ROBOTICS

Application manual

Collaborative Speed Control add-in

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Application manual

Collaborative Speed Control add-in

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Original instructions.

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Overview of this manual

About this manual

This manual contains information about the Collaborative Speed Control add-in.

Usage

This manual can be used to configure the lead-through function and speed control function for robots connected with a lead-through device and safety laser scanner. The installation about how to install the hardware of lead-through device and safety laser scanner is also described in this manual for reference.

> **Note**
>
> It is the responsibility of the integrator to conduct a risk assessment of the final application.
>
> It is the responsibility of the integrator to provide safety and user guides for the robot system.

Prerequisites

The reader should be familiar with:

- System parameters and how to configure them
- Safety configurations with SafeMove
- The RAPID programming language

References

Documentation referred to in the manual, is listed in the table below.

Reference	Document ID
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Operating manual - OmniCore	*3HAC065036-001*
Application manual - Controller software OmniCore	*3HAC066554-001*
Technical reference manual - System parameters	*3HAC065041-001*
Application manual - PROFINET Controller/Device	*3HAC066558-001*
Application manual - Scalable I/O	*3HAC070208-001*
Application manual - Functional safety and SafeMove	*3HAC066559-001*
Operating manual - RobotStudio	*3HAC032104-001*
Product manual - CRB 1100	*3HAC078007-001*
Product manual - CRB 1300	*3HAC083111-001*
Product manual - CRB 15000	*3HAC077389-001*
Operating instructions microScan3 - PROFINET	From vendor
Operating instructions microScan3 - Pro I/O	From vendor

[i] This manual contains all safety instructions from the product manuals for the manipulators and the controllers.

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Continued

Revisions

Revision	Description
A	First edition.

1 Introduction

Overview

The Collaborative Speed Control add-in is a RobotWare add-in enabling a robot to set up safe collaborative configurations. Combining ABB SafeMove solution, the Collaborative Speed Control add-in provides safety separation and speed control functions to robots connected with safety laser scanner(s), and lead-through function to robots connected with a lead-through device. The Collaborative Speed Control add-in also integrates the lamp indicator configurations for CRB 1100 and CRB 1300, detailed information of which can be referred to the product manual of corresponding robot.

The Collaborative Speed Control add-in is pre-installed in the robot system at delivery if any of following option is selected.

- 3313-1 Lead-through device
- 3051-*X*, any of safety laser scanner options
- 3143-1 Collab. speed control

It is also available separately in the add-ins section in RobotStudio to allow an installation to an existing controller or do an update.

Applicable robot types

The Collaborative Speed Control add-in is applicable to following robot types:

- CRB 1100
- CRB 1300
- CRB 15000

Prerequisites

The Collaborative Speed Control add-in is valid only for robots operating in RobotWare 7.6 or later.

To use the latest features of the Collaborative Speed Control add-in, it always recommended to upgrade the RobotWare and RobotStudio to the latest versions.

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2 Installation

2.1 Installation of the Collaborative Speed Control add-in

Overview

The Collaborative Speed Control add-in is pre-installed in robot systems if options 3313-1 Lead-through device, 3051-*X* for safety laser scanner or 3143-1 Collab. speed control is selected. It is also available for downloading from the Add-Ins Gallery in RobotStudio. After downloading, you can add or upgrade the add-in to the robot system using **Modify Installation**. This section described the procedure how to add or upgrade the add-in to an existing robot system.

Procedure

Perform the following procedure to install the Collaborative Speed Control add-in:

1. Start RobotStudio and click **Gallery** in the **Add-Ins** ribbon.
2. In the displayed **Gallery** window, use the **Search** function or **Common tags** to find the Collaborative Speed Control add-in.
3. Click the displayed add-in icon.
4. In the right pane, click **Add**.

   The package is automatically installed and listed in the **Add-in** navigation tree in the left pane of the window.
5. Select **Add Controller** > **Connect to Controller** in the **Controller** ribbon.
6. In the **Connect to Controller** window, connect to a real controller or select/create a virtual controller and tap **OK**.
7. Request write access.
8. Launch the **Modify Installation** dialog from the **Controller** ribbon.
9. Select **Software** > **Available**.

   The **Available Software** window displays all distribution packages that have been installed with RobotStudio.

   Select the Collaborative Speed Control add-in package and required version to be added to the system and click **Include**.
10. Proceed to the **Features** tab page and modify the system as required.
11. Choose required option in the **Collaborative Features** group.
12. The **Summary** tab shows an overview of all the changes.
13. Select **Apply** to confirm and save the changes.

    The controller is restarted automatically to apply the changes.

See more details about how to use Modify Installation for RobotWare 7 and how to install a distribution package, see *Operating manual - RobotStudio*.

2.2 Installation of lead-through device

Introduction

The lead-through functionality in Collaborative Speed Control add-in is applicable to robots selected with 3313-1 Lead-through device and with a lead-through device mounted on robot tool flange. With the lead-though functionality enabled, you can hold the handler of the lead-through device and move the robot arm manually to the desired position, as an alternative to jogging.

To use lead-through, make sure the system is running in manual mode; otherwise, the functionality cannot be enabled. If running the system in auto mode, always remove the lead-through device from the robot first to prevent any unexpected damages.

CAUTION

Be careful not to stretch or squeeze the device cabling when moving the robot with the lead-through device, especially to extreme positions. Otherwise, it will cause cabling damages.

Note

Two types are available to the lead-through device, no-button-type and two-button-type. The actual delivered device type varies according to the order time. Unless otherwise stated, the instructions of installing and configuring the device are applicable to both no-button-type device and two-button-type device. Always read the instructions carefully to install and configure your device based on the actual device type.

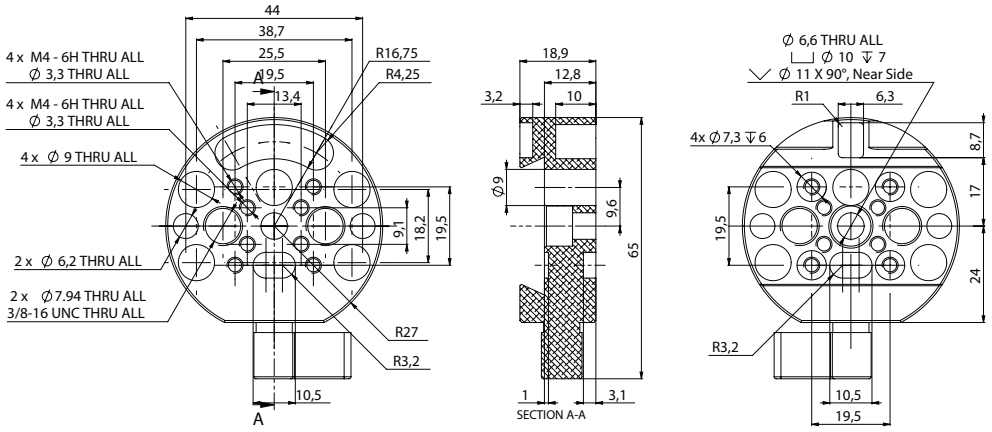
Preparing the adapter

The lead-through device is mounted to the device base and then to the robot tool flange through an adapter. Customers can use an L-shape adapter offered by ABB (option 3314-1) or design adapters according to actual requirements. During adapter design, hole dimensions on the device base and robot tool flange shall be considered.

Continues on next page

The following figure illustrates the hole dimensions on lead-through device base.

For no-button type



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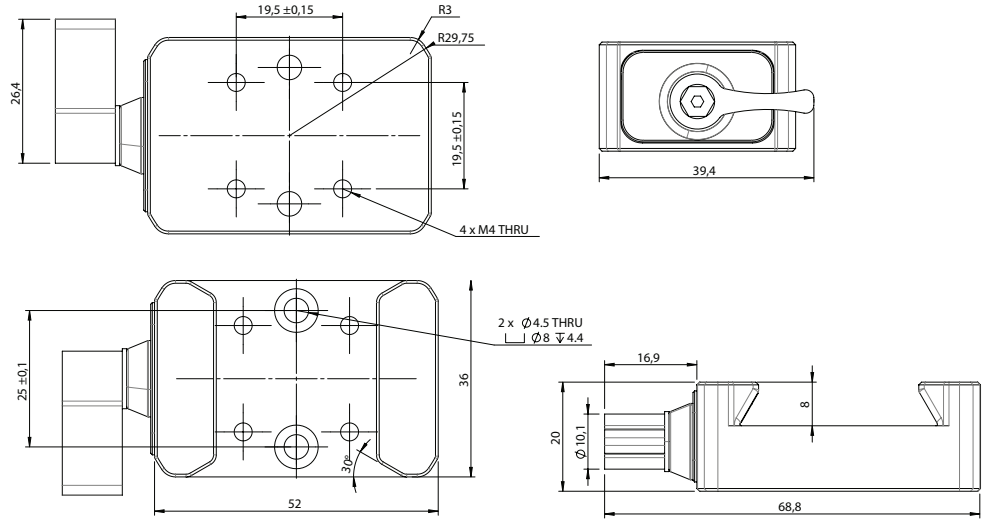
For two-button type



xx2200000767

For the hole dimensions on robot tool flange, see the product manual of corresponding robot.

Installing the lead-through device

Note

The lead-through device can be installed in any position according to actual applications. Figures in the following procedures only illustrate an example position of the lead-through device mounted on a CRB 1100.

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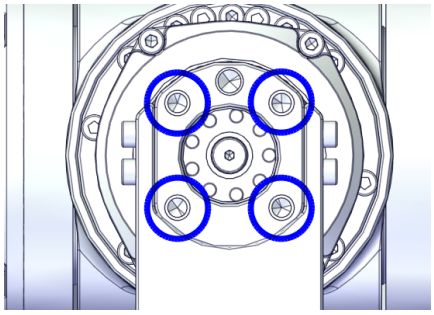
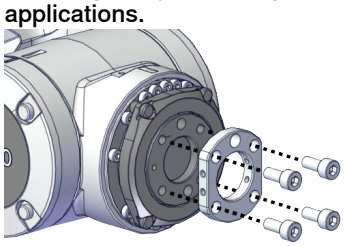
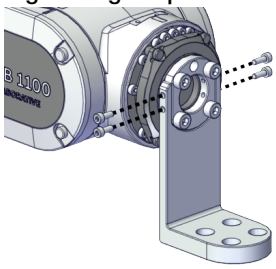
2.2 Installation of lead-through device

Continued

Preparations before installing the lead-through device

	Action	Note
1	Remove all tools from the mounting flange.	
2	Jog the robot to the synchronization position.	
3	Prepare the lead-through device adapter. **CAUTION** To calibrate the axis 6, the notch on the wrist must be aligned with the marked pin hole on the tool flange. Before installing the adapter on the tool flange, make sure a visible mark has been made to the adapter at the corresponding position.	Refer to *Preparing the adapter on page 12*.
4	Install the adapter to mounting flange. **Note** Secure the adapter to the tool flange using the screw holes circled in the following figure if there are no other tools to be fitted. Otherwise, the tools should use these holes as via holes to be fitted to the robot.  xx2100000167	Following figures illustrate installation of the offered L-shape adapter (option 3314-1). Specification and tightening torque of screws fixing the adapter to the tool flange vary according to actual applications.  xx2100000281 Screw: M3x8 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 1.8 Nm  xx2000002222

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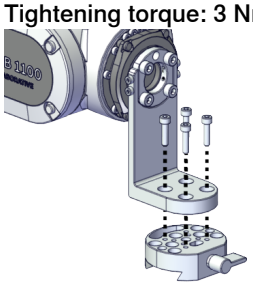
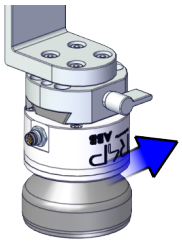
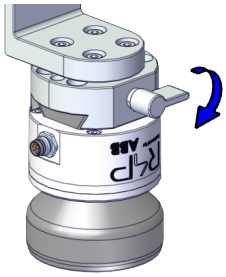
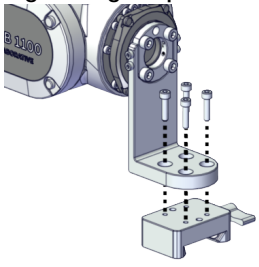
Installing the lead-through device (no-button type)

	Action	Note
1	Install the device base to the adaptor.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 3 Nm  xx2000002223
2	Insert the lead-through device to the base.	 xx2000002224
3	Turn the adjusting knob to lock the lead-through device. **Note** Do not use excessive force! The arrow in the figure indicates the direction of locking the lead-through device.	 xx2000002225

Installing the lead-through device (two-button type)

	Action	Note
1	Install the device base to the adaptor.	Screw: M4x16 12.9 Lafre 2C2B/FC6.9 (4 pcs) Tightening torque: 3 Nm  xx2200000763

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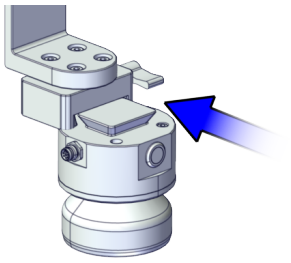
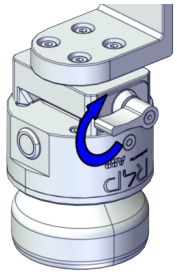
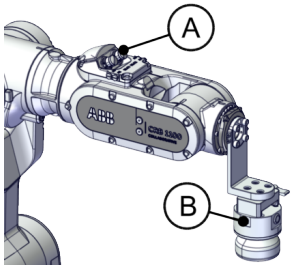
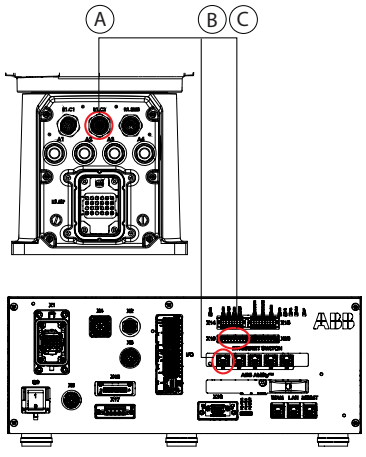
2.2 Installation of lead-through device

Continued

	Action	Note
2	Insert the lead-through device to the base.	 xx2200000764
3	Turn the adjusting knob to lock the lead-through device. **Note** Do not use excessive force! The arrow in the figure indicates the direction of locking the lead-through device.	 xx2200000765

Connecting the cables

	Action	Note
1	Connect the cabling between the lead-through device and robot. • R2.C2 connector on process hub of robot (A) • Lead through device connector (B)	 xx2200000766
2	Connect the cable between robot and controller. • R1.C2 connector on robot base (A) • Ethernet switch port on controller (B) • X19 connector on controller (C) **Note** Ethernet switch port is available for use only when the **5 Port Ethernet switch** option is selected. Otherwise, connect the cable to the MGMT port. **Note** Pins 3 and 4 of X19 connector are used for the lead-through device connection while pins 1 and 2 are occupied by the CP/CS cable for lamp unit.	 xx2100000292

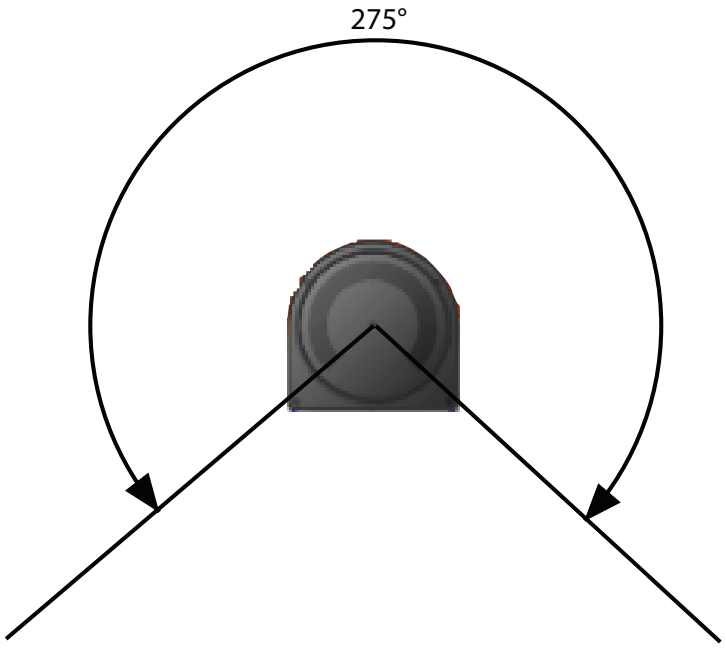
2.3 Installation of laser scanner

Overview

The safety separation technology and speed control function is based on the connection and communication of one or two safety laser scanners in the robot. Laser scanner(s) provides a timely and continuous monitor on the activities within its scanning area and forms a protective field. One laser scanner can provide a scanning range of approximately 275°. The system integrator shall investigate the site environment and place the laser scanner to a suitable location according to the actual requirements.

CAUTION

Safety in the area that not in the scanning range must always be considered. The system integrator shall assess the potential risks within this area and make sure that proper measures have been applied to reduce risks.



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Laser scanner types

The following laser scanner package options are available:

- 1 PROFIsafe-based laser scanner (option 3051-1 PROFIsafe scanner)
- 2 PROFIsafe-based laser scanners (option 3051-3 Dual PROFIsafe scanner)
- 1 SafetyIO-based laser scanner (option 3051-2 I/O scanner)
- 2 SafetyIO-based laser scanners (option 3051-4 Dual I/O scanner)

Continues on next page

Connection between PROFIsafe-based laser scanners and the OmniCore controller differs according to the PROFINET options selected and installed in the system.

- If only options [3020-2] PROFINET Device and [3023-2] PROFIsafe Device are selected and installed, the laser scanners shall connect to a PLC acting as a master first and then to the OmniCore controller with SafeMove via the PROFINET safe (PROFIsafe) network. Users need to prepare a safety PLC of their own.
- If options [3020-1] PROFINET Controller and [3023-1] PROFIsafe Controller are selected and installed, the laser scanner could communicate with the OmniCore controller directly via the LAN port.

SafetyIO-based laser scanners connects to the OmniCore controller with SafeMove and installed with the scalable I/O device DSQC1042 Safety digital base (option 3037-2). For details about the scalable I/O device, see the product specification of the controller and *Application manual - Scalable I/O*.

The supported PROFINET- and SafetyIO-base laser scanners are *SICK®* microScan 3 Core and *SICK®* microScan 3 Pro, respectively. Detailed scanner model can be obtained on the scanner nameplate. Other scanner types or models might not provide full functionality.

For more details about the safety laser scanners, see *Operating instructions microScan3 - PROFINET* and *Operating instructions microScan3 - Pro I/O* from the vendor, which are available on *SICK®* website.

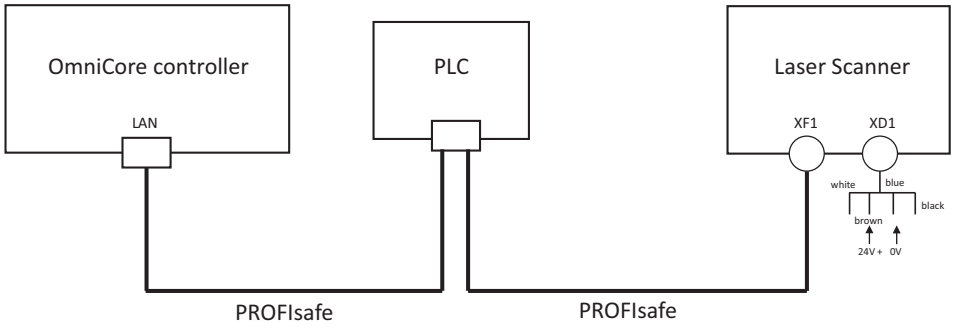
Connecting the laser scanner(s)

Safety laser scanners shall be connected properly according to the scanner type and system setup.

Note

External 24V power supply shall be prepared for power connection of laser scanners.

1 PROFIsafe-based laser scanner (option 3051-1), with PLC connected



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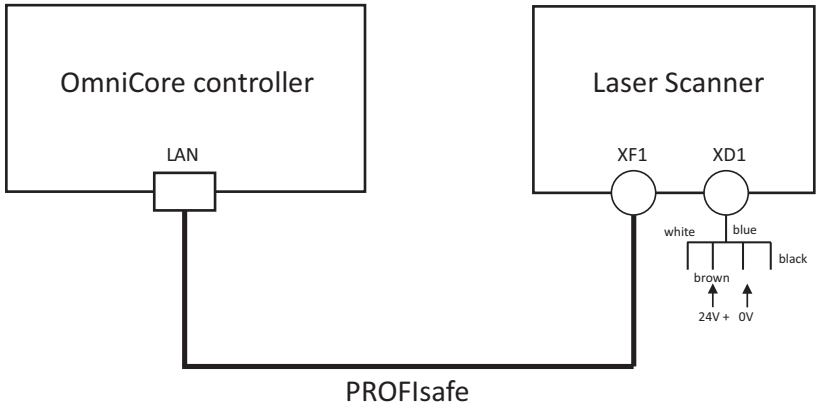
1 PROFIsafe-based laser scanner (option 3051-1), without PLC connected



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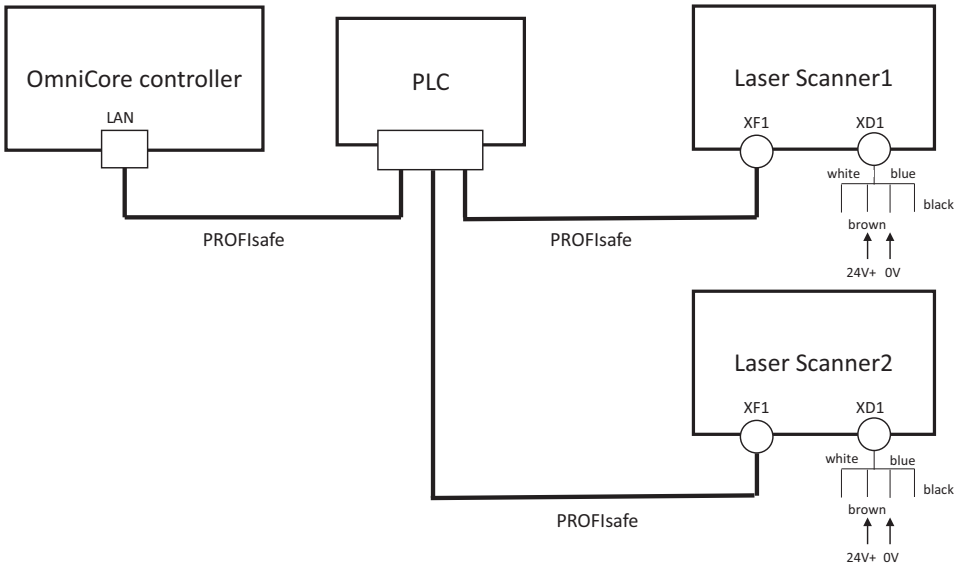
2 PROFIsafe-based laser scanners (option 3051-3), with PLC connected



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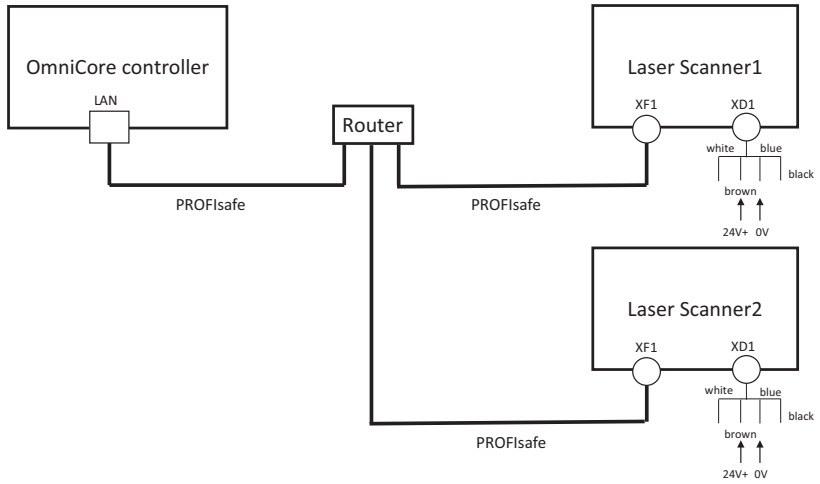
2.3 Installation of laser scanner

Continued

2 PROFIsafe-based laser scanners (option 3051-3), without PLC connected



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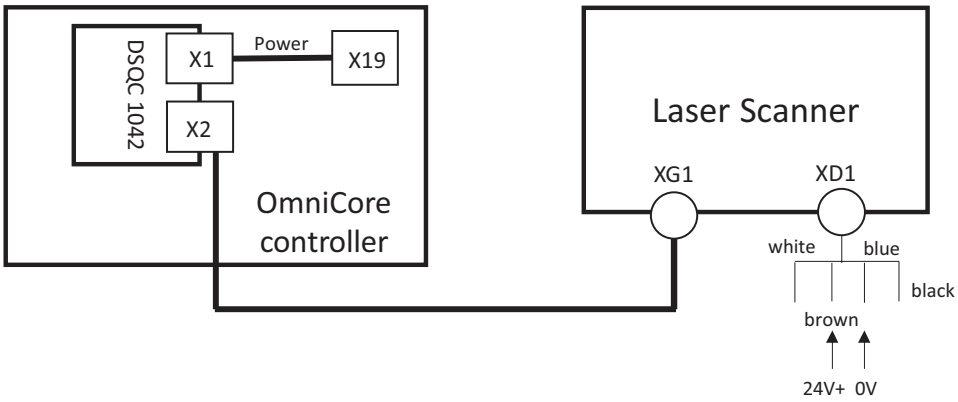
1 SafetyIO-based laser scanner (option 3051-2)



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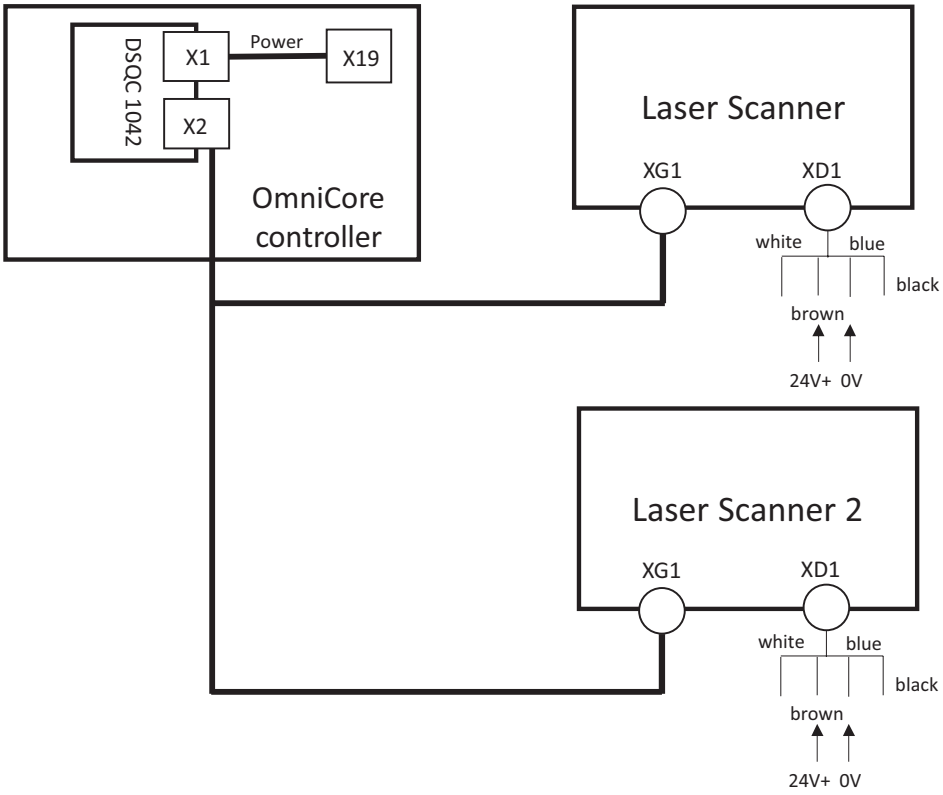
2 SafetyIO-based laser scanners (option 3051-4)



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Note

For PROFIsafe-based laser scanner, if working with the Collaborative Speed Control add-in in a version 1.2.1 or earlier, the scanners should connect to the WAN port on the controller.

Note

If there are additional scalable I/O devices available, install and configure the additional devices by following the detailed procedures in *Application manual - Scalable I/O*.

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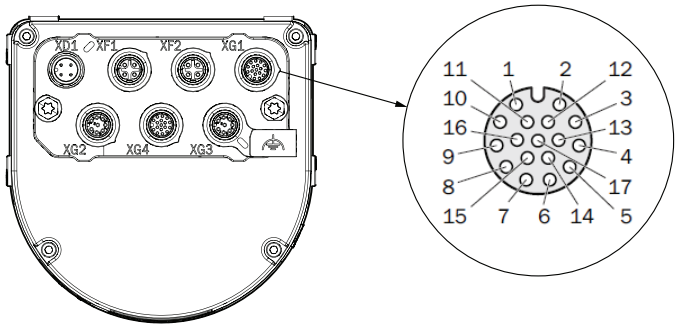
Connector information

Pin assignment on XG1 of SafetyIO-based laser scanners

XG1 connector on SafetyIO-based laser scanner is a 17-pin, A-coded M12 female connector. Pins 1-4 and pin 17 on XG1 are occupied for connecting the laser scanner and scalable I/O device, while other 12 pins can be used for local inputs and outputs.



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Pin	Description	Wiring color
1	OSSD pair 1, OSSD A	Brown
2	OSSD pair 1, OSSD B	Blue
3	OSSD pair 2, OSSD A	White
4	OSSD pair 2, OSSD B	Green
5	Universal input 1	Pink
6	Universal input 2	Yellow
7	Universal input 3	Black
8	Universal input 4	Grey
9	Universal input 5	Red
10	Universal input 6	Violet
11	Universal input 7	Grey with pink
12	Universal input 8	Red with blue
13	Universal input 9	White with green
14	Universal input 10	Brown with green
15	Universal output 1	White with yellow
16	Universal output 2	Yellow with brown
17	Voltage 0 V DC	White with grey

3 Configuration

3.1 Overview

General procedure

This section is intended for guiding users to set up robot system and configure necessary software for a robot with the Collaborative Speed Control add-in installed. It also contains information of some customizable safety configurations.

A general software configuration procedure is listed as below.

	Action	Reference to...
1	Configure RobotWare as required.	• *Information about RobotWare on page 24* • *Operating manual - Integrator's guide OmniCore*
2	If a lead-through device is connected, configure the lead-through functions.	*Lead-through on page 25*
3	Configure SafeMove.	
	For PROFIsafe-based scenarios with a PLC acting as the master connected (any supported RobotWare version) **For SafetyIO-based scenarios** Upload the template SafeMove configuration file using the SafeMove configurator app on FlexPendant.	• *The SafeMove configurator app on FlexPendant on page 32* • *Application manual - Functional safety and SafeMove*
	For PROFIsafe-based scenarios with the controller acting as the master (RobotWare 7.10 or later) Configure the template SafeMove configuration file using **Visual SafeMove** in RobotStudio and upload to the controller.	• *Configuration of SafeMove using Visual SafeMove in RobotStudio on page 40* • *Application manual - Functional safety and SafeMove*
4	Configure laser scanner(s) and apply speed control strategies.	*Speed control on page 48*
5	If required, modify customizable safety configurations.	*Use cases of safety configurations on page 86*

3.2 Information about RobotWare

Configuring RobotWare

The Collaborative Speed Control add-in is designed to simplify collaborative applications. To use the latest features of the Collaborative Speed Control add-in, it is always recommended to upgrade the RobotWare and RobotStudio to the latest versions.

How to configure RobotWare is described in *Operating manual - Integrator's guide OmniCore*.

3.3 Lead-through

What is lead-through?

The lead-through functionality is available for robots designed for collaborative applications. Using lead-through, you can move the robot manually to a desired position, as an alternative to jogging.

Using lead-through

> **Note**
>
> For robots newly ordered with option 3313-1 Lead-through Device, install the Collaborative Speed Control add-in with the option *[3313-1] Lead-through Device* selected first. See *Installation of the Collaborative Speed Control add-in on page 11*.

Checking lead-through status

The lead-through device is not configured by default. Users can perform the following procedure to check the configuration status:

1. In the FlexPandant, on the status bar, tap the **QuickSet** button.
   The **QuickSet** window is displayed.
2. Tap **Lead-through**.
   The **Lead-through Settings** tab page is displayed.
3. Check the lead-through device setting.
   The device is not configured by default and the **Enable Lead-through** switch is unavailable for use.

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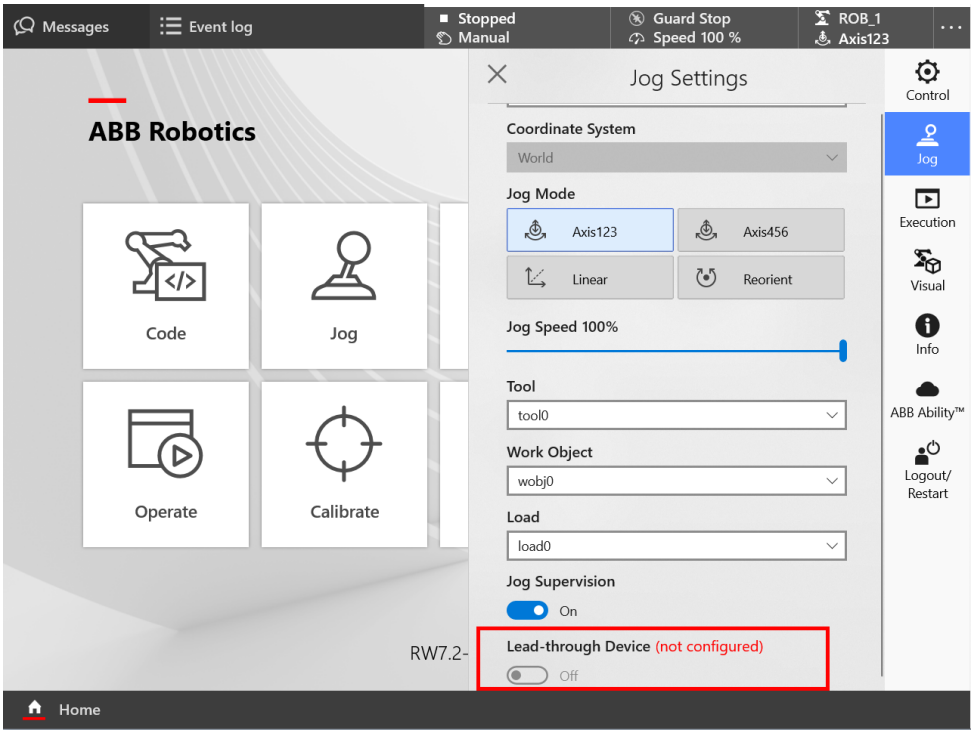
Note

For robots operating in RobotWare version earlier than 7.7, check the lead-through status in the **Jog Setting** tab page by tapping **Jog** in the **QuickSet** window.



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Configuring installation information of the lead-through device

Use the following procedure to configure the installation information of the lead-through device and get it ready for use:

1. Tap **Settings** on the home page of the FlexPendant.
2. Tap **Lead-through Device**.
3. Choose the lead-through device type from the drop-down list.

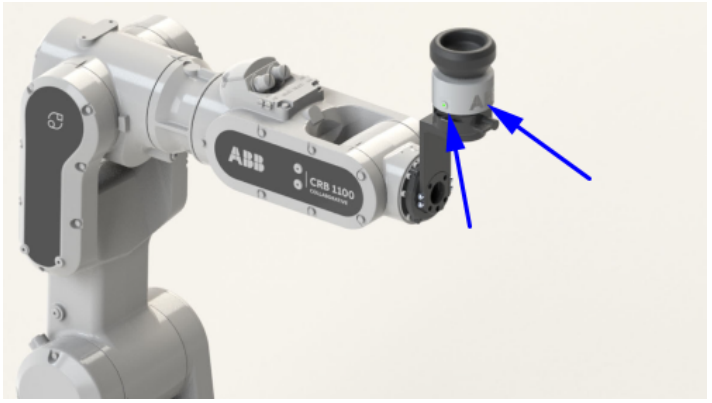
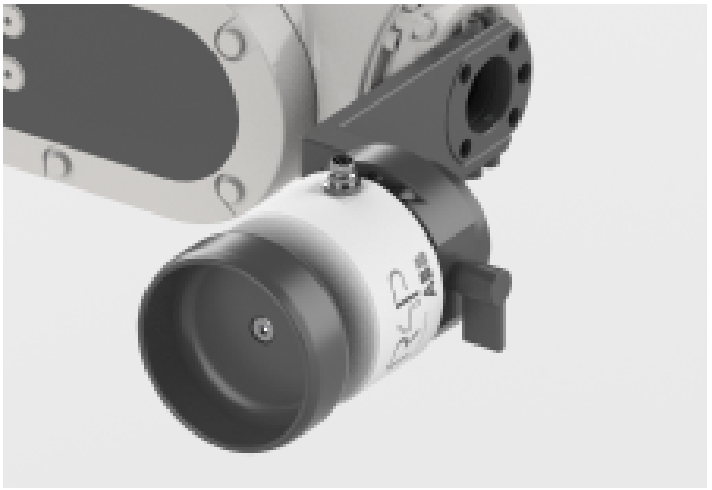
Tip

You can click **About the versions** and refer to the pictures to figure out your device type.

4. In the **Installation** page of the displayed window, select the installation position of the lead-through device.

Continues on next page

Four installation configurations are predefined, **Up**, **Right**, **Down** and **Left**. Observe your device and refer to the following table to make sure the actual device installation position is consistent with the selected configuration.

Device type	Observe...
No-button type	• The ABB logo on the device is in the correct direction. • The indicator on the lead-through is in the correct relative position with the lamp unit on the process hub. The following figure takes the configuration **Up** as an example.  xx2100000173 The device details are as follows.  xx2200000597

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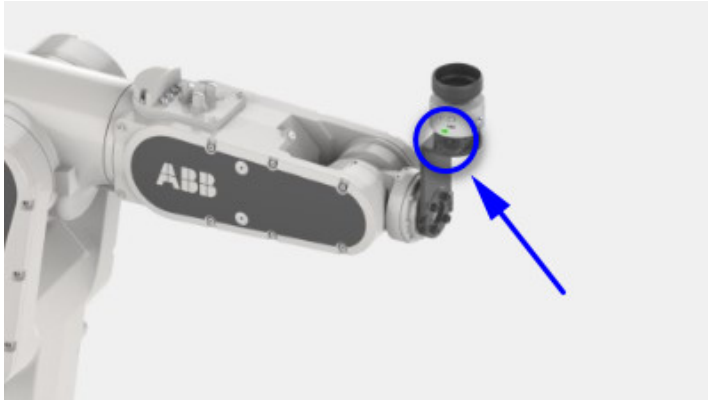
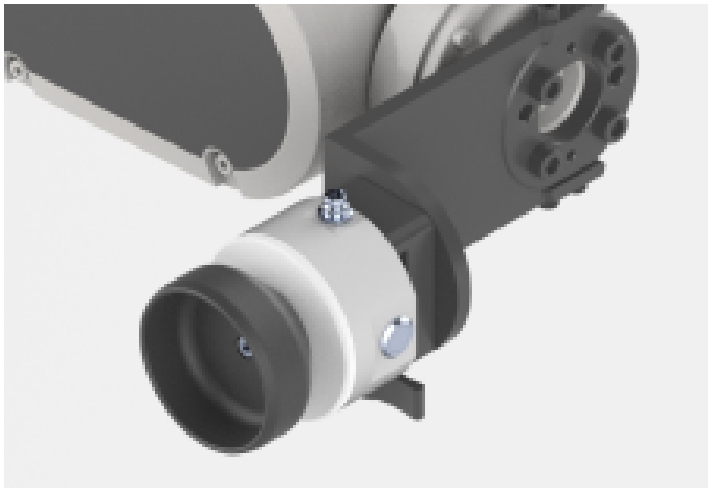
Device type	Observe...
Two-button type	The indicator and locking knob on the lead-through are in the correct relative position with the lamp unit on the process hub. The following figure takes the configuration **Up** as an example.  xx2200000577 The device details are as follows.  xx2200000598

5 If users want to define customized installation position, tap **Advanced installation**.

6 In the displayed window, set corresponding parameters according to actual requirements.

- For robots operating in RobotWare version earlier than 7.7, the device offset and orientation are available to set.
- For robots operating in RobotWare version 7.7 or later, the device offset, orientation, tool load mass and mass center are available to set.

7 Tap **Apply**.

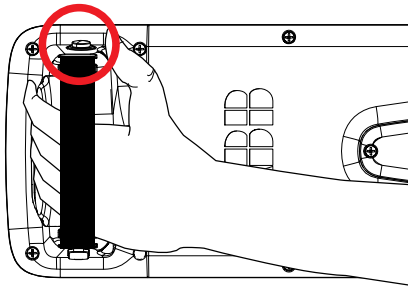
Enabling lead-through

Use the following procedure to enable lead-through:

1 Make sure the robot is in Manual mode.

Continues on next page

2 Enable lead-through in one of the following ways:
   - Press the thumb button on the FlexPendant.



xx2100000331

   - On the start screen, tap **Jog** and select the **Lead-through** menu.
   - In the **QuickSet** menu, select the **Lead-through** tab.

> **Note**
>
> If the robot is in motors off state, set the controller to Motors On state first by pressing the three-position enabling device or changing the state in the **Control Panel** tab page.

> **Note**
>
> For robots operating in RobotWare version earlier than 7.7, the lead-through device can only be enabled from the **Jog Setting** tab page by tapping **Jog** in the **QuickSet** window.

3 In the **Lead-through Mode** section select a mode.
4 If required, in the **Lead-through lock** section use the lock button next to a axis to lock it.
5 Hold the handler of the lead-through device and gently move the robot to the desired position.

   The robot moves to the selected position. If the **Lead-through lock** option is selected, the robot moves in such a way that the movement is restricted in the locked direction.

> **Note**
>
> You can feel if an axis reaches its end position. Do not try to force the axis beyond this position.

6 If desired, save the position.

Continues on next page

Note

The speed at which the robot moves when using the Lead-through functionality is managed using the horizontal scroll bar available in the **Lead-through Speed** section.

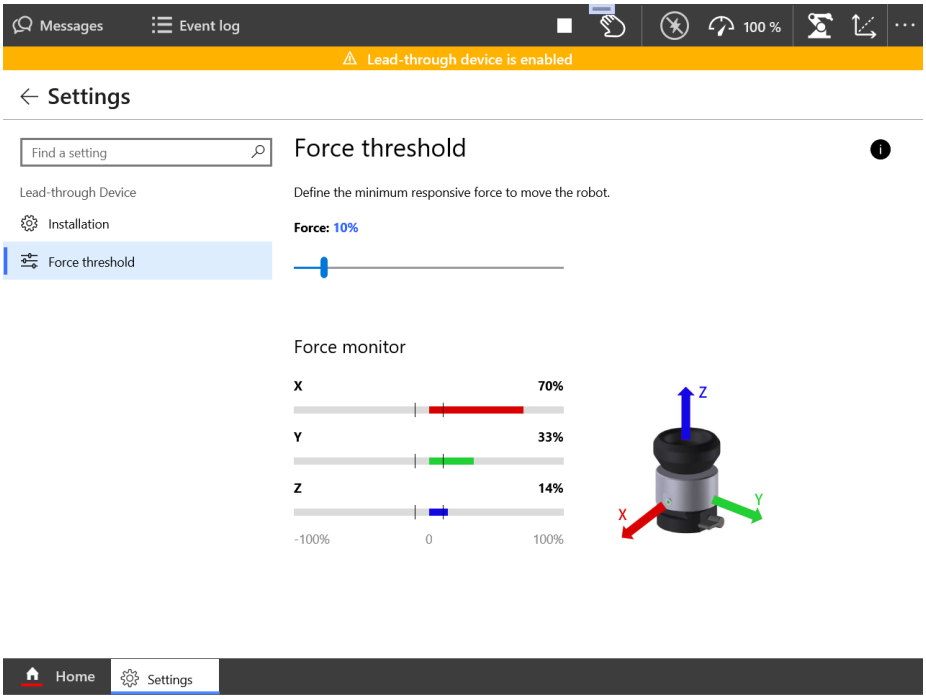
Setting force threshold

In actual applications, some strong background noises, for example, EMC and radiation, may be treated as a force by the lead-through device, which may results in an unexpected movement of the robot. To reduce such affections, users are allowed to set a force threshold. All the forces that are lower than the threshold will be filtered out.

Use the following procedure to set the force threshold:

1. Tap **Settings** on the home page of the FlexPendant.
2. Tap **Lead-through Device**.
3. Tap **Force threshold** on the left pane.
4. In the displayed window, drag the **Force** slider to define a response force to move the robot.

   The default force threshold is **10%**.



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5. Observe the forces applied on the lead-through device in real time in the **Force monitor** area.

Continues on next page

Configuring button functions

> **Note**
>
> The procedure is valid only for two-button type lead-through device.

The button-type lead-through device provides two buttons, flat and raised, for users to configure specific functions according to application requirements. The button function configuration is only available to:

- CRB 1100 operating in RobotWare version 7.6.1 or later
- CRB 1300 operating in RobotWare version 7.7 or later

Use the following procedure to configure the button functions:

1. Tap **Settings** on the home page of the FlexPendant.
2. Tap **Lead-through Device**.
3. Tap **Configurable buttons** on the left pane.
4. Select desired function from the drop-down list for the required button.
   - **Add a move location**: a **Move** block will be added to Wizard app. This is the default configuration for the flat button.
   - **Linear** / **Reorient**: the lead-through mode will be changed between linear and reorient. This is the default configuration for the raised button.
   - **Lock Z**: the movement along the Z direction will be locked.
   - **Lock XY**: the movement along the X and Y directions will be locked.

After selection, configured action takes effect when pressing the button.

3.4 SafeMove

3.4.1 The SafeMove configurator app on FlexPendant

Introduction

The application **SafeMove** on the FlexPendant offers an intuitive way to visualize and configure a safety configuration for systems with the option *SafeMove Collaborative*. This includes stop functions and *Cyclic Brake Check*. To get started, see *Use cases on page 34*.

Tip

Use the online user guide tool, included in the SafeMove configurator app, for help with the SafeMove configuration setup process.

Note

The SafeMove configurator app is available for the following robots:

- CRB 1100
- CRB 1300
- CRB 15000

The configuration follows the same principles as when using Visual SafeMove in RobotStudio but the functionality is not as extensive.

Overview of the user interface

The user interface consists of a configurator and a 3D model that visualizes the robot with the configured encapsulations and zones. The first time that the app is opened, a default factory setting is loaded. If a safety configuration is loaded, this will be shown.

- The tab **Robot Encapsulation** contains the configuration of the encapsulations of the robot itself.
- The tab **Tool Encapsulation** contains the configuration of the encapsulations of the tools.
- The tab **Tool Data** contains the configuration for the tools.
- The tab **Safe Zones** contains the configuration of the safe zones.
- The tab **Global Settings** contains the configuration for Cyclic Brake Check and supervision settings.
- The tab **Synchronization** contains functions for software synchronization.
- The **Context** menu (...) contains functionality for loading, saving, and viewing configurations, and to reset the configuration.

The functionality is described in detail in *Application manual - Functional safety and SafeMove*.

Continues on next page

Prerequisites

- The option *SafeMove Collaborative* is required.
- To edit a configuration, the grant *Safety Services* is required. A user without this grant can view a configuration, but not modify, write it to the controller, or apply it to the controller.

Template configurations

The template configuration is adapted for the specific manipulator, and typically contains one or two encapsulations of the arm, one encapsulation of the wrist (intended for the tool), one or two safe zones, and a Cyclic Brake Check setting. This configuration is typically a good start for a generic application with a smaller tool.

The factory setting is an empty safety configuration. A loaded configuration can be removed and the system is then reset to the factory setting.

Encapsulations

The encapsulations are geometries that can be in the shape of a sphere, capsule, or lozenge. A sphere or capsule encapsulation can be modified in dimension, length, and position. A lozenge capsule can also be modified in rotation.

Safe zones

The default safe zone is a rectangular box with four vertices. The vertices defines the shape of the safe zone, and the position in space. More vertices can be added to define the safe zone. The minimum number of vertices is 4, and the maximum is 24.

Each vertex can be edited in x and y values.

Each vertex is numbered, from 1 and up. When a new vertex is added between two existing vertices the vertex numbers will be automatically adjusted so that they come in order. For example, if a new vertex is added between vertices 2 and 3, the vertex with index 3 will change to 4 and the new vertex will be indexed 3.

Display of safety violations

During the validation of a robot cell using the SafeMove app, it is possible to check whether the robot is committing a safety violation. For example, robot crossing a forbidden zone, robot speed or force exceeding a certain value, and so on. Once a violation is detected and displayed on the SafeMove app, it is possible to take the necessary actions.

For more information about the Display of safety violations, see *Application manual - Functional safety and SafeMove*.

Supervision functions

The global supervision functions are not connected to a specific safe zone or safe range. They can be added, modified, and deactivated.

For more information about the global supervision functions, see *Application manual - Functional safety and SafeMove*.

Continues on next page

3.4.1 The SafeMove configurator app on FlexPendant
Continued

Synchronization

The **Synchronization** tab is used to manually set the current joint positions for the robot.

For more information about synchronization, see *Application manual - Functional safety and SafeMove*.

Recommended working procedure

Use this procedure when configuring SafeMove in the configurator app on FlexPendant.

1. Log in as a user with safety user grants.
2. Start the SafeMove configurator app.
3. Load a safety configuration template or an existing configuration from the **Context** menu (...).
4. Configure encapsulations.
5. Configure zones and the supervision functions.
6. Load the configuration to the safety controller.
7. Restart the controller.
8. In the **Settings** app, tap **Safety Controller** and validate the configuration.
9. In the **Settings** app, tap **Safety Controller** and set the safety configuration to validated and then lock it.

For more details, see *Use cases on page 34*.

For functionality not supported in the SafeMove configurator app, use Visual SafeMove in RobotStudio.

Use cases

Start the SafeMove configurator app

The SafeMove configurator app is available on the home screen of the FlexPendant for systems with the option *SafeMove Collaborative*. If the app is not shown, then review the system settings using the **Modify Installation** function in RobotStudio and add that option.

The first time that the app is opened, a default factory setting is loaded. This contains only the manipulator with *Cyclic Brake Check* activated. There are no encapsulations, safe zones, or tool data defined.

The factory setting can always be resumed, if needed.

To continue and create a safety configuration, see *Load a safety configuration template on page 34*.

Load a safety configuration template

The safety configuration template feature is available from RW 7.12 onwards. Systems with RW 7.10 or earlier will still have the default template solution.

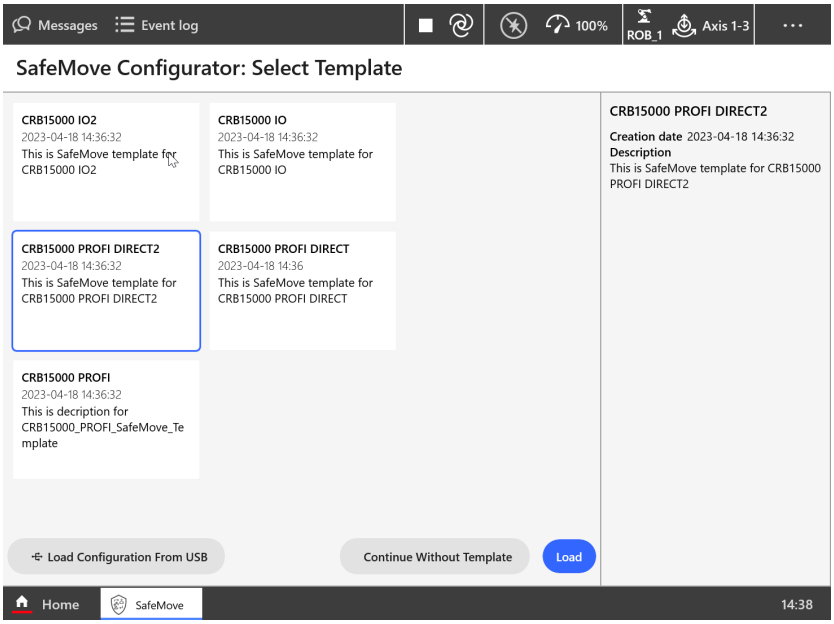
Use the following procedure to load a predefined safety configuration template and apply it to the robot controller.

1. Log in as a user with safety user grants.
2. Open the SafeMove app.

Continues on next page

3 Tap **Enable Edit Mode**.

The **SafeMove Configurator: Select Template** page is displayed with a list of available templates.



xx2300001391

4 Select a template from the list.

The metadata of the selected template is displayed on the right side panel.

5 Tap **Load**.

The **Load Safety Configuration** dialogue is displayed.

6 Tap **Yes**.

The selected safety configuration template is loaded on the FlexPendant.

7 Review that the selected template configuration is suitable for the intended application.

If modifications are needed, see *Modify a loaded safety configuration on page 36*.

> **Note**
>
> A SafeMove configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

8 If the template configuration is suitable, select **Write to controller**.

The safety report is presented on the screen.

9 Save the safety report. Take a print out and sign this safety report.

See *ABB Safety Configuration Report on page 38*. More information about the safety report and how to validate is described in *Application manual - Functional safety and SafeMove*.

10 Tap **Apply to controller**.

Continues on next page

The **Saved** dialogue is displayed

11 Tap **Restart Controller**.

The controller is restarted and loads the newly saved safety configuration template.

> **Note**
>
> To change the loaded safety configuration template, tap the **Context** menu, select **Open Template Selector**, select the required template from the list, and follow the rest of the steps.

Modify a loaded safety configuration

Use the following procedure to modify a loaded safety configuration and apply it to the robot controller.

1 Log in as a user with safety user grants.

2 Open the SafeMove app.

The **SafeMove Configurator** page is displayed along with the saved safety configuration.

3 Select **Enable Edit Mode** to edit the loaded safety configuration.

4 To add or modify an encapsulation, tap **Add** and select a geometry for **Robot Encapsulation** or **Tool Encapsulation**.

To modify the encapsulation, select it and modify the attributes.

5 To add or modify a zone, tap **Add** and **Add Zone**.

Select the safe zone and modify the attributes. See *Modify a safe zone on page 37*.

6 To add or modify a global setting, tap **Add** and select which supervision to modify.

7 When the configuration is done, select **Write to controller**.

The safety report is presented on the screen.

> **Note**
>
> A SafeMove configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

8 Save the safety report. Take a print out and sign this safety report.

The safety report and how to validate is described in detail in *Application manual - Functional safety and SafeMove*.

9 Tap **Apply to controller**.

The **Saved** dialogue is displayed

10 Tap **Restart Controller**.

The controller is restarted and loads the newly saved safety configuration.

Continues on next page

Modify a safe zone

Use the following procedure to modify a safe zone.

1. Add a new safe zone or select an existing safe zone.
2. Tap **Safe Zones** to open the attributes.
3. Add, modify, or remove vertices as needed to create the desired shape of the safe zone.

   The green dot in the 3D visualization shows where the new vertex is located. Use the arrows to change the position (index).

   Tap the grey **Add** button to place the vertex.
4. To add a supervision to a safe zone, tap to select the safe zone in the 3D view, then tap **Add**.
5. Select a supervision function or guide.
6. For supervision functions, select stop category, signal, and any other available setting applicable for the function.

Tip

The functionality is described in detail in *Application manual - Functional safety and SafeMove*.

Modify the Standstill Supervision settings

The Standstill Supervision functionality is not active by default. It can be added, modified, and deactivated.

Modify the global supervision settings

The global supervision functions are not connected to a specific safe zone or safe range. They can be added, modified, and deactivated.

Modify the Cyclic Brake Check settings

The Cyclic Brake Check functionality is active by default. It can be modified and deactivated.

Viewing the configuration report

The configuration report is available both on the FlexPendant and on the controller. It can be viewed from the **Context** menu.

Loading and exporting a safety configuration

An existing safety configuration on the FlexPendant can be exported from the **Context** menu, **Save Configuration To File**. It is also possible to load a safety configuration from a file.

Validate the safety configuration

DANGER

A SafeMove configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

Continues on next page

3.4.1 The SafeMove configurator app on FlexPendant
Continued

Each new or modified safety configuration must be validated before running in production. The validation should verify that the following is configured correctly:

- All I/O settings and signals used for safety interlocking including connected functionality
- All Stop configuration functions
- All safety zones with connected supervision functions and signals used for safety interlocking
- All global supervision functions
- All tools with corresponding supervision functions

Note

Depending on the combination of functions, the validation procedures have to be modified for the specific configuration.

A more detailed description of validation of the safety configuration is found in *Application manual - Functional safety and SafeMove*.

After safety configuration is validated, it must be set to validated and locked in the system.

Preparations before validation

Do the following checks before you start the validation procedure:

1. Carry out the synchronization procedure.
2. If configured, run the service routine for the function Cyclic Break Check.
3. Turn off the *SafeMove Assistant* functionality, with the system parameter *Disable SafeMove Assistant*.
4. Turn off collision detection during validation of any tool force supervision
5. Start the validation procedure.

   If using protected groups in the safety configuration, only the modified parts must be validated.

ABB Safety Configuration Report

The validation of each function should be documented in the safety report by signature of the validator.

The safety configuration report lists all parameters that are set for the installation. The report also includes a visual representation of the installation, a floor plan. This shows the robot and safety zones as seen from above.

The configuration report includes the checksum (multiple checksums if using protected groups in the safety configuration). The checksum can also be read using the RAPID function `SafetyControllerGetChecksum` or `SafetyControllerGetGroupChecksum`.

Continues on next page

Setting the configuration to validated

When the safety technician has validated the configuration and signed the safety report, the status of the configuration shall be changed to **Validated** on the FlexPendant.

1. Log in as a user with the grant **Safety Services**.
2. In the **Settings** app, select the **Safety Controller**, and then **Configuration**.
3. Select the checkbox **Validated**.

Setting the configuration to locked

When the responsible safety user has approved the validation of the configuration, the status of the configuration should be changed to **Locked** on the FlexPendant.

Running the robot in auto mode with the configuration unlocked will result in a warning message.

1. Log in as a user with the grant **Lock Safety Controller Configuration**.
2. In the **Settings** app, select the **Safety Controller**, and then **Configuration**.
3. Select the checkbox **Locked**.

Concluding steps

After the validation is concluded, turn on the the *SafeMove Assistant* functionality, with the system parameter *Disable SafeMove Assistant*.

3.4.2 Configuration of SafeMove using Visual SafeMove in RobotStudio

General

This section describes SafeMove configuration using Visual SafeMove for scenarios with PROFIsafe-based laser scanners connected and OmniCore controller acting as master.

What is Visual SafeMove

Visual SafeMove is the configuration tool for SafeMove and the functional safety options. The tool is completely integrated into the RobotStudio user interface and takes full advantage of the user interface elements such as tabs, browsers, and 3D graphics.

Visual SafeMove is enabled for robots with the safety module. It offers an intuitive way to visualize and configure safety zones. Zones can be adjusted by direct manipulation in the 3D window. Users with previous experience from SafeMove will recognize the same terminology used as before.

Visual SafeMove is used to configure safety stops. For this purpose, the SafeMove options are not required, that is, this functionality is available for all robots. More information about the configuration is available in the product manual for the robot controller.

Visual SafeMove works both with the real controller and the virtual controller. For a virtual controller, a RobotStudio station should be used, which allows zones to be generated automatically. When not running a RobotStudio station, **Online Monitor** is used to visualize the robot.

Starting Visual SafeMove

	Action
1	Start RobotStudio with a virtual controller (with or without a station) or connect a real controller. • The user account logging in the controller must be granted with the Safety Services permission. • The write access to the controller is also requested
2	In the **Controller** tab, click **Online Monitor**. (Not needed when running a RobotStudio station.)
3	In the **Controller** tab, click **Safety**, then select **Visual SafeMove**.

Configuring SafeMove

Configuring pre logic

1 On the **Visual SafeMove** tab page, click **Safe IO Configurator** in the **Configuration** group.
2 Click **Pre Logic** view in the **Safe IO Configuration** page.
3 Click **New expression** and create the following expressions.
   - ISH_Activate_SST
   - ISH_Activate_TSP
   - ISH_Delay_SST

Continues on next page

- ISH_Delay_TSP
- ISH_EnableDelay_Protecting
- ISH_EnableDelay_Warning
- ISH_Combination_Protecting
- ISH_Combination_Waning

In which, the expressions *ISH_Combination_Protecting* and *ISH_Combination_Waning* are required only when two PROFIsafe-based laser scanners are connected.

4 At the bottom of the **Safe IO Configuration** page, type the corresponding logical expression in the text box for each expression and click **Create signals**.

Expression	Logic
ISH_Activate_SST	**Valid for scenarios with 1 PROFIsafe-based laser scanner connected (robots other than CRB 15000)** ISH_Supervise_SST := ((NOT EDGE((NOT ProtectingArea1), ISH_Delayed_SST)) OR (NOT ISH_Enabler_Delay_SST))
	Valid for scenarios with 1 PROFIsafe-based laser scanner connected (CRB 15000) ISH_Supervise_SST := (Collaboration_Mode_Selector_1 OR (NOT EDGE((NOT ProtectingArea1),ISH_Delayed_SST)) OR (NOT ISH_Enabler_Delay_SST))
	Valid for scenarios with 2 PROFIsafe-based laser scanners connected (robots other than CRB 15000) ISH_Supervise_SST := ((NOT EDGE((NOT ProtectingAreaSM), ISH_Delayed_SST)) OR (NOT ISH_Enabler_Delay_SST))
	Valid for scenarios with 2 PROFIsafe-based laser scanners connected (CRB 15000) ISH_Supervise_SST := (Collaboration_Mode_Selector_1 OR (NOT EDGE((NOT ProtectingAreaSM),ISH_Delayed_SST)) OR (NOT ISH_Enabler_Delay_SST))
ISH_Activate_TSP	**Valid for scenarios with 1 PROFIsafe-based laser scanner connected** ISH_Supervise_TSP := ((NOT EDGE((NOT WarningArea1),ISH_Delayed_TSP)) OR (NOT ISH_Enabler_Delay_TSP))
	Valid for scenarios with 2 PROFIsafe-based laser scanners connected ISH_Supervise_TSP := ((NOT EDGE((NOT WarningAreaSM),ISH_Delayed_TSP)) OR (NOT ISH_Enabler_Delay_TSP))

Continues on next page

3.4.2 Configuration of SafeMove using Visual SafeMove in RobotStudio
Continued

Expression	Logic
ISH_Delay_SST	**Valid for scenarios with 1 PROFIsafe-based laser scanner connected** DELAY(ISH_Enabler_Delay_SST,ProtectingArea1,(ISH_AtUser_Period_ms_Until_SST / ISH_SMctrl_Frequency),ISH_CountDelay_SST,ISH_Delayed_SST)
	Valid for scenarios with 2 PROFIsafe-based laser scanners connected DELAY(ISH_Enabler_Delay_SST,ProtectingAreaSM,(ISH_AtUser_Period_ms_Until_SST / ISH_SMctrl_Frequency),ISH_CountDelay_SST,ISH_Delayed_SST)
ISH_Delay_TSP	**Valid for scenarios with 1 PROFIsafe-based laser scanner connected** DELAY(ISH_Enabler_Delay_TSP,WarningArea1,(ISH_AtUser_Period_ms_Until_TSP / ISH_SMctrl_Frequency),ISH_CountDelay_TSP,ISH_Delayed_TSP)
	Valid for scenarios with 2 PROFIsafe-based laser scanners connected DELAY(ISH_Enabler_Delay_TSP,WarningAreaSM,(ISH_AtUser_Period_ms_Until_TSP / ISH_SMctrl_Frequency),ISH_CountDelay_TSP,ISH_Delayed_TSP)
ISH_EnableDelay_Protecting [i]	ISH_Enabler_Delay_SST := (NOT ISH_UserMODE_bNot_IntermitCollab)
ISH_EnableDelay_Warning [i]	ISH_Enabler_Delay_TSP := ((NOT ISH_UserMODE_bNot_Cooperation) OR (NOT ISH_UserMODE_bNot_IntermitCollab))
ISH_Combination_Protecting [ii]	ProtectingAreaSM := (ProtectingArea1 AND ProtectingArea2)
ISH_Combination_Waning [ii]	WarningAreaSM := (WarningArea1 AND WarningArea2)

i Required no matter one or two PROFIsafe-based laser scanners are connected.
ii Required only when two PROFIsafe-based laser scanners are connected.

5 Click **Signals** view in the **Safe IO Configuration** page and then click **Global signals** to expand the signal list.

6 Click on the **Create new signal** row and create the following signals.

- ISH_TFO_Active
- ISH_TSP_Active
- ISH_TSP_Viol
- ISH_SST_Active
- ISH_SST_Viol
- Collaborative_Mode_Selector_1

Note

Signal *Collaborative_Mode_Selector_1* is required only for CRB 15000.

Continues on next page

7 Change the default value of following signals.

Signal	Default value
ISH_AtUser_Period_ms_Until_SST	650
ISH_AtUser_Period_ms_Until_TSP	550
ISH_SMctrl_Frequency	4
ISH_UserMODE_bNot_Cooperation	1

Creating encapsulation (for robots other than CRB 15000)

1 In the **Visual SafeMove** browser on the left pane of the window, select the robot (ROB_1) and click **Capsule** in the **Visual SafeMove** ribbon tab.

2 Set capsule properties for the robot.

Parameter		Value
Radius (mm)		150
Length (mm)		650
Start (Flange coordinates) (mm)	X value	0
	Y value	0
	Z value	0
End (Flange coordinates) (mm)	X value	650
	Y value	0
	Z value	0

3 In the **Visual SafeMove** browser, select the tool and click **Capsule** in the **Visual SafeMove** ribbon tab.

4 Set capsule properties for the tool.

Parameter		Value
Radius (mm)		150
Length (mm)		300
Start (Flange coordinates) (mm)	X value	0
	Y value	0
	Z value	0
End (Flange coordinates) (mm)	X value	0
	Y value	300
	Z value	300

Creating encapsulation (for CRB 15000)

1 In the **Visual SafeMove** browser on the left pane of the window, select the robot (ROB_1) and click **Capsule** in the **Visual SafeMove** ribbon tab to create two capsule geometries for the robot.

Continues on next page

2 Set capsule properties for the robot.

Parameter		Value	
		Capsule 1	Capsule 2
Radius (mm)		160.000	140.000
Length (mm)		228.859	141.421
Start (Flange coordinates) (mm)	X value	-30.356	380.000
	Y value	-22.120	30.000
	Z value	30.485	150.000
End (Flange coordinates) (mm)	X value	186.565	520.000
	Y value	0	10.000
	Z value	100.000	150.000

3 In the **Visual SafeMove** browser, select the tool and click **Capsule** in the **Visual SafeMove** ribbon tab.

4 Set capsule properties for the tool.

Parameter		Value
Radius (mm)		75
Length (mm)		250
Start (Flange coordinates) (mm)	X value	0
	Y value	0
	Z value	0
End (Flange coordinates) (mm)	X value	0
	Y value	250
	Z value	250

Configuring Cyclic Brake Check

1 In the **Visual SafeMove** ribbon tab, click **Cyclic Brake Check**.

2 Select the **Warning only, no stop** check box, enable CBC for all the joints, and set other cyclic brake check properties.

Parameter	Value
Max CRC test interval (h)	48
Pre warning time (h)	6
Standstill tolerance	2
Supervision threshold	0.02

Configuring the supervision functions (for robots other than CRB 15000)

1 In the **Visual SafeMove** ribbon tab, choose **Create Safe Zone** from the **Safe Zone** list.

Continues on next page

2 Set zone properties.

Parameter		Value
Tool Speed Supervision Priority		BASE
Reference		Task frame
Botton, Top (mm)	Bottom value	0.000
	Top value	2100.000
Vertices X, Y (mm)	X and Y values for vertices 1	-1400, -1400
	X and Y values for vertices 2	1400, -1400
	X and Y values for vertices 3	1400, 1400
	X and Y values for vertices 4	-1400, 1400

3 Click **Tool Position Supervision** in the **Modify** ribbon tab and set the properties.

Parameter		Value
Activation		PermanentlyActive
Function active status		No signal
Violation action	Stop category	Category1Stop
	Signal	No signal
Settings		Checked the **Include upper arm geometry** and **Allow inside** check boxes.

4 In the **Visual SafeMove** browser, right-click **Tool Speed Supervisions** and choose **Create Global Tool Speed Supervision**.

Parameter		Value
Activation		ISH_Supervise_TSP
Function active status		ISH_TSP_Active
Violation action	Stop category	Category1Stop
	Signal	ISH_TSP_Viol
Settings	Max speed (mm/s)	250.000
	Min speed (mm/s)	Leave blank

5 In the **Visual SafeMove** browser, right-click **Stand Still Supervisions** and choose **Create Global Stand Still Supervision**.

Parameter		Value
Activation		ISH_Supervise_SST
Function active status		ISH_SST_Active
Violation action	Stop category	Category0Stop
	Signal	ISH_SST_Viol
Tolerances		Enabled for all joints and remain default tolerance values.

Continues on next page

3.4.2 Configuration of SafeMove using Visual SafeMove in RobotStudio
Continued

Configuring the supervision functions (for CRB 15000)

1 In the **Visual SafeMove** ribbon tab, choose **Create Safe Zone** from the **Safe Zone** list.
2 Create three zones and rename as follows:
   - Transient_Contact_Zone
   - Quasi_Static_Contact_Zone_1
   - Quasi_Static_Contact_Zone_2
3 Set zone properties.

> **Note**
>
> All the parameter values provided in this section are for reference only. The values shall be modified according to actual requirements and based on risk assessment of the final application.

Parameter		Value[i]		
		Transient_Contact_Zone	Quasi_Static_Contact_Zone_1	Quasi_Static_Contact_Zone_2
Tool Speed Supervision Priority		BASE	BASE	BASE
Reference		Task frame	Task frame	Task frame
Botton, Top (mm)	Bottom value	50.000	-100.000	0.000
	Top value	2000.000	50.000	350.000
Vertices X, Y (mm)	X and Y values for vertices 1	-1500, -1500	-1600, -1600	-100, -200
	X and Y values for vertices 2	1500, -1500	1600, -1600	100, -200
	X and Y values for vertices 3	1500, 1500	1600, 1600	100, 150
	X and Y values for vertices 4	-1500, 1500	-1600, 1600	-100, 150

i Values for safe zone dimension are for reference only. It is allowed to customize the safe zone scope according to actual requirements. All the changes should be based on risk assessment of the final application.

4 Right click the three zones respectively in the left navigation tree and choose **Tool Speed Supervision**. Set following parameters.

Parameter		Value		
		Transient_Contact_Zone	Quasi_Static_Contact_Zone_1	Quasi_Static_Contact_Zone_2
Violation action	Stop category	Category1Stop	Category1Stop	Category1Stop
Speed limits	Max speed (mm/s)	434.000	20.000	20.000

Continues on next page

5 Right click the Quasi_Static_Contact_Zone_1 and Quasi_Static_Contact_Zone_2 zones respectively in the left navigation tree and choose **Tool Force Supervision**. Set following parameters.

Parameter		Value
Violation action	Stop category	Category1Stop
Force limits	Max force (N)	70.000

6 Click **Tool Position Supervision** in the **Modify** ribbon tab and set the properties.

Parameter		Value
Activation		PermanentlyActive
Function active status		No signal
Violation action	Stop category	Category1Stop
	Signal	No signal
Settings		Checked the **Include upper arm geometry** and **Allow inside** check boxes.

7 In the **Visual SafeMove** browser, right-click **Tool Speed Supervisions** and choose **Create Global Tool Speed Supervision**.

Parameter		Value
Activation		ISH_Supervise_TSP
Function active status		ISH_TSP_Active
Violation action	Stop category	Category1Stop
	Signal	ISH_TSP_Viol
Settings	Max speed (mm/s)	250.000
	Min speed (mm/s)	Leave blank

8 In the **Visual SafeMove** browser, right-click **Stand Still Supervisions** and choose **Create Global Stand Still Supervision**.

Parameter		Value
Activation		ISH_Supervise_SST
Function active status		ISH_SST_Active
Violation action	Stop category	Category0Stop
	Signal	ISH_SST_Viol
Tolerances		Enabled for all joints and remain default tolerance values.

Uploading the settings to the controller

1 In the **Visual SafeMove** ribbon tab, click **Controller** in the **Configuration** group.

2 Click **Write to controller**.

The configurations are uploaded to the controller after the controller restarts.

3.5 Speed control

General

Speed control configurations depend on the type and number of scanners connecting to the robot and RobotWare version. Refer to the following table for applicable scenario and proceed to specific section for configuration details.

Scanner type	Works with...			Number of connected scanners	RobotWare version	Refer to...
	PLC	Scalable I/O deviceDSQC1042	OmniCore controller with SafeMove			
PROFIsafe-based	Y	N	Y	1	RobotWare 7.6 or later	*Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master) on page 50*
	Y	N	Y	2	RobotWare 7.6 or later	*Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master) on page 56*
	N	N	Y	1	RobotWare 7.10 or later	*Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master) on page 62*
	N	N	Y	2	RobotWare 7.10 or later	*Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master) on page 67*
SafetyIO-based	N	Y	Y	1	RobotWare 7.6 or later	*Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later) on page 72*
	N	Y	Y	2	RobotWare 7.6 or later	*Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later) on page 78*

The following table lists the required actions for specific scenarios such as RobotWare upgrade or rollback.

Scenario	Actions
RobotWare 7.5 or an earlier version upgraded to RobotWare 7.6 or a later version	**Note** Applicable only when using PROFIsafe-based laser scanners 1 Install the Collaborative Speed Control add-in. See *Installation of the Collaborative Speed Control add-in on page 11*. 2 Reconfigure the PLC and laser scanner. See *Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master) on page 50*.

Continues on next page

Scenario	Actions
Adding a new laser scanner	1 Connect the new laser scanner in the same type as the one existing in the system. See *Connecting the laser scanner(s) on page 18*. 2 Configure the new laser scanner. See *Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master) on page 56* or *Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later) on page 78*.
PROFIsafe-based laser scanner(s) changed to SafetyIO-based laser scanner(s)	**Note** Applicable only for RobotWare 7.6 or later 1 Reset the SafeMove configurations to factory settings by choosing **Controller** > **Reset to factory settings** in the **Visual SafeMove** ribbon tab in RobotStudio. 2 Update the system using the **Modify Installation** function. a. Unselect the installed profisafe package option(s) and select the required IO package option(s). b. Make sure option *3020-2 PROFINET Device* and option *3023-2 PROFIsafe Device* under **PROFINET** group are selected in the **System Option** tab page. 3 Configure the new laser scanner. See *Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later) on page 72* or *Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later) on page 78*.
Connection via a PLC changed to direct connection with the OmniCore Controller	**Note** Applicable only when using PROFIsafe-based laser scanners 1 Upgrade the robot system to RobotWare 7.10 or later, and install the options [3020-1] PROFINET Controller and [3023-1] PROFIsafe Controller to the system. 2 Reconfigure the laser scanner. See *Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master) on page 62* or *Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master) on page 67*.

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3.5.1 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master)

Preparing the robot system

Required options for system setup

When setting up the system using the **Modify Installation** function in RobotStudio, select the options *[3020-2] PROFINET Device*, *[3023-2] PROFIsafe Device*, *[3043-3] SafeMove Collaborative* and *[3051-1] Profisafe Package*, and the correct robot variant. The option *Drive System IRB Small Robot* is selected automatically after the robot type is determined.

Supported parameters for connections to scanner and PLC

Both the laser scanner and the PLC uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded when the Collaborative Speed Control add-in is installed. The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

The following list shows the configuration parameters. They need to be correctly configured in the software tools to enable communication between the scanner, PLC, and OmniCore system.

- After the robot system is set up, the default IP address of the LAN port is automatically configured as 172.16.0.2. Make sure the scanners and PLC are also configured in the 172.16.0.XXX segment.

  Note

  If it is the WAN port connected, the IP address is 192.168.10.10/24. Make sure the scanner and PLC are also configured in the 192.168.10.XXX segment.

- In RobotStudio, open the configuration editor: Controller > Configuration > I/O Engineering Tool, and get the:

  - PROFIsafe parameter values

Device slot	Parameter	Value
SDI	Source address	4
SDI	Destination address	5

  - device mapping information

Signal name	Device mapping (default)	Category	Device	Device slot
ProtectingArea	0	ProfiSafe	OmniCore_Internal	SDI
WarningArea	1	ProfiSafe	OmniCore_Internal	SDI
SafetyCommunica-tionEnable	2	ProfiSafe	OmniCore_Internal	SDI

Continues on next page

3.5.1 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master)
Continued

- The PROFINET device name of the controller must be set to *omnicoreprofisafe*.

GSD file

The GSD file, *GSDML-V2.xx-ABB-Robotics-OmniCore-YYYYMMDD.xml*, can be obtained from the RobotStudio or the OmniCore controller.

- **In the RobotWare installation folder in RobotStudio**: *...\DistributionPackages\ABB.RobotWare-x.x.x-xxx\RobotPackages\RobotControl_x.x.xxx\utility\service\GSDML*
- **On the OmniCore Controller**: *...\products\RobotControl_x.x.x\utility\service\GSDML*

Configuring the laser scanner

Working modes

The Collaborative Speed Control add-in supports the laser scanner to work in two modes, intermittent collaboration mode and cooperation mode.

The speed control strategy applied to the robot depends on the working mode and protection fields defined for the laser scanner. In intermittent collaboration mode, two protection fields, warning area and protecting area, need to be defined. Within the warning area, the robot slows down to the defined reduced speed; and the within protecting area, the robot will stand still. In cooperation mode, one protection field is required and the robot works cooperatively by slowing down the robot to the defined reduced speed.

The cooperation mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

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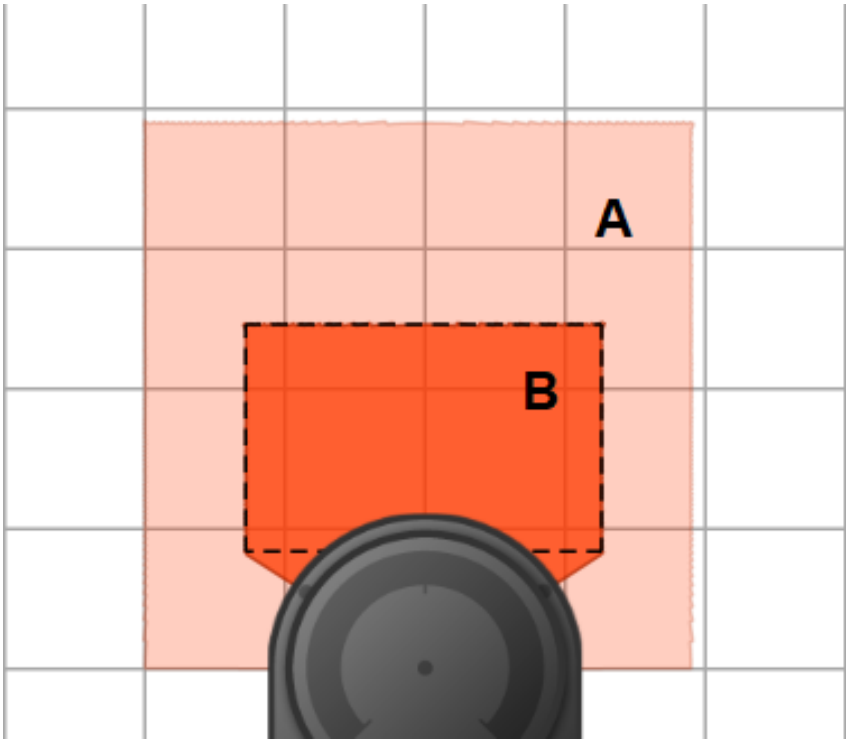
3.5.1 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master)
Continued

Protection fields

In intermittent collaboration mode, two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



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	Field	Device mapping (default)	Lamp color[i]	Description
A	WarningArea	1	Yellow	The warning area field defines the largest range, but it shall be within the scanning range of the scanner. Within in this field range, • The lamp lights up yellow for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed reduces to a lower speed that is set by the user.
B	ProtectingArea	0	Red	Within this field range, • The lamp turns to red for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed is reduced to 0. The robot stands still.

i Valid only for robots with a lamp unit configured to be controlled by the Collaborative Speed Control add-in.
For CRB 15000, the light ring will not change colors to show the status.

In cooperation mode, only one protection field needs to be defined. Within this field range, the speed control strategy is the same as that in the warning area under

Continues on next page

3.5.1 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master)

Continued

intermittent collaboration mode. That is, the robot movement speed remains the low speed that is set by the user.

Configuration procedure

> **Note**
>
> You can use both the common software tool *Safety Designer®* or the dedicated easy configuration tool *mS3 Configuration Tool - ABB* from SICK to configure the laser scanners. The following procedure describes how to configure the laser scanner using the tool *Safety Designer®*. For details about how to use *mS3 Configuration Tool - ABB*, you can scan the QR code available in the laser scanner package to download the tool and its instruction manual "*mS3 Configuration Tool - ABB*".

Before starting the configuration, obtain the *microScan 3 Core - PROFINET GSDML* file and the software tool *Safety Designer®* from SICK's website first. Make sure both the file and the software tool are in the latest versions.

Detailed procedures about how to configure the laser scanner are detailed in *SICK microScan3 Siemens PLC integration instruction manual - TIA Portal* and *SICK microScan3 Siemens PLC integration instruction manual - SIMATIC Step 7*. Following described roughly:

1. Connect the laser scanner to the PLC and controller.

   See the physical connection in *Connecting the laser scanner(s) on page 18*.
2. Open configuration software tool *Safety Designer®*.
3. Set IP address and PROFINET name in **Configuration** > **Addressing**.
   - The scanner IP address must be in the same network segment with the PLC and controller, that is, 172.16.0.XXX.
   - The PROFINET name must be the same in the PLC configuration.
4. Set **F-destination address** to **12** in **PROFINET** area in **Configuration** > **Protocol Settings**.
5. Define the two protection fields in **Configuration** > **Fields**.
6. Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.

   The **Use one input source** checkbox must be selected and choose **Rx: Process image (12 Bytes)** from the drop-down list.
7. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.

Configuring the PLC

The safety PLC connecting to the laser scanner and controller must support PROFIsafe and can act as a master. Before configuration, make sure the PLC is loaded with the GSD files of the controller and laser scanner.

Continues on next page

3.5.1 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master)
Continued

Detailed procedures about how to add an external device to the PLC and how to configure detailed settings, see the user manual from the vendor. Following lists the necessary settings during PLC configuration:

- Add the scanner to the PLC by adding a **mS3 12Byte In/Out PROFIsafe V2.6.1** module.

  The parameters f_dest_address and f_source_address are set to 12 and 1, respectively.
- Add the controller to the PLC by adding the **DI 8 bytes**, **DO 8 bytes**, **SDI 8 bytes** and **SDO 8 bytes** modules.

  The parameters f_dest_address and f_source_address for the SDI are set to 3 and 2, respectively, and for the SDO are set to 5 and 4, respectively.
- Make sure the address for the SDO signal is the first address of **SDO 8 bytes** slot.
- Create variables.

Name	Type	Example address[i]
ProtectingTrigger	Bool	%I3.0
WarningTrigger	Bool	%I3.1
ProtectingArea	Bool	%Q68.0
WarningArea	Bool	%Q68.1
SafetyCommunicationEnable	Bool	%Q68.2
ActivateScanner	Bool	%Q3.0

[i] %I3.*X* is the address of the laser scanner; %Q68.*X* is the address of the OmniCore controller. %Q3.0 is for activating the monitoring cases of the laser scanner.

- Check the communication between the PLC and controller is well and activate the laser scanner; set up the communication between the laser scanner, PLC and OmniCore controller.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1. Log in the FlexPendant.

   Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.
2. Tap **SafeMove** on the home page.
3. Tap **Load** in the pop-up message box to confirm loading of template SafeMove configuration files.

   The controller restarts.

   Tip

   If there is no message box popped up, you can also tap **Edit** and then tap **Open Template Selector** from the menu at the right corner to open it.
4. After the controller is restarted, tap **Settings** on the home page.

Continues on next page

3.5.1 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.6 or later and PLC acting as Master)
Continued

5 Tap **Safety Controller**.
6 Tap **Synchronization** in the left pane.
7 Jog the robot to match the **Actual Positions** values with the **Sync Positions** values.

   Make sure the values are the same.
8 Tap **Synchronize**.

Configuring cooperation mode

> **Note**
>
> The collaborative mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

To enable the collaborative mode, perform the following procedure:

1 Open RobotStudio and connect to the controller.
2 Open the configuration editor: **Controller** > **Configuration** > **I/O Engineering Tool**.
3 In the displayed **I/O Engineering** window, set the signal value of *Collaborative_Mode_Selector* to **1**.
4 Open Virtual SafeMove: **Controller** > **Safety** > **Virtual SafeMove**.
5 In the displayed **Visual SafeMove** window, double-click Safe I/O in the navigation tree on the left pane.
6 In the **Safe I/O Configuration** tab page, set the signal value of *Collaborative_Mode_Selector_1* to **1**.

3.5.2 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master)

Preparing the robot system

Required options for system setup

When setting up the system using the **Modify Installation** function in RobotStudio, select the options *[3020-2] PROFINET Device*, *[3023-2] PROFIsafe Device*, *[3043-3] SafeMove Collaborative* and *[3051-3] Dual Profisafe Package*, and the correct robot variant. The option *Drive System IRB Small Robot* is selected automatically after the robot type is determined.

Supported parameters for connections to scanners and PLC

Both laser scanners and the PLC uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded when the Collaborative Speed Control add-in is installed. The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

The following list shows the configuration parameters. They need to be correctly configured in the software tools to enable communication between the scanners, PLC, and OmniCore system.

- After the robot system is set up, the default IP address of the LAN port is automatically configured as 172.16.0.2. Make sure the scanners and PLC are also configured in the 172.16.0.XXX segment.

  Note

  If it is the WAN port connected, the IP address is 192.168.10.10/24. Make sure the scanner and PLC are also configured in the 192.168.10.XXX segment.

- In RobotStudio, open the configuration editor: Controller > Configuration > I/O Engineering Tool, and get the:

  - PROFIsafe parameter values

Device slot	Parameter	Value
SDI	Source address	4
SDI	Destination address	5

  - device mapping information

Signal name	Device mapping (default)	Category	Device	Device slot
ProtectingArea	0	ProfiSafe	OmniCore_Internal	SDI
WarningArea	1	ProfiSafe	OmniCore_Internal	SDI
SafetyCommunica-tionEnable	2	ProfiSafe	OmniCore_Internal	SDI

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3.5.2 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master)
Continued

- The PROFINET device name of the controller must be set to *omnicoreprofisafe*.

GSD file

The GSD file, *GSDML-V2.xx-ABB-Robotics-OmniCore-YYYYMMDD.xml*, can be obtained from the RobotStudio or the OmniCore controller.

- **In the RobotWare installation folder in RobotStudio**: *...\DistributionPackages\ABB.RobotWare-x.x.x-xxx\RobotPackages\RobotControl_x.x.xxx\utility\service\GSDML*
- **On the OmniCore Controller**: *...\products\RobotControl_x.x.x\utility\service\GSDML*

Configuring the laser scanner

Working modes

The Collaborative Speed Control add-in supports the laser scanner to work in two modes, intermittent collaboration mode and cooperation mode.

The speed control strategy applied to the robot depends on the working mode and protection fields defined for the laser scanner. In intermittent collaboration mode, two protection fields, warning area and protecting area, need to be defined. Within the warning area, the robot slows down to the defined reduced speed; and the within protecting area, the robot will stand still. In cooperation mode, one protection field is required and the robot works cooperatively by slowing down the robot to the defined reduced speed.

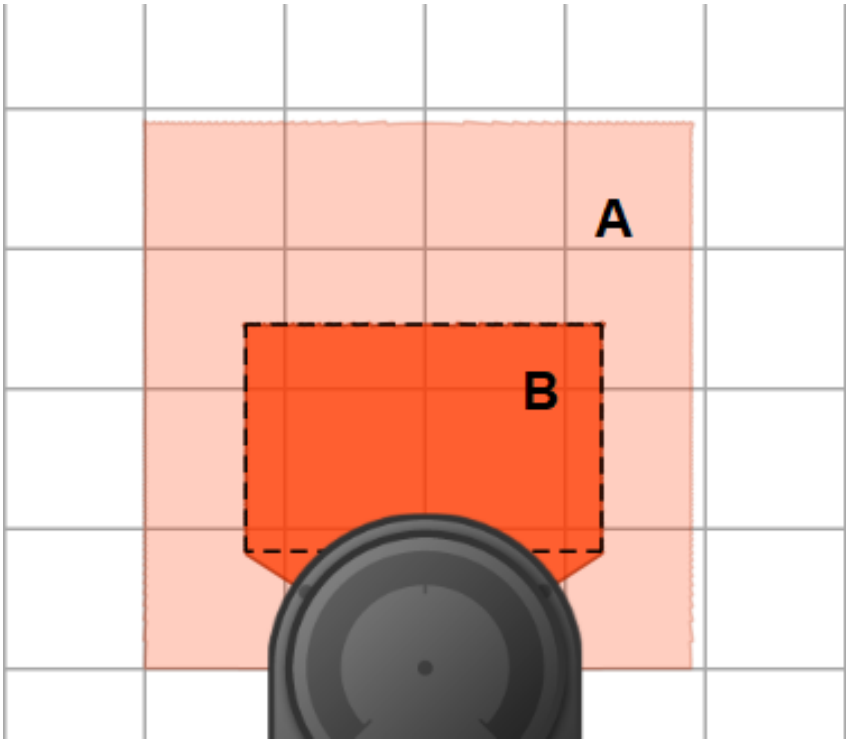
The cooperation mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

Continues on next page

3.5.2 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master)
Continued

Protection fields

In intermittent collaboration mode, two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



xx2200000301

	Field	Device mapping (default)	Lamp color[i]	Description
A	WarningArea	1	Yellow	The warning area field defines the largest range, but it shall be within the scanning range of the scanner. Within in this field range, • The lamp lights up yellow for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed reduces to a lower speed that is set by the user.
B	ProtectingArea	0	Red	Within this field range, • The lamp turns to red for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed is reduced to 0. The robot stands still.

i Valid only for robots with a lamp unit configured to be controlled by the Collaborative Speed Control add-in.
For CRB 15000, the light ring will not change colors to show the status.

In cooperation mode, only one protection field needs to be defined. Within this field range, the speed control strategy is the same as that in the warning area under

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3.5.2 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master)
Continued

intermittent collaboration mode. That is, the robot movement speed remains the low speed that is set by the user.

Configuration procedure

> **Note**
>
> You can use both the common software tool *Safety Designer®* or the dedicated easy configuration tool *mS3 Configuration Tool - ABB* from SICK to configure the laser scanners. The following procedure describes how to configure the laser scanner using the tool *Safety Designer®*. For details about how to use *mS3 Configuration Tool - ABB*, you can scan the QR code available in the laser scanner package to download the tool and its instruction manual "*mS3 Configuration Tool - ABB*".

Before starting the configuration, obtain the *microScan 3 Core - PROFINET GSDML* file and the software tool *Safety Designer®* from SICK's website first. Make sure both the file and the software tool are in the latest versions.

Detailed procedures about how to configure the laser scanners are detailed in *SICK microScan3 Siemens PLC integration instruction manual - TIA Portal* and *SICK microScan3 Siemens PLC integration instruction manual - SIMATIC Step 7*. Following described roughly:

1. Connect the laser scanners to the PLC and controller.

   See the physical connection in *Connecting the laser scanner(s) on page 18*.
2. Open configuration software tool *Safety Designer®*.
3. Set IP address, F-destination and PROFINET name in **Configuration** > **Addressing**.
   - The scanner IP address must be in the same network segment with the PLC and controller, that is, 172.16.0.XXX.
   - The PROFINET name must be the same in the PLC configuration.
   - The two scanners must be set to different IP address, F-destination and PROFINET name.
4. Set **F-destination address** to **12** for the first scanner and to **13** for the second scanner, in **PROFINET** area in **Configuration** > **Protocol Settings**.
5. Define the two protection fields for each scanners in **Configuration** > **Fields**.
6. Define the source for input signals of each scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.

   The **Use one input source** checkbox must be selected and choose **Rx: Process image (12 Bytes)** from the drop-down list.
7. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.

Configuring the PLC

The safety PLC connecting to the laser scanners and controller must support PROFIsafe and can act as a master. Before configuration, make sure the PLC is loaded with the GSD files of the controller and laser scanners.

Continues on next page

3.5.2 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master)
Continued

Detailed procedures about how to add an external device to the PLC and how to configure detailed settings, see the user manual from the vendor. Following lists the necessary settings during PLC configuration:

- Add two scanners to the PLC by adding two **mS3 12Byte In/Out PROFIsafe V2.6.1** modules.

  - The parameters f_dest_address and f_source_address are set to 12 and 1, for the first scanner, respectively.

  - The parameters f_dest_address and f_source_address are set to 13 and 1, for the second scanner, respectively.
- Add the controller to the PLC by adding the **DI 8 bytes**, **DO 8 bytes**, **SDI 8 bytes** and **SDO 8 bytes** modules.

  The parameters f_dest_address and f_source_address for the SDI are set to 3 and 2, respectively, and for the SDO are set to 5 and 4, respectively.
- Make sure the address for the SDO signal is the first address of **SDO 8 bytes** slot.
- Create variables.

Name	Type	Example address[i]
ProtectingTrigger	Bool	%I3.0
WarningTrigger	Bool	%I3.1
ProtectingTrigger1	Bool	%I14.0
WarningTrigger1	Bool	%I14.1
ProtectingArea[ii]	Bool	%Q68.0
WarningArea[iii]	Bool	%Q68.1
SafetyCommunicationEnable	Bool	%Q68.2
ActivateScanner	Bool	%Q3.0
ActivateScanner1	Bool	%Q14.0

i %I3.*X* and %I4.*X* are the addresses of laser scanners; %Q68.*X* is the address of the OmniCore controller.
%Q3.0 and %Q14.0 are for activating the monitoring cases of the laser scanners.
ii Value of ProtectingArea depends on logic AND value of ProtectingTrigger and ProtectingTrigger1.
iii Value of WarningArea depends on logic AND value of WarningTrigger and WarningTrigger1.

- Check the communication between the PLC and controller is well and activate the laser scanner; set up the communication between the laser scanner, PLC and OmniCore controller.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1 Log in the FlexPendant.

  Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.

2 Tap **SafeMove** on the home page.

3 Tap **Load** in the pop-up message box to confirm loading of template SafeMove configuration files.

Continues on next page

3.5.2 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.6 or later and PLC acting as Master)
Continued

The controller restarts.

> **Tip**
>
> If there is no message box popped up, you can also tap **Edit** and then tap **Open Template Selector** from the menu at the right corner to open it.

4 After the controller is restarted, tap **Settings** on the home page.
5 Tap **Safety Controller**.
6 Tap **Synchronization** in the left pane.
7 Jog the robot to match the **Actual Positions** values with the **Sync Positions** values.

   Make sure the values are the same.
8 Tap **Synchronize**.

Configuring cooperation mode

> **Note**
>
> The collaborative mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

To enable the collaborative mode, perform the following procedure:

1 Open RobotStudio and connect to the controller.
2 Open the configuration editor: **Controller** > **Configuration** > **I/O Engineering Tool**.
3 In the displayed **I/O Engineering** window, set the signal value of *Collaborative_Mode_Selector* to **1**.
4 Open Virtual SafeMove: **Controller** > **Safety** > **Virtual SafeMove**.
5 In the displayed **Visual SafeMove** window, double-click Safe I/O in the navigation tree on the left pane.
6 In the **Safe I/O Configuration** tab page, set the signal value of *Collaborative_Mode_Selector_1* to **1**.

3.5.3 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master)

Preparing the robot system

Required options for system setup

When setting up the system using the **Modify Installation** function in RobotStudio, select the options *[3020-1] PROFINET Controller*, *[3023-1] PROFIsafe Controller*, *[3043-3] SafeMove Collaborative* and *[3051-1] Profisafe Package*, and the correct robot variant. The option *Drive System IRB Small Robot* is selected automatically after the robot type is determined.

Configuring supported parameters of the robot system

The laser scanner needs to use a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are configure using I/O Engineering Tool in RobotStudio. Use the following procedure to perform the configuration:

1. Start RobotStudio and connect the controller.
   - The user account logging in the controller must be granted with the Safety Services permission.
   - The write access to the controller is requested.
2. In the **Controller** tab, click **I/O Engineering**.

   The **I/O Engineering** window is displayed.
3. In the **Configuration** tab page on the left pane of the window, right-click **PROFINET** under **I/O system** and select **Scan Network**.

   The connected laser scanner is displayed.
4. Right-click on the laser scanner and choose **Add as**.

   The laser scanner is added under **Controller** in the **Configuration** tab page.

   Note

   Two device names are displayed in the list by default.
5. Click the laser scanner with the asterisk(*) mark, and then in the **Device Catalog** tab page on the right pane of the window, double-click **mS3 12Byte In/Out PROFIsafe V2.6.1**.
6. In the displayed **Signal Editor** tab page, add signals with following settings.

Name	Type of Signal	Device Mapping[i]	Default value
ActiveDevice1	Digital Output	*8*	1
ProtectingArea1	Digital Input	*8*	0
WarningArea1	Digital Input	*9*	0

[i] The mappings are only for examples. Refer to the cut-off setting defined in the *Safety Designer* software and enter the actual value.

A new device name *mS3 12Byte In/Out PROFIsafe V2.6.1* is displayed under the scanner in the **Configuration** tab page.

Continues on next page

3.5.3 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master)
Continued

7 Click the new device name and check the settings in the **Properties** tab page on the right pane of the window.

   Make sure the Destination value is the same as the F-Destination address value for the scanner in the *Safety Designer* software.

8 In the **I/O Engineering** tab, click **Cross Connections** in the **Configuration** group, and check the created signals.

   Make sure the created signals are in the same name as the displayed signals.

9 In the **I/O Engineering** tab, click **Write Config** to write the configurations to the controller.

10 Restart the controller.

11 After the controller is restarted, check the laser scanner name in the RAPID program InternalSpeedHandling_User in task T_ROB1, and make sure it is consistent with the name that the user defines for the laser scanner.

   If the names are inconsistent, use the following steps to modify:

   a In the **Controller** pane, double-click the RAPID program InternalSpeedHandling_User in task T_ROB1.

      The RAPID program is displayed in the right pane.

   b Find the parameter *Scanner1* and modify its value to the user-defined laser scanner name.

Configuring the laser scanner

Working modes

The Collaborative Speed Control add-in supports the laser scanner to work in two modes, intermittent collaboration mode and cooperation mode.

The speed control strategy applied to the robot depends on the working mode and protection fields defined for the laser scanner. In intermittent collaboration mode, two protection fields, warning area and protecting area, need to be defined. Within the warning area, the robot slows down to the defined reduced speed; and the within protecting area, the robot will stand still. In cooperation mode, one protection field is required and the robot works cooperatively by slowing down the robot to the defined reduced speed.

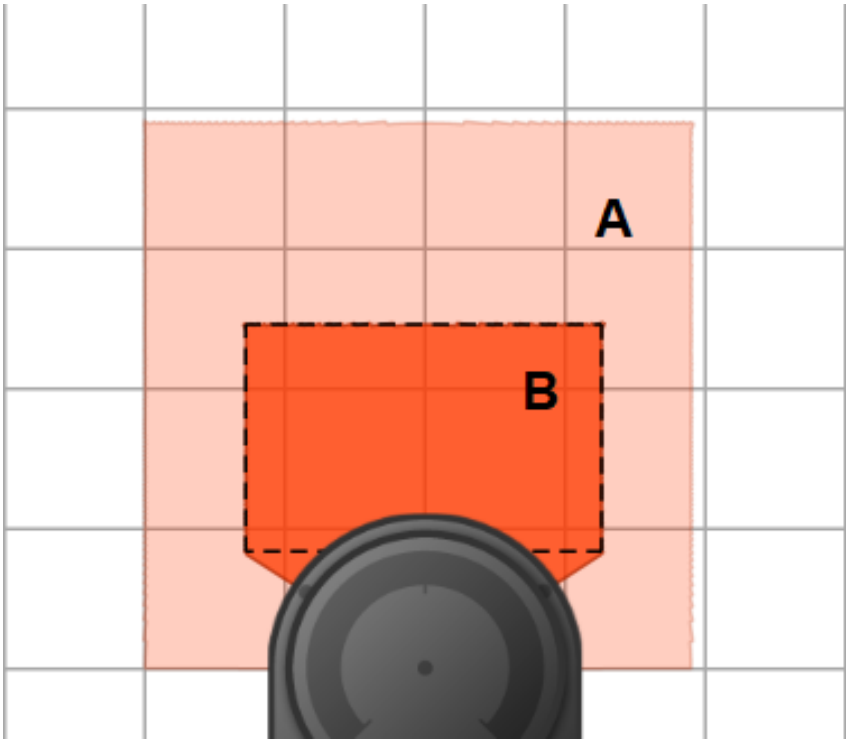
The cooperation mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

Continues on next page

3.5.3 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master)
Continued

Protection fields

In intermittent collaboration mode, two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



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	Field	Device mapping (default)	Lamp color[i]	Description
A	WarningArea	1	Yellow	The warning area field defines the largest range, but it shall be within the scanning range of the scanner. Within in this field range, • The lamp lights up yellow for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed reduces to a lower speed that is set by the user.
B	ProtectingArea	0	Red	Within this field range, • The lamp turns to red for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed is reduced to 0. The robot stands still.

i Valid only for robots with a lamp unit configured to be controlled by the Collaborative Speed Control add-in.
For CRB 15000, the light ring will not change colors to show the status.

In cooperation mode, only one protection field needs to be defined. Within this field range, the speed control strategy is the same as that in the warning area under

Continues on next page

3.5.3 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master)
Continued

intermittent collaboration mode. That is, the robot movement speed remains the low speed that is set by the user.

Configuration procedure

Note

You can use both the common software tool *Safety Designer®* or the dedicated easy configuration tool *mS3 Configuration Tool - ABB* from SICK to configure the laser scanners. The following procedure describes how to configure the laser scanner using the tool *Safety Designer®*. For details about how to use *mS3 Configuration Tool - ABB*, you can scan the QR code available in the laser scanner package to download the tool and its instruction manual "*mS3 Configuration Tool - ABB*".

Before starting the configuration, obtain the *microScan 3 Core - PROFINET GSDML* file and the software tool *Safety Designer®* from SICK's website first. Make sure both the file and the software tool are in the latest versions.

Detailed procedures about how to configure the laser scanner are detailed in *Operating instructions microScan3 - PROFINET*. Following described roughly:

1. Connect the laser scanner to the PC using a network cable.

   See the physical connection in *Connecting the laser scanner(s) on page 18*.
2. Open configuration software tool *Safety Designer®*.
3. Set IP address and PROFINET name in **Configuration** > **Addressing**.

   The scanner IP address must be in the same network segment with the controller, that is, 172.16.0.XXX.
4. Set **F-destination address** to **12** in **PROFINET** area in **Configuration** > **Protocol Settings**.
5. Define the two protection fields in **Configuration** > **Fields**.
6. Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.

   The **Use one input source** checkbox must be selected and choose **Rx: Process image (12 Bytes)** from the drop-down list.
7. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1. Start RobotStudio and connect the controller.
   - The user account logging in the controller must be granted with the Safety Services permission.
   - The write access to the controller is requested.
2. In the **Controller** tab, click **Safety**, then select **Visual SafeMove**.
3. In the **Visual SafeMove** window, configure SafeMove function as instructed in *Configuration of SafeMove using Visual SafeMove in RobotStudio on page 40*.

Continues on next page

3.5.3 Configuration of one PROFIsafe-based laser scanner (RobotWare 7.10 or later and OmniCore acting as Master)
Continued

Configuring cooperation mode

> **Note**
>
> The collaborative mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

To enable the collaborative mode, perform the following procedure:

1. Open RobotStudio and connect to the controller.
2. Open the configuration editor: **Controller** > **Configuration** > **I/O Engineering Tool**.
3. In the displayed **I/O Engineering** window, set the signal value of *Collaborative_Mode_Selector* to **1**.
4. Open Virtual SafeMove: **Controller** > **Safety** > **Virtual SafeMove**.
5. In the displayed **Visual SafeMove** window, double-click Safe I/O in the navigation tree on the left pane.
6. In the **Safe I/O Configuration** tab page, set the signal value of *Collaborative_Mode_Selector_1* to **1**.

3.5.4 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master)

Preparing the robot system

Required options for system setup

When setting up the system using the **Modify Installation** function in RobotStudio, select the options *[3020-1] PROFINET Controller*, *[3023-1] PROFIsafe Controller*, *[3043-3] SafeMove Collaborative* and *[3051-3] Dual Profisafe Package*, and the correct robot variant. The option *Drive System IRB Small Robot* is selected automatically after the robot type is determined.

Configuring supported parameters of the robot system

The laser scanners need to use a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are configure using I/O Engineering Tool in RobotStudio. Use the following procedure to perform the configuration:

1. Start RobotStudio and connect the controller.
   - The user account logging in the controller must be granted with the Safety Services permission.
   - The write access to the controller is requested.
2. In the **Controller** tab, click **I/O Engineering**.

   The **I/O Engineering** window is displayed.
3. In the **Configuration** tab page on the left pane of the window, right-click **PROFINET** under **I/O system** and select **Scan Network**.

   The connected laser scanners are displayed.
4. Right-click one of the laser scanners and choose **Add as**.

   The laser scanner is added under **Controller** in the **Configuration** tab page.

   Note

   Two device names are displayed in the list by default.
5. Click the laser scanner with the asterisk(*) mark, and then in the **Device Catalog** tab page on the right pane of the window, double-click **mS3 12Byte In/Out PROFIsafe V2.6.1**.
6. In the displayed **Signal Editor** tab page, add signals with following settings.

Name	Type of Signal	Device Mapping[i]	Default value
ActiveDevice1	Digital Output	*8*	1
ProtectingArea1	Digital Input	*8*	0
WarningArea1	Digital Input	*9*	0

[i] The mappings are only for examples. Refer to the cut-off setting defined in the *Safety Designer* software and enter the actual value.

A new device name *mS3 12Byte In/Out PROFIsafe V2.6.1* is displayed under the scanner in the **Configuration** tab page.

Continues on next page

3.5.4 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master)
Continued

7 Click the new device name and check the settings in the **Properties** tab page on the right pane of the window.

Make sure the Destination value is the same as the F-Destination address value for the scanner in the *Safety Designer* software.

8 In the **I/O Engineering** tab, click **Cross Connections** in the **Configuration** group, and check the created signals.

Make sure the created signals are in the same name as the displayed signals.

9 Repeat steps *4* to *8* to add the other laser scanner, for which the signal settings shall be as follows.

Name	Type of Signal	Device Mapping[i]	Default value
ActiveDevice2	Digital Output	*8*	1
ProtectingArea2	Digital Input	*8*	0
WarningArea2	Digital Input	*9*	0

[i] The mappings are only for examples. Refer to the cut-off setting defined in the *Safety Designer* software and enter the actual value.

10 In the **I/O Engineering** tab, click **Write Config** to write the configurations to the controller.

11 Restart the controller.

12 After the controller is restarted, check the laser scanner name in RAPID program InternalSpeedHandling_User in task T_ROB1, and make sure it is consistent with the name that the user defines for the laser scanner.

If the names are inconsistent, use the following steps to modify:

a In the **Controller** pane, double-click the RAPID program InternalSpeedHandling_User in task T_ROB1.

The RAPID program is displayed in the right pane.

b Find the parameters *Scanner1* and *Scanner2*, and modify their values to the user-defined laser scanner names.

Configuring the laser scanner

Working modes

The Collaborative Speed Control add-in supports the laser scanner to work in two modes, intermittent collaboration mode and cooperation mode.

The speed control strategy applied to the robot depends on the working mode and protection fields defined for the laser scanner. In intermittent collaboration mode, two protection fields, warning area and protecting area, need to be defined. Within the warning area, the robot slows down to the defined reduced speed; and the within protecting area, the robot will stand still. In cooperation mode, one protection field is required and the robot works cooperatively by slowing down the robot to the defined reduced speed.

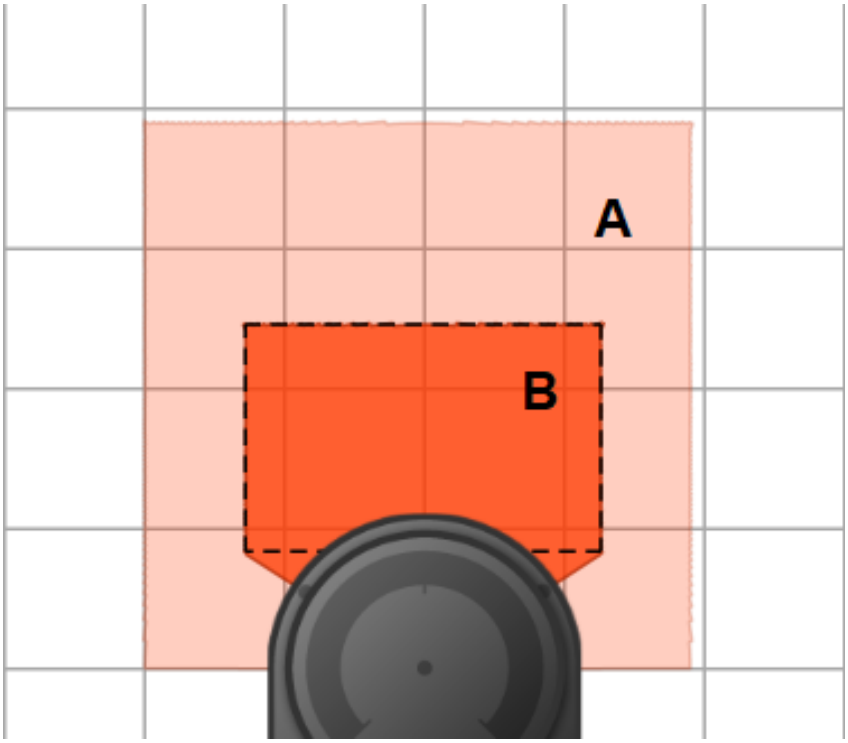
The cooperation mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

Continues on next page

3.5.4 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master)
Continued

Protection fields

In intermittent collaboration mode, two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



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	Field	Device mapping (default)	Lamp color[i]	Description
A	WarningArea	1	Yellow	The warning area field defines the largest range, but it shall be within the scanning range of the scanner. Within in this field range, • The lamp lights up yellow for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed reduces to a lower speed that is set by the user.
B	ProtectingArea	0	Red	Within this field range, • The lamp turns to red for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed is reduced to 0. The robot stands still.

i Valid only for robots with a lamp unit configured to be controlled by the Collaborative Speed Control add-in.
For CRB 15000, the light ring will not change colors to show the status.

In cooperation mode, only one protection field needs to be defined. Within this field range, the speed control strategy is the same as that in the warning area under

Continues on next page

3.5.4 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master)
Continued

intermittent collaboration mode. That is, the robot movement speed remains the low speed that is set by the user.

Configuration procedure

> **Note**
>
> You can use both the common software tool *Safety Designer®* or the dedicated easy configuration tool *mS3 Configuration Tool - ABB* from SICK to configure the laser scanners. The following procedure describes how to configure the laser scanner using the tool *Safety Designer®*. For details about how to use *mS3 Configuration Tool - ABB*, you can scan the QR code available in the laser scanner package to download the tool and its instruction manual "*mS3 Configuration Tool - ABB*".

Before starting the configuration, obtain the *microScan 3 Core - PROFINET GSDML* file and the software tool *Safety Designer®* from SICK's website first. Make sure both the file and the software tool are in the latest versions.

Detailed procedures about how to configure the laser scanner are detailed in *Operating instructions microScan3 - PROFINET* . Following described roughly:

1. Connect the laser scanner to the controller using a network cable.

   See the physical connection in *Connecting the laser scanner(s) on page 18*.
2. Open configuration software tool *Safety Designer®*.
3. Set IP address, F-destination and PROFINET name in **Configuration** > **Addressing**.
   - The scanner IP address must be in the same network segment with the controller, that is, 172.16.0.XXX.
   - The two scanners must be set to different IP address, F-destination and PROFINET name.
4. Set **F-destination address** to **12** for the first scanner and to **13** for the second scanner, in **PROFINET** area in **Configuration** > **Protocol Settings**.
5. Define the two protection fields in **Configuration** > **Fields**.
6. Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.

   The **Use one input source** checkbox must be selected and choose **Rx: Process image (12 Bytes)** from the drop-down list.
7. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1. Start RobotStudio and connect the controller.
   - The user account logging in the controller must be granted with the Safety Services permission.
   - The write access to the controller is requested.
2. In the **Controller** tab, click **Safety**, then select **Visual SafeMove**.

Continues on next page

3.5.4 Configuration of two PROFIsafe-based laser scanners (RobotWare 7.10 or later and OmniCore acting as Master)
Continued

3 In the **Visual SafeMove** window, configure SafeMove function as instructed in *Configuration of SafeMove using Visual SafeMove in RobotStudio on page 40*.

Configuring cooperation mode

> **Note**
>
> The collaborative mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

To enable the collaborative mode, perform the following procedure:

1 Open RobotStudio and connect to the controller.
2 Open the configuration editor: **Controller** > **Configuration** > **I/O Engineering Tool**.
3 In the displayed **I/O Engineering** window, set the signal value of *Collaborative_Mode_Selector* to **1**.
4 Open Virtual SafeMove: **Controller** > **Safety** > **Virtual SafeMove**.
5 In the displayed **Visual SafeMove** window, double-click Safe I/O in the navigation tree on the left pane.
6 In the **Safe I/O Configuration** tab page, set the signal value of *Collaborative_Mode_Selector_1* to **1**.

3.5.5 Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later)

Preparing the robot system

Required options for system setup

When setting up the system using the **Modify Installation** function in RobotStudio, select the options *[3043-3] SafeMove Collaborative* and *[3051-2] IO Package*, and the correct robot variant. The option *Drive System IRB Small Robot* is selected automatically after the robot type is determined.

Supported parameters for connections to scanners and scalable I/O device

The laser scanner uses a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to the system when the Collaborative Speed Control add-in is installed. The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

The following table lists the device mapping information of Scalable_IO signals, which are automatically configured after the add-in installation.

Signal name	Device mapping	Device
ABB_Scalable_IO_0_DI1 [i]	0	ABB_Scalable_IO
ABB_Scalable_IO_0_DI2 [i]	1	ABB_Scalable_IO
ABB_Scalable_IO_0_DI3 [ii]	2	ABB_Scalable_IO
ABB_Scalable_IO_0_DI4 [ii]	3	ABB_Scalable_IO

i Value of ProtectingArea depends on logic AND value of ABB_Scalable_IO_0_DI1 and ABB_Scalable_IO_0_DI2. For definition of ProtectingArea, see *Configuring the laser scanner on page 72*.

ii Value of WarningArea depends on logic AND value of ABB_Scalable_IO_0_DI3 and ABB_Scalable_IO_0_DI4. For definition of WarningArea, see *Configuring the laser scanner on page 72*.

Configuring the laser scanner

Working modes

The Collaborative Speed Control add-in supports the laser scanner to work in two modes, intermittent collaboration mode and cooperation mode.

The speed control strategy applied to the robot depends on the working mode and protection fields defined for the laser scanner. In intermittent collaboration mode, two protection fields, warning area and protecting area, need to be defined. Within the warning area, the robot slows down to the defined reduced speed; and the within protecting area, the robot will stand still. In cooperation mode, one protection field is required and the robot works cooperatively by slowing down the robot to the defined reduced speed.

The cooperation mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

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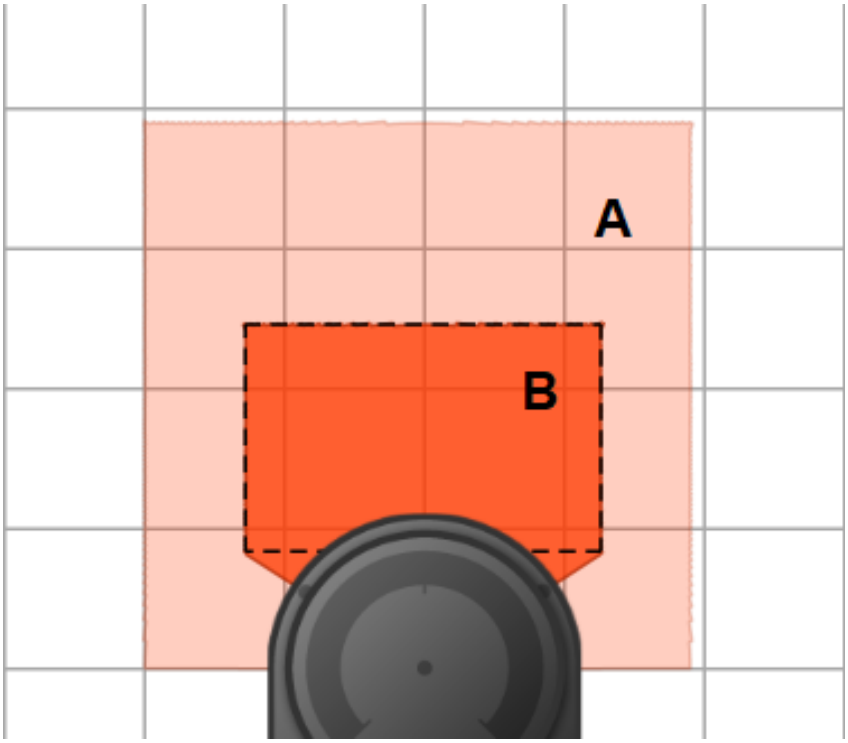
Protection fields

In intermittent collaboration mode, two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



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	Field	Lamp color[i]	Description
A	WarningArea	Yellow	The warning area field defines the largest range, but it shall be within the scanning range of the scanner. Within in this field range, • The lamp lights up yellow for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed reduces to a lower speed that is set by the user.
B	ProtectingArea	Red	Within this field range, • The lamp turns to red for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed is reduced to 0. The robot stands still.

i Valid only for robots with a lamp unit configured to be controlled by the Collaborative Speed Control add-in.
For CRB 15000, the light ring will not change colors to show the status.

In cooperation mode, only one protection field needs to be defined. Within this field range, the speed control strategy is the same as that in the warning area under intermittent collaboration mode. That is, the robot movement speed remains the low speed that is set by the user.

Continues on next page

3.5.5 Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later)
Continued

Configuration procedure

> **Note**
>
> You can use both the common software tool *Safety Designer®* or the dedicated easy configuration tool *mS3 Configuration Tool - ABB* from SICK to configure the laser scanners. The following procedure describes how to configure the laser scanner using the tool *Safety Designer®*. For details about how to use *mS3 Configuration Tool - ABB*, you can scan the QR code available in the laser scanner package to download the tool and its instruction manual "*mS3 Configuration Tool - ABB*".

Before starting the configuration, obtain the software tool *Safety Designer®* from SICK's website first. Make sure the software tool is in the latest version.

Detailed procedures about how to configure the laser scanner are detailed in *Operating instructions microScan3 - Pro I/O* from the vendor. Following described the procedure roughly:

1. Open configuration software tool *Safety Designer®*.
2. Set IP address in **Configuration** > **Addressing**.

   Make sure the scanner IP address is in the same network segment with the PC used for configuring the scanner.
3. Define the two protection fields for the scanner in **Configuration** > **Fields**.
4. Define the source for input signals of the scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.
5. Select one OSSD pair from the **Signals** panel to pin1 and pin2, and select another OSSD pair to pin3 and pin4.

   The two OSSD pairs will be used for defining the monitoring cases.
6. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.
7. Refer to the following table to obtain the pins defined to OSSD pairs. The pins are from a 17-pin cable that will be used to connect the laser scanner and scalable I/O device.

Pin	Wiring color	Name	Function
1	Brown	OSSD1A	OSSD pair 1, OSSD A
2	Blue	OSSD1B	OSSD pair 1, OSSD B
3	White	OSSD2A	OSSD pair 2, OSSD A
4	Green	OSSD2B	OSSD pair 2, OSSD B
17	White with grey	0 V DC	0 DC

8. Connect the laser scanner to scalable I/O device with the defined pins.

Pin in cable	Pin position number in X2 connector of the device[i]
Pin1 (OSSD1A)	DI01+
Pin2 (OSSD1B)	DI02+

Continues on next page

Pin in cable	Pin position number in X2 connector of the device[i]
Pin3 (OSSD2A)	DI03+
Pin4 (OSSD2B)	DI04+
Pin17	Circuit of D101-, D102-, D103- and D104-

i For detailed information of pin definitions in connector X2 Digital inputs of the scalable I/O device DSQC1042, see the product specification of the controller and *Application manual - Scalable I/O*.

Configuring the scalable I/O device

Detailed procedures about how to connect and configure the scalable I/O device DSQC1042 are specified in *Application manual - Scalable I/O*. Following provides a rough procedure:

1 Make sure that the laser scanner and scalable I/O device is connected as instructed in previous configuration procedure of laser scanner.

2 Connect the process power supply to connector X1 of the scalable I/O device via pin locations PWR DO and GND DO.

3 Connect the logic power supply to connector X4 of the scalable I/O device via pin locations PWR and GND.

4 Connect the Ethernet cable from the robot controller to connector X5.

5 Log in the RobotStudio using the admin use account and configure the device to make sure the device communication works.

   a Click the **Controller** tab and, in the **Controller** pane, choose **I/O System** > **EtherNetIP**.

   Information of three devices can be observed:

   - CabinetIO is used for the I/O device DSQC1030, and the communication status is normal.

   - ABB_Scalable_IO and ABB_Scalable_IO1 are used for the I/O device DSQC1042, and the communication status is abnormal.

   b Check the IP address and serial numbers associated with ABB_Scalable_IO and ABB_Scalable_IO1, which will display as follows.

Device name	IP address	Serial number
ABB_Scalable_IO	192.168.125.130	0
ABB_Scalable_IO1	192.168.125.131	Actual serial number of the device

   c Right-click **ABB_Scalable_IO1**, choose **Remove Configuration** from the shortcut menu and click **OK**.

   d Right-click **ABB_Scalable_IO**, choose **Configure Device** from the shortcut menu.

   e In the displayed dialog box, set **Safety Network Number** to 5Afe_1234_5678, and then click **OK**.

   f Right-click **ABB_Scalable_IO1** and choose **Configure Device** from the shortcut menu.

   g In the displayed dialog box,

Continues on next page

3.5.5 Configuration of one SafetyIO-base laser scanner (RobotWare 7.6 or later)
Continued

- verify the value of **Safety Network Number** is 5Afe_1234_5678.
- choose the **Configure as replacement device** option and select **ABB_Scalable_IO** from the drop-down list.
- remove the texts in the **Create new I/O signals using name prefix** text box.

h Click **OK**.

Information of two devices can be observed, CabinetIO and ABB_Scalable_IO. Communication status of ABB_Scalable_IO will turn to normal after the controller is restarted and SafeMove template file is uploaded using the SafeMove configurator app.

Note

The configuration could also be done using the I/O application in FlexPendant.

Note

If there are additional scalable I/O devices available, install and configure the additional devices by following the detailed procedures in *Application manual - Scalable I/O*.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1 Log in the FlexPendant.

Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.

2 Tap **SafeMove** on the home page.

3 Tap **Load** in the pop-up message box to confirm loading of template SafeMove configuration files.

The controller restarts.

Tip

If there is no message box popped up, you can also tap **Edit** and then tap **Open Template Selector** from the menu at the right corner to open it.

4 After the controller is restarted, tap **Settings** on the home page.

5 Tap **Safety Controller**.

6 Tap **Synchronization** in the left pane.

7 Jog the robot to match the **Actual Positions** values with the **Sync Positions** values.

Make sure the values are the same.

8 Tap **Synchronize**.

Continues on next page

Configuring cooperation mode

> **Note**
>
> The collaborative mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

To enable the collaborative mode, perform the following procedure:

1. Open RobotStudio and connect to the controller.
2. Open the configuration editor: **Controller** > **Configuration** > **I/O Engineering Tool**.
3. In the displayed **I/O Engineering** window, set the signal value of *Collaborative_Mode_Selector* to **1**.
4. Open Virtual SafeMove: **Controller** > **Safety** > **Virtual SafeMove**.
5. In the displayed **Visual SafeMove** window, double-click Safe I/O in the navigation tree on the left pane.
6. In the **Safe I/O Configuration** tab page, set the signal value of *Collaborative_Mode_Selector_1* to **1**.

3.5.6 Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later)

Preparing the robot system

Required options for system setup

When setting up the system using the **Modify Installation** function in RobotStudio, select the options *[3043-3] SafeMove Collaborative* and *[3051-4] Dual IO Package*, and the correct robot variant. The option *Drive System IRB Small Robot* is selected automatically after the robot type is determined.

Supported parameters for connections to scanners and scalable I/O device

The laser scanners use a PC-based software tool to configure the connection parameters that are used to connect to the OmniCore system. The supported parameters of the OmniCore system are predefined in the configuration file which could be loaded to the system when the Collaborative Speed Control add-in is installed. The I/O configuration can be seen using I/O Engineering Tool in RobotStudio.

The following table lists the device mapping information of Scalable_IO signals, which are automatically configured after the add-in installation.

Signal name	Device mapping	Device
ABB_Scalable_IO_0_DI1 [i]	0	ABB_Scalable_IO
ABB_Scalable_IO_0_DI2 [i]	1	ABB_Scalable_IO
ABB_Scalable_IO_0_DI3 [ii]	2	ABB_Scalable_IO
ABB_Scalable_IO_0_DI4 [ii]	3	ABB_Scalable_IO
ABB_Scalable_IO_0_DI5 [i]	4	ABB_Scalable_IO
ABB_Scalable_IO_0_DI6 [i]	5	ABB_Scalable_IO
ABB_Scalable_IO_0_DI7 [ii]	6	ABB_Scalable_IO
ABB_Scalable_IO_0_DI8 [ii]	7	ABB_Scalable_IO

i Value of ProtectingArea depends on logic AND value of ABB_Scalable_IO_0_DI1, ABB_Scalable_IO_0_DI2, ABB_Scalable_IO_0_DI5 and ABB_Scalable_IO_0_DI6. For definition of ProtectingArea, see *Configuring the laser scanner on page 78*.

ii Value of WarningArea depends on logic AND value of ABB_Scalable_IO_0_DI3, ABB_Scalable_IO_0_DI4, ABB_Scalable_IO_0_DI7 and ABB_Scalable_IO_0_DI8. For definition of WarningArea, see *Configuring the laser scanner on page 78*.

Configuring the laser scanner

Working modes

The Collaborative Speed Control add-in supports the laser scanner to work in two modes, intermittent collaboration mode and cooperation mode.

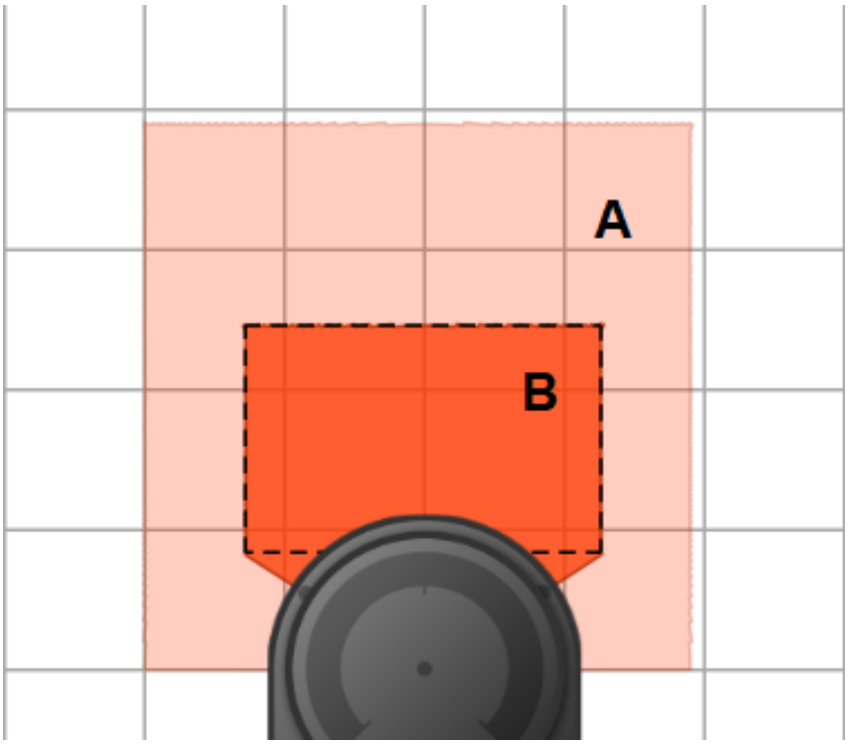
The speed control strategy applied to the robot depends on the working mode and protection fields defined for the laser scanner. In intermittent collaboration mode, two protection fields, warning area and protecting area, need to be defined. Within the warning area, the robot slows down to the defined reduced speed; and the within protecting area, the robot will stand still. In cooperation mode, one protection field is required and the robot works cooperatively by slowing down the robot to the defined reduced speed.

Continues on next page

The cooperation mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

Protection fields

In intermittent collaboration mode, two protection fields are defined to provide a progressive safety protection. The following figure illustrates the field ranges.



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	Field	Lamp color[i]	Description
A	WarningArea	Yellow	The warning area field defines the largest range, but it shall be within the scanning range of the scanner. Within in this field range, • The lamp lights up yellow for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed reduces to a lower speed that is set by the user.
B	ProtectingArea	Red	Within this field range, • The lamp turns to red for the robot with a lamp unit configured to be controlled by the Collaborative Speed Control add-in. • The robot movement speed is reduced to 0. The robot stands still.

i Valid only for robots with a lamp unit configured to be controlled by the Collaborative Speed Control add-in.
For CRB 15000, the light ring will not change colors to show the status.

In cooperation mode, only one protection field needs to be defined. Within this field range, the speed control strategy is the same as that in the warning area under

Continues on next page

intermittent collaboration mode. That is, the robot movement speed remains the low speed that is set by the user.

Configuration procedure

Note

You can use both the common software tool *Safety Designer®* or the dedicated easy configuration tool *mS3 Configuration Tool - ABB* from SICK to configure the laser scanners. The following procedure describes how to configure the laser scanner using the tool *Safety Designer®*. For details about how to use *mS3 Configuration Tool - ABB*, you can scan the QR code available in the laser scanner package to download the tool and its instruction manual "*mS3 Configuration Tool - ABB*".

Before starting the configuration, obtain the software tool *Safety Designer®* from SICK's website first. Make sure the software tool is in the latest version.

Detailed procedures about how to configure the laser scanners are detailed in *Operating instructions microScan3 - Pro I/O* from the vendor. Following described the procedure roughly:

1. Open configuration software tool *Safety Designer®*.
2. Set IP address in **Configuration** > **Addressing**.
   - Make sure the scanner IP addresses are in the same network segment with the PC used for configuring the scanner.
   - The two scanners must be set to different IP addresses.
3. Define the two protection fields for each scanner in **Configuration** > **Fields**.
4. Define the source for input signals of each scanner and configure basic settings for the inputs and outputs in **Configuration** > **Inputs and outputs**.
5. For both scanners, select one OSSD pair from the **Signals** panel to pin1 and pin2, and select another OSSD pair to pin3 and pin4.

   The two OSSD pairs will be used for defining the monitoring cases.
6. Create monitoring cases and assign the fields that are to be monitored to each monitoring cases in **Configuration** > **Monitoring cases**.
7. Refer to the following table to obtain the pins defined to OSSD pairs. The pins are from a 17-pin cable that will be used to connect a laser scanner and scalable I/O device.

Pin	Wiring color	Name	Function
1	Brown	OSSD1A	OSSD pair 1, OSSD A
2	Blue	OSSD1B	OSSD pair 1, OSSD B
3	White	OSSD2A	OSSD pair 2, OSSD A
4	Green	OSSD2B	OSSD pair 2, OSSD B
17	White with grey	0 V DC	0 DC

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8 Connect the laser scanners to safety module with the defined pins.

Scanner	Pin in cable	Pin position number in X2 connector of the device[i]
Scanner 1	Pin1 (OSSD1A)	D101+
	Pin2 (OSSD1B)	DI02+
	Pin3 (OSSD2A)	DI03+
	Pin4 (OSSD2B)	DI04+
	Pin17	Circuit of D101-, D102-, D103- and D104-
Scanner 2	Pin1 (OSSD1A)	D105+
	Pin2 (OSSD1B)	DI06+
	Pin3 (OSSD2A)	DI07+
	Pin4 (OSSD2B)	DI08+
	Pin17	Circuit of D105-, D106-, D107- and D108-

i For detailed information of pin definitions in connector X2 Digital inputs of the scalable I/O device DSQC1042, see the product specification of the controller and *Application manual - Scalable I/O*.

Configuring the scalable I/O device

Detailed procedures about how to connect and configure the scalable I/O device DSQC1042 are specified in *Application manual - Scalable I/O*. Following provides a rough procedure:

1 Make sure that the laser scanner and scalable I/O device is connected as instructed in previous configuration procedure of laser scanner.

2 Connect the process power supply to connector X1 of the scalable I/O device via pin locations PWR DO and GND DO.

3 Connect the logic power supply to connector X4 of the scalable I/O device via pin locations PWR and GND.

4 Connect the Ethernet cable from the robot controller to connector X5.

5 Log in the RobotStudio using the admin use account and configure the device to make sure the device communication works.

a Click the **Controller** tab and, in the **Controller** pane, choose **I/O System** > **EtherNetIP**.

Information of three devices can be observed:

- CabinetIO is used for the I/O device DSQC1030, and the communication status is normal.

- ABB_Scalable_IO and ABB_Scalable_IO1 are used for the I/O device DSQC1042, and the communication status is abnormal.

b Check the IP address and serial numbers associated with ABB_Scalable_IO and ABB_Scalable_IO1, which will display as follows.

Device name	IP address	Serial number
ABB_Scalable_IO	192.168.125.130	0

Continues on next page

3.5.6 Configuration of two SafetyIO-base laser scanners (RobotWare 7.6 or later)
Continued

Device name	IP address	Serial number
ABB_Scalable_IO1	192.168.125.131	Actual serial number of the device

c Right-click **ABB_Scalable_IO1**, choose **Remove Configuration** from the shortcut menu and click **OK**.

d Right-click **ABB_Scalable_IO**, choose **Configure Device** from the shortcut menu.

e In the displayed dialog box, set **Safety Network Number** to 5Afe_1234_5678, and then click **OK**.

f Right-click **ABB_Scalable_IO1** and choose **Configure Device** from the shortcut menu.

g In the displayed dialog box,

- verify the value of **Safety Network Number** is 5Afe_1234_5678.
- choose the **Configure as replacement device** option and select **ABB_Scalable_IO** from the drop-down list.
- remove the texts in the **Create new I/O signals using name prefix** text box.

h Click **OK**.

Information of two devices can be observed, CabinetIO and ABB_Scalable_IO. Communication status of ABB_Scalable_IO will turn to normal after the controller is restarted and SafeMove template file is uploaded using the SafeMove configurator app.

Note

The configuration could also be done using the I/O application in FlexPendant.

Note

If there are additional scalable I/O devices available, install and configure the additional devices by following the detailed procedures in *Application manual - Scalable I/O*.

Configuring SafeMove

To enable SafeMove, perform the following procedure:

1 Log in the FlexPendant.

Make sure the user logged in have access grants to lock safety controller configurations, safety services and software synchronization.

2 Tap **SafeMove** on the home page.

3 Tap **Load** in the pop-up message box to confirm loading of template SafeMove configuration files.

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The controller restarts.

> **Tip**
>
> If there is no message box popped up, you can also tap **Edit** and then tap **Open Template Selector** from the menu at the right corner to open it.

4 After the controller is restarted, tap **Settings** on the home page.
5 Tap **Safety Controller**.
6 Tap **Synchronization** in the left pane.
7 Jog the robot to match the **Actual Positions** values with the **Sync Positions** values.

   Make sure the values are the same.
8 Tap **Synchronize**.

Configuring cooperation mode

> **Note**
>
> The collaborative mode is available from Collaborative Speed Control add-in version 1.3.0 and only applicable to CRB 15000 robots.

To enable the collaborative mode, perform the following procedure:

1 Open RobotStudio and connect to the controller.
2 Open the configuration editor: **Controller** > **Configuration** > **I/O Engineering Tool**.
3 In the displayed **I/O Engineering** window, set the signal value of *Collaborative_Mode_Selector* to **1**.
4 Open Virtual SafeMove: **Controller** > **Safety** > **Virtual SafeMove**.
5 In the displayed **Visual SafeMove** window, double-click Safe I/O in the navigation tree on the left pane.
6 In the **Safe I/O Configuration** tab page, set the signal value of *Collaborative_Mode_Selector_1* to **1**.

3.5.7 Speed control strategies

General

The speed control of Collaborative Speed Control add-in is affected by several factors, such as, the RobotWare version, the speed setting in the FlexPendant, the speed setting in motion instruction and the `SpeedRefresh` value. Users in different protection fields defined for laser scanner to monitor and perform different program execution actions may result in different movement speed. This section describes the speed control strategies for typical scenarios.

Strategies (RobotWare 7.6 or later)

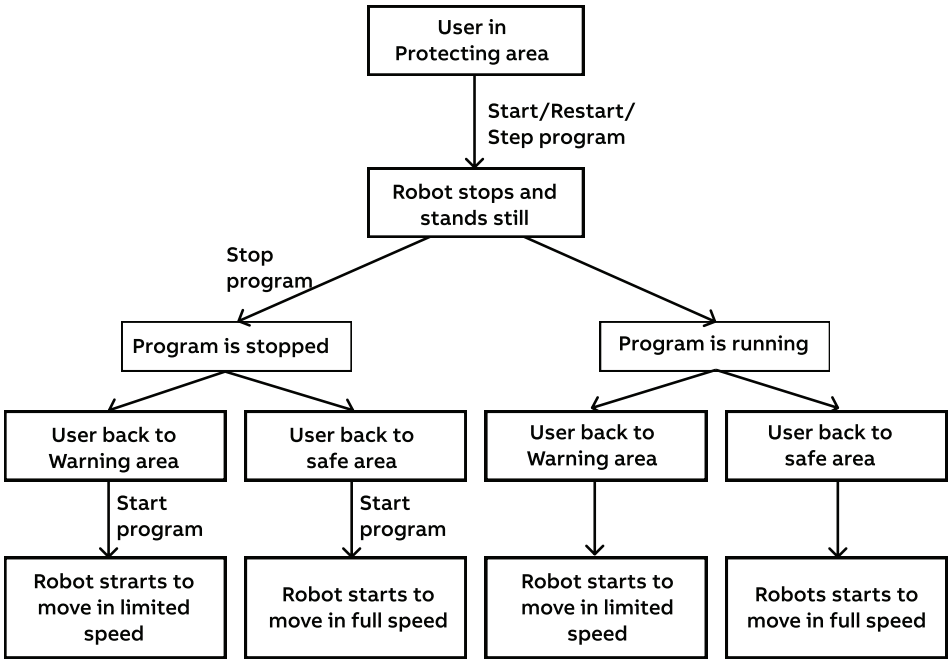
Note

The speed control strategy in protecting area applies only to the robots with laser scanners in intermittent collaborative mode.

The speed control strategy in warning area applies to both the robots with laser scanners in intermittent collaborative mode and those with laser scanners in cooperation mode.

See *Application manual - Collaborative Speed Control add-in* for details about the working modes and protection fields of the laser scanners.

Users in Protecting area



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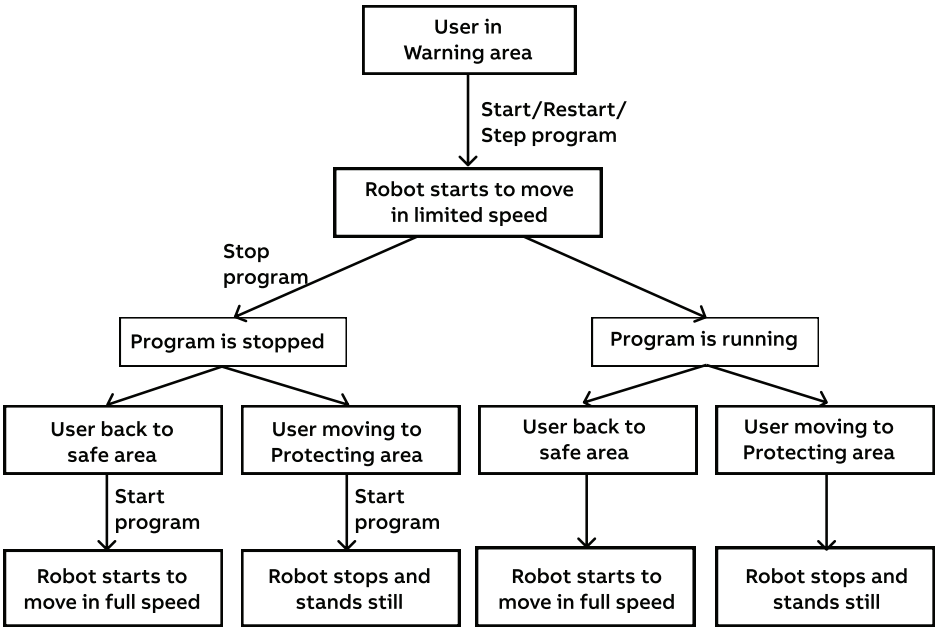
Users in Warning area



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3.6 Use cases of safety configurations

General

Note

Safety configurations can only be modified for robots running in RobotWare 7.6 and later versions.

Modified configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

Deactivating the SpeedHandling function

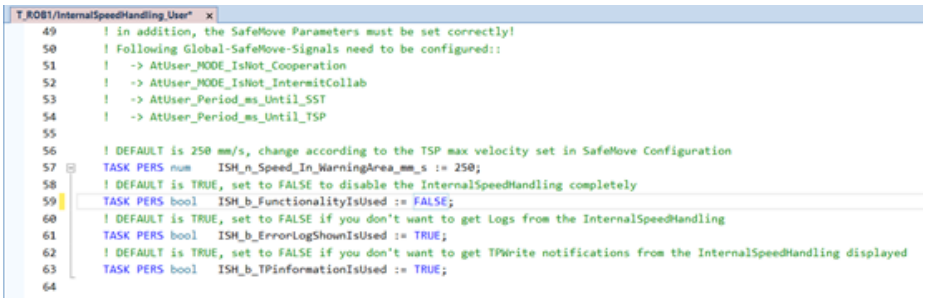
Note

Modified configuration must always be validated to verify that the desired safety is achieved. If no validation is performed, or the validation is inadequate, the configuration cannot be relied on for personal safety.

The SpeedHandling function is activated by default after the Collaborative Speed Control add-in is installed and the SafeMove template is loaded. The function is used to enable or disable speed-related actions for speed control.

It is possible to use the following procedure to deactivate the SpeedHandling function based on risk assessment of the final application:

1. In RobotStudio, open the RAPID program InternalSpeedHandling_User in task T_ROB1.
2. Navigate to the function ISH_b_FunctionlityIsUsed and set its value from default TRUE to FALSE.



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3. Save the change and apply to the controller.

SafeMove configurations also affect the speed control on the robot to achieve further safety. SafeMove is still functional after the SpeedHandling function in RAPID program is deactivated.

Use the following procedure to disable the speed control function provided by SafeMove:

1. Open the RobotStudio.

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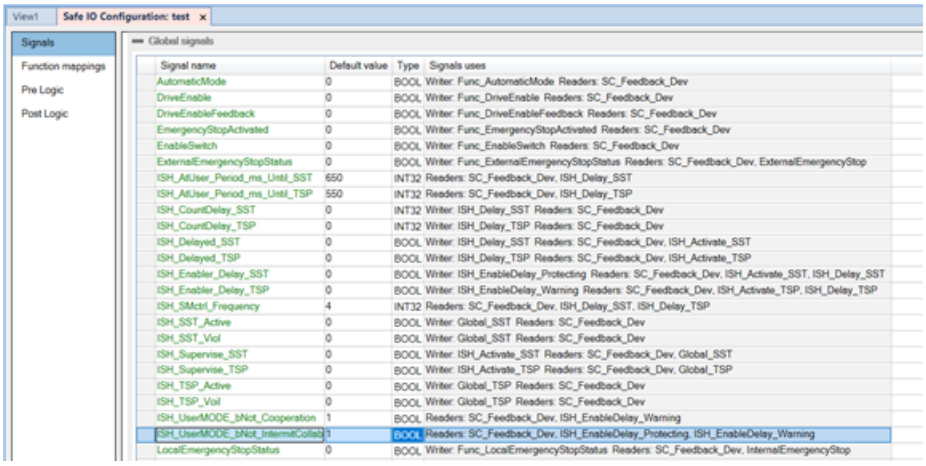
2 Log in the controller using the Admin account and request the write access.
3 In the **Controller** tab, choose **Visual SafeMove** from the **Safety** group in the **Configuration** category.
4 In the **Visual SafeMove** tab, click **Safe IO Configurator** in the **Configuration** group.
5 In the displayed **Safe IO Configuration** window, go to the signal **ISH_UserMODE_bNot_IntemitCollab** in the global signal list and set the value to **1**.



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6 Apply the configuration to the controller by clicking **Write to Controller** in the **Controller** group in the **Configuration** category.

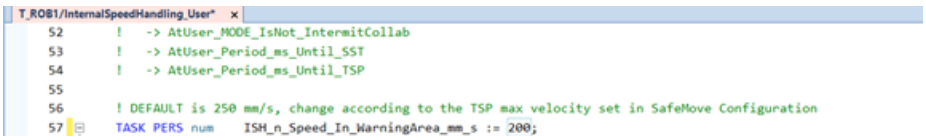
If the SpeedHandling function requires to be reactivated after deactivation, make sure:

- the signal ISH_UserMODE_bNot_IntemitCollab in SafeMove configuration is set to **0**, and,
- the function ISH_b_FunctionlityIsUsed in RAPID program is set to TRUE.

Changing the speed limit when WarningArea is triggered

When users enter the warning area, the robot speed is limited to 250 mm/sec by default. Use the following procedure to change the speed limit based on risk assessment of the final application:

1 In RobotStudio, open the RAPID program InternalSpeedHandling_User in task T_ROB1.
2 Navigate to the function ISH_n_Speed_In_WarningArea_mm_s and set its value from default 250 to any required value.



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3 Save the change and apply to the controller.

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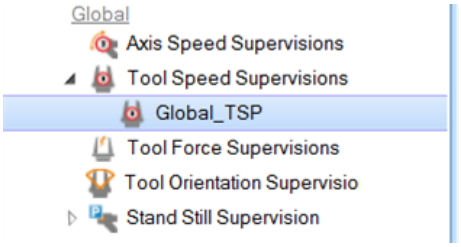
The speed limit can also be changed in SafeMove configurations using the following procedure:

1 Open the RobotStudio.

2 Log in the controller using the Admin account and request the write access.

3 In the **Controller** tab, choose **Visual SafeMove** from the **Safety** group in the **Configuration** category.

4 In the left pane of the window, choose **Global_TSP** under the **Tool Speed Supervisions** from the navigation tree.



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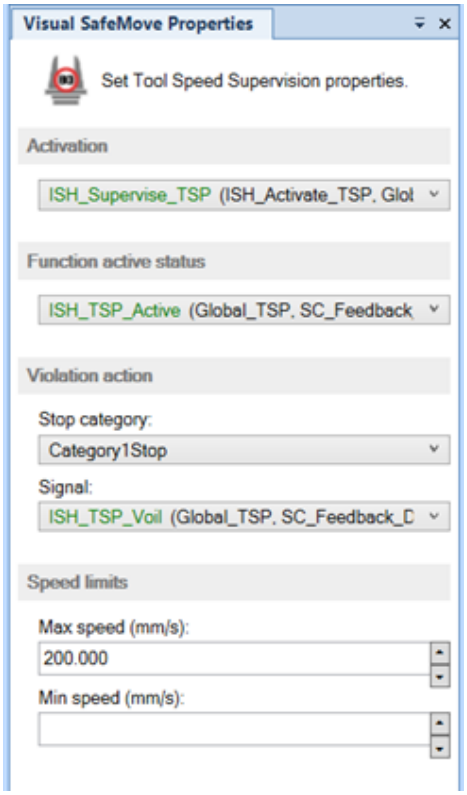
5 In the **Visual SafeMove Properties** window, set the **Max speed (mm/s)** in the **Speed limits** area to a required value.



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6 Apply the configuration to the controller by clicking **Write to Controller** in the **Controller** group in the **Configuration** category.

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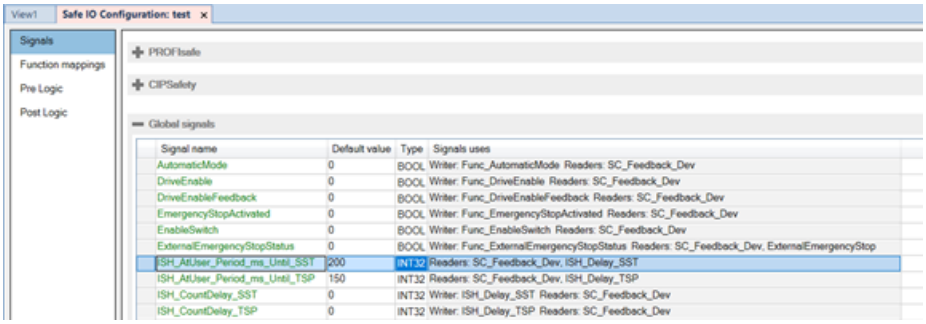
Changing the execution delay time in template SafeMove configuration file

Configurations of SST and TSP are predefined in the template SafeMove configuration file as two global signals ISH_AtUser_Period_ms_Until_SST and ISH_AtUser_Period_ms_Until_TSP.

- ISH_AtUser_Period_ms_Until_SST: default value is 650 ms. If a period of 650 ms elapses after ProtectingArea is triggered but the robot still moves, the SST will be triggers to stop robot movement immediately.
- ISH_AtUser_Period_ms_Until_TSP: default value is 550 ms. If a period of 550 ms elapses after WarningArea is triggered but the robot still moves in a speed larger than the defined speed limit value, the TSP will be triggered to stop robot movement immediately.

It is possible to change the values of ISH_AtUser_Period_ms_Until_SST and ISH_AtUser_Period_ms_Until_TSP according to application requirements using the following procedure. The change must be based on the risk assessment of the final application.

1 Open the RobotStudio.
2 Log in the controller using the Admin account and request the write access.
3 In the **Controller** tab, choose **Visual SafeMove** from the **Safety** group in the **Configuration** category.
4 In the **Visual SafeMove** tab, click **Safe IO Configurator** in the **Configuration** group.
5 In the displayed **Safe IO Configuration** window, go to the signals **ISH_AtUser_Period_ms_Until_SST** and **ISH_AtUser_Period_ms_Until_TSP** in the global signal list and reset the value as required.



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6 Apply the configuration to the controller by clicking **Write to Controller** in the **Controller** group in the **Configuration** category.

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4 Troubleshooting

4.1 Communication failure between PROFIsafe-based laser scanner, PLC, and controller

Description

The ProfiNet LED on the laser scanner is not lit up, indicating that the profinet communication between the laser scanner, PLC, and OmniCore controller fails to be set up. However, the cable connection is properly connected and necessary parameters are correctly set during the laser scanner configuration.

This issue may occur when PROFIsafe-based laser scanner(s) is connected.

Consequences

Communication fails to be set up between the laser scanner, PLC, and OmniCore. The safety separation function with the laser scanner cannot be applied.

Possible causes

The firewall for the ProfiNet network is disabled.

Recommended actions

1. Open RobotStudio.
2. In the **Controller** tab page, choose **Communication** from the **Configuration** group.
3. Select **Firewall Manager** in the **Type** pane.
4. Set **Enable on Public Network** to **Yes** for the network service **ProfiNet**.

4.2 Communication failure between PLC and controller

Description

The OmniCore controller and PLC are configured with all parameters correctly set. However, the communication between the OmniCore controller and PLC still fails.

This issue may occur when the PROFIsafe-based laser scanner(s) is connected.

Consequence

The safety configurations do not take effect.

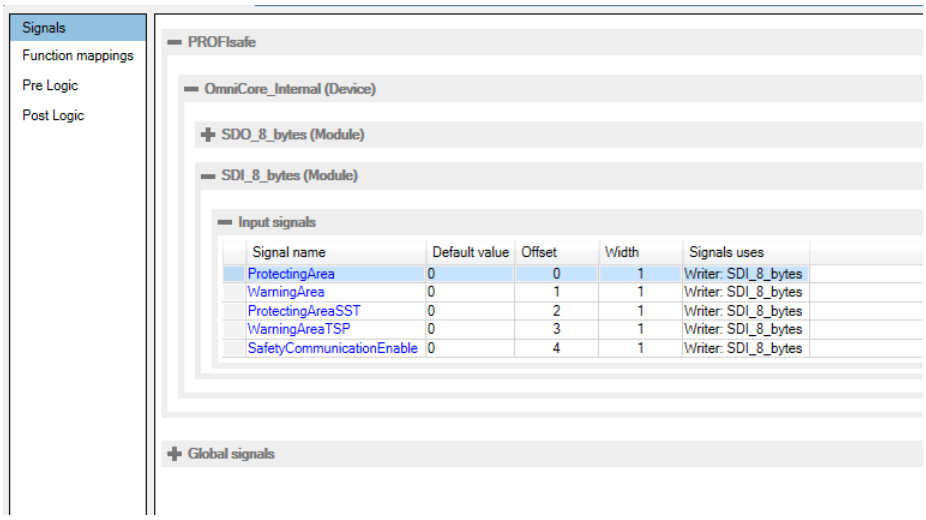
Possible causes

During configuration of communication between the OmniCore controller and PLC, the PROFIsafe device information must be configured on the OmniCore controller's side first. Otherwise, the configured signals will not be saved in the safety module in the OmniCore controller.

Recommended actions

1. Open the RobotStudio.
2. In the **Controller** tab page, choose **Visual SafeMove** from **Safety** in the **Configuration** group.
3. Check the Safe I/O configurations.

   For robots running RobotWare 7.5 or earlier, the following signals can be observed.



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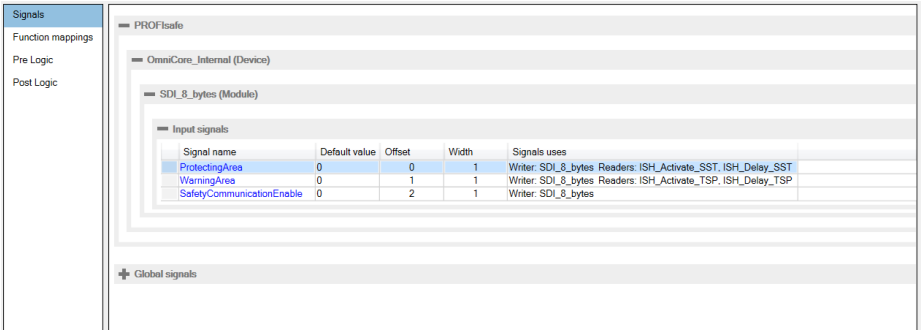
For robots running RobotWare 7.6 or later, the following signals can be observed.



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4 If the signals cannot be observed, choose **I/O Engineering Tool** from **Configuration** in the **Configuration** group.

5 Go back to the **Visual SafeMove** window and write the SafeMove configurations to the controller again.

You will observe the signals and the communication is correctly set up.

4.3 Communication failure between scalable I/O device and controller

Description

The OmniCore controller and scalable I/O device DSQC1042 are configured with all parameters correctly set. However, the communication between the OmniCore controller and scalable I/O device still fails.

This issue may occur when the SafetyIO-based laser scanner(s) is connected.

Consequence

The safety configurations do not take effect.

Possible causes

During configuration of communication between the OmniCore controller and scalable I/O device, the scalable I/O device information must be configured on the OmniCore controller's side first. Otherwise, the configured signals will not be saved in the OmniCore controller.

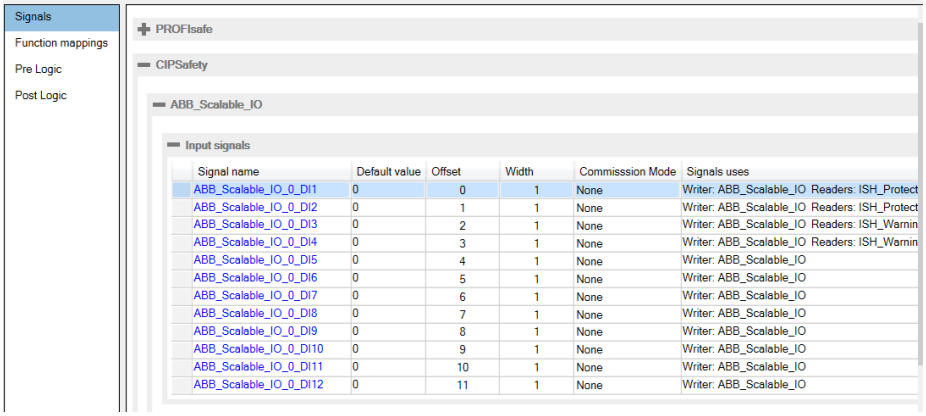
Recommended actions

1 Open the RobotStudio.

2 In the **Controller** tab page, choose **Visual SafeMove** from **Safety** in the **Configuration** group.

3 Check the Safe I/O configurations.

The following signals can be observed.



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4 If the signals cannot be observed, choose **I/O Engineering Tool** from **Configuration** in the **Configuration** group.

5 Go back to the **Visual SafeMove** window and write the SafeMove configurations to the controller again.

You will observe the signals and the communication is correctly set up.

4.4 System failure when changing PROFINET-based laser scanner to SafetyIO-based laser scanner

Description

The robot configured with PROFINET-based laser scanner(s) needs to replace with SafetyIO-based laser scanner. During system update using the **Modify Installation** function, system failure occurs after removing the profisafe package option(s) and selecting required IO package option(s).

Consequence

The system cannot be successfully set up.

Possible causes

Option *3020-2 PROFINET Device* and option *3023-2 PROFIsafe Device* are removed together with the profisafe package option(s), and the safety configurations become invalid.

Recommended actions

1. On the home page of the FlexPendant, tap **Settings**.
2. Tap **Backup & Recovery**.
3. Tap **Reset user data**.
4. Select **Reset safety settings**.
5. Tap **Reset**.
6. Restart the controller.

If the problem persists, reinstall the system.

4.5 Unable to change speed value in FlexPendant

Description

In manual mode, the **Speed** scrollbar in the FlexPendant cannot be dragged to edit the speed.

This issue may occur when robot is running in RobotWare 7.5 or an earlier version.

Consequences

Robot movement speed cannot be edited in manual mode in FlexPendant.

Possible causes

The speed control module uses the value of the system input whose **Action** is **Set speed** to control the actual movement speed. If the communication between the OmniCore controller and laser scanner fails, the controller considers this situation as that the protecting area is triggered, and the speed will be limited to 0%. If the communication failure remains when the operating mode is changed to Manual, the **Set speed** value is still valid.

Recommended actions

1. In the FlexPendant, tap **I/O** in the main page.
2. Reset the StartInProtecting DO.

   The speed limitation will be released.

4.6 Unable to remove or reselect installed options in Collaborative Speed Control add-in

Description

The installed lead-through or laser scanner options fail to be removed or reselected in the Collaborative Speed Control add-in using the **Modify Installation** function.

Consequence

- Modules of the SpeedHandling function remain in task T_ROB1 after the installed options are removed.
- Existing template SafeMove configuration file is not removed after the installed options are removed or not synchronized with new configuration file for the new option after the installed options are reselected.

Recommended actions

1. Reset the template SafeMove configuration file to factory settings and apply it to the controller.
2. For scenarios to remove options, de-select the checkboxes of the options that require to be removed in the Collaborative Speed Control add-in and apply it to the controller.
3. For scenarios to reselect options, de-select the checkboxes of the options not required first and then select the required options in the Collaborative Speed Control add-in and apply it to the controller.
4. Reset the RAPID programs and parameters in RobotStudio and restart the controller.
5. Load the template SafeMove configuration file using the SafeMove configurator app on FlexPendant.

4.7 Unexpected robot movement when starting the program in Protecting Area

Description

The robot moves unexpectedly in a speed not larger than 250 mm/sec when the user starts the program in Protecting area, in which situation the robot should be stopped and stand still.

Consequence

The unexpected robot movement may cause damages or injuries to objects or persons within its movement range.

Possible causes

The robot moves in mentioned scenario only when all of the following conditions are met:

- The function ISH_b_FunctionlityIsUsed in RAPID program InternalSpeedHandling_User is set to TRUE.
- The template SafeMove configuration file provided with the Collaborative Speed Control add-in is not loaded, or is loaded but Global_SST configuration is removed or the ISH_UserMODE_bNot_IntemitCollab is set to 1.
- The system is in Auto mode or Manual Full Speed mode.
- The robot was stopped during running a program, and then manually moved to another position which is within the range of the robot return path.
- The user stands in Protecting area and restarts the program using FlexPendant.

Recommended actions

Reset the template SafeMove configuration file to factory setting and then load the configuration file provided with the Collaborative Speed Control add-in.

4.8 Program execution stops because no safety configuration template loaded

Description

The robots installed with the Collaborative Speed Control add-in that provides safety configuration templates for easy use. However, the templates are not loaded after selecting **Enable Edit Mode** and **Use template configuration** in the SafeMove configurator app on FlexPendant.

When executing the program, a message box is displayed, prompting users to load templates from the controller file system.

Consequence

Program execution cannot proceed until a safety configuration template is loaded.

Possible causes

If the robot operating in RW 7.12 with a Collaborative Speed Control add-in earlier than 1.2.1, the safety configuration templates are unavailable in the controller file system for loading.

Recommended actions

1. Check the Collaborative Speed Control add-in version and make sure the version 1.2.1 is installed.
2. Log in the FlexPendant as a user with safety user grants.
3. Open the SafeMove app.
4. Tap **Enable Edit Mode**.
5. Tap **Load Configuration From File** from the **Context** menu (...).
6. Browse templates in the controller file folder: "*PRODUCTS/CollaborativeSpeedControl/SafeMove/<your robot type>/Templates*" and select the template for your option.
7. Tap **OK** and then **Yes** to load the template.
8. Tap **Write to controller**.
9. Select **Apply to controller** to proceed.

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