

SAFETY PRODUCTS

Safety relays

Sentry USR10

Product manual



Read and understand this document

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

Suitability for use

ABB 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. Third party certificates for the products are available at <https://new.abb.com/low-voltage/products/safety-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 PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Descriptions and examples show how the product works and can be used. It does not mean that it fulfills the requirements for all types of machines and processes. The buyer/user is responsible for installing and using the product according to applicable standards and regulations. We reserve the right to make changes to the product and the documentation without prior notice

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1 Introduction

1.1 Purpose of document

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

1.2 Intended audience

This document is intended for authorized personnel.

1.3 Reading prerequisites

It is assumed that the reader of this document has:

- Basic knowledge of ABB safety products.
- Knowledge of machine safety.
- Knowledge of safety devices.

1.4 Special notes

Pay attention to special notes in this document:



Warning!

Risk of severe personal injury!

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



Caution!

Risk of damage to the equipment!

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



Note!

Important or explanatory information.

2 Safety

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 inactivate the outputs within the system response time. The protective function of the safety device is only safe if the safety relay is correctly connected and configured. The safety relay is not by itself a complete protective device.

- Use the safety relay as a safety monitoring device.
- Use the safety relay as expansion device of safe outputs
- The safety relay is not intended for use in explosive or easily flammable adjacent air.
- Other use than defined as correct is considered as incorrect use.

2.2 Safety precautions



Warning!

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



Warning!

The safety functions must be tested at start up or at replacement before the system is put in operation.

Installation shall be conducted by authorized personnel following the Safety regulations, standards and local legal regulations. Carefully read through the entire original instruction before using the device.

Make sure that these instructions are included together with the documentation of the system. Make sure that these instructions always are available for users of the system.

The safety relay must be selected so its safety related capacity meets or exceed the performance level (PL) or safety integrity level (SIL) that has been estimated in the risk analysis. The safety relay must only be used after it has been selected according to related instructions, relevant standards, rules and regulations for protection and safety at work.

The entire dangerous zone must be visible from the position where the reset button is installed. The reset button must be positioned out of reach from the dangerous zone.

The safety functions must be tested after installation or replacement of components or cables. The safety relay must be exchanged within 20 years.

Failure to comply with instructions, operation that is not in accordance with the use prescribed in the instructions, improper installation or handling can affect the safety of people and the system. Failure to comply with the instructions or standards, excludes any liability.

3 Product description

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.
- 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:

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.

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.

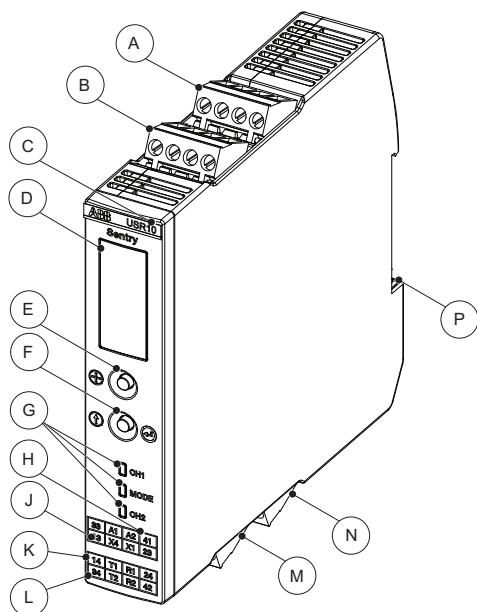
TSR (Timer function Safety Relay) group

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.

USR (Universal function Safety Relay) group

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

3.3 Safety relay overview



- A. Connection block, top side back.
- B. Connection block, top side front.
- C. Product name.
- D. Display.
- E. Increment button.
- F. Select button.
- G. LEDs for status indication.
- H. Print for connection block, top side back.
- J. Print for connection block, top side front.
- K. Print for connection block, bottom side front.
- L. Print for connection block, bottom side back.
- M. Connection block, bottom side front.
- N. Connection block, bottom side back.
- P. DIN rail latching device.

4 Installation

4.1 Installing precautions

Follow the instructions carefully to avoid personal injury or damage to the device.

The safety relay shall be attached on a 35 mm DIN rail in a lockable enclosure that has at least protection class IP54. Sentry safety relays shall be installed in an upright position.

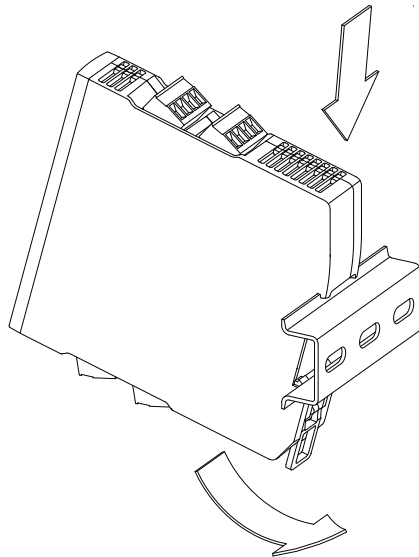
Make sure there is at least 10 mm distance between the safety relay and other non-Sentry units to prevent uncontrolled heating. Make sure there is at least 50 mm distance above and below the safety relay and other units for correct air flow in the venting holes of the safety relay.



Caution!

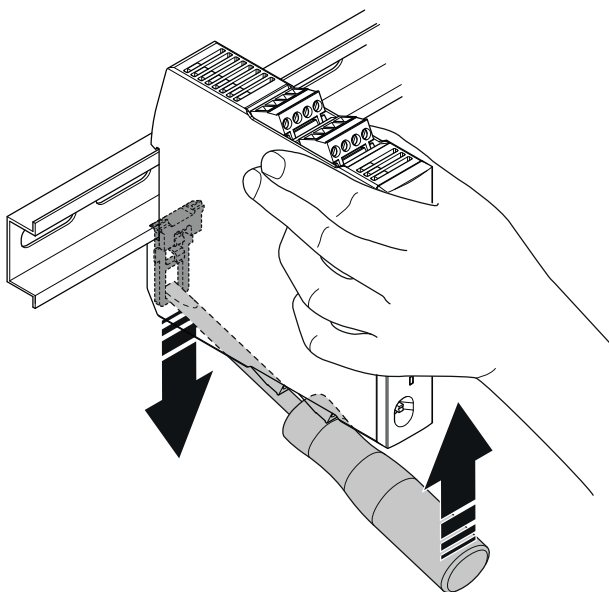
Sentry safety relays can be installed without distance to other Sentry safety relays, with exception of BSR23. Make sure there is at least 5 mm distance between BSR23 and other Sentry safety relays

4.2 Attaching the safety relay on the DIN rail



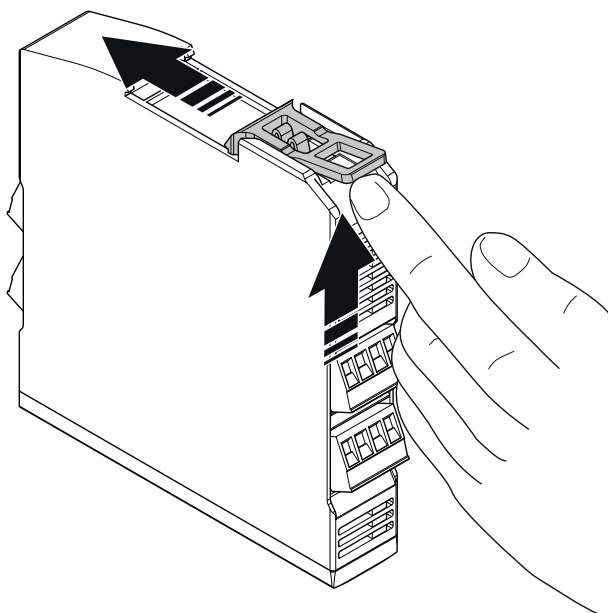
1. Make sure that the DIN rail latching is reset.
2. Hang the top rear side of the safety relay on the DIN rail.
3. Push the bottom rear side of the safety relay on the DIN rail until a click is heard.

4.3 Removing 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 a click is heard.
3. Lift the top rear side of the safety relay away from the DIN rail.

4.4 Resetting the latching device



- 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.

4.5 Connecting precautions



Warning!

Disconnect the power supply before attaching or removing the connection blocks.

Make sure that connection blocks and wires are clearly marked for correct connections. Use applicable requirements in IEC 60204-1 for wire connections. Make sure that the wires are fitted with crimp terminals or ferrules before connection, unless solid copper conductors are used.

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.

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

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

The safety requirement is that fuses shall be used on the relay outputs.

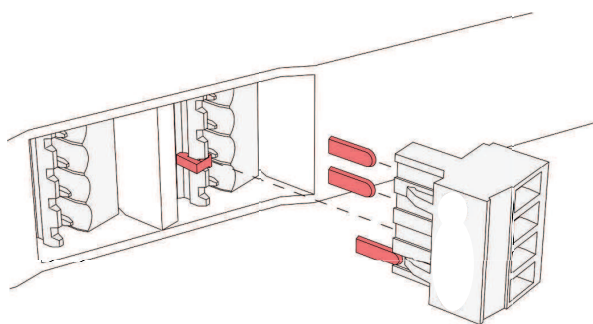
4.6 Connection blocks

The connection blocks on the safety relay are detachable to simplify installation and replacement. The safety relay can be ordered with two different types of connection blocks, screw compression type or push-in type.

4.7 Coding the connection blocks

The coding kit is used to make each connection point individual to avoid faulty connection. Place the coding parts in a specific order on the connection block and match these with the pin header.

- 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.



4.8 Connecting to a screw compression type terminal

Use a screwdriver with slot size 3,5 mm.

1. Open the terminal before inserting a wire.
2. Insert the wire in the correct terminal.
3. Close the terminal and secure the wire with torque 0,7 Nm \pm 0,1.

4.9 Connecting to a push-in type terminal

1. Press the actuating lever.
2. Insert the wire in the correct terminal.
3. Release the actuating lever.

4.10 Wire properties

Wire area, screw compression type connection block

Wire with crimp sleeve, ferrule or single solid conductor. Two wires with the same area must be used. Wire strip length 6,5 mm \pm 0,5.

Minimum 1x24 AWG and Maximum 1x12 AWG

Minimum 1x0,2 mm² and Maximum 1x3,3 mm²

Minimum 2x24 AWG and Maximum 2x16 AWG

Minimum 2x0,2 mm² and Maximum 2x1,5 mm²

Wire area, push-in type connection block

Wire with crimp sleeve, ferrule or single solid conductor. Two wires with the same area must be used. Wire strip length 6,5 mm \pm 0,5.

Minimum 1x24 AWG and Maximum 1x14 AWG

Minimum 1x0,2 mm² and Maximum 1x2,5 mm²

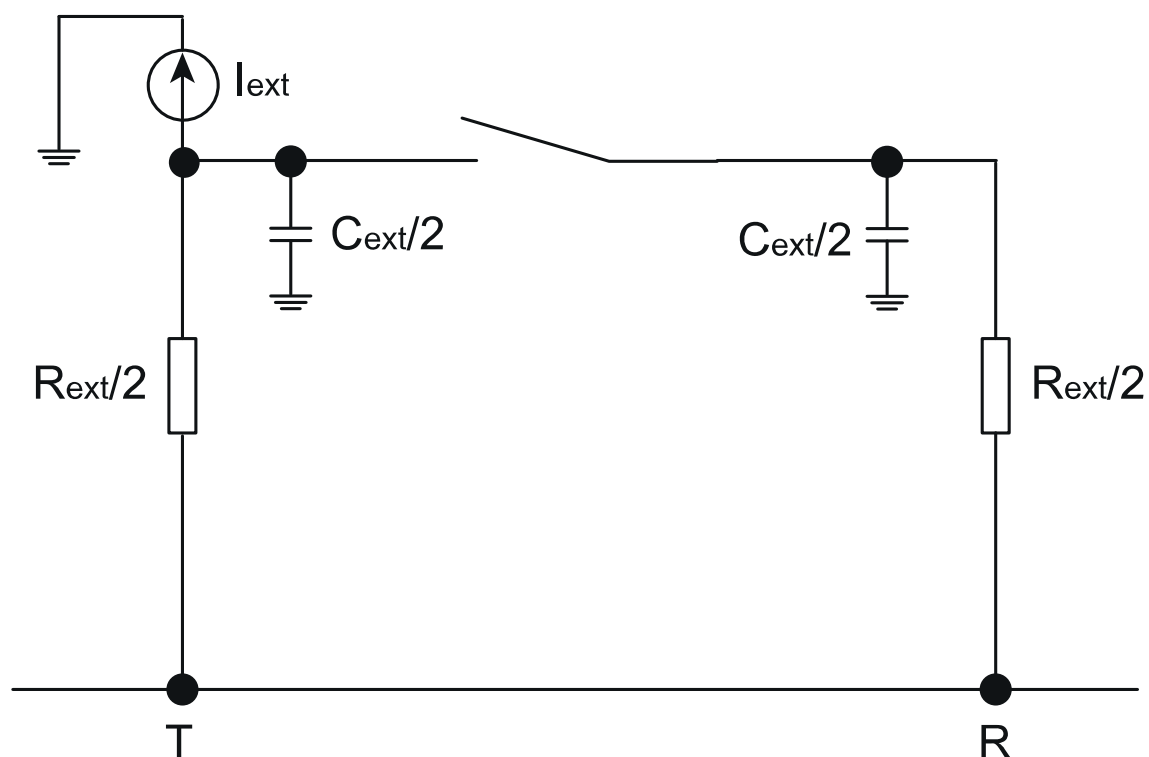
Minimum 2x24 AWG and Maximum 2x16 AWG

Minimum 2x0,25 mm² and Maximum 2x1,5 mm²

4.11 Wire length

The maximum wire length depends on the total resistance and total capacitance in the transmitter loop for each channel. The model used to determine the maximum allowed wire resistance and wire capacitance between the transmitter port (T) and the receiver port (R) is shown in the figure.

R_{ext} is the total wire resistance, and C_{ext} is the total wire capacitance (to ground, or shield). The switch symbolizes the sensor, placed halfway in the T-R loop (as indicated by having half of R_{ext}/C_{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 the table.



The maximal wire length is limited by the resistive loading to the maximum wire resistance divided with the wire resistance per length of the unit.

The maximal wire length is limited by capacitive loading to (100nF - external capacitive loading) divided with the wire capacitance per length of 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
30mA	220 Ω

5 Functions

5.1 Function overview

Power supply, 24 VDC

Relay output

- 3 NO + 1 NC

Safety device interface

- One channel connection
- Two channels with equivalent contacts
- Two channels with antivalent contacts
- Two channels OSSD
- Pressure sensitive device
- Two-hand device

Test, start and reset interface

- Automatic reset
- Manual reset
- Multi reset

Timer function

- Off-delay 0.5 s
- Off-delay 1.5 s
- Off-delay 0 – 999 s
- On-delay 0 – 999 s
- Time bypass 0 – 999 s
- Time reset 0 – 999 s

Features

- Display
- Error status code
- Password

5.2 Power supply

24 VDC

The safety relay and the safety devices are supplied with 24 VDC and common shared ground.

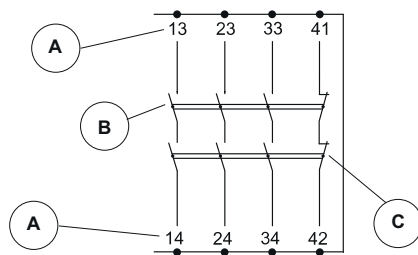


Warning!

The power supply must be of type PELV/SELV

5.3 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.



- A. **Connectors:** Terminals in connection blocks.
- B. **NO contact:** The NO contact is open when the relay is inactivated and closed when the relay is activated.
- C. **NC contact:** The NC contact is closed when the relay is inactivated and open 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. It is not a safe output.

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

Note! Arc suppression for inductive loads is recommended to get a longer lifetime for the relay contacts.

5.4 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.

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.

5.5 Test, start and reset interface

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

5.6 Automatic reset

When at least one input signal is not accepted, the safety relay enters inactivated 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 and the three LEDs will light green.

5.7 Manual reset



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).

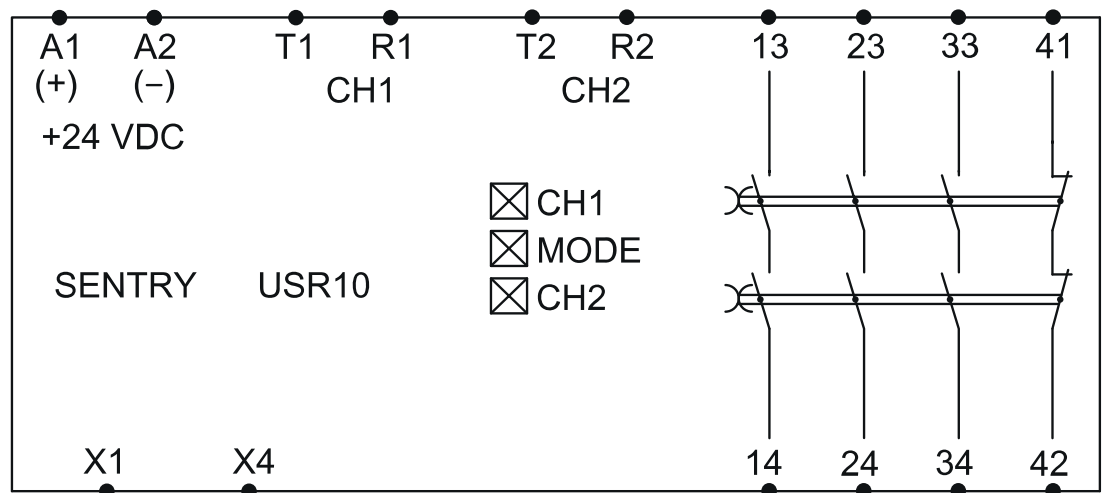
A reset button light test can be executed by pressing the reset button in active mode.

5.8 Multi-reset

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

6 Connections

6.1 Connection groups

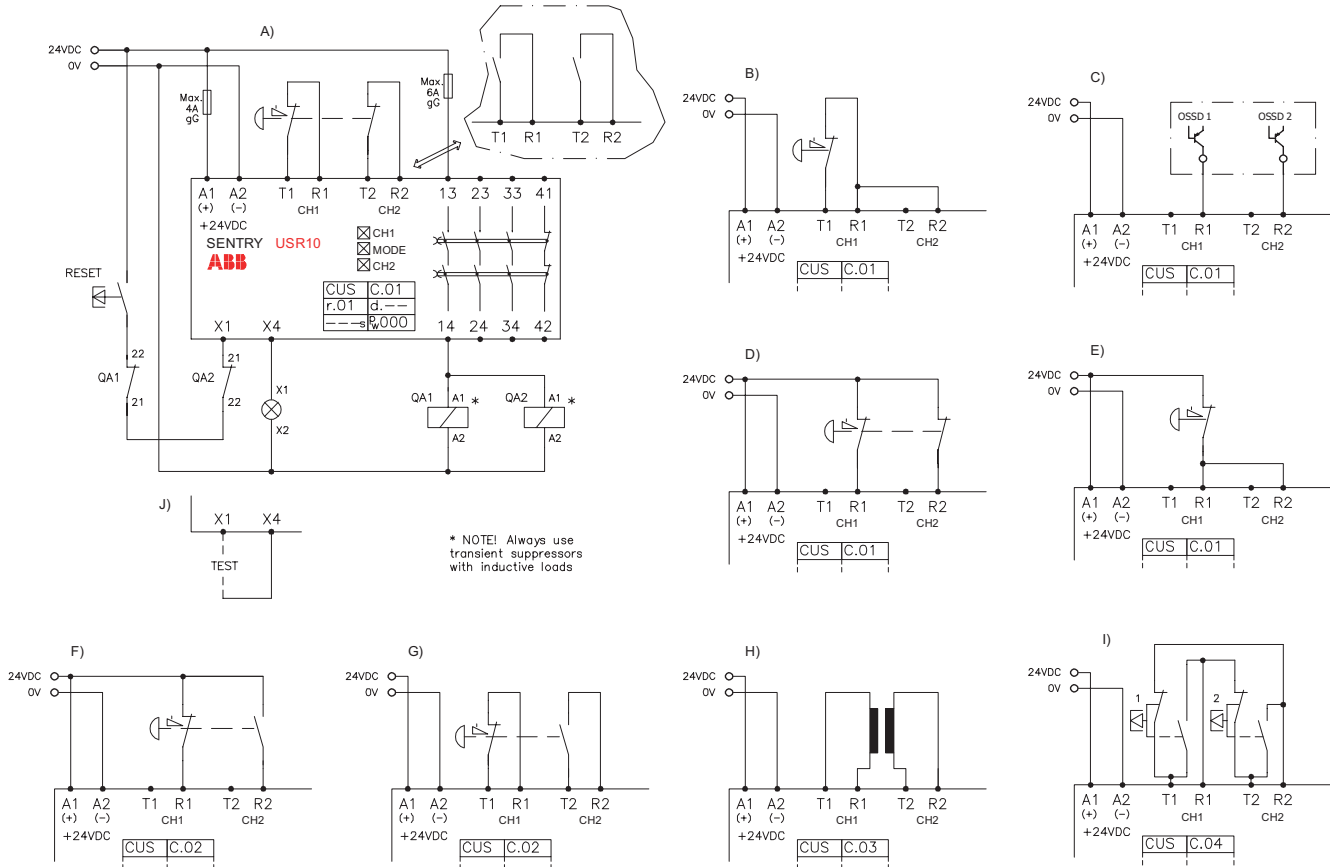


The connections are divided into groups.

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

7 Application connections

7.1 Connection examples



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

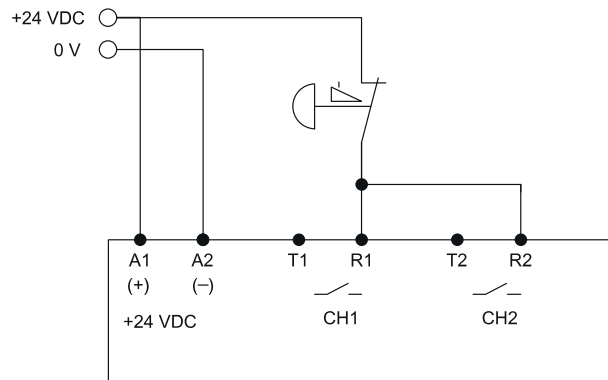
i Note!

Always use transient suppressors when inductive loads are connected to the relay outputs.

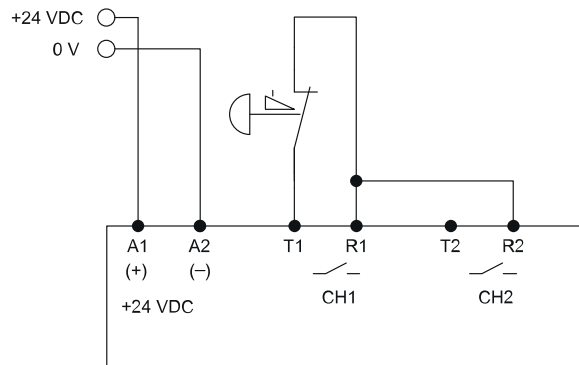
7.2 One channel connection

The safety device contact must be closed before the safety relay can be set in active mode. Opening of the safety device contact inactivates the safe outputs.

One channel connection, +24 VDC static signal



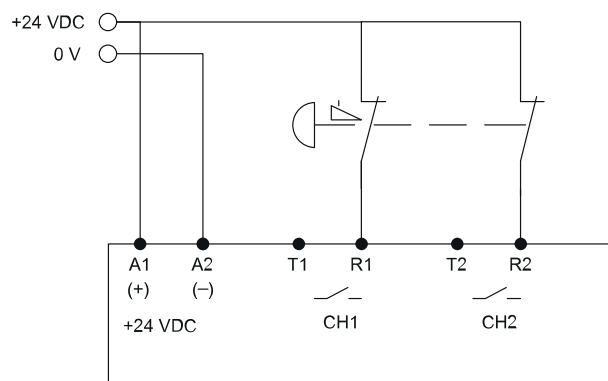
One channel connection from T1



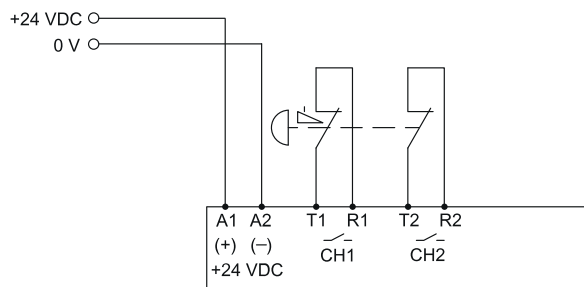
7.3 Two channels connection with equivalent contacts

Both contacts must be closed before the safety relay can be set in active mode. Opening one or both contacts inactivate the safe outputs. Both contacts must be opened and closed before the outputs can be activated. 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.

Two channels connection with equivalent contacts, +24 VDC static signal



Two channels connection with equivalent contacts from T1/T2

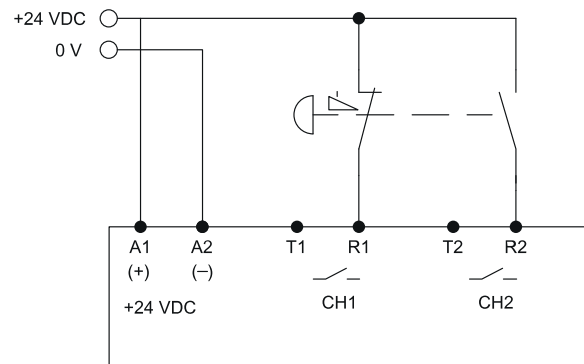


7.4 Two channels connection with antivalent contacts

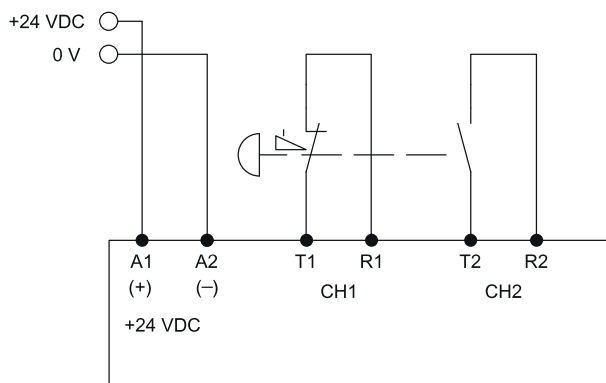
In the example the R1 contact must be closed and the R2 contact must be opened before the safety relay can be set in active mode. Switching one or both of the contacts inactivates the safety relay. If T1/T2 are used gives short circuit detection.

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

Two channels connection with antivalent contacts, +24 VDC static signal



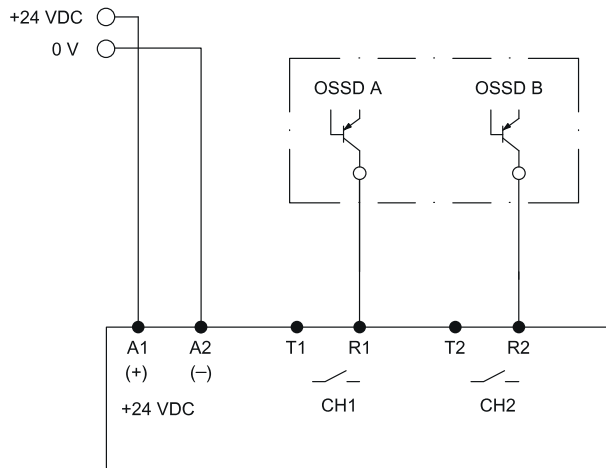
Two channels connection with antivalent contacts from T1/T2



7.5 Two channels OSSD connection

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

Two channels connection with OSSD external signals



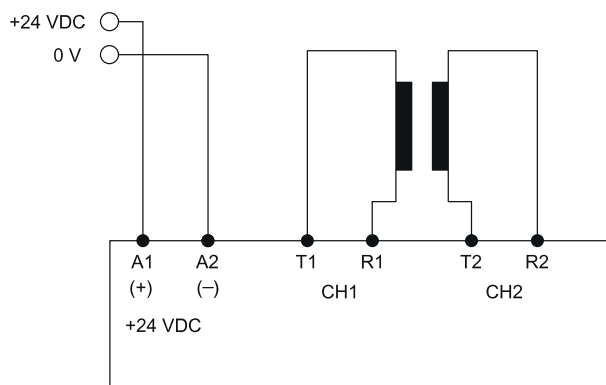
7.6 Pressure sensitive device connection

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 inactivate the safety relay output.

T1 and R1 shall be separated in different cables. T2 and R2 shall be separated in different cables

Pressure sensitive device connection with square wave signals

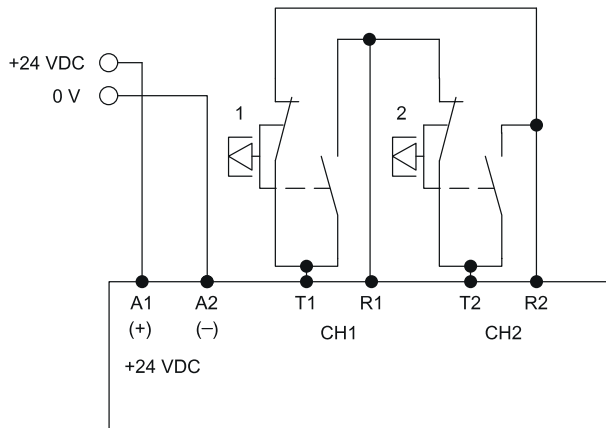


7.7 Two-hand device connection

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.

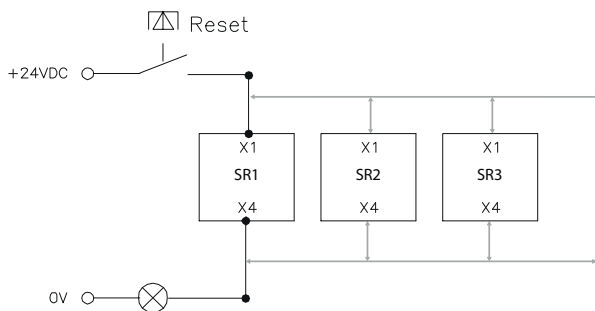
Two-hand safety device connection with square wave signal



7.8 Reset button connection example

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.

Connection example of reset button including indication light.



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.

8 Configuration

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

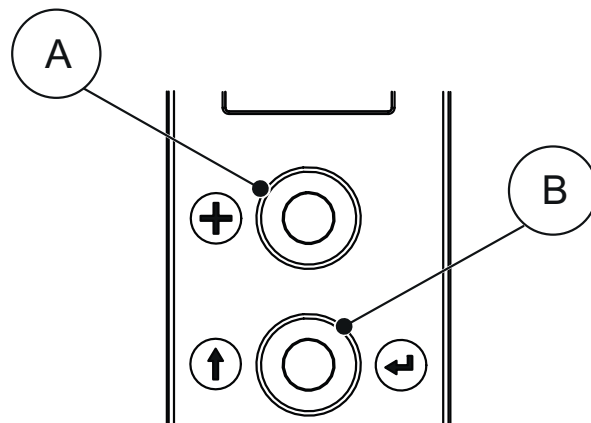
The safety relay must be in configuration mode in order to change the settings. To enter configuration mode, enter correct password or perform a factory reset. The factory preset password is 000. Navigate through available presets by pressing the increment button. The custom mode is available after the last preset choice.

i Note! A safety relay in preset mode does not have the password function.

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

8.1 Buttons

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



Increment button (A)

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.

Select button (B)

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.

8.2 Display

The display is placed in the upper part of the front panel. The display consists of three seven-segment digits. The display is used for navigation in the setting menus. Error codes are also shown on the display.

8.3 Password

A three-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.

8.4 Timer settings

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.

8.5 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 seconds.

8.6 Output groups

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

8.7 Preset

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

8.8 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.



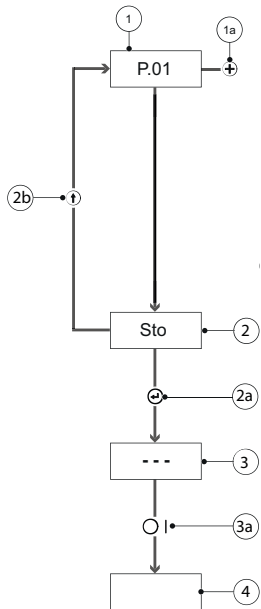
Note!

The wiring for automatic/manual reset has to be fulfilled to complete the reset functionality.

[P.OX]	Configuration	Signal type	Reset	Timer delay
P.01	Equivalent contacts	2 x NO, 24 VDC or signal from T1/T2	Manual reset	No-delay
P.02			Automatic reset	
P.03	Antivalent contacts	NO + NC, 24 VDC or signal from T1/T2	Manual reset	Automatic reset
P.04			Automatic reset	

[P.OX]	Configuration	Signal type	Reset	Timer delay
P.05	Pressure sensitive device	Square wave from T1/T2	Manual reset	No-delay
P.06			Automatic reset	
P.07	Two-hand device			

8.9 Configuration in preset mode



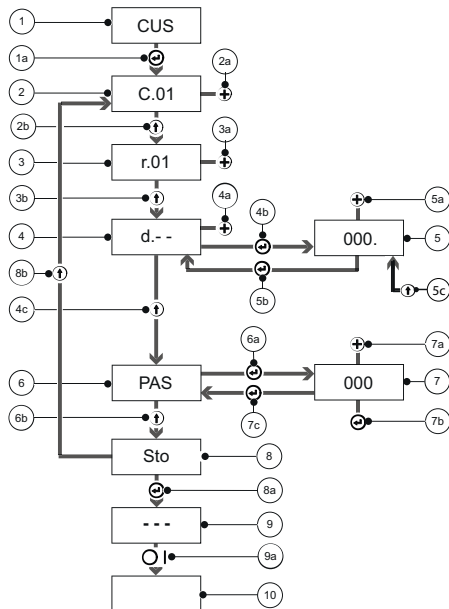
1. Preset mode.
 - a. Push the Increment button to select type of preset configuration or to select custom mode [CUS].
 - b. Push the Select button to step to the store mode [STO] .
2. Store mode.
 - a. Push and hold the Select button to store the configuration.
 - b. Push the Select button to return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

8.10 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 set manually in custom mode.

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

8.11 Configuration in custom mode



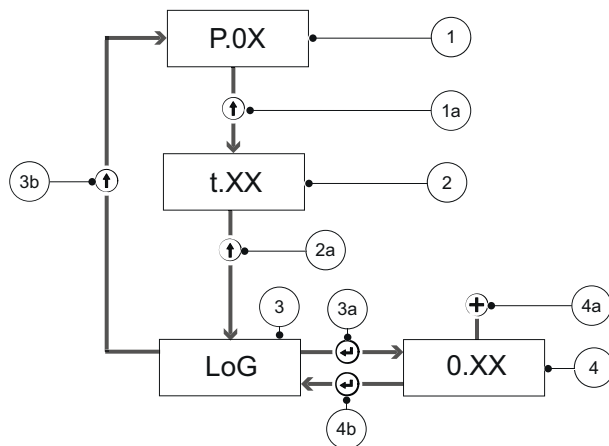
After a factory reset, the custom configuration mode is reached from the preset menu. Push the increment button several times until you see the blinking "CUS" text on the display. This entry is shown to indicate Custom mode.

Custom configuration mode can also be reached directly, by entering the correct password in custom operation mode.

1. Custom entry.
 - a. Push and hold 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].

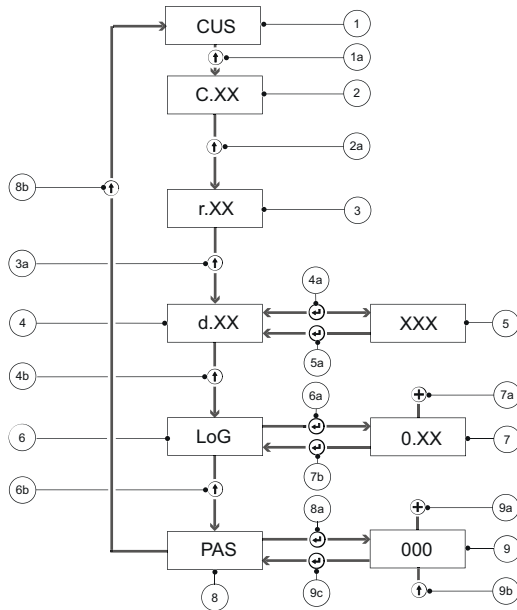
- b. Push and hold the select button to step to the Time setting.
 - c. Push the select button to step to the Password setting.
5. Time setting.
 - a. Push the increment button to select the Delay time.
 - b. Push and hold the select button to step to the Timer delay type setting.
 - c. Push the select button to step to the next segment.
6. Password setting is shown.
 - a. Push and hold the select button to step to Password entry.
 - b. Push the select button to step to the Store mode.
7. Password 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.
8. Store mode.
 - a. Push and hold the select button to store the settings.
 - b. Push the select button to return to Custom entry.
9. Fail safe mode waiting for power.
 - a. Power cycle the safety relay.
10. The safety relay is in operation mode with a custom configuration.

8.12 Operation mode with preset



1. Preset entry. This entry is shown to indicate the current preset mode.
 - a. Push the select button to step to the timer setting.
2. Timer setting.
 - a. Push the select button to step to the Log entry.
3. Log entry.
 - a. Push and hold the select button to enter the logged error codes.
 - b. Push the select button to step to the preset entry.
4. 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.

8.13 Operation mode with custom configuration

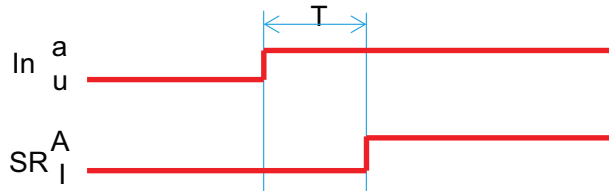


1. Custom entry. This entry is shown to indicate Custom mode. During countdown, the remaining time is displayed.
 - a. Push the select button to step to the Configuration setting.
2. Configuration setting.
 - a. Push the select button to step to the Reset setting.
3. Reset setting.
 - a. Push the select 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 and hold the select button to enter the Logged error codes.
 - b. Push the select button to step to the Password setting.
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 setting.
 - a. Push and hold the Select button to enter the new password.
 - b. Push the select button to step to the Custom entry.
9. Password entry.
 - a. Push the increment button to increment the flashing segment.
 - b. Push the select button to step to the next segment.

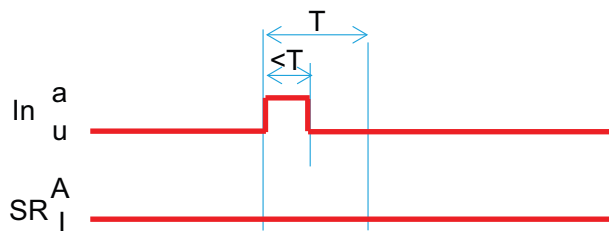
c. Push and hold the select button to verify the password. If the password is correct the safety relay will enter fail safe mode and the configuration can be updated. If the password is incorrect the display will show “Err” for a short while and return to the Password entry. See Configuration in custom mode for further action.

8.14 Delay functions

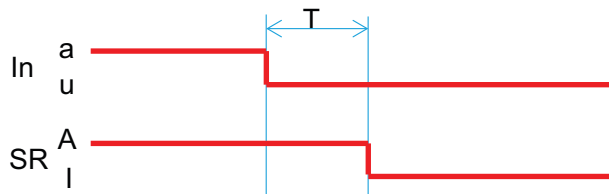
On-delay. When all safety input signals are accepted and a reset has been done, a countdown starts. After the set delay time the output activates.



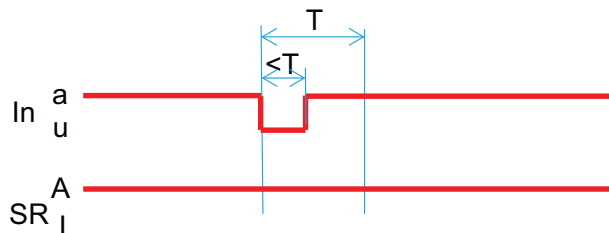
If at least one signal goes unaccepted within the set time, the output remains inactivated.



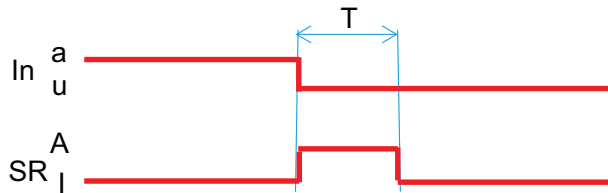
Off-delay. When at least one input signal becomes unaccepted, a countdown starts. After the set time, the output is inactivated.



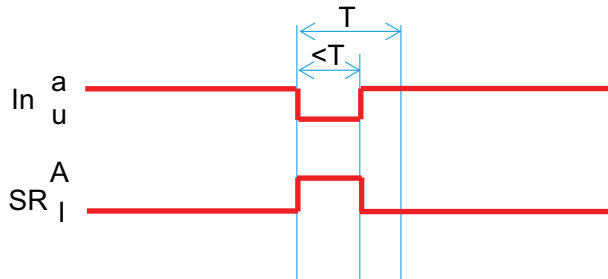
If the input condition becomes unaccepted and accepted again within the delay time period, the output will remain activated. Safety input signals go high within the delay time period.



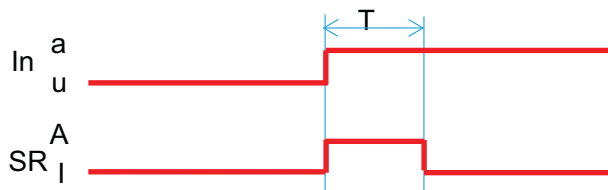
Timer reset. The output activates during a set time when the input conditions become unaccepted. At the same time a countdown starts. After the set delay time the output inactivates.



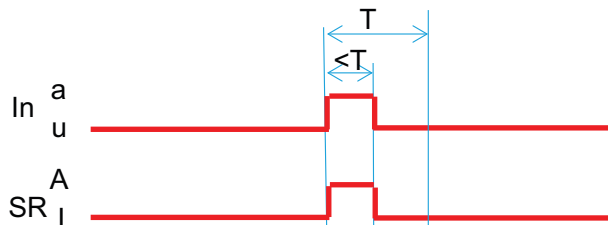
If the input conditions become accepted again within the set time, the output will be inactivated. Stopped timer reset function.



Timer 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 inactivated after the set time or if the input signals become unaccepted during the countdown.



If at least one input signal becomes unaccepted within the set time, the output will be inactivated. Timer bypass function when the input conditions become 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

9 Maintenance

9.1 Maintaining precautions



Warning!

Comply to maintenance precautions. Risk of severe personal injury.

A defective safety relay shall be replaced with a new. Never bypass the safety circuit. Repair and exchange of parts of the safety relay is forbidden. That may impair the safety of the system and could lead to serious personal injury. In case of breakdown or damage to the safety relay, contact nearest ABB Electrification service office or reseller.

ABB will not accept responsibility for failure of the functions if the installation and maintenance requirements shown in this document are not implemented. These requirements form part of the product warranty.

9.2 Scheduled test

Scheduled test, high demand application

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

Scheduled test, low demand application

All safety relays and connected safety devices used in low demand applications must be tested every third year.

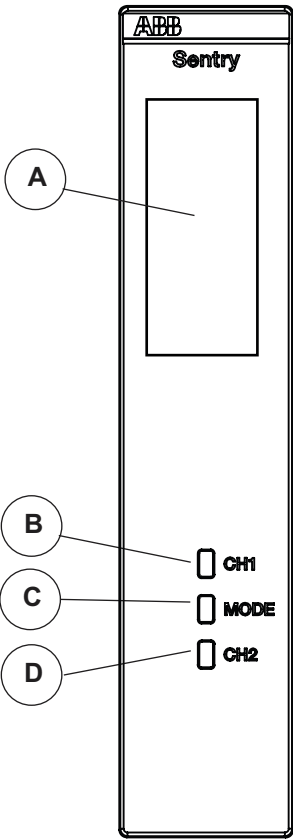
Test sequence

Test should be conducted according to:

1. Set inputs to inactivate outputs.
2. Wait until all outputs are in off-state.
3. Set inputs to activate outputs.
4. Monitor that outputs are activated.

10 Troubleshooting

10.1 Front LEDs and display



- A. Display
- B. **CH1** Safety input channel 1 status
- C. **MODE** Mode status
- D. **CH2** Safety input channel 2 status

10.2 LED operation indication and error status

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 done and outputs activated	
off	flash green	off	CH1 and CH2 unaccepted. A timer function is counting down while the safety relay remains activated	

CH1	Mode	CH2	Status	Action
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
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 inactivated	
off	flash blue	green	CH1 unaccepted and CH2 accepted, a timer function is counting down while remaining inactivated	

CH1	Mode	CH2	Status	Action
green	flash blue	off	CH1 accepted and CH2 unaccepted, a timer function is counting down while remaining inactivated	
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

10.3 Display codes

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

Error code	Error type	Procedure for correction
E.10 – E.14	Internal error	1. Power cycle the safety relay 2. If the error code remains, contact your ABB representative.
E.15	Relay hardware error	1. Power cycle the safety relay 2. If the error code remains, contact your ABB representative.
E.16	+24 V power error	Check the supply voltage
E.20 – E.26	Input/Output (I/O) error	1. Power cycle the safety relay 2. If the error code remains, contact your ABB representative.
E.30 – E.34	System error	1. Power cycle the safety relay 2. If the error code remains, contact your ABB representative.
E.50	Internal error	1. Power cycle the safety relay 2. If the error code remains, contact your ABB representative.

Error code	Error type	Procedure for correction
E.51	External error. Signal short on T1	Examine T1 for short circuits
E.52	External error. Signal short on T2	Examine T2 for short circuits
E.53 – E.58	Internal error	1. Power cycle the safety relay 2. If the error code remains, contact your ABB representative.

11 Model overview

11.1 Sentry models

The connection blocks are delivered without coding. The coding kit is an optional accessory and is ordered separately.

Model	Order code	Description
BSR10	2TLA010040R0000	Screw compression connection blocks. 24VDC
BSR10P	2TLA010040R0001	Push-in connection blocks. 24VDC
BSR11	2TLA010040R0200	Screw compression connection blocks. 24VDC
BSR11P	2TLA010040R0201	Push-in connection blocks. 24VDC
BSR23	2TLA010041R0600	Screw compression connection blocks. 24VDC
BSR23P	2TLA010041R0601	Push-in connection blocks. 24VDC
SSR10	2TLA010050R0000	Screw compression connection blocks. 24VDC
SSR10P	2TLA010050R0001	Push-in connection blocks. 24VDC
SSR10M	2TLA010050R0100	Screw compression connection blocks. 85-265VAC/120-375VDC
SSR10MP	2TLA010050R0101	Push-in connection blocks. 85-265VAC/120-375VDC
SSR20	2TLA010051R0000	Screw compression connection blocks. 24VDC
SSR20P	2TLA010051R0001	Push-in connection blocks. 24VDC
SSR20M	2TLA010051R0100	Screw compression connection blocks. 85-265VAC/120-375VDC
SSR20MP	2TLA010051R0101	Push-in connection blocks. 85-265VAC/120-375VDC
SSR32	2TLA010052R0400	Screw compression connection blocks. 24VDC
SSR32P	2TLA010052R0401	Push-in connection blocks. 24VDC
SSR42	2TLA010053R0400	Screw compression connection blocks. 24VDC
SSR42P	2TLA010053R0401	Push-in connection blocks. 24VDC
TSR10	2TLA010060R0000	Screw compression connection blocks. 24VDC
TSR10P	2TLA010060R0001	Push-in connection blocks. 24VDC

Model	Order code	Description
TSR20	2TLA010061R0000	Screw compression connection blocks. 24VDC
TSR20P	2TLA010061R0001	Push-in connection blocks. 24VDC
TSR20M	2TLA010061R0100	Screw compression connection blocks. 85-265VAC/120-375VDC
TSR20MP	2TLA010061R0101	Push-in connection blocks. 85-265VAC/120-375VDC
USR10	2TLA010070R0000	Screw compression connection blocks. 24VDC
USR10P	2TLA010070R0001	Push-in connection blocks. 24VDC
USR22	2TLA010070R0400	Screw compression connection blocks. 24VDC
USR22P	2TLA010070R0401	Push-in connection blocks. 24VDC

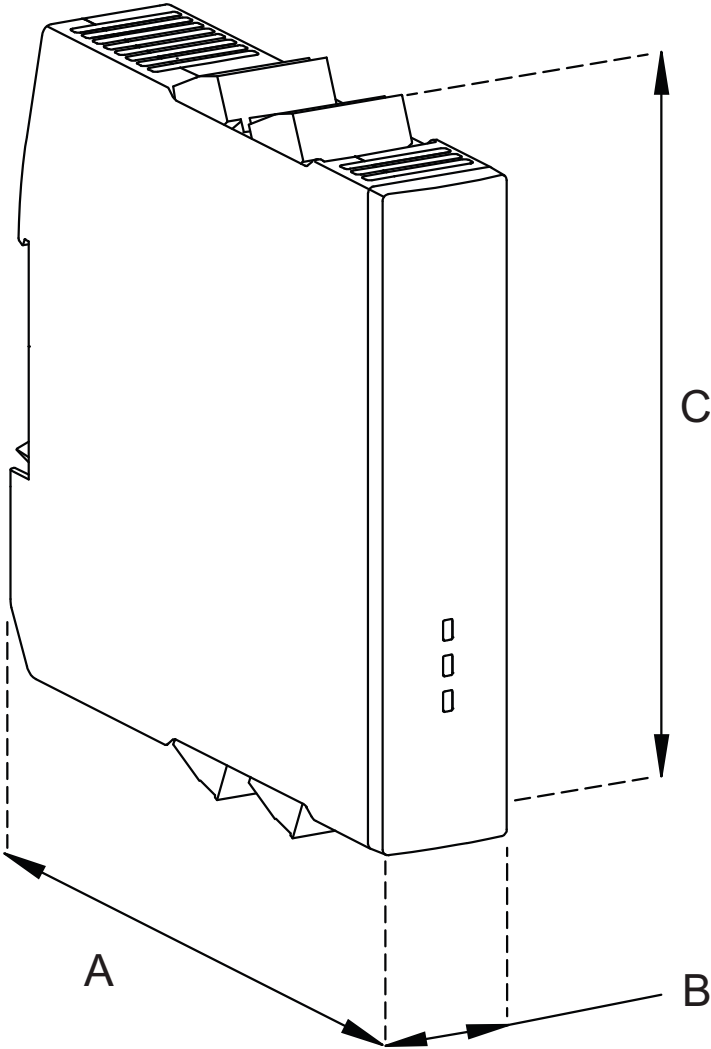
11.2 Accessories and spare parts

Type	Order code	Description
Connection block	2TLA010099R0000	Screw compression type
Connection block	2TLA010099R0001	Push-in type
Coding kit	2TLA010099R0100	For coding connection block

12 Dimensions

All dimensions are in mm.

12.1 Sentry



Measure	Connection block type	
	Screw connection type	Push-in type
A	120	120
B	22,5	22.5
C	120	123

13 Technical data

13.1 Technical data

Manufacturer

ABB Electrification Sweden AB
SE-721 61 Västerås
Sweden



Note!

While every effort has been taken to ensure the accuracy of the information contained in this document, ABB 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's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the ABB Warranty and Limitations of Liability.



Note!

There may be working points that will lead to higher performance for a specific application. An example would be the combination of installation distance between products, total load current and ambient temperature.



Caution!

The difference between absolute maximum rating and max operating rating is the following: The product will have full performance as long as all parameters are within operating rating, in any combination. If any of the values in Absolute maximum rating are exceeded, the relay must be disposed.

Absolute maximum rating

Maximum voltage rating for A1 and A2 ^{Note 2}	30 VDC
Maximum voltage rating for R ^{Note 2}	30 VDC
Maximum voltage rating for X1 ^{Note 2}	30 VDC
Maximum voltage rating for X4 ^{Note 2}	30 VDC
Maximum operating breaking voltage for relay contacts	500 Vp
Maximum voltage rating for NO/NC contacts	265 VAC or 350 VDC
Maximum current rating for 1 NO relay contact	8 A
Maximum current rating for 1 NC relay contact	5 A
Maximum load capacity, ΣI_{th}^2 ^{Note 1}	$\leq 72^2$

Note 1: ΣI_{th}^2 is the sum of the square for each relay output contact. For example: $I_1 = 2_{ARMS}$; $I_2 = 4_{ARMS}$; $I_3 = 5_{ARMS}$; $I_4 = 1_{ARMS} \rightarrow \Sigma I_{th}^2 = 4 + 16 + 25 + 1 = 46^2$

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

Power supply

Power supply type	PELV/SELV
Operating voltage	+24 VDC +15 %, -20 %
Terminal connection	A1 = +24 VDC and A2 = 0 VDC (GND)

Power supply	
Consumption	8 W
Internal consumption	5W
Required fuse	4 A gG external fuse is required (According to UL248: any (JDYX/7) Fast acting,Ratings 250V, 4A, IR200A)
Relay output specification	
Relay output configuration	3 NO + 1 NC
Maximum operating switching voltage ^{Note 1}	250 VAC
Overvoltage category	II
Rated impulse voltage	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
Rated isolation voltage	400 V


Note!

In a 400 V system a 3 phase load shall only be used in a star connection.

NO contact

AC load (AC15, AC1)	Rated operating voltage (Ue)	250 VAC
Rated operating current (Ie)	1 contact	5A
	2 contacts	5A
	3 contacts	4.6A
DC load (DC13, DC1)	Rated operating voltage (Ue)	+24 VDC
Rated operating current (Ie)	1 contact	6A
	2 contacts	5.6A
	3 contacts	4.6A
Required fuse	6.3 A gG, >=1 kA short circuit protection (6 A according to UL248)	

NC contact

AC load (AC15, AC1)	Rated operational voltage (Ue)	250 VAC
	Rated operational current (Ie)	0.5A
DC load (DC13, DC1)	Rated operational voltage (Ue)	+24 VDC
	Rated operational current (Ie)	2A
Required fuse	4 A gG (4 A according to UL 248)	

T1/T2 safety device interface specification
Output (O) T1 and T2

Output high voltage (VOH) ^{Note 1}	Minimum	15.8 VDC
	Maximum	25.6 VDC
		0.8 VDC
Maximum output low voltage (VOL _{max})		
Maximum output current ^{Note 2}		50 mA
Signal frequency		5 Hz ±1 Hz
Pulse length		500 µs ±100 µs
Square wave signal frequency		217 Hz ±3 Hz
Maximum capacitance to ground		100 nF

T1/T2 safety device interface specification		
Note 1: VOH typical = power supply voltage -2.8 VDC		
Note 2: Current limited internally to typical 70 mA		
R1/R2 safety device interface specification		
Input (I) R1 and R2		
Maximum operating input voltage		27.6 VDC
Minimum input high voltage (VIH _{min}) ^{Note 1}		9.8 VDC
Maximum input low voltage (VIL _{max}) ^{Note 2}		6 VDC
Typical input impedance		1.5 kΩ
Maximum current sink (I _{sink}) ^{Note 3}		20 mA
Maximum OSSD pulse length		1.0 ms
Note 1: Voltage level above VIH _{min} is interpreted as logic “1”, in worst case operating conditions.		
Note 2: Voltage level below VIL _{max} is interpreted as logic “0”, in worst case operating conditions.		
Note 3: If VIH ≥15 VDC is applied to R1 and R2 (Isink is typical 2.8/VDCR).		
Test/start/reset interface specification		
Input (I) X1		
Minimum input high voltage (VIH _{min}) ^{Note 1}	9.8 VDC	
Maximum input low voltage (VIL _{max}) ^{Note 2}	6 VDC	
Typical input impedance	800 Ω	
Input/Output (I/O) X4		
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 (VIHmin) ^{Note 1}		13.2 VDC
Maximum input low voltage (VILmax) ^{Note 2}		9.0 VDC
Typical input impedance		5 kΩ
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
Maximum current sink (I _{sink})		20 mA
Note 1: Voltage level above VIH _{min} is interpreted as logic “1”, in worst case operating conditions.		
Note 2: Voltage level below VIL _{max} is interpreted as logic “0”, in worst case operating conditions.		
Response time		
Delay at power on		≤ 1.5 s
Response time at activation	Automatic reset ^{Note 1}	≤ 50 ms
	Manual reset ^{Note 1}	≤ 50 ms
Response time at inactivation		≤ 20 ms

Response time		
Note 1: Additional 500 ms input acceptance delay for pressure sensitive device		
Electrical operations lifetime		
Load $\Sigma I_{th}^2 \leq 64$	AC1, AC15	160 000 operations
	DC1, DC13	100 000 operations
Measurement conditions:		
<ul style="list-style-type: none"> • 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.) • $T \leq 55^\circ\text{C}$ • No arc suppression (Usage of arc suppression will prolong life but may increase response time at inactivation.) • 3 phase load in a star connection. 		
Mechanical data		
Weight		190 – 230 g
Material	Housing	PA66 with 25 % fiberglass (UL94 V0)
	Connection block, screw compression type	PA66 (UL94 V0)
	Connection block, push-in type	PA66 with 25 % fiberglass (UL94 V0)
	Opener, push-in type	PBT/GF (UL94 V0)
Color	Housing	Yellow
	Connection block, screw compression type	Black
	Connection block, push-in type	Black
	Opener, push-in type	Orange
Attachment requirements		35 mm DIN rail (DIN 50022)
Environmental data		
Pollution degree		II
Protection class	Safety relay	IP20
	Enclosure for installation	At least IP54. Lockable.
Ambient temperature range for operation within specified operation range		$-25^\circ\text{C} - +65^\circ\text{C}$
Ambient temperature range for storage		$-40^\circ\text{C} \leq T_a \leq +70^\circ\text{C}$
Humidity range for operation		$10\% \leq Rh \leq 90\%$, no icing, occasional condensation
Humidity range for storage		$10\% \leq Rh \leq 95\%$, no icing, occasional condensation
Maximum temperature gradient		$2^\circ\text{C}/\text{min}$
Altitude		Suitable for use at ≤ 2000 meters above sea level
Vibration		10-55 Hz sine, 0.35 mm (1 oct/ min 20 sweep cycles, all directions)

Environmental data	
Shock	5g, 11 ms Half sine +/- 100 Shocks
EU Directive Compliance	
Directives	European Machinery Directive 2006/42/EC EMC Directive 2014/30/EU RoHS Directive 2011/65/EU RoHS3 Directive 2015/863
UK Regulations Compliance	
Regulations	2008 No.1597 Supply of Machinery (Safety) Regulations (MD) 2012 No.3032 Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations (RoHS) 2016 No.1091 Electromagnetic Compatibility Regulations (EMC)
US/CA Compliance	
Application standard compliance	UL 60947-5-1:2014 CSA C22.2 No. 60947-5-1:2014 CSA B44.1
Standard compliance and approvals	
Application standard compliance	EN ISO 13851:2019 EN ISO 13856-1:2013 EN ISO 13856-2:2013 EN ISO 13856-3:2013
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 60204-1:2018 EN 60664-1:2007 IEC 60947-5-1:2009
Electromagnetic compatibility standard compliance	EN 61326-3-1:2008
Approvals	
CE	
TÜV SÜD	
cULus	
CCC	
RCM	
S	
KC	

Approvals	
UKCA	
Standard	
IEC 61508	PFH _D 4.9E-9 and PFD 7.4E-5 (see chapter 8.2 Scheduled test)
EN ISO 13849-1, EN 62061	PFH _D 4.9E-9
Mission time	20 years
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 any (JDYX/7) fast acting, ratings 250V, 4 A, IR200A, and be installed in the +24 VDC and 230VAC power supply to the device in order to limit the available current.

14 Declaration of conformity



EC Declaration of conformity

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

We ABB Electrification Sweden AB
SE-721 61 Västerås
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
2015/863 – RoHS3

Authorised to compile the technical
file

ABB Electrification Sweden AB
SE-721 61 Västerås
Sweden

Product

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

EC type-examination certificate

M6A 049833 0032 Rev.00

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

Magnus Backman
R&D Manager
Kungsbacka 2021-11-02

abb.com/lowvoltage

Original



Declaration of conformity

(according to 2008 No 1597)

We	ABB Electrification Sweden AB SE-721 61 Västerås Sweden	declare that the safety components of ABB AB manufacture with type designations and safety functions as listed below, is in conformity with UK Statutory Instruments (and their amendments) 2008 No 1597 – Supply of Machinery (Safety) Regulations (MD) 2016 No. 1091 – Electromagnetic Compatibility Regulations (EMC) 2012 No 3032 – Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations (RoHS)
Authorised to compile the technical file	ABB Ltd. Tower Court Coventry CV6 5NX United Kingdom	

Product

Safety relay Sentry

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

Used designated 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
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Other used standards	EN 61508:2010
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Magnus Backman
R&D Manager
Västerås 2021-03-28

<https://new.abb.com/low-voltage/products/safety-products>

Original



ABB Electrification Sweden AB
SE-721 61 Västerås
Sweden

