OPERATING INSTRUCTIONS

safeRS3

9 meter sensors

Safe Radar System

SICK
Sensor Intelligence.

Described product

safeRS3

Distributor

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Manufacturer

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Legal information

Original document

This document is an original document of SICK AG.

CE

Contents

1 Glossary of terms

Activated output (ON-state)	Output that switches from OFF to ON-state.
Angular coverage	Property of the field of view that corresponds to the coverage on the horizontal plane.
Dangerous area	Area to be monitored because it is dangerous for people.
Deactivated output (OFF-state)	Output that switches from ON to OFF-state.
Detection distance x	Depth of the field of view configured for protective field x.
Detection signal x	Output signal that describes the monitoring status of the protective field x.
ESPE (Electro-Sensitive Protective Equipment)	Device or system of devices used for the safety-related detection of people or parts of the body. ESPEs provide personal protection at machines and plants/systems where there is a risk of physical injury. These devices/systems cause the machine or plant/system to switch over to a safe status before a person is exposed to a dangerous situation.
Field of view	Sensor area of vision characterized by a specific angular coverage.
Fieldset	Structure of the field of view which can be composed of up to four protective fields.
FMCW	Frequency Modulated Continuous Wave
Inclination	Sensor rotation around the x-axis. The sensor inclination is the angle between a line perpendicular to the sensor and a line parallel to the ground.
Machinery	The system for which the dangerous area is monitored.
Monitored area	Area that is monitored by safeRS3. It is composed of all the fields of all the sensors.
Detection field x	Portion of the field of view of the sensor. Detection field 1 is the field closer to the sensor.
OSSD	Output Signal Switching Device
RCS	Radar Cross-Section. Measure of how detectable an object is by radar. It depends, among other factors, on the material, dimension and position of the object.
Tolerance area	Area of the field of view where detection or not of a moving object/person depends on the characteristics of the same object itself.

2 This manual

2.1 Information on this manual

2.1.1 Objectives of this instruction manual

This manual explains how to integrate safeRS3 with 9 meter sensors to safeguard the machinery operators and how to install, use and maintain them safely.

This document includes all the information as Safety Manual according to IEC 61508-2/3 Annex D. Please refer in particular to Safety parameters on page 125 and to System software on page 156.

The functioning and safety of the machinery to which safeRS3 is connected is out of the scope of this document.

2.1.2 Obligations with regard to this manual

NOTICE

This manual is an integral part of the product and must be kept for its entire working life.

It must be consulted for all situations related to the life cycle of the product, from its delivery to decommissioning.

It must be stored so that it is accessible to operators, in a clean location and in good condition.

In the event of manual loss or damage, contact Technical Support.

Always make the manual available for consultation when the equipment is sold.

2.1.3 Provided documentation

Document	Code	Date	Distribution format
Operating instructions - 9 meter sensors (this manual)	8029009_operating_instructions_ safeRS3-9m_en_2023-12-30	2023-12-30	online PDF PDF downloadable from the site www.sick.com
Operating instructions - 5 meter sensors	8027489_1MLZ_operating_ instructions_safeRS3_en_2023-12-30	2023-12-30	online PDF PDF downloadable from the site www.sick.com
safeRS3 PROFIsafe communication Technical Information	8027614_1LU8_technical_ information_safeRS3 PROFIsafe communication_en_2023-10-15	2023-10-15	online PDF PDF downloadable from the site www.sick.com
safeRS3 Modbus communication Technical Information	8027611_1LU8_technical_ information_safeRS3 Modbus communication_en_2023-10-15	2023-10-15	online PDF PDF downloadable from the site www.sick.com

Document	Code	Date	Distribution format
safeRS3 FSoE communication Technical Information	8029069_technical_information_ safeRS3 FSoE communication_en	2023-10-15	online PDF PDF downloadable from the site www.sick.com
RCS Reader Tool instructions	8029009_technical_information_RCS Reader Tool_en	2022-09-30	online PDF PDF downloadable from the site www.sick.com

2.1.4 Intended users of this instruction manual

The recipients of the instruction manual are:

- the machinery manufacturer onto which the system will be installed
- system installer
- machinery maintenance technician

3 Safety

3.1 Safety information

3.1.1 Safety messages

Warnings related to the safety of the user and of the equipment as envisaged in this document are as follows:

WARNING
Indicates a hazardous situation which, if not avoided, may cause death or serious injury.

NOTICE
Indicates obligations that if not observed may cause harm to the equipment.

3.1.2 Safety symbols on the product

This symbol marked on the product indicates that the manual must be consulted. In particular, pay attention to the following activities:

- wiring of the connections (see Terminal blocks and connector pin-outs on page 131 and Electrical connections on page 133)
- cable operating temperature (see Terminal blocks and connector pin-outs on page 131)
- control cover, which was subjected to a low energy impact test (see Technical data on page 125)

3.1.3 Personnel skills

The recipients of this manual and the skills required for each activity presented herein are as follows:

Recipient	Assignments	Skills
Machinery manufacturer	• defines which protective devices should be installed and sets the installation specifications	• knowledge of significant hazards of the machinery that must be reduced based on risk assessment • knowledge of the entire machinery safety system and the system on which it is installed
Protection system installer	• installs the system • configures the system • prints configuration reports	• advanced technical knowledge in the electrical and industrial safety fields • knowledge of the dimensions of the dangerous area of the machinery to be monitored • receives instructions from the machinery manufacturer
Machinery maintenance technician	• performs maintenance on the system	• advanced technical knowledge in the electrical and industrial safety fields

3.1.4 Safety assessment

Before using a device, a safety assessment in accordance with the Machinery Directive is required.

The product as an individual component fulfills the functional safety requirements in accordance with the standards stated in Standards and Directives on page 19. However, this does not guarantee the functional safety of the overall plant/machine. To achieve the relevant safety level of the overall plant/machine's required safety functions, each safety function needs to be considered separately.

3.1.5 Intended use

safeRS3 is a human body detection system, certified SIL 2 according to IEC/EN 62061, PL d according to EN ISO 13849-1 and Performance Class D according to IEC TS 62998-1.

It performs the following safety functions:

- **Access detection function**:

WARNING
These safety-related functions work in exclusive mode: with the activation of the Custom target detection, the detection of a human body is no longer guaranteed.

  - access of one or more persons to a hazardous area deactivates the safety outputs to stop the moving parts of the machinery (Human detection), or
  - access of one or more targets with an RCS higher than a set threshold to a hazardous area deactivates the safety outputs to stop the moving parts of the machinery (Custom target detection)
- **Restart prevention function**: prevents unexpected starting or restarting of the machinery. Detection of motion within the dangerous area maintains the safety outputs deactivated to prevent machinery starting.

It performs the following additional safety-related functions:

- **Stop signal** (Category 3, according to EN ISO 13849-1): it forces all the safety outputs to OFF-state. Only on safeRS3 Control PROFINET and safeRS3 Control EC, it signals a stop request status with a specific safety message on the Fieldbus output interface.
- **Restart signal**: it enables the control to switch to ON-state the safety outputs related to all the protective fields with no motion detected. Only on safeRS3 Control PROFINET and safeRS3 Control EC, it makes disappear a stop request status with a specific safety message on the Fieldbus output interface. It can be performed:
  - using single channel inputs/OSSDs (Category 2, according to EN ISO 13849-1)
  - using dual channel inputs/OSSDs (Category 3, according to EN ISO 13849-1)
- **Muting** (Category 3, according to EN ISO 13849-1): it inhibits the detection capability of one or a group of sensors (see Muting on page 60).
- **Dynamic configuration switch** (Category 3, according to EN ISO 13849-1): it allows the dynamic switch among previously set configurations (see System configuration on page 43).
- **Fieldbus controlled**: it monitors the input status through Fieldbus communication. It can be performed:

- using single channel inputs/OSSDs (Category 2, according to EN ISO 13849-1): it provides the capability to safely redirect the value of the input data exchanged with the Fieldbus master to a physical status of the OSSDs.
- using dual channel inputs/OSSDs (Category 3, according to EN ISO 13849-1): it provides the capability to safely redirect the status of the digital inputs to the output data exchanged with the Fieldbus master.

WARNING
The following faults makes the Fieldbus controlled safety-related function unavailable: POWER ERROR, TEMPERATURE ERROR, FIELDBUS ERROR, PERIPHERAL ERROR, FEE ERROR and FLASH ERROR.

WARNING
Only for Stop signal, Restart signal, Muting and Dynamic configuration switch. Any fault on the sensors or the control brings the system to the safe state and makes the safety-related functions unavailable.

safeRS3 is suitable for protecting the human body in the following scenarios:

- dangerous area protection in stationary and mobile applications
- indoor and outdoor applications

safeRS3 meets requirements of applications safety functions that require a risk reduction level of:

- up to SIL 2, HFT = 0 according to IEC/EN 62061
- up to PL d, Category 3 according to EN ISO 13849-1
- up to Performance Class D according to IEC TS 62998-1

safeRS3, in combination with additional risk reduction means, can be used for applications safety functions that require higher risk reduction levels.

3.1.6 Improper use

The following is deemed improper use in particular:

- any component, technical or electrical modification to the product
- use of the product outside the areas described in this document
- use of the product outside the technical details, see Technical data on page 125

3.1.7 EMC-compliant electrical installation

NOTICE
The product is designed for use in an industrial environment. The product may cause interference if installed in other environments. If installed in other environments, measures should be taken to comply with the applicable standards and directives for the respective installation site with regard to interference.

3.1.8 General warnings

- Incorrect installation and configuration of the system decreases or inhibits the protective function of the system. Follow the instructions provided in this manual for correct installation, configuration and validation of the system.
- Changes to the system configuration may compromise the protective function of the system. After any changes made to the configuration, validate correct functioning of

the system by following the instructions provided in this manual.
- If the system configuration allows access to the dangerous area without detection, implement additional safety measures (e.g., guards).
- The presence of static objects, in particular metallic objects, within the field of view may limit the efficiency of sensor detection. Keep the sensor field of view unobstructed.
- The system protection level (SIL 2, PL d) must be compatible with the requirements set forth in the risk assessment.
- Check that the temperature of the areas where the system is stored and installed is compatible with the storage and operating temperatures indicated in the technical data of this manual.
- Radiation from this device does not interfere with pacemakers or other medical devices.

3.1.9 Warnings for the restart prevention function

- The restart prevention function is not guaranteed in blind spots. If required by the risk assessment, implement adequate safety measures in those areas.
- Machinery restarting must be enabled only in safe conditions. The button for the restart signal must be installed:
  - outside of the dangerous area
  - not accessible from the dangerous area
  - in a point where the dangerous area is fully visible

3.1.10 Responsibility

The machinery manufacturer and system installer are responsible for the operations listed below:

- Providing adequate integration of the safety output signals of the system.
- Checking the monitored area of the system and validating it based on the needs of the application and risk assessment.
- Following the instructions provided in this manual.

3.1.11 Limits

- If the static object detection option is disabled, the system cannot detect the presence of people who are immobile and not breathing or objects within the dangerous area.
- The system does not offer protection from pieces ejected from the machinery, from radiation, and objects falling from above.
- The machinery command must be electronically controlled.

3.1.12 Disposal

In safety-related applications, comply with the mission time reported in General specifications on page 125.

For decommissioning follow the instructions reported in Disposal on page 157.

3.2 Conformity

3.2.1 Standards and Directives

Directives	2006/42/EC (MD - Machinery) 2014/53/EU (RED - Radio equipment)
Harmonized standards	EN ISO 13849-1: 2015 PL d EN ISO 13849-2: 2012 IEC/EN 62061: 2021 ETSI EN 305 550-2 V1.2.1 IEC/EN 61010-1: 2010, A1:2019 ETSI EN 301 489-1 v2.2.3 (only emissions) ETSI EN 301 489-3 v2.1.1 (only emissions) IEC/EN 61000-6-2:2019 IEC/EN 62061: 2005, A1:2013, A2:2015, AC:2010 SIL 2
Non-harmonized standards	IEC/EN 61326-3-1:2017 IEC/EN 61496-1: 2013 (section 5.4.2 and 5.4.4), AC:2015 IEC/EN 61496-1: 2020 (section 5.4.2 and 5.4.4) IEC/EN 61508: 2010 Part 1-7 SIL 2 ETSI EN 305 550-1 V1.2.1 IEC TS 62998-1:2019 UL 61010-1 [1)] CAN/CSA 61010-1 [1)] UL 61496-1 [1)] CRD of IEC 61496-3 [1)] IEC/EN 61784-3-3:2016 for the PROFIsafe Fieldbus IEC/EN 61784-3-12:2010, A1:2019 for FSoE Fieldbus

Note: no type of failure has been excluded during the system analysis and design phase.

All updated certifications can be downloaded from www.sick.com.

3.2.2 CE

The manufacturer, Inxpect SpA, states that safeRS3 Safe Radar System complies with the 2014/53/EU and 2006/42/EC directives. You can call up the EU declaration of conformity and the current operating instructions for the protective device by entering the part number in the search field at www.sick.com (part number: see the type label entry in the “Art. No.” field).

3.2.3 UKCA

The manufacturer, Inxpect SpA, states that safeRS3 type of radio equipment complies with Radio Equipment Regulations 2017 and Supply of Machinery (Safety) Regulations 2008. You can call up the full UKCA declaration of conformity by entering the part number in the search field at www.sick.com (part number: see the type label entry in the “Art. No.” field).

3.2.4 Other conformities and national configurations

For a complete, up-to-date list of product conformities and any national configurations, please refer to the National configuration addendum document. The PDF can be downloaded from the site www.sick.com.

4 Get to know safeRS3

Product label description

The following table describes the information contained in the product label:

Part	Description
SID	Sensor ID
DC	"yy/ww" : year and week of the product manufacture
SRE	Safety Radar Equipment
Model	Product model (e.g., safeRS3 Sensor, safeRS3 Control I/O)
Type	Product variant, used for commercial purposes only
S/N	Serial number

4.1 safeRS3

4.1.1 Definition

safeRS3 is an active protection radar system that monitors the dangerous areas of machinery.

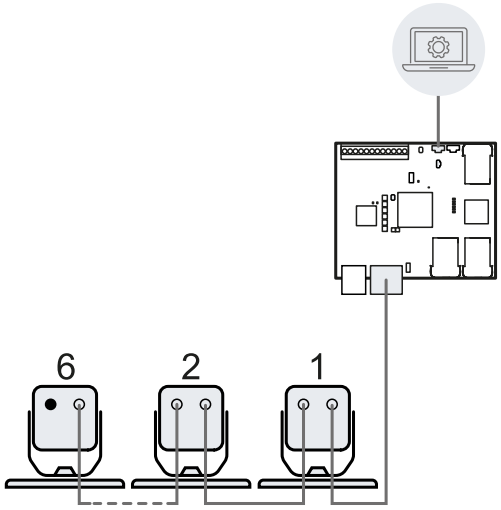
4.1.2 Special features

Some of the special features of this protection system are the following:

- detection of current distance and angle of the targets detected by each sensor
- customization of the protective field with advanced shapes (if available)
- up to four safe protective fields to define different behaviors of the machines
- programmable coverage angle for each protective field
- rotation around three axes during installation to allow better coverage of detection areas
- Safety Fieldbus to safely communicate with the PLC of the machinery (if available)
- possibility to switch dynamically between different preset configurations (max. 32 through Fieldbus, if available, and max. 8 with digital inputs)
- muting on the entire system or only on some sensors
- immunity to dust and smoke
- reduction of undesired alarms caused by the presence of water or processing waste
- communication and data exchange through MODBUS (if available)

4.1.3 Main components

safeRS3 is composed of a control and up to six sensors. The safeRS3 Designer application allows system operation configuration and checks.



NOTICE
Do not connect the control with other types of sensors (e.g., 5 meter sensors).

4.1.4 Control - sensor communication

The sensors communicate with the control via CAN bus using diagnostic mechanisms in compliance with standard EN 50325-5 to guarantee SIL 2 and PL d.

For correct functioning, each sensor must be assigned an identification number (Node ID).

Sensors on the same bus must have different Node IDs. By default, the sensor does not have a pre-assigned Node ID.

4.1.5 Control - machinery communication

The controls communicate with the machinery via I/O (see Control inputs on page 26 and Control outputs on page 28).

Moreover, according to the model-type, the control is provided with:

- a safe communication on a Fieldbus interface. The Fieldbus interface allows the control to communicate in real-time with the PLC of the machinery to send information about the system to the PLC (e.g., the position of the detected target) or to receive information from the PLC (e.g., to change the configuration dynamically). For details, see Fieldbus communication (PROFIsafe) on page 38 or see Fieldbus communication (Safety over EtherCAT® - FSoE) on page 40.
- an Ethernet port that allows unsafe communication on a MODBUS interface (see MODBUS communication on page 41).

4.1.6 Applications

safeRS3 integrates with the machinery control system: when performing safety functions or detecting failures, safeRS3 deactivates the safety outputs and keeps them deactivated, so the control system can put the area into a safe condition and/or prevent restarting of the machinery.

In the absence of other control systems, safeRS3 can be connected to the devices that control the power supply or machinery start-up.

safeRS3 does not perform normal machinery control functions.

For connection examples, see Electrical connections on page 133.

4.2 Controls

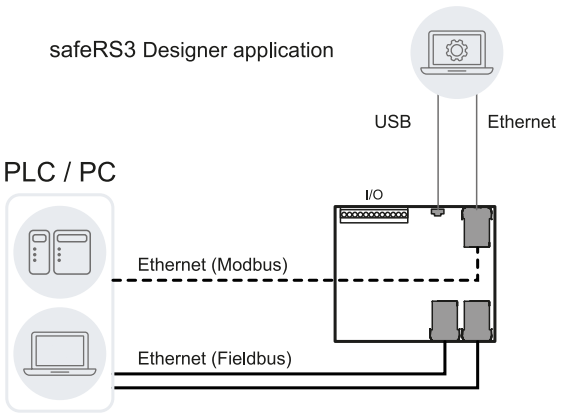
4.2.1 Interfaces

The safeRS3 supports different controls. The main difference among them is the connection ports, and therefore the communication interfaces available:

Control	micro-USB port	Ethernet port	Fieldbus port	microSD slot
safeRS3 Control PROFINET	x	x	x (PROFIsafe)	-
safeRS3 Control EC	x	x	x (FSoE)	-
safeRS3 Control I/O	x	-	-	-

4.2.2 Communication architecture

According to the model-type, this is the communication architecture between the control, PLC and PC.



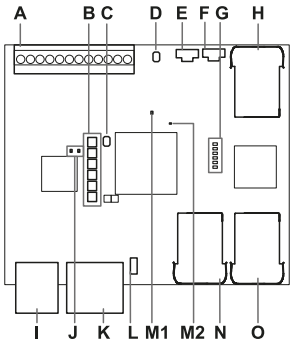
4.2.3 Functions

The control performs the following functions:

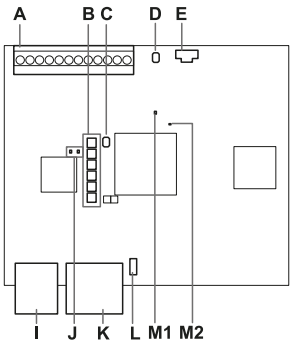
- Collects information from all the sensors via CAN bus.
- Compares the position of detected motion with the set values.
- Deactivates the selected safety output when at least one sensor detects motion in the protective field.

- Deactivates all the safety outputs if a failure is detected in one of the sensors or the control.
- Manages the inputs and outputs.
- Communicates with the safeRS3 Designer application for all configuration and diagnostic functions.
- Allows dynamically switching between different configurations.
- Communicates with a safety PLC through the safe Fieldbus connection (if available).
- Communicates and exchanges data through MODBUS protocol (if available).

4.2.4 Structures



safeRS3 Control PROFINET, safeRS3 Control EC



safeRS3 Control I/O

Part	Description
A	I/O terminal block
B	System status LEDs
C	Network parameter reset button / Factory reset button
D	Reserved for internal use. Output reset button
E	Micro-USB port (micro-B type) for connecting the PC and communicating with the safeRS3 Designerapplication
F[1)]	Micro-USB port, if mounted (reserved)
G[1)]	Fieldbus status LEDs See PROFIsafe Fieldbus status LEDs on the next page or FSoE Fieldbus status LEDs on page 26.
H[1)]	Ethernet port with LEDs for connecting the PC, communicating with the safeRS3 Designerapplication, and for MODBUS communication
I	Power supply terminal block
J	Power supply LEDs (steady green)
K	CAN bus terminal block for connecting the first sensor
L	DIP switch to turn on/off the bus termination resistance: • On (top position, default) = resistance included • Off (bottom position) = resistance excluded
M1	Status LED of hardware functions of the secondary micro-controller: • slow flashing orange: normal behavior • other status: contact Technical Support

Part	Description
M2	Status LED of hardware functions of the primary micro-controller: • off: normal behavior • steady red: contact Technical Support
N[1)]	Fieldbus port no.1 with LEDs (PROFIsafe or EtherCAT® IN)
O[1)]	Fieldbus port no.1 with LEDs (PROFIsafe or EtherCAT® OUT)

Note[1)]: not available for safeRS3 Control I/O.

Note: the processing direction is from the N connection to the O connection. In normal operation, the device receives the data from the controller on N and sends the outgoing data on O.

4.2.5 System status LEDs

The LEDs are each dedicated to a sensor, and can display the following statuses:

Status	Meaning
Steady green	Normal sensor function and no motion detected
Orange	Normal sensor function and some motion detected
Flashing red	Sensor in error (see Control LED on page 103)
Steady red	System error (see Control LED on page 103)
Flashing green	Sensor in boot status (see Control LED on page 103)

4.2.6 PROFIsafe Fieldbus status LEDs

The LEDs reflect the status of the PROFIsafe Fieldbus, and their meanings are reported below.

Note: F1 is the LED at the top, F6 is the LED at the bottom.

LED	Status	Meaning
F1 (power)	Steady green	Normal behavior
	Flashing green or off	Contact Technical Support
F2 (boot)	Off	Normal behavior
	Steady or flashing yellow	Contact Technical Support
F3 (link)	Off	Data exchange is running with the host
	Flashing red	No data exchange
	Steady red	No physical link
F4 (not used)	-	-
F5 (diagnosis)	Off	Normal behavior
	Flashing red	DCP signal service is initiated via the bus
	Steady red	diagnostic error at PROFIsafe layer (wrong F Dest Address, watchdog timeout, wrong CRC) or diagnostic error at PROFINET layer (watchdog timeout; channel, generic or extended diagnosis present; system error)
F6 (not used)	-	-

4.2.7 FSoE Fieldbus status LEDs

The LEDs reflect the status of the FSoE Fieldbus as described below.

Note: F1 is the LED at the top, F6 is the LED at the bottom.

LED		Status	Meaning
SYS	F1	Steady green	Normal behavior
		Flashing green or off	Contact Technical Support
	F2	Off	Normal behavior
		Steady or flashing yellow	Contact Technical Support
RUN	F3 (not used)	-	-
	F4	Off	INIT state
		Flashing green	Pre-Operational state
		Single flash green	Safe-Operational state
		Steady green	Operational state
ERR	F5	Off	Normal behavior
		Flashing red	*Invalid configuration*: General Configuration Error. Possible reason: State change commanded by the master is impossible due to register or object settings
		Single flash red	Local error: slave device application has changed the EtherCAT® state autonomously. Possible reasons: • a host watchdog timeout has occurred • synchronization error, the device enters the Safe-Operational state automatically
		Double flash red	*Application watchdog timeout*: an application watchdog timeout has occurred. Possible reason: Sync Manager watchdog timeout
	F6 (not used)	-	-

4.3 Control inputs

4.3.1 Introduction

The system has two type 3 dual channel digital inputs (according to IEC/EN 61131-2). Alternatively, the four channels can be used as single channel digital inputs (category 2). The ground reference is common for all the inputs (see Technical references on page 125).

When using digital inputs, it is mandatory that the additional SNS input "V+ (SNS)" is connected to 24 V DC and that the GND input "V- (SNS)" is connected to the ground in order to:

- perform the correct input diagnostic
- assure the system safety level

4.3.2 Input functions

The function of each digital input must be programmed through the safeRS3 Designer application. The available functions are the following:

- **Stop signal**: additional safety-related function, which manages a specific signal to force all the safety outputs (detection signals, if present) to OFF-state.
- **Restart signal**: additional safety-related function, which manages a specific signal which enables the control to switch to ON-state the safety outputs related to all the protective fields with no motion detected.
- **Muting group "N"**: additional safety-related function, which manages a specific signal, allowing the control to ignore the information from a selected sensor group.
- **Dynamic configuration switch**: additional safety-related function, which allows the control to select a specific dynamic configuration.
- **Fieldbus controlled** (if available): additional safety-related function monitors the input status through Fieldbus communication. For example, a generic ESPE can be connected to the input, respecting electrical specifications.
- **System recondition**: configures the system without changing any settings.
- **Restart signal + System recondition**: according to the input signal duration, performs the **Restart signal** function or the **System recondition** function.

For details about digital input signals, see Digital input signals on page 146.

4.3.3 Single or dual channel option

By default, each digital input function needs a signal on both channels to provide the redundancy required by Category 3.

The following digital input functions can also be used as a single channel (Category 2):

- **Restart signal**
- **Fieldbus controlled**
- **System recondition**
- **Restart signal + System recondition**

In the safeRS3 Designer application in **Settings** > **Digital Input-Output**, set the digital input function to **Single channel (Category 2)** and then choose the input function for each channel.

4.3.4 Redundancy mode

Two types of redundancy mode are available for the dual channels input functions:

- **Coherent redundancy**

Input Channel 1	Input Channel 2	Input logic value
0	0	Low
1	1	High
0	1	Error
1	0	Error

- **Inverted redundancy**

Input Channel 1	Input Channel 2	Input logic value
0	1	Low
1	0	High
0	0	Error
1	1	Error

By default, the redundancy mode is coherent. For the following input functions, the inverted redundancy mode can be set to guarantee compatibility with different connected devices:

- **Muting group “N”** (only if pulse width = 0)
- **Restart signal**
- **Fieldbus controlled**
- **Dynamic configuration switch**
- **System recondition**
- **Restart signal + System recondition**

4.3.5 SNS input

The control is provided with an **SNS** input (high logic level (1) = 24 V) needed to check the correct functioning of the inputs.

NOTICE
If at least one input is connected, the SNS input "V+ (SNS)" and the GND input "V- (SNS)" must also be connected.

4.4 Control outputs

4.4.1 Outputs

The system has four digital OSSD short-circuit protected outputs that can be used individually (non safe) or can be programmed as dual channel safety outputs (safe) in order to ensure the system safety level.

An output is activated when it switches from OFF to ON-state and it is deactivated when it switches from ON to OFF-state.

4.4.2 Output functions

The function of each digital output must be programmed through the safeRS3 Designer application.

The available functions are the following:

- **System diagnostic signal**: switches the selected output to OFF-state when a system fault is detected.
- **Muting enable feedback signal**: switches the selected output to ON-state in the following cases:
  - when a muting signal is received over the configured input and at least one group is in muting
  - when a muting command is received through Fieldbus communication (if available) and at least one sensor is in muting
- **Detection signal 1**: (e.g., alarm signal) switches the selected output to OFF-state when a sensor detects a motion in protective field 1, receives a stop signal from the related input, or when there is a system failure. The selected output remains in OFF-state for at least 100 ms.

Note: when an OSSD is configured as detection signal 1, a second OSSD is automatically assigned to it to provide a safe signal.

- **Detection signal 2**: switches the selected output to OFF-state when a sensor detects a motion in protective field 2, receives a stop signal from the related input, or when there is a system failure. The selected output remains in OFF-state for at least 100 ms.

Note: when an OSSD is configured as detection signal 2, a second OSSD is automatically assigned to it to provide a safe signal.

- **Detection signal 3**: switches the selected output to OFF-state when a sensor detects a motion in protective field 3, receives a stop signal from the related input, or when there is a system failure. The selected output remains in OFF-state for at least 100 ms.

Note: when an OSSD is configured as detection signal 3, a second OSSD is automatically assigned to it to provide a safe signal.

- **Detection signal 4**: switches the selected output to OFF-state when a sensor detects a motion in protective field 4, receives a stop signal from the related input, or when there is a system failure. The selected output remains in OFF-state for at least 100 ms.

Note: when an OSSD is configured as detection signal 4, a second OSSD is automatically assigned to it to provide a safe signal.

- **Fieldbus controlled** (if available): allows the specific output to be set through the Fieldbus communication.
- **Restart feedback signal**: switches the selected output to ON-state when it is possible to manually restart at least one protective field (Restart signal). It can be set as **Standard** or **Pulsed**.
  - If all the used protective fields are configured as **Automatic** restart (in **Settings** > **Restart function**), the selected output is always in OFF-state;
  - If at least one protective field in use is configured as **Manual** or **Safe manual** restart (in **Settings** > **Restart function**), the behavior depends on the option selected (see Restart feedback signal option settings on the next page.
- **Static object detection feedback signal**: switches the selected output to ON-state when at least one sensor detects a static object in one of its detection fields. The

selected output remains in ON-state for at least 100 ms. If, at the same time, a moving target is detected in the protective field, the **Static object detection feedback signal** will switch its selected output to OFF-state for the duration of the movement.

- **Detection signal group 1** or **Detection signal group 2**: switches the selected output to OFF-state when at least one sensor detects a motion in a protective field belonging to the group (see Detection signal group settings below), receives a stop signal from the related input, or when there is a system failure. The selected output remains in OFF-state for at least 100 ms.

Note: when an OSSD is configured as **Detection signal group 1** or **Detection signal group 2**, a second OSSD is automatically assigned to it to provide a safe signal.

Each output status can be retrieved by Fieldbus communication (if available).

4.4.3 Restart feedback signal option settings

If at least one protective field in use is configured as **Manual** or **Safe manual** restart (in **Settings** > **Restart function**), the behavior of the **Restart feedback signal** depends on the option selected:

Option	Restart feedback signal behavior
Standard	• The selected output is activated (ON-state) if there is no more motion within at least one protective field configured as **Manual** or **Safe manual** restart. The ON-state lasts as long as there is an absence of motion within one or more protective fields (configured as **Manual** or **Safe manual** restart) and until the restart signal is activated on the selected input. • The selected output remains in OFF-state if: ◦ none of the protective fields (configured as **Manual** or **Safe manual** restart) are ready to be restarted, and as long as a motion (or a fault) is detected within at least one protective field (configured as **Manual** or **Safe manual** restart), or ◦ as long as no motion is detected within any protective fields configured as **Manual** or **Safe manual** restart, but none can be restarted yet.
Pulsed	• The selected output is activated (ON-state) if there is no more motion within at least one protective field configured as **Manual** or **Safe manual** restart. The ON-state lasts as long as there is an absence of motion within one or more protective fields (configured as **Manual** or **Safe manual** restart) and until the restart signal is activated on the selected input. • The selected output switches continuously between ON-state and OFF-state if none of the protective fields (configured as **Manual** or **Safe manual** restart) are ready to be restarted, and as long as a motion (or a fault) is detected within at least one protective field (configured as **Manual** or **Safe manual** restart) • The selected output remains in OFF-state as long as no motion is detected within any protective fields configured as **Manual** or **Safe manual** restart, but none can be restarted yet.

4.4.4 Detection signal group settings

Each protective field of each sensor can be assigned to a group to associate them with the same safety output.

Through the safeRS3 Designer application (in **Settings > Protective field groups**), each detection field of each sensor can be associated with a group or both groups. By

default, a protective field does not belong to any group.

WARNING
Consider the protective field dependency choice during the group's configuration. See Protective fields dependency and detection signal generation on page 49

Example

It is possible to configure that the following protective fields belong to group 1:

- Protective field 1 of Sensor 1
- Protective field 1 of Sensor 3
- Protective field 2 of Sensor 1

By doing so, a specific output assigned to **Detection signal group 1** will switch to the OFF-state when a movement is detected in one of these protective fields.

4.4.5 Output configurations

The system installer can decide to configure the system as follows:

- two dual channel safety outputs (e.g., **Detection signal 1** and **Detection signal 2**, usually alarm and warning signals)
- one dual channel safety output (e.g., **Detection signal 1**) and two single channel output (e.g., **System diagnostic signal** and **Muting enable feedback signal**)
- each output as a single output (e.g., **System diagnostic signal**, **Muting enable feedback signal** and **Restart feedback signal**)

WARNING
To use safeRS3 for a category 3 safety system, both the channels of a safety output must be connected to the safety system. Configuring a safety system with only one channel safety output may result in serious injuries due to an output circuit fault and a failure of the machine to stop.

4.4.6 Dual channel safety output configuration

The dual channel safety output is automatically obtained by the safeRS3 Designer application and it only matches the single OSSD outputs as follows:

- OSSD 1 with OSSD 2
- OSSD 3 with OSSD 4

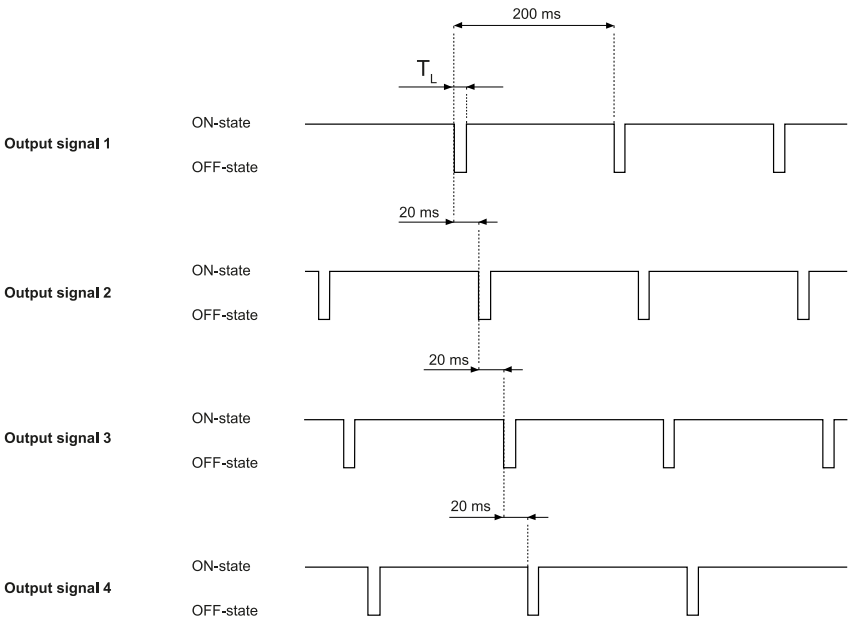
In the dual channel safety output, the output status is the following:

- activated output (24 V DC): no motion detected and normal functioning
- deactivated output (0 V DC): motion detected in the protective field or failure detected in the system

The idle signal is 24 V DC, periodically shortly pulsed to 0 V for the receiver to detect short-circuits to either 0 V or 24 V.

The pulse duration at 0 V (T_L) can be set at 300 µs or 2 ms through the safeRS3 Designer application (**Settings** > **Digital Input-Output** > **OSSD Pulse width**).

Note: the devices connected to the OSSD should not respond to these temporary, self-diagnostic 0 V pulses of the signal.



For details, see Technical references on page 125.

4.4.7 OSSD diagnostic checks

Per default, the OSSD Diagnostic check (e.g., for short-circuits) is deactivated. This check can be activated through the safeRS3 Designer application (**Settings** > **Digital Input-Output**).

If activated, the control will monitor:

- short-circuit between OSSDs
- 24 V short-circuit
- open circuit (only trips on demand, i.e., when the safety function is activated on the transition from 24 V to GND)

Note: the short-circuit to GND (fail-safe fault) is always monitored even if the OSSD diagnostic check is deactivated.

WARNING
If an external common cause failure leads to a 24 V short-circuit on both the OSSDs, the control cannot communicate the safe state condition via OSSD. The integrator is responsible for avoiding this condition by monitoring the test pulses generated periodically on the OSSDs.

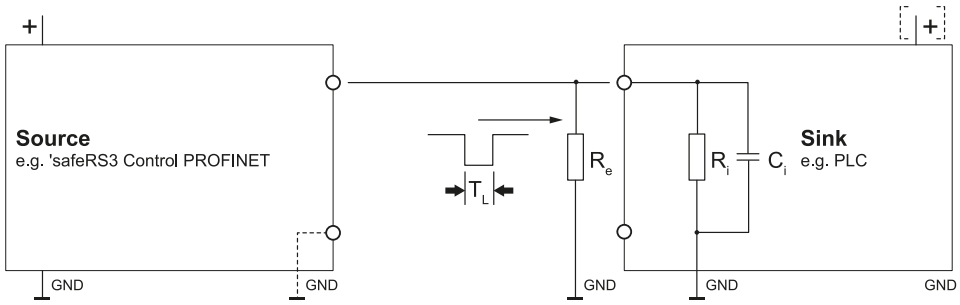
4.4.8 External resistor for OSSD outputs

To guarantee the correct connection between the OSSDs of the control and an external device, it may be necessary to add an external resistor.

If the pulse width set (**OSSD Pulse width**) is 300 µs, it is strongly recommended to add an external resistor to guarantee the discharge time of the capacitive load. If it is set at 2 ms, an external resistance must be added if the resistor of the external load is greater than the maximum resistive load allowed (see Technical data on page 125).

Below are some standard values for the external resistor:

OSSD Pulse width value	External resistor (R_e)
300 µs	1 kΩ
2 ms	10 kΩ



4.5 Sensors

4.5.1 9 meter sensors

These are the main characteristics of the sensors:

NOTICE
The sensors connected to the control must all be of the same type (e.g., all 5 meter sensors or all 9 meter sensors).

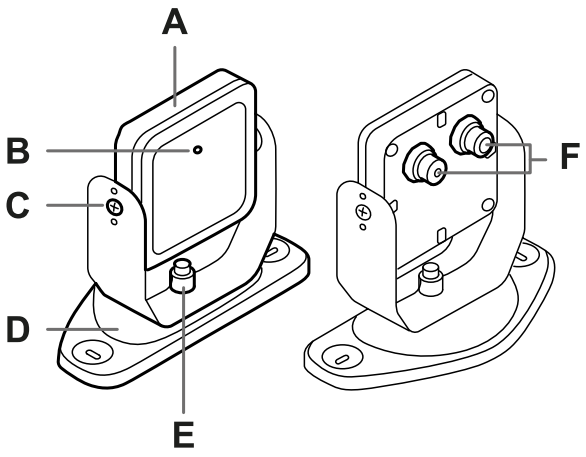
Access maximum distance	9 m (29.5 ft)
Restart maximum distance	5 m (16.4 ft)
Detection speed (Access detection function)	• Stationary use: [0.1, 1.6] m/s ([0.33, 5.25] ft/s) • Mobile use: [0.1, 4] m/s ([0.33, 13.12] ft/s)
Angular coverage (horizontal)	• In the first 5 m (16.4 ft), from 10° to 100° • From 5 to 9 m (from 16.4 to 29.5 ft), from 10° to 40°
Angular coverage (vertical)	20° with downward offset of 2.5
RCS threshold	RCS threshold for each detection field of each sensor

4.5.2 Functions

The sensors perform the following functions:

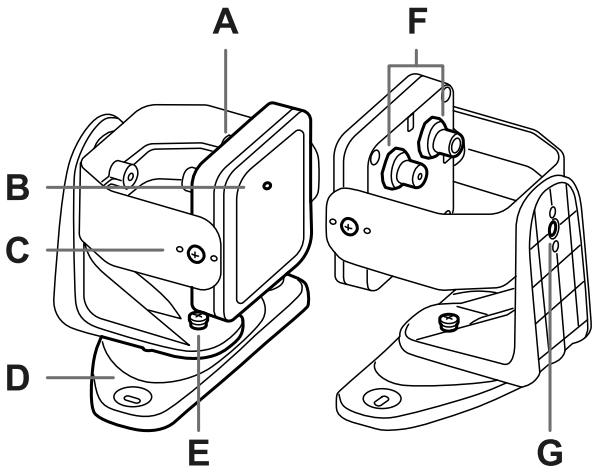
- Detect motion in their field of view.
- Send the motion detection signal to the control through CAN bus.
- Signal to the control through CAN bus the failures or faults detected on the sensor during diagnostics.

4.5.3 2-axes bracket



Part	Description
A	Sensor
B	Status LED
C	Tamper-proof screws to position the sensor at a specific angle around x-axis (tilt 10° steps)
D	Mounting bracket
E	Screw to position the sensor at a specific angle around y-axis (pan 10° steps)
F	Connectors for connecting the sensors in a chain and to the control

4.5.4 3-axes bracket



Part	Description
A	Sensor
B	Status LED
C	Tamper-proof screws to position the sensor at a specific angle around x-axis (tilt 10° steps)
D	Mounting bracket
E	Tamper-proof screw to position the sensor at a specific angle around y-axis (pan 10° steps)
F	Connectors for connecting the sensors in a chain and to the control
G	Tamper-proof screw to position the sensor at a specific angle around z-axis (roll 10° steps)

4.5.5 Status LED

Status	Meaning
Steady blue	Sensor is working. No motion detected.
Flashing blue	Sensor is detecting motion. Not available if the sensor is in muting.
Purple	Firmware update conditions (see Sensor LED on page 106)
Red	Error conditions (see Sensor LED on page 106)

4.6 safeRS3 Designer application

4.6.1 Functions

The application permits the following main functions to be performed:

- Configure the system.
- Create the configuration report.
- Check system functioning.
- Download system log.

4.6.2 safeRS3 Designer application usage

To use the application, the control must be connected to a computer with a data USB cable or, if the Ethernet port is available, an Ethernet cable. The USB cable allows to configure the system locally, whereas the Ethernet cable allows to do it remotely.

The Ethernet communication between the control and the safeRS3 Designer application is secured by the most advanced security protocols (TLS).

4.6.3 Authentication

The application can be downloaded free of charge at www.sick.com.

Different user levels are available. The Admin user is in charge of user management. All the passwords can be set through the application and then saved on the control.

4.6.4 User levels

These are the functions available for each user level:

	Observer	Expert	Engineer	Admin	Service[1)]
Read system configuration	x	x	x	x	x
Validation	-	x	x	x	x
Download log files	-	x	x	x	x
Sensor setup (e.g., Node ID) and configuration	-	-	x	x	-
Digital I/O configuration	-	-	x	x	-
Backup / Restore configuration	-	-	x	x	-
Network and Fieldbus settings (Network and MODBUS parameters, PROFIsafe F-addresses and endianness, FSoE Safe Address), and System labels	-	-	-	x	-
Control firmware upgrade	-	-	-	x	-
User management	-	-	-	x	-
Technical support and maintenance	-	-	-	-	x
Debug and statistical information	-	-	-	-	x

Note[1)]: Service user can be enabled/disabled by the administrator. Since only SICK technicians are allowed to access as Service, the Service user is protected by an activation code.

4.6.5 Main menu

Page	Function
Dashboard	Display main information on the configured system. **Note**: the messages show the same information in the log files. For the meanings of the messages, see the chapters on logs in Troubleshooting on page 103.
Configuration	Define the monitored area. Configure the sensors, their shape and the protective fields. Define the dynamic configurations. Choose the safety working mode. Enable the static object detection option. Set the restart timeout. Enable the Custom target detection Set the RCS Threshold parameter
Settings	Configure the sensor groups. Choose the protective fields dependency. Enable the anti-tampering functions. Synchronize more controls. Configure the inputs and outputs function. Perform the configuration backup and load a configuration. Download the log. Perform the sensor Node ID assignment. Other general functions.
Admin	Configure and manage the users. Enable the SD Backup and the SD Restore. Perform a factory reset. Configure, show, and change the Network parameters (if available). Configure, show and change the MODBUS parameters (if available). Configure, show and change the Fieldbus parameters (if available). Set labels for controls and sensors.
Validation	Start the validation procedure. **Note**: the messages shown are those in the log file. To know the meaning of the messages, see the chapters on logs in Troubleshooting on page 103.
REFRESH CONFIGURATION	Refresh configuration or ignore unsaved changes.
User	Change user profile. Modify account settings.
Control	Retrieve control information. Close the connection with the control and allow it to connect to another control.
	Change the language.

4.7 Fieldbus communication (PROFIsafe)

4.7.1 PROFIsafe support

The safety communication using PROFIsafe is available on all the controls provided with the PROFIsafe interface. For details, see Controls on page 23.

4.7.2 Communication with the machinery

The Fieldbus makes the following actions possible:

- Choose from 1 to 32 preset configurations dynamically.
- Read the status of the inputs.
- Control the outputs.
- Read the target data.
- Mute the sensors.
- Enable the restart signal.
- Enable the system recondition signal.

For details, see the safeRS3 PROFIsafe communication Technical Information.

4.7.3 Input data coming from the PLC

If neither digital input nor OSSD is configured as **Fieldbus controlled**, the behavior of the input data coming from the PLC is as described below:

Condition	Input data coming from the PLC	System behavior
IOPS (PLC provider status) = bad	the last valid value of the input variable is retained	the system keeps working in its normal operating state
Connection loss	the last valid value of the input variable is retained	the system keeps working in its normal operating state
After power-up	the initial values (set to 0) are used for the input variables	the system keeps working in its normal operating state

If at least one digital input or OSSD is configured as **Fieldbus controlled**, the behavior of the input data coming from the PLC is as described below:

Condition	Input data coming from the PLC	System behavior
IOPS (PLC provider status) = bad	the last valid value of the input variable is retained	the system keeps working in its normal operating state
Connection loss	the last valid value of the input variable is retained	the system transits to safe state, deactivating the OSSDs, until the connection is re-established.
After power-up	the initial values (set to 0) are used for the input variables	the system remains in a safe state with the OSSDs deactivated, until the input data are passivated.

4.7.4 Data exchanged through PROFIsafe

The following table details the data exchanged through the Fieldbus communication:

WARNING
The system is in the safe state if the control status byte of the System configuration and status module PS2v6 or PS2v4 is different from "0xFF".

Data type	Description	Communication direction
Safe	SYSTEM STATUS DATA Control: • internal status • status of each of the four OSSDs • status of each single channel and dual channel input Sensor: • status of each protective field (target detected or not) or error status • status of static object detection option • muting status	from the control
Safe	SYSTEM SETTING COMMAND Control: • set the ID of the dynamic configuration that shall be activated • set the status of each of the four OSSDs • save the reference for the anti-rotation around axes • enable the restart signal • enable the system recondition signal Sensor: • set the muting status	to the control
Safe	DYNAMIC CONFIGURATION STATUS • ID of the dynamic configuration currently active • signature (CRC32) of the dynamic configuration ID currently active	from the control
Safe	TARGET DATA • Current distance and angle of the targets detected by each sensor. For each protective field of each sensor, only the closest target to the sensor is considered.	from the control
Unsafe	DIAGNOSTIC DATA Control: • internal status with an extended description of the error condition Sensor: • internal status with an extended description of the error condition	from the control
Unsafe	SYSTEM STATUS AND TARGET DATA	from the control

4.8 Fieldbus communication (Safety over EtherCAT® - FSoE)

4.8.1 FSoE support

The safety communication using FSoE is available on all the controls provided with the FSoE interface. For details, see Controls on page 23.

4.8.2 Communication with the machinery

The Fieldbus makes the following actions possible:

- Choose dynamically from 1 to 32 preset configurations.
- Read the status of the inputs.
- Control the outputs.
- Mute the sensors.
- Enable the restart signal.
- Enable the system recondition signal.

For details, see the safeRS3 FSoE communication Technical Information.

4.8.3 Data exchanged through FSoE

The following table details the data exchanged through the Fieldbus communication:

WARNING
The system is in the safe state if Byte 0 of the selected TxPDO has at least one of its bits equal to 0, except for bit 4, which can assume any value.

Data type	Description	Communication direction
Safe	SYSTEM STATUS DATA Control: • internal status • status of each of the four OSSDs • status of each of single channel inputs and dual channel inputs Sensor: • status of each protective field (target detected or not) or error status • status of Static object detection for each protective field • muting status	from the control
Safe	SYSTEM SETTING COMMAND Control: • set the ID of the dynamic configuration that shall be activated • set the status of each of the four OSSDs • enable the system recondition signal • enable the restart signal Sensor: • set the muting status	to the control
Safe	DYNAMIC CONFIGURATION STATUS • ID of the dynamic configuration currently active • signature (CRC32) of the dynamic configuration ID currently active	from the control
Unsafe	DIAGNOSTIC DATA Control: • internal status with an extended description of the error condition Sensor: • internal status with an extended description of the error condition	from the control
Unsafe	SYSTEM STATUS	from the control

4.9 MODBUS communication

4.9.1 MODBUS support

The safety communication using MODBUS is available on all the controls provided with the MODBUS interface. For details, see Controls on page 23.

4.9.2 MODBUS communication enabling

In the safeRS3 Designer application, click on **Admin** > **MODBUS Parameters** and check that the feature is enabled (**ON**).

Within the Ethernet network, the control acts like a server. The client must send requests to the IP address of the server on the MODBUS listening port (default port is 502).

To show and change the address and the port, click on **Admin** > **Network Parameters** and **Admin** > **MODBUS Parameters**.

4.9.3 Data exchanged through MODBUS

The following table details the data exchanged through the MODBUS communication:

Data type	Description	Communication direction
Unsafe	SYSTEM STATUS DATA Control: • internal status • status of each of the four OSSDs • status of each single channel and dual channel input • revision information Sensor: • status of each protective field (target detected or not) or error status • muting status • revision information	from the control
Unsafe	DYNAMIC CONFIGURATION STATUS • ID of the dynamic configuration currently active • signature (CRC32) of the dynamic configuration ID currently active	from the control
Unsafe	TARGET DATA • Current distance and angle of the targets detected by each sensor. For each protective field of each sensor, only the closest target to the sensor is considered.	from the control
Unsafe	DIAGNOSTIC DATA Control: • internal status with an extended description of the error condition Sensor: • internal status with an extended description of the error condition	from the control

4.10 System configuration

4.10.1 System configuration

The control parameters have their own default values that can be modified via the safeRS3 Designer application (see Configuration application parameters on page 141).

When a new configuration is saved, the system generates the configuration report.

Note: after a physical change of the system (e.g., new sensor installed), the system configuration must be updated and a new configuration report must be generated, too.

4.10.2 Dynamic system configuration

safeRS3 allows a real-time adjustment of the most important system parameters, providing the means to switch dynamically among different preset configurations. Via the safeRS3 Designer application, once the first system configuration (default configuration) has been set, it is possible to set alternative presets to allow a dynamic real-time reconfiguration of the monitored area. The alternative presets are 7 through digital input and 31 through Fieldbus (if available).

4.10.3 Dynamic system configuration parameters

These are the programmable parameters for each sensor:

- protective field (from 1 to 4)
- RCS Threshold for each protective field of each sensor

These are the programmable parameters for each protective field:

- angular coverage
- detection distance
- safety working mode (**Access detection and restart prevention** or **Always-on access detection**) (see Safety working modes and safety functions on page 51)
- classic and corridor shapes (see Advanced field of view on page 70)
- static object detection option (see Restart prevention function: static object detection option on page 55)
- restart timeout

All the remaining system parameters cannot be changed dynamically and are considered static.

4.10.4 Dynamic system configuration switch

One of the preset configurations can be activated dynamically either through the digital inputs (**Dynamic configuration switch**) or through the safety Fieldbus (if available).

WARNING
If one or more digital inputs are configured as "**Dynamic configuration switch**", a switch through the safety Fieldbus is not considered.

Note: if the application type is set as **Stationary**, the system can manage only one dynamic configuration.

4.10.5 Dynamic configuration through the digital inputs

To activate one of the preset configurations dynamically, one or both the digital inputs of the control can be used. The result is the following:

If...	Then it is possible to switch dynamically between...
only **one** digital input is configured as **Dynamic configuration switch**	**two** preset configurations (see Case 1 below and Case 2 below)
both digital inputs are configured as **Dynamic configuration switch** and the encoded channel option is disabled	**four** preset configurations (see Case 3 below)
both digital inputs are configured as **Dynamic configuration switch** and the encoded channel option is enabled	**eight** preset configurations (see Case 4 on the next page)

Note: the configuration change is safe because two-channel inputs are used.

Note: if the encoded channel option is enabled, any invalid combination that lasts more than 33 ms results in a fault on the inputs that brings the system to a safe state.

Case 1

The first digital input has been configured as **Dynamic configuration switch**.

Dynamic configuration number	Input 1 (CH1 and CH2)	Input 2
#1	**0**	-
#2	**1**	-

0 = signal deactivated; 1 = signal activated

Case 2

The second digital input has been configured as **Dynamic configuration switch**.

Dynamic configuration number	Input 1	Input 2 (CH1 and CH2)
#1	-	**0**
#2	-	**1**

0 = signal deactivated; 1 = signal activated

Case 3

Both digital inputs have been configured as **Dynamic configuration switch**, and the encoded channel option is disabled.

Dynamic configuration number	Input 1 (CH1 and CH2)	Input 2 (CH1 and CH2)
#1	**0**	**0**
#2	**1**	**0**

Dynamic configuration number	Input 1 (CH1 and CH2)	Input 2 (CH1 and CH2)
#3	**0**	**1**
#4	**1**	**1**

0 = signal deactivated; 1 = signal activated

Case 4

Both digital inputs have been configured as **Dynamic configuration switch**, and the encoded channel option is enabled.

The valid combinations are only those that differ at least by two values, and they are listed below:

Dynamic configuration number	Input 1		Input 2	
	CH1	CH2	CH1	CH2
#1	**1**	**0**	**0**	**0**
#2	**0**	**1**	**0**	**0**
#3	**0**	**0**	**1**	**0**
#4	**0**	**0**	**0**	**1**
#5	**1**	**1**	**1**	**0**
#6	**1**	**1**	**0**	**1**
#7	**1**	**0**	**1**	**1**
#8	**0**	**1**	**1**	**1**

0 = signal deactivated; 1 = signal activated

4.10.6 Dynamic configuration through the safety Fieldbus

To activate one of the preset configurations dynamically, connect an external safety PLC that communicates through the safety Fieldbus to the control. This makes it possible to dynamically switch between all the preset configurations, therefore up to 32 different configurations. For all the parameters used for each configuration, see Dynamic system configuration on page 43.

For details about the supported protocol, please refer to the Fieldbus manual.

WARNING

Before activating one of the preset configurations through the safety Fieldbus, ensure that none of the digital inputs is configured as Dynamic configuration switch; otherwise, the safeRS3 ignores all the switches made through the safety Fieldbus.

5 Functioning principles

5.1 Sensor functioning principles

5.1.1 Introduction

The sensor is an FMCW (Frequency Modulated Continuous Wave) radar device based on a proprietary detection algorithm. It is also a multi-target sensor that sends pulses and receives information, analyzing the reflection of the nearest moving target that it encounters within each protective field.

The sensor can detect the current distance and the angle of each target.

Each sensor has its own fieldset. The fieldset corresponds to the structure of the field of view, which is composed of protective fields (see Protective fields on the next page).

5.1.2 Factors that influence the sensor field of view and object detection

WARNING
The presence of conductive material on the sensor could affect its field of view and, thus, object detection. For proper and safe system operation, validate the system under this condition.

5.1.3 Factors that influence the reflected signal

The signal reflected by the object depends on several characteristics of the same object:

- Metallic objects have a very high reflection coefficient, while paper and plastic reflect only a small portion of the signal
- The greater the surface exposed to the radar, the greater the reflected signal
- All other factors being equal, objects positioned directly in front of the radar generate a more significant signal than objects to the side
- Motion speed
- Inclination

All these factors have been analyzed for a human body during the safety validation of safeRS3 and cannot lead to a dangerous situation. These factors may occasionally influence the behavior of the system causing spurious activation of the safety function.

5.1.4 Detected and missed objects

The signal analysis algorithm considers only those objects that move within the field of view, ignoring completely static objects (if the static object detection option is disabled).

Furthermore, a *falling objects* algorithm allows ignoring undesired alarms generated by small work waste products that fall in the first part of the sensor's field of view.

5.1.5 Interference with pacemakers or other medical devices

Radiation from safeRS3 does not interfere with pacemakers or other medical devices.

5.2 Protective fields

5.2.1 Introduction

The field of view of each sensor can be composed of up to four protective fields. Each of the four protective fields has a dedicated detection signal.

WARNING
Configure the protective fields and associate them with the dual channel safety outputs according to the risk assessment requirements.

5.2.2 Protective field parameters

These are the programmable parameters for each protective field:

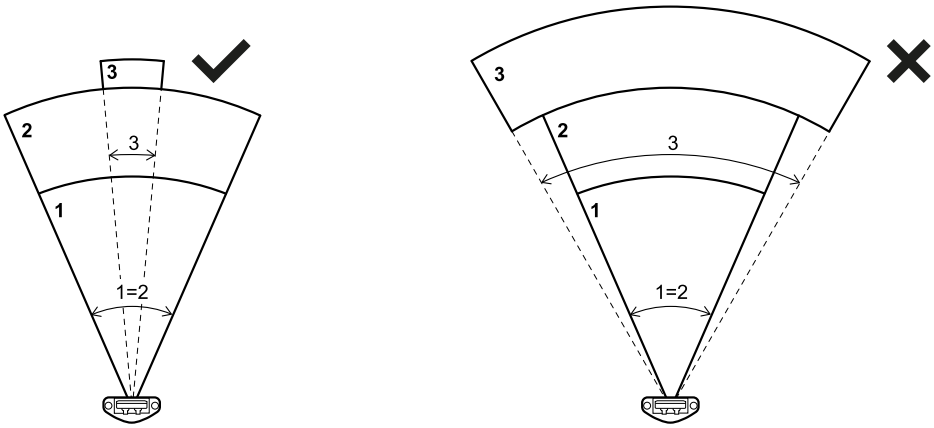
- angular coverage
- detection distance
- safety working mode (**Access detection and restart prevention** or **Always-on access detection**) (see Safety working modes and safety functions on page 51)
- restart timeout
- static object detection option
- Advanced field of view shape
- RCS Threshold

5.2.3 Angular coverage

The angular coverage has the following values:

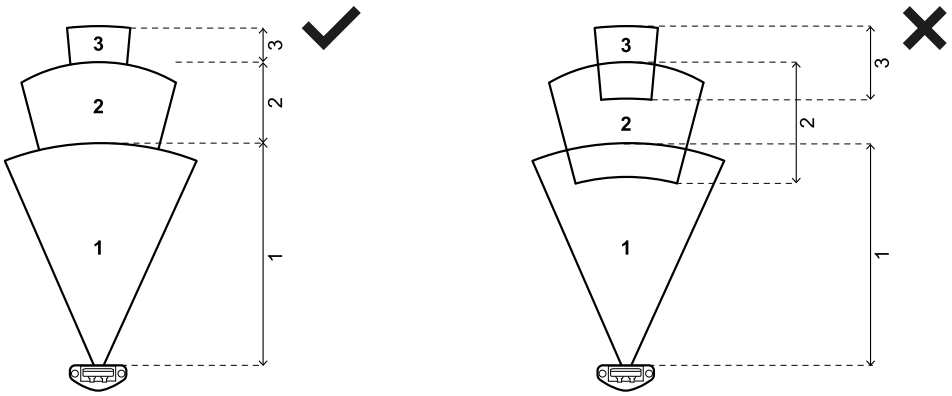
- in a range from 10° to 100° in the first 5 m (16.4 ft) of the field of view
- in a range from 10° to 40° from 5 to 9 m (from 16.4 to 29.5 ft) of the field of view

The angular coverage of the protective field must be wider than, or equal to, the angular coverage of the following protective fields.

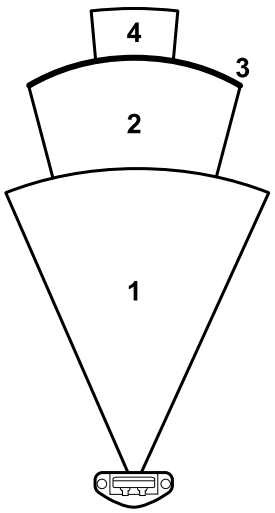


5.2.4 Detection distance

The detection distance of the first protective field starts from the sensor. The detection distance of one field starts where the one of the previous field ends.



The detection distance of one or more fields can be 0 (e.g., protective field 3). The first protective field with a detection distance other than 0 (e.g., protective field 1) must have a minimum detection distance of 200 mm.



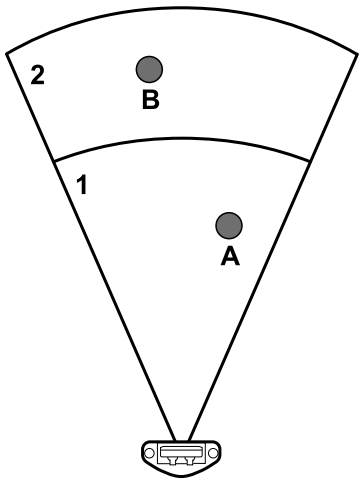
5.2.5 Protective fields dependency and detection signal generation

If a sensor detects motion within a protective field, its detection signal changes status and, when configured, the related safety output is deactivated. The behavior of the outputs related to the following protective fields depends on the protective field dependency set:

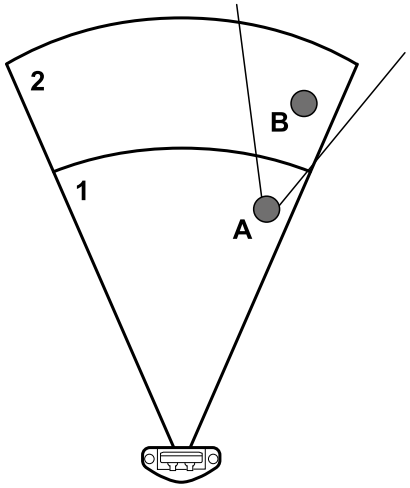
If...	Then...
the **Dependent mode** is set and thus protective fields are dependent on each other	if a sensor detects motion within a protective field, all the outputs related to its following protective fields are deactivated too. Example Protective field configured: 1, 2, 3 Protective field with target detected: 2 Protective field in alarm status: 2, 3
the **Independent mode** is set and thus protective fields are independent from each other	if a sensor detects motion within a protective field, only the output related to that protective field is deactivated. Example Protective field configured: 1, 2, 3 Protective field with target detected: 2 Protective field in alarm status: 2

WARNING
If protective fields are independent, an evaluation of the safety of the monitored area must be performed during the risk assessment. The blind area generated by a target can prevent the sensor from detecting targets in the following protective fields.

In this example, both protective field 1 and 2 generate a detection signal, for target **[A]** and **[B]** respectively.



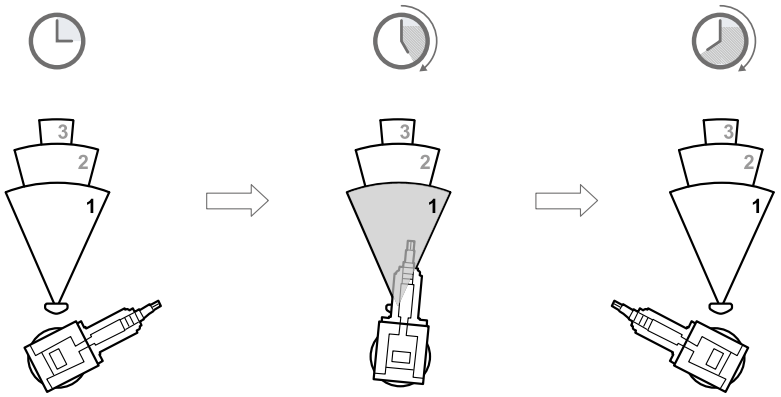
In this example, protective field 1 generates a detection signal for target **[A]** but target **[B]** could not be detected.



In the **safeRS3 Designer** application, click on **Settings** > **Advanced** > Protective field dependency to set the dependency mode of the protective fields.

5.2.6 Independent protective fields: a use case

It can be useful to set the protective fields as independent, for example, if there is a scheduled temporary motion of an object in a protective field. An example can be a robotic arm moving from right to left within the protective field 1 only during a specific phase of the operative cycle.



In this case, it is possible to ignore the detection signal in the protective field 1, thus avoiding unnecessary downtime.

WARNING
Evaluate the safety of the monitored area during risk assessment before deciding to ignore the detection signal of the protective field 1.

WARNING
The blind area generated by the moving robotic arm can prevent the sensor from detecting targets in the following other protective fields for a time interval. This time must be considered when defining the detection distance for protective field 2.

6 Safety functions

6.1 Safety working modes and safety functions

6.1.1 Introduction

Each protective field of each sensor can perform the following safety working modes:

- **Access detection and restart prevention**
- **Always-on access detection**

Each safety working mode is composed of one or both of the following safety functions:

Function	Description
Access detection	• Human detection: the machinery is reverted into a safe status when one or more persons enter the dangerous area • Custom target detection (see Custom target detection on page 54): the machinery is reverted into a safe status when one or more objects with an RCS higher than a set threshold enter the dangerous area ⚠ **WARNING** These safety-related functions work in exclusive mode: with the activation of the Custom target detection, the detection of a human body is no longer guaranteed.
Restart prevention	The machinery is prevented from restarting if people are in the dangerous area.

6.1.2 Safety working modes

Via the safeRS3 Designer application, you can select which safety working mode each sensor will employ for each of its protective fields:

- **Access detection and restart prevention** (default):
  - The sensor performs the access detection function when it is in normal operation (**No alarm** status).
  - The sensor performs the restart prevention function when it is in alarm status (**Alarm** status).
- **Always-on access detection**:
  - The sensor always performs the access detection function (**No alarm** status + **Alarm** status).

6.1.3 Access detection speed limits

The speed limits of the movements detected by the access detection function are reported below:

Application type	Minimum speed	Maximum speed
Stationary	0.1 m/s (0.33 ft/s)	1.6 m/s (5.25 ft/s)
Mobile	0.1 m/s (0.33 ft/s)	4 m/s (13.12 ft/s)

6.2 Safety working mode: Access detection and restart prevention (default)

6.2.1 Introduction

This safety working mode is composed of the following safety functions:

- access detection (Human detection or Custom target detection)
- restart prevention

6.2.2 Safety function: access detection (Human detection or Custom target detection)

Access detection allows what follows:

When...	Then...
no motion is detected in the protective field	the safety outputs remain active
motion is detected in the protective field (see Access detection speed limits on the previous page)	• the safety outputs are deactivated • the restart prevention function is activated

6.2.3 Safety function: restart prevention

Note: the maximum distance for the restart prevention function is 5 m (16.4 ft).

The restart prevention function remains active and the safety outputs deactivated as long as motion is detected in the protective field, or, with the static object detection option enabled (see Restart prevention function: static object detection option on page 55), as long as a static object is detected in the protective field.

The sensor can detect micro-movements of just a few millimeters, such as breathing movements (with normal breathing or a short apnea) or the movements necessary for a person to remain in balance in an upright or squatting position.

The system sensitivity is higher than the sensitivity that characterizes the access detection function. For this reason, the system reaction to vibrating and moving parts is different.

The sensor guarantees the detection of people moving at any speed from 0 up to 1.6 m/s (5.25 ft/s)[1)], provided that the guidelines described in Sensor positioning guidelines on page 56 are fulfilled.

Note[1)]: a stationary person still has static residual movements that the radar can detect.

WARNING
When the restart prevention function is active the monitored area may be affected by the position and inclination of the sensors, as well as by their installation height and angular coverage (see Sensor position on page 67).

6.2.4 Restart timeout parameter

When the system does not detect motion anymore or, with static object detection option enabled, no static object is detected, the OSSD outputs remain in OFF-state for the time set in the **Restart timeout** parameter.

The default and minimum certified value is 4 s (Certified Restart Timeout, CRT) while the maximum value is 60 s.

WARNING
The static object detection option allows reducing the value of the Restart timeout parameter and therefore it might affect the reliability of the restart prevention function (see Restart timeout parameter on page 56).

6.3 Safety working mode: **Always-on access detection**

6.3.1 Safety function: access detection (Human detection or Custom target detection)

This is the only safety function available for the **Always-on access detection**. Access detection allows what follows:

When...	Then...
no motion is detected in the protective field	the safety outputs remain active
motion is detected in the protective field	• the access detection function remains active • the safety outputs are deactivated • the sensitivity remains as it was before the motion detection

WARNING
If the **Always-on access detection** is selected, additional safety measures must be introduced to ensure the restart prevention function.

6.3.2 T_{OFF} parameter

If the safety working mode is **Always-on access detection**, when the system does not detect motion anymore, the OSSD outputs remain in OFF-state for the time set in the **T_{OFF}** parameter.

The T_{OFF} value can be set from 0.1 s to 60 s.

6.4 Custom target detection

6.4.1 Introduction

The Custom target detection is a safety function that allows detecting the access of one or more objects with an RCS higher than a specific value.

Note: the Custom target detection is referred only to the access detection safety function. If the Custom target detection is enabled, it does not affect the detection capabilities of the restart prevention function or the static object detection option.

6.4.2 How to enable the Custom target detection

The Custom target detection can be enabled on each sensor individually by setting its RCS threshold to a value higher than 0 dB.

6.4.3 RCS threshold description

The RCS threshold is expressed in decibels, and it represents the RCS value above which the system guarantees 100% detection.

Note: the reference (0 dB) corresponds to 0.17 m^2, which is the RCS of a detectable human body (Human detection).

In the **Configuration** page of the safeRS3 Designer application you can set the **RCS Threshold** parameter for each sensor.

6.4.4 RCS threshold range

The minimum and the default value is 0 dB (Human detection). The maximum value is 70 dB.

For example, with the RCS threshold set to 20 dB, the system guarantees 100% detection of targets with RCS greater than 20 dB (Custom target detection).

Note: setting the **RCS Threshold** to a value different from 0 dB does not guarantee that targets with RCS lower than the threshold will be filtered out and therefore not detected.

Note: an object with an **RCS Threshold** lower than the chosen threshold could not be detected but it could create an occlusion inside the sensor field of view.

6.4.5 RCS Reader Tool

The system provides the RCS Reader Tool application to assist in setting the parameter. You can access this tool from the **Configuration** page of the safeRS3 Designer application.

For information on how to use the RCS Reader Tool, refer to RCS Reader Tool instructions, downloadable from the site www.sick.com.

6.4.6 When to enable the Custom target detection

In outdoor installations on moving elements, you may need to increase the RCS Threshold, for example, under these conditions:

- to reduce weather disturbances or any other disturbances
- to detect only collisions with large objects or other vehicles.

WARNING
This setting no longer guarantees that the system will detect human access. Take all necessary precautions to prevent people from entering the area.

6.5 Restart prevention function: static object detection option

6.5.1 Introduction

The static object detection option allows the restart prevention function also to detect static objects in the dangerous area.

Note: the static object detection is an option of the restart prevention function and therefore cannot be enabled beyond 5 m (16.4 ft).

NOTICE
The ability to detect an object depends on the RCS of the object. The static object detection option does not guarantee 100% detection of static objects.

6.5.2 Availability

The static object detection option is available for:

- control firmware version 1.5.0 or later, and
- sensor firmware version 3.0 or later.

6.5.3 Possible applications

This option can be useful if the sensor is installed on moving elements (see Installations on moving elements (Mobile application) on page 77) or to prevent the restart of a robot that could bump into a static object in the area temporarily.

6.5.4 Operation

The option can be enabled for each protective field of each sensor with the safety working mode set to **Access detection and restart prevention**. Enable the option only if the protective field is free of static objects; otherwise, the system would never reactivate the detection signals after a motion is detected in the area.

6.5.5 Settings

It is possible to increase or decrease the sensitivity of the static object detection of the sensors through the safeRS3 Designer application (**Settings** > **Advanced** > **Static object detection sensitivity**)

6.5.6 Restart timeout parameter

With the static object detection option enabled, the **Restart timeout** parameter's minimum value is 0.1 s.

WARNING
If the Restart timeout is set to a value less than 4 s, the sensor is no longer able to detect breathing movement or the movements necessary for a person to remain in balance in an upright or a squatting position. Set a value less than 4 s only for areas where people have no access.

6.6 Features of the restart prevention function

6.6.1 Sensor positioning guidelines

The restart prevention function is effective if the sensor can detect a person's movements or their static residual movements. To detect people who are not standing or squatting, it is important that the sensor can clearly detect the person's chest.

Particular attention should be paid to the following situations:

- There are objects that limit or prevent the sensor from detecting motion.
- The risk assessment requires the detection of a lying person and the sensor is installed at a height below 2.5 m (8.2 ft) or with an inclination lower than 60° downward.
- The sensor does not detect a sufficient portion of the body or does not properly detect the person's chest.

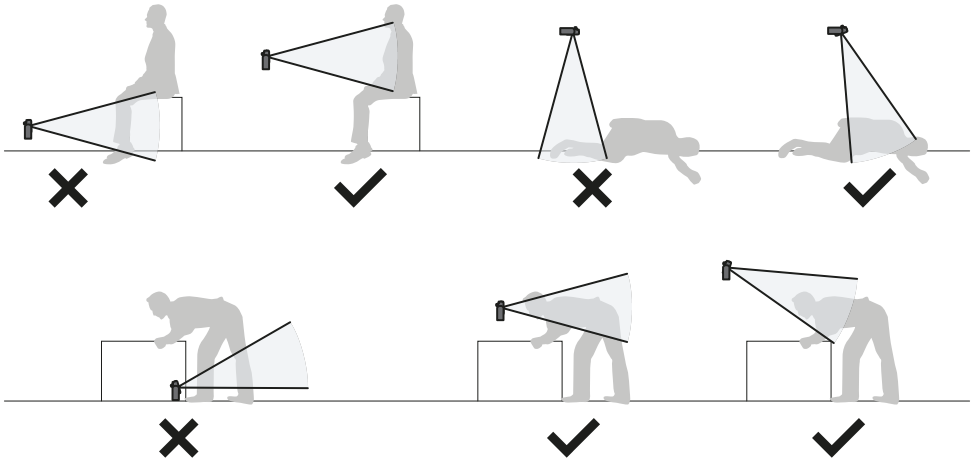
A validation procedure (see Validate the safety functions on page 93) must be performed when one or more of the above conditions are met.

If the conditions described above limit the performance of the sensor, take the following steps to reach an appropriate level of performance:

- Increase the **Restart timeout** parameter.
- Change the position of the sensors.
- Add more sensors.

If one or more of the above actions are taken, it is recommended to perform a validation procedure (see Validate the safety functions on page 93).

Below are some examples of situations where the above conditions are not met (X) and how to properly position the sensor (✓). These examples are not meant to be exhaustive.



6.6.2 Types of managed restart

NOTICE

It is the responsibility of the machinery manufacturer to assess if automatic restart can guarantee the same level of safety as manual restart (as defined in standard EN ISO 13849-1:2015, section 5.2.2).

For each protective field independently, the system manages three types of restart:

Type	Conditions for enabling machinery restart	Safety working mode allowed
Automatic	The time interval set through the safeRS3 Designer application (**Restart timeout**) has passed since the last motion detection[1].	All
Manual	The **Restart signal** was received correctly[2] (see Restart signal (dual channel, redundancy mode coherent) on page 149).	**Always-on access detection**
Safe manual	• The time interval set through the safeRS3 Designer application (**Restart timeout**) has passed since the last motion detection[1] and • The **Restart signal** was received correctly[2] (see Restart signal + System recondition (dual channel, redundancy mode coherent) on page 152).	**Access detection and restart prevention**

WARNING
If the Automatic restart is set with the Safety working mode Always-on access detection, the restart prevention safety function is not performed, and consequently, the system does not guarantee the detection of a person within the monitored area.

Note[1)]: machinery restart is enabled if no motion is detected up to 35 cm (13.8 in) beyond the protective field.

Note[2)]: (for all types of restart) other dangerous system statuses may prevent the restart of the machinery (e.g., diagnostic fault, sensor masking, etc.)

6.6.3 Precautions for preventing unexpected restarting

To prevent unexpected restarting, if the sensor is installed at a height of less than 15 cm (5.9 in) from the ground to its center, a minimum distance of 50 cm (20 in) from the sensor must be guaranteed.

Note: if the sensor is installed at a height of less than 15 cm (5.9 in) from the ground to its center, an option is to enable the masking function to generate a system error if a person stands in front of the sensor.

6.6.4 Configure the restart function

WARNING
If the **Restart signal** function has been enabled both through the safety Fieldbus and the digital inputs, the functionality can be activated from both of them.

Type	Procedure
Automatic	1. In the safeRS3 Designer application in **Settings** > **Restart function**, select **Automatic**. 2. In the safeRS3 Designer application, in **Configuration** for each protective field in use with automatic restart, select the desired **Safety working mode** and set the **Restart timeout** (or the $\mathbf{T_{OFF}}$ parameter, if present).
Manual	1. In the safeRS3 Designer application in **Settings** > **Restart function**, select **Manual**. 2. If there is a digital input configured as **Restart signal** (**Settings** > **Digital Input-Output**), connect the machinery button for the restart signal as convenient (see Electrical connections on page 133). 3. To use the Fieldbus communication for the restart signal, make sure that no digital input is configured as **Restart signal** (**Settings** > **Digital Input-Output**). See the Fieldbus protocol for details. 4. In the safeRS3 Designer application, in **Configuration** for each protective field in use with manual restart, set the $\mathbf{T_{OFF}}$ parameter value. **Note**: the **Safety working mode** is automatically set to **Always-on access detection** for all the protective fields in use with manual restart.

Type	Procedure
Safe manual	1. In the safeRS3 Designer application in **Settings** > **Restart function**, select **Safe manual**. 2. If there is a digital input configured as **Restart signal** (**Settings** > **Digital Input-Output**), connect the machinery button for the restart signal as convenient (see Electrical connections on page 133). 3. To use the Fieldbus communication for the restart signal, make sure that no digital input is configured as **Restart signal** (**Settings** > **Digital Input-Output**). See the Fieldbus protocol for details. 4. In the safeRS3 Designer application, in **Configuration** for each protective field in use with safe manual restart, select the **Safety working mode** among those allowed and set the **Restart timeout** parameter value.

7 Other functions

7.1 Muting

7.1.1 Description

The muting function is an additional safety-related function that inhibits the sensing capability of the sensor on which it is activated. It can be activated for a specific sensor or for a group of sensors. This results in keeping the ON-state of the OSSD or the safety Fieldbus even when the muted sensors detect motion.

When the muting function is enabled, its effective activation on one or more sensors occurs only as soon as the conditions permit (see Muting above).

7.1.2 Muting enabling

The muting function can be enabled through digital input (see Enable muting signal characteristics on the next page) or safety Fieldbus (if available).

WARNING
If the muting function has been enabled through the safety Fieldbus and the digital inputs, only the digital inputs enabling is considered for the function.

WARNING
When the sensor is in muting, no sensor error is available (see ERROR events (sensor) on page 117).

Through the safety Fieldbus (if available) the muting function can be enabled for each sensor individually.

Through digital inputs the muting function can be enabled for all the sensors simultaneously or only for a group of sensors. Up to two groups can be configured, each associated with a digital input.

Through the safeRS3 Designer application, the following must be defined:

- for each input, the group of managed sensors
- for each group, the sensors that belong to it
- for each sensor, whether it belongs to a group or not

Note: if the muting function is enabled for one sensor, it is enabled for all the protective fields of the sensor, regardless if the protective fields are dependent or independent and the anti-tampering functions are disabled for that sensor.

See Configure the inputs and outputs on page 92.

7.1.3 Muting activation conditions

The muting function is activated on a specific sensor only in the following conditions:

- All the protective fields involved have no active detection signal, no active static object detection signal, and the restart timeout has expired for all of them.
- There is no tampering signal or fault signal for that sensor.

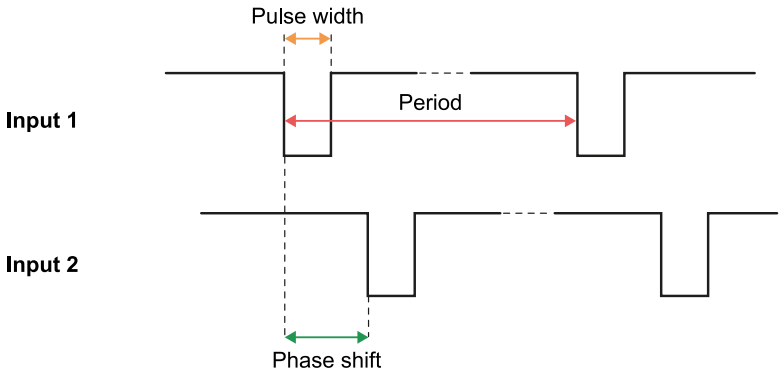
When the muting is enabled for a group of sensors, the function is activated for each sensor as soon as there is no detection in its monitored area, regardless of the status of the other sensors.

WARNING
Enable the muting signal on sensors monitoring the same dangerous area once the whole area is safe and nobody can access it. If the muting is enabled when some of the sensors are still detecting a movement, a person could move to a space monitored by a muted sensor, compromising the safety of the whole area.

7.1.4 Enable muting signal characteristics

The muting function is enabled only if both logic signals of the dedicated input meet certain characteristics.

Below is a graphic representation of the signal characteristics.



In the **safeRS3 Designer** application, in **Settings** > **Digital Input-Output** it is necessary to set the parameters that define the signal characteristics.

Note: with pulse duration = 0, it is sufficient that the input signals are at high logic level (1) to enable muting.

7.1.5 Muting status

Any output dedicated to the muting status (Muting enable feedback signal) is activated if at least one of the groups of sensors is in muting.

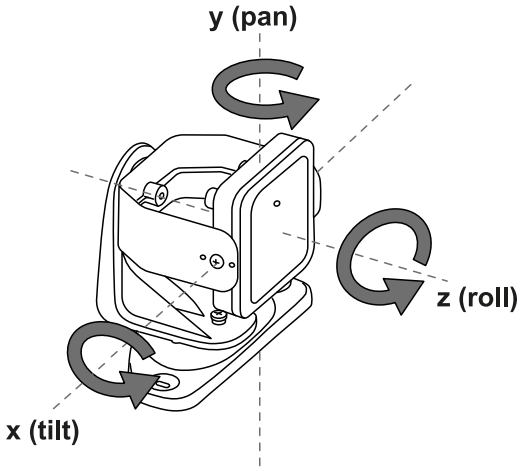
NOTICE
It is the responsibility of the machinery manufacturer to assess whether the indication of the muting status is necessary (as defined in section 5.2.5 of EN ISO 13849-1:2015 standard).

7.2 Anti-tampering functions: anti-rotation around axes

7.2.1 Anti-rotation around axes

The sensor detects rotation around its axes.

Note: the axes are those represented in the figure below, regardless of the installation position of the sensor.



When the system configuration is saved, the sensor also saves its position. Later, if the sensor detects changes in rotation around these axes, it sends a tamper alert to the control. Upon reception of a tampering signal, the control deactivates the safety outputs.

Note: when the position is modified with respect to the saved references (i.e., when a sensor is rotated) and the anti-rotation around axes function is enabled, the safeRS3 detects the tampering and sends the message within 5 s.

The sensor can detect changes in rotation around the x-axis and the z-axis even if it is switched off. The tamper alert is sent to the control at the following switch on.

A change in rotation around the y-axis is detected only if it is faster than 5 ° every 10 s and if the system is on.

WARNING
The tamper alert due to a rotation around the y-axis is reset at the next switch on. For proper and safe operation of the system, validate the system again.

7.2.2 Enable the anti-rotation around axes function

The anti-rotation around axes function is disabled by default.

WARNING
If the function is disabled, the system cannot signal a change in the rotation of the sensor around the axes and, therefore, any changes in the monitored area. See Checks when the anti-rotation around axes function is disabled on the next page.

WARNING
Take precautions to prevent tampering, if the function is disabled for at least one axis of one sensor and if the rotation around that axis is not protected with tamper-proof screws.

The function can be enabled and configured for each axis of each sensor individually. In the safeRS3 Designer application, in **Settings** > **Anti-tampering**, click on the specific option to enable the function for a sensor.

7.2.3 When to enable

Enable the anti-rotation around axes function only if it is necessary to detect a change in the rotation of a sensor around a specific axis.

It is strongly suggested not to enable the function if the sensor is installed on a moving object (e.g., carriage, vehicle) whose motion could change the sensor inclination (e.g., motion on a slope or in a curve).

7.2.4 Checks when the anti-rotation around axes function is disabled

When the anti-rotation around axes function is disabled, perform the following checks.

Safety function	Schedule	Action
Access detection function	Before each machinery restart	Check that the sensor is positioned as defined in the configuration. Check that the monitored area is the same as defined by the configuration. See Validate the safety functions on page 93.
Restart prevention function	Each time the safety outputs are deactivated	

7.3 Anti-tampering functions: anti-masking

7.3.1 Masking signal

The sensor detects the presence of objects that could obstruct the field of view. When the system configuration is saved, the sensor memorizes the surrounding environment. If the sensor subsequently detects variations in the environment that could influence the field of view, it sends a masking signal to the control. The sensor monitors from -50° to 50° on the horizontal plane regardless of the angular coverage set. Upon receiving a masking signal, the control deactivates the safety outputs.

Note: the masking signal is not guaranteed in the presence of objects which cause reflection effects that bring their RCS below the minimum detectable threshold.

Note: when the position is modified with respect to the saved references (i.e., when a sensor is masked) and the anti-rotation around axes function is enabled, the safeRS3 detects the tampering and notifies it within 5 s.

7.3.2 Environment memorization process

The sensor starts the surrounding environment memorization process when the safeRS3 Designer application configuration is saved. From that moment, it waits for the system to exit the alarm status and for the scene to be static up to 20 seconds, then scans and memorizes the environment.

NOTICE
If the scene is not static during the 20 seconds interval, the system remains in a fault status (SIGNAL ERROR) and the system configuration must be saved again.

Note: It is recommended to start the memorization process after at least 3 minutes from turning on the system to guarantee that the sensor has reached the operating temperature.

Only at the conclusion of the memorization process it is possible for the sensor to send masking signals.

7.3.3 Causes of masking

Possible causes of masking signals are the following:

- An object that obstructs the field of view of the sensor has been placed in the protective field.
- The environment in the protective field changes significantly, for example, if the sensor is installed on moving parts or if there are moving parts inside of the protective field.
- The configuration was saved with sensors installed in an environment that is different from the working environment.
- There were temperature fluctuations.

7.3.4 Masking signal when the system is turned on

If the system was off for several hours and there were temperature fluctuations, the sensor might send a false masking signal when it is turned on. The safety outputs activate automatically within 3 minutes when the sensor reaches its working temperature. This does not happen if this temperature is still very far from the reference temperature.

7.3.5 Settings

For each sensor, the anti-masking settings are the following:

- maximum distance from the sensor (range [20 cm/7.87 in, 100 cm/3.28 ft], 10 cm/3.94 in steps) in which the function is active
- sensitivity

These are the four levels of sensitivity:

Note: the function has a tolerance area where the actual detection of a masking object depends on the RCS of the object and on the sensitivity level set. The high sensitivity level has the largest area, about 10-20 cm (3.94-7.87 in).

Level	Description	Example application
High	The sensor has the highest sensitivity to changes in the environment. (Suggested level when the field of view is empty up to the set masking distance)	Installations with an empty environment and a height of less than one meter, where objects could occlude the sensor.
Medium	The sensor has low sensitivity to changes in the environment. Occlusion must be evident (deliberate tampering).	Installations with a height of more than one meter, where masking is likely to occur only if voluntary.

Level	Description	Example application
Low	The sensor detects masking only if the sensor occlusion is complete and the objects are highly reflective (e.g., metal, water) near the sensor.	Installations on moving parts, where the environment is changing continuously, but where static objects may be near the sensor (obstacles on the route).
Disabled	The sensor does not detect changes in the environment. ⚠ **WARNING** If the function is disabled the system cannot signal the presence of objects that might impede normal detection (see Checks when the anti-masking function is disabled below).	See When to disable below.

To change the sensitivity level or disable the function, in the safeRS3 Designer application, click **Settings** > **Anti-tampering** and search for **Anti-masking sensitivity**.

To set the distance, in the safeRS3 Designer application, click **Settings** > **Anti-tampering** and search for **Anti-masking distance**.

7.3.6 Checks when the anti-masking function is disabled

When the anti-masking function is disabled, perform the following checks.

Safety function	Schedule	Action
Access detection function	Before each machinery restart	Remove any objects that obstruct the field of view of the sensor. Reposition the sensor according to the initial installation.
Restart prevention function	Each time the safety outputs are deactivated	

7.3.7 When to disable

The anti-masking function should be disabled under the following conditions:

- (With restart prevention function) The monitored area includes moving parts that stop in different and unpredictable positions.
- The monitored area includes moving parts that vary their position while the sensors are in muting.
- The sensor is positioned on a part that can be moved.
- The presence of static objects is tolerated in the monitored area (e.g., loading/unloading area).

7.4 Auto-resume

7.4.1 Introduction

Some transient faults cause a permanent lock-out condition that prevents normal operation from being restored.

While the safe state is maintained, this behavior represents a limitation, especially for remote systems that are not easily accessible.

The Auto-resume function tries to restore the normal functioning of the sensor for five consecutive attempts: if the fault condition persists, the block condition is preserved. Otherwise, the normal functioning condition is automatically restored.

7.4.2 Function limitations

The following faults are not subjected to auto-resume:

- POWER ERROR
- SIGNAL ERROR
- TAMPER ERROR
- TEMPERATURE ERROR

The function is not performed when the sensor is muted.

7.5 Electromagnetic Robustness

7.5.1 Electromagnetic robustness parameter

With the **Electromagnetic robustness** parameter, it is possible to increase the robustness of the system to electromagnetic interference (e.g., due to sensors of different systems installed too close to each other or problems on the CAN bus).

In the safeRS3 Designer application in **Settings** > **Advanced**, the following levels of robustness can be set:

- **Standard** (default)
- **High**
- **Very High**

WARNING

The parameter impacts the system response time for the access detection safety function. According to the chosen level, the maximum guaranteed response time is 100 ms (Standard), 150 ms (High), or 200 ms (Very High).

8 Sensor position

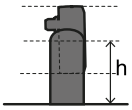
8.1 Basic concepts

8.1.1 Determining factors

The sensor installation height and inclination should be decided together with the angular coverage and the detection distances in order to have optimal coverage of the dangerous area.

8.1.2 Sensor installation height

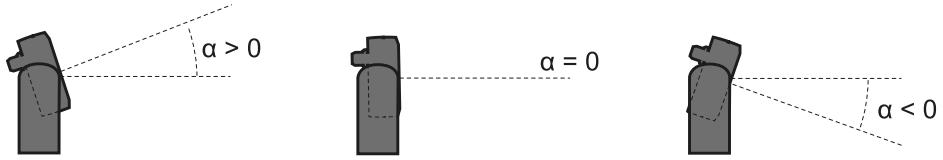
The installation height (h) is the distance between the center of the sensor and the ground or reference plane of the sensor.



8.1.3 Sensor inclination

Sensor inclination is the rotation of the sensor around its x-axis. Inclination is defined as the angle between a line perpendicular to the sensor and a line parallel to the ground. Three examples are presented as follows:

- sensor tilted upwards: α positive
- straight sensor: α = 0
- sensor tilted downwards: α negative



8.2 Sensor field of view

8.2.1 Types of field of view

During the configuration phase, for each sensor it is possible to select the angular coverage (see Angular coverage on page 47).

The actual protective field of the sensor also depends on the sensor installation height and inclination (see Calculation of range of distances on page 74).

The standard shapes of the field of view are described below. The Classic and Corridor shapes are also available (see Advanced field of view on page 70).

8.2.2 Areas and dimensions of the field of view

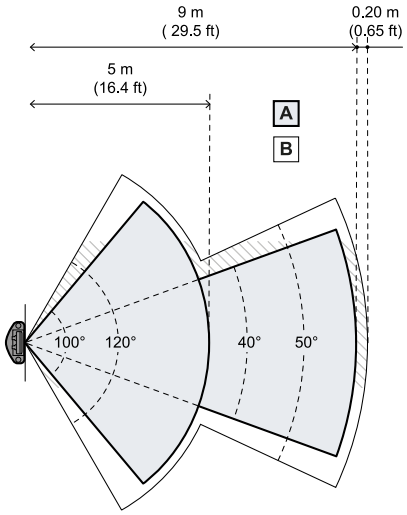
The sensor field of view is composed of two areas:

- protective field **[A]**: where detection of objects similar to humans in any position is guaranteed
- tolerance area **[B]**: where the actual detection of a moving object/person depends on the characteristics of the object itself (see Factors that influence the reflected signal on page 46)

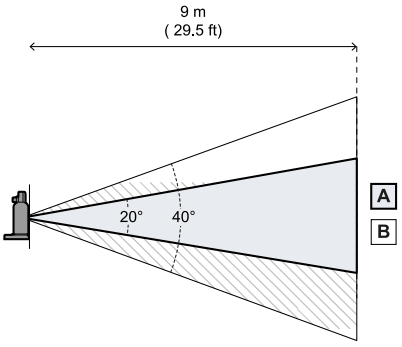
8.2.3 Dimensions for the access detection function

Note: the tolerance area dimensions described are related to the detection of humans.

The horizontal tolerance area is 20° greater than the angular coverage set.



Top view

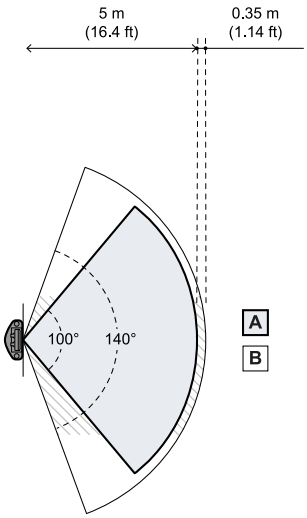


Side view

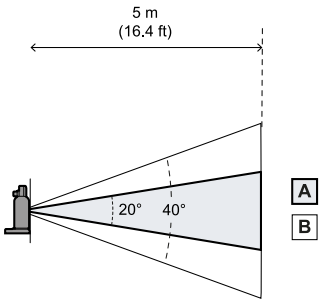
8.2.4 Dimensions for the restart prevention function

Note: the tolerance area dimensions described are related to the detection of humans.

The horizontal tolerance area is 40° greater than the angular coverage set.



Top view

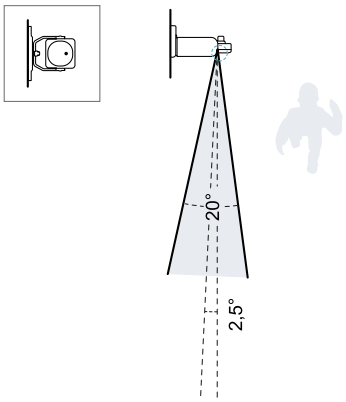


Side view

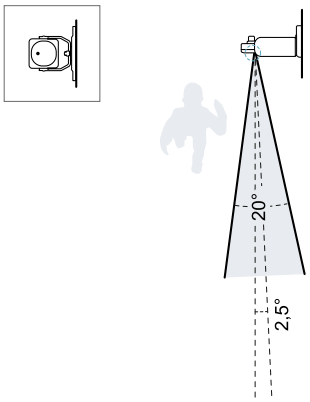
8.2.5 Position of the field of view

The field of view is shifted of 2.5°. To understand the actual position of the sensor field of view consider the LED position:

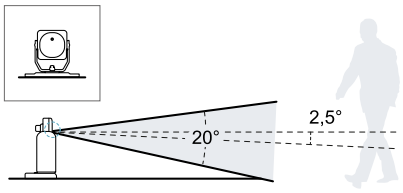
- left with sensor LED on the right (with respect to the sensor center, facing the sensor)
- right with sensor LED on the left (with respect to the sensor center, facing the sensor)
- downward with sensor LED up



Top view with sensor inclination 0°.



Top view with sensor inclination 0°.



Side view with sensor inclination 0 °.

8.3 Advanced field of view

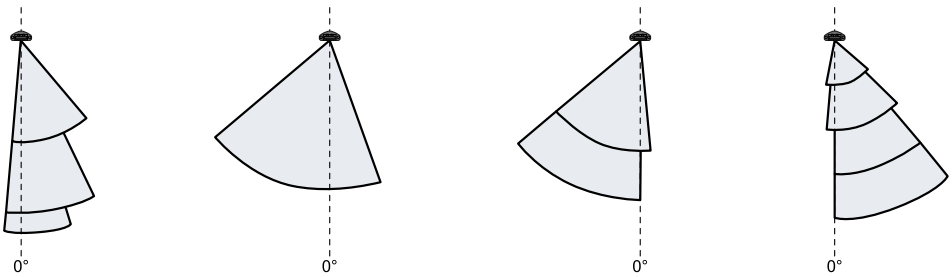
8.3.1 Introduction

For each sensor, two field of view shapes are available:

- Classic
- Corridor

8.3.2 Classic field of view

The classic shape allows you to choose the standard shape of the field of view and, if desired, to make it asymmetric. Each protective field can have its own symmetric/asymmetric angular coverage.

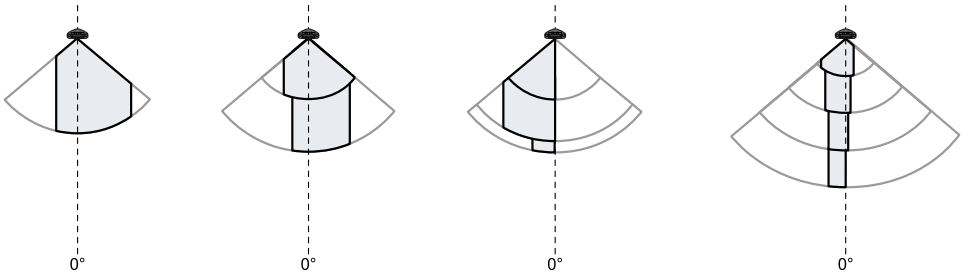


Conditions:

- The sensor axis must always be included in all the protective fields.
- The angular coverage of each protective field must be wider than, or equal to, the angular coverage of the following protective fields.
- The minimum field of view width is 10°.

8.3.3 Corridor field of view

The corridor shape allows to customize the shape of the field of view. Starting from the standard shape with maximum angular coverage, it is possible to crop it on the side with two flat surfaces parallel to the axis of the sensor. Each protective field can have its own corridor width.



Conditions:

- The sensor axis must always be included in all the protective fields.
- The angular coverage of each protective field must be wider than, or equal to, the angular coverage of the following protective fields.
- The minimum corridor width is:
  - 20 cm (7.87 in) in the first 5 m (16.4 ft) of the field of view
  - 30 cm (11.81 in) from 5 to 9 m (from 16.4 to 29.5 ft) of the field of view

8.4 Dangerous area calculation

8.4.1 Introduction

The dangerous area of the machinery to which safeRS3 is applied must be calculated according to the formulas described in this section, which are defined considering the guidelines and requirements of the ISO 13855:2010 (and ISO DIS 13855) standard.

8.4.2 Formula for stationary application

To calculate the depth of the dangerous area (S) for stationary applications, use the following formula:

$$S = K * T + C$$

Where:

Variable	Description	Value	Measurement unit
K	Maximum dangerous area access speed	1600	mm/s
T	Total system stopping time (safeRS3 + machinery)	0.1 + Machinery stopping time (calculated in accordance with standard ISO 13855:2010)	s

Variable	Description	Value	Measurement unit
C	Corrective value	If H ≤ 1000, C = 1200	mm
		If 1000 < H < 1400, C = 1200 - [(H - 1000) * 0.875]	mm
		If H ≥ 1400, C = 850 For more details about H, see H dimension definition below.	mm

Note: when using Fieldbus, add the communication and processing time required for the signal to reach the machine after the safety output is activated.

Example 1

- Machinery stopping time = 0.5 s
- H ≥ 1400

T = 0.1 s + 0.5 s = **0.6 s**

S = 1600 * **0.6** + **850** = **1810 mm**

Example 2

- Machinery stopping time = 0.3 s
- H = 1200

T = 0.1 s + 0.3 s = **0.4 s**

C = 1200 - [(1200-1000)* 0.875] = 1025 mm

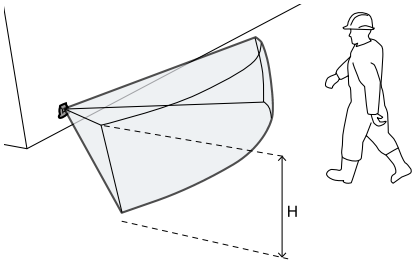
S = 1600 * **0.4** + **1025** = **1665 mm**

8.4.3 H dimension definition

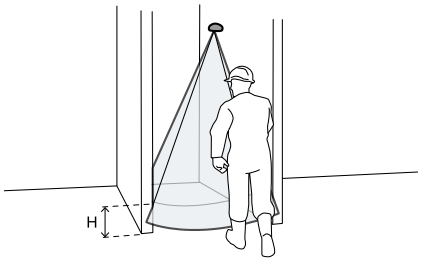
According to the approach, the H dimension has to be considered in the following way:

- for the parallel approach, H is the upper edge of the detection field **[A]**
- for the orthogonal approach, H is the highest point of intersection between the detection field and the body of a standing person, defined in the worst-case penetration position **[B]**, **[C]**, **[D]**

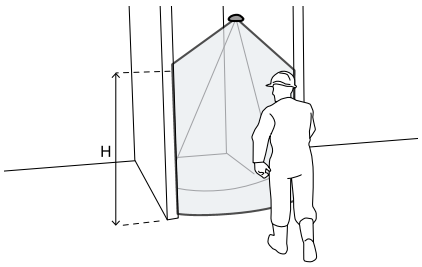
Note: **[A]**, **[B]**, **[C]** and **[D]** are examples to define H and not suggestions on how to install the sensor. For details about the calculation of H, please refer to the application notes downloadable from the site www.sick.com. For details about the difference between the two approaches, please refer to standard ISO 13855.



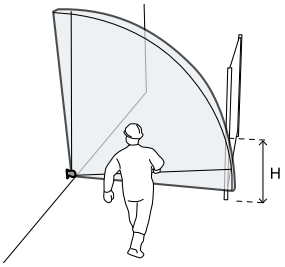
[A]



[B]



[C]



[D]

8.4.4 Formula for mobile application

To calculate the depth of the dangerous area (S) for mobile applications, use the following formula:

$$S = K * T + C$$

Where:

Variable	Description	Value	Measurement unit
K	Maximum vehicle/part of machinery speed [1].	≤ 4000	mm/s
T	Total system stopping time (safeRS3 + machinery)	0.1 + Machinery stopping time (calculated in accordance with standard ISO 13855:2010)	s
C	Corrective value	200	mm

Note[1]: only the speed of the vehicle or of the part of machinery is considered. This is based on the assumption that the person recognizes the hazard and stands still.

Note: when using Fieldbus, add the communication and processing time required for the signal to reach the machine after the safety output is activated.

Example 1

- maximum vehicle speed = 2000 mm/s
- machinery stopping time = 0.5 s

T = 0.1 s + 0.5 s = **0.6 s**

S = 2000 * **0.6** + **200** = **1400 mm**

8.5 Calculation of range of distances

8.5.1 Introduction

The range of detection distances for a sensor depends on the inclination (**α**) and the installation heights (**h**) of the sensor. The detection distance of each protective field (**Dalarm**) depends on a distance **d** that must be within the range of distances allowed.

The formulas for calculating the distances are reported as follows.

WARNING
Define the optimum sensor position according to the risk assessment requirements.

8.5.2 Legend

Element	Description	Measurement unit
α	Sensor inclination	degrees
h	Sensor installation height	m
d	Detection distance (linear) Must be within the range of distances allowed (see Installation configurations below).	m
Dalarm	Detection distance (real)	m
D_1	Start detection distance (for configuration 2 and 3); end detection distance (for configuration 1)	m
D_2	End detection distance (for configuration 3)	m

8.5.3 Installation configurations

Three configurations are possible based on the inclination of the sensor (**α**)

- **α** ≥ +13°: configuration 1, the field of view of the sensor never intersects the ground
- -7° ≤ **α** ≤ +12°: configuration 2, the upper portion of the field of view of the sensor never intersects the ground
- **α** ≤ -8°: configuration 3, the upper portion and the bottom portion of the field of view always intersect the ground

Note: the positive sign (+) indicates the tilt up, while the negative sign (-) the downward tilt.

8.5.4 Calculate the range of distances

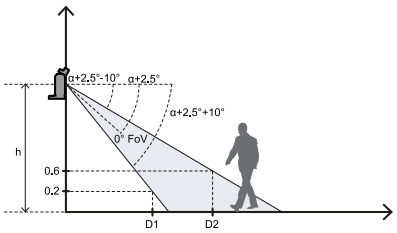
The range of detection distances for a sensor depends on the configuration:

Configuration	Range of distances
1	From 0 m to D_1
2	From D_1 to 9 m
3	From D_1 to D_2

$$D_1 = \frac{h-0.2}{tan((-\alpha)+2.5^\circ+10^\circ)}$$

$$D_2 = \frac{h-0.6}{tan((-\alpha)+2.5^\circ-10^\circ)}$$

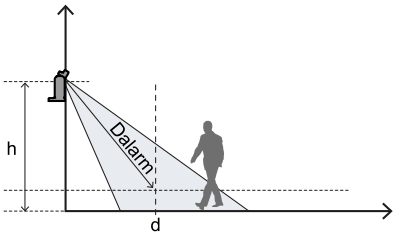
Below is an example for configuration 3, with D_1 = 0.9 m and D_2 = 1.6 m.



8.5.5 Calculate the real detection distance

The actual detection distance **Dalarm** is the value to be entered on the **Configuration** page of the safeRS3 Designer application.

Dalarm indicates the maximum distance between the sensor and the object to be detected.



$$Dalarm = \sqrt{d^2 + (h-0.2)^2}$$

8.6 Sensor position recommendations

8.6.1 For access detection function

Below are some recommendations for the sensor positioning for the access detection function:

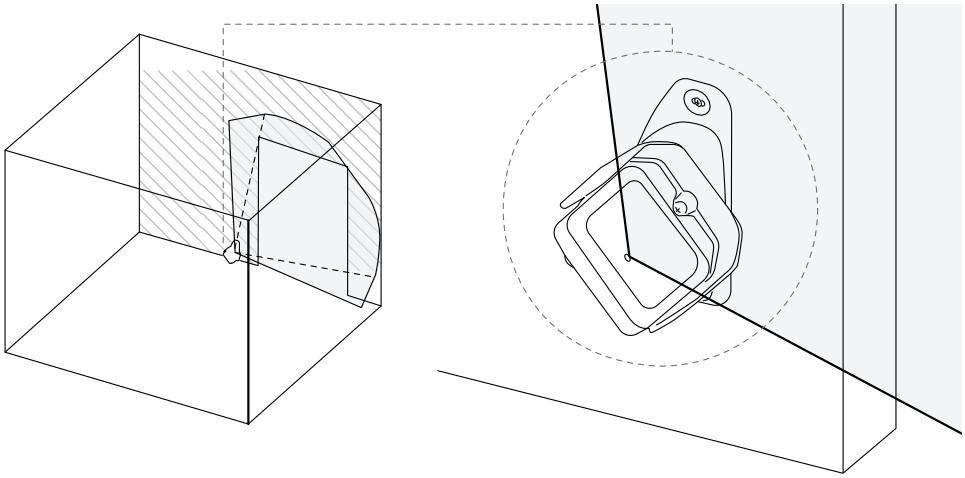
- If the distance between the ground and the bottom portion of the field of view is greater than 20 cm (7.9 in), take precautions to make sure that even a person entering the dangerous area below the volume monitored by the field of view is still detected.
- If the height above the ground is less than 20 cm (7.9 in), install the sensor with an inclination of minimum 10° upwards.
- The installation height (from the ground to the center of the sensor) must be greater than or equal to 15 cm (5.9 in).

8.6.2 For access control of an entrance

Below are some recommendations for the sensor positioning if it is installed for controlling an entrance:

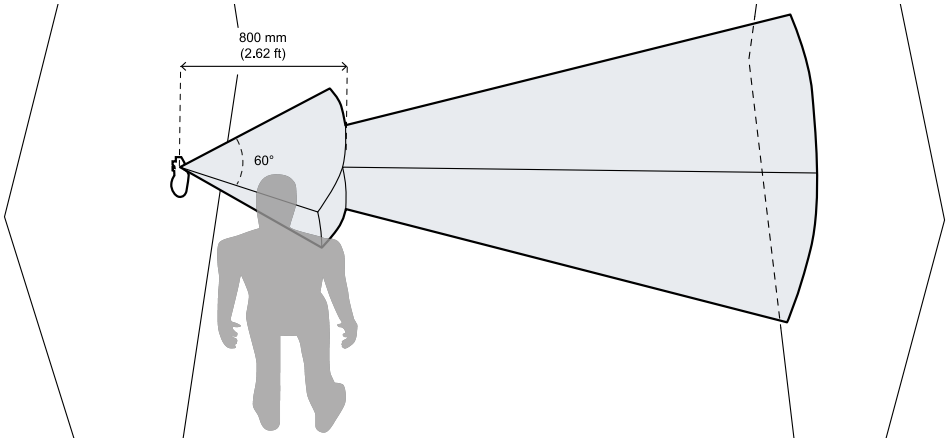
- The installation height (from the ground to the center of the sensor) must be greater than or equal to 20 cm (7.9 in).
- The angular coverage must be 90°.
- The inclination must be 40° upwards.
- The rotation around the z-axis must be 90°.

Below is an example:



WARNING

The angular coverage in the first 800 mm (31.5 in) of the field of view must be at least 60°. If this specification cannot be respected, take precautions to avoid the access of a human in the first 800 mm (31.5 in) of the field of view.



8.6.3 For restart prevention function

Below are some recommendations for the sensor positioning for the restart prevention function:

- The installation height (from the ground to the center of the sensor) must be greater than or equal to 15 cm (5.9 in).

8.7 Installations on moving elements (Mobile application)

8.7.1 Introduction

The sensors can be mounted on moving vehicles or moving machinery parts.

The characteristics of the protective field and the response time are the same as in stationary installations.

8.7.2 Speed limits

The detection is guaranteed only if the speed of the vehicle or part of the machinery is from 0.1 m/s (0.33 ft/s) to 4 m/s (13.12 ft/s).

Note: only the speed of the vehicle or of the part of machinery is considered. This is based on the assumption that the person recognizes the hazard and stands still.

8.7.3 Detection signal generation conditions

When the sensor is mounted on moving parts, it will detect static objects as moving objects.

The sensor will trigger a detection signal if the following conditions are met:

- For Human detection (**RCS Threshold** equal to 0 dB), the RCS (Radar Cross-Section) of one or more static objects is greater than or equal to the RCS of a human body.
- For Custom target detection (**RCS Threshold** greater than 0 dB), the RCS of one or more static objects is greater than or equal to the RCS value set in **RCS Threshold**.
- The relative speed between the objects and the sensor is greater than the minimum speed necessary for detection.

8.7.4 Prevention of unexpected restart

As for stationary installations, when the moving part where the sensor is installed is arrested because of detection, the system will switch to restart prevention safety function (if **Safety working mode** is not **Always-on access detection**), and the sensor will detect the presence of a human body (see Sensor positioning guidelines on page 56). Static objects are then automatically filtered out and no longer detected.

The restart of the moving vehicle or moving part of the machinery in the presence of static objects can be prevented using the following methods:

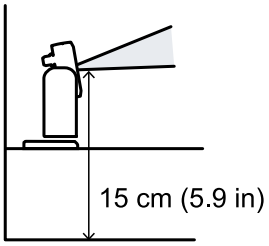
- Static object detection option enabled (see Restart prevention function: static object detection option on page 55).
- Anti-masking function: if the function is enabled, an error will occur when the static object will be close enough to limit the detection of the sensor.

Note: if the anti-masking function is active when the sensor is moving also, this could generate false alarms since the environment change during movement could be detected as tampering.

- Manual restart: the restart is triggered externally and only once the static object is removed from the trajectory of the moving vehicle or moving part.
- Application logic on PLC/control that permanently stops the moving part if multiple stops occur immediately after the restart of the part. If the vehicle or the part stops very quickly after the restart, this probably means that there is a static obstacle. Once the moving part is stopped, the sensor does not detect the object anymore and therefore the part moves but it stops again as soon as it detects the object again.

8.7.5 Recommendations for positioning the sensor

In mobile applications, the sensor moves with the vehicle or moving machinery parts. Position the sensor so the floor is excluded from its detection field to avoid undesired alarms.



8.8 Outdoor installations

8.8.1 Position exposed to precipitation

If the sensor installation position might be exposed to precipitation that can cause undesired alarms, it is recommended to take the following precautions:

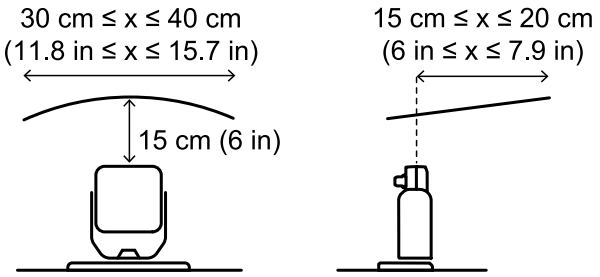
- Make a cover to protect the sensor from rain, hail or snow.
- Position the sensor so that it does not frame the ground where puddles might form.

NOTICE
Weather conditions outside specifications can prematurely age the device.

8.8.2 Recommendations for covering the sensor

Below are some recommendations for creating and installing a sensor cover:

- height from sensor: 15 cm (6 in)
- width: minimum 30 cm (11.8 in), maximum 40 cm (15.7 in)
- protrusion from the sensor: minimum 15 cm (6 in), maximum 20 cm (7.9 in)
- water outflow: at the sides or behind but not in front of the sensor (the cover should be arched and/or tilted backwards)



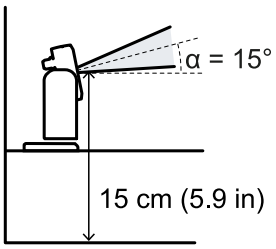
8.8.3 Recommendations for positioning the sensor

Below are some recommendations for defining the sensor position:

- installation height (from the ground to the center of the sensor): minimum 15 cm (5.9 in)
- suggested inclination: minimum 15°

Before installing a sensor facing downwards, make sure there are neither liquids nor radar reflective materials on the floor.

Note: if the above recommendations are followed and the monitored area is free of static objects, the system is robust against a rainfall rate up to 45 mm/h.



8.8.4 Position not exposed to precipitation

If the installation position of the sensor is not exposed to precipitation, no special precautions are required.

9 Installation and use procedures

9.1 Before installation

9.1.1 Materials required

- Two tamper-proof screws (see Tamper-proof screws specifications on page 129) to mount each sensor.
- Cables to connect the control to the first sensor and the sensors to one another (see CAN bus cables recommended specifications on page 129).
- A data USB cable with a micro-USB connector (micro-B type) or, only if the Ethernet port is available, an Ethernet cable to connect the control to the computer.
- A bus terminator (product code: 6073830) with resistance of 120 Ω for the last sensor of the CAN bus.
- A screwdriver for tamper-proof screws (see Tamper-proof screws specifications on page 129) to be used with the Hex pin security bit supplied in the control package.

9.1.2 Operating system required

- Microsoft Windows 10 or later
- Apple OS X 11.0 or later

9.1.3 Install the safeRS3 Designer application

Note: if the installation fails, the dependencies needed by the application may be missing. Update your operating system or contact our Technical Support to receive assistance.

1. Download the application from the www.sick.com website and install it on the computer.
2. With Microsoft Windows operating system, download and install from the same site also the driver for USB connection.

9.1.4 Initiate safeRS3

1. Calculate the position of the sensor (see Sensor position on page 67) and the depth of the dangerous area (see Dangerous area calculation on page 71).
2. " Install safeRS3".
3. "Configure safeRS3".
4. "Validate the safety functions".

9.2 Install safeRS3

9.2.1 Install procedure

1. "Install the control".
2. Optional. "Mount 3-axes bracket".
3. "Install the sensors".

4. "Connect the sensors to the control".
   Note: connect the sensors to the control off-site if access to the connectors becomes difficult once installed.

9.2.2 Install the control

WARNING
To prevent tampering, make sure the control is only accessible to authorized personnel (e.g., key-locked electrical panel)

1. Mount the control on the DIN rail.
2. Make electrical connections (see Terminal blocks and connector pin-outs on page 131 and Electrical connections on page 133).

NOTICE
if at least one input is connected, the SNS input "V+ (SNS)" and the GND input "V- (SNS)" must also be connected.

NOTICE
When powered, the system takes about 20 s to start.During that period, the outputs and the diagnostic functions are deactivated, and the green sensor status LEDs of the connected sensors in the controlflash.

NOTICE
make sure to avoid any EMC interference during the control installation.

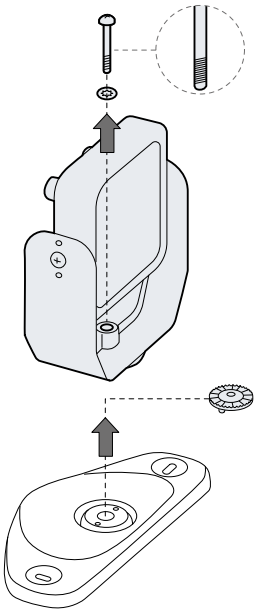
Note: to correctly connect the digital inputs, see Voltage and current limits for digital inputs on page 131.

9.2.3 Mount 3-axes bracket

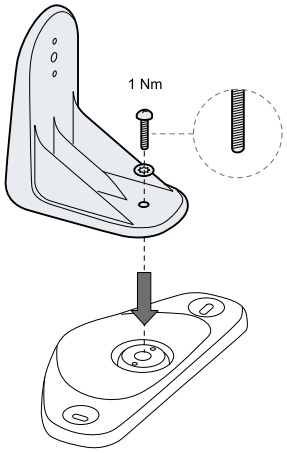
Note: for an example of sensor installation, see Examples of sensor installation on page 85.

The bracket that allows rotation around the z-axis (roll) is an accessory in the package. To mount it:

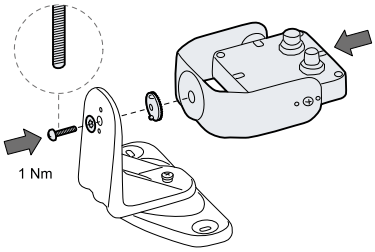
1. Unscrew the screw at the bottom and remove the bracket with the sensor and the aligning ring.



2. Attach the roll bracket to the base. Use the tamper-proof screw provided with the bracket.



3. Mount the bracket with the sensor and the aligning ring. Use the tamper-proof screw provided with the bracket.



9.2.4 Install the sensors

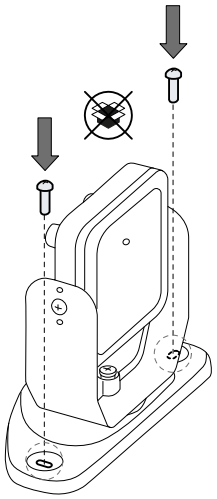
Note: for an example of sensor installation, see Examples of sensor installation on page 85.

Note: the usage of a thread-locking fluid on the threads of fasteners is suggested, especially when the sensor is installed on a moving or vibrating part of the machinery.

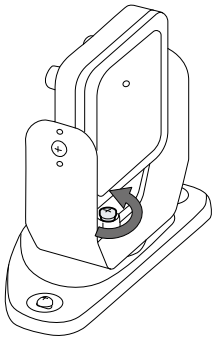
Note: if no bracket is used for sensor installation, use tamper-proof screws and threadlocker.

1. Position the sensor as indicated in the configuration report and fasten the bracket with two tamper-proof screws directly onto the floor or another support

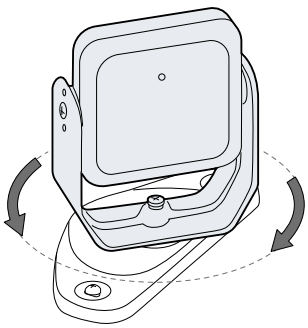
NOTICE
make sure the support does not inhibit machinery commands.



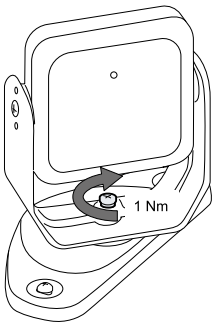
2. With an Allen key, loosen the screw at the bottom to pan the sensor.
   Note: to avoid damaging the bracket, loosen the screw completely before panning the sensor.



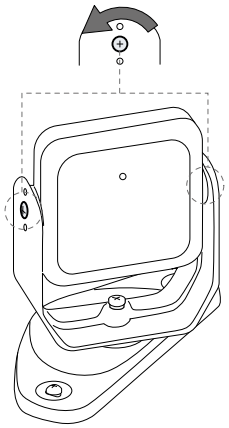
3. Pan the sensor until it reaches the desired position.
   Note: a notch is equal to a 10° of rotation.



4. Tighten the screw.

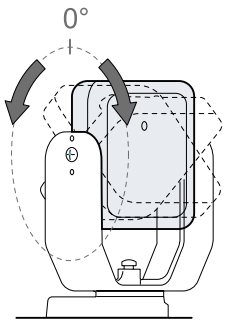


5. Loosen the tamper-proof screws to tilt the sensor.

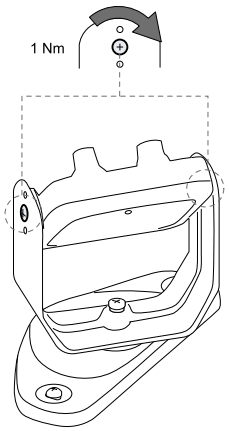


6. Tilt the sensor to the desired inclination (see Sensor position on page 67).

   Note: a notch is equal to a 10° of inclination. For a finer regulation of the sensor inclination with a 1° precision (see Set the sensor inclination with a 1° precision on page 87).



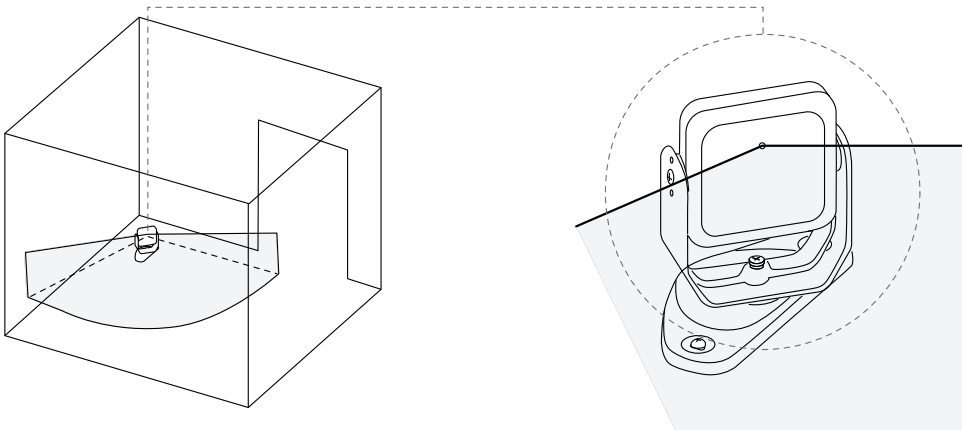
7. Tighten the screws.



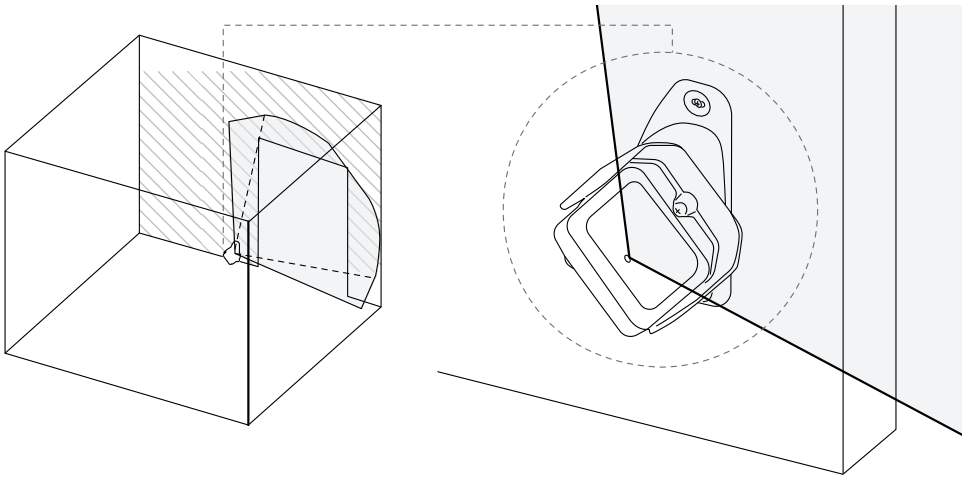
9.2.5 Examples of sensor installation

NOTICE

Refer to the sensor LED position to identify the sensor field of view (see Position of the field of view on page 69).

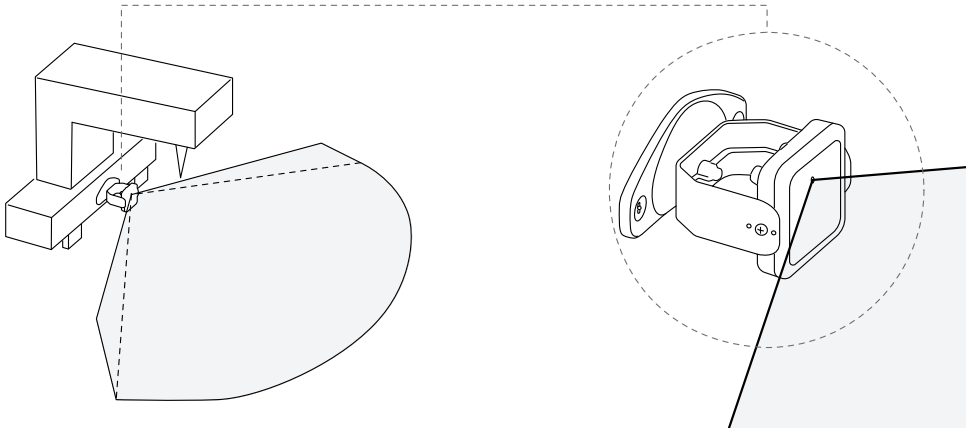


Floor installation



Wall installation (for example for access control of an entrance).

Note: install the sensor so that the field of view is tilted towards the outside of the hazardous area to avoid false alarms (seePosition of the field of view on page 69).



Installation on the machinery.

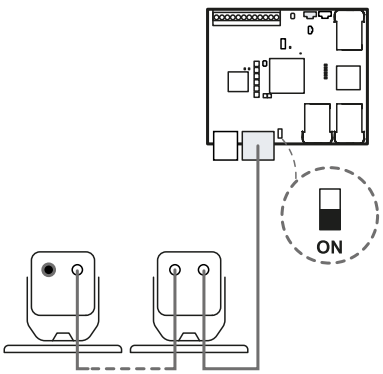
9.2.6 Connect the sensors to the control

Note: the total maximum length of the CAN bus line is 80 m (262.5 ft).

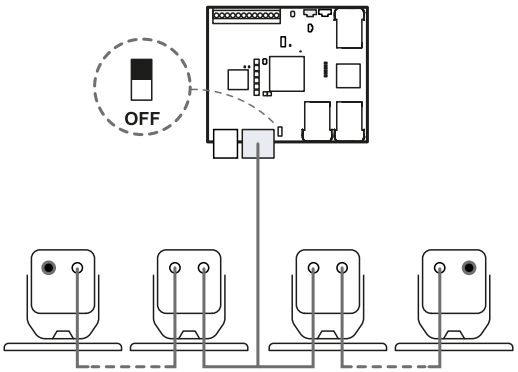
Note: when replacing a sensor, in the safeRS3 Designer application, click **APPLY CHANGES** to confirm the change.

1. With the cable validator tool (downloadable from the site www.sick.com), decide if the control will be positioned at the end of the chain or inside it (see Chain examples below).
2. Set the DIP switch of the control based on its position in the chain.
3. Connect the desired sensor directly to the control.
4. To connect another sensor, connect it to the last sensor in the chain or directly to the control to start a second chain.
5. Repeat step 4 for all the sensors to be installed.
6. Insert the bus terminator (product code: 6073830), into the free connector of the last sensor of the chain(s).

9.2.7 Chain examples



Chain with control at the end of the chain and a sensor with bus terminator

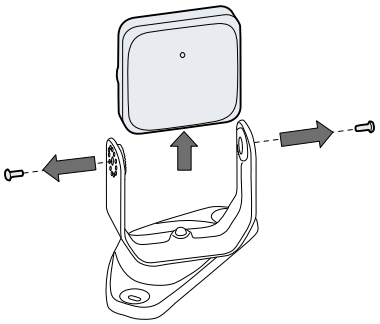


Chain with control inside the chain and two sensors with bus terminator

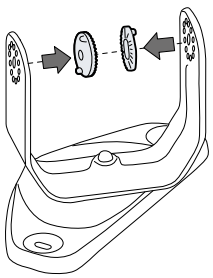
9.3 Set the sensor inclination with a 1° precision

9.3.1 Procedure

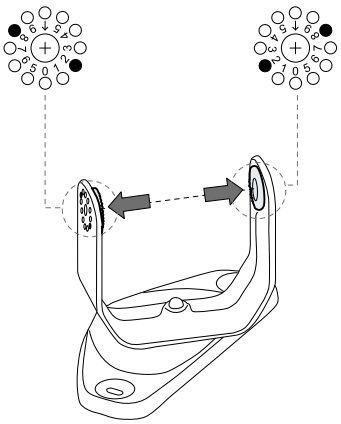
1. Remove the tamper-proof screws and remove the sensor from the bracket.



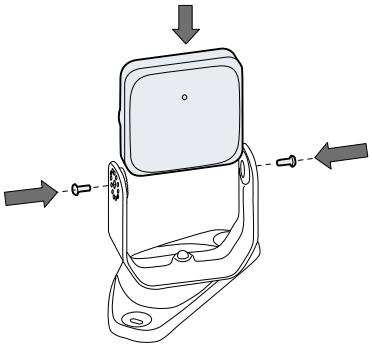
2. Remove the internal adjustment ring from the bracket.



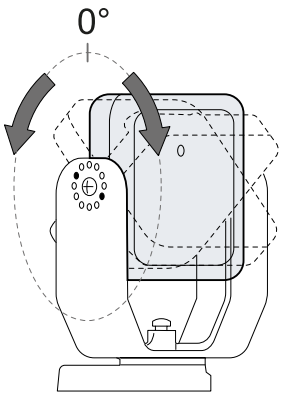
3. Reinsert the adjustment ring in the bracket holes according to the unit value of the desired inclination degrees (see How to choose the adjustment ring position on the next page).



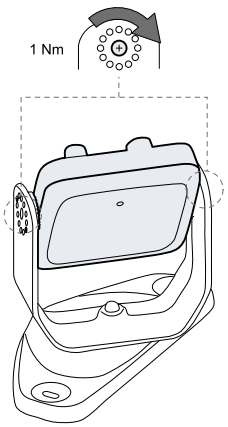
4. Insert the sensor and the tamper-proof screws in the bracket (see How to insert the sensor on the next page).



5. Tilt the sensor downward or upward the number of notches corresponding to the tens place value of the desired angle (for example, for an inclination angle of +38°, the tens place value is 3: tilt the sensor upward three notches).



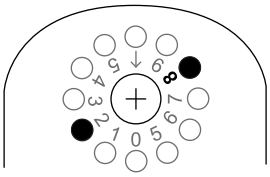
6. Tighten the screws.



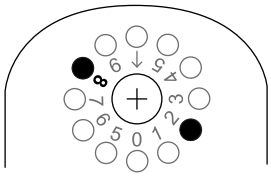
9.3.2 How to choose the adjustment ring position

On both sides of the bracket, insert the adjustment ring in the hole corresponding to the desired degree unit value (0-9°).

For example, for 8° (upward), +38° (upward) and -18° (downward) the unit value is always 8°:



Side 1



Side 2

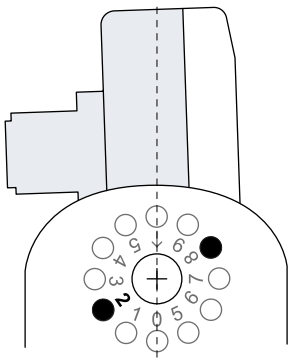
9.3.3 How to insert the sensor

To insert the sensor in the bracket, take into account the following rules:

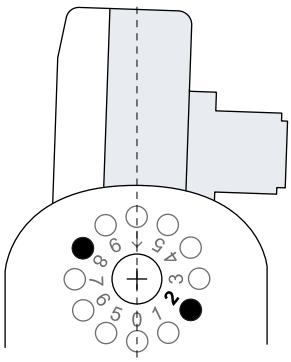
To tilt the sensor...	...then insert the sensor as follows	See
upward	with the **rear** of the case facing the desired angle	Example 1 (upward): +62° below
downward	with the **front** of the case facing the desired angle	Example 2 (downward): -37° on the next page

Example 1 (upward): +62°

In this example, the rear of the case is facing the following angles: 1°, **2°**, 3°, 4°, 5°.



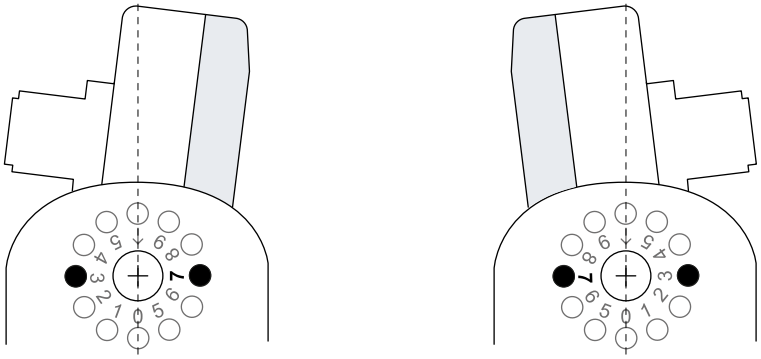
Side 1



Side 2

Example 2 (downward): -37°

In this example, the front of the case is facing the following angles: 5°, 6°, **7°**, 8°, 9°.



Side 1 *Side 2*

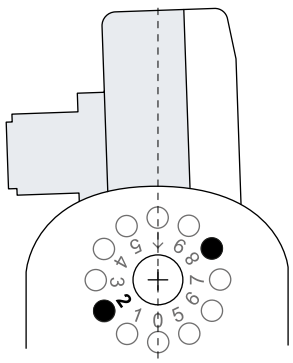
9.3.4 Example: set the sensor inclination to +62°

1. Insert the adjustment ring in the hole corresponding to 2°.

Side 1

Side 2

2. Insert the sensor in the bracket with the rear of the sensor facing the 2° angle.



3. Tilt the sensor upward of six notches.

9.4 Configure safeRS3

9.4.1 Configure procedure

1. "Start the safeRS3 Designer application".
2. "Define the area to be monitored".
3. "Configure the inputs and outputs".
4. "Save and print the configuration".
5. Optional. "Assign the Node IDs".
6. Optional. "Synchronize the controls".

9.4.2 Start the safeRS3 Designer application

1. Connect the control to the computer using a data USB cable with a micro-USB connector or the Ethernet cable (if an Ethernet port is available).
2. Supply power to the control.
3. Start the safeRS3 Designer application.
4. Choose the connection mode (USB or Ethernet).

   Note: the default IP address for the Ethernet connection is 192.168.0.20. The computer and the control must be connected to the same network.
5. Set a new admin password, memorize it, and provide it only to authorized people.
6. Select the system safeRS3, the type, and the number of sensors.
7. Optional. Reset and re-assign all Node IDs.
8. Set the country in which the system is installed.

   Note: this setting does not have any effect on system performance or safety. The country selection is requested during the first installation of the system to configure the system's radio profile, which must comply with the national regulations of the installation country.
9. Select the application type:
   - for stationary applications, select **Stationary**.
   - for installation on a machine moving gantry, on a truck on rails, on a crane, select **Mobile**.
   - for both automated guided vehicles and vehicles with driver, select **Vehicle**.

     Note: the algorithms are optimized to minimize the interference between sensors based on the installation conditions. Even though this choice does not affect the performance and the robustness, it is mandatory to select the correct application type.

Note: if the application type is set as **Stationary**, the system can manage only one dynamic configuration.

9.4.3 Define the area to be monitored

WARNING
The system is disabled during configuration. Prepare opportune safety measures in the dangerous area protected by the system before configuring the system.

1. In the safeRS3 Designer application click **Configuration**.
2. Optional. Add the desired number of sensors in the plane.
3. Define the position and inclination of each sensor.
4. Choose the area shape.
5. If necessary, set a **RCS Threshold** value higher than 0 dB to use the Custom target detection instead of the Human detection. To choose the value, click **RCS Reader Tool** to open the RCS Reader Tool. Refer to the RCS Reader Tool instructions for more information on how to use this tool.
6. Define the safety working mode, detection distance, angular coverage, and restart timeout for each protective field of each sensor.
7. Optional. Enable the **Static object detection** option for each protective field only if needed. For details, see Restart prevention function: static object detection option on page 55.

9.4.4 Configure the inputs and outputs

1. In the safeRS3 Designer application, click **Settings**.
2. Click **Digital Input-Output** and define the input and output functions.
3. If the muting is managed, click **Settings** > **Muting** and assign the sensors to the groups according to the logic of the digital inputs.
4. **Settings** > **Restart function** and choose the type of managed restart.
5. Click **APPLY CHANGES** to save the configuration.

9.4.5 Save and print the configuration

1. In the application, click **APPLY CHANGES**: the sensors will save the inclination set and the surrounding environment. The application will transfer the configuration to the control, and once transfer is complete it will generate a configuration report.
2. Click to save and print the report.
   Note: to save the PDF, a printer must be installed on the computer.
3. Ask the authorized person for a signature.

9.4.6 Assign the Node IDs

Type of assignment

Note: if the connected sensors do not already have a Node ID assigned (e.g., at first startup), the system automatically assigns them a Node ID during the installation procedure.

Three types of assignment are possible:

- Manual: to assign the Node ID to a sensor at a time. Can be performed with all the sensors already connected or after each connection. Useful for adding a sensor or to change Node ID to a sensor.

- Automatic: to assign the Node IDs to all the sensors at once. To be performed when all the sensors are connected.

  Note: the control assigns the Node ID in ascending order of sensor ID (SID).
- Semi-automatic: wizard for connecting the sensors and assign the Node ID one sensor at a time.

Procedure

1. Start the application.
2. Click **Configuration** and verify that the number of sensors in the configuration is the same as those installed.
3. Click **Settings** > **Node ID Assignment**.
4. Proceed according to the type of assignment:

If the assignment is...	Then...
manual	1. Click **DISCOVER CONNECTED SENSORS** to display the connected sensors. 2. To assign a Node ID, click **Assign** for the unassigned Node ID in the **Configured sensors** list. 3. To change a Node ID, click **Change** for the already assigned Node ID in the **Configured sensors** list. 4. Select the SID of the sensor and confirm.
automatic	1. Click **DISCOVER CONNECTED SENSORS** to display the connected sensors. 2. Click **ASSIGN NODE IDS** > **Automatic**: the control assigns the Node ID in ascending order of sensor ID (SID).
semi-automatic	Click **ASSIGN NODE IDS** > **Semi-automatic** and follow the instructions displayed.

9.4.7 Synchronize the controls

If there is more than one control in the area, perform the following steps:

1. In the safeRS3 Designer application, click **Settings** > **Advanced**.
2. In **Multi-control synchronization**, assign a different **Control channel** to each control.

Note: if there are more than four controls, the controls with the same channel must have their monitored areas as far from each other as possible.

9.5 Validate the safety functions

9.5.1 Validation

The validation is addressed to the machinery manufacturer and the system installer.

Once the system has been installed and configured, check that the safety functions are activated/deactivated as expected and that the dangerous area is monitored by the system.

The machinery manufacturer must define all the required tests based on the application conditions and the risk assessment.

WARNING
The system response time is not guaranteed during the validation procedure.

WARNING
The safeRS3 Designer application facilitates the installation and configuration of the system. Nevertheless, the validation process described below is still required to complete the installation.

9.5.2 Validation procedure for the access detection function

The access detection safety function must be operative, and the following requirements must be fulfilled:

- If the Custom target detection safety function is not enabled, the target should be a human.
- If the Custom target detection safety function is enabled, the target should be chosen according to the smallest object to be detected.
- The target (for stationary applications) or the machinery/vehicle on which the sensor is installed (for mobile applications) must move in compliance with the maximum allowed speed. For details, see Access detection speed limits on page 51.
- No objects should completely occlude the target.

Starting conditions

- Machinery switched off (Safe condition)
- safeRS3 configured to fulfill the access detection safety function
- Detection signals monitored via digital outputs or safety Fieldbus (i.e., PROFIsafe or FSoE)

Test setup

The following tests aim to validate the sensor's performance for the access detection safety function.

In stationary applications, all the tests share these parameters:

Target type	Either human (if the Custom target detection safety function is disabled) or the smallest object to be detected (if the Custom Target Detection safety function is enabled)
Target speed	In the range [0.1, 1.6] m/s ([0.33, 5.25] ft/s), with particular attention to the minimum and the maximum speeds.
Acceptance criteria	The system reaches the safe state via digital outputs or Fieldbus when the target accesses the area during the test.

In mobile applications, all the tests share these parameters:

Target type	Either human (if the Custom target detection safety function is disabled) or the smallest object to be detected (if the Custom Target Detection safety function is enabled)
Machinery/Vehicle speed	In the range [0.1, 4] m/s ([0.33, 13.12] ft/s), with particular attention to the minimum and the maximum speeds.
Target movement	Stationary
Acceptance criteria	The system reaches the safe state via digital outputs or Fieldbus when, during the movement of the machinery/vehicle, the sensor's field of view reaches the target.

Validation test

The validation procedure of safeRS3 is reported below:

1. Identify the test positions, including those locations where the operator could access during the production cycle:
   a. boundaries of the dangerous area
   b. intermediate points between sensors
   c. positions that are partially hidden by existing or presumed obstacles during the operating cycle
   d. positions indicated by the risk assessor
2. Check that the corresponding detection signal is active or wait for its activation.
3. Perform the test according to the test setup previously defined, moving toward one of the test positions.
4. Check that the test acceptance criteria previously defined are fulfilled. If the test acceptance criteria are not fulfilled, see Troubleshooting validation on page 98.
5. Repeat steps 2, 3, and 4 for each test position.

9.5.3 Validation procedure for the restart prevention function

The restart prevention safety function must be operative, and the following requirements must be fulfilled:

- The person must breathe normally.
- No objects should completely occlude the person.

Starting conditions

- Machinery switched off (safe condition)
- safeRS3 configured to fulfill the restart prevention safety function
- Detection signals monitored via digital outputs or safety Fieldbus (i.e., PROFIsafe or FSoE)

Test setup

The following tests aim to validate the performance of the sensor restart prevention safety function.

All the tests share the following parameters:

Configured radar restart timeout	At least 4 s
Target type	Human according to ISO 7250, breathing normally
Target speed	0 m/s (0 ft/s)
Target pose	Standing or crouching (or other poses if requested by specific risk assessment)
Test duration	At least 20 s
Acceptance criteria	The detection signal remains deactivated during the test. When the operator leaves the area; the detection signal is activated.

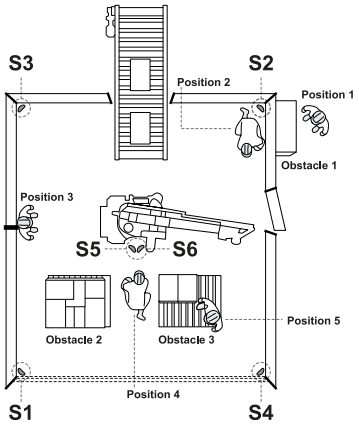
Validation test

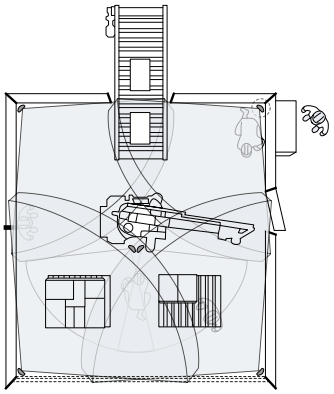
The validation procedure of the safeRS3 system is reported below:

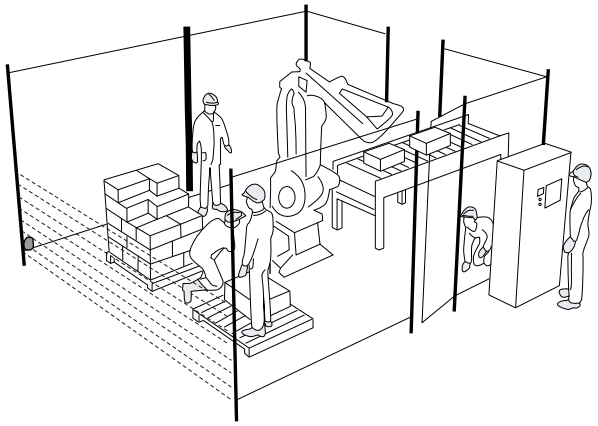
1. Identify the test positions, including those locations where the operator should normally be located during the production cycle:
   - boundaries of the dangerous area
   - intermediate points between sensors
   - positions that are partially hidden by already present or presumed obstacles during the operating cycle
   - positions indicated by the risk assessor
2. Access the dangerous area and go to one of the test positions: the corresponding detection signal should be deactivated.
3. Perform the test according to the test setup previously defined.
4. Check that the test acceptance criteria previously defined are fulfilled.
5. If the test acceptance criteria are not fulfilled, see Validate the system with safeRS3 Designer on the next page.
6. Repeat steps 2, 3, and 4 for each test position.

Example of test positions

The following images show examples of positions to be tested and suggestions about identifying other possible positions of interest.







Position 1: position outside the dangerous area

Position 2: position hidden from the operator's viewpoint at "Position 1". Any other similar hidden position should be tested.

Position 3: position at the center distance between two sensors and/or close to the boundaries of the dangerous area (e.g., along safety fences). This position is suggested to verify that the detection fields of different sensors overlap without leaving uncovered areas. Standing close to the fences also allows for verifying that the sensors are rotated correctly, covering both the right and the left side.

Position 4: possible hidden position by elements in the environment that are present or not present during the validation process. Examples: Obstacle 2 precludes detection by Sensor 1 **(S1)**. Obstacle 3 is partially present during the Validation process but will likely be present during the normal operating cycle and will preclude the detection of Sensor 4 **(S4)**. This position must be covered by additional Sensor 5 **(S5)** and Sensor 6 **(S6)** that should be added within a proper feasibility study.

Position 5: any raised and walkable position indicated by the risk assessor.

Other positions can be indicated by the risk assessor or the machine manufacturer.

9.5.4 Validate the system with safeRS3 Designer

WARNING
When the validation function is active, the system response time is not guaranteed.

The safeRS3 Designer application is helpful during the safety functions validation phase and allows the actual field of view of the sensors to be checked based on their installation position.

1. Click **Validation**: the validation starts automatically.
2. Move in the monitored area as indicated in Validation test on the previous page and Validation procedure for the restart prevention function on page 95.
3. Check that the sensor behaves as expected.
   Note: if the static object detection option is enabled, the empty dot represents a moving target, and the full dot represents a static target.
4. Check that the distance and the angle where the motion is detected are the expected values.

9.5.5 Troubleshooting validation

Problem	Cause	Solution
The detection signal does not remain deactivated during the restart prevention test, or it does not deactivate during the access detection test	Presence of objects obstructing the field of view	If possible, remove the object. Otherwise, implement additional safety measures in the area where the object is present (e.g., adding new sensors).
	Position of one or more sensors	Position the sensors to ensure that the monitored area is adequate for the dangerous area (see Sensor position on page 67).
	Inclination and/or installation height of one or more sensors	1. Change the sensor's inclination and/or installation height to ensure the monitored area is adequate for the dangerous area (see Sensor position on page 67). 2. Note or update the inclination and installation height of the sensors in the printed configuration report.
	Inadequate restart timeout (only with the static object detection option enabled)	Change the **Restart timeout** parameter through the safeRS3 Designer application and verify that it is set to at least 4 seconds for each sensor (**Configuration** > select the affected sensor and protective field)
After that the operator leaves the area, the detection signal does not activate	Presence of moving objects in the sensor's field of view (including vibrations of metal parts where the sensors are installed or vibration of brackets)	Identify the moving objects/brackets and, if possible, tighten all the loose parts
	Reflections of signals	Change the sensor positions or adjust the protective fields reducing the detection distance

9.6 Manage the configuration

9.6.1 Configuration checksums

In the safeRS3 Designer application in **Settings** > **Configuration checksums**, it is possible to consult:

- the configuration report hash, a unique alphanumeric code associated with a report. It is computed considering the entire configuration, plus the time of the **APPLY CHANGES** operation, and the name of the computer which did it
- dynamic configuration checksum, associated with a specific dynamic configuration. It considers both common and dynamic parameters

9.6.2 Configuration reports

After changing the configuration, the system generates a configuration report with the following information:

- configuration data
- unique hash
- date and time of configuration change
- name of the computer used for the configuration

The reports are documents that cannot be changed and can only be printed and signed by the machinery safety manager.

Note: to save the PDF, a printer must be installed on the computer.

9.6.3 Change the configuration

WARNING
The system is disabled during configuration. Prepare opportune safety measures in the dangerous area protected by the system before configuring the system.

1. Start the safeRS3 Designer application.
2. Click **User** and enter the admin password.
   Note: after five wrong password entries, application authentication is blocked for one minute.
3. Depending on what you want to change, follow the instructions below:

To change...	Then...
Monitored area and sensors configuration	Click **Configuration**
Node ID	Click **Settings** > **Node ID Assignment**
Function of inputs and outputs	Click **Settings** > **Digital Input-Output**
Detection field groups configuration	Click **Settings** > **Protective field groups** and select the group for each protective field of each connected sensor. Then click **Settings** > **Digital Input-Output** and set a digital output as **Detection signal group 1** or **Detection signal group 2** function
Muting	Click **Settings** > **Muting**
Sensor number and positioning	Click **Configuration**

4. Click **APPLY CHANGES**.
5. Upon conclusion of transfer of the configuration to the control, click to print the report.
   Note: to save the PDF, a printer must be installed on the computer.

9.6.4 Display previous configurations

In **Settings**, click **Activity History** and then click **Configuration reports page**: the reports archive opens.

9.7 Other procedures

9.7.1 Change language

1. Click .
2. Select the desired language. The language changes automatically.

9.7.2 Restore factory default settings

WARNING
The system is provided without any valid configuration. Therefore the system maintains the safe state at the first start-up until a valid configuration is applied through the safeRS3 Designer application by clicking APPLY CHANGES.

WARNING
The procedure resets both the configuration and the password of all the users.

To restore the configuration parameters to the default settings, follow the procedures reported below:

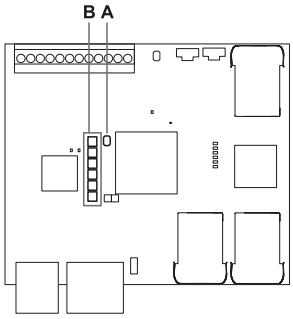
Procedure using the safeRS3 Designer application

1. Log in to the safeRS3 Designer application as the Admin user.
2. In **Admin** > **FACTORY RESET**.

Procedure using the reset button on the control

1. Press and hold the button **[A]** for longer than 10 seconds: all the system status LEDs **[B]** turn on (steady orange), and the system is ready to be reset.
2. Release the button **[A]**: all the system status LEDs **[B]** turn on (flashing green), and the reset procedure starts. The procedure can last up to 30 seconds. Do not switch off the system during the reset.

   Note: if the button is pressed for longer than 30 seconds, the status of the LEDs switches to red, and the reset is not performed even after the button is released.



For the default values of the parameters, see Configuration application parameters on page 141.

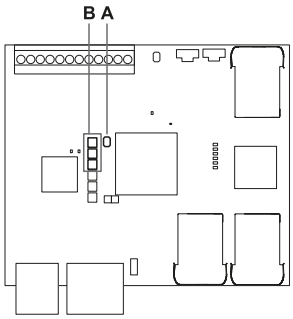
9.7.3 Reset the control Ethernet parameters

1. Ensure the control is turned on.
2. Press the Network parameter reset button and hold it down during steps 3 and 4.
3. Wait for five seconds.
4. Wait until all the six LEDs on the control turns steady green: the Ethernet parameters are set to their default values (see Ethernet connection (if available) on page 126).
5. Configure the control again.

9.7.4 Restore network parameters

WARNING
After the restore network parameters procedure, the system goes into the safe state. The configuration must be validated and, if necessary, modified through the safeRS3 Designer application by clicking APPLY CHANGES.

1. To restore the network parameters to the default settings, press and hold the reset button **[A]** on the control for 2 to 5 seconds: the first three system status LEDs **[B]** turn on (steady orange) and the network parameters are ready to be reset.
2. Release the button **[A]**: the reset is performed.



For the default values of the parameters, see Configuration application parameters on page 141.

9.7.5 Identify a sensor

In **Settings** > **Node ID Assignment** or **Configuration**, click **Identify by LED** near the desired sensor Node ID: the LED on the sensor flashes for 5 seconds.

9.7.6 Change network parameters

In **Admin** > **Network Parameters** change the IP address, the netmask and the gateway of the control as desired.

9.7.7 Change MODBUS parameters

In **Admin** > **MODBUS Parameters**, enable/disable the MODBUS communication and modify the listening port.

9.7.8 Change Fieldbus parameters

In **Admin** > **Fieldbus Parameters**, change the F-addresses and the Fieldbus Endianness of the control if the control is provided with a PROFIsafe interface; or the Safe Address if it is provided with a Safety over EtherCAT® interface.

9.7.9 Set system labels

In **Admin** > **System labels**, choose the desired labels for the control and the sensors.

10 Troubleshooting

Machinery maintenance technician

The machinery maintenance technician is a qualified person with the administrator privileges required to modify the configuration of safeRS3 through the software and perform maintenance and troubleshooting.

10.1 Troubleshooting procedures

Note: if requested by Technical Support, in **Settings** > **Activity History**, click **Download sensor debug info** to download the files and forward them to SICK for debugging.

10.1.1 Control LED

For more details about the LEDs in the control, see Controls on page 23 and System status LEDs on page 25.

LED	Status	safeRS3 Designer application messages	Problem	Solution
S1[1)]	Steady red	CONTROL POWER ERROR	At least one voltage value on the control is wrong	If at least one digital input is connected, check that the SNS input and the GND input are connected. Check that the input power supply is the specified type (see General specifications on page 125).
S1 + S3	Steady red	BACKUP or RESTORE ERROR	Error during the backup and restore to/from microSD card	Check if the microSD card is inserted. Check if the configuration file on the microSD card is present and not corrupted.
S2	Steady red	CONTROL TEMPERATURE ERROR	Control temperature value is wrong	Check that the system is operating at the correct operating temperature (see General specifications on page 125).
S3	Steady red	OSSD ERROR or INPUT REDUNDANCY ERROR	At least one input or output is in error	If at least one input is used, check that both the channels are connected and that there is no short-circuit on the outputs. If the problem persists, please contact Technical Support.

LED	Status	safeRS3 Designer application messages	Problem	Solution
S4	Steady red	PERIPHERAL ERROR	At least one of the control peripherals is in error	Check the status of the terminal block and connections. If the problem persists, please contact Technical Support.
S5	Steady red	CAN ERROR	Communication error with at least one sensor	Check connections of all sensors in the chain starting from the last sensor in error. Check that all the sensors have an assigned ID (in safeRS3 Designer **Settings** > **Node ID Assignment**).
S6	Steady red	FEE ERROR, FLASH ERROR or RAM ERROR	Configuration saving error, configuration not performed or memory error	Reconfigure or configure the system (see Manage the configuration on page 98). If the error persists, please contact Technical Support.
All LEDs from S1 to S6 together	Steady red	FIELDBUS ERROR	Communication error on the Fieldbus	At least one input or output is configured as **Fieldbus controlled**. Check that the cable is correctly connected, communication with the host is correctly established, watchdog timeout is configured correctly, and exchanged data are not maintained passivated.
All LEDs from S1 to S5 together	Steady red	DYNAMIC CONFIGURATION ERROR	Error in the selection of the dynamic configuration: invalid ID	Check the preset configurations within the safeRS3 Designer application.

LED	Status	safeRS3 Designer application messages	Problem	Solution
All LEDs from S1 to S4 together	Steady red	SENSOR CONFIGURATION ERROR	Error during the configuration of the sensors	Check the sensors connected and try again to perform the configuration of the system via the safeRS3 Designer application. Check that the firmware of the control and sensors are updated to compatible versions.
At least one LED	Flashing red	See Sensor LED on the next page	Sensor corresponding to the flashing LED in error [2] (seeSensor LED on the next page)	Check the problem through the LED on the sensor.
At least one LED	Flashing green	See Sensor LED on the next page	Sensor corresponding to the flashing LED in error [2] (seeSensor LED on the next page)	If the issue persists longer than one minute, please contact Technical Support.
All LEDs	Steady orange	-	The system is starting up.	Wait for a few seconds.
All LEDs	Flashing green one after the other in sequence	-	The control is in boot state.	Open the latest available version of the safeRS3 Designer application, connect to the device and proceed with the automatic recovery procedure. If the issue persists, please contact Technical Support.
All LEDs	Off	In **Dashboard** > **System status** ⚠ icons	Configuration not yet applied to the control.	Configure the system.
All LEDs	Off	Progress icon	Configuration transfer to the control in progress.	Wait for the transfer to be completed.

Note: fault signal on the control (steady LED) takes priority over a faulty sensor signal. For the status of the single sensor, check the sensor LED.

Note[1)]: S1 is the first from the top.

Note[2)]: S1 corresponds to the sensor with ID 1, S2 corresponds to the sensor with ID 2 and so on.

10.1.2 Sensor LED

Status	safeRS3 Designer application messages	Problem	Solution
Steady purple	-	Sensor in boot state	Contact Technical Support.
Flashing purple [1]	-	Sensor receiving a firmware update	Wait for the update to be completed without disconnecting the sensor.
Flashing red. Two flashes followed by a pause [2]	CAN ERROR	Sensor without a valid identifier assigned	Assign a Node ID to the sensor (see Connect the sensors to the control on page 86).
Flashing red. Three flashes followed by a pause [2]	CAN ERROR	Sensor does not receive valid messages from the control	Verify the connection of all the sensors in the chain and check that the number of sensors configured in the safeRS3 Designer application is equal to the number of the sensors physically connected
Flashing red. Four flashes followed by a pause [2]	SENSOR TEMPERATURE ERROR or SENSOR POWER ERROR	Sensor in temperature error or is receiving an incorrect supply voltage	Check the sensor connection and that the cable length is within the maximum limits. Verify that the temperature of the environment in which the system is operating conforms to the operating temperatures listed in the technical data in this manual.
Flashing red. Five flashes followed by a pause [2]	MASKING, SIGNAL PATTERN ERROR	Sensor detected a masking (tampering) or there are radar signal errors	Not available if the sensor is in muting. Check that the sensor is installed correctly and that the area is clear of objects that obstruct the sensor's field of view.
	MASKING REFERENCE MISSING	Sensor is not able to save the monitored area reference for occlusion	Repeat the system configuration making sure no movement is present inside the monitored area

Status	safeRS3 Designer application messages	Problem	Solution
	MSS ERROR/DSS ERROR	Error detected by diagnostics relative to the internal micro-controllers (MSS and DSS), their internal peripherals or memories	If the issue persists, please contact Technical Support.
Flashing red. Six flashes followed by a pause [2)]	TAMPER ERROR	Sensor detected a variation in rotation around the axes (tampering)	Not available if the sensor is in muting. Check if the sensor has been tampered with or if the side or mounting screws have loosened.

Note [1)]: flashes at 100 ms intervals without pause

Note [2)]: flashes at 200 ms intervals and then with a 2 s pause.

10.1.3 Other problems

Problem	Cause	Solution
Undesired detections	Transit of people or objects in close proximity to the protective field	Change the configuration (see Change the configuration on page 99).
Machinery in safe status without motion in the protective field	No power supply	Check electrical connection. Contact Technical Support if necessary.
	Failure of the control or one or more sensors	Check the status of the LEDs on the control (see Control LED on page 103). Access the safeRS3 Designer application, on the **Dashboard** page, mouse-over on ⊗ in correspondence with the control or the sensor.
The voltage value detected on the SNS input is zero	The chip that detects inputs is faulty	Contact Technical Support.
The system does not function correctly	Control error	Check the status of the LEDs on the control (see Control LED on page 103). Access the safeRS3 Designer application, on the **Dashboard** page, mouse-over on ⊗ in correspondence with the control or the sensor.
	Sensor error	Check the status of the LEDs on the sensor (see Sensor LED on the previous page). Access the safeRS3 Designer application, on the **Dashboard** page, mouse-over on ⊗ in correspondence with the control or the sensor.

10.2 Event log management

10.2.1 Introduction

The event log recorded by the system can be downloaded from the safeRS3 Designer application in a PDF file. The system saves up to 4500 events, divided in two sections. In each section the events are displayed from the most recent to the least recent. Above this limit, the oldest events are overwritten.

10.2.2 Download the system log

WARNING
The system response time is not guaranteed while downloading the log file.

1. Start the safeRS3 Designer application.
2. Click **Settings** and then **Activity History**.
3. Click **DOWNLOAD LOG**.
   Note: to save the PDF, a printer must be installed on the computer.

10.2.3 Log file sections

The first line of the file reports the NID (Network ID) of the device and the date of the download.

The rest of the file log is divided in two sections:

Section	Description	Content	Size	Reset
1	Event log	Information events Error events	3500	On demand using the safeRS3 Designer application
2	Diagnostic event log	Error events	1000	Not possible

10.2.4 Log line structure

Each line in the log file reports the following information, separated by tab character:

- Timestamp (seconds counter from the latest boot)
- Timestamp (absolute/relative value)
- Event type:
  - [ERROR]= diagnostic event
  - [INFO]= information event
- Source
  - CONTROL = if the event is generated by the control
  - SENSOR ID = if the event is generated by a sensor. In this case, the Node ID of the sensor is also provided
- Event description

10.2.5 Timestamp (seconds counter from the latest boot)

An indication of the instant when the event occurred is provided as relative time from the latest boot, in seconds.

Example: 92

Meaning: the event occurred 92 seconds after the latest boot

10.2.6 Timestamp (absolute/relative value)

An indication of the instant when the event occurred is provided.

- After a new system configuration, it is provided as absolute time.

  Format: *YYYY/MM/DD hh:mm:ss*

  Example: 2020/06/05 23:53:44

- After a reboot of the device, it is provided as relative time from the latest boot.

  Format: *Rel. x d hh:mm:ss*

  Example: Rel. 0 d 00:01:32

Note: when a new system configuration is performed, even the older timestamps are updated in absolute time format.

Note: during system configuration, the control is receiving the local time of the machine where the software is running.

10.2.7 Event description

A complete description of the event is reported. Whenever possible, depending on the event, additional parameters are reported.

In case of a diagnostic event, an internal error code is also added, useful for the purpose of debug. If the diagnostic event disappears, the label “(Disappearing)” is reported as an additional parameter.

Examples

Detection access (field #3, 1300 mm/40°)

System configuration #15

CAN ERROR (Code: 0x0010) COMMUNICATION LOST

CAN ERROR (Disappearing)

10.2.8 Log file example

Event logs of ISC NID UP304 updated 2020/11/18 16:59:56

[Section 1 - Event logs]

380 2020/11/18 16:53:49 [ERROR] SENSOR#1 CAN ERROR (Disappearing)

375 2020/11/18 16:53:44 [ERROR] SENSOR#1 CAN ERROR (Code: 0x0010) COMMUNICATION LOST

356 2020/11/18 16:53:25 [INFO] CONTROL System configuration #16

30 2020/11/18 16:53:52 [ERROR] SENSOR#1 ACCELEROMETER ERROR (Disappearing)

27 2020/11/18 16:47:56 [ERROR] SENSOR#1 ACCELEROMETER ERROR (Code: 0x0010) TILT ANGLE ERROR

5 2020/11/18 16:47:30 [ERROR] SENSOR#1 SIGNAL ERROR (Code: 0x0012) MASKING

0 2020/11/18 16:47:25 [INFO] CONTROL Dynamic configuration #1

0 2020/11/18 16:47:25 [INFO] CONTROL System Boot #60

92 Rel. 0 d 00:01:32 [INFO] CONTROL Detection exit (field #2)

90 Rel. 0 d 00:01:30 [INFO] CONTROL Detection exit (field #1)

70 Rel. 0 d 00:01:10 [INFO] SENSOR#1 Detection access (field #2, 3100 mm/20°)

61 Rel. 0 d 00:01:01 [INFO] SENSOR#1 Detection access (field #1, 1200 mm/30°)

0 Rel. 0 d 00:00:00 [INFO] CONTROL Dynamic configuration #1

0 0 d 00:00:00 [INFO] CONTROL System Boot #61

[Section 2 - Diagnostic events log]

380 Rel. 0 d 00:06:20 [ERROR] SENSOR #1 CAN ERROR (Disappearing)

375 Rel. 0 d 00:06:15 [ERROR] SENSOR #1 CAN ERROR (Code: 0x0010) COMMUNICATION LOST

356 Rel. 0 d 00:05:56 [INFO] CONTROL System configuration #16

30 Rel. 0 d 00:00:30 [ERROR] SENSOR #1 ACCELEROMETER ERROR (Disappearing)

27 Rel. 0 d 00:00:27 [ERROR] SENSOR #1 ACCELEROMETER ERROR (Code: 0x0012) TILT ANGLE ERROR

5 Rel. 0 d 00:00:05 [ERROR] SENSOR #1 SIGNAL ERROR (Code: 0x0014) MASKING

10.2.9 Event list

The event logs are listed below:

Event	Type
Diagnostic errors	ERROR
System Boot	INFO
System configuration	INFO
Factory reset	INFO
Stop signal	INFO
Restart signal	INFO

Event	Type
Detection access	INFO
Detection exit	INFO
Dynamic configuration in use	INFO
Muting status	INFO
Fieldbus connection	INFO
MODBUS connection	INFO
Session authentication	INFO
Validation	INFO
Log download	INFO

For further information about the events, see INFO events on the next page and ERROR events (control) on page 115.

10.2.10 Verbosity level

There are six verbosity levels for the log. The verbosity can be set during the configuration of the system via the safeRS3 Designer application (**Settings** > **Activity History** > **Log verbosity level**).

Depending on the selected verbosity level, the events are logged in accordance to the following table:

Event	Level 0 (default)	Level 1	Level 2	Level 3	Level 4	Level 5
Diagnostic errors	x	x	x	x	x	x
System Boot	x	x	x	x	x	x
System configuration	x	x	x	x	x	x
Factory reset	x	x	x	x	x	x
Stop signal	x	x	x	x	x	x
Restart signal	x	x	x	x	x	x
Detection access	-	See Verbosity level for detection access and exit events below				
Detection exit	-	See Verbosity level for detection access and exit events below				
Dynamic configuration in use	-	-	-	-	x	x
Muting status	-	-	-	-	-	x

10.2.11 Verbosity level for detection access and exit events

Depending on the selected verbosity level, the detection access and exit events are logged as follows:

- LEVEL 0: no detection info is logged
- LEVEL 1: the events are logged at the control level, and the additional information is the detection distance (in mm) and the detection angle (in °) in detection access

  Format:

CONTROL Detection access (distance mm/azimuth °)

CONTROL Detection exit

- LEVEL 2: the events are logged in a single field at the control level, and the additional information is: protective field, detection distance (in mm) and detection angle (in °) in access, and protective field at exit

  Format:

  CONTROL Detection access (field #n, distance mm/azimuth °)

  CONTROL Detection exit (field #n)

- LEVEL 3 / LEVEL 4 / LEVEL 5 The events are logged:
  - in a single field at the control level, and the additional information is: protective field, detection distance (in mm) and detection angle (in °) in access, and protective field at exit
  - at the sensor level and the additional information read by the sensor is: detection distance (in mm) and detection angle (in °) in access, and protective field at exit

  Format:

  CONTROL #k Detection access (field #n, distance mm/azimuth °)

  SENSOR #k Detection access (distance mm/azimuth °)

  CONTROL Detection exit (field #n)

  SENSOR #k Detection exit

10.3 INFO events

10.3.1 System Boot

Every time the system is powered up, the event is logged reporting the incremental count of the boot from the beginning of the life of the device.

Format: *System Boot #n*

Example:

0 2020/11/18 16:47:25 [INFO] CONTROL SYSTEM BOOT #60

10.3.2 System configuration

Every time the system is configured, the event is logged reporting the incremental count of the configuration from the beginning of the life of the device.

Format: *System configuration #3*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL System configuration #3

10.3.3 Factory reset

Every time a factory reset is required, the event is logged.

Format: *Factory reset*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL Factory reset

10.3.4 Stop signal

If configured, every change of the Stop Signal is logged as ACTIVATION or DEACTIVATION.

Format: *Stop signal ACTIVATION/DEACTIVATION*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL Stop signal ACTIVATION

10.3.5 Restart signal

If configured, every time the system is waiting for the restart signal or the restart signal is received, the event is logged as WAITING or RECEIVED.

Format: *Restart signal WAITING/RECEIVED*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL Restart signal RECEIVED

10.3.6 Detection access

Every time motion is detected, a detection access is logged with additional parameters depending on the selected verbosity level: the protective field number, the sensor which detected the motion, the detection distance (in mm) and the detection angle (°) (see Verbosity level for detection access and exit events on page 111).

Format: *Detection access (field #n, distance mm/azimuth°)*

Example:

20 2020/11/18 16:47:25 [INFO] SENSOR #1 Detection access (field #1, 1200 mm/30°)

10.3.7 Detection exit

After at least one detection access event, a detection exit event related to the same field is logged when the detection signal returns to its default no-motion status.

Depending on the selected verbosity level additional parameters are logged: the protective field number, the sensor which detected the motion.

Format: *Detection exit (field #n)*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL Detection exit (field #1)

10.3.8 Dynamic configuration in use

At every change of the dynamic configuration, the new ID of the dynamic configuration selected is logged.

Format: *Dynamic configuration #1*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL Dynamic configuration #1

10.3.9 Muting status

Every change of the muting status of each sensor is logged as disabled or enabled.

Note: the event indicates a change of the muting status of the system. It does not correspond to the muting request.

Format: *Muting disabled/enabled*

Example:

20 2020/11/18 16:47:25 [INFO] SENSOR#1 Muting enabled

10.3.10 Fieldbus connection

The Fieldbus communication status is logged as CONNECTED, DISCONNECTED or FAULT.

Format: *Fieldbus connection CONNECTED/DISCONNECTED/FAULT*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL Fieldbus connection CONNECTED

10.3.11 MODBUS connection

The MODBUS communication status is logged as CONNECTED or DISCONNECTED.

Format: *MODBUS connection CONNECTED/DISCONNECTED*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL MODBUS connection CONNECTED

10.3.12 Session authentication

The status of the session authentication and the interface used (USB/ETH) are logged.

Format: *Session OPEN/CLOSE/WRONG PASSWORD/UNSET PASSWORD/TIMEOUT/CHANGE PASSWORD via USB/ETH*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL Session OPEN via USB

10.3.13 Validation

Every time a validation activity starts or ends on the device, it is logged. The interface used (USB/ETH) is logged as well.

Format: *Validation STARTED/ENDED via USB/ETH*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL Validation STARTED via USB

10.3.14 Log download

Every time a log download is performed on the device, it is logged. The interface used (USB/ETH) is logged as well.

Format: *Log download via USB/ETH*

Example:

20 2020/11/18 16:47:25 [INFO] CONTROL Log download via USB

10.4 ERROR events (control)

10.4.1 Introduction

A diagnostic error is logged every time the periodic diagnostic functions detect a coming or going fault on the control.

10.4.2 Temperature errors (TEMPERATURE ERROR)

Error	Meaning
BOARD TEMPERATURE TOO LOW	Board temperature below minimum
BOARD TEMPERATURE TOO HIGH	Board temperature above maximum

10.4.3 Control voltage errors (POWER ERROR)

Error	Meaning
Control voltage UNDERVOLTAGE	Undervoltage error for the indicated voltage
Control voltage OVERVOLTAGE	Overvoltage error for the indicated voltage
ADC CONVERSION ERROR	ADC conversion error in the micro-controller

The following table describes the control voltage:

Screen printing	Description
VIN	Power supply voltage (+24 V DC)
V12	Internal supply voltage
V12 sensors	Sensors power supply voltage
VUSB	USB port voltage
VREF	Inputs reference voltage (**VSNS Error**)
ADC	Analog-digital converter

10.4.4 Peripheral error (PERIPHERAL ERROR)

Error detected by diagnostics relative to the micro-controller, its internal peripherals or memories.

10.4.5 Configuration errors (FEE ERROR)

Indicates that the system must still be configured. This message can appear when the system is first turned on or after reset to default values. It can also represent another error on the FEE (internal memory).

10.4.6 Output errors (OSSD ERROR)

Error	Meaning
OSSD 1 SHORT-CIRCUIT	Short-circuit error on MOS output 1
OSSD 2 SHORT-CIRCUIT	Short-circuit error on MOS output 2
OSSD 3 SHORT-CIRCUIT	Short-circuit error on MOS output 3
OSSD 4 SHORT-CIRCUIT	Short-circuit error on MOS output 4
OSSD 1 NO LOAD	No load on OSSD 1
OSSD 2 NO LOAD	No load on OSSD 2
OSSD 3 NO LOAD	No load on OSSD 3
OSSD 4 NO LOAD	No load on OSSD 4

10.4.7 Flash errors (FLASH ERROR)

A flash error represents an error on the external flash.

10.4.8 Dynamic configuration error (DYNAMIC CONFIGURATION ERROR)

A dynamic configuration error indicates an invalid dynamic configuration ID.

10.4.9 Internal communication error (INTERNAL COMMUNICATION ERROR)

Indicates that there is an internal communication error.

10.4.10 Input redundancy error (INPUT REDUNDANCY ERROR)

Error	Meaning
INPUT 1	Error in the redundancy on Input 1
INPUT 2	Error in the redundancy on Input 2
ENCODING	Invalid encoding when the encoded channel option is enabled
PLAUSIBILITY	0->1->0 transition not compliant with input functionality specification

10.4.11 Fieldbus error (FIELDBUS ERROR)

At least one of the inputs and outputs has been configured as **Fieldbus controlled**, but the Fieldbus communication is not established or not valid.

Error	Meaning
NOT VALID COMMUNICATION	Error on the Fieldbus

10.4.12 RAM error (RAM ERROR)

Error	Meaning
INTEGRITY ERROR	Wrong integrity check on the RAM

10.4.13 Sensor configuration errors (SENSOR CONFIGURATION ERROR)

Error occurred on the sensors during the configuration process or at the system power up. At least one of the connected sensors did not get the correct configuration.

As details, the list of sensors not configured is reported.

10.5 ERROR events (sensor)

10.5.1 Introduction

A diagnostic error is logged every time the periodic diagnostic functions detect a coming or going fault on the sensor.

WARNING
No sensor errors are available if the sensor is in muting.

Note: if requested by Technical Support, in **Settings** > **Activity History**, click **Download sensor debug info** to download the files and forward them to SICK for debugging.

10.5.2 Sensor configuration error (SENSOR CONFIGURATION ERROR)

Error occurred on the sensors during the configuration process or at the system power up. At least one of the connected sensors is not correctly configured.

The list of sensor configuration errors is the following:

Error	Meaning
UNKNOWN MODEL-TYPE	Unknown model-type
WRONG MODEL-TYPE	Model-type different from the one set during system configuration
RADIO BANDWIDTH n.a.	Selected radio bandwidth not supported
STATIC OBJECT DETECTION n.a.	Static object detection not supported
CUSTOM TARGET DETECTION n.a.	Custom target detection not supported
ADVANCED FOV n.a.	Advanced field of view not supported
ANTI-MASKING REF	Error occurred during the anti-masking reference grabbing
ANTI-ROTATION REF	Error occurred during the anti-rotation around axes reference grabbing
TIMEOUT	Timeout error occurred during the system recondition
ASSIGN NODE ID ERROR	Error occurred during the Node ID setting of the system recondition
SEQUENCE, STREAM SEQUENCE, STREAM END, STREAM CRC	Sequence error occurred during the sensor configuration
MISSING SENSORS	Too many sensors are missing during the system recondition

10.5.3 Misconfiguration error (MISCONFIGURATION ERROR)

The misconfiguration error occurs when the sensor does not have a valid configuration or it has received an invalid configuration from the control.

10.5.4 Status error and fault (STATUS ERROR/FAULT ERROR)

The status error occurs when the sensor is in an internal invalid status or it has reached an internal fault condition.

10.5.5 Protocol error (PROTOCOL ERROR)

The protocol error occurs when the sensor receives commands with an unknown format.

10.5.6 Sensor voltage errors (POWER ERROR)

Error	Meaning
Sensor voltage **UNDERVOLTAGE**	Undervoltage error for the indicated voltage
Sensor voltage **OVERVOLTAGE**	Overvoltage error for the indicated voltage

The following table describes the sensor voltage:

Screen printing	Description
VIN	Power supply voltage (+12 V DC)
V3.3	Internal chip power supply voltage
V1.2	Micro-controller power supply voltage
V1.8	Internal chip power supply voltage (1.8 V)
V1	Internal chip power supply voltage (1 V)

10.5.7 Anti-tampering sensor (TAMPER ERROR)

Error	Meaning
TILT ANGLE ERROR	Sensor rotation around the x-axis
ROLL ANGLE ERROR	Sensor rotation around the z-axis
PAN ANGLE ERROR	Sensor rotation around the y-axis

Note: the information of the angle (in degrees) is reported.

10.5.8 Signal error (SIGNAL ERROR)

The signal error occurs when the sensor detected an error in the RF signals part, in particular:

Error	Meaning
MASKING	The sensor is obstructed
MASKING REFERENCE MISSING	During the configuration process, it was not possible to get the masking reference
SIGNAL PATTERN ERROR	Radar internal fault or unexpected signal pattern

10.5.9 Temperature errors (TEMPERATURE ERROR)

Error	Meaning
BOARD TEMPERATURE TOO LOW	Board temperature below minimum
BOARD TEMPERATURE TOO HIGH	Board temperature above maximum
CHIP TEMPERATURE TOO LOW	Internal chip below minimum
CHIP TEMPERATURE TOO HIGH	Internal chip above maximum
IMU TEMPERATURE TOO LOW	IMU below minimum
IMU TEMPERATURE TOO HIGH	IMU above maximum

10.5.10 MSS error and DSS error (MSS ERROR/DSS ERROR)

Error detected by diagnostics relative to the internal micro-controllers (MSS and DSS), their internal peripherals or memories

10.6 ERROR events (CAN bus)

10.6.1 Introduction

A diagnostic error is logged every time the periodic diagnostic functions detect a coming or going fault on the CAN bus communication.

Depending on the communication bus side, the logged source can be the control or a single sensor.

10.6.2 CAN errors (CAN ERROR)

Error	Meaning
TIMEOUT	Timeout on message to sensor/control
CROSS CHECK	Two redundant messages do not coincide
SEQUENCE NUMBER	Message with sequence number different from the expected number
CRC CHECK	Packet control code does not match
COMMUNICATION LOST	Impossible to communicate with the sensor
PROTOCOL ERROR	Control and sensors have different and incompatible firmware versions
POLLING TIMEOUT	Timeout on data polling

NOTICE

A shielded cable between the control and the first sensor, and between the sensors is strongly recommended. Nevertheless, route the CAN cables separately from high-potential power lines or through an exclusive conduit.

11 Maintenance

11.1 Planned maintenance

Generic maintenance technician

The generic maintenance technician is a person qualified only to perform basic maintenance without the administrator privileges required to modify the configuration of safeRS3 through the application.

11.1.1 Cleaning

Keep the sensor clean and free of any work residues and conductive material to prevent masking and/or poor system operation.

11.1.2 Spare parts

Component	Part number
safeRS3 Sensor	6080599
safeRS3 9m Sensor	6082806
safeRS3 Control PROFINET	6080601
safeRS3 Control EC	6083697
safeRS3 Control I/O	6080600

11.2 Extraordinary maintenance

11.2.1 Machinery maintenance technician

The machinery maintenance technician is a qualified person with the administrator privileges required to modify the configuration of safeRS3 through the safeRS3 Designer application and perform maintenance and troubleshooting.

11.2.2 Control firmware update

1. Download the latest safeRS3 Designer application version from the www.sick.com website and install it on your computer.
2. Connect to the control via Ethernet and log in as Admin user.
   Note: update via USB is available only for safeRS3 Control I/O.
3. In **Settings** > **General**, check if a new update is available.
4. Update without disconnecting from or turning off the device.

11.2.3 Replace a sensor: System recondition function

The system recondition function is useful for replacing an existing sensor without changing current settings. The function can be enabled through digital inputs (**System recondition** or **Restart signal + System recondition**) or via Fieldbus (**System recondition** only).

WARNING
If the system recondition function has been configured through the safety Fieldbus and the digital inputs, the function can be used from both.

Note: keep the scene static while running the system recondition function so that the anti-tampering functions can save their references.

Note: while running the system recondition function, the system goes to the safe state, deactivating the OSSDs, until the process is completed.

1. Configure the digital inputs or Fieldbus to perform the system recondition function.
2. Connect a sensor without Node ID in the same position of the CAN bus line as the replaced sensor.
   Note: only one sensor at a time must be connected to complete the procedure correctly.
3. Activate the function (via digital inputs or Fieldbus) and wait for the operation to be performed. See Control LED on page 103 to know which is the system status.

The following actions are performed:

- The first available Node ID is assigned to the new sensor.
- The previous configuration of the system is applied (**APPLY CHANGES** operation).
- The event is logged in the reports archive (**Settings** > **Activity History** > **Configuration reports page**) with the following strings in the **User, PC** column:
  - “sys-recondition-i” when the function is performed via digital input
  - “sys-recondition-f” when Fieldbus is used

Note: for more details, see Digital input signals on page 146.

11.2.4 Back up the configuration to a PC

The current configuration can be backed up, including the input/output settings. The configuration is saved in a .cfg file, which can be used to restore the configuration or to facilitate configuration of several safeRS3.

1. In **Settings** > **General**, click **BACKUP**.
2. Select the file destination and save.

Note: user login credentials are not saved using this backup mode.

11.2.5 Load a configuration from a PC

1. In **Settings** > **General**, click **RESTORE**.
2. Select the previously saved .cfg file (see Back up the configuration to a PC above) and open it.

Note: a re-imported configuration requires new downloading onto the control and approval according to the safety plan.

Note: this SD Restore function also includes a System recondition operation, see Replace a sensor: System recondition function on the previous page.

12 Technical references

12.1 Technical data

12.1.1 General specifications

Detection method	Motion detection algorithm based on FMCW radar
Frequency	Working band: 60.6-62.8 GHz Maximum radiated power: 16 dBm mean EIRP Modulation: FMCW
Detection interval	• Access detection: from 0 to 9 m (from 0 to 29.5 ft) • Restart prevention: from 0 to 5 m(from 0 to 16.4 ft)
Detectable target RCS (Human detection)	0.17 m^2
Field of view	Horizontal coverage programmable depending on distance: • in the first 5 m (16.4 ft), from 10° to 100° • from 5 to 9 m (from 16.4 to 29.5 ft), from 10° to 40° Vertical coverage: 20°
Decision probability	> 1-(2.5E-07)
CRT (Certified Restart Timeout)	4 s
Guaranteed response time	Access detection: < 100 ms [1)] Restart prevention: 4000 ms ⚠ **WARNING** During the real-time validation and the download of the log file, the response time is not guaranteed.
Total consumption	Max. 25.4 W (control and six sensors)
Electrical protections	Polarity inversion Overcurrent through resettable integrated fuse (max. 5 s @ 8 A)
Overvoltage category	II
Altitude	Max. 1500 m ASL
Air humidity	Max. 95%
Noise emission	Negligible[2)]

Note[1)]: the value depends on the Electromagnetic robustness level set through the safeRS3 Designer application, see Electromagnetic Robustness on page 66.

Note[2)]: the A-weighted emission sound pressure level does not exceed 70 dB(A).

12.1.2 Safety parameters

SIL (Safety Integrity Level)	2
HFT	0
SC[1)]	2
TYPE	B
PL (Performance Level)	d
ESPE Type (EN 61496-1)	3
Category (EN ISO 13849)	3 equivalent
Class (IEC TS 62998-1)	D

Communication protocol (sensors-control)	CAN complies with standard EN 50325-5
Mission time	20 years
$MTTF_D$	42 years
PFH_D	With Fieldbus communication: • Access detection: 1.40E-08 [1/h] • Restart prevention: 1.40E-08 [1/h] • Muting: 6.37E-09 [1/h] • Stop signal: 6.45E-09 [1/h] • Restart signal: 6.45E-09 [1/h] • Dynamic Configuration Switch: 6.37E-09 [1/h] • Fieldbus controlled: 6.45E-09 [1/h] Without Fieldbus communication: • Access detection: 1.30E-08 [1/h] • Restart prevention: 1.30E-08 [1/h] • Muting: 5.37E-09 [1/h] • Stop signal: 5.45E-09 [1/h] • Restart signal: 5.45E-09 [1/h] • Dynamic Configuration Switch: 5.37E-09 [1/h] • Fieldbus controlled: 5.45E-09 [1/h]
SFF	≥ 99.89%
DCavg	≥ 99.46%
MRT[2)]	< 10 min
Safe state when a fault occurs	At least one channel for each safety output is in OFF-state. Stop message sent on Fieldbus (if available) or communication interrupted

Note[1)]: the systematic capability is guaranteed only if the user uses the product according to the instructions of this manual and uses the product in the appropriate environment.

Note[2)]: the MRT considered is the Technical Mean Repair Time, i.e., it takes in consideration availability of skilled personnel, adequate tools and spare parts. Considering the type of device, the MRT corresponds to the time necessary for the device replacement.

12.1.3 Ethernet connection (if available)

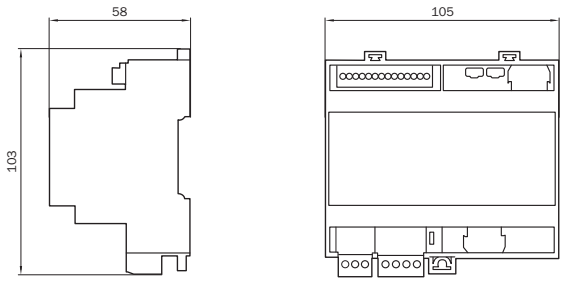
Default IP address	192.168.0.20
Default TCP port	80
Default netmask	255.255.255.0
Default gateway	192.168.0.1

12.1.4 Control features

Outputs	Configurable as follows: • 4 Output Signal Switching Devices (OSSDs) (used as single channels) • 2 dual channel safety outputs • 1 dual channel safety output and 2 Output Signal Switching Devices (OSSDs)
OSSD characteristic	• Maximum resistive load: 100 KΩ • Minimum resistive load: 70 Ω • Maximum capacitive load: 1000 nF • Minimum capacitive load: 10 nF
Safety outputs	High-side outputs (with extended protection function) • Maximum current: 0.4 A • Maximum power: 11.2 W The OSSDs provide what follows: • ON-state: from Uv-1V to Uv (Uv = 24V +/- 4V) • OFF-state: from 0 V to 2.5 V r.m.s.
Inputs	Configurable as follows: • 4 single channel (cat. 2) type 3 digital inputs with common GND • 2 dual channel (cat. 3) type 3 digital inputs with common GND • 1 dual channel (cat. 3) and 2 single channels (cat. 2) type 3 digital inputs with common GND See Voltage and current limits for digital inputs on page 131.
Fieldbus interface (if available)	Ethernet based interface with different standard Fieldbus (e.g., PROFIsafe, FSoE)
Power supply	24 V DC (20–28 V DC) [1)] Maximum current: 1 A
Consumption	Max. 5 W
Assembly	On DIN rail
Weight	With cover: 170 g (6 oz)
Degree of protection	IP20
Terminals	Section: 1 mm^2 (16 AWG) max. Maximum current: 4 A with 1 mm^2 cables (16 AWG)
Impact test	With cover: 0.5 J, 0.25 kg ball from a 20 cm height
Shock/Bump	In accordance with IEC/EN 61496-1:2013 sec. 5.4.4.2 (IEC 60068-2-27)
Vibration	In accordance with IEC/EN 61496-1:2013 sec. 5.4.4.1 (IEC 60068-2-6)
Pollution degree	2
Outdoor use	No
Operating temperature	From -30 to +60 °C (from -22 to +140 °F)
Storage temperature	From -40 to +80 °C (from -40 to +176 °F)

Note[1)]: the unit shall be supplied by an isolated power source which fulfils the requirements of:

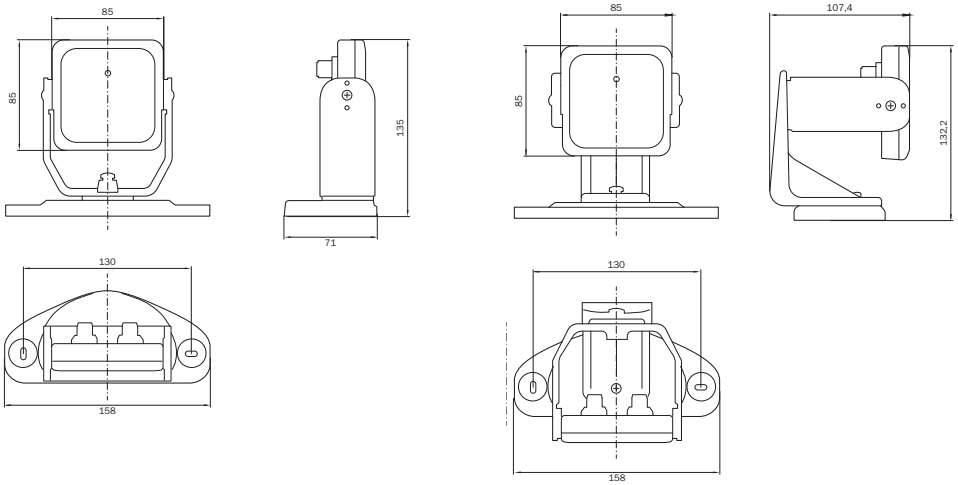
- *Limited-Energy Circuit in accordance with IEC/UL/CSA 61010-1/ IEC/UL/CSA 61010-2-201 or*
- *Limited Power Source (LPS) in accordance with IEC/UL/CSA 60950-1 or*
- *(For North America and/or Canada only) a Class 2 supply source which complies with the National Electrical Code (NEC), NFPA 70, Clause 725.121 and Canadian Electrical Code (CEC), Part I, C22.1. (typical examples are a Class 2 transformer or a Class 2 power sources in compliance with, UL 5085-3/ CSA-C22.2 No. 66.3 or UL 1310/CSA-C22.2 No. 223).*



12.1.5 Sensor features

Connectors	2 5-pin M12 connectors (1 male and 1 female)
CAN bus termination resistance	120 Ω (not supplied, to be installed with a bus terminator)
Power supply	12 V DC ± 20%, through control
Consumption	Average 2.2 W Peak 3.4 W
Degree of protection	Type 3 enclosure, according to UL 50E, in addition to IP 67 rating
Material	Sensor: PA66 Bracket: PA66 and glass fiber (GF)
Frame rate	62 fps
Weight	With 2-axes bracket: 300 g (10.6 oz) With 3-axes bracket: 355 g (12.5 oz)
Shock/Bump	In accordance with IEC/EN 61496-1:2013 sec. 5.4.4.2 (IEC 60068-2-27)
Vibration	In accordance with IEC/EN 61496-1:2013 sec. 5.4.4.1 (IEC 60068-2-6)
Pollution degree	4
Outdoor use	Yes
Operating temperature	From -30 to +60 °C (from -22 to +140 °F)[1)]
Storage temperature	From -40 to +80 °C (from -40 to +176 °F)

Note[1)]: in environmental conditions where the operating temperature can reach values higher than the supported range, install a cover to shield the sensor from sun rays.

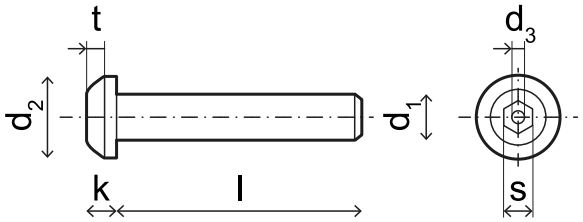


12.1.6 CAN bus cables recommended specifications

Section	2 x 0.50 mm2 (21 AWG) power supply 2 x 0.22 mm^2 (24 AWG) data line
Type	Two twisted pairs (power supply and data) and one drain wire (or shield)
Connectors	5-pole M12 (see Connectors M12 CAN bus on page 132) Connectors shall be type 3 (raintight)
Impedance	120 Ω ±12 Ω (f = 1 MHz)
Shield	Shield with twisted wires in tin-plated copper. To be connected to ground circuit on the power supply terminal block of the control.
Standards	Cables shall be listed in accordance with application as described in the National Electrical Code, NFPA 70, and in the Canadian Electrical Code, C22.1. Total maximum length of the CAN bus line: 80 m (262.5 ft)

12.1.7 Tamper-proof screws specifications

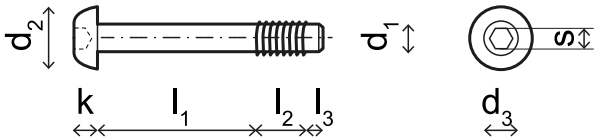
Pin Hex button head security screw



d_1	M4
l	10 mm (0.39 in)
d_2	7.6 mm (0.30 in)
k	2.2 mm (0.09 in)
t	min 1.3 mm (0.05 in)
s	2.5 mm (0.10 in)
d_3	max. 1.1 mm (0.04 in)

12.1.8 Non tamper-proof screws specifications

Hex button head screw



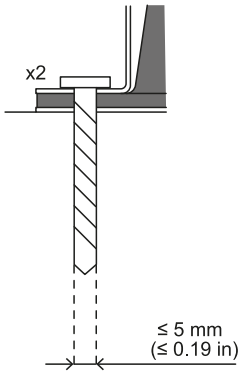
d_1	M4
l_1	19 mm (0.74 in)
l_2	6 mm (0.23 in)
l_3	2 mm (0.07 in)
d_2	7.6 mm (0.30 in)
k	3 mm (0.11 in)
s	2.5 mm (0.10 in)
d_3	4 mm (0.15 in)

12.1.9 Bottom screws specifications

The bottom screws can be:

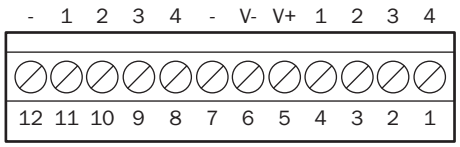
- cheese head
- button head

Note: avoid using countersunk head screws.



12.2 Terminal blocks and connector pin-outs

12.2.1 Digital inputs and outputs terminal block



Note: facing the control so that the terminal block is on the top left, number 12 is the closest to the control corner.

Terminal block	Symbol	Description	Pin
Digital In	**4**	Input 2, Channel 2, 24 V DC type 3 - INPUT #2-2	1
	3	Input 2, Channel 1, 24 V DC type 3 - INPUT #2-1	2
	2	Input 1, Channel 2, 24 V DC type 3 - INPUT #1-2	3
	1	Input 1, Channel 1, 24 V DC type 3 - INPUT #1-1	4
	V+	V+ (SNS), 24 V DC for diagnostics of the digital inputs (mandatory if at least one input is used)	5
	V-	V- (SNS), common reference for all digital inputs (mandatory if at least one input is used)	6
Digital Out	**-**	GND, common reference for all digital outputs	7
	4	Output 4 (OSSD4)	8
	3	Output 3 (OSSD3)	9
	2	Output 2 (OSSD2)	10
	1	Output 1 (OSSD1)	11
	-	GND, common reference for all digital outputs	12

Note: the cables used must have a maximum length of 30 m (98.4 ft) and the maximum operating temperature must be at least 80 °C.

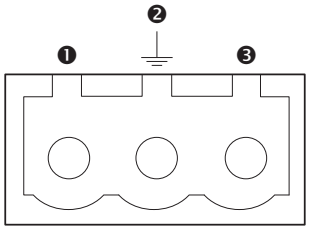
Note: use only copper wires with a minimum gauge of 18 AWG and a torque of 0.62 Nm (5.5 lbs in).

12.2.2 Voltage and current limits for digital inputs

The digital inputs (input voltage 24 V DC) adhere to the following voltage and current limits, in accordance with standard IEC/EN 61131-2:2003.

	Type 3
Voltage limits	
0	from - 3 to 11 V
1	from 11 to 30 V
Current limits	
0	15 mA
1	from 2 to 15 mA

12.2.3 Power supply terminal block



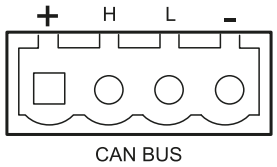
Note: connector front view.

Symbol	Description
1	GND
2	Earth
3	+ 24 V DC

Note: the maximum operating temperature of the cables must be at least 70 °C.

Note: use only copper wires with a minimum gauge of 18 AWG and a torque of 0.62 Nm (5.5 lbs in).

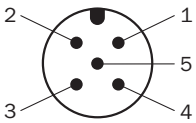
12.2.4 CAN bus terminal block



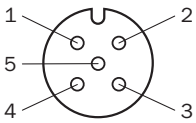
Symbol	Description
+	+ 12 V DC output
H	CAN H
L	CAN L
-	GND

Note: the maximum operating temperature of the cables must be at least 70 °C.

12.2.5 Connectors M12 CAN bus



Male connector



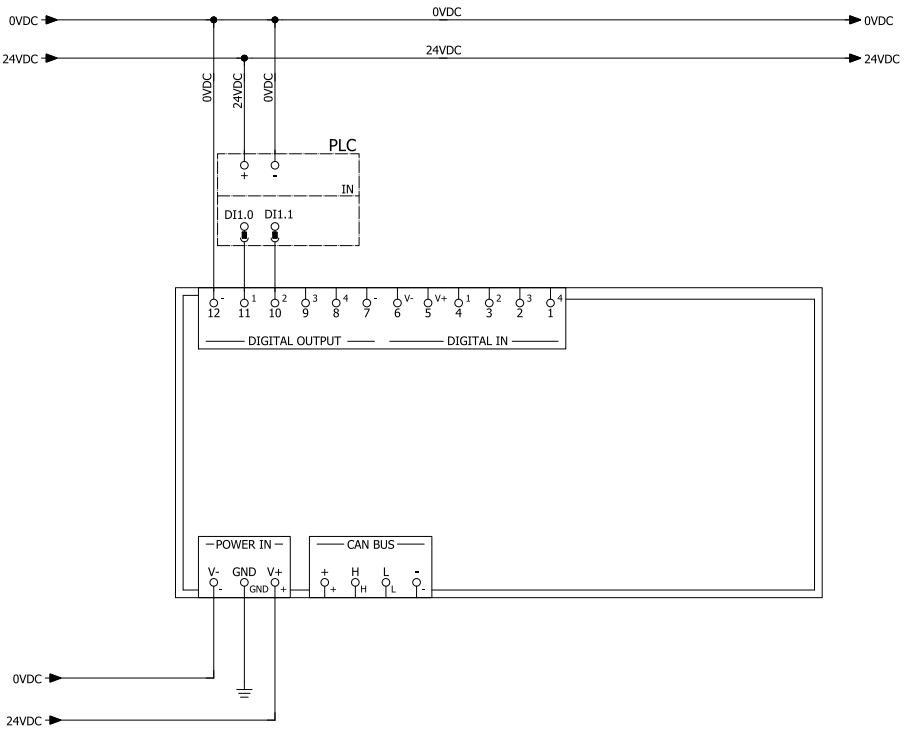
Female connector

Pin	Function
1	Shield to be connected to the functional earth on the power supply terminal block of the control.
2	+12 V dc
3	GND

Pin	Function
4	CAN H
5	CAN L

12.3 Electrical connections

12.3.1 Connection of safety outputs to the Programmable Logic Controller



Digital I/O settings (through the safeRS3 Designer application)

Digital input #1 Not configured

Digital input #2 Not configured

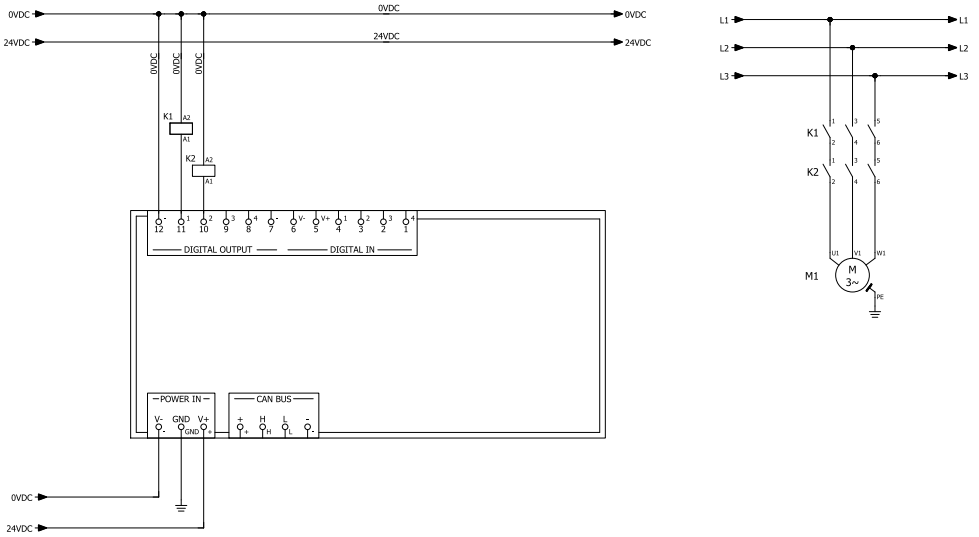
Digital output #1 Detection signal 1

Digital output #2 Detection signal 1

Digital output #3 Not configured

Digital output #4 Not configured

12.3.2 Connection of safety outputs to an external safety relay



Digital I/O settings (through the safeRS3 Designer application)

Digital input #1 Not configured

Digital input #2 Not configured

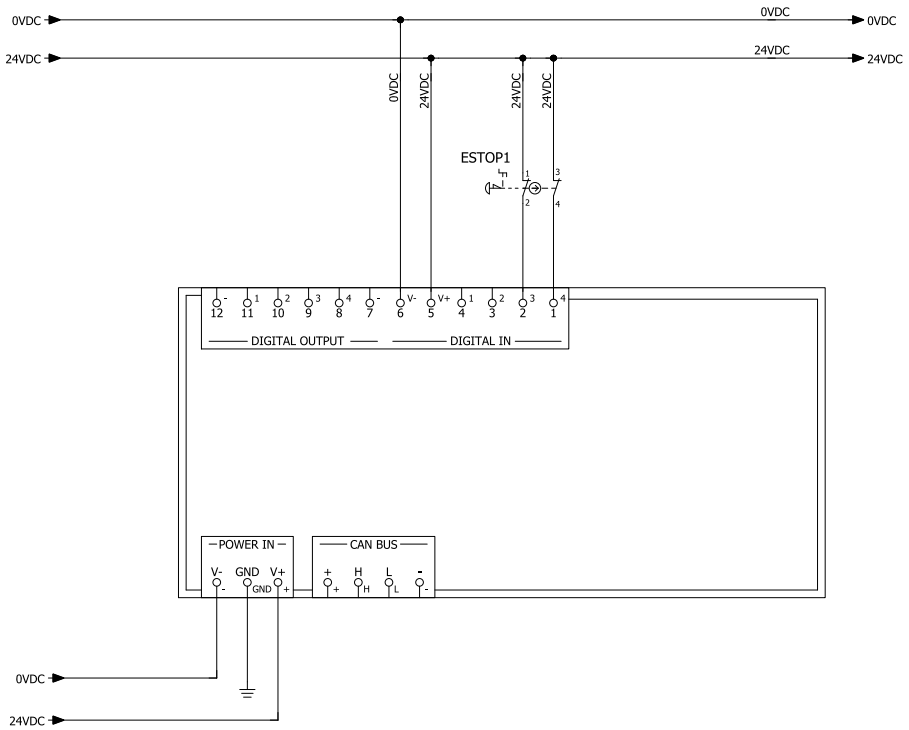
Digital output #1 Detection signal 1

Digital output #2 Detection signal 1

Digital output #3 Not configured

Digital output #4 Not configured

12.3.3 Connection of stop signal (Emergency button)



Note: the indicated emergency button opens the contact when pressed.

Note: the cables used for wiring the digital inputs must have a maximum length of 30 m (98.4 ft).

Digital I/O settings (through the safeRS3 Designer application)

Digital input #1 Not configured

Digital input #2 Stop signal

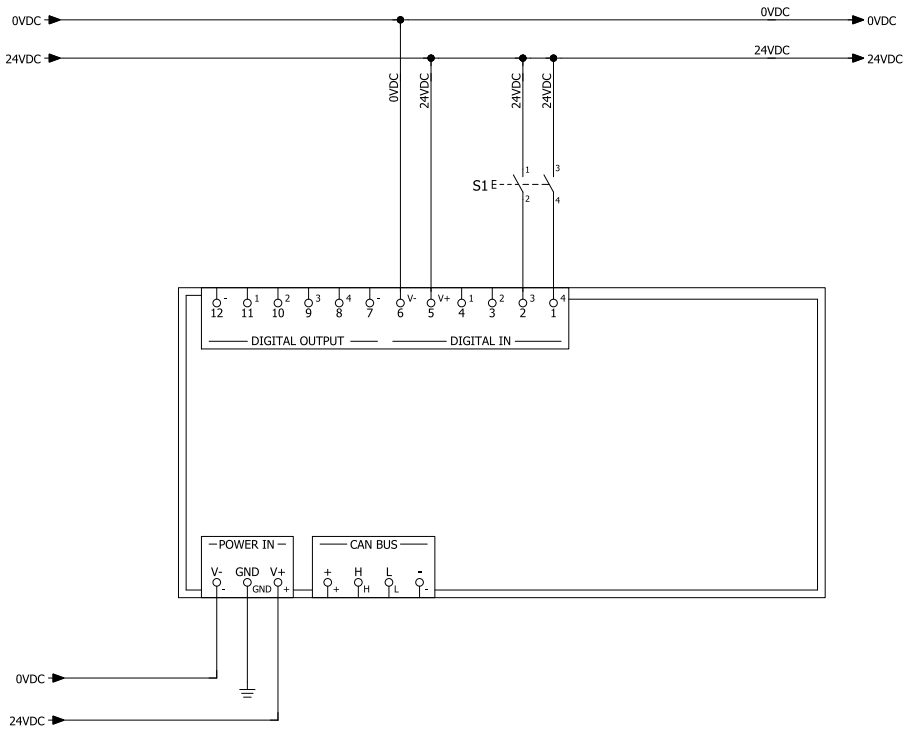
Digital output #1 Not configured

Digital output #2 Not configured

Digital output #3 Not configured

Digital output #4 Not configured

12.3.4 Connection of restart signal (dual channel)



Note: the button indicated for the restart signal closes the contact when pressed.

Note: the cables used for wiring the digital inputs must have a maximum length of 30 m (98.4 ft).

Digital I/O settings (through the safeRS3 Designer application)

Digital input #1 Not configured

Digital input #2 Restart signal

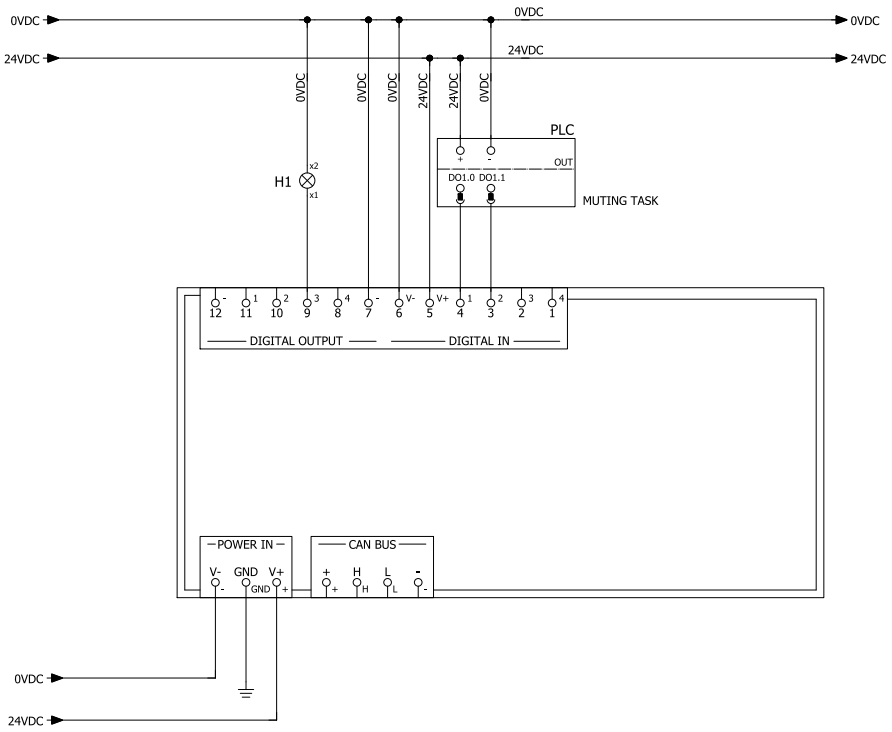
Digital output #1 Not configured

Digital output #2 Not configured

Digital output #3 Not configured

Digital output #4 Not configured

12.3.5 Connection of the muting input and output (one group of sensors)



Note: the cables used for wiring the digital inputs must have a maximum length of 30 m (98.4 ft).

Digital I/O settings (through the safeRS3 Designer application)

Digital input #1 Muting group 1

Digital input #2 Not configured

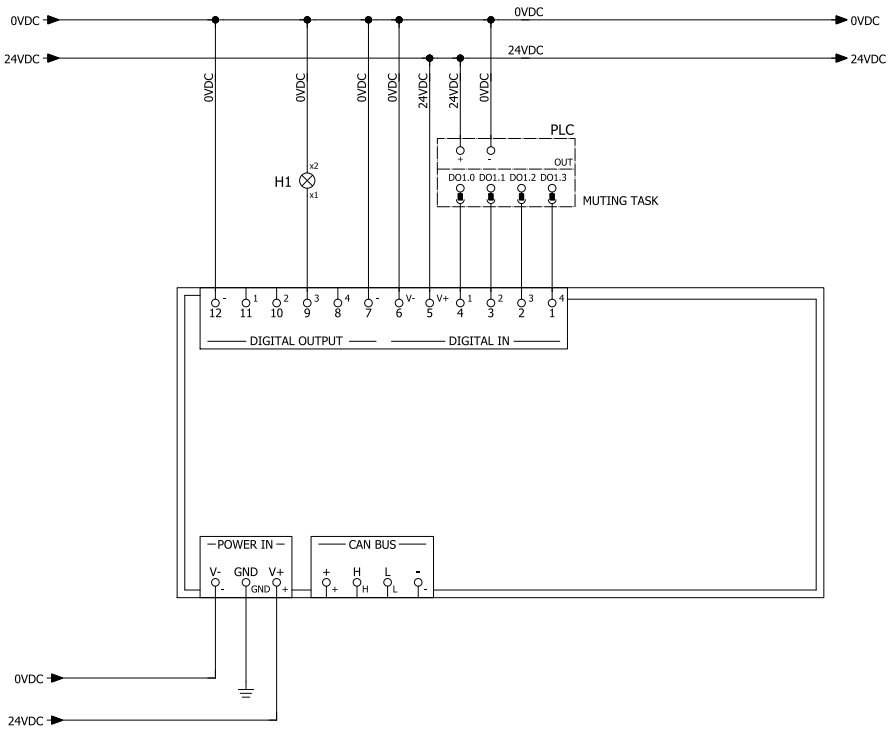
Digital output #1 Not configured

Digital output #2 Not configured

Digital output #3 Muting enable feedback signal

Digital output #4 Not configured

12.3.6 Connection of the muting input and output (two groups of sensors)



Note: the cables used for wiring the digital inputs must have a maximum length of 30 m (98.4 ft).

Digital I/O settings (through the safeRS3 Designer application)

Digital input #1 Muting group 1

Digital input #2 Muting group 2

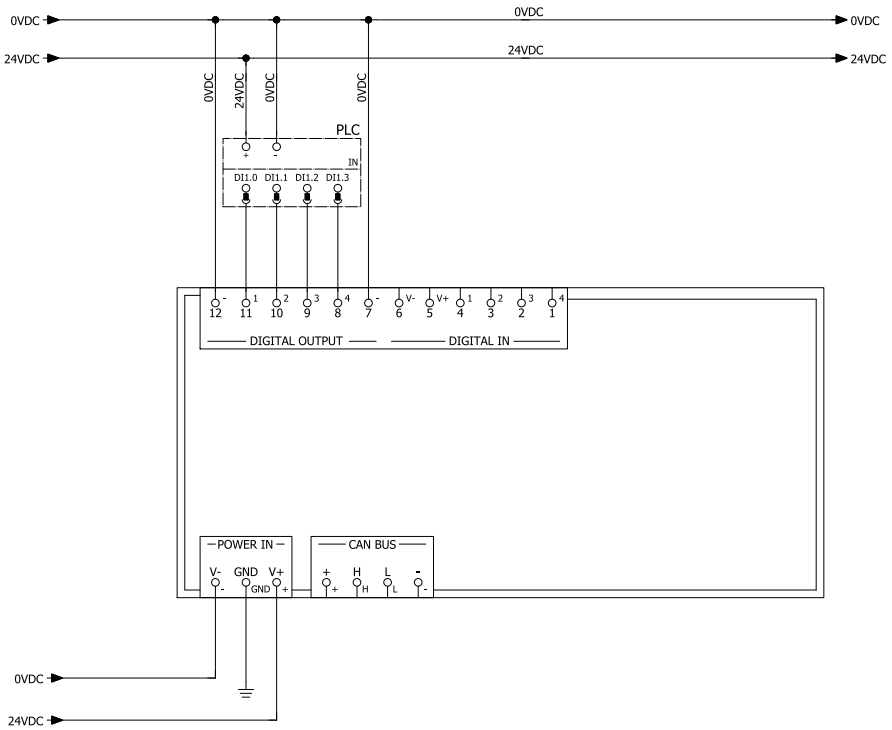
Digital output #1 Not configured

Digital output #2 Not configured

Digital output #3 Muting enable feedback signal

Digital output #4 Not configured

12.3.7 Detection signal 1 and 2 connection



Digital I/O settings (through the safeRS3 Designer application)

Digital input #1 Not configured

Digital input #2 Not configured

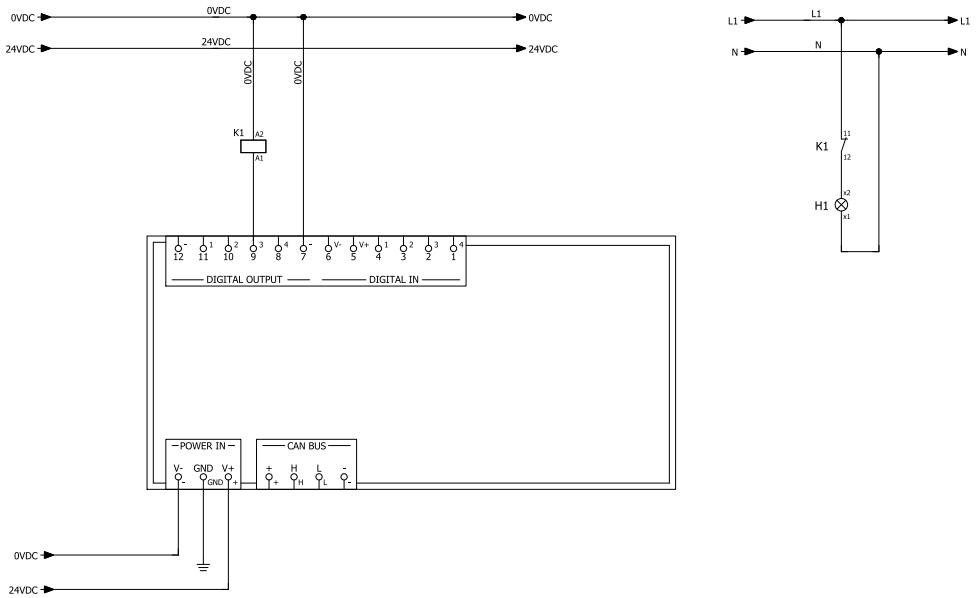
Digital output #1 Detection signal 1

Digital output #2 Detection signal 1

Digital output #3 Detection signal 2

Digital output #4 Detection signal 2

12.3.8 Diagnostic output connection



Note: the cables used for wiring the digital inputs must have a maximum length of 30 m (98.4 ft).

Digital I/O settings (through the safeRS3 Designer application)

Digital input #1 Not configured

Digital input #2 Not configured

Digital output #1 Not configured

Digital output #2 Not configured

Digital output #3 System diagnostic signal

Digital output #4 Not configured

12.4 Configuration application parameters

12.4.1 Parameter list

Parameter	Min	Max	Default value
Settings > Account			
Password	-	-	Not available
Settings > General			
System	safeRS/safeRS3 mixed system, safeRS3		safeRS/safeRS3 mixed system
Sensors model and type	5 meter sensors, 9 meter sensors		5 meter sensors
Country	Europe, Rest of the certified countries or list of countries		Europe, Rest of the certified countries
Application type selection	Stationary, Mobile, Vehicle		Stationary
Configuration			
Number of installed sensors	1	6	1
Plane	Dim. X: 1000 mm Dim. Y: 1000 mm	Dim. X: 65000 mm Dim. Y: 65000 mm	Dim. X:10000 mm Dim. Y: 7000 mm
Position (for each sensor)	X: 0 mm Y: 0 mm	X: 65000 mm Y: 65000 mm	Default position of sensor #1: X: 2000 mm Y: 3000 mm
Rotation 1 (for each sensor)	0°, 90°, 180°, 270°		0°
Rotation 2 (for each sensor)	0°	359°	180°
Rotation 3 (for each sensor)	-90°	90°	0°
Sensor installation height (for each sensor)	0 mm	10000 mm	0 mm
RCS Threshold (for each sensor)	0 dB	70 dB	0 dB
RCS Threshold (for each detection field of each sensor)	0 dB	70 dB	0 dB
RCS Threshold	0 dB	70 dB	0 dB
Detection Distance 1, 2 (for each sensor)	0 mm **Note**: the minimum value for the first detection field with distance > 0 is 200 mm.	9000 mm **Note**: the sum of all the detection distances (for each sensor) cannot exceed 9000 mm.	1000 mm

Parameter	Min	Max	Default value
Detection Distance 2, 3 and 4 (for each sensor)	0 mm **Note**: the minimum value for the first detection field with distance > 0 is 200 mm.	9000 mm **Note**: the sum of all the detection distances (for each sensor) cannot exceed 9000 mm.	0 mm
Detection area shape	Classic, Corridor		Classic
Angular coverage left (Classic shape), for a total detection distance lower than or equal to 5000 mm	0° **Note**: the minimum angular coverage (left + right) is 10°	50°	45°
Angular coverage right (Classic shape), for a total detection distance lower than or equal to 5000 mm	0° **Note**: the minimum angular coverage (left + right) is 10°	50°	45°
Angular coverage left (Classic shape), for a total detection distance greater than 5000 mm	0° **Note**: the minimum angular coverage (left + right) is 10°	20°	-
Angular coverage right (Classic shape), for a total detection distance greater than 5000 mm)	0° **Note**: the minimum angular coverage (left + right) is 10°	20°	-
(Corridor shape) – Corridor left	0 mm Note: the minimum corridor width (left + right) is 200 mm in the first 5 m; it is 300 mm between 5 and 9 m.	4000 mm	500 mm
(Corridor shape) – Corridor right	0 mm Note: the minimum corridor width (left + right) is 200 mm in the first 5 m; it is 300 mm between 5 and 9 m.	4000 mm	500 mm

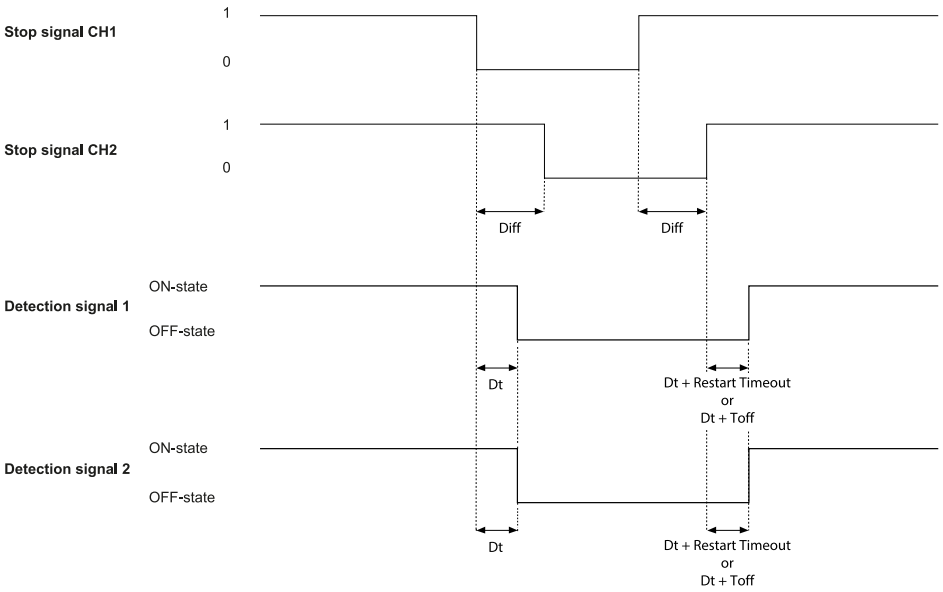
Parameter	Min	Max	Default value
Safety working mode (for each protective field of each sensor)	Access detection and restart prevention, Always-on access detection		Access detection and restart prevention
Static object detection (for each protective field of each sensor)	Enabled, Disabled		Disabled
Restart timeout (for each protective field of each sensor)	100 ms	60000 ms	4000 ms
T_{OFF}	100 ms	60000 ms	100 ms
Settings > Advanced			
Protective field dependency	Enabled, Disabled		Enabled
Electromagnetic robustness	Standard, High, Very High		Standard
Static object detection sensitivity	-20 dB	+20 dB	0 dB
Settings > Advanced > Multi-control synchronization			
Control channel	0	3	0
Settings > Anti-tampering			
Anti-masking sensitivity (for each sensor)	Disabled, Low, Medium, High		High
Anti-masking distance (for each sensor)	200 mm	1000 mm	1000 mm
Anti-rotation around axes (for each sensor)	Disabled, Enabled		Disabled
Anti-rotation around axes - Enable specific axis - Tilt (for each sensor)	Disabled, Enabled		Disabled
Anti-rotation around axes - Enable specific axis -Roll (for each sensor)	Disabled, Enabled		Disabled
Anti-rotation around axes - Enable specific axis - Pan (for each sensor)	Disabled, Enabled		Disabled
Settings > Digital Input-Output			
Digital input (for each input)	Not configured, Stop signal, Restart signal, Muting group “N”, Dynamic configuration switch, Fieldbus controlled, System recondition, Restart signal + System recondition, Single channel (Category 2)		Not configured
Digital input channel (for each channel of each input)	Not configured, Restart signal, Fieldbus controlled, System recondition		Not configured
Redundancy mode	Coherent, Inverted		Coherent
Encoded channel	Enabled, Disabled **Note**: available only when both the digital inputs are configured as Dynamic configuration switch		Disabled
Digital output (for each output)	Not configured, System diagnostic signal, Muting enable feedback signal, Fieldbus controlled, Restart feedback signal, Detection signal "N", Static object detection feedback signal, Detection signal group 1, Detection signal group 2		Not configured

Parameter	Min	Max	Default value
OSSD Pulse width	Short (300 µs), Long (2 ms)		Short (300 µs)
Short-circuit/Open circuit diagnostics	Enabled, Disabled		Disabled
Settings > Muting			
Group for muting (for each sensor)	None, Group 1, Group 2, both		Group 1
Pulse width (for each input)	0 µs (= Period and Phase shift disabled) 200 µs	2000 µs	0 µs
Period (for each input)	200 ms	2000 ms	200 ms
Phase shift (for each input)	0.4 ms	1000 ms	0.4 ms
Settings > Restart function			
Protective field 1, 2, 3, 4	Automatic, Manual, Safe manual		Automatic
Settings > Activity History			
Log verbosity level	0	5	0
Settings > Protective field groups			
Protective field 1, 2, 3, 4 (for each sensor)	None, Group 1, Group 2, Both		None
Admin > Network Parameters			
IP Address	-		192.168.0.20
Netmask	-		255.255.255.0
Gateway	-		192.168.0.1
TCP port	1	65534	80
Admin > Fieldbus Parameters			
System configuration and status PS2v6	1	65535	145
Sensors information PS2v6	1	65535	147
Sensor 1 detection status PS2v6	1	65535	149
Sensor 2 detection status PS2v6	1	65535	151
Sensor 3 detection status PS2v6	1	65535	153
Sensor 4 detection status PS2v6	1	65535	155
Sensor 5 detection status PS2v6	1	65535	157
Sensor 6 detection status PS2v6	1	65535	159
System configuration and status PS2v4	1	65535	146
Sensors information PS2v4	1	65535	148
Sensor 1 detection status PS2v4	1	65535	150
Sensor 2 detection status PS2v4	1	65535	152
Sensor 3 detection status PS2v4	1	65535	154
Sensor 4 detection status PS2v4	1	65535	156
Sensor 5 detection status PS2v4	1	65535	158
Sensor 6 detection status PS2v4	1	65535	160
Fieldbus endianness	Big Endian, Little Endian		Big Endian

Parameter	Min	Max	Default value
FSoE Safe Address	1	65535	145
Admin > MODBUS Parameters			
MODBUS Enable	Enabled, Disabled		Enabled
Listening port	1	65534	502
Admin > System labels			
Control	-		-
Sensor 1	-		-
Sensor 2	-		-
Sensor 3	-		-
Sensor 4	-		-
Sensor 5	-		-
Sensor 6	-		-
Admin > Users management			
User name	-		-
Access level	Admin, Engineer, Expert, Observer, Service		Observer
Admin > SD Card			
Automatic backup creation	Enabled, Disabled		Disabled
Users data included	Enabled, Disabled		Disabled
Enable restore by button	Enabled, Disabled		Enabled

12.5 Digital input signals

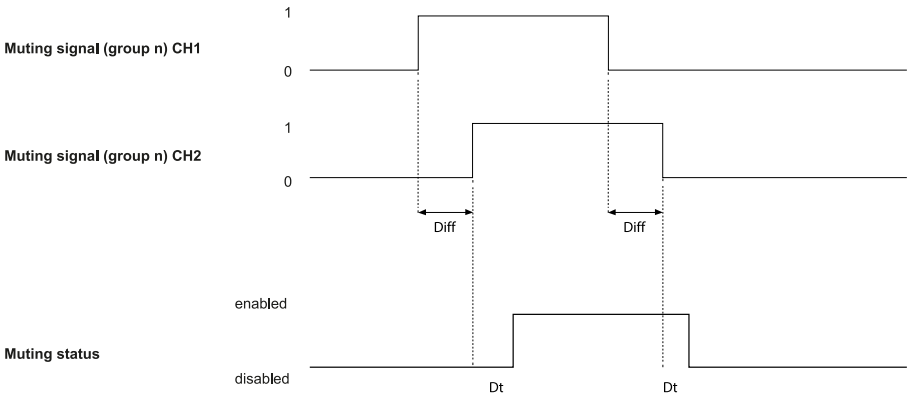
12.5.1 Stop signal



Part	Description
Detection signal 1 **Detection signal 2**	Both deactivate on the falling edge of, at least, one of the two input channels of the input signal. They remain in OFF-state as long as one of the two input channels remains to the low logic status (0).
Stop signal CH1 **Stop signal CH2**	Interchangeable channel. As soon as one channel goes to the low logic level (0), Detection signal 1 and Detection signal 2 are set to OFF-state.
Diff	Less than 50 ms. If the value is greater than 50 ms, the diagnostic alarm starts and the system deactivates the safety outputs.
Dt	Activation delay. Less than 5 ms.

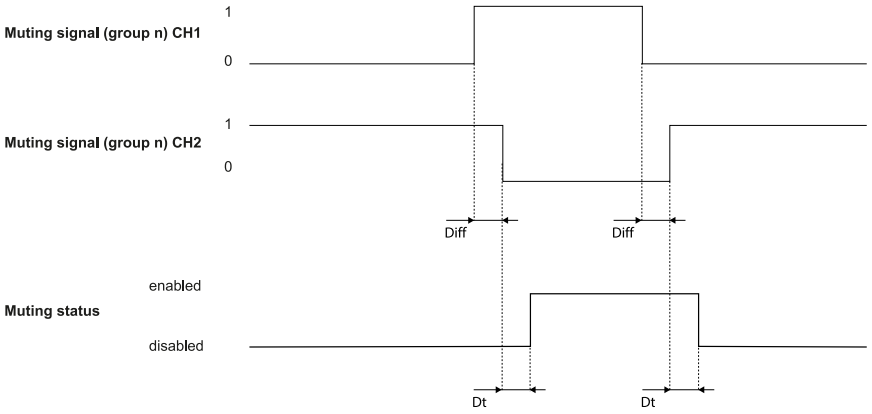
12.5.2 Muting (with/without pulse)

Without pulse (redundancy mode coherent)



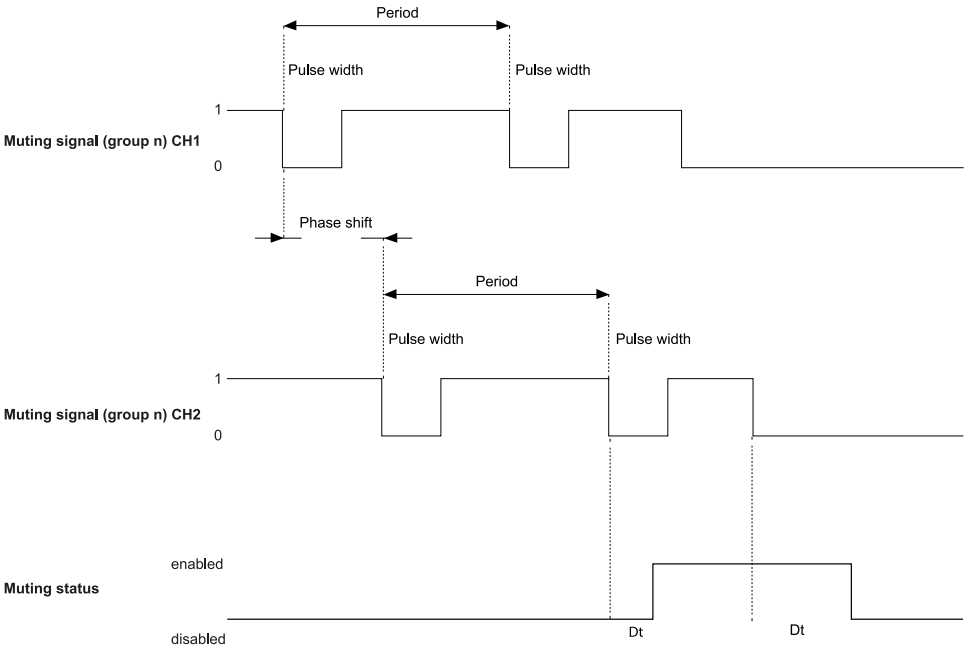
Part	Description
Diff	Less than 100 ms. If the value is greater than 100 ms, the diagnostic alarm starts and the system deactivates the safety outputs.
Muting signal (group *n*) CH 1 **Muting signal (group *n*) CH 2**	Interchangeable channel.
Muting status	They are enabled as long as both channels are at a high logic level (1) and deactivated when both channels go to a low logic level (0).
Dt	Activation/deactivation delay. Less than 50 ms.

Without pulse (redundancy mode inverted)



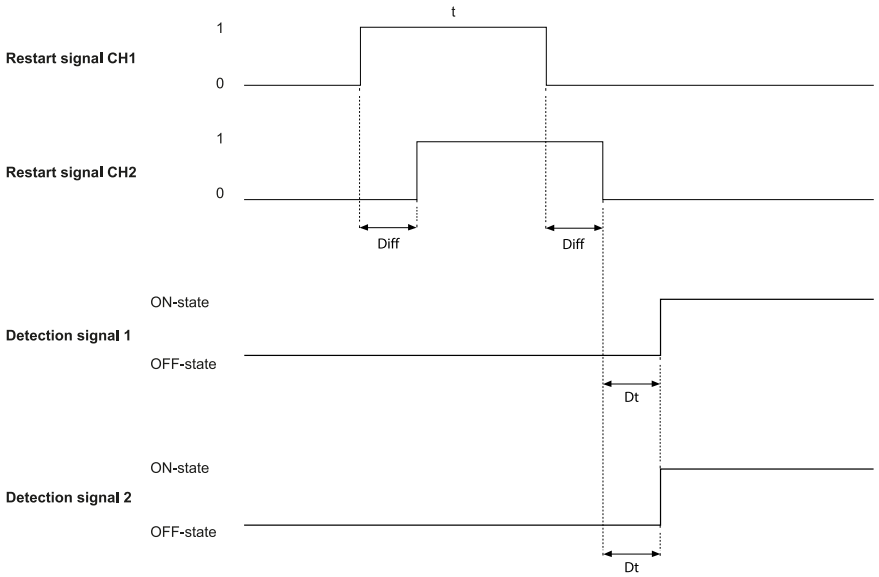
Part	Description
Diff	Less than 100 ms. If the value is greater than 100 ms, the diagnostic alarm starts and the system deactivates the safety outputs.
Muting status	They are enabled as long as channel 1 of the Muting signal is at a high logic level (1) and channel 2 is at a low logic level (0). Disabled as long as channel 1 is at a low logic level (0) and channel 2 is at a high logic level (1).
Dt	Activation/deactivation delay. Less than 50 ms.

With pulse



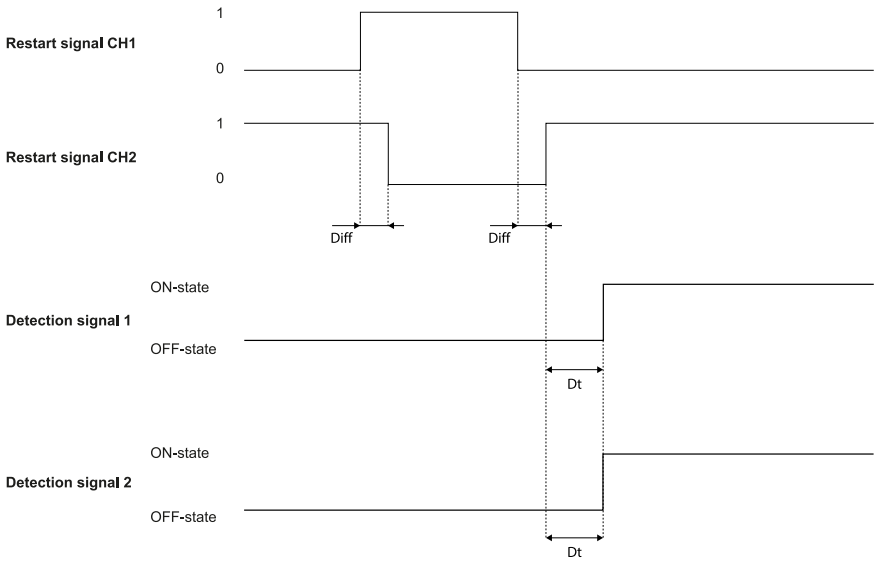
Part	Description
Diff	Less than 100 ms. If the value is greater than 100 ms, the diagnostic alarm starts and the system deactivates the safety outputs.
Muting signal (group *n*) CH 1 **Muting signal (group *n*) CH 2**	Interchangeable channel.
Muting status	They are enabled as long as both the input signals follow the configured muting parameters (pulse width, period, and phase shift).
Dt	Activation/deactivation delay. Less than three times the period.

12.5.3 Restart signal (dual channel, redundancy mode coherent)



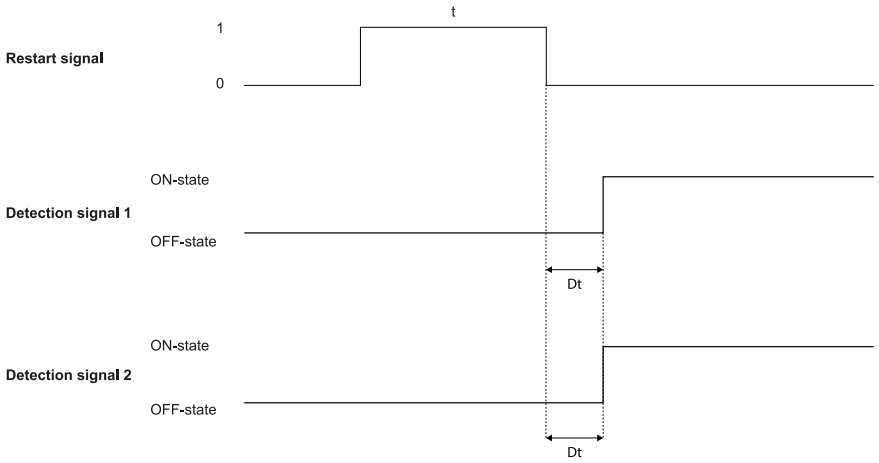
Part	Description
Detection signal 1 **Detection signal 2**	The Detection signal 1 and Detection signal 2 outputs go to ON-state as soon as the last channel has correctly completed the transition 0 -> 1 -> 0.
Restart signal CH1 **Restart signal CH2**	Interchangeable channel. Both channels of Restart signal must have a transition of logical level 0 -> 1 ->0. The time they stay at a high logical level (t) must be at least 200 ms and less than 5 s.
Dt	Activation delay. Less than 50 ms.
Diff	Less than 100 ms. If the value is greater than 100 ms, the system maintains the outputs deactivated.

12.5.4 Restart signal (dual channel, redundancy mode inverted)



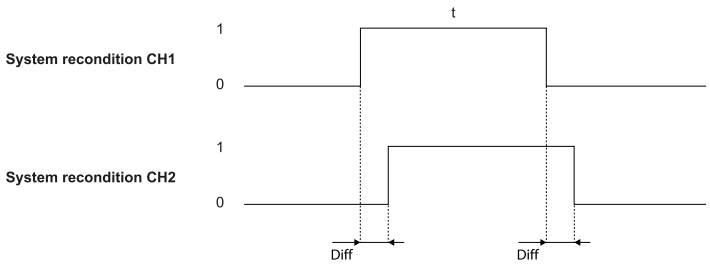
Part	Description
Detection signal 1 **Detection signal 2**	The Detection signal 1 and Detection signal 2 outputs go to ON-state as soon as the last channel has correctly completed the transition.
Restart signal CH1 **Restart signal CH2**	Channel 1 of the Restart signal must have a transition of logical level 0 -> 1 -> 0. Channel 2 of Restart signal must have a transition of logical level 1 -> 0 -> 1. The time they stay at a high logical level (t) must be at least 200 ms and less than 5 s.
Dt	Activation delay. Less than 50 ms.
Diff	Less than 100 ms. If the value is greater than 100 ms, the system maintains the outputs deactivated.

12.5.5 Restart signal (single channel)



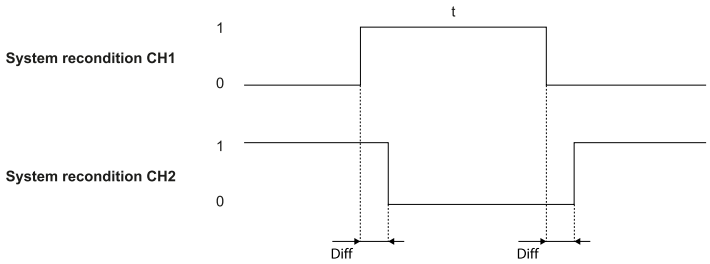
Part	Description
Detection signal 1 **Detection signal 2**	The Detection signal 1 and Detection signal 2 outputs go to ON-state as soon as the Restart signal has correctly completed the transition 0 -> 1 -> 0.
Restart signal	The channel must have a transition of logical level 0 -> 1 ->0. The time they stay at a high logical level (t) must be at least 200 ms and less than 5 s.
Dt	Activation delay. Less than 50 ms.

12.5.6 System recondition (dual channel, redundancy mode coherent)



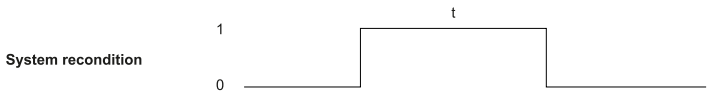
Part	Description
System recondition CH1 **System recondition CH2**	Interchangeable channel. Both channels of System recondition must have a transition of logical level 0 -> 1 ->0. They must stay at a high logical level (t) for at least 10 s and less than 30 s.
Diff	Less than 100 ms. If the value is greater than 100 ms, the system maintains the outputs deactivated.

12.5.7 System recondition (dual channel, redundancy mode inverted)



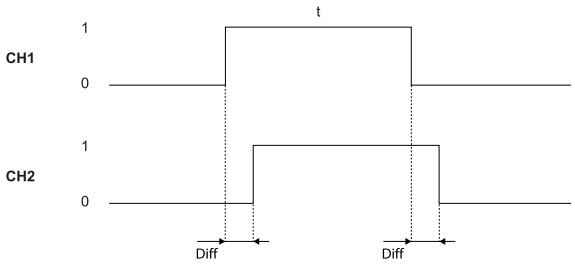
Part	Description
System recondition CH1 **System recondition CH2**	Channel 1 of System recondition must have a transition of logical level 0 -> 1 -> 0. Channel 2 of System recondition must have a transition of logical level 1 -> 0 -> 1. They must stay at a high logical level (t) for at least 10 s and less than 30 s.
Diff	Less than 100 ms. If the value is greater than 100 ms, the system maintains the outputs deactivated.

12.5.8 System recondition (single channel)



Part	Description
System recondition	The channel must have a transition of logical level 0 -> 1 ->0. The time it stays at a high logical level (t) must be at least 10 s and less than 30 s.

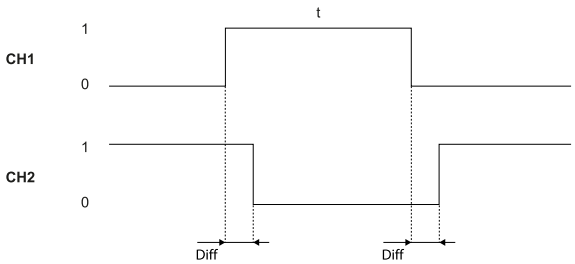
12.5.9 Restart signal + System recondition (dual channel, redundancy mode coherent)



Part	Description
CH1 **CH2** **(Restart signal)**	Interchangeable channel. Both channels must have a transition of logical level 0 -> 1 ->0. The time they stay at a high logical level (t) must be at least 200 ms and less than 5 s. For details about the behavior of Detection signal 1 and 2 outputs and the deactivation delay, see Restart signal (dual channel, redundancy mode coherent) on page 149.
CH1 **CH2** **(System recondition)**	Interchangeable channel. Both channels must have a transition of logical level 0 -> 1 ->0. They must stay at a high logical level (t) for at least 10 s and less than 30 s.

Part	Description
Diff	Less than 100 ms. If the value is greater than 100 ms, the system maintains the outputs deactivated.

12.5.10 Restart signal + System recondition (dual channel, redundancy mode inverted)



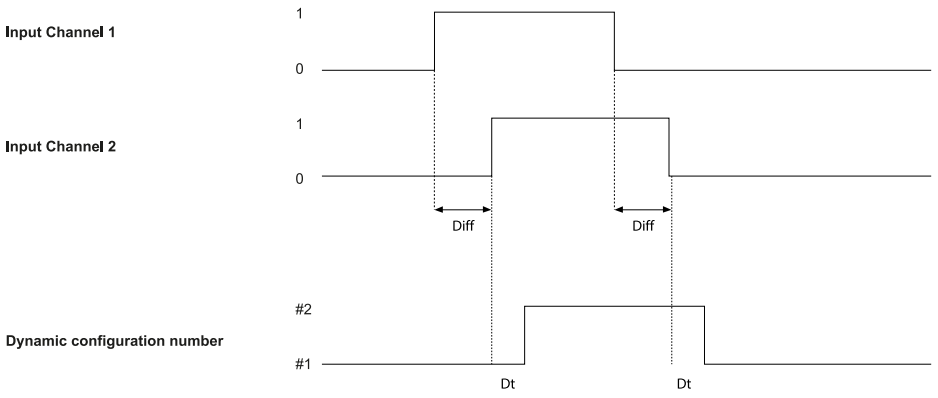
Part	Description
CH1 **CH2** **(Restart signal)**	Channel 1 of the Restart signal must have a transition of logical level 0 -> 1 -> 0. Channel 2 of Restart signal must have a transition of logical level 1 -> 0 -> 1. The time they stay at a high logical level (t) must be at least 200 ms and less than 5 s. For details about the behavior of Detection signal 1 and 2 outputs and the deactivation delay, see Restart signal (dual channel, redundancy mode inverted) on page 150.
CH1 **CH2** **(System recondition)**	Channel 1 of System recondition must have a transition of logical level 0 -> 1 -> 0. Channel 2 of System recondition must have a transition of logical level 1 -> 0 -> 1. They must stay at a high logical level (t) for at least 10 s and less than 30 s.
Diff	Less than 100 ms. If the value is greater than 100 ms, the system maintains the outputs deactivated.

12.5.11 Restart signal + System recondition (single channel)

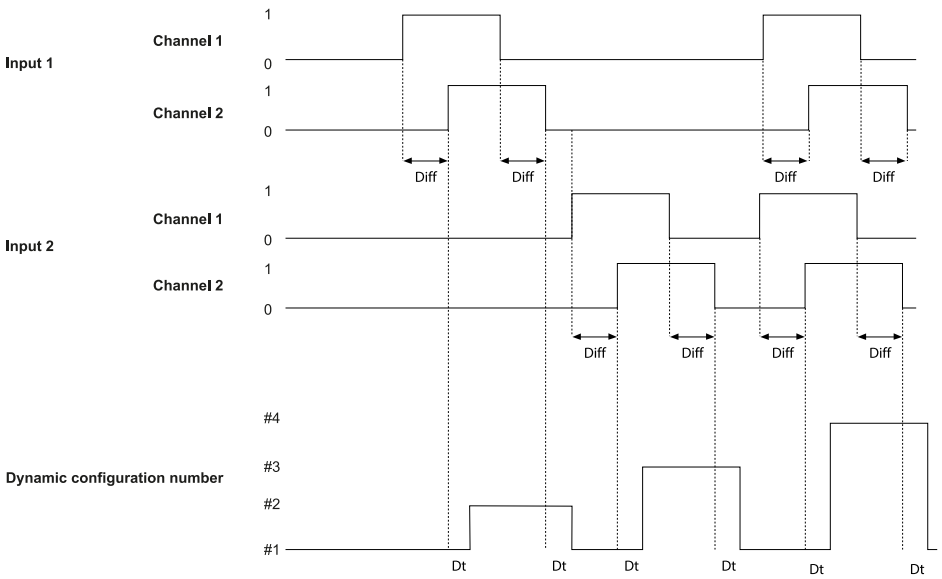
Part	Description
Restart signal	The channel must have a transition of logical level 0 -> 1 ->0. The time it stays at a high logical level (t) must be at least 200 ms and less than 5 s. For details about the behavior of Detection signal 1 and 2 outputs and the deactivation delay, see Restart signal (single channel) on page 151.
System recondition	The channel must have a transition of logical level 0 -> 1 ->0. The time it stays at a high logical level (t) must be at least 10 s and less than 30 s.

12.5.12 Dynamic configuration switch (redundancy mode coherent)

With one input



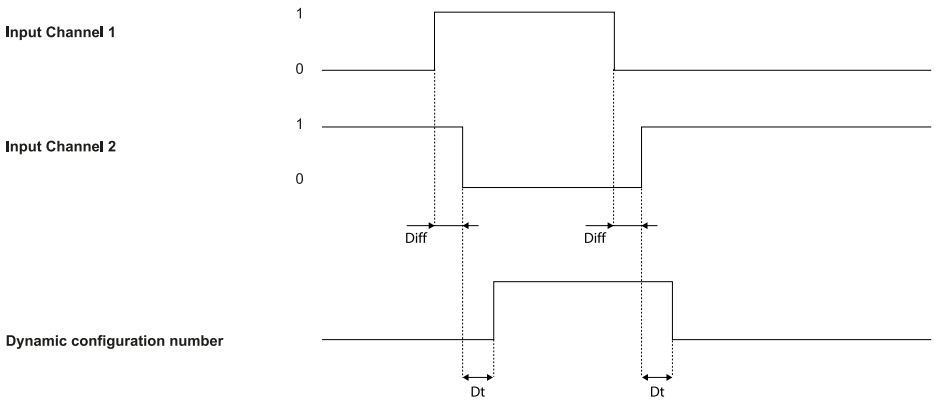
With two inputs (encoded channels disabled)



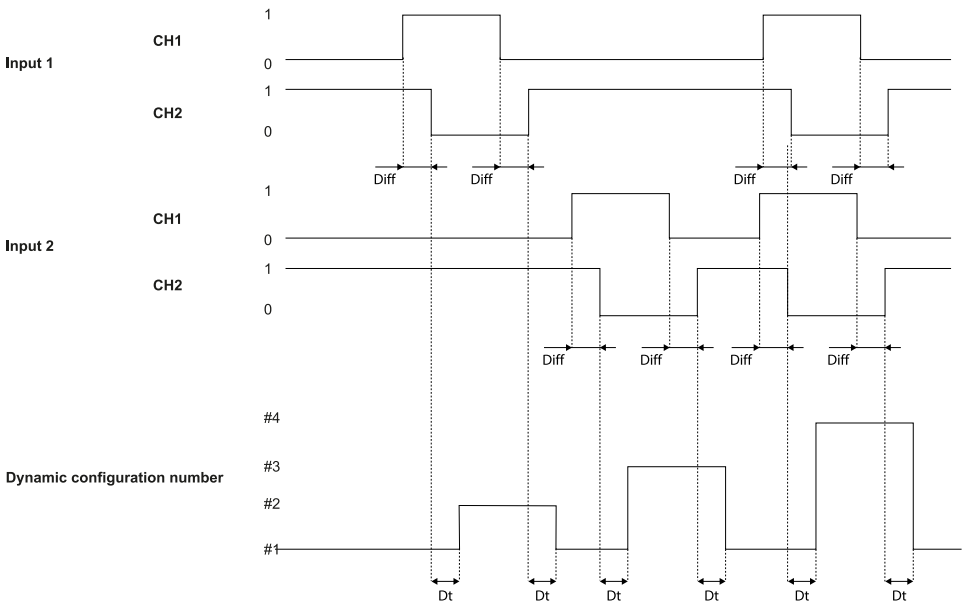
Part	Description
Diff	Less than 100 ms. If the value is greater than 100 ms, the diagnostic alarm starts and the system deactivates the safety outputs.
Dynamic configuration number	For details about the dynamic configuration number and the encoded channel option, see Dynamic configuration through the digital inputs on page 44.
Dt	Activation/deactivation delay. Less than 50 ms.

12.5.13 Dynamic configuration switch (redundancy mode inverted)

With one input



With two inputs



Part	Description
Diff	Less than 100 ms. If the value is greater than 100 ms, the diagnostic alarm starts and the system deactivates the safety outputs.
Dynamic configuration number	For details about the dynamic configuration number and the encoded channels option, see Dynamic configuration through the digital inputs on page 44.
Dt	Activation/deactivation delay. Less than 50 ms.

13 Appendix

13.1 System software

13.1.1 Introduction

The aim of this appendix is to provide and clarify the information related to the system software. It includes the information necessary for the integrator during the installation and integration in accordance with IEC 61508-3 Annex D.

Considering that safeRS3 is an embedded system provided with a firmware already deployed on board, no software integration is required by the system installer or by the end user. The following paragraphs analyzes all the information required in IEC 61508-3 Annex D.

13.1.2 Configuration

The system configuration can be performed by means of a PC-based configuration tool, called the safeRS3 Designerapplication.

The system configuration is described in Installation and use procedures on page 80.

13.1.3 Competence

Although no competence is required for software integration, a skilled person is required for system installation and configuration, as described in Installation and use procedures on page 80.

13.1.4 Installation instructions

The firmware is already deployed on the hardware, the PC-based configuration tool includes a self-explanatory setup installer.

13.1.5 Outstanding anomalies

At the moment of the issue of this document, no software/firmware anomalies or bugs are known.

13.1.6 Backward compatibility

Backward compatibility is guaranteed.

13.1.7 Change control

Any change proposal suggested by the integrator or the end user should be forwarded to SICK and evaluated by the Product Owner.

13.1.8 Implemented security measures

Firmware upgrade packages are managed by the SICK Technical Support and are signed to prevent the use of unverified binary files.

13.2 Disposal

safeRS3 contains electrical parts. As set forth in European Directive 2012/19/EU, do not dispose of the product with unsorted urban waste materials.

It is the responsibility of the owner/distributor to dispose of these products, as well as other electrical and electronic equipment, through specific waste collection facilities indicated by the waste disposal services.

Correct disposal and recycling will contribute to the prevention of potentially harmful consequences to the environment and human health.

For more detailed information about disposal, contact the waste disposal services or the representative from whom you purchased the product.

13.3 Intellectual property

13.3.1 Trademarks

EtherCAT® and Safety over EtherCAT® are registered trademarks and patented technologies licensed by Beckhoff Automation GmbH, Germany.

13.4 Checklist for installing ESPE

13.4.1 Introduction

Collecting the details relating to the following items is mandatory no later than when the system is commissioned for the first time.

This checklist should be kept with the machine documentation to serve as a reference during periodic tests.

This checklist does not replace the initial commissioning or regular inspection by qualified safety personnel.

13.4.2 Checklist

Question	Yes	No
Have the safety rules and regulations been observed in compliance with the directives and standards applicable to the machine?		
Are the applied directives and standards listed in the declaration of conformity?		
Does the ESPE comply with the required PL/SIL claim limit and PFHd in accordance with EN ISO 13849-1/EN 62061 and the required type in accordance with EN 61496-1?		
Is access to the dangerous area only possible through the detection field of the ESPE?		
Have appropriate measures been taken to detect any persons in the dangerous area?		
Have the safety devices been secured or locked to prevent their removal?		
Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching below, above, or around the ESPE?		
Has the maximum stopping time of the machine been measured, specified, and documented?		
Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved?		
Are the ESPE devices properly mounted and secured against manipulation after adjustment?		
Are the required protective measures against electric shock in effect (protection class)?		
Is the control switch for resetting the protective devices (ESPE) or restarting the machine present and correctly installed?		
Are the outputs of the ESPE integrated according to the required PL/SIL in accordance with EN ISO 13849-1/EN 62061, and does the integration correspond to the circuit diagrams?		
Has the protective function been checked in compliance with the test notes of this documentation?		

Question	Yes	No
Are the specified protective functions effective at every operating mode that can be set?		
Does the ESPE activate the switching elements?		
Is the ESPE effective over the entire period of the dangerous state?		
Once initiated, will a dangerous state be stopped when switching the ESPE on or off, when changing the operating mode, or when switching to another protective device?		

8029009/2023-12-30/en

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