross-circuit monitoring

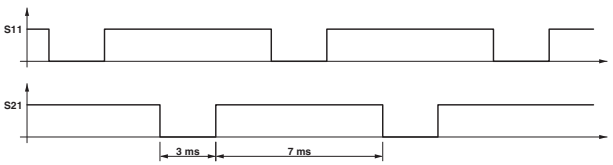


Signal form of the clock outputs

The following figure shows the signal form of clock outputs S11 and S22.

To ensure correct function of the application, the signals must not be smoothed too greatly by the capacitive and inductive behavior of the cable.

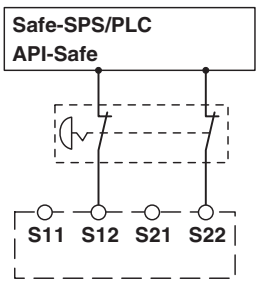
Figure 10 Signal form of the clock outputs



11.2 Two-channel with cross-circuit monitoring via external clock signals

If digital inputs S12 and S22 are controlled with the output signals of a safe PLC or API safe, the emergency stop circuits are monitored for cross circuits by the external clock signals.

Figure 11 Cross-circuit monitoring via external clock signals



Permitted signal form for light grid, safe PLC, and API safe

The following figure shows the permitted signal forms for external clock signals at inputs S12 and S22.

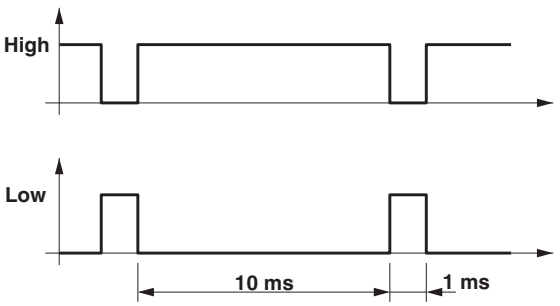
The following applies to the high signal:

– The blanking intervals must not exceed 1 ms.
– The time between the blanking intervals must be no less than 10 ms.

The following applies to the low signal:

– The pulses must not exceed 1 ms.
– The time between two pulses must be no less than 10 ms.

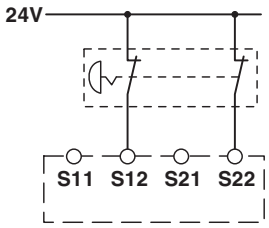
Figure 12 Permitted signal form for light grid, safe PLC, and API safe



11.3 Two-channel without cross-circuit monitoring

As an option, the two digital inputs S12 and S22 can be activated with a static 24 V DC signal. However, cross-circuit monitoring will no longer be available.

Figure 13 Two-channel without cross-circuit monitoring

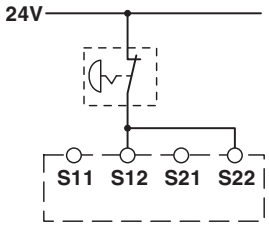


11.4 Single-channel without cross-circuit monitoring

Digital inputs S12 and S22 can be connected via a 24 V connection

This application is not “single-fault tolerant”

Figure 14 Single-channel without cross-circuit detection

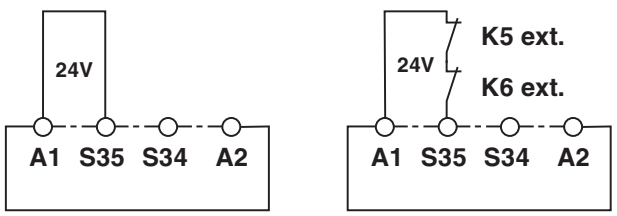


11.5 Automatic start circuit

Connect S35 to A1. The enabling current paths close automatically when the power supply is switched on with closed emergency stop circuits.

After the emergency stop, the enabling current paths close automatically when the emergency stop circuits are closed. This also applies if the emergency stop circuits are closed before the delay time has elapsed.

Figure 15 Automatic start circuit



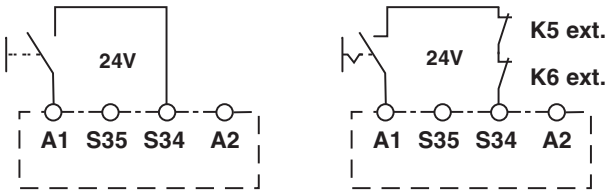
11.6 Manual start circuit

Connect S34 to A1 via a button or an enabling contact or use a PLC output for control.

Monitoring of input S34 prevents the enabling current paths from closing in the following situations:

- Digital input S34 at HIGH level when switching on the power supply.
- Digital input S34 does not switch to LOW level on demand and before the set delay time has elapsed.
- Digital input S34 at HIGH level when closing the emergency stop circuits.
- Manual and automatic start circuit simultaneously at HIGH level.

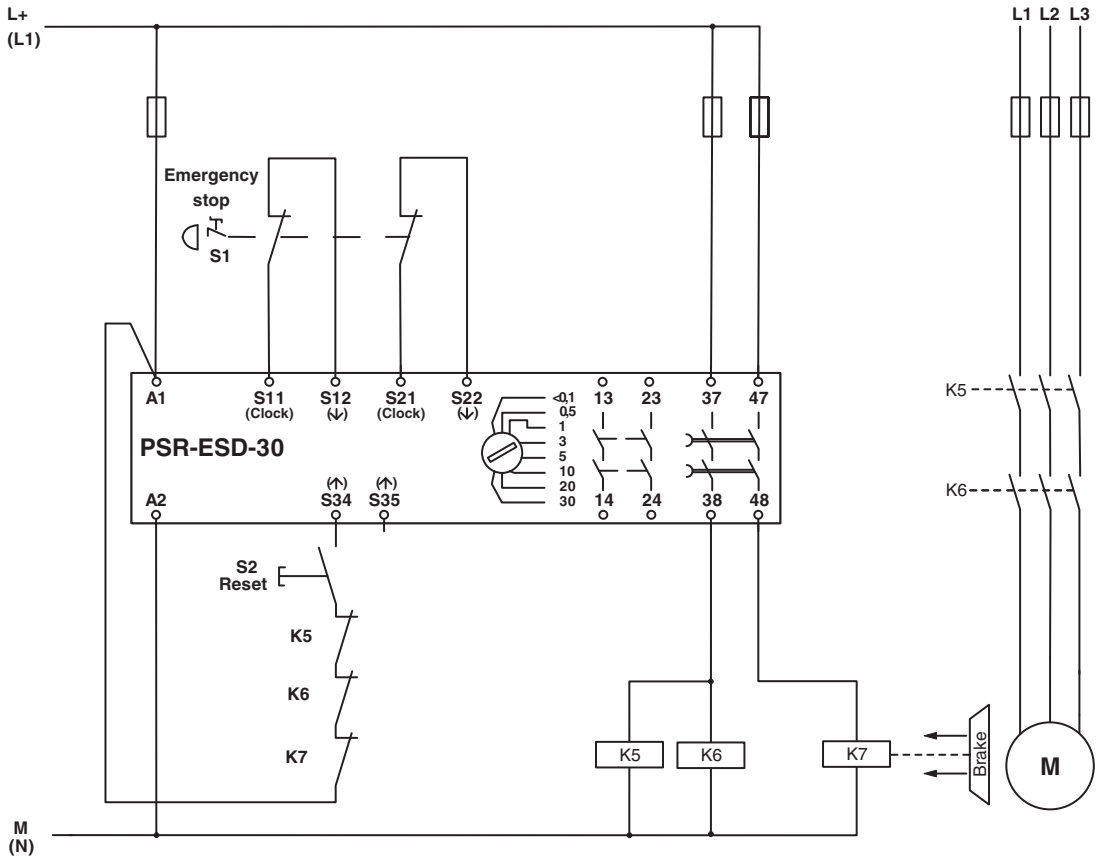
Figure 16 Manual start circuit



12 Application examples

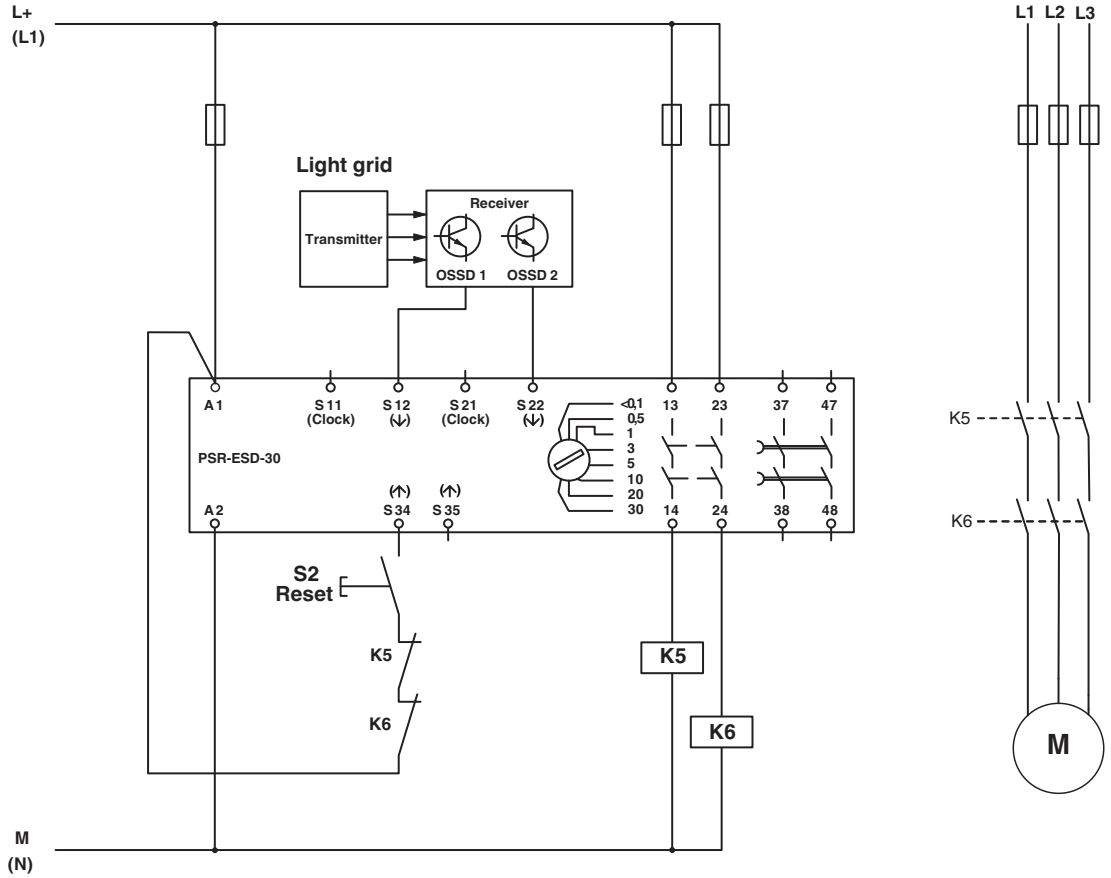
12.1 Two-channel emergency stop circuit with monitored reset button

Figure 17 Two-channel emergency stop circuit



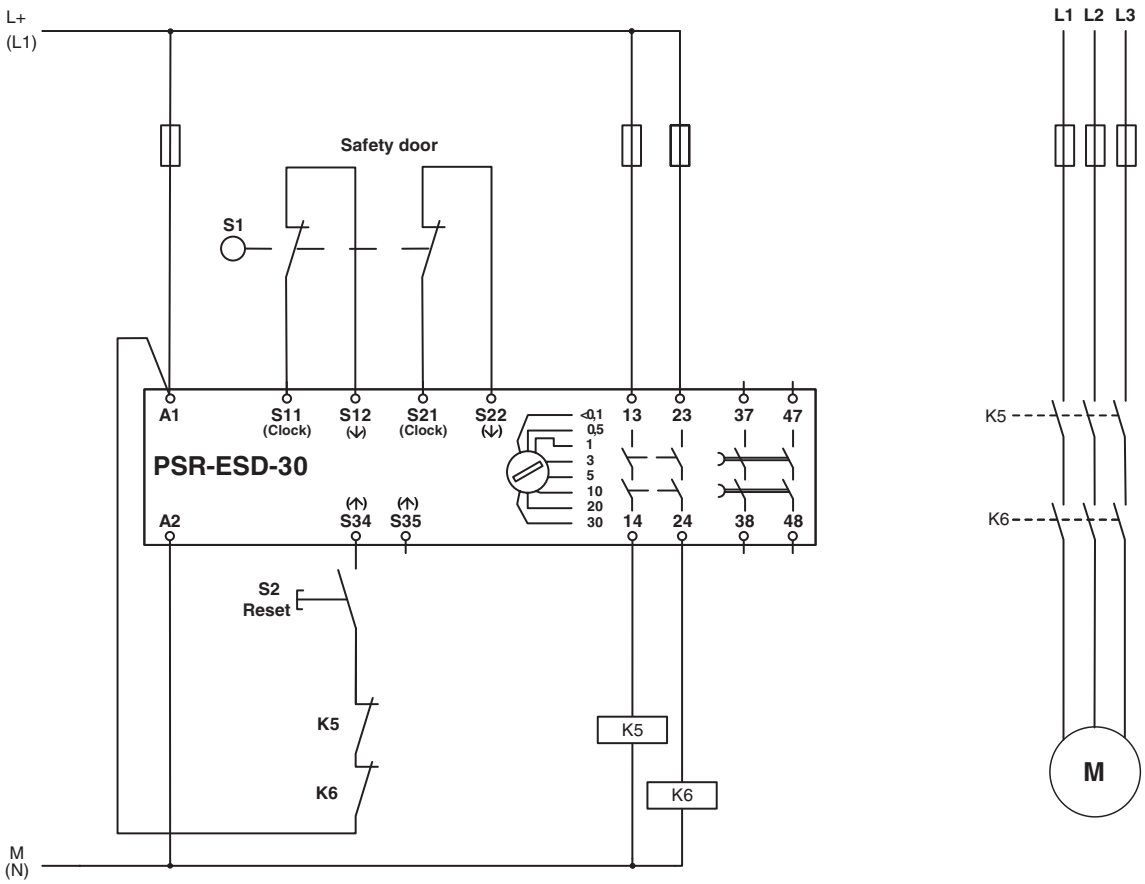
12.2 Two-channel light grid monitoring (cross-circuit detection by light grid) with monitored reset button

Figure 18 Two-channel light grid monitoring



12.3 Two-channel safety door monitoring with cross-circuit detection and monitored contact extension, with monitored reset button

Figure 19 Two-channel safety door monitoring



13 Cable lengths

For applications which use clock outputs S11 and S21, the cables may have an overall length of up to 500 m (per channel).

If no clock outputs are used, the maximum cable length can be calculated using the total permissible resistance (500 Ω).

Path	maximum cable length	Cable resistance
A1 -> S34	1 km	500 Ω
A1 -> S35		
S11 -> S12 S21 -> S22	500 m without external wiring	500 Ω
S21 -> S22	> 500 m wiring with an external resistance of 1 kΩ from S11 to A2 and from S21 to A2.	
A1 -> S12	1 km	500 Ω
A1 -> S22		

The aforementioned values are intended as a guide.

Depending on the wiring and installation of the cable, different lengths can be achieved.

14 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.