PSR-...- 24DC/ESP4/2X1/1X2

SIL IEC 61508

PL EN ISO 13849

Safety relay for emergency stop and safety door monitoring

Data sheet
100516_en_06

1 Description

Intended Use

The safety relay is used to monitor single-channel signal generators and to control actuators.

If the enable signal of the signal generator is not present at A1, the safety relay initiates the safe state.

The safety relay interrupts circuits in a safety-related way.

Possible signal generators

- Emergency stop button
- Door locking mechanisms
- Failsafe controllers

Contact type

- 2 undelayed enabling current paths
- 1 undelayed enabling current path

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

Control

- Single-Channel
- Automatic or manual start

A connected reset button is not monitored.

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

- Safe isolation between mains voltage and 24 V supply voltage in accordance with EN 50178
- Option of screw or spring-cage terminal blocks for plug-in
- 22.5 mm housing width

Approvals

c UL us LISTED, EAC, GL, TÜVRheinland CERTIFIED

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.

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2 Table of contents

3 Ordering data

Description	Type	Order No.	Pcs./Pkt.
Safety relay for SIL 3 high and low-demand applications, also approved according to EN 50156, Germanischer Lloyd, and EN ISO 13849, emergency stop and safety door monitoring, single-channel, 2 enabling current paths, 1 alarm contact, plug-in screw terminal blocks, width: 22.5 mm	PSR-SCP- 24DC/ESP4/2X1/ 1X2	2981020	1
Safety relay for SIL 3 high and low-demand applications, also approved according to EN 50156, Germanischer Lloyd, and EN ISO 13849, emergency stop and safety door monitoring, 1-channel, 2 enabling current paths, 1 signal contact, plug-in spring-cage terminal block, width: 22.5 mm	PSR-SPP- 24DC/ESP4/2X1/ 1X2	2981017	1

4 Technical data

Hardware/firmware version	
HW/FW	≥ 07/--
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. 50 mA DC
Inrush current	1 A (Δt <10 ms at U_s)
Power consumption at U_S	1.2 W
Filter time	max. 3 ms (Test pulse duration)
Typical response time at U_s	60 ms (Automatic/manual start)
Typical release time with U_s	20 ms
Recovery time	approx. 1 s
Operating voltage display	Green LED
Status display	Green LED
Protective circuit	Surge protection Suppressor diode, 33 V (A1 - A2, Y2 - A2) Reverse polarity protection

Output data	
Contact type	2 enabling current paths 1 signaling current path (type B according to EN 50205)
Contact material	$AgSnO_2$, gold-flashed
Minimum switching voltage	10 V
Maximum switching voltage	250 V AC/DC (Observe the load curve)
Limiting continuous current	6 A (N/O contact/N/C contact, high demand) 4 A (N/O contact, for low-demand applications)
Maximum inrush current	6 A
Inrush current, minimum	10 mA
Sq. Total current $I_{TH}^2 = I_1^2 + I_2^2 + ... + I_N^2$	72 A^2 (observe derating)
Interrupting rating (ohmic load) max.	144 W (24 V DC, τ = 0 ms) 200 W (48 V DC, τ = 0 ms) 77 W (110 V DC, τ = 0 ms) 70 W (220 V DC, τ = 0 ms) 1500 VA (250 V AC, τ = 0 ms)
Maximum interrupting rating (inductive load)	42 W (24 V DC, τ = 40 ms) 40 W (48 V DC, τ = 40 ms) 35 W (110 V DC, τ = 40 ms) 33 W (220 V DC, τ = 40 ms)
Switching capacity min.	0.2 W
Mechanical service life	approx. 10^7 cycles
Switching capacity (360/h cycles)	5 A (24 V (DC13)) 5 A (230 V (AC 15))
Switching capacity (3600/h cycles)	5 A (24 V (DC13)) 5 A (230 V (AC 15))
Output fuse	6 A gL/gG NEOZED (High demand) 4 A gL/gG NEOZED (Low demand)

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	On horizontal and vertical DIN rail
Weight	199.6 g
Type of housing	PBT yellow
Air clearances and creepage distances between the power circuits	DIN EN 50178/VDE 0160
Rated insulation voltage	250 V
Rated surge voltage/insulation	6 kV / Safe isolation, increased insulation Basic insulation 4 kV between all current paths and housing
Degree of pollution	2

General data	
Overvoltage category	III
Maximum power dissipation for nominal condition	15.9 W (I^2 = 72 A^2)
Note on power dissipation	See “Calculating the power dissipation”

Dimensions	Screw connection	Spring-cage connection
W x H x D	22.5 x 99 x 114.5 mm	22.5 x 112 x 114.5 mm

Connection data	Screw connection	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, flexible	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)	-20 °C ... 55 °C
Ambient temperature (storage/transport)	-40 °C ... 70 °C
Max. permissible relative humidity (operation)	75 % (on average, 85% infrequently, non-condensing)
Max. permissible humidity (storage/transport)	75 % (on average, 85% infrequently, non-condensing)
Maximum altitude	≤ 2000 m (Above sea level)
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	
SIL	3
PFH_D	1,16 x 10^{-10}
Demand rate	< 12 Months
Proof test interval	240 Months
Duration of use	240 Months
The specifications apply assuming the following calculation basis	
B_{10D}	160000 (AC15 5 A)
d_{op}	365.25 Days
h_{op}	24 h
t_{Cycle}	3600 s

Safety parameters for IEC 61508 - Low demand	
SIL	3
PFD_{avg}	1,24 x 10^{-4}
Proof test interval	72 Months
Duration of use	240 Months

Safety characteristic data according to EN ISO 13849	
Category	4
Performance level	e
DC_{avg}	99 %
$MTTF_D$	269 Years
Duration of use	240 Months
For applications in PL e, the required demand rate for the safety function is once per month.	
The specifications apply assuming the following calculation basis	
B_{10D}	160000 (AC15 5 A)
d_{op}	365.25 Days
h_{op}	24 h
t_{Cycle}	3600 s

Safety parameters for EN 62061	
SILCL	3
For applications in SILCL 3, the required demand rate for the safety function is once per month.	

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 wiring

The signal generator or 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 enable signal of the signal generator or failsafe controller.

6.3 Manual start

When the enable signal is present, the device starts once the start circuit has been closed by pressing the reset button.

A connected reset button is not monitored.

6.4 Safe shutdown

Once the external enable signal has been deactivated, the enabling current paths open and the contacts enter the safe state.

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

The signaling current path closes.

7 Basic circuit diagram

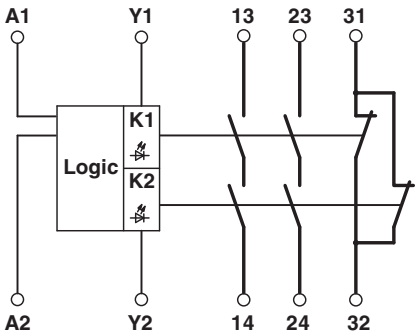


Figure 1 Block diagram

Key:

A1	Power supply/control 24 V DC
A2	Power supply/control 0 V
Y1/Y2	Start and feedback circuit
13/14 **23/24**	Undelayed enabling current paths
31/32	Signaling current path, undelayed

8 Derating

8.1 Vertical or horizontal mounting position

The derating curve applies for the following conditions:

– Mounting on a vertical or horizontal DIN rail
– Devices mounted next to each other without spacing

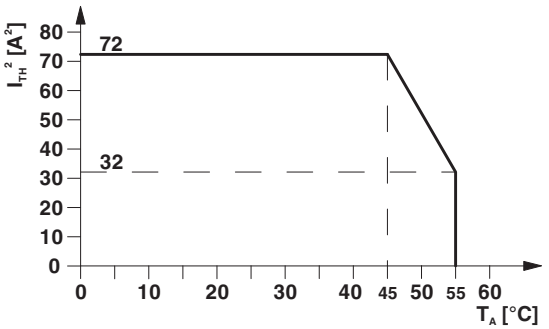
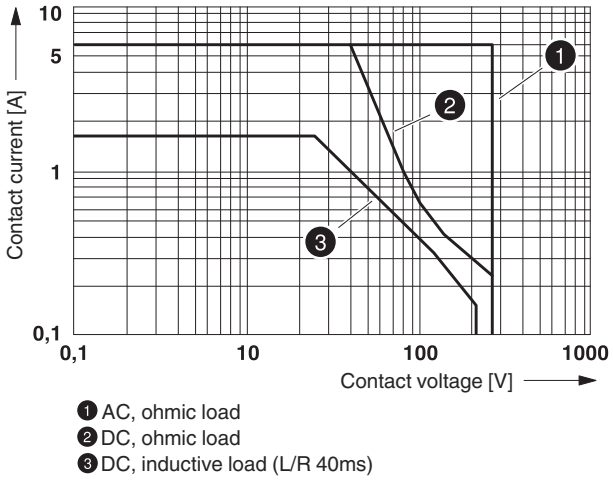


Figure 2 Derating curve - vertical or horizontal mounting position, without spacing

9 Load limit curve

9.1 Ohmic and inductive load

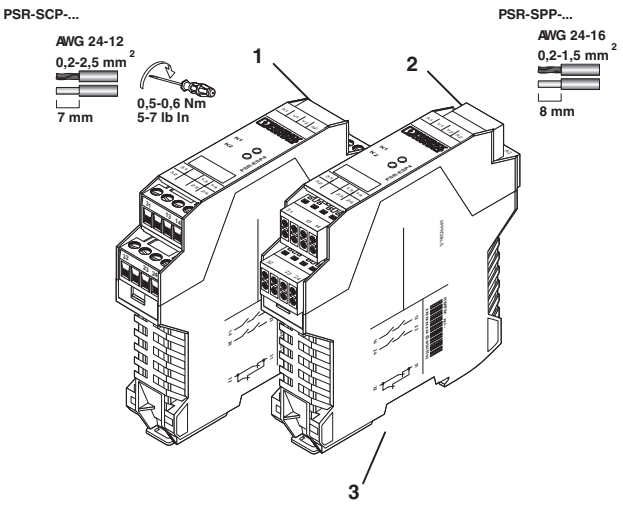


❶ AC, ohmic load
❷ DC, ohmic load
❸ DC, inductive load (L/R 40ms)

Figure 3 Load limit curve - ohmic and inductive load

10 Operating and indication elements

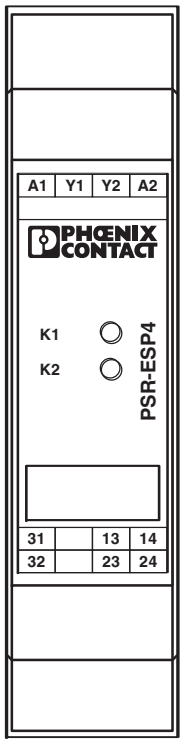
10.1 Connection versions



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

Figure 4 Connection versions

10.2 Connection assignment



A1	Power supply/control 24 V DC
A2	Power supply/control 0 V
Y1/Y2	Start and feedback circuit
K1	Status indicator safety circuit; LED (green)
K2	Status indicator safety circuit; LED (green)
31/32	Signaling current path, undelayed
13/14	Undelayed enabling current paths
23/24	

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.

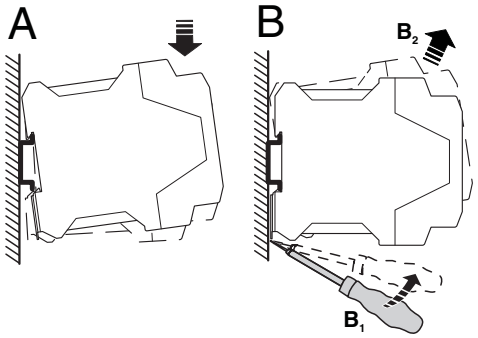


Figure 5 Mounting and removing

12 Wiring

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

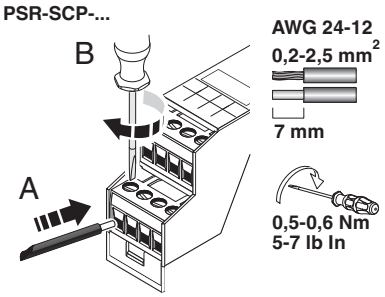


Figure 6 Connecting the cables for PSR-SCP-... (Screw terminal block)

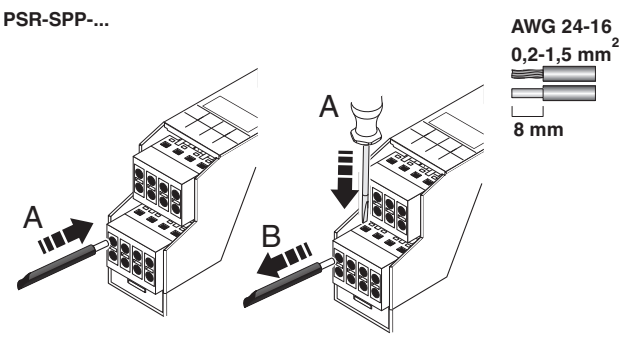


Figure 7 Connecting the cables for PSR-SPP-... (Spring-cage terminal block)

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.

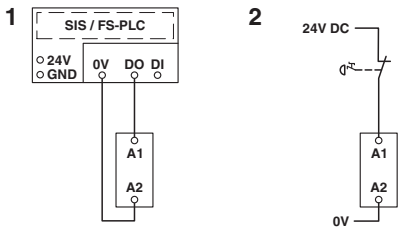


Figure 8 Signal generator connection versions

1 Single-channel control via failsafe controller
2 Single-channel connection of a signal generator

12.2 Start and feedback circuit connection variants

Automatic start

- Bridge contacts Y1/Y2.

Manual start

- Connect a reset button to contacts Y1/Y2.

A connected reset button is not monitored.

Start and feedback circuit

- Place the relevant N/C contacts in path Y1/Y2 to monitor external contactors or extension devices with force-guided contacts.

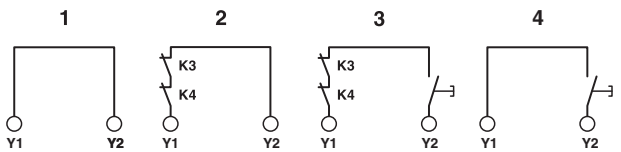


Figure 9 Start and feedback circuit connection variants

1 Automatic start
2 Automatic start with monitored contact extension
3 Manual start with monitored contact extension
4 Manual start

13 Startup

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

Automatic start

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

Signaling current path 31/32 opens.

The K1 and K2 LEDs light up.

Manual start

- Press the reset button.

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

Signaling current path 31/32 opens.

The K1 and K2 LEDs light up.

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 the device.
2. Restart the device.
3. Check whether the K1 and K2 LEDs light up.

If the K1 and K2 LEDs light up, both safety circuits have been started correctly.

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 High-demand application with failsafe controller

- Automatic start
- It is assumed that errors in the cable installation have been eliminated
- Monitoring of external, force-guided contactors
- The digital output (DO) of the failsafe controller satisfies the requirements in accordance with the required safety integrity
- Suitable for high-demand applications up to SIL 3 (IEC 61508), SIL 3 (IEC 61511), Cat. 4 / PL e (EN ISO 13849), SIL 3 (EN 62061)

Cross-circuits in the cable installation can be ruled out in the same electrical installation space or through mechanically protected cable installation.

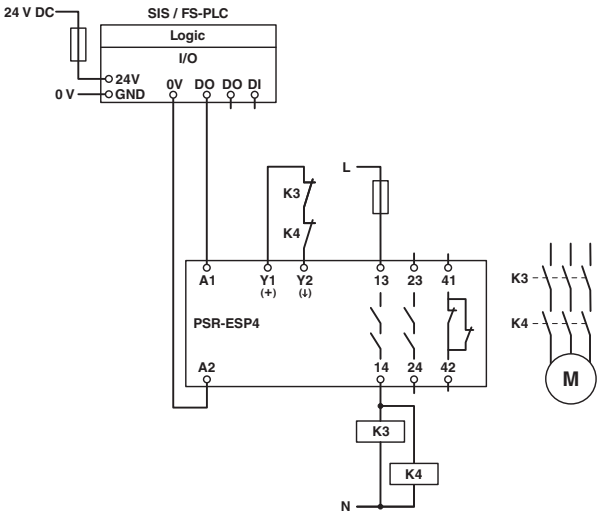


Figure 10 High-demand application with failsafe controller

Key:

SIS / FS-PLC	Safety Instrumented System / failsafe controller
DI	Digital input
DO	Digital output
K3/K4	Force-guided contactors

16.2 Low-demand application with failsafe controller

- Automatic start
- It is assumed that errors in the cable installation have been eliminated
- The digital output (DO) of the failsafe controller satisfies the requirements in accordance with the required safety integrity
- Suitable for low-demand applications up to SIL 3 (IEC 61508, IEC 61511, EN 50156)

Cross-circuits in the cable installation can be ruled out in the same electrical installation space or through mechanically protected cable installation.

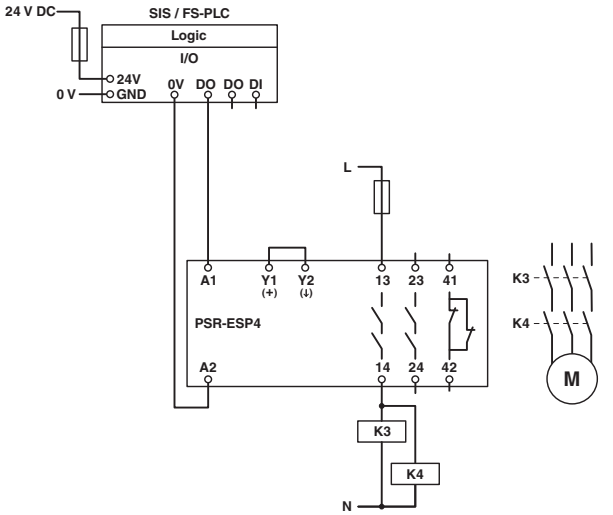


Figure 11 Low-demand application with failsafe controller

Key:

SIS / FS-PLC	Safety Instrumented System / failsafe controller
DI	Digital input
DO	Digital output
K3/K4	Force-guided contactors

16.3 Single-channel emergency stop monitoring

- Automatic start
- Monitoring of external contactor
- The emergency stop button satisfies the requirements in accordance with the required safety integrity
- Suitable up to category 1, PL c (EN ISO 13849-1), SIL 1 (EN 62061)

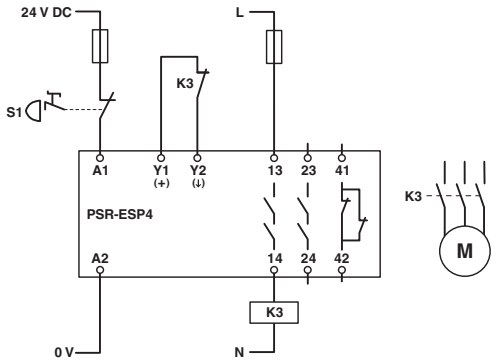


Figure 12 Single-channel emergency stop monitoring/ autostart

Key:

S1	Emergency stop button
K3	Contactor

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

1. 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

1. Reduce the maximum ambient temperature for operation by the corresponding factor in accordance with the table below.
2. 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

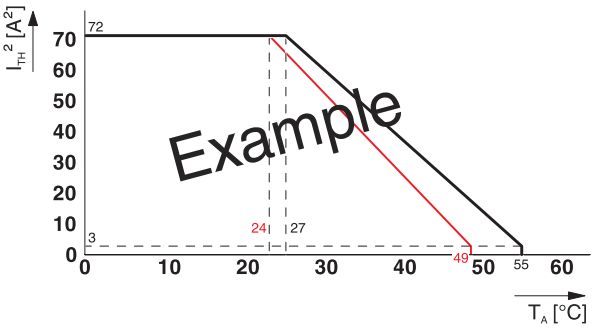


Figure 13 Example of a suspended derating curve (red)

17.2 Revision history

Version	Date	Contents
06	2019-03-08	New edition of the data sheet

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

At Scattergood & Johnson Ltd, we pride ourselves on being a technical distributor to specialist industries.

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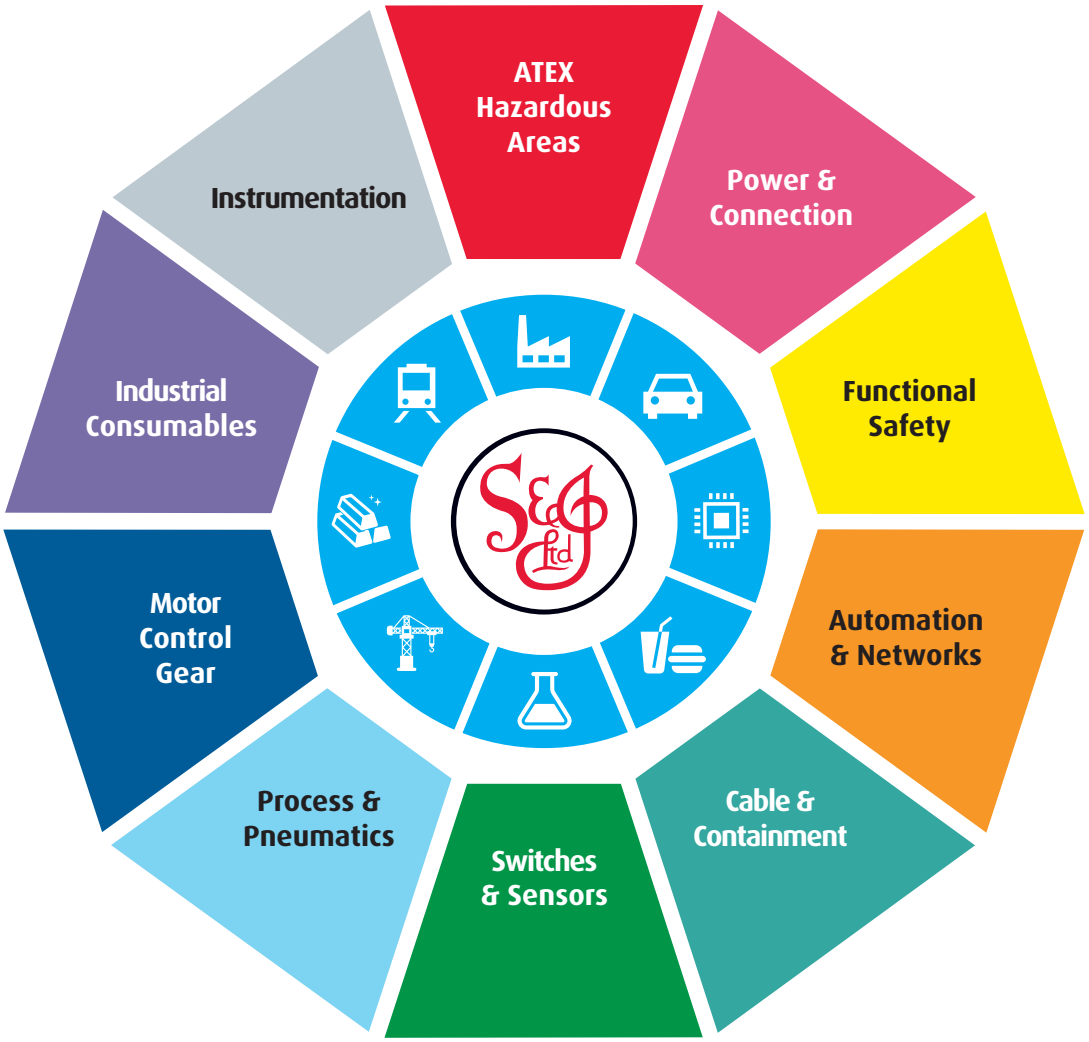

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