OPERATING INSTRUCTIONS

sBot – URCap

Safety System

SICK
Sensor Intelligence.

Described product

sBot – URCap

Manufacturer

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Legal information

Original document

This document is an original document of SICK AG.

Contents

1 About this document

1.1 Purpose of this document

These operating instructions contain the information required during the life cycle of the safety system. This document describes:

- The individual components
- The project planning
- The mounting and electrical installation, insofar as special measures are necessary for the safety system
- The configuration
- The necessary thorough checks
- The commissioning
- The maintenance
- The troubleshooting

1.2 Scope

These operating instructions contain information on the following safety systems:

- sBot Stop - URCap
- sBot Stop2 - URCap
- sBot Speed - URCap
- sBot Speed2 - URCap

This document is included with the following SICK part numbers (this document in all available language versions):

8025715

1.3 Target groups and structure of these operating instructions

These operating instructions are intended for the following target groups: project developers (planners, developers, designers), installers, electricians, operators, and maintenance personnel.

These operating instructions are organized by the life phases of the safety system: project planning, mounting, electrical installation, commissioning, operation and maintenance.

1.4 Further information

www.sick.com

The following information is available via the Internet:

- This document in other languages
- Operating instructions and mounting instructions of SICK components suitable for the safety system
- Guide for Safe Machinery (“Six steps to a safe machine”)

1.5 Related applicable documents

Important information

NOTICE
The operating instructions for the components also apply.
The relevant information must be made available to the employees for all work performed on the safety system.

Related applicable documents from SICK

Document	Title	Part number	Source
Operating instructions	nanoScan3 I/O	8024594	www.sick.com/8024594
Operating instructions	Flexi Classic	8011562	www.sick.com/8011562
Mounting instructions	nanoScan3	8024613	www.sick.com/8024613

Related applicable documents from other manufacturers

Document	Source
Robot controller documentation	https://www.universal-robots.com/download

1.6 Symbols and document conventions

Warnings and other notes

DANGER
Indicates a situation presenting imminent danger, which will lead to death or serious injuries if not prevented.

WARNING
Indicates a situation presenting possible danger, which may lead to death or serious injuries if not prevented.

CAUTION
Indicates a situation presenting possible danger, which may lead to moderate or minor injuries if not prevented.

NOTICE
Indicates a situation presenting possible danger, which may lead to property damage if not prevented.

NOTE
Highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

Instructions to action

► The arrow denotes instructions to action.

1. The sequence of instructions for action is numbered.
2. Follow the order in which the numbered instructions are given.

✓ The check mark denotes the result of an instruction.

2 Safety information

2.1 General safety note

Integrating the product

The information and tools will not fulfill the safety requirements for your application without further adjustments being made! The project planning provided by way of example is intended to serve as the basis to allow you to perform your own project planning and programming in line with your specific requirements. What this means is that the information and tools merely provide an example to demonstrate how a safety function can be taken care of.

When it comes to your own project planning and programming, you will need to rely on qualified staff given that it is your responsibility to ensure that the following requirements are complied with at the very least:

- ► Carry out a risk assessment.
- ► Take applicable standards into account.
- ► Verify and validate the safety functions.

Note for safety systems that are no longer available

If the safety system is no longer available on the SICK homepage or has been decommissioned, only the components listed in the decommissioning letter may be used up to the corresponding firmware and hardware version. If the required information from the decommissioning letter (maximum firmware and hardware versions of the individual components) is not available, this should be requested from SICK, as safety, availability and compatibility cannot be guaranteed for newer versions.

2.2 Intended use

The safety system provides protection against mechanical hazards (crushing, shearing, impact) caused by movement of the robot arm by means of area safeguarding. The safety system can only be used in certain applications.

The product may be used in safety functions.

The product must only be used within the limits of the prescribed and specified technical specifications and operating conditions at all times.

Incorrect use, improper modification or manipulation of the product will invalidate any warranty from SICK; in addition, any responsibility and liability of SICK for damage and secondary damage caused by this is excluded.

2.3 Inappropriate use

Impermissible use

- As a physical guard. The product works as an indirect protective measure and cannot provide protection from parts thrown from the application nor from emitted radiation.

Impermissible ambient conditions

- Outdoor areas
- Explosion-hazardous area
- In the water

2.4 Qualification of personnel

Any work on the product may only be carried out by personnel qualified and authorized to do so.

Qualified personnel are able to perform tasks assigned to them and can independently recognize and avoid any potential hazards. This requires, for example:

- technical training
- experience
- knowledge of the applicable regulations and standards

3 Product description

3.1 Scope of delivery

Table 1: Scope of delivery

Component	1111884	1111885	1137604	1137605
Hardware				
nanoScan3 Core I/O safety laser scanner	1×	–	2×	–
System plug for nanoScan3 Core I/O	1×	–	2×	–
nanoScan3 Pro I/O safety laser scanner	–	1×	–	2×
System plug for nanoScan3 Pro I/O	–	1×	–	2×
Mounting kit 1b (with protection for optics cover) for safety laser scanners	1×	1×	2×	2×
Main module for Flexi Classic safety controller	–	–	1×	1×
Extension module for Flexi Classic safety controller	–	–	–	1 ×
Connecting cable female connector, M12, 8-pin, straight, A-coded <-> cable with flying leads, 10 m	1×	–	2×	–
Connecting cable female connector, M12, 17-pin, straight, A-coded <-> cable with flying leads, 10 m	–	1 ×	–	2×
Ethernet cable male connector, M12, 4-pin, straight, D-coded <-> male connector, RJ45, 4-pin, straight	1×	1×	2×	2×
Software				
nanoScan3 Tool - URCap	Provided upon purchase.			
Circuit diagram (macro for ePlan and PDF)				
SISTEMA project file				
Operating instructions				

3.2 Overview of the product

Figure 1: Overview

① Safety laser scanner (including mounting bracket)
② Optional: 2nd safety laser scanner (including mounting bracket)
③ Configuration software for safety laser scanners (URCap on robot controller)

3.3 Product characteristics

3.3.1 Design and function

Overview

The safety system is used for protecting people. The safety laser scanners monitor the environment of the robot.

The safety system combines safety laser scanners, a URCap for configuring the safety laser scanners, and safety functions of the robot controller.

In the event of a detection, a safety stop of the robot is triggered. Some variants also trigger a reduction in the speed of the robot before a safety stop is triggered.

Design

The following elements work together:

- 1 or 2 nanoScan3 safety laser scanners (from SICK)
- nanoScan3 Tool - URCap for configuring the safety system (from SICK)
- Flexi Classic safety controller (from SICK)
- Robots and robot controller (from Universal Robots)

Configuration for variants with 1 safety laser scanner

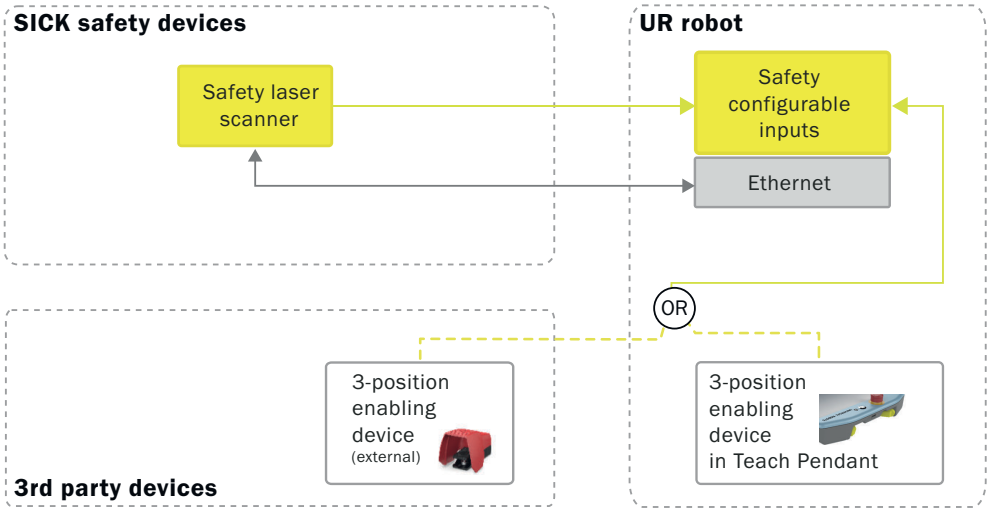


Figure 2: Configuration with 1 × safety laser scanner

Configuration for variants with 2 safety laser scanners

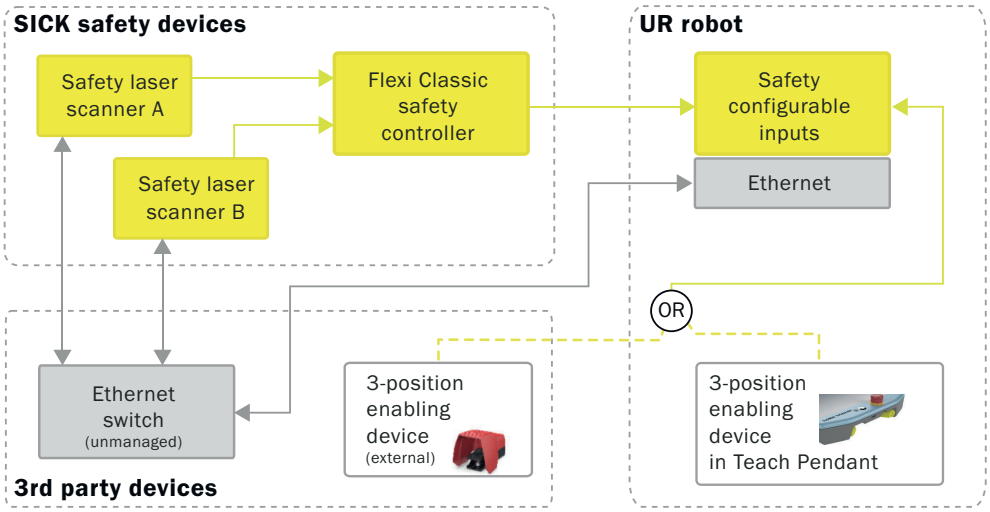


Figure 3: Configuration with 2 × safety laser scanners

Components relevant for the safety system

Table 2: Hardware

Component	Part of the safety system?	Included in scope of delivery
nanoScan3 safety laser scanner	Variant-dependent[1)]	Variant-dependent
Flexi Classic safety controller	Variant-dependent	Variant-dependent
Robots of type UR3e, UR5e, UR10e, UR16e, UR20 and UR30	Partially [2)]	No
Three-position enabling device	No, but it is needed[3)]	No
Ethernet switch	Variant-dependent	No

1) If more than 1 safety laser scanner is used: All safety laser scanners must be of the same type. It is not possible, for example, to mix nanoScan3 Core I/O and nanoScan3 Pro I/O devices.
2) Only the robot controller safety functions considered in this document are part of the safety system.
3) The enabling device is required when teaching the robot and for configuring the 'Automatic Mode Safeguard Stop'.

Table 3: Software and documentation

Name	Availability
nanoScan3 Tool (URCap)	SICK provides you with a ZIP archive when you purchase the safety system.
Complete subsystems for SISTEMA	
Circuit diagram (,acro for ePlan and PDF)	
Operating instructions for the safety system	
Quickstart for the safety system	

Implementing all the safety functions for the application requires a complete system consisting of sensors, a controller, actuators, and control switches.

Function

The safety laser scanners monitor the environment of the robot using the principle of time-of-flight measurement. The environment of the robot is divided into different fields for this purpose. If an object that could be a person is detected in a field, a function is triggered. The type of function triggered depends on the field in which the detection takes place. Which fields are available depends on the variant of the safety system.

Table 4: Fields and functions of the safety system

Field	Function		Available in safety system
	Detection in field	Field becomes clear	
Stop field	Triggers safety stop of the robot (function: Automatic mode safe-guard stop).	Automatic restart of the robot	All variants
Reduced field	Triggers the safety-rated monitored speed (function: Reduced mode).	When the reduced field is clear: Return to normal speed	sBot Speed – URCap sBot Speed2 – URCap
Warning field	Not defined. The signal can be used for any non-safety-related functions during integration.		sBot Stop – URCap sBot Stop2 – URCap

sBot Stop – URCap function

The safety laser scanner monitors the access to the hazardous area using 2 fields:

- Warning field
- Stop field (protective field)

When a person approaches the robot, detection first occurs in the non-safety warning field. The signal can be used for any non-safety-related functions during integration, e.g., indicator lights or acoustic signal transmitters.

If the person continues to approach, detection occurs in the stop field. This triggers a safety stop of the robot.

If the person moves away from the robot, the stop field becomes clear again. This triggers an automatic restart of the robot.

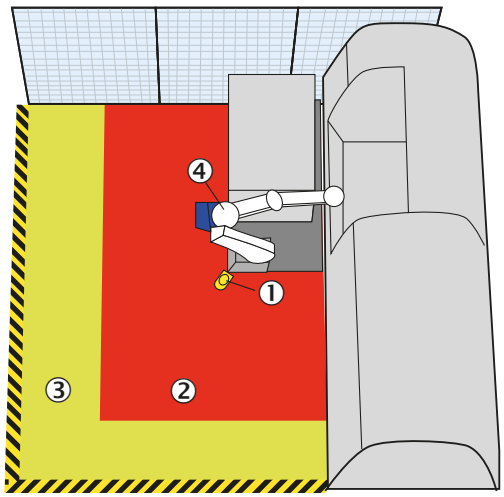


Figure 4: Example robot application using sBot Stop – URCap

① Safety laser scanner
② Stop field protective field
③ Warning field
④ Robot

sBot Stop2 function

The sBot Stop2 – URCap variant is functionally identical to the sBot Stop - URCap variant

The variants contain a second safety laser scanner. This makes it possible to monitor a larger area around the robot, e.g., when people can approach the robot from 3 directions.

sBot Speed – URCap function

The safety laser scanner monitors the access to the hazardous area using 2 fields:

- Stop field (protective field)
- Reduced field (protective field)

When a person approaches the robot, detection first occurs in the reduced field. This triggers the safety-rated monitored speed. The robot slows down. The robot controller continuously monitors that the robot does not exceed the reduced speed.

If the person continues to approach, detection occurs in the stop field. This triggers a safety stop of the robot.

If the person moves away from the robot, the stop field becomes clear again. This triggers an automatic restart of the robot. At this point, a detection in the reduced field usually still occurs. The safety-rated monitored speed is therefore active. The robot moves slowly.

If the person moves further away from the robot, the reduced field also becomes clear. This triggers the discontinuation of the safety-rated monitored speed. The robot operates at normal speed.

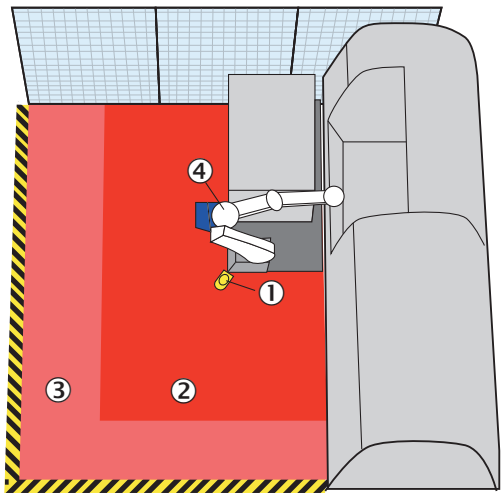


Figure 5: Example robot application using sBot Speed – URCap

① Safety laser scanner
② Stop field protective field
③ Reduced field protective field
④ Robot

sBot Speed2 – URCap

The sBot Speed2 – URCap variant is functionally identical to the sBot Speed - URCap variant

The variants contain a second safety laser scanner. This makes it possible to monitor a larger area around the robot, e.g., when people can approach the robot from 3 directions.

3.3.2 Requirements on the application

To use the product, the application must meet the following requirements:

- The robot must be one of the following types from Universal Robots:
  - UR3e
  - UR5e
  - UR10e
  - UR16e
  - UR20
  - UR30
- Robots and humans perform their work in the same workspace, but at different times (cooperation, see "Human-robot interaction", page 17).
- The robot works at a fixed position. If the robot is mounted on a moving table, the safety laser scanner must be mounted on the same table.
- The application requires a protective field ≤ 3 m.
- Access to the hazardous area must be designed so that the protective fields of the safety laser scanner cover the entire access to the hazardous area. A person cannot enter or reach into the hazardous area without interrupting the protective fields. It must not be possible to stand behind the protective fields.
- Bypassing the protective field (e.g. by reaching around or stepping over it) is not possible and this is ensured by additional measures as necessary.
- It is ensured that persons do not bring any aids into the monitored area with which persons can use to get above the scan plane without interrupting the protective field (e.g. ladder or chair).
- The area to be monitored is free from all airborne particles or process residues in its operational status.

3.3.3 Human-robot interaction

This safety system is suitable for cooperative human-robot interaction.

Table 5: Types of human-robot interaction

	Application with sequential processing	**Application with simultaneous processing**
Shared workspace	**Cooperation**	Collaboration
Different workspace	(Not interactive)	Coexistence

Cooperative human-robot interaction is characterized by the fact that tasks are being carried out in the same working area at different times.

4 Project planning

4.1 Manufacturer of the overall system

The safety system was developed under consideration of typical application cases. A partial safety function can be implemented with the safety system in these application cases. The manufacturer must check whether the safety system is suitable for its specific application case (risk assessment according to ISO 12100). Further protective measures may be required in addition to the safety system.

If the thorough check shows that the safety system is not suitable for the specific application case, the safety system can be used as a basis for an individualized development suitable for the specific application case. This case will not be considered further in this document.

In any event, additional work is necessary for the safety system to be used, e.g. subsequent configuration of the safety controller.

The manufacturer has the following duties:

- ► Executing a risk assessment.
- ► Verifying and validating the safety functions.
- ► Integrating the individual components in accordance with the appropriate standards.
- ► Please note that C standards have priority compared to statements about this safety system.

4.2 Operating entity of the overall system

Changes to the electrical integration of the safety system in the machine controller and changes to the mechanical mounting of the safety system necessitate a new risk assessment. The same applies to changes to the overall system. The results of this risk assessment may require the entity operating the machine to meet the obligations of a manufacturer.

Changes to the safety system's configuration may impair the protective function. The effectiveness of the safety system must be checked after any change to the configuration. The person carrying out the change is also responsible for maintaining the protective function of the safety system.

4.3 Design

4.3.1 Position of the safety laser scanner

Requirements on the position of the safety laser scanner

Position the safety laser scanner so that it meets all of the following criteria:

- If the robot is mounted on a movable table, the safety laser scanner must be mounted on the same table.
- The scan plane runs horizontally.
- The scan plane runs 300 mm above the floor.
- The safety laser scanner must be mounted with the optics cover facing upwards.
- The entire access to the hazardous area can be monitored by the safety laser scanner. For large or complex access areas, a variant with 2 safety laser scanners may need to be selected.
- There are no areas that are not monitored where are person can be present. It is not possible to stand behind the protective field.

4.3.2 Protective field design

4.3.2.1 Calculating value for Stop Field radius

Overview

The **Stop Field radius** value determines the maximum extent of the stop field protective field. The value is calculated from the radius of the robot hazardous area and the minimum distance to the hazardous area. A detection in the stop field activates the “Trigger safety stop” function. You must calculate **Stop Field radius** so that the robot comes to a standstill in the event of a protective field interruption before the person reaches the hazardous area.

All other settings for the protective field (e.g. surrounding walls) are made during commissioning.

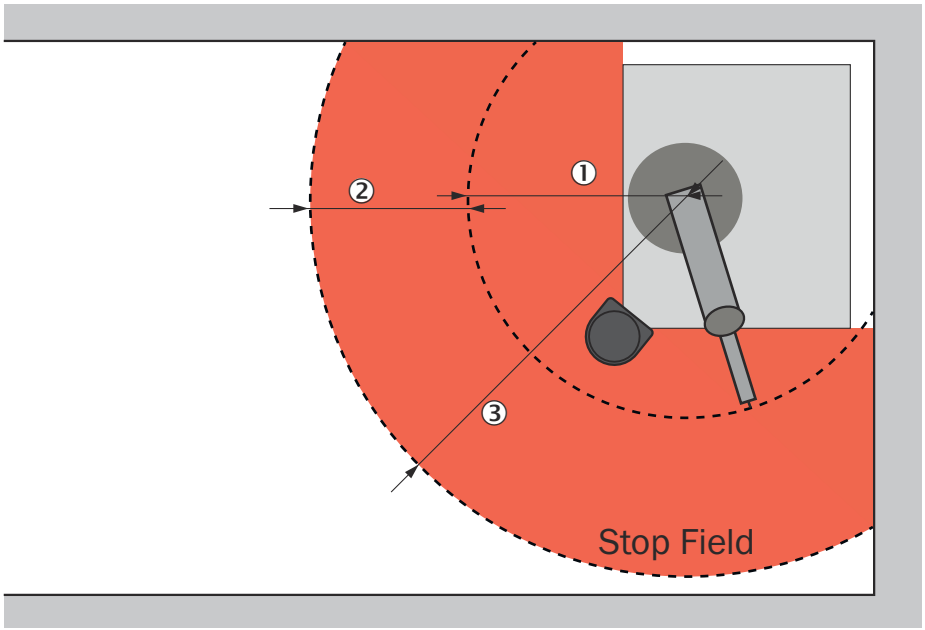


Figure 6: Distances for stop field

① Radius of the robot hazardous area (S_R)

② Minimum distance to the hazardous area for the stop field protective field ($S_{Stop\ Field}$)

③ Stop Field radius

Procedure

The value for **Stop Field radius** is composed of the minimum distance to the hazardous area $S_{Stop\ Field}$ and the radius of the hazardous area of the robot S_R.

Calculate the minimum distance to the hazardous area for stop field ($S_{Stop\ Field}$)

► Calculate the minimum distance to the hazardous area for stop field. The following calculation example according to ISO13855:2010 can be used for this.
$S_{Stop\ Field} = K \times (t_{Safetysystem} + t_{Robot}) + TZ + ZR + C$

Parameter	Description
K	Approach speed of a person. The approach speed is 1,600 mm/s according to EN ISO 10218-2.

Parameter	Description
$t_{Safetysystem}$	Response time of safety system **Variant with 1 safety laser scanner** $t_{Safetysystem} = t_{safetylaserscanner}$ • 70 ms **Variant with 2 safety laser scanners** $t_{Safetysystem} = t_{safetylaserscanner} + t_{safetycontroller}$ • 70 ms + 13 ms = 83 ms
t_{Robot}	Robot stopping time sBot Speed – URCap variants only: The size of the reduced field affects which value must be used for t_{Robot} (see "Calculating value for Reduced Field radius", page 21).
TZ (TT)	Tolerance range of the safety laser scanner 65 mm[1)]
ZR	Supplement for reflection-related measurement errors [2)] 350 mm[1)]
C	Supplement to protect against reaching over in millimeters (mm) C = 1,200 mm – (0.4 × protective field height (mm)) At a protective field height of 300 mm: 1,080 mm

1) Value in delivery state Check the actual value with operating instructions 8024594.
2) Is not required in all applications

Calculating radius of the hazardous area of the robot S_R

► Calculate the radius of the hazardous area of the robot S_R. The radius is composed of the scanning range of the robot arm, the size of the end effector and the workpiece.
The radius is the maximum horizontal distance between the center of the robot base and the outermost point of the transported workpiece. Every point that can be reached by the robot arm is part of the hazardous area.

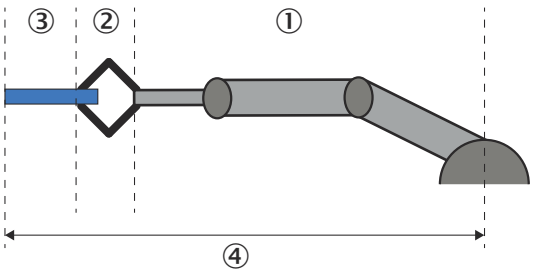


Figure 7: Composition of the radius of the hazardous area of the robot S_R

① Robot arm
② End effector
③ Workpiece
④ Radius of the hazardous area of the robot S_R

Calculating value for Stop Field radius

► **Stop Field radius** = $S_{Stop\ Field} + S_R$

Further topics

- "Calculating value for Reduced Field radius", page 21

4.3.2.2 Calculating value for Reduced Field radius

Overview

The **Reduced Field radius** value determines the maximum extent of the reduced field. A detection in the reduced field triggers the safety-rated monitored speed (reduced mode). The reduced field must be larger than the stop field.

All other settings for the reduced field (e.g. surrounding walls) are configured during commissioning.

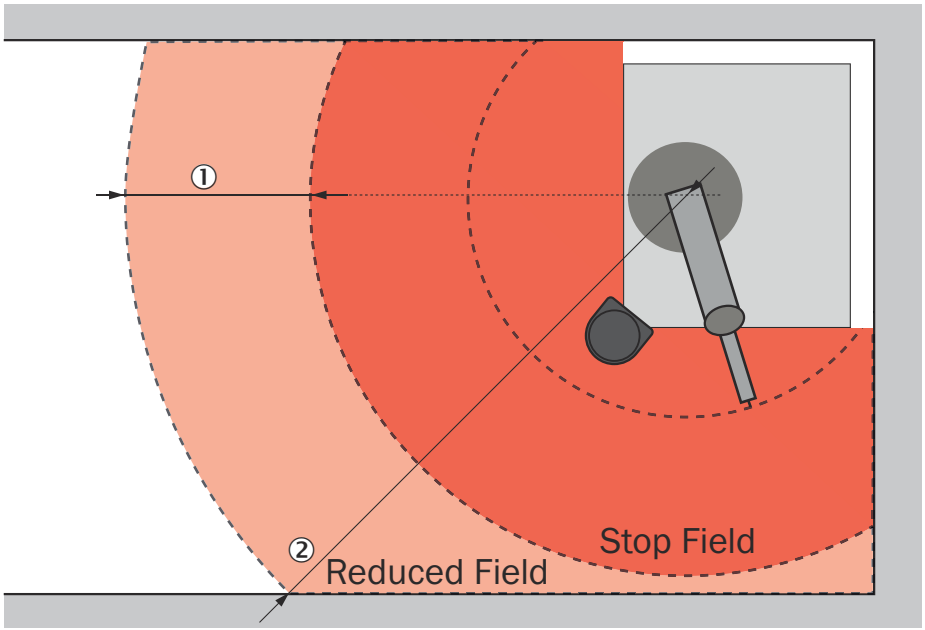


Figure 8: Difference between the minimum distances to the hazardous area

① Difference between safety distances S_{Diff}

② Reduced Field radius

Prerequisites

- Safety system is a variant of the type sBot Speed – URCap

Affect of S_{Diff} on the calculation of the stop field radius

The difference between the safety distances S_{Diff} must be > 0 mm. In principle, you can freely determine S_{Diff}. However, S_{Diff} has an effect on which value must be used for the t_{Robot} parameter.

Table 6: Effect of S_{Diff} on t_{Robot}

Number of safety laser scanners	Effect on the t_{Robot} parameter when calculating the stop field radius.	
1 ×	S_{Diff} ≤ 912 mm t_{Robot} = stopping time of the robot at maximum speed (normal mode).[1)]	S_{Diff} > 912 mm t_{Robot} = stopping time of the robot at safety-rated monitored speed (reduced mode).[1)]
2 ×	S_{Diff} ≤ 933 mm t_{Robot} = stopping time of the robot at maximum speed (normal mode).[1)]	S_{Diff} > 933 mm t_{Robot} = stopping time of the robot at safety-rated monitored speed (reduced mode).[1)]

1) The stopping time of the robot in normal mode and reduced mode can be viewed in the safety configuration of the robot limits. In Polyscope: **Installation** > **Safety** > **Robot Limits**
Parameter **Stopping Time**

It must be ensured that the safety laser scanner can completely cover S_{Diff} at all relevant points.

The value of 912 mm or 933 mm results from the following fact.

When an object is detected in the reduced field, the safety-rated monitored speed is triggered (reduced mode). If the robot monitors the reduced speed before an approaching person is detected in the stop field, the values for the reduced speed can be used to calculate the minimum distance to hazardous area $S_{Stop\ Field}$. This leads to a smaller minimum distance to the hazardous area $S_{Stop\ Field}$.

It takes 500 ms for the robot to monitor the reduced speed (see robot documentation). The response time of the safety laser scanner is 70 ms. At an approach speed of 1,600 mm/s, a difference in the minimum distances 912 mm results. When using 2 safety laser scanners, the 13 ms response time of the safety controller must also be taken into account.

Procedure

► **Reduced Field radius = Stop Field radius +** S_{Diff}

Further topics

- "Calculating value for Stop Field radius", page 19

4.3.3 Position of the robot

The robot must be mounted at a fixed position. If the robot is mounted on a moving table, the safety laser scanner must be mounted on the same table. The robot and the safety laser scanner must always be positioned in the same relationship to each other.

If the position of the robot is changed, the protective fields must be reestablished because the environment of the system has changed.

4.3.4 Robot operating modes

Switching the operating mode

Switching the operating mode of the robot is not part of this safety system. You must carry out selection of the operating mode and the safety functions in the manual operating mode via the robot controller. You can, for example, use the buttons on the pendant.

This safety system takes the following operating modes into account:

- Automatic
- Manual (with reduced speed and three-position enabling device)

Complementary information

The three-position enabling device can either be a separate one, or the integrated enabling device in the pendant of the robot can be used (UR 3PE Teach Pendant).

Further topics

- "Setting password for switching operating modes", page 32

4.3.5 Implementing emergency stop

Integration of an external emergency stop is not part of this safety system. You must decide for yourself whether an external emergency stop is necessary in addition to the emergency stop of the pendant. You must implement the integration of an external emergency stop on your own responsibility.

4.3.6 Implementing an Ethernet switch

For the variants with 2 safety laser scanners, an Ethernet switch satisfying the following requirements is needed:

- Suitable for use in industrial environments
- Min. 3 Ethernet ports
- Unmanaged switch

4.3.7 Preventing unexpected start-up

Preventing unexpected start-up after switching on the robot is not a part of this safety system. You must implement this function via the robot controller.

4.3.8 Automatic restart

You must attach a “Warning, automatic restart” pictogram to the system (see ISO 7010, registration number W018).

If all protective fields free up in the “Automatic” operating mode, the robot performs an automatic restart. The automatic restart complies with ISO 10218.

4.3.9 Warning field

Depending on the variant, a warning field must be configured in the configuration software. This warning field is not used by the safety system. You can use the signal as you wish in your application.

Signal behavior

- LOW: Warning field free
- HIGH: Object in warning field

4.4 Testing plan

The manufacturer of the machine and the operating entity must define all required thorough checks. The definition must be based on the application conditions and the risk assessment.

The following tests must be planned:

- A thorough check must be carried out during commissioning and following modifications.
  The check must detect if it is possible to enter the hazardous area without being detected.
- The regular thorough checks of the safety system must fulfill certain minimum requirements. The minimum requirements for the thorough check of the safety system comply at least with the sum of the minimum requirements for the thorough check of the components of the safety system (see operating instructions of the components).
  The check must detect if it is possible to enter the hazardous area without being detected. Such possibilities may exist due to modifications, manipulations or external influences.
- In many cases, depending on the application conditions, the risk assessment can determine that further thorough checks are required.

The thorough checks must be carried out by qualified safety personnel or specially qualified and authorized personnel, and must be documented in a traceable manner.

The regular thorough checks serve to assess the effectiveness of the safety system and to identify defects as a result of changes or other influences (e.g., damage or manipulation).

4.4.1 Special minimum requirements for the regular thorough check of the components

Prerequisites

- Variant used: sBot Stop2 – URcap or sBot Speed2 – URcap

Flexi Classic safety controller

When planning the thorough checks, it is necessary to take into consideration that the safety controller must be restarted once a year. Otherwise the specified performance level will not be achieved.

5 Mounting

5.1 For mounting the components

NOTE
Information is included in the operating instructions for the components.

6 Electrical installation

6.1 Electrical installation of the components

NOTE
Information is included in the operating instructions for the components.

6.2 General requirements

The manufacturer must take measures against failures resulting from the same cause. The manufacturer must document this appropriately in SISTEMA. During the electrical installation, the following, for example, must be taken into consideration:

- Protection against overvoltage, overcurrent, etc. per the manufacturer instructions for the individual components
- Measures for controlling the consequences of voltage failure, voltage fluctuations, overcurrent and undercurrent in the voltage supply of the robot controller

6.3 Connecting the safety system

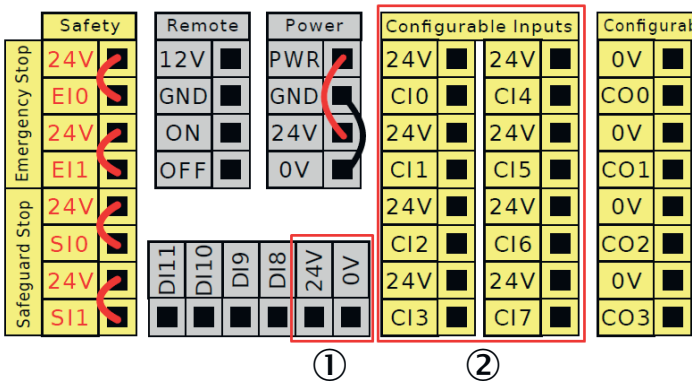
Important information

NOTE
The safety system is supplied with voltage by the robot controller.

NOTE
If the UR 3PE Teach Pendant is used as an enabling device, the external enabling device that uses the configurable inputs must not be used.

Procedure

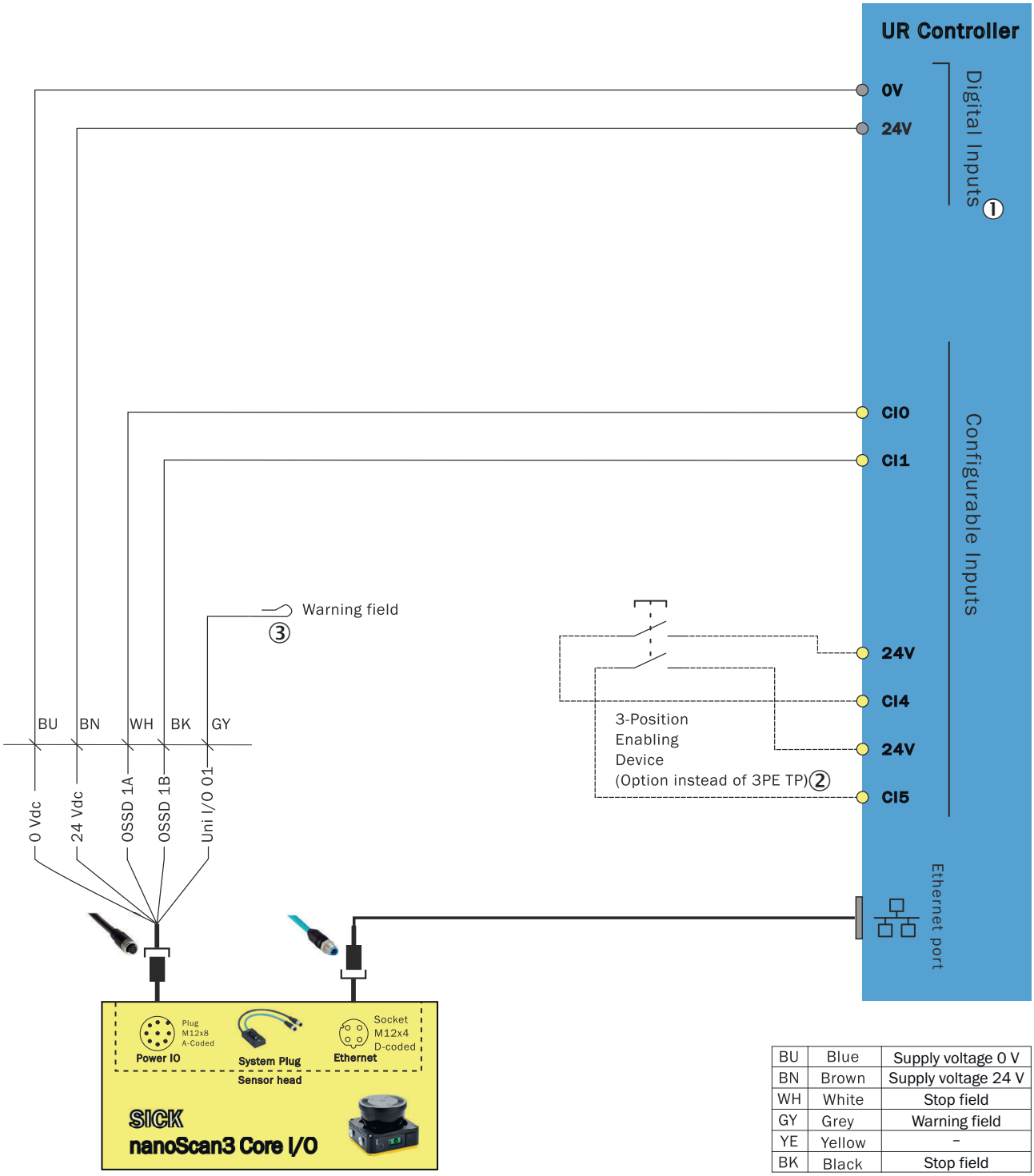
1. Connect the components of the safety system. When doing so, be aware of the following:
   - A complete circuit diagram for all variants of the safety system can be found in the following sections.
   - The safety system uses the following terminal strips on the robot controller:



① Digital Inputs
② Configurable Inputs

   - For safety systems with 2 safety laser scanners: The cables for the Automated Safeguard Stop and Reduced mode signals must be physically separated (prevention of cross-circuit to maintain the performance level).

6.3.1 Circuit diagram for sBot Stop – URCap (1 safety laser scanner)



BU	Blue	Supply voltage 0 V
BN	Brown	Supply voltage 24 V
WH	White	Stop field
GY	Grey	Warning field
YE	Yellow	–
BK	Black	Stop field

Figure 9: Circuit diagram for sBot Stop – URCap (1 safety laser scanner)

① This terminal strip is an extension of the digital inputs. It is located under the “POWER” terminal strip.

② UR 3PE TP: Pendant with integrated three-position enabling device

③ Signal for warning field can be used for non-safety-related functions.

6.3.2 Circuit diagram for sBot Stop – URCap (2 safety laser scanners)

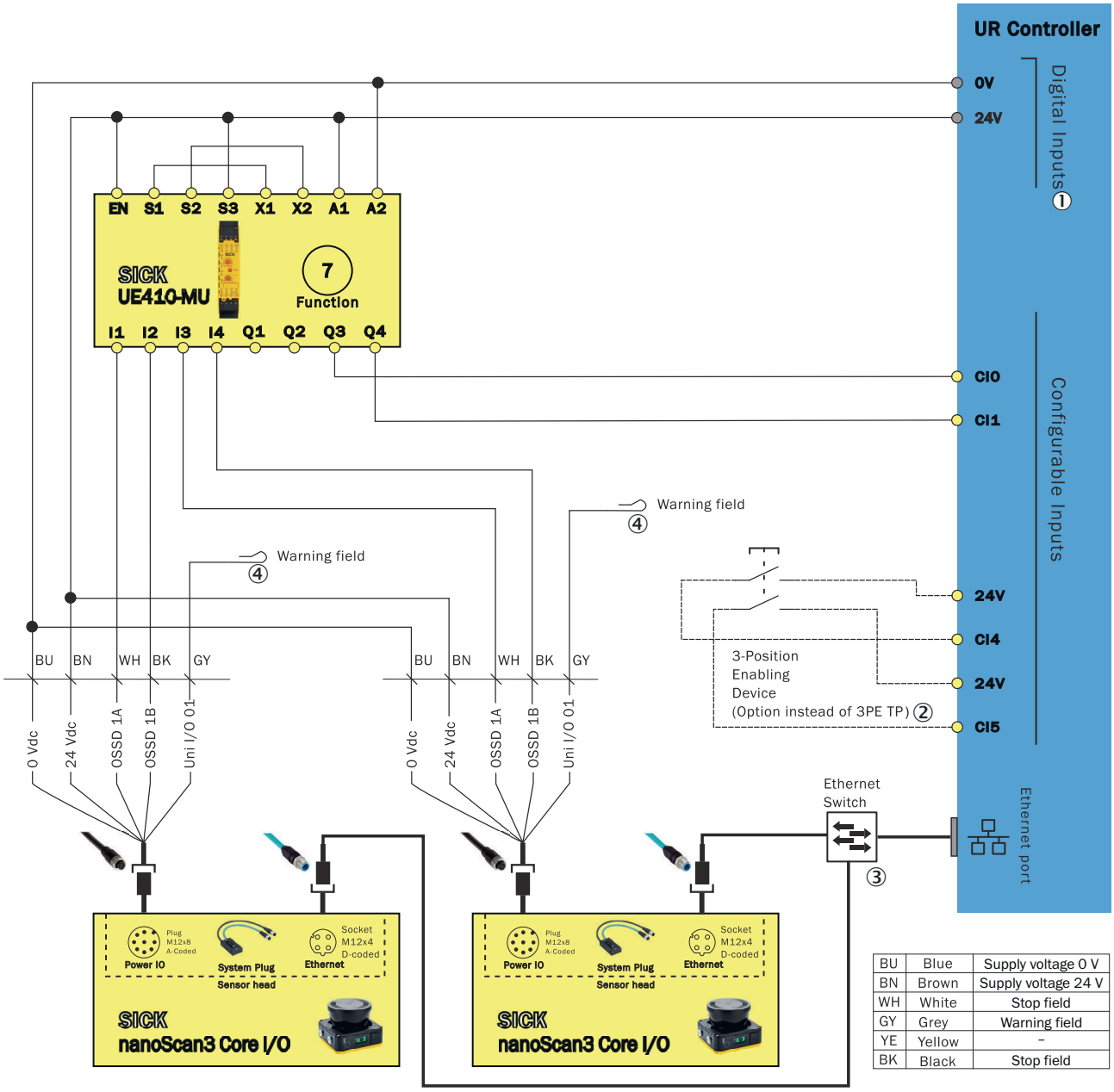


Figure 10: Circuit diagram for sBot Stop2 – URCap (2 safety laser scanners)

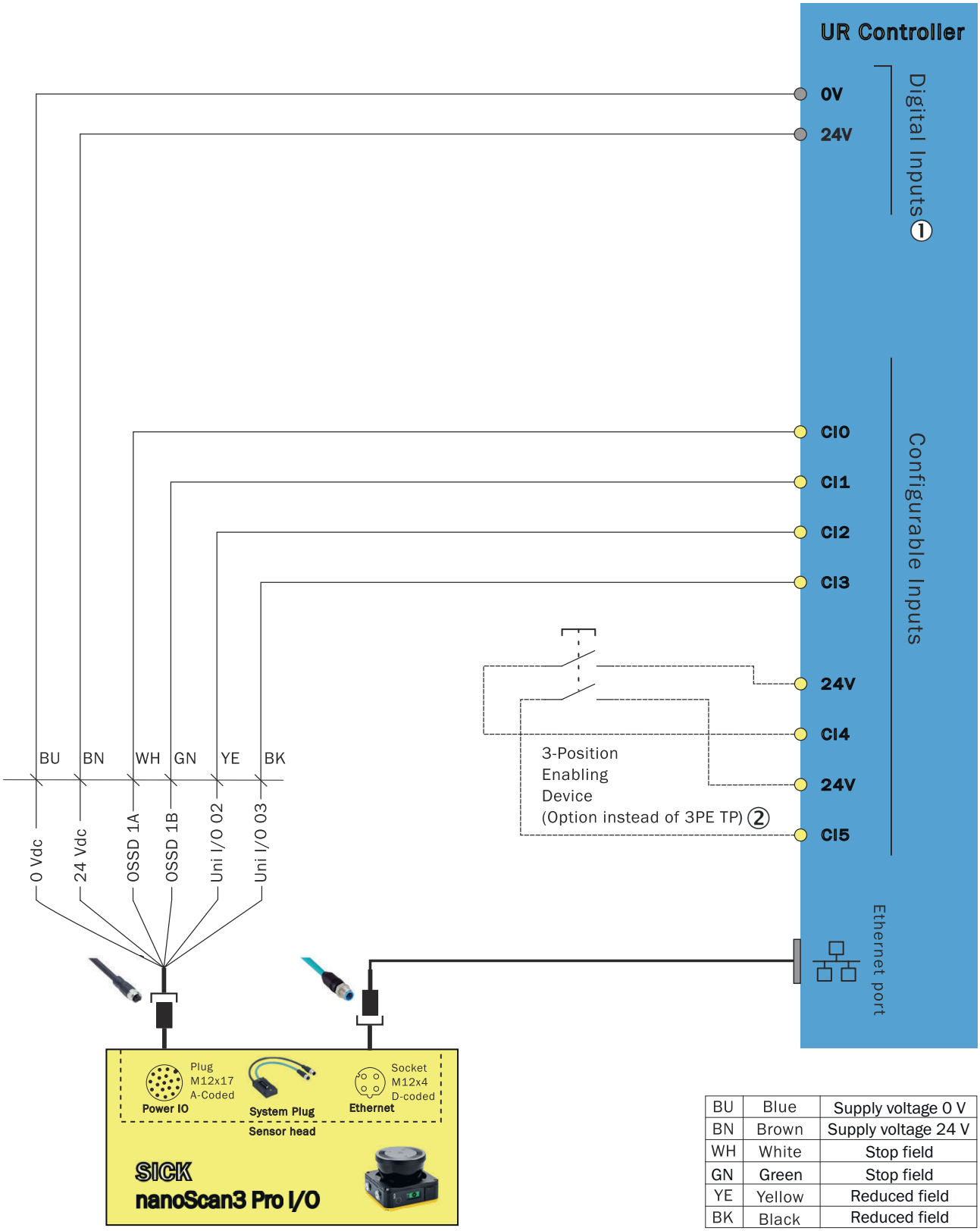
① This terminal strip is an extension of the digital inputs. It is located under the “POWER” terminal strip.

② UR 3PE TP: Pendant with integrated three-position enabling device

③ Voltage supply of the Ethernet switch not shown.

④ Signal for warning field can be used for non-safety-related functions.

6.3.3 Circuit diagram for sBot Speed – URCap (1 safety laser scanner)



BU	Blue	Supply voltage 0 V
BN	Brown	Supply voltage 24 V
WH	White	Stop field
GN	Green	Stop field
YE	Yellow	Reduced field
BK	Black	Reduced field

Figure 11: Circuit diagram for sBot Speed – URCap (1 safety laser scanner)

① This terminal strip is an extension of the digital inputs. It is located under the “POWER” terminal strip.

② UR 3PE TP: Pendant with integrated three-position enabling device

6.3.4 Circuit diagram for sBot Speed2 – URCap (2 safety laser scanners)

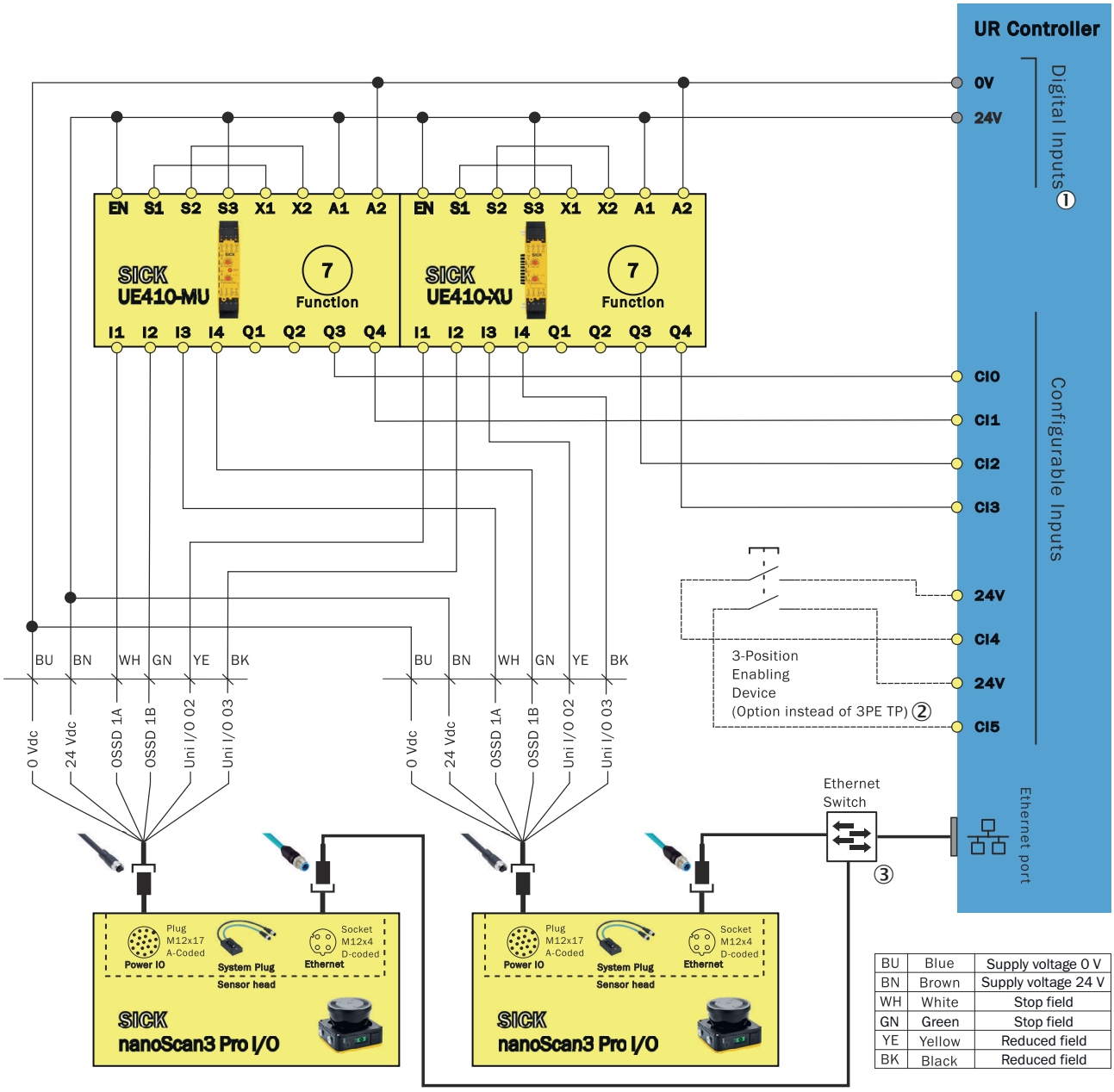


Figure 12: Circuit diagram for sBot Speed2 – URCap (2 safety laser scanners)

① This terminal strip is an extension of the digital inputs. It is located under the “POWER” terminal strip.

② UR 3PE TP: Pendant with integrated three-position enabling device

③ Voltage supply of the Ethernet switch not shown.

7 Installation

7.1 Installing nanoScan3 Tool

Overview

The nanoScan3 Tool configuration software is installed on the robot controller. The configuration software can be used to configure the nanoScan3 safety laser scanners connected to the robot controller. The configuration can also be verified in the configuration software.

The configuration software is operated via the pendant of the robot.

Procedure

1. Copy the file **nanoScan3_Tool_[...].urcap** in the ZIP file from SICK to the USB stick.
2. Connect USB stick to robot controller.
3. In the robot control:
   Hamburger menu > **SETTINGS** > **SYSTEM** > **URCAPS** > **PLUS icon**
4. Search for and select **nanoScan3_Tool_[...].urcap** file.
5. Click on **OPEN**.
6. Reboot robot controller.

8 Configuration

8.1 Requirements for software and functional scope

Table 7: Functional scope of SICK components

Component	Functional scope
nanoScan3 Core I/O	1.0.0
nanoScan3 Pro I/O	1.0.0

Table 8: Version for robots

Software	Version
Polyscope	
UR3e, UR5e, UR10e or UR16e Without UR 3PE Teach Pendant	5.6
UR3e, UR5e, UR10e or UR16e With UR 3PE Teach Pendant	5.10
UR20 or UR30	5.15

8.2 Configuring the safety controller

Prerequisites

- A safety system with more than 1 safety laser scanner is used.
- All components are connected correctly.

Procedure

1. Switch off the voltage supply (terminals A1, A2) at all main modules.
2. Use a screwdriver to set the rotary switches on all safety controller modules to program 7.
3. Switch on the voltage supply of all the modules while keeping the ENTER pushbutton of the UE410-MU main module pressed.
4. When the ERR indicator begins to flash, release the ENTER button within 3 seconds.

✓ Selected program is active. Safety controller successfully configured.

Complementary information

- If the ENTER button is pressed for more than 3 seconds, the entire system switches to the error state. The ERR display flashes.
- All subsequent changes to the wiring on S1, S2, S3 will cause a lockout (ERR).
- Further troubleshooting options can be found in the operating instructions for the safety controller.

8.3 Configuring the robot controller

8.3.1 Setting password for switching operating modes

Procedure

1. Click on the Hamburger icon.
2. Under **Password**, select the **Mode** menu item.
3. In the **New password** and **Confirm new password** fields, enter the desired password.
4. Click on **Apply**.

✓ You can switch between the operating modes using the icon at the top right. You must enter the password defined above to change to Manual operating mode.

8.3.2 Activating the integrated enabling device

Important information

NOTE
The pendant comes with its own documentation for integrating and using the integrated enabling device.

Prerequisites

- The pendant has an integrated enabling device (type: UR 3PE Teach Pendant).
- Robot is in manual operating mode.

Procedure

1. Select **Installation** in the robot controller.
2. Under **Safety**, select the **Hardware** menu item.
3. Enter the password and continue.
4. In the **Teach Pendant** drop-down menu, select the **3PE Enabled** entry.
5. Select **Apply**.

✓ The robot controller is restarted.

6. Select **Confirm Safety Configuration**.

8.3.3 Configuring inputs of the robot controller

Prerequisites

- Robot is in manual operating mode.

Procedure

1. Select **Installation** in the robot controller.
2. Under **Safety**, select the **I/O** menu item.
3. Assign the functions to the inputs.

   NOTE | The **Automatic Mode Safeguard Stop** function only becomes available once an external or internal enabling device has been configured. External: Function Assignment: **3-Position Switch**. Internal: see "Activating the integrated enabling device", page 33.

Input Signal	Function Assignment
config_in[0], config_in[1]	Automatic Mode Safeguard Stop
config_in[2], config_in[3]	Variant-dependent • sBot Stop variant: Unassigned • sBot Speed variant: Reduced Mode
config_in[4], config_in[5]	3-Position Switch[1)]

1) Only when using an external enabling device

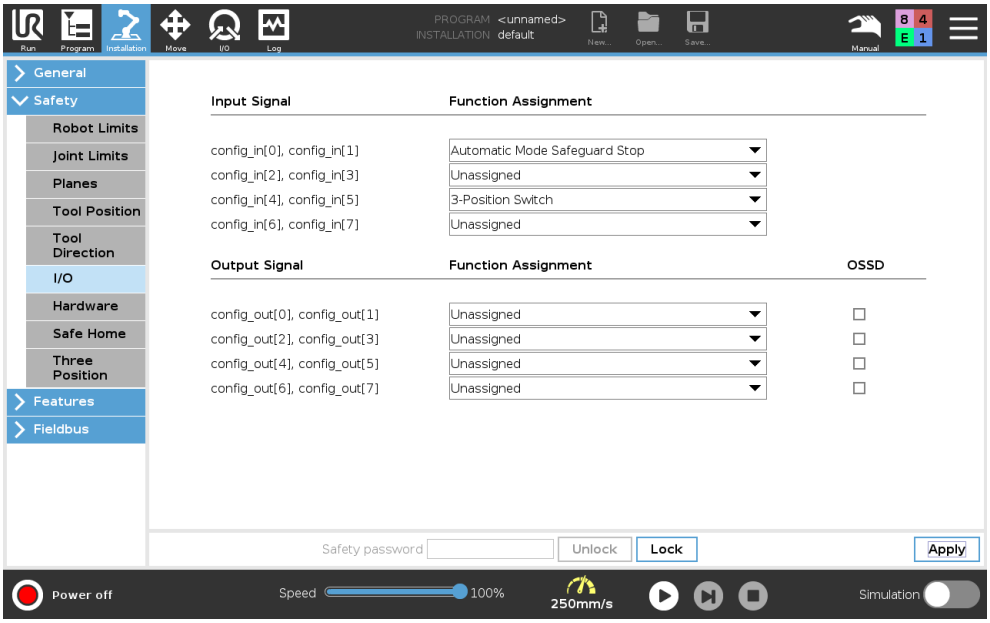


Figure 13: Configuration of the inputs for sBot Stop variants with an external enabling device

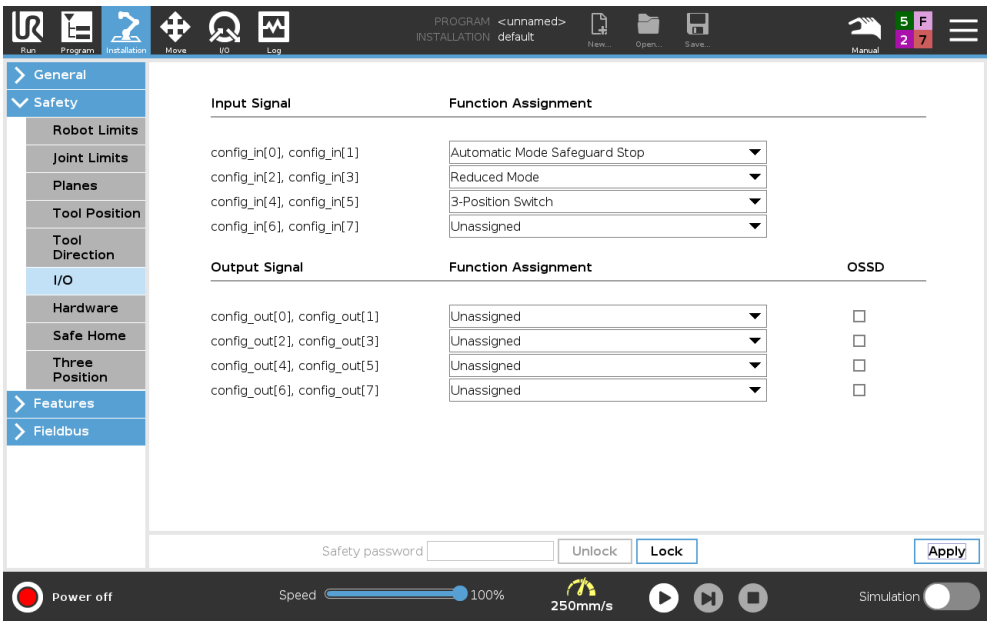


Figure 14: Configuration of the inputs for sBot Speed variants with an external enabling device

8.3.4 Configuring network

Important information

NOTE

The safety system requires a fixed IP address. The IP addresses in the network must therefore not be allocated by a DHCP server.

Procedure

1. Click on the Hamburger icon.
2. Under **System**, click on **Network**.

3. Activate **Static Address**.
4. Configure network settings as desired. The IP address of the robot controller and safety laser scanner must be in the same subnet, i.e., only the digit after the last dot may differ (example: 192.168.1.xxx).

Example

Table 9: Example network configuration

	Robot controller	Safety laser scanner A	Safety laser scanner B
Configured in	Polyscope	nanoScan3 Tool (URCap)	nanoScan3 Tool (URCap)
IP address	192.168.1.3	192.168.1.10	192.168.1.11
Subnet mask	255.255.255.0	255.255.255.0	255.255.255.0
Default gateway	0.0.0.0	–	–

8.3.5 Enabling port 30719

Overview

Port 30719 needs to be enabled to allow the nanoScan3 tool to communicate with the safety laser scanner.

Procedure

1. On the UR Teach Pendant, click on the hamburger menu at the top right.

2. Select **Settings**.
3. In the navigation pane under **Security**, select the **General** menu.
4. Enter the following value in the **Restrict inbound network access to this subnet** field:
   `0.0.0.0/0`
5. Enter the following value in the **Disable inbound access to additional interface (by port)** field:
   `1-30718,30720-65535`

8.4 Configuring safety laser scanner

8.4.1 Starting nanoScan3 Tool configuration software

1. Click on **Installation** in the robot controller.
2. Under **URCaps**, click on **nanoScan3 Tool**.

✓ The start screen is displayed.

8.4.2 Configuration in 2 steps

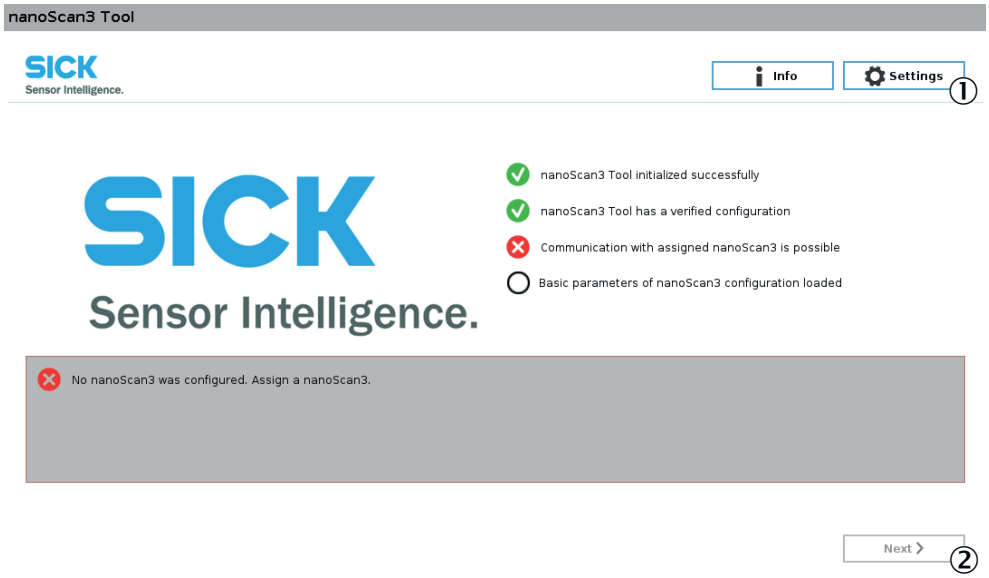


Figure 15: Start screen after installation

Number	Menu	Function
1	**Settings**	General configuration Here, for example, the dimensions of the table or safety-relevant distances are configured. The general configuration usually only needs to be carried out during initial commissioning.
2	**Next**	Configuration of fields The fields are configured in the layout screen. You can then check and transfer the configuration. Available as soon as the general configuration is complete. The fields must be reconfigured as soon as the position or the environment of the robot is changed.

8.4.3 General configuration

8.4.3.1 Logging in

8.4.3.1.1 Logging in as service technician

Procedure

1. In the start screen, click on **Settings**.
✓ The **Settings** dialog is displayed.
2. During the first login, the password must be changed. Use the following standard password:
SICKSAFE
Enter new desired password 2 × and click on **Approve**.
3. Enter selected password for service technician.
4. Click on **Login**.
✓ You are registered as a service technician. The configuration menu opens.

8.4.3.1.2 Resetting the password for service technician

Procedure

1. In the start screen, click on **Settings**.

✓ The **Login** dialog is displayed.
2. Click on **Forgot PW**.
✓ A reset code is displayed on the screen.
3. Follow the instructions on the screen to contact SICK technical support. Technical support can be provide a reset key using the reset code. Do not leave the dialog until the reset key is available.
4. Enter reset key in the **Service technician Password** field and click on **Login**.
5. Assign desired password 2 × and click on **Approve**.
✓ The password is assigned. You can log in with the new password.

8.4.3.2 Configuring table

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on the **Desk** tab. Alternatively, click on the table.
2. In the **Width** and **Length** fields, enter the table dimensions.
✓ The table display is adjusted.
3. Click on **Apply**.
✓ The **Success** dialog is displayed. Confirm dialog to continue.

8.4.3.3 Configuring position of the robot

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on the **Robot** tab. Alternatively, click directly on the robot.
2. In the **X** and **Y** fields, configure the position of the robot.
3. Click on **Apply**.
✓ The **Success** dialog is displayed. Confirm dialog to continue.

Complementary information

Safety-relevant values are marked with the following symbol:

8.4.3.4 Configuring mode and distances for field generation

Overview

Under the **Fields** tab, you can select the mode in which the fields can be configured. When the **Robot Centric** mode is selected, the calculated safety-relevant distances can be entered.

Prerequisites

- You are registered as a service technician.
- The value for Stop Field radius was calculated during project planning.
- The value for Reduced Field radius was calculated during project planning.

Procedure

1. Click on **Fields**.
2. Select mode.
    - **Free Fields**

No distances are configured in this mode. Responsibility for safe design of the protective fields thus lies with the person who carries out commissioning.

- **Robot Centric**
  Distances are configured in this mode. These distances are circular with the robot base at the center of the circle. The distances are displayed during commissioning and are taken into account in the automatic generation of fields.

3. Enter values for safety-relevant distances.

Table 10: Parameters in the Fields tab

Distance	Description
Warning Field radius	Distance of the warning field to the robot.
Reduced Field radius	The calculated minimum distance for triggering the safety-rated monitored speed.
Stop Field radius	The calculated minimum distance for triggering the protective stop.

4. Click on **Apply**.

✓ The **Success** dialog is displayed. Confirm dialog to continue.

Complementary information

Safety-relevant values are marked with the following symbol:

Further topics

- "Calculating value for Stop Field radius", page 19
- "Calculating value for Reduced Field radius", page 21

8.4.3.5 Configuring information for application

Important information

NOTE
These settings are optional and not required for operation of the safety system.

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on the **App** tab.
2. In the **Application name** and **Project name** fields, enter the desired information.
3. Click on **Apply**.

✓ The **Success** dialog is displayed. Confirm dialog to continue.

8.4.3.6 Assigning passwords for the service technician or operator

Overview

You can assign passwords for the different user groups here. If desired, you can specify that all actions are performed by a single user group.

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on the **Pass** tab.
2. If desired, activate the **Use one user for all actions** checkbox. If the option is activated, the Operator user role loses all rights. All actions that require authentication can only be performed by the Service technician user role.
3. To change the password for the service technician, activate the **Change service technician password** checkbox, enter the desired password in the **New password** field and repeat in the **Confirm new password** field.
4. To change the password for the operator, activate the **Change operator password** checkbox, enter the desired password in the **New password** field and repeat in the **Confirm new password** field.
5. If desired, activate the **User signature required to activate safety** checkbox. If the option is activated, the user must save a signature to complete commissioning. For example, the report can be used to track which user performed commissioning.
6. Click on **Apply**.

✓ The **Success** dialog is displayed. Confirm dialog to continue.

8.4.3.7 Configuring safety laser scanner

8.4.3.7.1 Assigning safety laser scanner

Prerequisites

- You are registered as a service technician.
- Port 30719 has been enabled in the settings of the robot controller.

Procedure

1. In the graphic overview, click on the free placeholder (e.g. **A**). Free placeholders are gray.

✓ A list of available and not yet assigned safety laser scanners is displayed.

2. If several safety laser scanners are used, click on **Identify** if needed.

✓ The display of the selected safety laser scanner flashes.

3. If the desired safety laser scanner is not displayed, if applicable click on **Rescan** to update the list.
4. Click on **Assign** to assign the desired safety laser scanner to a position.

✓ The desired safety laser scanner is assigned to the position. The view changes to the **Password** tab.

Complementary information

A password must be assigned to the safety laser scanner to enable operation.

If the safety laser scanner is in the delivery state, the IP address must be adjusted after the password has been assigned.

Further topics

- "Configuring the connection data", page 41
- "Assigning password for the safety laser scanner", page 41
- see "Enabling port 30719", page 35

8.4.3.7.1.1 Removing safety laser scanner

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on the desired safety laser scanner. Placeholders with an assigned safety laser scanner are colored orange.
✓ A trash can icon appears next to the safety laser scanner.
2. Click on the garbage can icon.
3. Click on **Apply**.

8.4.3.7.2 Configuring the position of the safety laser scanner

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on the desired safety laser scanner. Placeholders with an assigned safety laser scanner are colored orange.
2. Click on the **Position** tab.
3. In the **X** or **Y** fields, enter the offset between the zero point of the coordinate system (lower left table corner) and the center point of the safety laser scanner. The center of the safety laser scanner is marked on the top side.
4. In the **Rotation** field, enter the alignment of the safety laser scanner in degrees.
✓ The entered alignment of the safety laser scanner is displayed with a mark in the preview. This mark must correspond to the 90° mark on the top of the safety laser scanner.
5. Click on **Apply**.
✓ The **Success** dialog is displayed. Confirm dialog to continue.

Example

In this example, the safety laser scanner is mounted on the lower right corner (B). The table is 1,200 mm × 600 mm.

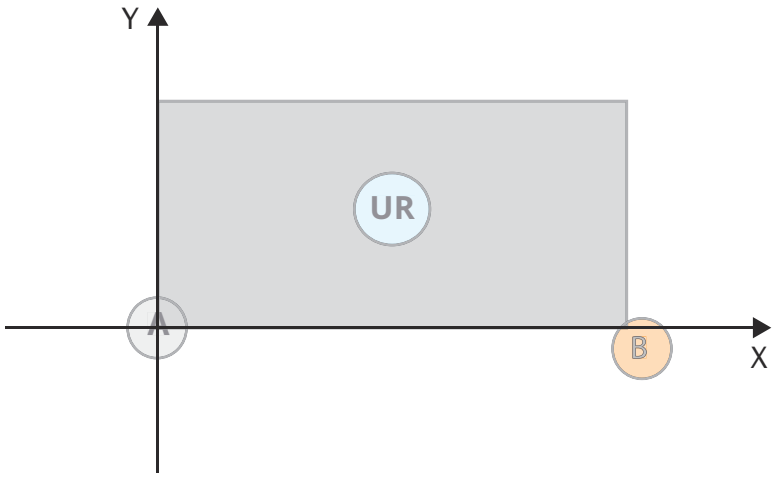


Figure 16: Example positioning of a safety laser scanner at position B

The X and Y values for the safety laser scanner can be determined by measuring the offset between the center point of the safety laser scanner and the table corner. If you calculate the offset of the safety laser scanner to the table corner with the coordinates of the table corner, you get the values for **X** and **Y**.

	X	Y
Offset between safety laser scanner and the lower right table corner	80 mm	– 80 mm
Coordinates of the lower right table corner	1,200 mm	0 mm
Position values for safety laser scanner	**1,280 mm**	**-80 mm**

Complementary information

Safety-relevant values are marked with the following symbol:

8.4.3.7.3 Configuring the name of the safety laser scanner

Important information

NOTE
These settings are optional and not required for operation of the safety system.

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on the desired safety laser scanner. Placeholders with an assigned safety laser scanner are colored orange.
2. Click on **Name**.
3. In the **Name** field, enter the desired name.
4. Click on **Apply**.

✓ The **Success** dialog is displayed. Confirm dialog to continue.

8.4.3.7.4 Configuring the connection data

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on the desired safety laser scanner. Placeholders with an assigned safety laser scanner are colored orange.
2. Click on the **Address** tab.
3. In the **IP Address**, **Subnet** and **Router** fields, enter connection data.
4. Click on **Apply**.

✓ The **Success** dialog is displayed. Confirm dialog to continue.

8.4.3.7.5 Assigning password for the safety laser scanner

Overview

You must assign a password for the safety laser scanner before the settings can be transmitted to the device.

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on the desired safety laser scanner. Placeholders with an assigned safety laser scanner are colored orange.
2. Click on the **Password** tab.
3. In the **Current nanoScan3 password** field, enter the password of the safety laser scanner (in delivery condition: “SICKSAFE”)
4. In the **New nanoScan3 password** and **Confirm new nanoScan3 password** fields, enter the desired password.
5. Click on **Apply**.

✓ The **Success** dialog is displayed. Confirm dialog to continue.

Complementary information

The password for the safety laser scanner can only be reset using the Safety Designer configuration software.

8.4.3.8 Verifying settings

Prerequisites

- You are registered as a service technician.

Procedure

1. Click on **Verify**.

✓ The **Plausibility Checks** window is displayed. The software automatically checks whether the configuration is plausible. A failed test is labeled with the following symbol:

In some cases, you can navigate directly to the corresponding setting by clicking on the following icon:

2. Click on **Proceed**.

✓ The configuration report is displayed.

3. Check configuration report.
4. Click on **Verify**.
5. Click on **Logout** to return to the start screen.

✓ The **Success** dialog is displayed. Confirm dialog to continue.

8.4.4 Configuration of fields

8.4.4.1 Checking requirements for configuration of fields

Procedure

1. Start nanoScan3 Tool - URCap configuration software.

✓ The start screen is displayed. The readiness for configuration of the fields is signaled via several parameters.

2. Make sure that all parameters are displayed in green.
3. Click on **Next**.

Further topics

- "Error messages on the start screen", page 51

8.4.4.2 Teaching in area

Overview

Before configuring the fields, the environment must be taught into the configuration software. The safety laser scanner scans the environment for this reason. The taught-in contour is taken into account when creating the fields so that walls are not considered, for example.

Procedure

1. Click on **Teach**.
2. Use the slider on the right side to set the delay time for teach-in. During this time, persons can leave the scan area.
3. Click on **Teach area**.
4. Leave the area.

✓ The safety laser scanner scans the environment.

✓ In **Robot Centric** mode, the configured safety-relevant distances are combined with the results of the scan to automatically generate the fields..

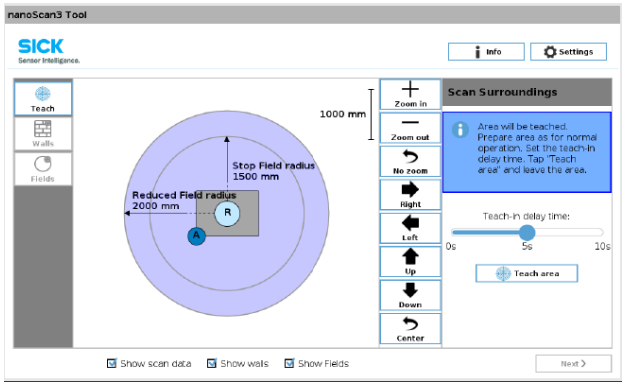


Figure 17: Before teach-in

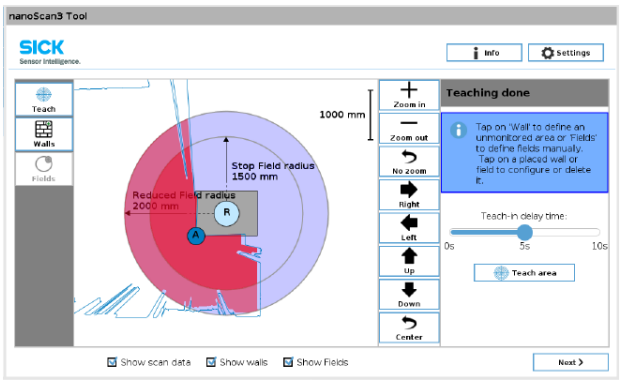


Figure 18: After teach-in

8.4.4.3 Defining walls

Overview

With the **Walls** functions, areas can be excluded from monitoring. This allows you to take into account physical guards that could not be detected by the safety laser scanner when teaching in the area, e.g. fences or covers made of acrylic glass. It can also be used to define areas in which persons cannot be present.

Important information

WARNING

Unmonitored areas

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

► Only use this function for physical guards where it is not possible to climb over, reach over, crawl under, etc.

Prerequisites

- The area has been taught in.

Procedure

1. Click on **Walls**.
2. Draw a line in the layout.

✓ The wall is drawn. The protective fields are adjusted so that areas behind the wall are no longer monitored.

Complementary information

The lines must be drawn so that they do not end in the middle of a field. This would mean that a person from an unmonitored area could step directly into the protective field. The required minimum distances would possibly not be observed.

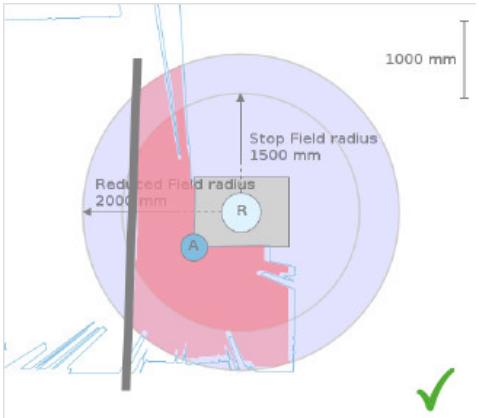


Figure 19: Valid line

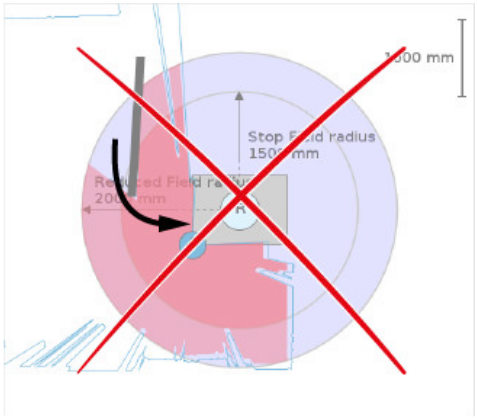


Figure 20: Invalid line

8.4.4.4 Drawing fields manually

Overview

With the **Fields** function, the fields can be drawn manually.

Prerequisites

- The area has been scanned.
- **Free Fields** mode is active (**Settings**).

Procedure

1. Click on **Fields**.
2. In the preview, click on the position where the circle is to be placed.

✓ 2 circles with different radii are displayed.
The inner circle is for the protective field for the “Trigger protective stop” function.
sBot Stop – RCap variants only: The outer circle is for the warning field.
sBot Speed – URCap variants only: The outer circle is for the protective field for the “Trigger safety-rated monitored speed” function.

3. Use the displayed tools to configure the circles as desired and confirm by ticking the check mark (see figure 21).
sBot Speed – URCap variants only: When configuring the outer circle, care must be taken to ensure that the S_{Diff} value specified in the project planning is adhered to.

✓ The drawn circles are combined with the results of the scan. The protective fields are generated.

4. If necessary, draw other circles to protect all relevant areas with protective fields.

✓ Several circles are merged into a single field.

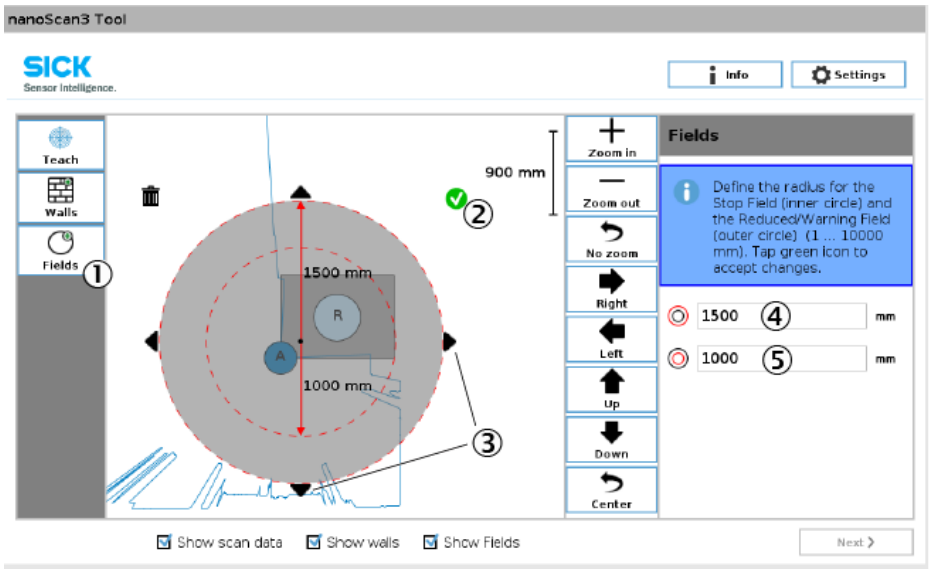


Figure 21: Drawing fields manually

① **Fields** function
② Save changes.
③ Move circle.
④ Adjust Warning Field radius or Reduced Field radius.
⑤ Adjust Stop Field radius.
⑥ Delete circle.

8.4.5 Transferring configuration to device

Prerequisites

- Protective fields can be configured.

Procedure

1. Click on **Next**.
✓ The **Confirmation** dialog is displayed.
2. Enter the password of the user and confirm with **Yes**.
3. Confirm dialog for transferring the configuration with **Yes**.
✓ Configuration is being transferred to the device.

8.4.6 Checking configuration

Overview

You can check the configuration in the **Commissoning** screen. The view shows the real time data of the safety laser scanner.

Important information

DANGER
Unmonitored areas
The robot does not stop or does not stop on time.

► Perform test carefully.
► This requires appropriate expertise and experience. You must be able to assess if the system is operationally safe.

Prerequisites

- Configuration has been transferred to the device.

Procedure

1. Check the following points:
   - The blue areas are not monitored. Persons cannot stay in blue areas or are protected from movement of the robot by other measures.
   - The configured protective fields can be completely monitored by the safety laser scanner. Monitoring is not restricted by the scanning range of the safety laser scanner.

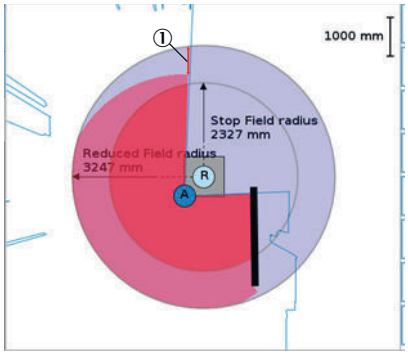


Figure 22: Negative example of the scanning range of the safety laser scanner

① Unmonitored area of the reduced field protective field. Scanning range of the safety laser scanner not sufficient.

   - The display on the lower edge visualizes the switching behavior of the fields. Green = Field free; Red = detection in field. The Stop Field switches inputs CI0 and CI1. If available, the Reduced Field switches the inputs CI2 and CI3.
   - Access to the hazardous area is only possible through the Stop Field.
   - It is not possible to bypass the fields, e.g. by stepping over them. It is not possible to stay in the hazardous area without being detected in the Stop Field.
2. Click on **Next**.

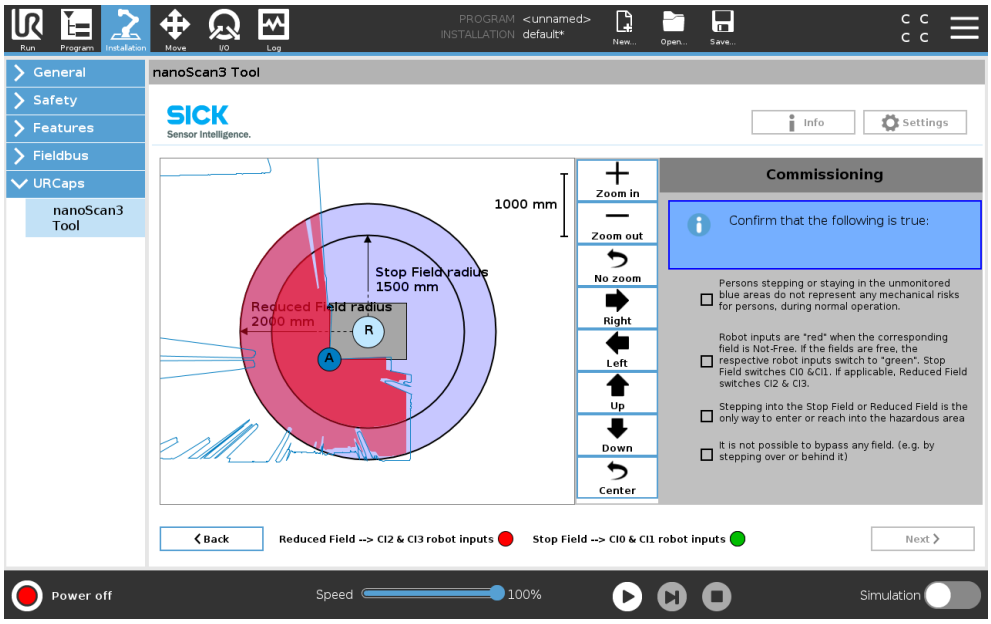


Figure 23: Check configuration

9 Commissioning

9.1 Safety

DANGER
Dangerous state of the machine

During commissioning, the machine or the protective device may not yet behave as you have planned.

► Make sure that there is no-one in the hazardous area during commissioning.

9.2 Overview of initial commissioning

Procedure

Step	Procedure	See
1	Identify the hazardous area and determine a suitable position for the safety laser scanner.	Operating instructions for the safety system, section “4.3 Design”
2	Mount the safety laser scanner.	Mounting instructions for the safety laser scanner
3	Connect the components as per the circuit diagram and supply them with voltage.	Operating instructions for the safety system, section “6.3 Connecting the safety system”
4	For safety systems with 2 safety laser scanners only: Set program 7 on the safety controller.	Operating instructions for the safety system, section “8.2 Configurate the safety controller”
5	Install nanoScan3 Tool configuration software on the robot controller.	Operating instructions of the safety system, chapter “7.1 Installing nanoScan3 Tool.”
6	Configure the robot controller.	Operating instructions for the safety system, section “8.3 Configuring the robot controller”
7	Configure the safety laser scanner using the nanoScan3 Tool.	Operating instructions for the safety system, section “8.4 Configuring the safety laser scanner”
8	Put safety system into operation.	Operating instructions of the safety system, chapter “9.3 Performing commissioning at a new location”
9	Verify and validate the safety functions.	Operating instructions of the safety system, chapter “17.1 Checklists”

9.3 Performing commissioning at a new location

Overview

If the safety laser scanner is mounted on a table together with the robot, the location of the table can be changed without having to reconfigure the safety system from scratch. Only the fields need to be reconfigured and the configuration transferred to the safety laser scanner. The configuration of the fields is safety relevant. The responsibility for the safety of the application thus lies with the person who carries out commissioning at a new location. The fields can also be configured by users with the Operator role.

Important information

WARNING
Unmonitored or not completely monitored areas
The robot does not stop or not on time.

► Ensure that the fields are only configured by users who can evaluate a safe working condition.

Procedure

Configuring fields (short description)

1. In the start screen, click on **Next**.
✓ The layout screen is displayed.
2. Scan the area.
3. If necessary, define areas not to be monitored with the **Walls** function.
4. When **Free Fields** mode is activated in the general settings, define the fields with the **Fields** function. Otherwise the fields are generated automatically.
5. Click on **Next**.

Transferring configuration (short description)

6. Follow instructions to transfer configuration to device.

Checking configuration (short description)

7. Check the configuration in the **Commissoning** screen.
8. Click on **Next**.

Completing commissioning

The **Report** screen shows an overview of the configuration. Commissioning is complete when the configuration is confirmed.

9. Otherwise the user signature is entered in the **User signature** field.
10. Click on **Activate Safety**.
✓ Robot is secured.

Further topics

- "Checking requirements for configuration of fields", page 42
- "Teaching in area", page 43
- "Defining walls", page 43
- "Drawing fields manually", page 44
- "Transferring configuration to device", page 45
- "Checking configuration", page 45

10 Operation

10.1 Operating the components

NOTE
Information is included in the operating instructions for the components.

10.2 Regular thorough check

The thorough check is intended to ensure that the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

- ► Carry out the checks specified in the test plan of the manufacturer of the machine and the operating entity.

11 Maintenance

11.1 Maintenance of the components

NOTE
Information is included in the operating instructions for the components.

12 Troubleshooting

12.1 Troubleshooting the components

NOTE
Information is included in the operating instructions for the components.

12.2 Error messages on the start screen

Several tests are performed when starting the software. Failed tests are labeled with a red icon.

The following information help you rectify the cause for the failed test.

Failed test	Possible measure
nanoScan3 Tool initialized successfully	Restart software.
nanoScan3 Tool has a verified configuration	Verify the configuration in the **Settings** menu.
Communication with assigned nanoScan3 is possible	Check cabling and type of the connected safety laser scanner. Check network configuration.
Basic parameters of nanoScan3 configuration successfully loaded	Check configuration of the safety laser scanner. Contact SICK if necessary.

12.3 Carry out diagnosis

Procedure

1. Click on Info.
2. Click on Diagnostic.

✓ Diagnostic information is shown.

12.4 Diagnostics via Live View

Procedure

1. Click on **Info**.
2. Click on **Live View**.

✓ The real time data of the safety laser scanner are displayed.

12.5 Displaying last verified report

Procedure

1. Click on **Info**.
2. Click on **Last verify report**.

✓ The last transferred configuration is displayed. If you want, you can save them on a USB data card using **Copy report to USB**.

13 Technical data

13.1 Data sheet

Table 11: sBot – URCap data sheet

	sBot Stop – URCap sBot Speed – URCap	**sBot Stop2 – URCap sBot Speed2 – URCap**
Performance level	PL d	
SIL claim limit	SILCL 2 (IEC 62061)	
Safety integrity level	SIL 2 (IEC 61508)	
Protective field range	≤ 3.0 m	
Warning field range	≤ 10 m	
Response time	70 ms	83 ms
Safe state	The robot is at a standstill.	

Table 12: Fixed parameters for the safety laser scanner [1)]

	sBot Stop – URCap	**sBot Speed – URCap**
Safety laser scanner used	nanoScan3 Core I/O	nanoScan3 Pro I/O
Protective field resolution	70 mm	
Multiple sampling	2	
Response time	70 ms	
Application type	Stationary	
External device monitoring (EDM)	Deactivated	
Universal I/O 1	Warning field	Not used
Universal I/O 2	Not used	OSSD pair 2, OSSD A (OSSD 2.A)
Universal I/O 3	Not used	OSSD pair 2, OSSD B (OSSD 2.B)

1) These parameters can always be configured on the safety laser scanner. In this safety system, however, the parameters are permanently set to the specified values.

13.2 Dimensional drawings and CAD models

Dimensional drawings and CAD models of the components can be found at www.sick.com. Enter the part number of the component in the search field at the top right. The part number of the component can be found on the type label or in the scope of delivery.

14 Spare parts

14.1 Spare parts for the safety system

Table 13: Ordering information for safety laser scanner

Product	Type code	Part number
nanoScan3 Core I/O safety laser scanner	NANS3-AAAZ30AN1	1100333
nanoScan3 Pro I/O safety laser scanner	NANS3-CAAZ30AN1	1100334

Table 14: Ordering information for system plug

Accessories for		Connection type	Type code	Part number
Device	Part number			
nanoScan3 Core I/O	1100333	Cable with plug connector M12 Ethernet connection	NANSX-AAABAEZZ1	2104949
nanoScan3 Pro I/O	1100334	Cable with plug connector M12 Ethernet connection	NANSX-AAACAEZZ1	2104860

Table 15: Brackets ordering information

Part	Part number
Mounting kit 1b (with protection for optics cover)	2111768

Table 16: Optics cover ordering information

Part	Part number
Optics cover for nanoScan3 (with seal and screws)	2111696

15 Accessories

15.1 Connectivity

Table 17: Ethernet cable, M12, 4-pin, D-coding on RJ45 ordering information

Part	Type code	Part number
Male connector, straight, 2 m cable, RJ45 male connector	YM2D24-020PN1MRJA4	2106182
Male connector, straight, 5 m cable, RJ45 male connector	YM2D24-050PN1MRJA4	2106184
Male connector, straight, 10 m cable, RJ45 male connector	YM2D24-100PN1MRJA4	2106185

16 Glossary

Dangerous state	A dangerous state is a status of the machine or facility, where people may be injured. Protective devices prevent this risk if the machine is operated within its intended use. The figures in this document always show the dangerous state of the machine as movement of a machine part. In practice, there are different dangerous states, such as: • Machine movements • Electrical parts • Visible and invisible beam • A combination of multiple hazards
EDM	External device monitoring
Enabling device	Additional manually operated device used in conjunction with a start control and which, when continuously actuated, allows a machine to function. (EN ISO 12100)
External device monitoring	The external device monitoring (EDM) monitors the status of downstream contactors. In order to use external device monitoring, positively guided contactors must be used to switch off the machine. If the auxiliary contacts of the positively guided contactors are connected to the external device monitoring, the external device monitoring checks whether the contactors switch correctly when the OSSDs are switched off.
Hazardous area	Hazardous area is any space within and/or around machinery in which a person can be exposed to a hazard. (ISO 12100)
Navigation	Navigation is the determination and continuous adaptation of the route of a vehicle. This requires precise knowledge of the position of the vehicle and the nature of the environment in which the vehicle is moving.
Navigation	Navigation is a central element of a website or software interface that enables the user to always have an overview of the structure of the website or software and to navigate as directly as possible to any page of the website or software that is considered important.
OSSD	Output signal switching device: signal output for the protective device, which is used for stopping the dangerous movement. An OSSD is a safety switching output. The functionality of each OSSD is tested periodically. OSSDs are always connected in pairs and must undergo dual-channel analysis for safety reasons. An OSSD pair is formed from 2 OSSDs that are connected and analyzed together.
PL	Performance level (ISO 13849)
Position determination	Position determination or localization is the determination of the position of an object. For vehicles, localization is a prerequisite for navigation.
Protective field	The protective field is the area in which the test object specified by the manufacturer is detected by the electro-sensitive protective equipment (ESPE). As soon as the electro-sensitive protective device detects an object in the protective field, it switches the associated safety outputs to the OFF state. This signal can be passed to controllers resulting in the dangerous state coming to an end, e.g. to stop the machine or the vehicle.

Protective stop	Type of interruption of operation that allows a cessation of motion for safeguarding purposes and which retains the program logic to facilitate a restart. (ISO 10218-1)
Reset	When a protective device has sent a stop command, the stopped state must be maintained until a reset device is activated and the machine can be restarted in a second step. The reset brings the protective device back to the monitoring state after it has sent a stop command. The reset also quits the start-up or restart interlock of a protective device, so that the machine can be restarted in a second step. The reset must only be possible, when all safety functions and protective devices are functional. The reset of the protective device must not introduce any movement or dangerous situations itself. The machine is only permitted to start after the reset once a separate start command has been sent. • Manual resets are performed using a separate, manually operated device, such as a reset pushbutton. • Automatic resets by the protective device are only permitted in special cases, if one of the following conditions is met: o It must not be possible for people to be in the hazardous area without triggering the protective device. o It must be ensured that no people are in the hazardous area during or after the reset.
Resolution	The resolution of an active opto-electronic protective device (also known as the sensor detection capability) is the minimum size of an object for it to be reliably detected.
Response time	The protective device's response time is the maximum time between the occurrence of the event leading to the sensor's response and supply of the switch-off signal to the protective device's interface (for example OFF state of the OSSD pair).
Safety function	Function of a machine whose failure can result in an immediate increase of the risk(s). (ISO 12100)
Scan plane	The scan plane is the geometric plane in which the 2D laser scanner captures its environment. A scan layer is created by deflecting a laser beam using a rotating mirror. In practice, the area scanned is not precisely flat. Deviations from the ideal plane are specified as a conical error. Deviations from the ideal alignment are specified as a tilt error.
SIL	Safety integrity level
SILCL	SILCL: SIL claim limit. Designation in older versions of IEC 62061. Replaced by SIL in versions from 2021.
Universal I/O	Universal I/O can be configured as universal input or as universal output.
Warning field	The warning field monitors larger areas than the protective field. Simple switching functions can be triggered with the warning field, e.g. a warning light or an acoustic signal can be triggered if a person approaches, even before the person enters the protective field. The warning field must not be used for safety applications.

17 Annex

17.1 Checklists

17.1.1 Checklist for initial commissioning and commissioning

Important information

NOTE

This checklist should be retained and kept with the machine documentation to serve as a reference during recurring thorough checks.

This checklist is not a substitute for initial commissioning or periodic thorough checks by qualified safety personnel.

Tests for the “Protective stop” safety function

Table 18: Tests for the “Protective stop” safety function

Test sequence	Expected result	Result OK?
1. Start the robot in “Automatic” operating mode. 2. Introduce the test object into the stop field protective field to trigger a detection. 3. While the test object is detected in the stop field protective field, change to “Manual” operating mode. 4. Actuate the enabling device. 5. Start robot program using teach panel.	The robot carries out a safety stop if something is detected in the stop field protective field. Via the icon in the lower left corner of the teach panel, you can see how the robot changes from **Normal Mode** to **Automatic Mode Safeguard Stop**. When changing to the “Manual” operating mode, the status in the teach panel changes to **System Three Position Enabling** (With the 3PE Teach Pendant from UR: **Teach Pendant 3PE Stop**). When the enabling device is actuated, the status in the teach panel changes depending on the variant of the safety system. • For safety systems with 1 protective field: **Normal Mode** • For safety systems with 2 protective fields: **Manual Mode** In the “Manual, reduced speed” operating mode, the robot can also move when the enabling device is actuated while the stop field protective field is interrupted. Document the settings of the “Safety-rated monitored speed” function in the “Comments” field:	Yes ☐ No ☐
Comments:		

Tests for “Safety-rated monitored speed” safety function

Table 19: Tests for “Safety-rated monitored speed” safety function

Test sequence	Expected result	Result OK?
1. Start the robot in “Automatic” operating mode. 2. Introduce the test object into the reduced field protective field to trigger a detection	The robot reduces its speed. Via the icon in the lower left corner of the teach panel, you can see how the robot changes from **Normal Mode** to **Reduced Mode**. Document the settings of the “Safety-rated monitored speed” function in the “Comments” field:	Yes ☐ No ☐
Comments:		

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