

# (Dual Work Zones) Features Settings

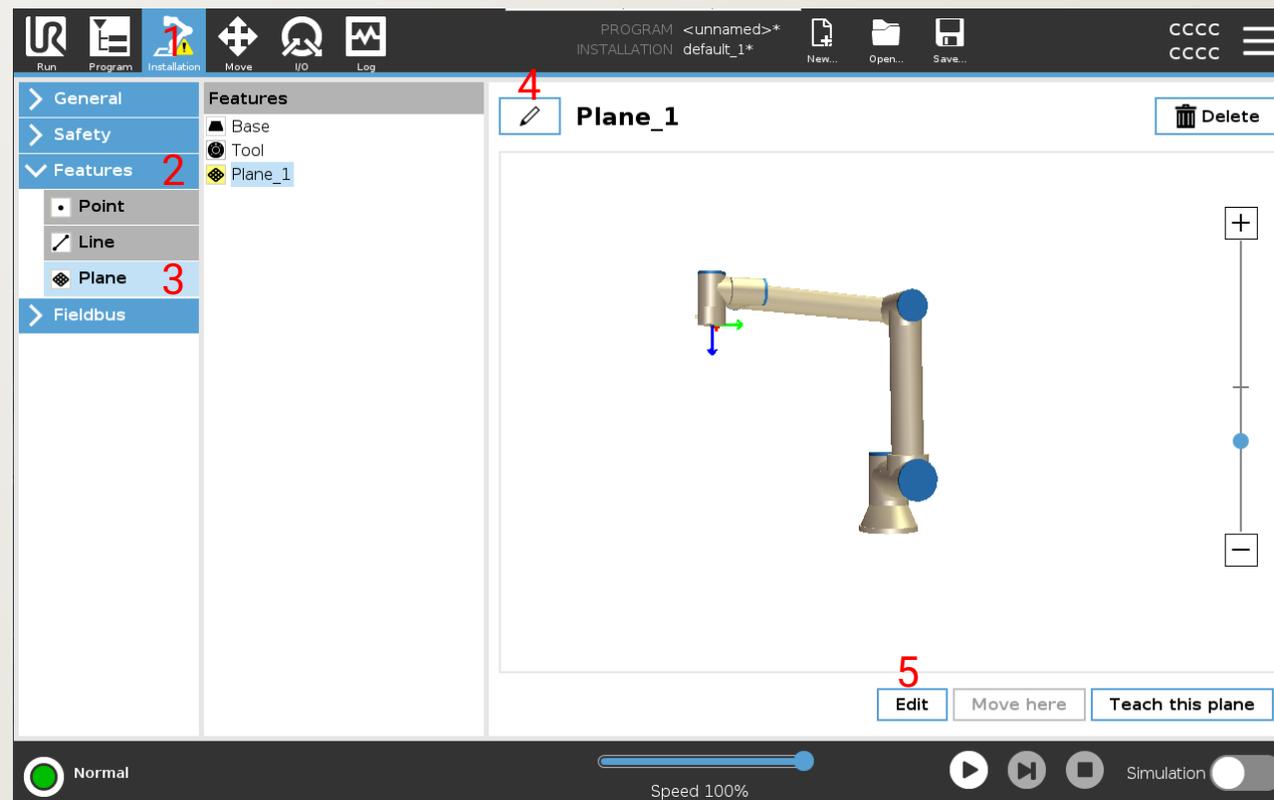
First, a plane feature is needed, as this is going to be used to set up a trigger plane later in the safety settings.

1. Go to Installation
2. Tap Features
3. Tap Plane. A new Plane feature is now added to the Features list
4. Rename the plane to something meaningful by tapping the pencil 
5. Highlight the plane in the Features list and click Edit

(Optional)

You can use the TCP of the robot (as default, this will be the tool flange) to teach three points in space to create a plane. To do this, click the “Teach this plane” button and follow the Wizard.

# Planes



(Dual Work Zones)

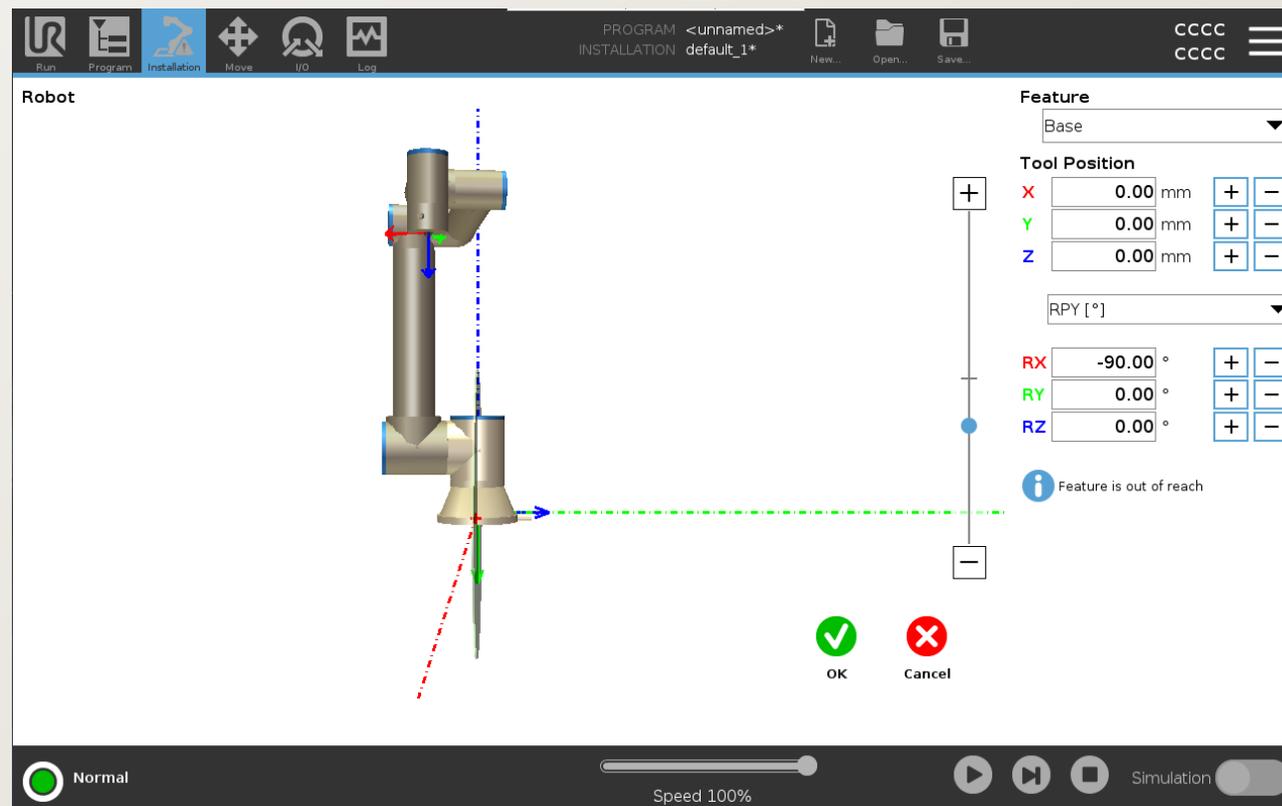
# Features Settings

In this example, an x-z-plane w.r.t. the base feature is created.

It is possible to offset this later in the safety settings if needed.

Tap "OK" once satisfied.

# Planes

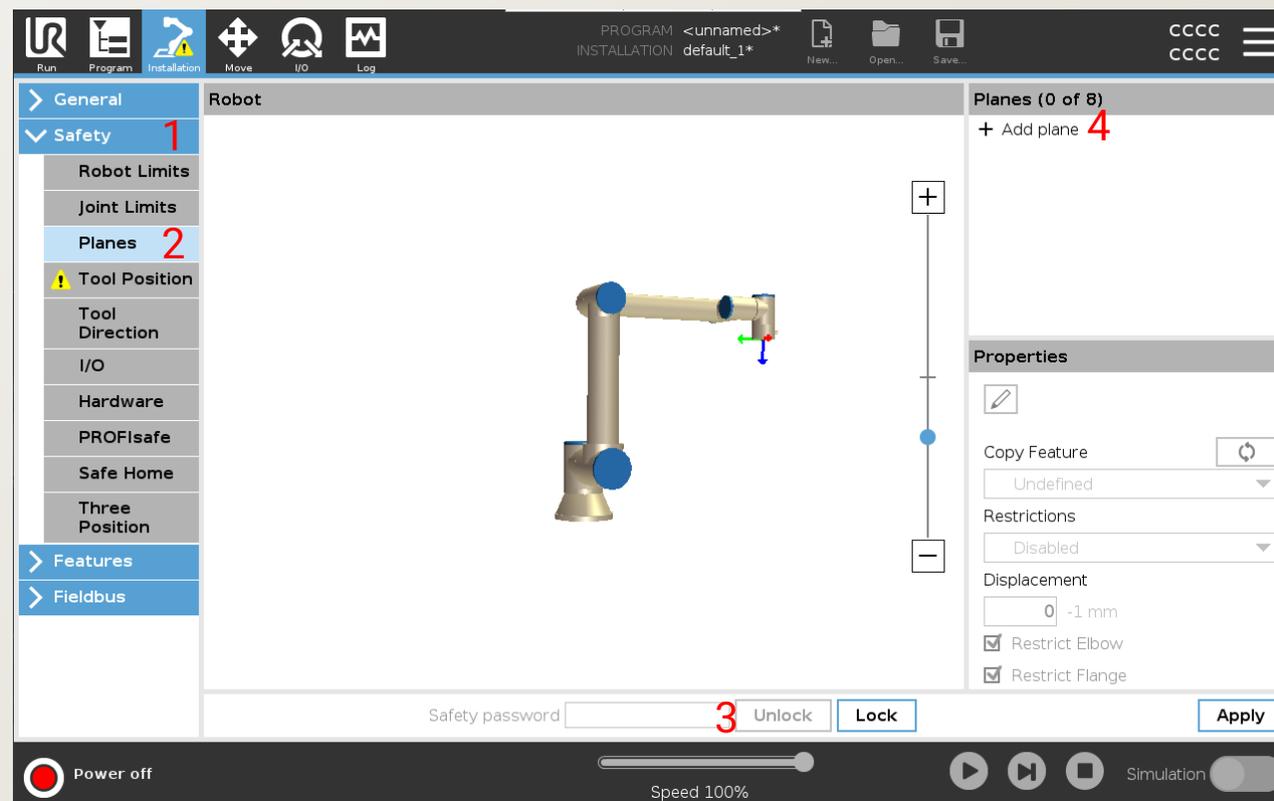


# Safety Settings

## Planes

Now we need to go to the Safety Settings to actually set up the feature plane as a safety plane.

1. Go to the Safety settings
2. Tap "Planes"
3. Unlock the Safety settings by entering your pre-configured Safety password and then tap Unlock
4. Then tap "Add plane"

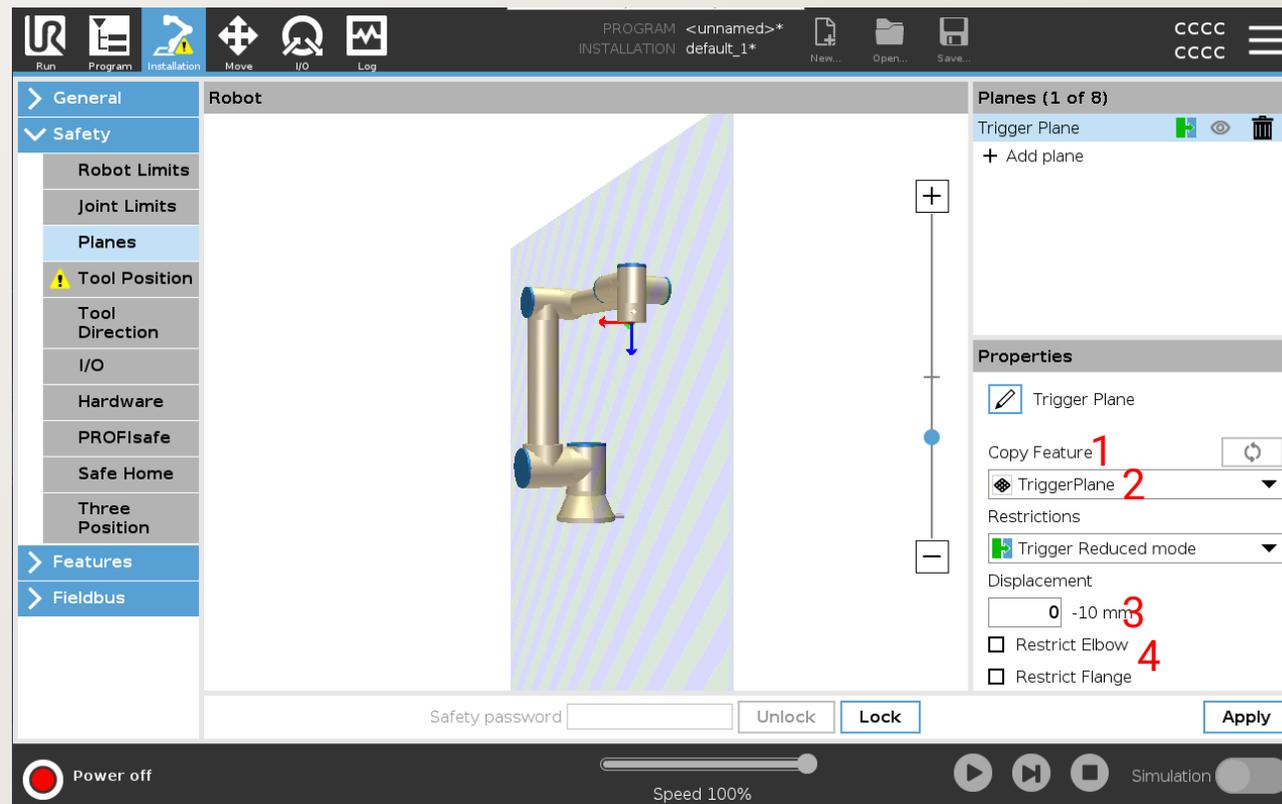


# (Dual Work Zones) Safety Settings

Rename the safety plane to something meaningful by tabbing the pencil. 

1. Copy the feature from the drop-down list and choose the desired feature plane which is needed.
2. In this example, the plane created earlier in the Feature Settings (TriggerPlane) is chosen.
3. Displacement will offset the plane in either the positive or negative direction along the plane normal (Z-axis of the plane feature).
4. Uncheck the checkbox for the "Restrict Elbow" and the "Restrict Tool Flange" so these won't trigger the safety plane. The Elbow can be left checked if your application needs it.

# Planes



# (Dual Work Zones) Safety Settings

We want the robot to run with the same speed and limits on both sides of the trigger plane.

1. Go to the Safety settings
2. Tap "Robot Limits"
3. Tap the "Custom" radio button
4. Change the limits in both the "Normal" and the "Reduced" columns to be the same values.

# Robot Limits

PROGRAM <unnamed>\*  
INSTALLATION default

Run Program Installation Move I/O Log

Local

> General

> Safety **1**

**2** Robot Limits

Joint Limits

Planes

Tool Position

Tool Direction

I/O

Hardware

Safe Home

Three Position

> Features

> Fieldbus

> URCaps

**3**  Factory Presets

Most Restricted | Least Restricted

**4**  Custom

Limit	Normal	Reduced
Power	300 W	300 W
Momentum	25.0 kg m/s	25.0 kg m/s
Stopping Time	400 ms	400 ms
Stopping Distance	500 mm	500 mm
Tool Speed	1500 mm/s	1500 mm/s
Tool Force	150.0 N	150.0 N
Elbow Speed	1500 mm/s	1500 mm/s
Elbow Force	150.0 N	150.0 N

Safety password

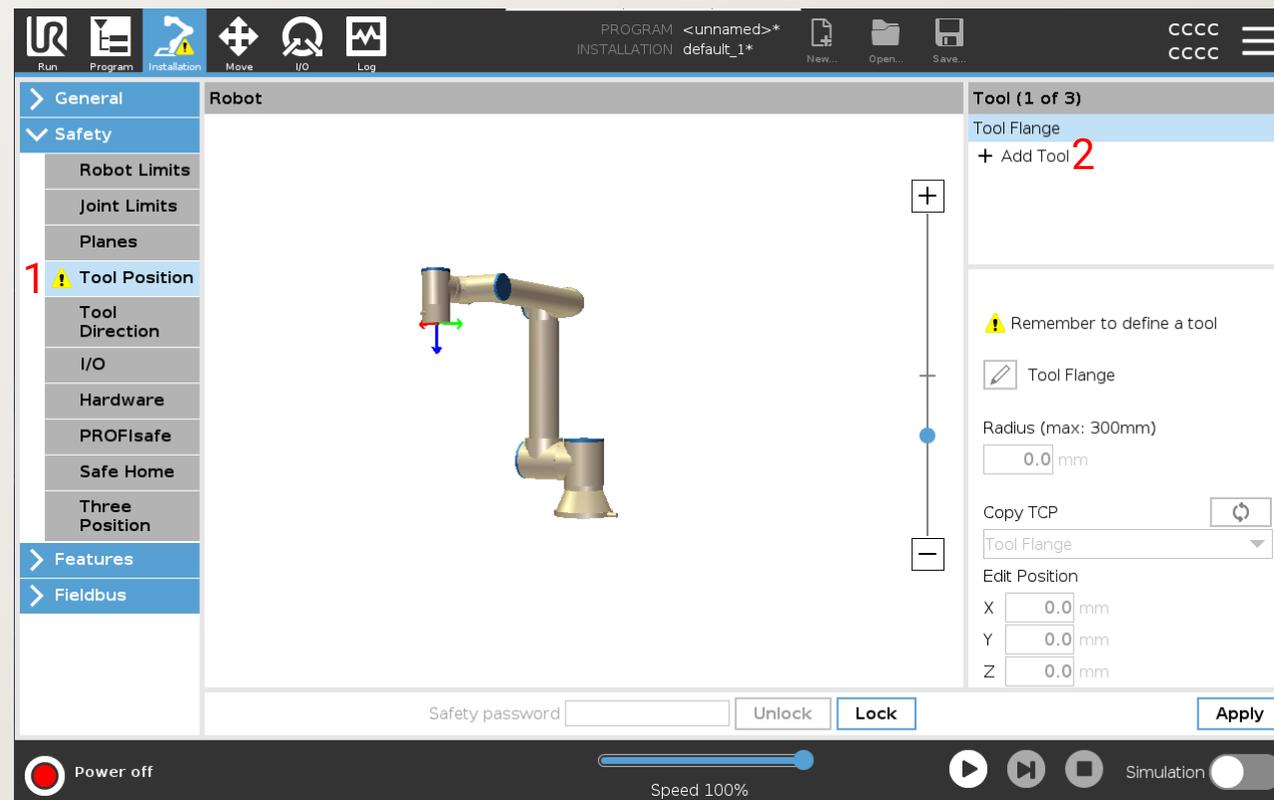
Power off Speed 100% Simulation

# (Dual Work Zones) Safety Settings

For the safety plane to trigger correctly, when the tool TCP gets close, it is mandatory to set a Tool Position within the safety settings. This is also shown by the yellow sign on the Tool Position.

1. Go to Tool Position
2. Tap Add Tool

# Tool Position



# (Dual Work Zones) Safety Settings

Rename the tool to something meaningful by tapping the pencil. 

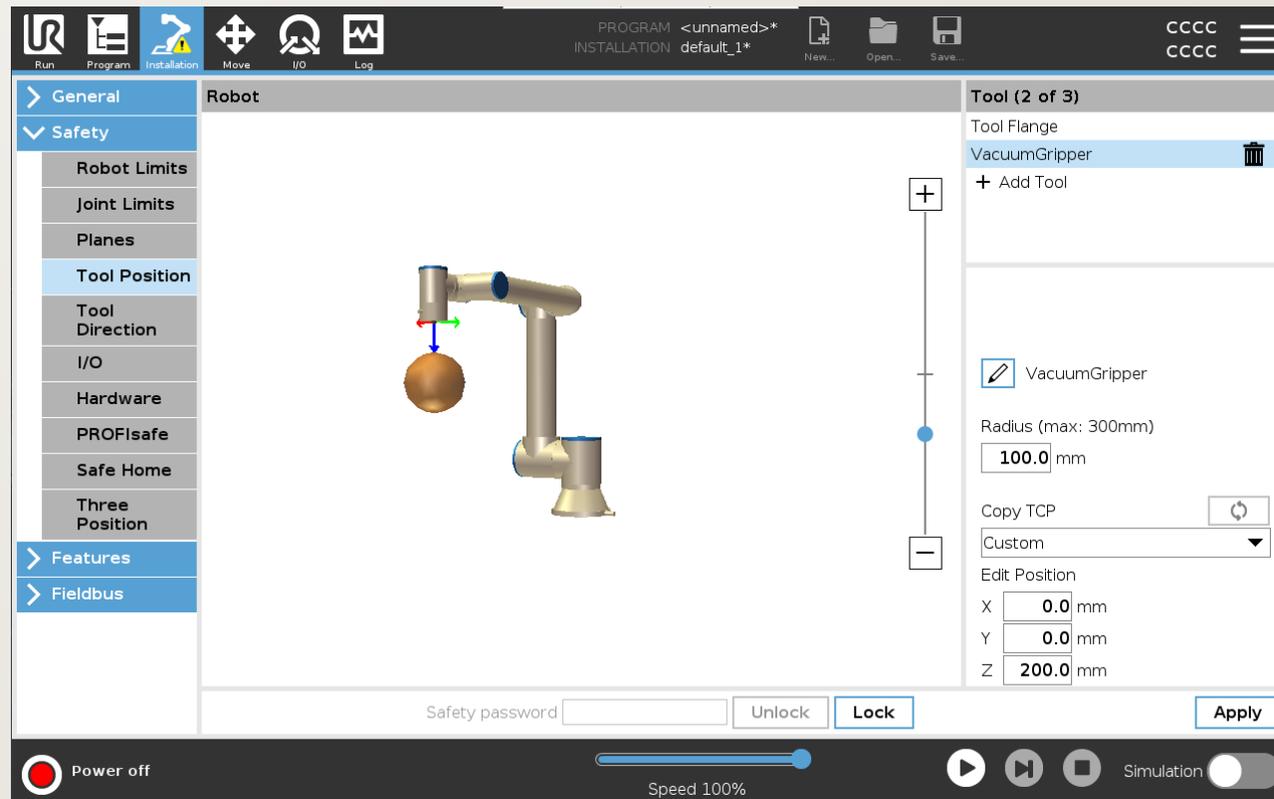
Edit the Radius and Position to match the tool attached to the robot.

In this example, we are setting a Radius of 100 mm and the TCP position to XYZ [0, 0, 200] in millimeters respectively.

If a TCP has already been configured in the ->General/TCP settings, you can copy it by selecting it in the drop-down menu under "Copy TCP".

Tap Apply in the bottom right corner of the screen, wait for the .

# Tool Position



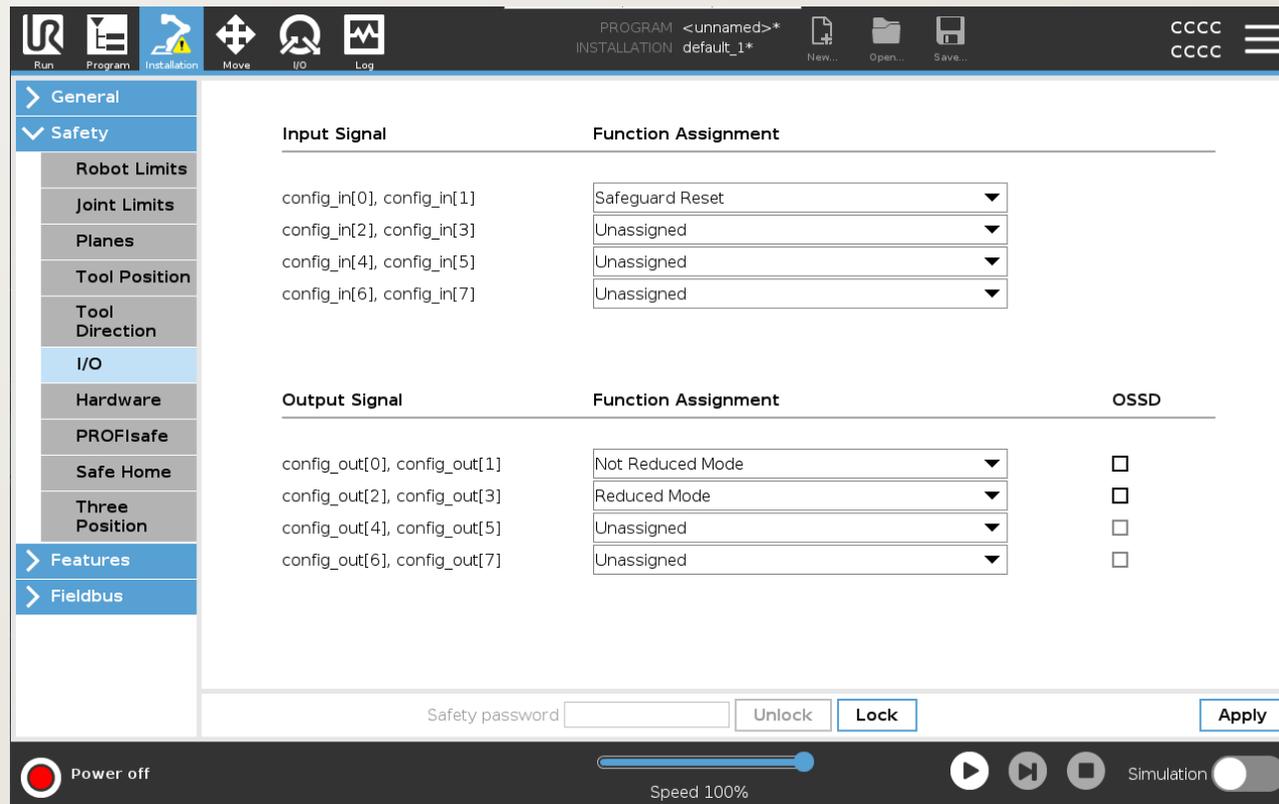
# (Dual Work Zones) Safety Settings

## I/O

The SICK nanoScan3 requires a complementary input to switch between fieldsets. To accommodate this, we'll use both Not Reduced Mode and Reduced Mode function assignments to tell if the robot is on either side of the trigger plane i.e. if it has triggered reduced mode or not.

For this example, the first pair of COs(config\_out[0] & config\_out[1]) is set to "Not Reduced Mode" and the second pair (config\_out[2] & config\_out[3]) is set to "Reduced Mode".

Tap "Apply" to apply the safety settings.



The screenshot shows the 'Safety' settings page in the Universal Robots software. The 'I/O' category is selected in the left sidebar. The main area is divided into two sections: 'Input Signal' and 'Output Signal'.

Input Signal	Function Assignment
config_in[0], config_in[1]	Safeguard Reset
config_in[2], config_in[3]	Unassigned
config_in[4], config_in[5]	Unassigned
config_in[6], config_in[7]	Unassigned

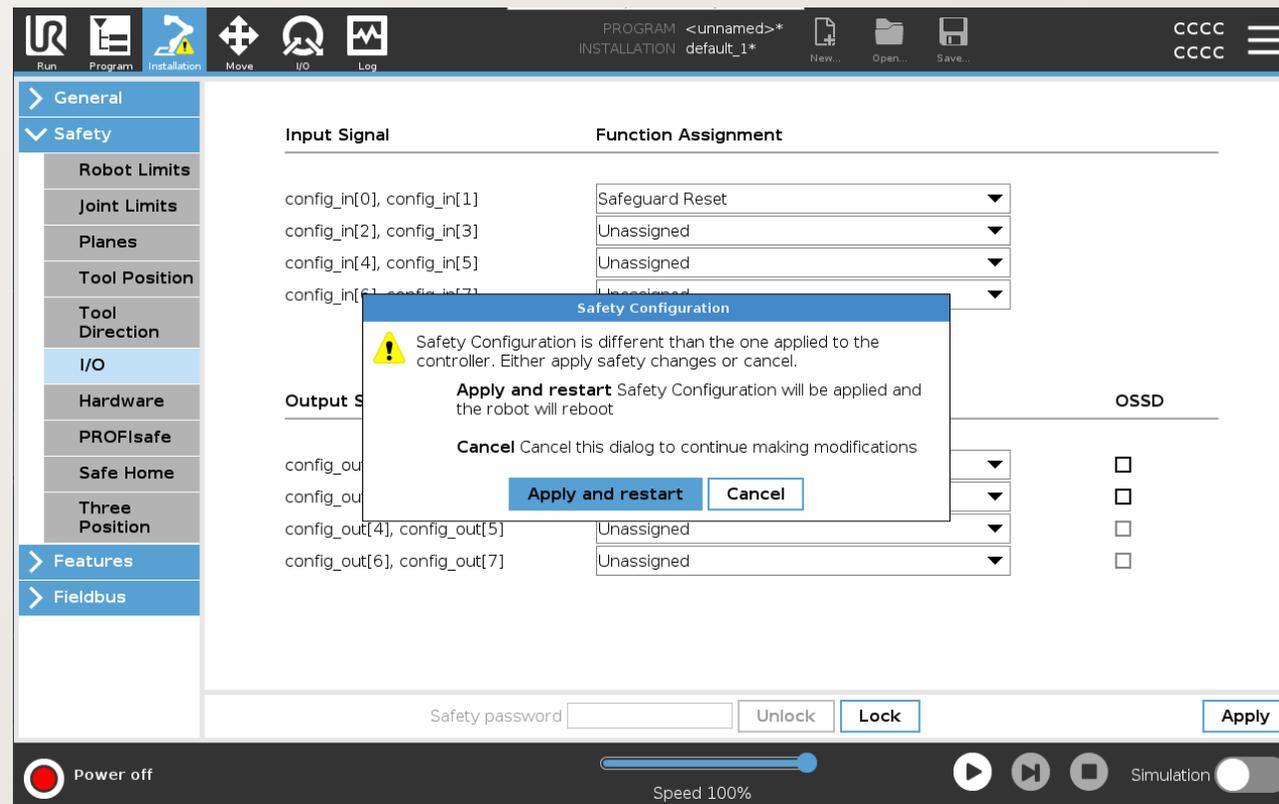
Output Signal	Function Assignment	OSSD
config_out[0], config_out[1]	Not Reduced Mode	<input type="checkbox"/>
config_out[2], config_out[3]	Reduced Mode	<input type="checkbox"/>
config_out[4], config_out[5]	Unassigned	<input type="checkbox"/>
config_out[6], config_out[7]	Unassigned	<input type="checkbox"/>

At the bottom of the screen, there is a 'Safety password' field, 'Unlock' and 'Lock' buttons, and an 'Apply' button. The status bar at the very bottom shows 'Power off', a speed slider at 100%, and a 'Simulation' toggle switch.

# (Dual Work Zones) Safety Settings

## I/O

When prompted, tap "Apply and restart"



The screenshot shows the I/O configuration screen in the Universal Robots software. A dialog box titled "Safety Configuration" is displayed in the center, warning that the current safety configuration differs from the one applied to the controller. The dialog offers two options: "Apply and restart" (which will apply changes and reboot the robot) and "Cancel" (which will allow the user to continue making modifications). The background interface shows a table for configuring input and output signals.

Input Signal	Function Assignment
config_in[0], config_in[1]	Safeguard Reset
config_in[2], config_in[3]	Unassigned
config_in[4], config_in[5]	Unassigned
config_in[6], config_in[7]	Unassigned

Output Signal	Function Assignment	OSSD
config_out[0], config_out[1]	Unassigned	<input type="checkbox"/>
config_out[2], config_out[3]	Unassigned	<input type="checkbox"/>
config_out[4], config_out[5]	Unassigned	<input type="checkbox"/>
config_out[6], config_out[7]	Unassigned	<input type="checkbox"/>

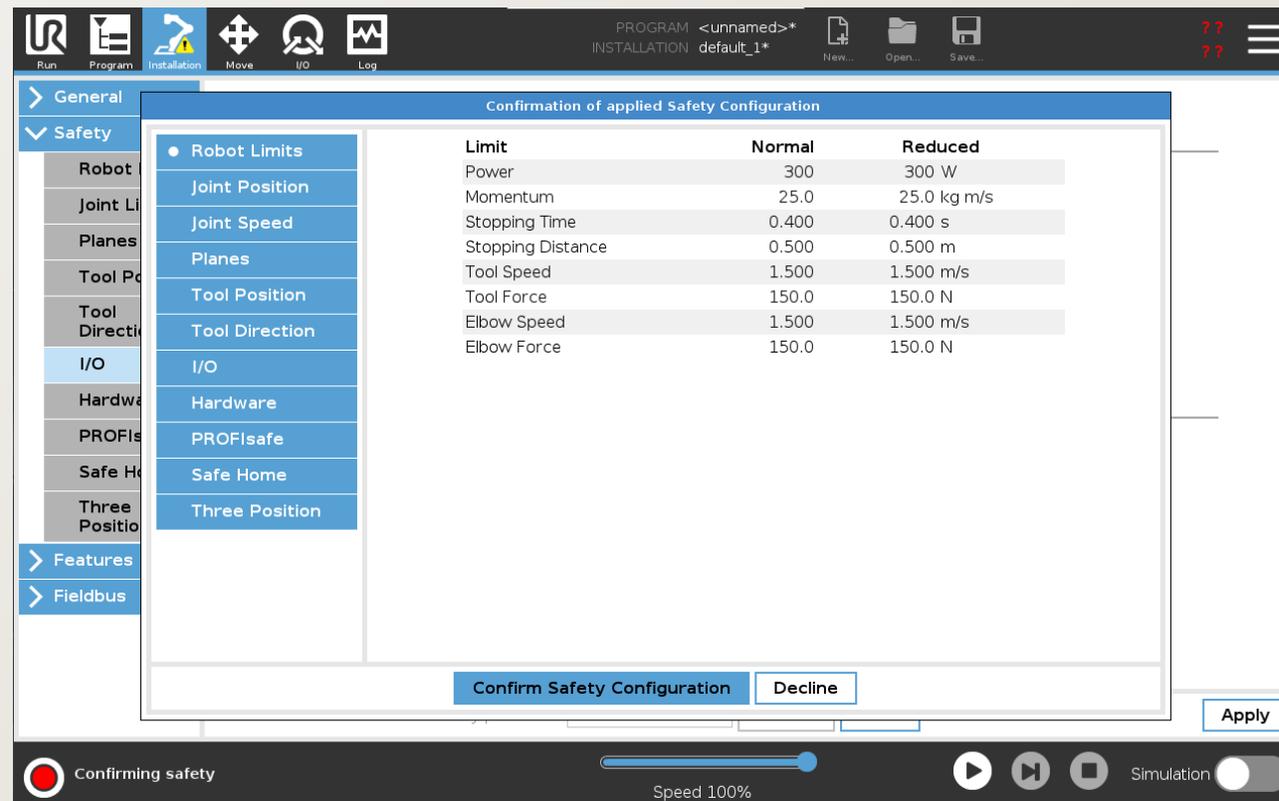
At the bottom of the screen, there is a "Safety password" field with "Unlock" and "Lock" buttons, and an "Apply" button. The status bar at the very bottom shows "Power off", a speed slider set to "Speed 100%", and a "Simulation" toggle switch.

# (Dual Work Zones) Safety Settings

## I/O

In the "Confirmation of applied Safety Configuration" popup, make sure to go through all the settings to confirm that everything is set correctly.

Then tap "Confirm Safety Configuration"



The screenshot shows the 'Confirmation of applied Safety Configuration' dialog box in the Universal Robots software. The dialog box is titled 'Confirmation of applied Safety Configuration' and contains a table of safety limits. The table has three columns: 'Limit', 'Normal', and 'Reduced'. The 'Reduced' column contains values with units. Below the table are buttons for 'Confirm Safety Configuration', 'Decline', and 'Apply'. The 'Confirm Safety Configuration' button is highlighted in blue.

Limit	Normal	Reduced
Power	300	300 W
Momentum	25.0	25.0 kg m/s
Stopping Time	0.400	0.400 s
Stopping Distance	0.500	0.500 m
Tool Speed	1.500	1.500 m/s
Tool Force	150.0	150.0 N
Elbow Speed	1.500	1.500 m/s
Elbow Force	150.0	150.0 N

(Dual Work Zones)

# Offsetting the Trigger Plane

When the Tool Position sphere comes into contact with the trigger plane, the robot goes from "Normal" to "Reduced" mode. This results in the robot entering reduced mode before the TCP reaches the plane with a distance  $d$  equal to the radius of the sphere.

When the sphere moves from "Reduced" to "Normal", the sphere needs to clear the plane completely, before the robot enters "Normal" mode again.

Because of this, you might want to consider offsetting the plane by the radius of the sphere to obtain a more intuitive behavior.

# Tool Position Sphere

The screenshot displays the Universal Robots software interface. At the top, there are icons for Run, Program, Installation, Move, I/O, and Log. The main window is divided into several sections:

- TCP Position:** Shows a 3D coordinate system with axes Z+, Z-, X-, X+, Y-, and Y+.
- TCP Orientation:** Shows a 3D coordinate system with axes RZ+, RZ-, RY-, RY+, RX+, and RX-.
- Robot:** Shows the active TCP (Tool Center Point) and the robot's current position.
- Tool Position:** Displays the current tool position in millimeters and radians:
 

X	708.24 mm	RX	1.942 rad
Y	-107.28 mm	RY	-2.460 rad
Z	670.85 mm	RZ	-0.012 rad
- Joint Position:** Displays the current joint positions in degrees:
 

Base	5.39 °
Shoulder	-90.48 °
Elbow	-89.98 °
Wrist 1	-90.15 °
Wrist 2	89.90 °
Wrist 3	18.80 °

At the bottom, there are buttons for Home, Align, and FreeDrive. A speed slider is set to 100%. The Simulation toggle is turned off. Below the screenshot, there are two radio buttons: "Normal" (selected) and "Reduced".

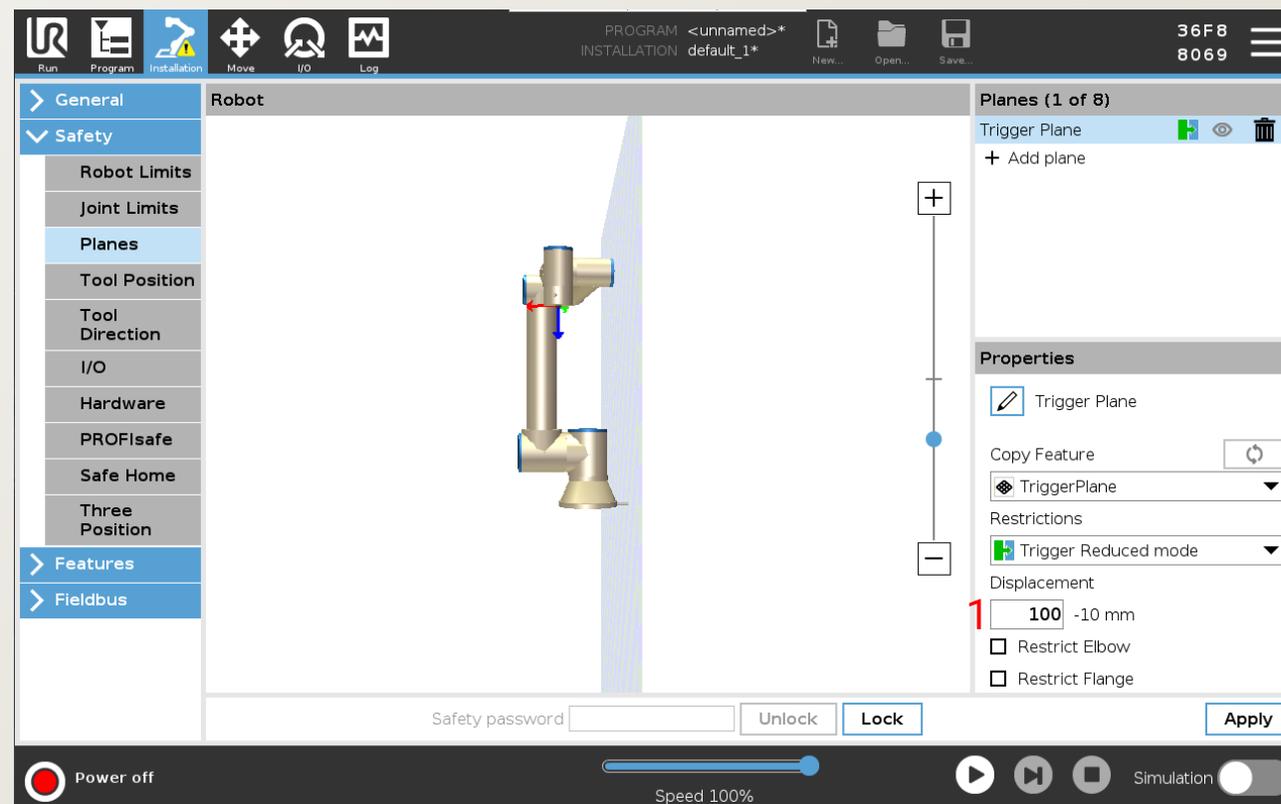
(Dual Work Zones)

# Safety Settings

To do this, go back to Installation->Safety->Planes and unlock the safety settings.

1. In the "Displacement" input field, enter the radius of the Tool Sphere.
2. Tap "Apply" and confirm the safety settings again.

# Planes

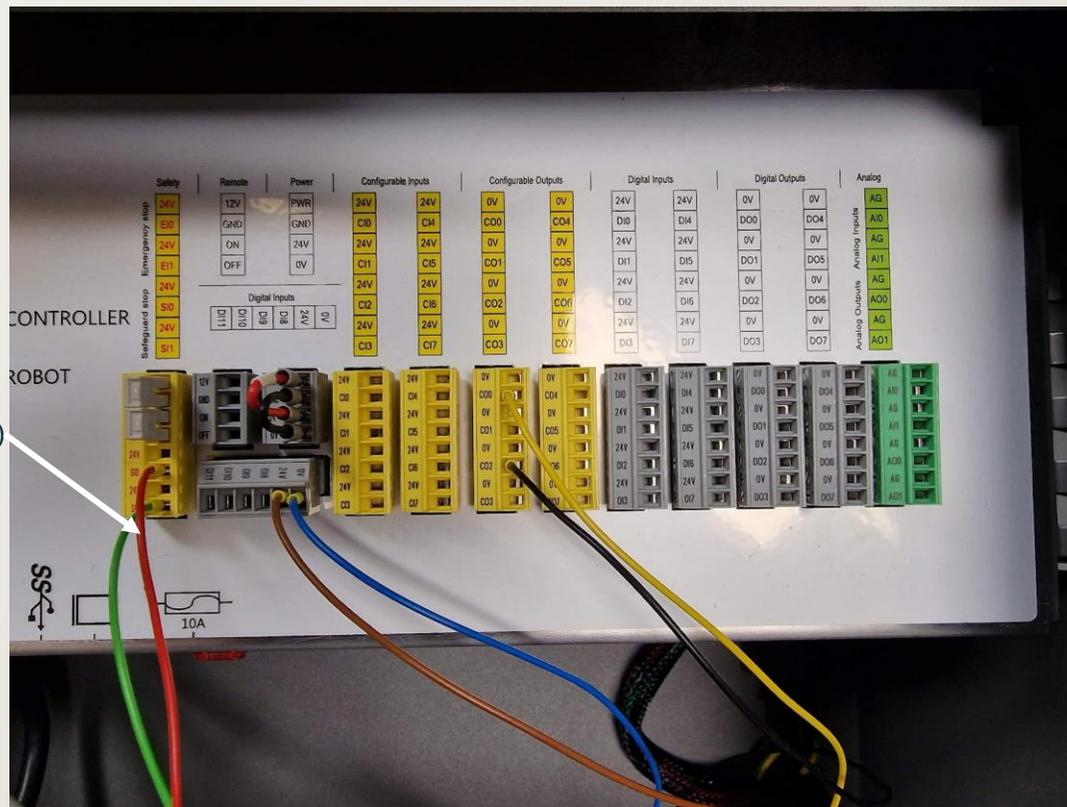
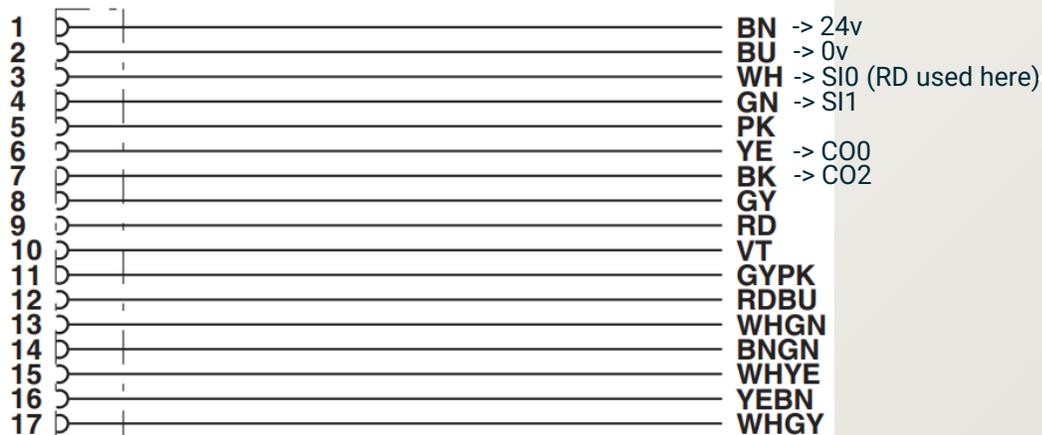


# (Dual Work Zones) Wiring

## I/O

If you do not have an original cable for the SICK nanoScan3, then you can use individual wires, which have also been used in this example. This is why a red(RD) wire has been used instead of a white (WH) wire.

Circuit diagram



(Dual Work Zones)

# SICK Safety Designer

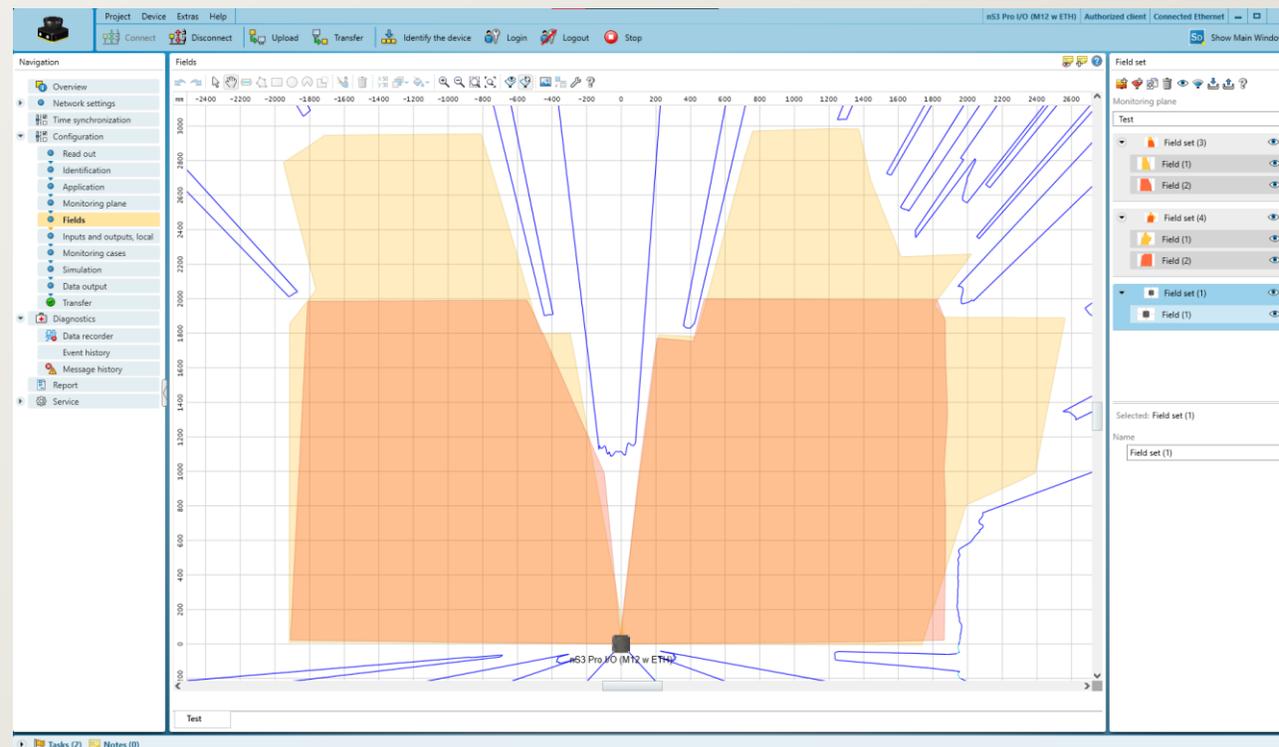
## NOTE!

Refer to the documentation of the particular scanner you are using for information on how to configure it correctly.

We have used the SICK nanoScan3 in our example, so you can skip the following pages if they don't apply to you.

The warning fields are redundant in this example, but can still be used to set the configurable outputs on the nanoScan3 to, e.g. a signal tower or similar.

## Fields



(Dual Work Zones)

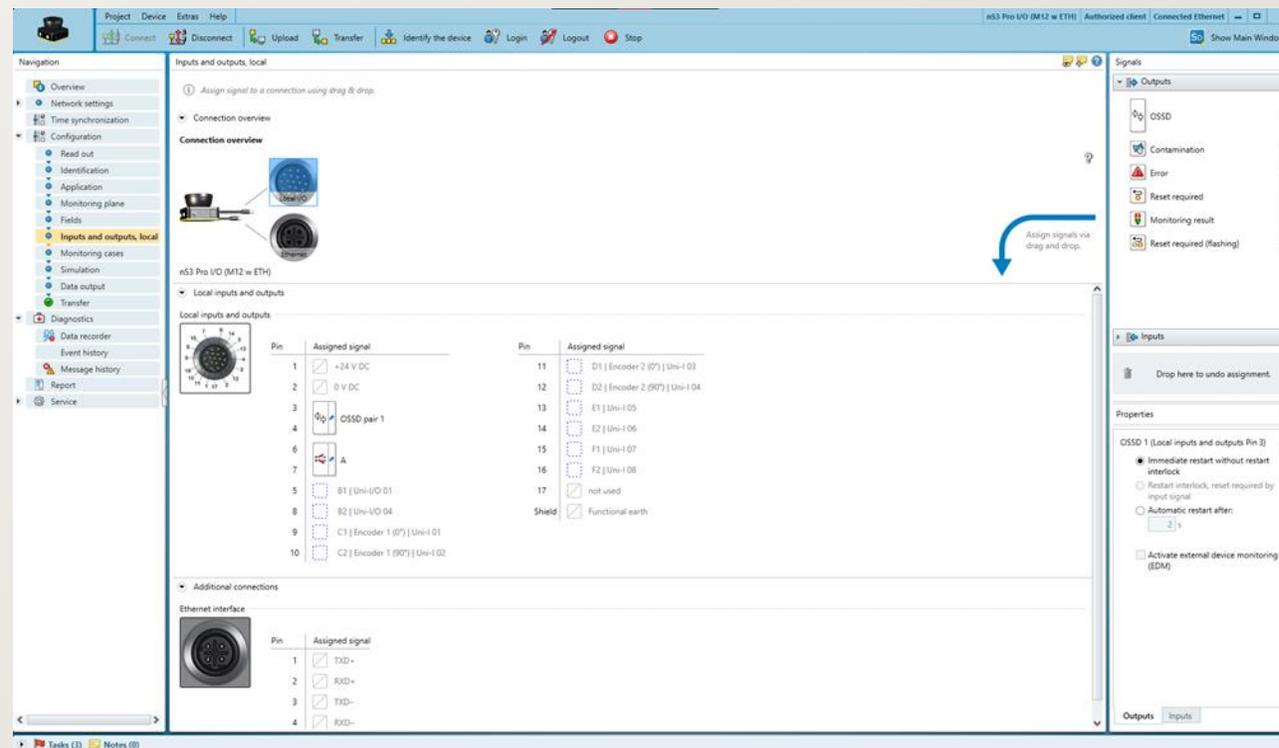
# SICK Safety Designer

# I/O

A static control input consists of 2 channels. The channels of a static control input are switched inversely. The following table shows which status the static control input's channels must have to define logical input conditions 1 and 0 at the relevant control input.

This is why both "Not Reduced Mode" and "Reduced Mode" Function Assignments are used in the robot safety I/O settings.

A1	A2	Logical input status (input A)
1	0	0
0	1	1
1	1	Error
0	0	Error



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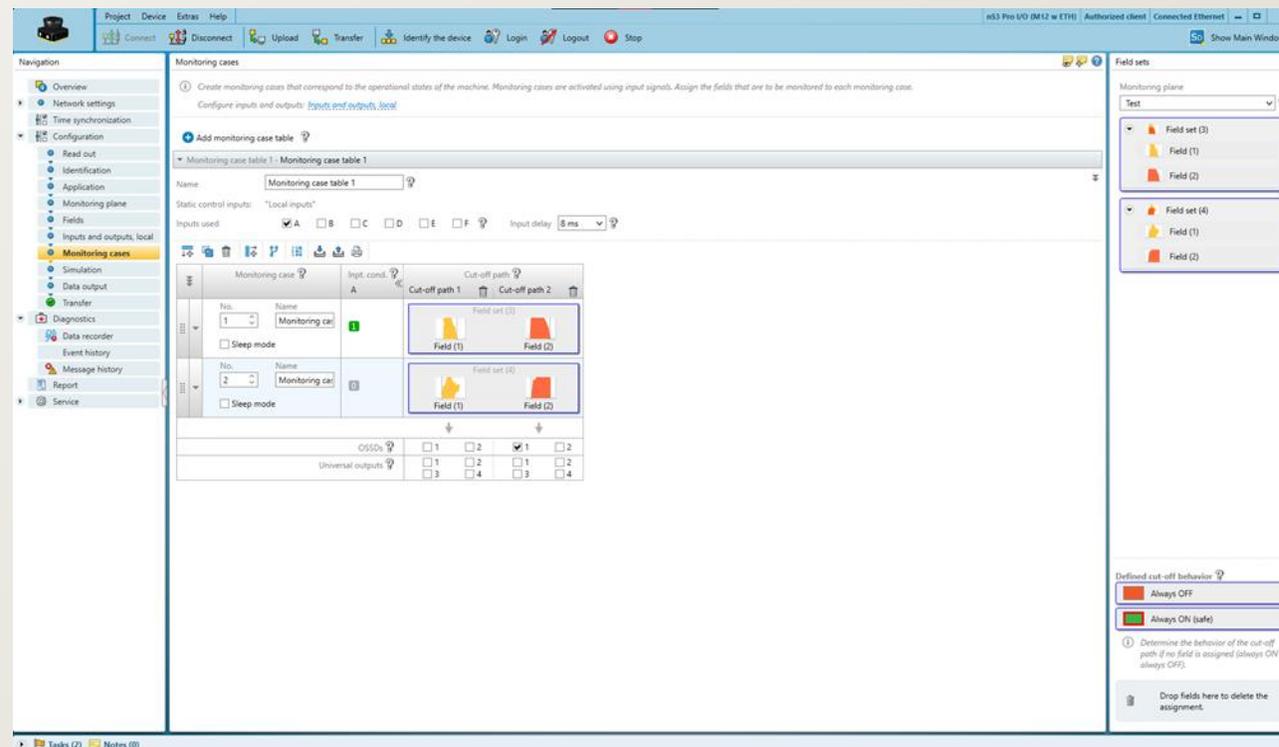
(Dual Work Zones)

# SICK Safety Designer

Here we see that the yellow Warning fields aren't used for anything.

Only the orange/red Protective fields are used to set the OSSD signal pair to LOW, thereby triggering a safeguard stop of the robot.

## Monitoring Cases



A	Field set 3	Field set 4
1	Active	NOT Active
0	NOT Active	Active