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PRSU/2, PRSU/4, PRSU/5

Operating Instructions Manual

Safety controllers for safety mats and sensing edge products



Introduction

This operating instruction shall familiarize you with the safety relay controller models: PRSU/2, PRSU/4 and PRSU/5.

Target Audience

These operating instructions are addressed to the following personnel:

- Skilled personnel who plan or develop safety equipment for machines and plants, who are familiar with the safety instructions and safety regulations.
- Skilled personnel who build, install, maintain and operate safety equipment in plants and machinery.

Symbol Key

These operating instructions contain several symbols which are used to highlight important information:



This symbol indicates text passages which *must absolutely be paid attention to*. Disregarding may lead to serious personal injury or damage to property.



This symbol indicates text passages which contain important information.



This sign is used to indicate actions by the installer or operator.



This sign illustrates that a condition has changed after an action has been carried out.



Safety Indications

Intended Application

The safety relays PRSU/2, PRSU/4 and PRSU/5 are intended for the use with:

- Single or dual-channel capability safety mats.
- Single or dual-channel capability sensing edges, bumpers or ribbon switches.

Operator and asset protection are only guaranteed if the safety relay is operated according to its intended purpose and within the limits stated in its specification.

Please pay attention to the following points:

Safety Warning



- The device must be wired and operated by specialized staff who are familiar with the current regulations for safety at work and accident prevention and who have read this manual's content in full. Installation, assembly and maintenance of electrical equipment is only permitted by specialized staff.
- Pay attention to valid regulations, particularly in reference to preventative measures.
- Any repairs or modifications that are attempted outside of a Tapeswitch factory, or by personnel that are not authorized by the manufacturer may render the unit unreliable to serve as a safety component and should be replaced immediately. Unauthorized modification will immediately void any warranty.
- Avoid mechanical vibrations more than 5g/33 Hz during transportation, installation and operation.
- The unit should be panel mounted in an enclosure rated IP 54 or better. Dust and dampness could lead to malfunction.
- Adequate fuse protection must be provided on all output contacts with capacitive and inductive loads.

PRSU/2 Electrical Overview

The PRSU/2 can be operated with an input voltage of +24VDC, or 24VAC. This model features two normally-open safety relays that are triggered by the “Sensor Monitoring” terminals (S11, S12, S21, S22).

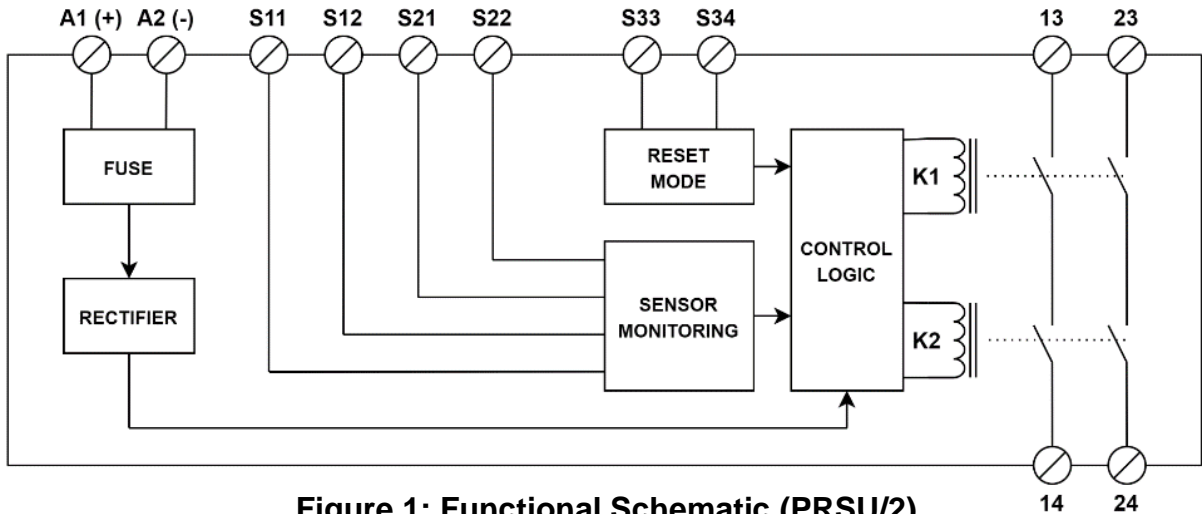
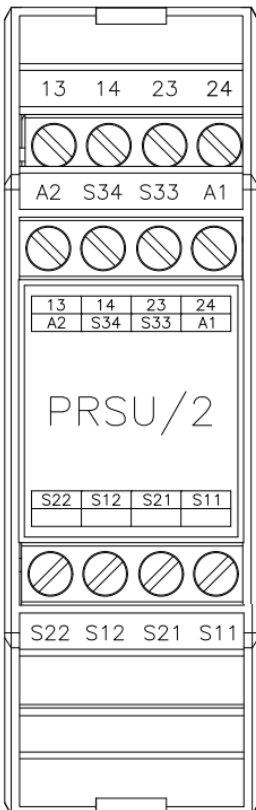


Figure 1: Functional Schematic (PRSU/2)



Terminals	Description
A1	Power input (+24VDC, or 24V _{AC})
A2	Power input (GND, or 24V _{AC})
13, 14	Safety Relay #1
23, 24	Safety Relay #2
S33, S34	RESET Mode Control
S11, S12	Sensor Connection
S21, S22	Sensor Connection

Table 1: Device Terminals (PRSU/2)

PRSU/4 Electrical Overview

The PRSU/4 can be operated with an input voltage of +24VDC, or 24VAC. This model features three normally-open safety relays that are triggered by the “Sensor Monitoring” terminals (S11, S12, S21, S22). This model also features an additional normally-closed auxiliary relay (not for safety use).

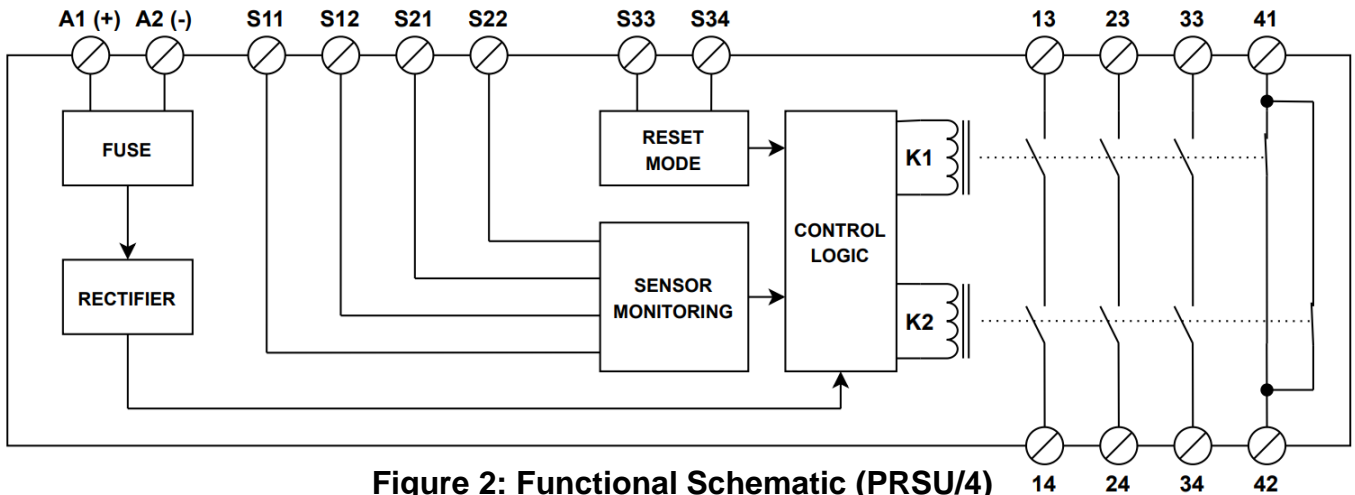
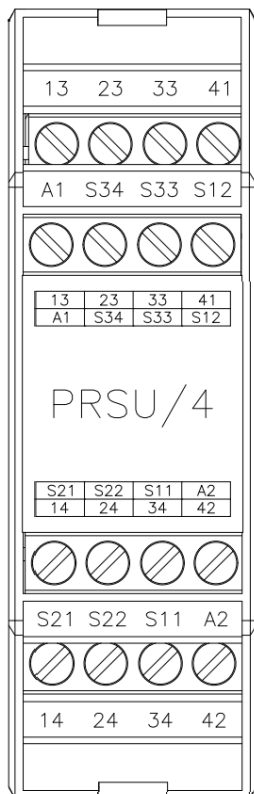


Figure 2: Functional Schematic (PRSU/4)



Terminals	Description
A1	Power input (+24V _{DC} , or 24V _{AC})
A2	Power input (GND, or 24V _{AC})
13, 14	Safety Relay #1
23, 24	Safety Relay #2
33, 34	Safety Relay #3
41, 42	Auxiliary Relay (Non-Safety)
S33, S34	RESET Mode Control
S11, S12	Sensor Connection
S21, S22	Sensor Connection

Table 2: Device Terminals (PRSU/4)



PRSU/5 Electrical Overview

The PRSU/5 can be operated with an input voltage of 115VAC. This model features three normally-open safety relays that are triggered by the “Sensor Monitoring” terminals (S11, S12, S21, S22). This model also features an additional normally-closed auxiliary relay (not for safety use).

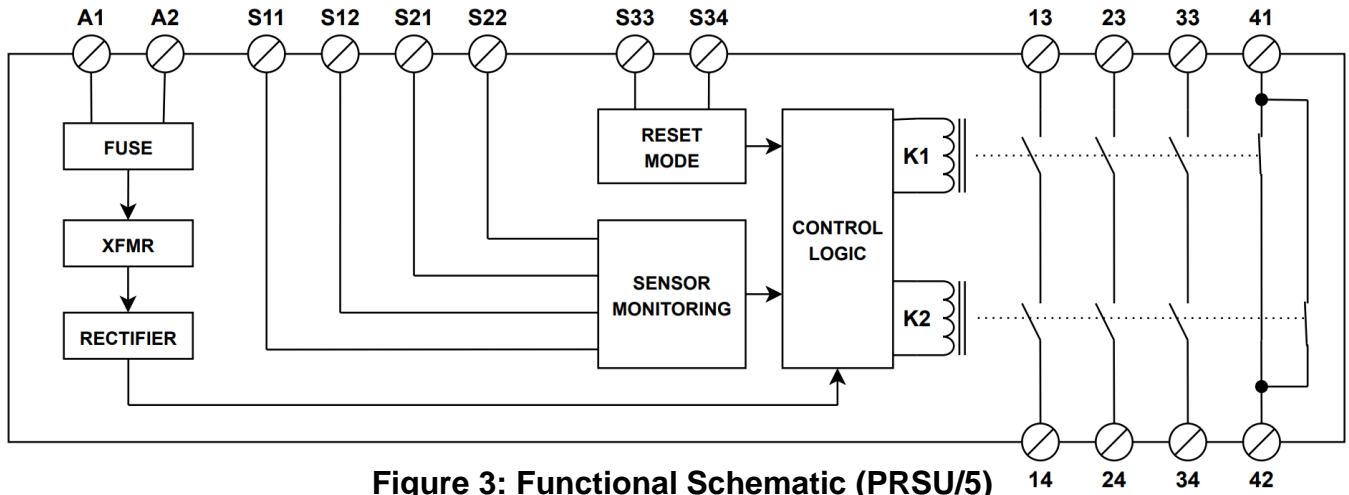
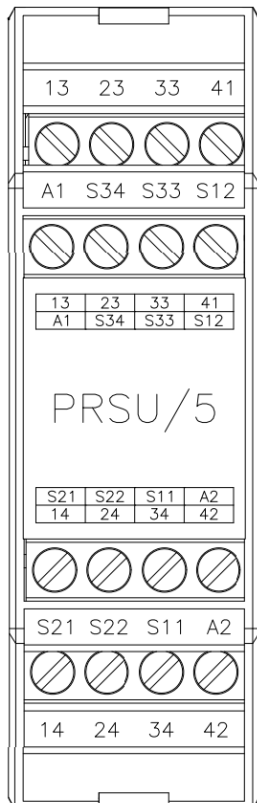


Figure 3: Functional Schematic (PRSU/5)





Terminals	Description
A1	Power input (115V _{AC})
A2	Power input (115V _{AC})
13, 14	Safety Relay #1
23, 24	Safety Relay #2
33, 34	Safety Relay #3
41, 42	Auxiliary Relay (Non-Safety)
S33, S34	RESET Mode Control
S11, S12	Sensor Connection
S21, S22	Sensor Connection


Table 3: Device Terminals (PRSU/5)





Device Startup Verification (PRSU/2)

-  Before creating any electrical connection to the device’s relay channels, RESET circuit, or switch monitoring terminals, select a power supply with appropriate voltage settings and ensure its output is set OFF.


-  Connect the power supply output (with appropriate input power source; see requirements listed on Pages 13 and 14 of this manual) to the PRSU/2 power input terminals (A1, A2), then apply the correct voltage for the device and verify that the “Power” LED illuminates.


-  Turn OFF power from the supply and make the appropriate connections to the switch monitoring channels, relays and RESET circuit according to the configuration guidelines laid out on Pages 8 through 10 of this manual.


-  When the correct configuration is implemented and power is again applied, monitoring of the switches/sensors will only occur once a RESET signal is received by bridging S33 and S34 with an appropriately rated wire. See pages 8 through 10 of this manual for more information.


-  After the RESET signal is received and the monitored switch is in the unactuated state, the relay contacts (13 → 14), (23 → 24) will close.


Device Startup Verification (PRSU/4, PRSU/5)

-  Before creating any electrical connection to the device’s relay channels, RESET circuit, or switch monitoring terminals, select a power supply with appropriate voltage settings and ensure its output is set OFF.

-  Connect the power supply output (with appropriate input power source; see requirements listed on Pages 13 and 14 of this manual) to the PRSU/4 or PRSU/5 power input terminals (A1, A2), then apply the correct voltage for the device and verify that the “Power” LED illuminates.

-  Turn OFF power from the supply and make the appropriate connections to the switch monitoring channels, relays and RESET circuit according to the configuration guidelines laid out on Pages 8 through 10 of this manual.

-  When the correct configuration is implemented and power is again applied, monitoring of the switches/sensors will only occur once a RESET signal is received by bridging S33 and S34 with an appropriately rated wire. See Pages 9 through 10 of this manual for more information.

-  After the RESET signal is received and the monitored switch is in the unactuated state, the relay contacts (13 → 14), (23 → 24) and (33 → 34) will close. Contacts (41 → 42) will open.



Recommended Limits

Performance of the PRSU/2, PRSU/4 and PRSU/5 are limited according to the values listed on Pages 13 and 14 of this manual. In particular, a 200Ω limit on short-circuit (actuated state) series resistance is required for four-wire, fail-safe applications. The overall series resistance of different products, cables and layouts can vary greatly. To ensure that a particular application will require only a single PRSU/2, PRSU/4 or PRSU/5, the following rule-of-thumb guidelines can be used:

Recommended Application Limits		
Product Type	Maximum Area	Maximum Length
ControlMat, ArmorMat, DPM	100ft ²	N/A
Sensing Edge Products (all)	N/A	200ft
Ribbon Switches	N/A	200ft
SE-45, SE-75, SE-C Bumpers	N/A	200ft
All values listed assuming 20AWG/4, Ø3/16, lead cable @ 500ft max.		

Table 4: Safety Product Recommended Limits

Common Device Configurations				
See below for graphical representation of lead styles.				
Product Type	S11	S21	S12	S22
Single Lead, Fail-safe	BLACK	RED	YELLOW	WHITE
Dual Lead, Fail-safe, Style 1	BLACK ₁	WHITE ₁	BLACK ₂	WHITE ₂
Dual Lead, Fail-Safe, Style 2	RIBBED ₁	SMOOTH ₁	RIBBED ₂	SMOOTH ₂

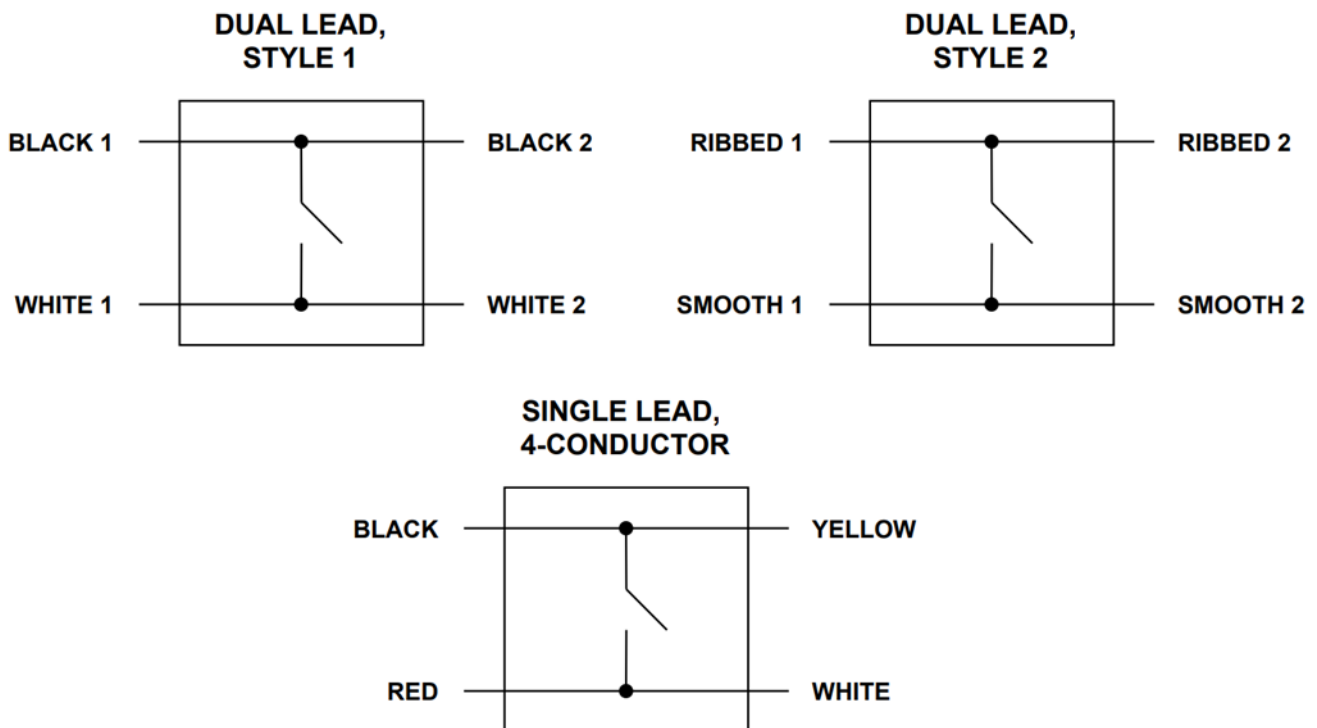


Table 5: Common Wiring Configurations

Device Mounting and Unmounting

Mechanical Mounting

All units should be DIN-rail mounted and/or panel-mounted in an enclosure rated at IP 54 or better. Dust and dampness could lead to malfunction.



- There is a notch on the rear of the unit for DIN-Rail attachment.

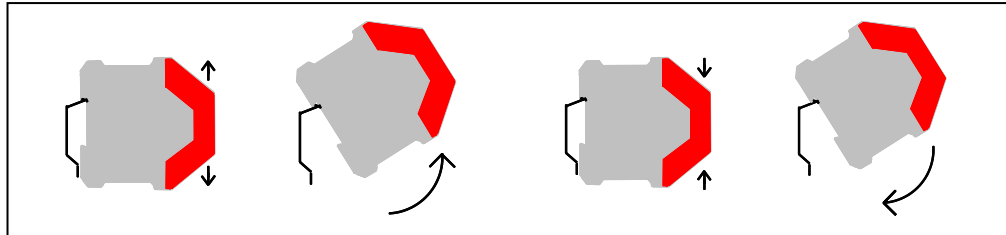


Figure 4: DIN Rail Mounting Detail

Electrical Connections

Wire the device based on which of the following options best suits the target application:

RESET Mode Control Wiring:



1. Automatic:

In this operating mode, the output relay coils will become energized automatically if and only if a properly working safety sensor is appropriately connected and unactuated. Implement this mode of operation by electrically bridging the device's S33 and S34 terminals with a wire.

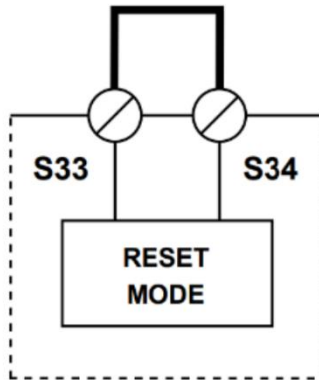


Figure 5: RESET Mode (Automatic) Configuration

2. Manual:



In this operating mode, the output relay coils will de-energize upon the closure of conductors within the monitored sensor/switch system. The coils will not energize again until the closure is broken and a RESET signal is manually generated by the operator (via a mechanical N.O. pushbutton or switch).

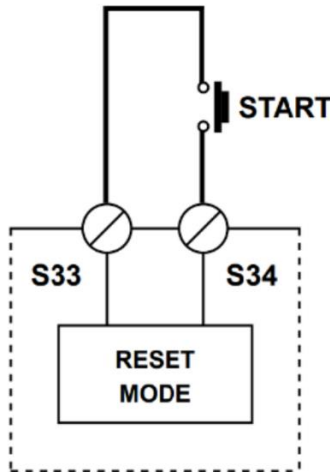


Figure 6: RESET Mode (Manual) Configuration

3. Conditional:



In this operating mode, the RESET signal cannot propagate unless *all* of the following conditions are met:

- The contacts have opened in the monitored sensor/switch.
- The machine primary control elements (MPCE 1 and MPCE 2) have closed.
- A manual RESET signal is subsequently generated by an operator pressing the “Start” pushbutton.

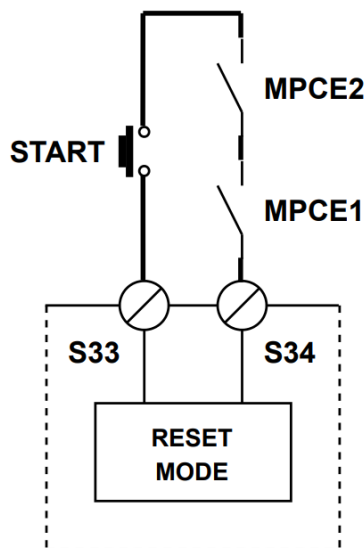


Figure 7: RESET Mode (Conditional) Configuration

Monitoring Channel Mode Wiring

For both of the following configurations, please note the maximum and minimum electrical parameters for these devices listed in the table on Pages 13 and 14.



1. Dual channel (fail-safe):

For fail-safe (safety) applications, the following configuration must be used:

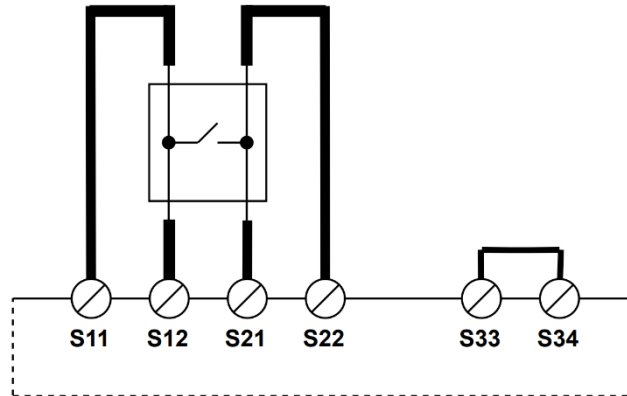


Figure 8: Dual-Channel (With Wire-Break Safety) Configuration

This configuration ensures that the full length of all switch/sensor conductors are monitored. If the switch/sensor's conductors are compromised at any point along their length, the controller will detect the fault and cause the output relay to de-energize.



Warning: For this configuration to work as intended, the series resistance between each end of the sensor's conductors cannot exceed 10Ω. Additionally, the short circuit resistance between both of the switch/sensor's conductors cannot exceed 200Ω. (Up to Category 3, SIL2, PLd Unreachable).

2. Single channel (Non-Safety):

For non-failsafe applications (non-safety), utilize the following configuration where one side of each switch/sensor's conductors is connected to a monitoring terminal:

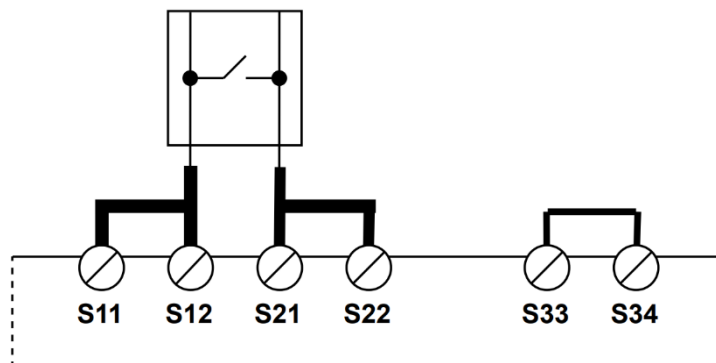


Figure 9: Single-Channel (Non-Safety) Configuration



Warning: This configuration does NOT provide detection of a broken conductor/malfunctioning switch and is therefore unsuitable for safety-related applications. For such applications, do NOT use this configuration and opt for a "Dual Channel" fail-safe configuration instead.



Maintenance Info and Replacement Procedure

The safety relay controller works without maintenance.

For replacement of the device, follow the procedure below:

1. Turn OFF and disconnect the source of applied power to the device.
Ensure that no terminal of the device is connected to a live voltage before continuing.
2. Unscrew terminals A1 and A2 from the device before removing any other connections.
3. One at a time, free connections from the device's terminal blocks by unscrewing. Ensure that freed conductors are not left in the vicinity of live voltage conductors.
4. Insulate wire ends if necessary.
5. When all connections are freed, remove the defective device from the DIN rail.
6. Mount new device to the DIN rail (see Page 8, Figure 4).
7. Perform "Device Startup Verification" procedure described earlier on Page 6 of this manual.





Fault Diagnostic and Subsequent Measures

If the controller appears to be operating erroneously, please use the following diagnostic guide to determine what action should be taken.

Ground fault AC/DC (with electronic fuse protection)

If the input fuse blows and the output contacts open, safely locate the source of the fault and correct it, then replace the input fuse and follow the "Device Startup Verification" procedure on Page 6 of this manual. If normal operation of the device does not resume, retire the device and send to Tapeswitch Corporation for evaluation.

Faulty/welded Contact

In the case of welded contacts, the device can no longer implement its intended function. Retire this device and send back to Tapeswitch Corporation for evaluation.

Only one or no LED illuminates

In cases where either one or both "Channel" LEDs is OFF during normal operation, please verify that the device is properly wired. If the problem persists, the device is no longer capable of service. Retire the device and send to Tapeswitch Corporation for evaluation.

Excessive contact-to-contact resistance

In cases where the device does not appear to operate properly, perform the following checks (cables removed from controller ports):

1. Upper (cables between S22 and S21) conductor plus total cable resistance in the unactuated state. Must be less than 10Ω.
2. Lower (cables between S11 and S12) conductor plus total cable resistance in the unactuated state. Must be less than 10Ω.
3. Upper to lower (cables going from S11 to S21) conductor plus total cable resistance. Measure at both sides (includes S21 to S22) during actuation. Must be less than 200Ω.

If the results exceed the stated limits, the system will need one or more additional controllers to conform to the maximum resistance parameters per relay.

If the results are within the allowable limits and the controller is still not working, contact Tapeswitch as the unit is likely faulty.



Technical Data (PRSU/2)

Electrical data	
Supply Voltage U_v	PRSU/2 24V _{DC} Or 24V _{AC}
Voltage Range	$U_v \pm 10\%$
Frequency	48Hz (min) to 62Hz (max)
Power Consumption (typ.)	+24V _{DC} : 2.5W, 24V _{AC} : 2.5VA
4-Wire Safety Switches	
Maximum Short Circuit Resistance	$\leq 5 \Omega$
Maximum Signal Wires Resistance	$\leq 1 \Omega$
Conductor Data	
Conductor Connection	2 x 1.5 mm ² solid wire 2 x 1.5 mm ² stranded wire-end ferrule
Max. Conductor Length (input circuit)	UL: Use 60/75°C copper wire only! 2 x 100m (Single channel) 4 x 100m (Dual channel)
Conductor Cross-Section	1.5 mm ²
Capacitance/cable length	150 nF/km (maximum)
Reference Temperature	+ 25°C
Contact Data	
Contact Allocation	2 N.O. safety
Contact Type	Relay positive guided
Contact Material	AgSnO ₂ or comparable material
Switching Voltage	250V _{AC} , 24V _{DC}
Max. Switch/Relay Current	6A (individual), 13.8A (combined)
Min. Switching Current	10mA
Max. Switching Capability (per relay)	AC 15 3 A
DIN EN 60947-5-1	DC 13 3 A
Max. Switching Capacity	1500 VA (resistive load)
Mechanical Lifetime	10 ⁷ switching cycles
Creeping Distance and Clearance	-EN 50178 at pollution grade 2, over voltage category 3 / 250V -Basis isolation: over voltage category 3 / 250 V
Contact Security	NO contact: 6.3A brief or 4A inert
Short Circuit Withstand (IEC60947-5-1)	NO-contacts: 10A
Weld Free Protection at $I_{psc} \geq 1kA$ SCPD (Short Circuit Protection Device) (Fuse links), size D01 acc IEC IEC60269-1; IEC60269-3-1; VDE036-T301	
Restarting Readiness Time (minimum switch off time the inputs)	0.5 s
Delay on De-energisation	24V DC: < 30 ms, 24V AC: < 70ms
Mechanical Data	
Housing Material	Polyamide PA 6.6
Dimensions (W x H x D)	22.5mm x 114.5mm x 99mm
Fastening	Click-fastening for DIN-Rail
Humidity	95% 0-50°C
Torque Setting for Connection Terminals	0.5 Nm (min), 0.6 Nm (max) UL: Overtorquing may cause enclosure breakage
Weight with Terminals	Max. 185g
Storage	In dry areas
Environmental data	
Operating Temperature	-25°C ... +55°C (UL:...+40°C)
Terminal Type	IP 20
Housing Type	IP 40
Shock Resistance of N.O Contacts	5g, 33Hz
Certifications	
Tested I.A.W.	EN ISO 13849-1
Achieved Level/Category	Performance Level e, Cat. 4
DC	99% (high)
CCF	Achieved
MTTF _D	69 years (high)
PFH _D	$3.8 \cdot 10^{-8}$ 1/h



Technical Data (PRSU/4, PRSU/5)

Electrical data	PRSU/4	PRSU/5
Supply Voltage U_V	24V _{DC} Or 24V _{AC}	115V _{AC}
Voltage Range	$U_V \pm 10\%$	$U_V \pm 10\%$
Frequency	48Hz (min) to 62Hz (max)	48Hz (min) to 62Hz (max)
Power Consumption (typ.)	+24V _{DC} : 3W, 24V _{AC} : 5VA	5VA
4-Wire Safety Switches		
Maximum Short Circuit Resistance	$\leq 200 \Omega$	$\leq 200 \Omega$
Maximum Signal Wires Resistance	$\leq 10 \Omega$	$\leq 10 \Omega$
Conductor Data		
Conductor Connection	2 x 1.5 mm ² solid wire 2 x 1.5 mm ² stranded wire-end ferrule	2 x 1.5 mm ² solid wire 2 x 1.5 mm ² stranded wire-end ferrule
Max. Conductor Length (input circuit)	UL: Use 60/75°C copper wire only! 2 x 100m (Single channel) 4 x 100m (Dual channel)	UL: Use 60/75°C copper wire only! 2 x 100m (Single channel) 4 x 100m (Dual channel)
Conductor Cross-Section	1.5 mm ²	1.5 mm ²
Capacitance/cable length	150 nF/km (maximum)	150 nF/km (maximum)
Reference Temperature	+ 25°C	+ 25°C
Contact Data		
Contact Allocation	3 N.O. safety, 1 N.C. aux	3 N.O. safety, 1 N.C. aux
Contact Type	Relay positive guided	Relay positive guided
Contact Material	AgSnO ₂ or comparable material	AgSnO ₂ or comparable material
Switching Voltage	240V _{AC} , 24V _{DC}	240V _{AC} , 24V _{DC}
Max. Switch/Relay Current	5A (individual), 13.8A (combined)	5A (individual), 13.8A (combined)
Min. Switching Current	10mA	10mA
Max. Switching Capability (per relay)	AC 15 230 V / 5 A	AC 15 230 V / 5 A
DIN EN 60947-5-1	DC 13 24 V / 5 A	DC 13 24 V / 5 A
Max. Switching Capacity	1200 VA (resistive load)	1200 VA (resistive load)
Mechanical Lifetime	10 ⁷ switching cycles	10 ⁷ switching cycles
Electrical Lifetime	10 ⁵ switching cycles (DC 24V/2A)	10 ⁵ switching cycles (DC 24V/2A)
Creeping Distance and Clearance	-EN 50178 at pollution grade 2, over voltage category 3 / 250V -Basis isolation: over voltage category 3 / 250 V	-EN 50178 at pollution grade 2, over voltage category 3 / 250V -Basis isolation: over voltage category 3 / 250 V
Contact Security	NO contact: 6.3A brief NC contact: 4A gL/gG	NO contact: 6.3A brief NC contact: 4A gL/gG
Short Circuit Withstand (IEC60947-5-1)	NO-contacts: 6A NC-contacts: 6A	NO-contacts: 6A NC-contacts: 6A
Weld Free Protection at $I_{PSC} \geq 1kA$ SCPD (Short Circuit Protection Device) (Fuse links), size D01 acc IEC IEC60269-1; IEC60269-3-1; VDE036-T301		
Restarting Readiness Time (minimum switch off time the inputs)	0.5 s	0.5 s
Delay on De-energisation	< 30 ms, 24V AC: < 50ms	< 30 ms
Mechanical Data		
Housing Material	Polyamide PA 6.6	Polyamide PA 6.6
Dimensions (W x H x D)	22.5mm x 114.5mm x 99mm	22.5mm x 114.5mm x 99mm
Fastening	Click-fastening for DIN-Rail	Click-fastening for DIN-Rail
Humidity	95% 0-50°C	95% 0-50°C
Torque Setting for Connection Terminals	0.5 Nm (min), 0.6 Nm (max) UL: Overtorquing may cause enclosure breakage	0.5 Nm (min), 0.6 Nm (max) UL: Overtorquing may cause enclosure breakage
Weight with Terminals	Max. 180g	Max. 180g
Storage	In dry areas	In dry areas
Environmental data		
Operating Temperature	-25°C ... +55°C (UL:...+40°C)	-25°C ... +55°C (UL:...+40°C)
Terminal Type	IP 20	IP 20
Housing Type	IP 40	IP 40
Shock Resistance of N.O./N.C. Contacts	8/2g	8/2g
Certifications		
Tested I.A.W.	EN ISO 13849-1	EN ISO 13849-1
Achieved Level/Category	Performance Level e, Cat. 3	Performance Level e, Cat. 3
DC	90% (Medium - redundant switch off channel with monitoring)	90% (Medium - redundant switch off channel with monitoring)
CCF	Achieved	Achieved
MTTF _D	100 years – high	100 years – high
PFH	$5.81 \cdot 10^{-9}$ 1/h	$5.81 \cdot 10^{-9}$ 1/h
SFF	99%	99%