

# PSR-PS21



## SIL coupling relay



Data sheet  
106253\_en\_02

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## 1 Description

### Intended Use

The **PSR-PS21** SIL coupling relay can be used for power adaptation and electrical isolation in high and low-demand applications up to SIL 2 according to IEC 61508 as well as EN 61511.

Using this module, circuits are interrupted in a safety-oriented manner.

The safety relay is equipped with an enabling current path and a confirmation current path that drop out without delay according to stop category 0 in accordance with EN 60204-1.

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

If an error occurs inside the module, the internal device input impedance is affected. As such with compatible, safe systems, the test pulses sent from the controller may be disrupted and the error can be reported back to the corresponding digital output without any additional wiring effort.

### Features

- SIL 2 coupling relay for safety-related switching off
- Can be used in high and low-demand applications
- Approved for Class I, Zone 2 applications
- Easy proof test:
  - Active error acknowledgment via A1
  - Visually on the device
  - Evaluation of the force-guided N/C contact
- Integrated DCS test pulse filter
- Low inrush current
- 1 undelayed enabling current path
- 1 undelayed confirmation current path
- 1 digital signal output
- Fixed screw connection
- 6.8 mm housing width
- Controller-specific Termination Carrier available 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 2 high- and low-demand applications, couples digital output signals to the I/O, 1 enabling current path, 1 confirmation current path, 1 digital signal output, safe state off applications, test pulse filter, fixed screw terminal block | PSR-PS21-1NO-1NC-24DC-SC | 2700357   | 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. 45 mA   |
| Supply voltage                     | 24 V DC -15 % / +10 % (Diagnostic supply voltage $U_D$ )   |
| Input current                      | 6 mA (at 21-A2 for $U_D$ ; depending on load + 100 mA at M1 and 22)  |
| Typical inrush current             | 400 mA ( $\Delta t < 10 \mu s$ at $U_S$ )<br>2.5 A ( $\Delta t < 20 \mu s$ at $U_D$ )  |
| Power consumption at $U_S$         | typ. 1.08 W  |
| Filter time                        | max. 2 ms (at A1-A2; test pulse width)<br>≥ 100 ms (at A1-A2; test pulse rate)   |
| Typical starting time with $U_S$   | < 100 ms (when controlled via A1)  |
| Typical release time with $U_S$    | < 35 ms (when controlled via A1)   |
| Recovery time                      | 500 ms   |
| Maximum switching frequency        | 1 Hz   |
| Operating voltage display          | 1 x yellow LED   |
| Status display                     | 2 x green LEDs   |
| Indication                         | 1 x red LED  |
| Protective circuit                 | Surge protection Suppressor diode<br>Polarity reversal protection for rated control supply voltage and diagnostic supply voltage |
| Output data                        |  |
| Contact type                       | 1 enabling current path<br>1 confirmation current path   |
| Contact material                   | AgSnO <sub>2</sub> (enabling current path)<br>AgCuNi, + Au (confirmation current path)   |
| Minimum switching voltage          | 10 V AC/DC (N/O contact)<br>20.4 V DC (N/C contact)  |
| Maximum switching voltage          | 250 V AC/DC (N/O contact)<br>26.4 V DC (N/C contact)   |
| Nominal current                    | 6 A (N/O contact)  |
| Limiting continuous current        | 6 A (N/O contact)<br>100 mA (N/C contact)  |
| Maximum inrush current             | 6 A (N/O contact)<br>100 mA (N/C contact)  |
| Inrush current, minimum            | 3 mA (N/O contact)<br>1 mA (N/C contact)   |
| Sq. Total current                  | 36 A <sup>2</sup> (see to derating)  |


| Output data             |  |
|-------------------------|--|
| Switching capacity min. | 30 mW  |
| Mechanical service life | 10 x 10 <sup>6</sup> cycles  |
| Output fuse             | 6 A gL/gG (N/O contact)<br>4 A gL/gG (for low-demand applications)<br>150 mA fast blow (Confirmation current path) |

| Alarm outputs            |  |
|--------------------------|--|
| Number of outputs        | 1 (digital, PNP)                               |
| Voltage                  | 22 V DC (U <sub>D</sub> - 2 V)                 |
| Current                  | max. 100 mA                                    |
| Maximum inrush current   | 500 mA ( $\Delta t = 1$ 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, horizontal, with front of module upward  |
| 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, EN 60079-15  |
| Rated insulation voltage                                     | 250 V AC   |
| Rated surge voltage/insulation                               | Safe isolation, 6 kV reinforced insulation from control circuit, start circuit, confirmation current path, signal output to the enabling current path; 4 kV/basic insulation 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 ... 65 °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)                          | 2g  |

| Conformance / approvals    |   |
|----------------------------|---|
| Conformance                | CE-compliant  |
| Approvals                  |  |
| UL, USA / Canada (E140324) | cULus   |

**Conformance / approvals**

|  |  |
|--|--|
| UL, USA / Canada ( E360692 )                   | Class I, Zone 2, AEx nA nC IIC T4 / Ex nA nC IIC Gc T4 X |
| Shipbuilding                                   | GL applied for   |
| Functional Safety in accordance with IEC 61508 | to SIL 2   |

**Safety data**

|                                      |   |
|--------------------------------------|---|
| Stop category according to IEC 60204 | 0 |
|--------------------------------------|---|

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

|                     |   |
|---------------------|---|
| Equipment type      | Type A  |
| HFT                 | 0   |
| SIL                 | 2 (< 15% of the overall SIL)  |
| PFH <sub>d</sub>    | $8.8 \times 10^{-9}$ (4 A DC13; 5 A AC15; 8760 switching cycles/year) |
| Demand rate         | < 12 Months   |
| Proof test interval | 240 Months  |
| Duration of use     | 240 Months  |

For use in high-demand applications, the diagnostics function must be implemented via the confirmation current path.

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

|                             |   |
|-----------------------------|---|
| Equipment type              | Type A  |
| HFT                         | 0   |
| SIL                         | 2 (< 15% of the overall SIL)  |
| Safe Failure Fraction (SFF) | 99.18 %   |
| $\lambda_{SD}$              | 494.66 FIT  |
| $\lambda_{SU}$              | 79.10 FIT   |
| $\lambda_{DD}$              | 494.66 FIT  |
| $\lambda_{DU}$              | 8.80 FIT  |
| $\lambda_{Total}$           | 1077.22 FIT   |
| MTBF                        | 91.65 Years   |
| PFH                         | $8.8 \times 10^{-9}$ (4 A DC13; 5 A AC15; 8760 switching cycles/year) |

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

|                     |                              |
|---------------------|------------------------------|
| Equipment type      | Type A                       |
| HFT                 | 0                            |
| SIL                 | 2 (< 15% of the overall SIL) |
| PFD <sub>avg</sub>  | $1.34 \times 10^{-3}$        |
| Proof test interval | 20 Months                    |
| Duration of use     | 240 Months                   |

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

|                             |   |
|-----------------------------|---|
| Equipment type              | Type A                                  |
| HFT                         | 0                                       |
| SIL                         | 2 (< 15% of the overall SIL)            |
| Safe Failure Fraction (SFF) | 81.2 %                                  |
| $\lambda_{SD}$              | 0 FIT                                   |
| $\lambda_{SU}$              | 794.1 FIT                               |
| $\lambda_{DD}$              | 0 FIT                                   |
| $\lambda_{DU}$              | 183.8 FIT                               |
| $\lambda_{Total}$           | 977.9 FIT                               |
| MTBF                        | 99 Years                                |
| PFD <sub>avg</sub>          | $8.06 \times 10^{-4}$ (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: 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 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.

## 5.1 Installation in the Ex area (class I, zone 2)



### 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.

## Ambient temperature in hazardous areas (class I, zone 2)

Observe the derating curves.

Observe the special temperature conditions according to the rating plate.

|                     | NO-contact   | DO-contact                     |
|---------------------|--|--------------------------------|
| Output              | 250 V AC / 24 V DC<br>6 A, Resistive<br>B300, R300 | 24 V DC<br>100 mA<br>Resistive |
| Ambient Temperature | -20 °C to 65 °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

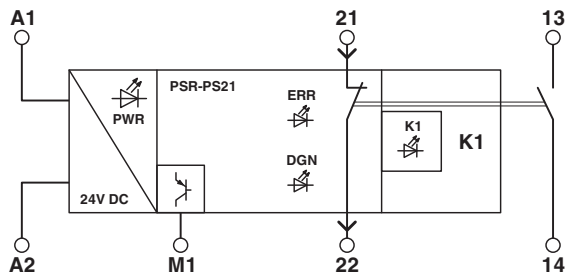


Figure 1 Block diagram

### Key:

| Designation | Explanation  |
|-------------|--|
| A1          | +24 V control input with active error acknowledgment |
| A2          | 0 V (GND)  |
| M1          | Signal output (PNP)                                  |
| 21          | +24 V diagnostics input                              |
| 22          | Diagnostic output +24 V                              |
| 13/14       | Enabling current path, undelayed                     |



Confirmation current path 21/22 (N/C contact) is **not** an electrically isolated current path and may only be connected to a maximum voltage of 26.4 V in relation to A2.

## 7 Derating

### 7.1 Vertical mounting position

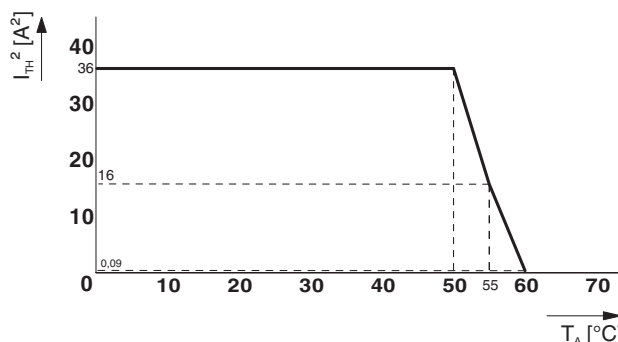


Figure 2 Derating curve - vertical mounting position with connected modules

Expanded ambient temperature range (with no distance): up to +65 °C

#### Conditions:

Max. rated control supply voltage 24 V DC  
 Max. total current of the enabling current path 1 A<sup>2</sup>

### 7.2 Horizontal mounting position

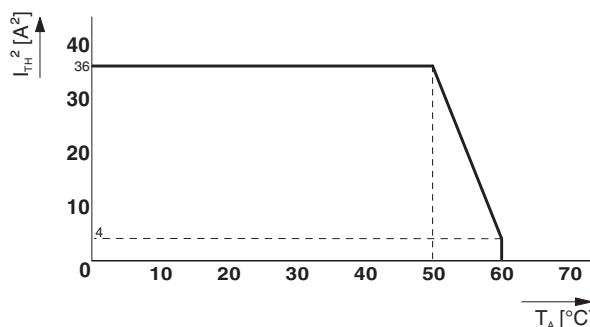


Figure 3 Derating curve - horizontal mounting position with connected modules

Expanded ambient temperature range (with no distance): up to +65 °C

#### Conditions:

Max. rated control supply voltage 24 V DC  
 Max. total current of the enabling current path 250 mA<sup>2</sup>



### 7.3 Mounting position with module front at the top

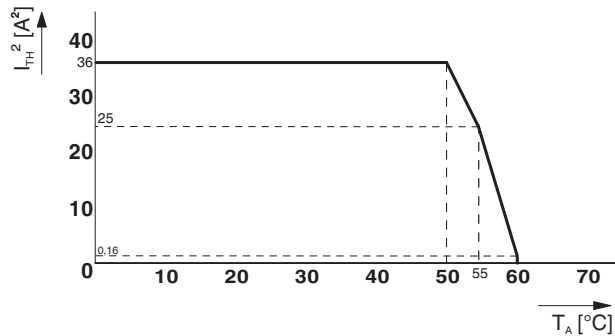


Figure 4 Derating curve - mounting position with module front at the top and aligned modules

Expanded ambient temperature range (with no distance): up to +65 °C

#### Conditions:

|   |                     |
|---|---------------------|
| Max. rated control supply voltage               | 24 V DC             |
| Max. total current of the enabling current path | 250 mA <sup>2</sup> |

## 8 Load curve

### 8.1 Ohmic load

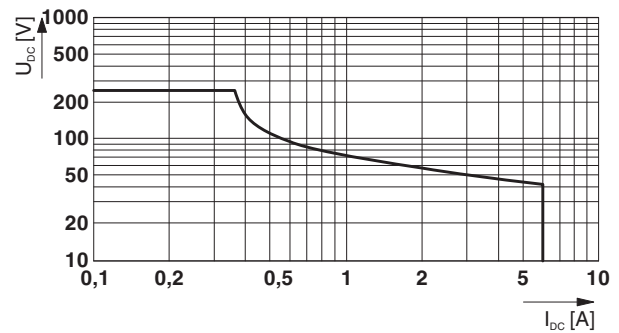


Figure 5 Relay load curve - ohmic load

## 9 Operating and indication elements

### 9.1 Connection versions

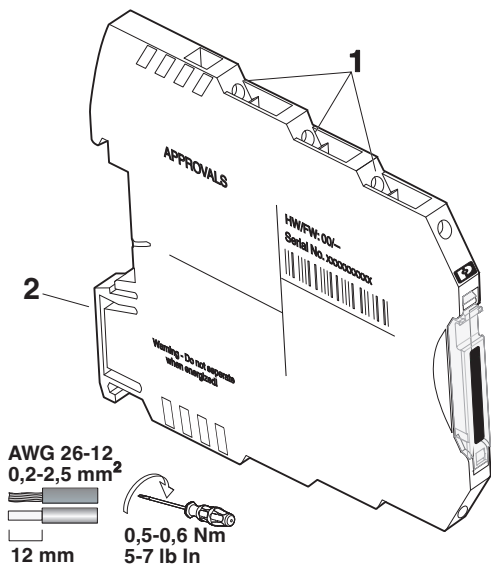


Figure 6 Connection versions

- 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.

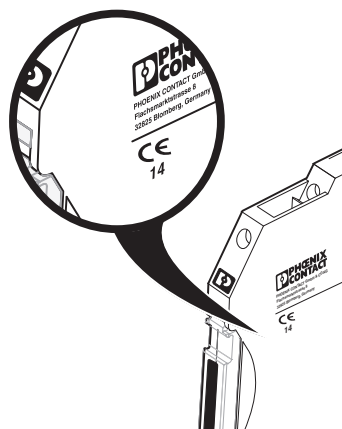


Figure 7 Year of manufacture of the device

### 9.2 Connection assignment

| Figure | Designation | Explanation  |
|--------|-------------|--|
|        | 22          | Diagnostic output +24 V                              |
|        | 21          | +24 V diagnostics input                              |
|        | A2          | 0 V (GND)  |
|        | A1          | +24 V control input with active error acknowledgment |
|        | PWR         | Power LED (yellow)                                   |
|        | K1          | Status indicator safety circuit; LED (green)         |
|        | ERR         | Error LED (red)                                      |
|        | DGN         | Diagnostics LED (green)                              |
|        | PS 21       |  |
|        | 13/14       | Enabling current path, undelayed                     |
|        | M1          | Signal output (PNP)                                  |
|        | 13          |  |
|        | 14          |  |
|        | M 1         |  |

## 10 Mounting and connection

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

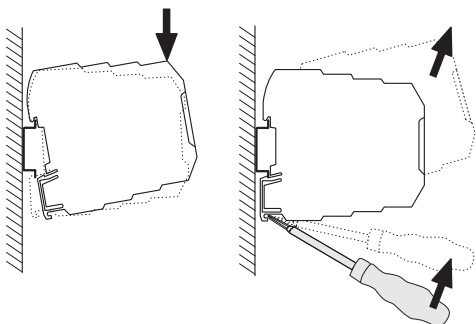


Figure 8 Mounting and removing

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

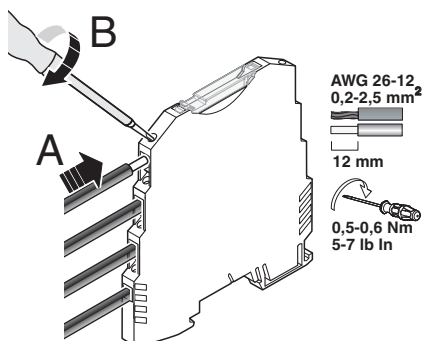


Figure 9 Connection of the cables



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

## 12 Proof test

In the proof test, you check the individual relay channels.

1. Deactivate A1/A2.
2. Apply the 24 V DC diagnosis power supply to contact 21.

If the green DGN-LED lights up, the module is functional.  
(Apply 24 V DC to signal output M1.)

If the red ERR LED lights up, replace the module.  
(Apply 0 V DC to signal output M1. Error acknowledgment via A1 is inactive.)

If the diagnostic voltage supply is present and the green DGN LED and the red ERR LED are on, replace the module.

If the diagnostic voltage supply is present but **neither** of the LEDs specified is on, replace the module.



Replace the device in the event of an error.

## 11 Startup

Apply the rated control supply voltage at terminal blocks A1/A2. The PWR LED and K1 LED light up.

Enabling current path 13/14 closes, and confirmation current path 21/22 opens.

### 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:

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

With different load currents:

$$P_{\text{Contact}} = (I_{L1}^2 + I_{L2}^2 + \dots + I_{Ln}^2) \cdot 25 \text{ m}\Omega$$

#### Total power dissipation

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

therefore

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

or

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

#### 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

### Applications with the PSR-PS21

#### 14.1 Application example 1 - SIL 2

- Low-demand application
- Single-channel control
- Diagnostic supply voltage is present

| Data for the application example as 1001 structure |  |
|--|--|
| Equipment type                                     | A  |
| HFT  | 0  |
| SIL  | 2  |
| SFF  | 81.20 %                                    |
| $\lambda_{SD}$                                     | 0 FIT                                      |
| $\lambda_{SU}$                                     | 794.1 FIT                                  |
| $\lambda_{DD}$                                     | 0 FIT                                      |
| $\lambda_{DU}$                                     | 183.8 FIT                                  |
| $\lambda_{Total}$                                  | 977.9 FIT                                  |
| MTBF   | 99 years                                   |
| $PFD_{avg}$  | $8.06 \times 10^{-04}$ (for $T1 = 1$ year) |

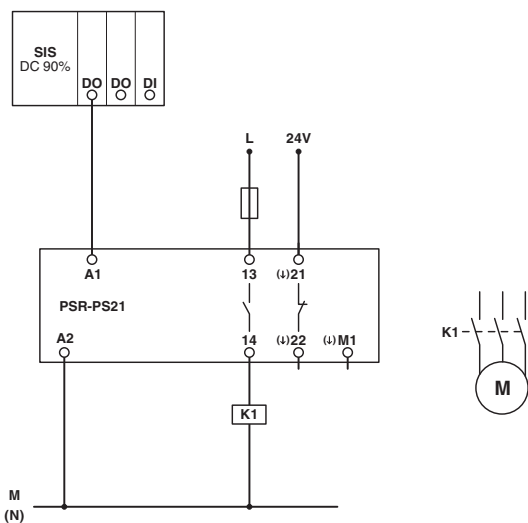


Figure 10 Application example 1 - SIL 2

## 15 Revision history

| Version | Date       | Contents                                   |
|---------|------------|--|
| 00      | 2015-03-10 | First publication                          |
| 01      | 2015-04-29 | Info box for application example 1 deleted |
| 02      | 2015-07-14 | Texts / safety notes for ATEX deleted      |