

Sentry safety relays Original instructions



Read and understand this document

Please read and understand this document before using the products. Please consult your ABB JOKAB SAFETY representative if you have any questions or comments.

Suitability for use

ABB JOKAB SAFETY shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product. At the customer's request, ABB JOKAB SAFETY will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE ABB JOKAB SAFETY PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Sentry safety relays

Original instructions

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1 Introduction

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1.1 The purpose of this document

The purpose of this document is to describe the functions and to provide instructions for installation, operation, maintenance and troubleshooting of the Sentry safety relays.

1.2 Intended audience

This document is intended for authorized installation personnel.

1.3 Reading prerequisites

It is assumed that the reader of this document has knowledge of the following:

- Basic knowledge of ABB Jokab Safety products.
- Knowledge of machine safety.
- Knowledge of safety relays.

1.4 Warning symbols

The following warning symbols are used in this document:



WARNING: Danger of severe personal injury!

An instruction or procedure which, if not carried out correctly, may result in injury to the operator or other personnel.



CAUTION: Danger of damage to the equipment!

An instruction or procedure which, if not carried out correctly, may damage the equipment.



Note: Important or explanatory information.

1.5 Abbreviations

Definitions of abbreviated terms used in this document.

Table 1: Abbreviations

Abbreviation	Definition
AWG	American Wire Gauge
BSR	Basic Safety Relay
LED	Light Emitting Diode
NC	Normally Closed
NO	Normally Open
OSSD	Output Signal Switching Device
PELV	Protected Extra Low Voltage

Abbreviation	Definition
PFD	Probability of Failure on Demand
PFH	Probability of dangerous Failure per Hour
PL	Performance Level
PWR	Power
SELV	Separated or Safety Extra Low Voltage
SIL	Safety Integrity Level
SSR	Single function Safety Relay
TSR	Timer function Safety Relays
USR	Universal Safety Relays

2 Safety

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2.1 Intended use

The intended use of the Sentry safety relay is to monitor the state of a safety device and, depending on the state, activate or deactivate the outputs within the system response time.

2.2 Correct use

The protective function of the safety device is only safe if the safety relay is correctly connected and configured.

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Obey the following conditions to prevent misuse and cause danger:

- Make sure that these instructions are included together with the documentation of the system to which the protective device is attached to.
- Make sure that these instructions always are available for the operators.
- Use the safety relay as a safety monitoring device.
- The safety relay must only be used after it has been selected referred to related instructions, relevant standards, rules and regulations for labour protection and safety at work, and when installation, connection, check and start-up are done by an approved person.
- The safety relay must be connected and started according to its specifications, for example the technical data.
- The reset button must be placed out of reach from the dangerous zone.
- The entire dangerous zone must be visible from the place where the reset button is installed.
- The safety relay must be selected so that its safety related capacity meet or exceed the performance level (PL) or safety integrity level (SIL) that has been estimated in the risk analysis.
- The machine or system control must be electrically controllable so that deactivation of the safety relay causes immediate stop.
- The safety relay must not be modified. If the design or the functions are changed the protective function can be damaged and the warranty of the safety relay is not applicable.
- The safety relay must be tested regularly by an approved person.
- The safety relay must be exchanged within 20 years.
- Repair and exchange of parts of the safety relay is not permitted.

2.3 Foreseeable misuse

- Other use than defined as correct use and foreseeable misuse, or which is beyond that use, is considered as incorrect use.
- The safety relay is not by itself a complete protective device.
- The safety relay is not intended for use in explosive or easily flammable adjacent air.

2.4 Approved person

An approved person must have ...

- a suitable technical education.
- knowledge about rules and regulations for occupational safety, safety at work, safety technology and how to estimate the safety of the machine.
- received instructions from the person that is responsible for the installation and operation of the safety relay and the device/machine which it monitors.

See **Chapter Intended use** and **Chapter Correct use** for further information.

2.5 Safety precautions

The following safety precautions must be followed during installation, operation, maintenance and troubleshooting.

2.5.1 General safety information



WARNING:

- Carefully read through this entire manual before using the product.
- Always respect the documented minimum or maximum values of the product.
- For installation and prescribed use of the product, the special notes in these instructions must be carefully observed and the technical standards relevant to this product must be considered.
- This product must be installed by a trained electrician following applicable safety regulations, standards and the machine directive.
- Failure to comply with these instructions, operation that is not in accordance with the use prescribed in these instructions, improper installation or handling of the device can affect the safety of people and the plant.
- In case of failure to comply with these instructions or the applicable standards, especially when tampering with and/or modifying the product, liability is excluded.
- The safety functions of the product must be tested before the system is put in operation.
- The safety functions of the product must be tested after installation or replacement of components or cables.
- The safety functions and the mechanics of the product must be tested regularly to confirm that all the safety functions are working properly (EN 62061:2005).
- In case of breakdown or damage to the product, contact ABB Jokab Safety, www.abb.com/jokabsafety. Do not try to repair the product. It might accidentally cause permanent damage, impairing the safety of the product and in turn lead to serious personnel injuries.

2.5.2 Disposal



The safety relay shall be disposed in accordance with WEEE directive, 2012/19/EU.

3 Product description

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3.1 Sentry safety relays

Sentry safety relays provide safe stop and start of monitored devices to prevent errors.

The following safety device types are applicable for the Sentry safety relays:

- 1 channel safety device
- 2 channel safety device with equivalent contacts
- 2 channel safety device with antivalent contacts
- Expansion of safety modules (including Pluto PLC, -24 VDC)
- Pressure sensitive safety device (short-circuit detection)
- Two-hand safety device
- OSSD safety device

Examples of devices for connection to the Sentry safety relays:

- Light beams
- Light curtains
- Three position safety device
- Safety interlock switches
- Emergency stop buttons
- Bumpers, contact edges and safety mats.

3.2 Sentry product range

The Sentry product range has the following groups of safety relays.

3.2.1 BSR (Basic function Safety Relay) group

The BSR group include BSR10, BSR11 and BSR23. The safety relays have basic monitoring functions for 1- and 2-channel safety devices.

The safety relay can be used as an expansion of other safety modules, including Pluto PLC -24 VDC.

3.2.2 SSR (Single function Safety Relay) group

The SSR group includes SSR10, SSR10M, SSR20, SSR20M, SSR32 and SSR42. The safety relays have single safety device functions and limited configuration possibilities for automatic and manual reset.

SSR32 and SSR42 have a timer function.

3.2.3 TSR (Timer function Safety Relay) group

The TSR group includes TSR10, TSR20 and TSR20M. The safety relays have timer functions and configuration possibilities. TSR10 is fully configurable with preset selection possibilities and password protection.

3.2.4 USR (Universal function Safety Relay) group

The USR group include USR10 and USR22. The safety relays have multiple functionality for monitoring safety device including timer functions. The USR group is fully configurable with preset selection possibilities and password protection.

3.3 Product overview

3.3.1 BSR10, BSR11 and BSR23

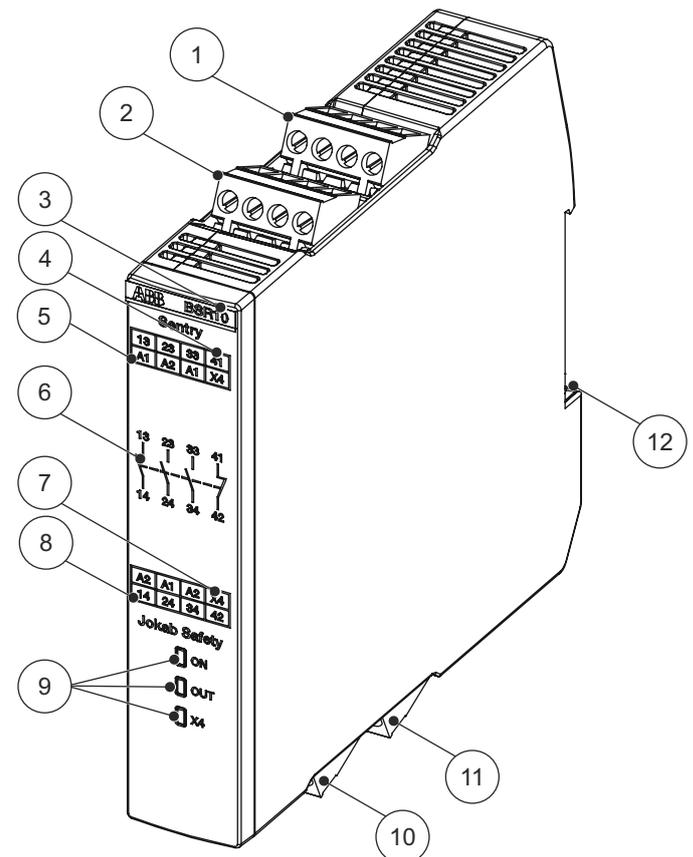


Figure 1: Product overview BSR10, BSR11 and BSR23

1. Connection block, top side back
2. Connection block, top side front
3. Product name
4. Print for connection block, top side back
5. Print for connection block, top side front
6. Relay output configuration
7. Print for connection block, bottom side front
8. Print for connection block, bottom side back
9. LEDs for status indication
10. Connection block, bottom side front
11. Connection block, bottom side back
12. DIN rail latching device

3.3.2 SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42, TSR20 and TSR20M

3.3.3 TSR10, USR10 and USR22

3

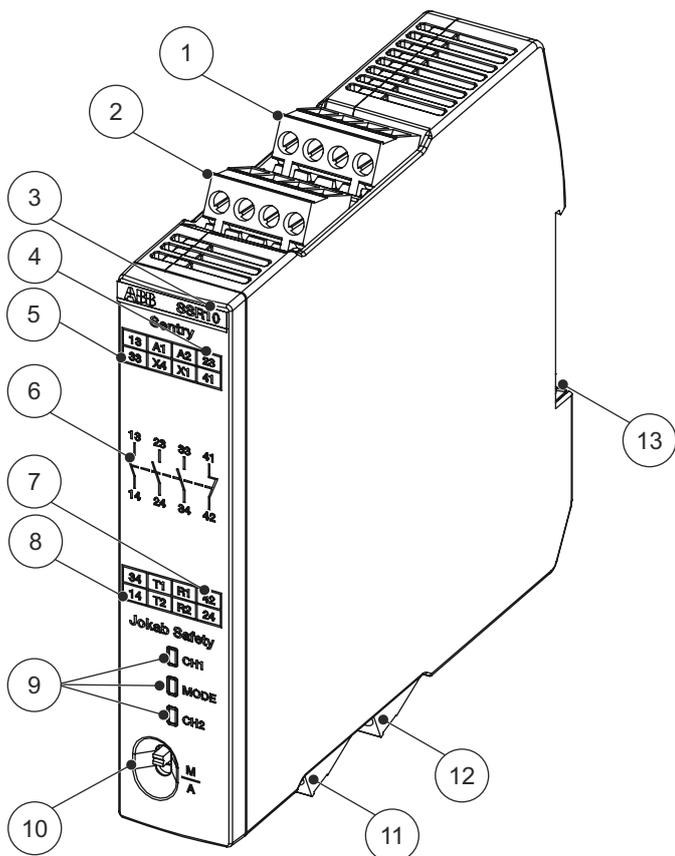


Figure 2: Product overview SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42; TSR20 and TSR20M

1. Connection block, top side back
2. Connection block, top side front
3. Product name
4. Print for connection block, top side back
5. Print for connection block, top side front
6. Relay output configuration
7. Print for connection block, bottom side front
8. Print for connection block, bottom side back
9. LEDs for status indication
10. Switch for settings
11. Connection block, bottom side front
12. Connection block, bottom side front
13. DIN rail latching device

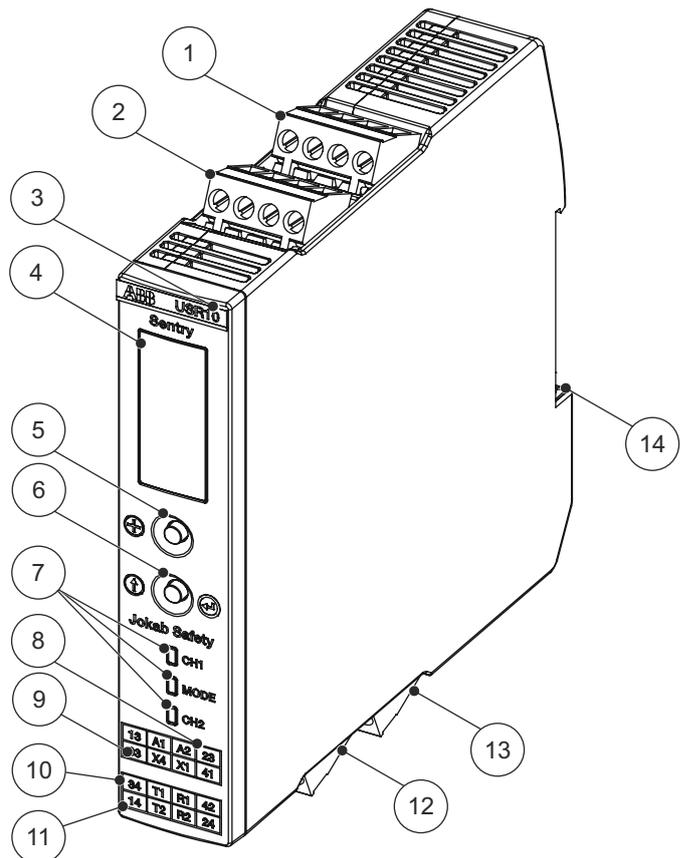


Figure 3: Product overview TSR10, USR10 and USR22

1. Connection block, top side back
2. Connection block, top side front
3. Product name
4. Display
5. Increment button
6. Select button
7. LEDs for status indication
8. Print for connection block, top side back
9. Print for connection block, top side front
10. Print for connection block, bottom side front
11. Print for connection block, bottom side back
12. Connection block, bottom side front
13. Connection block, bottom side back
14. DIN rail latching device

3.4 Dimensions

i Notice: All measurements are in millimeter (mm).

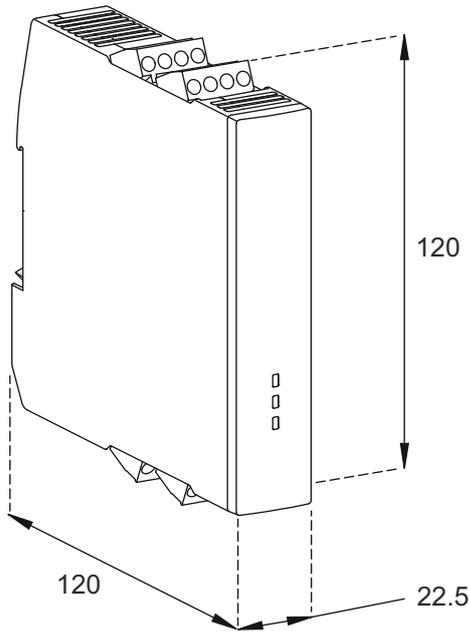


Figure 4: Safety relay dimensions

3.5 Function overview

Table 2: Function overview Sentry product range

Safety relay	BSR10	BSR11	BSR23	SSR10	SSR10 M	SSR20	SSR20 M	SSR32	SSR42	TSR10	TSR20	TSR20 M	USR10	USR22
Power supply														
Mains					x		x					x		
PELV/SELV (+24 VDC)	x	x	x	x		x		x	x	x	x		x	x
Relay output														
3 NO + 1 NC	x			x	x	x	x			x	x	x	x	
4 NO		x												
2 NO + 2 NO								x	x					x
4 NO + 1 NC			x											
Safety device interface														
1 channel	x	x	x	x				x	x	x	x		x	x
2 channels with equivalent contacts	x ¹⁾	x ¹⁾	x ¹⁾	x	x			x	x	x	x	x	x	x
2 channels with anti-parallel contacts													x	x
2 channels OSSD				x				x	x	x	x		x	x
Expansion of Pluto PLC -24 VDC	x	x	x											

Safety relay	BSR10	BSR11	BSR23	SSR10	SSR10 M	SSR20	SSR20 M	SSR32	SSR42	TSR10	TSR20	TSR20 M	USR10	USR22
Pressure sensitive device													x	x
Two-hand device						x	x						x	x
Test/Reset														
Automatic reset				x	x	x	x	x	x	x	x	x	x	x
Manual reset				x	x	x	x	x	x				x	x
Start/Test	x	x												
Timer function														
Off-delay 0.5 s								x		x	x	x	x	x
Off-delay 1.5 s									x	x	x	x	x	x
Off-delay 0 – 999 s										x			x	x
On-delay 0 – 999 s										x			x	x
Time bypass 0 – 999 s										x			x	x
Time reset 0 – 999 s										x			x	x
Features														
Display										x			x	x
Error status code										x			x	x
Password										x			x	x

Note 1: No 2 channel monitoring

4 Connections

4.1 Connection groups

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4.1 Connection groups

The connections are divided in the following groups.

- A: Power supply
- T: Signal to safety device
- R: Signal from safety device
- X: Test/reset/start/indication
- 13, 23, 33, 43: Safety output, NO
- 14, 24, 34, 44, 42, 52: Safety output, NO
- 41, 51: Output, NC
- 42, 52: Output, NC

See **Chapter Function descriptions** and **Chapter Connection block and wire properties** for further information.

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4.1.1 BSR10

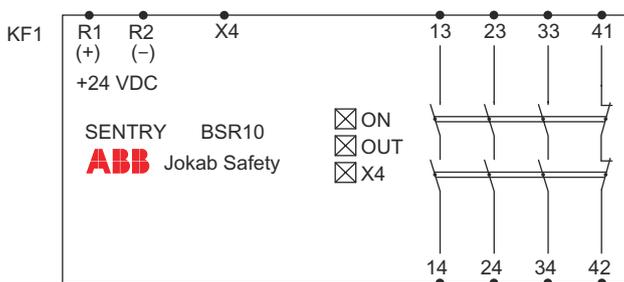


Figure 5: Connections BSR10

4.1.2 BSR11

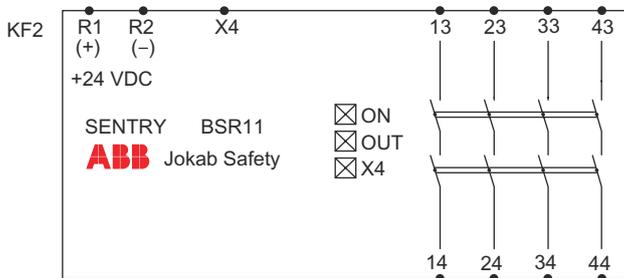


Figure 6: Connections BSR11

4.1.3 BSR23

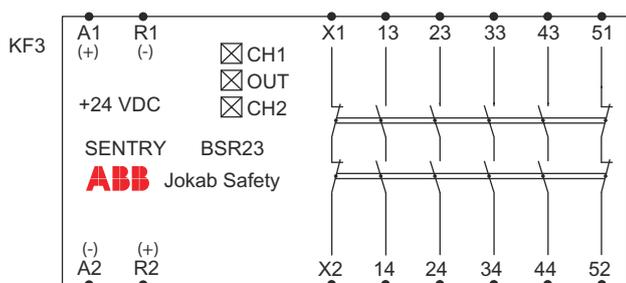


Figure 7: Connections BSR23

4.1.4 SSR10

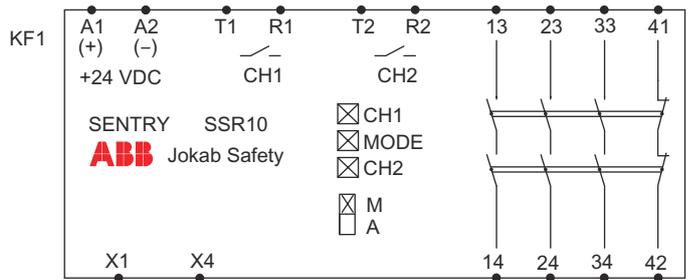


Figure 8: Connections SSR10

4.1.5 SSR10M

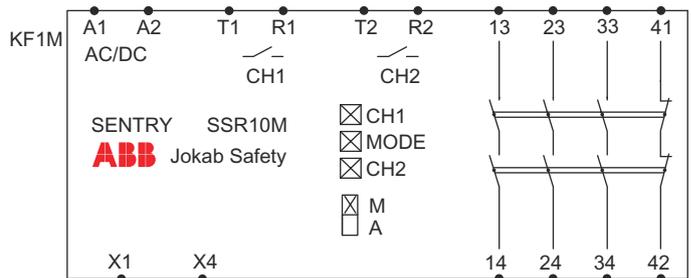


Figure 9: Connections SSR10M

4.1.6 SSR20

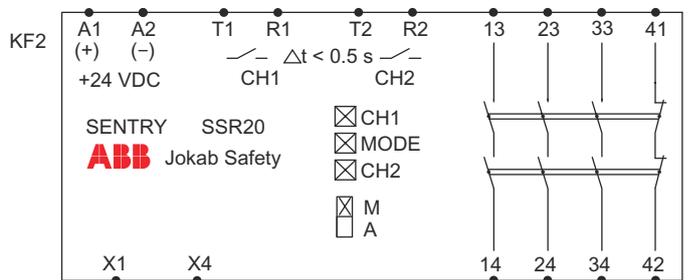


Figure 10: Connections SSR20

4.1.7 SSR20M

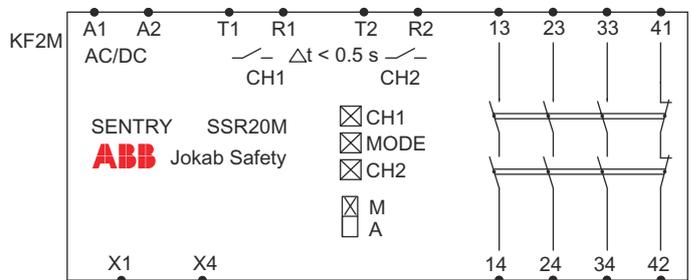


Figure 11: Connections SSR20M

4.1.8 SSR32

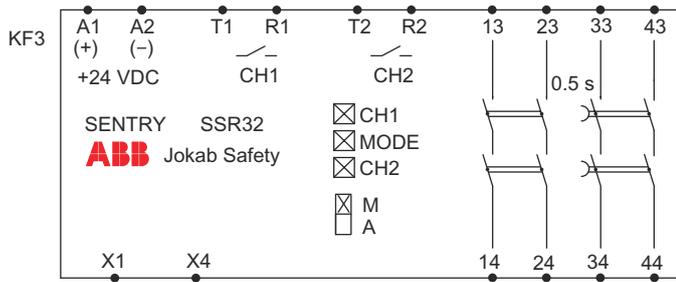


Figure 12: Connections SSR32

4.1.12 TSR20M

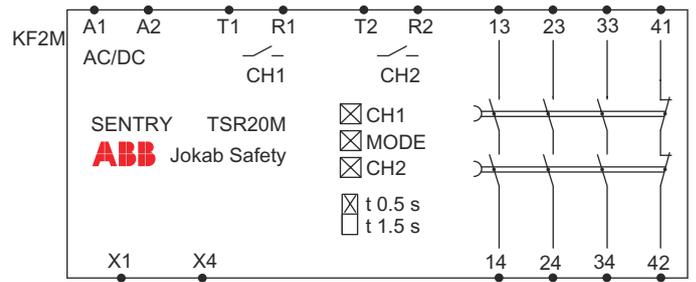


Figure 16: Connections TSR20M

4.1.9 SSR42

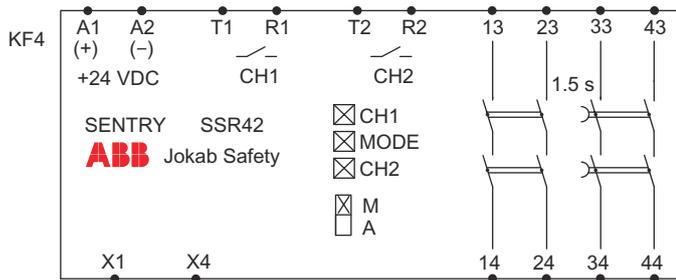


Figure 13: Connections SSR42

4.1.13 USR10

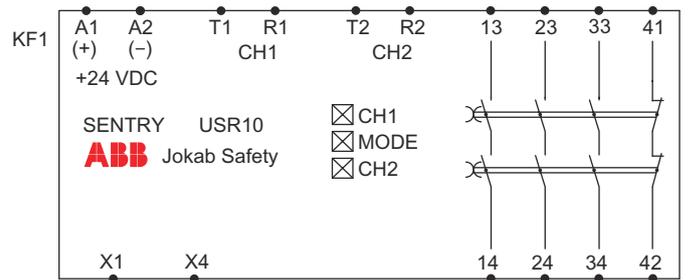


Figure 17: Connections USR10

4.1.10 TSR10

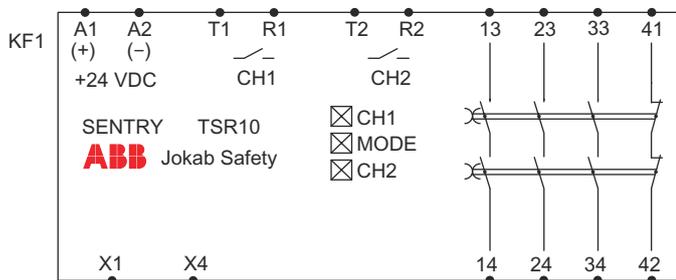


Figure 14: Connections TSR10

4.1.14 USR22

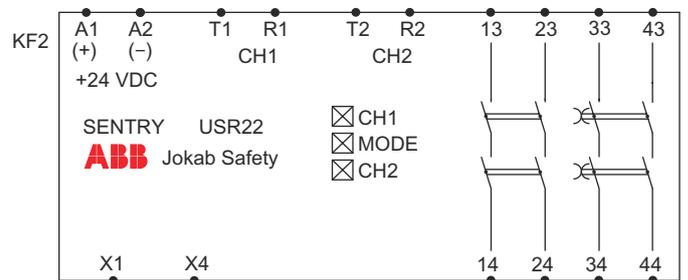


Figure 18: Connections USR22

4.1.11 TSR20

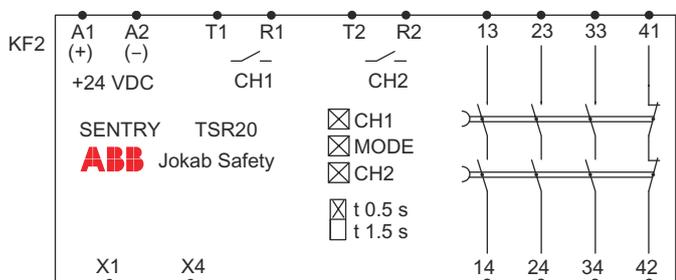


Figure 15: Connections TSR20

4.2 Connection examples

4.2.1 BSR10

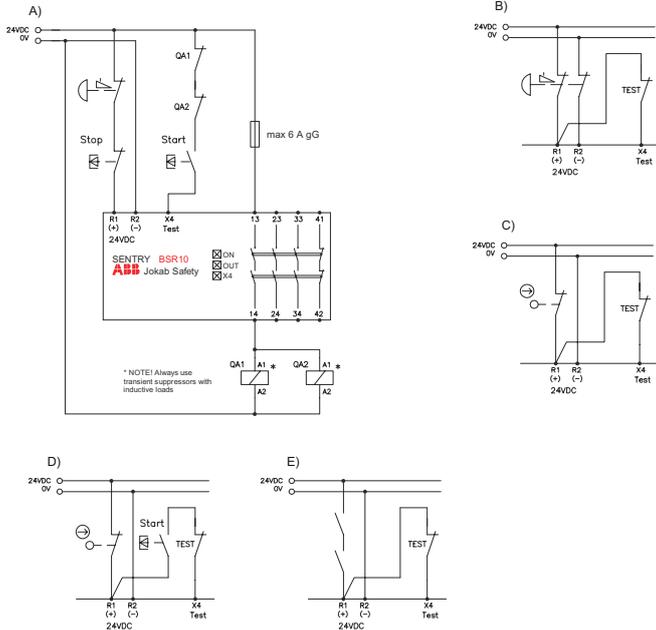


Figure 19: Connection examples BSR10

- A. One signal from +24VDC, start and stop
- B. Two signals from +24VDC / 0V
- C. One signal from +24VDC
- D. One signal from +24VDC, start
- E. One signal from +24VDC

Note: Always use transient suppressors when inductive loads.

4.2.2 BSR11

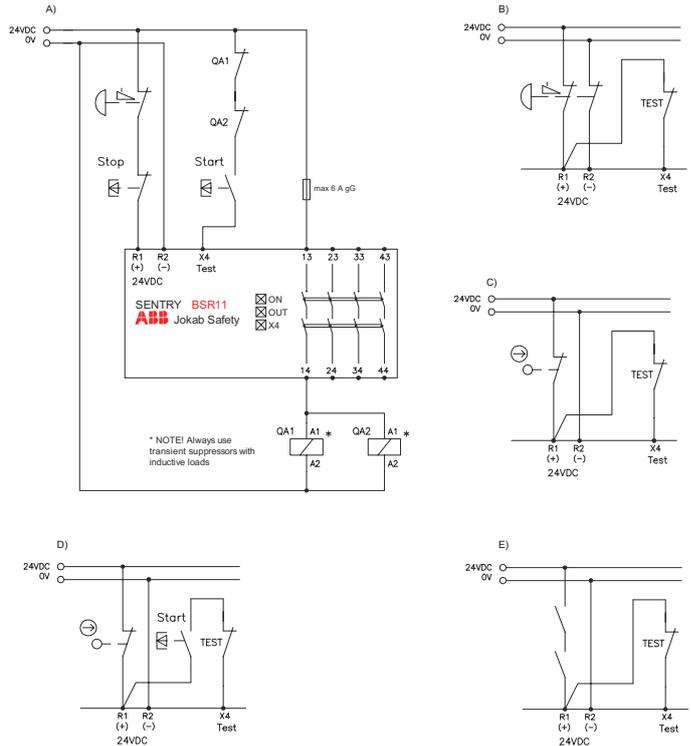


Figure 20: Connection examples BSR11

- A. One signal from +24VDC, start and stop
- B. Two signals from +24VDC / 0V
- C. One signal from +24VDC
- D. One signal from +24VDC, start
- E. One signal from +24VDC

Note: Always use transient suppressors when inductive loads.

4.2.3 BSR23

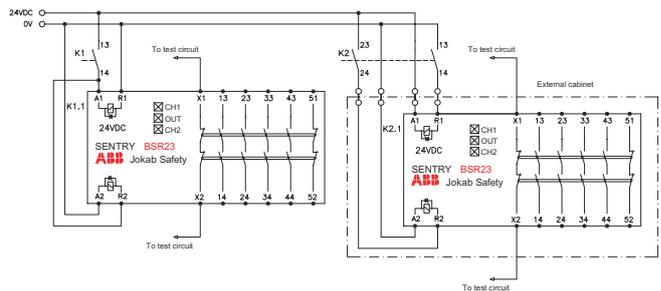


Figure 21: Connection example BSR23

Note: Always use transient suppressors when inductive loads.

4.2.4 SSR10

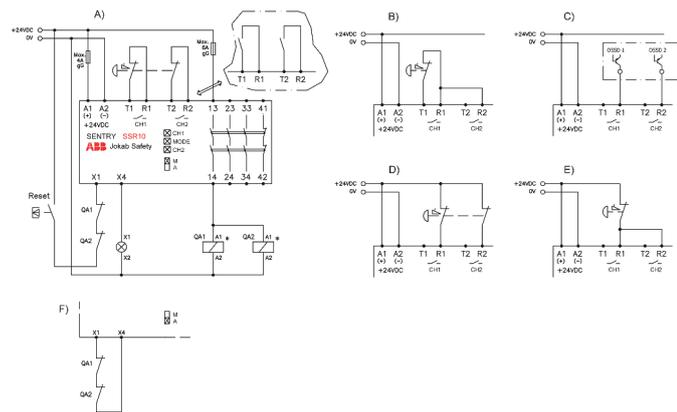


Figure 22: Connection examples SSR10

- A. Two signals from T1/T2
- B. One signal from T1
- C. Two OSSD-signals
- D. Two signals from +24VDC
- E. One Signal from +24VDC
- F. Automatic reset

Note: Always use transient suppressors when inductive loads.

4.2.5 SSR10M

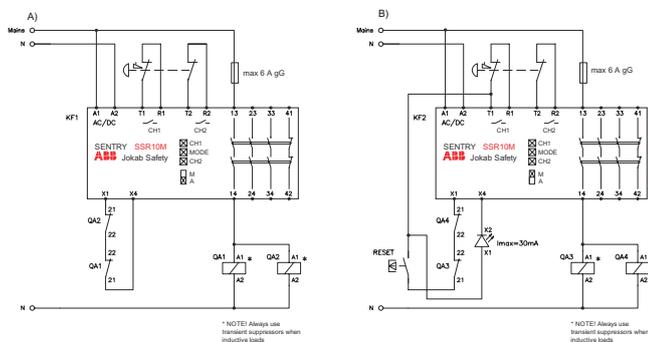


Figure 23: Connection examples SSR10M

- A. Two signals from T1/T2 / Auto reset
- B. Two signals from T1/T2 / Manual reset

Note: Always use transient suppressors when inductive loads.

4.2.6 SSR20

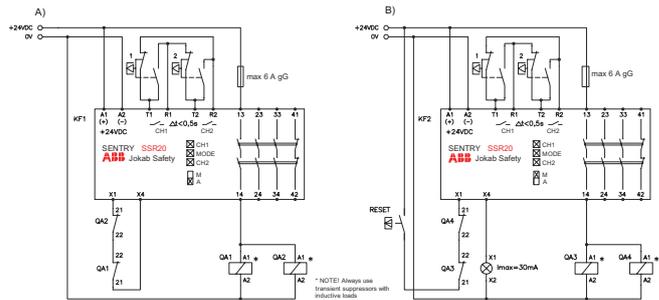


Figure 24: Connection examples SSR20

- A. Two-hand device / Auto reset
- B. Two-hand device / Manual reset

Note: Always use transient suppressors when inductive loads.

4.2.7 SSR20M

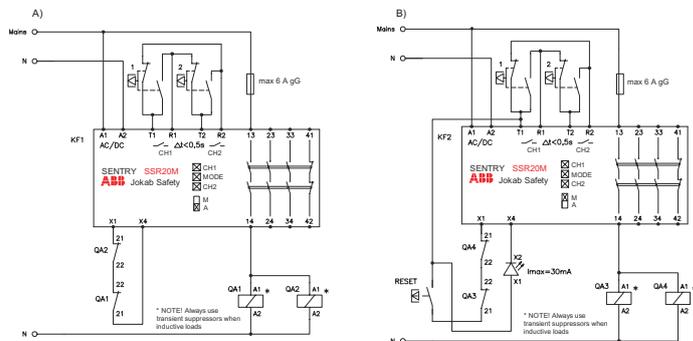


Figure 25: Connection examples SSR20M

- A. Two-hand device / Auto reset
- B. Two-hand device / Manual reset

Note: Always use transient suppressors when inductive loads.

4.2.8 SSR32

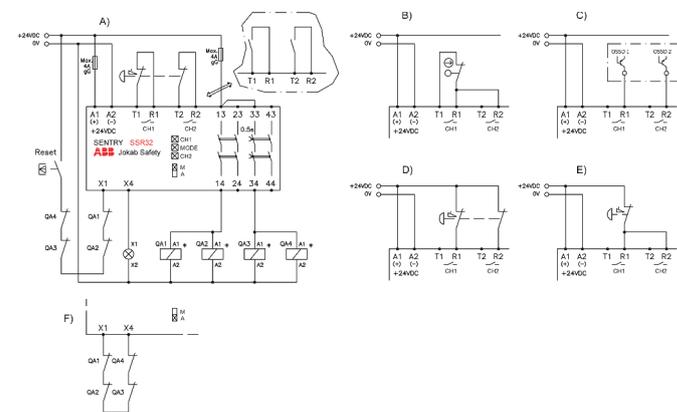


Figure 26: Connection examples SSR32

- A. Two signals from T1/T2
- B. One signal from T1
- C. Two OSSD signals
- D. Two signals from +24VDC
- E. One signal from +24VDC
- F. Automatic reset

Note: Always use transient suppressors when inductive loads.

4.2.9 SSR42

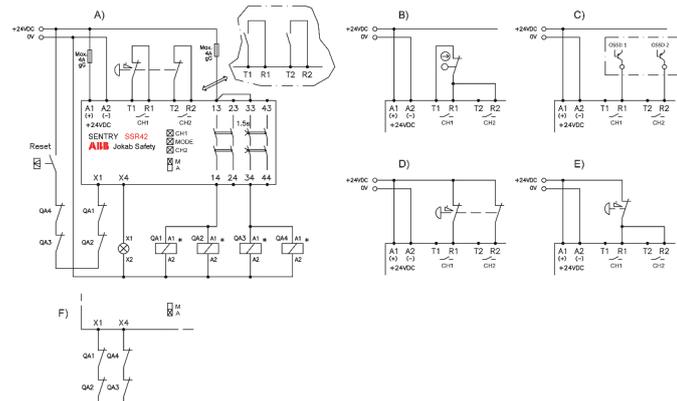


Figure 27: Connection examples SSR42

- A. Two signals from T1/T2
- B. One signal from T1
- C. Two OSSD signals
- D. Two signals from +24VDC
- E. One signal from +24VDC
- F. Automatic reset

Note: Always use transient suppressors when inductive loads.

4.2.10 TSR10

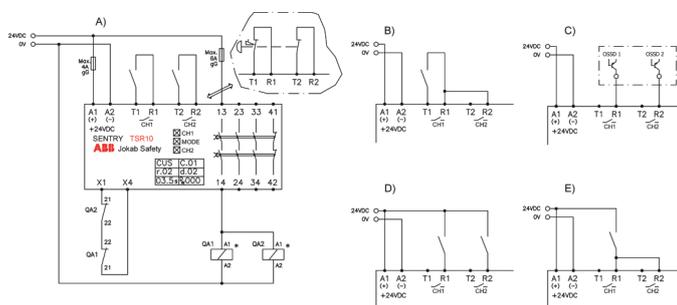


Figure 28: Connection examples TSR10

- A. Two signals from T1/T2
- B. One signal from T1
- C. Two OSSD signals
- D. Two signals from +24VDC

- E. One signal from +24VDC

Note: Always use transient suppressors when inductive loads.

4.2.11 TSR20

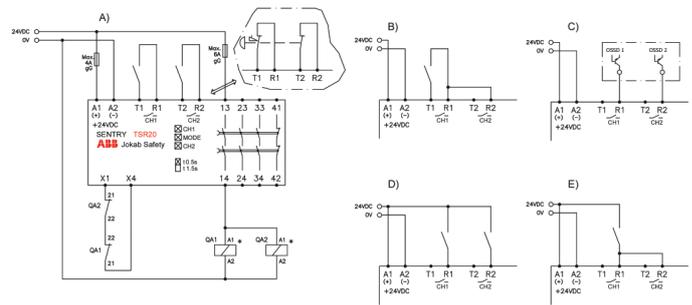


Figure 29: Connection examples TSR20

- A. Two signals from T1/T2
- B. One signal from T1
- C. Two OSSD signals
- D. Two signals from +24VDC
- E. One signal from +24VDC

Note: Always use transient suppressors when inductive loads.

4.2.12 TSR20M

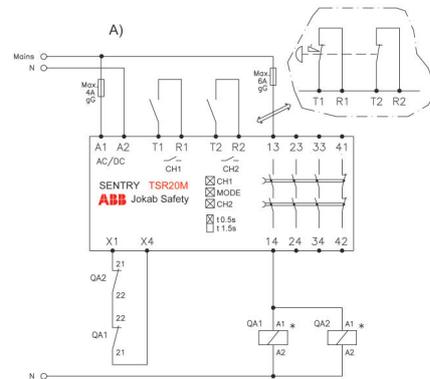


Figure 30: Connection examples TSR20M

- A. Two signals from T1/T2

Note: Always use transient suppressors when inductive loads.

4.2.13 USR10

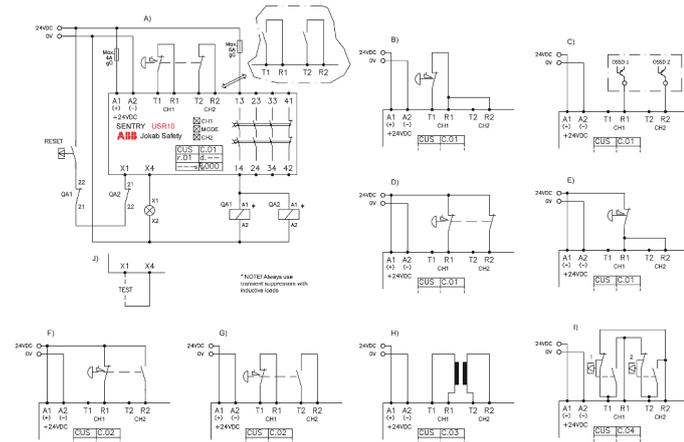


Figure 31: Connection examples USR10

- A. Two signals from T1/T2
- B. One signal from T1
- C. Two OSSD signals
- D. Two signals from +24VDC
- E. One signal from +24VDC
- F. Antivalent signals from +24VDC
- G. Antivalent signals from T1/T2
- H. Mat/Bumper/Safety edge
- I. Two-hand device

Note: Always use transient suppressors when inductive loads.

4.2.14 USR22

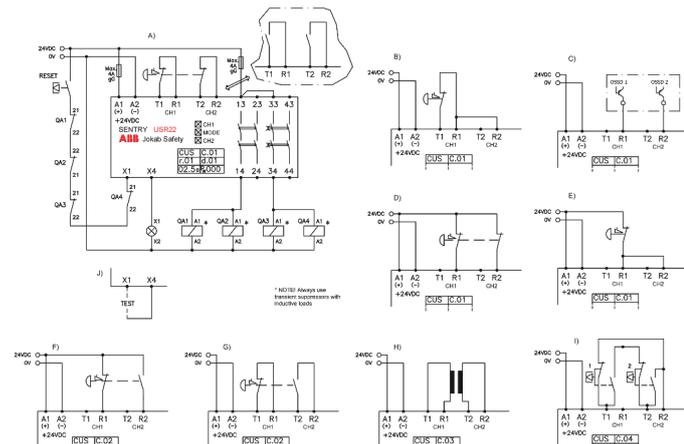


Figure 32: Connection examples USR22

- A. Two signals from T1/T2
- B. One signal from T1
- C. Two OSSD signals
- D. Two signals from +24VDC
- E. One signal from +24VDC

- F. Antivalent signals from +24VDC
- G. Antivalent signals from T1/T2
- H. Mat/Bumper/Safety edge
- I. Two-hand device



Note: Always use transient suppressors when inductive loads.

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5.1 Power supply

5.1.1 24 VDC via safety device

Applicable to: BSR10, BSR11, BSR23

The safety relays are powered from the connected safety devices.

The safety relay is designed for connection to 24 VDC. See **Table 18** for complete power supply requirement.

5.1.2 24 VDC

Applicable to: SSR10, SSR20, SSR32, SSR42, TSR10, TSR20, USR10, USR22

The safety relay is designed to be powered by 24 VDC. See **Table 18** for complete power supply requirement.

5

WARNING: The safety relays and the safety devices supplied with 24 VDC must be connected to PELV/SELV power supply and common shared ground.

5.1.3 Mains power supply

Applicable to: SSR10M, SSR20M, TSR20M

The safety relay is designed for connection to a wide range of AC and DC voltages, including 110 VAC and 230 VAC. See **Table 18** for complete power supply requirement.

5.2 Relay outputs

The safety relay output contacts are opened or closed based on the signals from the safety device.

Each safety relay output has two contacts in series, one contact for each internal output relay.

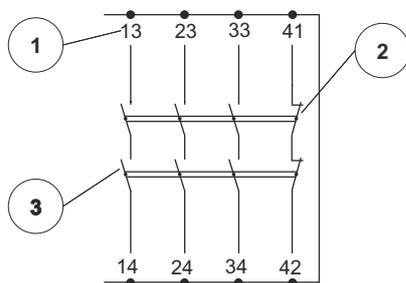


Figure 33: Example of relay output configuration (3 NO + 1 NC).

1. **Connectors:** Connectors in terminal blocks.
2. **NC contact:** The NC contact is closed when the relay is de-activated and open when the relay is activated.
3. **NO contact:** The NO contact is open when the relay is de-activated and closed when the relay is activated.



CAUTION: A relay output is in safe state when the contact is open.



CAUTION: The NC contact is intended to monitor the state of a safety device only.



Note: The NO contact is open at all types of internal failures and is a safe output.

See **Chapter Connection groups** for the applicable relay output configuration to each safety relay in the Sentry product range.



Note: Arc suppression for inductive loads is recommended to get a longer life time for the relay contacts.

5.3 Safety device interface

Sentry safety relays have interfaces with inputs/outputs (I/O:s) for connections of safety devices.

Inputs/Outputs

T1/T2 detect short circuits to +24 VDC or other OSSD signals and are designed for supplying signals to different types of safety devices.



Note: It is not necessary to connect T1/T2 to the safety devices. The safety level may be reduced if T1/T2 are not used. Possible errors in the connected safety devices and wires may not be identified.



WARNING: T1/T2 must be used on the mains powered relays.

R1/R2 receives the signals from the safety devices.



WARNING: The safety relays and the safety devices supplied with 24 VDC must be connected to PELV/SELV power supply and common shared ground.



Note: Always perform a function test after setup of or changes to the installation.

5.3.1 1 channel connection

Applicable to: SSR10, SSR32, SSR42, TSR10, TSR20, USR10, USR22

The safety device contact must be closed before the safety relay can be set in active mode.

Opening of the safety device contact deactivates the safe outputs.

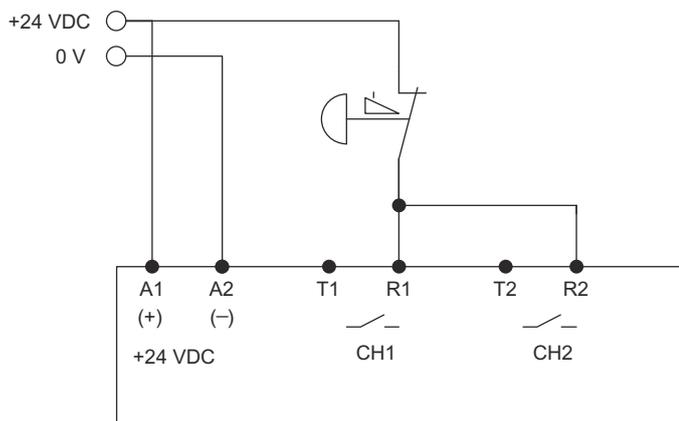


Figure 34: 1 channel connection, +24 VDC static signal

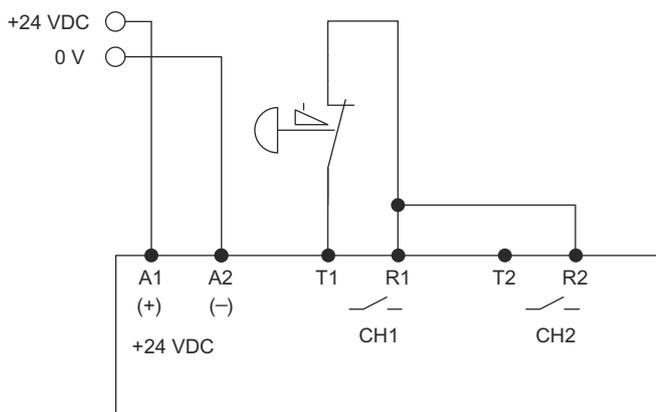


Figure 35: 1 channel connection from T1

5.3.2 2 channels connection with equivalent contacts 24 VDC models

Applicable to: SSR10, SSR32, SSR42, TSR10, TSR20, USR10, USR22

Both contacts must be closed before the safety relay can be set in active mode.

Opening one or both of the contacts deactivates the safe outputs.

Both contacts must be opened and re-closed before the outputs can be reactivated.

A short-circuit between the safety inputs is not monitored by the safety relay if T connections are not used. In this case category 4 can only be achieved if a safety device with short-circuit monitored outputs is connected.

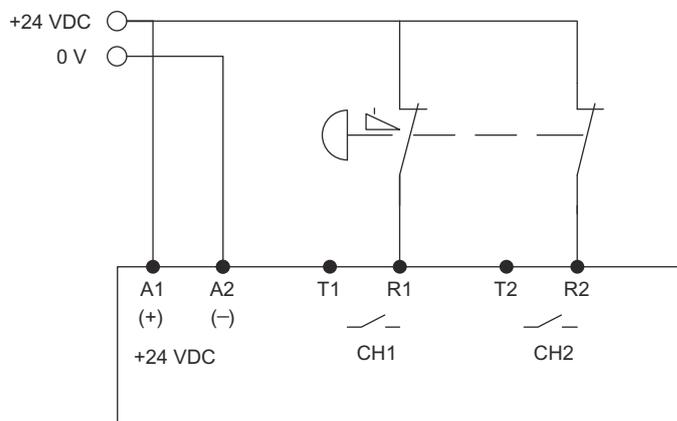


Figure 36: 2 channels connection with equivalent contacts, +24 VDC static signal

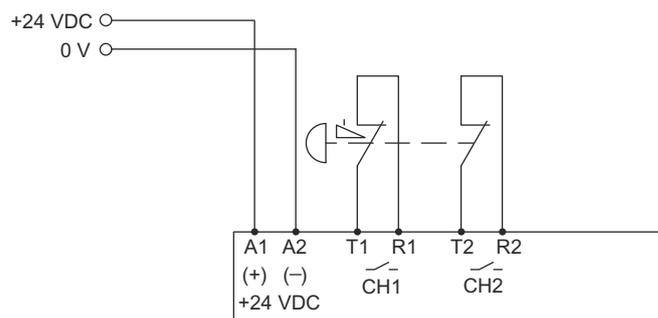


Figure 37: 2 channels connection with equivalent contacts from T1/T2

5.3.3 2 channels connection with equivalent contacts mains models

Applicable to: SSR10M, SSR20M, TSR20M

Both contacts must be closed before the safety relay can be set in active mode.

Opening one or both of the contacts deactivates the safe outputs.

Both contacts must be opened and re-closed before the outputs can be reactivated.

T1/T2 must be used.

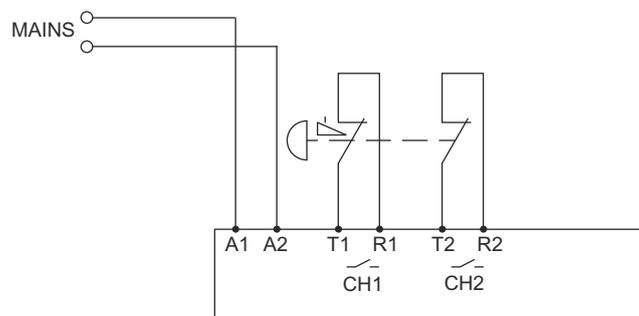


Figure 38: 2 channels connection with equivalent contacts from T1/T2

5.3.4 2 channels connection with antivalent contacts

Applicable to: USR10, USR22

In the example the R1 contact must be closed and the R2 contact must be opened before the safety relay can be set in active mode.

Switching one or both of the contacts deactivates the safety relay.

If T1/T2 are used gives short circuit detection.

Both contacts must switch from their initial position and back again before the outputs can be reactivated.

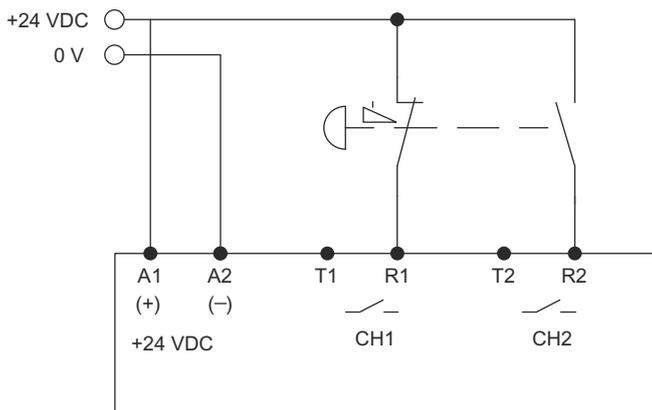


Figure 39: 2 channels connection with antivalent contacts, +24 VDC static signal

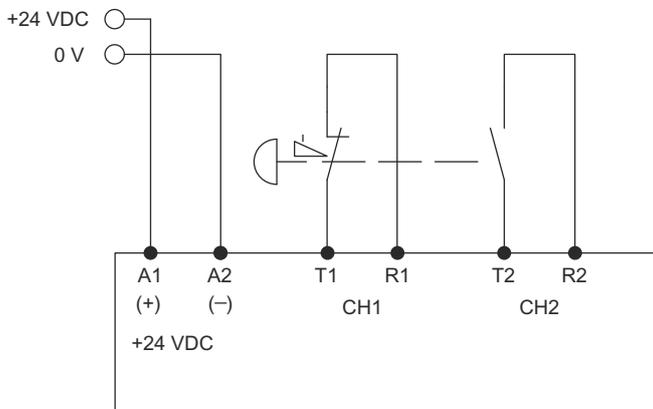


Figure 40: 2 channels connection with antivalent contacts from T1/T2

5.3.5 2 channels OSSD connection

Applicable to: SSR10, SSR32, SSR42, TSR10, TSR20, USR10, USR22

Safety devices with dual OSSD outputs can be connected to R1 and R2. Short-circuit between the signals and to 24V DC is detected by the safety device from where the OSSD-signal originates.

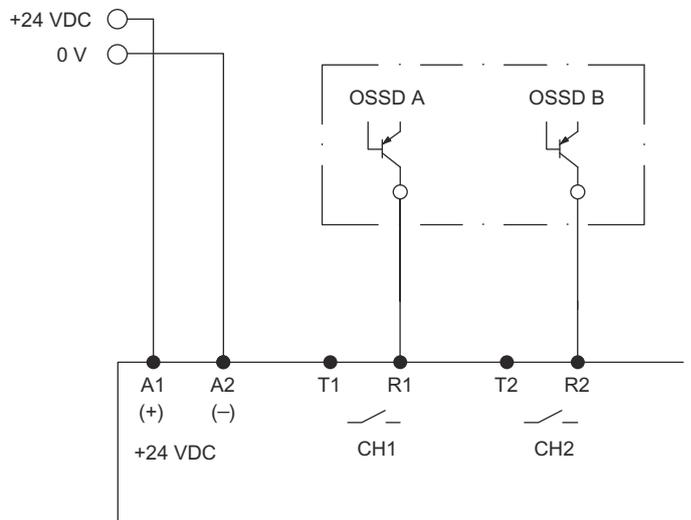


Figure 41: 2 channels connection with OSSD external signals

5.3.6 Pressure sensitive device connection

Applicable to: USR10, USR22

Both T1/R1 and T2/R2 safety inputs must be used for this function. The total resistance of the circuit including inactivated pressure sensitive devices and cables is shown in chapter ..

A force activated pressure sensitive device will result in a short-circuit over T1/R1 and T2/R2.

A short-circuit will deactivate the safety relay output.



WARNING: T1 and R1 shall be separated in different cables. Likewise, T2 and R2 shall be separated in different cables

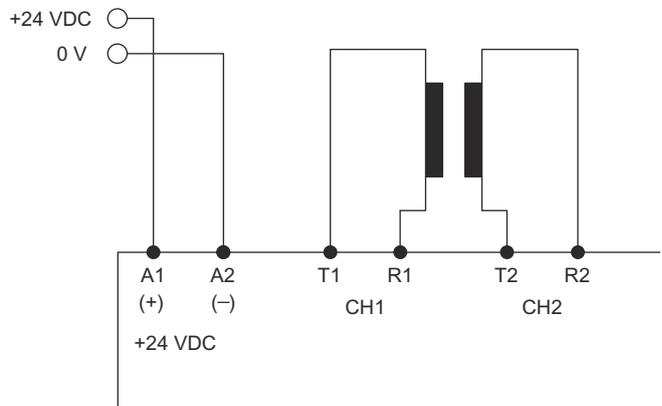


Figure 42: Pressure sensitive device connection with square wave signals

5.3.7 Two-hand device connection

Applicable to: SSR20, SSR20M, USR10, USR22,

A two-hand device has 2 NO and 2 NC contacts. These 4 contacts must be activated within 0.5 seconds in order for the signals to be accepted by the safety relay.

If any of the 4 safety device contacts is inactivated during the process the signal will be unaccepted.

A short-circuit to +24 VDC or 0 V will give an unaccepted signal.

All 4 contacts must leave and return to their unactuated positions before a new accepted signal can be given.

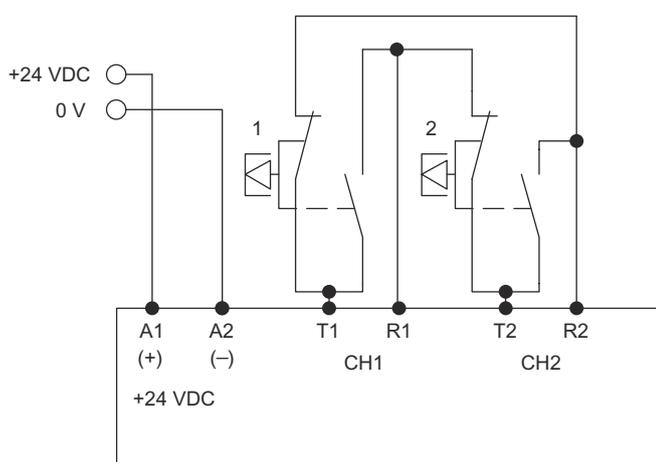


Figure 43: Two-hand safety device connection with square wave signal (SSR20, USR10, USR22)

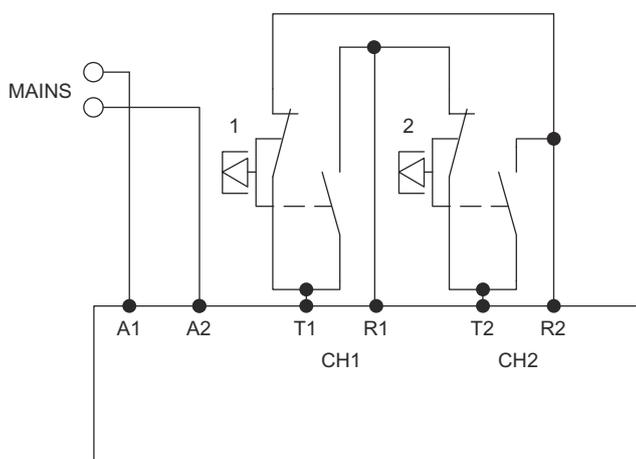


Figure 44: Two-hand safety device connection with square wave signal (SSR20M)

5.4 Test, start and reset interface

The safety relay has an interface for test, start and reset functions.

Note: The safety relay enters inactive mode when at least one input is not accepted. The safety relay enters active mode when the inputs are accepted and a reset is performed.

5.4.1 Test and start

Applicable to: BSR10, BSR11

The safety relay has a Test/Start connection, the X4 input can be connected either directly to +24 VDC or to a test circuit for supervised contactors and/or a button for Start.

The relay output will turn active if X4 is set to +24 VDC while it is powered via R1/R2. After activation, X4 can be removed and the active state will be kept solely by R1/R2.

The BSR10 and BSR11 can both be used as a safe expansion relay without external monitoring since the internal output relays are monitored by the unit itself.

Applicable to: BSR23

The BSR23 is a safety relay for output expansion of other safety devices. The internal relays will follow the safety input channels directly and individually.

The Safety relay needs to be monitored by the master unit controlling it. This is done via X1/X2 which need to be included in serial connection with the test/reset circuit of the master unit.

5.4.2 Reset

5.4.2.1 Automatic reset

Applicable to: SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42, TSR10, TSR20, TSR20M, USR10, USR22

When at least one input signal is not accepted, the safety relay enters deactivated mode. The MODE LED light blue and at least one of CH1/CH2 LED will turn OFF.

When the safety input signals are accepted and the test (X1/X4) circuit is closed, an automatic reset is made. The relay activates. All three LEDs will light green.

5.4.2.2 Manual reset

Applicable to: SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42, USR10, USR22



WARNING: Always use the manual reset function when a reset button is installed.

When at least one input safety signal is not accepted, the safety relay enters to inactive mode. The MODE LED is blue and at least one of the CH1/CH2 LEDs will turn OFF and the reset button light is static on.

When the safety input safety signals are accepted, the CH1 LED and the CH2 LED are green and the MODE LED is blue. The reset button light is flashing to indicate that a reset is possible. To reset the safety circuit, press the reset button for 0.05 s to 2 s. The relay goes to active mode and the button light turns off when the button is released (falling edge).

A reset button light test can be executed by pressing the reset button in active mode.

5.4.2.3 Multi-reset

Applicable to: SSR10, SSR20, SSR32, SSR42, USR10, USR22

It is possible to use 1 reset button to reset up to 10 safety relays while maintaining the reset button light function..

To use the multi-reset function the X1 inputs must be connected in parallel from the reset button. The X4 outputs must be parallel connected to the reset button indication light. All the

safety relays involved in the multi-reset chain must be set to manual reset.

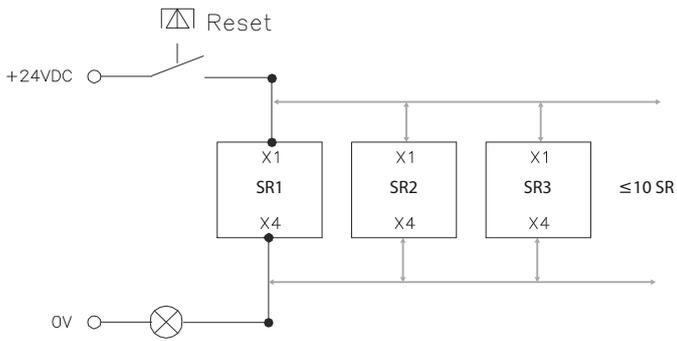


Figure 45: Connection of reset button including indication light. Up to 10 safety relays can be connected.

Table 3: Mixed state examples

SR1	SR2	SR3	Mixed state
A	A	A	A
A	A	I _{WFL}	I _{WFL}
A	I _{WFL}	I	I
A	I _{WFL}	I	I

A = Active. The reset button light is turned off.

I_{WFL} = Inactive, waiting for reset. The input signals are accepted, the reset button light is flashing, waiting for a button press.

I = Inactive. The input signals are not accepted and the reset button light is constant on.

5.5 LED

The three LEDs in the safety relay front indicates operation status and errors in the system. To interpret the LED information see **Chapter Troubleshooting**.

5.5.1 BSR10, BSR11

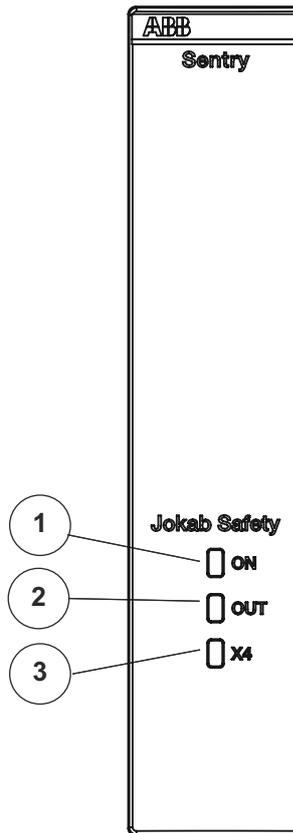


Figure 46: Indication LEDs on BSR10, BSR11

1. ON: 24 V on R1/R2
2. OUT: Output status
3. X4: 24 V on X4/R2

5.5.2 BSR23

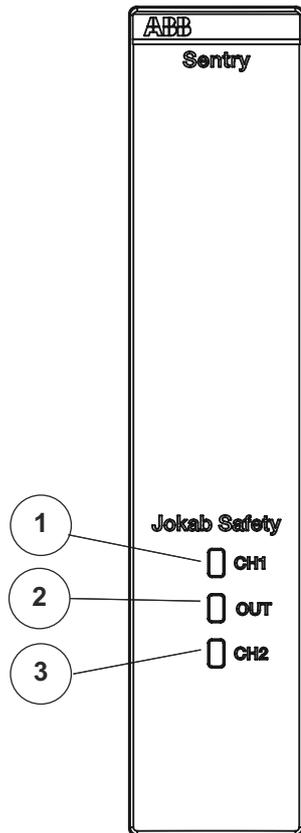


Figure 47: Indication LEDs on BSR23

1. CH1: 24V on A1/R1
2. OUT: Output status
3. CH2: 24V on R2/A2

5.5.3 SSR, TSR, USR

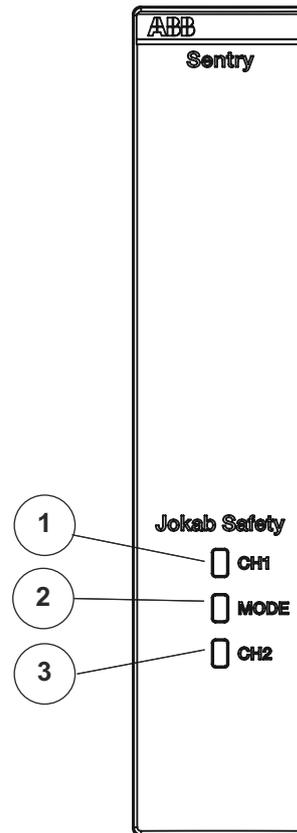


Figure 48: Indication LEDs on SSR, TSR, USR

1. CH1 Safety input channel 1 status
2. MODE Mode status
3. CH2 Safety input channel 2 status

5.6 Timer

See **Chapter Configuration** for information how to set the timer functions.

5.6.1 Output groups

5.6.1.1 TSR10, TSR20, TSR20M, USR10

The delay time settings have effect on all the safety relay outputs.

5.6.1.2 SSR32, SSR42, USR22

The delay time settings have effect on the secondary output group, pair (33/34 and 43/44).

The primary output group, pair (13/14 and 23/24) is effected immediately, following the mode of the safety relay.

5.6.2 Timer settings

5.6.2.1 SSR32, SSR42

The safety relay has fixed off-delay function time.

- SSR32 0.5 seconds
- SSR42 1.5 seconds

5.6.2.2 TSR20, TSR20M

The off-delay function time can be set to 0.5 second or 1.5 second by using the switch in the front of the safety relay.

5.6.2.3 TSR10, USR10, USR22

5

The delay function can be set to on-delay, off-delay, time reset or bypass. The delay time can be set to 0-999 seconds with 100 ms granularity.

Applicable to TSR10 and USR22: The delay time can be selected in 10 preset steps. See **Chapter Configuration** for further information.

5.6.3 Delay functions

5.6.3.1 On-delay

When all safety input signals are accepted and a reset has been done, a countdown starts. After the set delay time the, output activates.

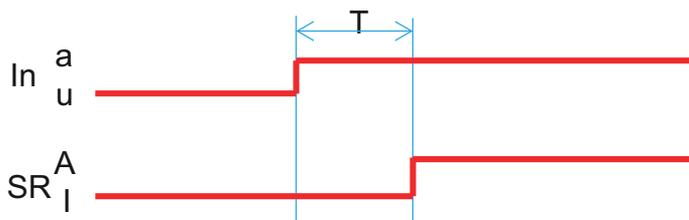


Figure 49: On-delay

If at least one signal goes unaccepted within the set time, the output remains deactivated.

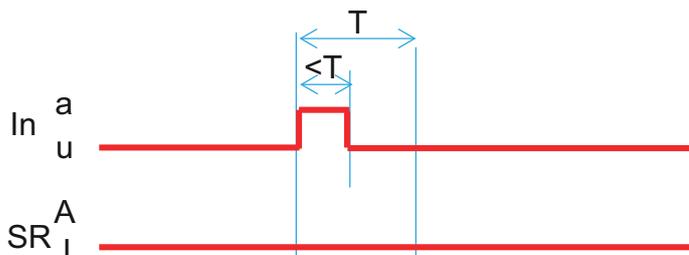


Figure 50: The safety input goes low within the delay time

In: Input conditions

a: Accepted safety inputs and reset

u: Unaccepted safety inputs

SR: Safety relay output

A: Activated output

I: Inactivated output

T: Time

5.6.3.2 Off-delay

When at least one input signal becomes unaccepted, a countdown starts. After the set time, the output is deactivated.

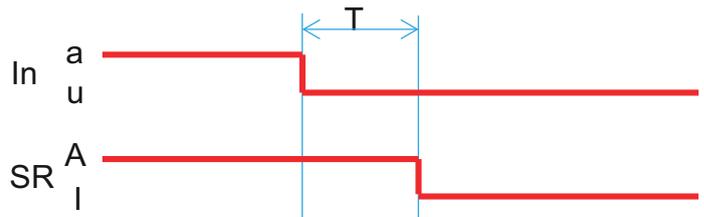


Figure 51: Off-delay

If the input condition becomes unaccepted and accepted again within the delay time period, the output will remain activated.

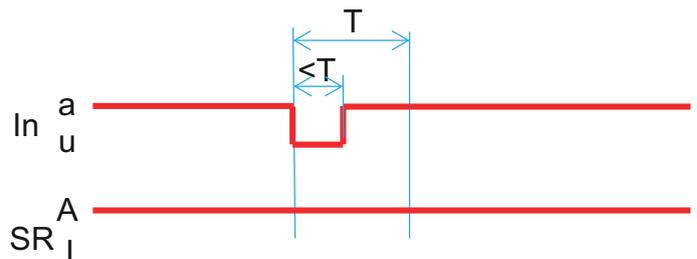


Figure 52: Safety input signals go high within the delay time period

In: Input conditions

a: Accepted safety inputs and reset

u: Unaccepted safety inputs

SR: Safety relay output

A: Activated output

I: Inactivated output

T: Time

5.6.3.3 Reset

The output activates during a set time when the input conditions becomes unaccepted. At the same time a countdown starts. After the set delay time the output deactivates.

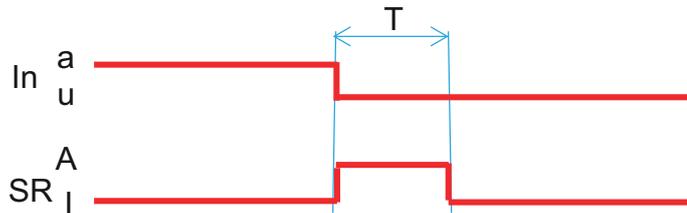


Figure 53: Timer reset function

If the input conditions becomes accepted again within the set time, the output will be deactivated.

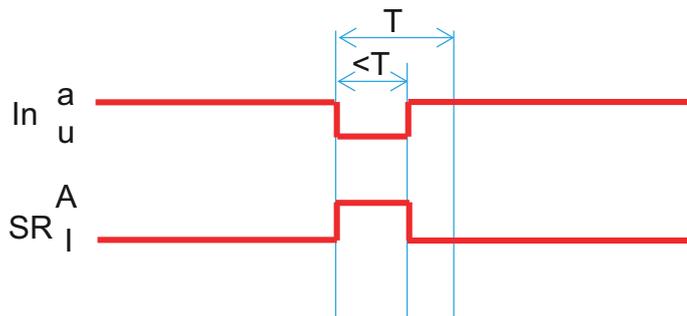


Figure 54: Stopped timer reset function

In: Input conditions
a: Accepted safety inputs and reset
u: Unaccepted safety inputs
SR: Safety relay output
A: Activated output
I: Inactivated output
T: Time

5.6.3.4 Bypass

When the safety input signals are accepted and a reset has been done, the output is activated and a countdown starts. The output will be deactivated after the set time or if the input signals becomes unaccepted during the countdown.

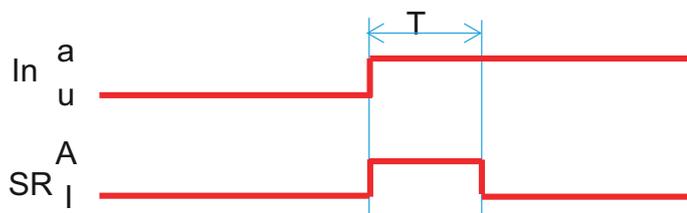


Figure 55: Time bypass function

If at least one input signal becomes unaccepted within the set time, the output will be deactivated.

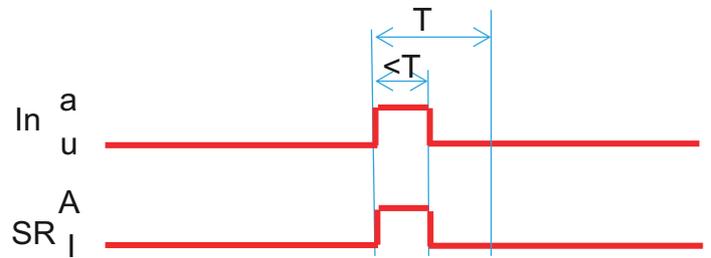


Figure 56: Timer bypass function when the input conditions becomes unaccepted during the countdown

In: Input conditions
a: Accepted safety inputs and reset
u: Unaccepted safety inputs
SR: Safety relay output
A: Activated output
I: Inactivated output
T: Time

5.7 Buttons

Applicable to: TSR10, USR10, USR22

Two buttons are used to navigate in the configuration menus for preset mode and custom mode.

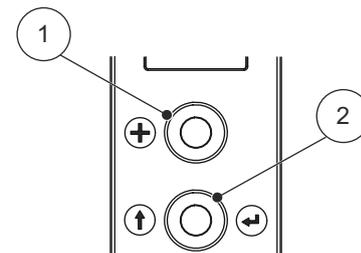


Figure 57: Increment button and Select button.

1. Increment button
2. Select button

5.7.1 Increment button

The Increment button is used to increase the value that is shown on the display, for example the value for a timer setting or to step to the next option in a setting.

To increase the value for a setting

- Push the Increment button 0.1-0.5 s.

5.7.2 Select button

The Select button is used to step between settings and to confirm settings.

To step between settings

- Push the Select button 0.1 – 0.5 s.

To confirm a setting

- Push and hold the Select button more than 0.5 s.

5.8 Display

Applicable to: TSR10, USR10, USR22

The display is placed in the upper part of the front panel. The display consists of three 7 segment digits.

The display is used for navigation in the setting menus. Error codes are also shown on the display.

5.9 Password

Applicable to: TSR10, USR10, USR22

A 3 digit password will be set when using customized settings. The factory preset password is 000.



Note: The password is not for security, but to prevent unintentional changes of settings in the safety relay.

5

5.10 Preset

Applicable to: TSR10, USR10, USR22

The preset function modes can be used to configure the safety relay for the most common types of applications.

To set other functions, custom mode must be used.

See **Chapter Configuration** for more information.

5.10.1 TSR10

The safety relay has presets to cover four types of timer delays and are chosen in the first configuration step. In the second, the delay time is set by choosing between the fixed options.

The TSR10 is always set to automatic reset.

See **Chapter Configuration** for preset.

5.10.2 USR10, USR22

The safety relay has 7 presets, to cover the most common usage. No timer settings are available in the presets.

See **Chapter Configuration** for timer setting and preset.

6 Installation

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This chapter contains information about the installation procedures for the Sentry safety relays.

WARNING: Installation shall be done by an approved person. See **Chapter Approved person** for more information.

6.1 Mounting to the DIN rail

CAUTION: The safety relay shall be mounted on a 35 mm DIN rail in a lockable enclosure that has at least protection class IP54.

CAUTION: Make sure there is at least 10 mm distance between the safety relay and other non-Sentry units to prevent uncontrolled heating.

CAUTION: Make sure there is at least 50 mm distance above and below the safety relay and other units for correct air flow in the venting holes of the safety relay.

CAUTION: Sentry safety relays, except for BSR23, can be mounted without distance to other Sentry safety relays. For BSR23, make sure there is at least 5 mm distance between the safety relay and other Sentry safety relays.

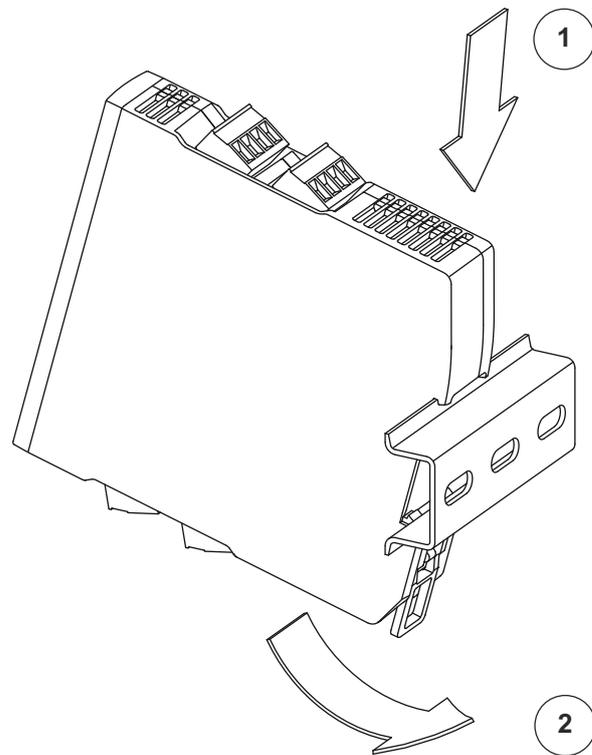


Figure 58: Mount the safety relay on the DIN rail.

6.1.1 To mount the safety relay on the DIN rail

1. Make sure that the DIN rail latching is reset, see **Figure 60**.
2. Hang the top rear side of the safety relay on the DIN rail. See **Figure 58** (1).
3. Push the bottom rear side of the safety relay on the DIN rail until you hear a click. See **Figure 58** (2).

6.1.2 To remove the safety relay from the DIN rail

1. Use a screwdriver to unlock the DIN relay latching device from the DIN rail.
2. Pull the bottom rear side of the safety relay away from the DIN rail until you hear a click.
3. Lift the top rear side of the safety relay away from the DIN rail.
4. Pull the bottom side of the DIN rail latching device from the safety relay and push it upwards to release it to its original position. See **Figure 60**.

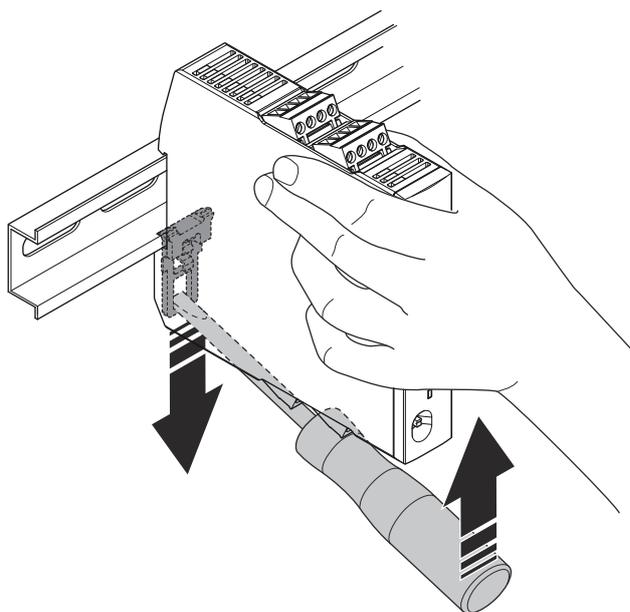


Figure 59: Remove the safety relay from the DIN rail.

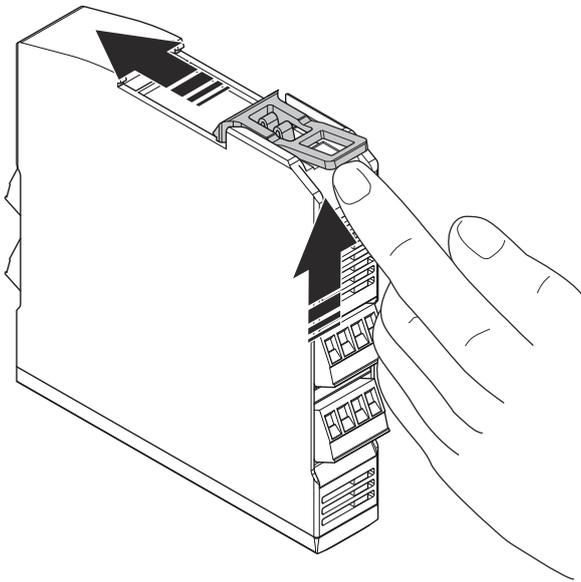


Figure 60: Reset the DIN rail latching device.

6.2 Connection blocks

The connection blocks on the safety relay are detachable to simplify installation and replacement.

WARNING: Disconnect the power supply before connect or disconnect the connection blocks.

WARNING: Make sure that connection blocks and wires are clearly marked to avoid incorrect connections.

See **Chapter Product description** for the positioning of the connection blocks on the safety relay and for the applicable connections.

6.2.1 Coding of connection blocks

The connection blocks are delivered without coding.

With a coding kit it can be coded into a fixed coded connector on the safety relay to avoid a mix up.

The coding kit is an optional accessory that can be ordered separately. See **Table 16** for the order code of Sentry Coding kit.

- The risk assessment must include the risk of mistakes when using the connection blocks without coding.
- If coding is used, a test of the outcome of the coding against the identified risks must be done.

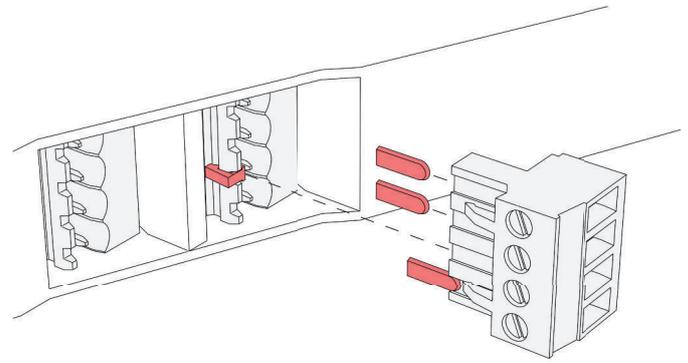


Figure 61: Example of connection block coding

6.3 Electrical connection

WARNING: Make sure that wires and connection blocks are clearly marked to avoid incorrect connections.

WARNING: Obey applicable requirements in IEC 60204-1 for wire connections to ensure that no short circuits will occur.

WARNING: For connections of relay output contacts: Make sure that all power supplies or signal sources are connected to one side of the safety relay and that all power consumers or signal receivers are connected to the opposite side of the safety relay to ensure that no short circuits occur.

WARNING: Make sure to use at least one of the following methods to ensure correct wire protection against short circuits for the safety relay outputs:

1. The wires are permanently connected and protected against external damage, for example by wire ducts or other types of covers for protection.
2. The use of separate multi-core wires.
3. The use of cables with wires being individually shielded with earth connection.

6.3.1 Connection of wires

WARNING: Make sure that the wires are fitted with crimp terminals or ferrules before connection, unless solid copper conductors are used.

7 Configuration

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7.1 BSR10, BSR11, BSR23

The safety relays can not be configured.

7.2 SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42

The initial setting is automatic reset.

- Use the switch (1) to change settings between automatic reset (2) and manual reset (3).
- Power cycle (power off and on) the safety relay when a setting has been changed.

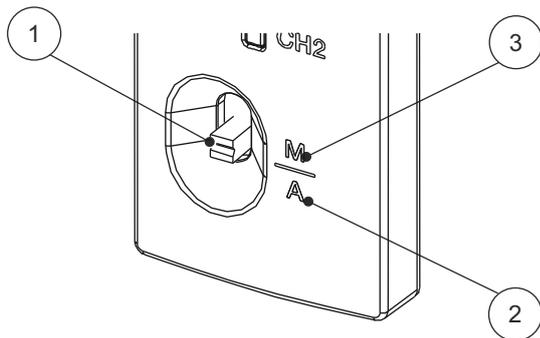


Figure 62: Switch for automatic reset and manual reset.

7.3 TSR20, TSR20M

The initial setting for Off-delay is 1.5 s.

- Use the switch (1) to change settings for Off-delay between 1.5 s (2) and 0.5 s (3).
- Power cycle (power off and on) the safety relay when a setting has been changed.

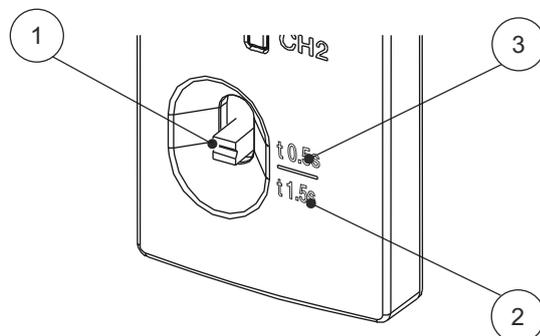


Figure 63: Switch for Off-delay settings.

7.4 TSR10, USR10, USR22

Use the display and the buttons for settings and navigation.

See **Chapter Buttons** for information about the buttons.

See **Chapter Display** for information about the display.

The safety relay starts in configuration mode the first time it is used. Configuration mode is indicated with flashing LED segments on the display.

The safety relay must be configured and power cycled (power off and on) before it is in operation. The safety relay can be configured into preset mode or custom mode.



Note: Before a new configuration of a preset configured safety relay is possible, a factory reset must be performed.

7.4.1 Settings in preset mode

Preset mode has specified settings according to applicable type of safety device connection. A number of selectable pre-defined settings, where each type of setting has a combination of parameters for signal type, reset type, timer delay and time.

7.4.1.1 TSR10

Table 4: Preset TSR10

[P.0X]	Configuration	Signal type	Reset	Timer delay	Time [XXX/XX.X]
P.01	Equivalent contacts	24 VDC/24 VDC	Automatic reset	Off-delay	0.0 s, 0.5 s, 1.0 s, 1.5 s, 2.0 s, 3.0 s, 5.0 s, 10.0 s, 15.0 s, 30.0 s
P.02				On-delay	
P.03				Time bypass	
P.04				Time reset	

7.4.1.2 USR10

Table 5: Preset USR10

[P.0X]	Configuration	Signal type	Reset	Timer delay	Time
P.01	Equivalent contacts	2 x NO, 24 VDC or signal from T1/T2	Manual reset	No-delay	Not applicable
P.02			Automatic reset		
P.03	Antivalent contacts	NO + NC, 24 VDC or signal from T1/T2	Manual reset		
P.04			Automatic reset		
P.05	Pressure sensitive device	Square wave from T1/T2	Manual reset		
P.06			Automatic reset		
P.07	Two-hand device				

7.4.1.3 USR22

Table 6: Preset USR22

[P.0X]	Configuration	Signal type	Reset	Timer delay	Time
P.01	Equivalent contacts	2 x NO, 24 VDC or signal from T1/T2	Manual reset	Off-delay	0.0 s, 0.5 s, 1.0 s, 1.5 s, 2.0 s, 3.0 s, 5.0 s, 10.0 s, 15.0 s, 30.0 s
P.02			Automatic reset		
P.03	Antivalent contacts	NO + NC, 24 VDC or signal from T1/T2	Manual reset		
P.04			Automatic reset		
P.05	Pressure sensitive device	Square wave from T1/T2	Manual reset		
P.06			Automatic reset		
P.07	Two-hand device				

7.4.2 Configuration of preset mode

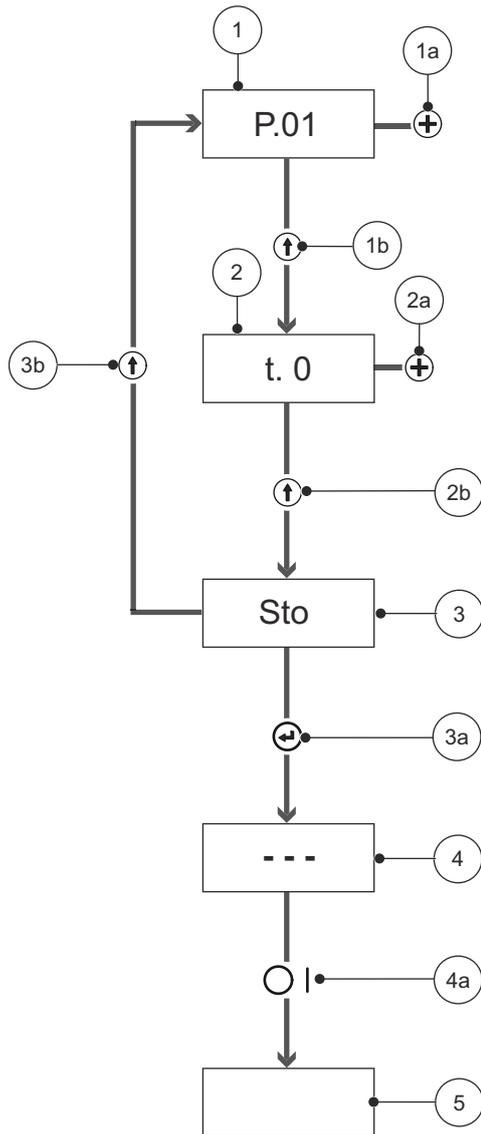


Figure 64: Configuration of preset mode

1. Preset mode.
 - a. Push the Increment button to select type of preset configuration or to select custom mode [CUS].
 - b. Push the Select button to step to the time selection. (TSR10 and USR22).
2. Timer setting.
 - a. Push the Increment button to step between the available time settings. (TSR10 and USR22).
 - b. Push the Select button to confirm the setting and step to store mode [Sto].
3. Store mode.
 - a. Push and hold the Select button to store the configuration.
 - b. Push the Select button to return to Preset mode.
4. Failsafe mode waiting for power cycling.
 - a. Power cycle (power off and on) the safety relay.
5. The safety relay is in operation mode with a preset configuration.

7.4.3 Settings in custom mode

The Custom mode must be used to get a function which is not available with the preset alternatives. The configuration parameters are manually set in custom mode.

7.4.3.1 TSR10

Table 7: Settings TSR10

Custom [CUS]	Configuration [C]	Reset	Timer delay [d.XX]	Time	Log [LoG]
[CUS] Custom	[c.01] Equivalent contacts	[r.02] Automatic reset	[d. - -] No delay	[XXX/XX.X] 0 – 999 s	[Y.XX] 10 latest errors
			[d.01] Off-delay		
			[d.02] On-delay		
			[d.03] Time bypass		
			[d.04] Time reset		

7.4.3.2 USR10, USR22

Table 8: Settings USR10, USR22

Custom [CUS]	Configuration [C]	Reset [r.0X]	Timer delay [d.XX]	Time	Log [LoG]
[CUS] Custom	[C.01] Equivalent contacts	[r.01] Manual reset [r.02] Automatic reset	[d. - -] No delay	[XXX/XX.X] 0 – 999 s	[Y.XX] 10 latest errors
	[C.02] Antivalent contacts		[d.01] Off [d.02] On-delay		
	[C.03] Pressure sensitive device		-delay		
	[C.04] Two-hand device		[d.03] Time bypass [d.04] Time reset		

7

7.4.4 Configuration in custom mode

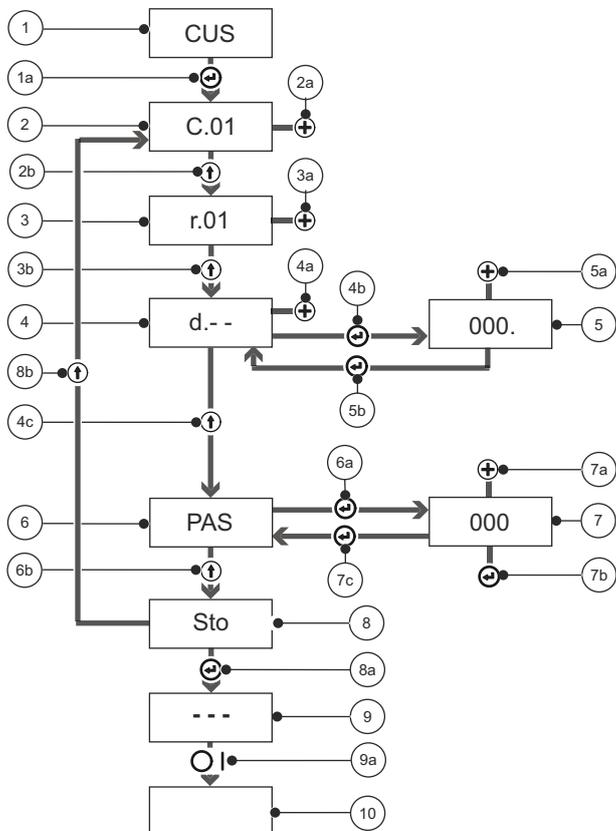


Figure 65: Configuration in custom mode

1. Custom entry, reached from the preset menu. This entry is shown to indicate Custom mode. During countdown, the remaining time is displayed.
 - a. Push the select button to step to the Configuration setting.
2. Configuration setting.
 - a. Push the increment button to select configuration [C.01-C.04]
 - b. Push the select button to step to the Reset setting.
3. Reset setting.
 - a. Push the increment button to select Manual reset [r.01] or Automatic reset [r.02]
 - b. Push the select button to step to the Timer delay type setting.
4. Timer delay type.
 - a. Push the increment button to select Timer delay type [d.01-d04]
 - b. Push and hold the select button to step to the Time setting.
 - c. Push the select button to step to the Password setting
5. Time setting.
 - a. Push the increment button to select the Delay time.
 - b. Push and hold the select button to step to the Time delay type setting.
6. The current password is shown.
 - a. Push and hold the select button to step to Password setting.
 - b. Push the select button to step to the Store mode.
7. Password setting

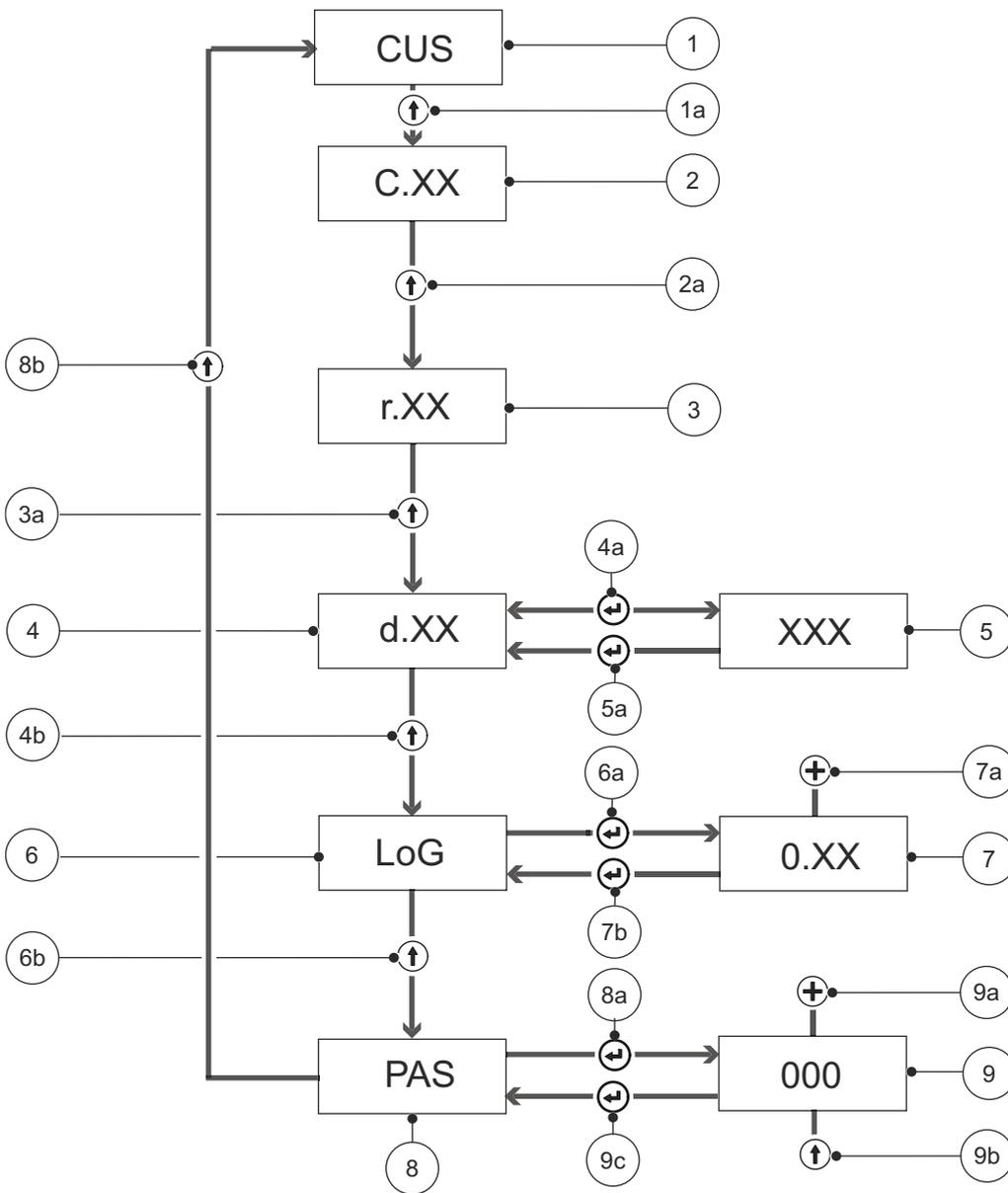


Figure 67: Operation mode with custom configuration.

1. Custom entry. This entry is shown to indicate Custom mode. During countdown, the remaining time is displayed.
 - a. Push the select button to step to the Configuration setting.
2. Configuration setting.
 - a. Push the select button to step to the Reset setting.
3. Reset setting.
 - a. Push the select button to step to the Timer delay setting.
4. Timer delay setting.
 - a. Push and hold the select button to enter the Timer delay timeout value.
 - b. Push the select button to step to the Log entry.
5. Timer delay timeout value.
 - a. Push and hold the select button to return to the Timer delay setting.
6. Log entry.
 - a. Push the increment button to enter the Logged error codes.
 - b. Push the select button to step to the Password entry.
7. Logged error codes. The latest 10 errors can be displayed, where 0.XX is the latest error code and 9.XX is the oldest error code.
 - a. Push the increment button to increment the error code number.
 - b. Push and hold the select button to return to the LoG entry.
8. Password entry.
 - a. Push the Select button to enter a new password.
 - b. Push the select button to step to the Custom entry.
9. The current password is shown.
 - a. Push the increment button to increment the error code number.
 - b. Push and hold the select button to return to the LoG entry.

- a. Push the increment button to increment the flashing segment.
- b. Push the select button to step to the next segment.
- c. Push and hold the select button to verify the password. If the password is correct the safety relay will enter safe mode and the configuration can be updated. If the password is incorrect the display will show "Err" for a short while and return to the Password entry. See **Chapter Configuration in custom mode** for further action.

7.4.7 Factory reset

Factory reset erases all settings including the password, except for the error codes. The safety relay will enter configuration mode after a factory reset.

To do a factory reset:

- Push and hold the Increment button and the Select button for 5 s.

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8.1 Regular maintenance



WARNING: Test the safety functions and mechanics regularly to confirm that the safety functions work properly.



WARNING: Repair and exchange of parts of the safety relay is not permitted since it may accidentally cause permanent damage to the product, impairing the safety of the device which in turn could lead to serious injury to personnel. In case of breakdown or damage to the product contact ABB Jokab Safety to replace the safety relay.

8.2 Scheduled test

8.2.1 Scheduled test, high demand application

All safety relays and connected safety devices used in high demand applications must be tested once a year.

8.2.2 Scheduled test, low demand application

All safety relays and connected safety devices used in low demand applications must be tested according to the selected test interval.

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9.1 Display codes

Table 9: Status messages for TSR10, USR10 and USR22

Display indication	Status message
8.8.8.	The safety relay is powering up. The segments on the display are shortly lit up during the powering up process.
E.XX	Error code. The error code E.xx is flashing if an error is present.

Table 10: Error codes for TSR10, USR10 and USR22

Error code	Error type	Procedure for correction
E.10 – E.14	Internal error	<ol style="list-style-type: none"> 1. Power cycle the safety relay. 2. If the error code remains, contact your ABB Jokab Safety representative.
E.15	Relay hardware error	<ol style="list-style-type: none"> 1. Power cycle the safety relay. 2. If the error code remains, contact your ABB Jokab Safety representative.
E.16	+24 V power error	<ul style="list-style-type: none"> • Check the supply voltage.
E.20 – E.26	Input/Output (I/O) error	<ol style="list-style-type: none"> 1. Power cycle the safety relay. 2. If the error code remains, contact your ABB Jokab Safety representative.
E.30 – E.34	System error	<ol style="list-style-type: none"> 1. Power cycle the safety relay. 2. If the error code remains, contact your ABB Jokab Safety representative.
E.50	Internal error	<ol style="list-style-type: none"> 1. Power cycle the safety relay. 2. If the error code remains, contact your ABB Jokab Safety representative.
E.51	External error. Signal short on T1.	<ul style="list-style-type: none"> • Examine T1 for short circuits.
E.52	External error. Signal short on T2.	<ul style="list-style-type: none"> • Examine T2 for short circuits.
E.53 – E.58	Internal error	<ol style="list-style-type: none"> 1. Power cycle the safety relay. 2. If the error code remains, contact your ABB Jokab Safety representative.

9.2 LED indications

9.2.1 BSR10, BSR11

Table 11: LED indications for BSR10 and BSR11

ON	OUT	X4	Status	Action
off	off	off	Loss of power supply or too low voltage. Occurs during regular operation.	<ul style="list-style-type: none"> • Measure R1/R2 voltage.
green	off	off	Input X4 is not powered with correct voltage. Occurs during regular operation.	<ul style="list-style-type: none"> • Measure X4/R2 voltage. • Troubleshoot the monitored device. • Troubleshoot the test/start circuit.
green	off	green	Safety relay internal error.	<ul style="list-style-type: none"> • Exchange the safety relay.

ON	OUT	X4	Status	Action
off	off	green	No signal to R1/R2. Occurs during regular operation.	<ul style="list-style-type: none"> Measure R1/R2 voltage.
green	green	green	Normal operation.	
green	green	off	Normal operation.	

9.2.2 BSR23

Table 12: LED indications for BSR23

CH1	OUT	CH2	Status	Action
off	off	off	No channel is activated or no voltage to A1/A2.	<ul style="list-style-type: none"> Check safety input channels A1 to R1 and R2 to A2. Measure A1/A2 voltage.
green	off	off	+24 VDC is not connected to R2 or 0 V is not connected to A2.	<ul style="list-style-type: none"> Check R2 and A2 connections.
green	green	green	Normal operation, outputs activated.	
off	off	green	+24 VDC is not connected to A1 or 0 V is not connected to R1.	<ul style="list-style-type: none"> Check A1 and R1 connections.
off	green	green	Channel 1 is stuck	Change the safety relay
green	green	off	Channel 2 is stuck	Change the safety relay

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9.2.3 SSR32, SSR42, TSR20, TSR20M

Table 13: LED operation and error status for SSR32, SSR42, TSR20, TSR20M

CH1	Mode	CH2	Status	Action
off	off	off	The safety relay is not powered.	Check A1–A2 voltage and connections.
green	green	green	CH1 and CH2 accepted. Reset made and outputs activated.	
off	flash green	off	CH1 and CH2 unaccepted. A timer function is counting down while the safety relay remains activated.	
off	flash green	green	CH1 unaccepted and CH2 accepted. A timer function is counting down while the safety relay remains activated.	
green	flash green	off	CH1 accepted and CH2 unaccepted. A timer function is counting down while the safety relay remains activated.	
off	blue	off	No channels accepted.	Check CH1 and CH2

CH1	Mode	CH2	Status	Action
off	blue	green	CH1 unaccepted, CH2 accepted	Check CH1
green	blue	off	CH1 accepted, CH2 unaccepted	Check CH2
green	blue	green	CH1 and CH2 accepted, the safety relay wait for reset.	Check reset settings, wiring and reset/test circuit
green	blue	fast flash green	Two-channels error: CH2 has been unaccepted and then accepted again while CH1 remained accepted.	Check installation. Restore by opening and closing both CH:s at the same time.
fast flash green	blue	green	Two-channels error: CH1 has been unaccepted and then accepted again while CH2 remained accepted.	Check installation. Restore by opening and closing both CH:s at the same time.
fast flash green	blue	fast flash green	Reading error on R1 and R2.	Check installation. Restore by opening and closing both CH:s at the same time.
red	fast flash blue	red	Fail-safe mode, a new setting has been stored.	Power cycle the unit to use the new setting.
red	flash red	red	Fail-safe mode, the system is waiting for a new setting.	Change the timer setting switch.
red	fast flash red	red	The safety relay is in failsafe mode.	Check installation and power cycle.
red	fast flash red	fast flash red	Failsafe mode due to short circuit between CH2 and 24 VDC or T1	Check and remove the short circuit.
fast flash red	fast flash red	red	Failsafe mode due to short circuit between CH1 and 24 VDC or T2	Check and remove the short circuit.

9.2.4 SSR10, SSR10M, SSR20, SSR20M

Table 14: LED operation and error status

LED indication			Status	Action
CH1	Mode	CH2		
off	off	off	The safety relay is not powered.	Check A1–A2 voltage and connections.
green	green	green	CH1 and CH2 accepted. Reset done and outputs activated.	
off	blue	off	No channels accepted.	Check CH1 and CH2
off	blue	green	CH1 not closed, CH2 accepted	Check CH1
green	blue	off	CH1 accepted, CH2 not closed	Check CH2
green	blue	green	CH1 and CH2 accepted, the safety relay is waiting for reset.	Check reset settings, wiring and reset circuit
green	blue	fast flash green	Two-channels error: CH2 has been unaccepted and then accepted again while CH1 remained accepted.	Check installation. Restore by opening and closing both CH:s at the same time.

LED indication			Status	Action
CH1	Mode	CH2		
fast flash green	blue	green	Two-channels error: CH1 has been unaccepted and then accepted again while CH2 remained accepted.	Check installation. Restore by opening and closing both CH:s at the same time.
fast flash green	blue	fast flash green	Reading error on R1 and R2.	Check installation. Restore by opening and closing both CH:s at the same time.
red	fast flash blue	red	Fail-safe mode, a new setting has been stored.	Power cycle the unit to use the new settings.
red	flash red	red	Fail-safe mode, the system is waiting for a new setting.	Enter and store a new setting.
red	fast flash red	red	The safety relay is in failsafe mode.	Check installation and power cycle.
red	fast flash red	fast flash red	Failsafe mode due to short circuit between CH2 and 24 VDC or T1	Check and remove the short circuit.
fast flash red	fast flash red	red	Failsafe mode due to short circuit between CH1 and 24 VDC or T2	Check and remove the short circuit.

9.2.5 TSR10, USR10, USR22

Table 15: LED indications for TSR10, USR10, USR22

CH1	Mode	CH2	Comment	Action
off	off	off	The safety relay is not powered.	Check A1–A2 voltage and connections.
green	green	green	CH1 and CH2 accepted. Reset done and outputs activated.	
off	flash green	off	CH1 and CH2 unaccepted. A timer function is counting down while the safety relay remains activated.	
off	flash green	green	CH1 unaccepted and CH2 accepted. A timer function is counting down while the safety relay remains activated.	
green	flash green	off	CH1 accepted and CH2 unaccepted. A timer function is counting down while the safety relay remains activated.	
off	blue	off	No channels accepted.	Check CH1 and CH2
off	blue	green	CH1 unaccepted, CH2 accepted	Check CH1
green	blue	off	CH1 accepted, CH2 unaccepted	Check CH2
green	blue	green	CH1 and CH2 accepted, the safety relay wait for reset.	Check reset settings, wiring and reset circuit.
green	blue	fast flash green	Two-channels error: CH2 has been unaccepted and then accepted again while CH1 remained accepted.	Check installation. Restore by opening and closing both CH:s at the same time.

CH1	Mode	CH2	Comment	Action
fast flash green	blue	green	Two-channels error: CH1 has been unaccepted and then accepted again while CH2 remained accepted.	Check installation. Restore by opening and closing both CH:s at the same time.
fast flash green	blue	fast flash green	Reading error on R1 and R2.	Check installation. Restore by opening and closing both CH:s at the same time.
off	flash blue	off	CH1 and CH2 unaccepted, a timer function is counting down while remaining deactivated.	
off	flash blue	green	CH1 unaccepted and CH2 accepted, a timer function is counting down while remaining deactivated.	
green	flash blue	off	CH1 accepted and CH2 unaccepted, a timer function is counting down while remaining deactivated.	
red	fast flash blue	red	Fail-safe mode, a new setting has been stored.	Power cycle the unit to use the stored setting.
red	flash red	red	Fail-safe mode, the system is waiting for a new setting.	Enter and store a new setting.
red	fast flash red	red	The safety relay is in failsafe mode.	Check error codes and installation.
red	fast flash red	fast flash red	Failsafe mode due to short circuit between CH2 and 24 VDC or T1	Check error code. Check and remove the short circuit.
fast flash red	fast flash red	red	Failsafe mode due to short circuit between CH1 and 24 VDC or T2	Check error code. Check and remove the short circuit.

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10.1 Manufacturer and order information

Table 16: Manufacturer and order information

Manufacturer and order information

Manufacturer

ABB AB

Jokab Safety

Varlabergsvägen 11

S-434 39 Kungsbacka

Sweden

Order information

Safety relay	Order code
BSR10	2TLA010040R0000
BSR11	2TLA010040R0200
BSR23	2TLA010041R0600
SSR10	2TLA010050R0000
SSR10M	2TLA010050R0100
SSR20	2TLA010051R0000
SSR20M	2TLA010051R0100
SSR32	2TLA010052R0400
SSR42	2TLA010053R0400
TSR10	2TLA010060R0000
TSR20	2TLA010061R0000
TSR20M	2TLA010061R0100
USR10	2TLA010070R0000
USR22	2TLA010070R0400
Sentry S30A Contact block	2TLA010099R0000
Sentry S30B Coding kit	2TLA010099R0100

10.2 Performance data



Note: While every effort has been taken to ensure the accuracy of the information contained in this manual ABB Jokab Safety cannot accept responsibility for errors or omissions and reserves the right to make changes and improvements without notice. Performance data given in this document is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of ABB Jokab Safety's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the ABB Jokab Safety Warranty and Limitations of Liability.

10.3 Absolute maximum rating



CAUTION: If any of the following values are exceeded, the relay must be disposed of.

Table 17: Absolute maximum rating

Safety relay	BSR10, BSR11	BSR23	SSR10M, SSR20M, TSR20M	SSR10, SSR20, SSR32, SSR42, TSR10, TSR20, USR10, USR22
Maximum voltage rating for A1 and A2 ^{Note 2}	–	27.6 VDC	275 VAC or 385 VDC	30 VDC
Maximum voltage rating for R and T ^{Note 2}	30 VDC	27.6 VDC	30 VDC	30 VDC
Maximum voltage rating for X1 ^{Note 2}	–	265 VAC or 350 VDC	30 VDC	30 VDC
Maximum voltage rating for X2	–	265 VAC or 350 VDC	–	–
Maximum voltage rating for X4 ^{Note 2}	30 VDC	–	30 VDC	30 VDC
Maximum operating breaking voltage for relay contacts	500 V _p	500 V _p	500 V _p	500 V _p
Maximum voltage rating for NO/NC contacts	265 VAC or 350 VDC	265 VAC or 350 VDC	265 VAC or 350 VDC	265 VAC or 350 VDC
Maximum current rating for 1 NO relay contact	8 A	8 A	8 A	8 A
Maximum current rating for 1 NC relay contact	5 A (Not for BSR11)	5 A	5 A	5 A ^{Note 3}
Maximum load capacity, $\sum I_{th}^2$ ^{Note 1}	$\leq 7^2$	$\leq 7^2$	$\leq 7^2$	$\leq 7^2$ for SSR10 SSR20 TSR10 TSR20 USR10 $\leq 36^2$ for SSR32 SSR42 USR22

Note 1: $\sum I_{th}^2$ is the sum of the square for each relay output contact. For example: I1 = 2 A_{RMS}; I2 = 4 A_{RMS}; I3 = 5 A_{RMS}; I4 = 1 A_{RMS} → $\sum I_{th}^2 = 4 + 16 + 25 + 1 = 46^2$

Note 2: Fault voltages up to 60 V is not dangerous but the safety relay might be broken or its performance might be degraded.

Note 3: Not applicable for SSR32, SSR42, USR22

10.4 Power supply



Note: BSR10 and BSR11 has no input for power supply. See **Table 21** for electrical data of the safety device interface.

Table 18: Power supply

Safety relay	SSR10, SSR20, TSR10, TSR20, USR10	SSR32, SSR42, USR22	BSR23	SSR10M, SSR20M, TSR20M
Power supply type	PELV/SELV	PELV/SELV	PELV/SELV	Mains
Overvoltage category	–	–	–	II
Rated impulse withstand voltage when determined	–	–	–	4 kV

Safety relay	SSR10, SSR20, TSR10, TSR20, USR10	SSR32, SSR42, USR22	BSR23	SSR10M, SSR20M, TSR20M
Operating voltage	+24 VDC +15 %, -20 %	+24 VDC +15 %, -20 %	+24 VDC +15 %, -20 %	85 – 265 VAC (50/60 Hz) or 120 – 375 VDC
Terminal connection	A1 = +24 VDC	A1 = +24 VDC	A1 and R2 = +24 VDC	A1 = Line
	A2 = 0 VDC (GND)	A2 = 0 VDC (GND)	A2 = 0 VDC (GND)	A2 = Neutral
Consumption	8 W	10 W	3 W	12 VA
Required fuse	4 A gG external fuse is required (4 A according to UL 248)	4 A gG external fuse is required (4 A according to UL 248)	4 A gG external fuse is required (4 A according to UL 248)	4 A gG external fuse is required (4 A according to UL 248)

10.5 Internal consumption

Table 19: Values for calculation of heating effect

Safety relay	Consumption
BSR10	2 W
BSR11	2 W
BSR23	3 W
SSR10	4 W
SSR10M	12 VA
SSR20	4 W
SSR20M	12 VA
SSR32	6 W
SSR42	6 W
TSR10	4 W
TSR20	4 W
TSR20M	12 VA
USR10	5 W
USR22	6 W

10.6 Relay output specification

Table 20: Relay output specification

Safety relay		BSR11	BSR23	BSR10, SSR10, SSR10M, SSR20, SSR20M, TSR10, TSR20, TSR20M, USR10	SSR32, SSR42, USR22
Relay output configuration		4 NO	4 NO + 1 NC	3 NO + 1 NC	2 NO + 2 NO ^{Note 1}
Maximum operating switching voltage ^{Note 2}		250 VAC			
Overvoltage category		II			
Rated impulse withstand voltage when determined		4 kV			
Rated operational voltage		250 VAC			
Minimum operating contact load		5 VDC / 10 mA (15 VDC / 3 mA)			
Maximum operating switching frequency		0.5 Hz			
NO contact					
AC load (AC15, AC1)	Rated operating voltage (U _e)	250 VAC			
Rated operating current (I _e)	1 contact	5 A		5 A	3 A
	2 contacts	5 A		5 A	3 A
	3 contacts	4.6 A		4.6 A	3 A
	4 contacts	4 A		–	3 A
DC load (DC13, DC1)	Rated operating voltage (U _e)	+24 VDC			
Rated operating current (I _e)	1 contact	6 A			3 A
	2 contacts	5.6 A			3 A
	3 contacts	4.6 A			3 A
	4 contacts	4 A		–	3 A
Required fuse		6.3 A gG, 1 kA short circuit protection (6 A according to UL248)			4 A gG, 1 kA short circuit protection (4 A according to UL248)
NC contact					
AC load (AC15, AC1)	Rated operational voltage (U _e)	–	250 VAC		–
	Rated operational current (I _e)	–	0.5 A		–
DC load (DC13, DC1)	Rated operational voltage (U _e)	–	+24 VDC		–

Safety relay	BSR11	BSR23	BSR10, SSR10, SSR10M, SSR20, SSR20M, TSR10, TSR20, TSR20M, USR10	SSR32, SSR42, USR22
	Rated operational current (Ie)	–	2 A	–
	Required fuse	–	4 A gG (4 A according to UL 248)	–
Note 1: Two relay groups. The second relay group can be controlled with timer settings.				
Note 2: In a 400 V system a 3 phase load shall only be used in a star connection.				

10.7 Safety device interface specification

Table 21: T1/T2 safety device interface specification

Safety relay		SSR10, SSR10M, SSR32, SSR42, TSR10, TSR20, TSR20M	SSR20, SSR20M	USR10, USR22
Output (O) T1 and T2				
Output high voltage (VOH) ^{Note 1}	Minimum	15.8 VDC		
	Maximum	25.6 VDC		
Maximum output low voltage (VOL _{max})	0.8 VDC			
Maximum output current ^{Note 2}	50 mA			
Signal frequency	5 Hz ±1 Hz	–	5 Hz ±1 Hz	
Pulse length	500 µs ±100 µs	–	500 µs ±100 µs	
Square wave signal frequency	–	217 Hz ±3 Hz	217 Hz ±3 Hz	
Maximal capacitance to ground	100 nF			
Note 1: VOH typical = power supply voltage -2.8 VDC (21.2 VDC for SSR10M SSR20M TSR20M).				
Note 2: Current limited internally to typical 70 mA.				

Table 22: R1/R2 safety device interface specification

Safety relay	BSR10, BSR11	BSR23	SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42, TSR10, TSR20, TSR20M, USR10, USR22
Input (I) R1 and R2			
Maximum operating input voltage	27.6 VDC		
Minimum input high voltage (VIH _{min}) ^{Note 1}	15 VDC	19.2 VDC	9.8 VDC

Safety relay	BSR10, BSR11	BSR23	SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42, TSR10, TSR20, TSR20M, USR10, USR22
Maximum input low voltage ($V_{IL_{max}}$) ^{Note 2}	1 VDC	2 VDC	6 VDC
Typical input impedance	550 Ω	1.5 k Ω	1.5 k Ω
Maximum current sink (I_{sink})	200 mA ^{Note 3}	70 mA	20 mA
Maximum OSSD pulse length	–	–	1.0 ms ^{Note 4}
Note 1: Voltage level above $V_{IH_{min}}$ is interpreted as logic "1", in worst case operating conditions.			
Note 2: Voltage level below $V_{IL_{max}}$ is interpreted as logic "0", in worst case operating conditions.			
Note 3: If $V_{IH} \geq 15$ VDC is applied to R1 and R2 (I_{sink} is typical 2.8/VDC _R).			
Note 4: Valid for 24 VDC safety relays only.			

10.8 Test/start/reset interface specification

Table 23: Test/start/reset interface specification

Safety relay	BSR10, BSR11	BSR23	SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42, TSR10, TSR20, TSR20M, USR10, USR22
Input (I) X1			
Minimum input high voltage ($V_{IH_{min}}$) ^{Note 1}	–	–	9.8 VDC
Maximum input low voltage ($V_{IL_{max}}$) ^{Note 2}	–	–	6 VDC
Typical input impedance	–	–	800 Ω
Input (I) X1/X2			
Applied voltage rating	Minimum	–	5 VDC
	Maximum	–	300 VDC
Input/Output (I/O) X4^{Note 3, Note 4}			
Output high voltage (VOH)	Minimum	–	15.8 VDC
	Maximum	–	25.6 VDC
Output low voltage (VOL)	Minimum	–	0 VDC
	Maximum	–	0.8 VDC
Minimum input high voltage ($V_{IH_{min}}$) ^{Note 1}	15 VDC	–	13.2 VDC
Maximum input low voltage ($V_{IL_{max}}$) ^{Note 2}	2 VDC	–	9.0 VDC
Typical input impedance	100 Ω	–	5 k Ω
Output current limit, short circuit protection	Minimum	–	64 mA
	Maximum	–	75 mA
Square wave signal frequency for automatic reset configuration/manual reset configuration	Minimum	–	98 Hz
	Maximum	–	102 Hz

Safety relay	BSR10, BSR11	BSR23	SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42, TSR10, TSR20, TSR20M, USR10, USR22
Maximum current sink (I_{sink})	200 mA	–	20 mA (Only valid for: SSR10M, SSR20M, TSR20M)
Note 1: Voltage level above $V_{\text{IH}_{\text{min}}}$ is interpreted as logic "1", in worst case operating conditions.			
Note 2: Voltage level below $V_{\text{IL}_{\text{max}}}$ is interpreted as logic "0", in worst case operating conditions.			
Note 3: X4 is only Input (I) for SSR10M SSR20M TSR20M.			
Note 4: X4 is Input/Output (I/O) for SSR10 SSR20 SSR32 SSR42 TSR10 TSR20 USR10 USR22.			

10.9 Connection block and wire properties

Table 24: Connection block and wire properties

Connection block		
Maximum screw torque	0.8 Nm	
Screwdriver bits	Slot size 3.5 mm	
Connection area		
Solid conductor	Minimum	1 x 24 AWG (0.2 mm ²), 2 x 24 AWG (0.2 mm ²)
	Maximum	1 x 12 AWG (3.31 mm ²), 2 x 16 AWG (1.31 mm ²)
Conductor with crimp sleeve	Minimum	1 x 24 AWG (0.2 mm ²), 2 x 24 AWG (0.2 mm ²)
	Maximum	1 x 12 AWG (3.31 mm ²), 2 x 16 AWG (1.31 mm ²)
Wire strip length	Minimum	6 mm
	Maximum	7 mm
Wire length	See Chapter Wire resistance .	

10.10 Wire resistance

Applicable to: SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42, TSR10, TSR20, TSR20M, USR10, USR22

Model used to determine the maximum allowed wire resistance between the transmitter port (T) and the receiver port (R). R_{ext} is the total wire resistance, and C_{ext} is the total wire capacitance (to ground, or shield). The switch symbolises the sensor, placed halfway in the T-R loop (as indicated by having half of $R_{\text{ext}}/C_{\text{ext}}$ on each side). I_{ext} is the current drawn by the sensor for its operation and/or other external loads. The maximum allowed wire resistance, R_{ext} , vs. the externally drawn current I_{ext} is listed in **Table 25**.

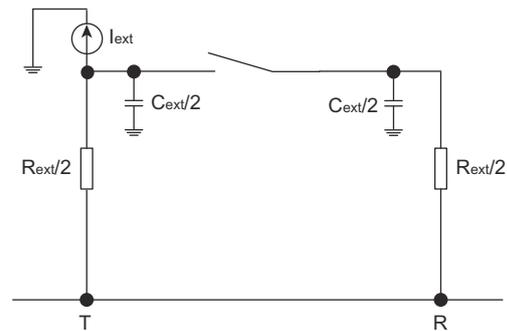


Figure 68: Safety device wire resistance balance

Table 25: Safety device wire resistance

The maximum wire length is the maximum wire resistance divided with the wire resistance per length of the unit.

R_{ext} is resistance for the complete wire.

I_{ext}	Maximum wire resistance R_{ext} (T–R)
0 mA	850 Ω

5 mA	600 Ω
10 mA	460 Ω
15 mA	370 Ω
20 mA	300 Ω
25 mA	260 Ω
30 mA	220 Ω

10.11 Timing

Table 26: Maximum response time and service lifetime

Safety relay		BSR10, BSR11	BSR23	SSR10, SSR10M, SSR20, SSR20M, SSR32, SSR42, TSR10, TSR20, TSR20M, USR10, USR22
Delay at power on		–	≤ 40 ms	≤ 1.5 s
Response time at activation	Start	≤ 40 ms	–	–
	Automatic reset ^{Note 1}	–	–	≤ 50 ms
	Manual reset ^{Note 1}	–	–	≤ 50 ms
Response time at deactivation		≤ 20 ms	≤ 20 ms	≤ 20 ms

Note 1: Additional 500 ms input acceptance delay for pressure sensitive device.

Table 27: Electrical operations lifetime

Safety relay		BSR10, BSR23	BSR11	SSR10, SSR10M, SSR20, SSR20M, TSR10, TSR20, TSR20M, USR10	SSR32, SSR42, USR22
Load $\Sigma I_{th}^2 \leq 64$	AC1, AC15	160 000 operations	–	160 000 operations	–
	DC1, DC13	100 000 operations	–	100 000 operations	–
Load $\Sigma I_{th}^2 \leq 36$	AC1, AC15	–	50 000 operations	–	–
	DC1, DC13	–	150 000 operations	–	–
Load $\Sigma I_{th}^2 \leq 13$	AC1, AC15	–	–	–	30 000 operations
	DC1, DC13	–	–	–	100 000 operations

Measurement conditions:

- Maximum breaking voltage for relay contacts: 250 V
- Maximum switching voltage for relay contacts: 400 V
- Rated current
- Switching frequency ≤ 0.1 Hz (Switching frequency > 0.1 Hz will shorten life.)
- T ≤ 55 °C
- No arc suppression (Usage of arc suppression will prolong life but may increase response time at deactivation.)
- 3 phase load in a star connection.

10.12 Mechanical data

Table 28: Mechanical data

Mechanical data		
Weight		190 – 230 g
Material	Housing	PA66 with 25 % fiberglass (UL94 V0)
	Connection block	PA66 (UL94 V0)
Color	Housing	Yellow plastic
	Connection block	Black
Mounting		35 mm DIN rail (DIN 50022)
Vibration and shock		N/A

10.13 Environmental data

Table 29: Environmental data

Safety relay		BSR10, BSR11, BSR23, SSR10M, SSR20M, TSR20M,	SSR10, SSR20, SSR32, SSR42, TSR10, TSR20, USR10, USR22
Pollution degree		II	
Protection class	Safety relay	IP20	
	Enclosure for installation	At least IP54 Lockable	
Ambient temperature range for operation within specified operation range		-10°C – +55°C	-10°C – +65°C
Ambient temperature range for storage		$-25^{\circ}\text{C} \leq T_a \leq +70^{\circ}\text{C}$	
Humidity range for operation		25 % ≤ Rh ≤ 90 %, no icing or condensation	
Humidity range for storage		25 % ≤ Rh ≤ 95 %, no icing or condensation	
Maximum temperature gradient		2°C/min	
Suitable for use at ≤ 2000 metres above sea level.			

For information about mounting distances see **Chapter Mounting to the DIN rail**.

10.14 Standard compliance and approvals

Table 30: Standard compliance and approvals

Standard compliance and approvals
European directive
2006/42/EC
Application standard compliance

Standard compliance and approvals

IEC 60947-5-1:2009

UL 60947-5-1:2014

CSA C22.2 No. 60947-5-1:2014

CSA B44.1

EN 574:1996+A1:2008 (type IIIC)

EN ISO 13856-1-3:2013

Functional safety standard compliance

IEC 61508-1-4:2010, up to SIL3

EN ISO 13849-1:2015, up to PLe/Cat.4

EN 62061:2005, up to SILCL3

EN 61511-1:2003

UL 61508

Electrical safety standard compliance

EN 50178-1:1997

EN 60204-1:2006

EN 60664-1:2007

Electromagnetic compatibility standard compliance

EN 61326-3-1:2008

EN ISO 13856-2:2013

Information for use in USA/Canada

Intended use

Applications according to NFPA 79

Power source

A suitable isolating source in conjunction with a fuse in accordance with UL248. The fuse shall be rated max. 4 A and be installed in the +24 VDC and 230Vac power supply to the device in order to limit the available current.

Approvals

CE

TÜV SUD

cULus

CCC

RCM

10

Table 31: Functional safety data

Standard	BSR10	BSR11, BSR23	SSR10, SSR10M, SSR20, SSR20M, TSR10, TSR20, TSR20M, USR10	SSR32, SSR42, USR22
IEC 61508	PFHd 3.0E-9	PFHd 4.1E-9	PFHd 4.9E-9	PFHd 3.9E-9
	PFD 5.2E-6	PFD 6.8E-6	PFD 7.4E-5	PFD 7.3E-5
EN ISO 13849-1, EN 62061	PFHd 3.0E-9	PDHd 4.1E-9	PFHd 4.9E-9	PFHd 3.9E-9
Mission time	20 years			

10.15 Declaration of Conformity



EC Declaration of conformity

(according to 2006/42/EC, Annex 2A)

We ABB AB
JOKAB Safety
Varlabergsvägen 11
SE-434 39 Kungsbacka
Sweden

declare that the safety components of ABB AB manufacture with type designations and safety functions as listed below, is in conformity with the Directives
2006/42/EC - Machinery
2014/30/EU - EMC
2011/65/EU - RoHS

Authorised to compile the technical file

ABB AB
JOKAB Safety
Varlabergsvägen 11
SE-434 39 Kungsbacka
Sweden

Product

Safety relay
Sentry
USR10, USR22,
SSR10M, SSR10, SSR20M,
SSR20, SSR32, SSR42,
TSR10, TSR20M, TSR20,
BSR10, BSR11, BSR23

EC type-examination certificate

M6A 17 05 49833

Notified Body

TÜV Süd Product Service GmbH
Ridlerstrasse 65
80339 München
Germany
Notified body No. 0123

Used harmonized standards

EN ISO 12100:2010, EN ISO 13849-1:2015,
EN 62061:2005+A2:2015, EN 60204-1:2006+A1:2009,
EN 60664-1:2007, EN 61000-6-2:2005, EN 61000-6-4:2007

Other used standards

EN 61508:2010

Tobias Gentzell
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Original

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