

# PSR-PC50

## SIL 3 coupling relay for safety-related switch on



Data sheet  
105818\_en\_02

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### 1 Description

The PSR-PC50 SIL coupling relay can be used for power adaptation and electrical isolation in Safe-State-ON applications up to SIL 3 according to IEC 61508 as well as IEC 61511.

The category 3 device is designed for installation in zone 2 potentially explosive areas.

By filtering the controller test pulses, premature failure of the safety relays is prevented.

The contact side is fully monitored for open circuit and short circuit as well as load and diagnostics supply voltage.

If an error occurs, the internal device input impedance is affected. As such, the test pulses sent from the controller are disrupted and the error is reported to the corresponding digital output without additional wiring effort.

#### Features

- SIL 3 coupling relays for safety-related switch on
- Applications: Energized-to-Safe / Class I Div II
- Complete monitoring of the load side for:
  - Open circuit
  - Short circuit
  - Presence of supply voltage for diagnostics and loads
- Error message output through interrupting test pulses of the higher-level controller
- Easy proof test
- Integrated DCS test pulse filter
- Low inrush current
- One undelayed enabling channel
- Option of screw or spring-cage terminal blocks for plug-in
- Special design for avoiding spurious trips
- Housing width 17.5 mm
- Compatible with EMERSON DeltaV SIS SLS1508 and CSL5 (further controller cards on request)



#### **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 is valid for all products listed on the following pages.

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### 3 Ordering data

| Description  | Type                     | Order No. | Pcs./Pkt. |
|--|--------------------------|-----------|-----------|
| Coupling relay for SIL 3 low demand applications, couples digital output signals to the periphery, 1 enabling current path, module for F&G applications, test pulse filter, plug-in screw connection, 17.5 mm width      | PSR-PC50-1NO-1DO-24DC-SC | 2904664   | 1         |
| Coupling relay for SIL 3 low-demand applications, couples digital output signals to the I/O, 1 enabling current path, module for F&G applications, test pulse filter, plug-in spring-cage terminal block, width: 17.5 mm | PSR-PC50-1NO-1DO-24DC-SP | 2904665   | 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  |  |
| Nominal input voltage $U_N$   | 24 V DC -15 %; +10 % (A1/A2 and 24V/A2)  |
| Input voltage range (factor)  | 0.85 ... 1.1   |
| Typical input current   | 65 mA (A1/A2)<br>15 mA (24V/A2; depending on load M1 +100 mA)  |
| Typical inrush current  | ≤ 200 mA (A1/A2)<br>2.5 A (24V/A2; for 10 μs)<br>200 mA (Inputs TP1, TP2 and TP3)                    |
| Current consumption   | typ. 20 mA (Input TP1)<br>typ. 18 mA (Input TP2)<br>typ. 35 mA (Input TP3)                           |
| Max. permissible overall conductor resistance (Input and reset circuit at $U_N$ ) | < 10 Ω (LO/LO' and NI/NI' and load resistance in the event of a short circuit)                       |
| Typical pick-up time  | 30 ms (when controlled via A1)   |
| Typical release time  | 30 ms (when controlled via A1)   |
| Recovery time   | 1 s  |
| Maximum switching frequency   | 0.5 Hz   |
| Operating voltage display   | Yellow LED   |
| Status display  | Green LED  |
| Indication  | Red LED  |
| Protective circuit  | Overload protection Suppressor diode   |
| Output data   |  |
| Contact type  | 1 enabling current path  |
| Contact material  | AgNi, gold-flashed   |
| Minimum switching voltage   | 15 V AC/DC (without diagnostics)<br>20 V AC/DC (with diagnostics)                                    |
| Maximum switching voltage   | 250 V AC<br>125 V DC   |
| Limiting continuous current   | 5 A (N/O contact)  |
| Diagnostic threshold  | 20 Ω / 18 kΩ (lower/upper)   |
| Maximum inrush current  | 5 A  |
| Inrush current, minimum   | 100 mA   |
| Switching capacity min.   | 1.5 W  |
| Mechanical service life   | Approx. $5 \times 10^7$ cycles   |

| Alarm outputs  |   |   |
|--|---|---|
| Number of outputs  | 1 (digital)   |   |
| Voltage  | 23 V DC   |   |
| Current  | max. 100 mA   |   |
| 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 position  | vertical or horizontal  |   |
| Mounting type  | DIN rail mounting   |   |
| Air clearances and creepage distances between the power circuits | DIN EN 50178  |   |
| Rated insulation voltage   | 250 V AC  |   |
| Rated surge voltage/insulation                                   | 6 kV/safe isolation (through protective impedance)  |   |
| Pollution degree   | 2   |   |
| Surge voltage category   | III   |   |
| Dimensions   | Screw connection  | Spring-cage connection                      |
| W x H x D  | 17.5 x 112.2 x 114.5 mm   | 17.5 x 117.4 x 114.5 mm                     |
| Connection data  | Screw connection  | Spring-cage connection                      |
| Conductor cross section, solid                                   | 0.2 mm <sup>2</sup> ... 2.5 mm <sup>2</sup>   | 0.2 mm <sup>2</sup> ... 1.5 mm <sup>2</sup> |
| Conductor cross section, stranded                                | 0.2 mm <sup>2</sup> ... 2.5 mm <sup>2</sup>   | 0.2 mm <sup>2</sup> ... 1.5 mm <sup>2</sup> |
| Conductor cross section AWG/kcmil                                | 24 ... 12   | 24 ... 16                                   |
| Stripping length   | 7 mm  | 8 mm  |
| Ambient conditions   |   |   |
| Ambient temperature (operation)                                  | -20 °C ... 55 °C  |   |
| Ambient temperature (storage/transport)                          | -40 °C ... 65 °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)  | 2g  |   |
| Conformance / approvals  |   |   |
| Conformance  | CE-compliant  |   |
| Approvals  |                            |   |
| IECEX ( IECEx ULD 14.0003X )                                     | Ex nA nC IIC T4 Gc  |   |
| ATEX ( DEMKO 14 ATEX 1284X )                                     |  II 3 G Ex nA nC IIC T4 Gc |   |
| UL, USA / Canada ( E140324 )                                     | cULus   |   |
| UL, USA / Canada ( E360692 )                                     | Class I, Zone 2, AEx nA nC IIC T4 / Ex nA nC IIC Gc T4 X  |   |
| Shipbuilding ( 11253-14 HH )                                     | C, EMC2   |   |
| Functional Safety in accordance with IEC 61508                   | to SIL 3  |   |

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

|                     |                       |
|---------------------|-----------------------|
| SIL                 | 3 (15 % of total SIL) |
| PFD <sub>avg</sub>  | $1,49 \times 10^{-4}$ |
| Proof test interval | 120 Months            |
| Duration of use     | 240 Months            |

**Alternative illustration of the device as 1001 structure for process customers**

|                             |   |
|-----------------------------|---|
| Calculation basis           | Application example 1 - SIL 3           |
| Equipment type              | Type A                                  |
| HFT                         | 0                                       |
| SIL                         | 3 (15 % of total SIL)                   |
| Safe Failure Fraction (SFF) | 99.6 %                                  |
| $\lambda_{SD}$              | 4.27 FIT                                |
| $\lambda_{SU}$              | 849 FIT                                 |
| $\lambda_{DD}$              | 4.21 FIT                                |
| $\lambda_{DU}$              | 3.40 FIT                                |
| $\lambda_{Total}$           | 860.88 FIT                              |
| MTBF                        | 110.5 Years                             |
| PFD <sub>avg</sub>          | $1,49 \times 10^{-5}$ (For T1 = 1 year) |

## 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: 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 of electric shock!**

The safety relay may only be connected to devices which meet the requirements of EN 60950.

Suitable devices are available online at [phoenixcontact.net/products](http://phoenixcontact.net/products).



### **WARNING: Loss of safety function**

When an error is detected by the higher-level controller, it is assumed that the safety function can no longer be performed.

The error must be removed within 72 hours or within the process safety time if required by the application.



### **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.



### **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/ IEC 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 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).

## 5.1 Installation in the Ex area (zone 2)



### WARNING: Explosion hazard

The category 3 device is suitable for installation in the zone 2 potentially explosive area. It fulfills the requirements of EN 60079-0:2012+A11:2013 (IEC 60079-0:2011 6th ED.) and EN 60079-15:2010 (IEC 60079-15:2010 4th ED.).



### WARNING: Explosion hazard

The device should be installed in a housing (control or distributor box) that fulfills the requirements of EN 60079-15:2010 (IEC 60079-15:2010 4th ED.) and at least IP54 (EN/ IEC 60529) degree of protection.



### WARNING: Explosion hazard

The device must be used in no more than a pollution degree 2 environment as defined by EN/ IEC 60664-1.



### WARNING: Explosion hazard

When installing and connecting the supply and signal circuits observe the requirements of EN/ IEC 60079-14. Only devices suitable for operation in Ex zone 2 and the conditions at the application site may be connected to the circuits in zone 2.

In potentially explosive areas, only connect and disconnect cables when the power is disconnected.



### WARNING: Explosion hazard

The device must be stopped and immediately removed from the Ex area if it is damaged or was subject to an impermissible load or stored incorrectly or if it malfunctions.



Only use category 3G devices (ATEX 94/9/ EC).

## Ambient temperature in hazardous areas (zone 2)

Observe the derating curves.

Observe the special temperature conditions according to the rating plate.

|                     |   |                              |
|---------------------|---|------------------------------|
| Relay Output        | 250 V AC /<br>24 V DC, 5 A<br>Resistive<br>B300, R300 | 250 V AC /<br>24 V DC, 0.5 A |
| Ambient Temperature | -20 °C to 40 °C                                       | -20 °C to 60 °C              |

## 5.2 Installation in areas with a danger of dust explosions



### WARNING: Explosion hazard

The device is not designed for use in atmospheres with a danger of dust explosions.

## 6 Basic circuit diagram

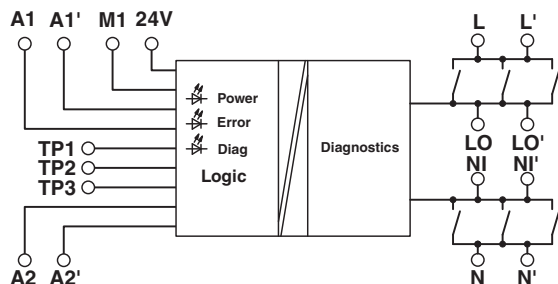


Figure 1 Block diagram

### Key:

| Designation | Explanation  |
|-------------|--|
| A1/A2       | Safety relay input voltage                                 |
| A1'/A2'     | Safety relay input voltage for optionally redundant wiring |
| M1          | Digital alarm output                                       |
| 24 V        | Supply voltage for connectable load monitoring             |
| TP1/TP2/TP3 | Test point for proof test                                  |
| L/L'        | On-load voltage input                                      |
| N/N'        | 0 V  |
| LO/LO'      | Load input   |
| NI/NI'      | Load output  |



Contacts A1', A2', L', N', LO', NI' are **not** suitable for further wiring. These contacts may only be used for optional redundant wiring.

## 7 Derating

### 7.1 Vertical mounting position

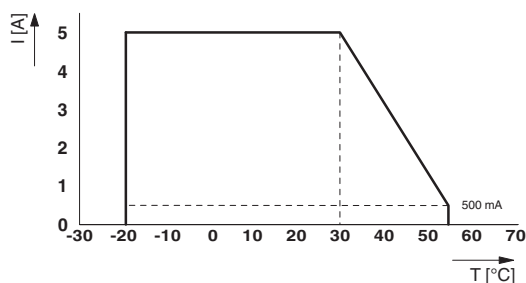


Figure 2 Vertical installation derating curve

### 7.2 Horizontal mounting position

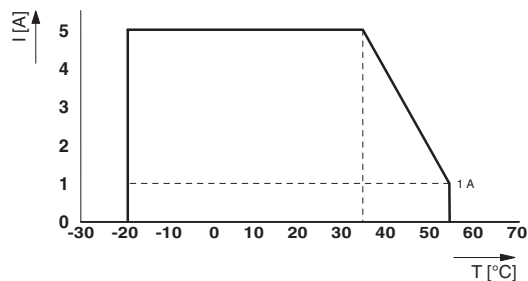


Figure 3 Horizontal installation derating curve

## 8 Load curve

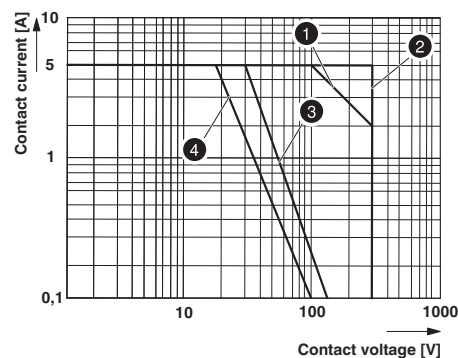


Figure 4 Relay load curve

### Key:

| No. | Explanation                            |
|-----|--|
| 1   | AC inductive load $\cos \varphi = 0.4$ |
| 2   | AC resistive load                      |
| 3   | DC resistive load                      |
| 4   | DC inductive load $L/R = 7 \text{ ms}$ |



## 9 Operating and indication elements

### 9.1 Connection versions

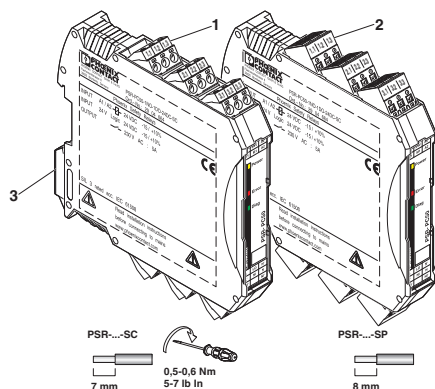
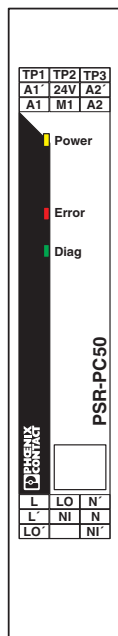


Figure 5 Connection versions

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

### 9.2 Connection assignment

**Figure**



| Designation | Explanation   |
|-------------|---|
| TP1/TP2/TP3 | Test point for proof test   |
| A1/A2       | Safety relay input voltage  |
| A1'/A2'     | Safety relay input voltage for optionally redundant wiring          |
| 24 V        | Supply voltage for connectable load monitoring                      |
| M1          | Digital alarm output  |
| Power       | LED status indicator, yellow - contacts on the load side are closed |
| Error       | LED status indicator, red - error                                   |
| Diag        | LED status indicator, green - diagnostics are active                |
| L/L'        | On-load voltage input   |
| N/N'        | 0 V   |
| LO/LO'      | Load input  |
| NI/NI'      | Load output   |



Contacts A1', A2', L', N', LO', NI' are **not** suitable for further wiring. These contacts may only be used for optional redundant wiring.

## 10 Mounting and connection

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

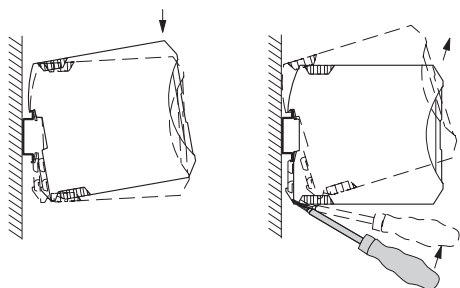


Figure 6 Mounting and removing

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

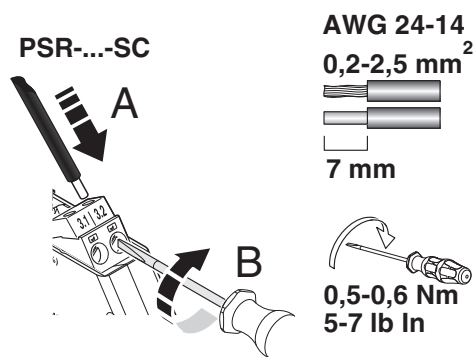


Figure 7 Connecting the cables for PSR-...-SC (screw terminal block)

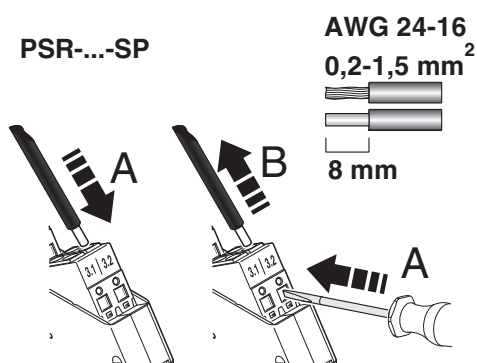


Figure 8 Connecting the cables for PSR-...-SC (spring-cage terminal block)



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

## 11 Startup

Once the nominal input voltage of 24 V DC has been enabled at terminals **A1** and **A2** (as well as **A1'** and **A2'** for optionally redundant wiring), the Power LED lights up.

The contacts **L, L', LO, LO'** as well as **NI, NI'** and **N, N'** close.

The **24 V** connection should only be activated if the diagnostic function is to be used, and should be set to **A2**.

The minimum diagnostic threshold value is **20 Ω**, the maximum value is **18 kΩ**.

Diagnostics is performed for open circuit and short circuit of the load as well as for a loss of on-load voltage, load supply voltage and supply voltage for diagnostics.

The activation of diagnostic functions is indicated by the **Diag LED**.

If the diagnostics respond, the minimum current consumption is pushed and a **bad channel** is generated via **A1** (depending on the controller).

Additionally the **Error LED** illuminates and the semiconductor alarm output **M1** is active.

The load is not monitored when the contacts are closed on the output side.

The diagnostic function is not suitable for semiconductor loads.

- Perform a full function and diagnostic test during start-up.

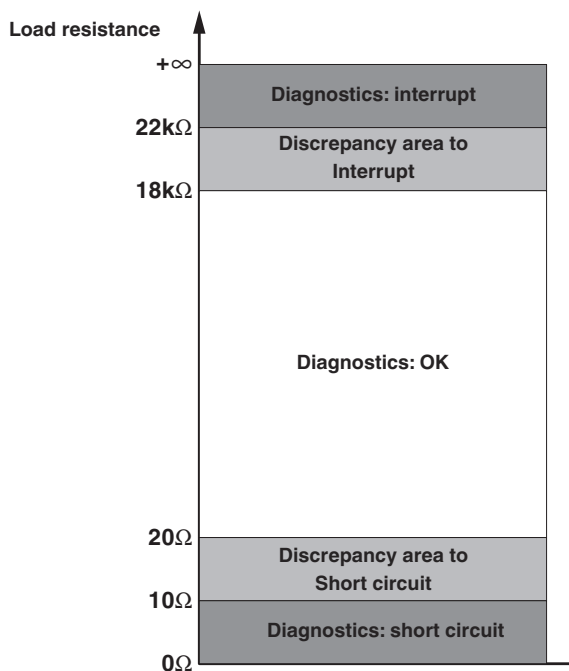


Figure 9 Diagnostic thresholds

## 12 Proof test

The Proof test checks the individual relay channels and device diagnostics to ensure proper functioning.



**CAUTION:** The enabling contacts are closed during the Proof test!

### 12.1 Testing of relay channels

1. Disconnection of A1/A1'
2. Apply 24 V DC to TP1 (set to A2/A2'. Check whether the load is activated/whether the contacts L to LO to N to NI have continuity. Then disconnect TP1 again.
3. Repeat step 2 for TP2 and TP3
4. Restore the original configuration so that the reference configuration and the physical configuration are the same again.
5. Check switchability by the controller!



**CAUTION:** If during step 2 or 3 the load is not activated or no continuity can be measured, the device is faulty. Replace the device!

### 12.2 Testing diagnostics

1. Interrupt the load path then close it again.
2. Interrupt the load path briefly then restore this to the operating state.
3. Interrupt the supply voltage of the load before connection L or after connection N. Then restore the supply voltage.



**CAUTION:** If during this diagnostics test no error (ERROR) is displayed, the device is faulty. Replace the device!

## 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 Application examples

### Key:

- SIS = Safety Instrumented System (safe control)
- DC = Diagnostic Coverage according to IEC 61508  
(line/load diagnostics at DO)
- DI = Digital input
- DO = Digital output

### Connection options:

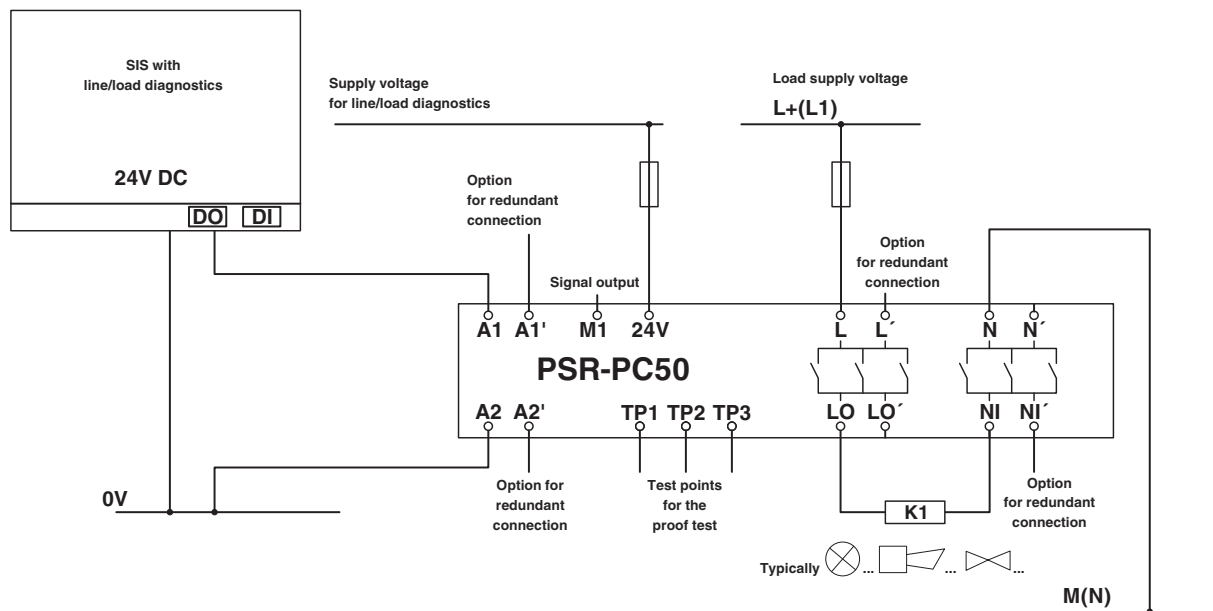


Figure 10 Connection options

### 14.1 Application example 1 - SIL 3

#### Assumptions, information, and marginal conditions

- The DC of the digital output is 90%.
- Diagnostics of PSR-PC50 are active.
- The test pulses of the controller are activated and evaluated.
- A potential error is indicated accordingly.



A fault e.g., open circuit or short circuit of the load is reported by detuning the test pulse of the safe controller.

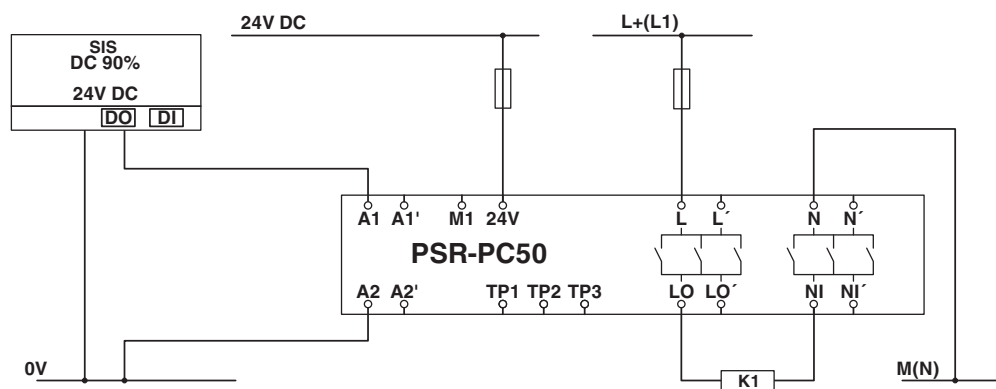


Figure 11 Application example 1 - SIL 3

## 15 Revision history

| Version | Date       | Contents  |
|---------|------------|---|
| 00      | 2014-05-23 | First publication   |
| 01      | 2014-08-14 | Data added regarding the compatible controllers; technical data updated; notes on contacts A1', A2', L', N', LO', NI' added; figure on diagnostic thresholds added; general conditions for application example extended |
| 02      | 2014-04-08 | HW/FW status added; safety notes revised; section added: mounting and connection, calculation of power dissipation, revision history; data added according to Ex approval   |

## Данный компонент на территории Российской Федерации

### Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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