PSR-...-24DC/FSP/2X1/1X2

SIL coupling relay

Data sheet
104510_en_02

1 Description

Intended Use

The SIL coupling relay is used to adjust the power and for electrical isolation in high- and low-demand applications.

The coupling relay safely interrupts circuits.

Possible signal generators

– Failsafe controllers

Contact type

– 2 undelayed enabling current paths
– 1 undelayed confirmation current path

The enabling current paths and the confirmation current path drop out without delay according to stop category 0 (EN 60204-1).

Control

– Single-Channel
– Automatic start

Achievable safety integrity

– Suitable for high- and low-demand applications up to SIL 3 (IEC 61508), SIL 3 (IEC 61511), Cat. 4 / PL e (EN ISO 13849), SIL 3 (EN 62061)

Additional features

– Easy proof test according to IEC 61508 due to forcibly guided signal contact
– Integrated DCS test pulse filter
– Option of screw or spring-cage terminal blocks for plug-in
– 17.5 mm housing width

Approvals

WARNING: Risk of electric shock

Observe the safety regulations and installation notes in the corresponding section.

Make sure you always use the latest documentation.
It can be downloaded from the product at phoenixcontact.net/products.

This document is valid for the products listed in the “Ordering data”.

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	Order No.	Pcs./Pkt.
Safe coupling relay for SIL 3 high and low demand applications, connects digital output signals to the I/O, 2 enabling current paths, 1 signal contact, module for safe state off applications, integrated test pulse filter, plug-in screw connection, width: 17.5 mm	PSR-SCP- 24DC/FSP/2X1/ 1X2	2986960	1
Safe coupling relay for SIL 3 high and low-demand applications, couples digital output signals to the I/O, 2 enabling current paths, 1 signal contact, module for safe state off applications, integrated test pulse filter, plug-in spring-cage terminal block, width: 17.5 mm	PSR-SPP- 24DC/FSP/2X1/ 1X2	2986957	1

Documentation	Type	Order No.	Pcs./Pkt.
User manual, English, for applications for PSR safety relay	UM EN SAFETY RELAY APPLICATION	2888712	1

4 Technical data

Hardware/firmware version	
HW/FW	≥ 03/--
The technical data and safety characteristics are valid as of the specified HW/FW version.	

Input data	
Rated control circuit supply voltage U_S	24 V DC -15 % / +10 %
Rated control supply current I_S	typ. 55 mA
Inrush current	max. 100 mA
Power consumption at U_S	typ. 1.32 W
Filter time	max. 5 ms (at A1 in the event of voltage dips at U_s) max. 2 ms (Test pulse width; high test pulse at A1/A2) ≥ 100 ms (Test pulse width; high test pulse at A1/A2) Test pulse rate = 80 x Test pulse width max. 5 ms (Test pulse width; low test pulse at A1/A2) ≥ 50 ms (Test pulse rate; low test pulse at A1/A2) Test pulse rate = 15 x Test pulse width
Typical starting time with U_s	50 ms
Typical release time with U_s	50 ms
Recovery time	1 s
Maximum switching frequency	0.5 Hz
Operating voltage display	1 x yellow LED
Protective circuit	Surge protection Suppressor diode, 33 V (A1 - A2)

Output data	
Contact type	2 enabling current paths 1 confirmation current path
Contact material	AgCuNi, + 0.2 µm Au
Minimum switching voltage	15 V AC/DC (N/O contact / N/C contact)
Maximum switching voltage	250 V AC/DC (N/O contact / N/C contact, observe the load curve)
Limiting continuous current	5 A (N/O contact, pay attention to the derating) 100 mA (N/C contact)
Maximum inrush current	5 A (N/O contact) 100 mA (N/C contact)
Inrush current, minimum	5 mA (N/O contact / N/C contact)
Sq. Total current $I_{TH}^2 = I_1^2 + I_2^2 + ... + I_N^2$	50 A^2 (observe derating)
Interrupting rating (ohmic load) max.	120 W (24 V DC, τ = 0 ms, N/C contact: 2.4 W) 192 W (48 V DC, τ = 0 ms, N/C contact: 4.8 W) 162 W (60 V DC, τ = 0 ms, N/C contact: 6 W) 66 W (110 V DC, τ = 0 ms, N/C contact: 11 W) 60 W (220 V DC, τ = 0 ms, N/C contact: 22 W) 1250 VA (250 V AC, τ = 0 ms, N/C contact: 25 VA)
Maximum interrupting rating (inductive load)	72 W (24 V DC, τ = 40 ms, N/C contact: 2.4 W) 43 W (48 V DC, τ = 40 ms, N/C contact: 4.8 W) 41 W (60 V DC, τ = 40 ms, N/C contact: 6 W) 35 W (110 V DC, τ = 40 ms, N/C contact: 11 W) 48 W (220 V DC, τ = 40 ms, N/C contact: 22 W)
Switching capacity	min. 75 mW
Mechanical service life	10x 10^6 cycles
Switching capacity (3600/h cycles)	5 A (24 V (DC13)) 5 A (230 V (AC15))
Output fuse	10 A gL/gG (N/O contact) 4 A gL/gG (for low-demand applications) 150 mA Fast-blow (N/C contact)

General data	
Relay type	Electromechanical relay with forcibly guided contacts in accordance with EN 50205
Nominal operating mode	100% operating factor
Degree of protection	IP20
Min. degree of protection of inst. location	IP54
Mounting type	DIN rail mounting
Mounting position	any
Type of housing	PBT yellow
Air clearances and creepage distances between the power circuits	DIN EN 50178/VDE 0160
Rated insulation voltage	250 V

General data	
Rated surge voltage/insulation	Safe isolation, reinforced insulation 6 kV between the control circuits (A1/A2), (31/32), (13/14, 23/24)
Degree of pollution	2
Overvoltage category	III

Dimensions	Screw connection	Spring-cage connection
W x H x D	17.5 x 99 x 114.5 mm	17.5 x 112 x 114.5 mm

Connection data	Screw connection	Spring-cage connection
Conductor cross section, solid	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/kcmil	24 ... 12	24 ... 16
Stripping length	7 mm	8 mm
Screw thread	M3	

Ambient conditions	
Ambient temperature (operation)	-20 °C ... 55 °C (observe derating)
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)
Information on operating height	See the “Using PSR devices at altitudes greater than 2000 m above sea level” section
Shock	15g
Vibration (operation)	10 Hz ...150 Hz, 2g

Conformance/Approvals	
Conformance	CE-compliant
The full EC Declaration of Conformity can be downloaded for the product at phoenixcontact.net/products.	
Approvals	

Safety data	
Stop category according to IEC 60204	0

Safety parameters for IEC 61508 - High demand	
Equipment type	Type A
HFT	0
SIL	3 (max. 10% of the entire SIL; diagnostic coverage (DC) of the control unit at A1/A2 must be ≥ 90%)
PFH_D	2.02×10^{-11} (4 A DC13; 5 A AC15; 8760 switching cycles/year)
Diagnostic coverage (DC)	99 % (during evaluation of the confirmation current path)
Demand rate	< 12 Months
Proof test interval	240 Months
Duration of use	240 Months
The specifications apply assuming the following calculation basis	
B_{10D}	1000000 (At 5 A DC 13)
d_{op}	365 Days
h_{op}	24 h
t_{Cycle}	3600 s

Alternative illustration as 1oo1 structure	
Equipment type	Type A
HFT	0
SIL	3 (max. 10% of the entire SIL; diagnostic coverage (DC) of the control unit at A1/A2 must be ≥ 90%)
Safe Failure Fraction (SFF)	99.99 %
λSD	198 FIT
λSU	63.9 FIT
λDD	3.66 FIT
λDU	0.02 FIT
λTotal	264.38 FIT
MTBF	342 Years (includes errors which are not part of the safety function; MTTR = 8 h)
PFH	2.02×10^{-11} (4 A DC13; 5 A AC15; 8760 switching cycles/year)

Safety parameters for IEC 61508 - Low demand	
Equipment type	Type A
HFT	0
SIL	3 (max. 10% of the entire SIL; diagnostic coverage (DC) of the control unit at A1/A2 must be ≥ 90%)
PFD_{avg}	9.88×10^{-05}
Proof test interval	60 Months
Duration of use	240 Months

The safety characteristic data is calculated assuming an average ambient temperature of 40°C. At higher ambient temperatures, a safety factor of 1.8 should be applied to the characteristics.

Alternative illustration as 1oo1 structure	
Equipment type	Type A
HFT	0
SIL	3 (max. 10% of the entire SIL; diagnostic coverage (DC) of the control unit at A1/A2 must be ≥ 90%)
Safe Failure Fraction (SFF)	99.76 %
λSD	0 FIT
λSU	1026.9 FIT
λDD	0 FIT
λDU	2.42 FIT
λTotal	1029.32 FIT
MTBF	104 Years (includes errors which are not part of the safety function; MTTR = 8 h)
PFD_{avg}	1.06×10^{-5} (For T1 = 1 year)

The safety characteristic data is calculated assuming an average ambient temperature of 40°C. At higher ambient temperatures, a safety factor of 1.8 should be applied to the characteristics.

Safety characteristic data according to EN ISO 13849	
Category	4 (Diagnostic coverage (DC) of the control unit at A1/A2 must be ≥ 99%)
Performance level	e (Diagnostic coverage (DC) of the control unit at A1/A2 must be ≥ 99%)
CCF	Passed
Duration of use	240 Months

The specifications apply assuming the following calculation basis

d_{op}	365 Days
h_{op}	24 h
t_{Cycle}	3600 s

Safety parameters for EN 62061	
SILCL	3 (max. 10% of the entire SIL; diagnostic coverage (DC) of the control unit at A1/A2 must be ≥ 90%)

5 Safety regulations and installation notes

WARNING: Death, serious personal injury or damage to equipment

Depending on the application, incorrect handling of the device may pose serious risks for the user or cause damage to equipment.

- Observe all the safety notes and warning instructions provided in this chapter and elsewhere in this document.

General

- 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.

- Only use power supply units with safe isolation and SELV/PELV according to EN 50178/VDE 0160.

Startup, mounting, and modifications

Startup, mounting, modifications, and upgrades may only be carried out by an electrically skilled person.

- Before working on the device, disconnect the power.
- Carry out wiring according to the application. Refer to the “Application examples” section for this.

Reliable operation is only ensured if the device is installed in housing protected from dust and humidity.

- Install the device in housing protected from dust and humidity (min. IP54).

In operation

During operation, parts of electrical switching devices carry hazardous voltages.

- Protective covers must not be removed when operating electrical switching devices.

For emergency stop applications, automatic startup of the machine can pose serious risks for the user.

- The machine must be prevented from restarting automatically by a higher-level controller.

Inductive loads can lead to welded relay contacts.

- Connect a suitable and effective protective circuit to inductive loads.
- Implement the protective circuit parallel to the load and not parallel to the switch contact.

Noise emission may occur when operating relay modules. Wireless reception may be disrupted in residential areas.

The device is a Class A product.

- Observe the requirements for noise emission for electrical and electronic equipment (EN 61000-6-4).
- Implement appropriate precautions against noise emission.

Surge voltages can destroy the device.

- Make sure that the output voltage of the power supply does not exceed 30 V even in the event of an error.

Faulty devices

The devices may be damaged following an error. Correct operation can no longer be ensured.

- In the event of an error, replace the device.

Only the manufacturer or their authorized representative may perform the following activities. Otherwise the warranty is invalidated.

– Repairs to the device
– Opening the housing

Taking out of service and disposal

- Dispose of the device in accordance with environmental regulations.
- Make sure that the device can never be reused.

6 Function description

6.1 Single-channel control

The external enable signal of the failsafe controller is switched at A1.

6.2 Automatic start

The device starts automatically once it has received the external enable signal of the failsafe controller.

6.3 Safe shutdown

Once the external enable signal of the failsafe controller has been deactivated, the enabling current paths open and the contacts fall into the safe state.

When the enabling current paths are open, the device is in the safe state.

The confirmation current path closes.

6.4 Diagnostics / proof test

You can carry out an optional diagnostic function, whereby the floating confirmation current path is read back into the failsafe controller.

This allows the repeat test required by standards to be carried out easily and safely.

If several devices are used, the N/C contacts of the confirmation current paths can be connected in series.

See section “Feedback circuit connection versions”.

6.5 Test pulse filter

By filtering the control controller test pulses, premature failure of the forcibly guided safety relay is prevented.

7 Basic circuit diagram

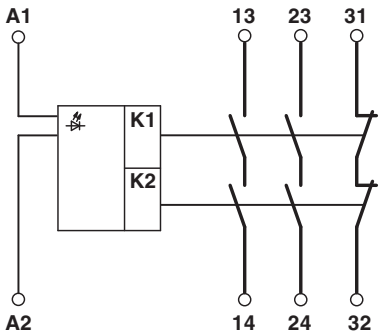


Figure 1 Block diagram

Key:

A1	24 V DC control
A2	0 V control
13/14 **23/24**	Undelayed enabling current paths
31/32	Confirmation current path, undelayed

8 Derating

8.1 Any mounting position

The derating curve applies for the following conditions:

– Mounting on a DIN rail in any mounting position
– Devices mounted next to each other without spacing

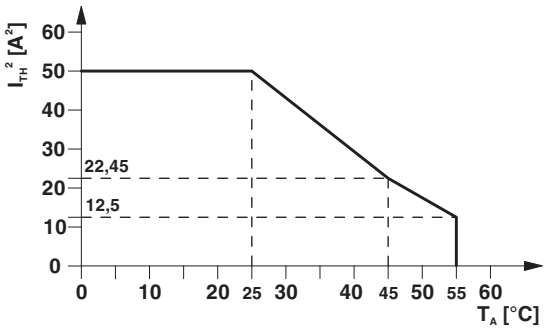


Figure 2 Derating curve - any mounting position, without spacing

9 Load curve

9.1 Resistive load

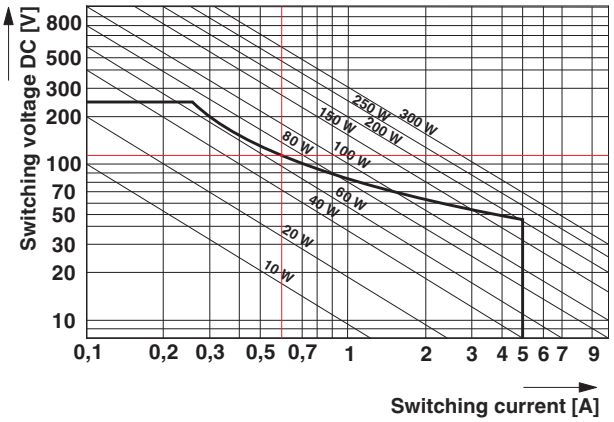


Figure 3 Relay load curve - resistive load

9.2 Inductive load

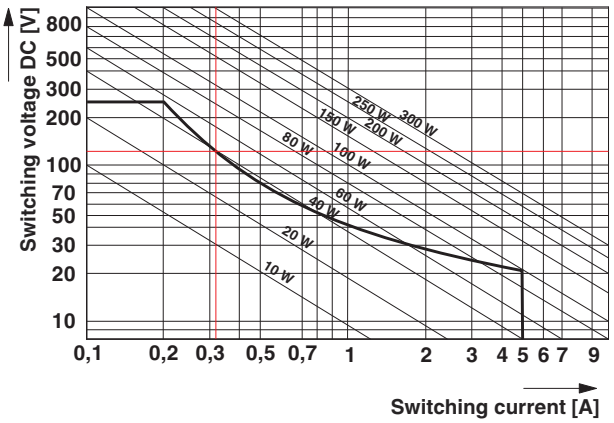
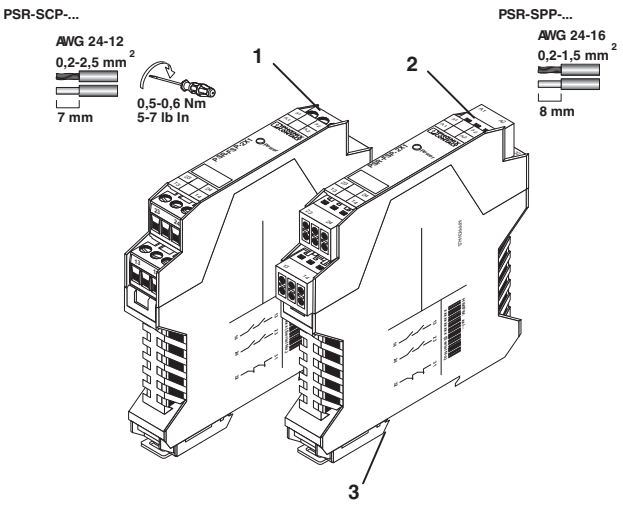


Figure 4 Relay load curve - inductive load

10 Operating and indication elements

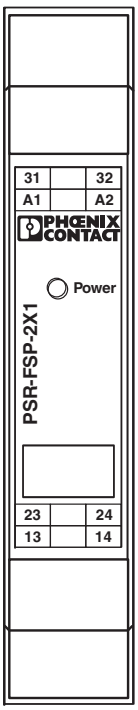
10.1 Connection versions



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

Figure 5 Connection versions

10.2 Connection assignment



A1 24 V DC control
A2 0 V control
31/32 Confirmation current path, undelayed

Power Power LED (yellow)

13/14
23/24 Undelayed enabling current paths

11 Mounting and removing

- Mount the device on a 35 mm DIN rail according to EN 60715.
- To remove the device, use a screwdriver to release the snap-on foot.

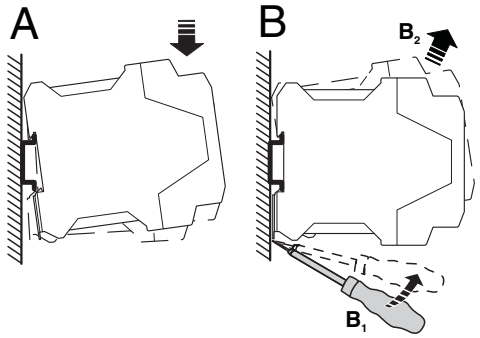


Figure 6 Mounting and removing

12 Wiring

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

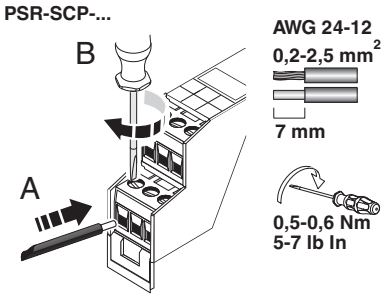


Figure 7 Connecting the cables for PSR-SCP-... (Screw terminal block)

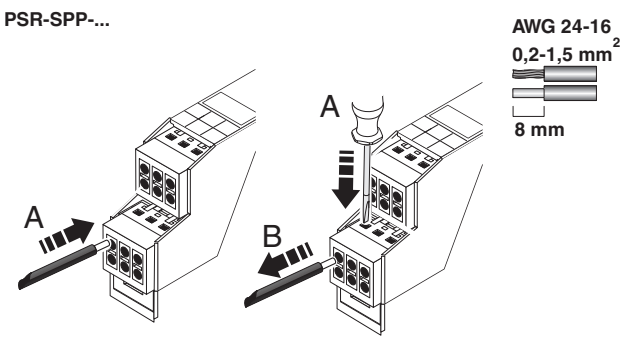


Figure 8 Connecting the cables for PSR-SPP-... (Spring-cage terminal block)

It is recommended that ferrules are used to connect stranded cables.

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

12.1 Signal generator connection versions

- Connect suitable signal generators to A1.

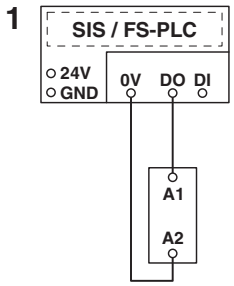


Figure 9 Signal generator connection versions

1 Single-channel control via failsafe controller

12.2 Feedback circuit connection versions

To carry out the optional diagnostic function via the confirmation current path, proceed as follows:

- Read confirmation current path 31/32 back into one of the digital inputs of the failsafe controller.
- Place the relevant N/C contact in the path from 31/32 to the digital input of the failsafe controller to monitor external contactors or extension devices with force-guided contacts.

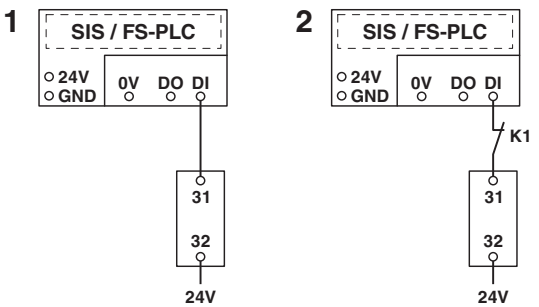


Figure 10 Feedback circuit connection versions

1 Confirmation current path without monitored contact extension

2 Confirmation current path with monitored contact extension

13 Startup

- Provide the external enable signal of the failsafe controller (24 V DC) at terminal block A1.

PWR LED lights up.

The enabling current paths 13/14 and 23/24 close.

Confirmation current path 31/32 opens.

14 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:

$P_{Contact} = n \bullet I_L^2 \bullet 200\ m\Omega$

With different load currents:

$P_{Contact} = (I_{L1}^2 + I_{L2}^2 + ... + I_{Ln}^2) \bullet 200\ m\Omega$

Total power dissipation

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

therefore

$P_{Total} = U_B^2 / (U_S/I_S) + n \bullet I_L^2 \bullet 200\ m\Omega$

or

$P_{Total} = U_B^2 / (U_S/I_S) + (I_{L1}^2 + I_{L2}^2 + ... + I_{Ln}^2) \bullet 200\ m\Omega$

Key:

P	Power dissipation in mW
U_B	Applied operating voltage
U_S	Rated control circuit supply voltage
I_S	Rated control supply current
n	Number of enabling current paths used
I_L	Contact load current

15 Proof test

To verify the device function, proceed as follows:

1. Deactivate A1.
2. Perform a continuity test for the confirmation current path (31/32).

Or:

Read the confirmation current path back into the failsafe controller.

WARNING: Loss of functional safety due to malfunction.

If the proof test contains errors, the device no longer functions correctly.

- Replace the device.

16 Application examples

16.1 Important information about applications with the device

For high demand applications, evaluation of the confirmation contact must take place within the process safety time.

The configuration path is not absolutely necessary for low-demand applications. However, readback is recommended so a potential error in the switching operation can be read into the controller. In any case, verify proper function with regular proof tests.

Key:

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

16.2 Single-channel connection with integration of the confirmation current path

– Integrating the 31/32 configuration path into the safe controller
– It is assumed that errors in the cable installation have been eliminated
– Suitable for high-demand applications up to:
  - SIL 3 (IEC 61508), SIL 3 (IEC 61511), SIL 3 (IEC 62061), if the diagnostic coverage (DC) of the failsafe controller is ≥ 90%
  - Cat. 4 / PL e (EN ISO 13849), if the diagnostic coverage (DC) of the failsafe controller is ≥ 99%
– For low-demand applications suitable up to SIL 3 (IEC 61508), SIL 3 (IEC 61511), if the diagnostic coverage (DC) of the failsafe controller is at 90 %

Cross-circuits in the cable installation can be excluded if the failsafe PLC, safety relay, and external contactors K1 and K2 are located in the same electrical installation space.

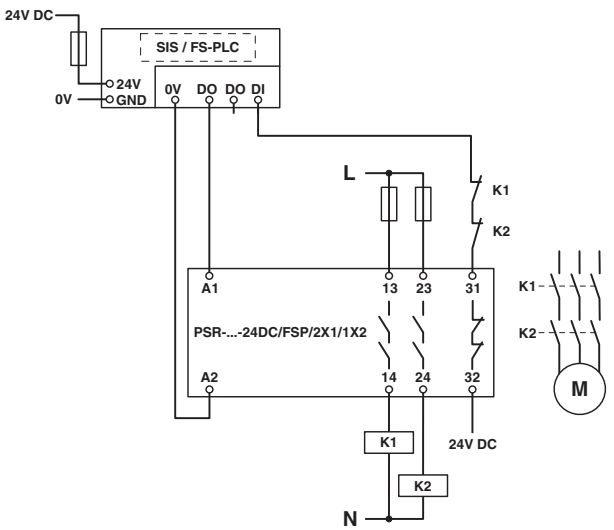


Figure 11 Single-channel connection with integration of the confirmation current path

16.3 Two-channel connection with integration of the confirmation current path

- Integrating the 31/32 configuration paths into the safe controller
- It is assumed that errors in the cable installation have been eliminated
- Suitable for high-demand applications up to:
  - SIL 3 (IEC 61508), SIL 3 (IEC 61511), SIL 3 (IEC 62061), if the diagnostic coverage (DC) of the failsafe controller is ≥ 90%
  - Cat. 4 / PL e (EN ISO 13849), if the diagnostic coverage (DC) of the failsafe controller is ≥ 99%
- For low-demand applications suitable up to SIL 3 (IEC 61508), SIL 3 (IEC 61511), if the diagnostic coverage (DC) of the failsafe controller is at 90 %

Cross-circuits in the cable installation can be excluded if the failsafe PLC, safety relay, and external contactors K1 and K2 are located in the same electrical installation space.

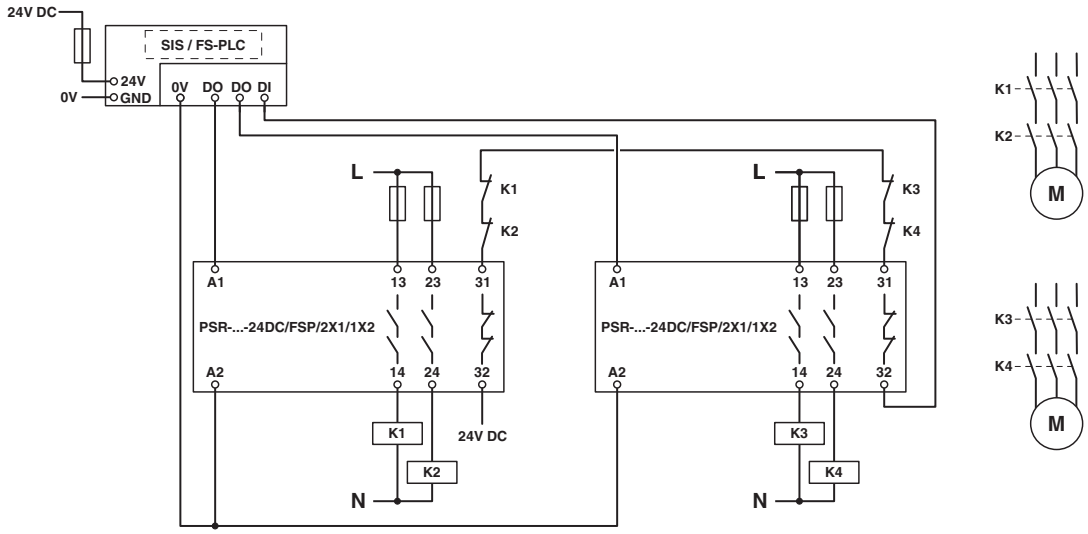


Figure 12 Two-channel connection with integration of the confirmation current path

17 Attachment

17.1 Using PSR devices at altitudes greater than 2000 m above sea level

The following section describes the special conditions for using PSR devices at altitudes greater than 2000 m above sea level. Observe the relevant device-specific data (technical data, derating, etc.) according to the product documentation for the individual device.

Using the device at altitudes **greater than 2000 m above sea level up to max. 4500 m above sea level** is possible under the following conditions:

1. Limit the rated control circuit supply voltage (U_S) in accordance with the table below. Observe the technical data for the device.

U_S according to the technical data for the device	U_S when used at altitudes greater than 2000 m above sea level
< 150 V AC/DC	U_S according to the technical data for the device still valid
> 150 V AC/DC	Limited to max. 150 V AC/DC

2. Limit the maximum switching voltage in accordance with the table below. Observe the technical data for the device.

Max. switching voltage according to the technical data for the device	Max. switching voltage when used at altitudes greater than 2000 m above sea level
< 150 V AC/DC	Max. switching voltage according to the technical data for the device still valid
> 150 V AC/DC	Limited to max. 150 V AC/DC

3. Reduce the maximum ambient temperature for operation by the corresponding factor in accordance with the table below.
4. If derating is specified, offset all the points of the derating curve by the corresponding factor in accordance with the table below.

Altitude above sea level	Temperature derating factor
2000 m	1
2500 m	0.953
3000 m	0.906
3500 m	0.859
4000 m	0.813
4500 m	0.766

Example calculation for 3000 m

The following calculation and the illustrated derating curve are provided as examples. Perform the actual calculation and offset the derating curve for the device used according to the technical data and the “Derating” section.

27 °C • 0.906 ≈ 24 °C

55 °C • 0.906 ≈ 49 °C

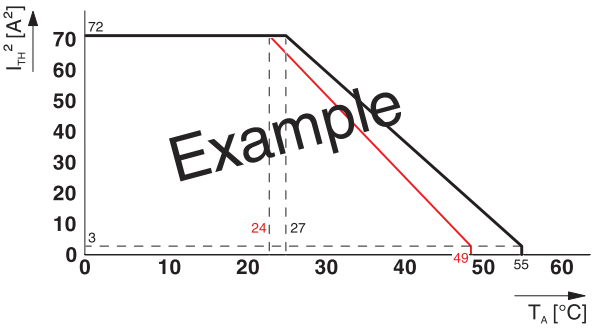


Figure 13 Example of a suspended derating curve (red)

17.2 Revision history

Version	Date	Contents
02	2018-12-06	New edition of the data sheet

SCATTERGOOD & JOHNSON LTD
ELECTRICAL ENGINEERING & FLUID CONTROL DISTRIBUTORS
Est.1899

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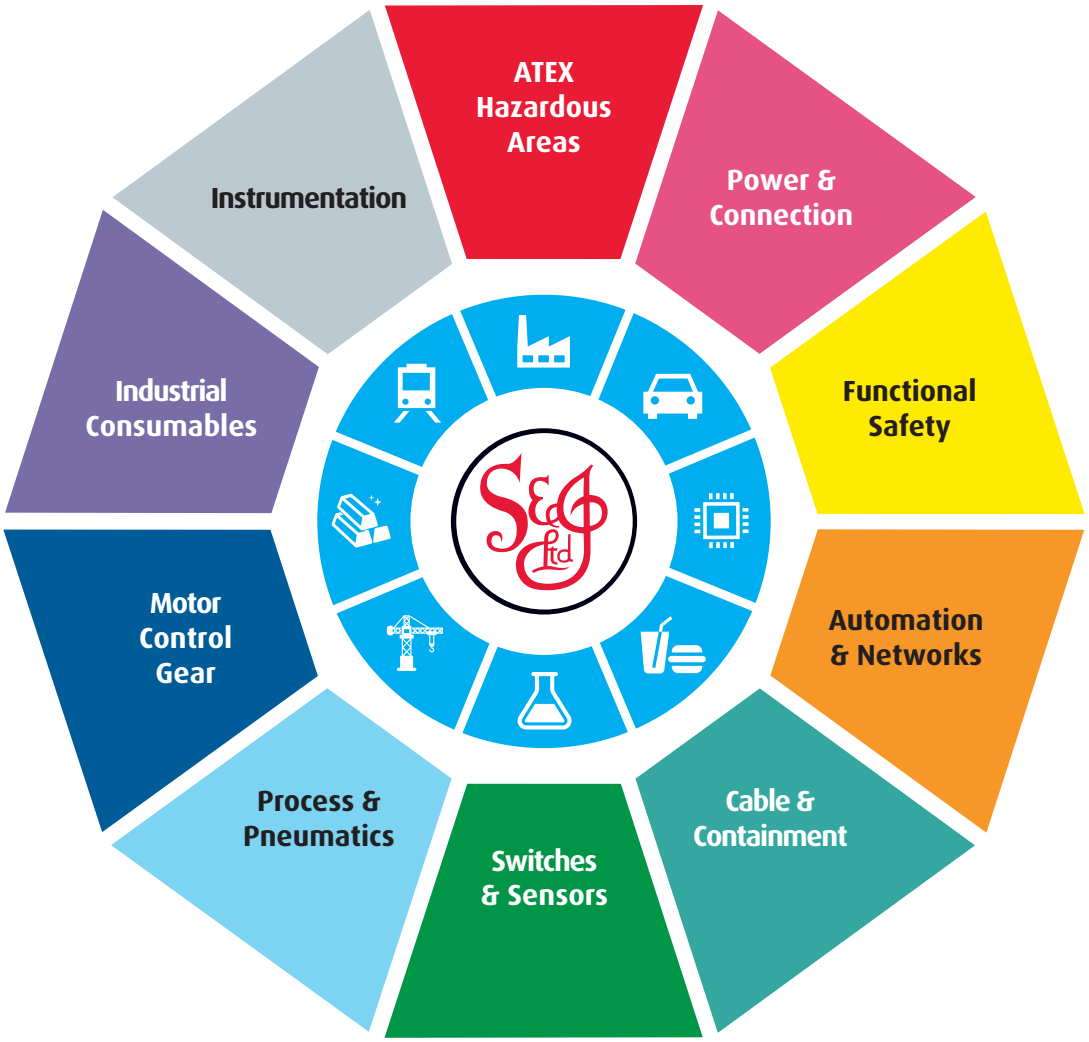

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