Cobot Lift User Manual

INCREASING YOUR PAYLOAD

Cobot Lift

Cobot Lift | Denmark | 15.01.2021

CONTENT

1.0 INTRODUCTION

Congratulations with your Cobot Lift!

The information contained in this manual is the property of Cobot Lift ApS. The information herein is subject to change without notice. This manual is periodically reviewed and revised. Cobot Lift ApS assumes no responsibility for any errors or omissions in this document.

IMPORTANT

The Cobot Lift system is a partly completed machinery and as such a risk assessment is required for each installation. A risk assessment must include (but not be limited to) all the safety instructions in this manual.

This manual contains important safety information, which must be read and understood by the integrator of Universal Robots/Cobot Lift before the system/robot is powered on for the first time. It is essential to observe and follow all assembly instructions and guidance provided in other chapters and parts of this manual.
The information in this manual does not cover a complete robot application, nor does it cover all peripheral equipment that can influence the safety of the complete system. The complete system must be designed and installed in accordance with the safety requirements set forth in the standards and regulations of the country where the robot is installed.

The integrators of Universal Robot/Cobot Lift are responsible for ensuring that the applicable safety laws and regulations in the country concerned are observed and that any significant hazards in the complete robot application are eliminated.
This includes, but is not limited to:

- Performing a risk assessment for the complete robot system (UR robot, end-effector, Cobot Lift tool, vacuum tube lift)
- Interfacing other machines and additional safety devices if defined by the risk assessment
- Setting up the appropriate safety settings in the software
- Ensuring that the user will not modify any safety measures
- Validating that the total robot system (UR robot, end-effector, Cobot Lift tool, vacuum tube lift) is designed and installed correctly
- Specifying instructions for use
- Marking the robot installation with relevant signs and contact information of the integrator
- Collecting all documentation in a technical file; including the risk assessment and this manual

Any safety information provided in this manual must not be construed as a warranty, by Cobot Lift, that the system will not cause injury or damage, even if it complies with all safety instructions.
UR robots are equipped with special safety-related features, which are purposely designed to enable collaborative operation, where the robot system operates without fences and/or together with a human. Collaborative operation is only intended for non-hazardous applications, where the complete application, including tool/end effector, work piece, obstacles and other machines, is without any significant hazards according to the risk assessment of the specific application. This also applies when used in combination with a Cobot Lift.

2.0 GENERAL DESCRIPTION OF THE COBOT LIFT

The Cobot Lift is a hybrid of several existing technologies, taking the best from each innovation. The collaborate robot technology comes from an UR Robot and the lifting force comes from a conventional vacuum lift. The result is a collaborate application that can lift items up to 25kg while still being able to run without shielding.

In other words, we let the Cobot solve the automation task, while the vacuum lifter does all the lifting. In order to get these two technologies to work together, we have developed a unique and patented interlocking tool – the Cobot Lift. This tool enables the Cobot to move the vacuum lifter horizontally without being affected by the weight of the load vertically.

2.1 INSTALLATION OF THE COBOT LIFT

A complete installation with the Cobot Lift tool consists of minimum 4 parts:

1. A Cobot Lift tool with slider, control box, rubber dampers and possibly extra order-specific accessories (like indicatorlamps, pillar for robot, external control screen etc.).

2. An end-effector (e,g, a suction pad for the vacuum lifter).

3. A vacuum tube lifter including pillar, swing arm, vacuum pump with filter and suction hose and frequency converter.

4. A UR10 from Universal Robots.

The vacuum lifter is mounted according to the supplier's instructions (please note requirements for the floor, to ensure secure mounting). The Cobot is mounted approx. 50cm from the pillar (on a separate pillar or possibly mounted on the vacuum lifter column with an arm). The Cobot Lift tool is connected to the vacuum hose and mounted on the Cobot. The control box and extra accessories are connected according to the instructions, and the system is ready for start-up.

2.2 BEFORE USE

Before using the Cobot Lift, some important adjustments must be made (See detailed instructions below). In the main, the movements of the Cobot must be limited, ie. since the load can only be lifted vertically, the robot's TCP (tool center point) must be told not to deviate more than 20 degrees on the vertical axis to prevent overloading.

In addition, in the robot's safety settings, rotation must be limited in relation to the coupling tool, to protect fingers and hands from pinching/crushing hazards.

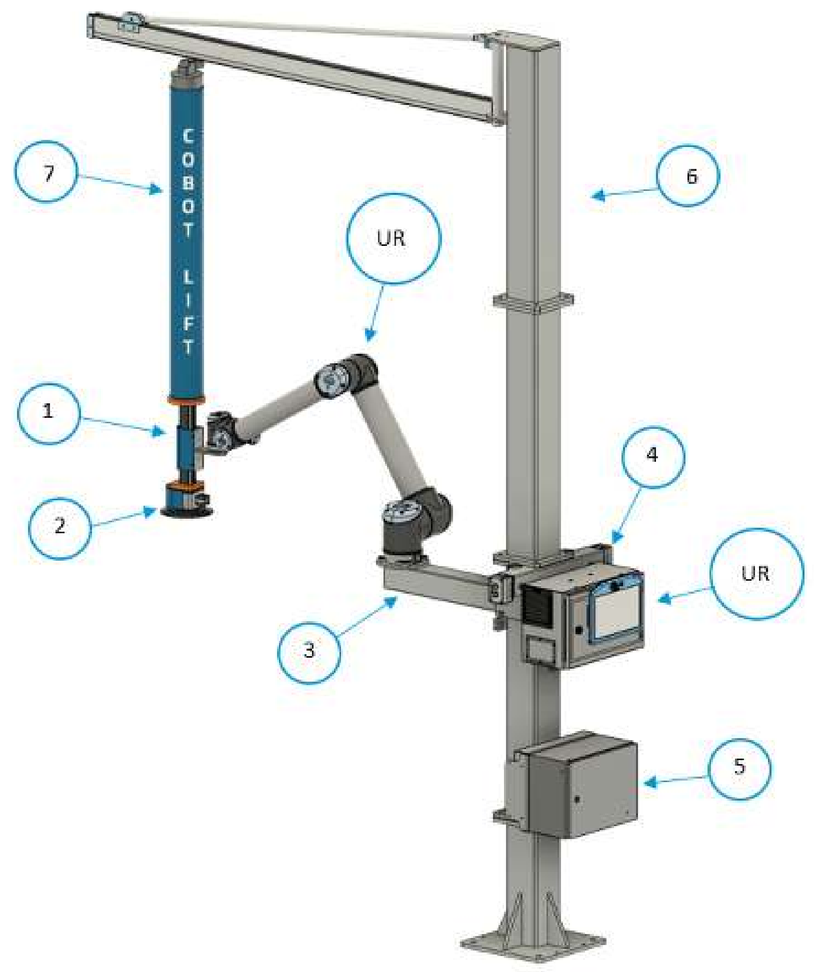
Now load the small USB via the robot's teach pendant and select URCap (a program called Cobot Lift). By clicking the small icon, a program for controlling the robot is loaded. This program broadly constitutes the backbone of the final programming and will help you create programs to fit the current task. This is done to ensure easy and quick programming/ installation.

NOTE

Before using the equipment, a comprehensive risk assessment of the entire solution must be carried out according to the Machinery Directive, and a final CE marking of the system must be made. Should the risk assessment show that extra emergency stops/safety scanners or similar are required in the current situation, these can be connected to the robot's emergency stop circuit (see the robot manual for correct connection to the emergency stop circuit).

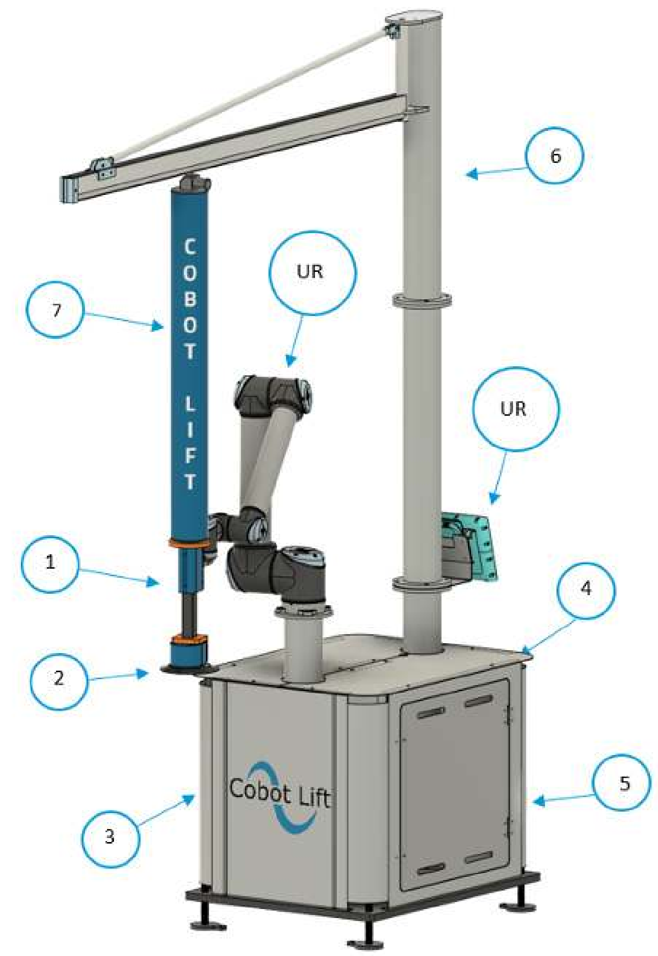
3.0 SCOPE OF SUPPLY

Stationary
Cobot Lift



	Cobot Lift Tool	Stationary Cobot Lift	Mobile Cobot Lift
1	Cobot Lift tool (Patented)		
2	Release valve, electrically controlled from robot excl. end effector		
3	Mounting arm for robot, including flanges for robot and column		Steel cabinet with solid bottom plate for maximum stability with electrical components for robot controller
4	Status indicator with button and light- 2pcs.		
5	Cobot Lift Control box with electrical components		
6		Modular column with brackets for electrical cabinet, UR controller cabinet and teach pendant	Modular column with brackets for UR teach pendant
7		Vacuum tube lifter including vacuum tube, vacuum pump and frequency converter	
Preprogrammed software to simplify required installation programming (URCap). Documentation incl. parts lists, user manual and installation guidance.			

Mobile
Cobot Lift



	Cobot Lift Tool	Stationary Cobot Lift	Mobile Cobot Lift
1	Cobot Lift tool (Patented)		
2	Release valve, electrically controlled from robot excl. end effector		
3	Mounting arm for robot, including flanges for robot and column		Steel cabinet with solid bottom plate for maximum stability with electrical components for robot controller
4	Status indicator with button and light- 2pcs.		
5	Cobot Lift Control box with electrical components		
6		Modular column with brackets for electrical cab-inet, UR controller cabinet and teach pendant	Modular column with brackets for UR teach pendant
7		Vacuum tube lifter including vacuum tube, vacuum pump and frequency converter	
Preprogrammed software to simplify required installation programming (URCap). Doc-umentation incl. parts lists, user manual and installation guidance.			

NOTE

(UR) Universal Robot with controller can be bought locally. Tube lifter and customer specific suction cup has to specified when ordering the Cobot Lift. To be priced/sold separately: Touch screen for easy operation customized to the palletizing solution.

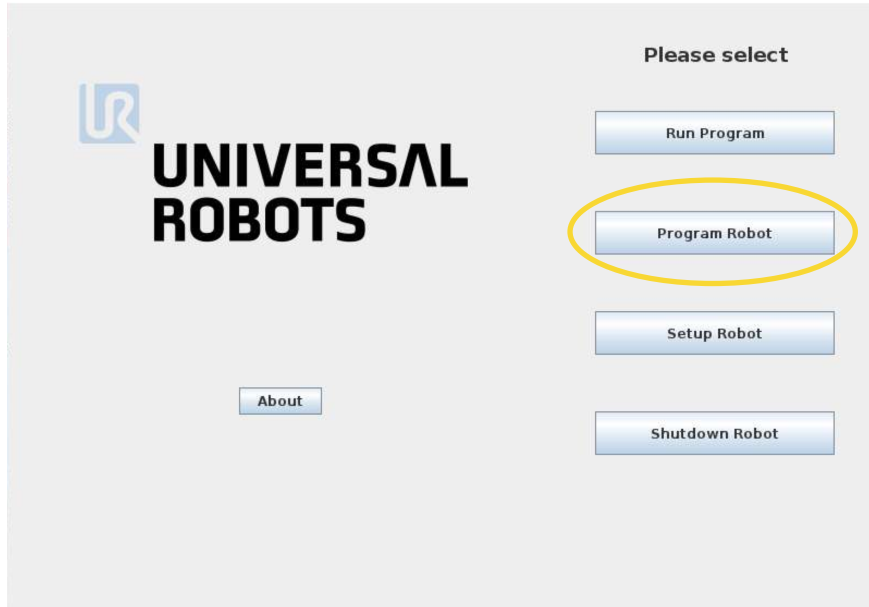
4.0 SAFETY SETTINGS

Before starting the production, it is important to make some general safety settings of the robot. First off, the TCP must be set. Secondly, the vertical orientation of the tool must be limited to avoid unnecessary forces to the robot. And to make sure the Cobot Lift tool does not reach an angle where pinching of a finger is possible, you can set the robot tool orientation limits like described.

So please follow this “safety-settings-guide” to the end, before you start running the system.

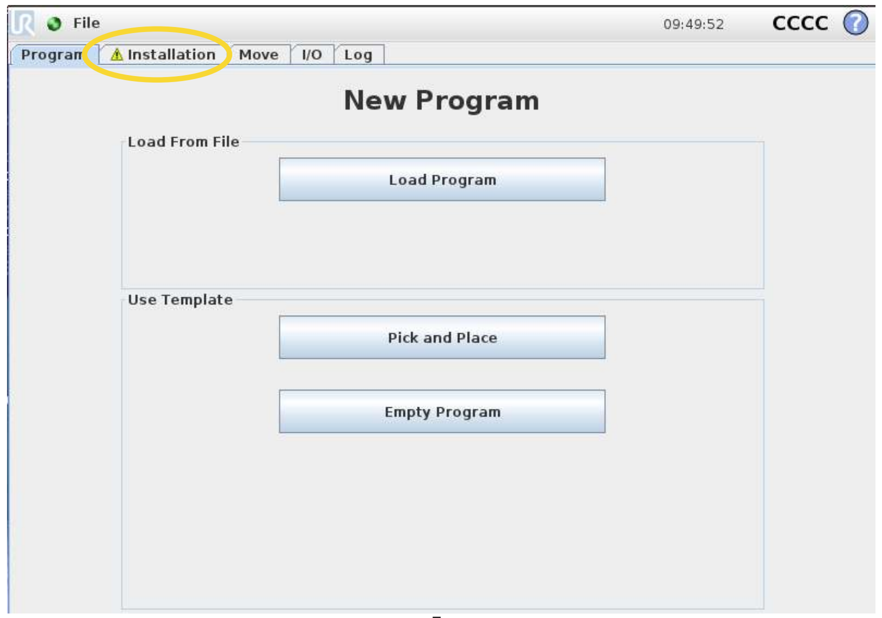
Step 1

Select **Program Robot**.



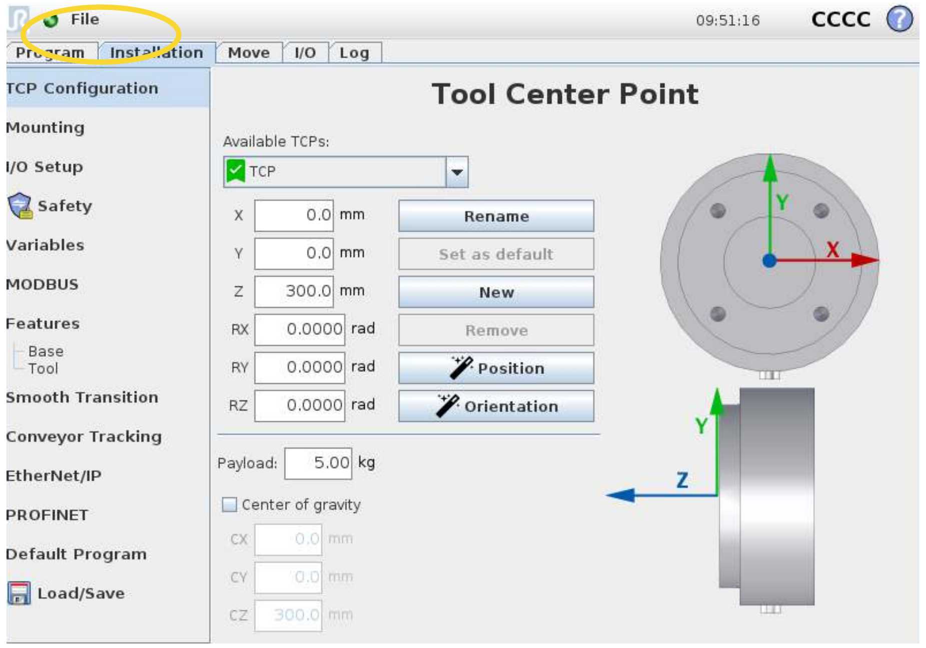
Step 2

Choose **Installation**.



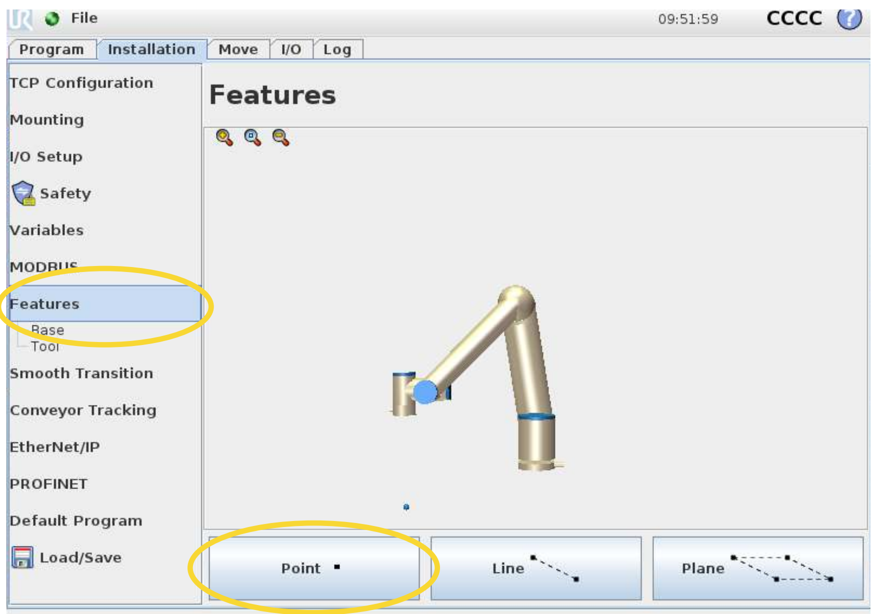
Step 3

Select the **TCP Configuration** tab and enter the Z value at ex. 300.00 mm. Values will vary from one tool/application. X and Y values are set as usual when setting up the robot. In this case Y is -140mm. Payload is typically set between 4 and 6 kg.



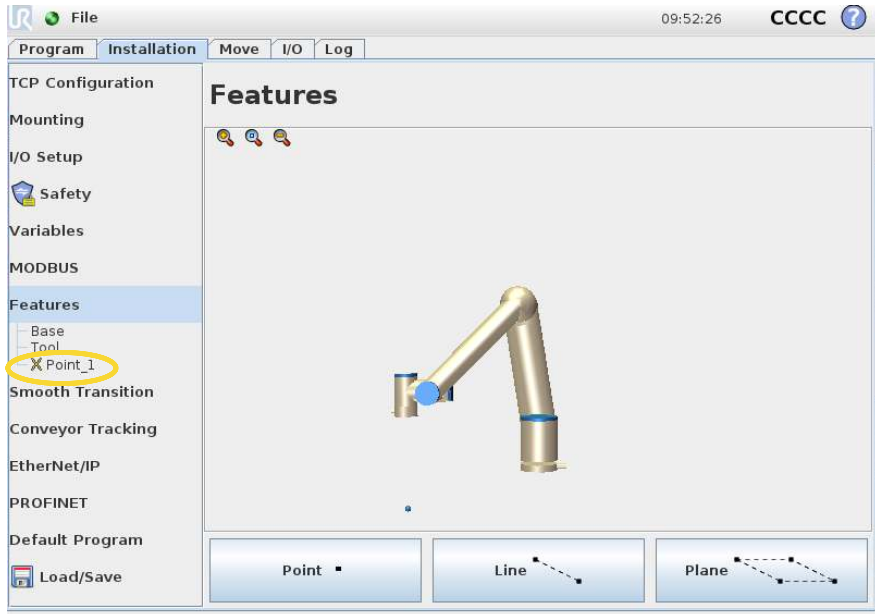
Step 4

Select the **Features** tab and then **Point**.



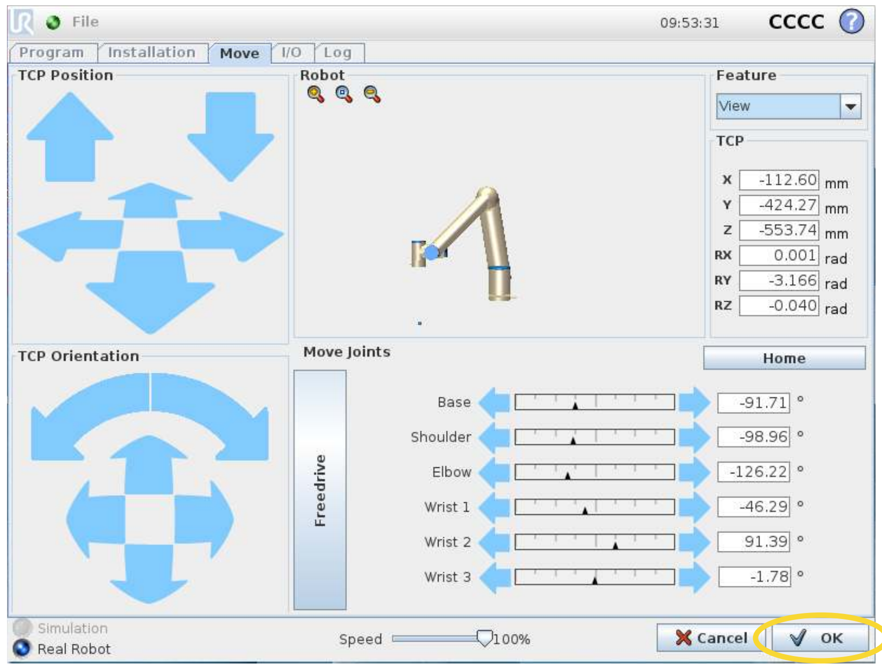
Step 5

Select **Point 1**.



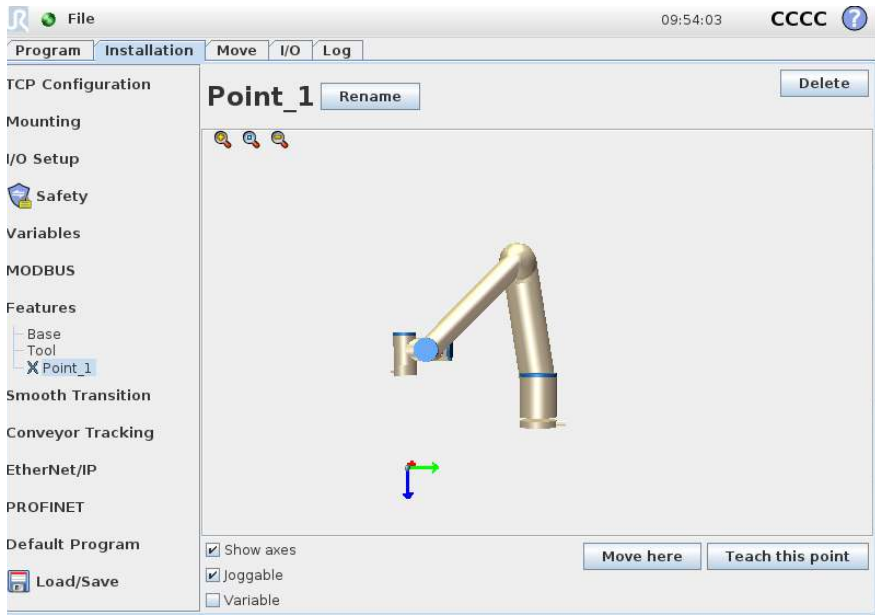
Step 6

Select **OK**.



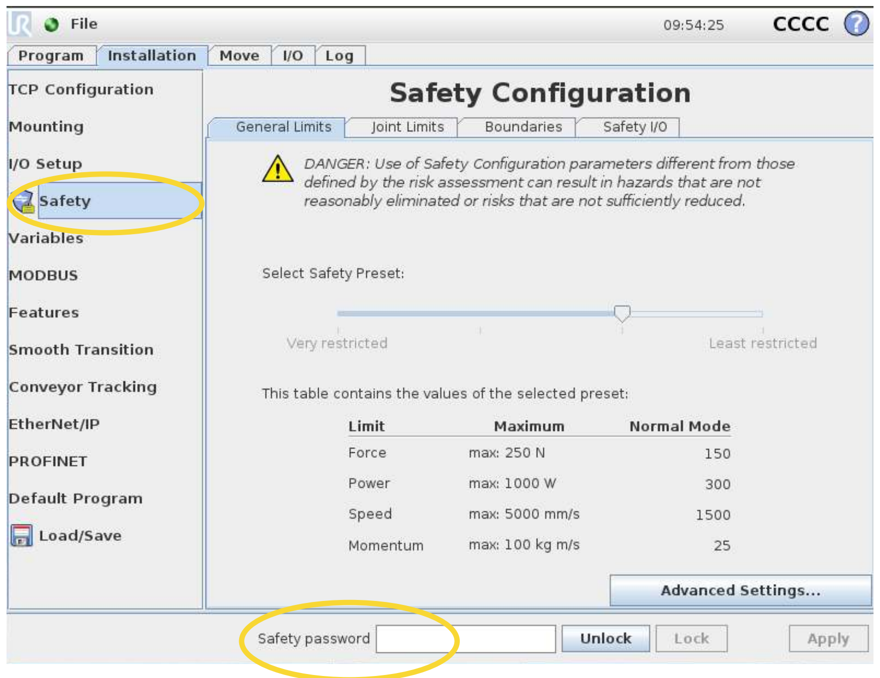
Step 7

You can now see the points you have chosen.



Step 8

Pick **Safety** and select the **Safety password** box.

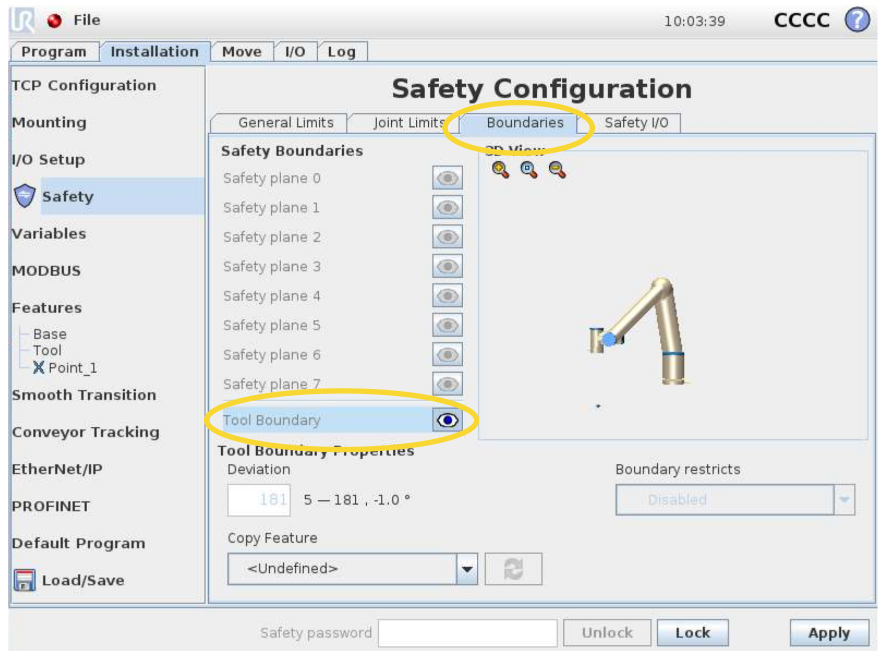


Step 9

Type your safety password.

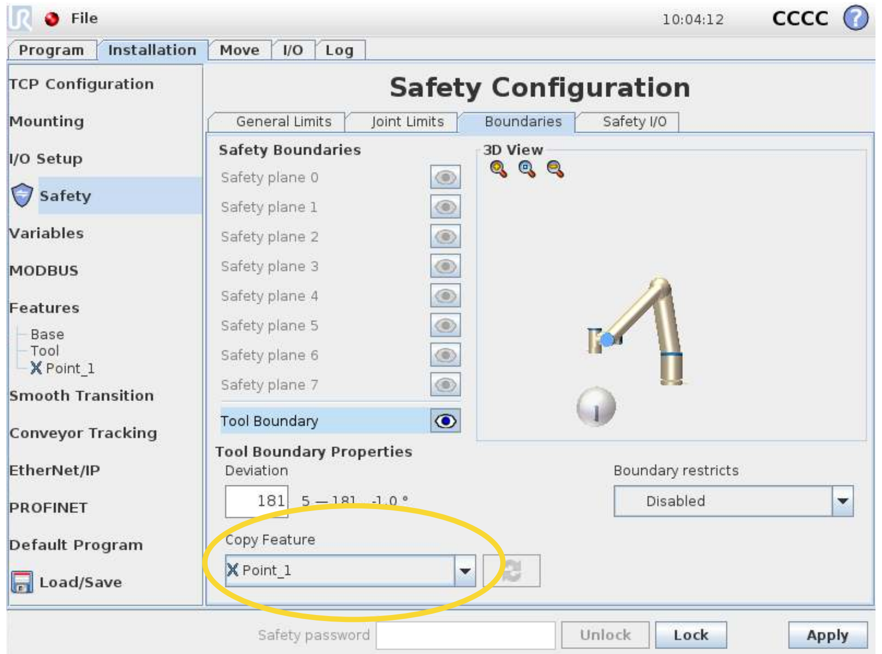
Step 10

Select **Boundaries** and then **Tool Boundary**.



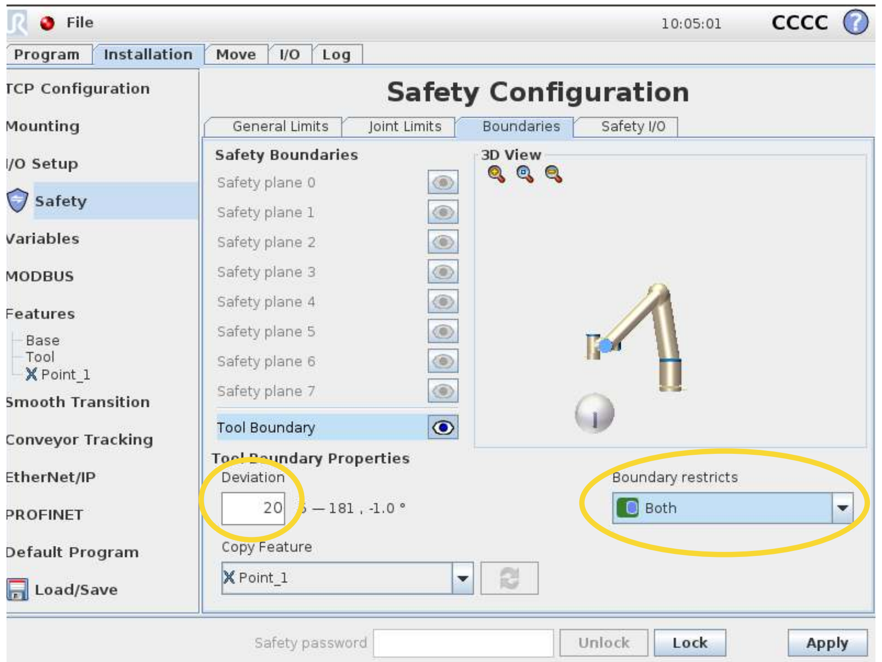
Step 11

In **Copy Feature** select **Point 1**.



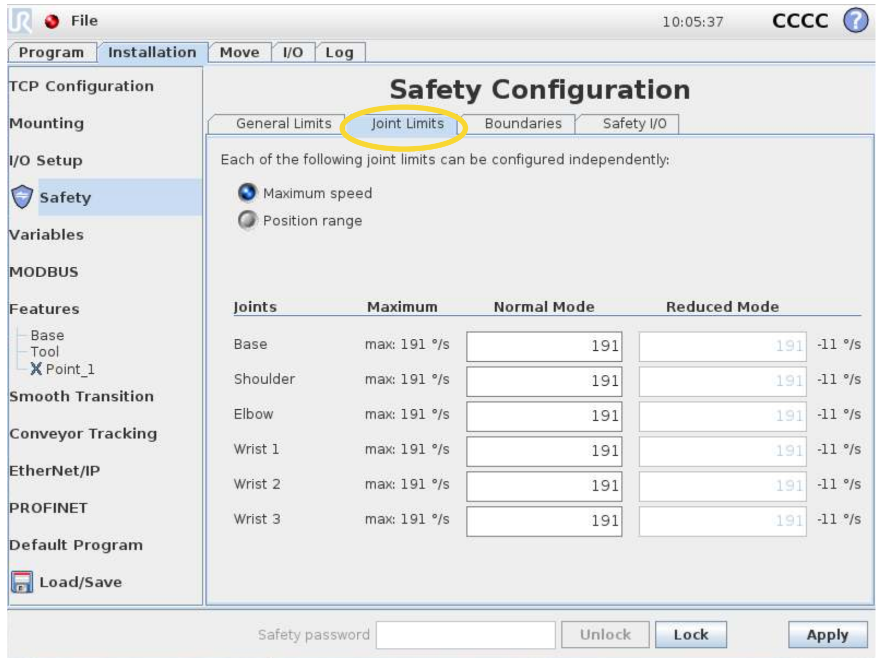
Step 12

In **Boundary restricts** select **Both** and in **Deviation** type in **20**. Now the robot will only be able to make small deviations in the vertical direction. This means the tools orientation will always be close to vertical, to avoid unnecessary forces to the robot.



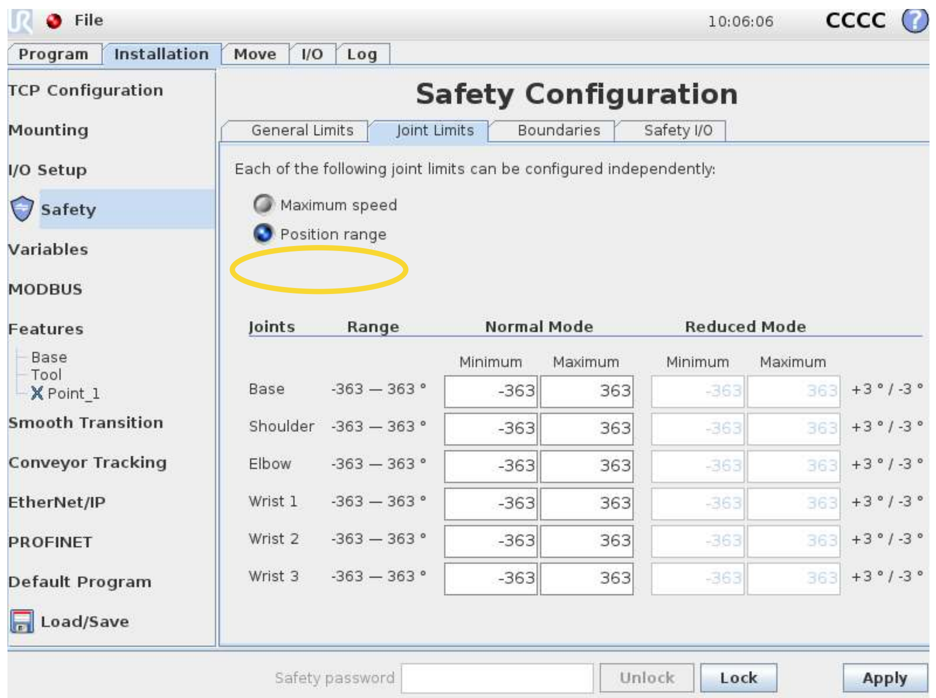
Step 13

Select the **Joint Limits** tab.



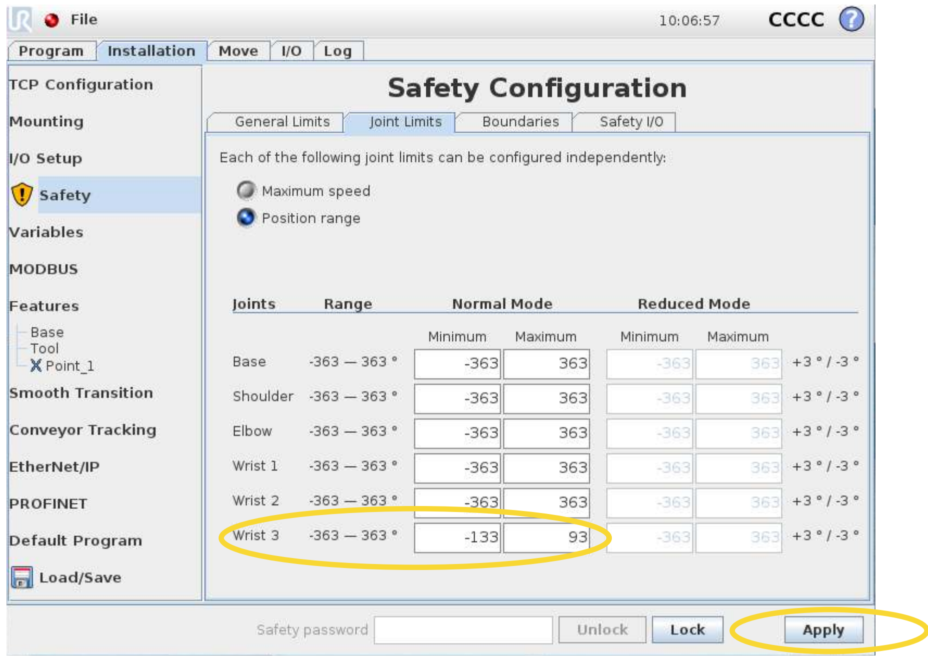
Step 14

Select **Position range**.



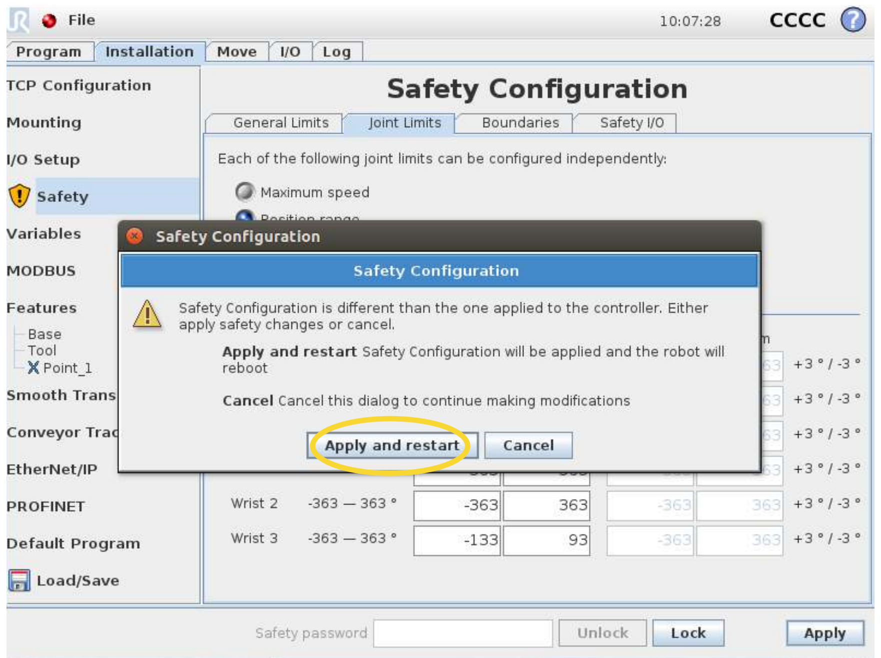
Step 15

If the Cobot Lift is positioned straight forward, like shown on the picture below with the electrical connector facing forward. Set **Wrist 3** to ex. -133 and 93. Value will, however, depend on how the tool is mounted on the robot tool flange and a small test before setting the value would be preferable. Then click **Apply** in the bottom right corner. The idea is to avoid pinching, but also maintain maximum possible rotation, so please adjust value to match the best compromise.



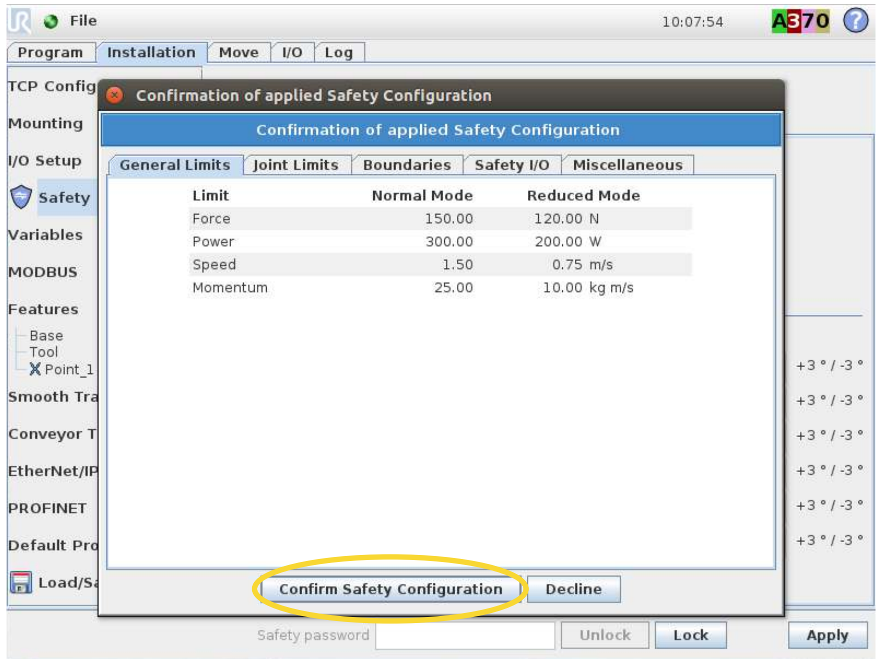
Step 16

This pop-up will now appear. Select **Apply and restart**.



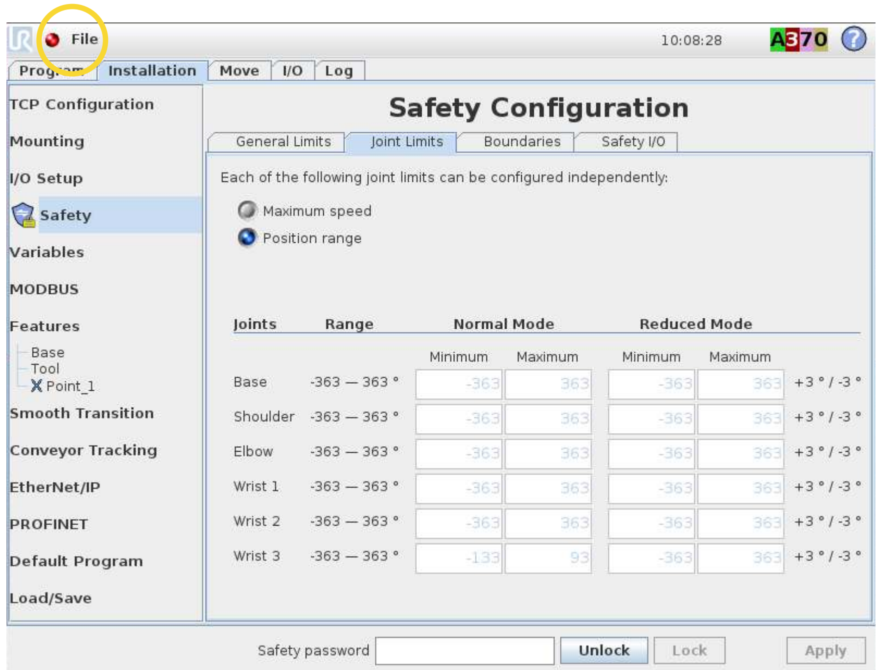
Step 17

Select **Confirm Safety Configuration**.



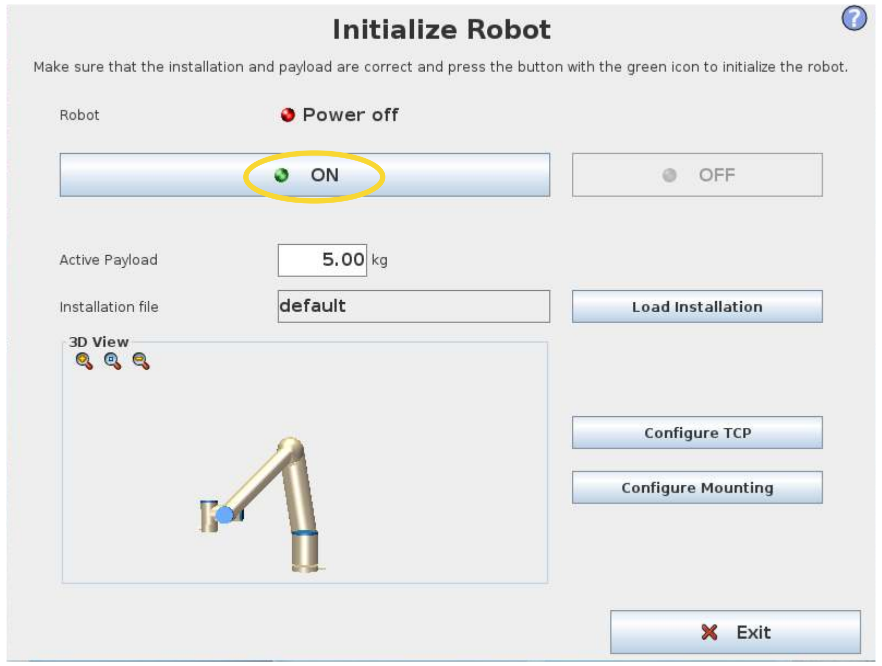
Step 18

Restart the robot by clicking the red dot in the left corner.



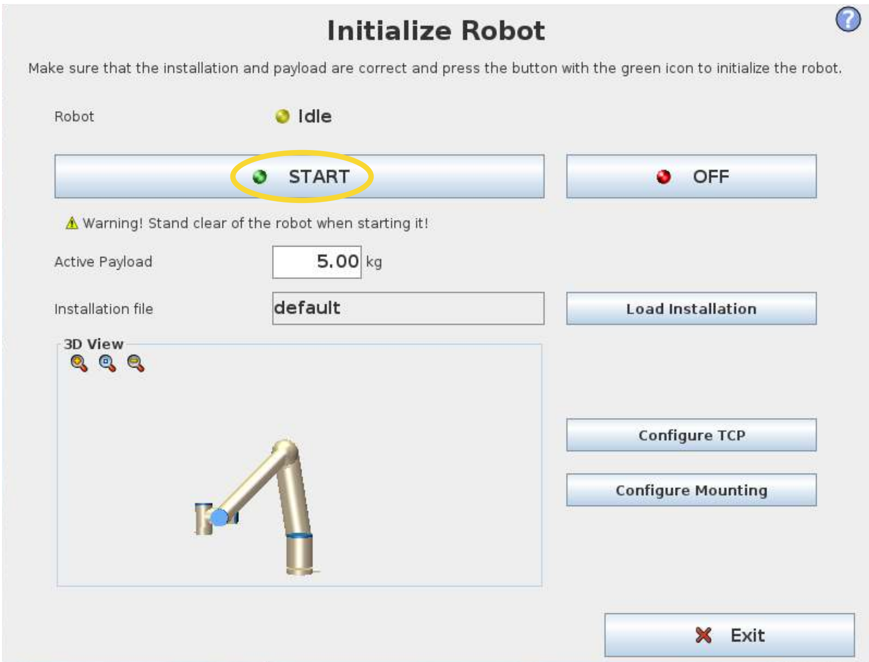
Step 19

Now select **ON**.



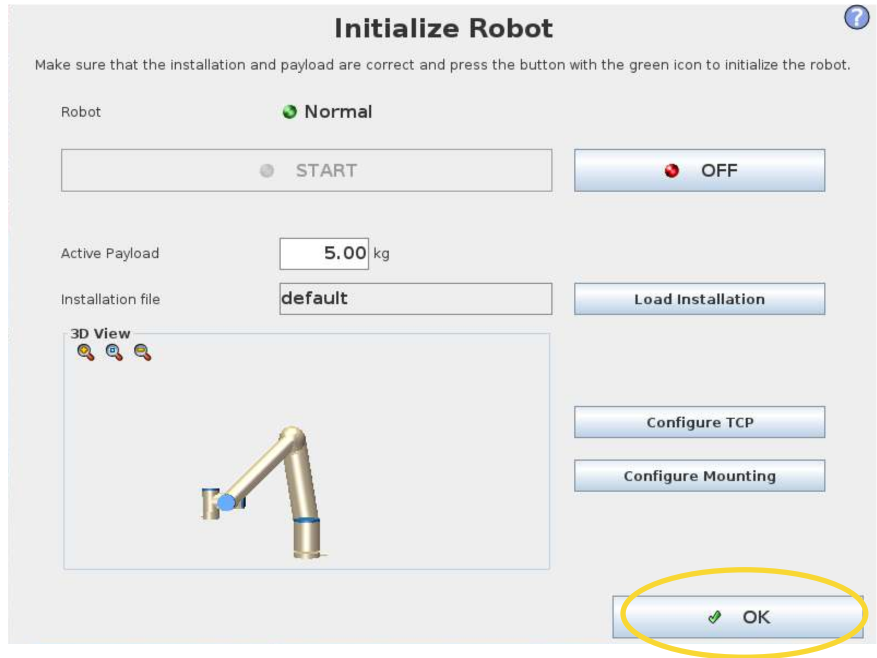
Step 20

Click **START**.



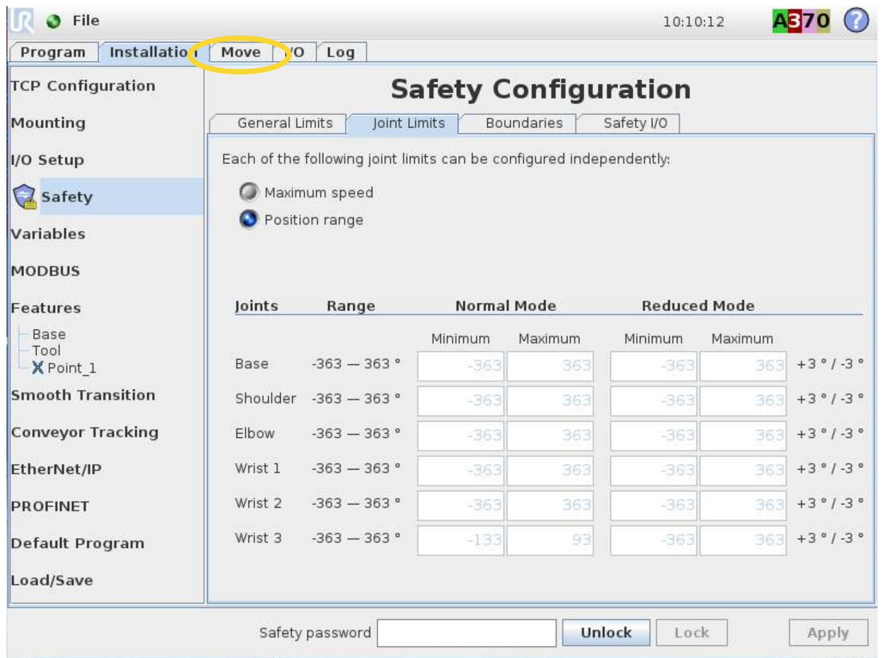
Step 21

Click **OK** in the bottom right corner.



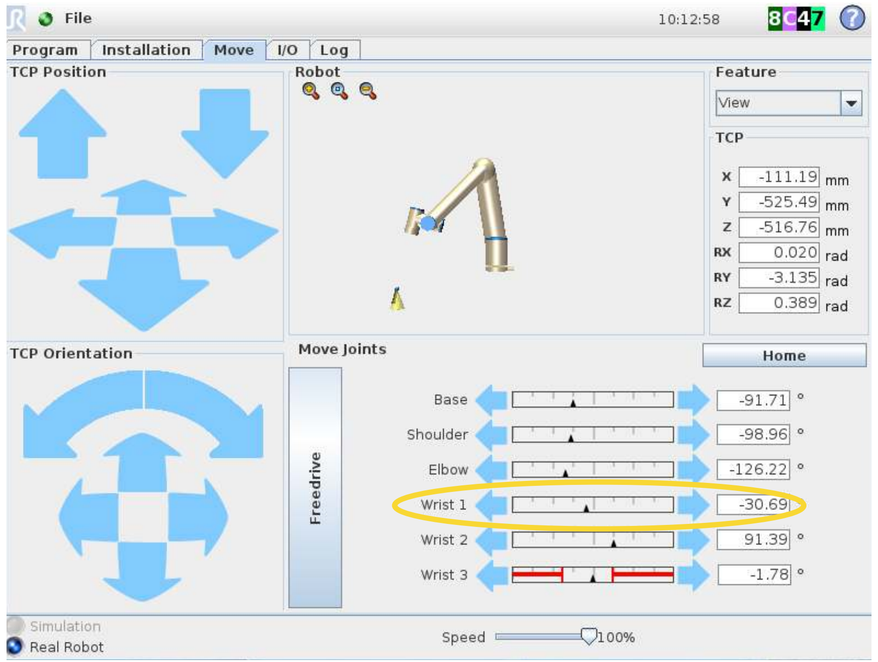
Step 22

Select the **Move** tab



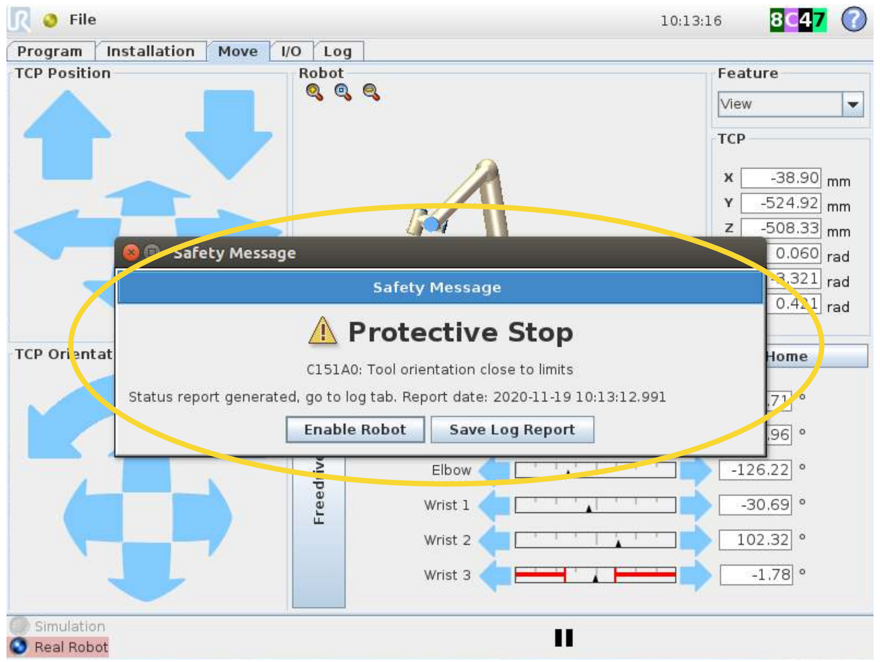
Step 23

Click on one of the arrows by **Wrist 1**. A yellow field will appear when you tip the robot.



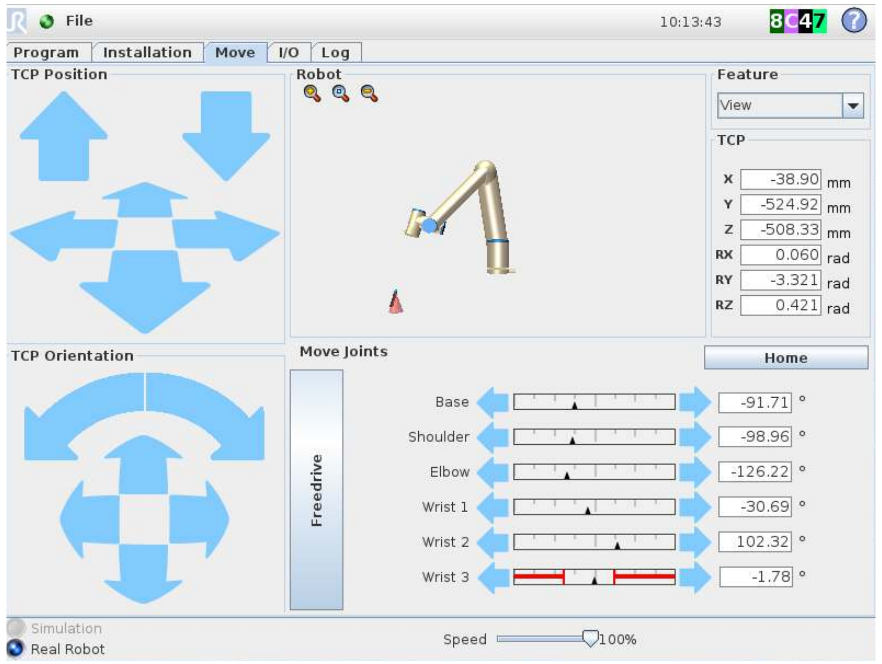
Step 24

If you continue to press on one of the arrows, the field will turn red and you will get this pop-up message. Press **Enable Robot**.



Step 25

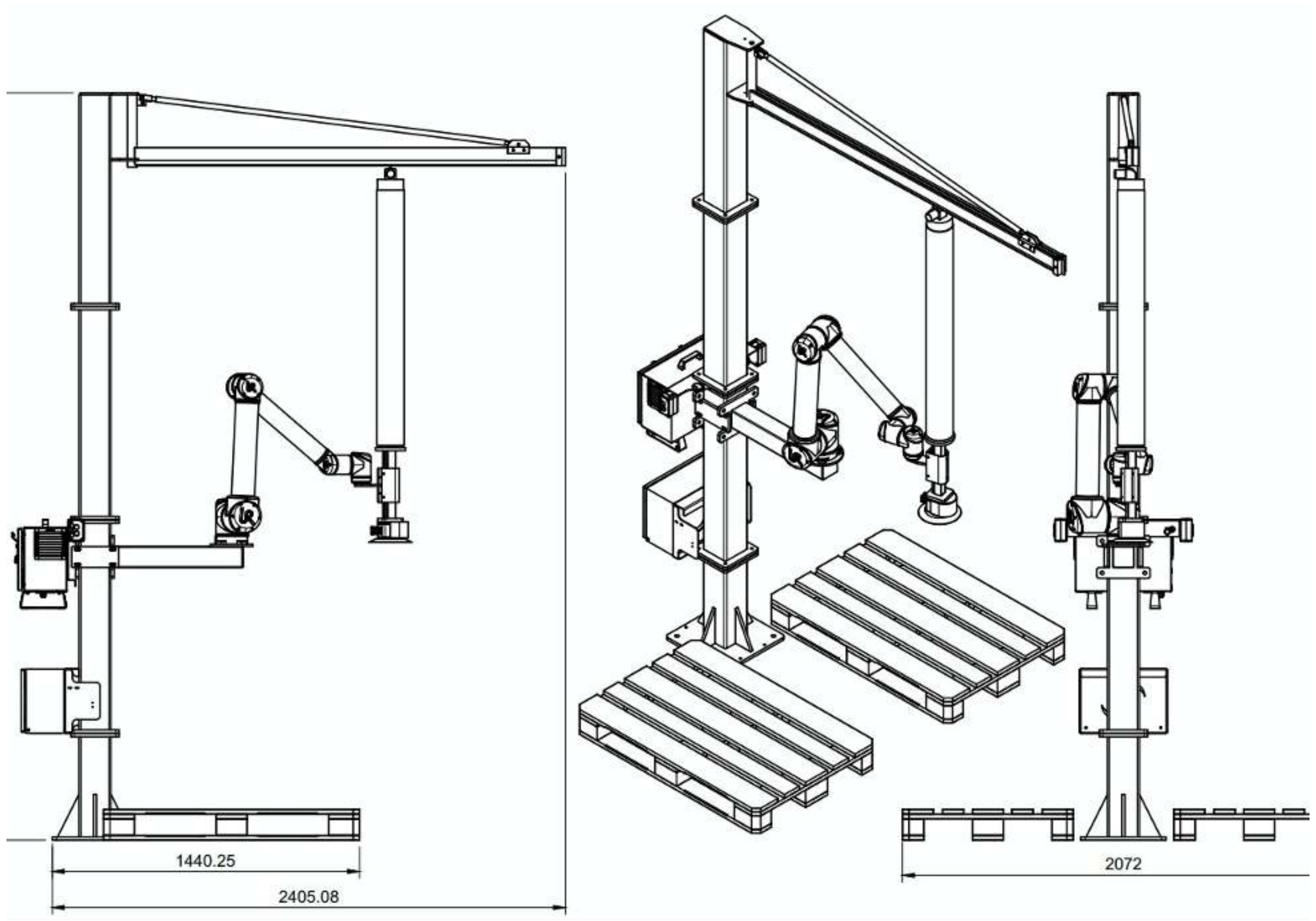
After you have pressed **Enable Robot** this screen will pop-up.

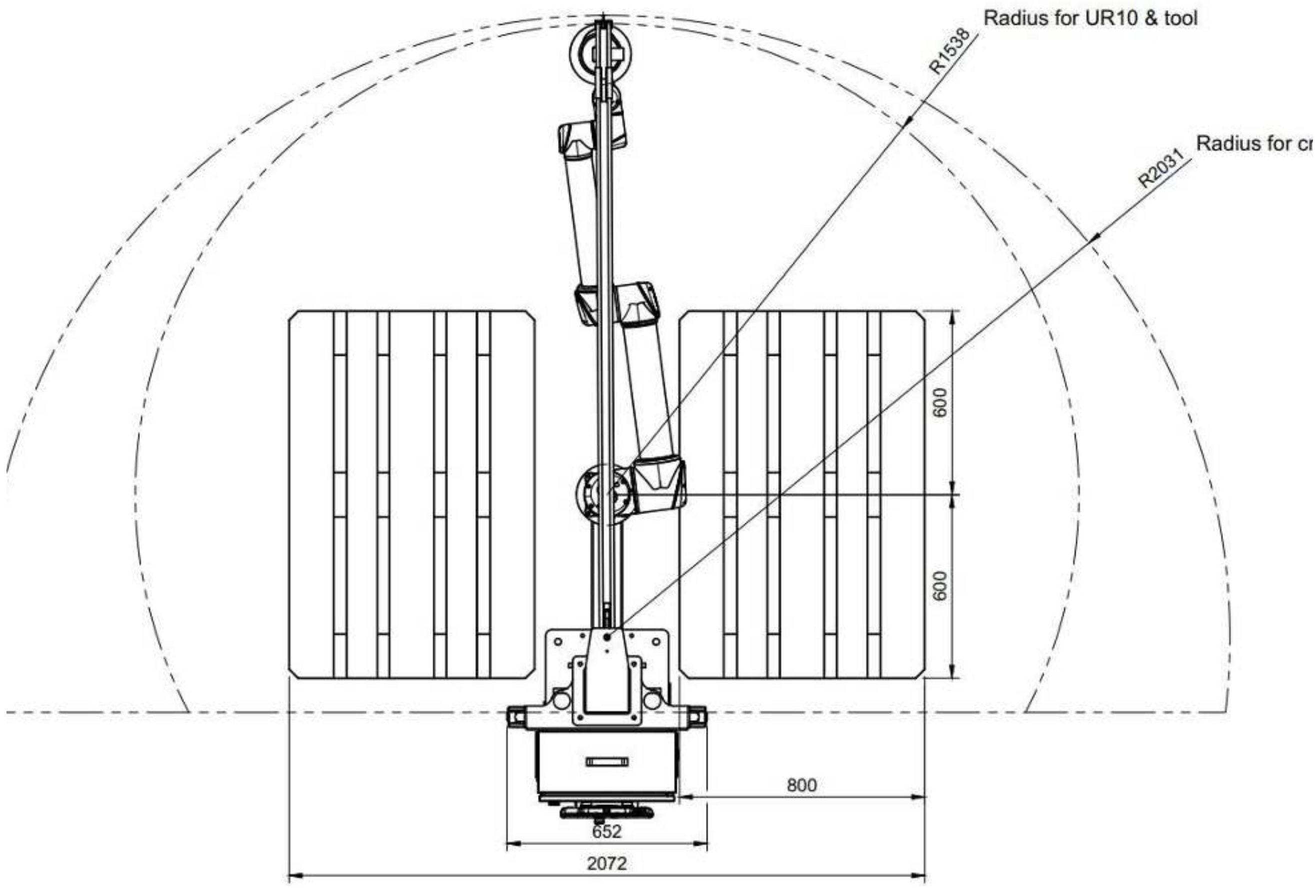


Well done! You have now concluded the safety installation steps for the Cobot Lift.

5.0 DATASHEET STATIONARY COBOT LIFT

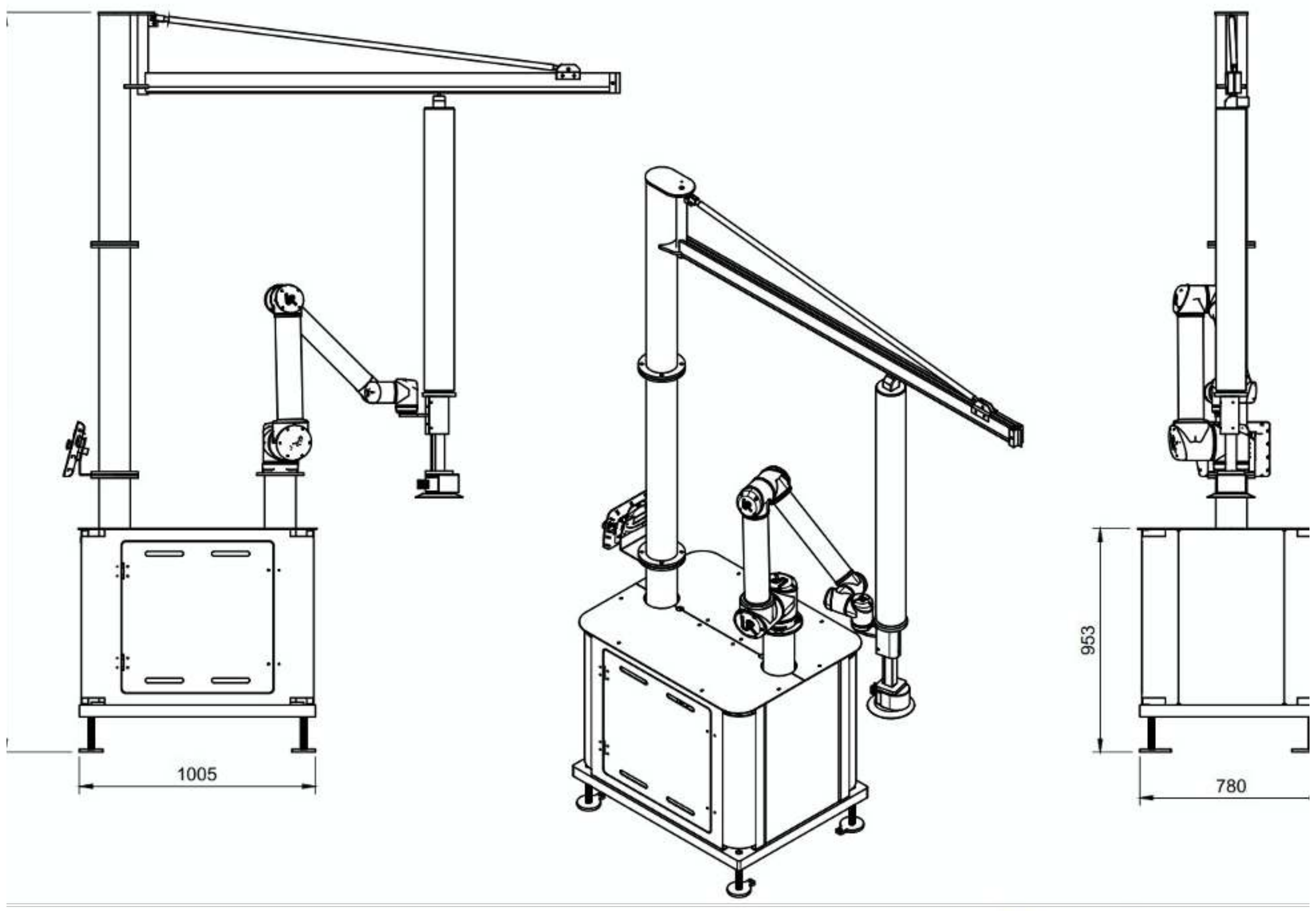
Payload	5-45 kg
Weight of complete solution	Approx. 250 kg
Reach	Up to 1400 mm
Degree of freedom	4
Power Supply	400V/16 Amp 230v/16 Amp
Air supply	5-8 bar
Stacking height	Max 1600 mm (depending on product and layout of robot cell)
Robot position height	The arm on which the Cobot is placed can be adjusted from 700-1400 mm , extra crane module of 0.5mtr length incl. for more flexibility
Dimensions – complete solution with Cobot Lift, vacuum tube lift and UR arm	Footprint of crane, 40x40 cm, Standard height of crane 3,5 meter
Certifications and standards	Declaration of Incorporation Directive 2006/42 EC, Annex II B
Collaborative Robot, Compatibility	UR10 CB3 or e-series
Software version required	Min. 3.5 or e-series
Programming	Cobot Lift URCap in Polyscope
Vacuum tube lifter	120mm vacuumtube and 3 kW vacuumpump
Main material	Steel
Accessories	Suction foot for sacks Suction cup for boxes and buckets Quick connector for end effector Silencer box for vacuumpump

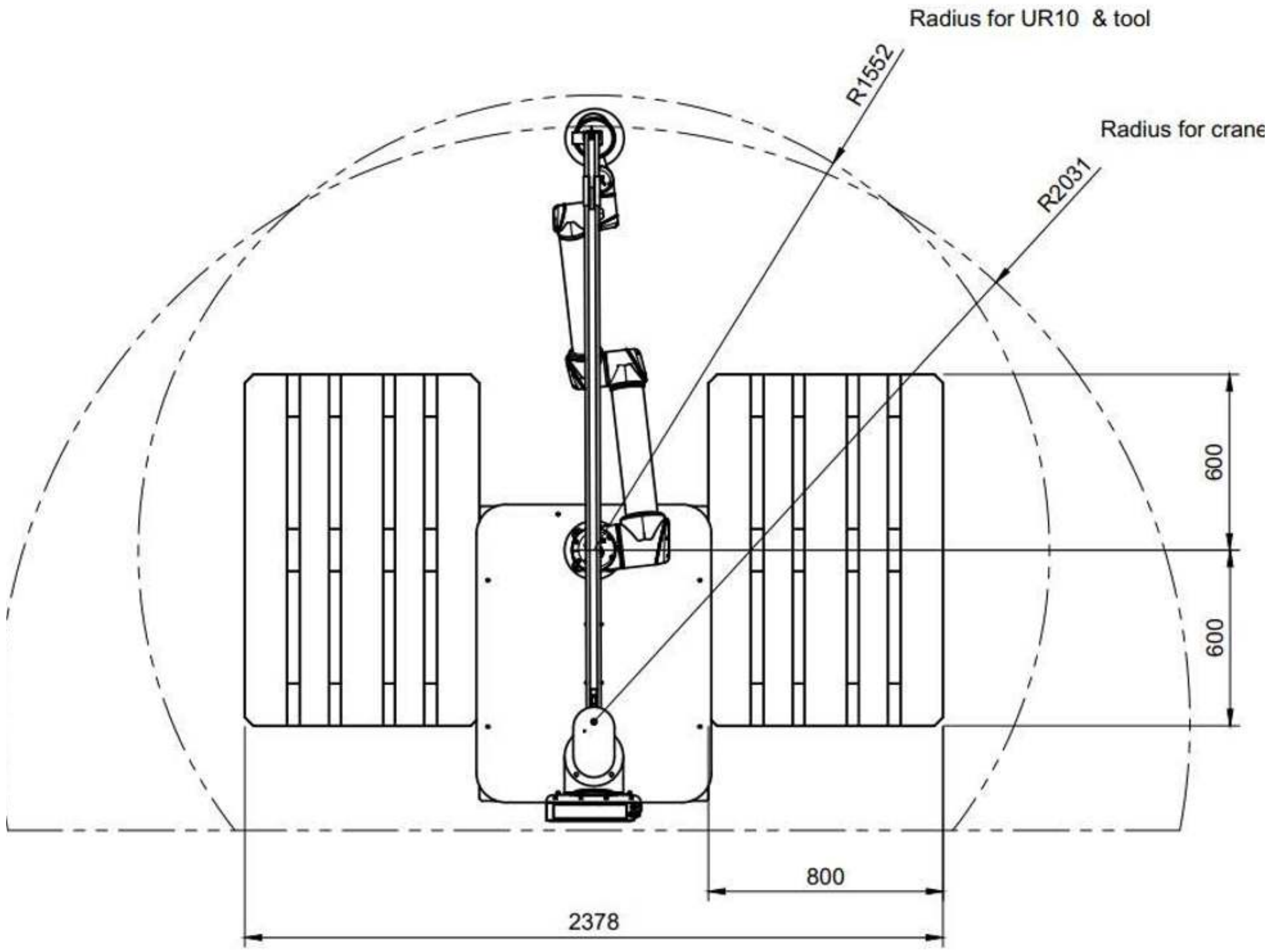




5.1 DATASHEET MOBILE COBOT LIFT

Payload	5-45 kg
Weight of complete solution	Approx. 600 kg
Reach	Up to 1400 mm
Degree of freedom	4
Power Supply	380-440V/16 Amp 230V/16 Amp
Air supply	5-8 bar
Stacking height	Max 1600 mm (depending on product and reach)
Robot position height	Approx. 120 cm
Dimensions – complete solution with Cobot Lift, vacuum tube lift and UR arm	Footprint (80x100 cm), height of crane 3,2 meter
Certifications and standards	Declaration of Incorporation Directive 2006/42 EC, Annex II B
Collaborative Robot, Compatibility	UR10 CB3 or e-series
Software version required	Min. 3.5 or e-series
Programming	Cobot Lift URCap in Polyscope
Vacuum tube lifter	Approx. 120mm vacuumtube and 3KW vacuum-pump
Main material	Steel
Accessories	Suction foot for sacks Suction cup for boxes and buckets Quick connector for end effector

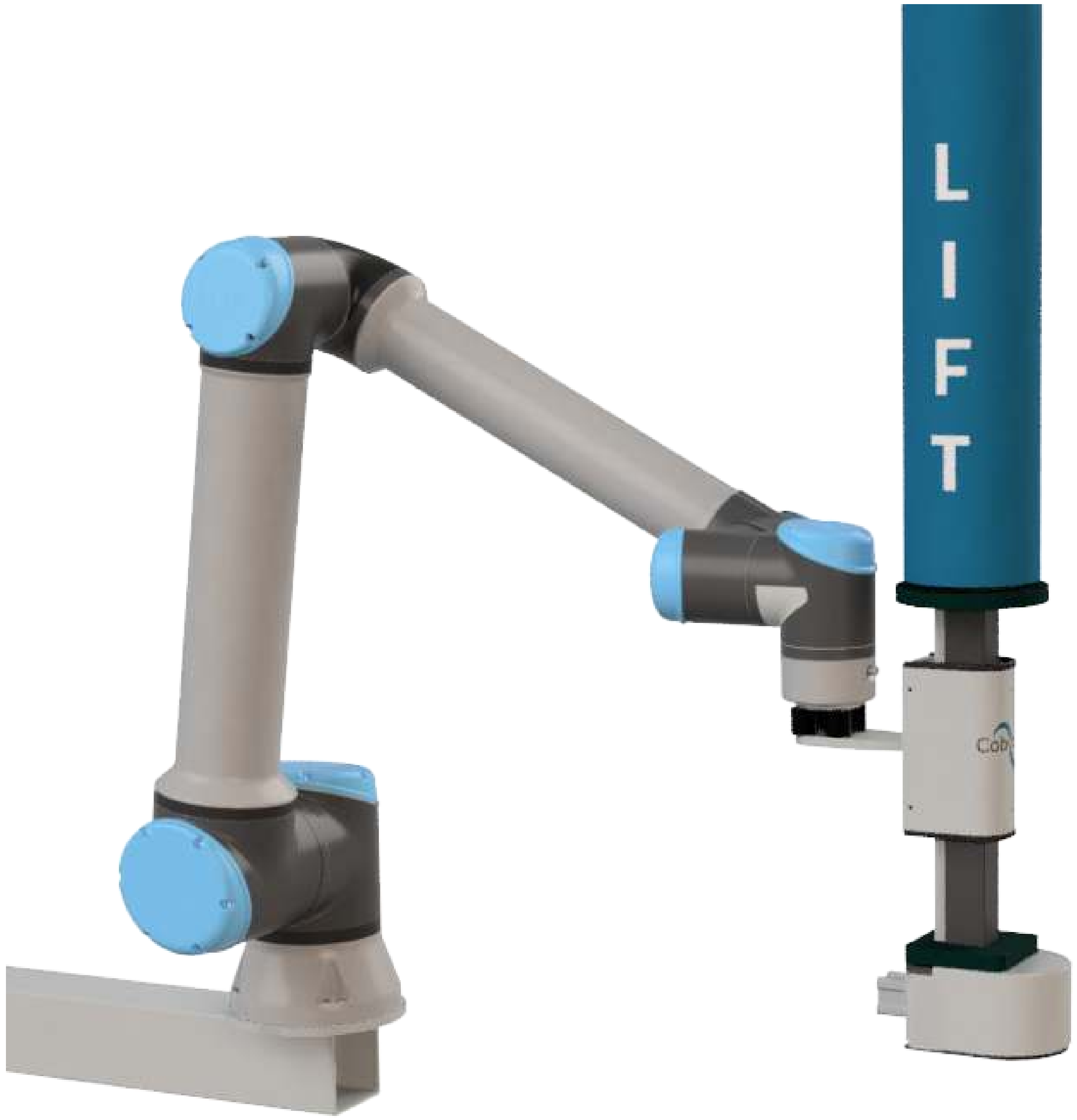




6.0 WHAT IS IN THE BOX

There are several options when buying the Cobot Lift. Stationary Cobot Lift, Mobile Cobot Lift and Cobot Lift tool kit.

Cobot Lift Tool kit



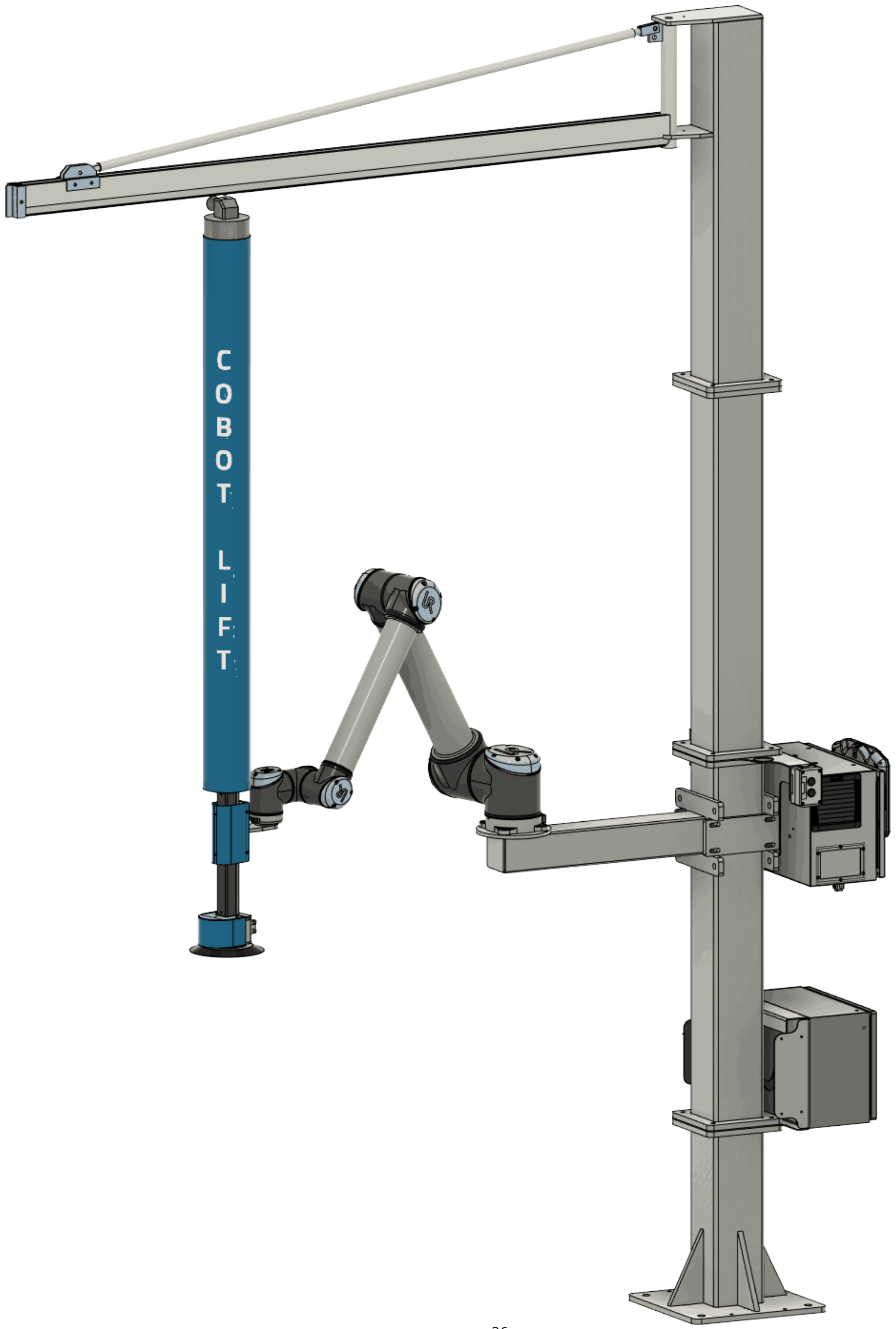
The Cobot Lift kit is designed to fit directly on any vacuum tube lifter with a 150x150mm squared tube column.

The Cobot Lift kit is delivered in a standard EU pallet, which contains:

1. Cobot Lift tool – connector tool between UR10 robot and vacuumlift. Pre-assembled.
2. Rubber vibration dampers for mounting between UR10 robot and Cobot Lift flanges. 4 pcs.
3. Control box containing frequency converter and main switch.
4. Push buttons and cables included.
5. Arm for Robot for a squared 150x150mm column (optional).
6. Pneumatics for release valve.
7. USB stick containing URCap and manual.

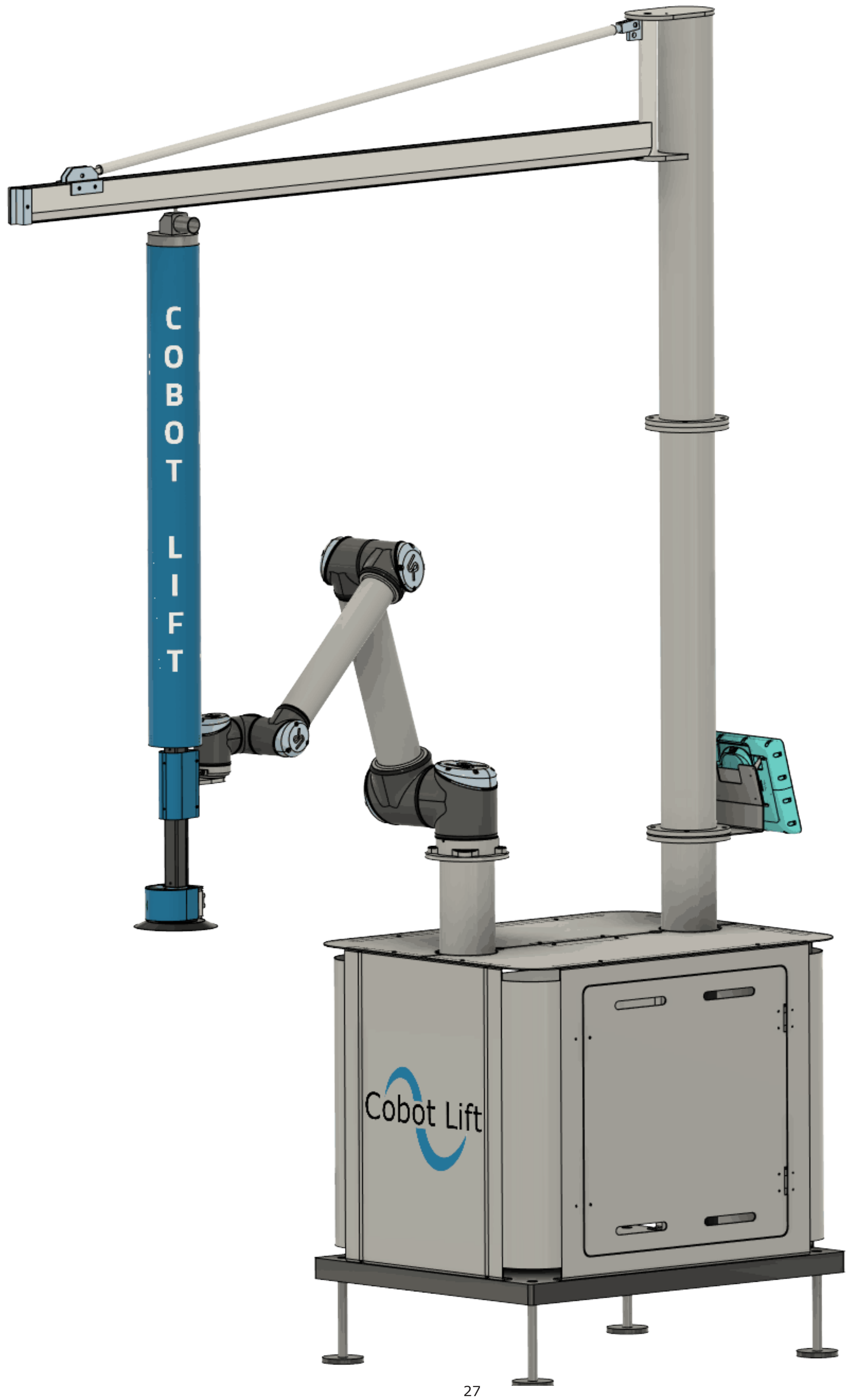
Stationary Cobot Lift

The Stationary Cobot Lift is a modular system that can be configured in several heights for different applications. It comes with a modular column in 5 pcs (with a total height of up to 4m above the floor), 2m crane arm, vacuum tube lifter from TAWI (as standard) and mounting brackets for controls, filters, silencers etc. Arm for robot can be mounted from 700mm and up.



Mobile Cobot Lift

The Mobile Cobot Lift is delivered as a complete unit, ready for installation. The Mobile system makes it ideal where there is a need for a very flexible production or for fairs. It is delivered with a column in 3 sections (total height of 3,2m from the floor), 2m crane arm, vacuum tube lifter from TAWI (as standard) and mounting brackets for controls, filters, silencers etc mounted inside the cabinet. Robot is mounted in approx. 120cm height.



7.0 MOUNTING INSTRUCTIONS

In the following section we will provide a guide as to how to assemble the Cobot Lift tool so it is ready to be installed in the overall installation covering a UR robot arm, vacuum tube lift and end effector.

This is what the tool looks like. A sliding unit with flanges in both ends and a release valve in the bottom. The flanges has to be specified to fit the vacuumtubelifter for the system (ex. Tawi/PIAB, Schmalz, Fezer etc.)

Cobot Lift tool with quick connector for suction foot

Step 1

The Cobot Lift tool comes with 2 flanges / plates with different sized holes. Depending on the task (which product to lift) choose the flange best suited for the job. For a dense product, choose the plate with a small hole. For a loose product like sacks (where a lot of false air is caught) choose a large hole for a larger air flow in the system.

Step 2

The intermediate plate is mounted over the vent valve by pushing by means of 2 pcs M6 screws.

Step 3

The slider is placed on top of the intermediate plate

Step 4

Mount the valve cover by means of the 2 screws

Step 5

Finally, mount the desired suction tool and tighten the 2 M6 nuts.

Alternatively the suction foot can be mounted on a quick connector

Step 6

Depending on the task (which product to lift) the orientation of the product may in some cases need a certain orientation. The orientation of the tool can also be changed either on the flange mounted to the robot or on the flange above the suction head/vent valve.

Step 7

In some suction heads a perforated plate need to be mounted (typically when lifting sacks). Please check directions of this subject with your suction head supplier.

Step 8

4 vibration dampers are mounted on the tool flange.

Step 9

The Cobot Lift tool is mounted on the vibration dampers

Step 10

Connect the airhoses to the vent valve and align them to the robot. Make sure the robot can move freely without stretching the hoses too much or pinching them.

Step 11

The vacuum tube is mounted on the Cobot Lift, by using a hoseclamp on the top plastic flange on the tool.

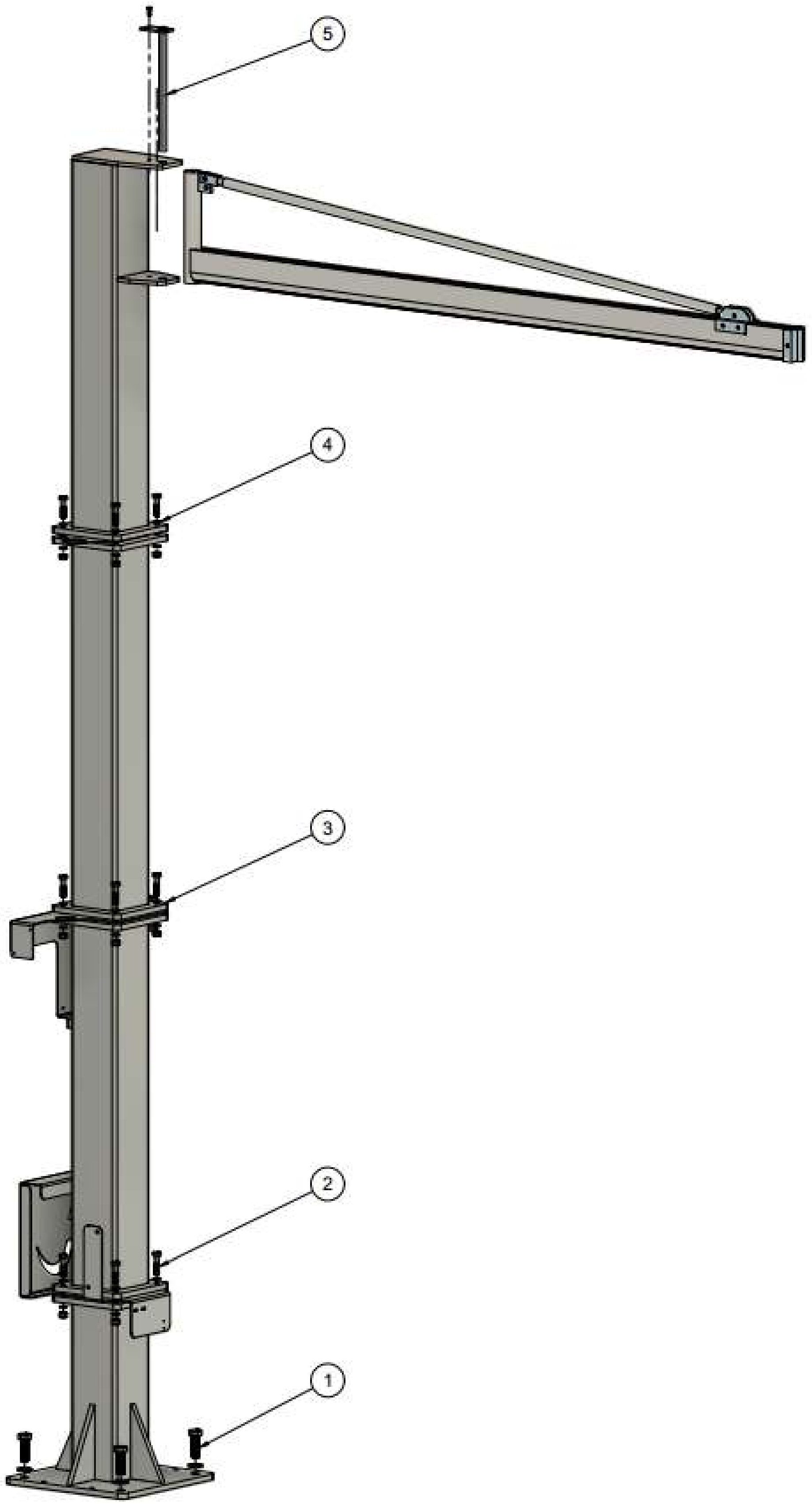
Step 12

When the clamp is mounted, a rubber hose (or similar) delivered with the vacuum-lifter is mounted to avoid sharp edges of the clamp getting in contact with operators.

Congratulations! The Cobot Lift tool is now mounted and ready for action.

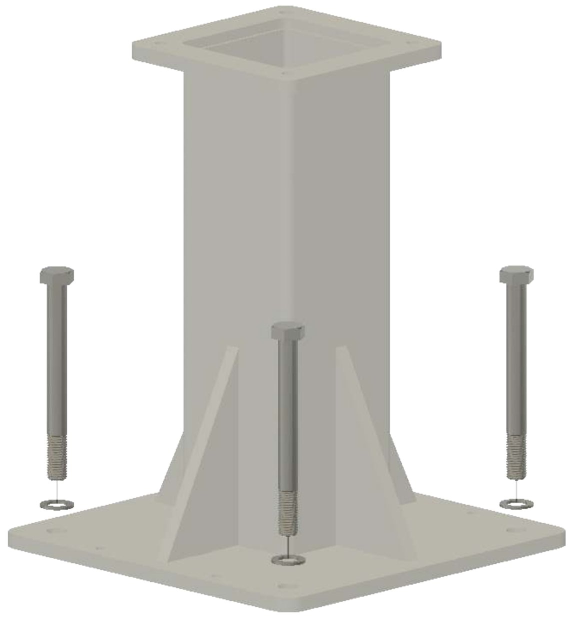
Mounting instructions, Stationary Cobot Lift

The Stationary Cobot Lift Column is a modular system that can be configured in several heights for different applications.



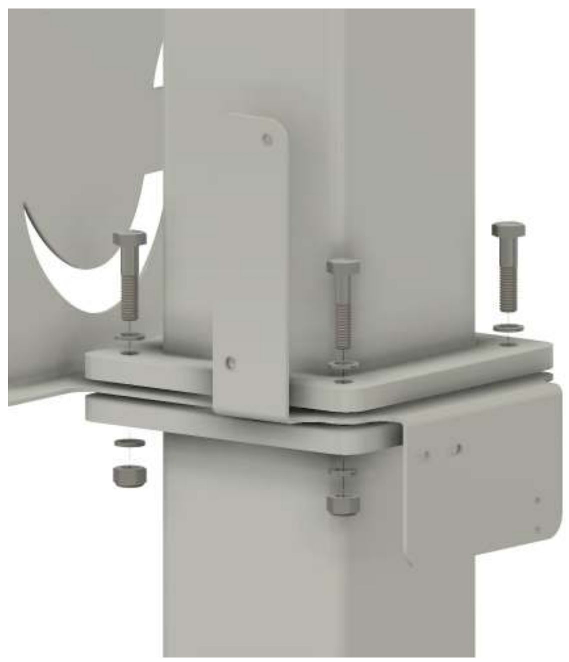
Step 1

Components:
-M20 screw x 4
-M20 disc x 4
Mount a screw in each of the 4 holes of the bottom flange in the column lower part, and tighten it down with a minimum of xx Nm.
Lenght of M20 screws depends on the strenght of the the floor. Her skal der lidt mere ind omkring de krav vi stiller til det.



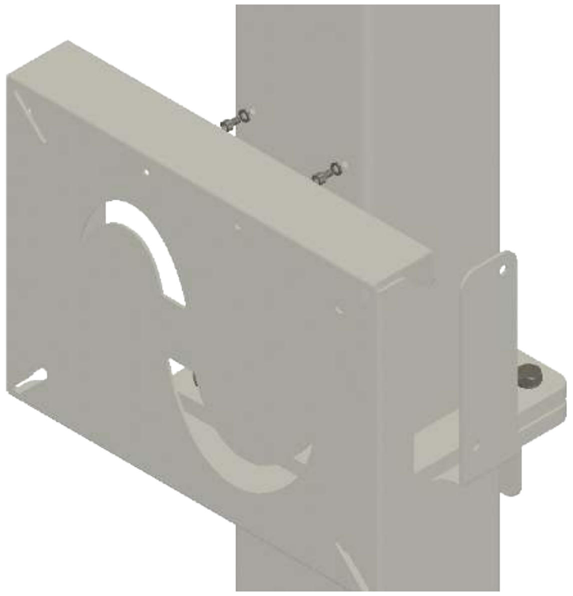
Step 2

Components:
-M12 50 mm screws x 4
-M12 disc x 8
-M12 locknuts x 4
The M12 screws are mounted with the flange for the electrical cabinet and tightened.



Step 2.5

Components:
-M6 20 mm screw x 2
-M6 disc x 2
Mount the two M6 screws and tighten them.



Step 3

Components:
-M12 50 mm screws x 4
-M12 disc x 8
-M12 locknuts x 4

The M12 screws are mounted with the flange for the robot controller and tightened.

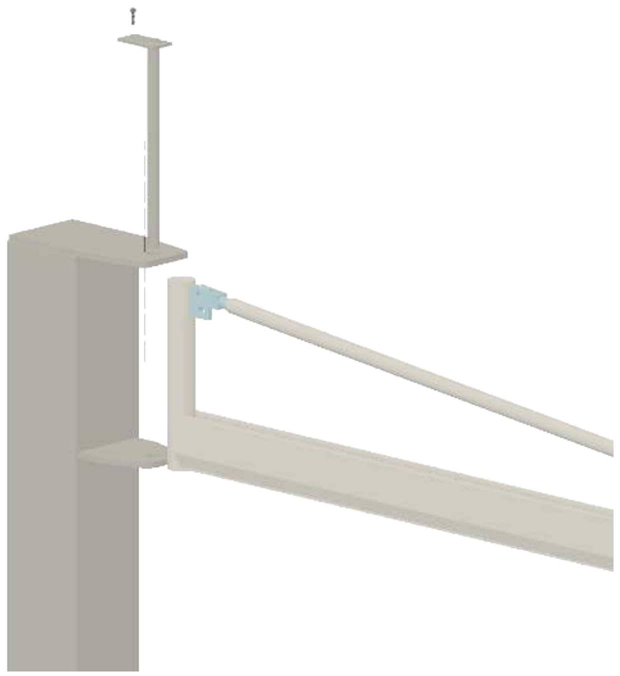
Step 4

Components:
-M12 50 mm screws x 4
-M12 disc x 8
-M12 locknuts x 4

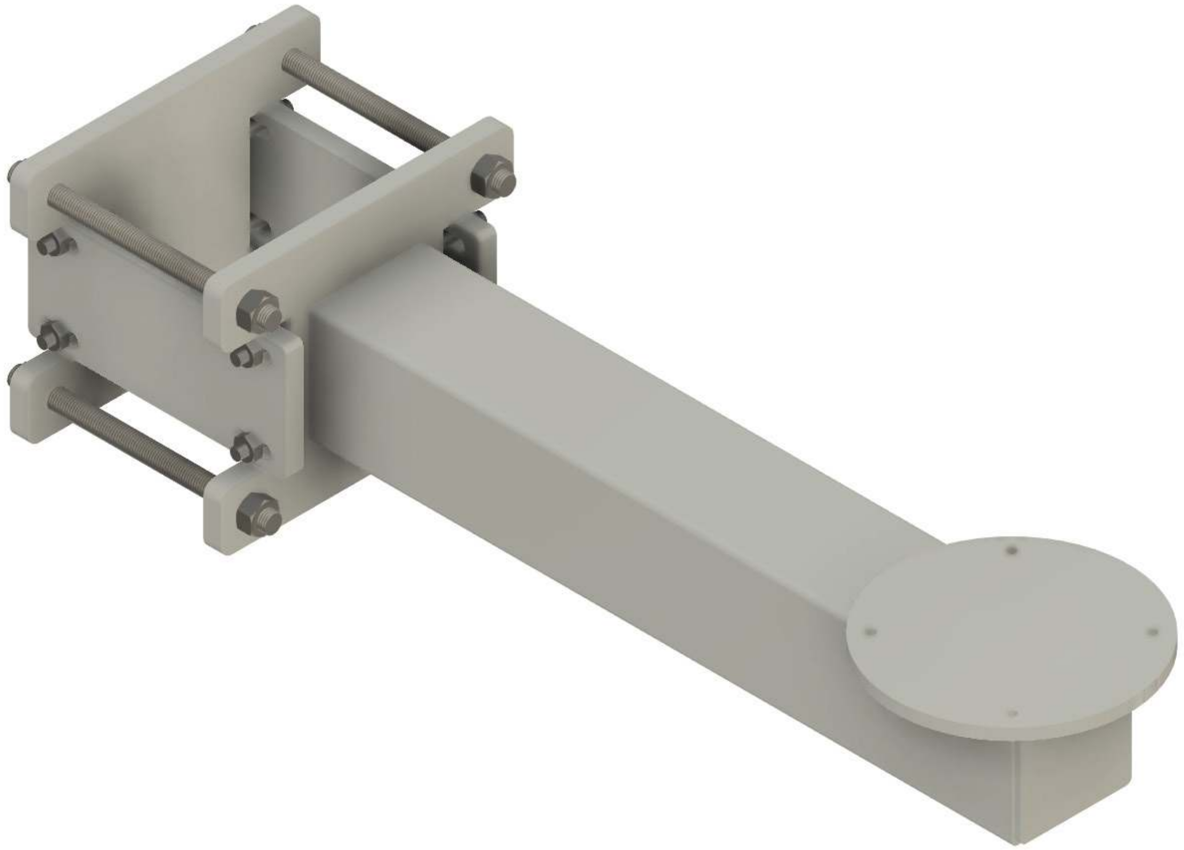
The flange for the tube is mounted between the flanges and two discs are mounted in the two other wholes to make sure it is aligned.

Step 5

Components:
-M6 20 mm screw x 1
The jib arm is mounted with the long pin bolt and the M6 screw.

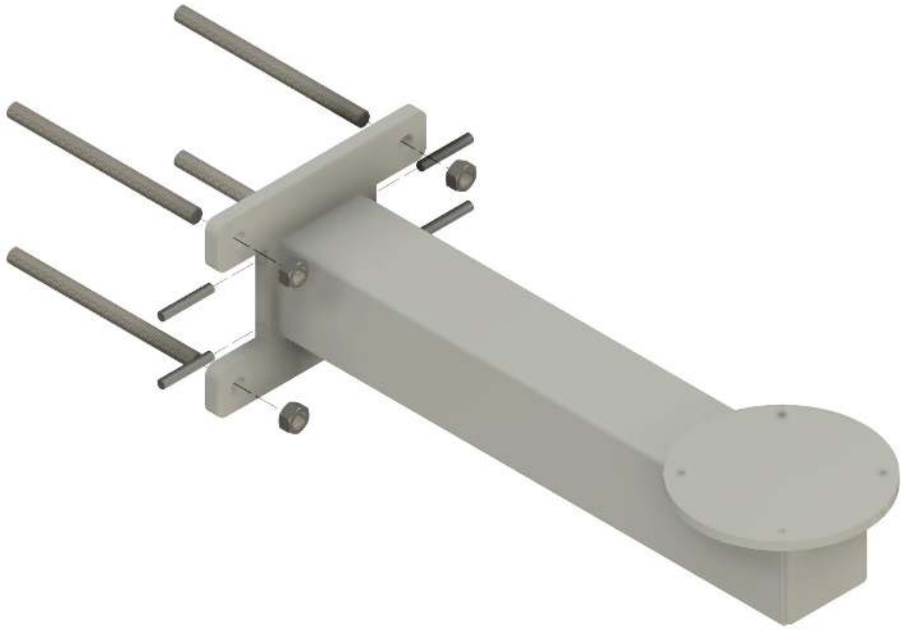


Mounting of arm for Universal Robots on Stationary Cobot Lift 2



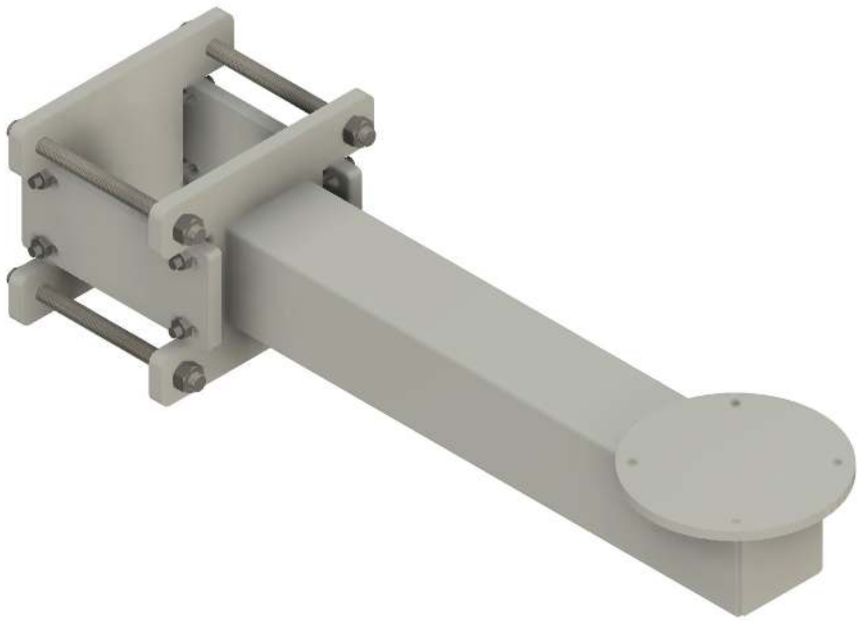
Step 1

Components:
-M16, 220 mm threaded rod x 4
-M10, 70 mm threaded rod x 4
-M16, nuts x 4
The 4 M16 threaded rods are mounted loosely.



Step 2

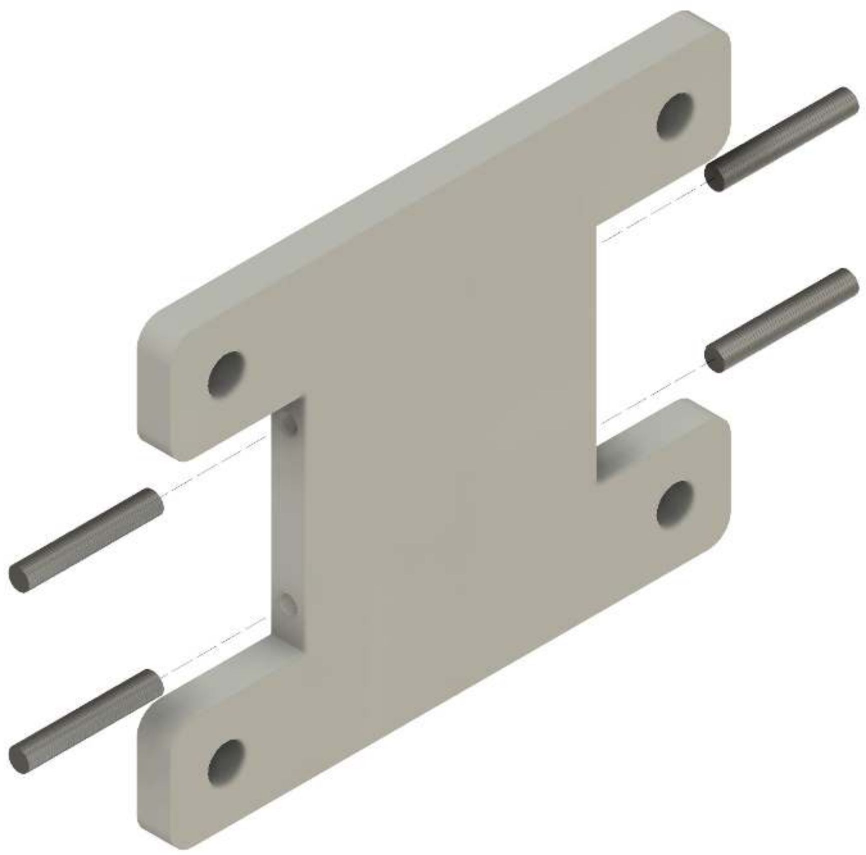
Components:
-M10 threaded rod 70 mm x 4
The 4 M10 threaded rods are mounted in the clamp flange.



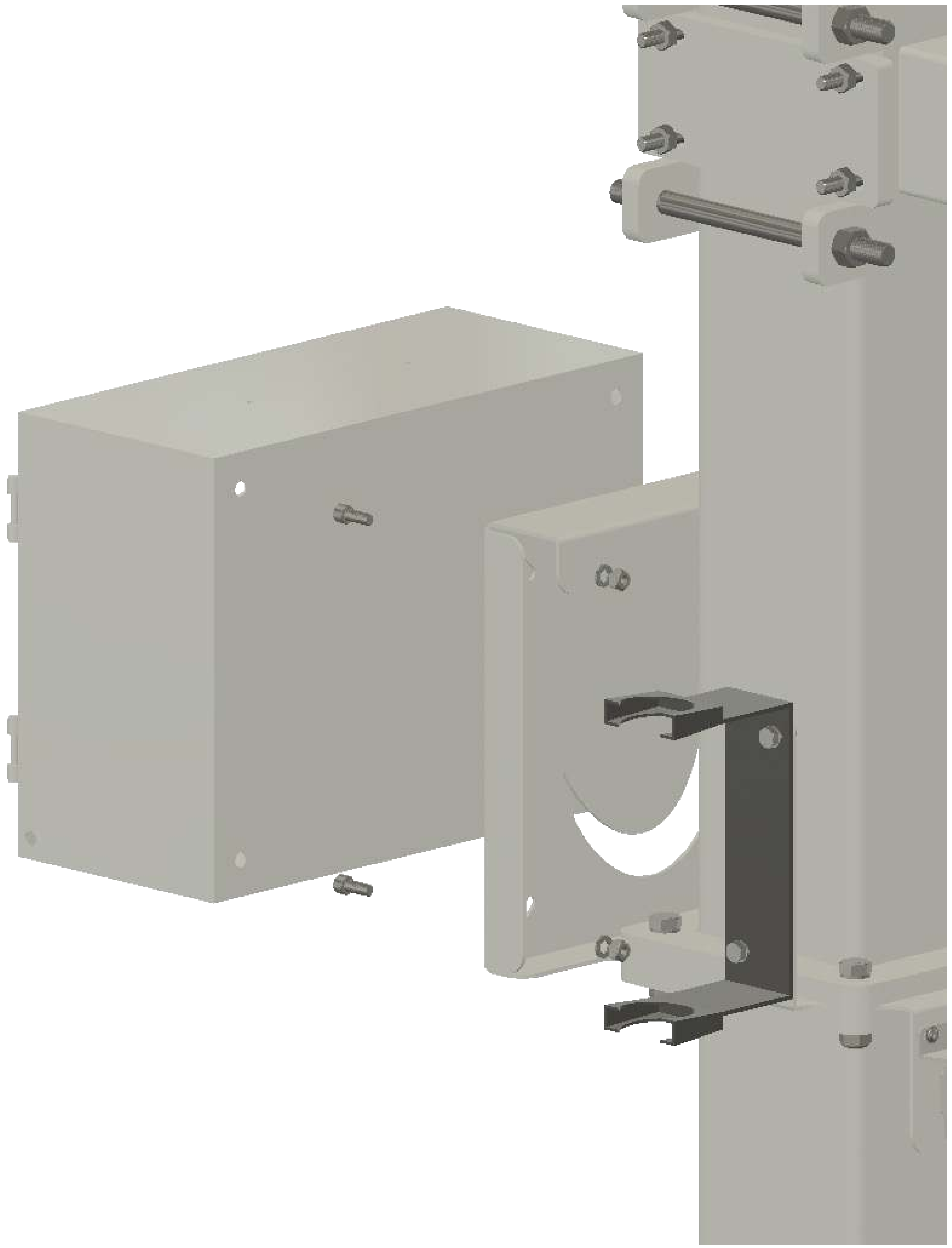
Step 3

Components:
-M16 nuts x 4
-M10 nuts x 8
-Side clamps x 2

Decide which height the robot should be mounted en and fix the arm to the column.
The arm has to be aligned in all directions so please pay attention with the tightening of the arm. This may take some time, but has to be done.
Use a spirit leveler to level the arm.



Mounting of components on the flange for the electrical cabinet



Step 1

Components:
-M8 20 mm screws x 2
-M8 disc x 4
-M8 locknut x 2
-Vacuum filter holder
The Vacuum filter holder is mounted withe the two M8 screws and tightened.

Step 2

Components:
-M5 12 mm screws x 2
-M5 discs x 2
-M5 lock nut x 2
-Regulator
-M3 30 mm screw x 2
-M3 disc x 2
-M3 locknu x 2
-Magnetic valve
Regulator and magnetic valve is mounted on the flange with screws and nuts.

Step 3

Components:
-M4 25 mm screws x 4
-M4 disc x 8
-M4 locknut x 4
-Brake resistor (optional)
Brake resistor is mounted with 4 M4 screws and nuts.
Wire on brake resistor should turn downwards.

Step 4

Components:
-M8 20 mm screws x 4
-M8 disc x 4
-M8 locknut x 4
-Electrical cabinet
Electrical cabinet is mounted with the 4 M8 screws.

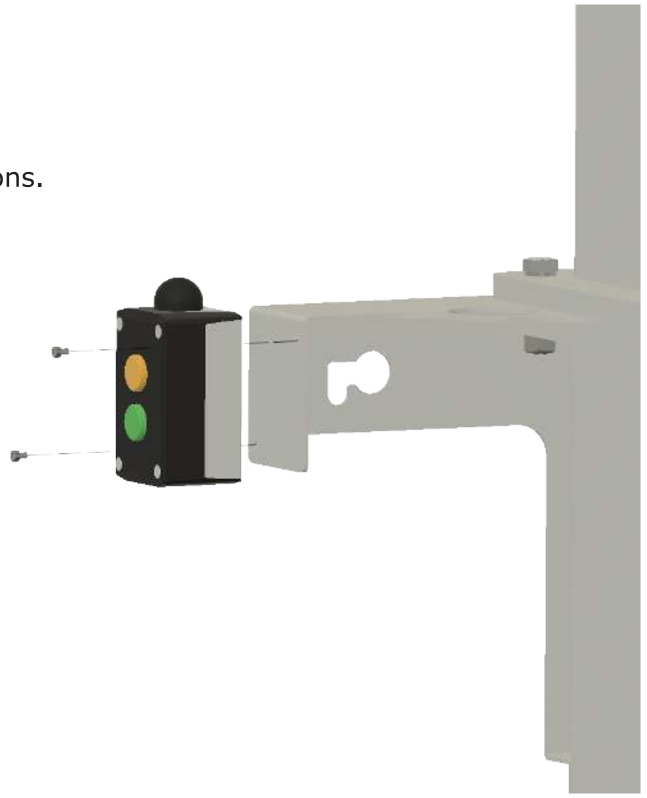
Mounting of components on the UR controller flange

Step 1

Components:
-15 mm bumper x 2
-10-15 mm bumper x2
-M6 20 mm screws x 4
-M6 nut x 4
Mount the bumpers on the flange.

Step 2

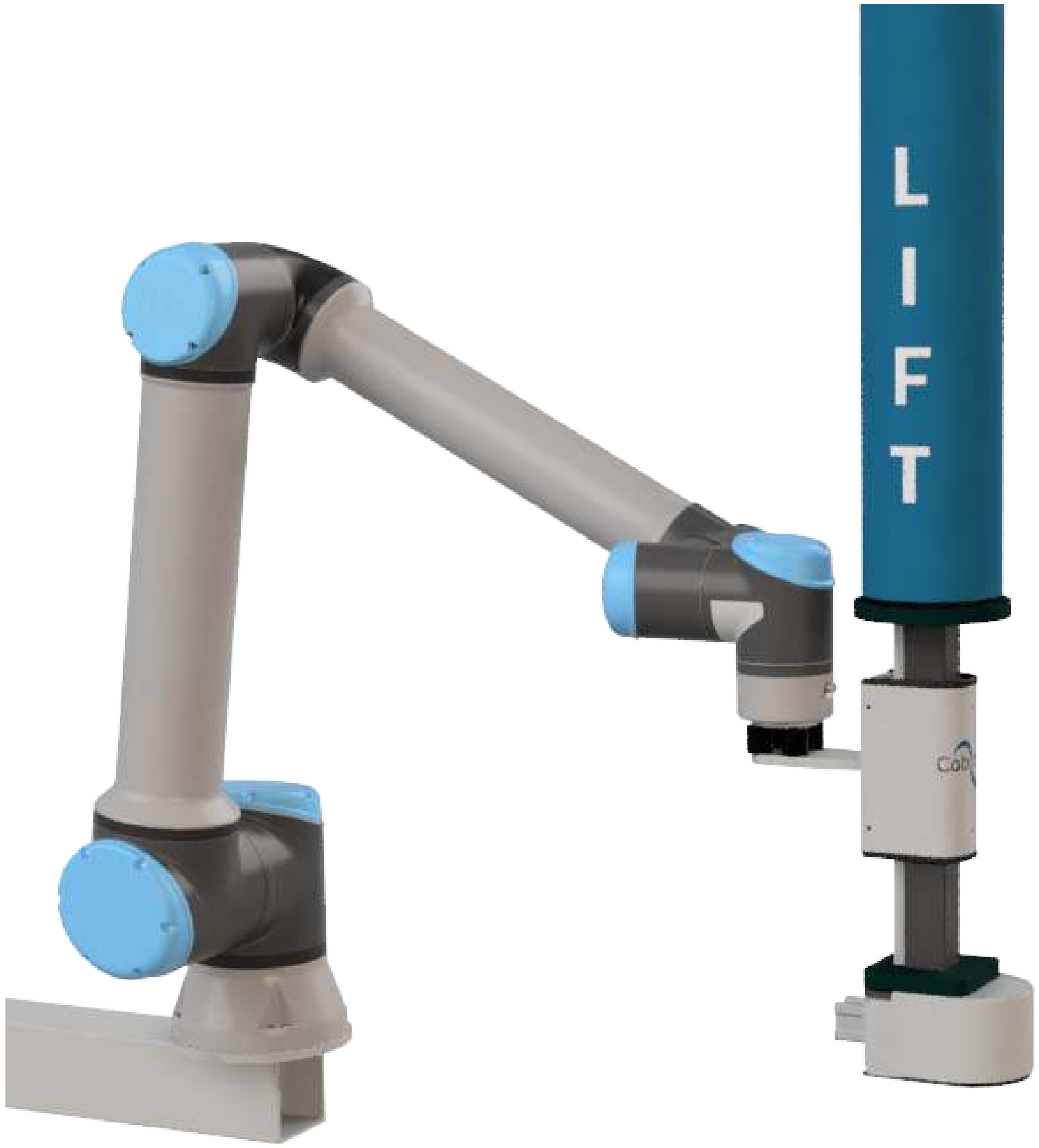
Components:
-M4 16 mm screws x 4
-Status buttons x 2
Fix the plastic cabint with the status buttons.



Step 3

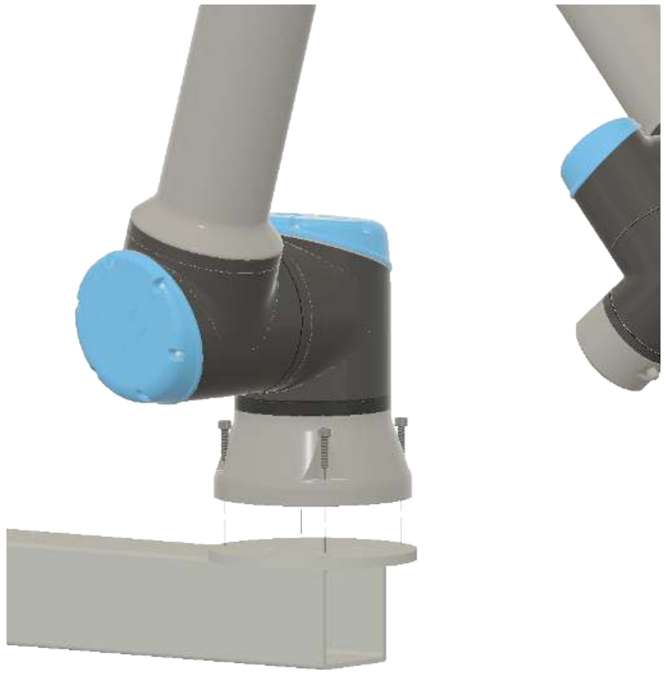
Components:
-UR controller
Mount the controller on the flange.

Mounting of UR10 and tool on the Stationary Cobot Lift



Step 1

Components:
-M8 16 mm bolt x 4
-UR10(e)
The weight of the robot arm is 28kg, so be aware when mounting it.
The electrical connector should be facing towards the column.

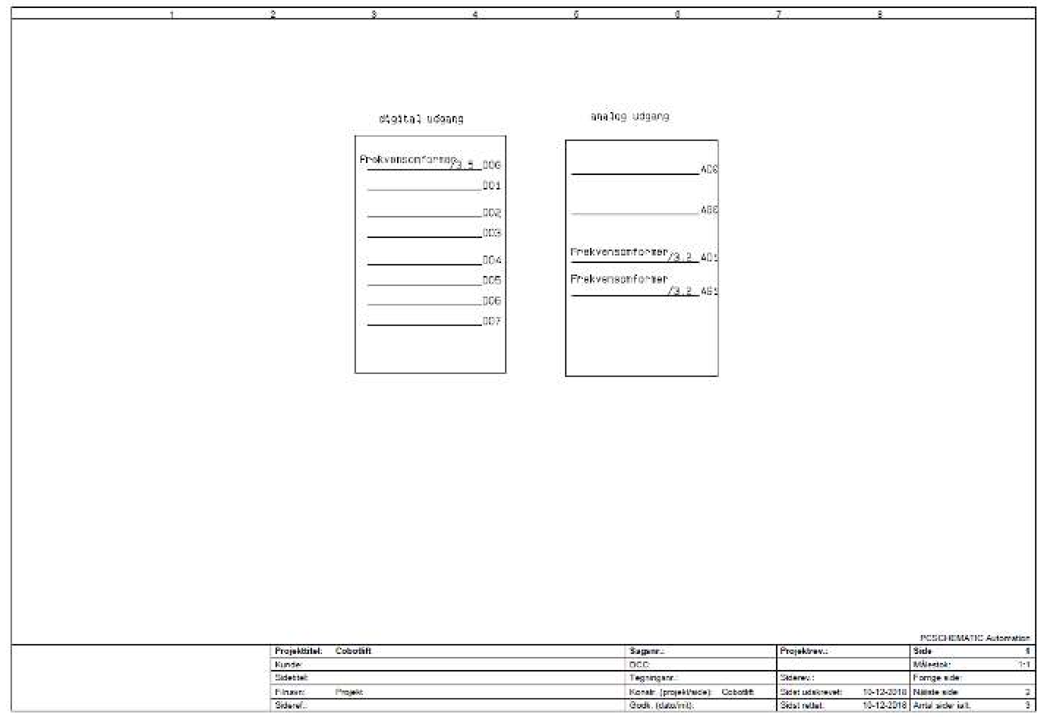


Step 2

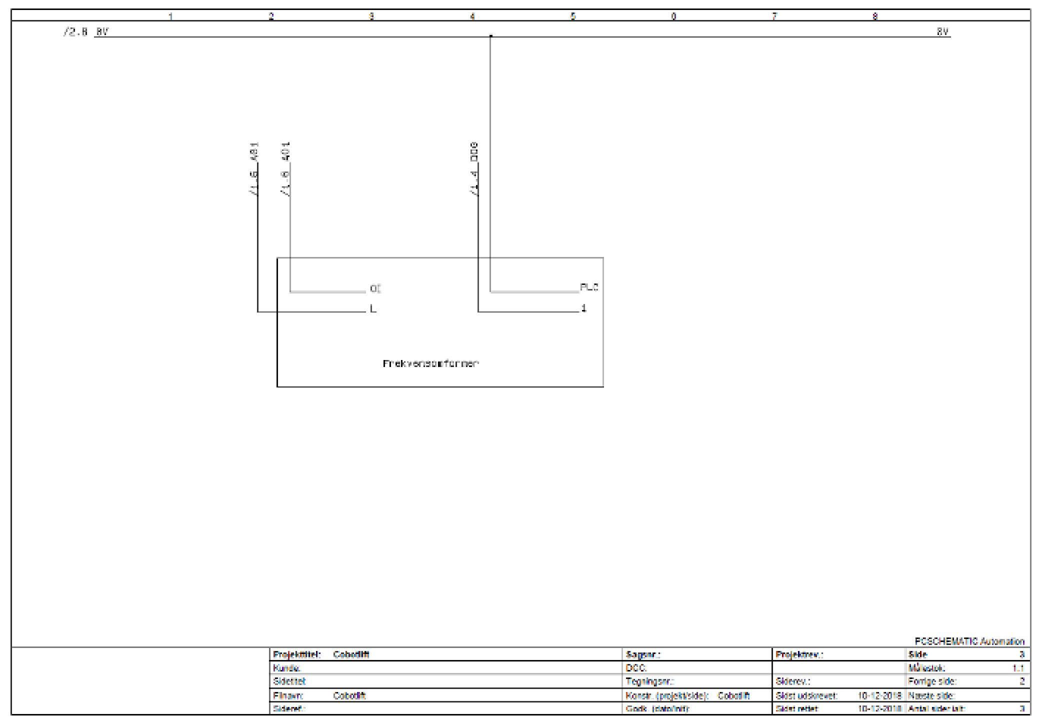
Components:
-M6 16 mm screws x 4
-M6 25x25 rubber bumpers x 4
-UR10(e)
-Cobot Lift Tool
Mount the bumpers between the robot flange and the Cobot Lift Tool and connect the air hoses for the release valve.

9.0 HOW TO CONNECT THE FREQUENCY CONVERTER

There is a need for a frequency converter on the vacuum pump in order to get full control of the vacuum system. This of course has to fit to the vacuum pump and it is mounted like this in the Electrical Diagram:



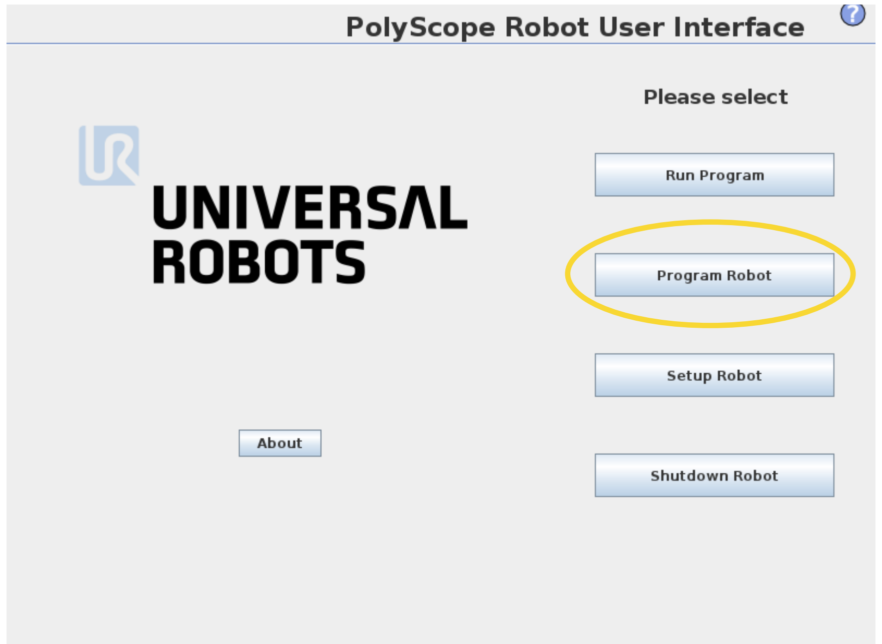
A digital output is used for start and stop of the frequency converter and an analog signal is used for adjusting the level.



To name the vacuum output please go to the UR teach pendant

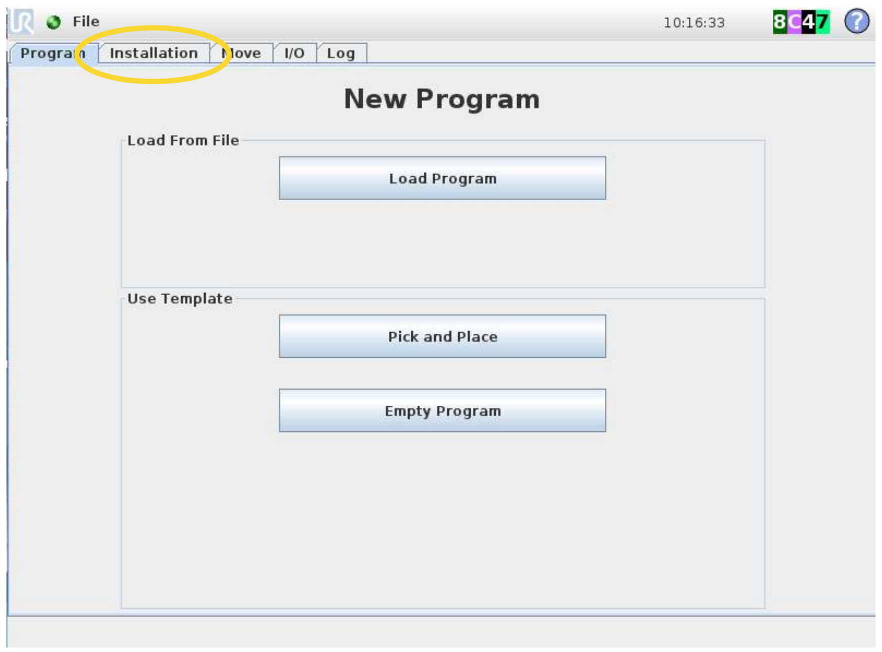
Step 1

Select **Program robot**.



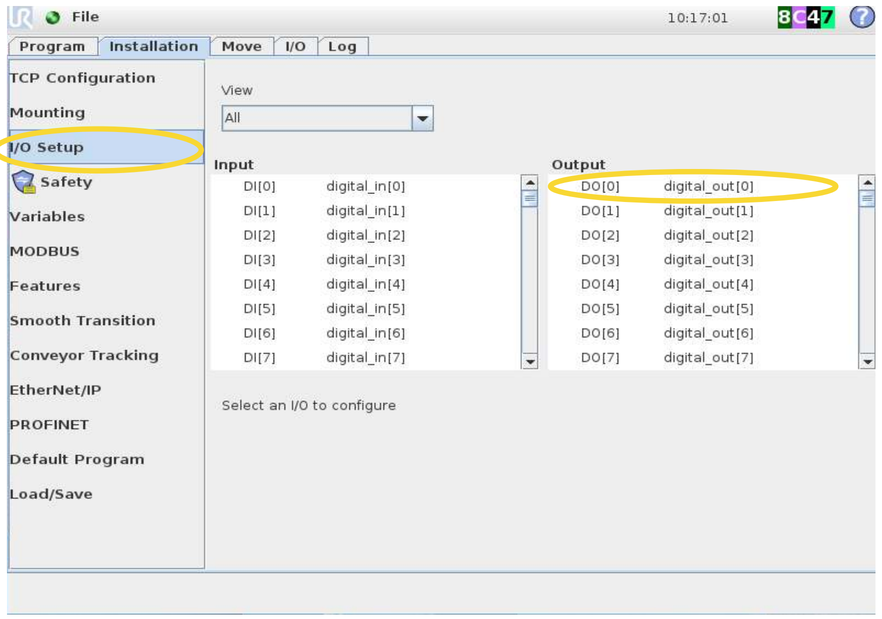
Step 2

Select **Installation**.



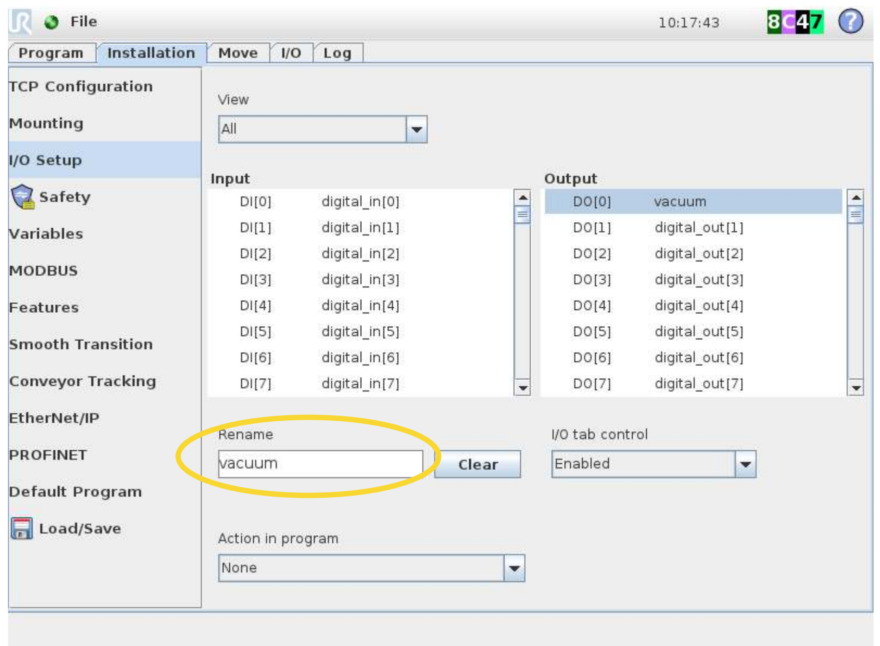
Step 3

Select **I/O Setup** and then click **digital_out[0]**.



Step 4

Write **Vacuum** in the box called **Rename**. The frequency converter can now be programmed. Remember to set both digital and analog output.

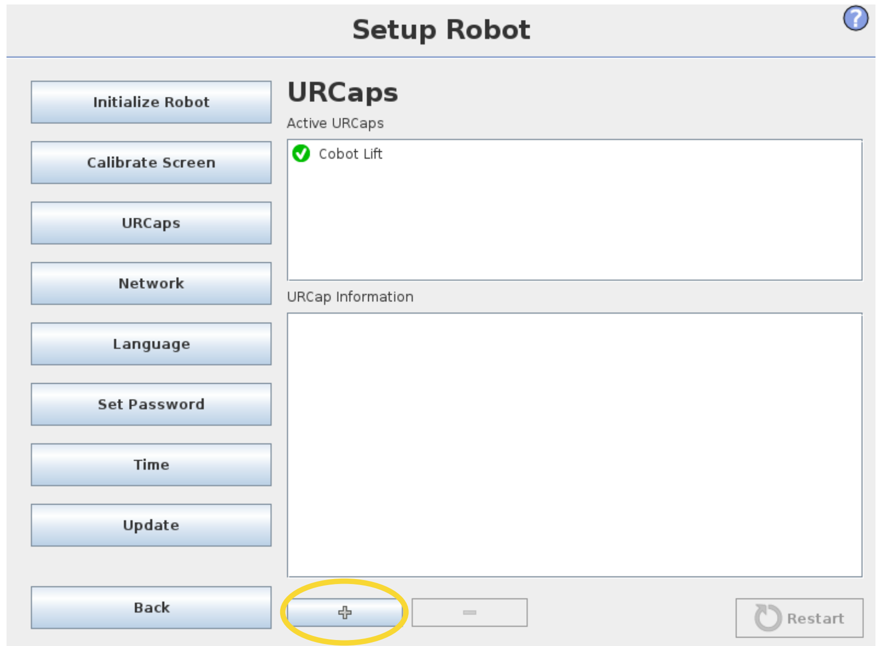


10.0 HOW TO PROGRAM THE COBOT LIFT

When the Cobot Lift is installed according to the manual/specifications and all connections are made it is time for the programming of the robot. The Cobot Lift comes with a URCap that can help minimize installation time. The URCap provides the user/integrator with a good starting point for the palletizing program.

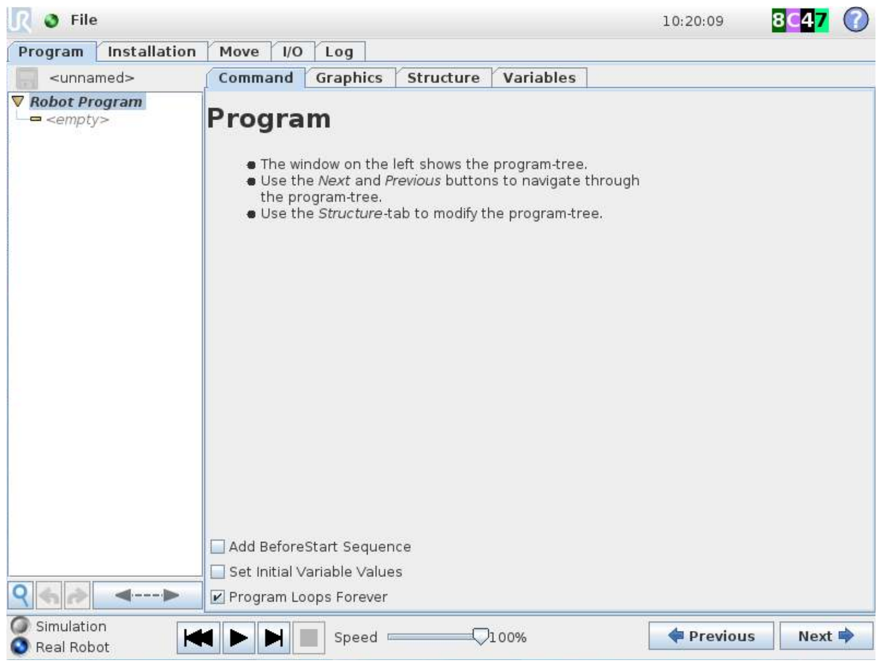
Step 1

Insert the USB stick in the teach pendant and download the URCap **COBOTLIFT** (go to settings – system – URCaps and add the program by clicking "**+**")



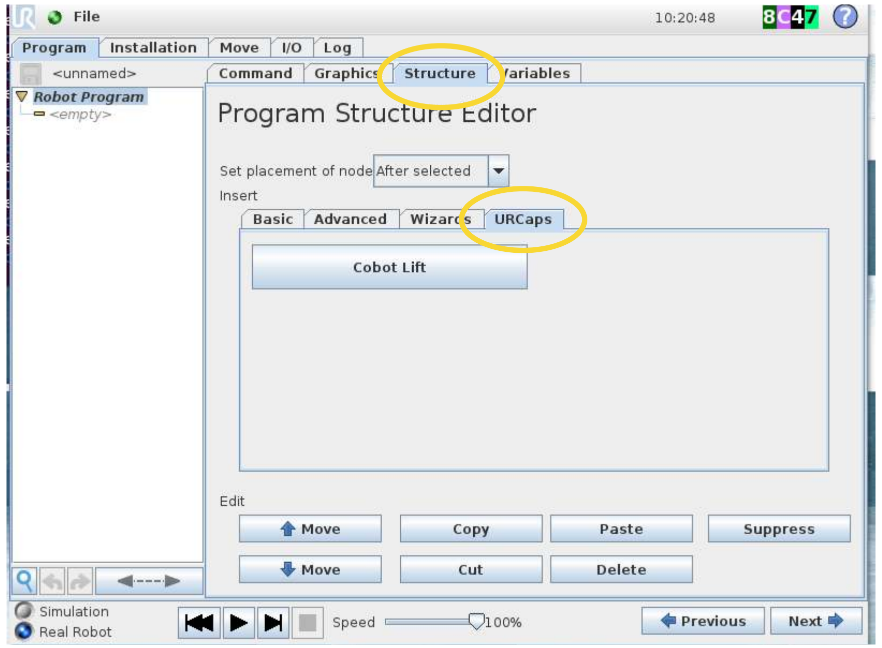
Step 2

Create a new program.



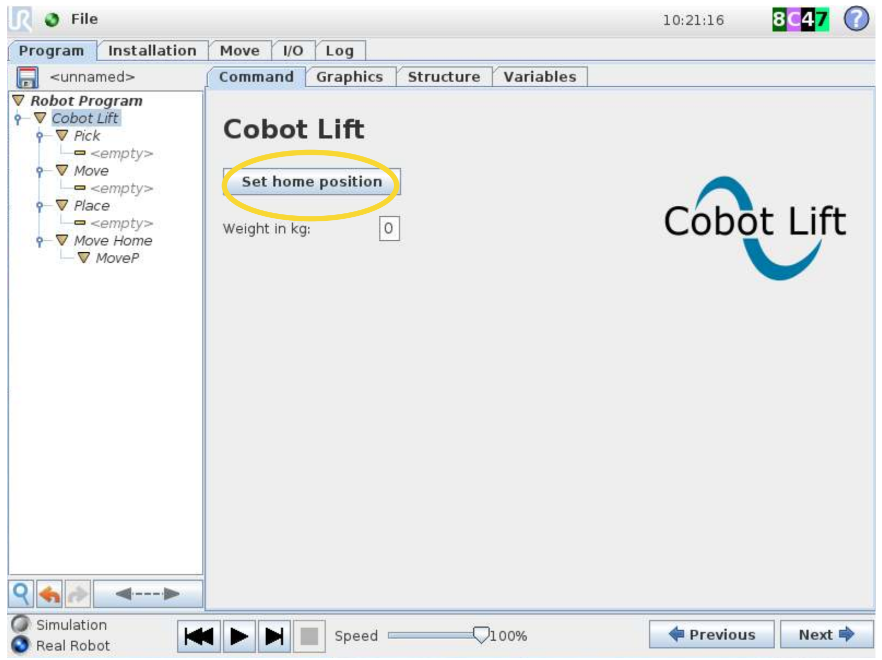
Step 3

Step 3. Click on **Structure** and select **URCaps** tab.



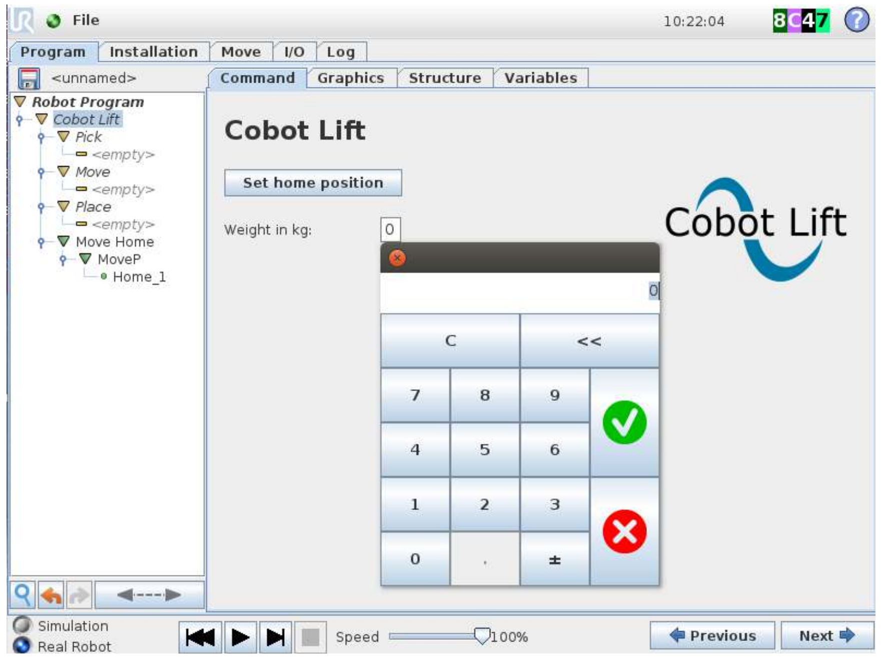
Step 4

The program structure will now appear and you can set the home position.



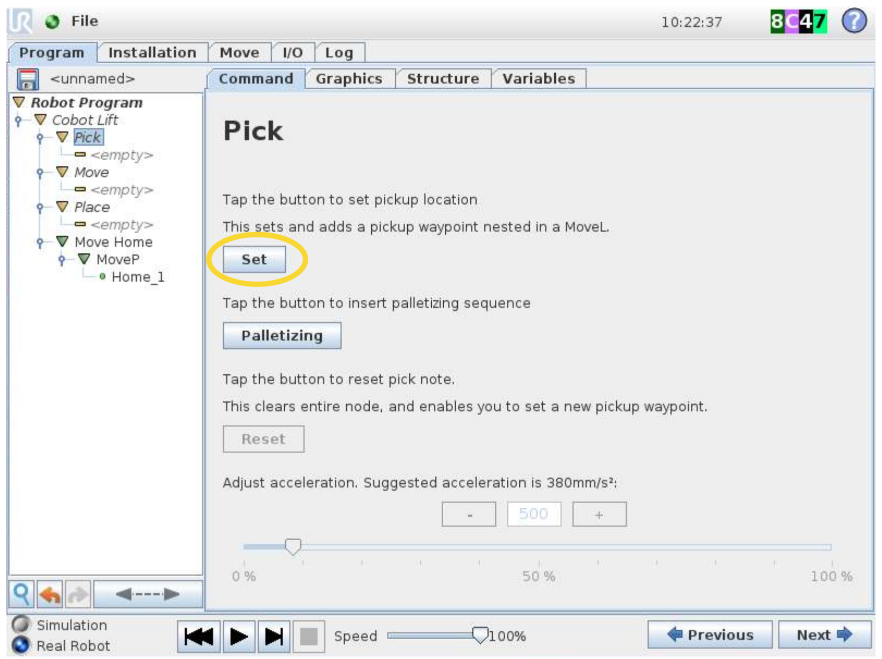
Step 5

Then set the weight of the product.



Step 6

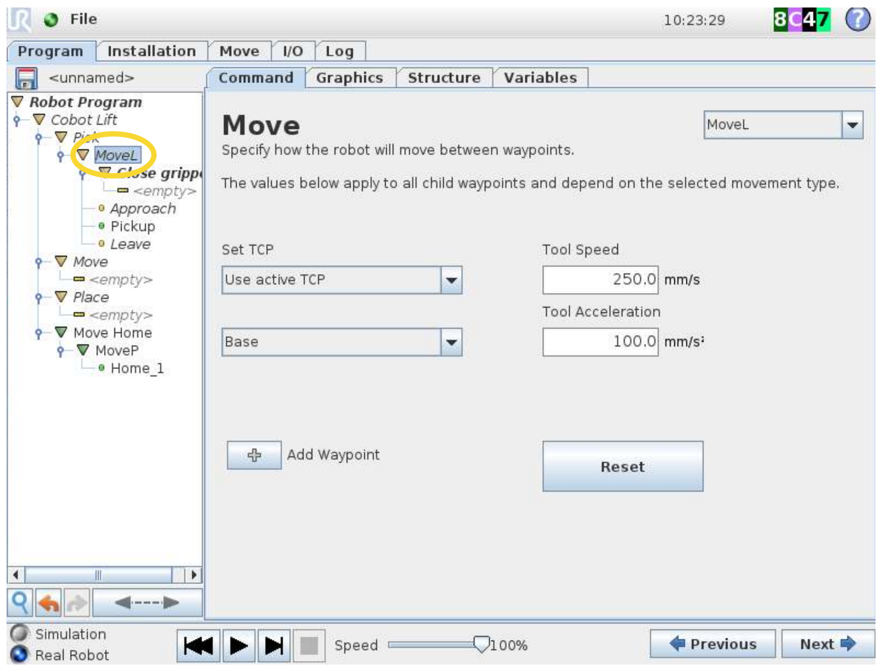
Now go to the **Pick** line and click the **Set** button. Set the waypoint.



When the waypoint is set, the slider will become active. According to the typed-in weight a value is set, and a speed recommendation is given in text. However, as products can vary a lot, it is recommended to start the programming with a low acceleration for example around 100mm/s2.

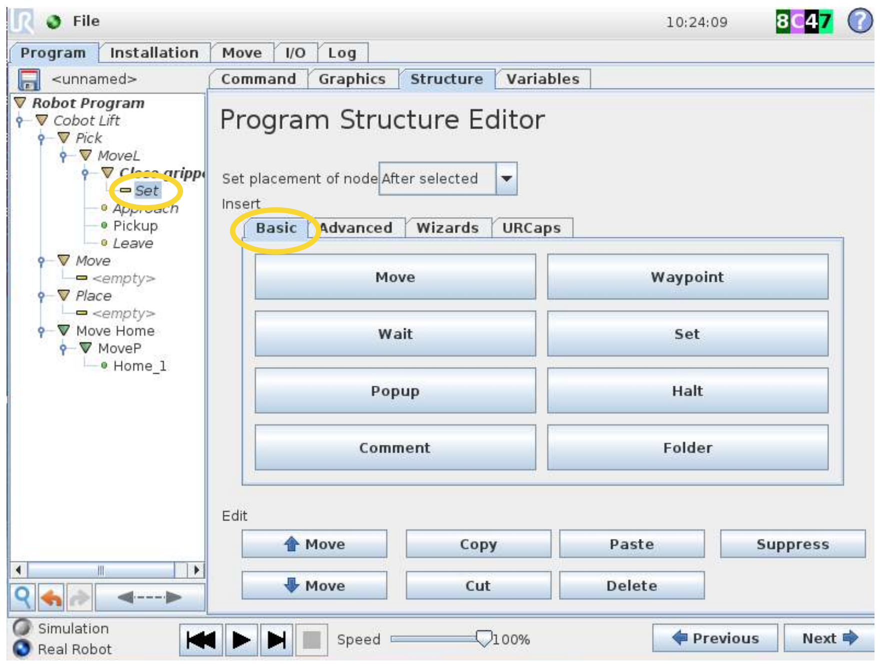
Step 7

If you go to the **MOVE** line you will see the value is used for the waypoints that just came up. There is an approach point, a pick point and a leave point which is typical in a pickup situation, but you can add waypoints and functions if this is required for the actual application.



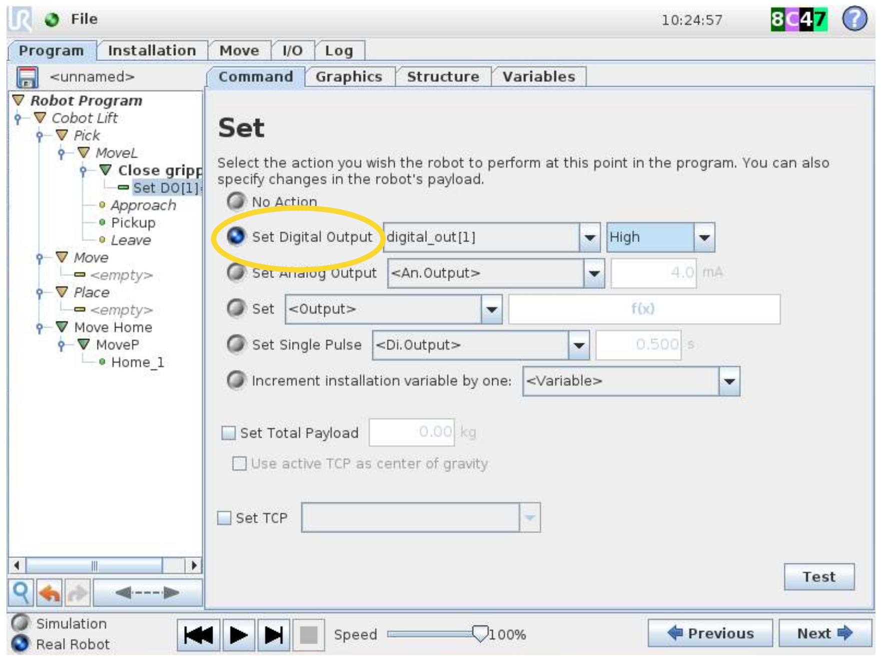
Step 8

There is also an empty folder called **Close gripper**. In most cases this is where you activate the pneumatic cylinder for the release valve, but it could also be other types of grippers. In the example here we will activate the release valve.
Go to the **BASIC** tab and push **SET**.



Step 9

You can now set the digital output you have chosen for the **gripper function**.

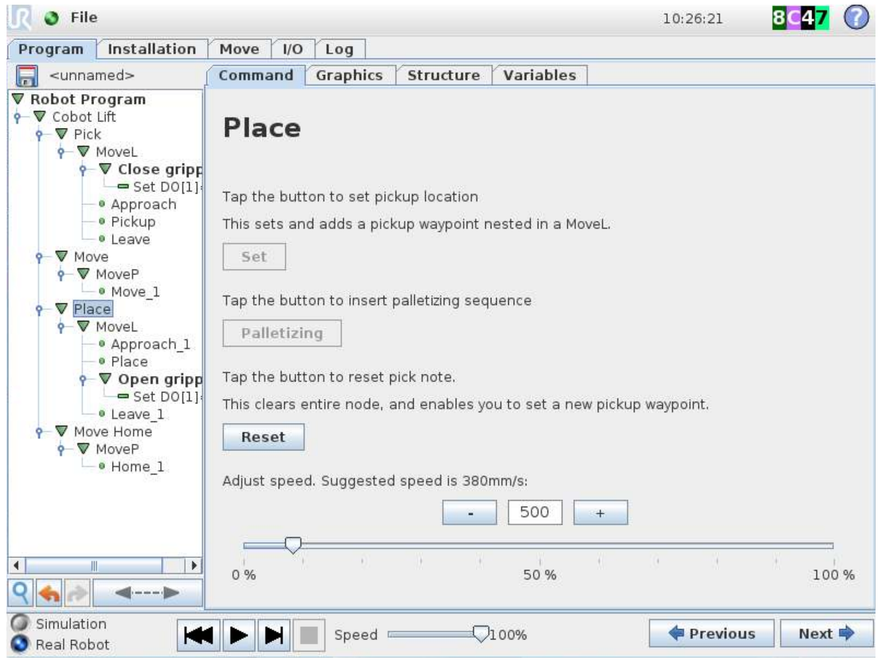


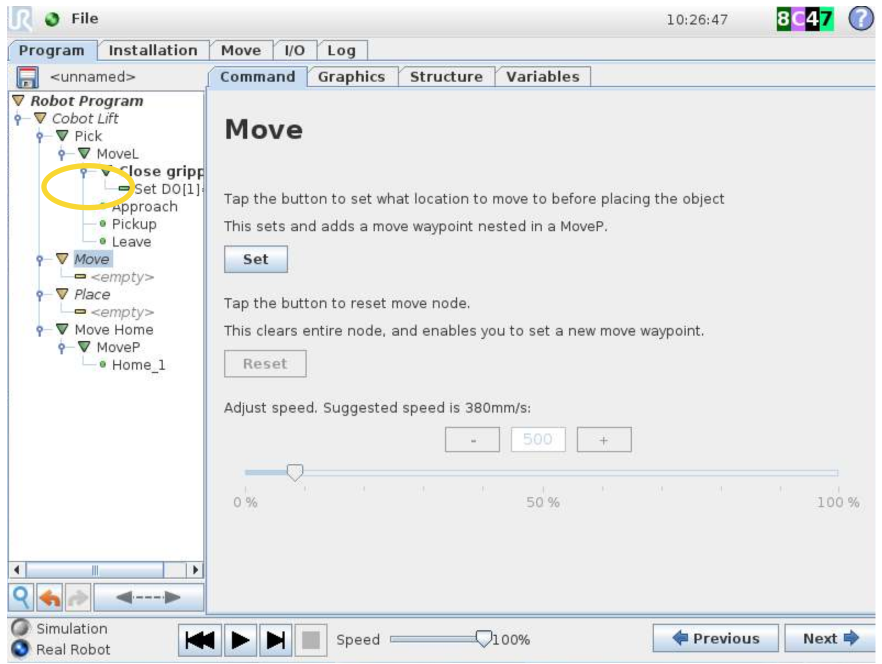
Step 10

Now the pick positions and actions are set. Please do the same in the **MOVE** and **PLACE** lines too. If the application in question is suitable for the UR palletizing wizards, this function is also available in the URCap.

Step 11

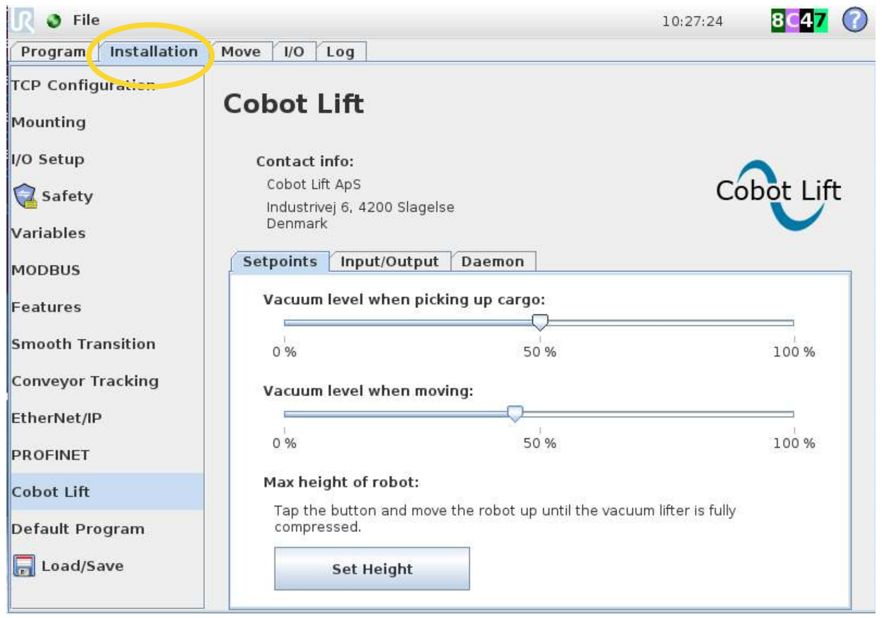
When the positions and the gripping actions are set, the program is ready to run.





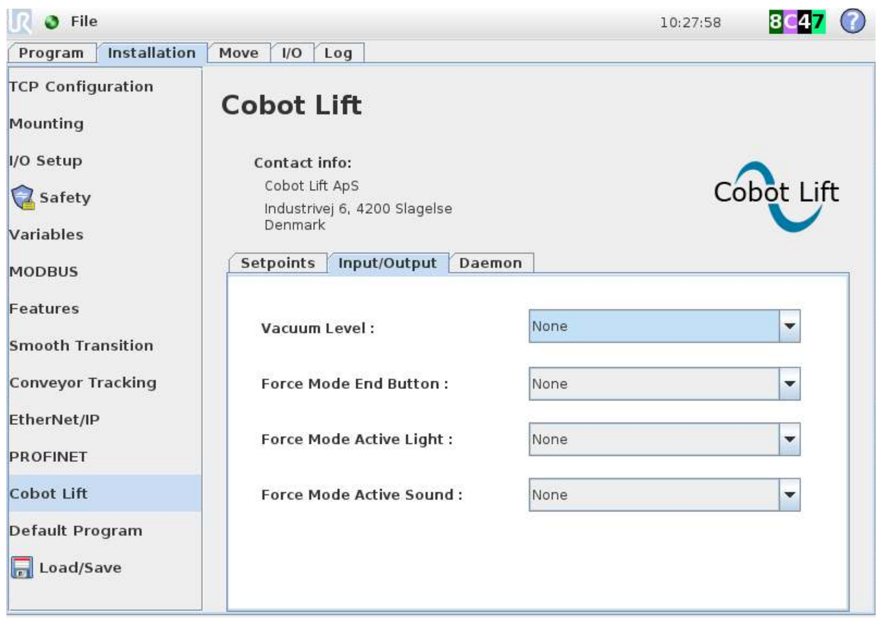
Step 12

However, before you start the program, a value for the vacuum level must be set. This is done in the **INSTALLATION** tab. Here you can set the value on the two sliders. One for picking up the product and one for the other movements. In most cases these two can use the same level.



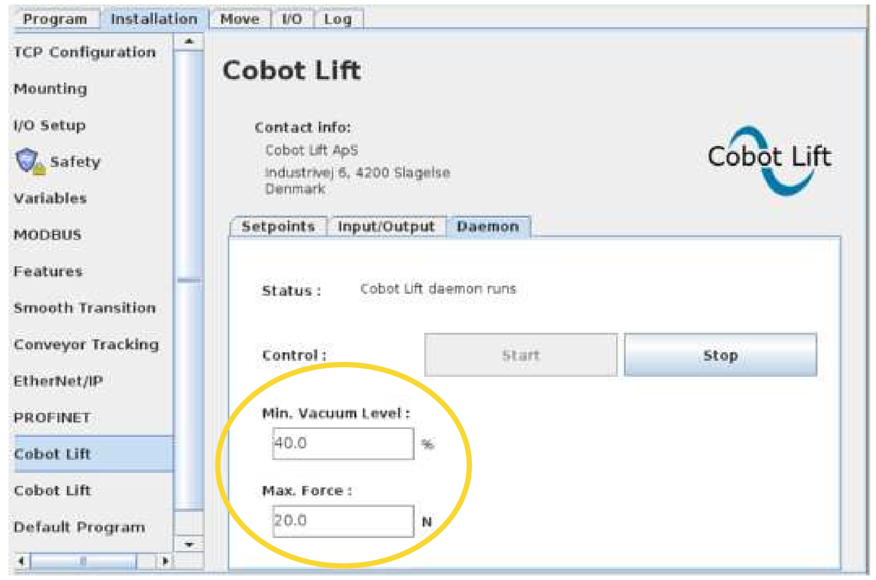
Step 13

Set Vacuum Level, Force Mode End Button and Force Mode Active Light .



Step 14

Set value for **Min. Vacuum Level** and **Max. Force** and press **Start**.



Congratulations, you have completed the programming!

10.1 IMPORTANT GUIDELINES BEFORE STARTING PROGRAMMING

When doing the programming always make sure to follow the guidelines

1. Always use low accelerations and try to get the movements as smooth as possible using large blends when possible.
2. Vacuum level should be adjusted so the tool is "floating" in the middle of the sliding unit when running without product.
3. Make sure the tool is aligned in the vertical plane.

11.0 RISK ASSESSMENT

One of the most important things that an integrator needs to do, is to perform a risk assessment of the complete installation. In many countries this is required by law.

The robot itself is partly completed machinery, as the safety of the robot installation depends on how the robot is integrated (E.g. tool/end effector, obstacles and other machines). The risk assessment that the integrator conducts shall consider all work tasks throughout the lifetime of the robot application. A risk assessment must be conducted before the robot arm is turned on for the first time.

A part of the risk assessment conducted by the integrator is to identify the proper safety configuration settings, as well as the need for additional emergency stop buttons and/or other protective measures required for the specific robot application. Identifying the correct safety configuration settings is a particularly important part of developing collaborative robot installations.

Some safety-related features are purposely designed for collaborative robot applications. These features are configurable through the safety configuration settings and are particularly relevant when addressing specific risks in the risk assessment conducted by the integrator: Please read the risk assessment part of the Universal Robots manual as these instructions also apply to the Cobot Lift system. Please also ensure to read relevant vacuum tube lift producers manual.

If the robot is installed in a non-collaborative robot application where hazards cannot be reasonably eliminated or risks cannot be sufficiently reduced by use of the built-in safety-related functions, then the risk assessment conducted by the integrator must conclude the need for additional protective measures (e.g. an enabling device to protect the operator during set-up and programming).

The following hazards must be considered by the integrator (Other significant hazards can be present in a specific robot installation).

1. Penetration of skin by sharp edges and sharp points on tool/end effector or tool/end effector connector.
2. Bruising due to contact with the robot.
3. Sprain or bone fracture due to strokes between a heavy payload and a hard surface.
4. Items falling out of tool/end effector, e.g. due to a poor grip or power interruption. This point is extra important to consider with the Cobot Lift system due to the high payload of the robot.
5. Mistakes due to different emergency stop buttons for different machines.
6. Mistakes due to unauthorized changes to the safety configuration parameters.
7. Which height is the robot/workload working in during production.
8. What kind of damage is the product able to do to the operator? (soft bag vs. hard bucket)

12.0 QUESTIONS AND ANSWERS

12.1 PAYLOAD RELATED

How should the payload be configured to ensure no damage to the robot?
So far, we have used payloads between 4 and 6 kg. Depending a bit on the tool/suction cup. It is only in case the vacuum pump is not running, otherwise this will take up the load, but we have found it a good compromise to be somewhere in the middle to avoid protective stops.

How is the payload defined?
As usual with the x-y-z tcp offsets (z is a mean value of min. and max., but it does not seem to make much of an influence). We do not take the load of the product into consideration when we define the payload in the robot.

How does it change with and without product?
It doesn't change. The load does not influence the robot, but usually you can just use a higher speed without the extra load. The vacuumlifter is carrying the load and the swivel arm does not need much force to move the weight around sideways.

12.2 MOTION RELATED

What is the maximum speed that the robot should be allowed to work at with the upgraded payload? We do not have a fixed figure. There are many factor that can have an impact on this. We have made trials with water-like products in plastic bags weighing 11kg where we needed to use a slower speed, than running with more compact materials weighing 20kg.

Allowed working conditions – max. speed, acceleration, payload:
Accelerations should generally be kept low, high accelerations with high inertia payloads cause large forces and torques which can lead to protective stops etc. So low acceleration, big blends and in general very smooth movements are the key to be able to run the extra loads. The more weight (or viscosity like water), the lower the speed.

12.3 SAFETY RELATED

How will the increased payload/momentum affect the risk assessment?
Very general rules has to be used here like with any other installation, but very pointy/hard loads are of course extra critical if they are also heavy. Layouts in the individual installation will also affect this (is it possible to walk in the working zone and so on).

Can the Cobot Lift be used with any safety configuration? For example, force and power to the minimum?
In our opinion it will not make much sense, as the required speed will be very low to avoid protective stops.

The total payload from the robot and the supporting machine may have to be considered for the risk assessment. In this case, the risk reduction by robot safety functions may not be sufficient. Then, how can we reduce the risk from the heavy load? Our experience and testing tells us that the weight typically helps us stop the robot very easily when pushing to the load/robot, both vertically and horizontally. When very little force is applied the load stops the robot.

The safety system of the robot is not designed for payloads beyond the nominal payload of the robot. Therefore it is necessary to clearly inform the integrator/end-user of the system to do a risk assessment and specifically consider the risk of being hit/clamped/crushed by the payload, as well as the risks involved in case a large payload is dropped accidentally. This should be made clear in the information for use. If the vacuum pump stops, you can set the robot in freedrive to protect the robot from overload, however some loads (for instance a bag with much leakage) will be dropped before the robot hits the ground. In this case extra measures has to be taken to avoid any risks. There could also be instances where the freedrive function actually could be hazardous to the operators safety and thereby not relevant. However, this could potentially damage the robot in case of power failure to the vacuumsystem, why back-up power supply could be worth integrating in the final installation.

12.4 LONGEVITY RELATED

Do you foresee any circumstances in which the device may malfunction and overload the robot?
In case of power failure where both the vacuum pump and the robot is turned off immediately. If this is most likely to happen it will be worth integrating back-up power supply to the installation. If one of the two is still powered on, it should not be an issue. But a backup source of the power supply could prevent this from happening.

How can we guarantee, that the force/weight applied on the robot is within the given limits? (Preventing joint damage over time)
Our first installation has been running 18 months (1½ shift) now with a very low cycle time and without any issues so far. Data logging also tells us that we are running within reasonable limits. In principal the robot is running without any load.

Will the robot breakdown due to pushing 25 kg and over a time period?
The robot does not push 25kg. The vacuumlift set-up is helping us here. With this type of lifter a man can lift hundreds of kilos and still move it around without using a lot of power to move it. The workload is less than 10kg when moving around unless sudden stops or hard accelerations are used.

Does the lift assist mechanism apply a force to the robot in the z-direction when approaching and retracting during pick and place and will that force have an impact on the longevity of the robot?
We do not think so. We sometimes use force mode when picking up a product, but we are within the normal limits.

12.5 ACCURACY RELATED

What’s the position deviation of the joints?
Due to the rubber connection between the robot and the lifter, the accuracy will be poor. However, if the z movement is done slowly when setting down the load (so there is little swing in the system) the accuracy will be pretty good. The Cobot Lift can also be mounted without the dampers, but then speed and acceleration settings must be quite low.

How can the system ensure that the robot's repeatability does not deteriorate?
Repeatability will also be poor compared to the robot itself, but I think this is the price you pay when going up in load. Again the way to solve it is as mentione

13.0 TROUBLESHOOTING GUIDE

Problem / Error	Solution
Vacuum pump is not running.	Check if it receives signal from the robot on the I / O side. Check if analog slider is set to zero.
Robot cannot hold onto items.	Check if the rubber lip on the suction head is damaged. Check if the center distance is correct when the robot picks up the item.
Robot cannot dispose items properly.	Check if the point of disposal is correctly adjusted in the system. Reduce speed if the objects are swinging too much at the point of disposal.
Robot does not stop when it has run out of items.	Make sure the sensor on the pick-up spot works.
Robot runs slowly.	Check that the speed indicator on the display is at 100%. (Applies only when the program is opened in programing mode)
Robot does not hit its positions.	Zero point is offset. Contact the supplier or correct the waypoints involved.
Robot reports error on the display *.	Contact supplier if error repeats.
Robot goes into error in the middle of program. Some features are still running.	Disable the current functions from the I / O page and restart the program when the error is corrected.
Pneumatic cylinders do not work.	Check if the machine has access to compressed air and whether the given cylinders/valve communicates with the robot on the I / O page.
Robot goes into protective stop when running	Adjust speed and/or acceleration settings to a lower level. Use blends to make the movements as smooth as possible.

* Additional troubleshooting and maintenance of the UR robot can be found in the Universal Robots service manual for UR on the Support website (http://www.universal-robots.com/support).

14.0 DECLARATION OF CONFORMITY

Declaration of Incorporation
Directive 2006/42 EC, Annex II B

Cobot Lift ApS
Industrivej 6
4200 Slagelse
Denmark

Herewith declares that
Machine: Cobot lift tool CL-XXX-2019

Year: 2019
Declaration of Incorporation
Directive 2006/42 EC, Annex II B

The following parts of national technical standards have been used

EN 12100:2010

Cobot Lift tool is intended to be incorporated into machinery or to be assembled with other machinery to constitute machinery covered by Directive 2006/42/EC

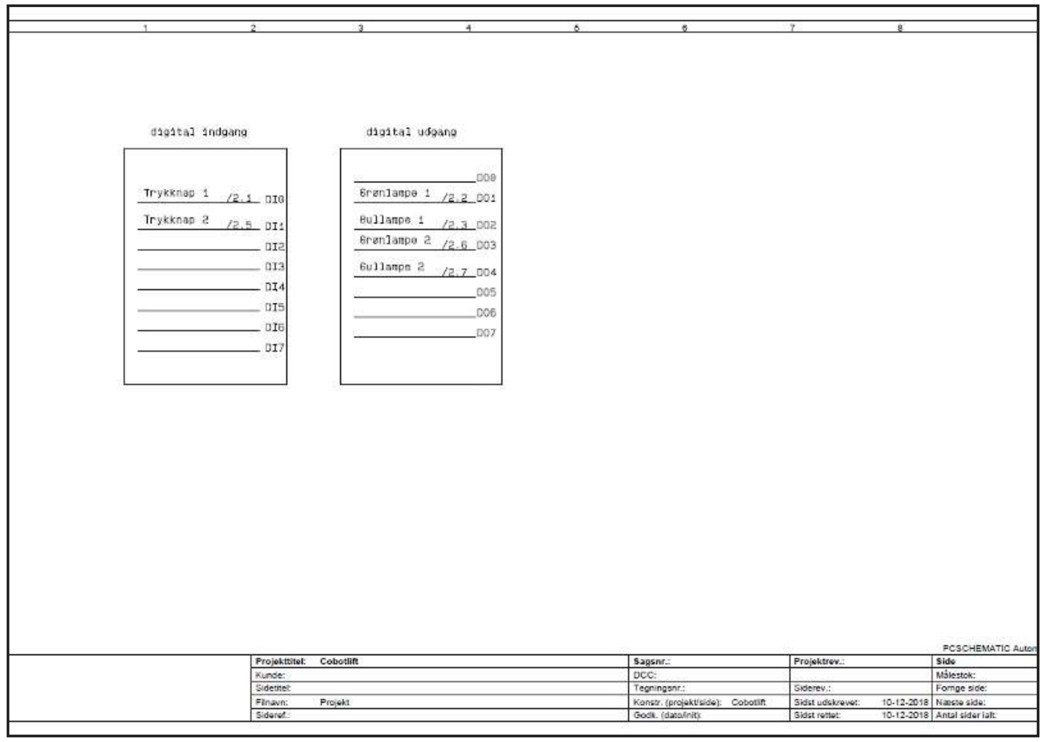
And furthermore declares that it is not allowed to put the machinery into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of Directive 2006/42/EC and with national implementing legislation i.e as a whole, including the machinery referred to in this declaration.

Signature Date
Flemming Bischoff Truelsen

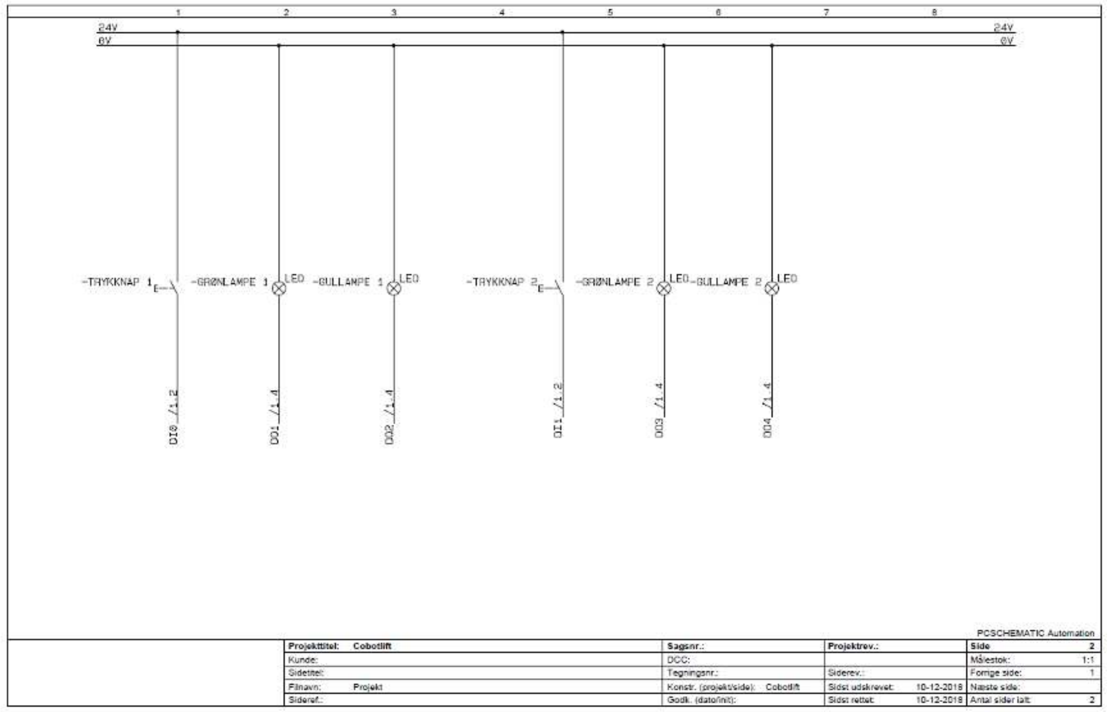
15.0 CONNECTION OF STATUS INDICATION

In some cases a status indication can be helpful. In the following section we will describe how to install a status indication lamp. Status indication can be done by means of two small boxes with indication or a light tower.

Electrical documentation of the addition.

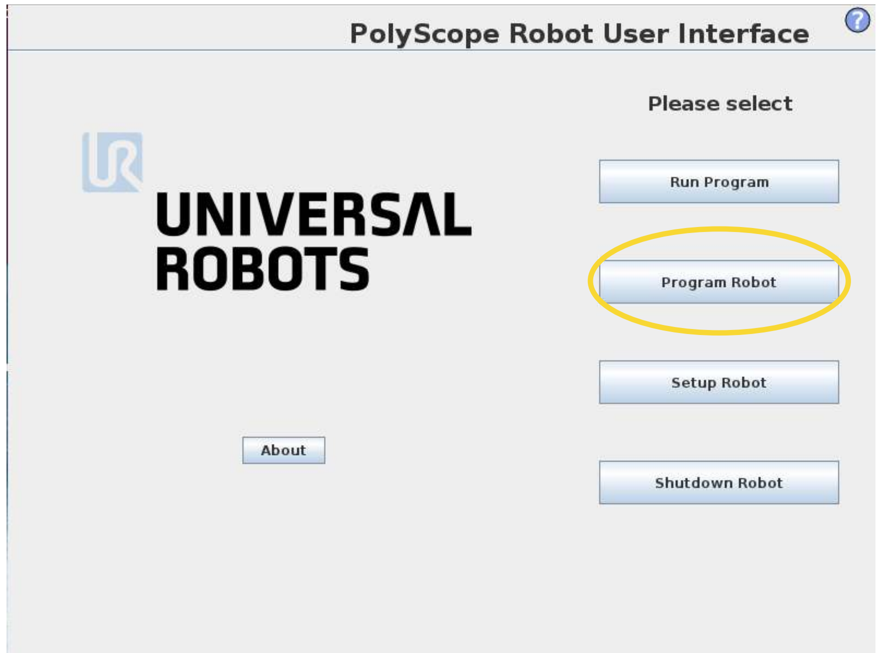


Wires must be mounted on the robot I/O connections.



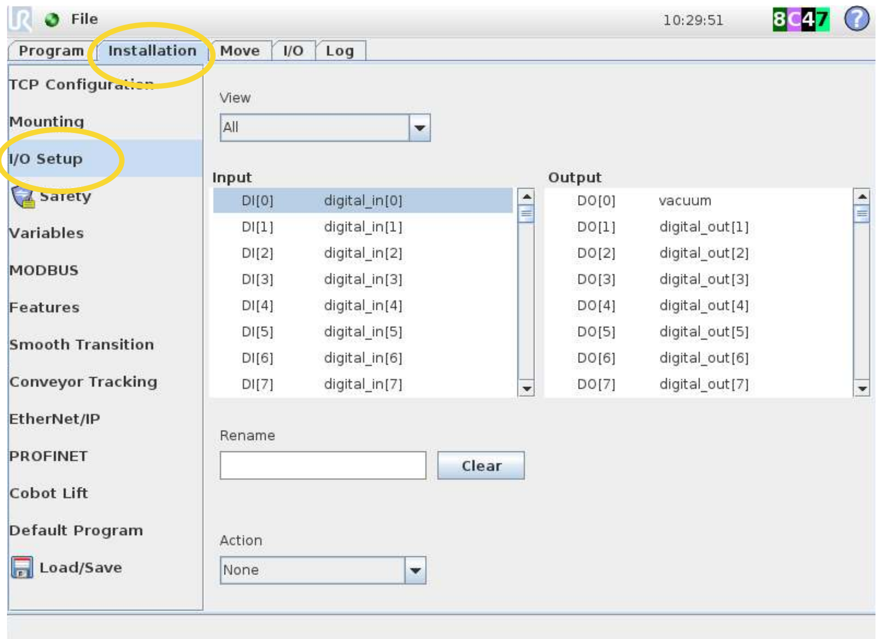
Step 1

Go to the polyscope panel for programming, choose **Program robot**.



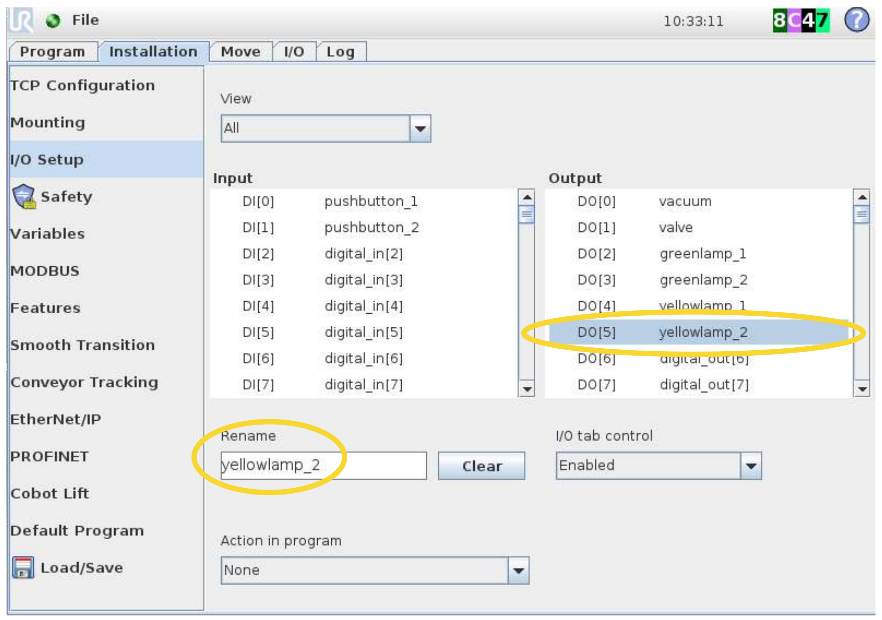
Step 2

Choose **Installation** and then I/O Setup.



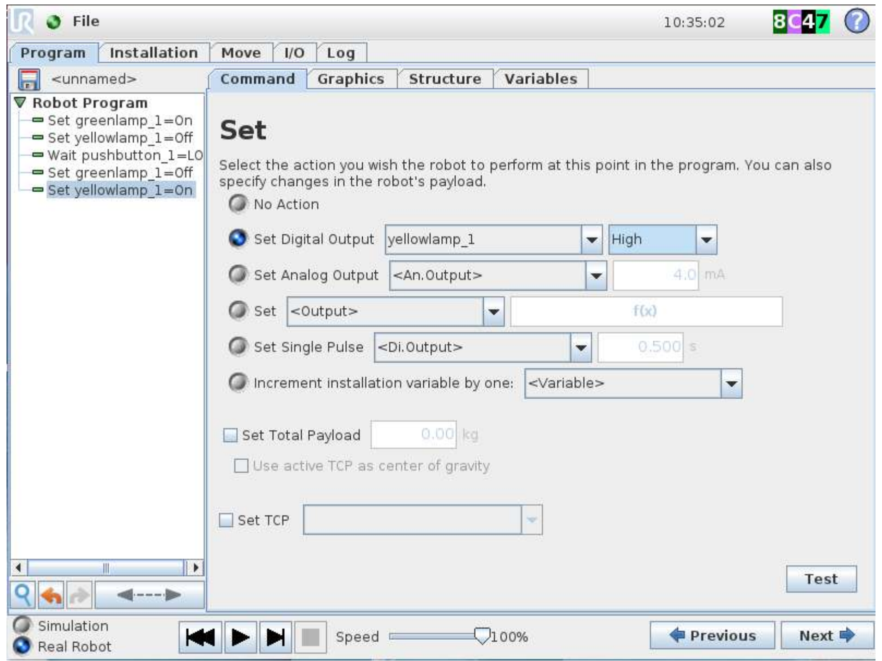
Step 3

Select input/output and name it as desired in the **Rename** box.



Step 4

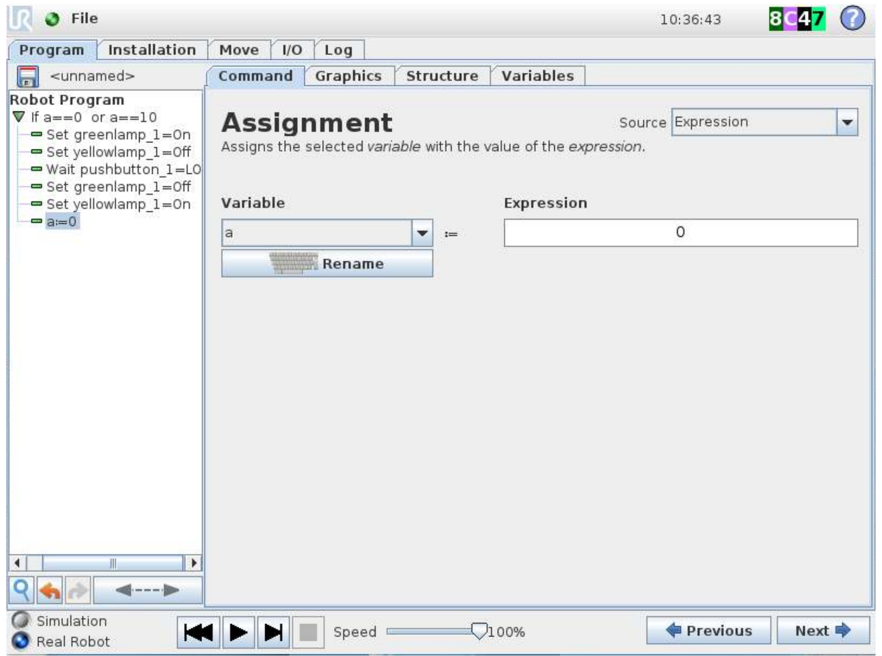
Now you can use them in your program.



First examples shows how to use the button each time a cycle has to be started.

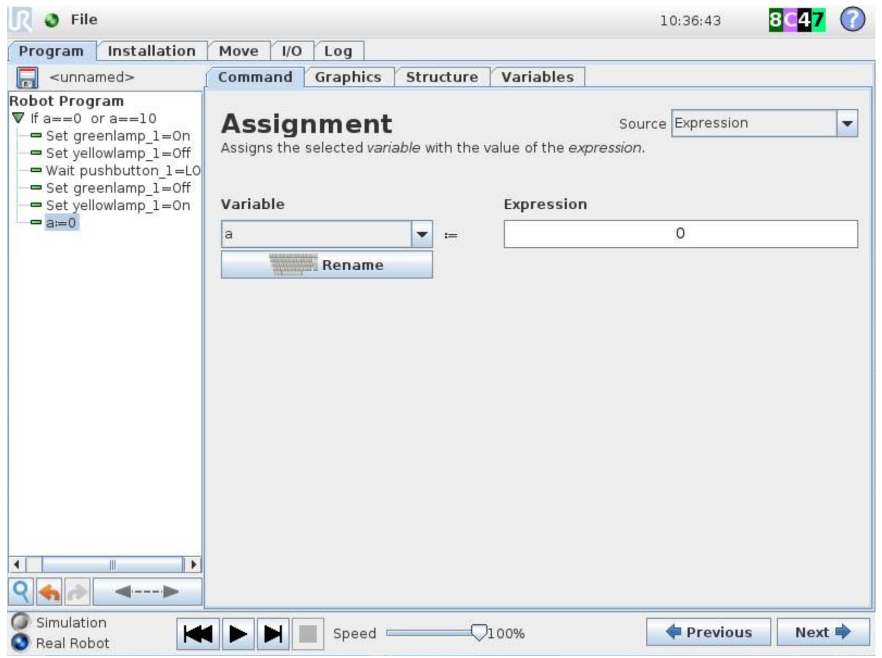
Step 5

By using a statement and a counter you can decide how many items you need on the pallet.



Step 6

You have now completed your status indication configuration



NOTE

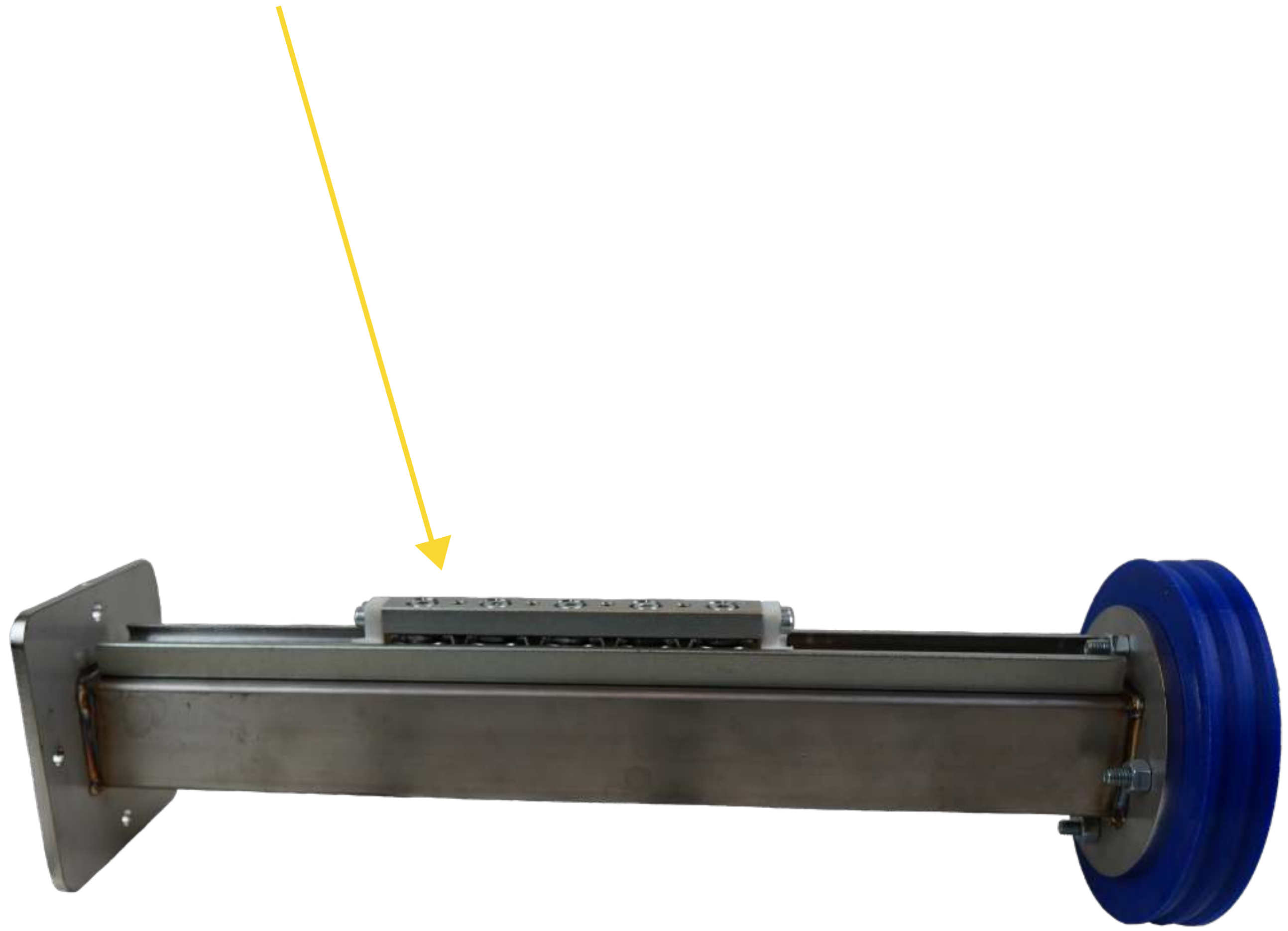
There are other ways of implementing a status indication, so please only see the above example as a help to your installation.

16.0 SERVICE AND MAINTENANCE

Service and maintenance of the robot and vacuum system is done according to the manual of the supplier. However, a visual inspection should be done every day before starting production.
Service and maintenance of the Cobot Lift tool is done by means of a visual inspection to check that all connections are in place (screws, pneumatic connections etc.).
There is a sliding unit on the tool that might wear out over time. This can easily be exchanged by means of a few screws, however, it is our experience that the unit typically works for years before wearing out.

Adjusting the sliding unit

There are 5 rollers in the sliding unit. These rollers can be adjusted in tension by means of the fixing screws that are positioned on an eccentric screw/bolt.



Cobot Lift Aps

Industrivej 6,
4200 Slagelse
Denmark

sales@cobotlift.com
+45 22 20 53 65

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Cobot Lift
Cobot Lift