PSR-PC20

SIL coupling relay

Data sheet
106255_en_01

1 Description

Intended Use

The **PSR-PC20** SIL coupling relay can be used for power adaptation and electrical isolation in high and low-demand applications up to SIL 3 according to IEC 61508 as well as EN 61511.

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

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

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.

The enabling current path can be connected via internal 5AT fuses as an option.

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.

The safety relay has an interface for the TBUS DIN rail connector via which the diagnostic supply voltage can be routed.

Features

- SIL 3 coupling relay for safety-related switching off
- 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
- 2 internal 5AT fuses, TBUS connection
- 1 undelayed enabling current path
- 1 undelayed confirmation current path
- 1 digital signal output
- Option of screw or spring-cage terminal blocks for plug-in
- 12.5 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.

This data sheet is valid for all products listed on the following pages.

2 Table of contents

3 Ordering data

Description	Type	Order No.	Pcs. / Pkt.
Coupling relay for SIL 3 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, PSR-TBUS connection, plug-in screw terminal block	PSR-PC20-1NO-1NC-24DC-SC	2700577	1
Coupling relay for SIL 3 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, PSR-TBUS connection, plug-in spring-cage terminal block	PSR-PC20-1NO-1NC-24DC-SP	2700578	1

Accessories	Type	Order No.	Pcs. / Pkt.
DIN rail connector for DIN rail mounting. Universal for TBUS housing. Gold-plated contacts, 5-pos. Plug component, Number of positions: 5, Pitch: 3.81 mm	ME 6,2 TBUS-2 1,5/5-ST-3,81 GN	2869728	10
Plug component, Nominal current: 8 A, Rated voltage (III/2): 160 V, Number of positions: 5, Pitch: 3.81 mm, Connection method: Screw connection, Color: green, Contact surface: Tin	MC 1,5/ 5-ST-3,81	1803604	50

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. 50 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 ($\Delta t < 10$ µs at U_s) 2.5 A ($\Delta t < 20$ µs at U_D)
Power consumption at U_S	typ. 1.2 W
Filter time	max. 2 ms (at A1-A2; test pulse width) ≥ 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	1 x green LED
Indication	1 x red LED
Protective circuit	Surge protection Suppressor diode Polarity reversal protection for rated control supply voltage and diagnostic supply voltage

Output data	
Contact type	1 enabling current path 1 confirmation current path
Contact material	$AgSnO_2$ (enabling current path) AgCuNi, + Au (confirmation current path)
Minimum switching voltage	20 V AC/DC (N/O contact) 20.4 V DC (N/C contact)

Output data	
Maximum switching voltage	250 V AC/DC (N/O contact) 26.4 V DC (N/C contact)
Nominal current	6 A (N/O contact)
Limiting continuous current	6 A (13/14, see to derating) 4 A (13F/14, see to derating) 100 mA (N/C contact)
Maximum inrush current	6 A (N/O contact) 100 mA (N/C contact)
Inrush current, minimum	3 mA (N/O contact) 1 mA (N/C contact)
Sq. Total current	36 A^2 (see to derating)
Switching capacity min.	60 mW
Mechanical service life	10 x 10^6 cycles
Output fuse	6 A gL/gG (N/O contact 13/14) 4 A gL/gG (for low-demand applications) 150 mA fast blow (Confirmation current path)

Alarm outputs	
Number of outputs	1 (digital, PNP)
Voltage	22 V DC (U_D - 2 V)
Current	max. 100 mA
Maximum inrush current	500 mA (Δt = 1 ms at U_s)
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
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

Dimensions	Screw connection	Spring-cage connection
W x H x D	12.5 x 112.2 x 114.5 mm	12.5 x 116.6 x 114.5 mm

Connection data	Screw connection	Spring-cage connection
Conductor cross section, solid	0.2 mm^2 ... 2.5 mm^2	0.2 mm^2 ... 1.5 mm^2
Conductor cross section, stranded	0.2 mm^2 ... 2.5 mm^2	0.2 mm^2 ... 1.5 mm^2
Conductor cross section AWG/kcmil	24 ... 12	24 ... 16
Stripping length	7 mm	8 mm
Screw thread	M3	

Ambient conditions

Ambient temperature (operation)	-40 °C ... 70 °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
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 3

Safety data

Stop category according to IEC 60204	0

Safety parameters for IEC 61508 - High demand

Equipment type	Type A
HFT	1
SIL	3 (< 15% of the overall SIL)
PFH_d	1.95×10^{-10} (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	3 (< 15% of the overall SIL)
Safe Failure Fraction (SFF)	99.98 %
λSD	989.32 FIT
λSU	230.38 FIT
λDD	52.58 FIT
λDU	0.20 FIT
λTotal	1272.48 FIT
MTBF	76.43 Years
PFH	1.95×10^{-10} (4 A DC13; 5 A AC15; 8760 switching cycles/year)

Safety parameters for IEC 61508 - Low demand

Equipment type	Type A
HFT	1
SIL	3 (< 15% of the overall SIL)
PFD_{avg}	1.27×10^{-4}
Proof test interval	72 Months
Duration of use	240 Months

Alternative illustration of the device as 1001 structure for process customers	
Equipment type	Type A
HFT	0
SIL	3 (< 15% of the overall SIL)
Safe Failure Fraction (SFF)	99.68 %
λSD	0 FIT
λSU	1660 FIT
λDD	0 FIT
λDU	5.392 FIT
λTotal	1666 FIT
MTBF	60 Years
PFD_{avg}	2.36×10^{-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: 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).

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.

	NO-contact	DO-contact
Output	250 V AC / 24 V DC 6 A, Resistive B300, R300	24 V DC 100 mA 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

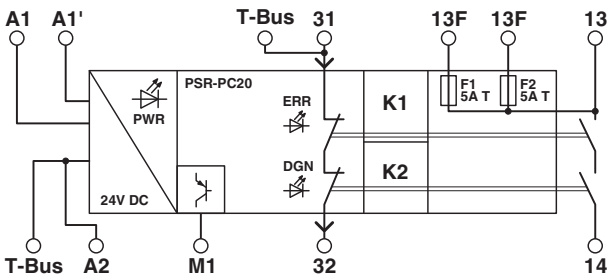


Figure 1 Block diagram

Key:

Designation	Explanation
A1	+24 V control input with active error acknowledgment
A2	0 V (GND)
A1'	+24 V control input without active error acknowledgment
M1	Signal output (PNP)
31	+24 V diagnostics input
32	Diagnostic output +24 V
13F	Enabling current path - input with 5AT fuse
13	Enabling current path - input without 5AT fuse
14	Enabling current path - output
TBUS	Routing of the diagnostic supply voltage

Connect at most 10 devices in series via the TBUS DIN rail connector.

Confirmation current path 31/32 (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 or horizontal installation for enabling current path 13/14

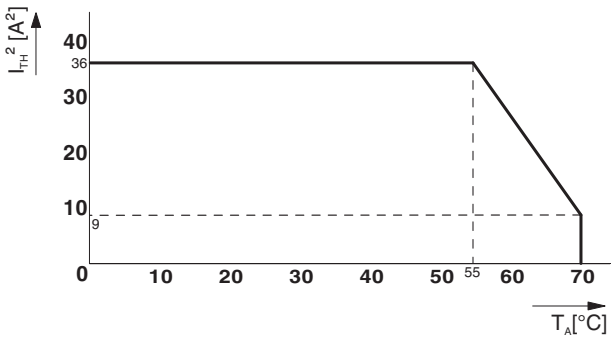


Figure 2 Derating curve (13/14) - vertical mounting position with connected modules

7.2 Vertical or horizontal installation for enabling current path 13F/14

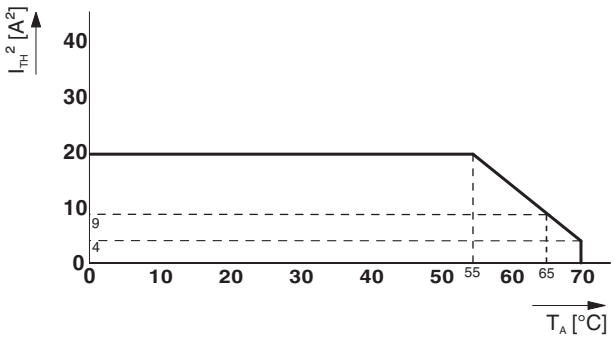


Figure 3 Derating curve (13F/14) - vertical mounting position with connected modules

7.3 Mounting position with module front at the top, enabling current path 13/14

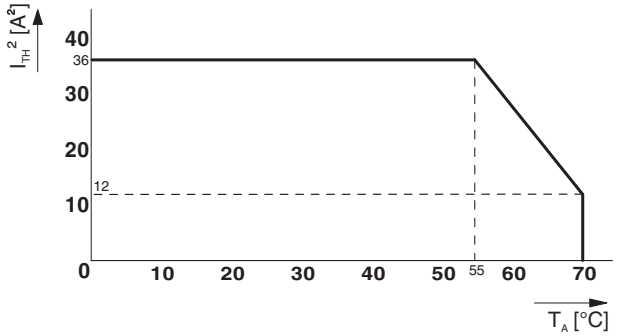


Figure 4 Derating curve (13/14) - mounting position with module front at the top and aligned modules

7.4 Mounting position with module front at the top, enabling current path 13F/14

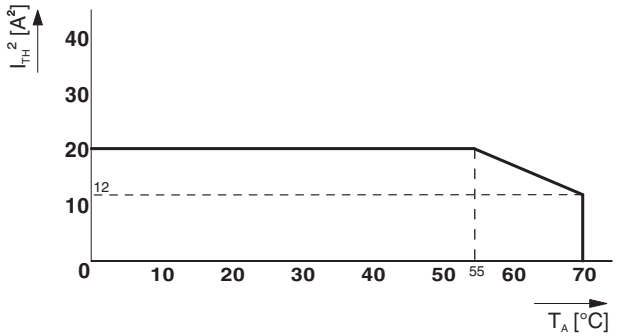


Figure 5 Derating curve (13F/14) - mounting position with module front at the top and aligned modules

8 Load curve

8.1 Ohmic load

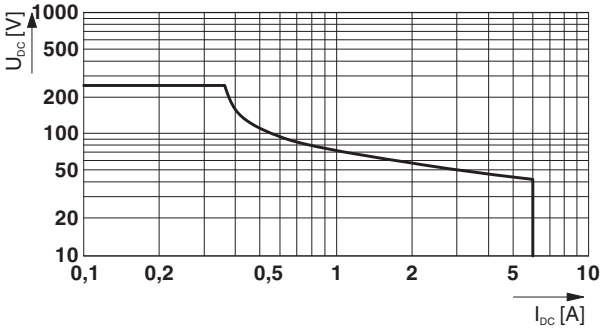


Figure 6 Relay load curve - ohmic load

9 Operating and indication elements

9.1 Connection versions

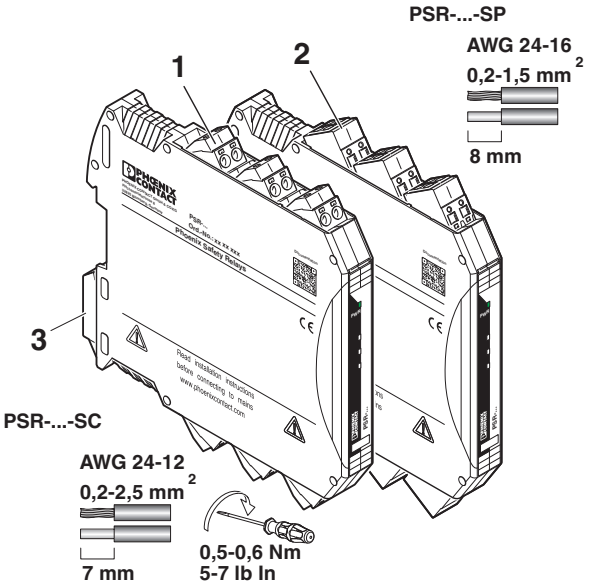


Figure 7 Connection versions

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

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

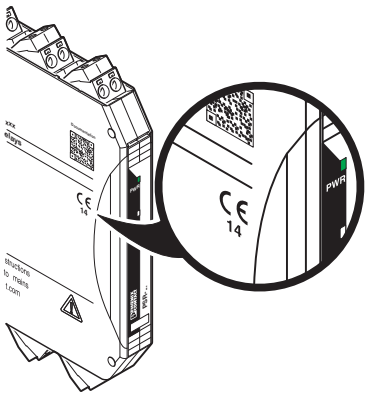
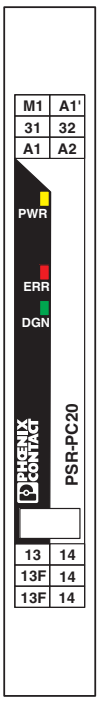


Figure 8 Year of manufacture of the device

9.2 Connection assignment

Figure	Designation	Explanation
	M1	Signal output (PNP)
	A1'	+24 V control input without active error acknowledgment
	31	+24 V diagnostics input
	32	Diagnostic output +24 V
	A1	+24 V control input with active error acknowledgment
	A2	0 V (GND)
	PWR	Power LED (yellow)
	ERR	Error LED (red)
	DGN	Diagnostics LED (green)
	13F	Enabling current path - input with 5AT fuse
	13	Enabling current path - input without 5AT fuse
	14	Enabling current path - output

10 Mounting and connection

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

When using the TBUS DIN rail connector to redirect the diagnosis power supply, insert it into the DIN rail first.

In this case, it is vital to observe the mounting direction of the module and DIN rail connector:
metal lock at the bottom and connector on the left.

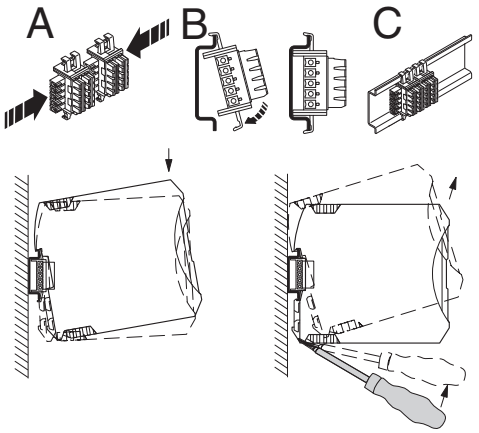


Figure 9 Mounting and removing

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

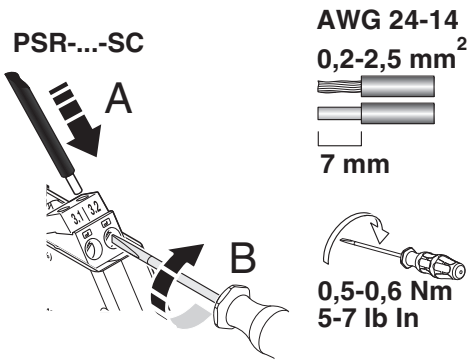


Figure 10 Connecting the cables for PSR-...-SC (screw terminal block)

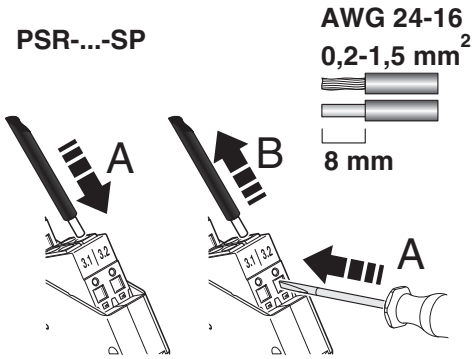


Figure 11 Connecting the cables for PSR-...-SC (spring-cage terminal block)

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

11 Startup

Apply the rated control supply voltage to terminals A1/A2 (with active error acknowledgement) or A1'/A2 (without active error acknowledgement). The PWR LED lights up.

Enabling current path 13/14 (or 13F/14) closes, and confirmation current path 31/32 opens.

12 Proof test

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

1. Deactivate A1/A2 (or A1'/A2).
2. Apply the 24 V DC diagnosis power supply to contact 31 or the TBUS.

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.

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:

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

With different load currents:

$P_{Contact} = (I_{L1}^2 + I_{L2}^2 + ... + I_{Ln}^2) \bullet 50\ m\Omega$

Total power dissipation

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

therefore

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

or

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

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-PC20

14.1 Application example 1 - SIL 3

– 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	3
SFF	99.68 %
λ_{SD}	0 FIT
λ_{SU}	1660 FIT
λ_{DD}	0 FIT
λ_{DU}	5.392 FIT
λ_{Total}	1666 FIT
MTBF	60 years
PFD_{avg}	2.36 x 10^{-05} (for T1 = 1 year)

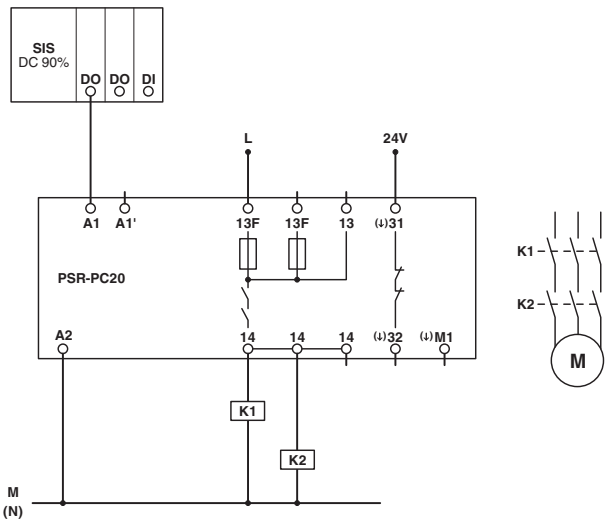


Figure 12 Application example 1 - SIL 3

15 Revision history

Version	Date	Contents
00	2015-03-10	First publication
01	2015-04-29	Info box for application example 1 deleted