



Nuevas técnicas de automatización industrial

1st february 2024

tidyPal User Manual

www.nutai.com

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Overview

- 1 Introduction
- 2 Requirements
- 3 Elements
- 4 Functionalities
- 5 Axis configuration
- 6 Safety
- 7 Assembly and maintenance
- 8 Best practices
- 9 Support

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What is tidyPal?

tidyPal is a solution made up of hardware and software, which allows the automation of the palletizing process.

With the software you can configure the different hardware components of the station such as pallet types, box types, robot I/O, work mode, etc. Also with the option to create the automatic mosaic.

tidyPal  by nutai

The logo icon for tidyPal is a blue square with a white square inside, which has a smaller black square in the center.

 **Warning:** we are not responsible for damage caused by misuse of this product. An e-series robot is used in this manual, the software is not compatible with the CB series.

Introduction

Automatic mosaic

tidyPal is capable of working without the need to define the mosaic to be palletized by the user. The software will calculate the most optimal distribution both in stability and in use of space, you will only need the dimensions of the box and the pallet to be palletized.

Pallets:

- American pallet
- Euro pallet
- Half euro pallet



Dimensions:

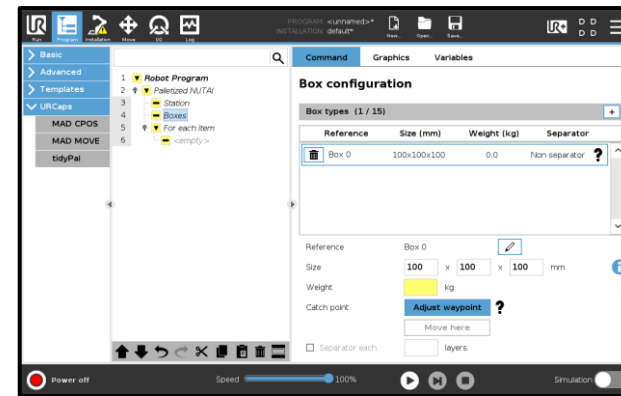
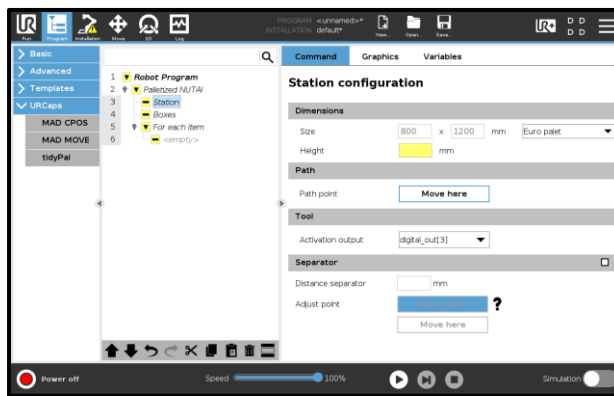
- Width (W)
- Length (L)
- Height (H)



Automatic mosaic

The product has a graphical interface where you can configure the different parameters and functionalities¹. Once set, at the beginning of the palletizing process, it will calculate the mosaic automatically and then start the process.

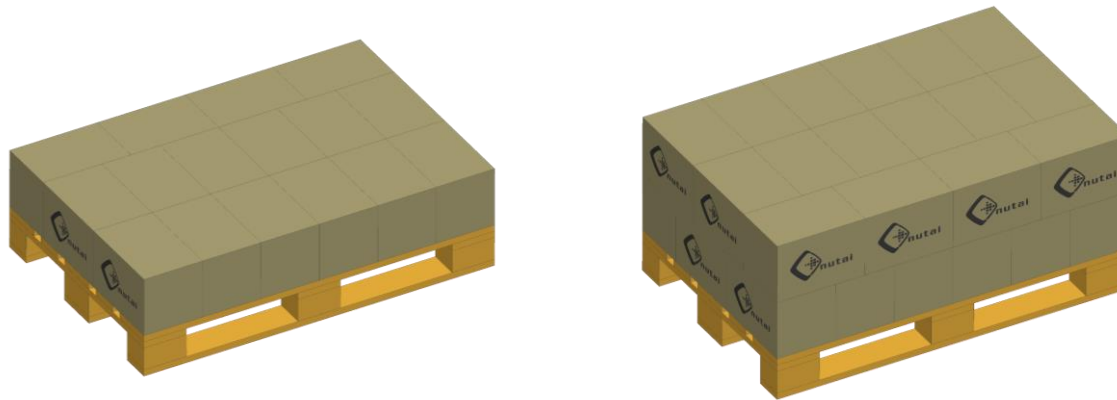
The result of the calculation algorithm will always be the same for a given configuration.



¹ These functionalities will be explained later in the manual.

Automatic mosaic

This section presents the distribution of layers obtained by the algorithm for a box with dimensions (W=200,L=300,H=200) mm and in a Euro pallet. The odd and even layers are shown below:



The algorithm will try to make the layers avoiding columns of boxes in the same position to obtain greater stability.

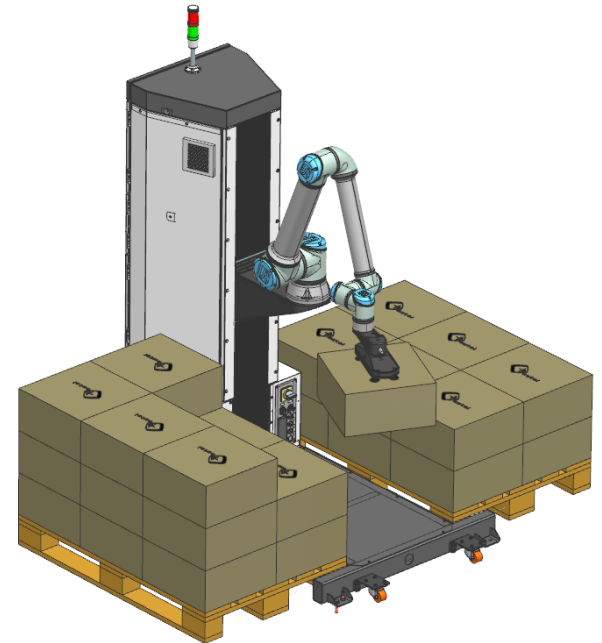
Overview

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Requirements

Product specifications tidyPal:

- Allowable box weight 10 Kg
- Maximum pallet height 2150 mm (from the ground)
- Station for two bays.
- American, Euro and Half pallet.
- Palletizing speed 6/10 boxes per minute*



* Depending on the speed and accelerations configured for both the robot and the vertical axis.


Requirements

RTDE connection

This software uses the Real-Time Data Exchange (RTDE) protocol of Universal Robots to synchronize information necessary for the operation of URCap.

Below is a table with the registers in use:

Type of register	Numbers of registers
int_register	40,41,42
bit_register	66

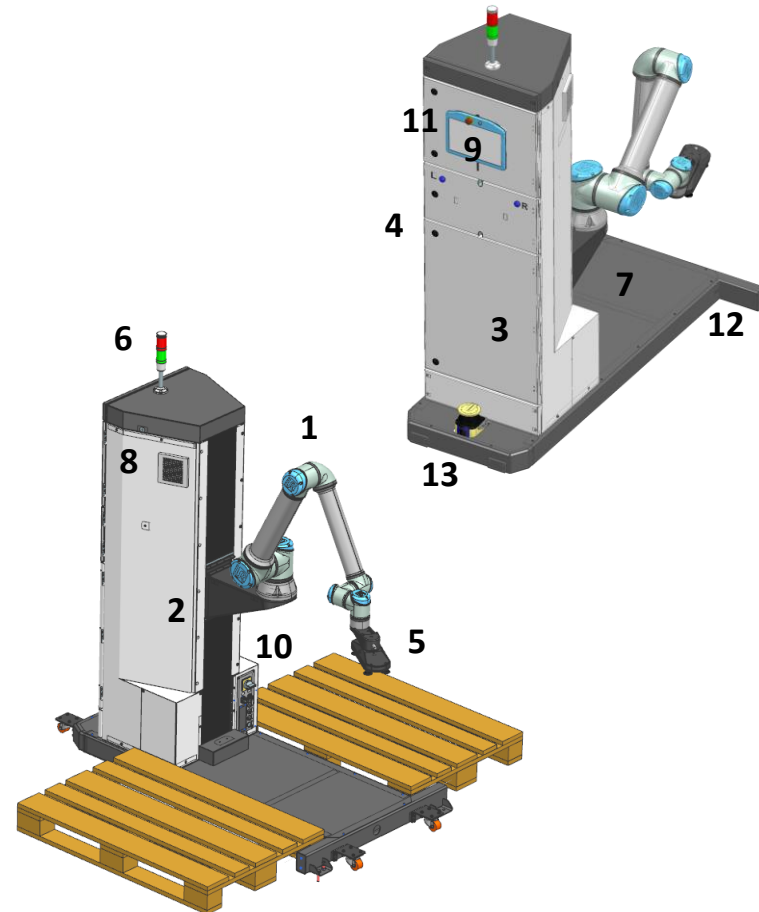
 **Warning:** verify that no other program or URCAP mentioned above to void possible interference that may cause the software to function incorrectly.

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Product elements tidyPal:

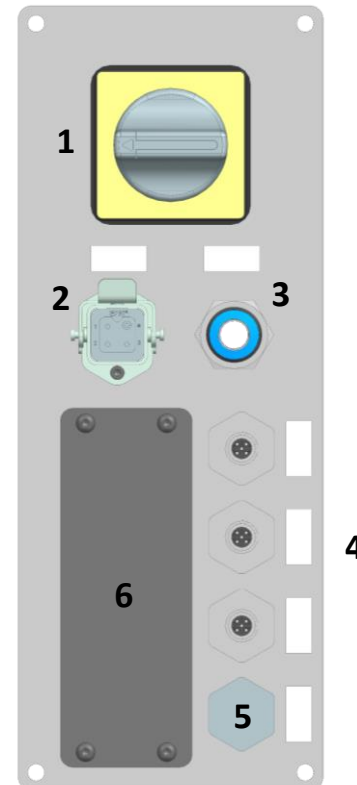
- (1) Robot UR10e
- (2) Electric axis 1000 mm career
- (3) Festo motor driver CMMP-AS
- (4) Software URCap
- (5) Custom gripper
- (6) Signalling beacon
- (7) Frame
- (8) Control cabinet
- (9) Teachpendant
- (10) Connection plate
- (11) Emergency button
- (12) Pallet presence sensor
- (13) Safety Scanner (optional)



Connection plate:

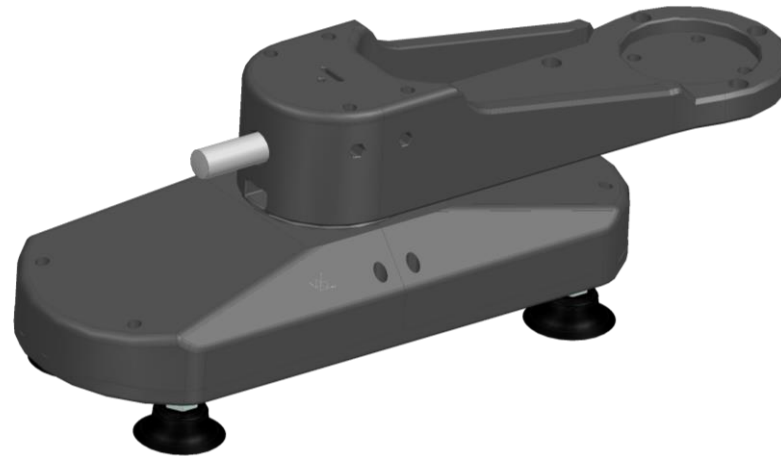
This section presents the connections available at the station:

- (1) Master switch
- (2) Supply
- (3) Air entry
- (4) Digital inputs
- (5) Extension input
- (6) Extension plate



Custom gripper:

This section presents the gripper designed by Nutai S.L. for the palletizing process with which loads of up to 10 Kg* can be lifted.



* The maximum load of the claw will depend on the material to be handled, it will be necessary to carry out tests for each application.

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This section explains everything related to the functionalities of the URCap software. It is divided into the following subsections:

1. Program panel

Configuración de parámetros del modo de trabajo, estación y caja.

Parameters configuration of the work mode, station and box.

2. Toolbar panel

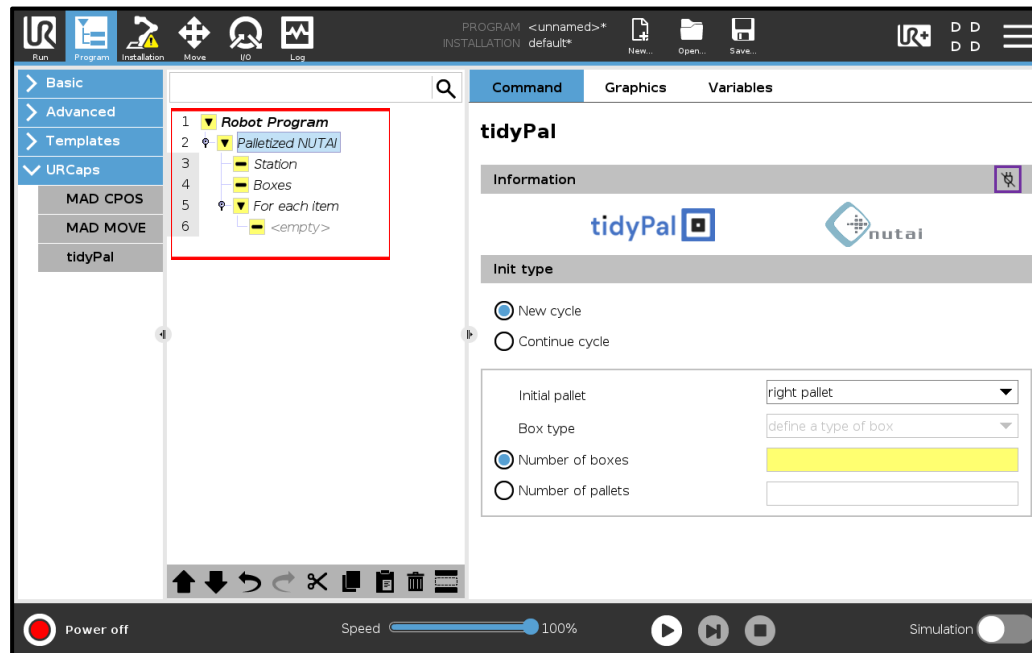
Diagnosis of the machine during the process.

1 Program panel

Functionalities



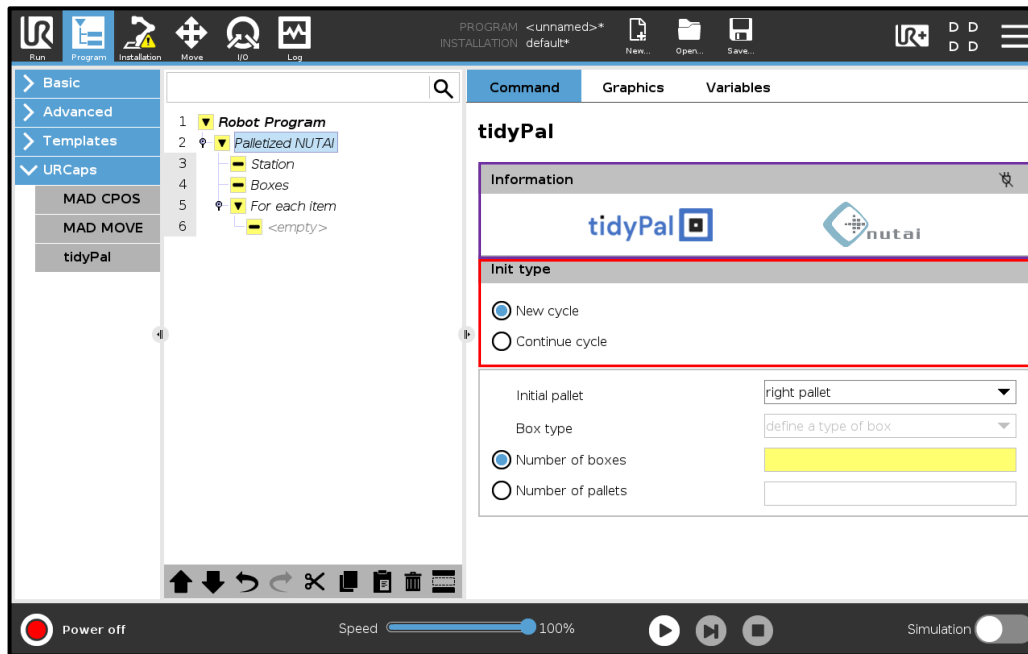
The program panel has 4 main nodes: *Palletized NUTAI*, *Station*, *Boxes* y *At each item*. (□)



□ Icon about ethernet connection.

Palletized NUTAI

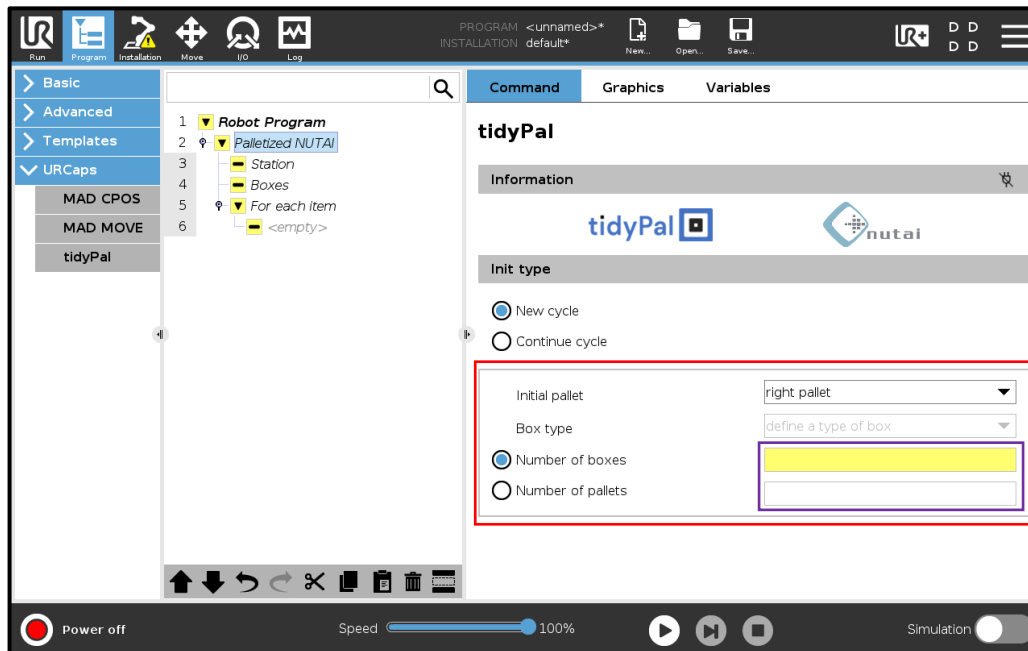
You can configure from the NUTAI Palletizing node the different start modes of the station: New cycle and Continue cycle(□).



□ Logos from product and company is also displayed.

Palletized NUTAI

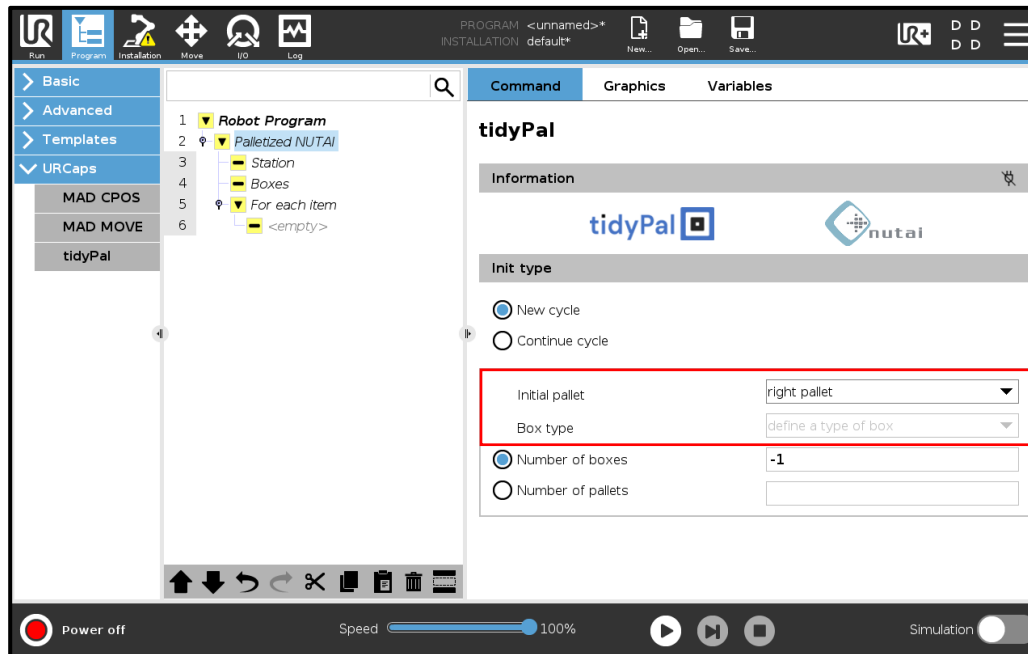
The New cycle mode allows you to start a palletizing process with the possibility of working on demand for boxes, pallets or infinite¹. (□)



□ ¹ To configure infinite mode, enter -1 in Number of boxes or pallets.

Palletized NUTAI

Other parameters that must be configured are the initial pallet and the type of box¹ (□)

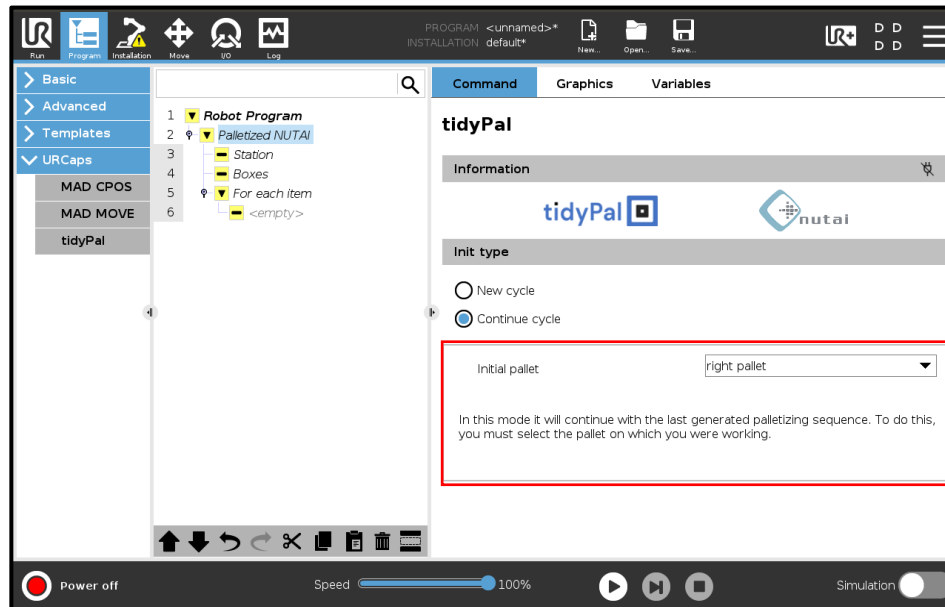


¹ In the Boxes node, later, it Will be explained how to define a type of box.

Palletized NUTAI

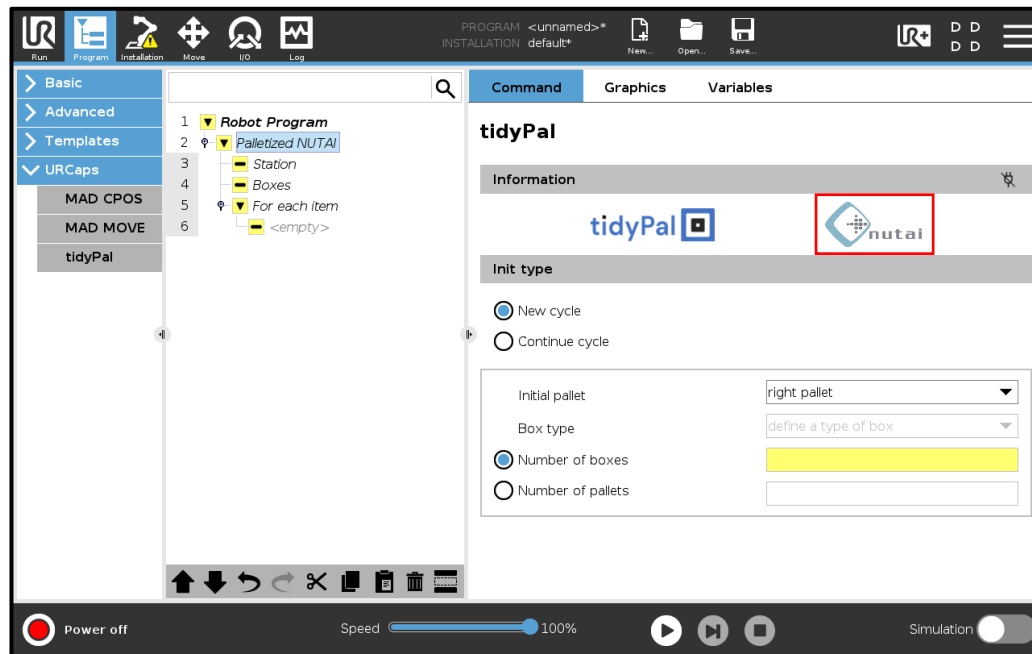
The Continue cycle mode should be used when the robot stops in the middle of a cycle for any reason such as machine failure, protection/emergency stop, power failure, etc.

To continue with the previous cycle, you must choose the pallet you were working on. (□)



Palletized NUTAI

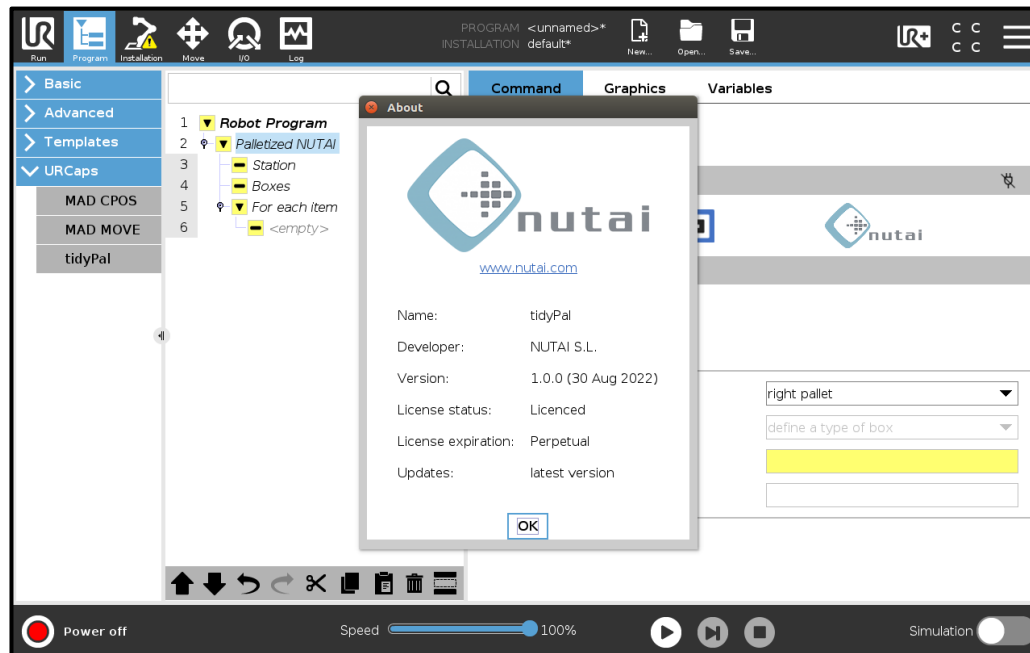
In this node, to find more information about the software, click on the NUTAI logo and a pop-up (□) will appear.



Functionalities

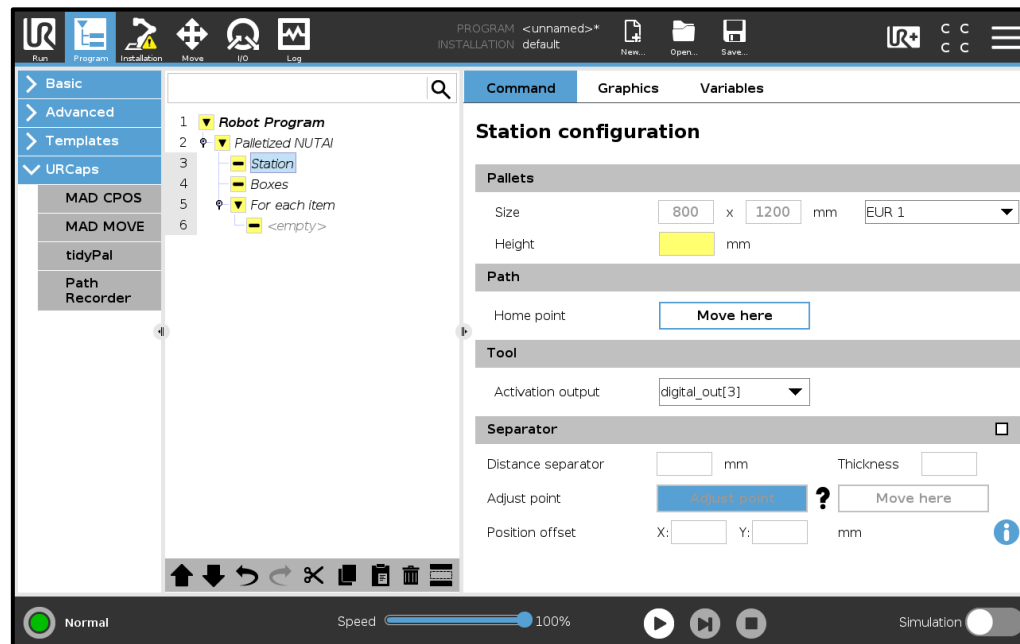
Palletized NUTAI

The pop-up will display additional information about the software, such as its current version, whether it is up to date or the type of licence.



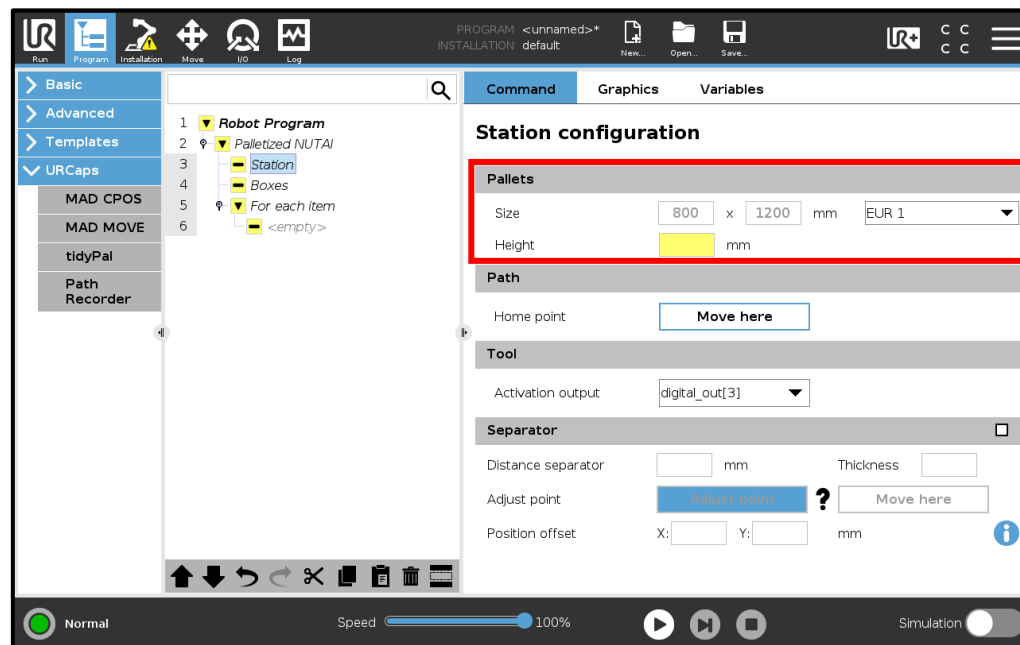
Station

In this node the different general parameters for the palletizing station are configured.



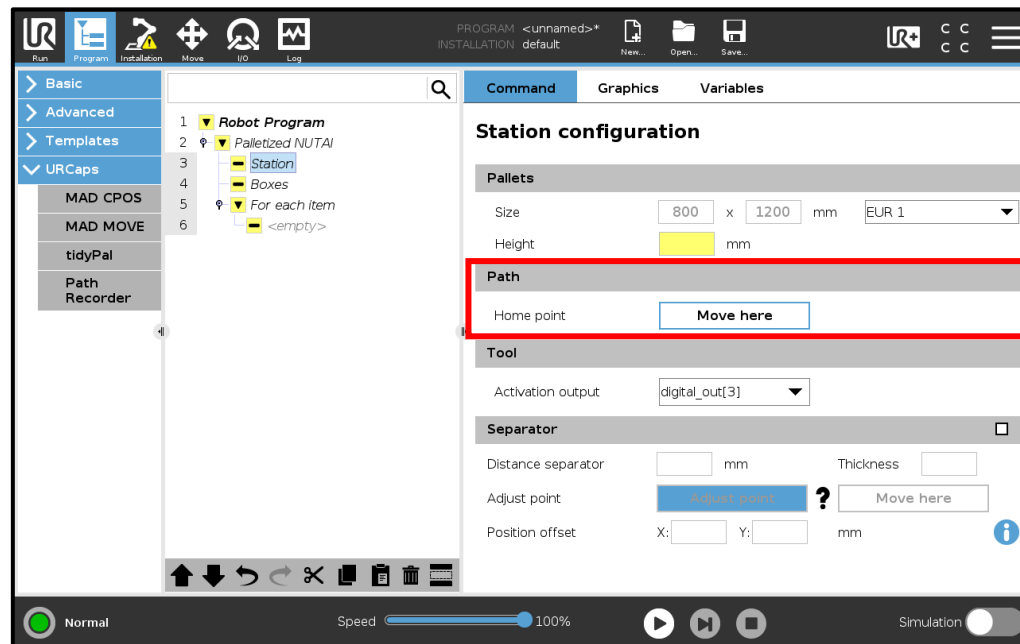
Station

In the section of *Dimensions* the type of pallet and the palletizing height must be configured. (□)



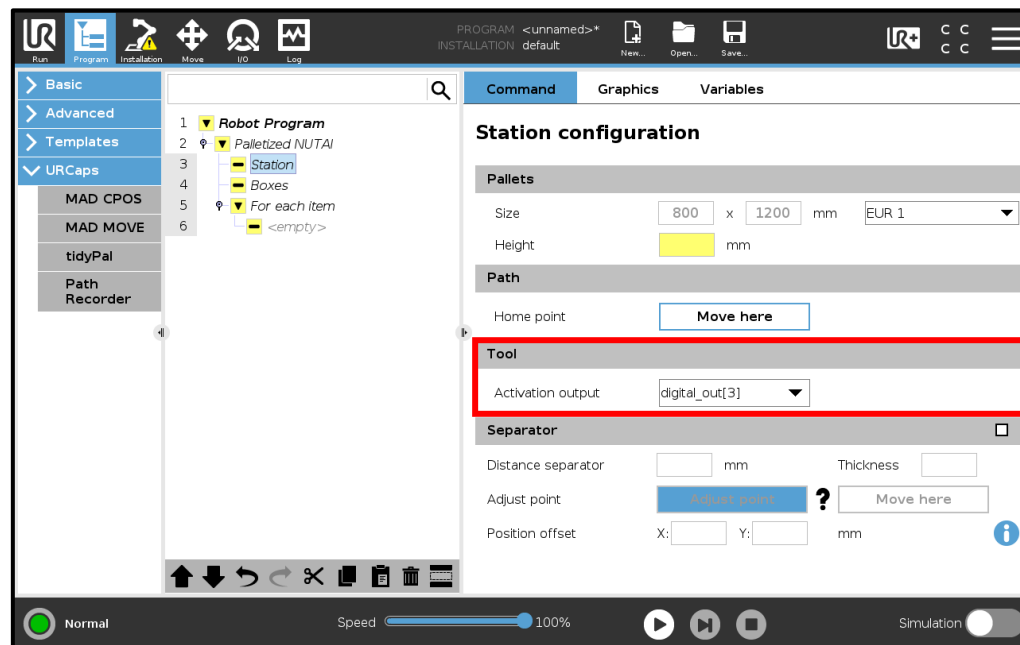
Station

In the Trajectory section, the robot can be positioned at the waypoint. (□)



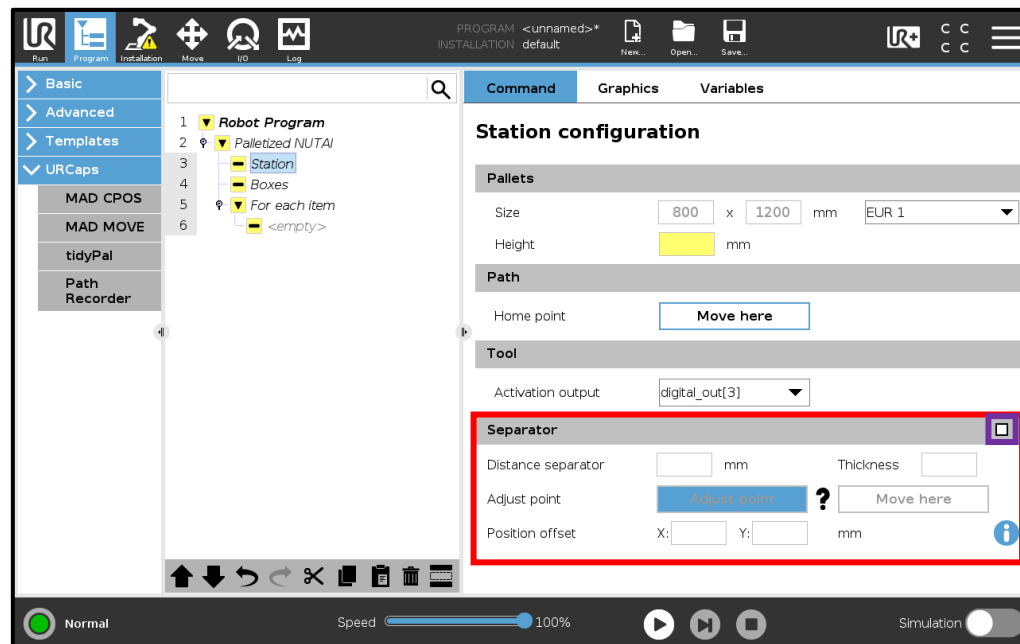
Station

In the Tool section, the digital output that will be used to control the action of the gripper must be configured. (□)



Station

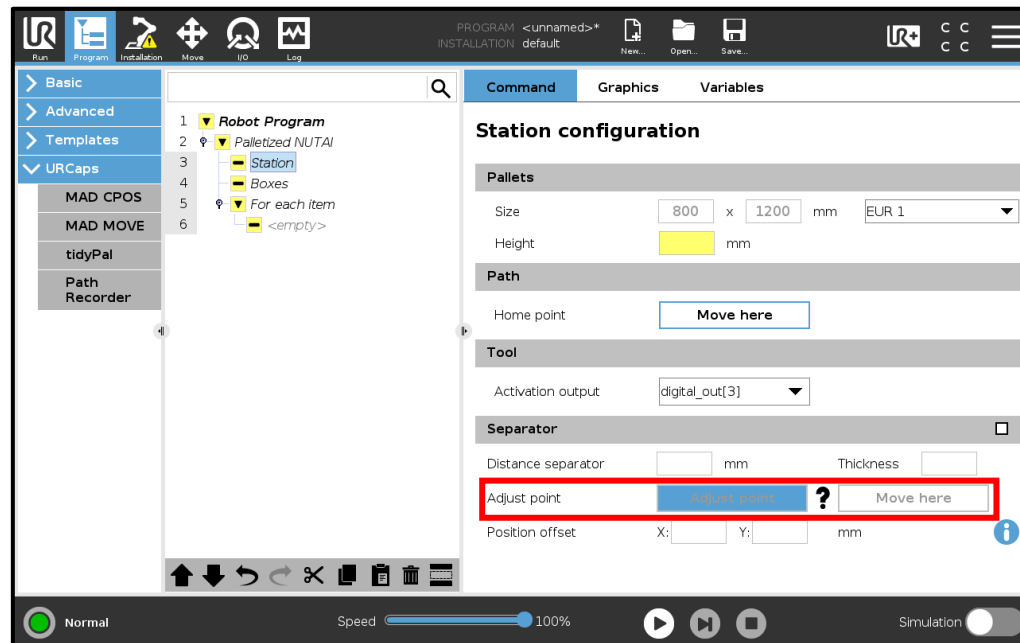
In the Spacer section, the travel distance is configured, which is the maximum distance from the configurable point to the last available spacer and the thickness of the spacers. (❑)



❑ This section can be disabled using the checkbox.

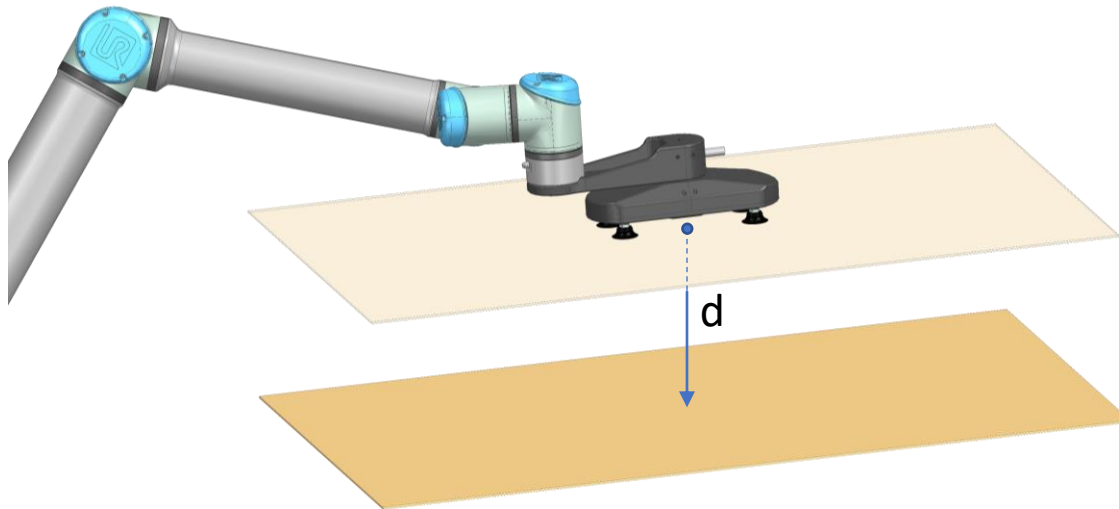
Station

In addition, the pick-up point must be configured, this being the beginning of the stack of separators. Using the Move button here you can move the robot to the configured point(□).



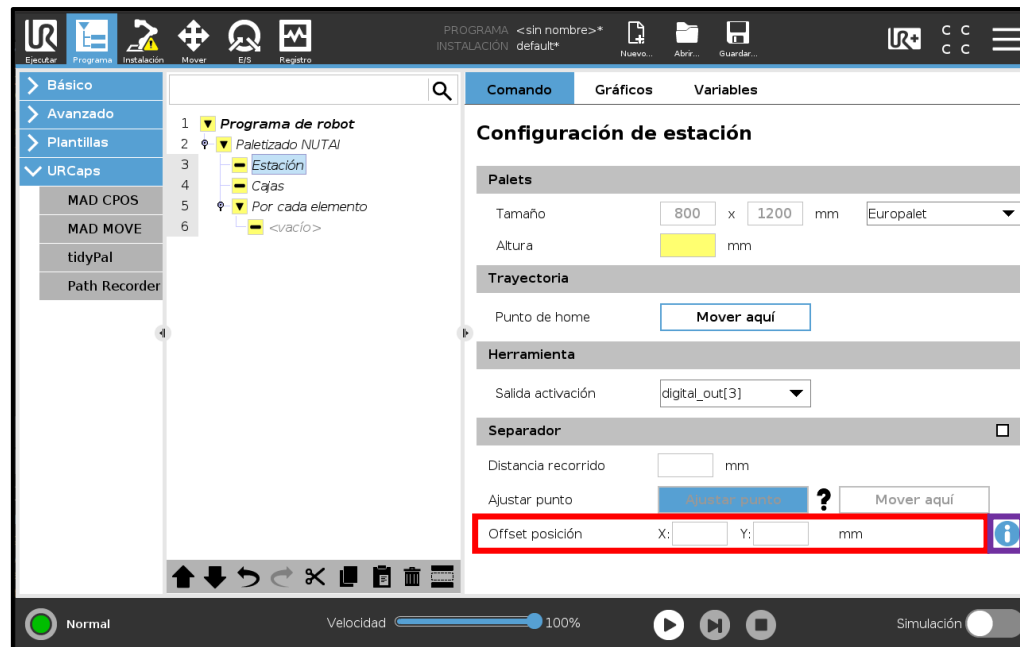
Station

The following image shows the pick-up point and the distance that must be configured for the Separator section.



Station

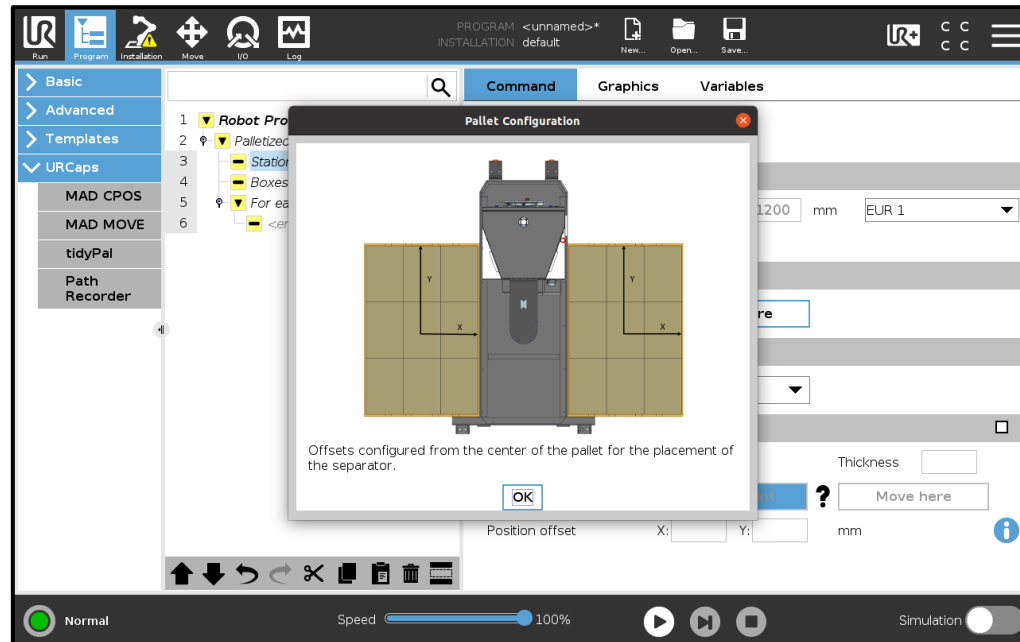
Finally, the distances from the center of the spacer to the gripping point of the gripper must be configured. (□).



□ The icon will display a pop up with extra information.

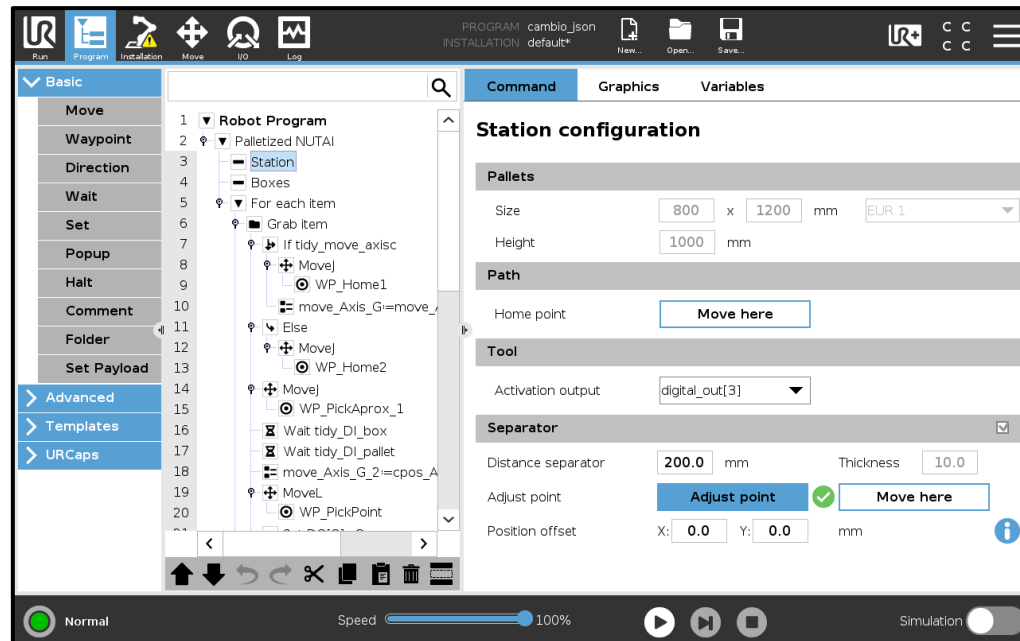
Station

Distance between the gripper with the separator and the center of the pallet layer.



Station

In manual mode, the data from the configuration¹ shall be loaded. The interface shall be updated with these parameters and the components shall be locked.

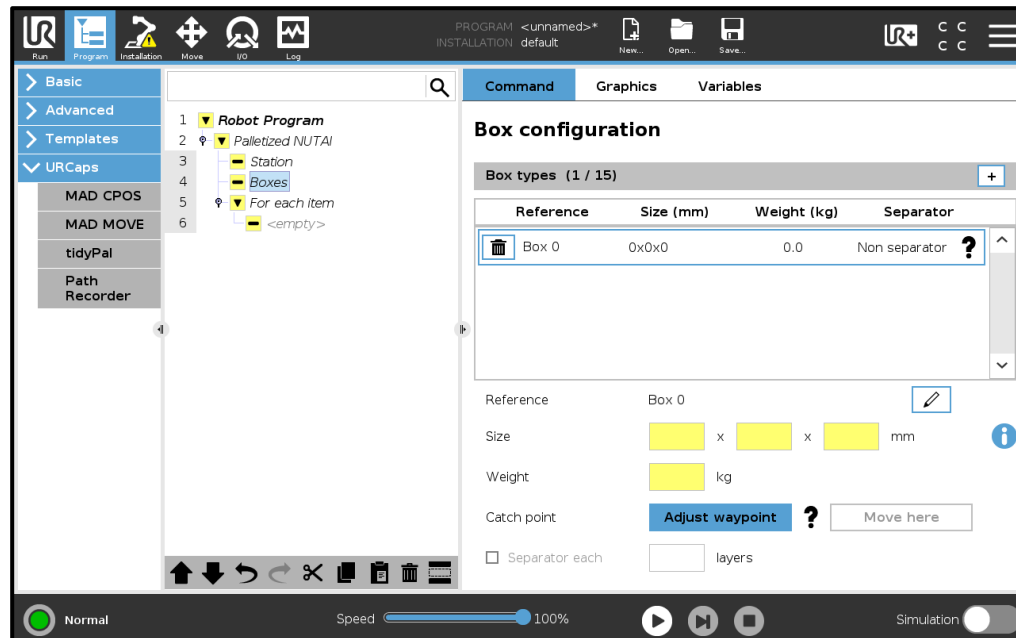


¹ In the Installation section, the configuration of the file is detailed.

Functionalities



Boxes

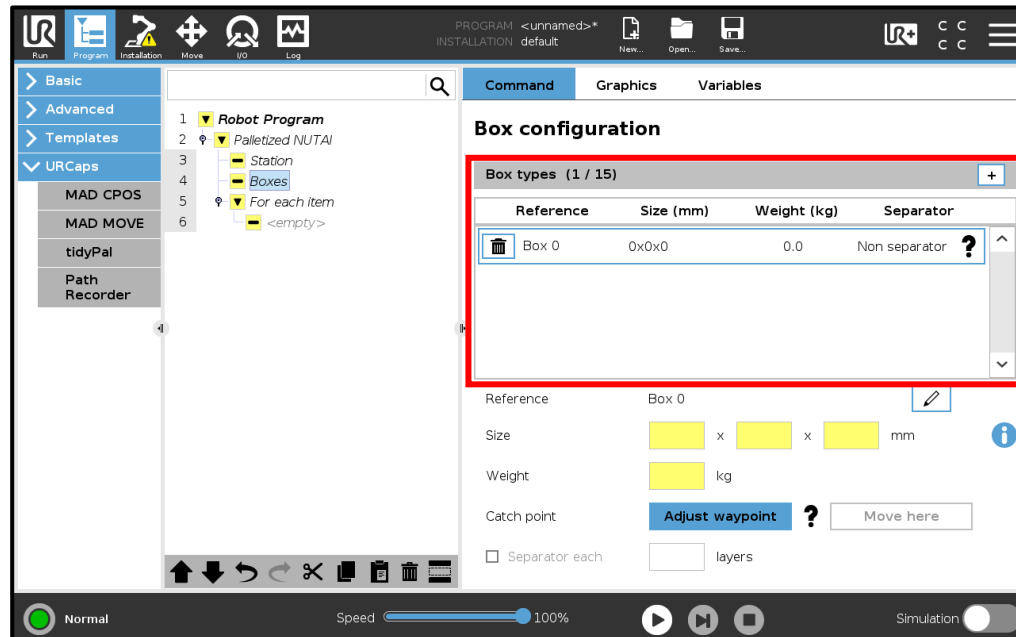
In this node the different general parameters will be completed to configure the different types of boxes.



Functionalities

Boxes

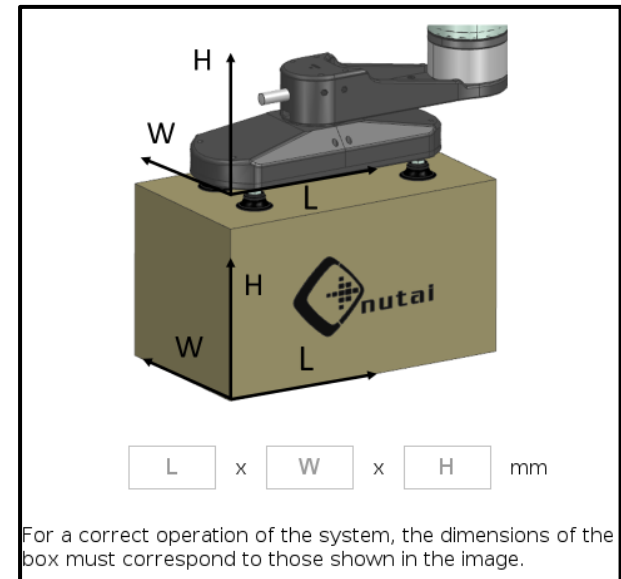
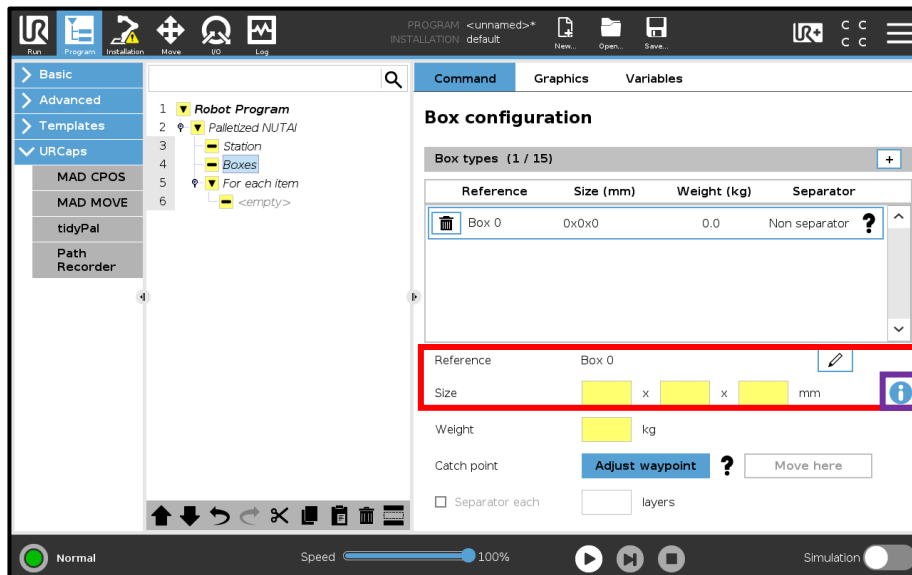
First, a list is shown with the different boxes with their parameters and configuration status. This list is expandable up to 15 types of boxes, to insert new boxes, the button will be used.  



Functionalities

Boxes

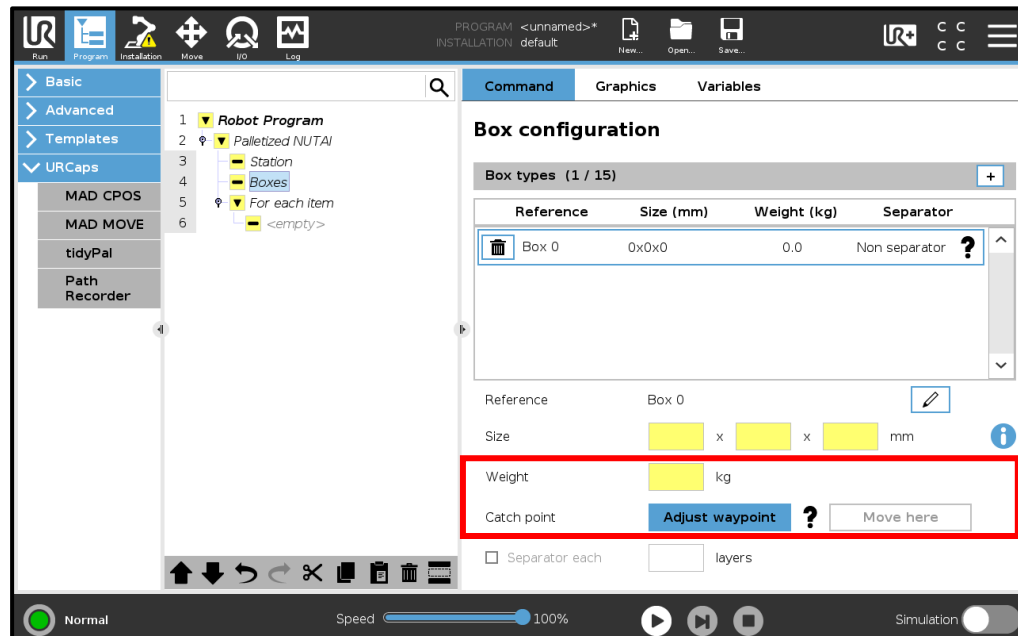
In this section (□) the reference and dimensions of the box will be configured, as well as an Information button with a representative image of the box (□).



If you set the box size incorrectly, it may cause equipment malfunction.

Boxes

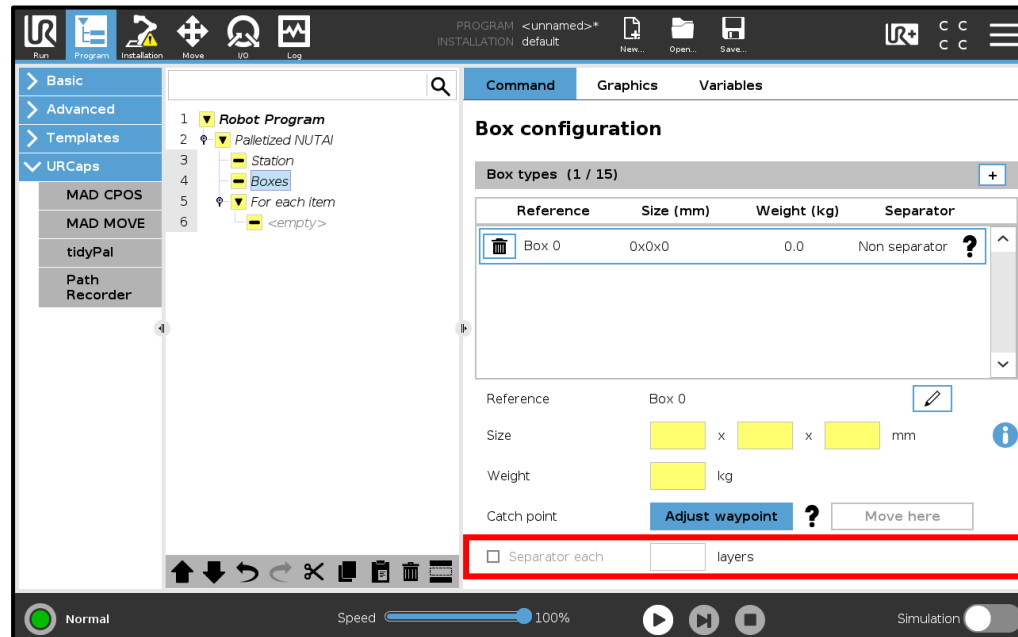
In this section (□) the weight of the box and its collection point are configured, as well as a button to position the robot in this same position.



Functionalities

Boxes

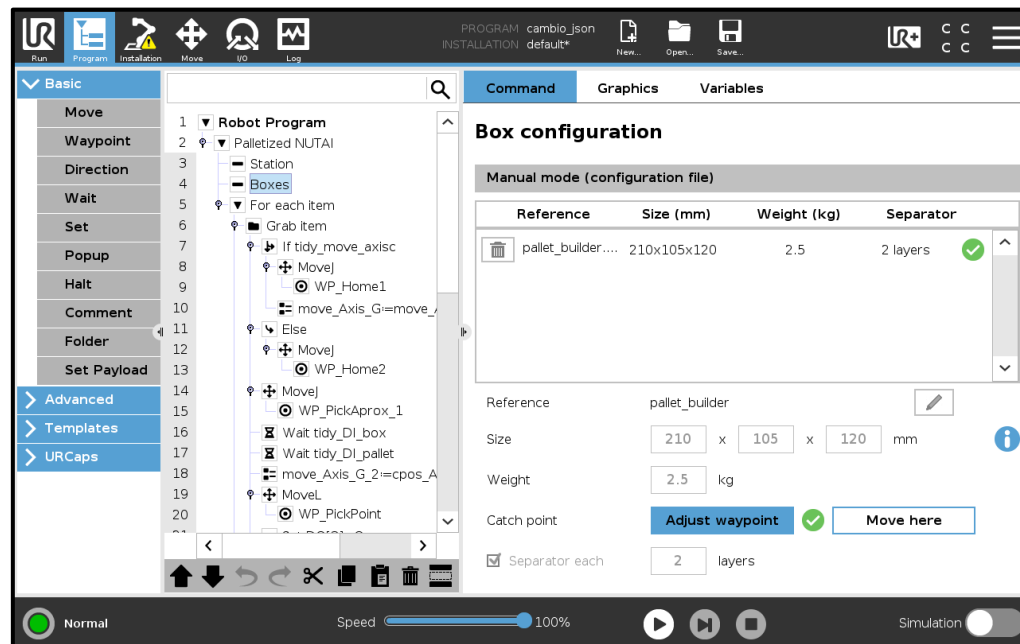
In this section () it is selected if a separator is needed and every how many layers to position it.



Functionalities

Boxes

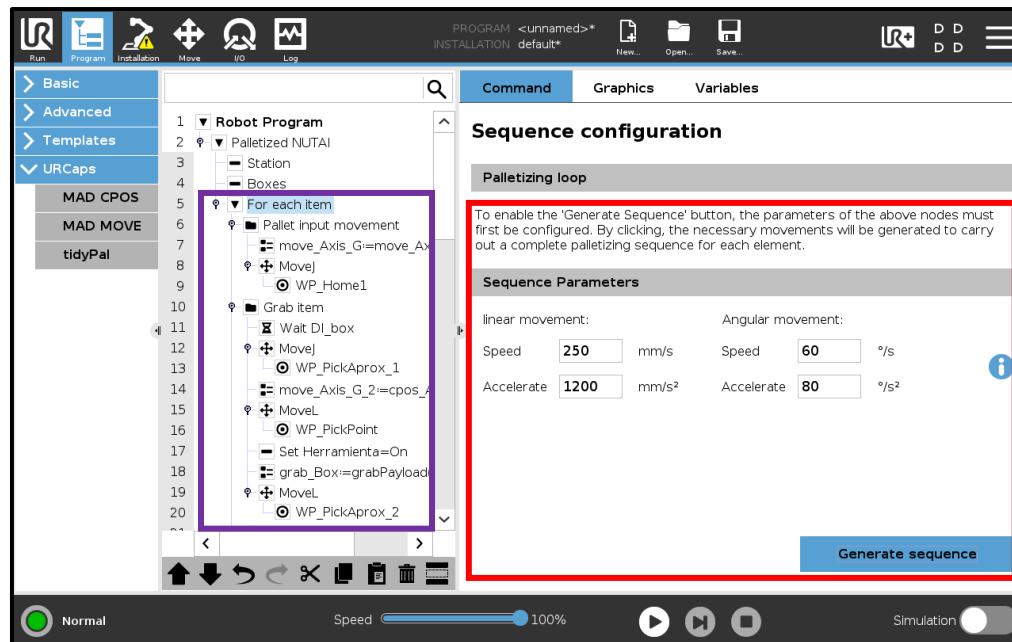
In manual mode, you will only have a box with the parameters from the configuration file. As in the Station node, the components will be locked and updated with the parameters from the file.



Functionalities

At each item

In the node At each item you can configure the speed and acceleration of the movements. In addition, the nodes of the cycle will be generated using the Generate Sequence button. (□)

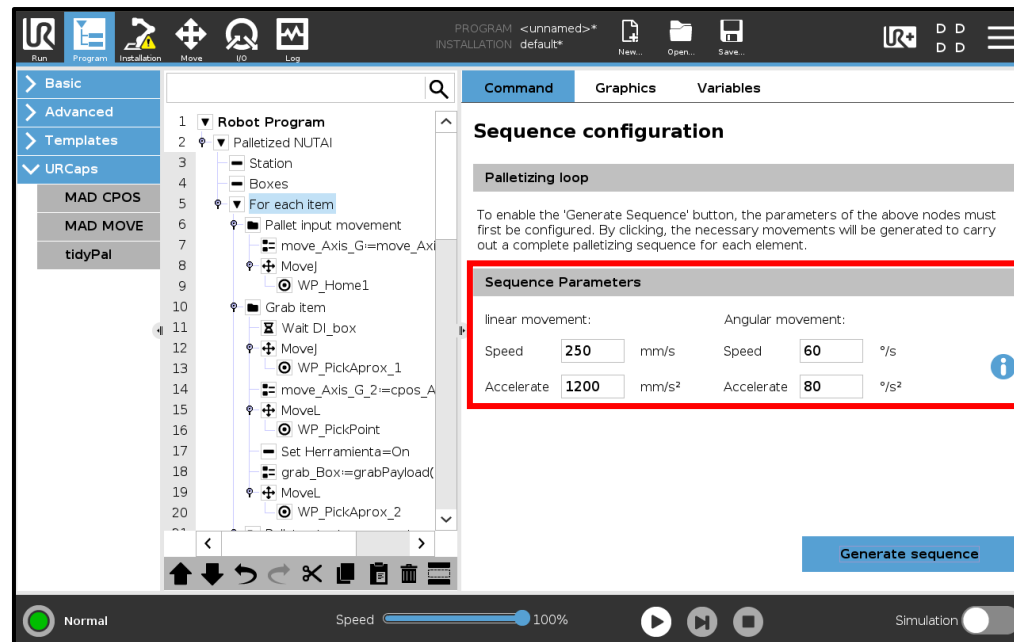


□ Tree of nodes generated by the URCap.

Functionalities

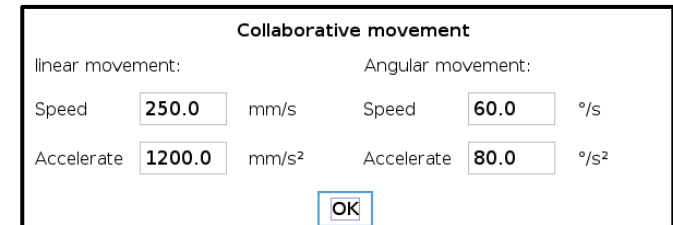
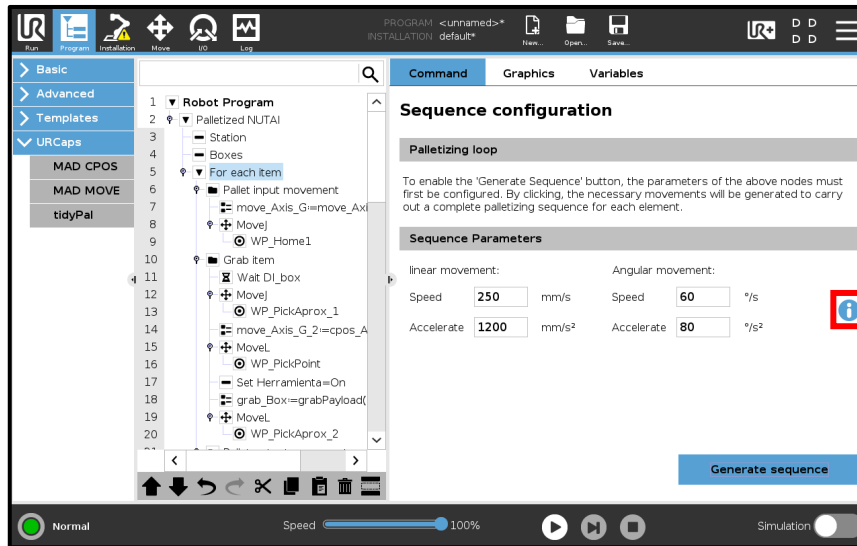
At each item

In the Sequence Parameters section, you can adjust the different speeds and accelerations of the process. (□)



At each item

When selecting the information button, a pop-up will appear with the default parameters for a collaborative movement. (□)

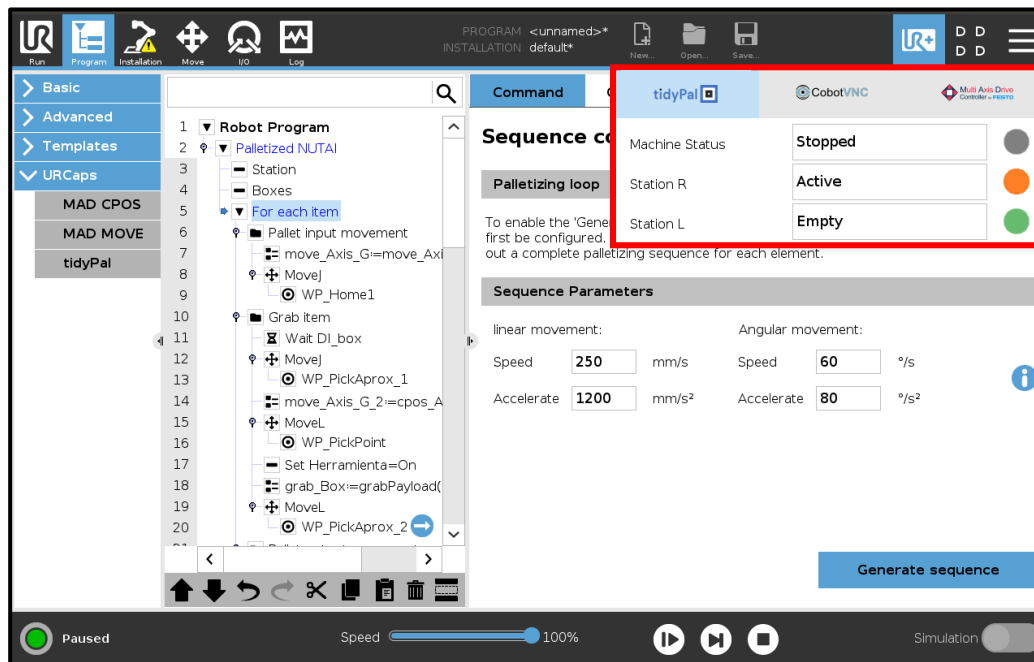


* The collaborative movement values are indicative because they may change depending on the gripper, material to be handled, etc.

2 Toolbar panel

Functionalities

The toolbar panel shows the status of the machine during the work cycle as well as the status of the bays. (□)









In this section presents the different states of the toolbar:




MACHINE STATE	COLOUR	
STOPPED/WAITING BOOT	Off	
WORKING	Green	
WARNING M. CYCLING	Yellow	
WARNING M. BLOCKED	Orange	
FAILURE	Red	

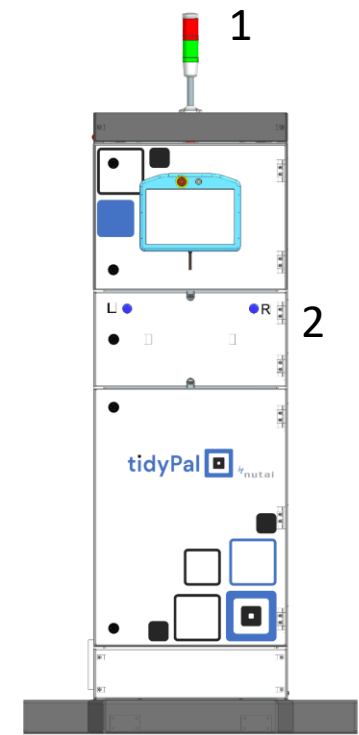
BAY R/L	COLOUR	
NO PRESENCE	Off	
EMPTY	Green	
ACTIVE	Orange	
FULL	Red	

Functionalities

This section presents the different states of the signaling beacon and the pilots in the palletizing station:

MACHINE STATE (1)	COLOUR		
STOPPED/WAITING BOOT	R - off / V - blink		
WORKING	R - off / V - on		
WARNING M. CYCLING	R - blink / V - on		
WARNING M. BLOCKED	R - blink / V - off		
FAILURE	R - on / V - off		

BAHÍA R/L (2)	COLOR	
NO PRESENCE	A - off	
EMPTY	A - blink (1 Hz)	
ACTIVE	A - blink (2 Hz)	
FULL	A - on	

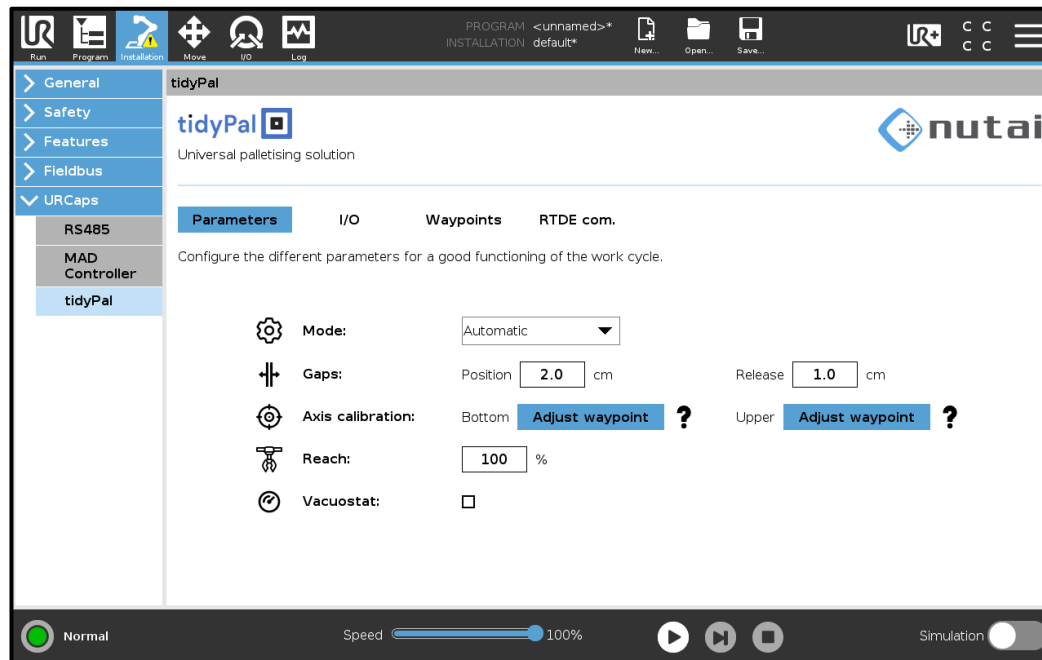


3 Installation Panel

Functionalities

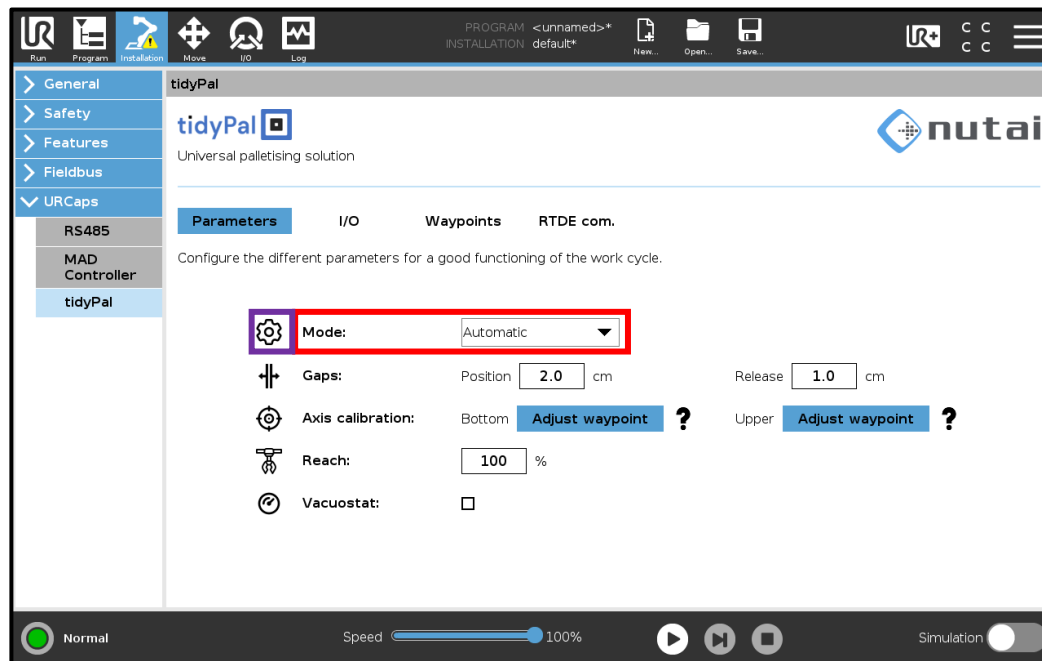


Additional parameters for the palletising process can be configured in the installation panel. There are 4 sections: Parameters, RTDE Communication, Waypoints and I/O.



Functionalities

In the parameters section, different general parameters of the palletising process are configured. (□)

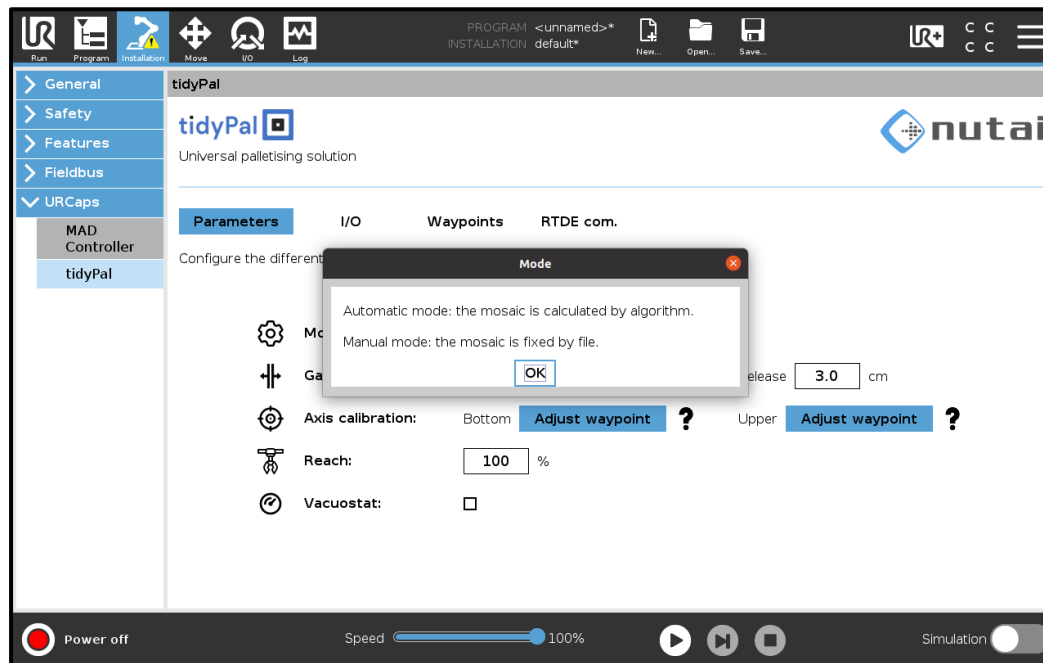


□ Button to display pop-up message.

Functionalities

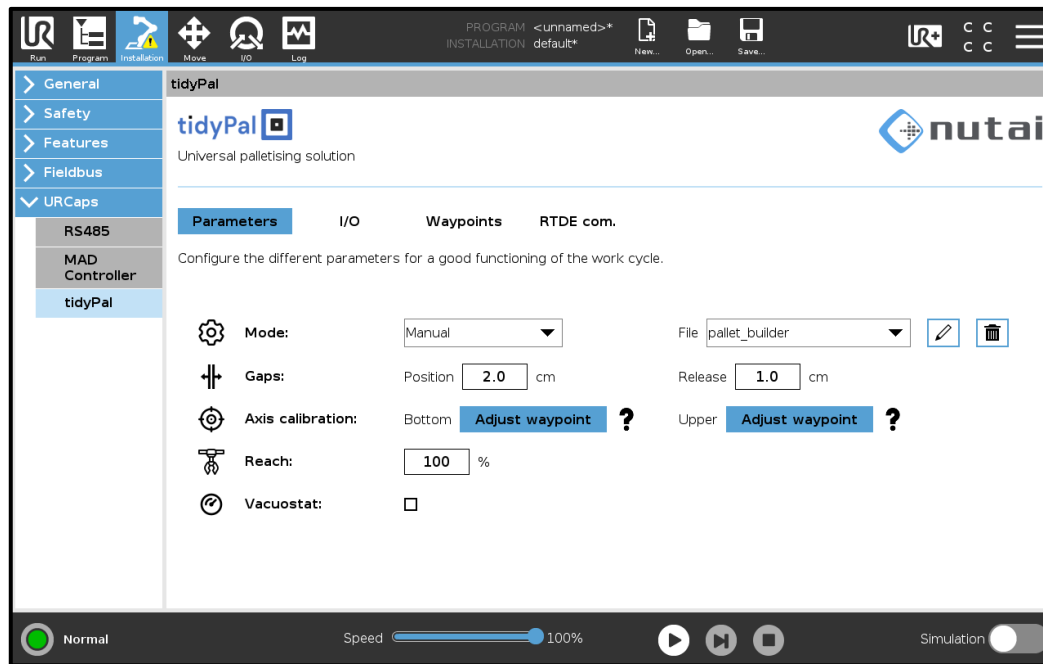


There are two working modes: Automatic in which the mosaic is calculated by algorithm and Manual in which the mosaic is fixed per file.



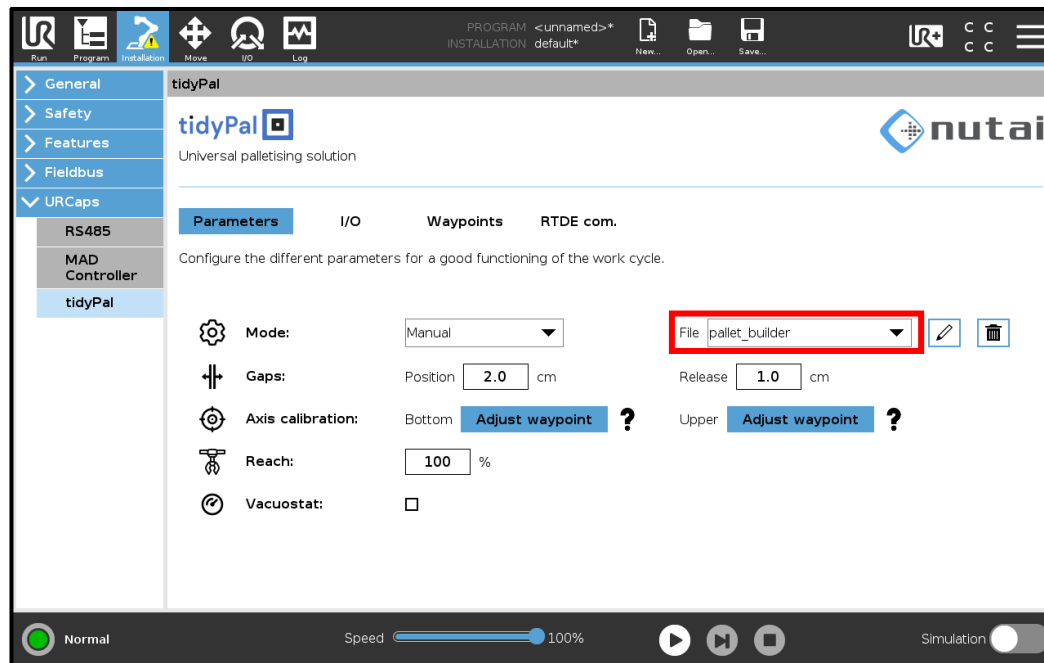
Functionalities

In manual mode the configuration file that has the necessary parameters for the sequence required by the client must be configured. In this mode the graphical interface of the programme node will automatically update and lock the already configured elements.



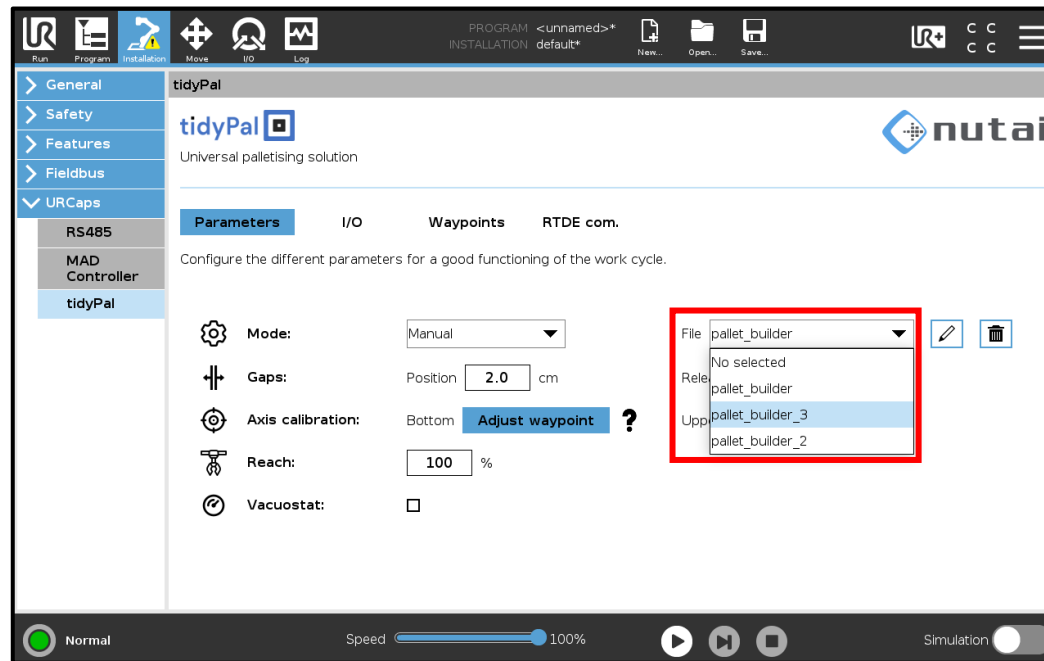
Functionalities

In the file selector will appear the files that we previously installed with the configuration file generated by the Pallet Builder application. Link:

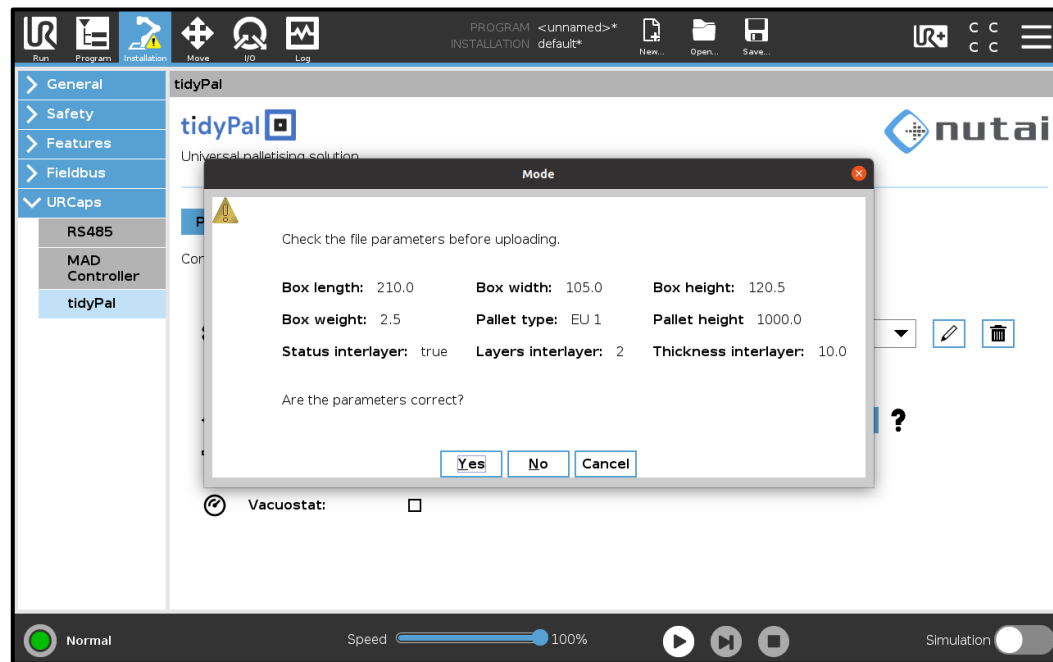


Functionalities

The list of files installed and available for use is displayed here.




When selecting a configuration file, the parameters must be checked before applying them to the programme.

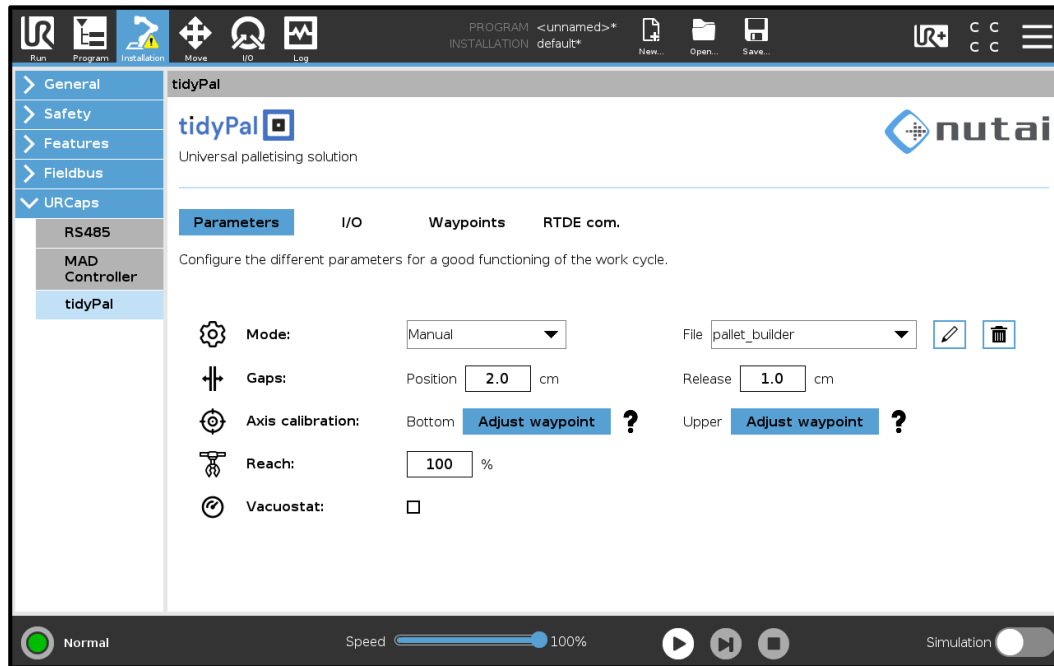


Functionalities

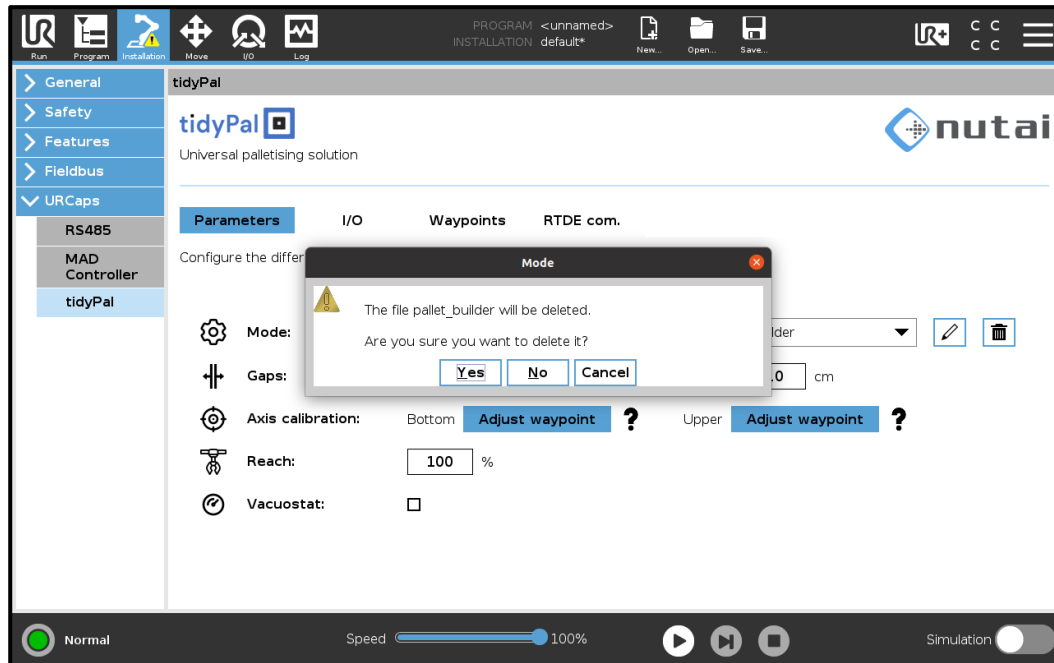
Two buttons are available:

: will edit the name of the selected file.

: will delete the selected file.



When deleting a file, a window will appear to confirm if you want to delete it.



Functionalities

Now that the configuration file has been presented, we will explain how to add new configuration files to the robot.

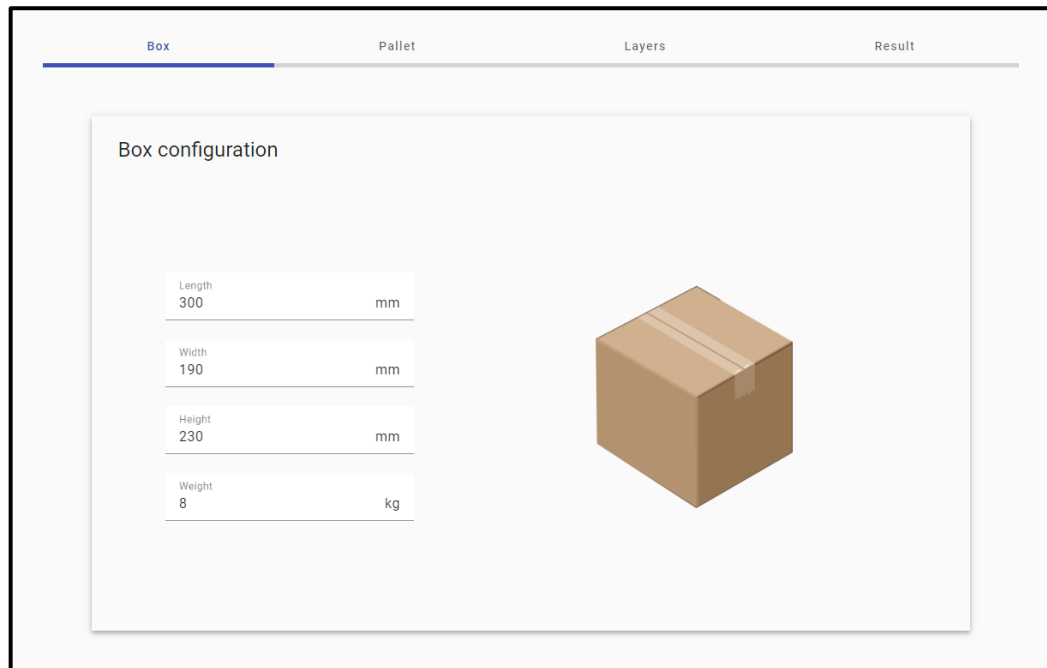
With the software developed by Nutai, Pallet Builder, a Zip file is generated with which we will follow the following steps:

- Unzip to the root of a USB flash drive.
- Insert the flash drive into the USB port of the teach pendant.
- Wait until the file is copied and the confirmation message appears.
- Make sure that the flash drive is in FAT32 format.

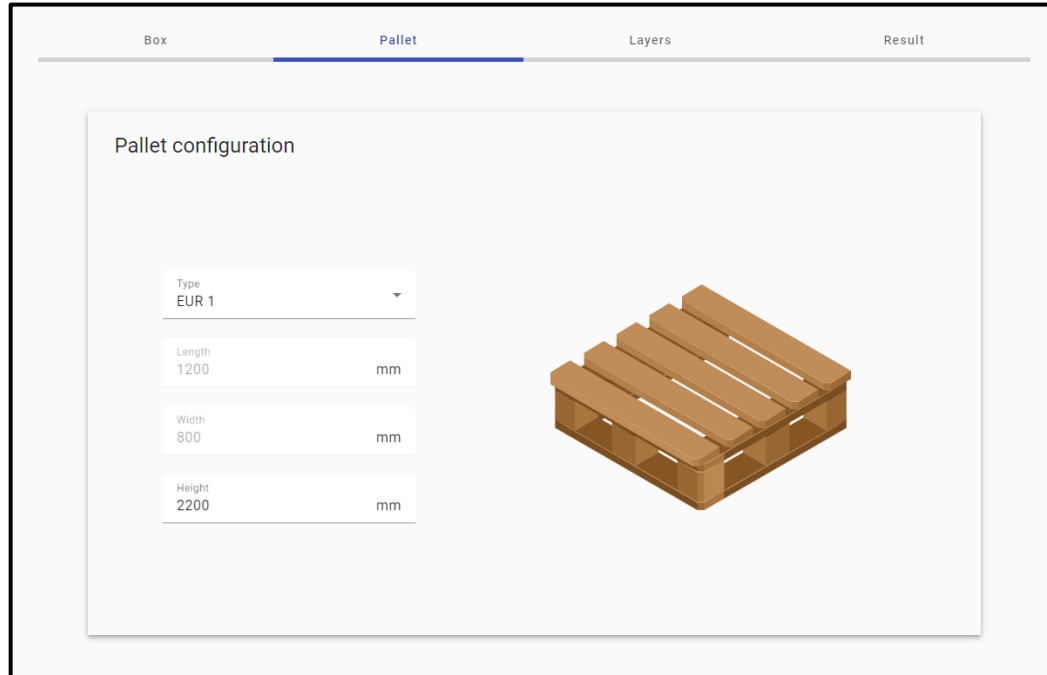
Functionalities

The pallet builder software and its different functionalities are shown below.

The first window allows you to configure the parameters of the box, such as length, width, height and weight.

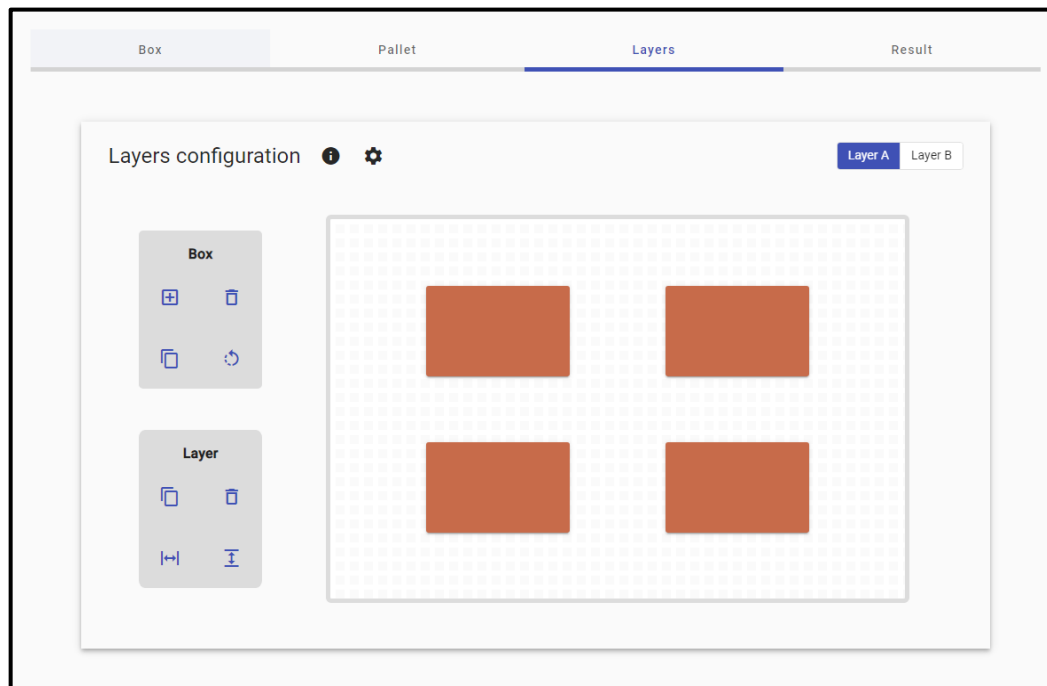


In the following window, the pallet type and maximum palletising height are configured.



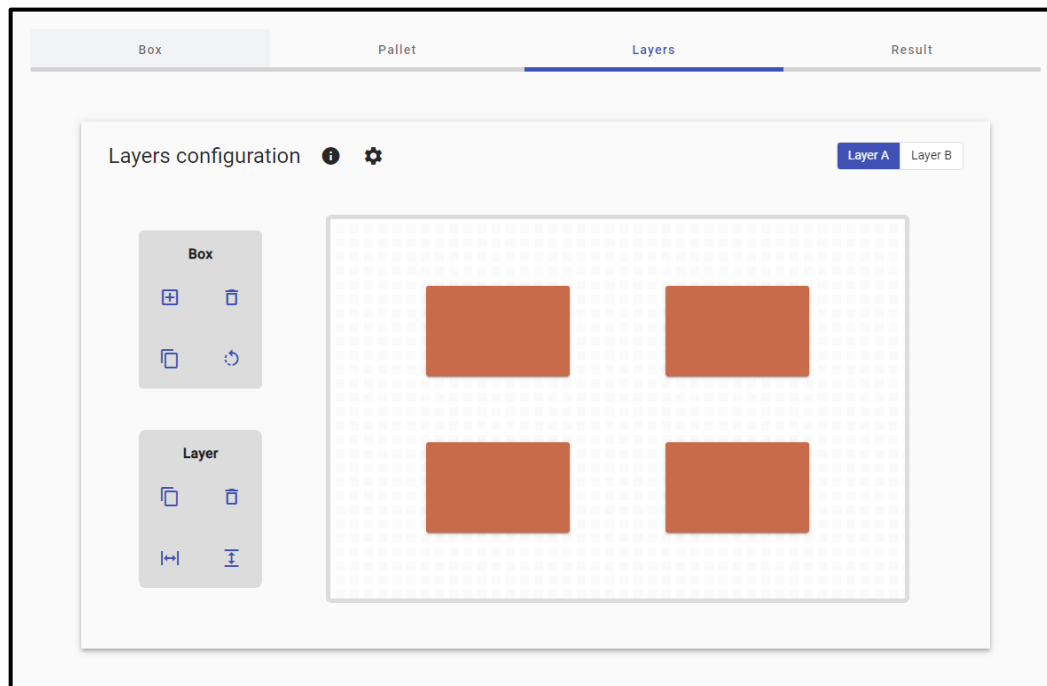
Functionalities

In the layers window, the mosaic is constructed by placing each box in the desired position. There are different functionalities such as add box, delete box, duplicate box and undo action.

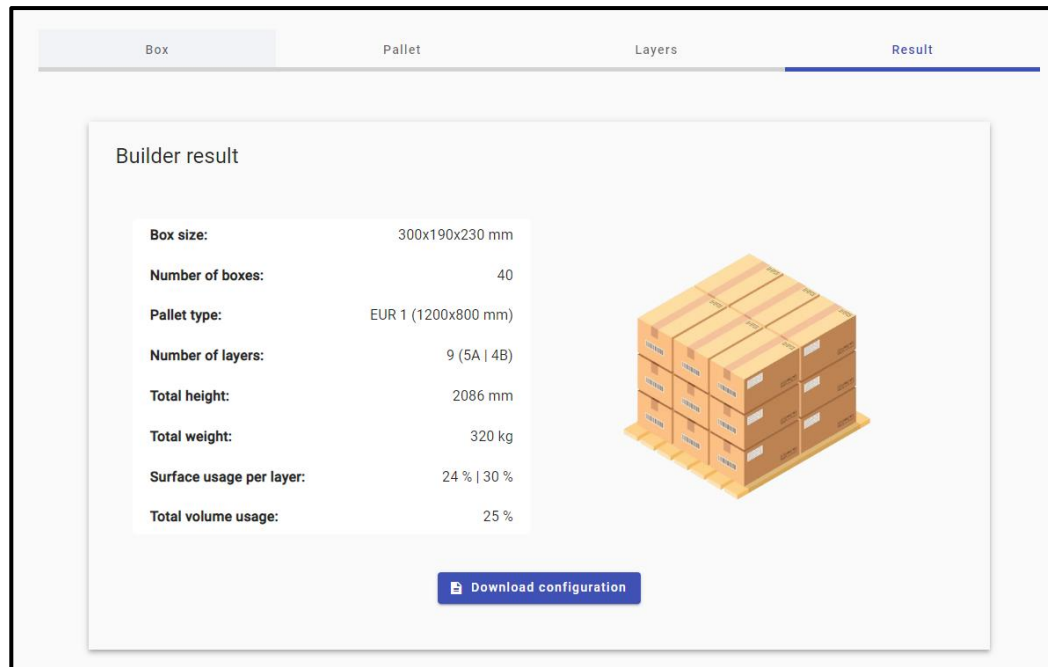


Functionalities

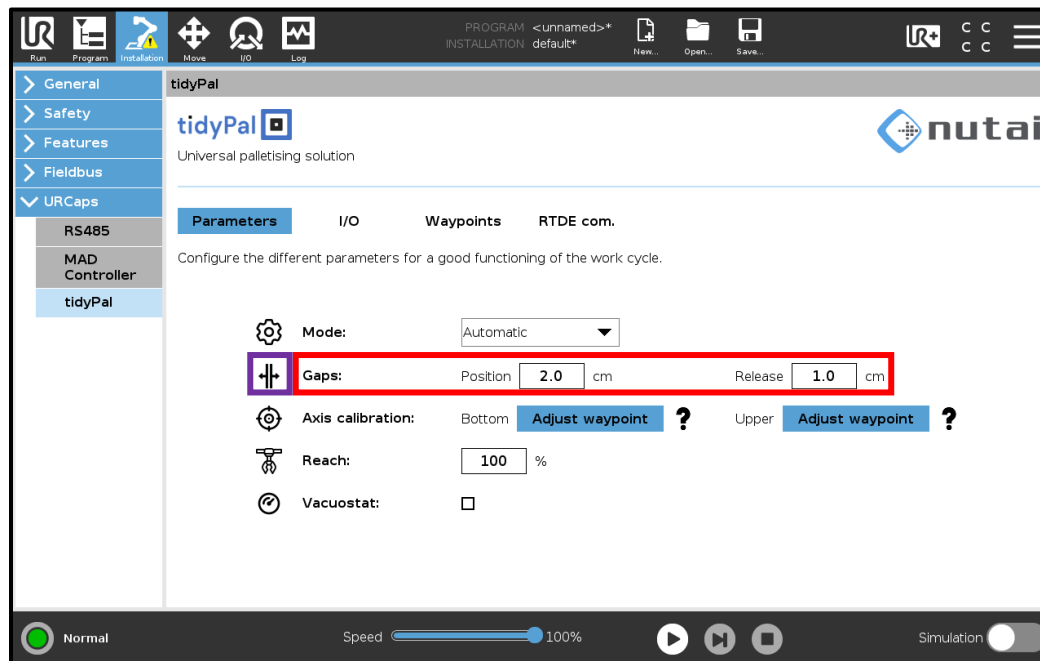
In addition there are other functionalities applied to the layer such as duplicate layer, delete layer, align on X-axis and align on Y-axis.



In the last window, general information about the generated mosaic is displayed.



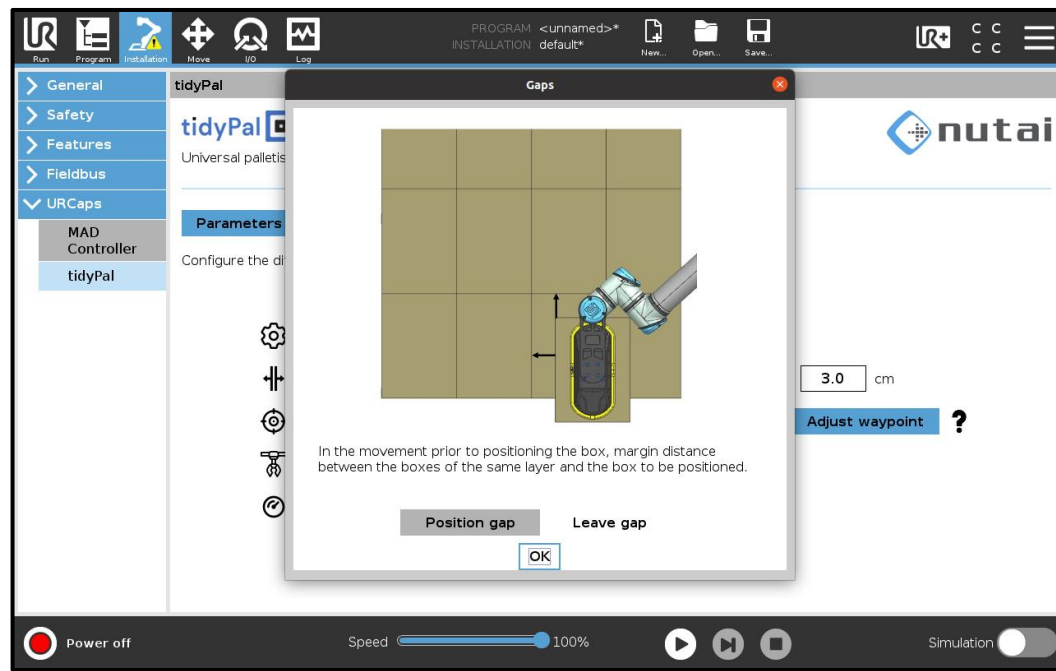
Gaps can be configured to adjust the positioning of the enclosures. These gaps are applied in the movement prior to the final position of the box. (□)



□ Button to display pop-up message.

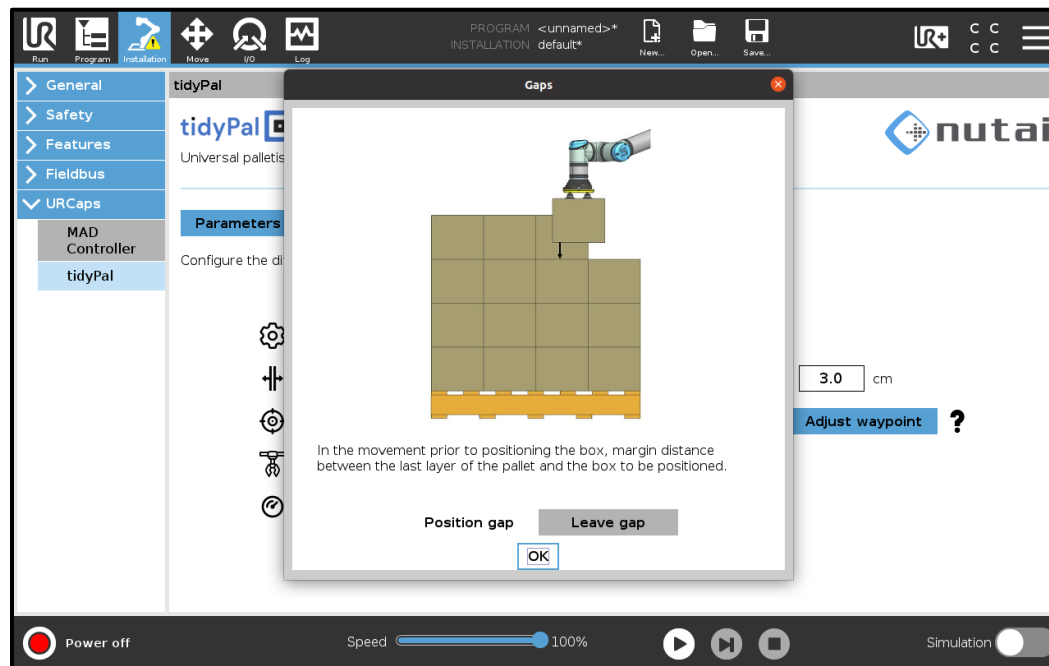
Functionalities

The *position gap* is the margin between boxes of the same layer. This is done to avoid collisions.



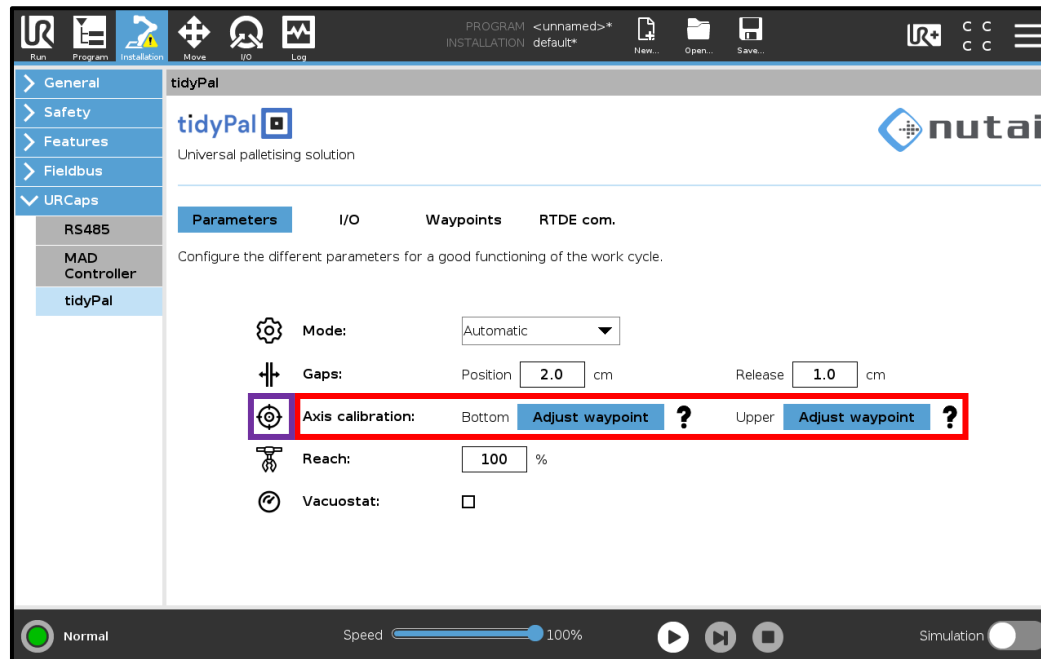
Functionalities

The *release gap* is the margin height between the position of the box and the height of the previous layer.



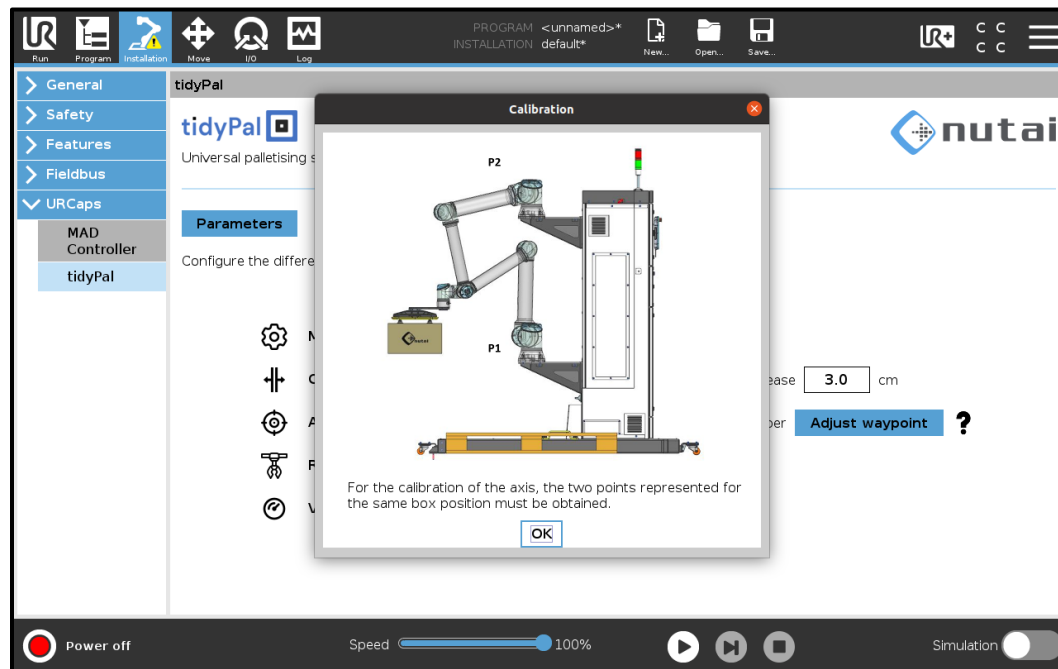
Functionalities

The *calibration of the axis* is carried out by taking two points of pick-up of the box at the same position and with two different positions of the vertical linear axis. (□)



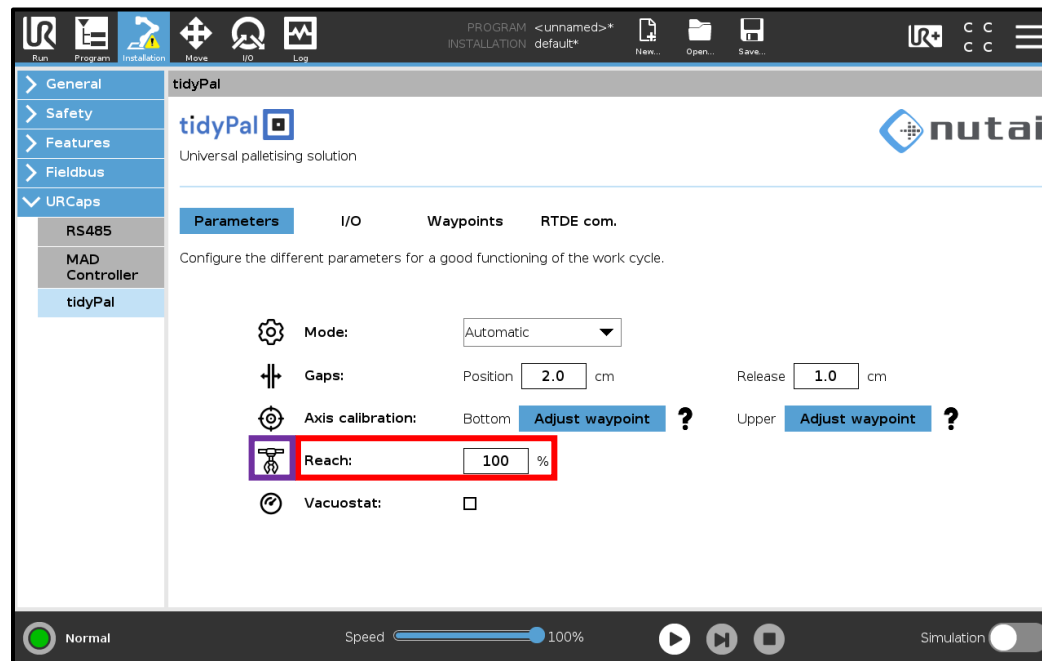
□ Button to display pop-up message.

Axis configuration and movement will be discussed later in the manual in the section *Axis configuration*.



Functionalities

The reach parameter is used to limit the robot's reach to avoid forced movements and singularities. (□)

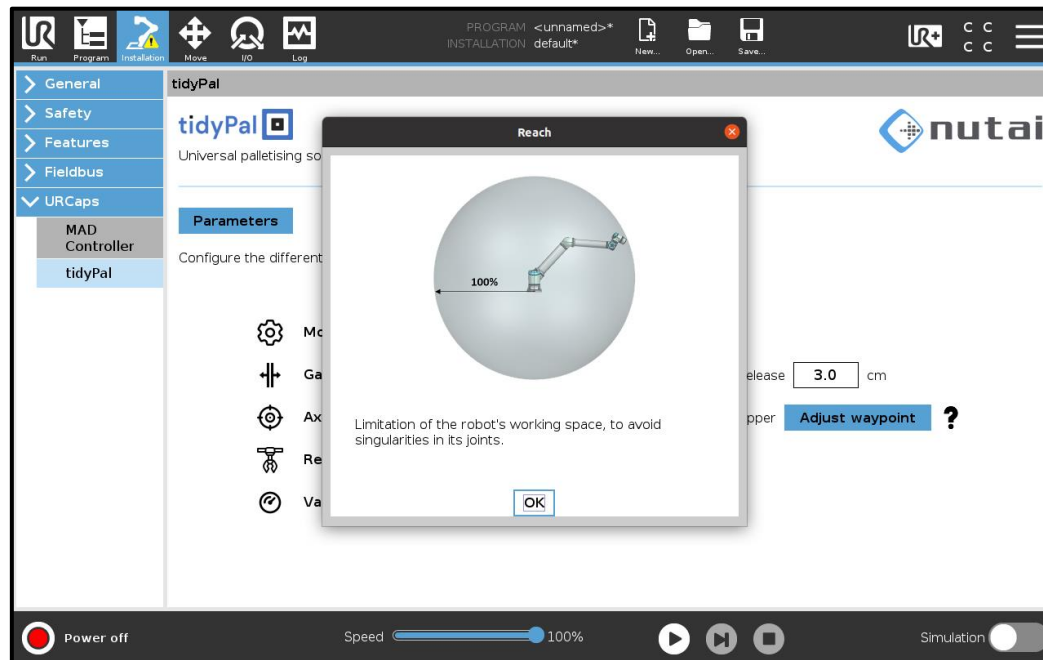


□ Button to display pop-up message.

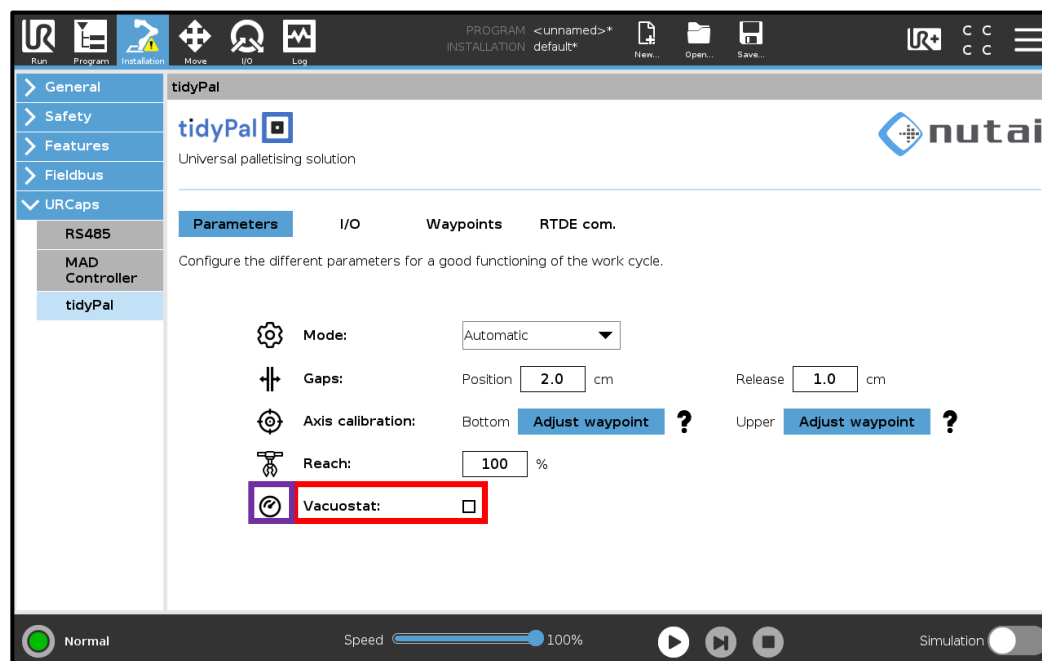
Functionalities



For a good performance it is recommended to select a value between 90 and 100 %.



Finally, the integrated vacuum switch can be configured. (□)

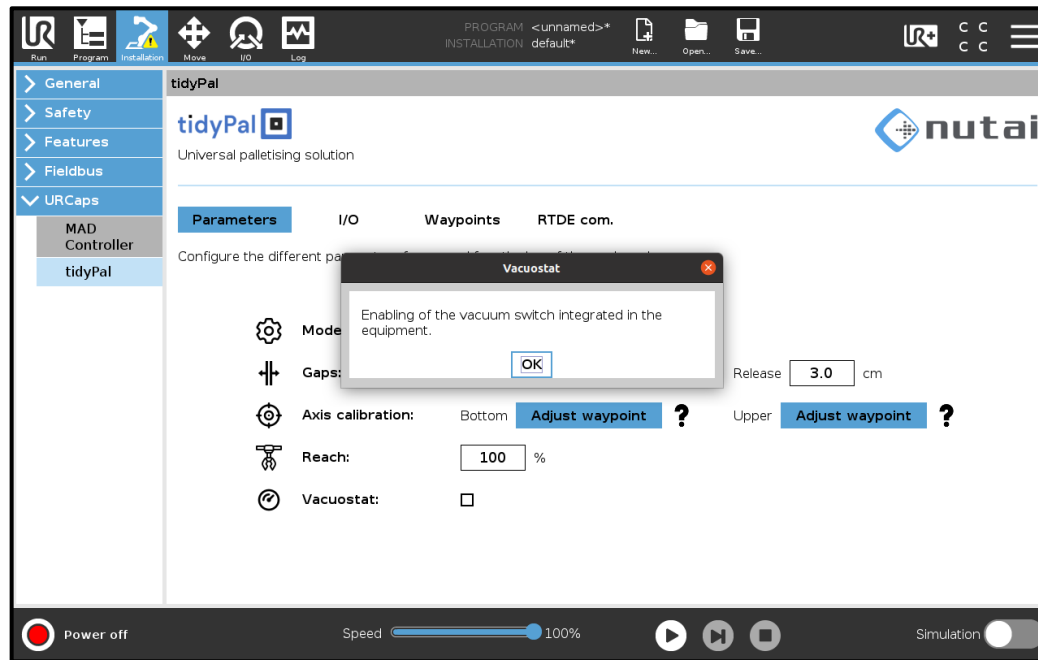


□ Button to display pop-up message.

Functionalities



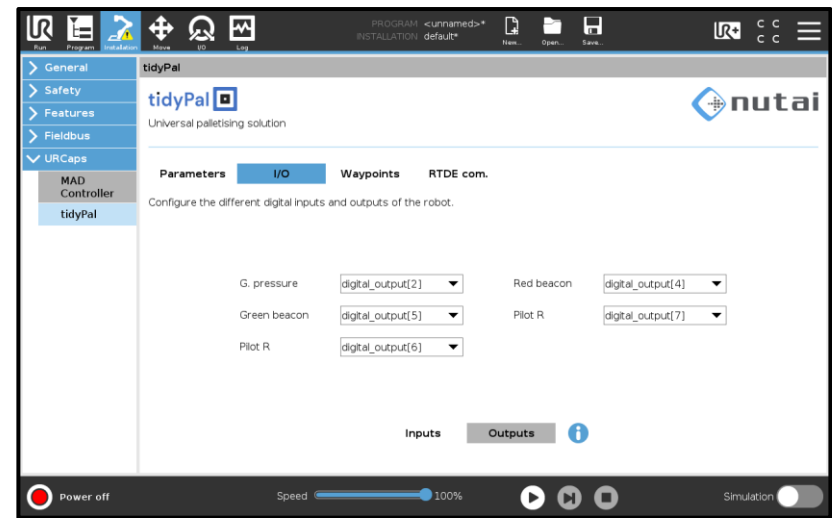
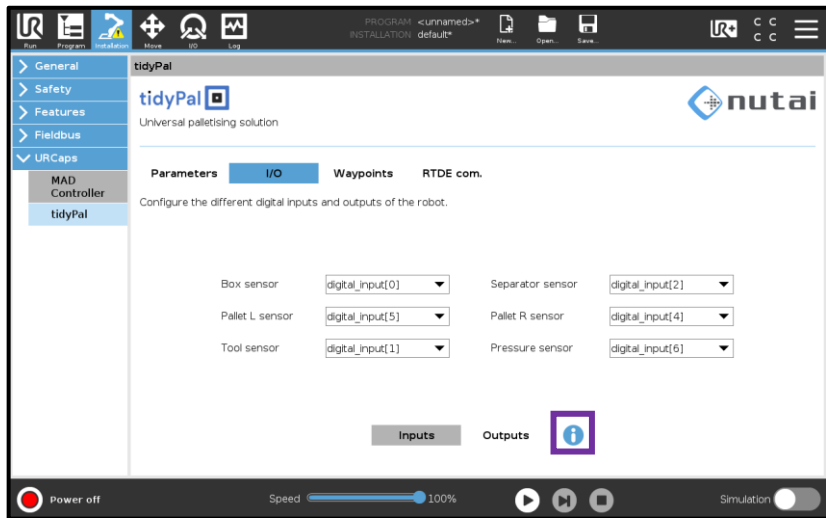
The vacuum switch provides information on the status of the enclosure during positioning.



Functionalities

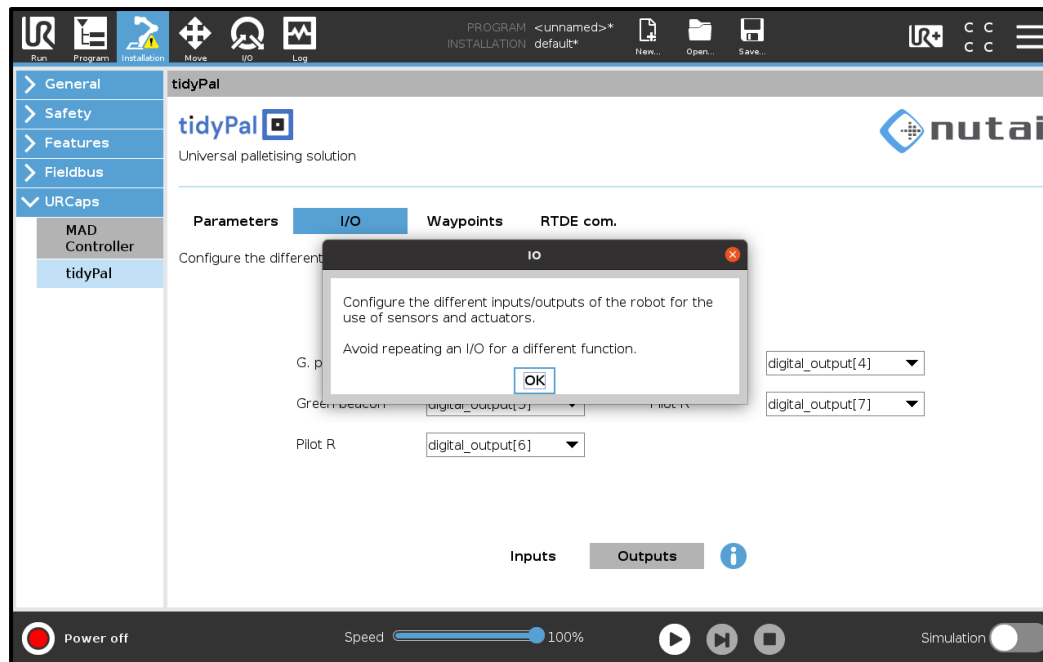


In the I/O section, the digital inputs/outputs of the robot will be configured for the use of sensors and actuators. The two available panels are shown below.



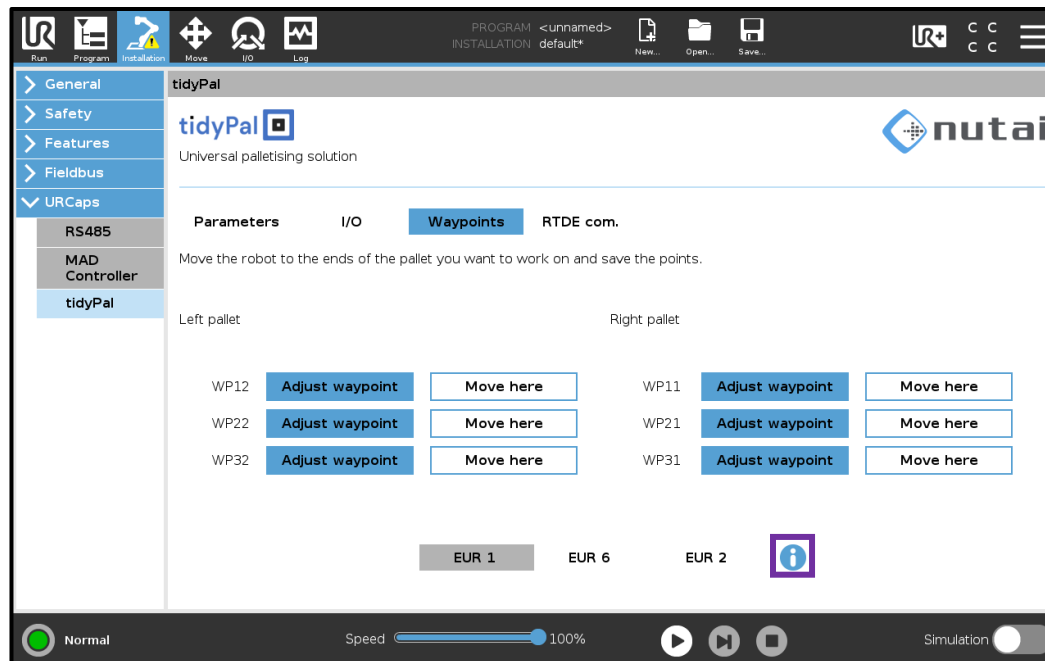
 Button to display pop-up message.

When configuring I/O, avoid repeating the same digital input or output for different functions to avoid malfunctions.



Functionalities

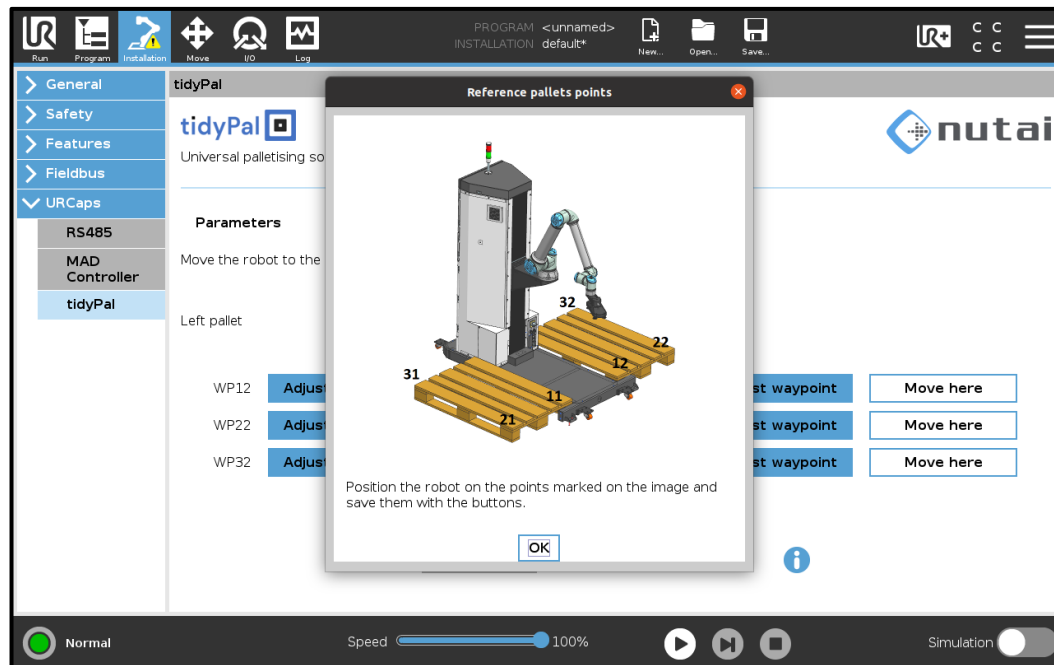
In the Waypoints section, the ends of the different types of pallets are configured to reference them in the system.



□ Button to display pop-up message.

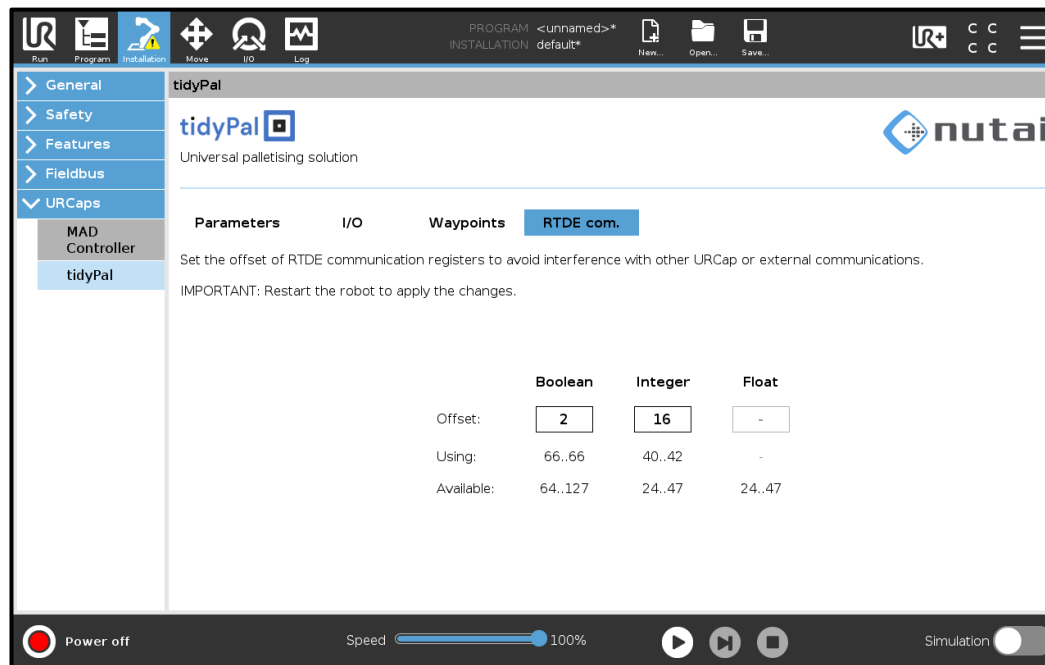
Functionalities

The message shows the points where the robot tool should be placed to obtain the points.



Functionalities

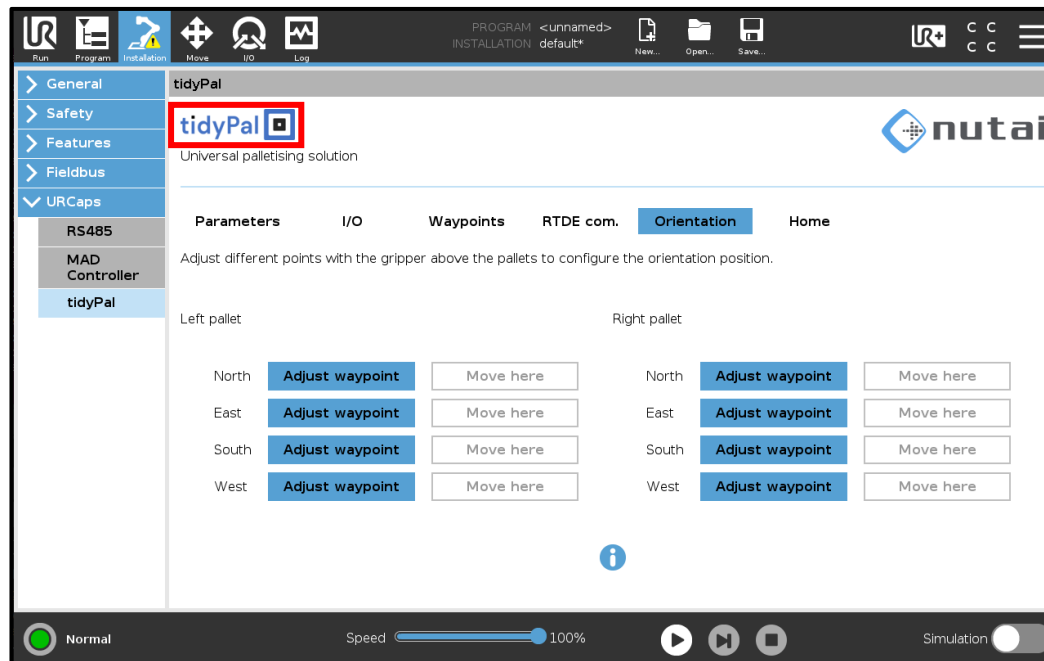
In the RTDE Communication section, the offsets for the RTDE communication registers shall be configured.



Functionalities



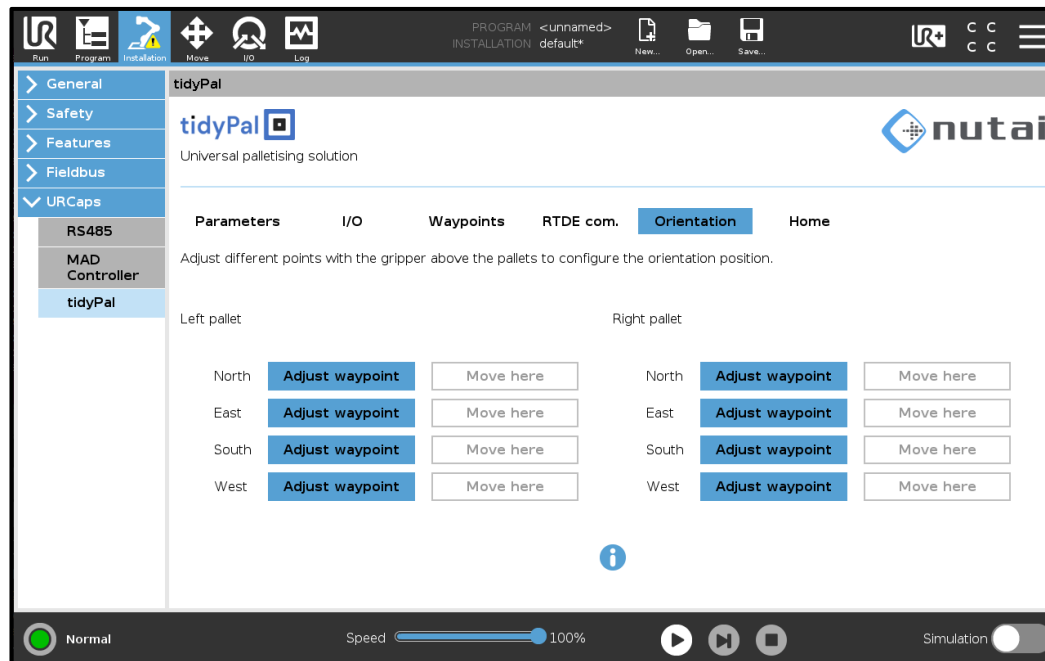
In addition we will have two additional windows with advanced parameters, Orientation and Home. To display these parameters, press the tidyPal logo for 3 seconds (□).



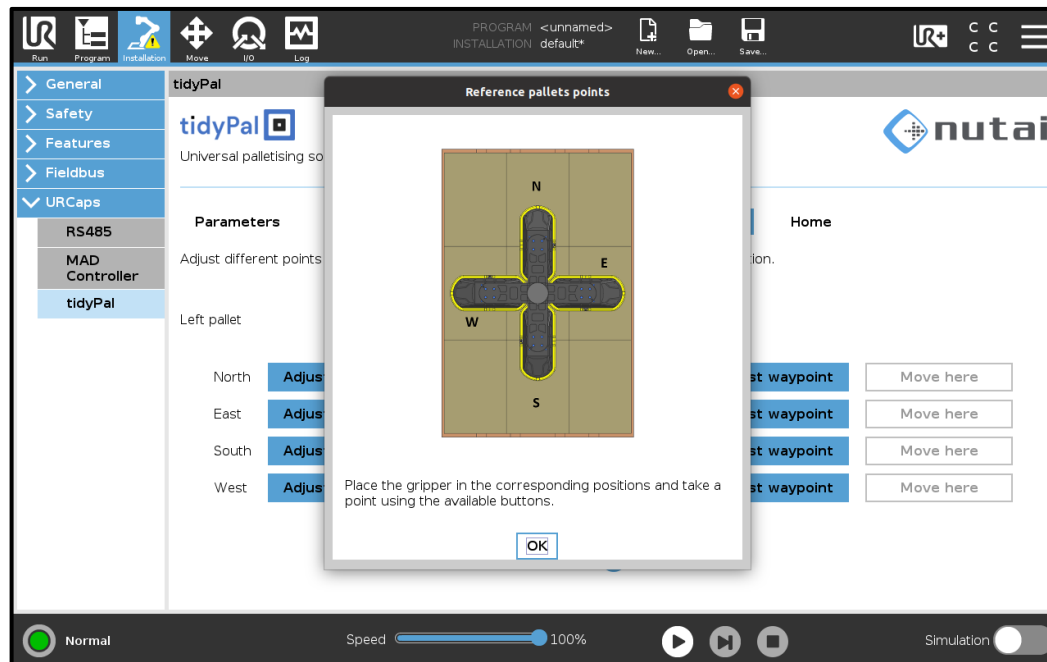
Functionalities



By default, the orientations will be factory set but can be changed by taking a point with the robot with the gripper orientation in the desired position.



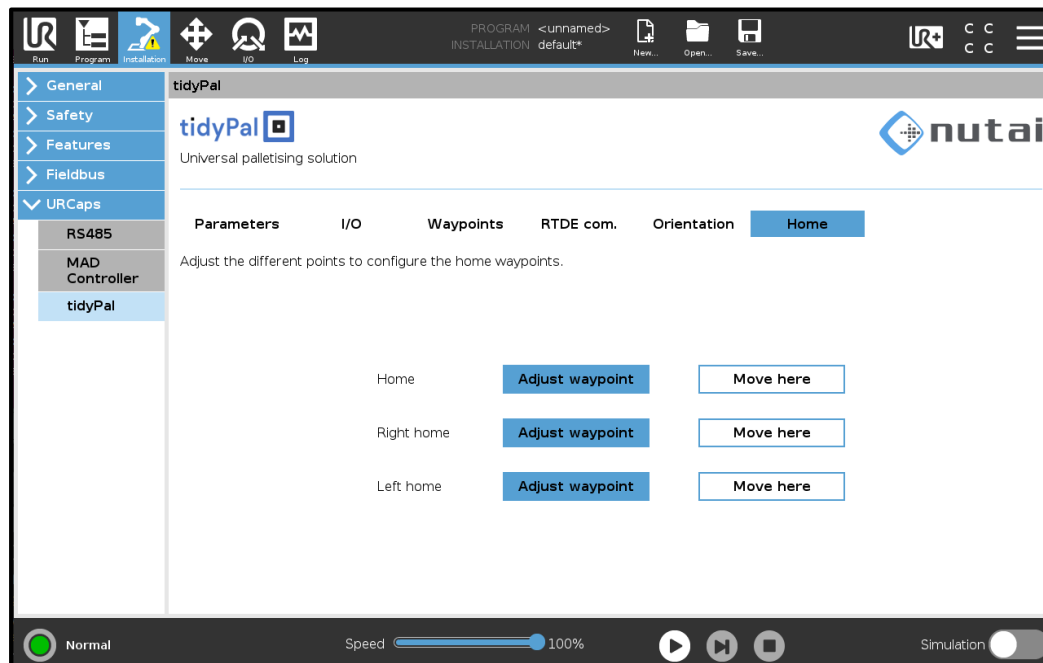
The following image shows the positions necessary to obtain the correct orientation.



Functionalities



In the last window you can configure the different waypoints of the robot. These are points to ensure a safe trajectory and avoid collisions.



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Axis configuration

In this section, the URCap **MAD Controller**¹ Will be shown, which will allow us to control the vertical axis of the palletizer. In addition, its different functionalities will be explained, such as axis status and parameters.

With this software you can move up to 4 axes towards points or coordinates in a simple and programming-free way, without the need for other external components such as PLC/HMI.

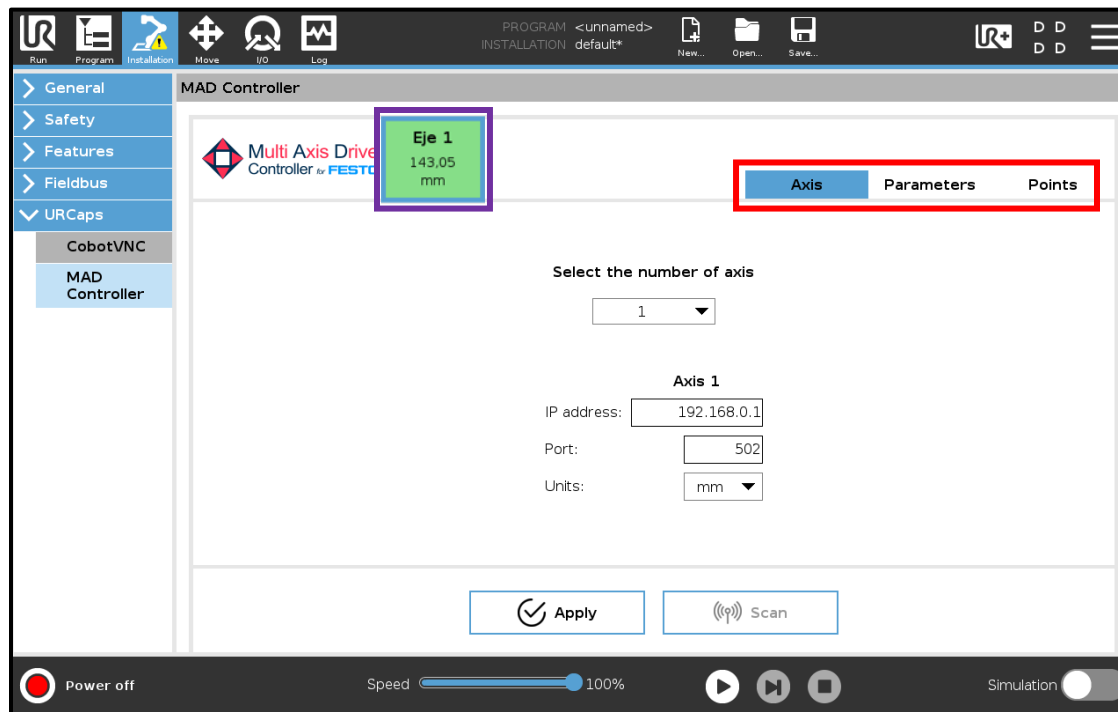


¹ See all the details about the URCAP in its manual:

<http://nutai.com/urcaps/madcontroller/urcap-user-manual-es.pdf>

Axis configuration

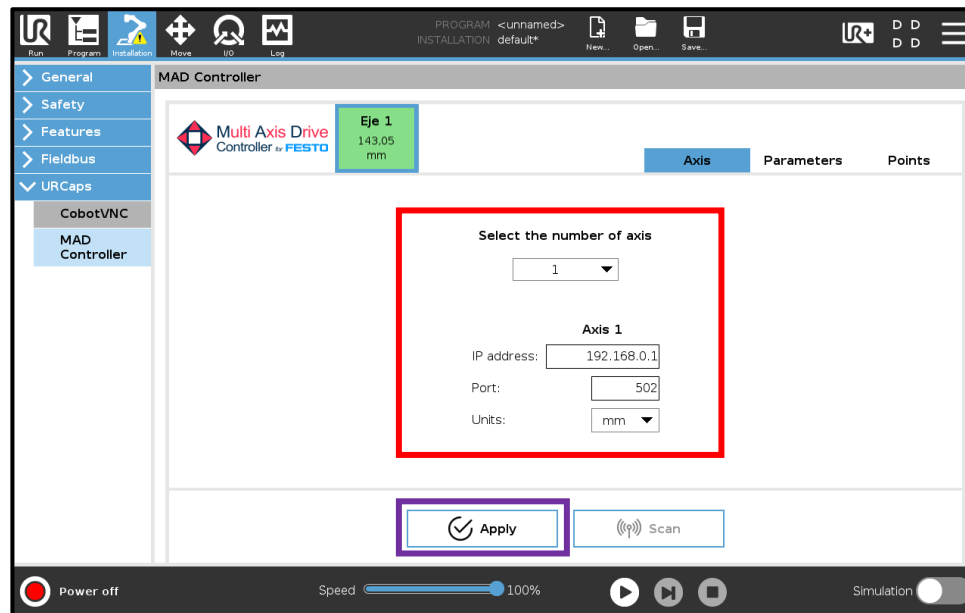
You can configure all the features of the URCap from the installation panel.
This window has 3 tabs (□): Axes, Parameters and Points:



□ The information of the configured axes is also displayed: their status and their current position.


Axis configuration

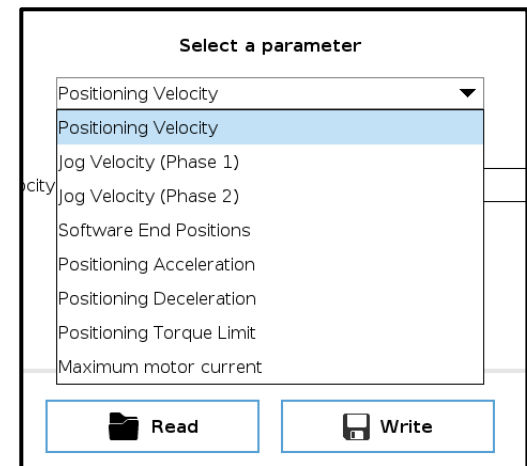
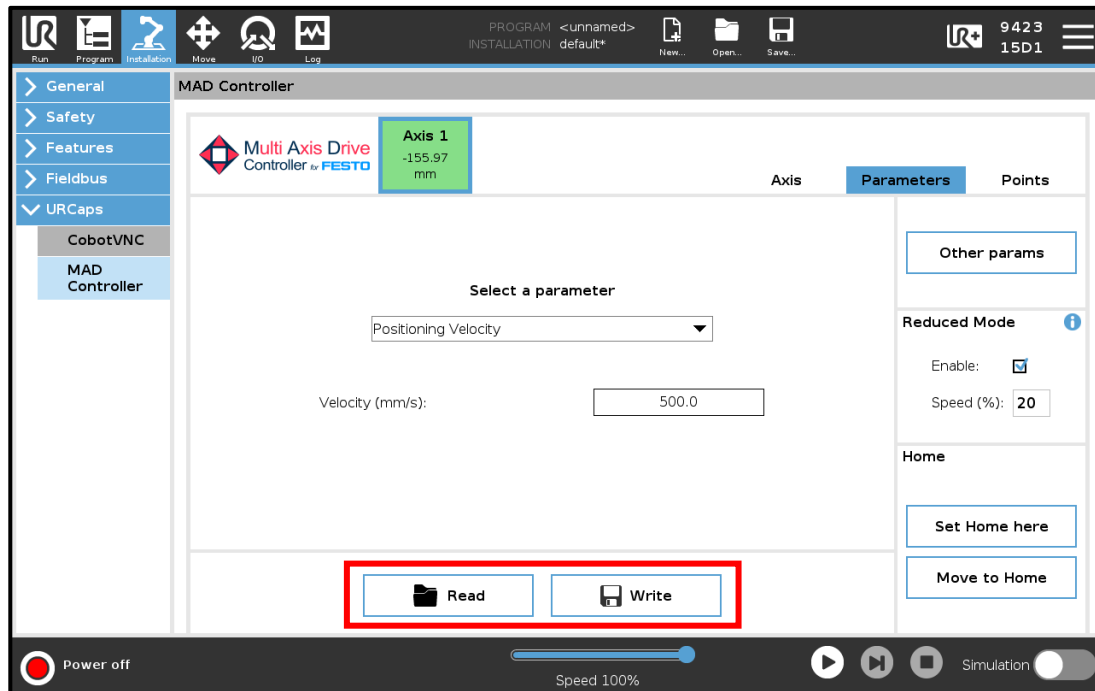
From the Axes tab you can select the number of axes you want to work with, assigning each one its IP address, port and position units. In the case of the tidyPal we will only need 1 axis.




□ Once the axes have been indicated, press the Apply button to connect¹ or reconnect to them.

Axis configuration

From the Parameters tab you can consult —Read button— and configure —Write button— () the most common parameters of the controller.



 **Warning:** modifying the parameters will affect the operation of its components. All parameters (except Reduced Mode) are saved in the motor controller and not in the installation file.

Axis configuration

Description of the main configuration parameters:

1. **Positioning speed:** base speed for positioning tasks in direct mode — no Jog — (limited to the maximum speed allowed).
2. **Jog speed (phase 1):** maximum speed in manual mode (Jog) during the initial phase (limited to the maximum speed allowed).
3. **Jog speed (phase 2):** maximum speed in manual mode (Jog) during the final phase (limited to the maximum speed allowed).
4. **Software position limits:** minimum and maximum final position by software (not limited). Plausibility rule: Lower bound \leq Upper bound.

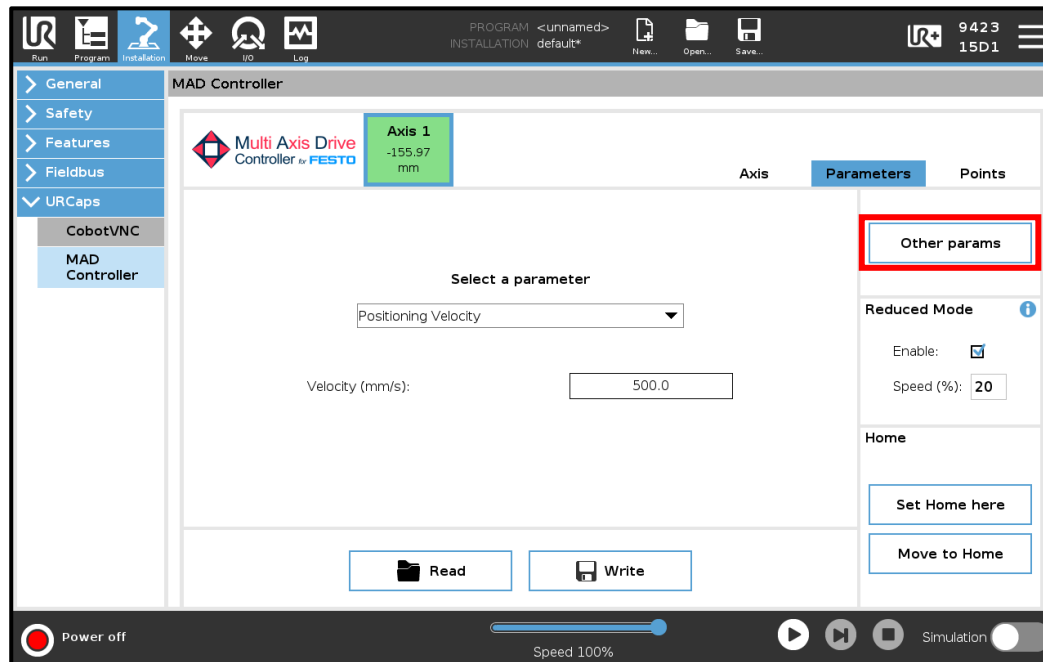
Axis configuration


Description of the main configuration parameters:

5. **Positioning Acceleration:** Acceleration for direct mode positioning tasks (limited to maximum allowable acceleration).
6. **Positioning Deceleration:** Deceleration for direct mode positioning tasks (limited to maximum allowable acceleration).
7. **Positioning torque limit:** torque limit in mNm (not limited). If the axis exceeds this limit, it goes into fault. Value 0 disables torque limitation.

Axis configuration

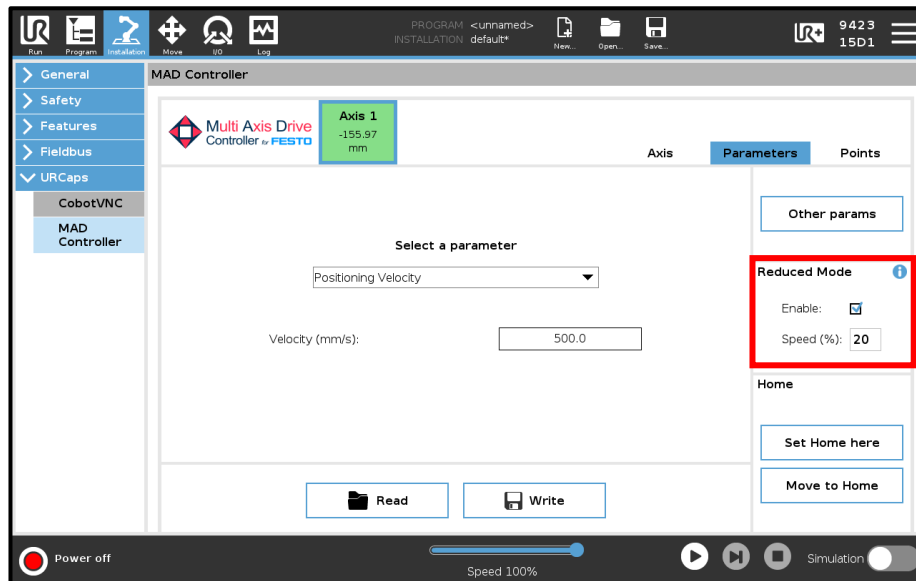
IMPORTANT: Changes to any parameter will only persist until the next reboot. For permanent changes, press the Save button (□).



 **Warning:** Reading, writing and saving of parameters in the controller may not work correctly in case there are any active warnings or errors in the motor controller (which you can consult from the Toolbar).

Axis configuration

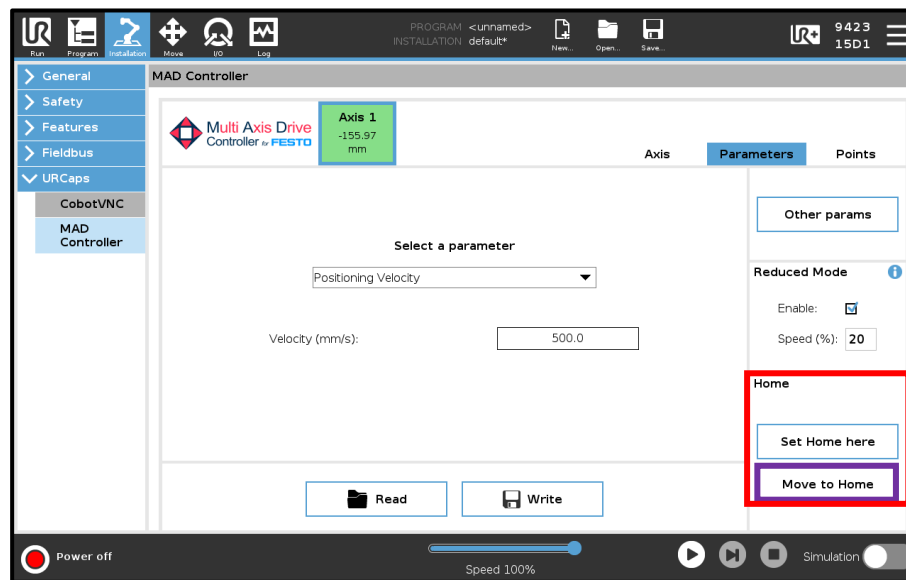
It is possible to enable and configure the speed of the axes in Reduced mode (☐). By enabling this option, if the robot is in Reduced Mode, the maximum positioning speed of the axes will be limited to the configured percentage.



Warning: Will apply to all axes and not just the selected axis. This software functionality does not replace the SLS safety function (Safe Limited Speed, EN 61800-5-2) of the axis, which would require the CAMC-G-S3 safety module.

Axis configuration

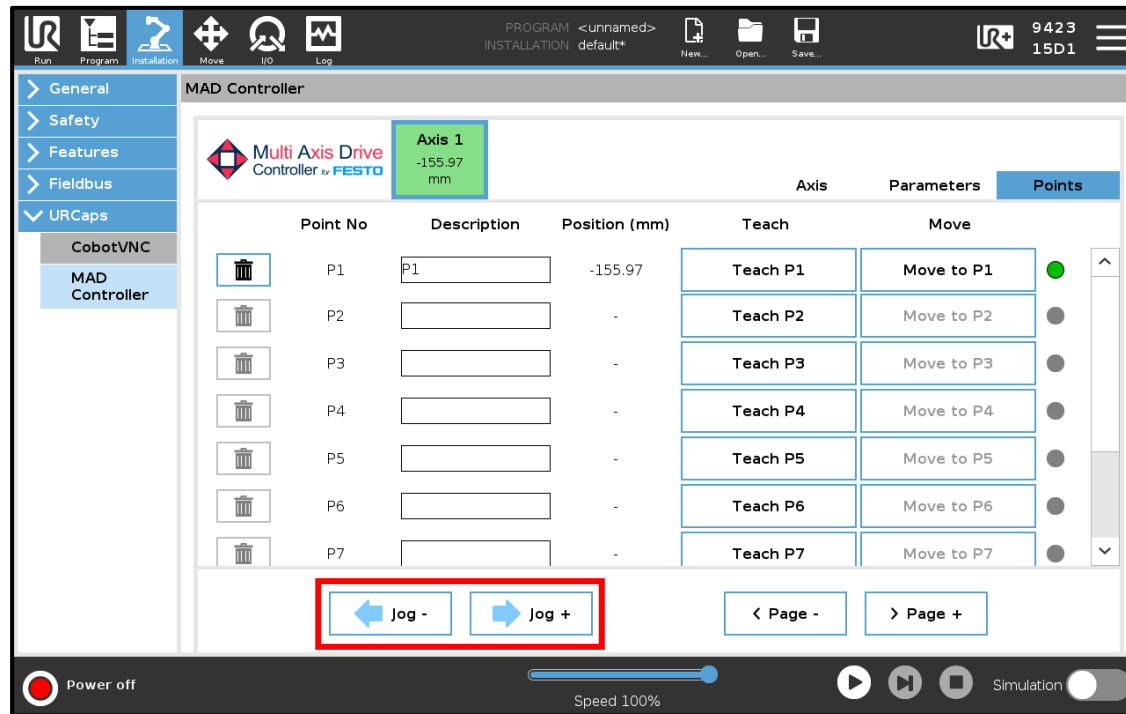
- You can set the current position as Home (□) by using the Set Home Here button¹.
- Clicking on Move to Home will move the axis to the current zero position.



¹ For more information consult MAD Controller manual.

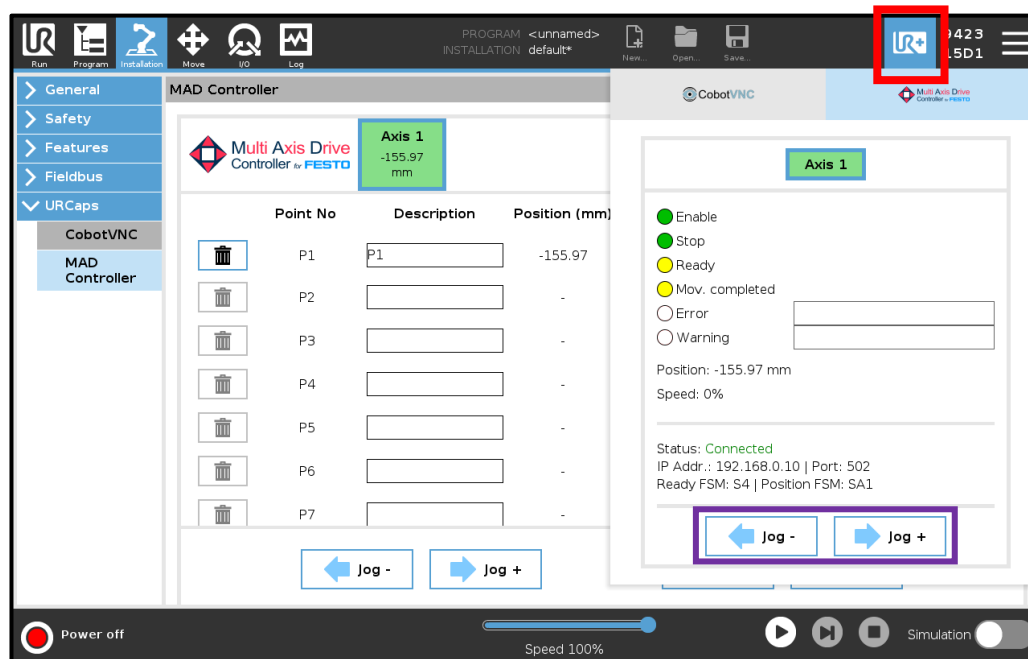
Axis configuration

From this tab it is possible to move the selected axis in manual mode with the Jog (◻) buttons. In addition, it is possible to save points although this is not necessary for the tidyPal process.



Axis configuration

You can access the URCap toolbar¹ from any window (□) to check the status of the controller and move the axis manually using Jog (□).



¹ The toolbar is only available on e-Series models.

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This section explains everything related to the safety of the palletising station:

1. Impact test

Validation of robot force and pressure.

2. Integration recommendations

Configuration-dependent aspects of product integration.

1 Impact test

This section presents the conditions when performing the impact test with the Nutai gripper. This process has been carried out in accordance with ISO/TS 15066 to certify that the equipment meets the force and pressure requirements.

Detailed test results are presented in Annex I.

Conditions:

Gripper	Ang. Speed	Ang. Acce.	Lin. Speed	Lin. Acce.
Nutai	180 °/s	800 °/s ²	1750 mm/s	9000 mm/s ²

The following images show the process of carrying out the impact test. For this purpose, the KMG-500 force sensor and Fuji Prescale paper were used.



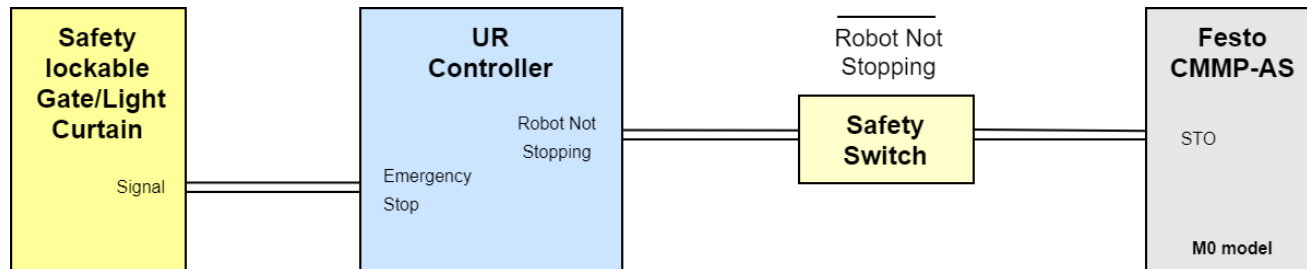
2 Integration recommendations

The integration will depend on the customer's requirements, therefore, there may be different configurations for the station.


The following are some integration schemes depending on the level of security required:

- 1. Basic level:** the station is in a fenced area. Both are stopped if the operator enters the fenced area.
- 2. Medium level:** the station is NOT in a fenced area. The robot slows down if the operator enters the operating area.
- 3. Advanced level:** the station is NOT in a fenced area. The robot and/or axis slows down or stops if the operator enters the operating area.

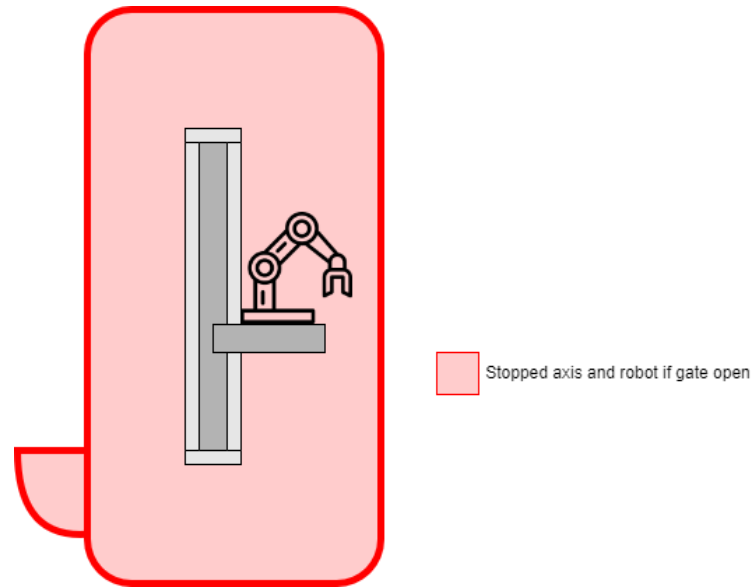
- 1. Basic level:** the station is in a fenced area. Both are stopped if the operator enters the fenced area.




Connection diagram

 **Warning:** these slides are safety recommendations only. We are not responsible for damage caused by misuse or incorrect integration of this product.

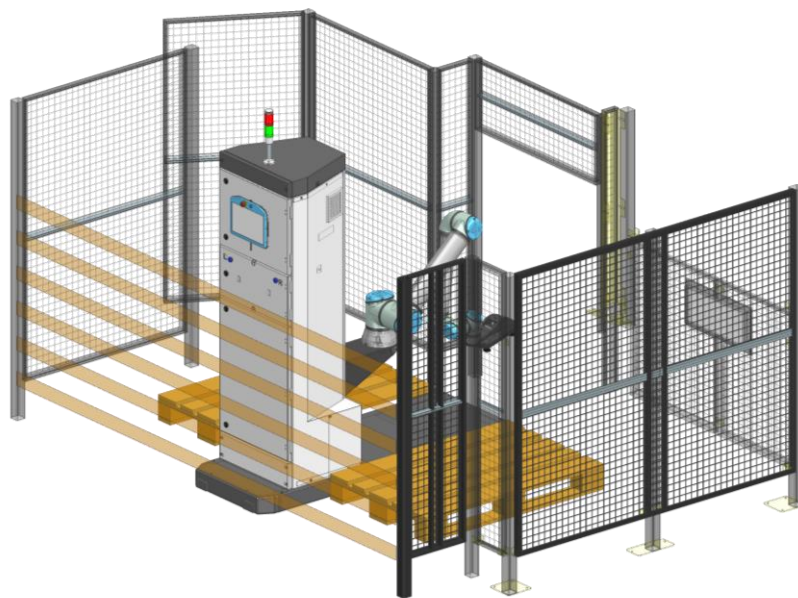
- 1. Basic level:** the station is in a fenced area. Both are stopped if the operator enters the fenced area.



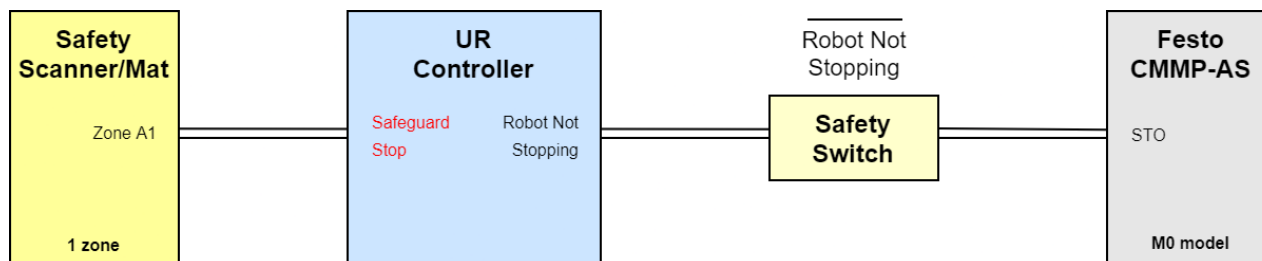
Integration scheme

 **Warning:** these slides are safety recommendations only. We are not responsible for damage caused by misuse or incorrect integration of this product.


- 1. Basic level:** a possible integration with the fence is shown below. In this mode, when the operator enters the working area, the robot and axis will stop.



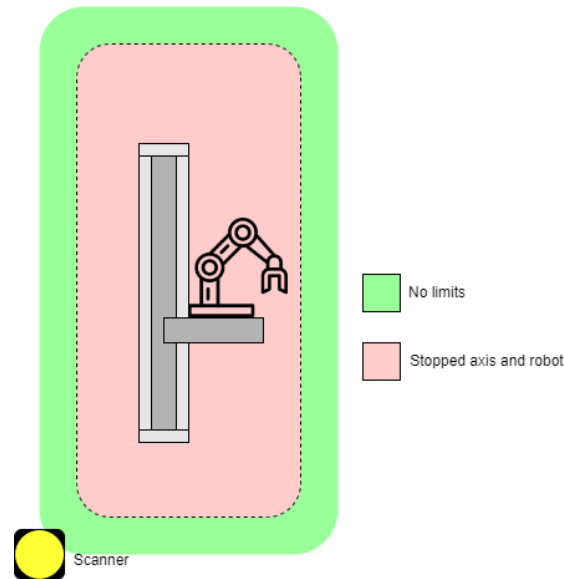
- 2. Medium level:** the station is NOT in a fenced area. The robot and axis stop if the operator enters the operating area.




Connection diagram

 **Warning:** these slides are safety recommendations only. We are not responsible for damage caused by misuse or incorrect integration of this product.

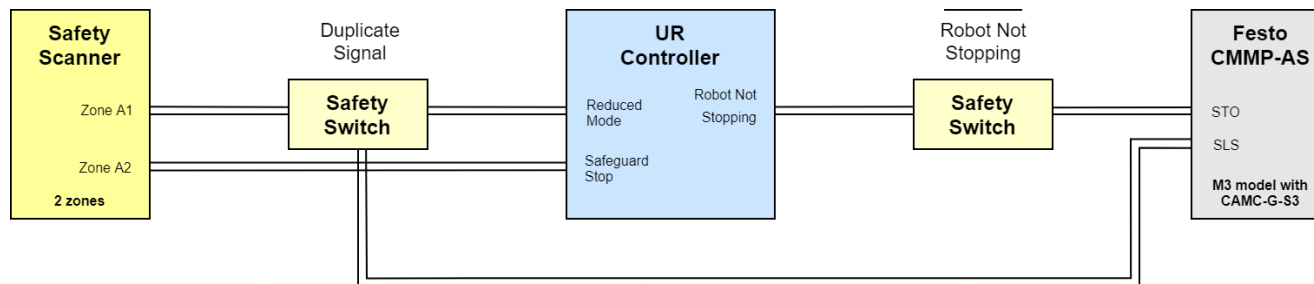
2. **Medium level:** the station is NOT in a fenced area. When the operator enters the restricted area, the robot slows down, the linear axis will maintain its speed because mechanically it is already limited to a collaborative speed.




Integration scheme

 **Warning:** these slides are safety recommendations only. We are not responsible for damage caused by misuse or incorrect integration of this product.

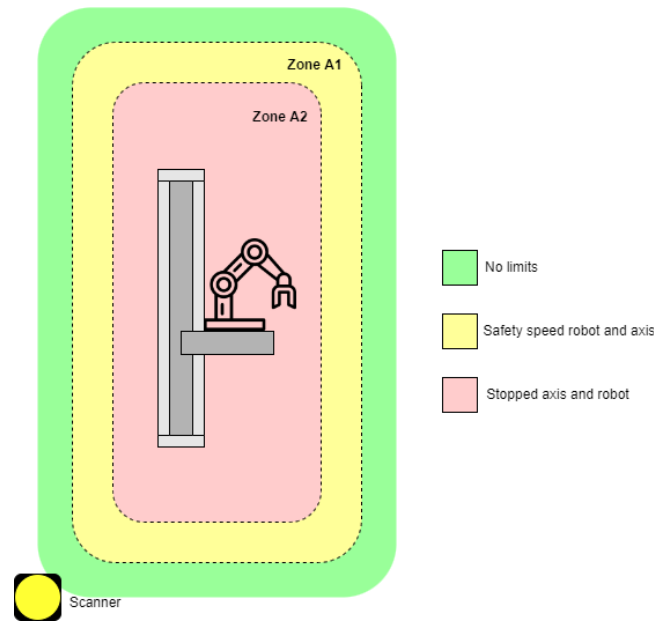
3. **Advanced level:** the station is NOT in a fenced area. The robot and axis slow down if the operator enters the operating area.




Connection diagram

 **Warning:** these slides are safety recommendations only. We are not responsible for damage caused by misuse or incorrect integration of this product.

3. **Advanced level:** the station is NOT in a fenced area. A detection in the first zone will slow down the robot, in the second zone robot and axis will stop.



Integration scheme

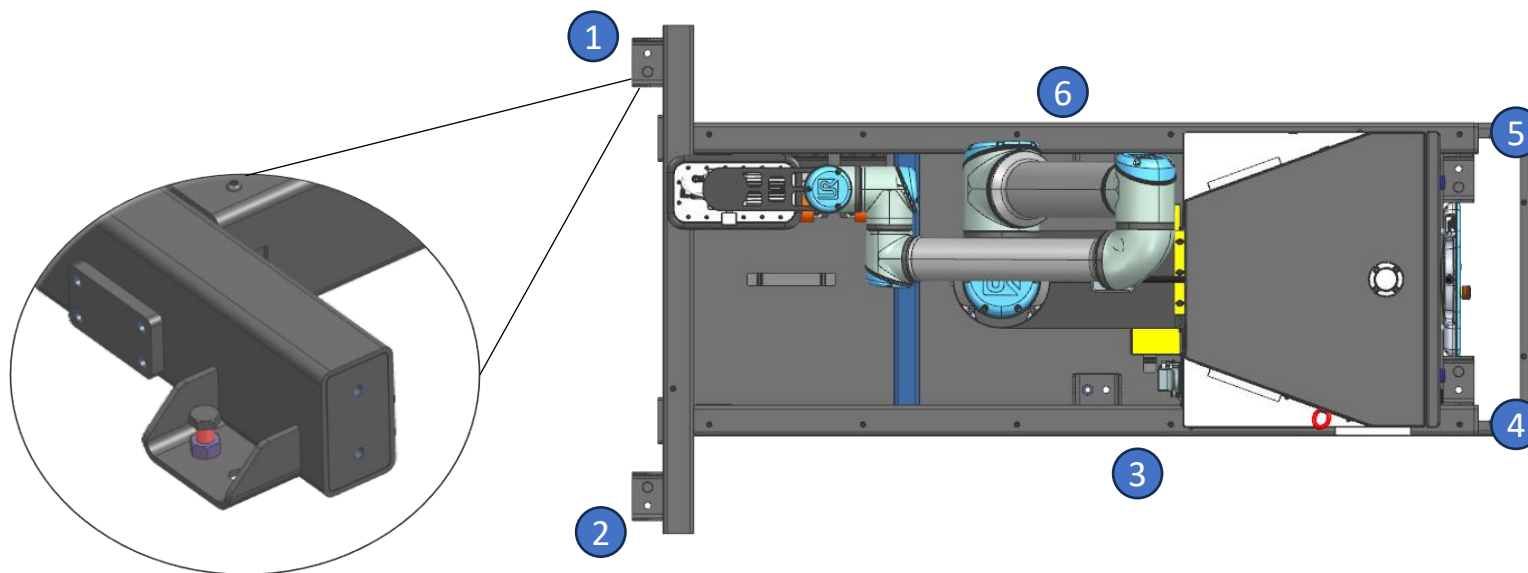
 **Warning:** these slides are safety recommendations only. We are not responsible for damage caused by misuse or incorrect integration of this product.

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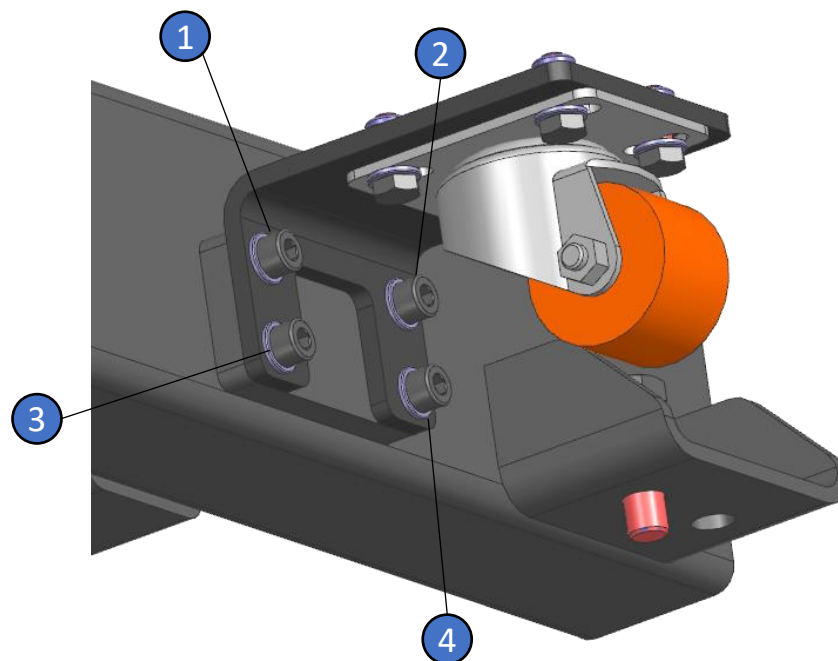
Caster wheels Assembly

- 1. Raise TidyPAL.** Tighten the supplied screws M12 at a distance of 12mm to achieve a space to install the wheels. Use 19mm socket. *(The use of an extender is highly recommended for better work)*



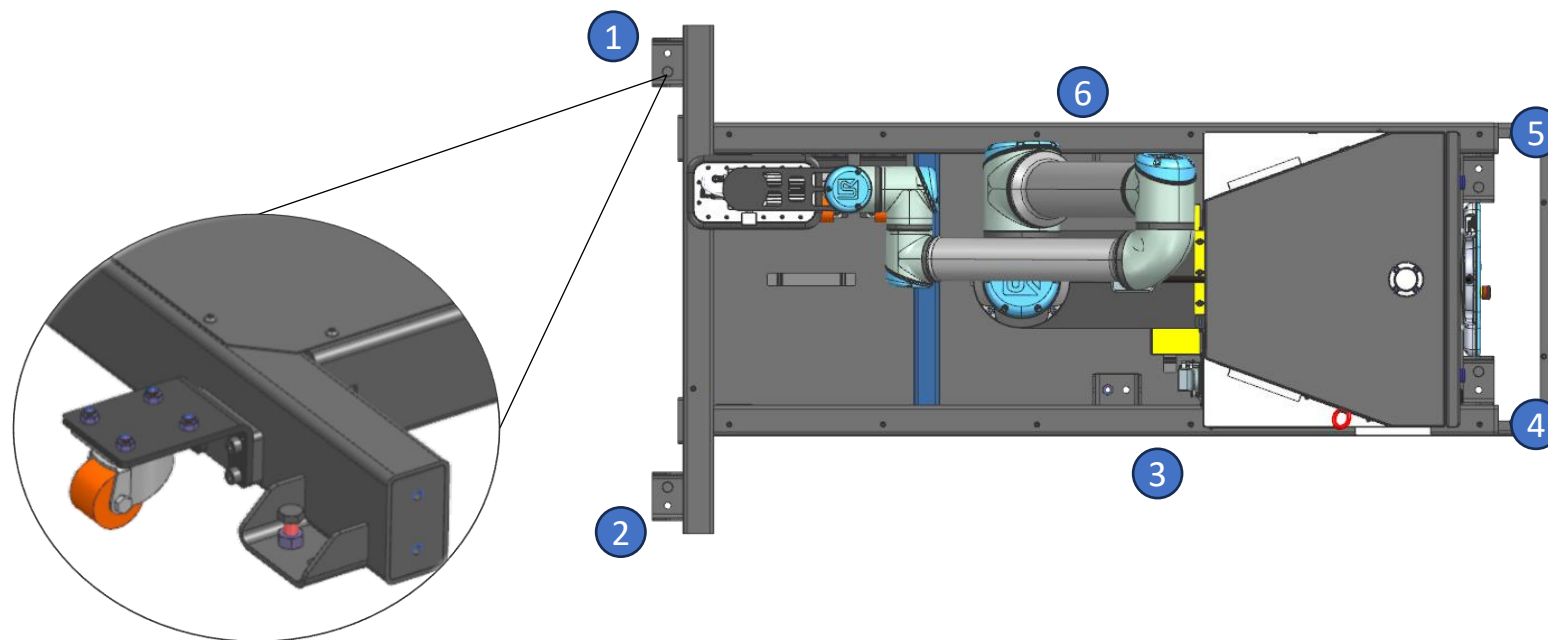
Caster wheels Assembly

2. **Wheels holder installation.** Tight the M8x20 screws and washers supplied using the wheels holder. Repeat this step in the 4 points previously shown.



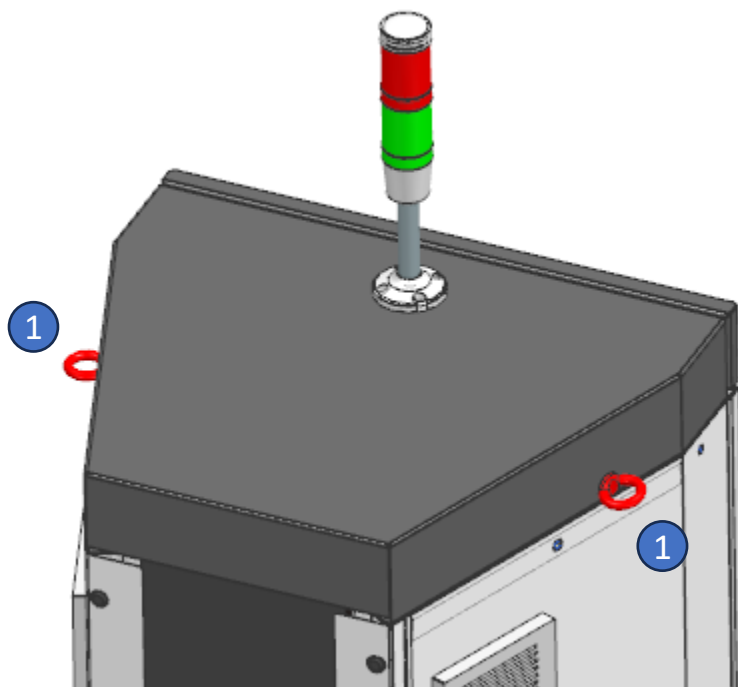
Caster wheels Assembly

1. **Go down TidyPAL.** Remove the 4 M12 supplied screws until the wheels touch the ground. Use 19mm socket. *(The use of an extender is highly recommended for better work)*



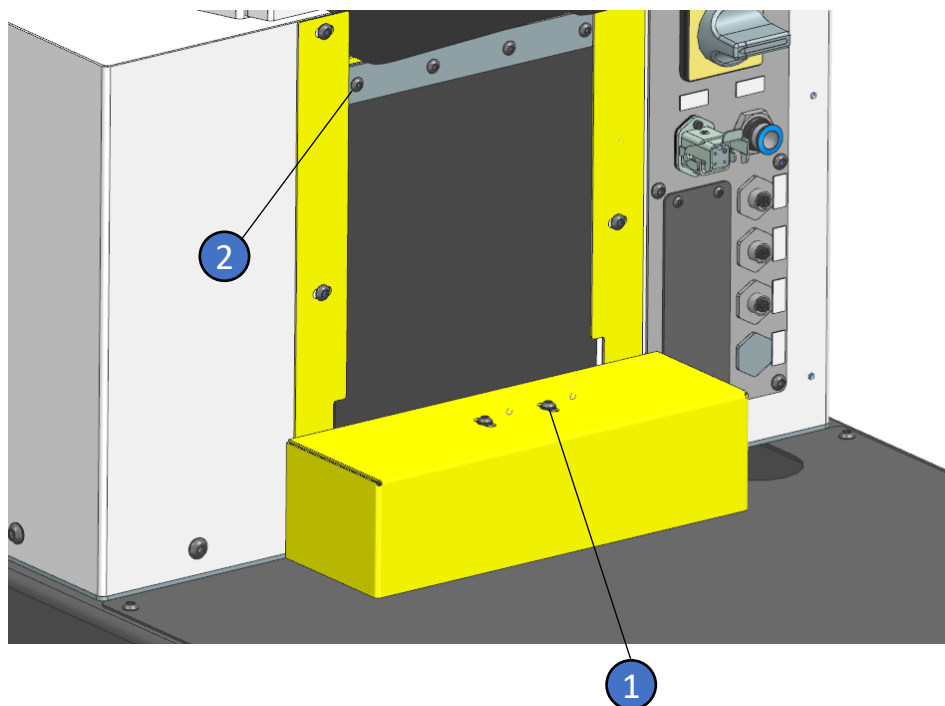
Lifting for transport

1. **Lift TidyPAL.** There are two lifting point. Use any type of holder like slings or ropes with M10 eyebolt.



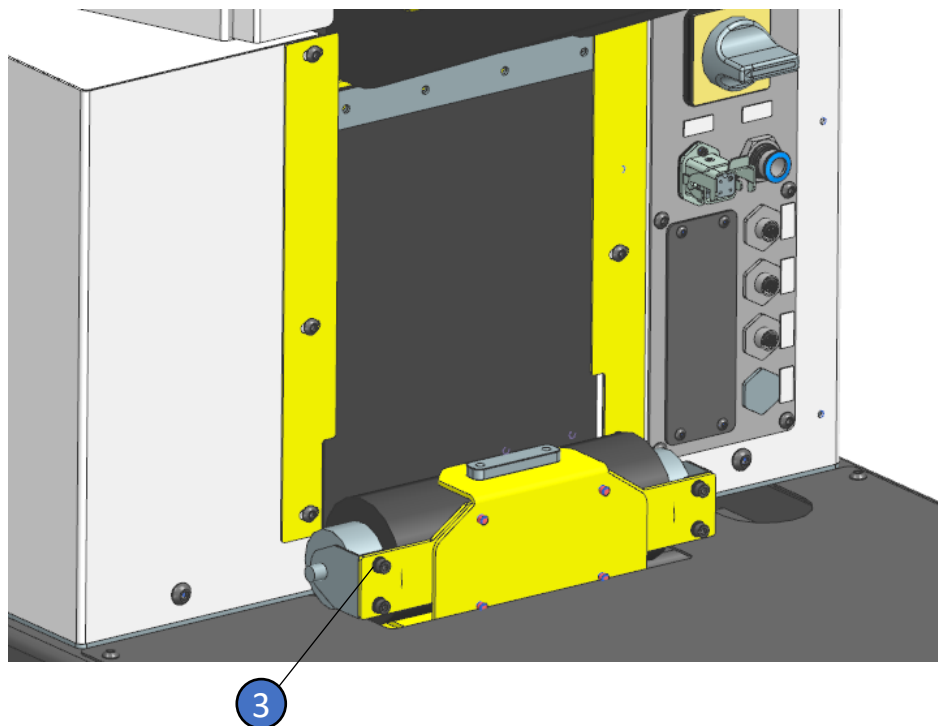
Remove curtain (Lower)

1. **Remove drawer.** Remove M5 screws and washers.
2. **Loosen plate holder.** Remove M5 screws and washer. Be careful with the square before loseen all screws, the spring is tauten.



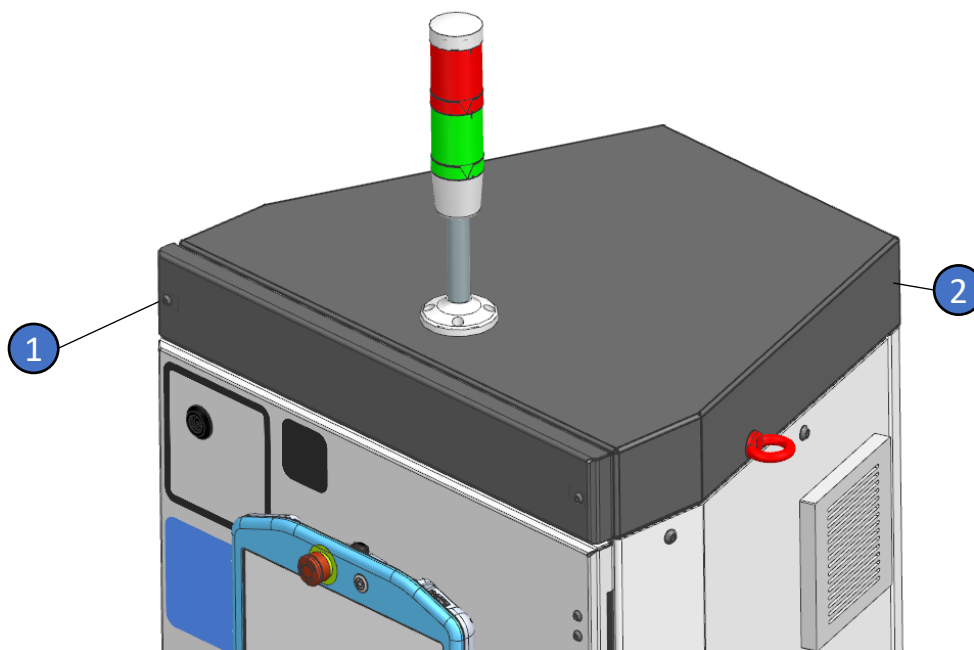
Remove curtain (Lower)

- 3. Remove plate.** Remove M5 screws, nuts and washers. Be careful with the square of the holder due to the spring is pre-tauten. The square can rotate violently.



Remove curtain (Top)

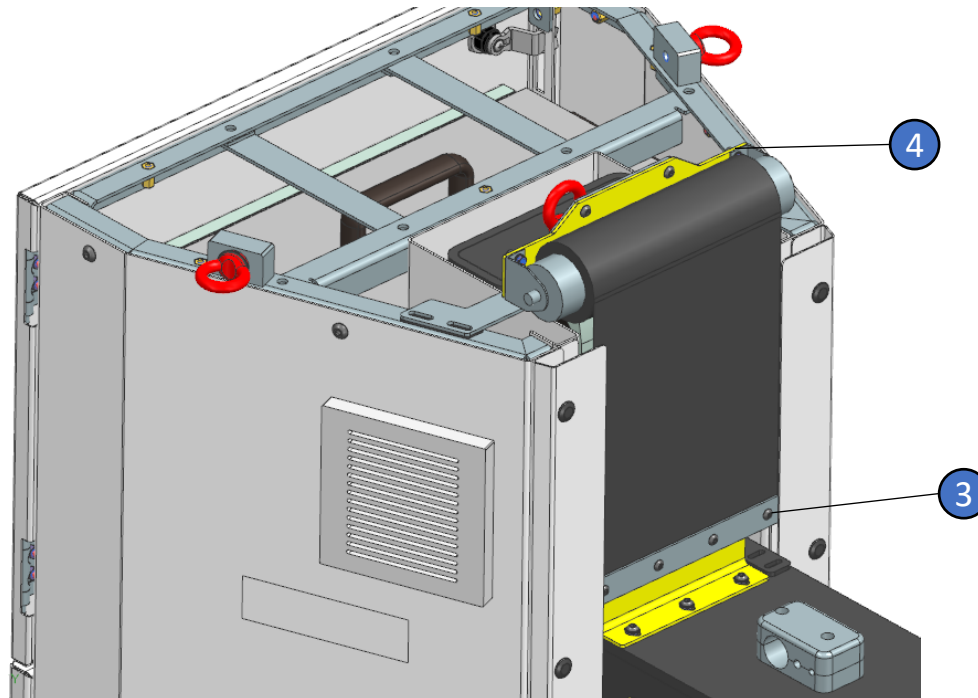
1. **Remove the front cover.** Remove the 2 M6 screws.
2. **Remove the top cover.** Remove the 6 M6 screws on the inside of the cover.



Assembly and maintenance

Remove self-retracting bellows (Upper)

- 3. Remove the plate.** Remove the 4 M5 screws and washers. Be careful when loosening the screws as the spring is pre-tensioned.
- 4. Remove the bellows plate.** Remove the 4 M5 screws, nuts and washers. When removing the bellows, be careful with the spring tension as once removed from the bracket, the bracket will tend to rotate.



Assembly and maintenance

Preventive maintenance work

Each maintenance plan for each functional group of the product is detailed below.

Component	Work	Measures	FREQUENCY			
			Monthly	Quarterly	Half-yearly	Annual
Maintenance unit	Review	Check for condensation. Possibility of air leakage.	X			
General installation	Review	Checking of all sensors and cleaning	X			
General installation	Damages	Check the equipment for the following damage: <ul style="list-style-type: none"> • Paint deterioration • Bent components • Cracks in components • Cracks in welding 		X		

Assembly and maintenance

Preventive maintenance work

Each maintenance plan for each functional group of the product is detailed below.

Component	Work	Measures	FREQUENCY			
			Monthly	Quarterly	Half-year	Annual
General installation	Loose components	Check tightening torques of bolts and nuts, according to tables on page 116.			X	
Linear guides	Review	Check for dirt and grease. Clean and grease according to manufacturer's specifications.			X	
Vacuum claw	Review	Check the condition of the equipment. In case of damage or deterioration, contact the manufacturer.			X	

Assembly and maintenance

Preventive maintenance work

Each maintenance plan for each functional group of the product is detailed below.

Component	Work	Measures	FREQUENCY			
			Monthly	Quarterly	Half-year	Annual
Roll-up bellows	Review	Check the tension of the roller shutter. If tensioning is necessary, follow the manufacturer's instructions.			X	
Components	Check the condition of components such as: <ul style="list-style-type: none"> • Detectors • Beacons • Light beacons • Pneumatic components 	Replacement of worn, damaged or malfunctioning parts.			X	

Assembly and maintenance



Preventive maintenance work

The tightening torque tables for the fasteners are attached below.

Galvanised screws

Tamaño de rosca	Par de apriete [Nm]		
	8.8	10.9	12.9
M3	1.1	1.58	1.9
M4	2.6	3.9	4.5
M5	5.2	7.6	8.9
M6	9	13.2	15.4
M8	21.6	31.8	37.2
M10	43	63	73
M12	73	108	126
M14	117	172	201
M16	180	264	309
M20	363	517	605
M22	495	704	824
M24	625	890	1041
M27	915	1304	1526
M30	1246	1775	2077
M36	2164	3082	3607

Blued screws

Tamaño de rosca	Par de apriete [Nm]		
	8.8	10.9	12.9
M4	3	4.6	5.1
M5	5.9	8.6	10
M6	10.1	14.9	17.4
M8	24.6	36.1	42.2
M10	48	71	83
M12	84	123	144
M14	133	195	229
M16	206	302	354
M20	415	592	692
M22	567	804	945
M24	714	1017	1190
M27	1050	1496	1750
M30	1420	2033	2380
M36	2482	3535	4136

Stainless steel screws

Tamaño de rosca	Par de apriete [Nm]		
	50	70	80
M3	0.37	0.8	1.1
M4	0.86	1.85	2.4
M5	1.6	3.6	4.8
M6	2.9	6.3	8.4
M8	7.1	15.2	20.3
M10	14	30	39
M12	24	51	68
M14	38	82	109
M16	58	126	168
M20	115	247	330
M22	157	337	450
M24	198	426	568
M27	292	—	—
M30	397	—	—
M36	690	—	—

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Best practices

 **We advise you to follow the recommendations below:**

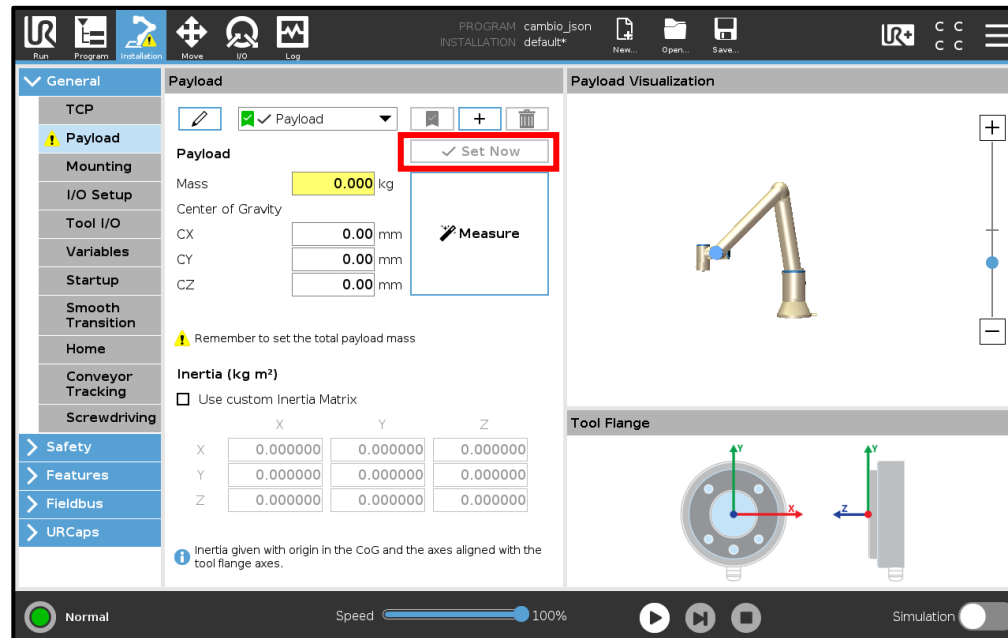
- Before starting a cycle, check that there is no risk of collision.
- Check the operation of the sensors before starting a cycle.
- The components may only be handled by qualified technical personnel.
- During a cycle, position the teach pendant in the cabinet.
- If you replace any components, perform a Home and check their functioning
- Carry out regular maintenance on your mechanical components¹
- After assembly of the equipment, [the vertical axis](#) and [the pallet points](#) must be calibrated.

¹ For more information, please visit the manufacturer's website:

<https://www.festo.com>

Best practices

- In the event of a protective shutdown or sudden stop of the program in progress, check the robot load on the installation node.



□ Be sure to apply the load.

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 For more information, contact with:



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