FlexiExpert

SOFTWARE MANUAL

ARS Automation

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INTRODUCTION

This document is intended to describe all the functions of the “Flexi-Expert” Plug-In.

With the above mentioned software, adequately loaded in a Fanuc controller, it is possible to develop a complete application even for less experienced programming users.

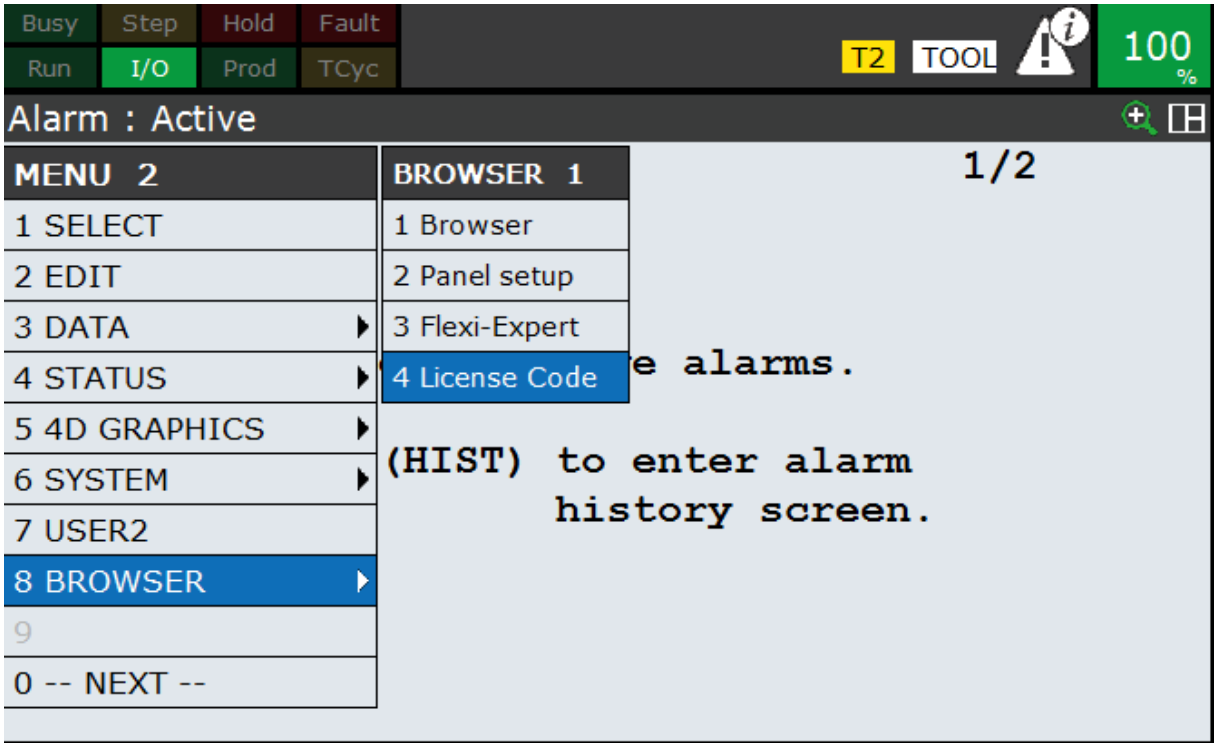
Flexi-Expert is an intuitive Plug-In that allows you to have a recipe database with ample customisation, making it universal for most applications.

Activating the Flexi-Expert licence

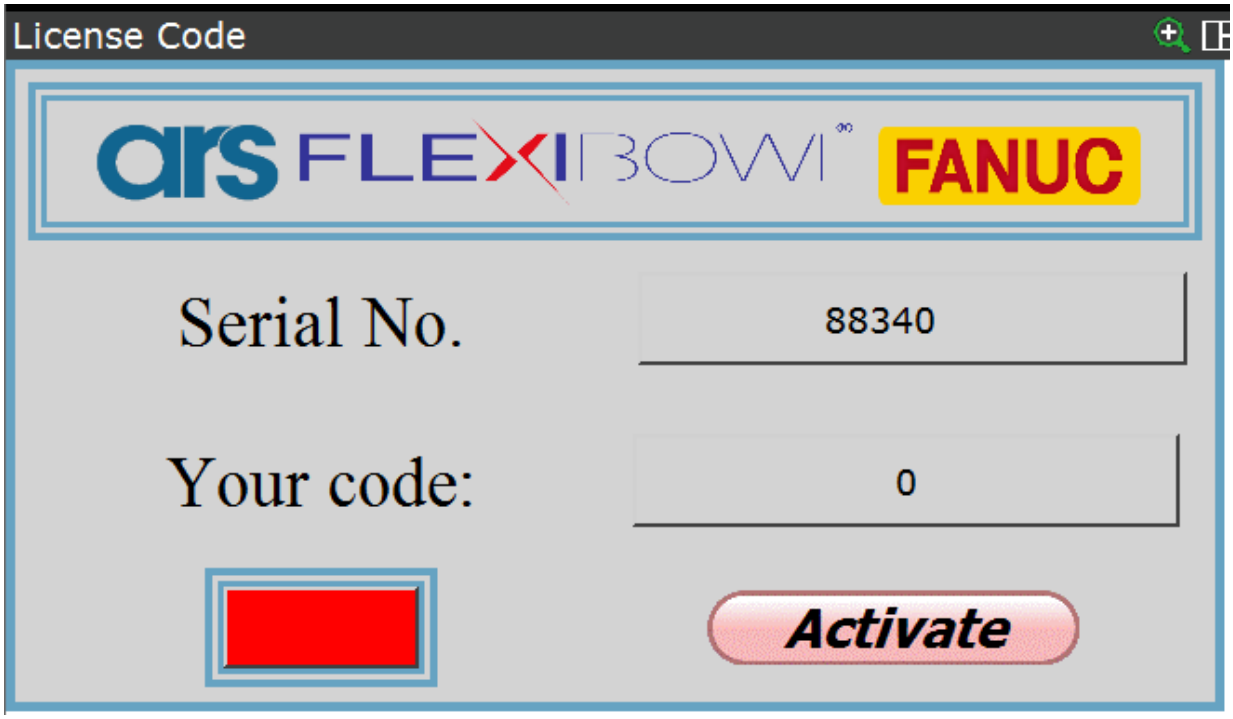
You must enable the licence before you can use the Flexi Expert Plug-In

Access the activation page by pressing:

Menu→0→Browser→License Code



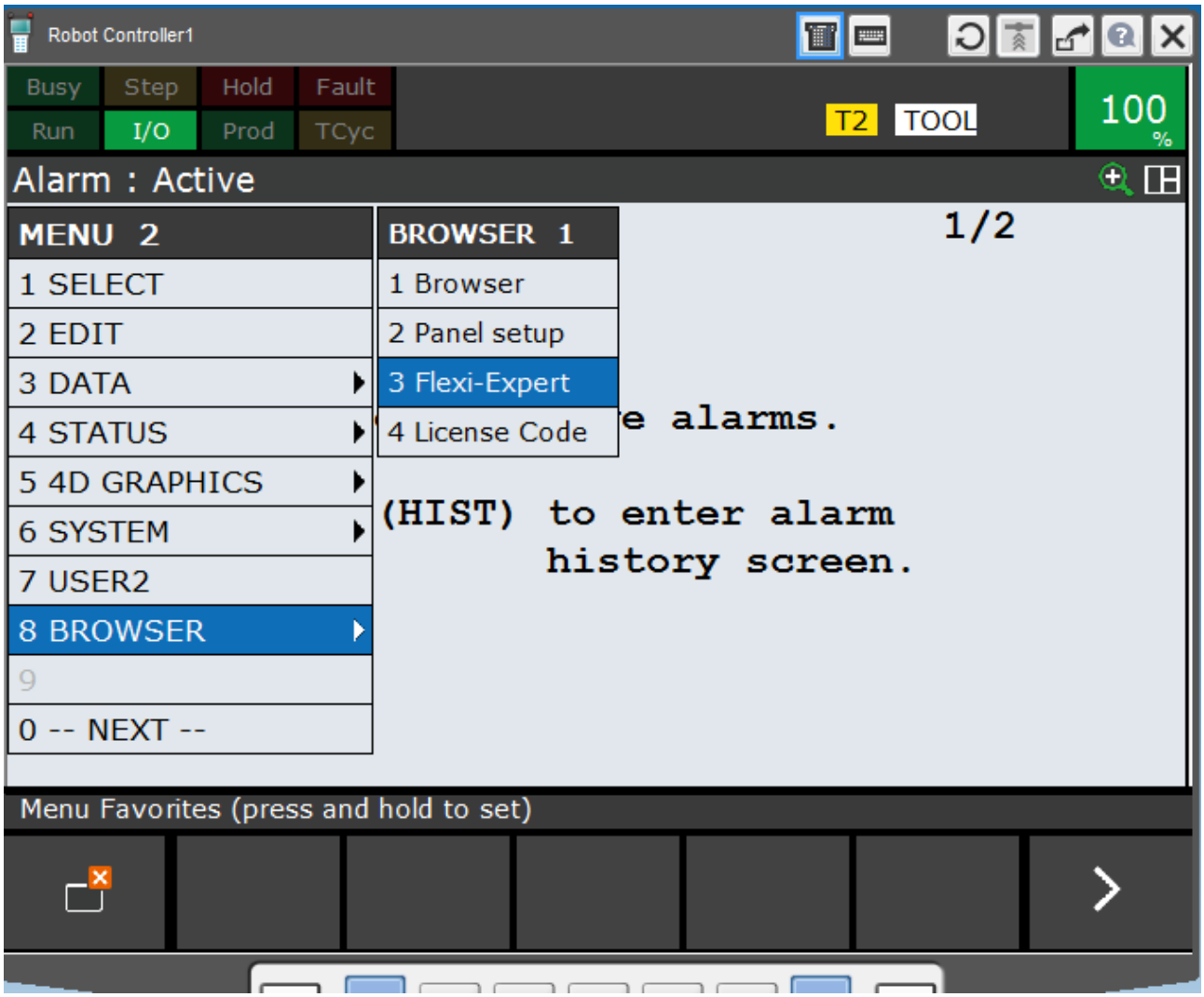
Contact ARS and provide the Serial Number found in the first box. An activation code will be provided to be entered in the “Your code” box, then press the “Activate” button to enable the licence.



Flexi-Expert main interface

Access the Flexi-Expert interface from the Fanuc keypad by pressing:

Menu→0→Browser→Flexi-Expert



Creating a new recipe

Use the “New Recipe” button, found on the first page of the interface, to access the submenus for creating a new recipe and therefore, a new product to be processed.

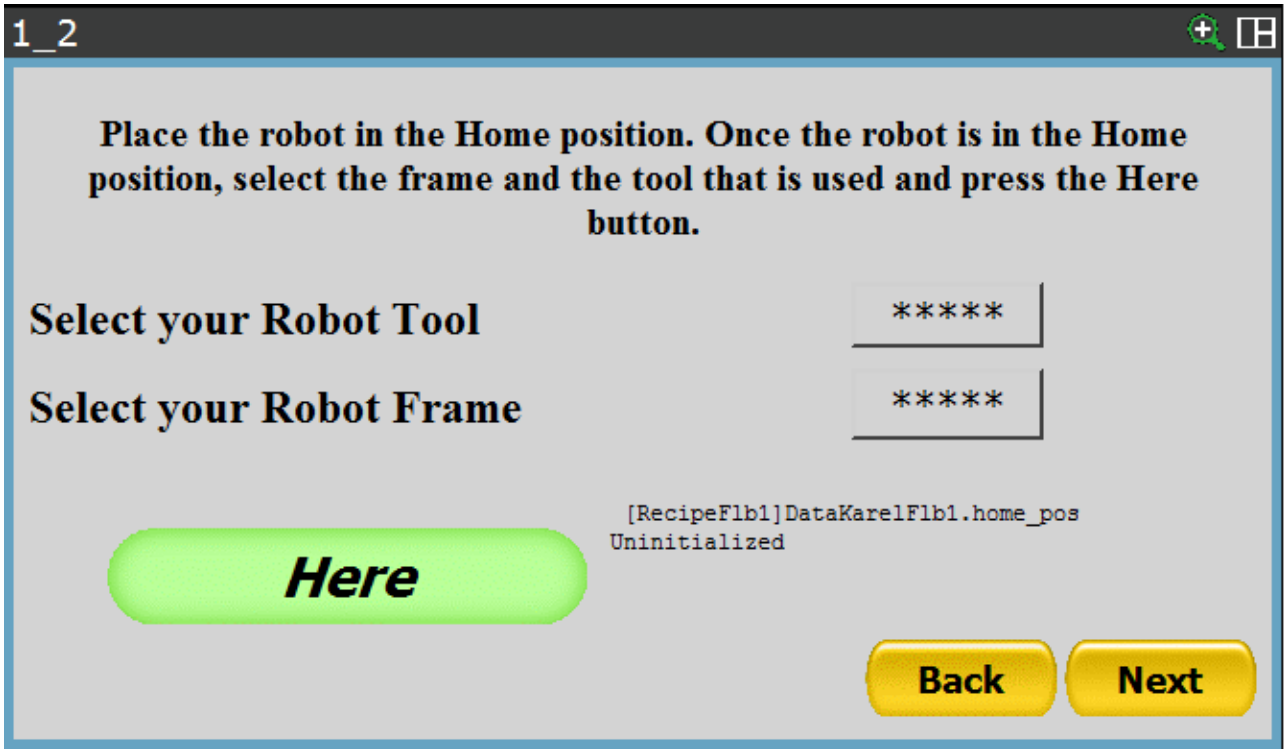
Recipe name

You can choose the name of the new recipe according to your needs. To write the product name that will be entered, you must select the white textbox that by default contains *****.

As soon as the virtual keyboard appears, it will be possible to enter the recipe name.

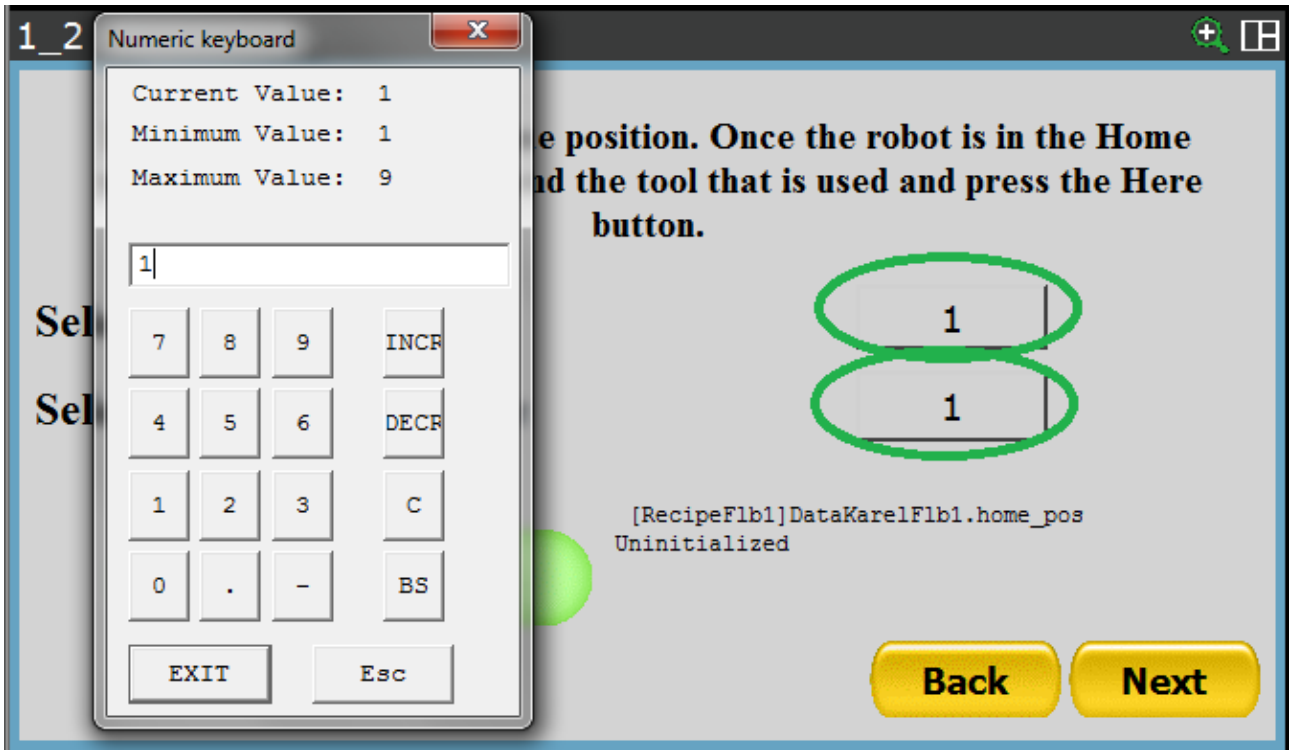
Once the product name has been entered, you can proceed by pressing the “Next” button.

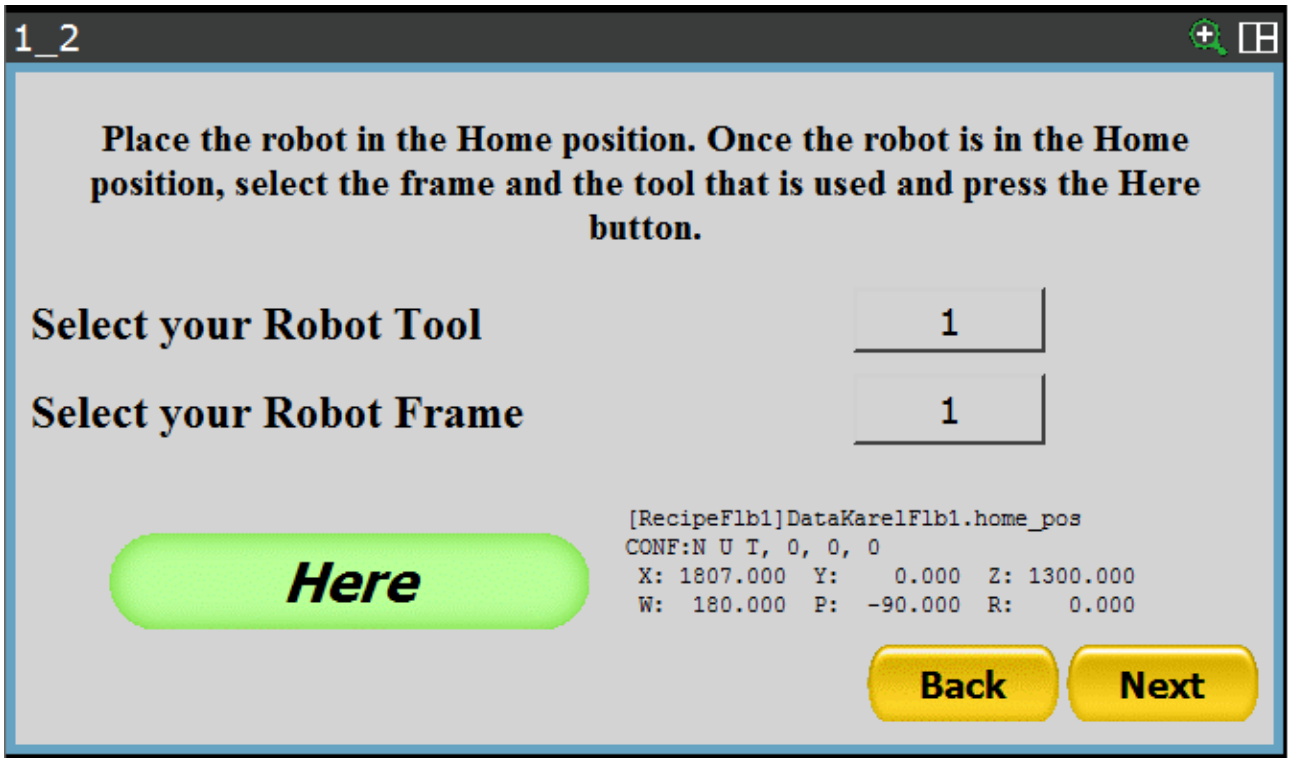
Home Position



The page that will be shown allows the “Home” point to be recorded as well as the starting or resting position of the robot. The number of the Tool and that of the Frame which the position will refer to must be set so as to record this position.

By selecting the boxes where ***** is shown, you can set the Tool and Frame that will be used when the robot is moved to the “Home” point.

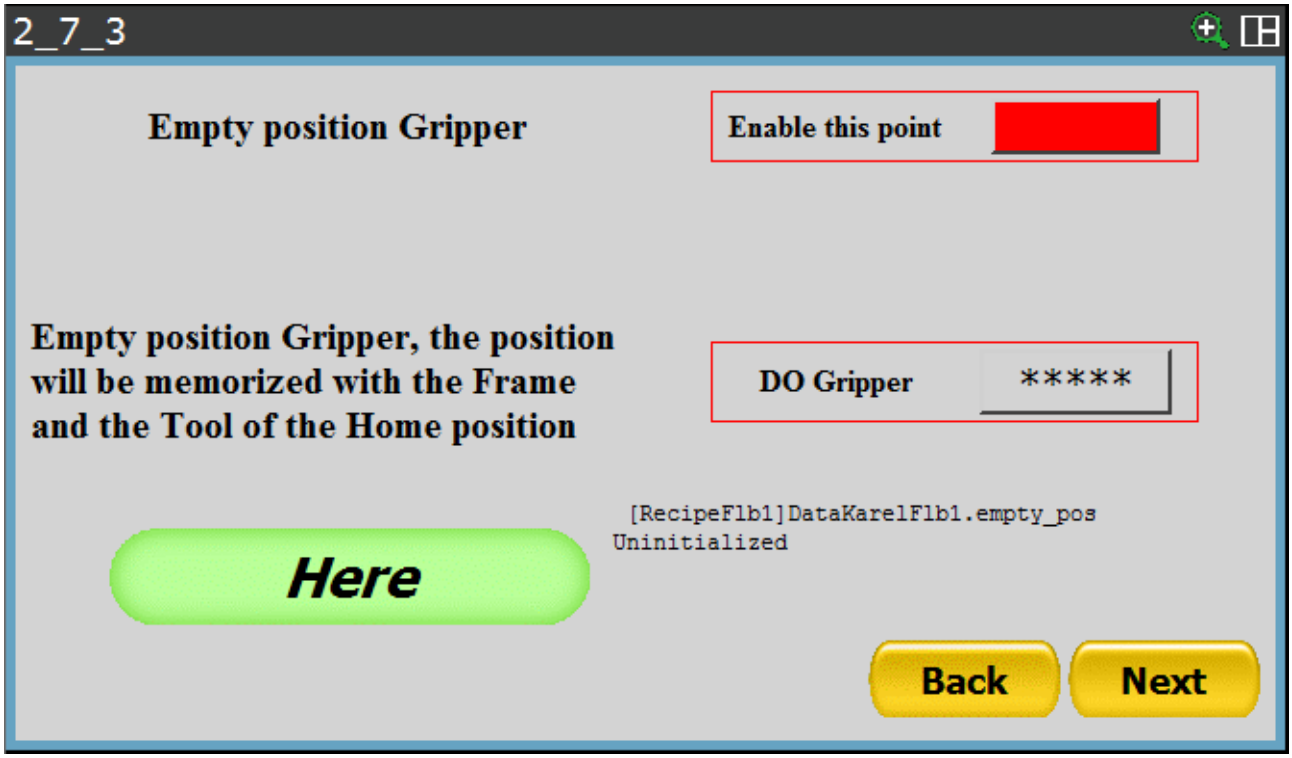




Once both the Tool and Frame have been set, you must move the robot to the desired position and then press the “Here” button. The Cartesian coordinates that describe the “Home” position will be displayed on the right.

You can access the next page by pressing “Next”.

Gripper emptying position



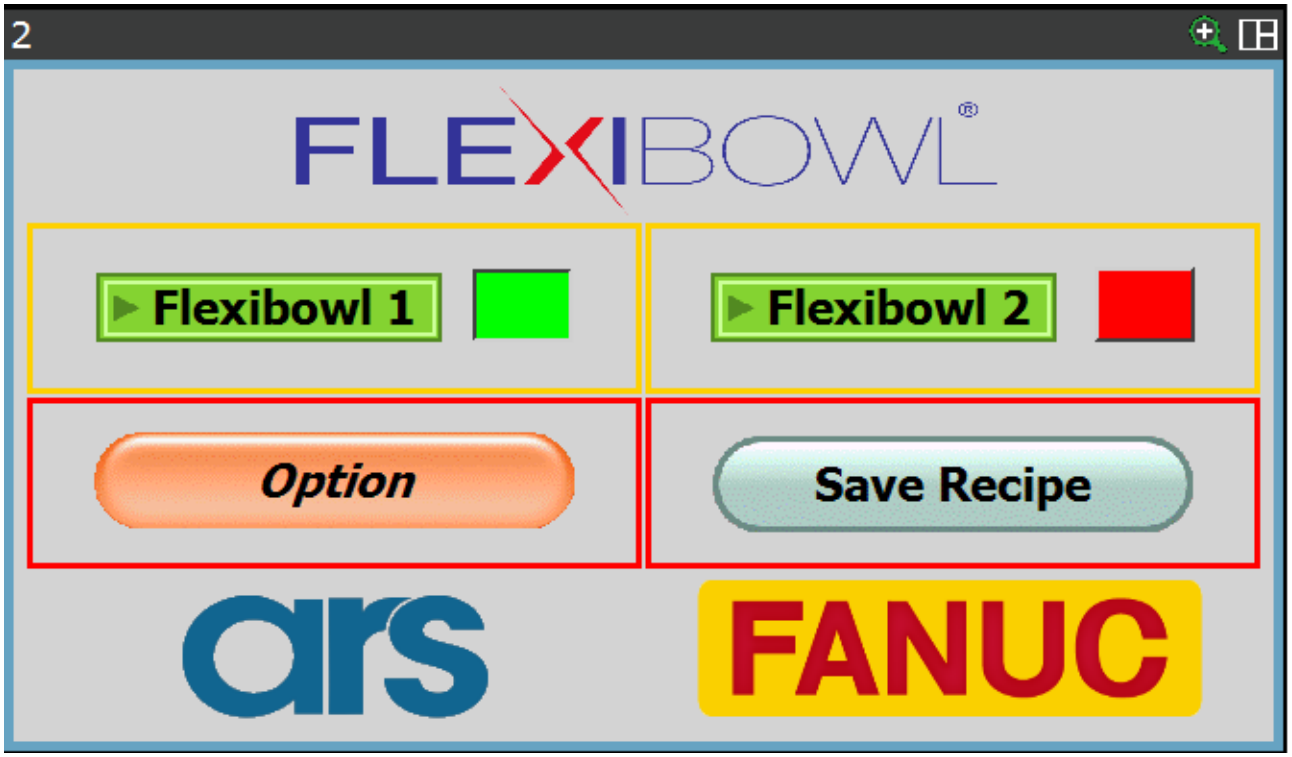
The page that will be shown allows the “Empty Gripper” point to be recorded as well as the emptying position in a given area. In order to record this position, you must only set the signal that will be reset once it reaches the position.

The robot will use the same frame and Tool that have been set for the “Home” position, and the standard cycle that will be performed will be the following:

1. From the Home position, the robot will reach the emptying position using the Tool and Frame set on the “Home” position recording page.
2. The robot will use the usual variable at which the “Home” position was recorded as the point approach Z variable.
3. After approaching the point, the robot will move to the gripper emptying point, reset the specified signal and rise to the usual Z variable of the “Home” position.
4. The emptying cycle ends by returning the robot to the “Home” position.

Selecting Flexibowl

The displayed screen allows you to decide whether to work with a single Flexibowl or in a double configuration with two feeders:



In order to save a recipe correctly, it is essential to first enter all the required fields. The “Save Recipe” button will be discussed later.

Assuming that you need to create an application where the robot picks from a single feeder, you will only need to enable one Flexibowl.

Flexibowls are enabled by selecting the box next to “Flexibowl 1” and “Flexibowl 2”. The green colour indicates enabling; once selected, it will then be possible to access the submenus that will allow all the points necessary for the application to be recorded.

The creation of a recipe that will have to work with a single Flexibowl will be analysed in this paragraph.

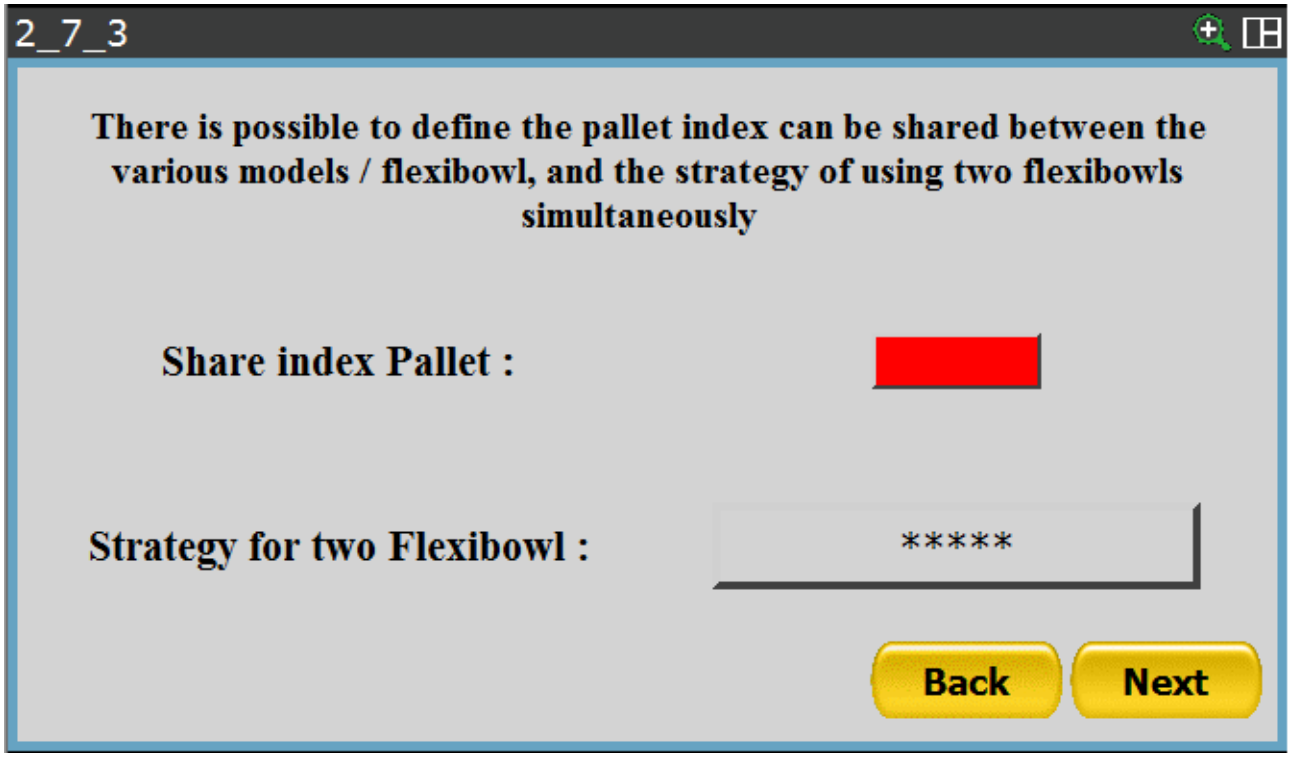
Depending on the requirements of the installer, if the application to be developed will require 2 Flexibowls to be used, the procedure will be the same as that shown below and must also be repeated for the second feeder.

In order to continue, at least one of the two Flexibowls must be enabled, otherwise an error will be generated.

After enabling the Flexibowl you want to use, you must press the “Flexibowl 1” or “Flexibowl 2” button to continue.

Option

By selecting the “Option” screen, you have access to 2 variables that can be set accordingly.



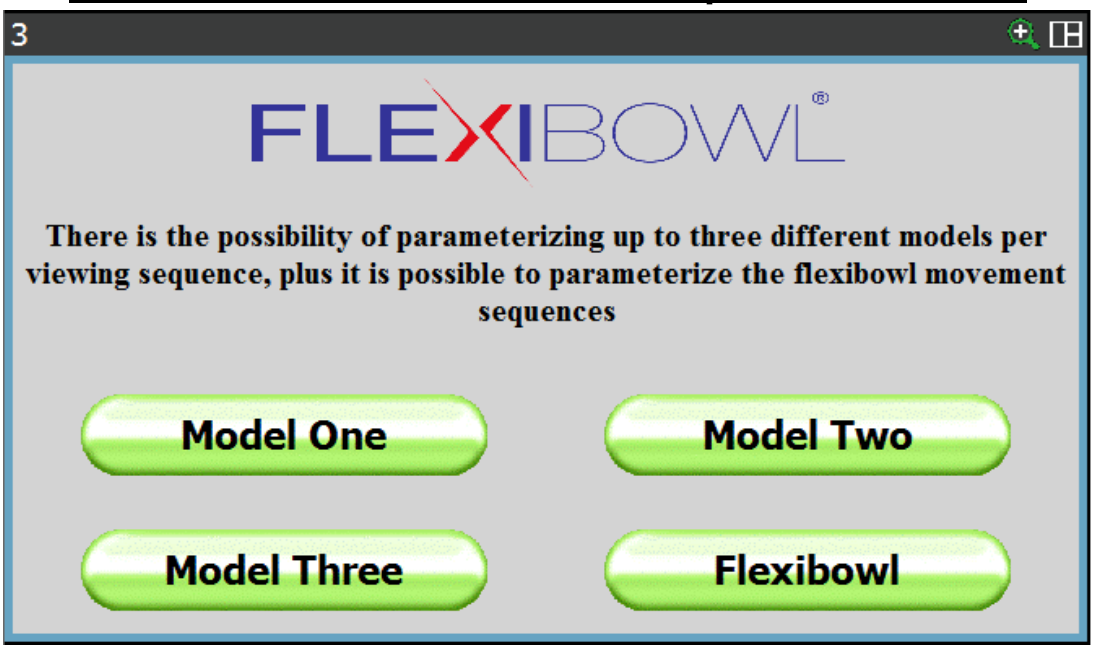
- **Share index Pallet:** if you work with more than one model or with more than one Flexibowl, you can use the shared pallet index for the Flexibowls/Models.

  Two application examples can be:

  - By processing the same component in 2 different Flexibowls, you can enable this variable to always go to the next position of the pallet, regardless of where the piece is picked up.
  - 2 different models are picked when using a single Flexibowl:
    - The first model is picked and placed directly on the pallet
    - After being picked, the second model is brought to a tipping station and then placed on the pallet.

- **Strategy for two Flexibowls:** allows you to select the operating strategy when using 2 Flexibowls:
  - **Best Result:** There is no picking order, however, the piece that is first available is picked from the relevant Flexibowl.
  - **Flexibowl 1 ➔ Flexibowl 2:** the robot cycle implements the pick up first from Flexibowl 1 and then from Flexibowl 2.
  - **Flexibowl 2➔ Flexibowl 1:** the robot cycle implements the pick up first from Flexibowl 2 and then from Flexibowl 1

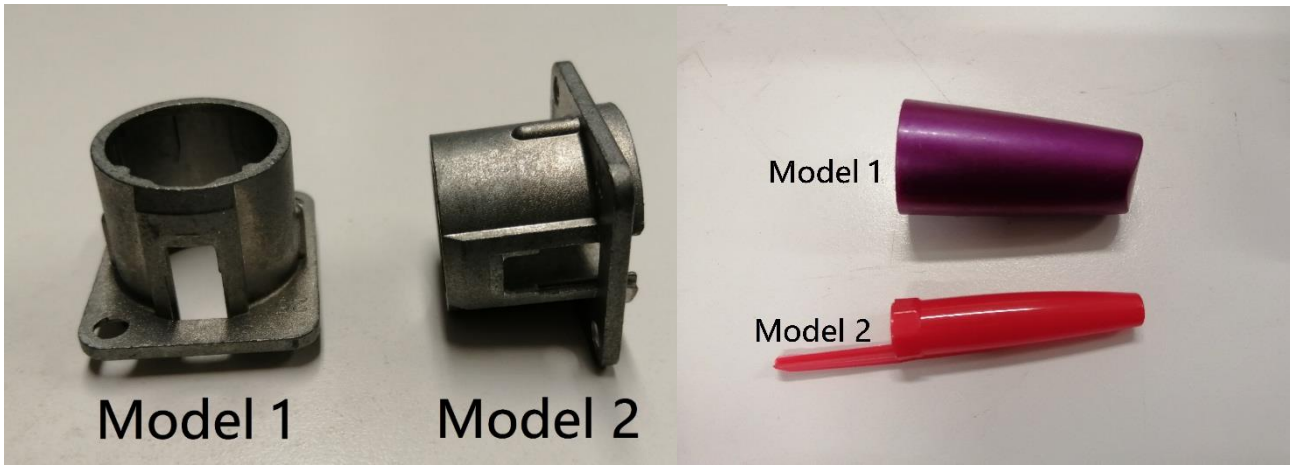
Flexibowl models and parameters



The next page shows 4 buttons, 3 of which show the item “Model”: this refers to:

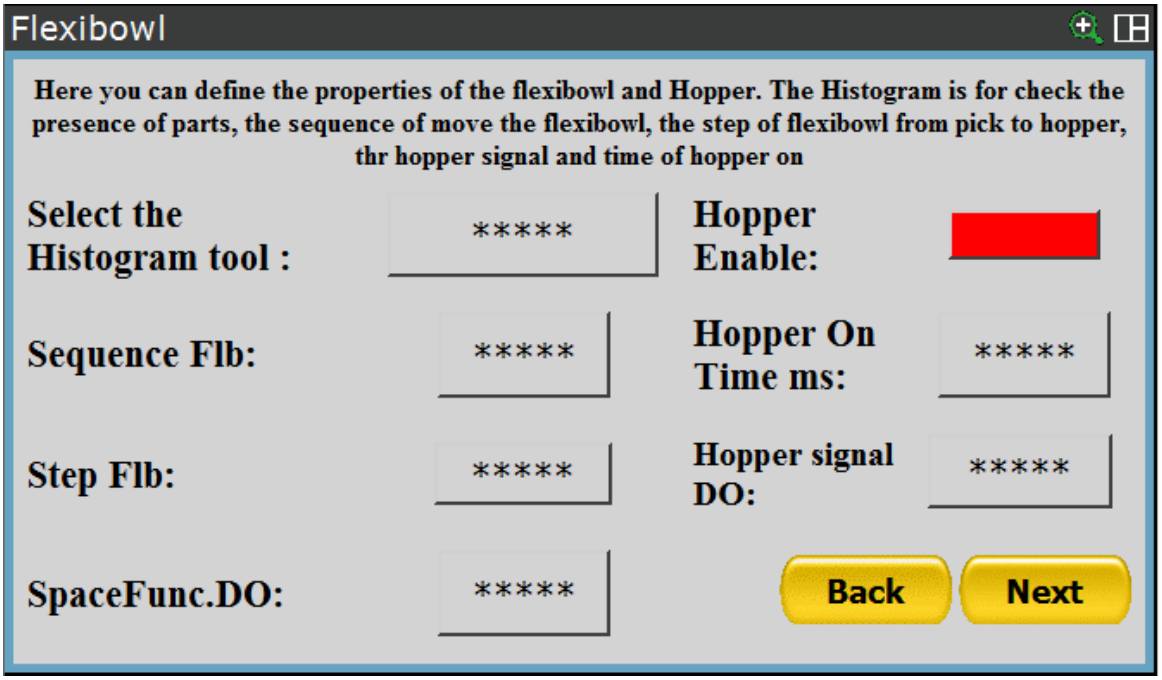
- One of the possible positions of the component to be handled
- A component, if there are 2 different parts inside the Flexibowl.

The pick and place points and any intermediate positions must be recorded for every model introduced in the recipe.

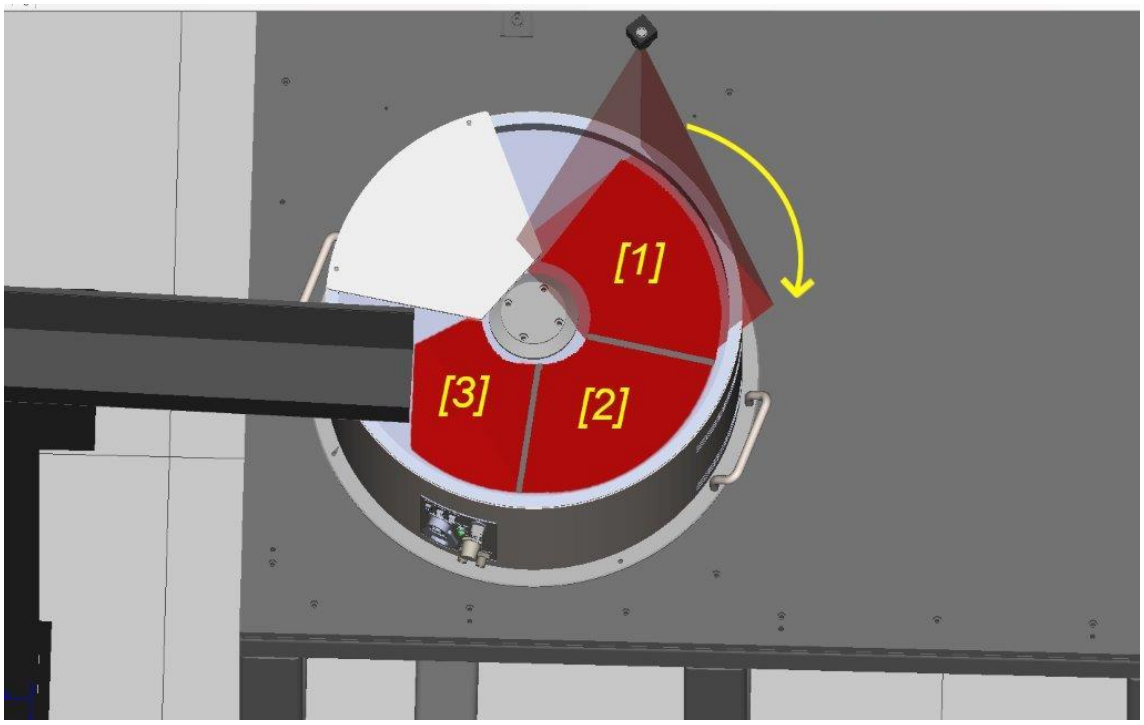


Flexibowl and hopper control

In addition to 3 buttons dedicated to the creation of the models, there is a last button that bears the wording “Flexibowl” – you must access it before proceeding with the creation of the recipe:



- **Hopper Enable**: this button enables the automatic control of a digital output which will control the loading hopper. Before carrying out a Flexibowl step, it is saved if sector 1 contains a sufficient number of pieces or if it needs to be loaded. At the end of each movement, the results are transferred from one sector to another so that sector number 3 can always be analysed and downloaded only if actually necessary.



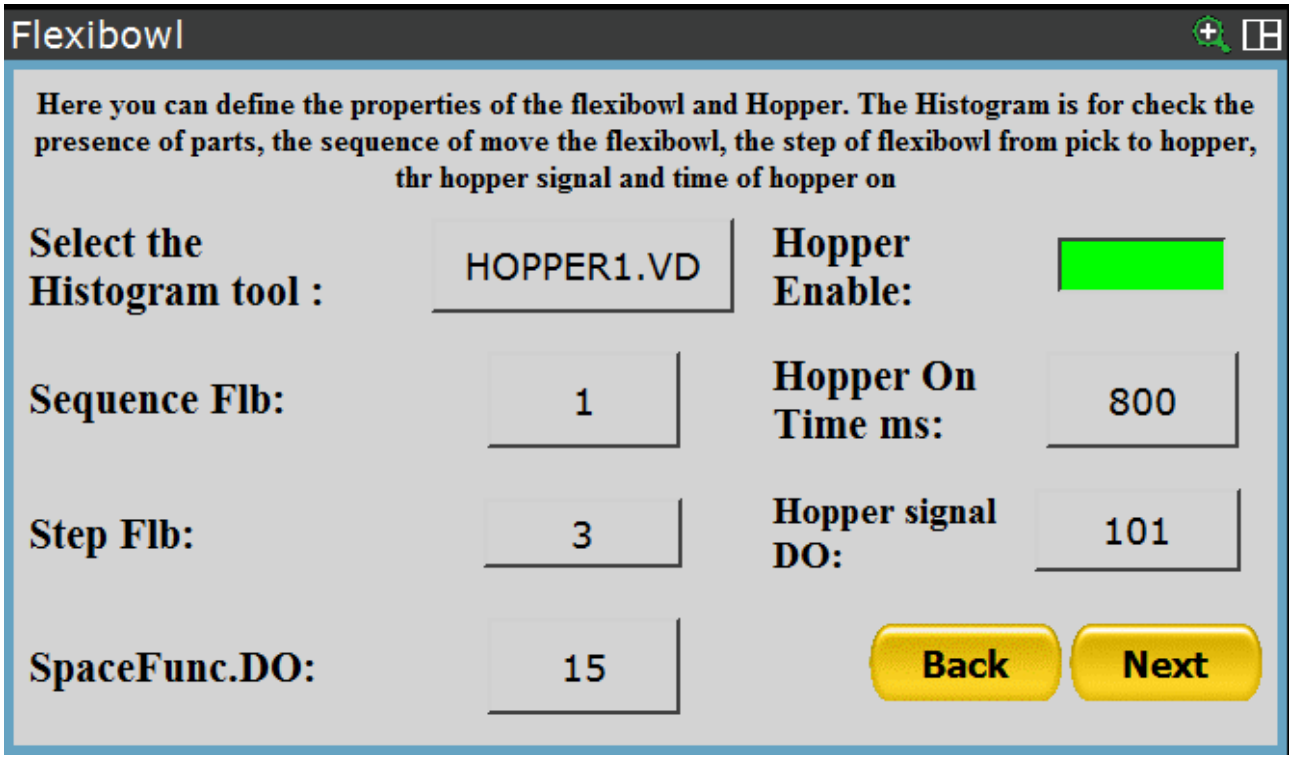
The following fields must be filled in if hopper control is enabled:

- **Select the Histogram tool**: by selecting the box found next to this item, you can choose the vision tool that will check the number of pieces inside the Flexibowl. How to create this vision program will be analysed further on.
- **Step Flb**: Specifies the number of steps needed to move a piece from the centre of the vision area to the hopper unloading area. This number will vary according to the advancement angle and the hopper position with respect to the vision area.
- **Hopper signal DO**: Specifies the number of the signal that will be activated to activate the hopper.
- **Hopper On Time ms**: Specifies the duration that the "Hopper signal DO" signal remains ON.

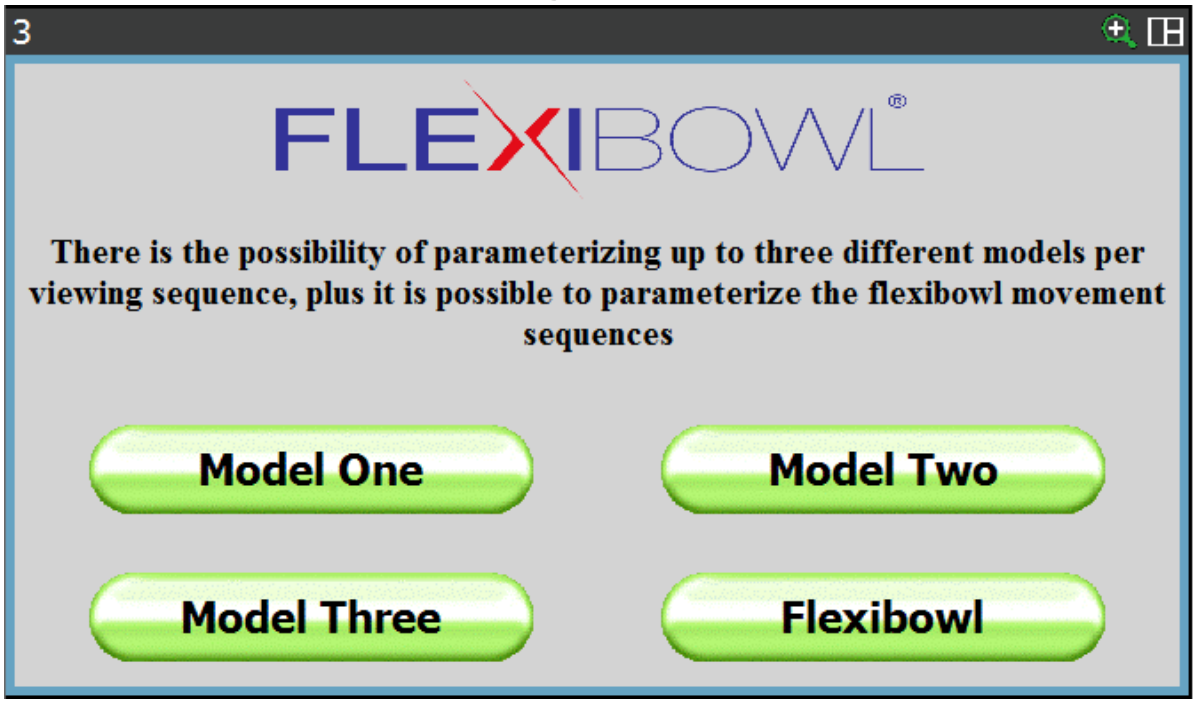
The other 2 items that are always mandatory, even if the hopper control is not enabled, are:

- **Sequence Flb**: by selecting the box found next to this item, you can specify a number from 1 to 6, which will recall a sequence of movements. To set this sequence, you must access the area reserved for configuring the Flexibowl.
- **SpaceFunc.DO**:Specifies the "DO" digital output number, which will be set or reset depending on the robot position. This digital output will indicate that the robot is out of the way with respect to the pick-up area and therefore from the vision area. The procedure for defining this area will be shown below

Once the settings have been completed, you must go back to the previous page by pressing "Back"



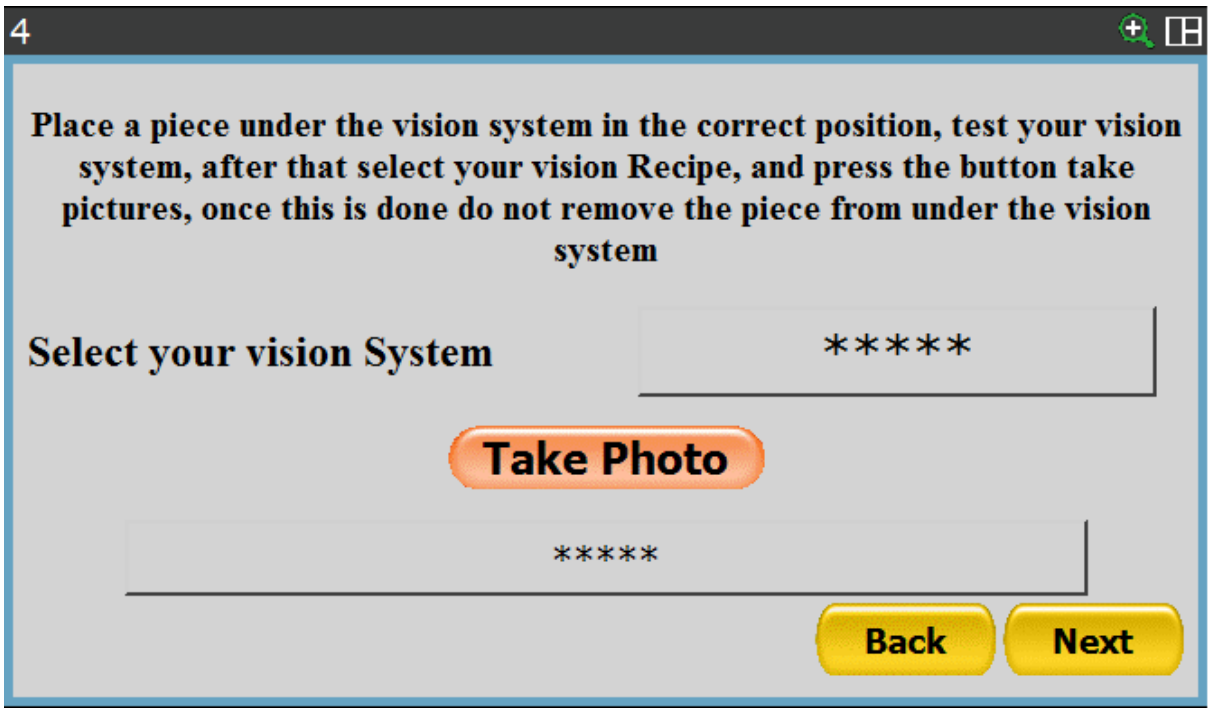
Entering the Model



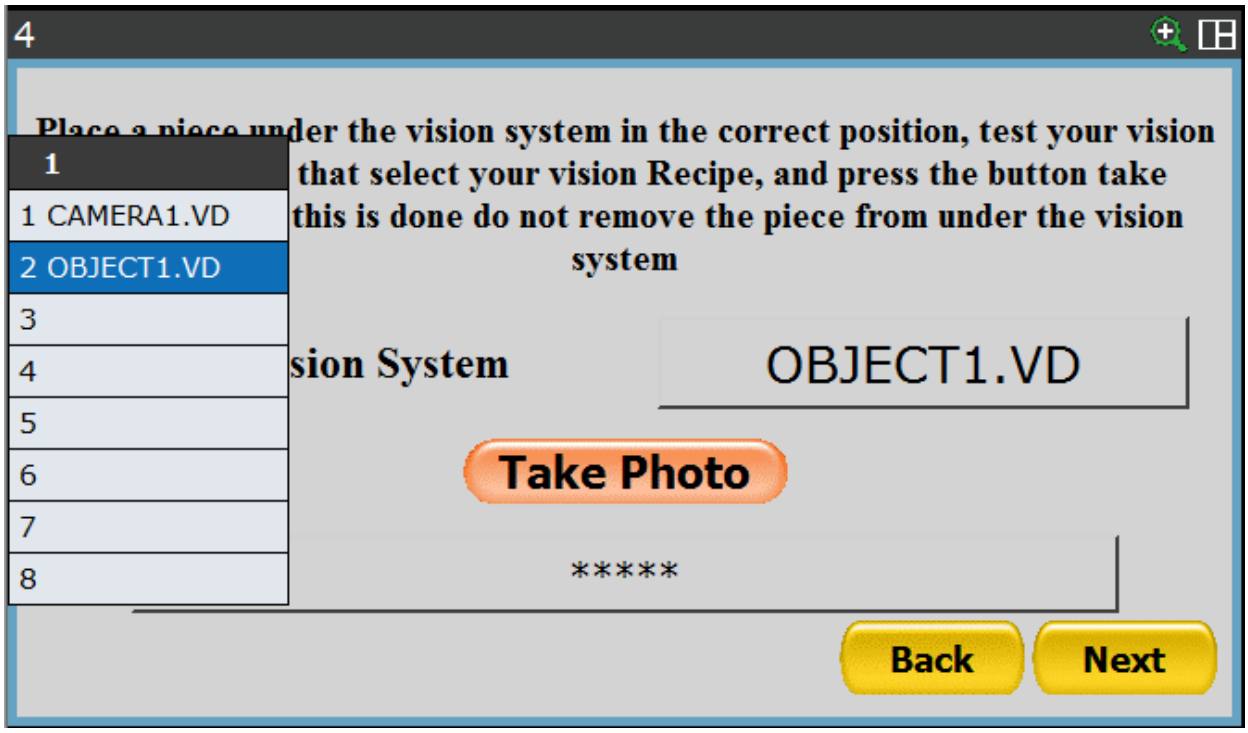
Assuming you must develop an application where the robot picks up a piece from a Flexibowl in a single position, item “Model One” must be selected.

The procedure for entering a model will be shown below. This procedure also applies for creating recipes with multiple models; simply repeat the usual steps and select the items “Model Two” and “Model Three”.

Before moving on to this stage, it is important that there is a correctly calibrated camera and at least one vision process related to the object that will be fed with the Flexibowl.

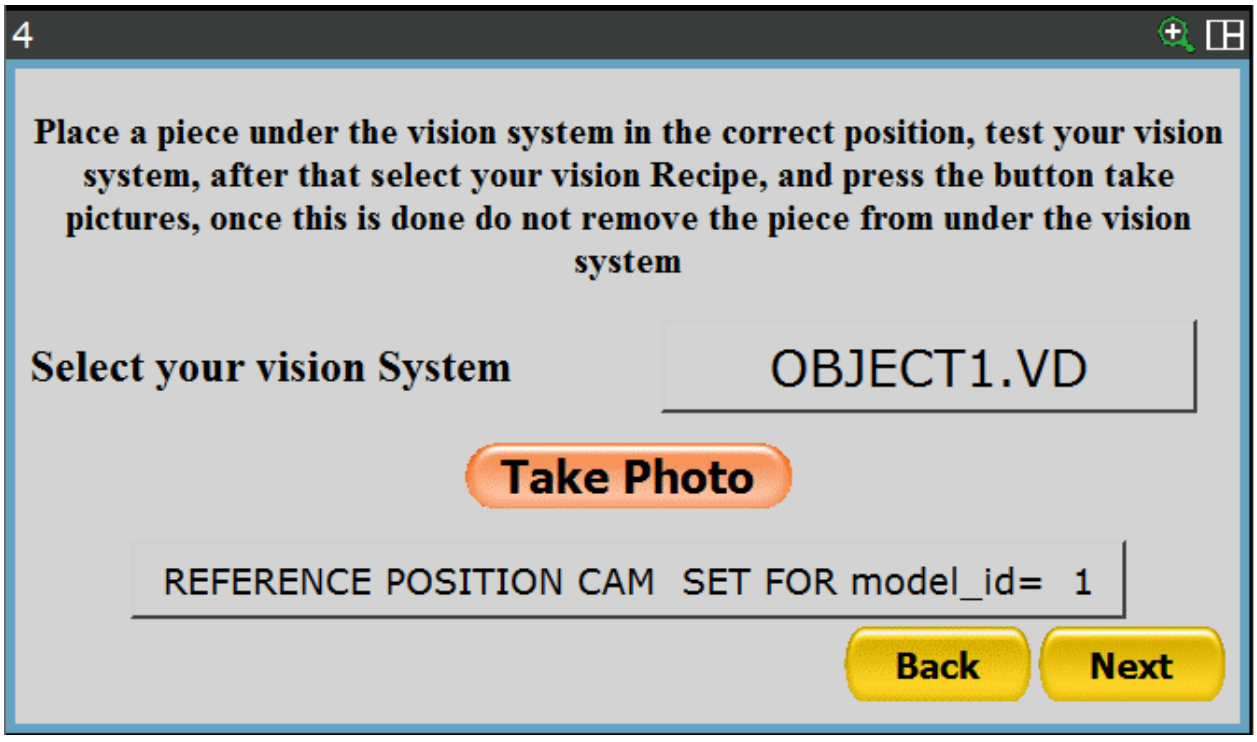


After clicking the header box with ***** you can select the vision process from the drop-down menu, which you want to associate with the recipe being created.



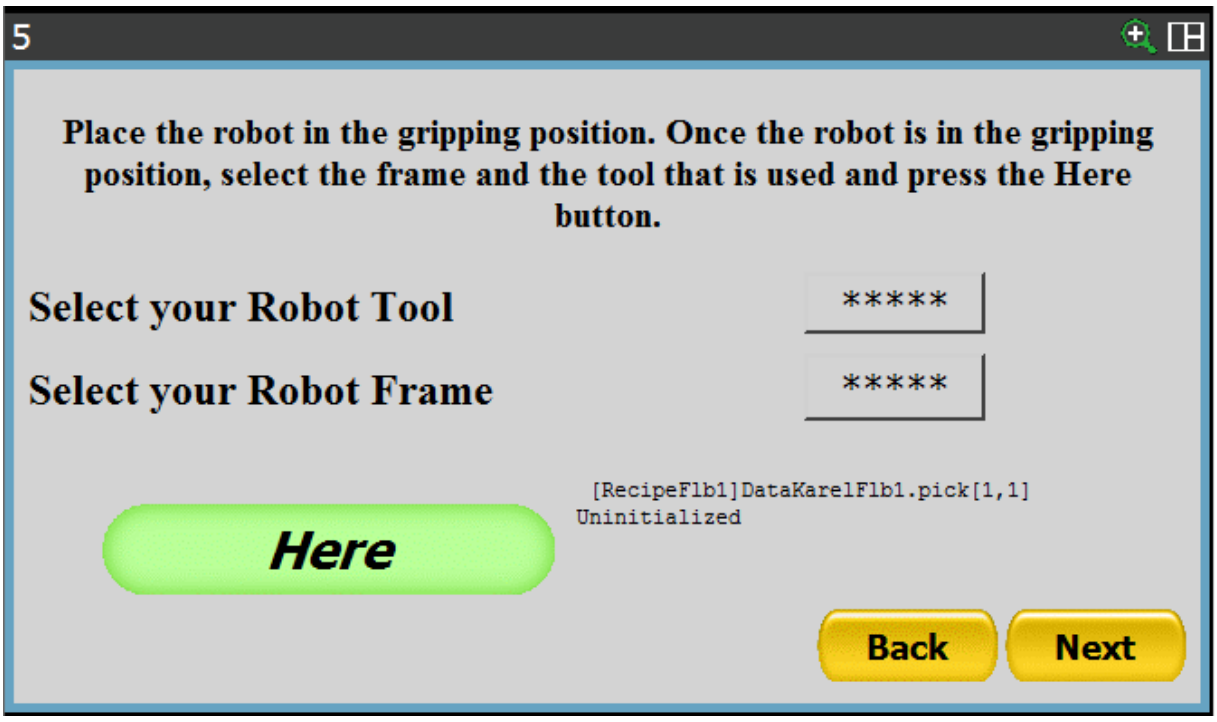
After selecting it, you must place a single piece on the Flexibowl in the vision area. Once the component has been positioned, the robot must be taken out of the way so that the camera can take a photo and identify the position of the piece.

If the step was successful, the text “REFERENCE POSITION CAM SET” in the textbox at the bottom indicates that the camera has detected the piece and has saved its coordinates. Then press “Next” to continue.



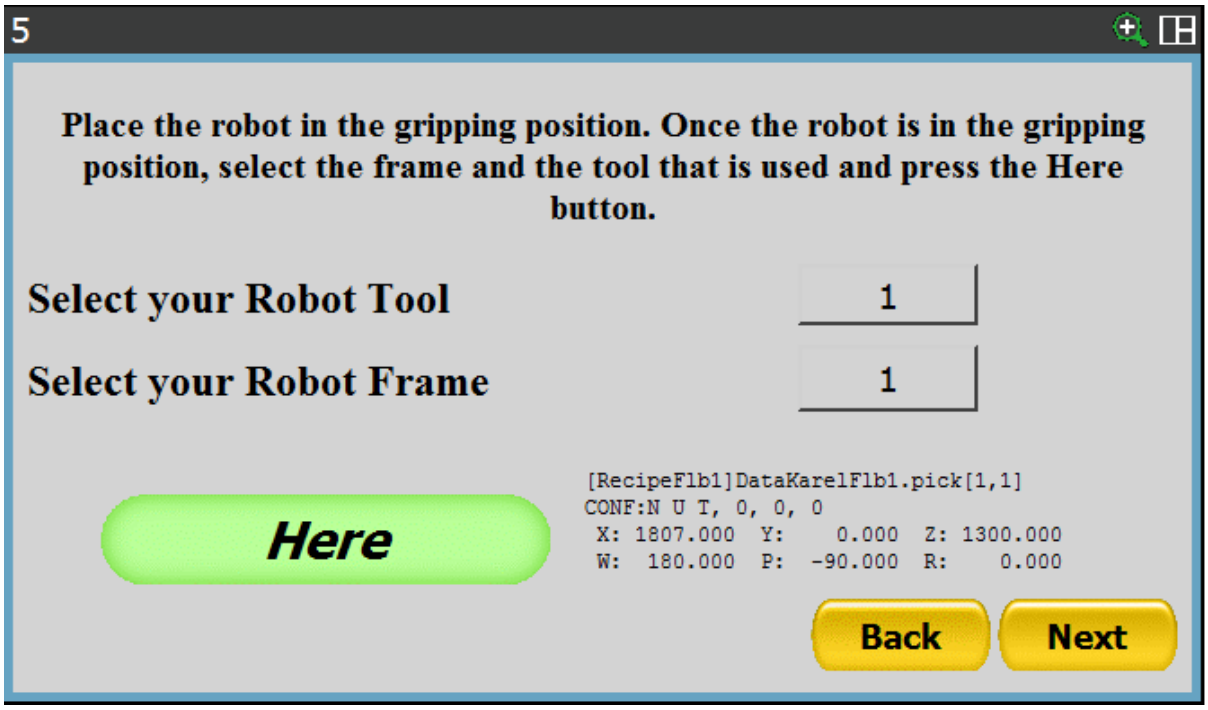
Saving a pick-up point

The page that will be shown is that related to the recording of the pick-up point.



Just like the previously seen point recording pages, this page also offers the option of setting Tool and Frame.

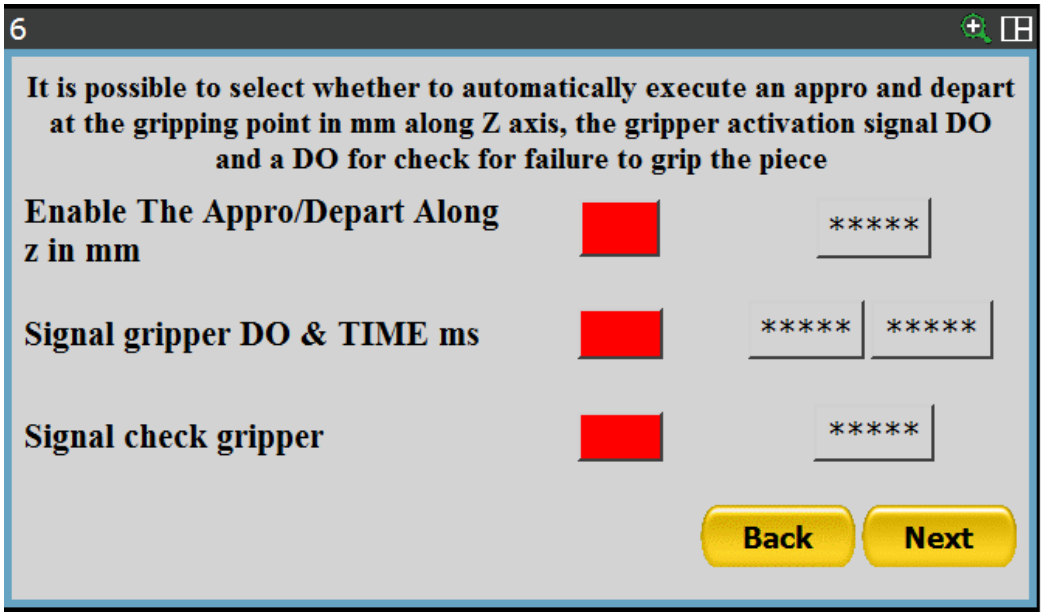
Usually, if a standard calibration has been used, the number of Frames to be used corresponds to that used to define the Calibration frame.



Then bring the robot to the final pick-up point and press the “Here” button to record the pick-up point. Then press “Next” to proceed.

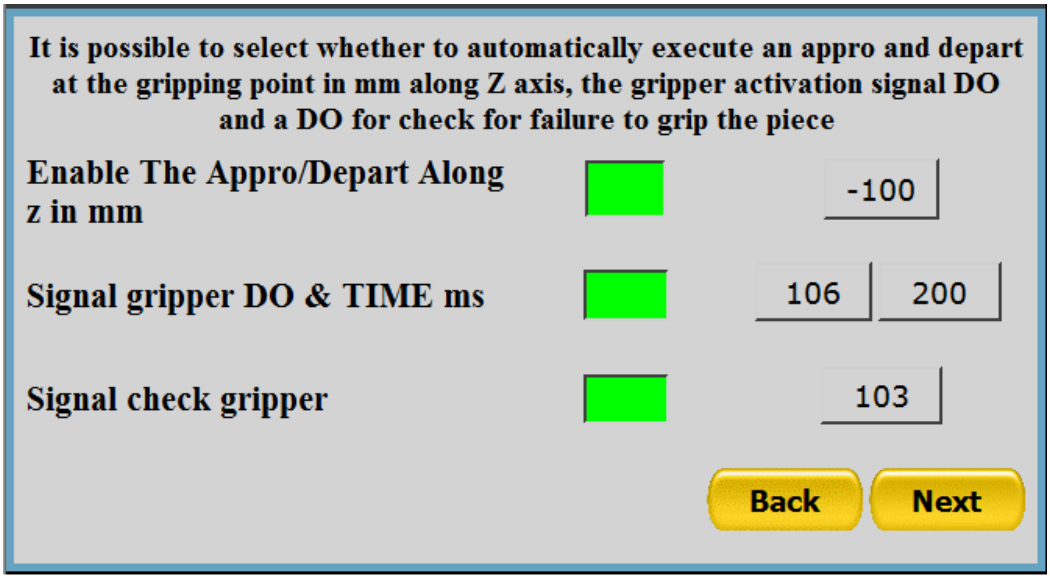
Pick-up parameters

The following screen is suggested after the pick-up point is recorded:



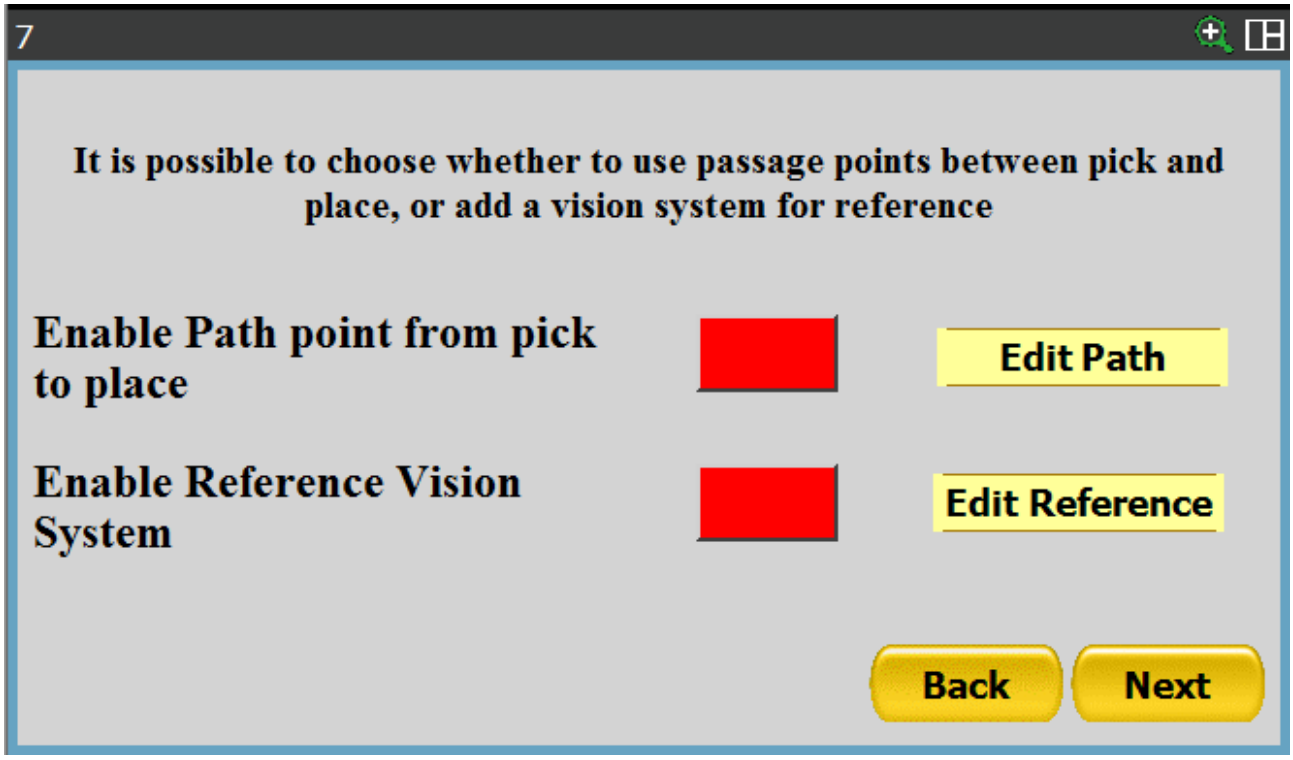
All the variables listed below must first be enabled in order to be used.

- **Enable The Appro/Depart Along Z in mm**: a value must be entered, which will be used as an offset to reach and then depart from the pick-up point. This value in standard configuration must be negative.
- **Signal gripper DO & TIME ms:** the first textbox specifies the number of the signal that will be activated when the robot finds the pick-up position. The second textbox instead represents the time in milliseconds that the robot will wait after activating the signal described above.
- **Signal check gripper:** the number of the signal that will be specified inside the textbox relating to this field indicates the digital input that will be checked to find out if the piece has been picked up correctly. If the check results negative, the robot will automatically try to pick up the next component.



Intermediate points between pick and place

After having entered all the data relative to the pick-up phase, pressing “Next” will display the following page:

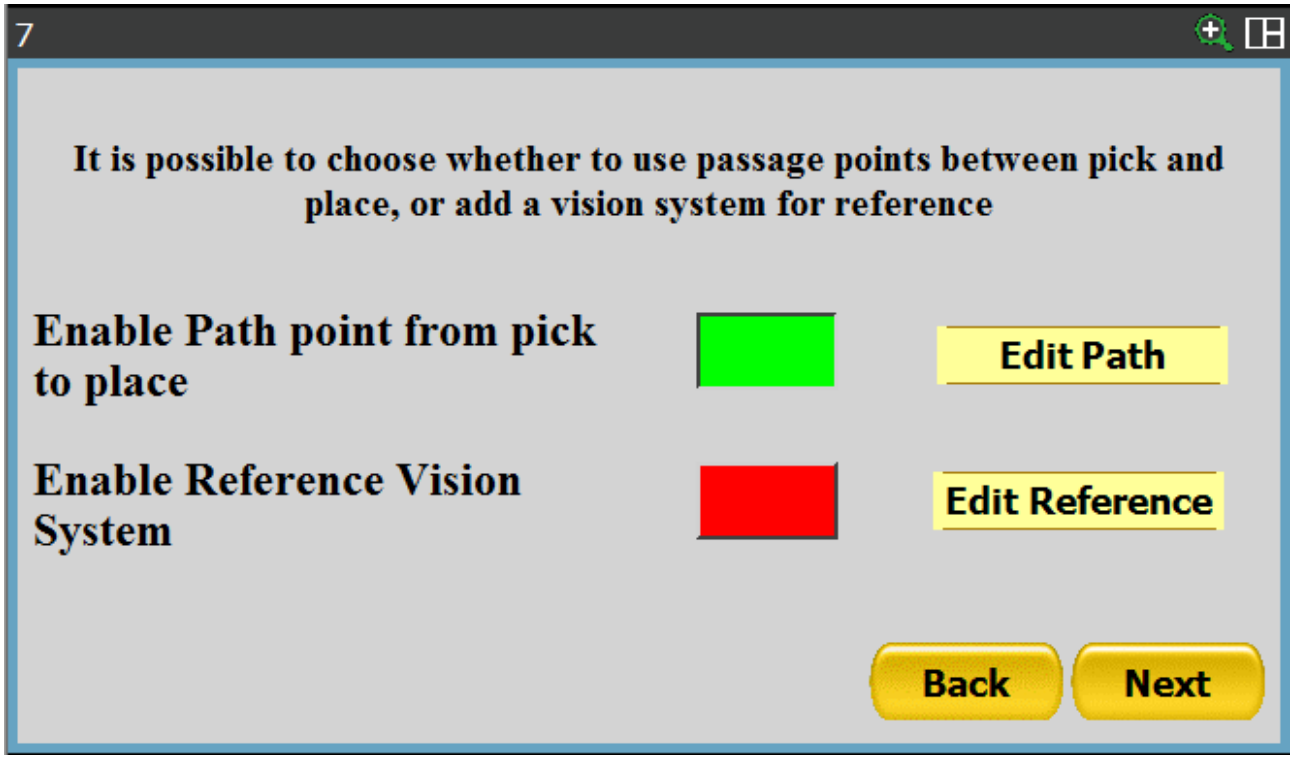


On this screen you can choose whether to enable or not the introduction of intermediate passage points between the pick and place phases.

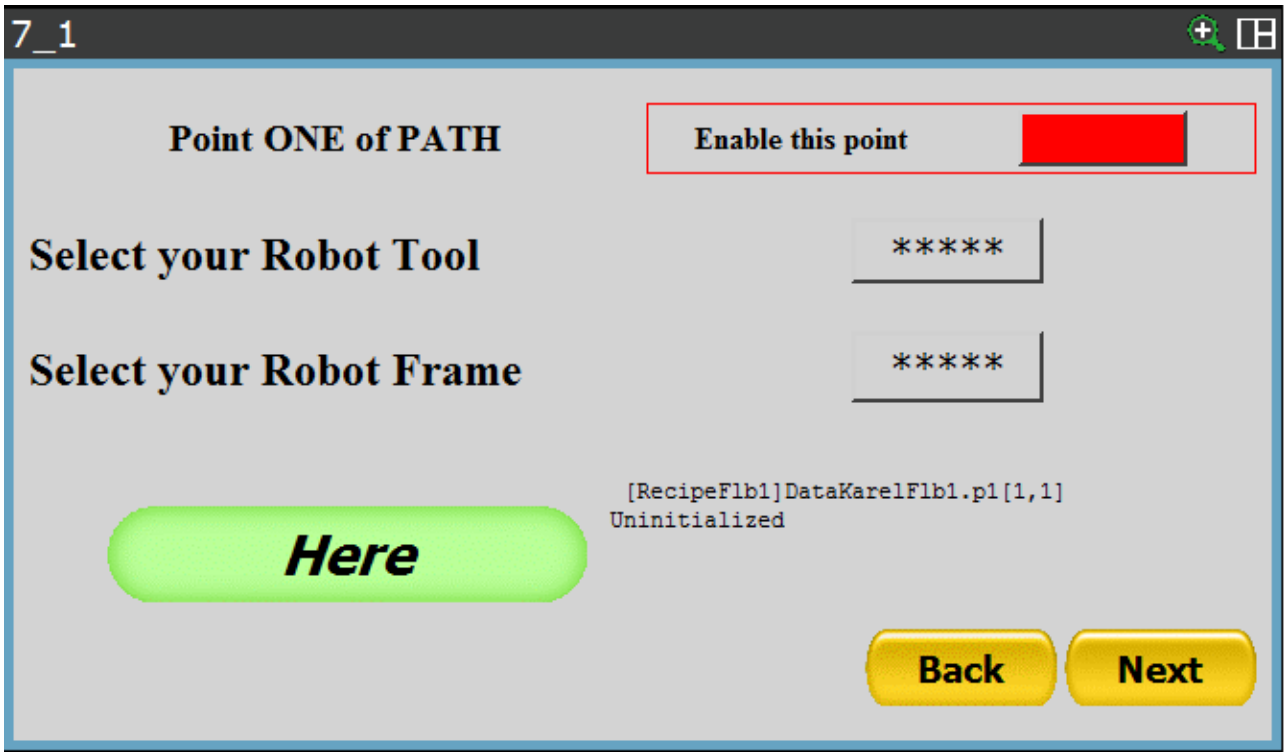
In addition, it will be possible to pair a vision process to the recipe in use. This function allows to use the Fanuc camera as a quality check or re-centering system.

Robot path

Select the enabling box and press the “Edit Point” button.



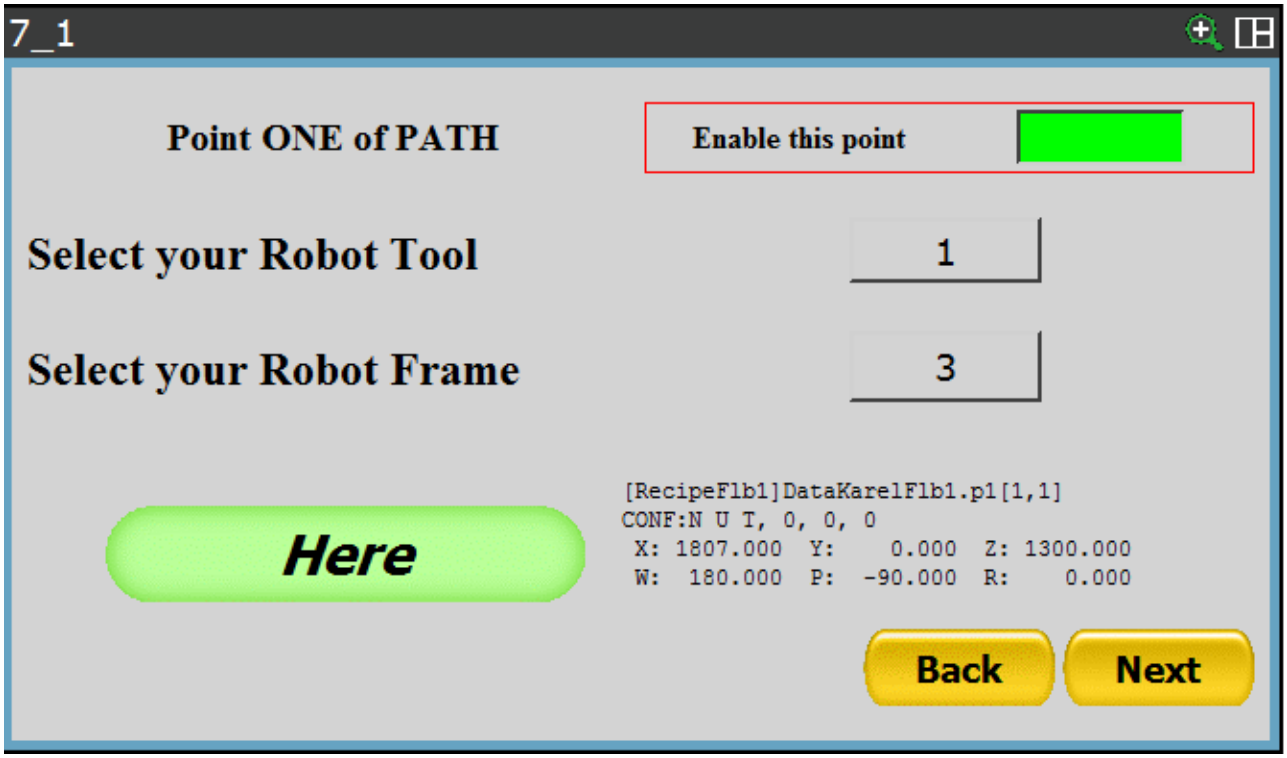
With the following procedure you can add up to 10 intermediate points, related to a particular model.



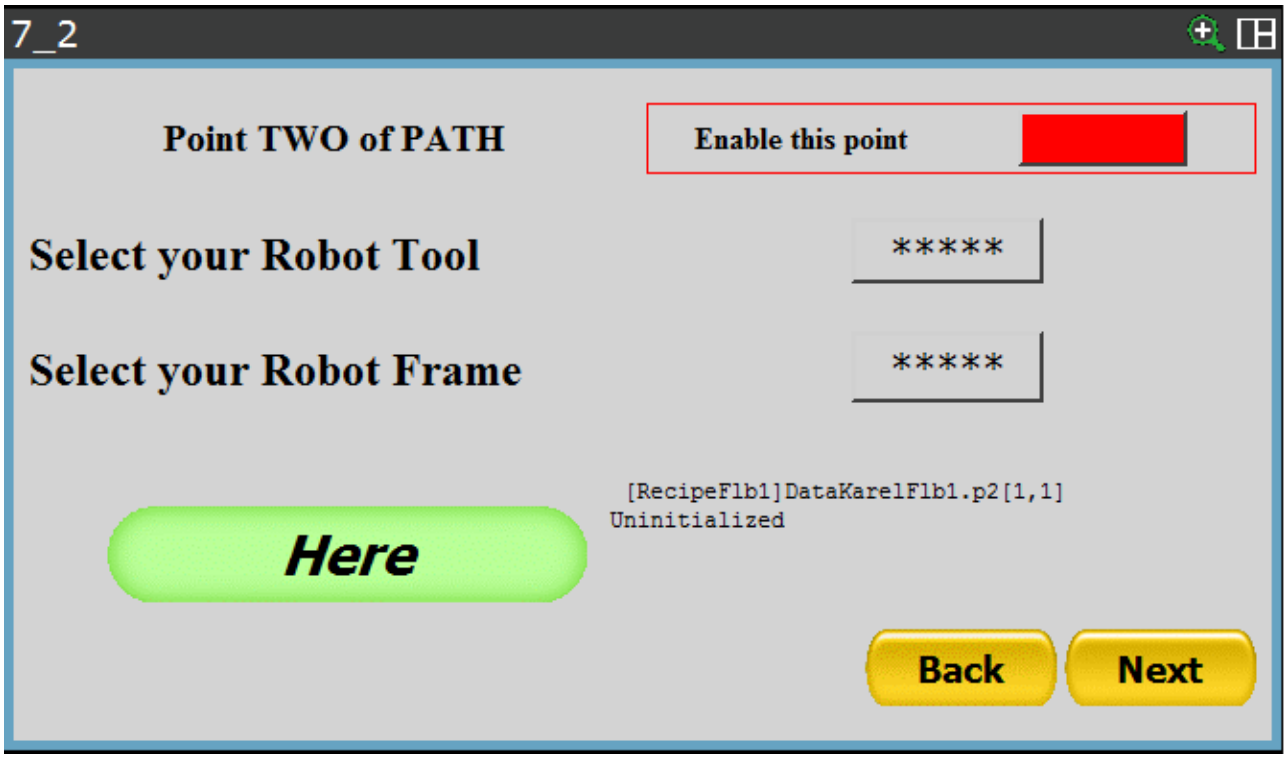
Enable the passage point using the relevant button found at the top right.

The recording method requires that you specify the number of the Tool and Frame associated with that point; then you can press the “Here” button to save the position.

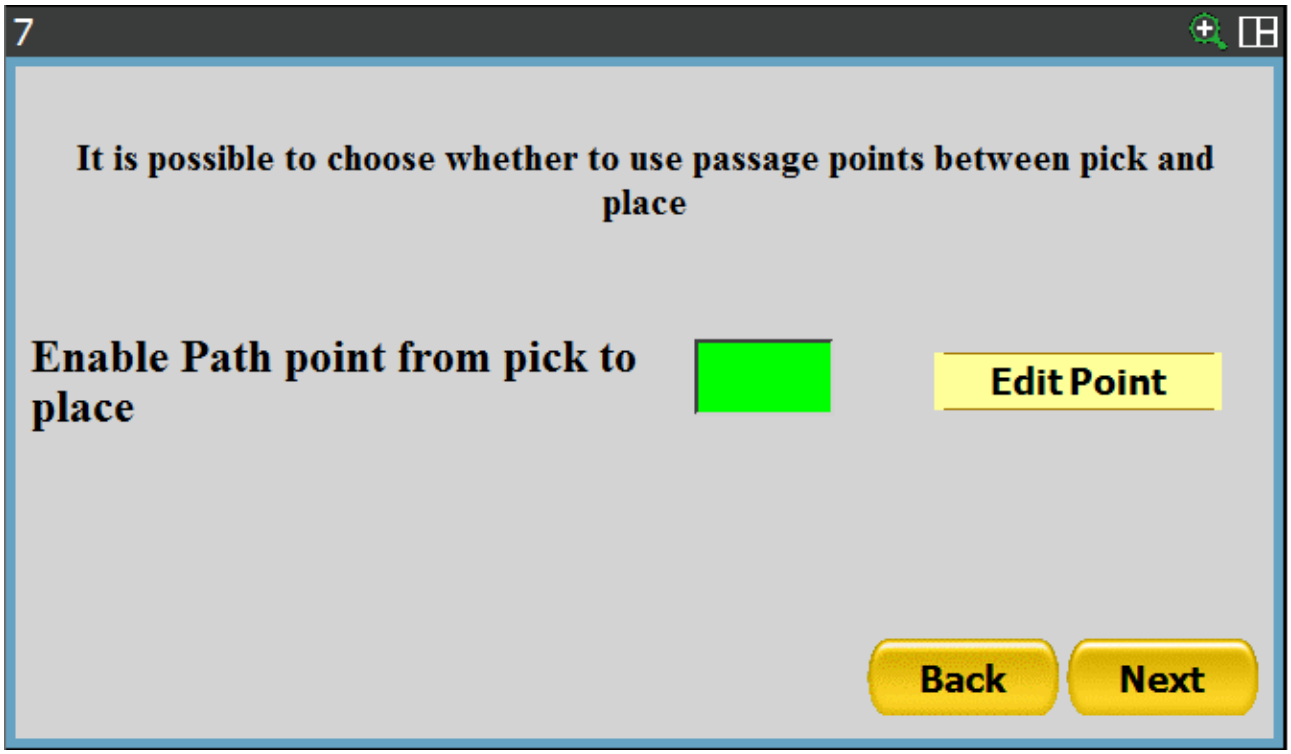
Press “Next” to proceed.



With the same procedure, the following pages allow you to enter up to 10 passage points for the robot.



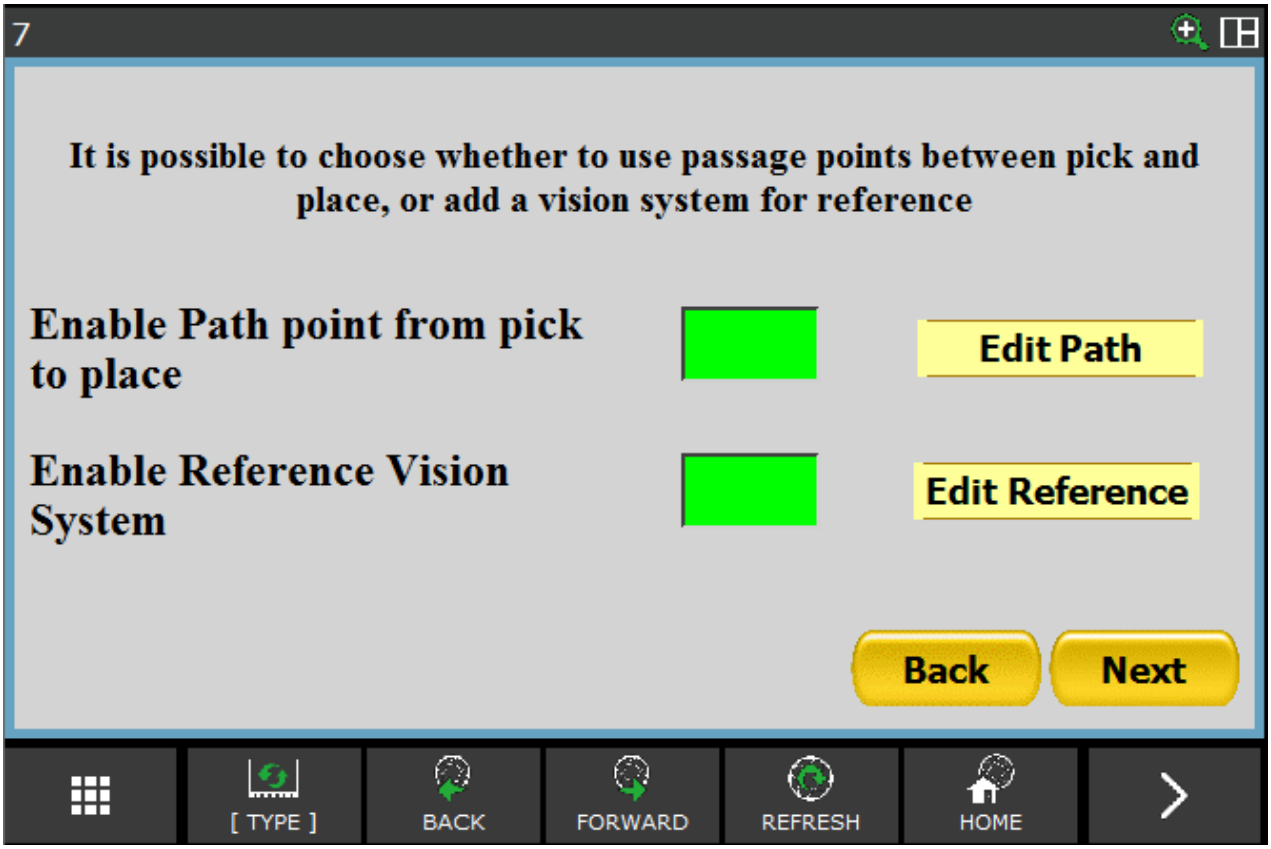
If there is no need to record other passage points, you can proceed forward by pressing “Next” until you get to the page shown below:



Press “Next” to access the place position saving screen.

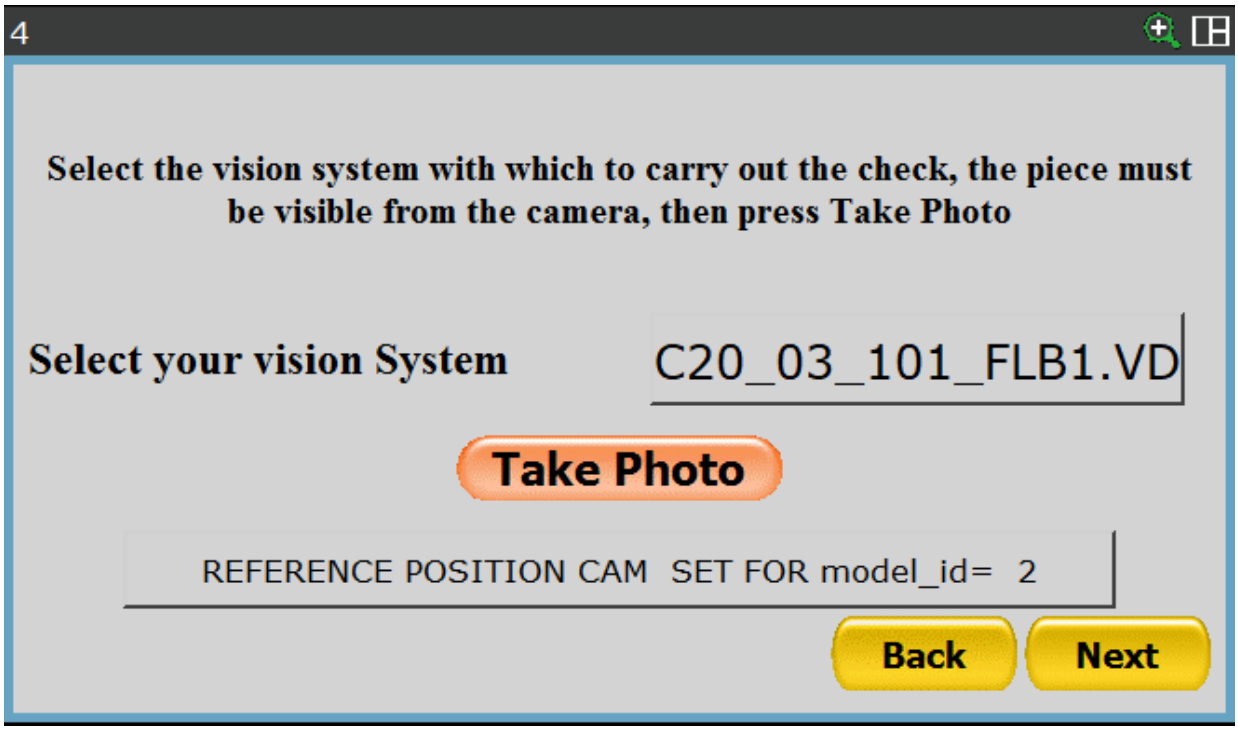
Reference Vision System

In the main screen is therefore possible to define a vision process or a reference position in order to carry out checks or centering with a Fanuc camera.



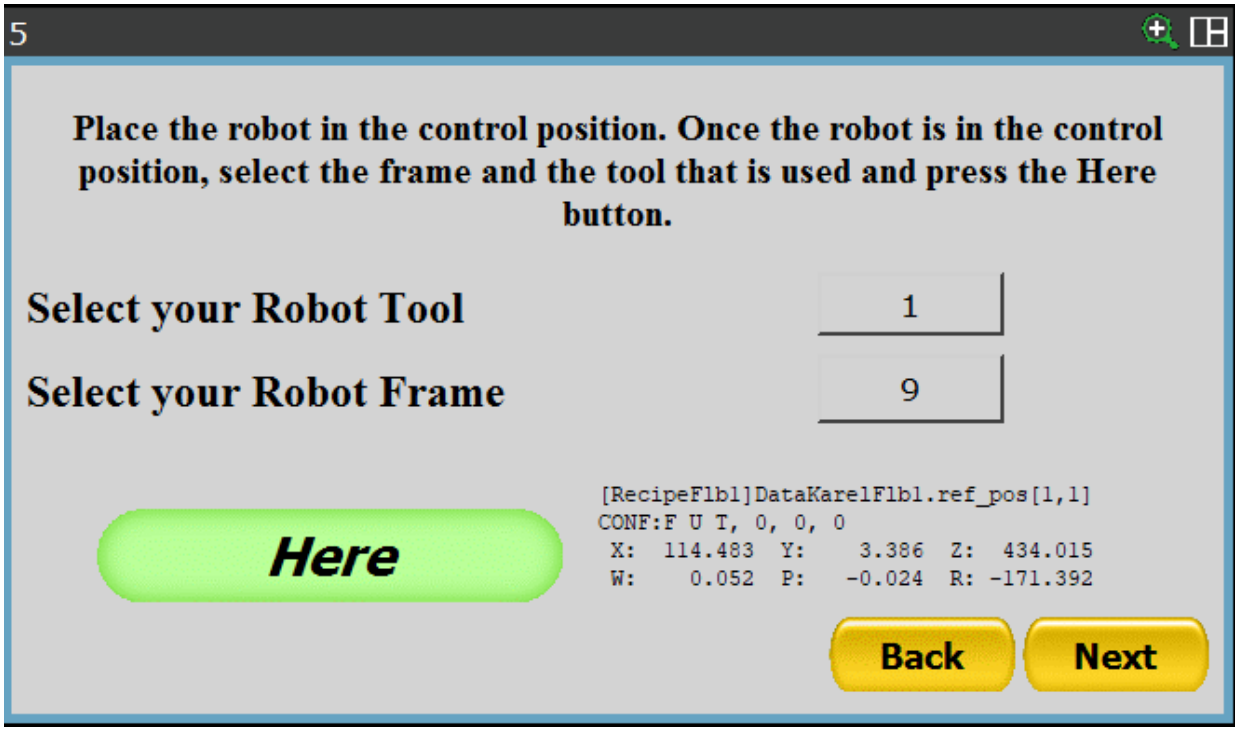
Enable the option “Enable Reference Vision System” by using the dedicated button placed next to the entry “Edit Reference”. Once you have selected the option, it will be possible to access the relative menus, then press the button “Edit Reference”.

The page that will be shown allows to set the name of the vision process you wish to use; the selection allows to set a vision process among those present in the robot memory.

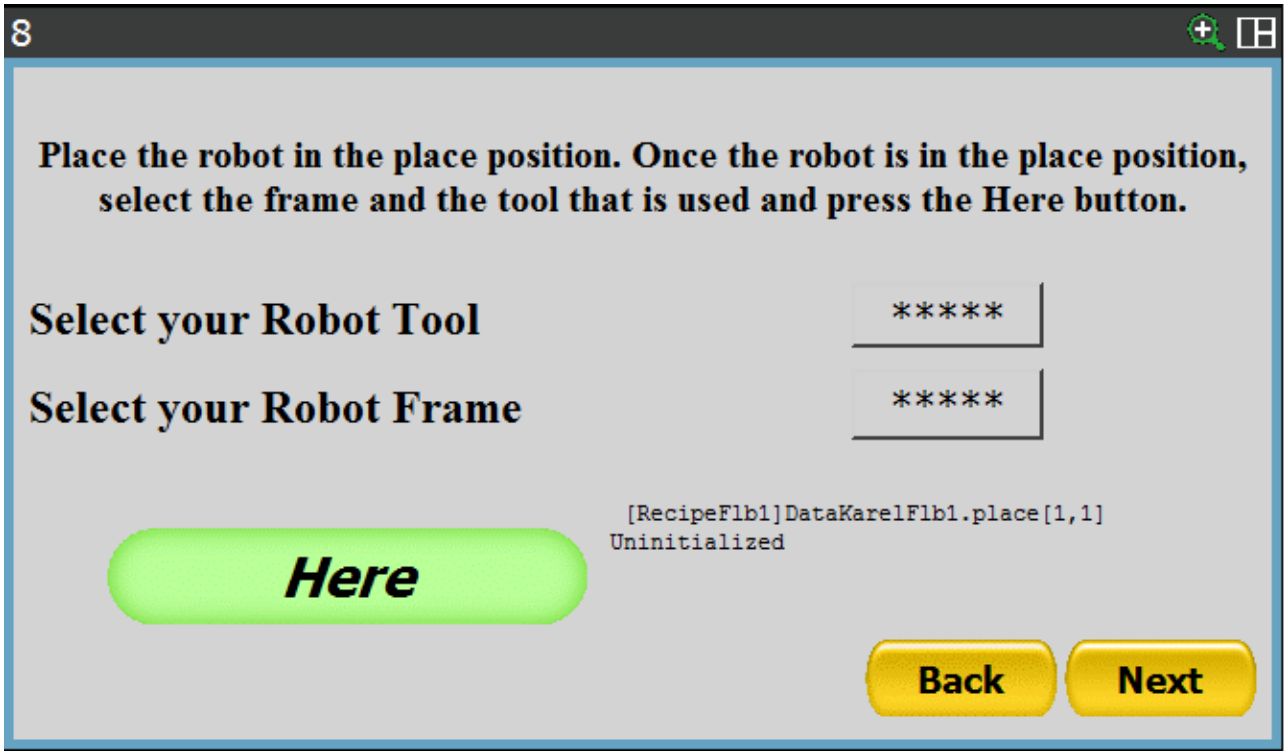


Following the selection of the vision process, it will be possible to press the “Take Photo” button to define the current position of the object as reference position. This function is particularly useful when using the camera to center the object held by the robot gripper. The vision tool must have already been defined.

By pressing the button “Next”, it will be possible to move to the next screen, which allows to register the position where the check will be carried out; the registration modes stay the same as seen before.

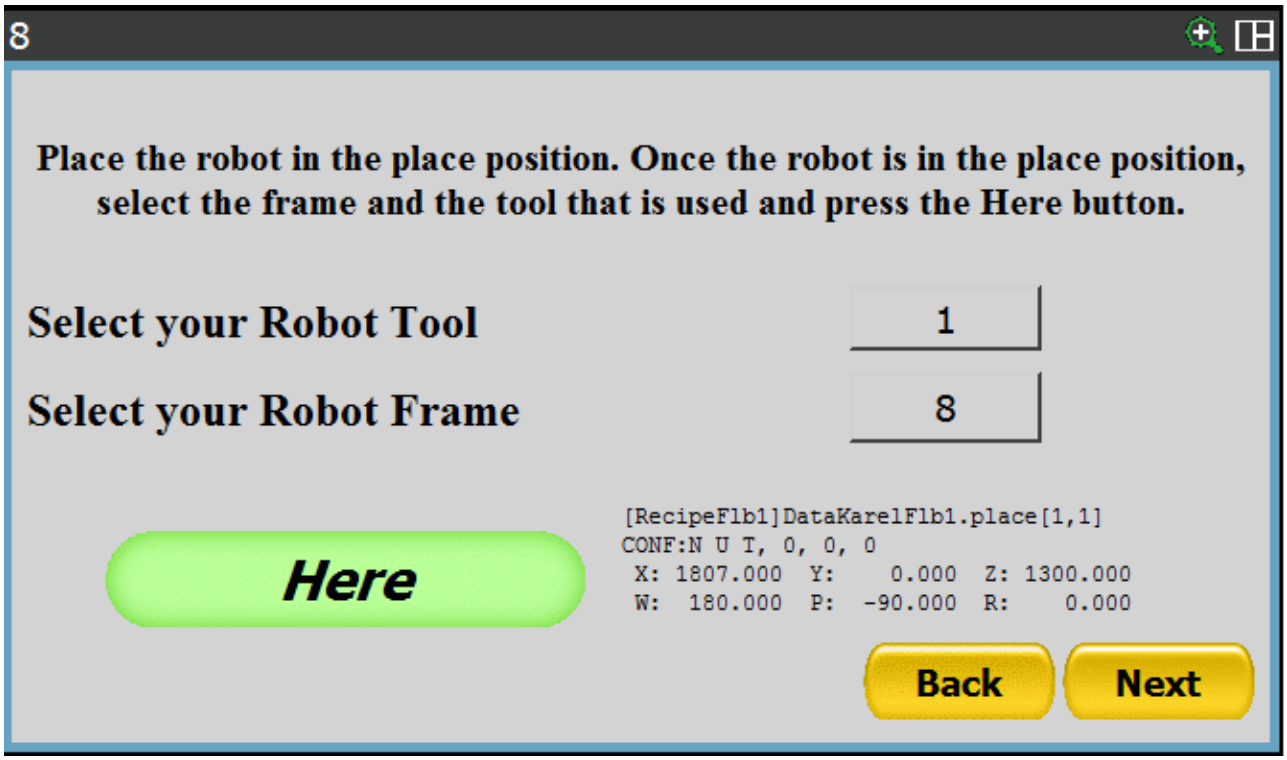


Saving a place position



The place position must be recorded on this page.

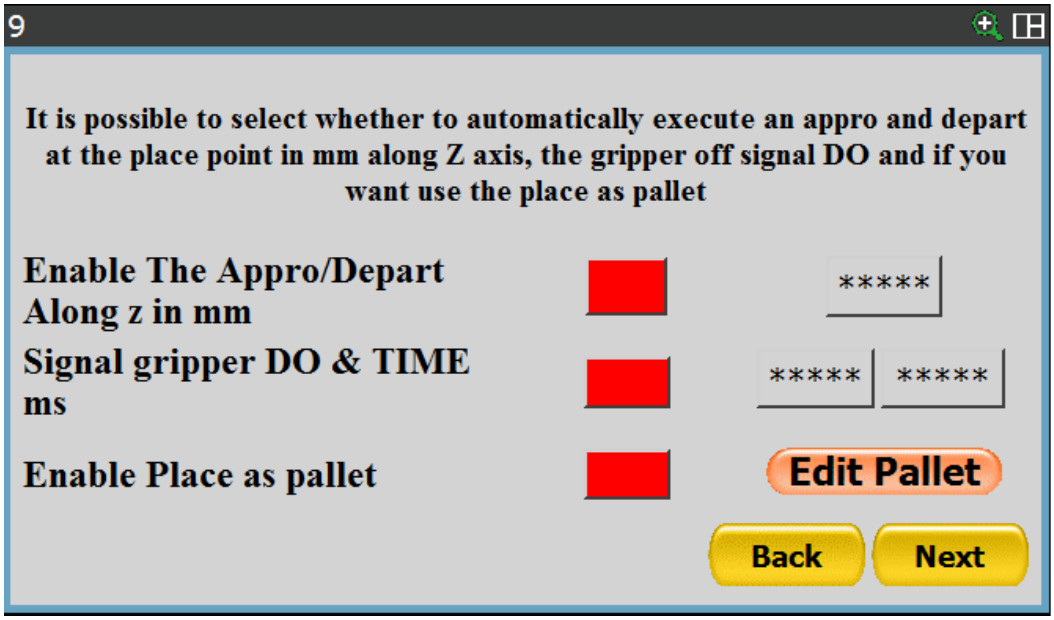
Enter the Tool and Frame numbers, move the robot to the desired position and press the “Here” button to save the position.



Press “Next” to proceed.

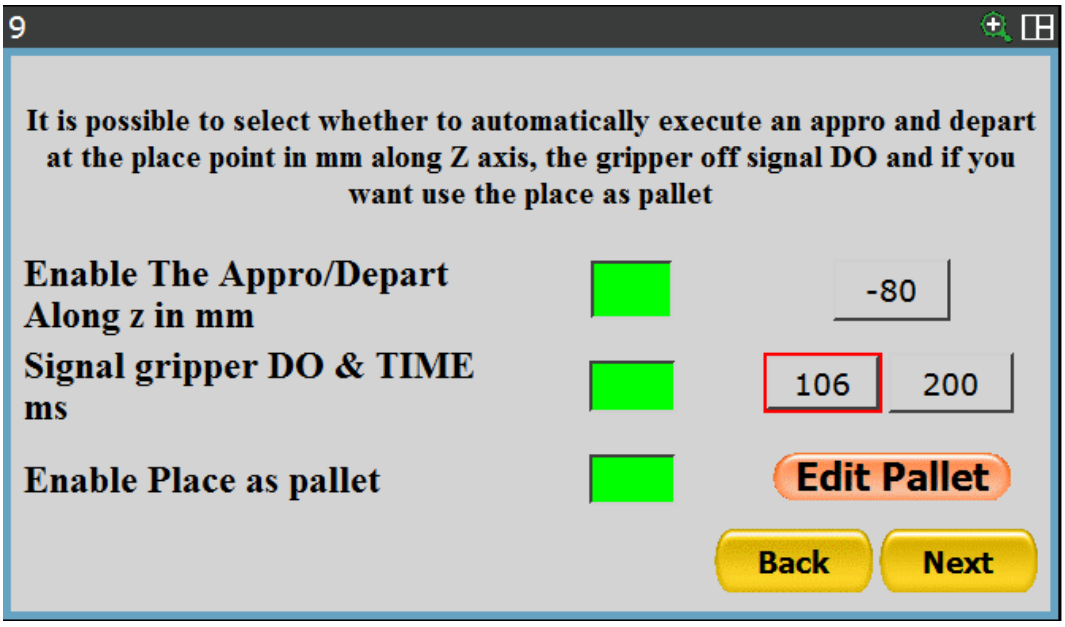
Place parameters

The next screen is the following:



All the variables listed below must first be enabled in order to be used.

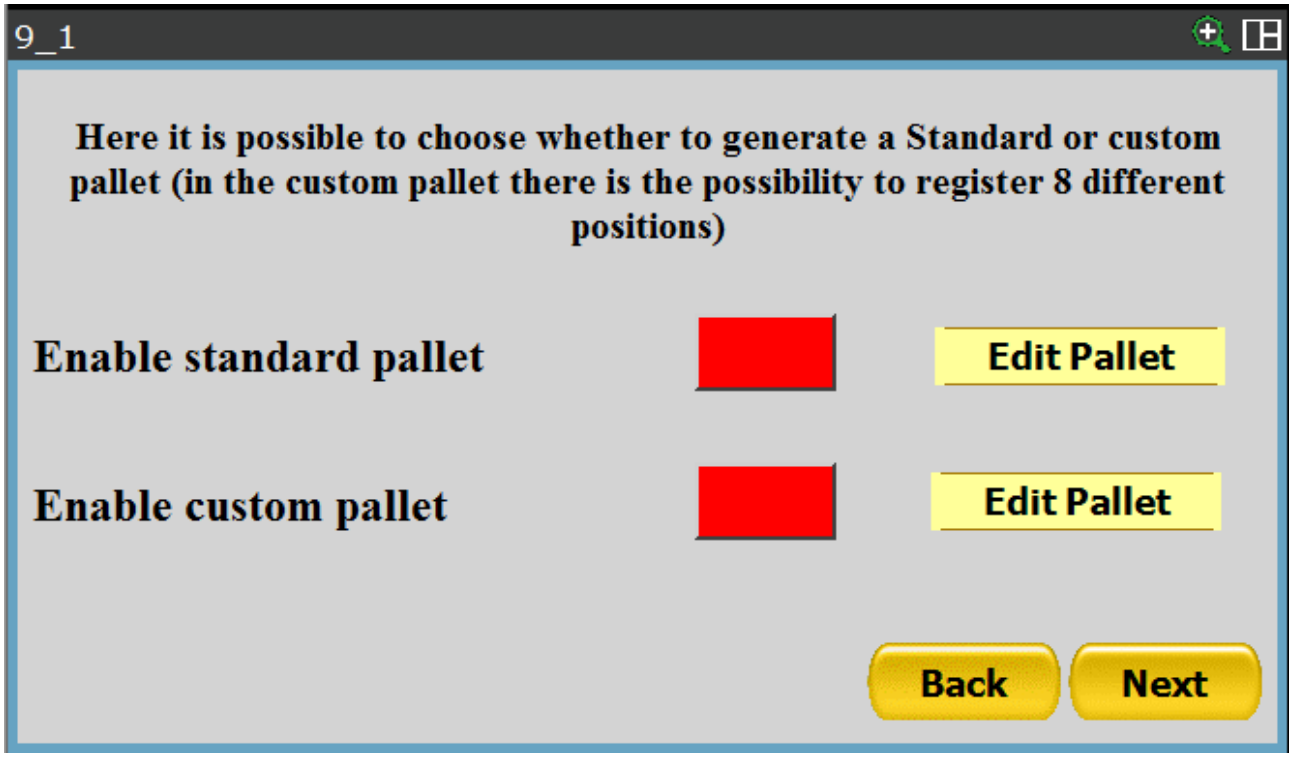
- **Enable The Appro/Depart Along Z in mm**: a value must be entered, which will be used as an offset to reach and then depart from the place position. This value in standard configuration must be negative.
- **Signal gripper DO & TIME ms:** the first textbox specifies the number of the signal that will be deactivated when the robot finds the place position. The second textbox instead represents the time in milliseconds that the robot will wait after deactivating the signal described above.
- **Enable Place as pallet:** Press the “Edit pallet” button to access a screen that allows you to create a pallet using the place position as a starting point.



Pallet

There are two different possibilities when the application requires the use if a deposit called “Pallet”

- Standard pallet→The distance between the points is constant and defined precisely; just an origin point will be necessary since the other points will be calculated following the inserted information.
- Custom pallet →In this case the pallet will be consisting of maximum 8 positions, that will be registered singularly, as many independent placing points.



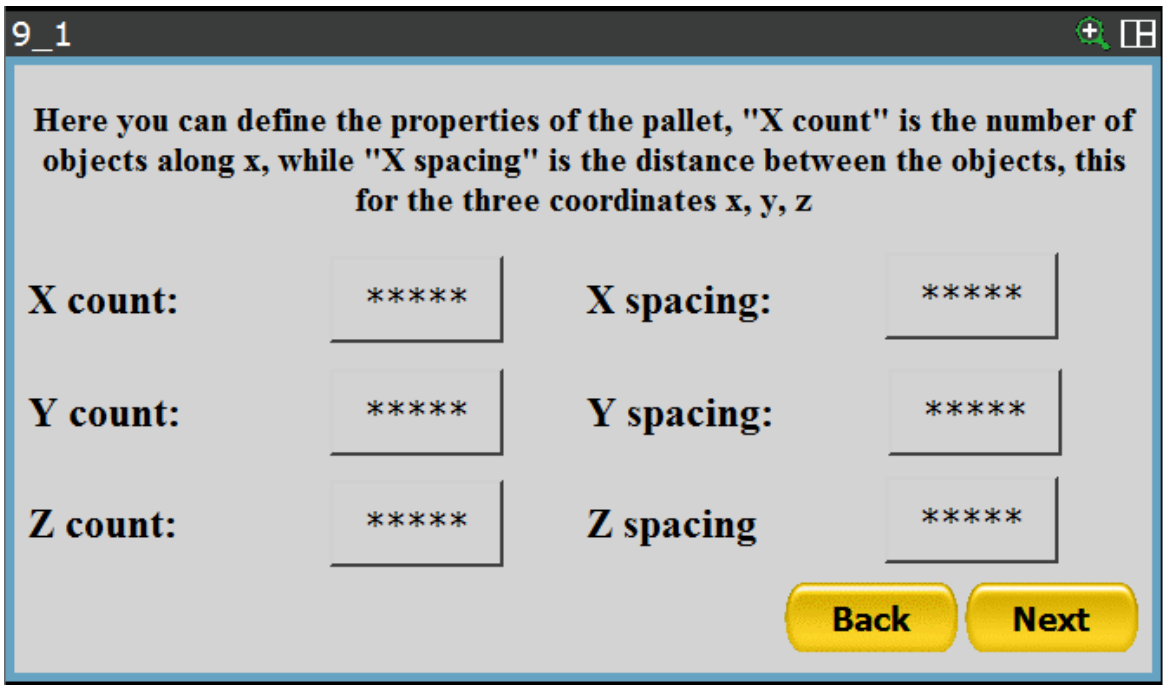
Press the enabling button according to the type of pallet you wish to create.

It is not possible to enable both pallets simultaneously.

After having enabled the pallets, press the “Edit Pallet” button connected to the type of pallet selected to access the dedicated configuration pages.

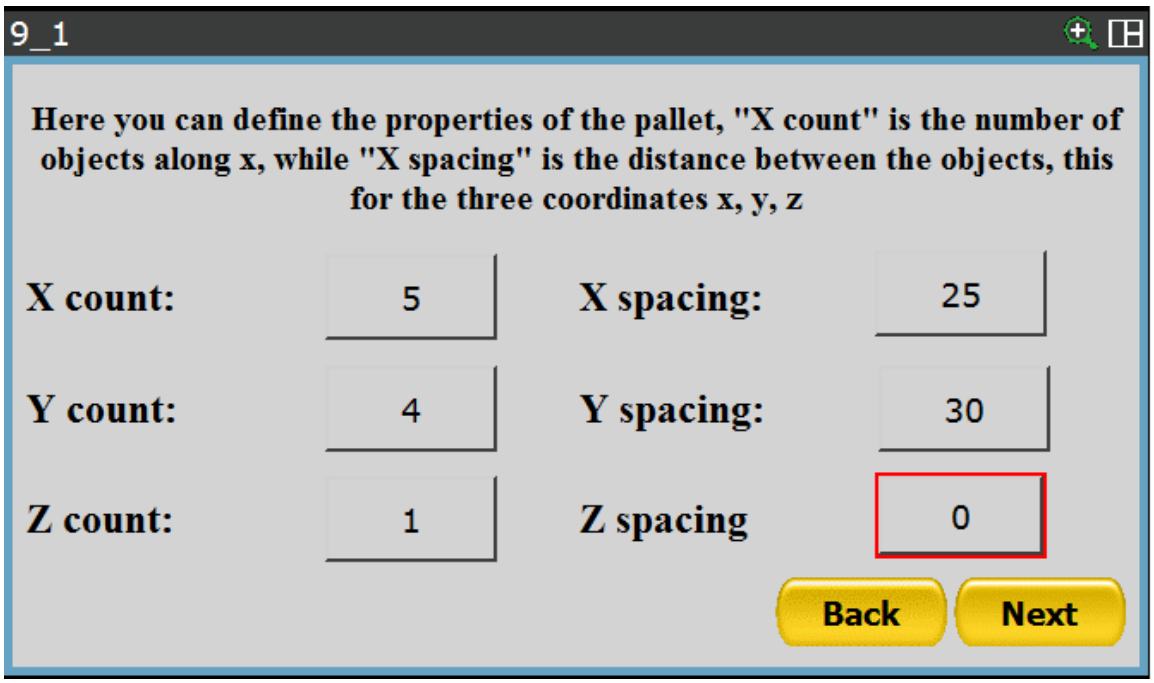
Standard Pallet

That shown below is the configuration page of the pallet which can be accessed by pressing the "Edit Pallet" button



- **X count:** specifies the number of rows that will make up the pallet.
- **Y count:** specifies the number of columns that will make up the pallet.
- **Z count:** specifies the number of layers that will make up the pallet.
- **X spacing:** specifies the distance between objects in the same row.
- **Y spacing:** specifies the distance between objects in the same column.
- **Z spacing:** specifies the distance between one layer and another.

Below is an example of creating a single layer pallet:

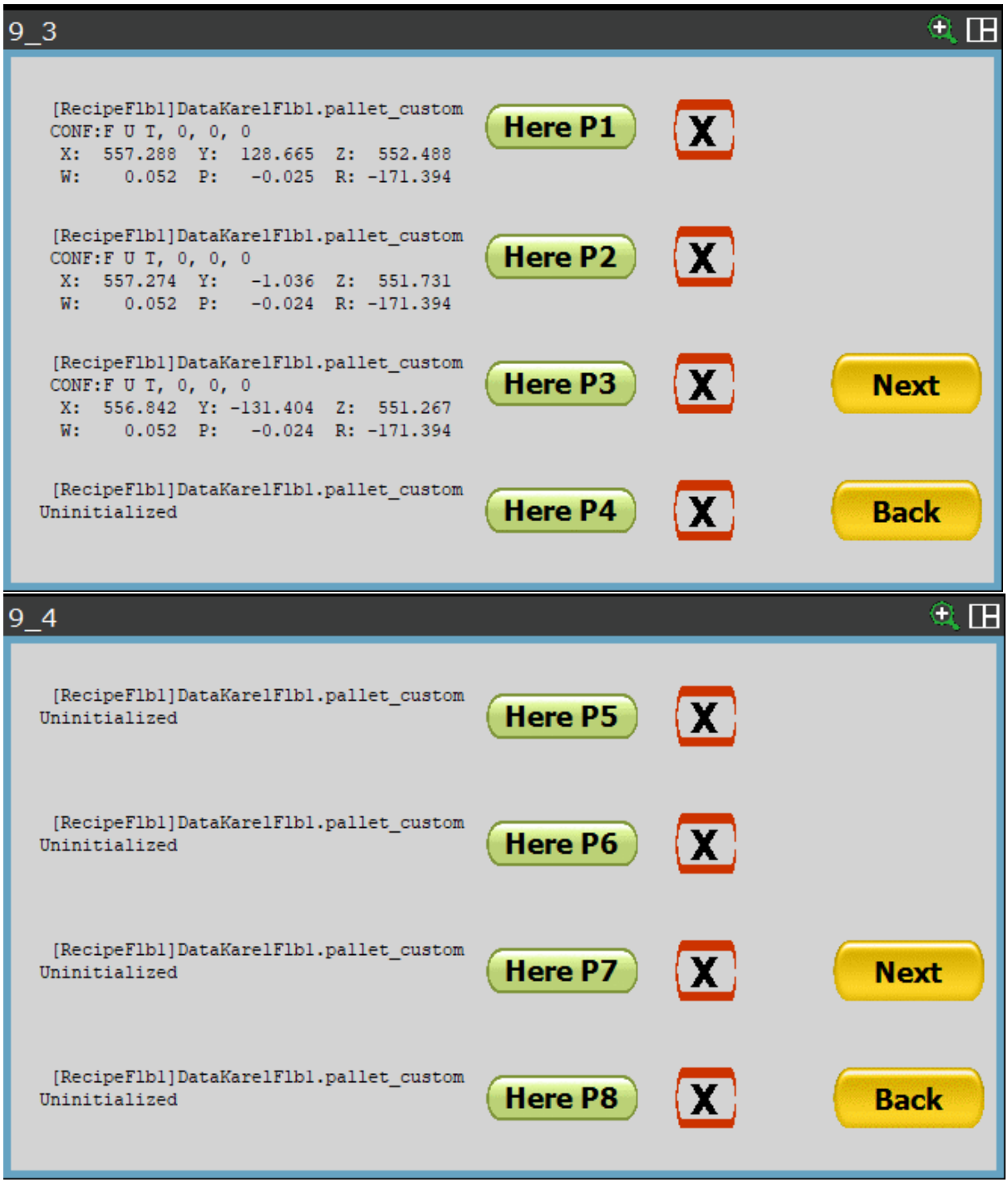


Custom pallet

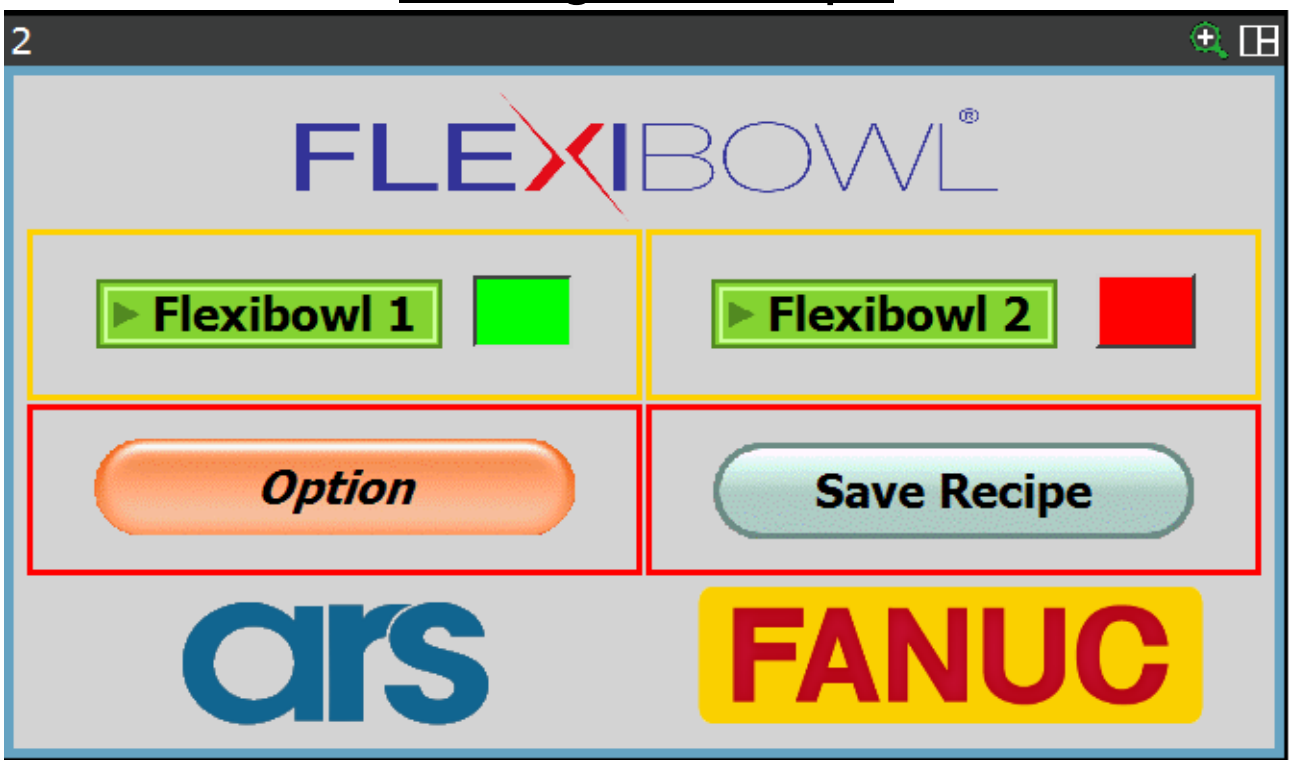
Move the robot in the placing position and press “Here P1” to register the first position, repeat this operation for all the desired positions.

Via the “X” button, placed next the entry “HERE P°”, it will be possible to delete an existing position.

The dimension of the pallet will be defined by the number of positions registered; in the example below the pallet will consist of 3 positions

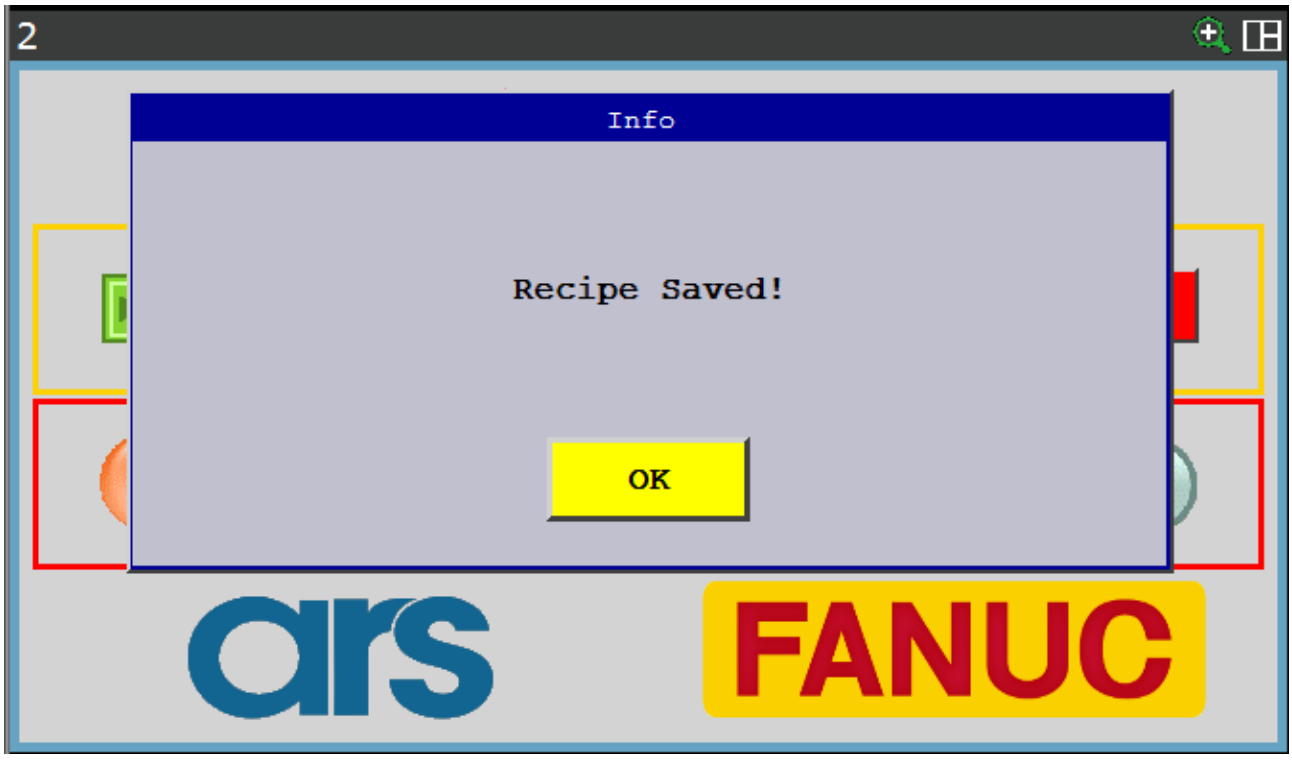


Saving the recipe



After clicking “Next”, the system will show the above screen and it will now be possible to save the recipe.

The correct save message is “Recipe Saved!”; all other messages indicate an error while saving due to missing information.

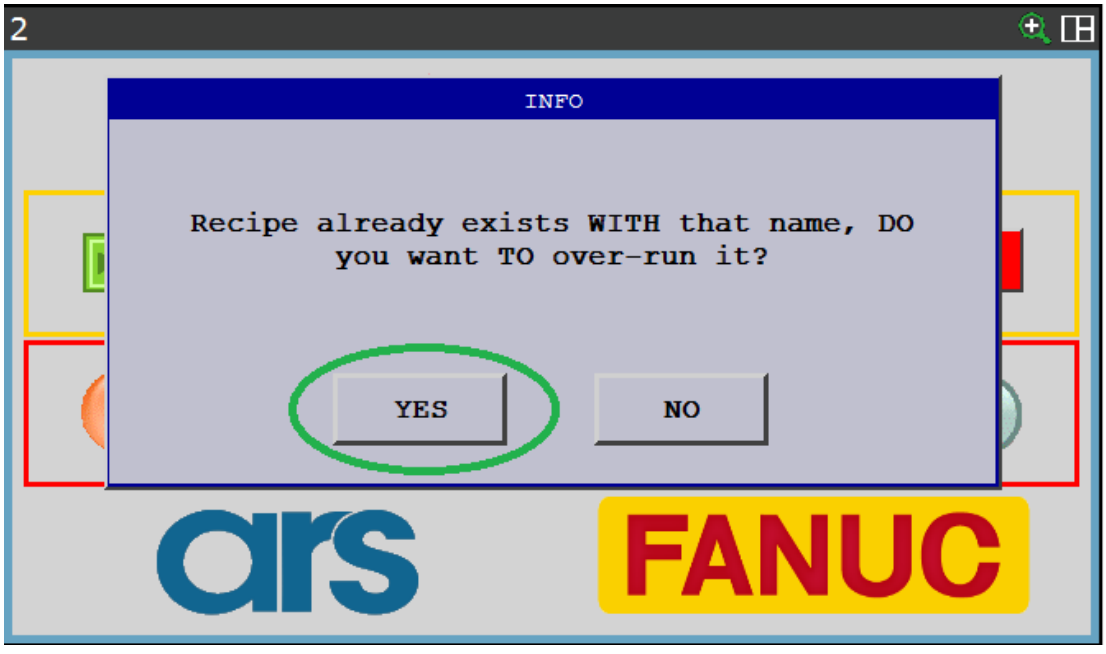


Editing an existing recipe

Use the “Edit Recipe” button on the main page of the interface to select a recipe from those that already exist so as to access all the positions and variables relating to this recipe.

The methods to edit remain unchanged with respect to that described to create a new recipe.

After making the necessary changes, it will be mandatory to save so as not to lose the changes; answer “Yes” to confirm the save and overwrite the data.



Loading an existing recipe

A recipe can be loaded manually without having to retrieve it from an external device.

After selecting the “Load Recipe” button, you can choose one of the recipes already entered and load it as the “current recipe”.

Press “Next” to save.

Deleting an existing recipe

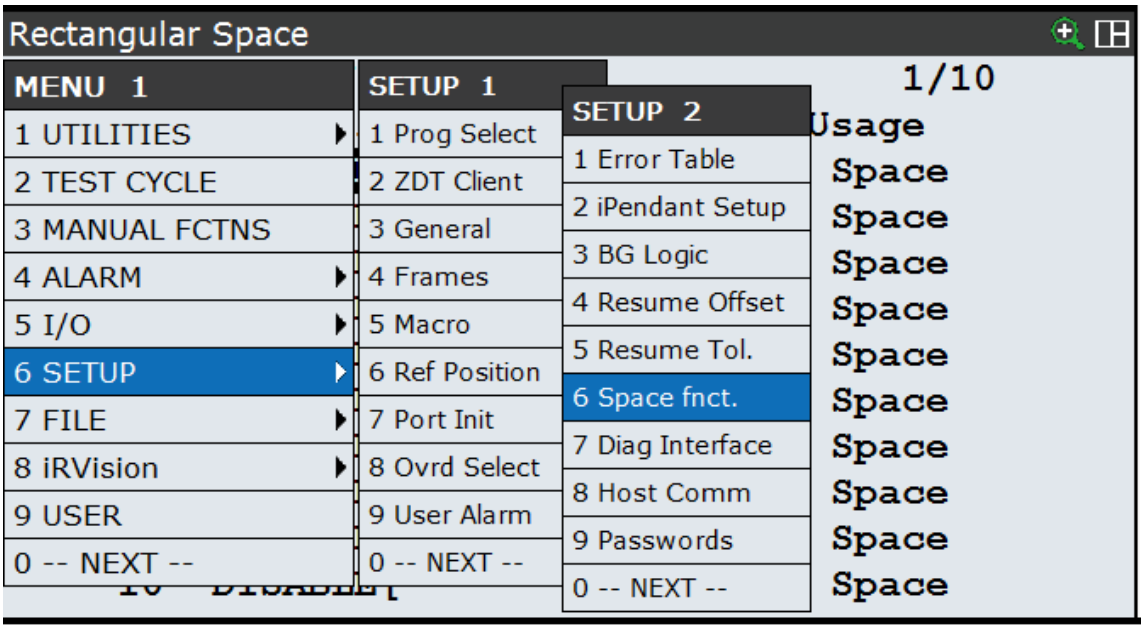
A recipe can be deleted by using the “Delete Recipe” button.

After selecting the “Delete Recipe” button, you can choose one of the recipes already entered and delete it from the database.

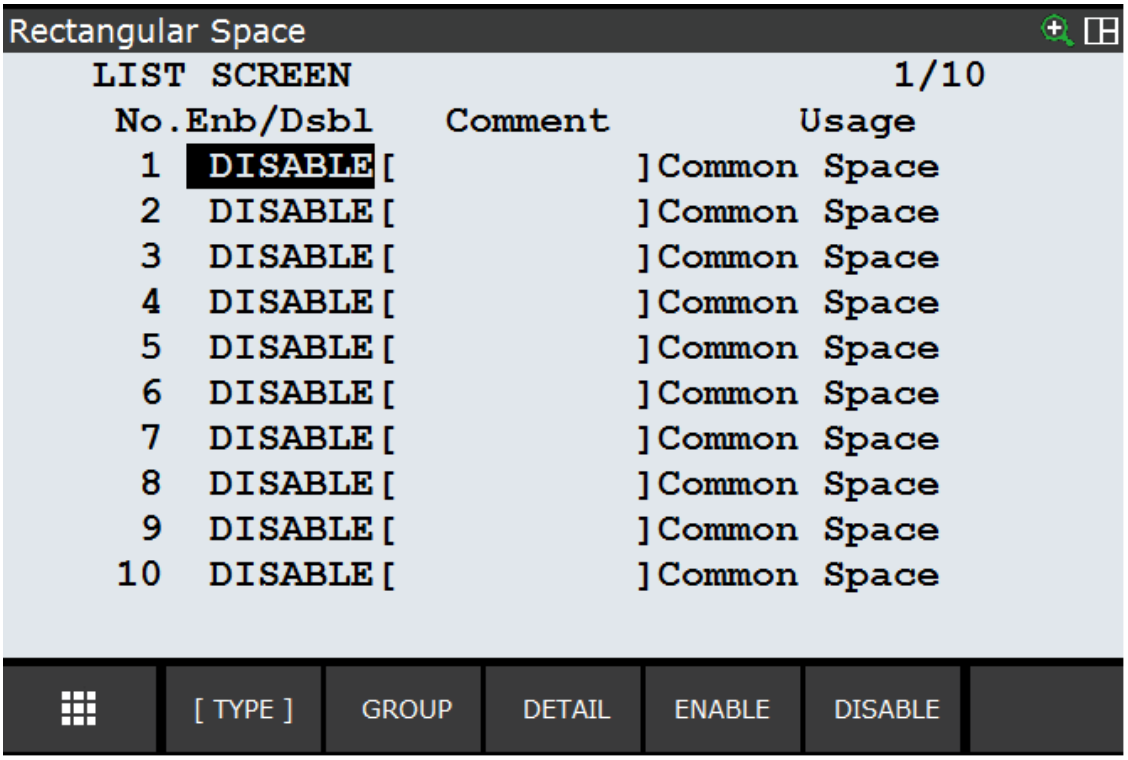
Space Function robot

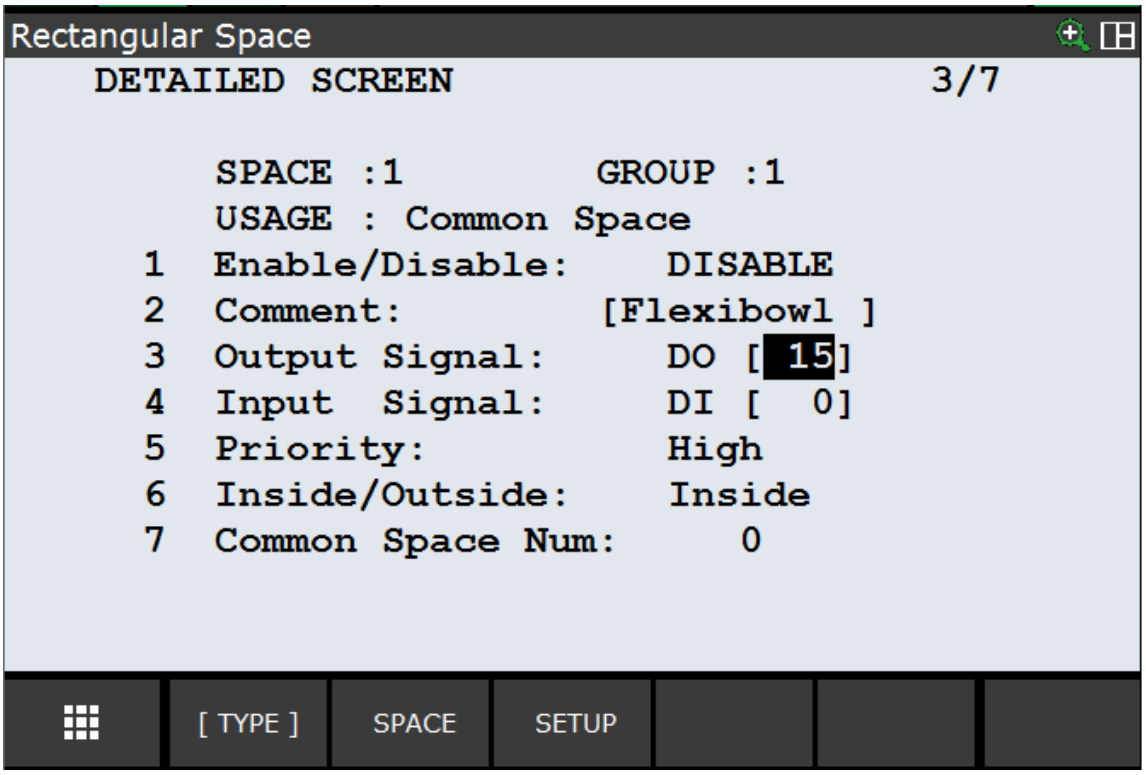
The space function is used to define an area of encumbrance in the pick-up area so as to take the new photo only when the robot is actually out of the vision area.

To define a new space function, press the Pendant Menu→Setup→Space Fnct.

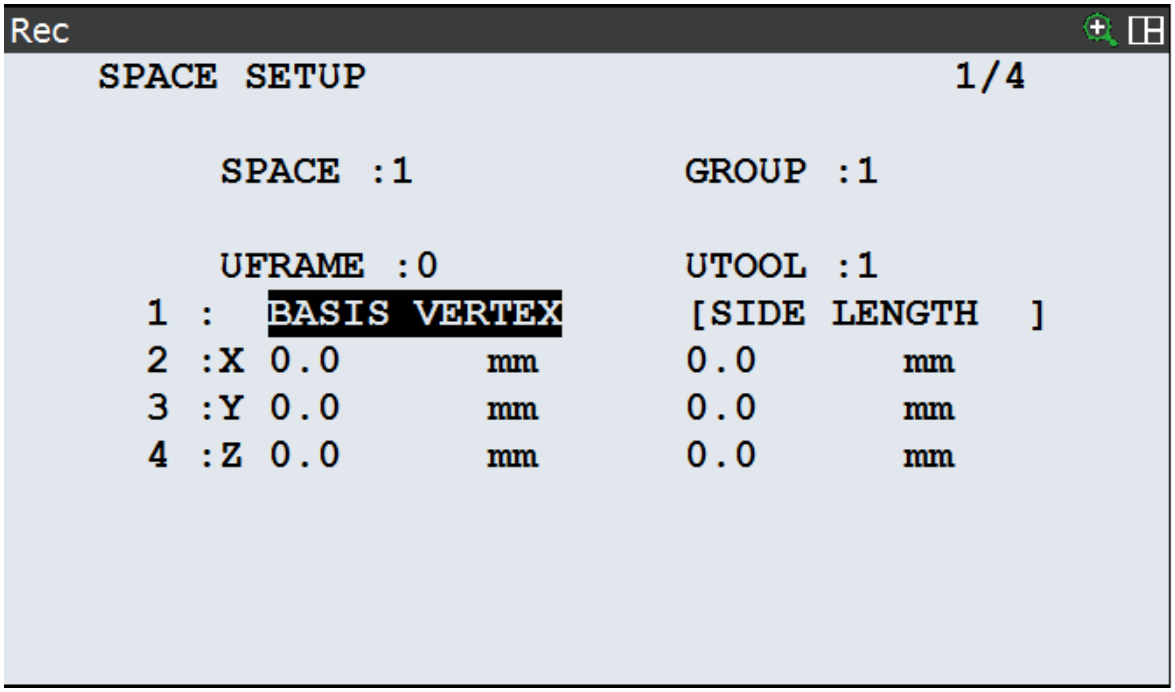


Select the desired space function and press the “Detail” button to configure it

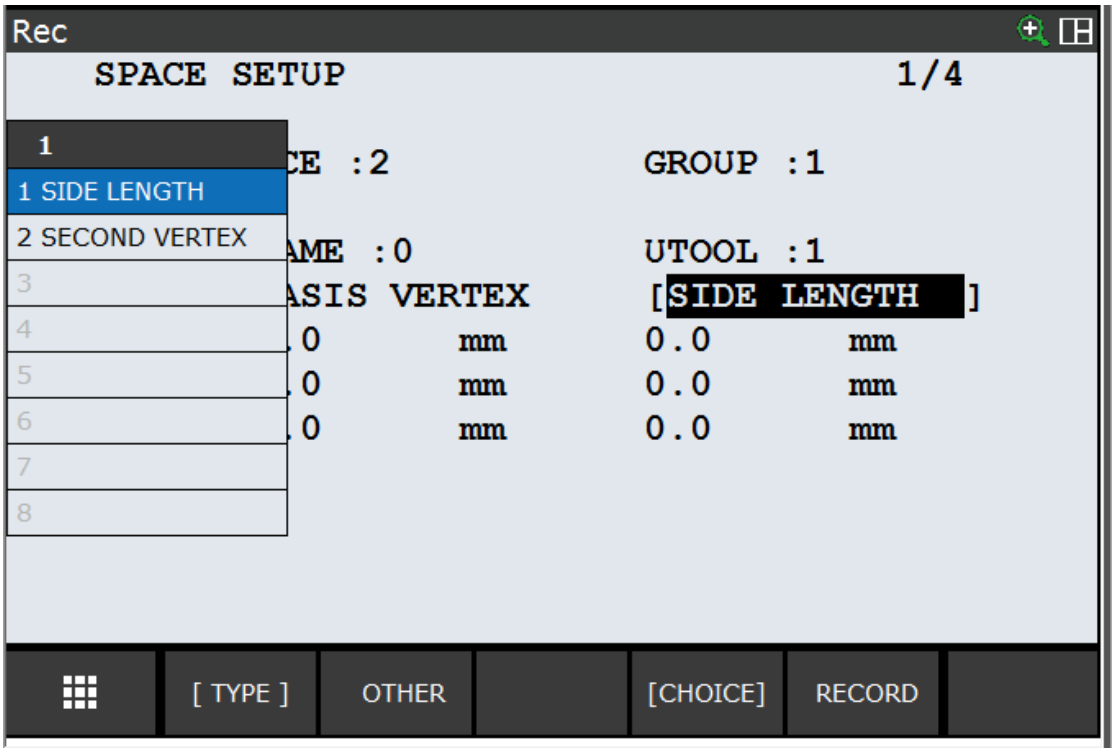




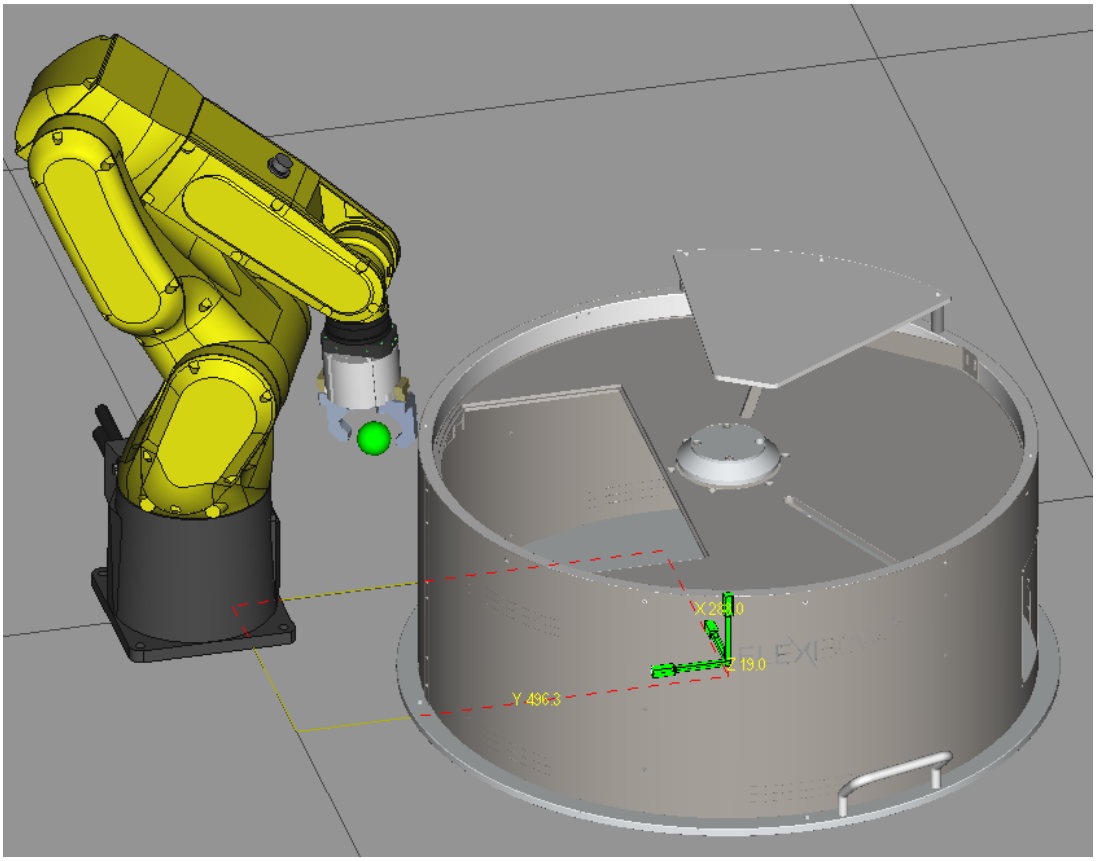
1. Enter a comment to define what it refers to
2. Specify the Digital Output signal that will be set at 1 when the robot is out of the "Space Function" and at 0 when it is within.
3. Press the "Space" button to define the area of encumbrance.



Move the cursor to the “Side Length” item, press the “Choice” key and select “Second Vertex” from the menu on the left.

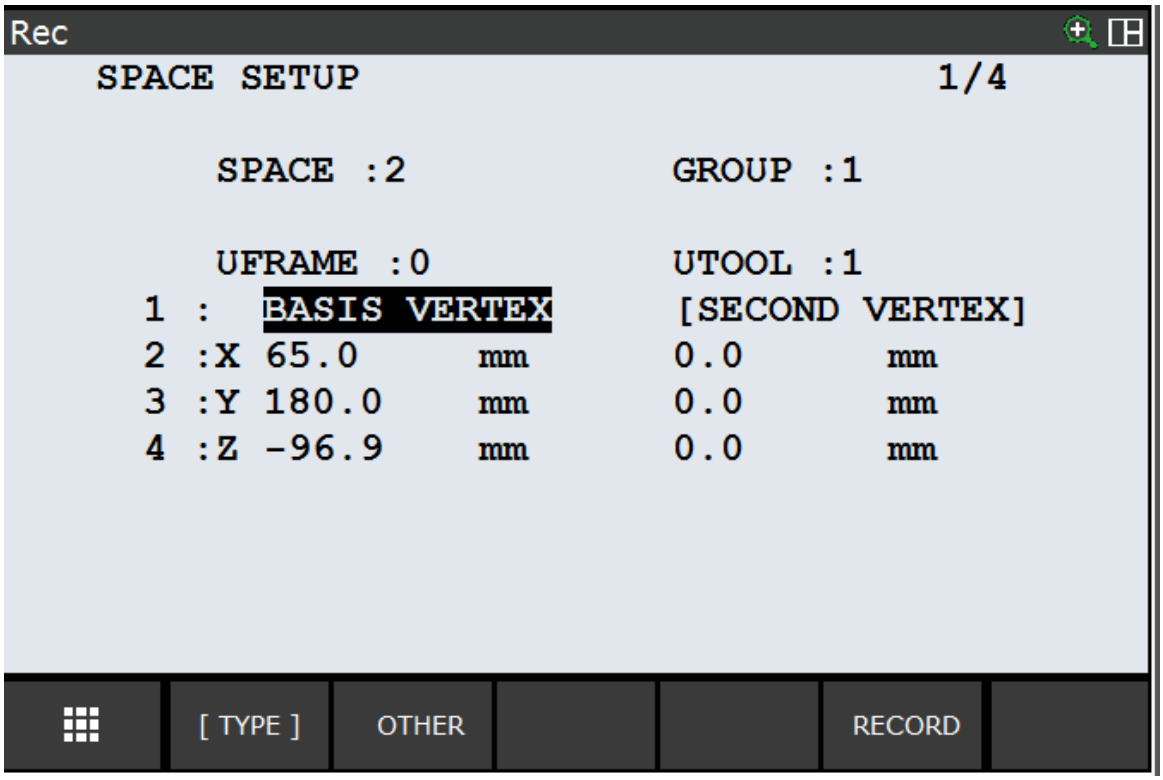


Move the robot to the first position while imagining to build a virtual parallelepiped by memorising the two opposite vertices.

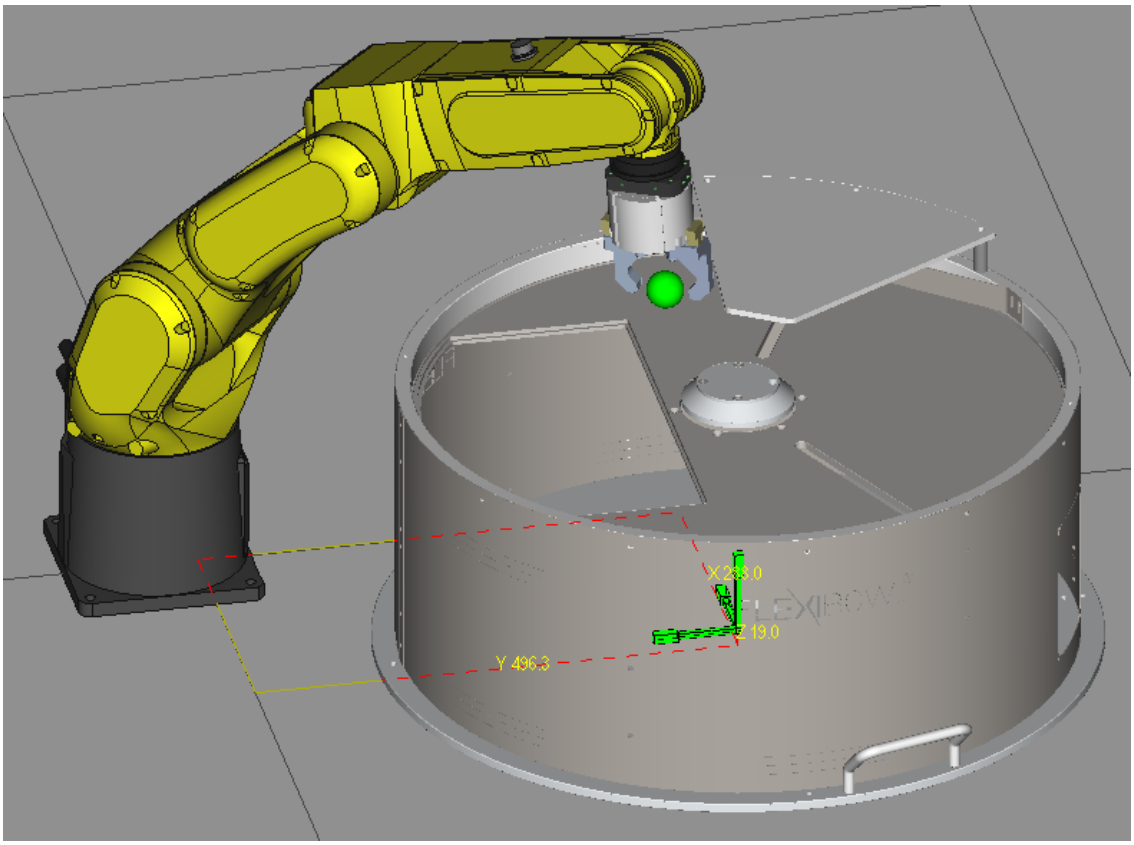


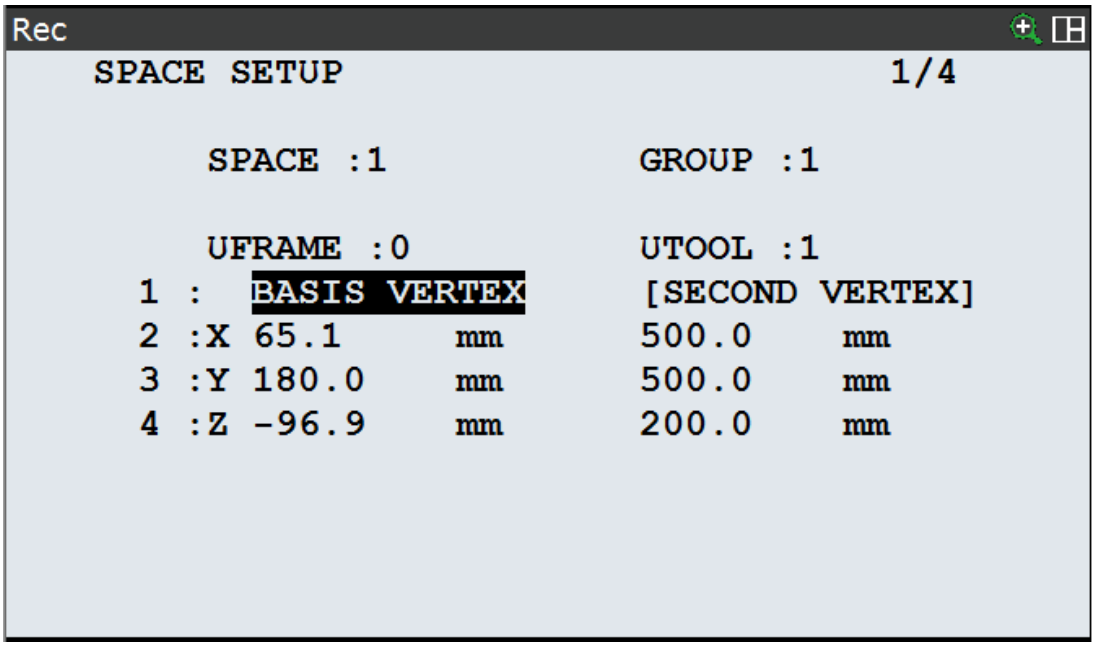
.

To record the first point, move the cursor over the “Basic Vertex” item and press the “Record” button together with the “Shift” button on the keyboard.



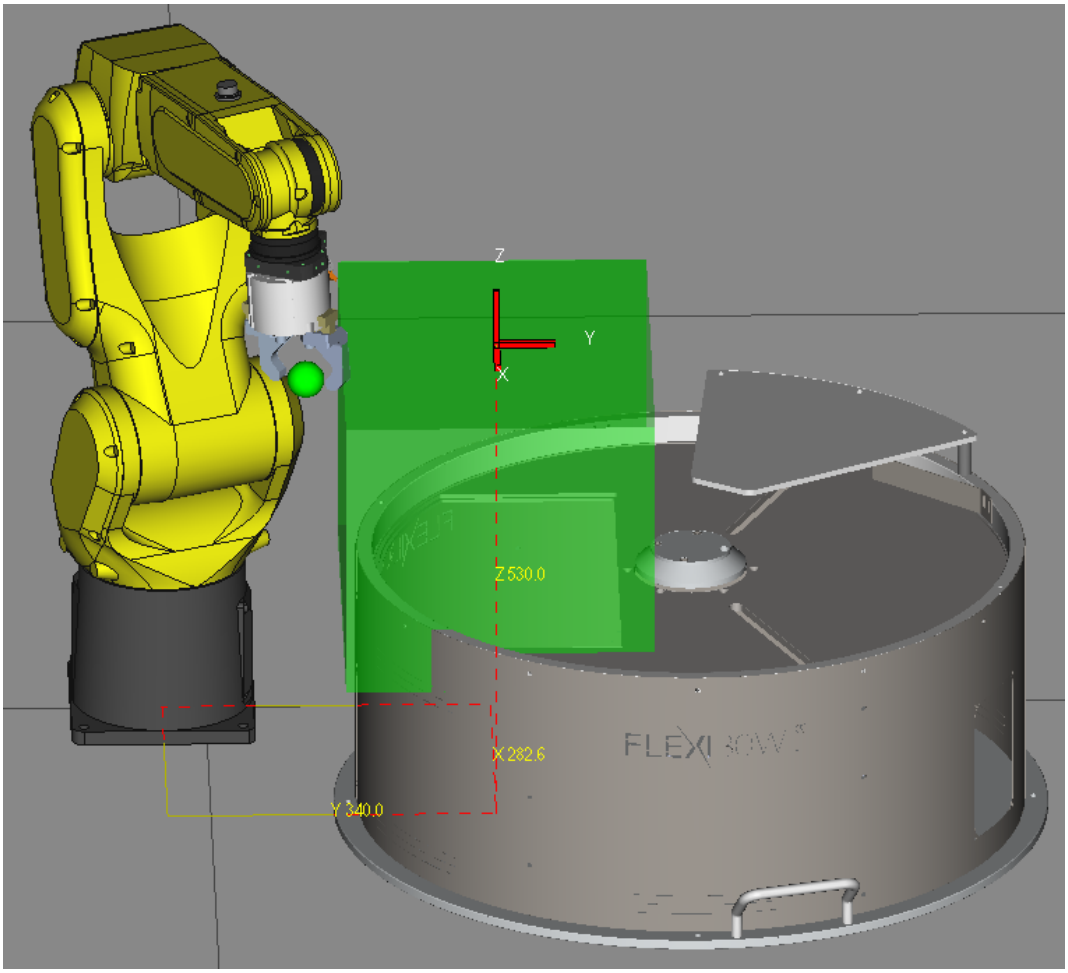
Now move the robot to the second vertex

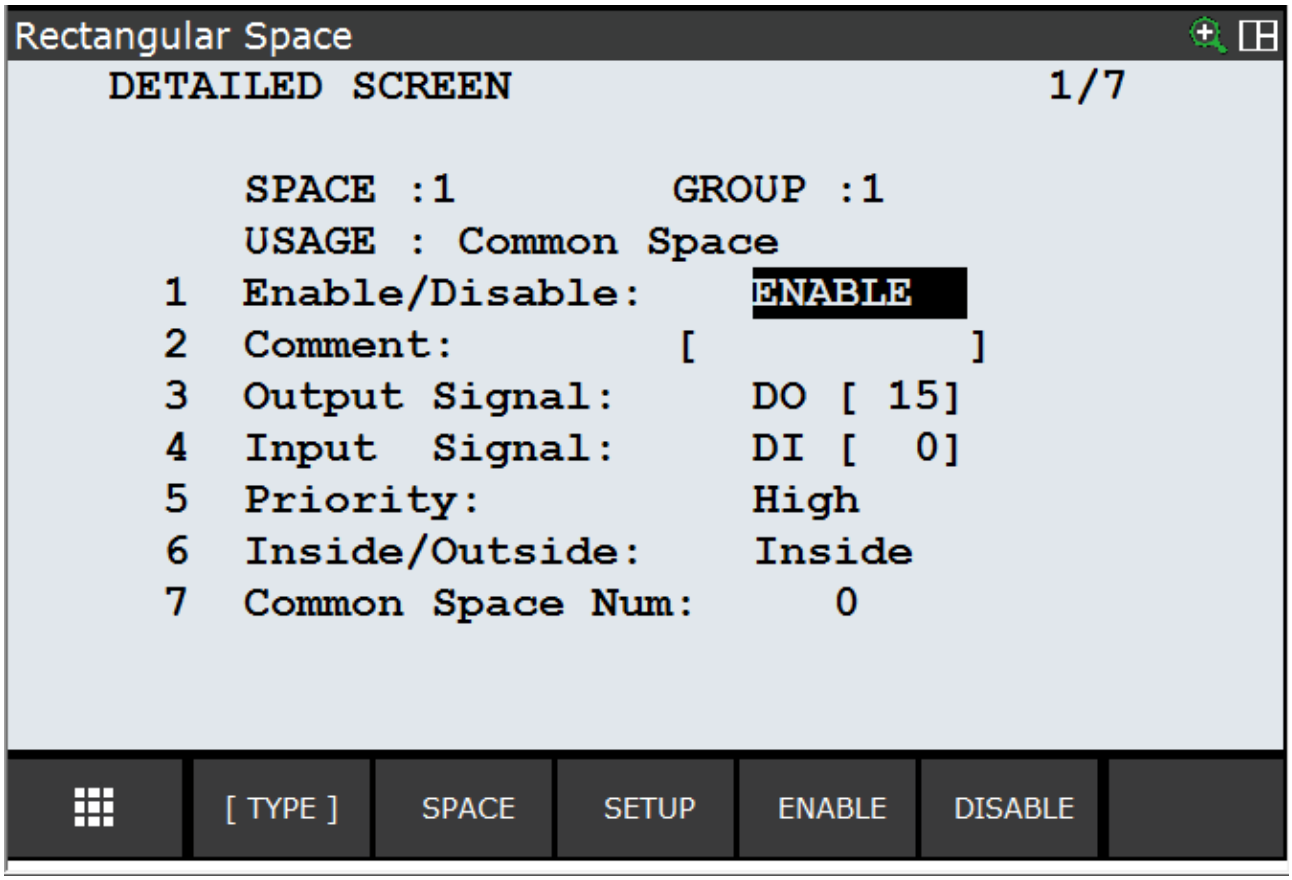




After also recording the second point, an area similar to that shown in the photo will be generated.

The area must cover the entire pick-up area of the Flexibowl, keeping a minimum of extra margin so as to function correctly even in the most external points.





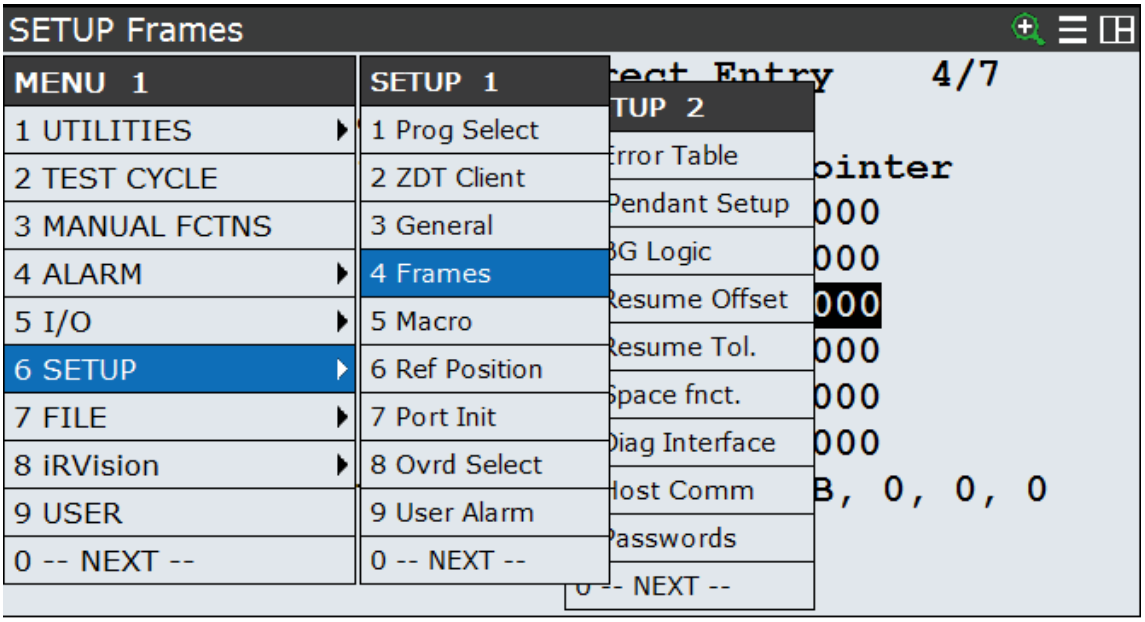
Enable the “Space Function” by pressing “Enable”.

To verify that the “Space Function” that you have set, works correctly, you must move the robot manually while simultaneously checking the status of the signal specified in the “Output Signal” item.

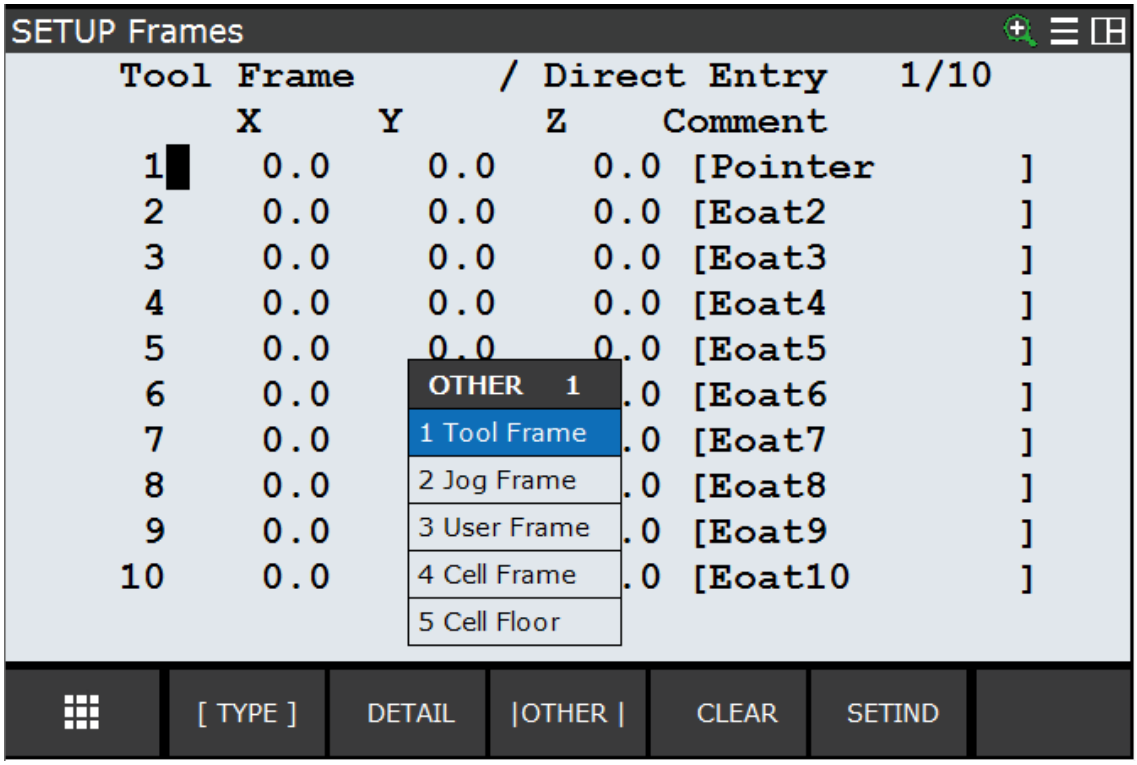
Entering a robot User Tool

The TOOL is a reference system that defines the position and angle of the tool centre (TCP) and the angle referred to it. The origin of the system is usually the tool centre and Z is the tool axis. When this system is not defined, the origin is the centre of the flange.

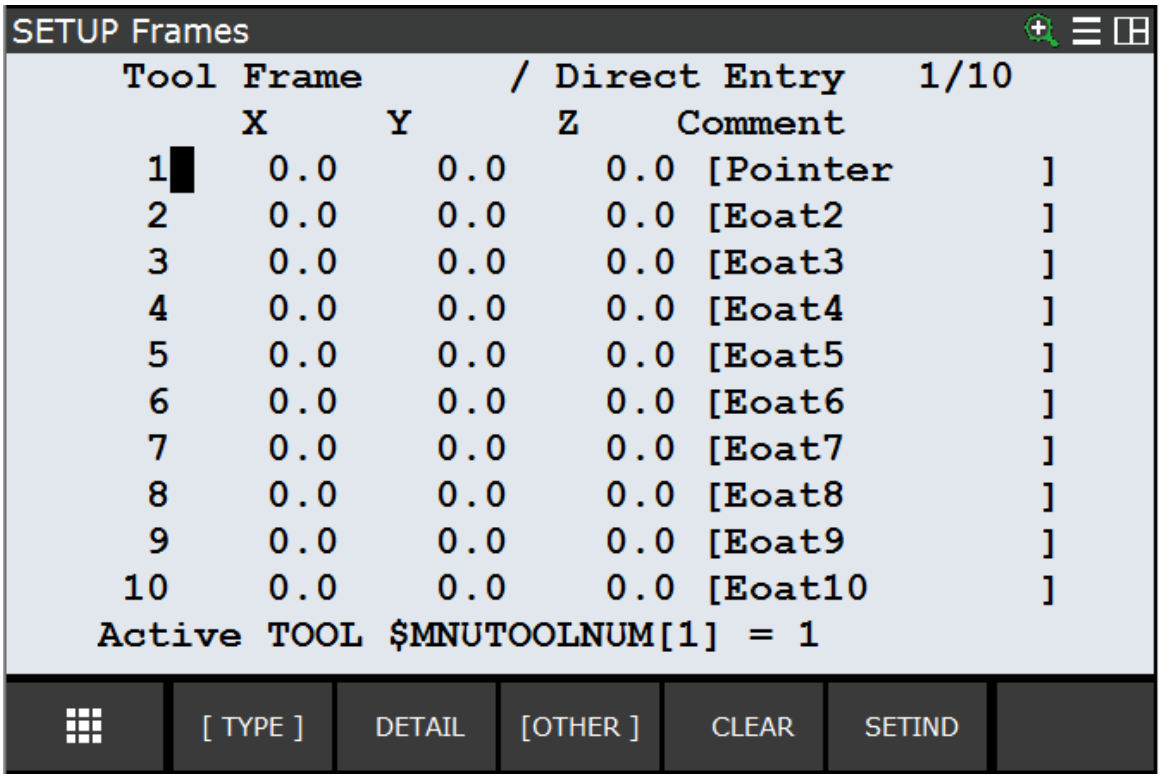
To access the Robot Tool configuration menu, press Menu→Setup→Frames



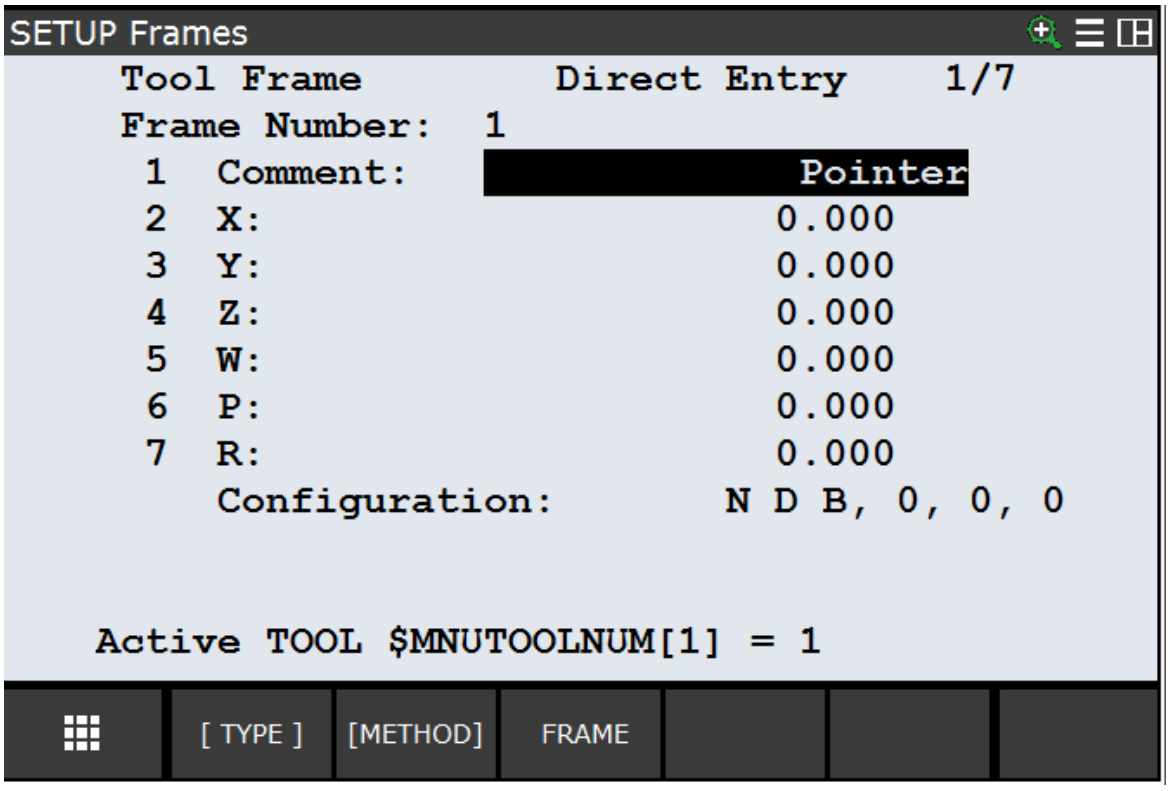
Press “Other” and select “Tool Frame”



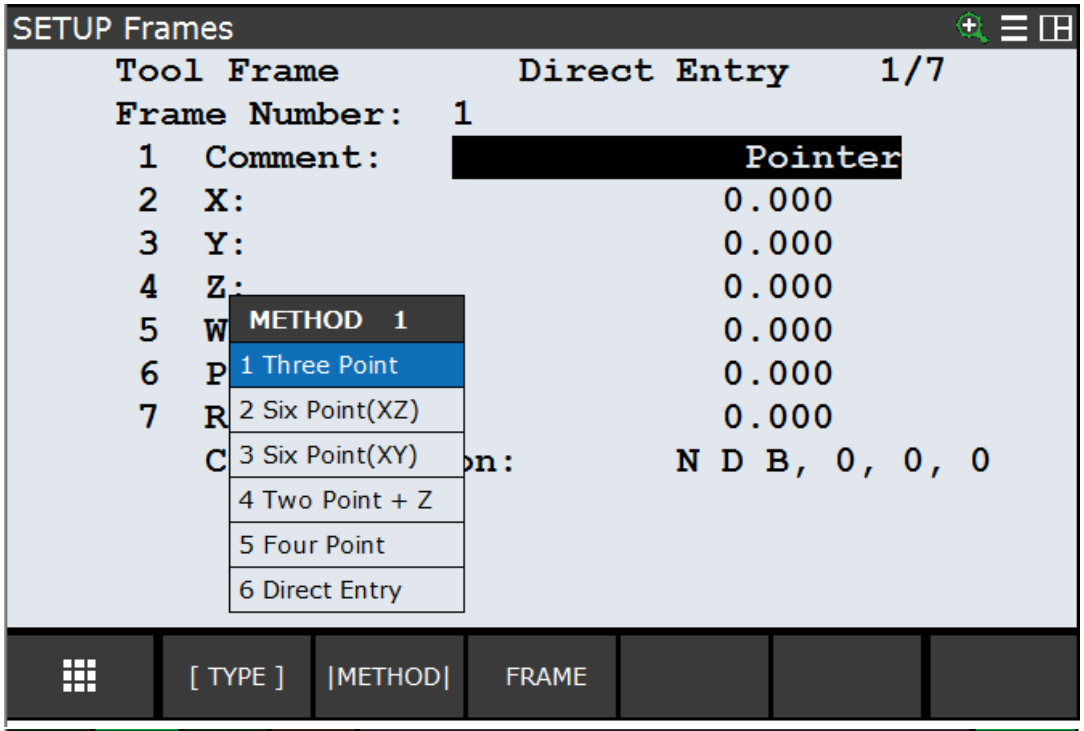
Press “Detail” to access the Tool configuration parameters

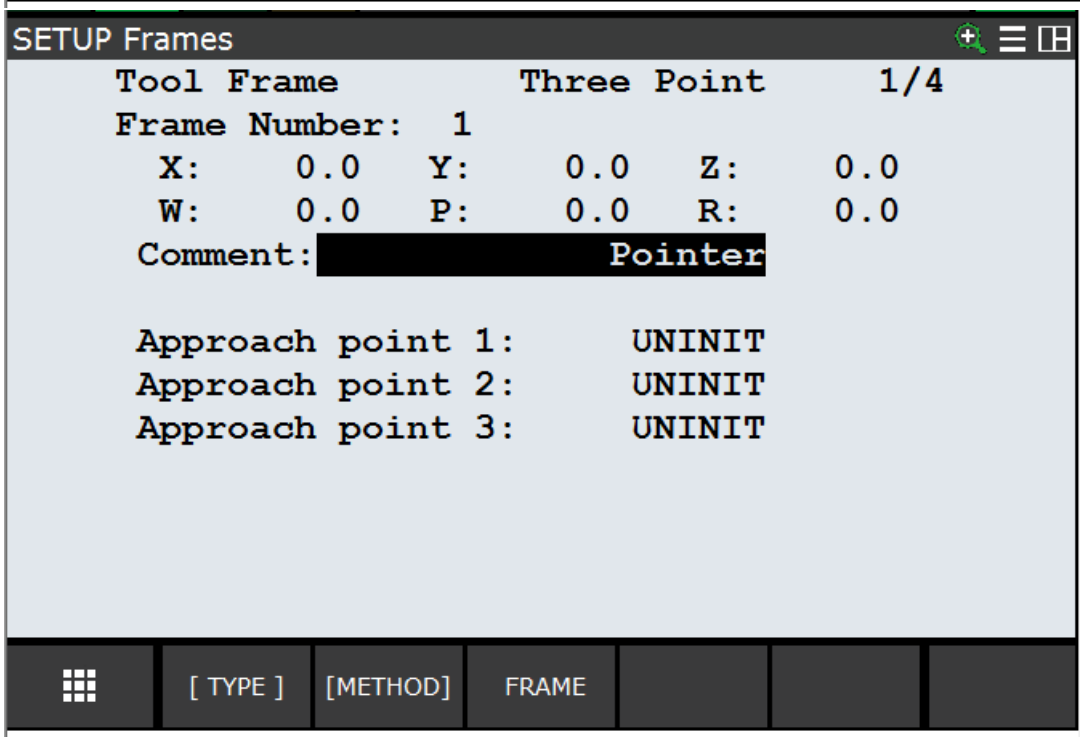


If you know the measurements of the TCP that will be applied to the robot, you can enter them manually (Method: Direct Entry)



If, on the other hand, you do not know the measurements of the Tool applied to the robot flange, you can use the 3-point method to define it. If the robot in question is a 4-axis scara robot, you must use the 2-point + Z method.

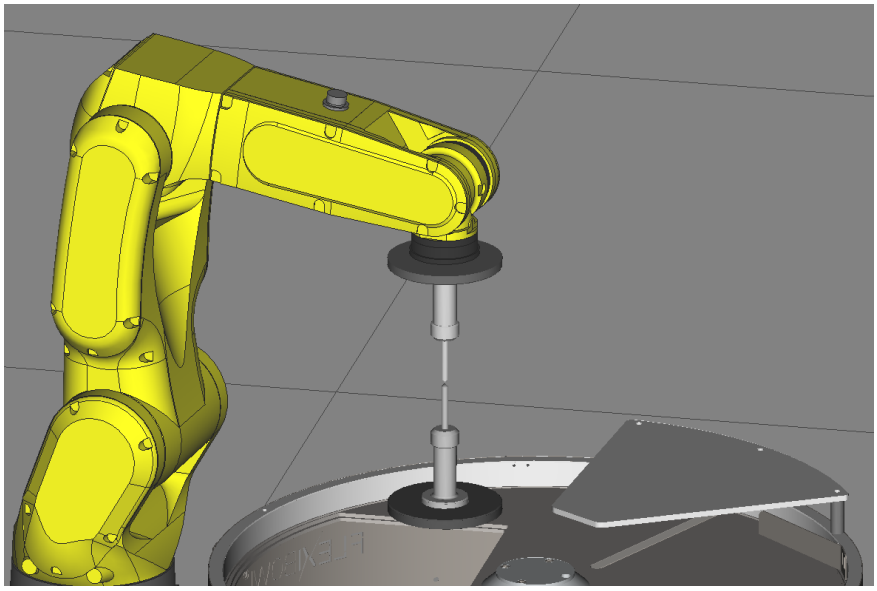




Use the three-point method to set the tool reference system. The three points must be memorised in reference to a common point with three approaches from different positions. As a result, the tool centre position is calculated.

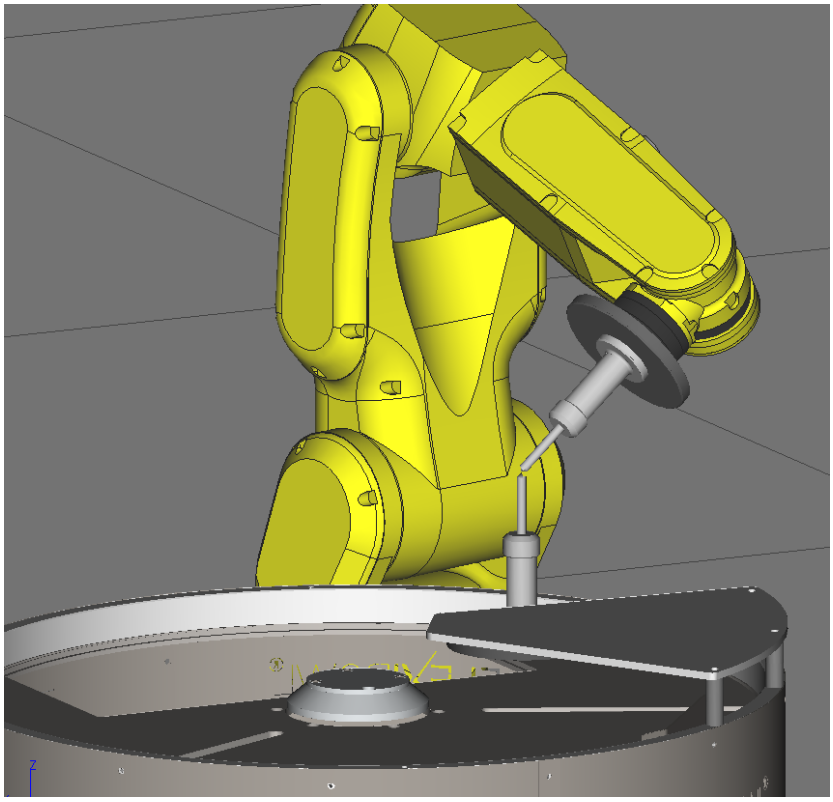
To achieve high accuracy, the three points must be as different as possible from each other. With the 3-point method, only the X, Y, and Z coordinates can be set.

Assuming you need to create a Tool that will be indispensable to complete good calibration, secure the Calibration tool to the robot and place a tailstock in a plane that can be reached by the robot.

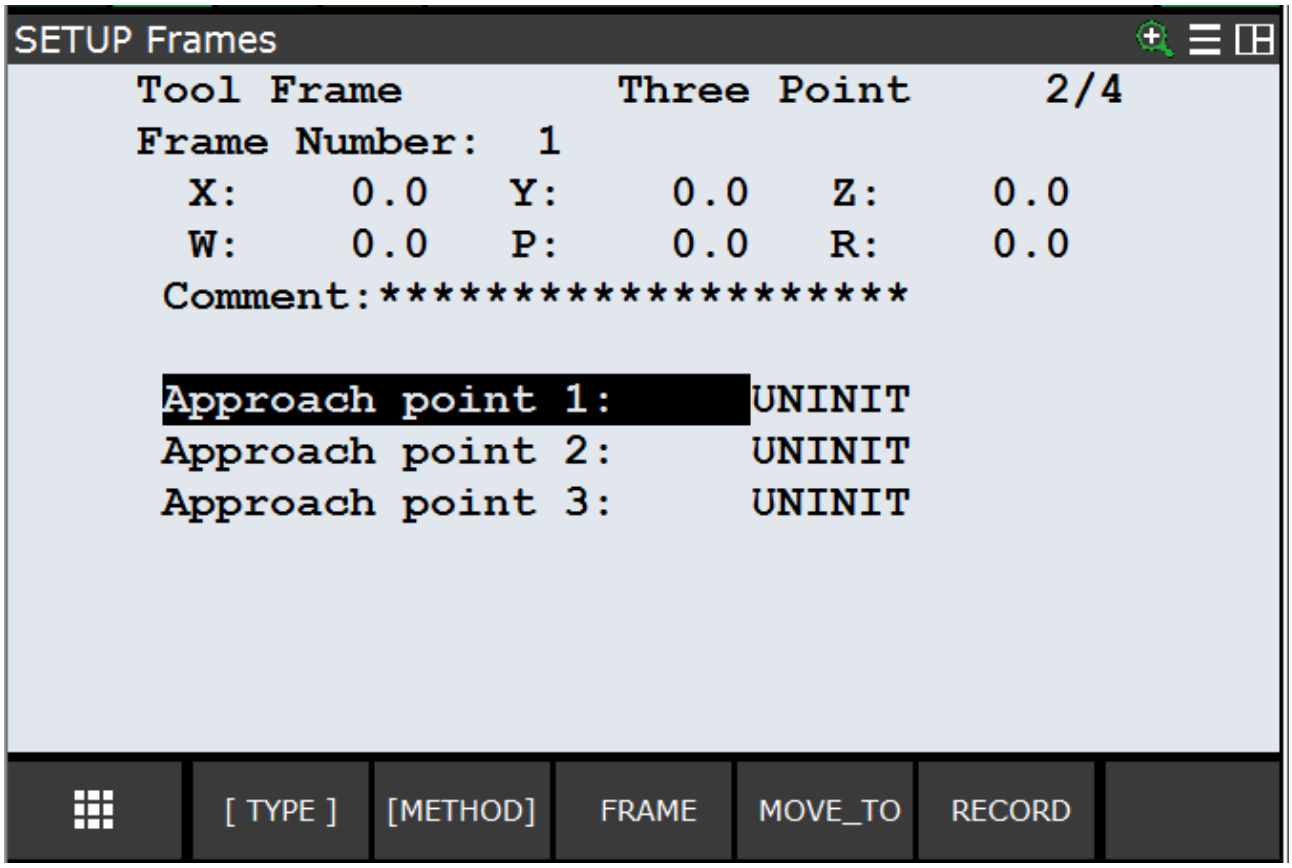


The 3 points to record are usually:

1. Align the 2 tools by matching the position of the 2 ends. Record this as the first point.
2. Rotate joint 6 of the robot by about 180° and re-align the 2 tools by matching the position of the 2 points. Record this as the second point.
3. Turn joint 4 and joint 5 of the robot to a position similar to that shown in the photo below. Record this as the third point.



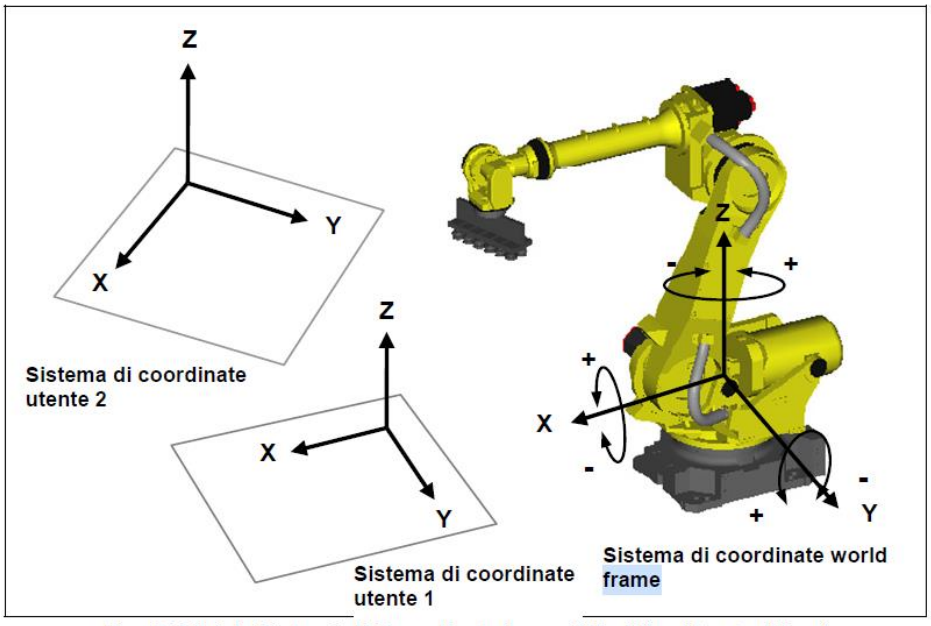
To record the points described above, you must select the desired point by moving the cursor to it and then pressing “Shift” and “Record” simultaneously.



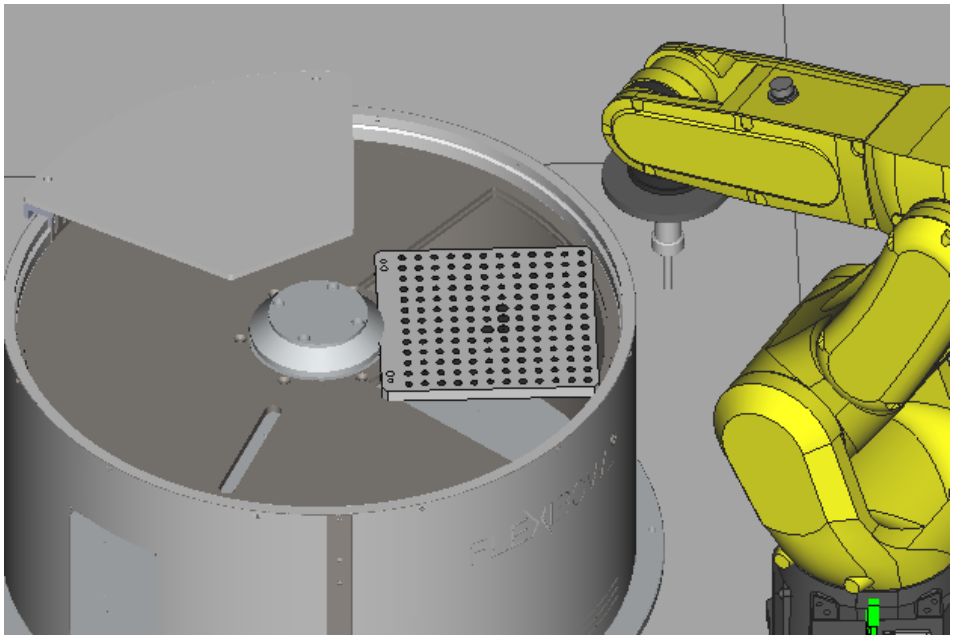
Entering a robot User Frame

A user coordinate system is the geometric definition of the origin and orientation of the coordinates defined by the operator. If no coordinate system has been set for manual movements, the movements are based on the basic system.

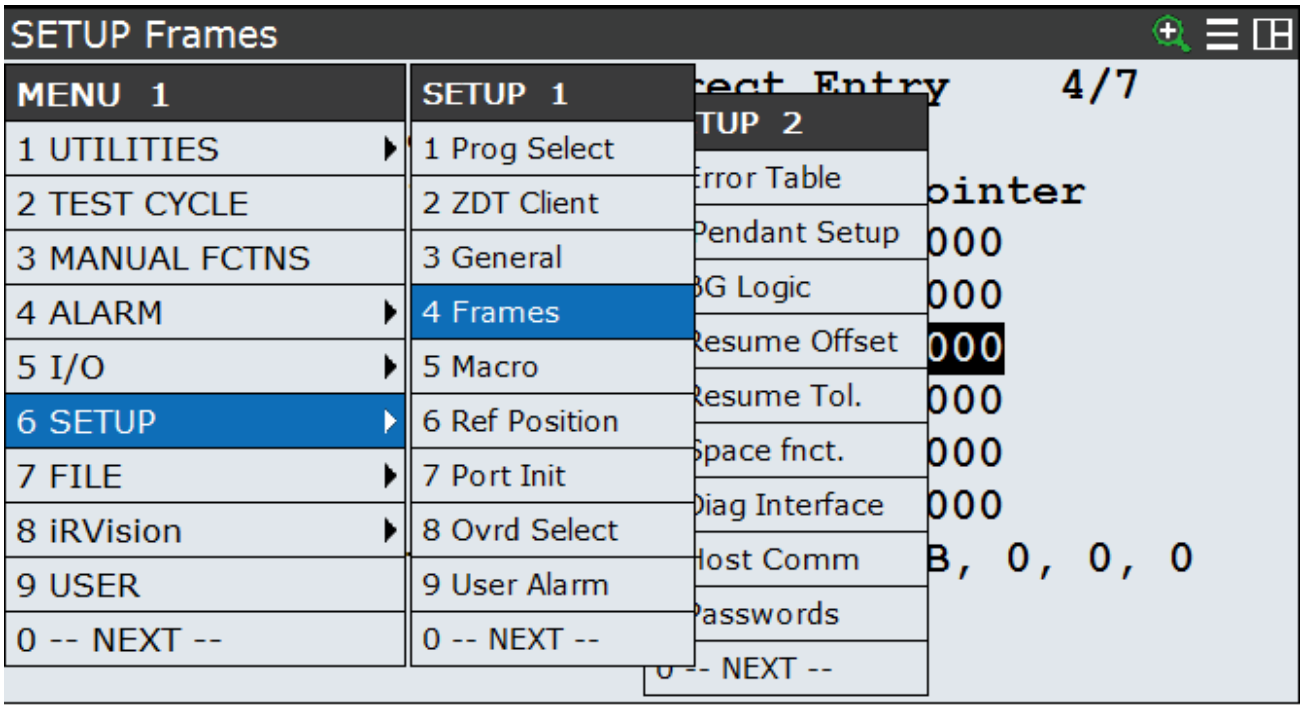
For user coordinates, the position of the origin (in X, Y and Z), and the angle and the triad of the resulting axes (around the X, Y and Z axes) are specified with reference to the original Cartesian coordinates of the robot (World Frame).



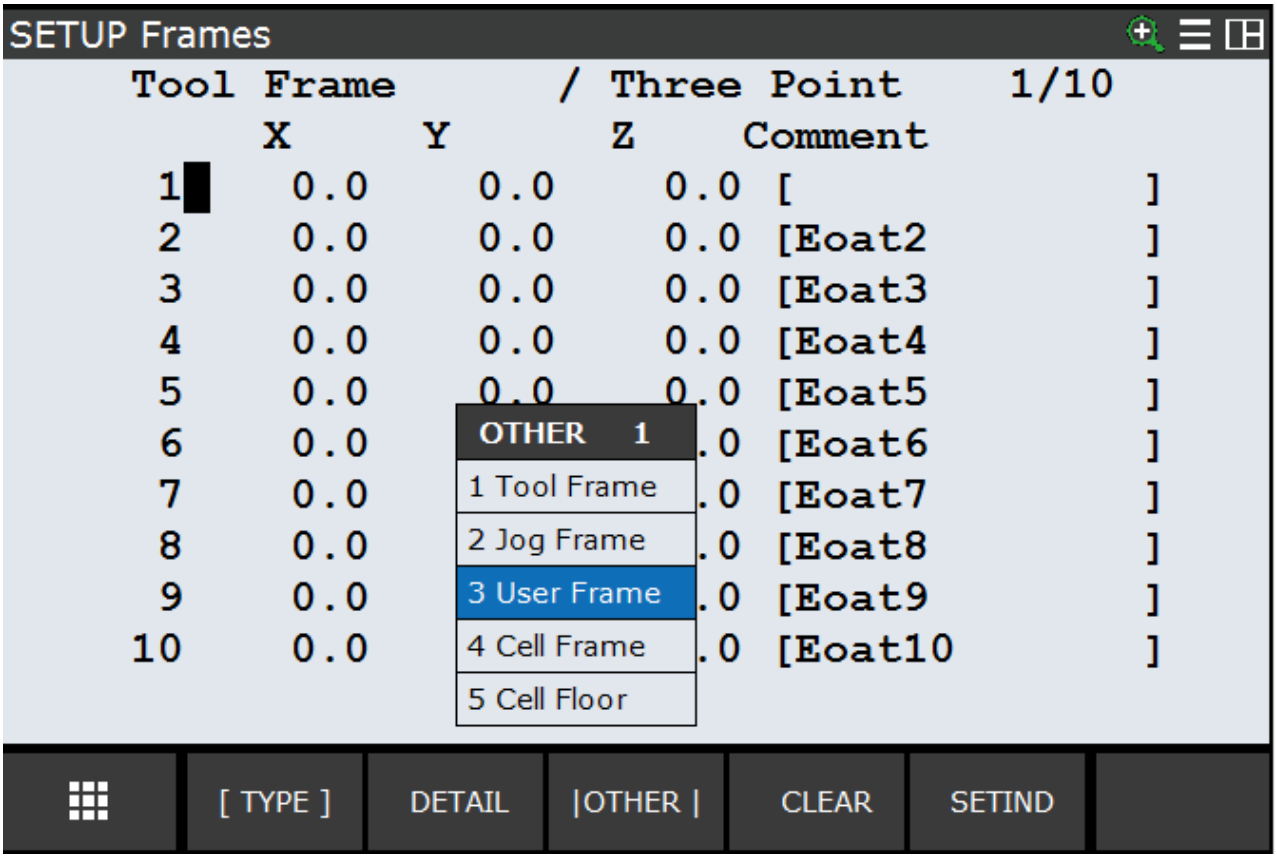
Assuming you need to create a Frame based on a calibration grid, place the grid in the work area.

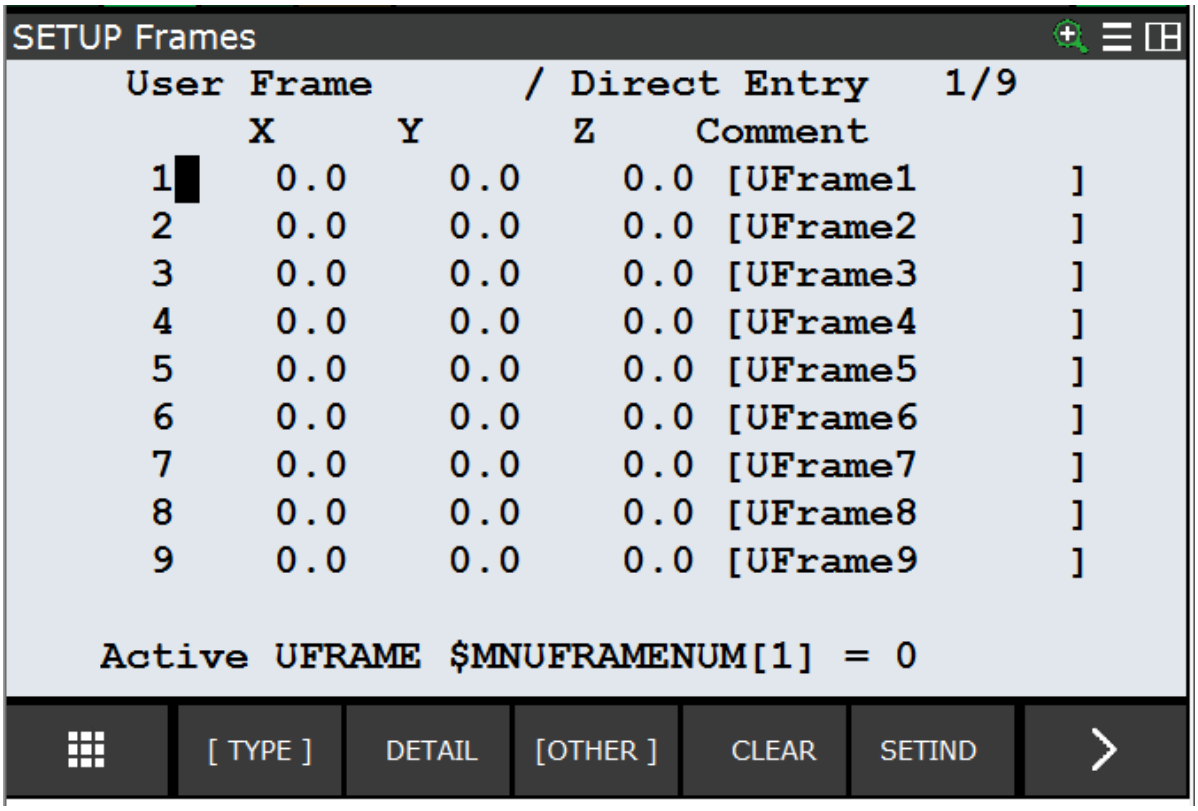


Press Menu→Setup→ Frame on the pendant

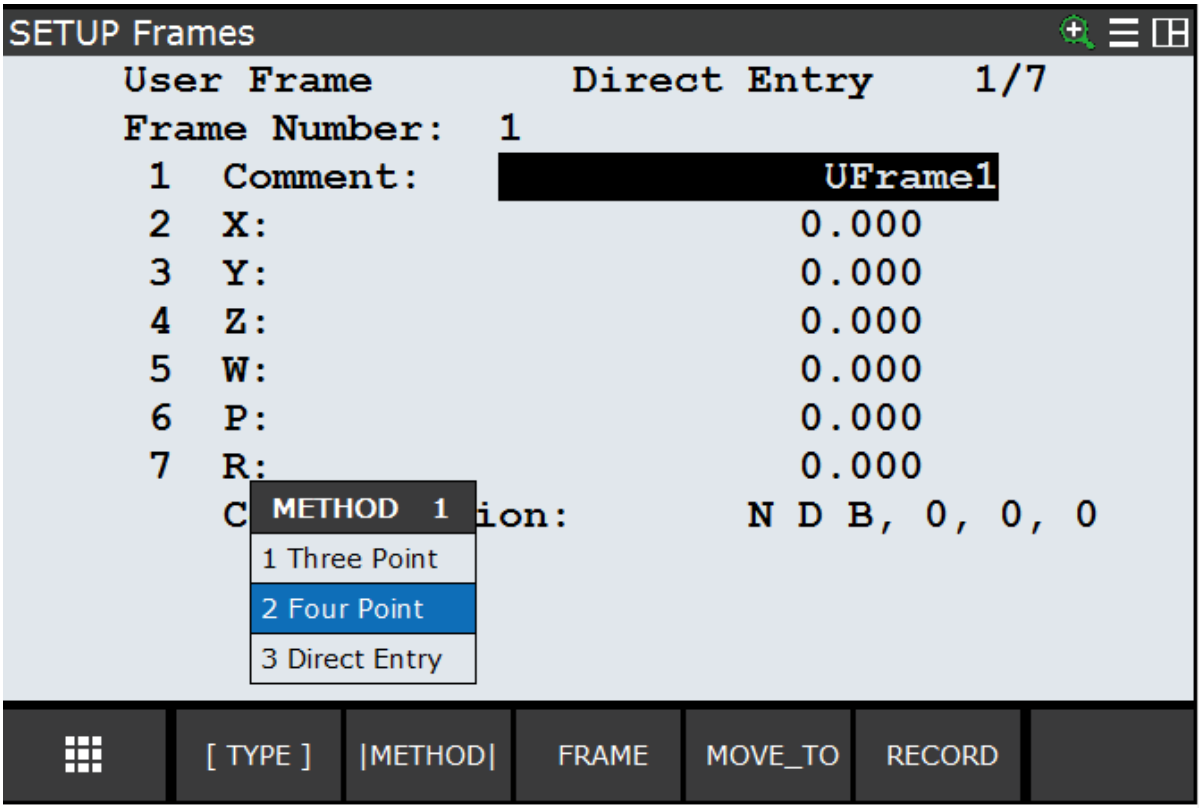


Press “Other” and then select “User Frame”.

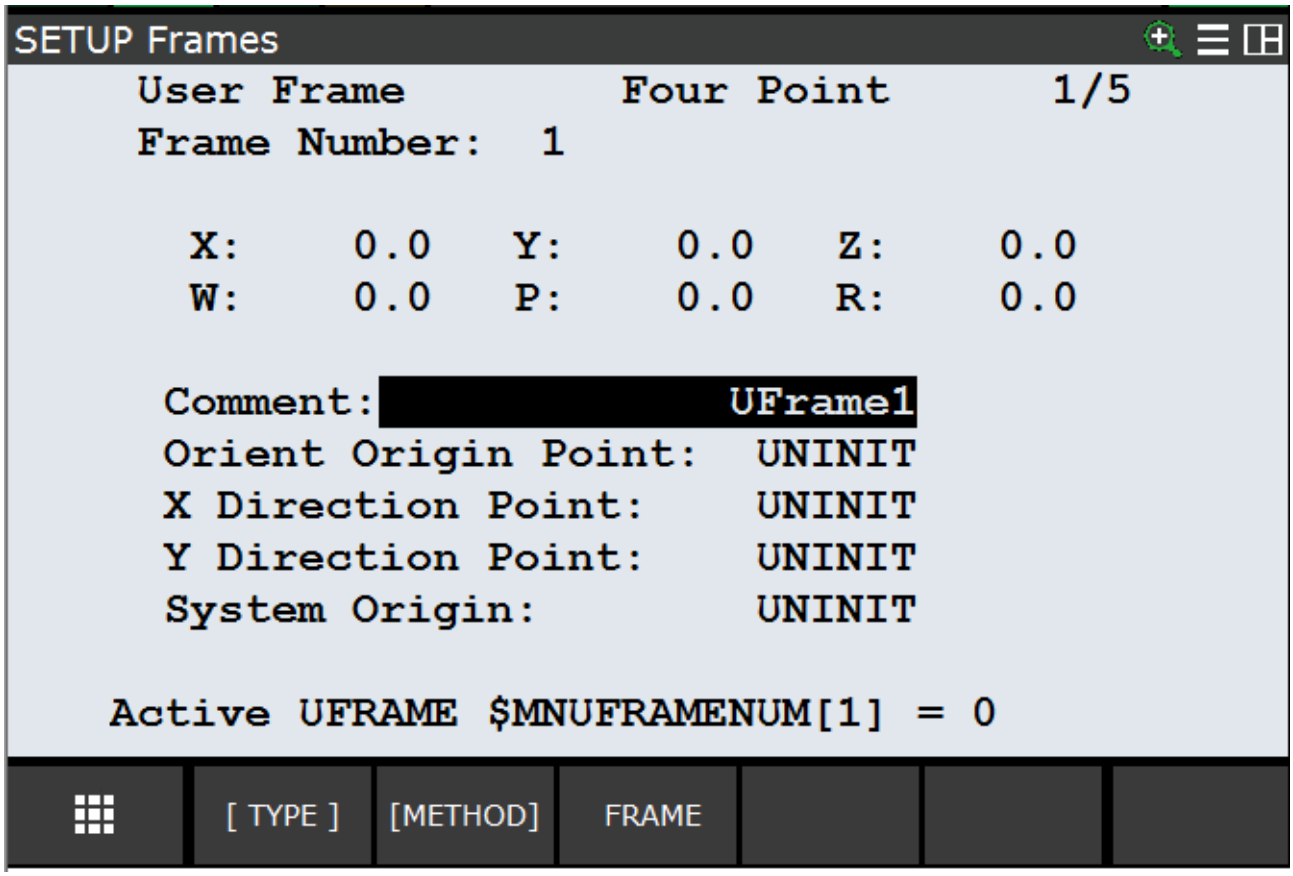


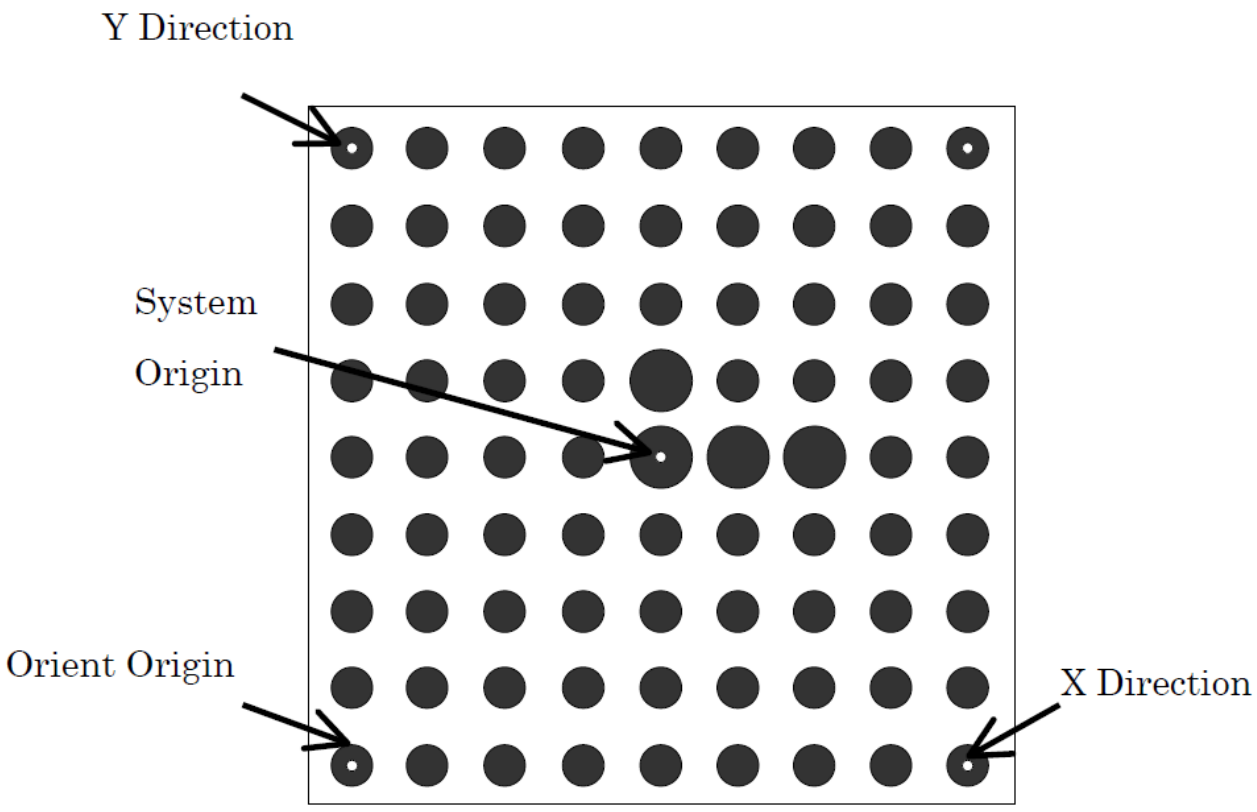


Press “Detail” to configure the selected Frame.

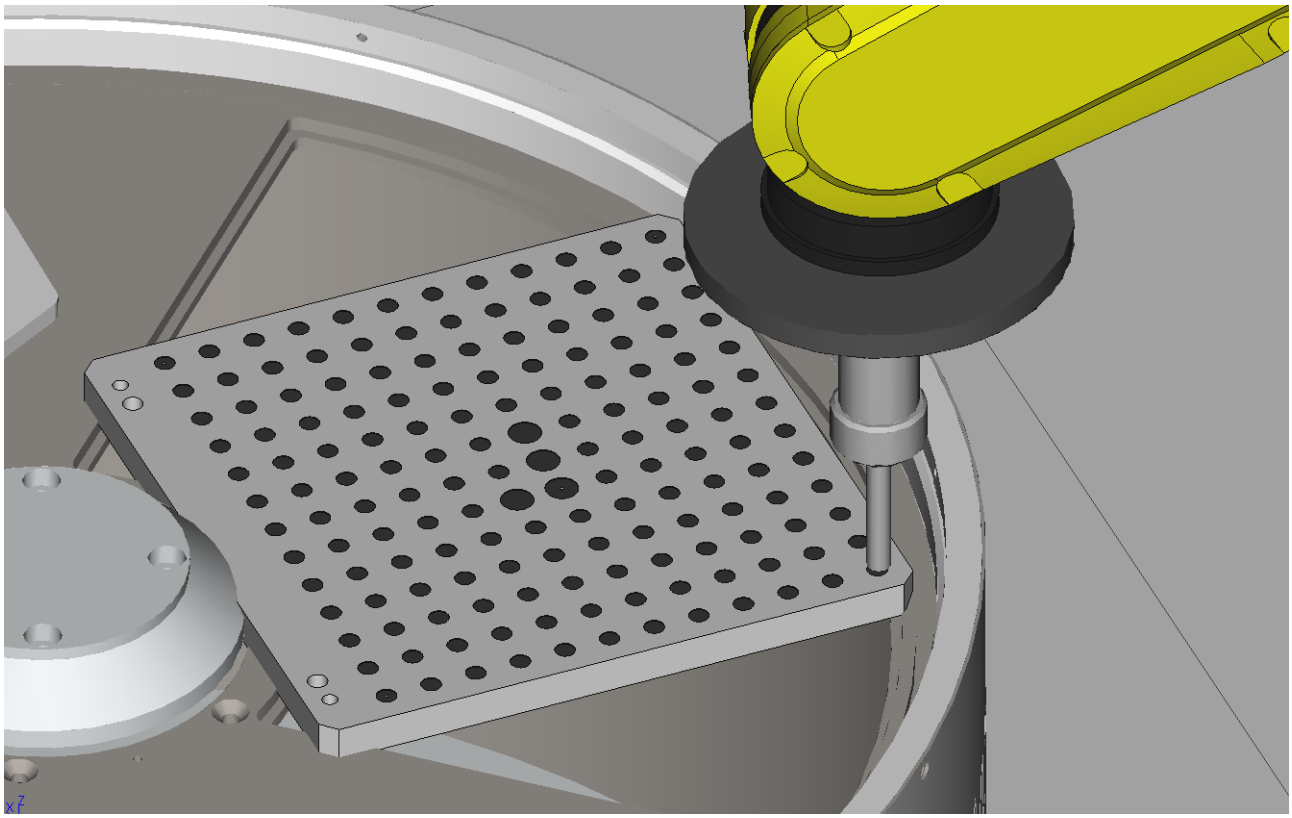


Press “Method” and select “Four Point”. Creating a frame with the 4-point method is ideal for creating frames on the calibration grids, whereas the 3-point one can be used to create reference systems for creating pallets, for example. The 4-point method will be shown on the following pages.

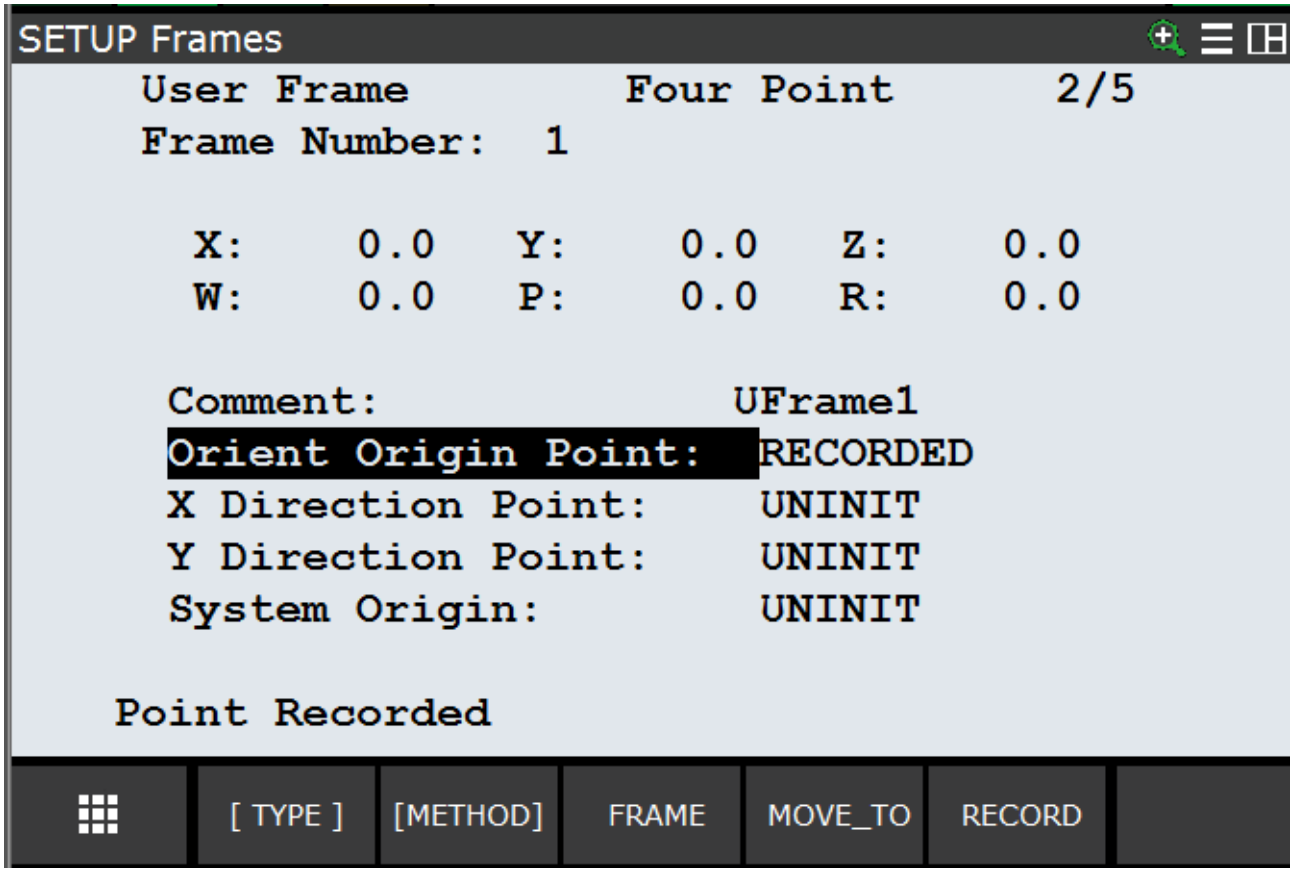

SETUP Frames
User Frame Four Point 1/5
Frame Number: 1
X: 0.0 Y: 0.0 Z: 0.0
W: 0.0 P: 0.0 R: 0.0
Comment: UFrame1
Orient Origin Point: UNINIT
X Direction Point: UNINIT
Y Direction Point: UNINIT
System Origin: UNINIT
Active UFRAME $MNUFRAMENUM[1] = 0
[TYPE]
[METHOD]
FRAME


Y Direction
System
Origin
Orient Origin
X Direction

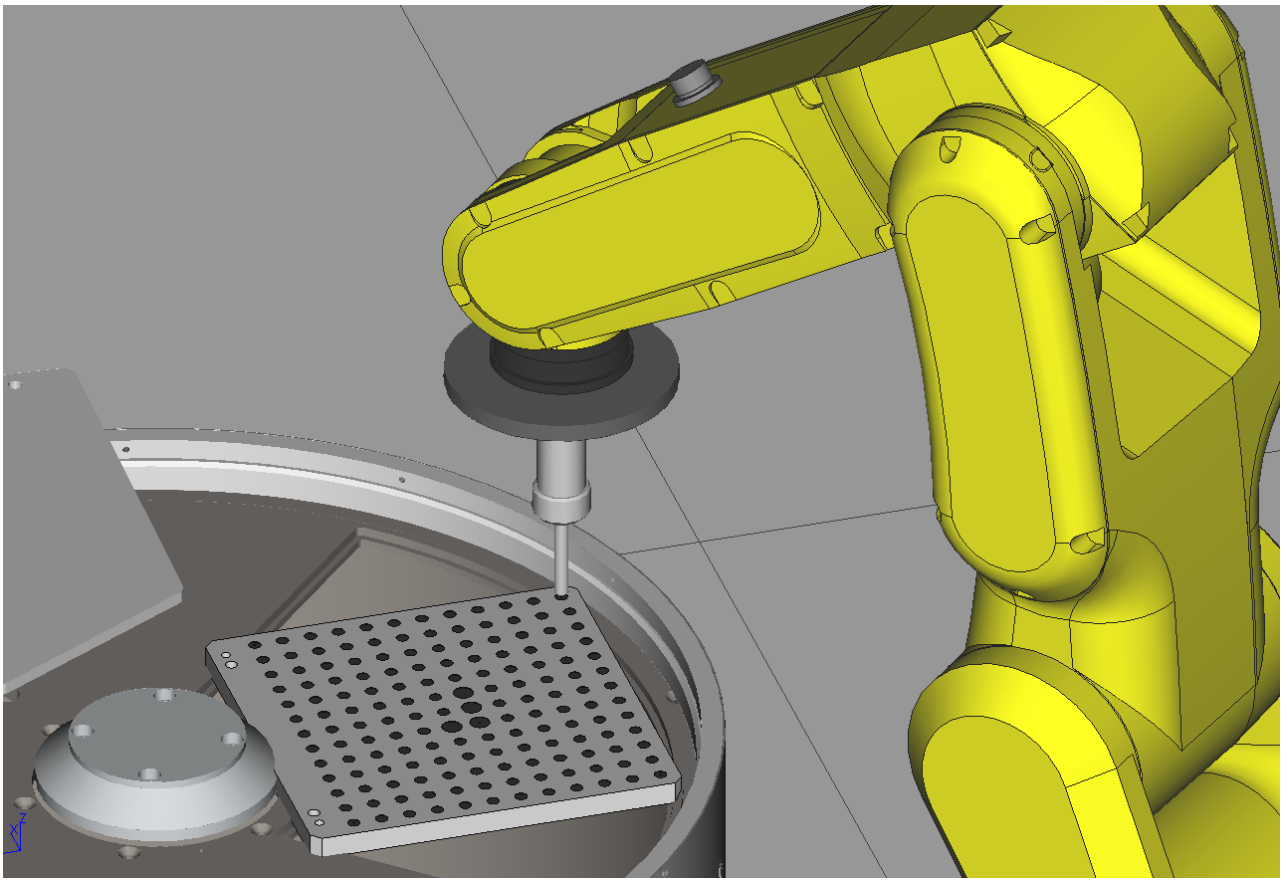
Then activate the correct Tool and move the robot to the first point.



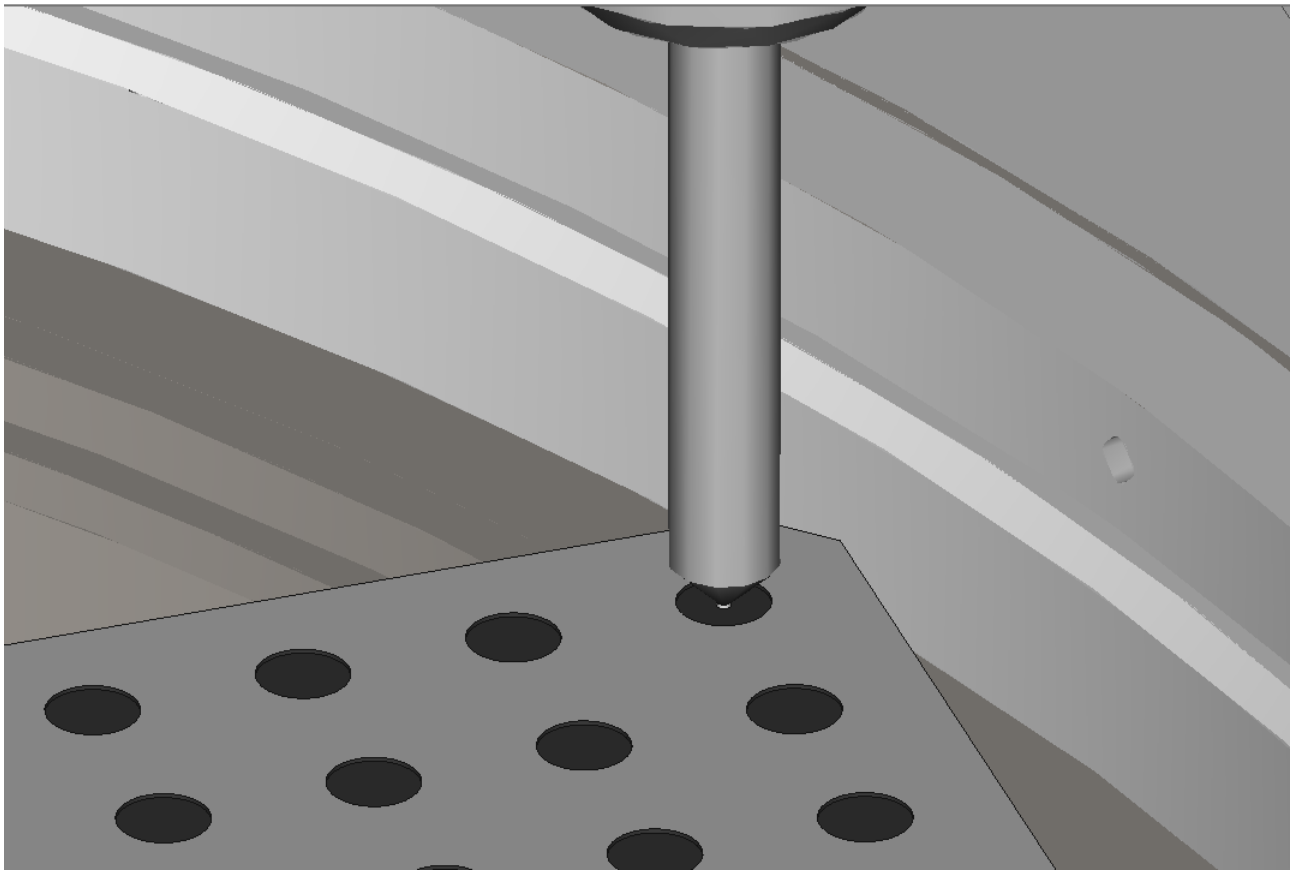
Then select the first point (Orient Origin Point) and press “Shift” + “Record” to save the position.



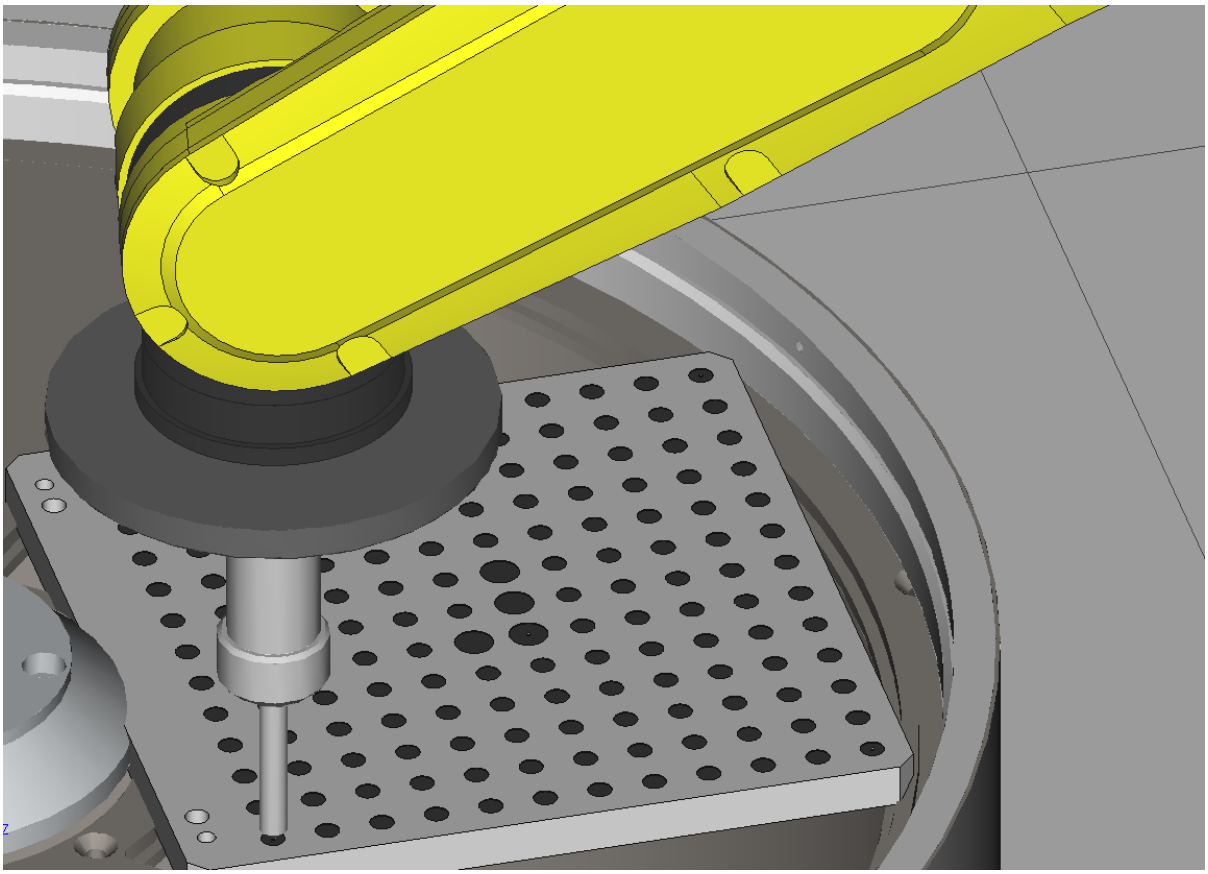
Move the robot to the second point (X Direction Point) and record this too.



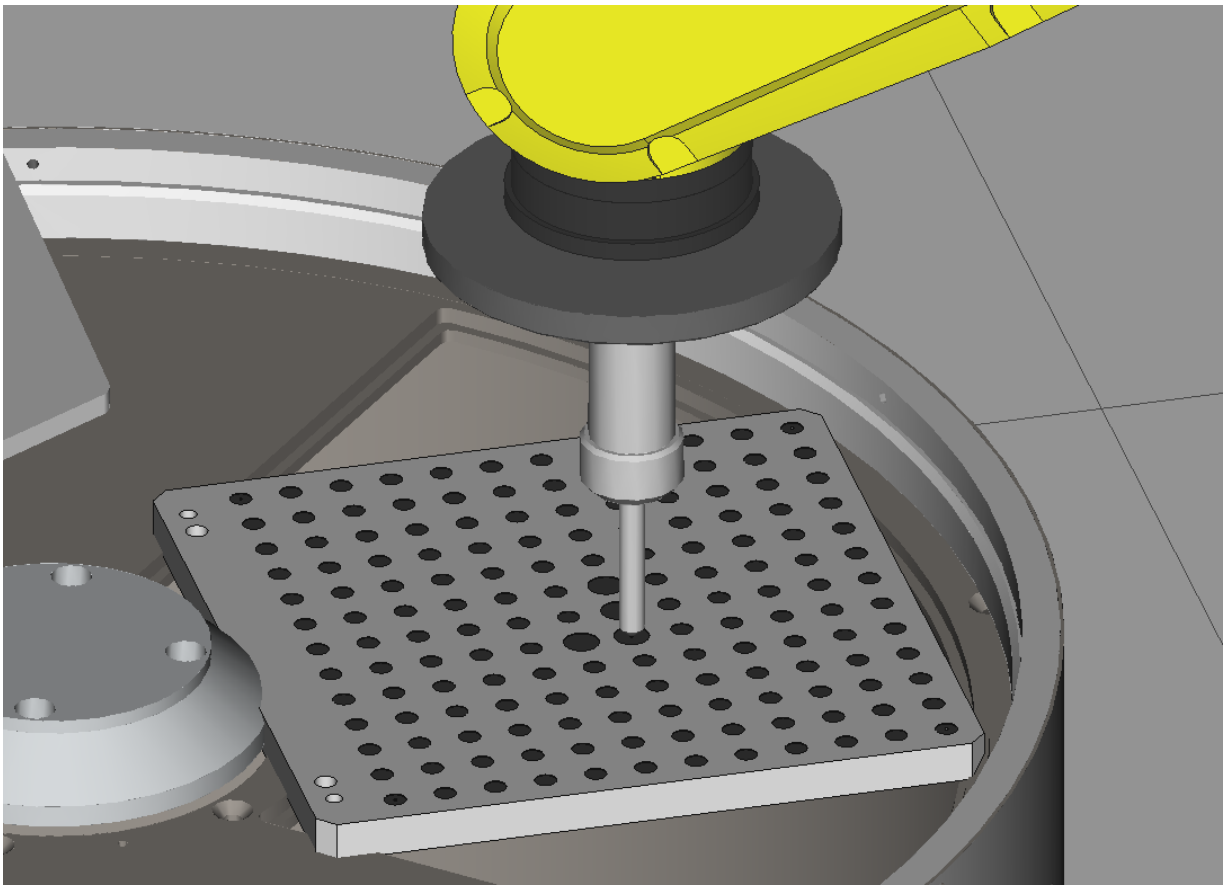
Be careful when saving the points for them to be as accurate as possible.



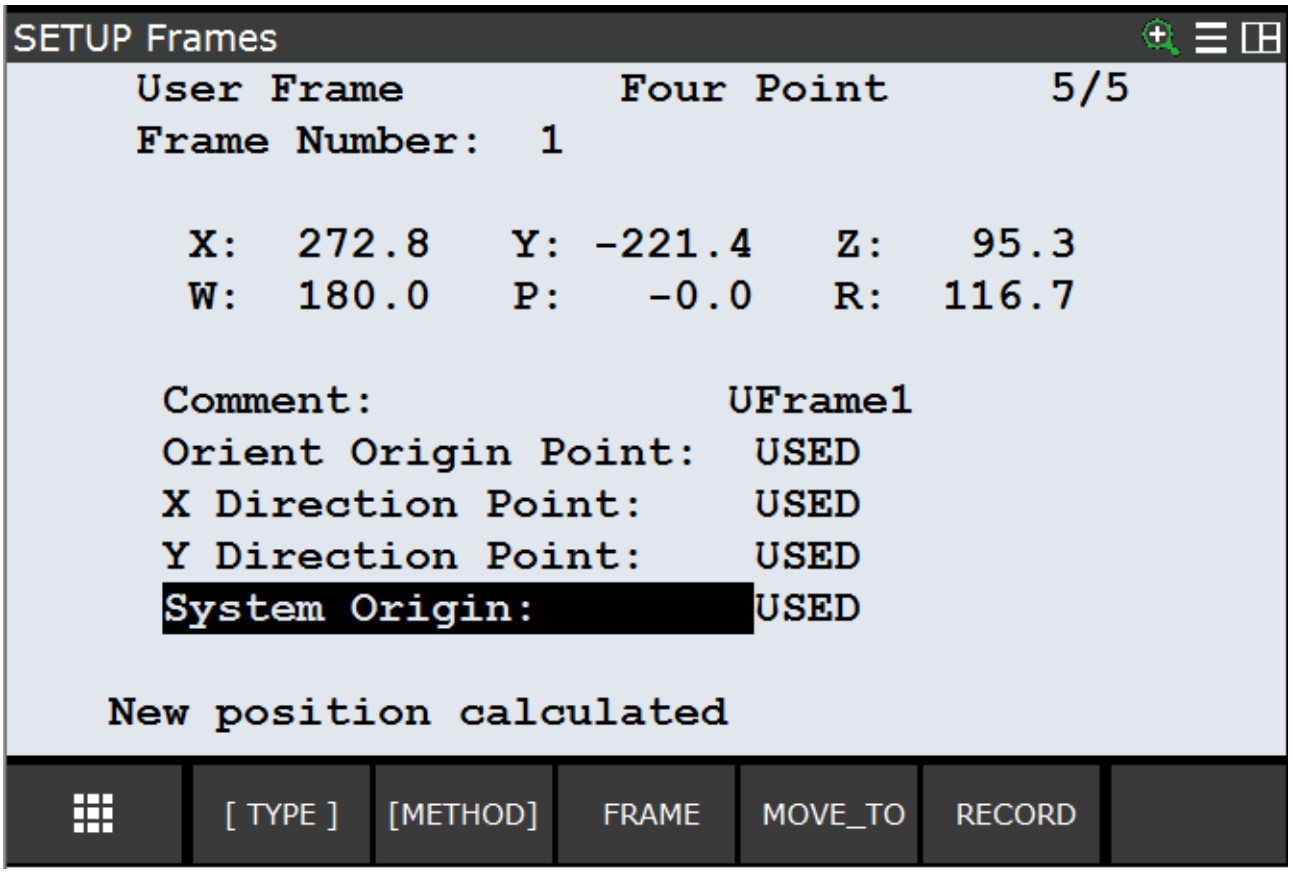
Move the robot to the third position (Y Direction Point) and record this position.



Move the robot to the last position (System Origin) and also record this last one.



After saving all 4 points, the Frame will be calculated and the XYZWPR values referring to the robot base will be written.

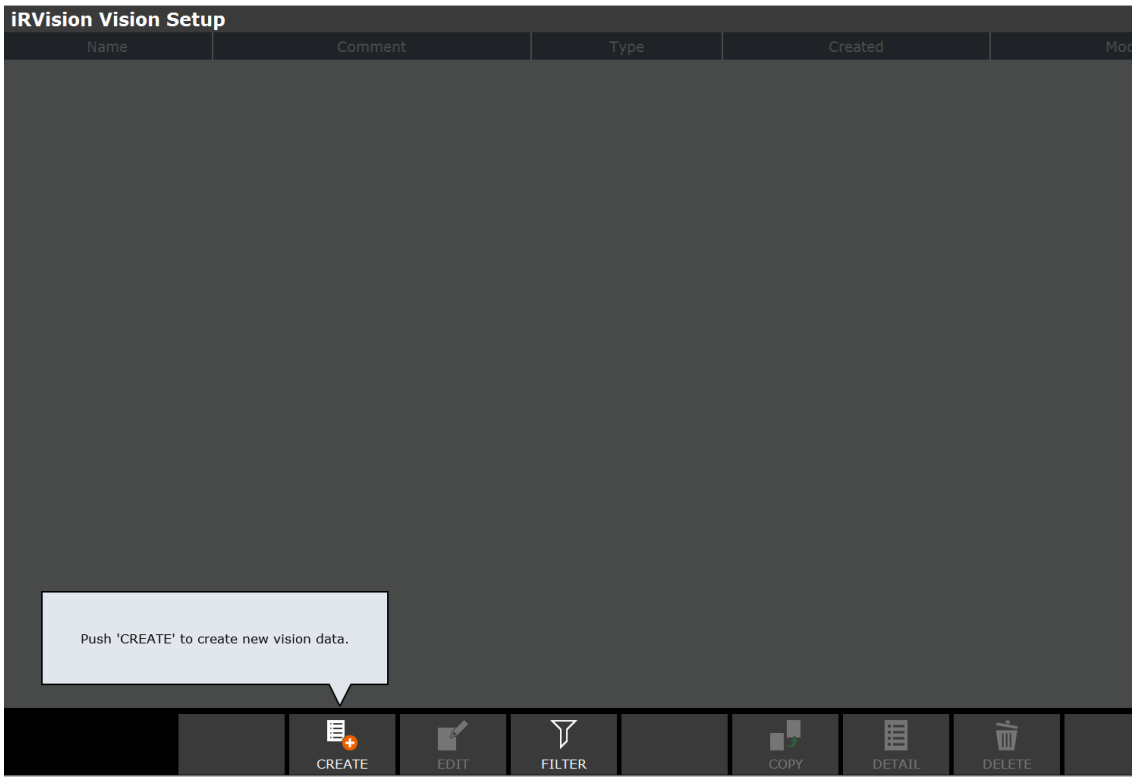


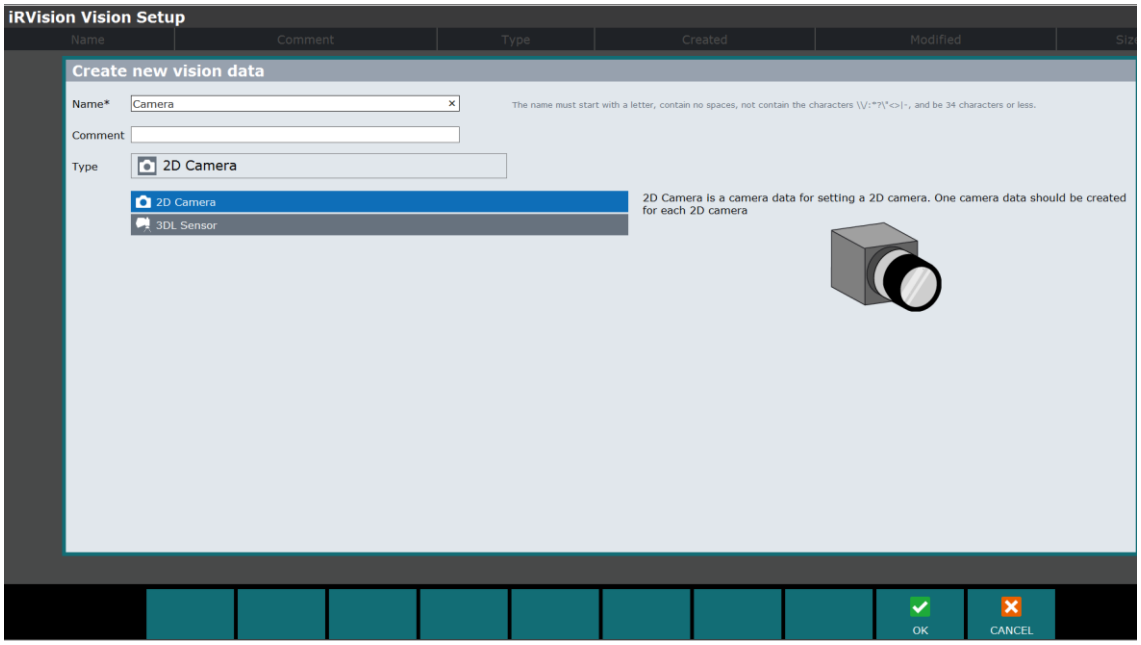
Calibrating the 2D Camera

Knowing how the User Frame and User Tool can be entered is essential to be able to calibrate the camera; below are the main steps that are necessary for correct calibration.

To access the vision menu you can use the robot's keypad (Teach Pendant) or connect via an Ethernet cable to the robot controller for convenience and quick programming.

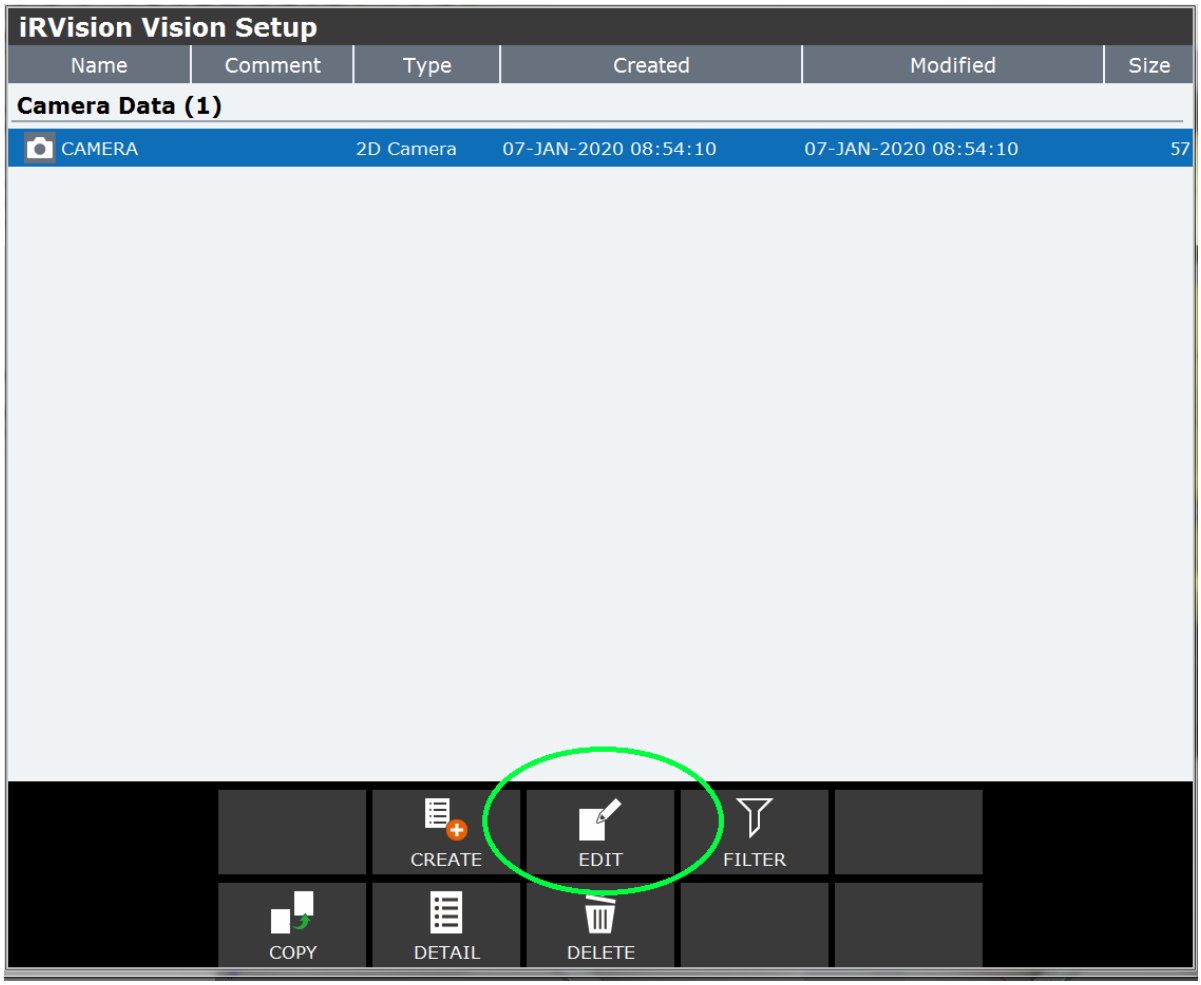
Press Menu→IRVision→Vision Setup on the Pendant



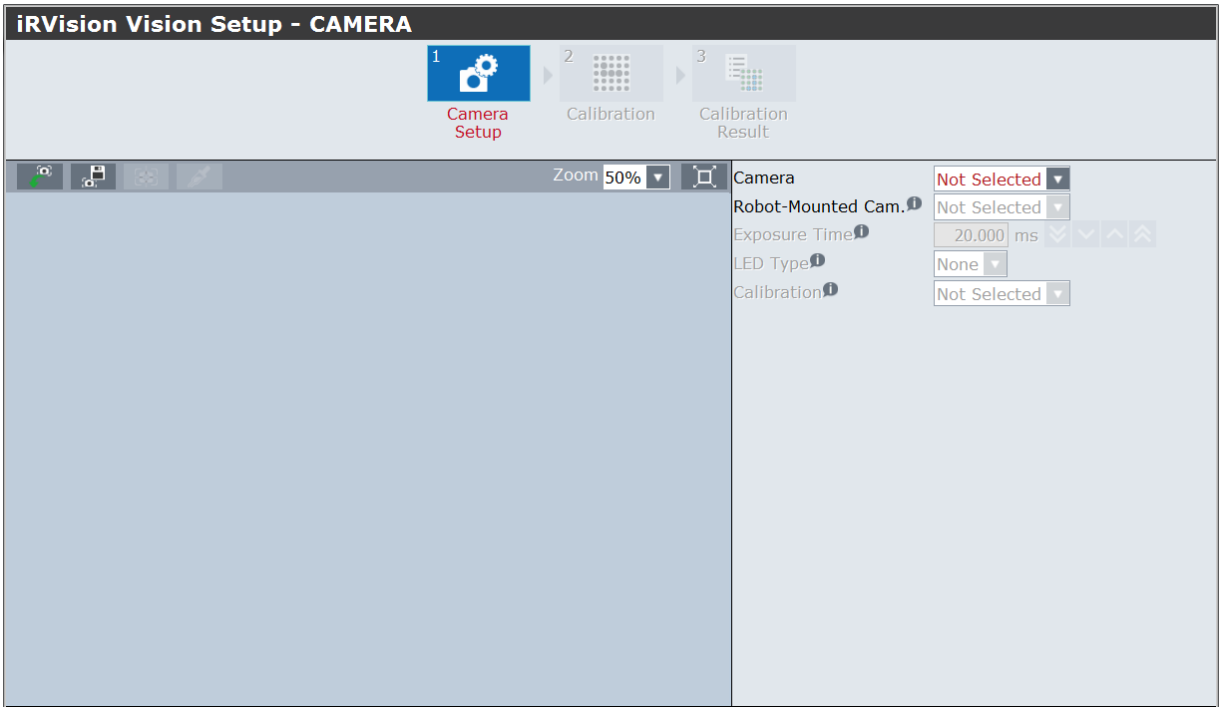


Select “2D Camera” from the menu and press “OK”

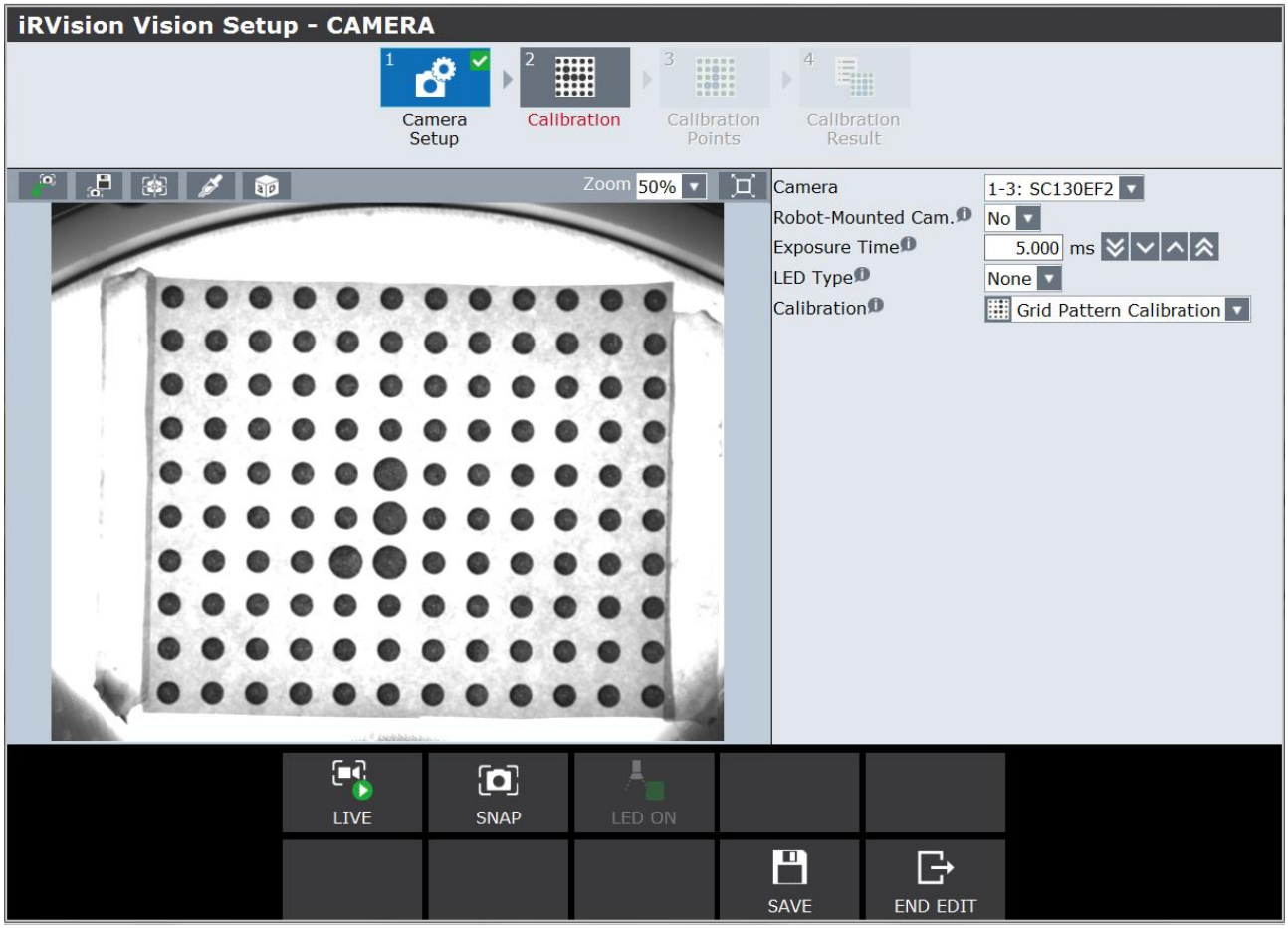
Select the newly created object and press “Edit” to be able to edit it.



The following screen will be shown



Place the calibration grid in line with the Flexibowl pick-up area and complete the fields on the right side of the page.



Camera: select the desired camera from the drop-down menu.

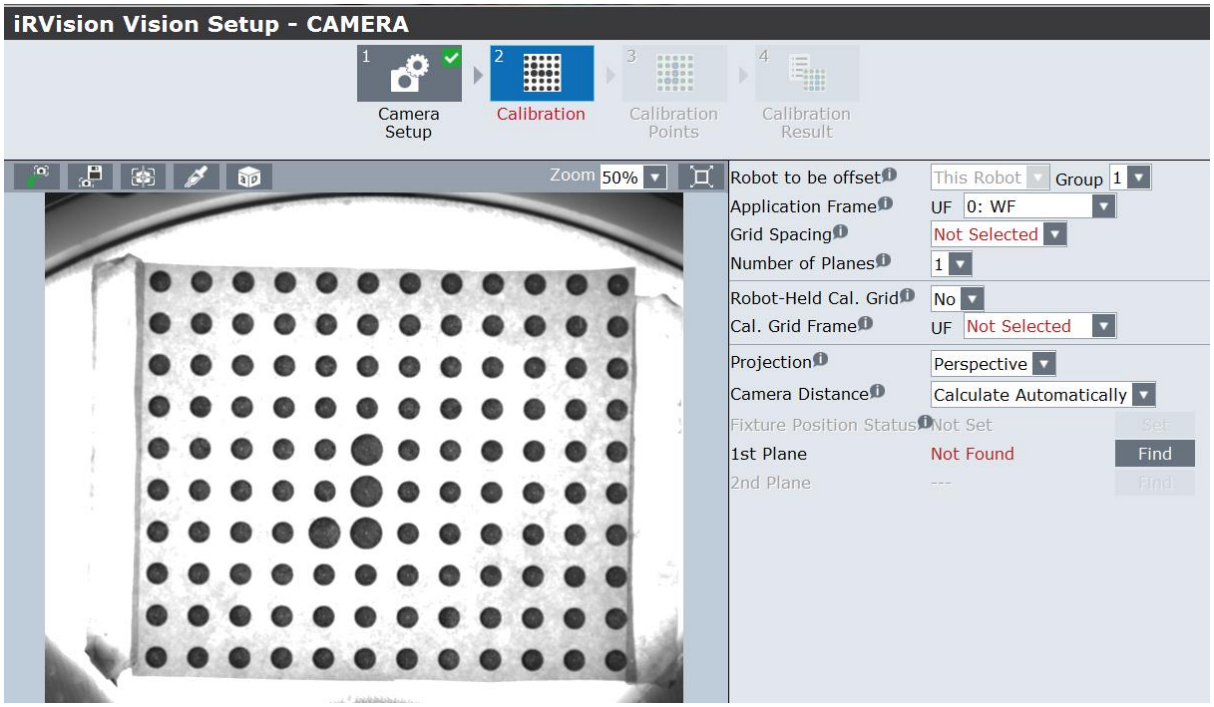
Robot-Mounted.Cam: this manual will analyse the “Standard” calibration, where the camera is placed above the vision area of the Flexibowl, at a height that varies from 850 to 1000 mm, depending on the application. Select “NO” for this type of calibration.

Exposure Time: this parameter indicates the exposure time of the camera; the image will become clearer by increasing its value.

LED Type: the Fanuc vision system is able to manage “Strobe” type lighting; the parameters relating to stroboscopic lighting can be set via this item. In the example given, the lighting is always on, therefore, “NO” will be selected.

Calibration: from the drop-down menu you can select 2 types of calibration; select the “Grid Pattern Calibration” item.

Select “Calibration” from the menus at the top

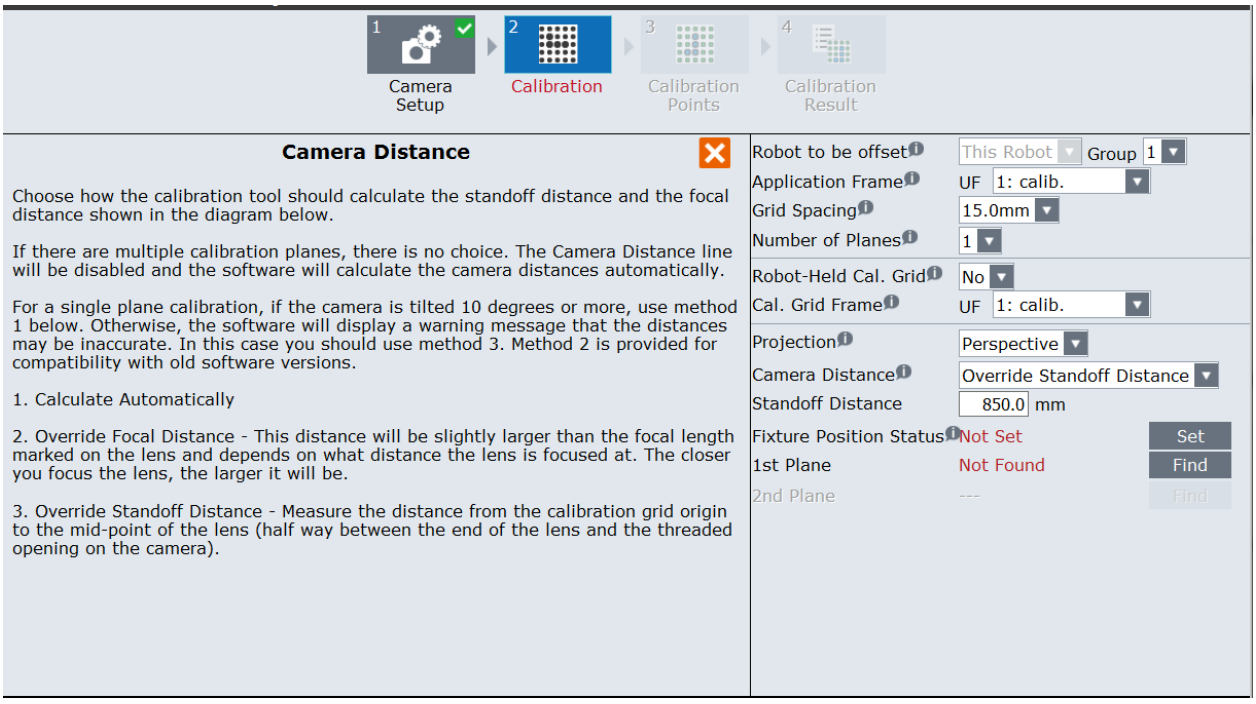


Application Frame: set the User Frame number that will be recorded on the calibration grid.

Grid Spacing: set the centre-to-centre distance between the markers in the calibration grid.

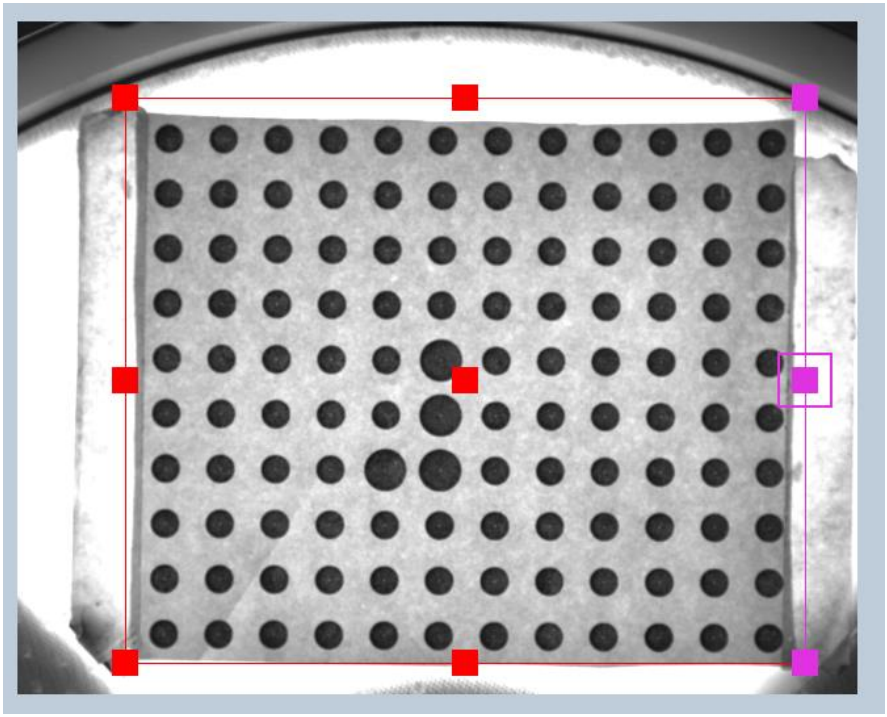
Cal. Grid Frame: set the User Frame number that will be recorded on the calibration grid.

Camera Distance: for better calibration, select “Override Standoff Distance” and enter the distance between the calibration plane and the midpoint of the lens.



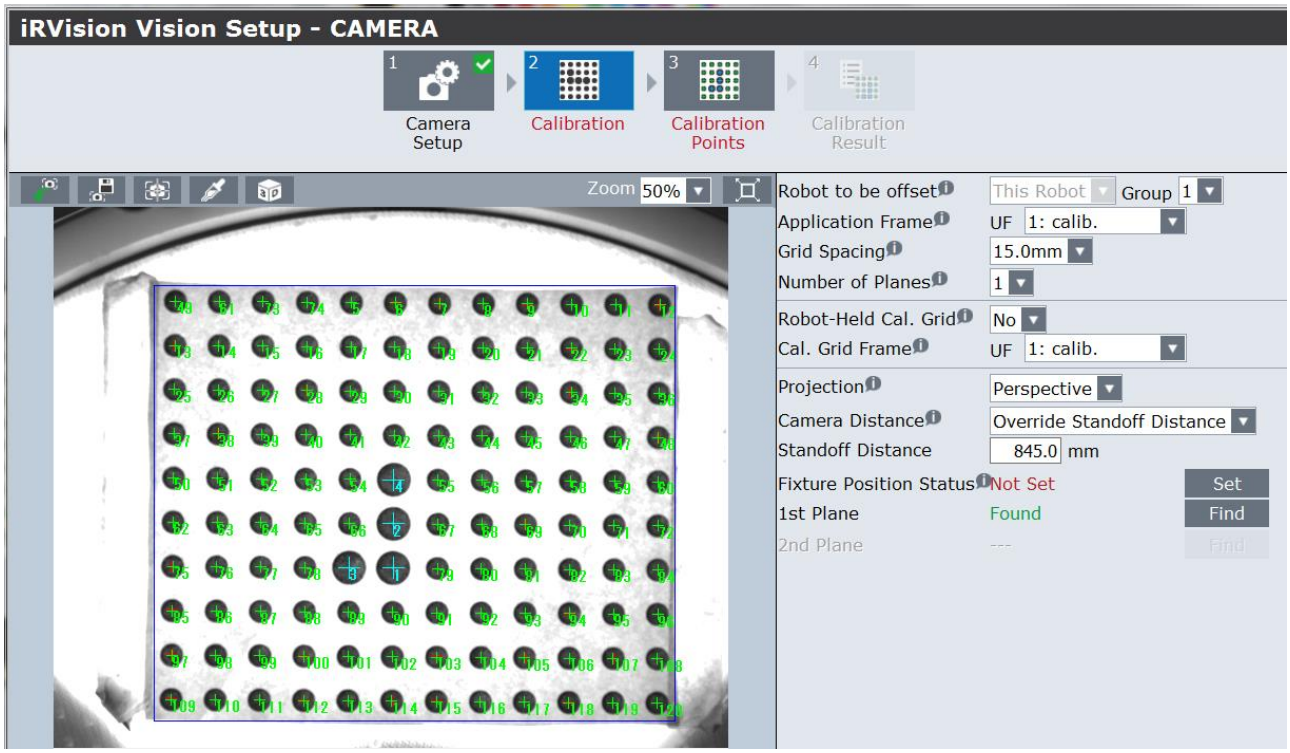
Once the necessary parameters have been set in order to perform correct calibration, place and secure the grid in the vision area of the Flexibowl.

Then press “Find” to select the search area. Resize the search rectangle to include the grid inside, as shown in the photo below,



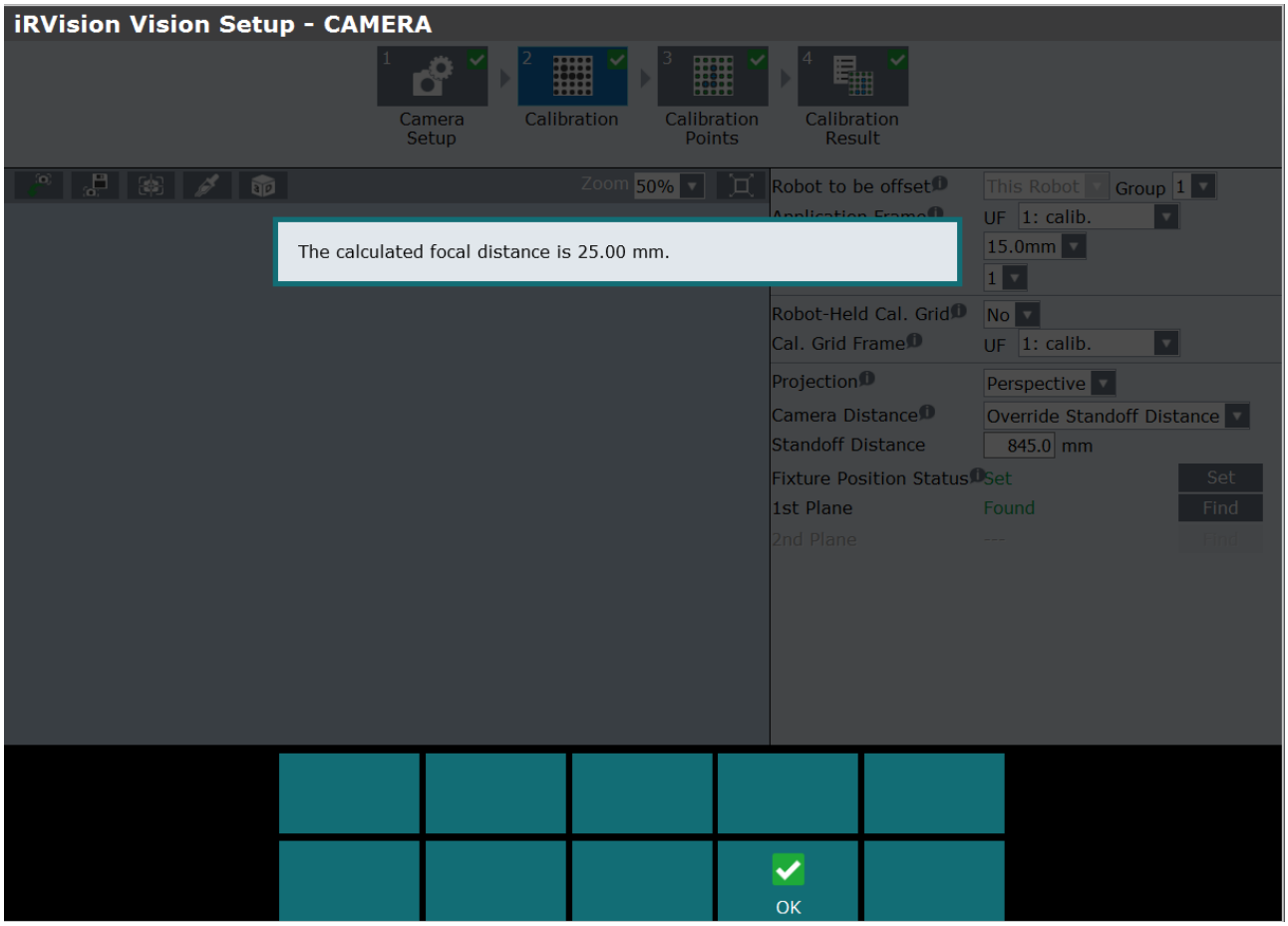
The vision system will identify all the circles it will be able to recognise, with a cross reference.

For optimal calibration, all the points on the grid must be recognised.



From the moment the photo is taken and the markers of the calibration grid are identified, this must not be moved, otherwise the calibration will not be accurate.

Press “SET” to check the lens calculated by the vision system.



If the data entered are correct, the data relating to the focal length of the lens used will be given. It is important to compare this data with the actual one of the lens used; if there are significant differences, check the entered data.

If the given value conforms to the lens used, save and close the vision process,

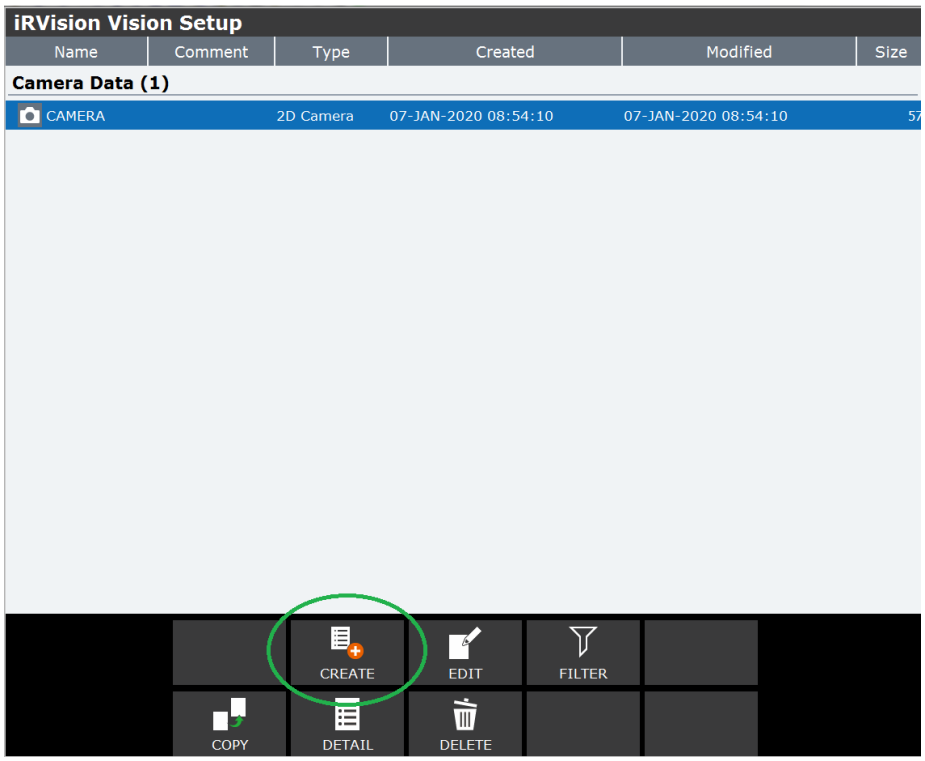
The last step to conclude the calibration procedure is to record the Frame on the calibration grid. It is important to <u>never</u> move the calibration grid before the end of the procedure.

Creating a Model

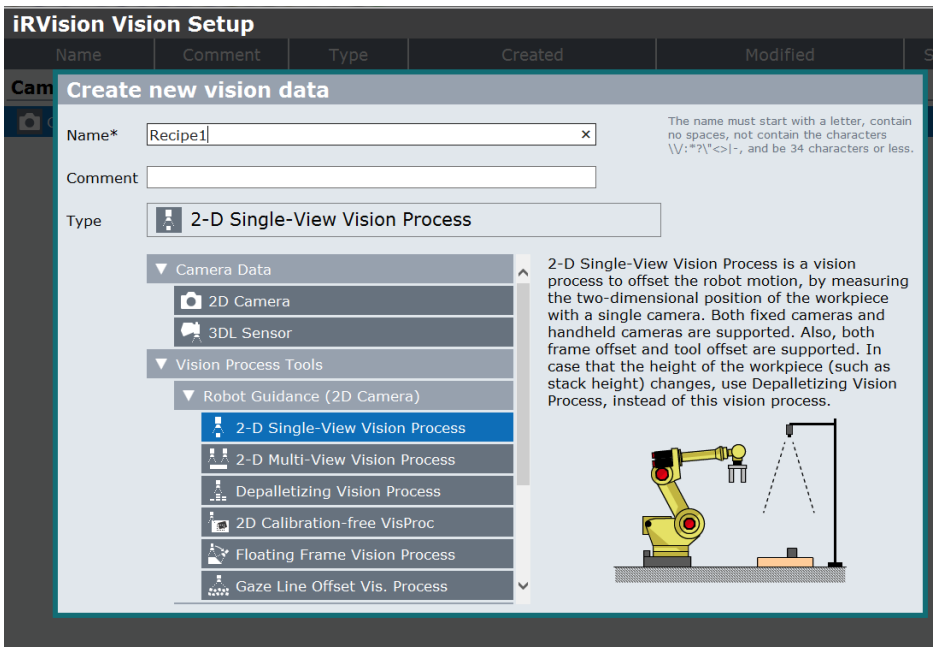
The following will show how to create a model of the object that will need to be handled.

To access the vision menu you can use the robot's keypad (Teach Pendant) or connect via an Ethernet cable to the robot controller for convenience and quick programming.

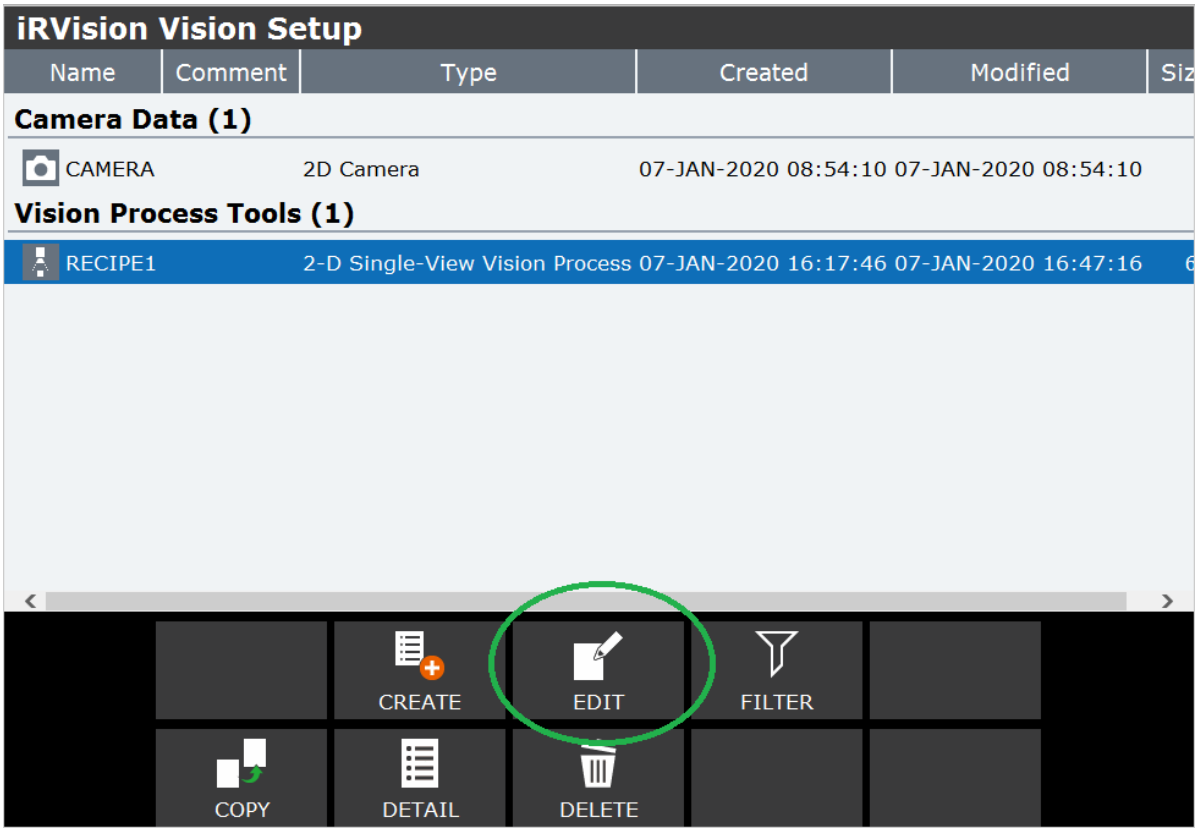
After opening the vision page, you must create a new process relating to the object to be recognised.

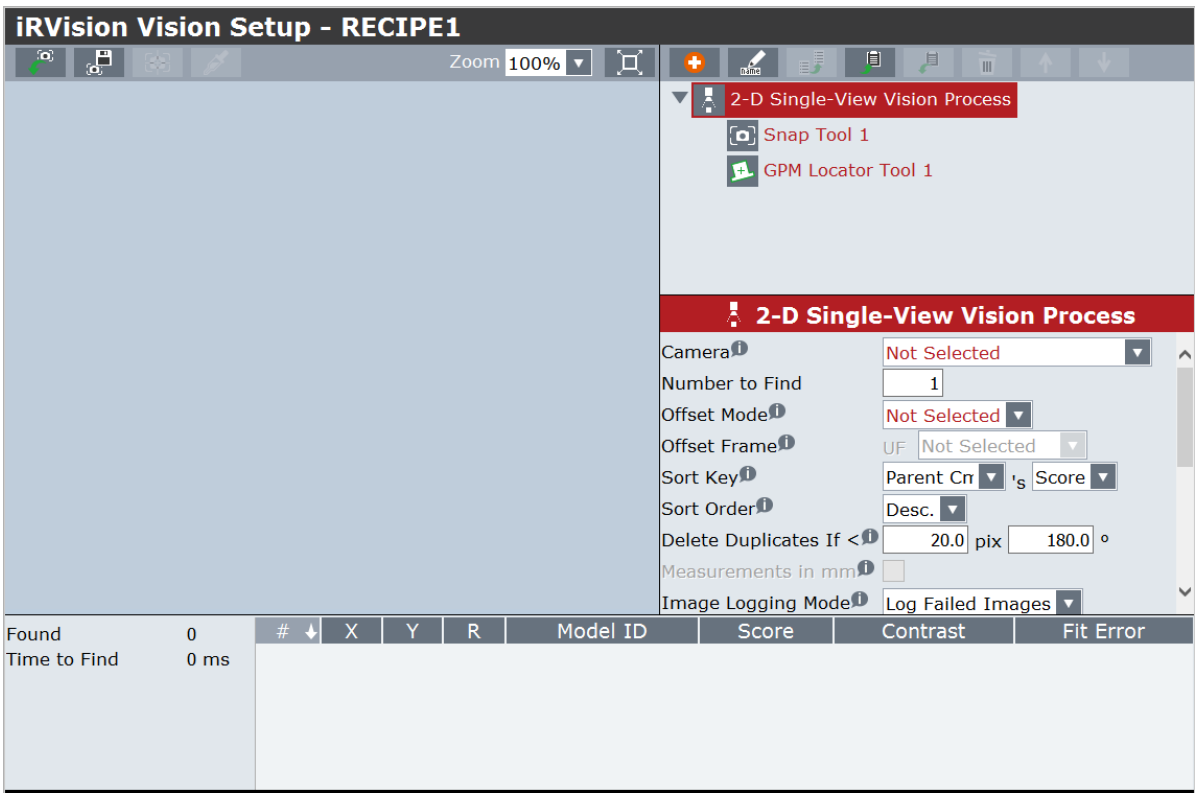


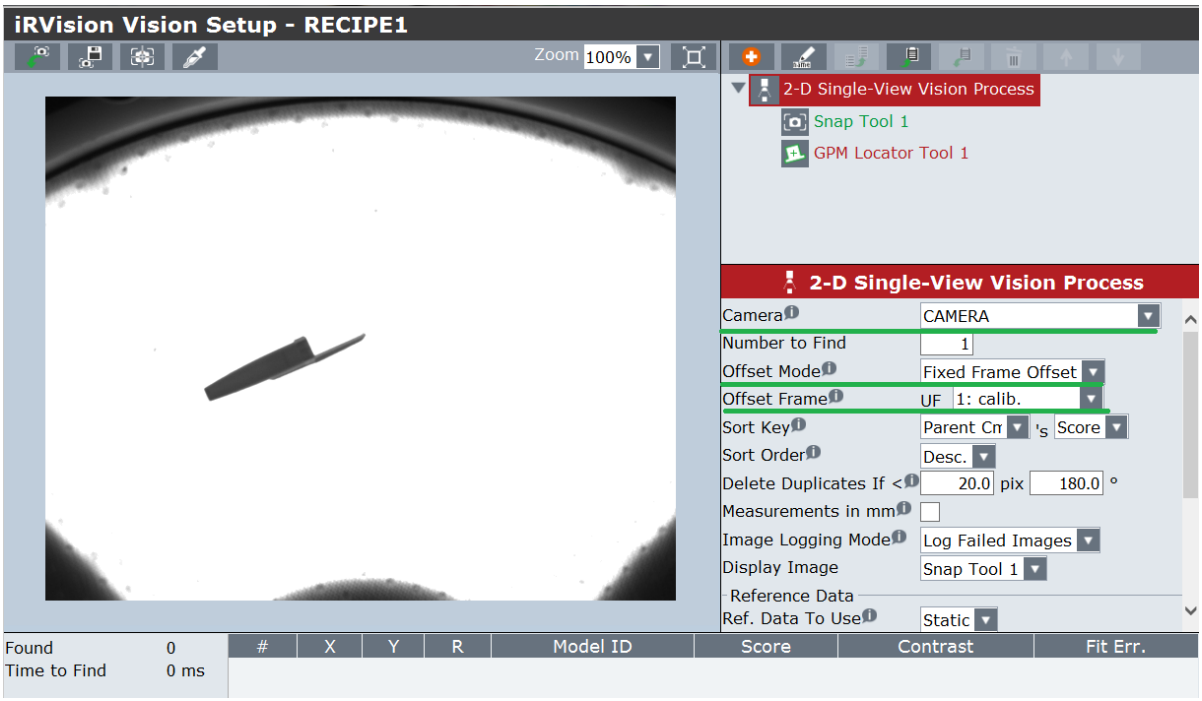
Select “2-D Single-View Vision Process” and set a name for the product.



Select the vision process and press “Edit”





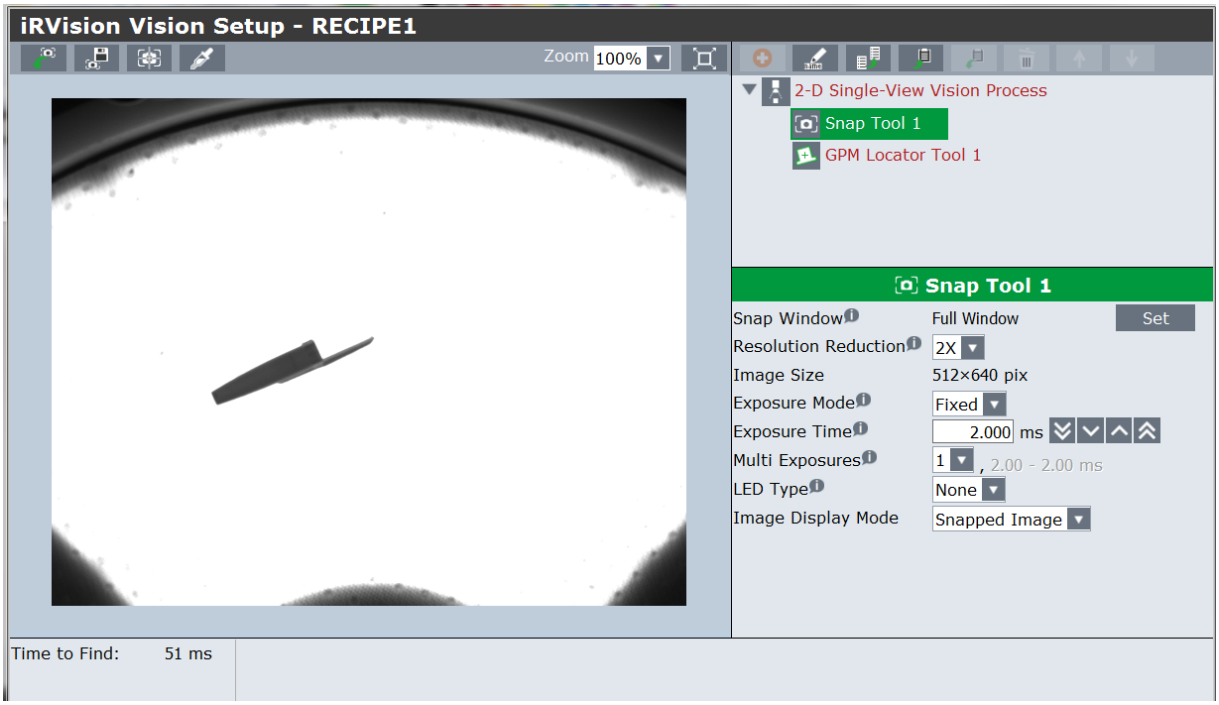


Camera: set the correct camera.

Offset Mode: select “Fixed Frame Offset”

Offset Frame: choose and set the frame number on which the calibration was recorded

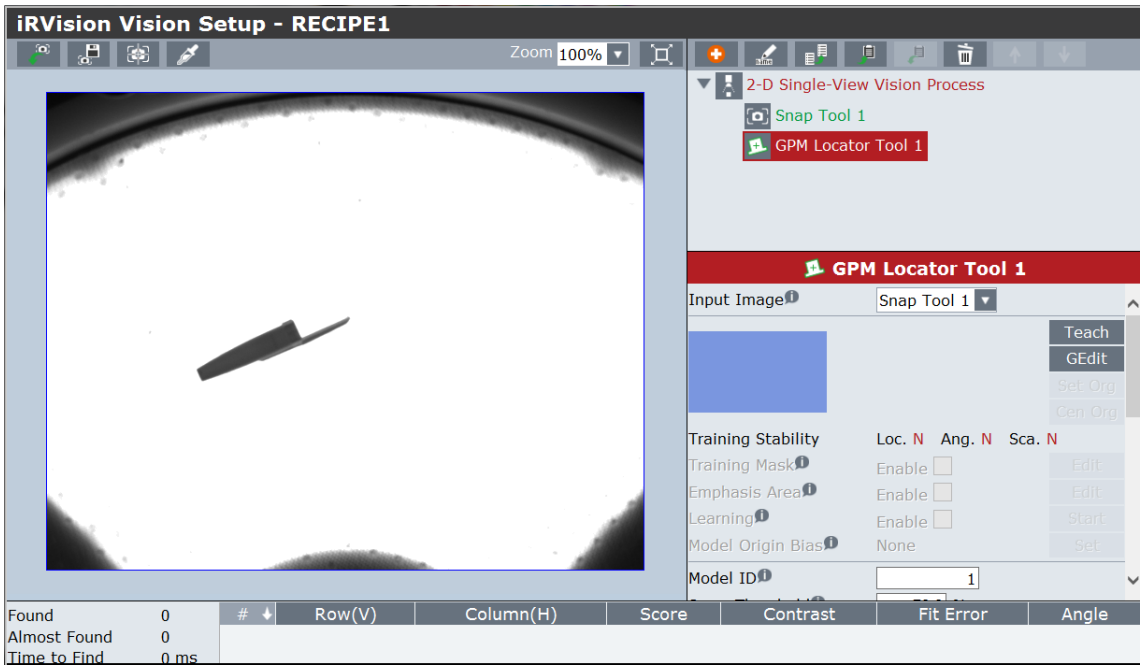
Then select the “Snap Tool 1” submenu



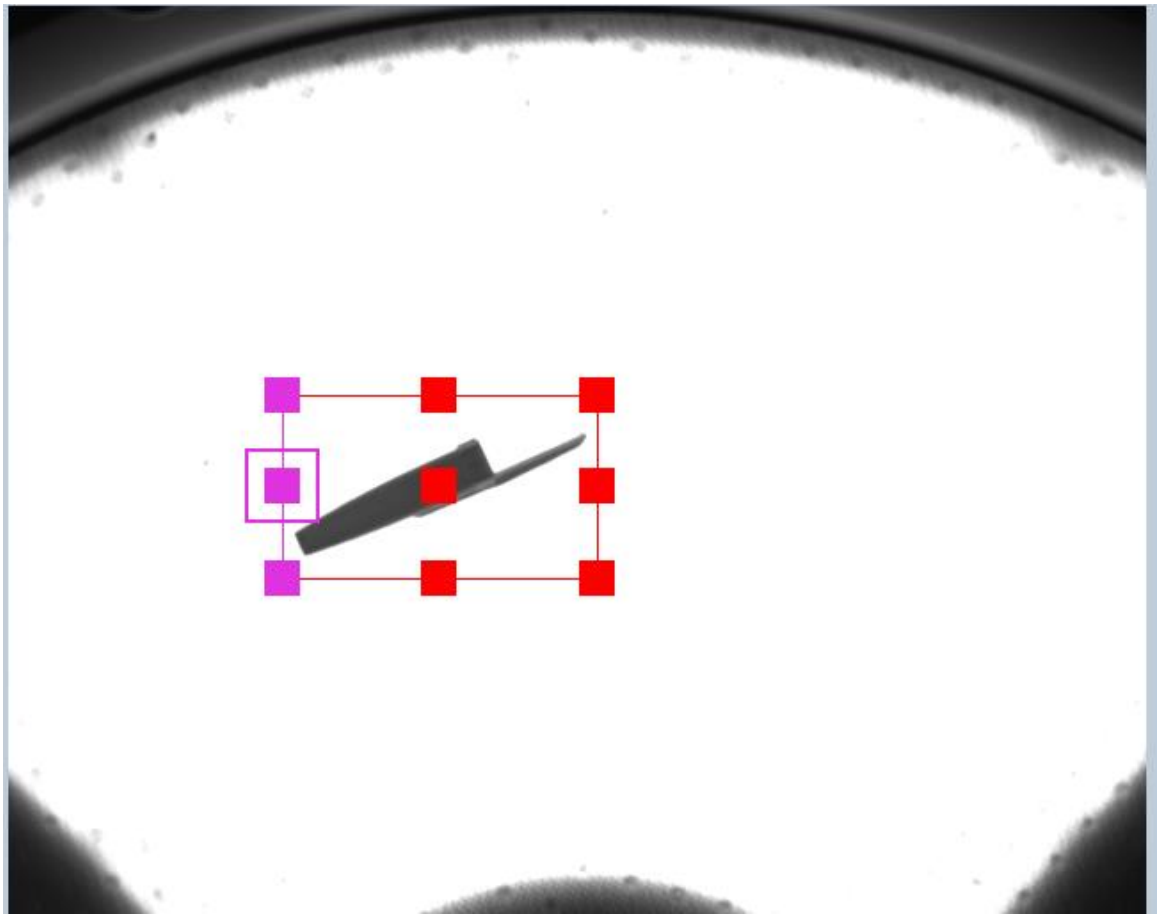
From this page, you can adjust the exposure time of the image and the resolution you want to work on; the higher the resolution, the longer the processing time.

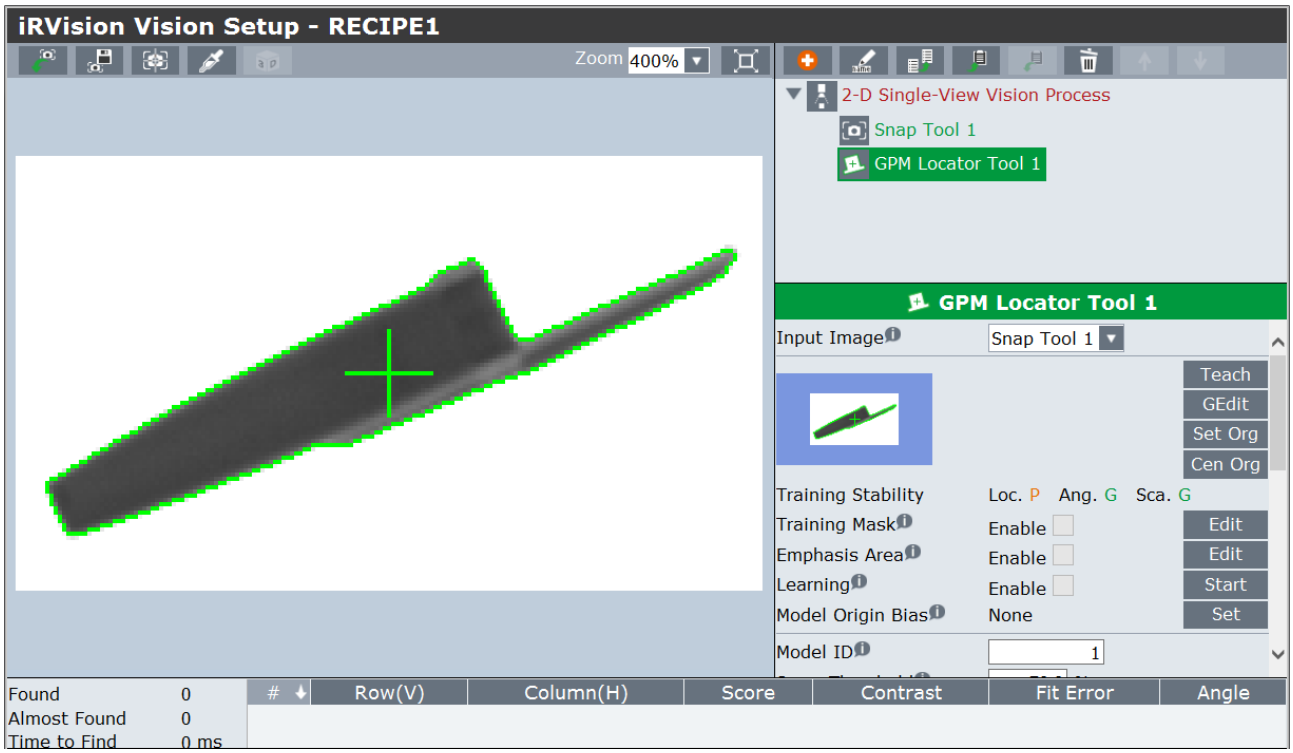
Select the “GPM Locator Tool 1” tab to proceed with the creation of the model.

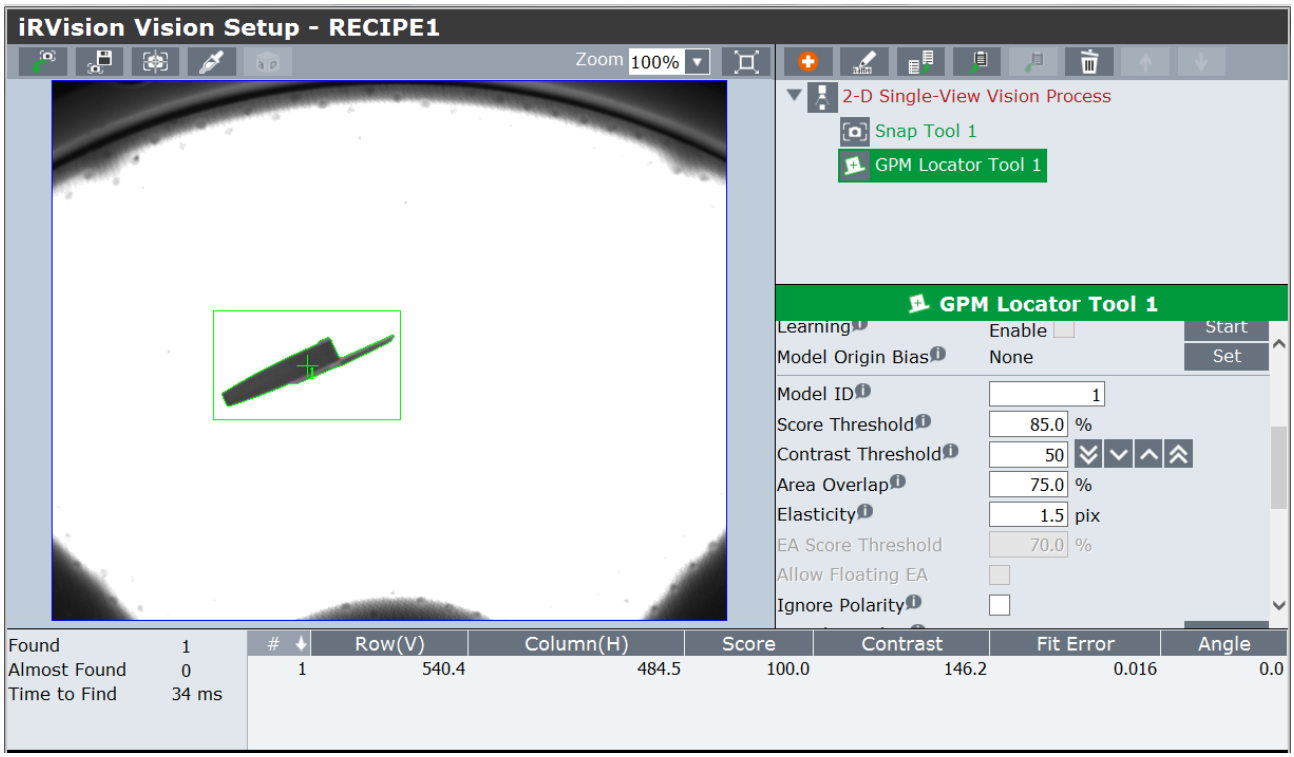
Place a piece at the centre of the vision area and press “Teach” to learn the new model.



Resize the search rectangle, making sure to include the object model inside it







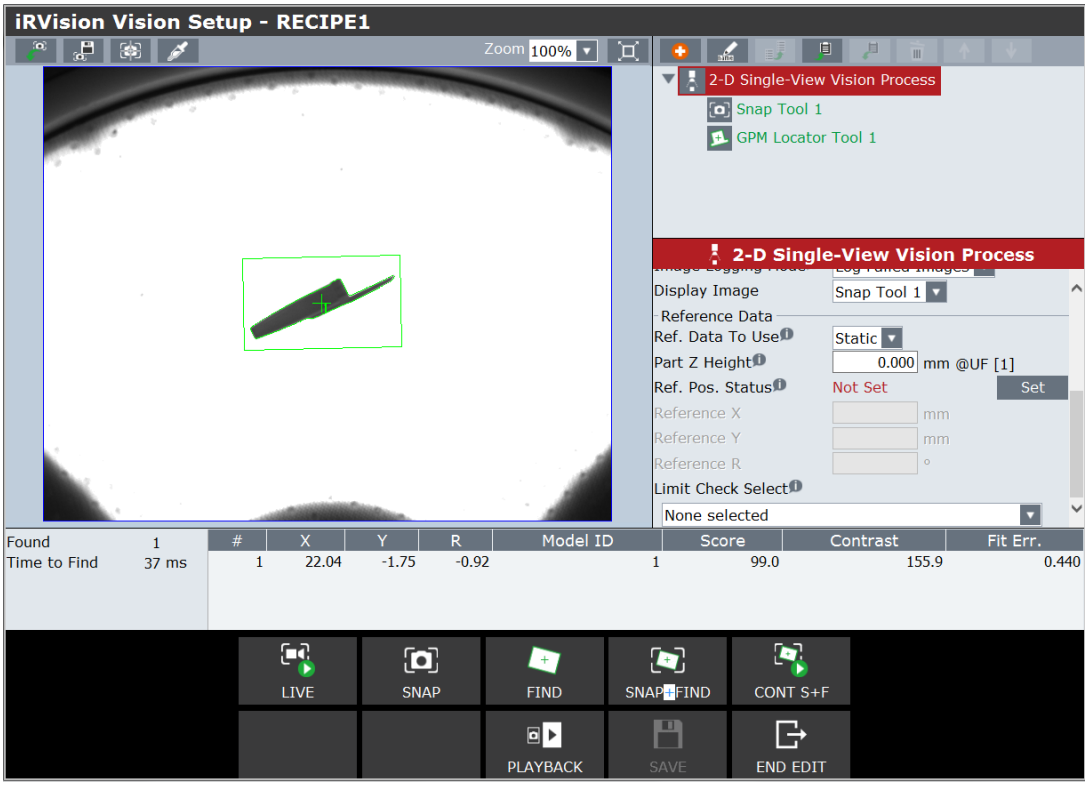
Score Threshold: this parameter sets the minimum recognition percentage.

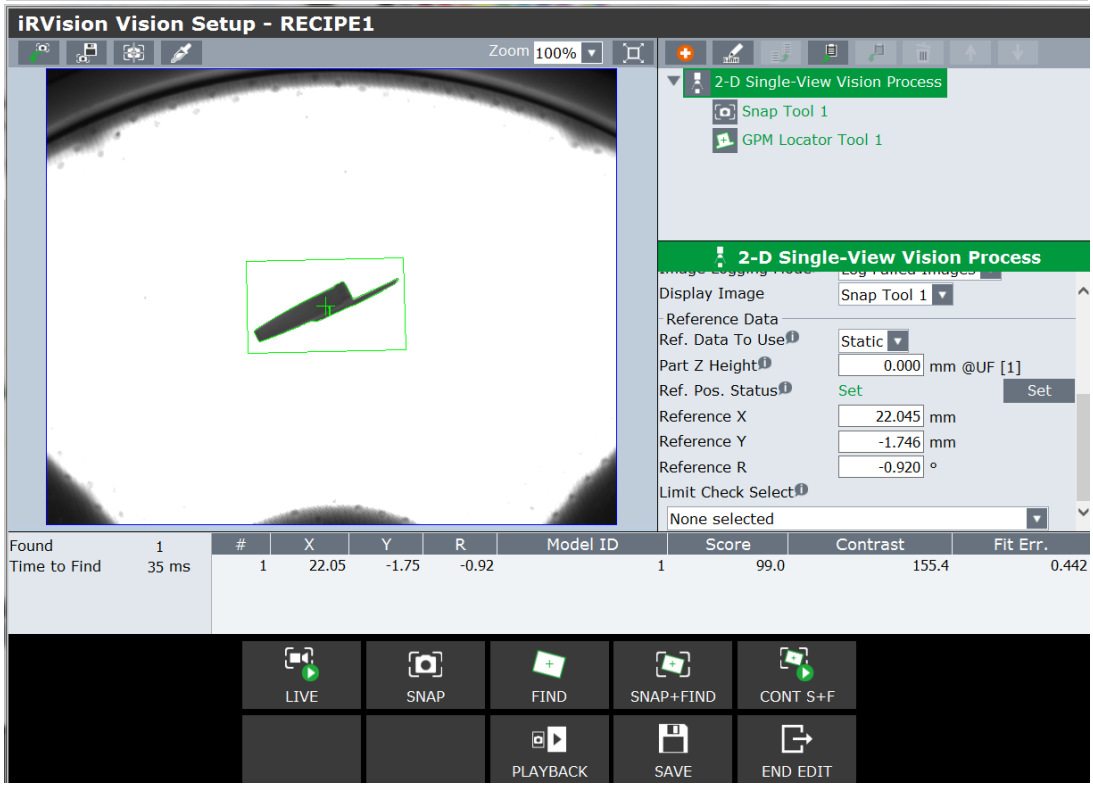
Contrast Threshold: this parameter establishes the minimum contrast threshold; transparent pieces require lower thresholds.

Elasticity : this parameter sets the recognition elasticity: the points that make up the model can deviate from the number of pixels specified in this variable, compared to the previously set master model.

Go to the home screen: “2-D Single-View Vision Process” and press “Snap+Find”

After checking that the vision system correctly recognises the objects, press “Set” to define the reference position of the object.





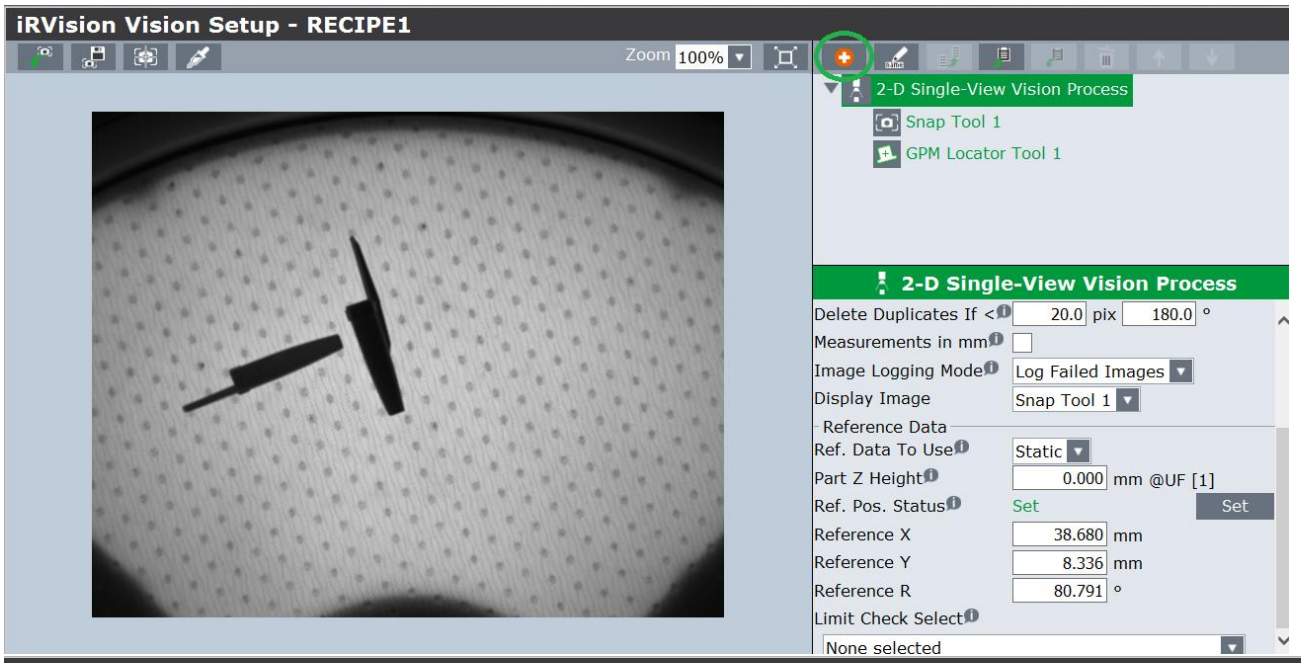
Save and exit from the vision process.

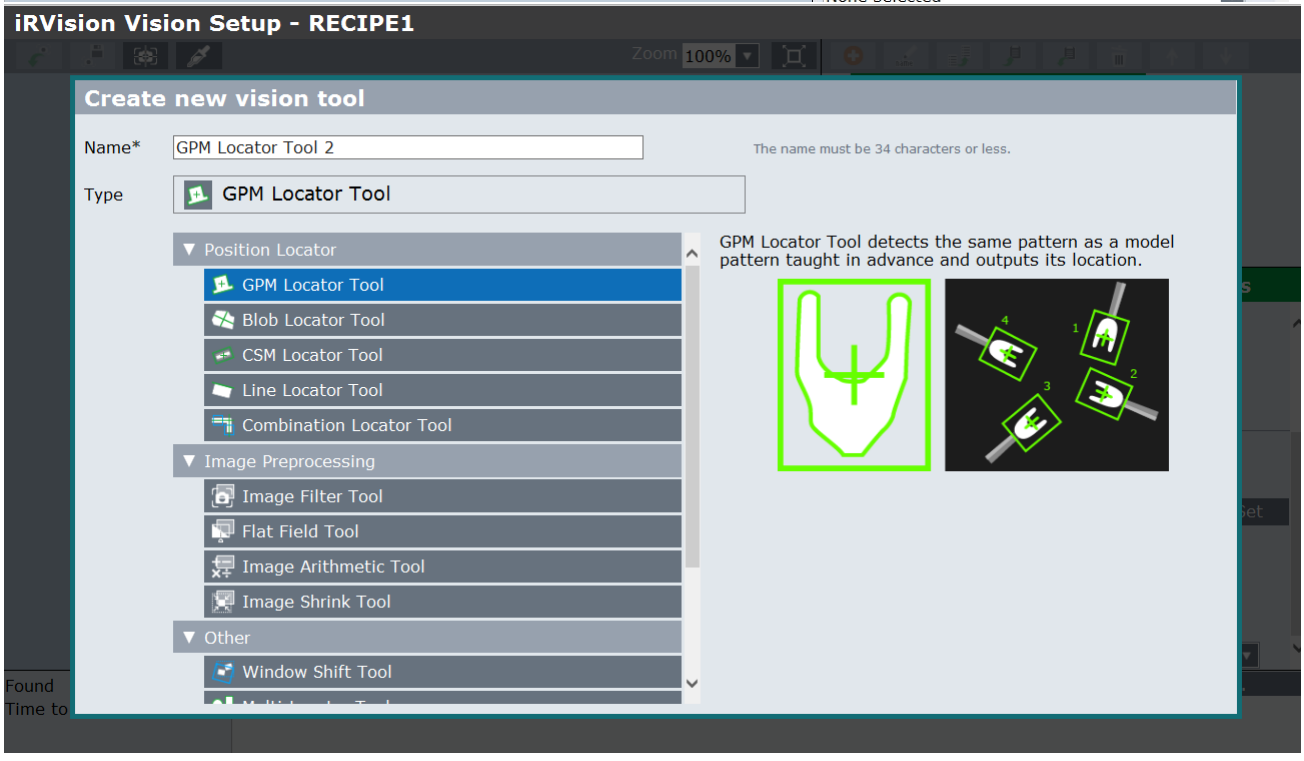
Creating a second model

If the application requires recognition of multiple models, the following shows how to add the second-third model.

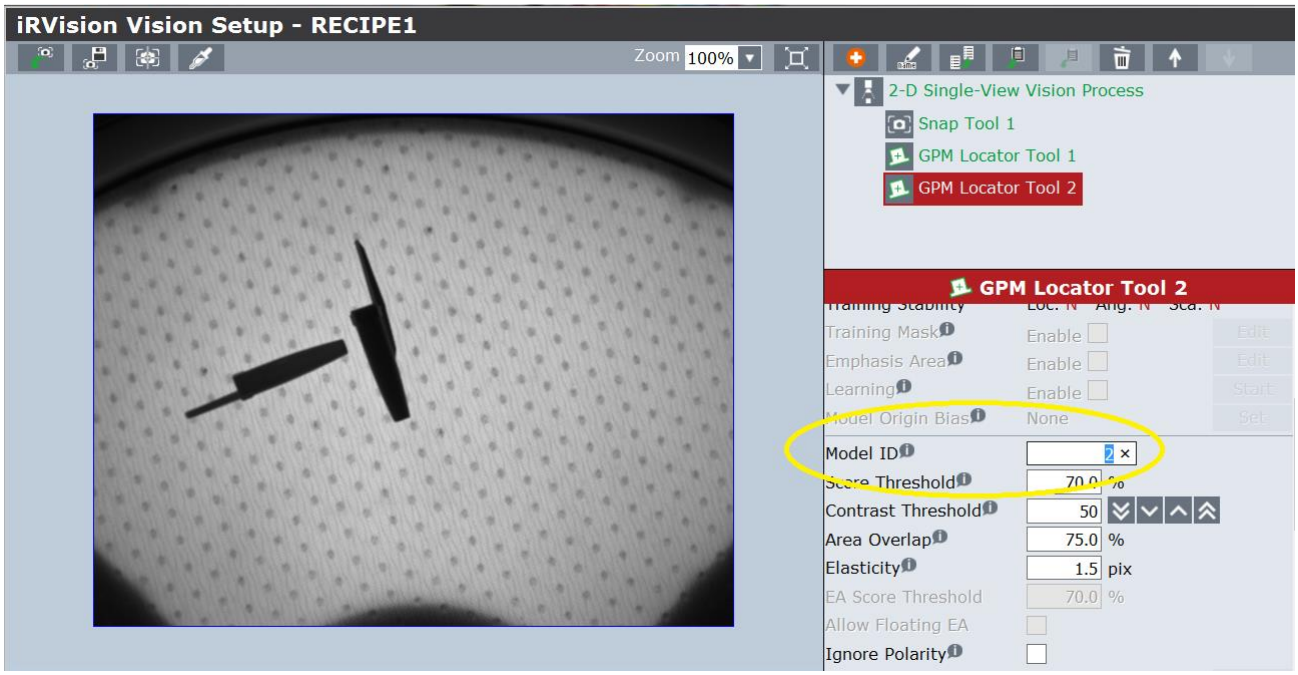
The addition of the models can be useful when there are pieces inside the Flexibowl or when the usual piece must be picked from multiple layouts.

From the previously created vision process, select the main tool “2D Single-View Vision Process” and press the “+” button to add a new “Locator Tool”

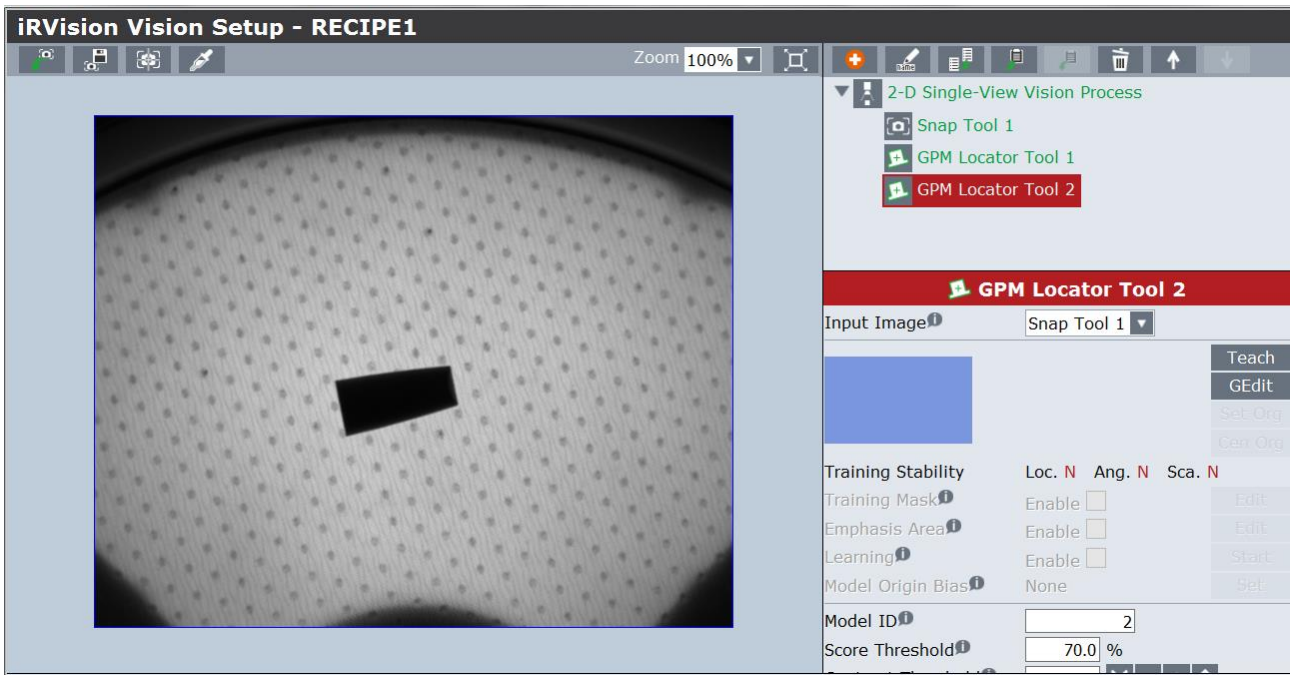




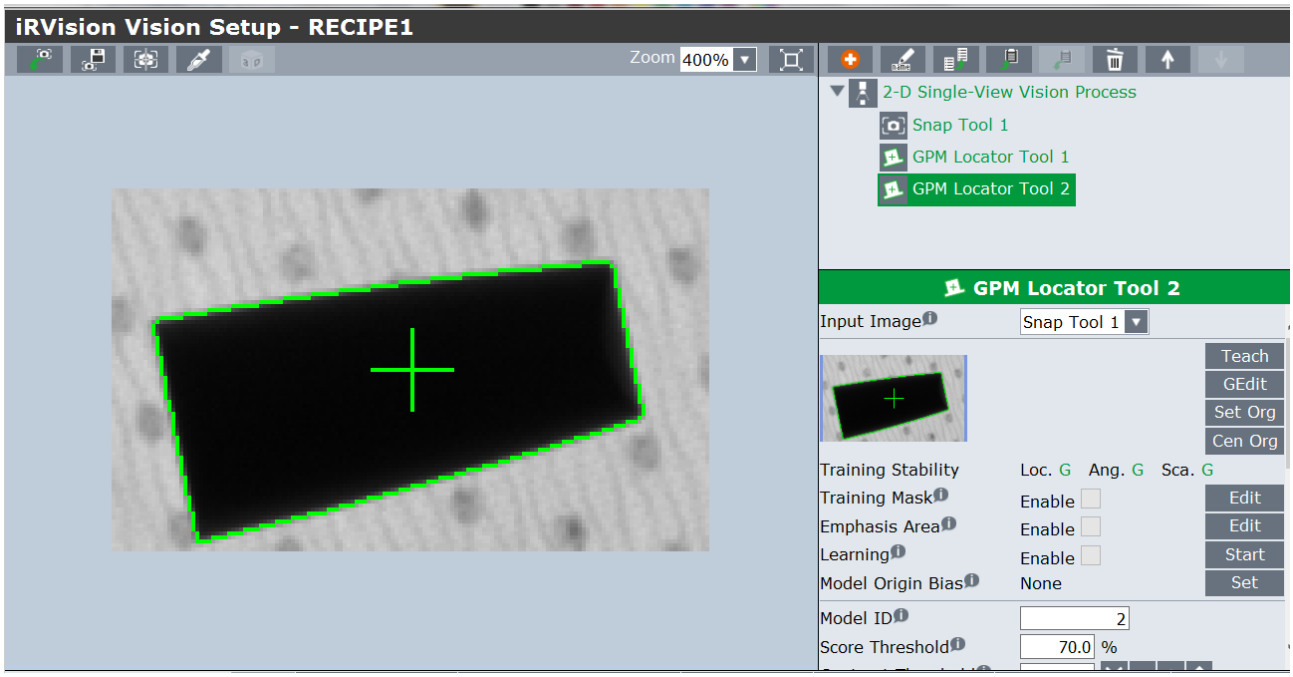
Specify value 2 in "Model ID", this is very important to distinguish the 2 models.



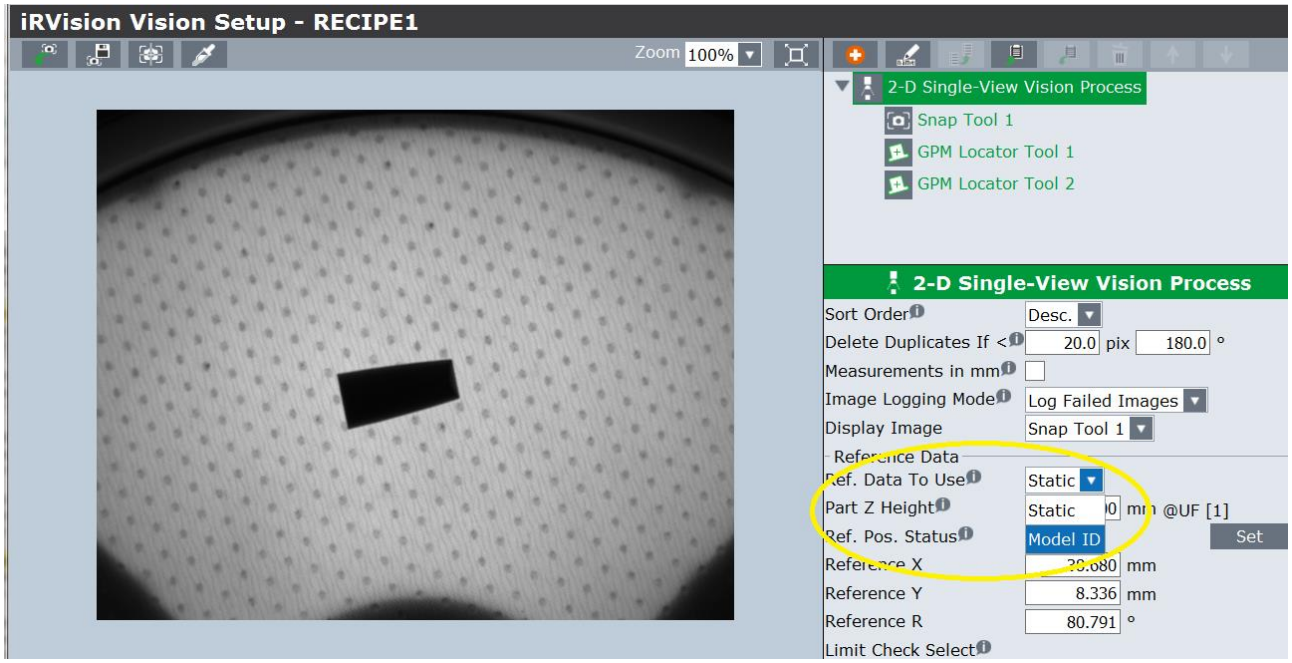
Place the new piece under the vision area and press "Teach" to create the model.



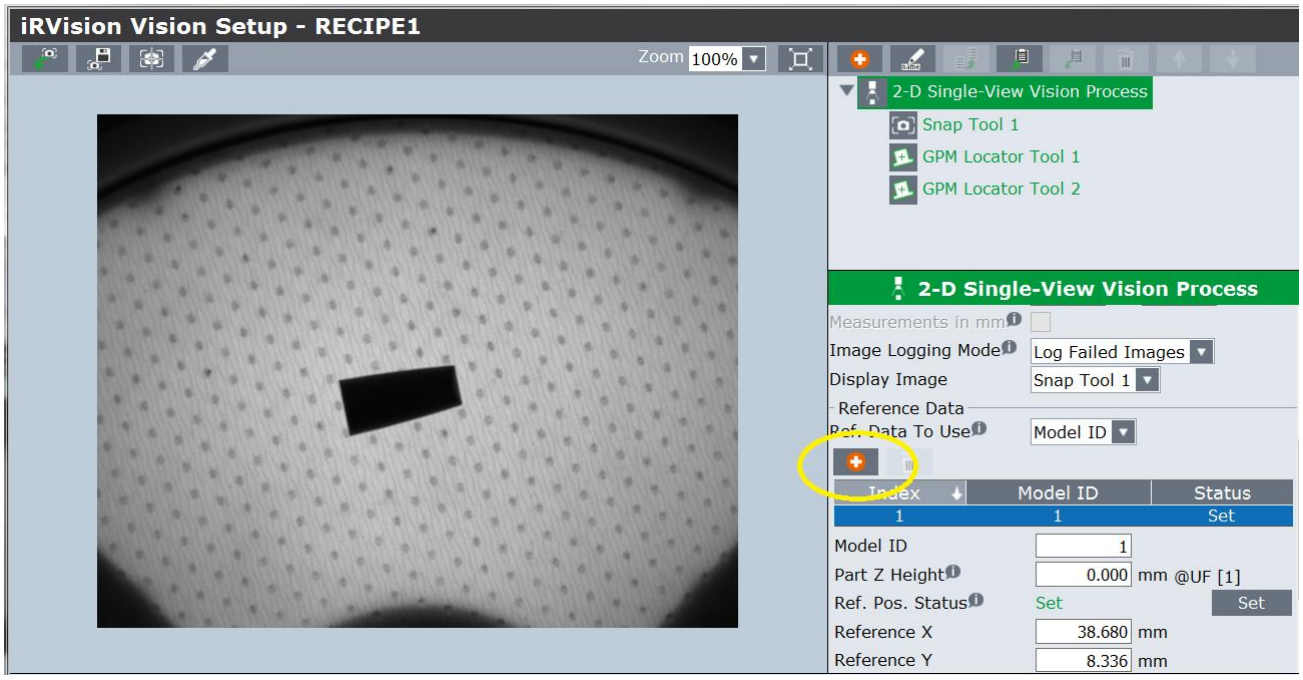
In this example, a model of a different component will be created but the procedure is the same even if 2 models must be created, associated with 2 different sides of the same piece.



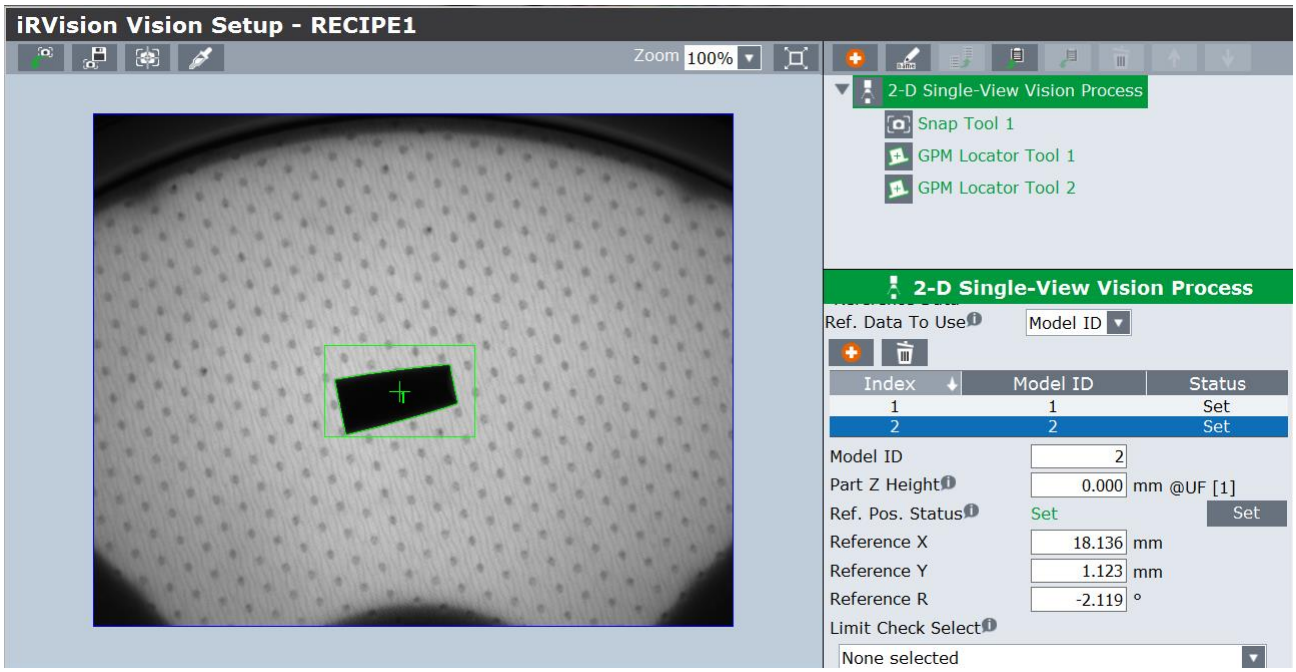
Select "2D Single-View Vision Process" and **edit "Ref data to Use" from "Static" to "Model ID"**



Press the “+” button to add a new line associated to model 2

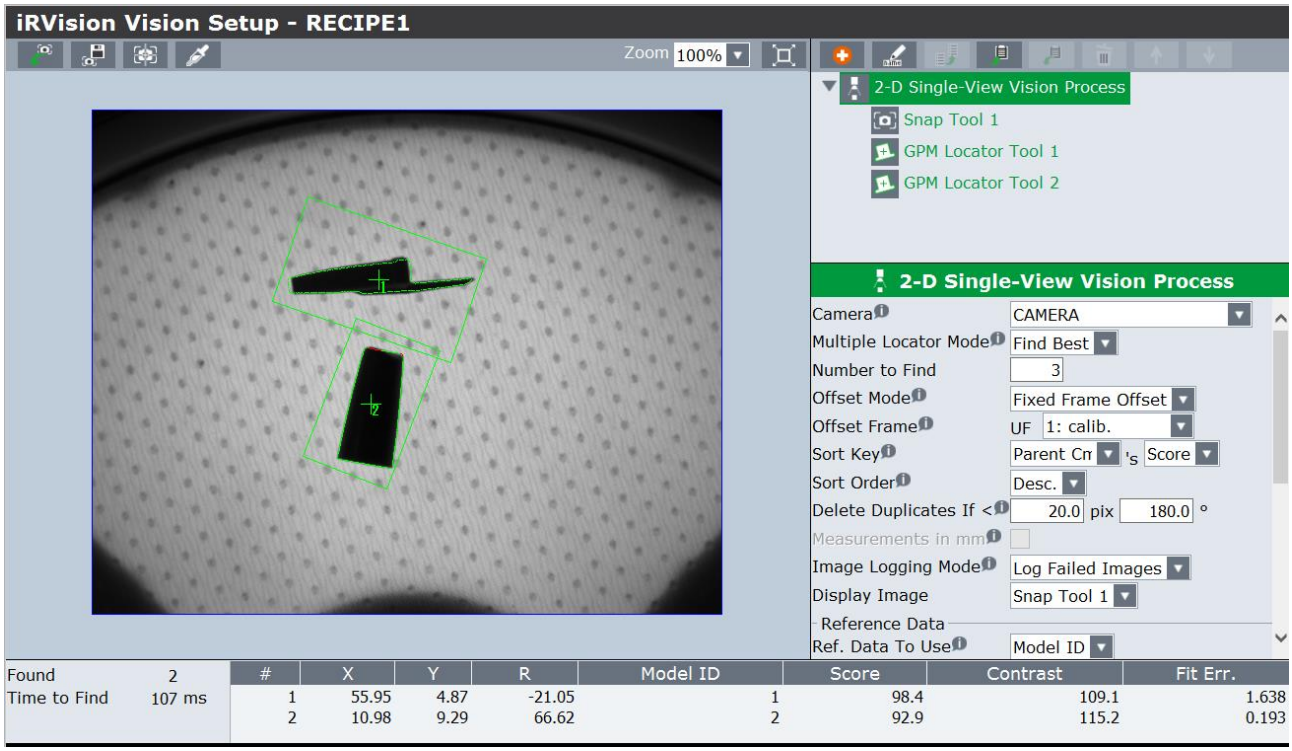


Specify the number 2 on Model ID; press “Snap+Find” and lastly, press “Set”



Increase the number of the variable “Number to Find” to 3.

By positioning both models in the vision area and pressing “Snap+Find”, the components must be recognised and identified with their own “Model ID”

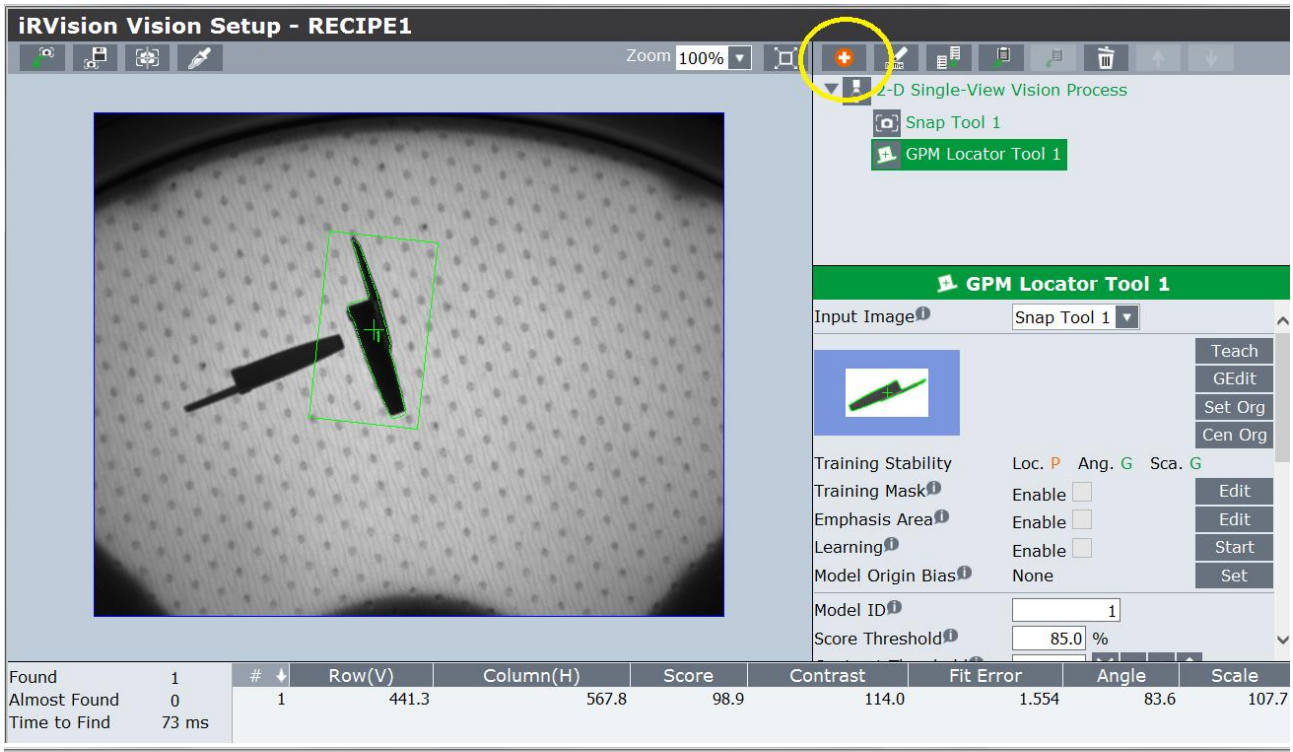


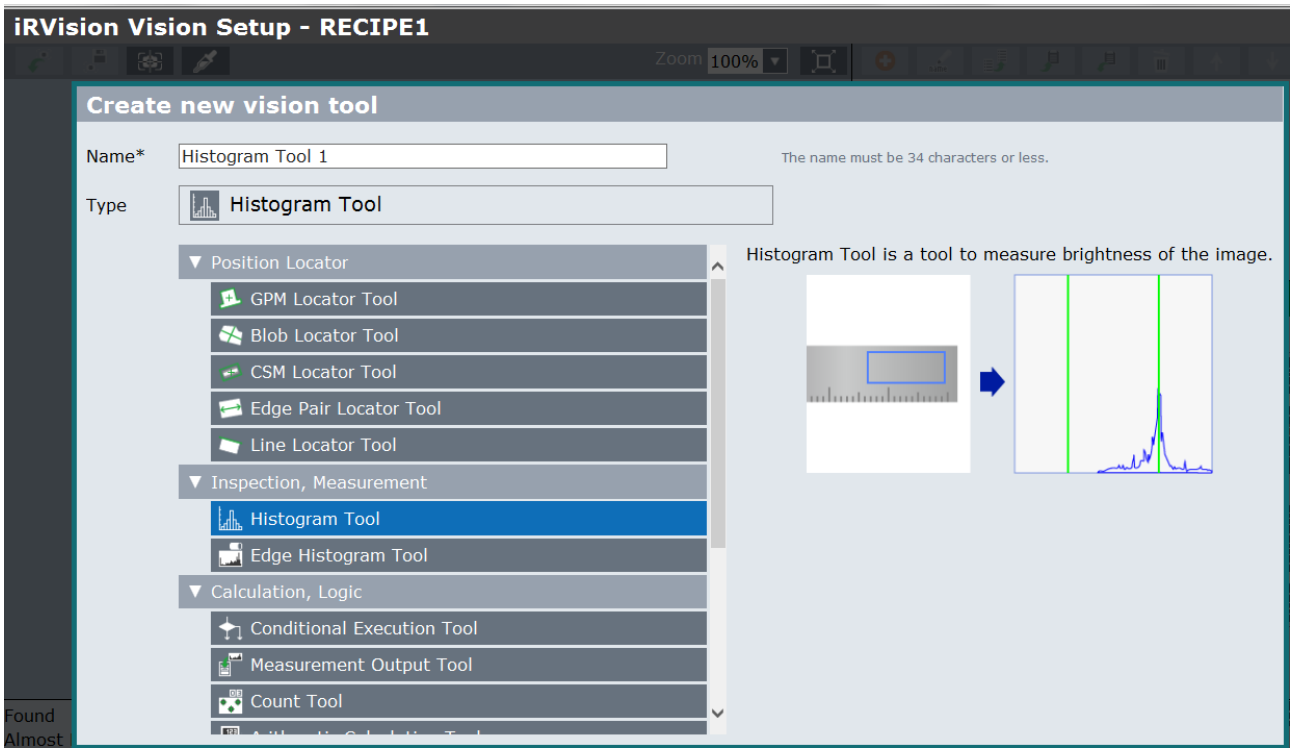
Save and exit.

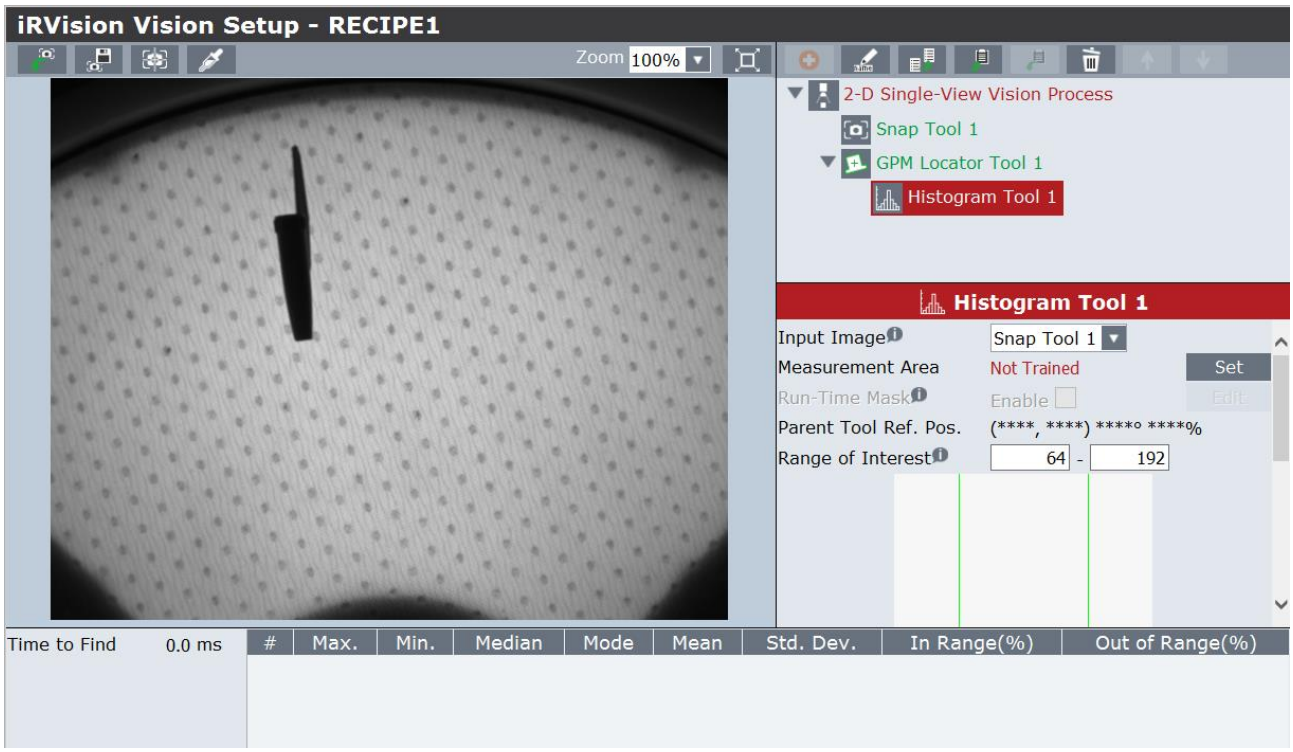
Pick-up clearance control

For applications where the gripper is used to pick up the piece, a check is usually carried out in the pick-up area so as to ensure that the piece can be picked up without bumping into other nearby objects.

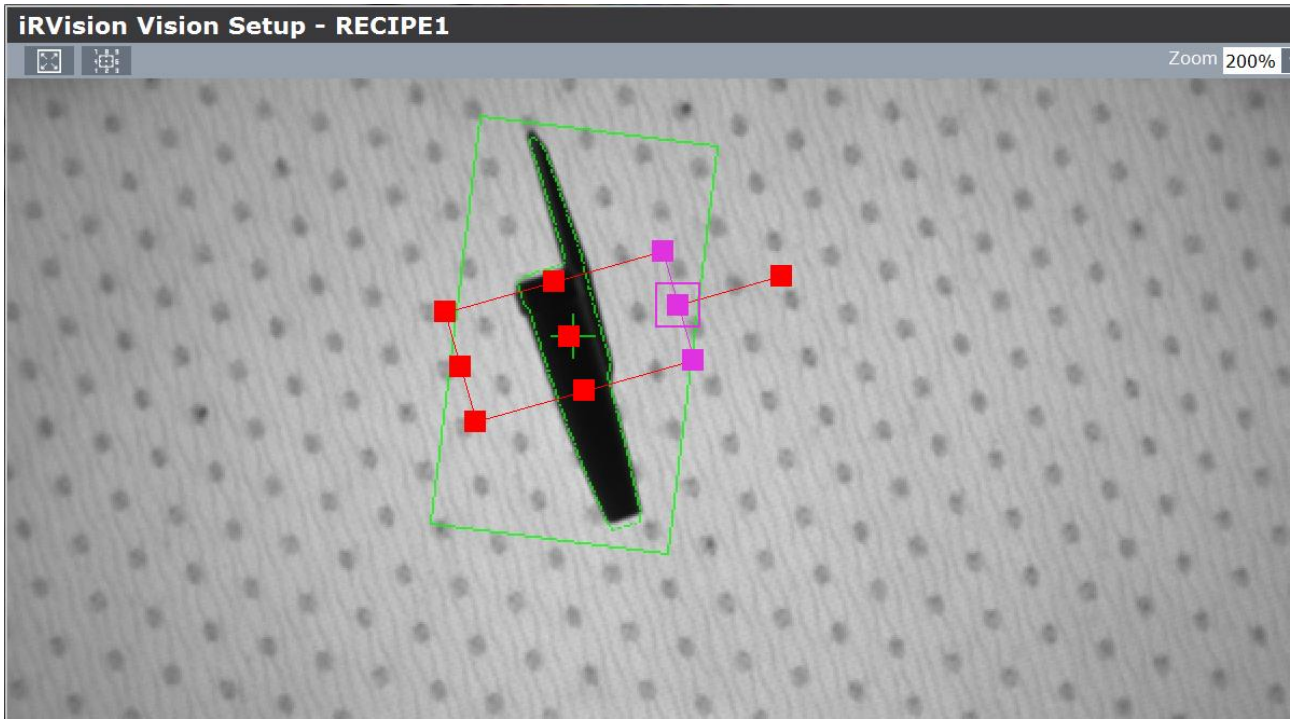
From the vision process related to model recognition, select “GPM Locator Tool 1” and press the “+” button and add a “Histogram Tool”



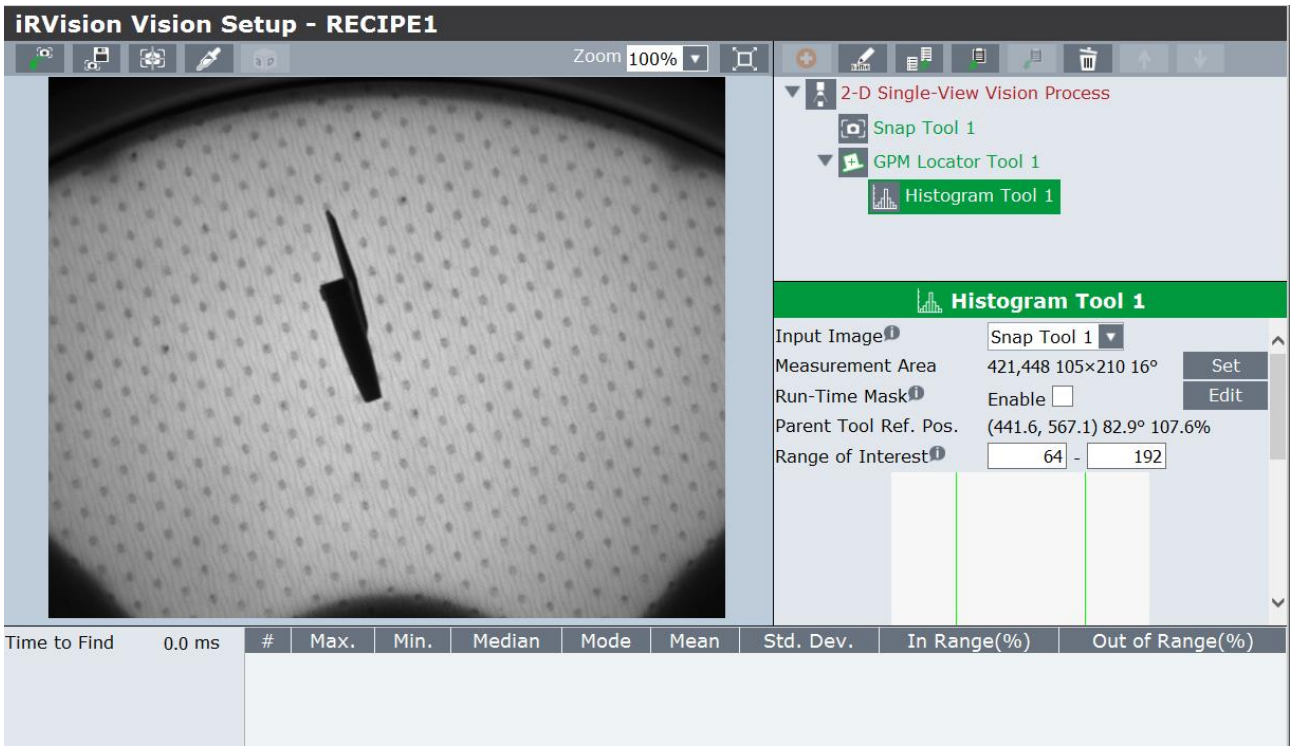




Press “Set” and define the control area; this area must correspond to the overall dimensions of the grippers.

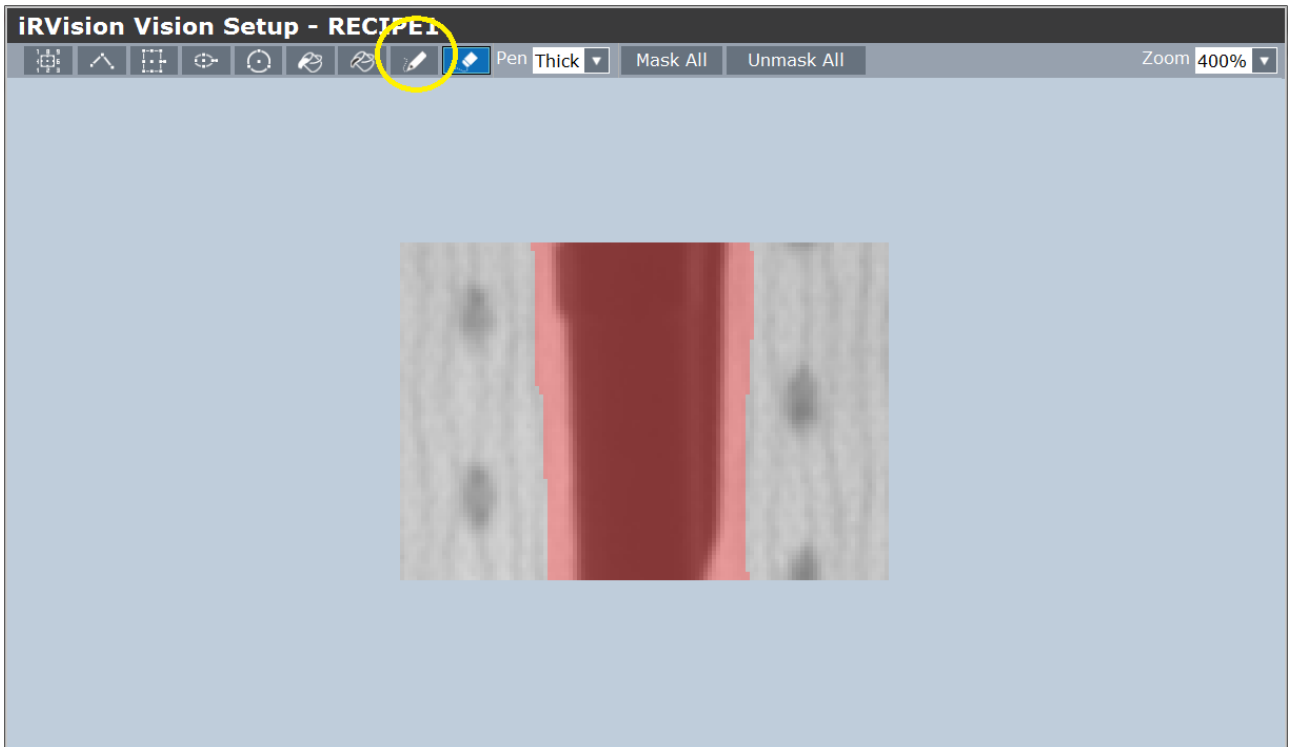


Press “OK” and go back to the previous menu

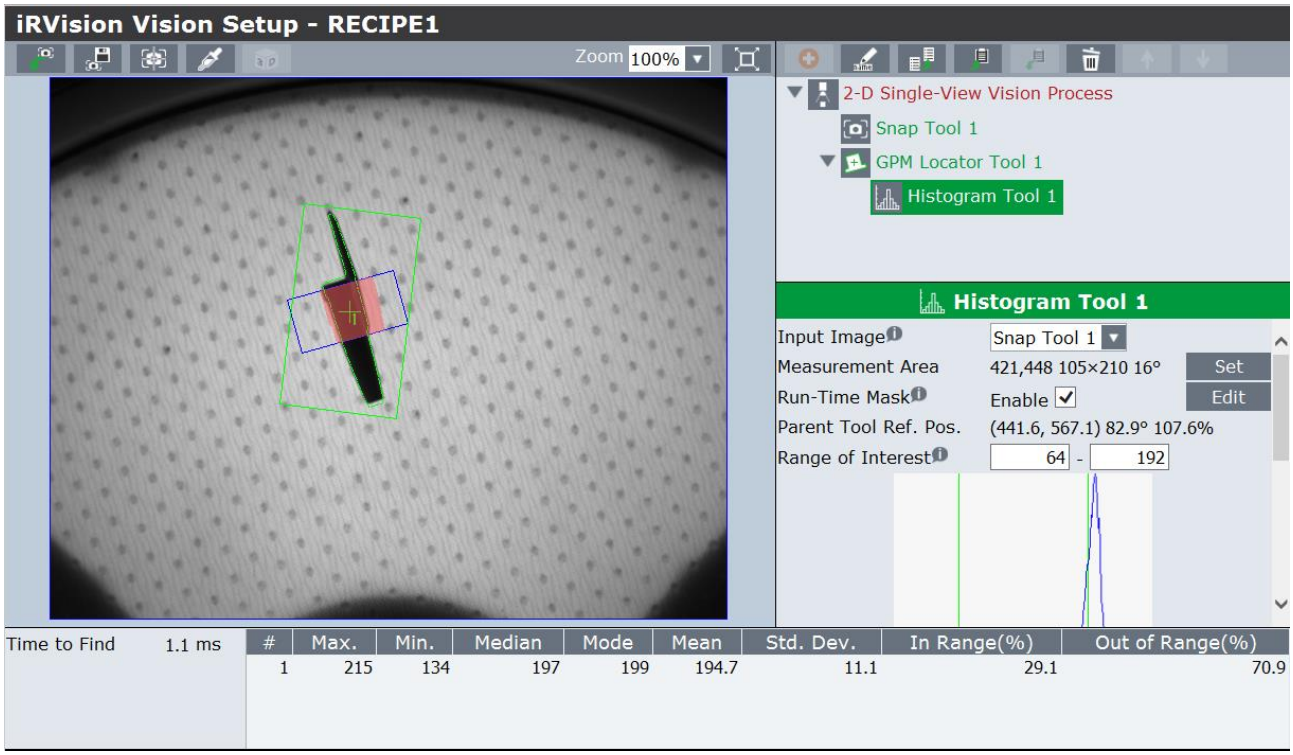


Then press “Edit” to mask the central zone so as to control only the external zones.

Use the pencil tool to colour the areas that do not need to be controlled in red.

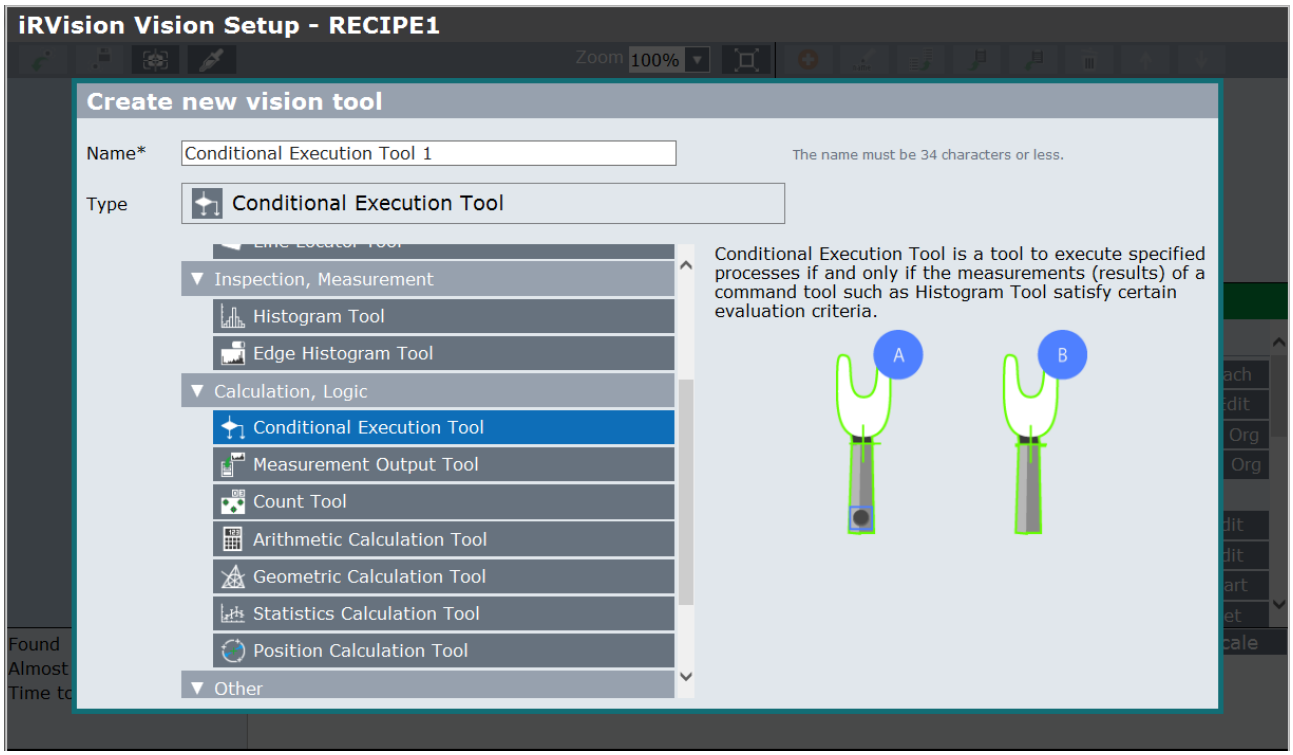


By executing a “Snap+Find” command, the histogram will give the results relating to the analysed area.



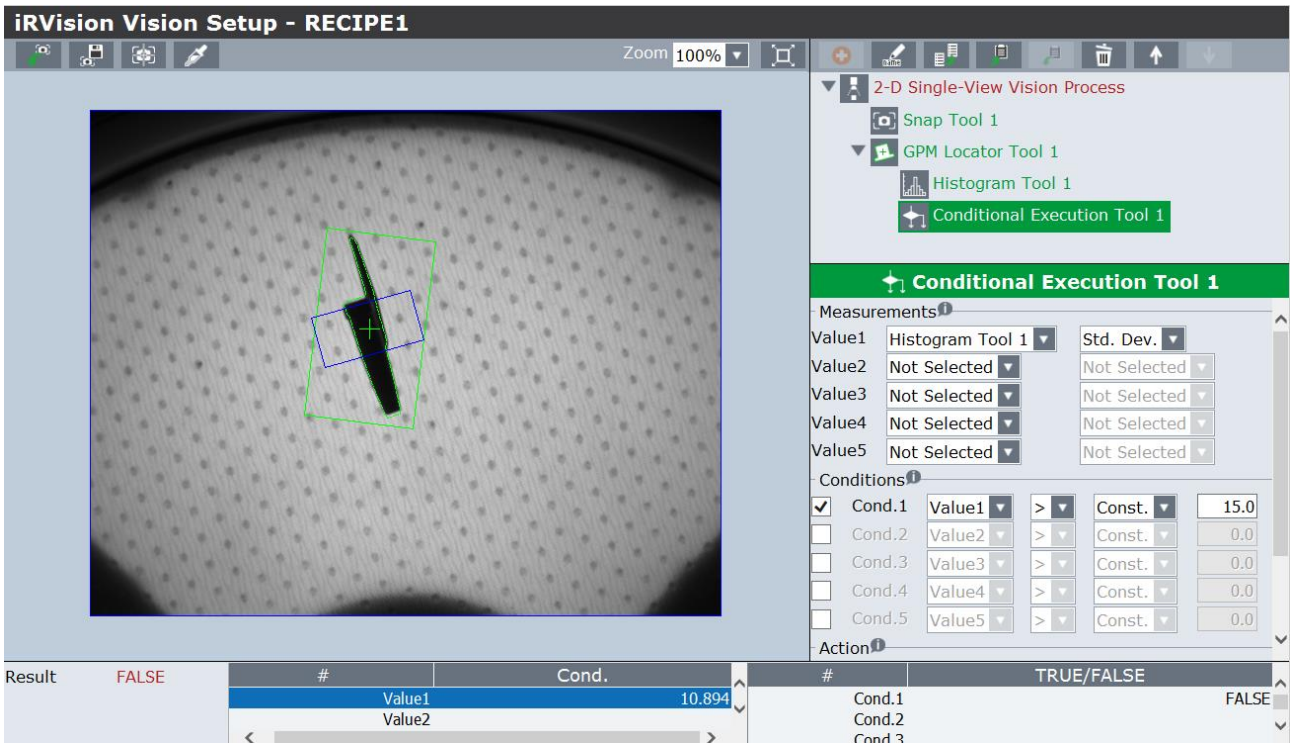
Therefore, a control tool must be created, which identifies only the components that can actually be picked up as good parts.

Select “GPM Locator Tool 1” and press the “+” button to add a “Conditional Execution Tool”

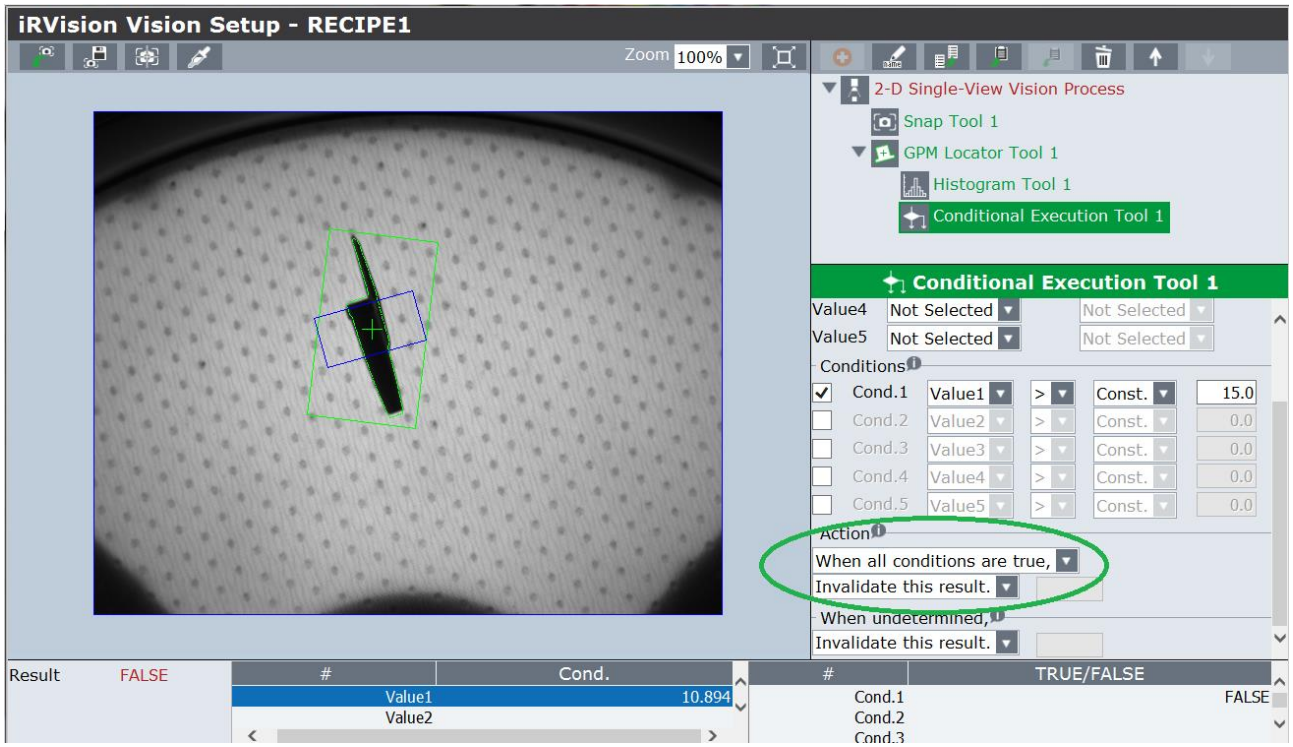


After creating the Tool, specify:

- Value 1 → Histogram Tool 1→ Std. Dev.
- Cond.1→ Value1 > Constant that varies according to the defined area and brightness. In the specific case, the “Standard Deviation” (Std. Dev) values is about 10 when the piece is free, and the threshold value will therefore be set to 15.

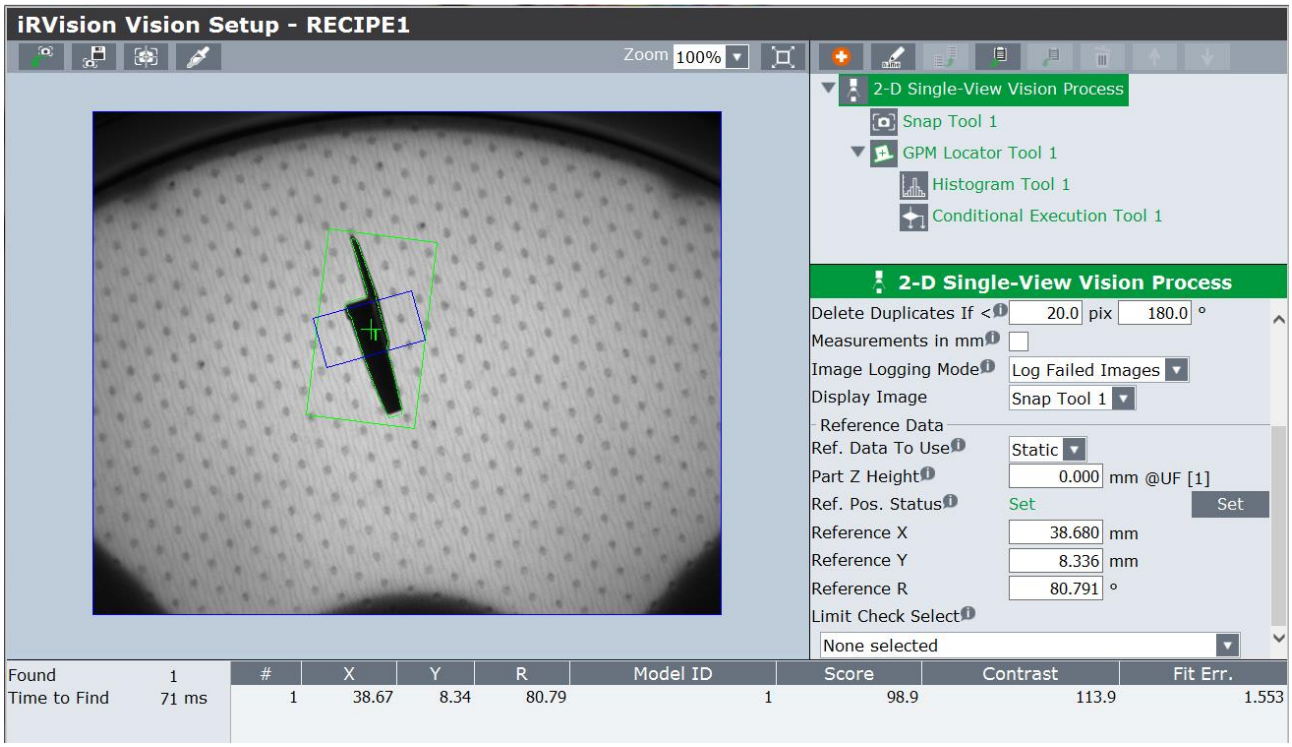


Set the parameters shown in the picture below as parameters under Action.

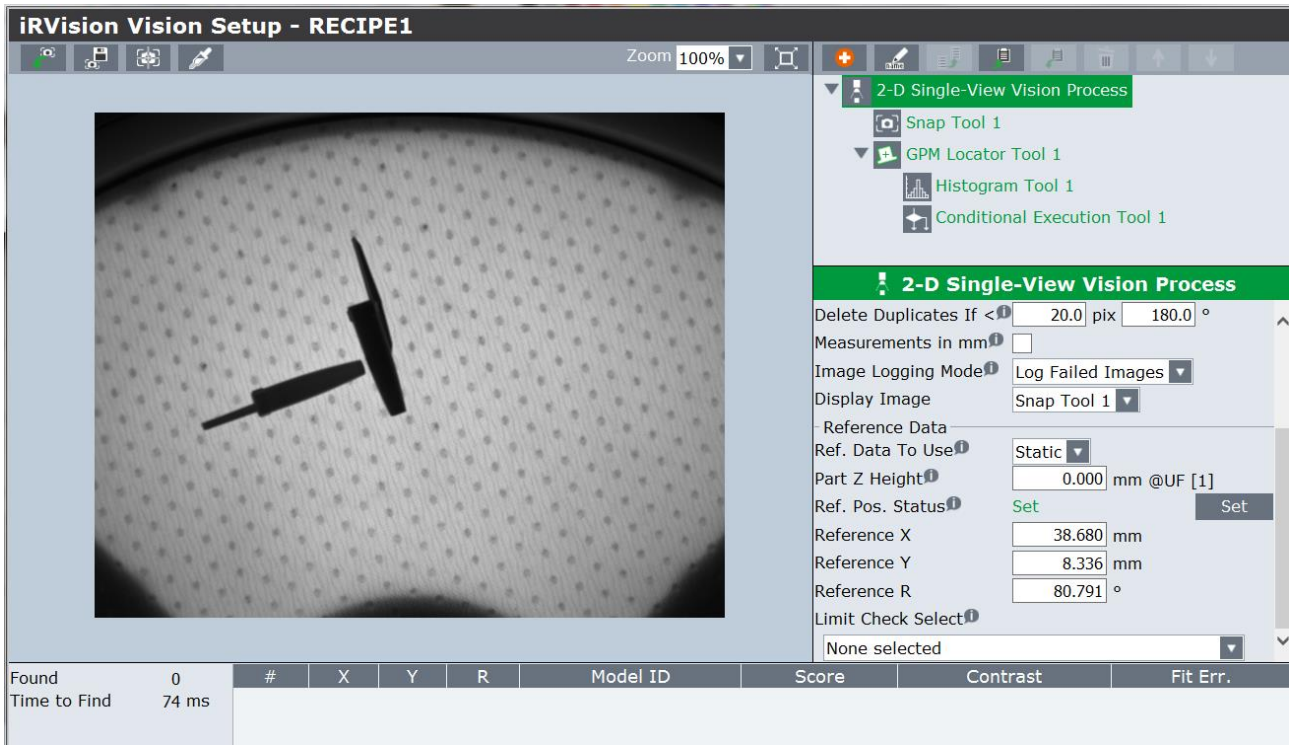


Select the “2D Single-View Vision Process” main tool and press “Snap+Find”

The main tool executes all sub-tools and therefore, the relative controls.

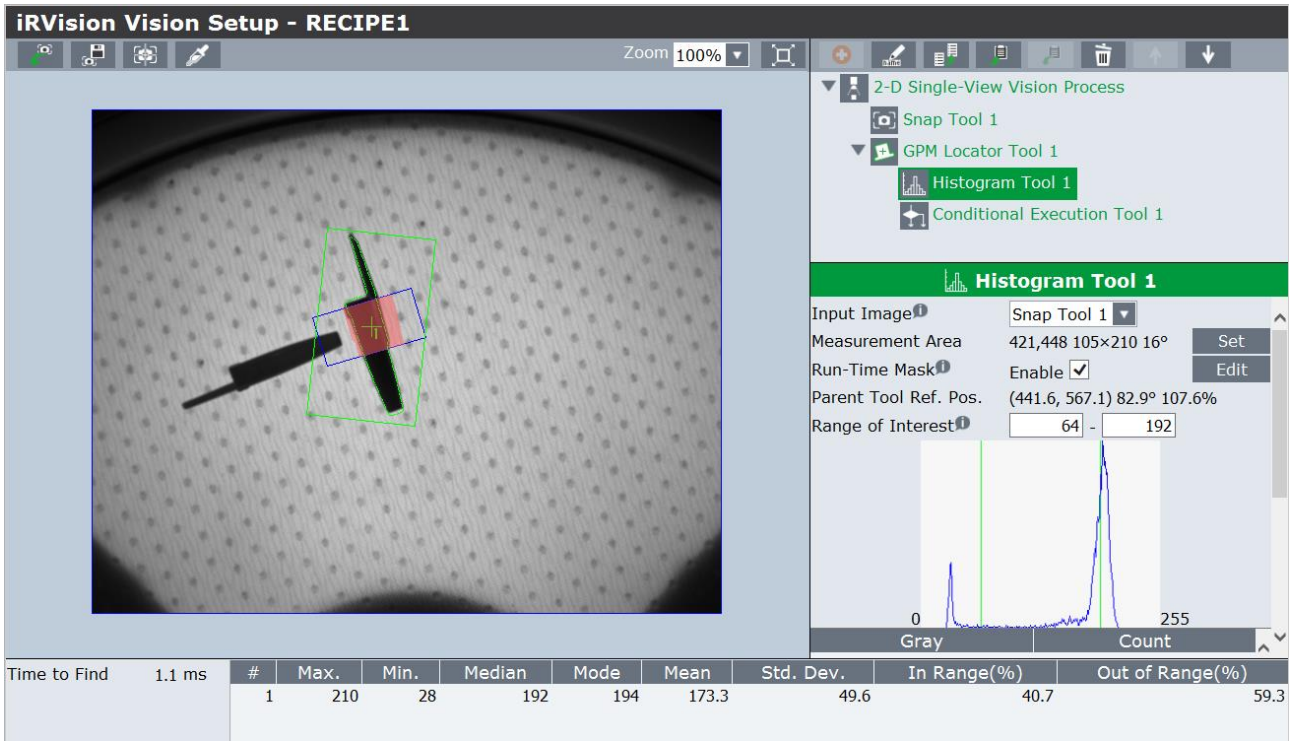


Place another piece close to the part to be picked up and repeat the photo with the “Snap+Find” button; the vision system must discard the object.



Check by selecting the “Histogram Tool 1” tool and press “Snap+Find”.

As can be seen from the photo below, the “Std.Dev” value is 49.6 and therefore, exceeds the set threshold.



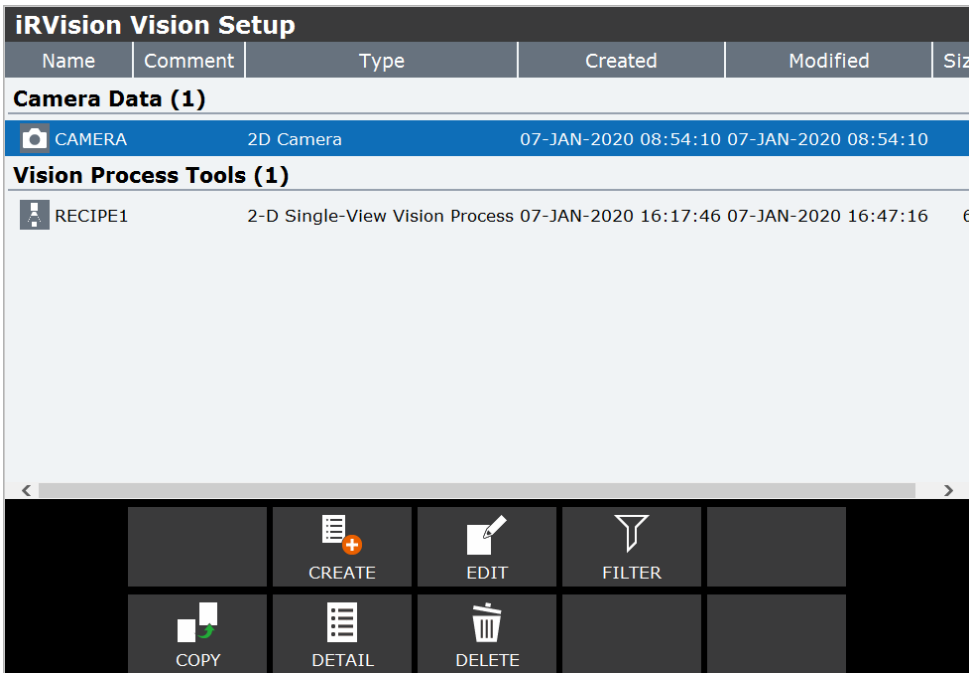
Save and exit.

Hopper Histogram Tool

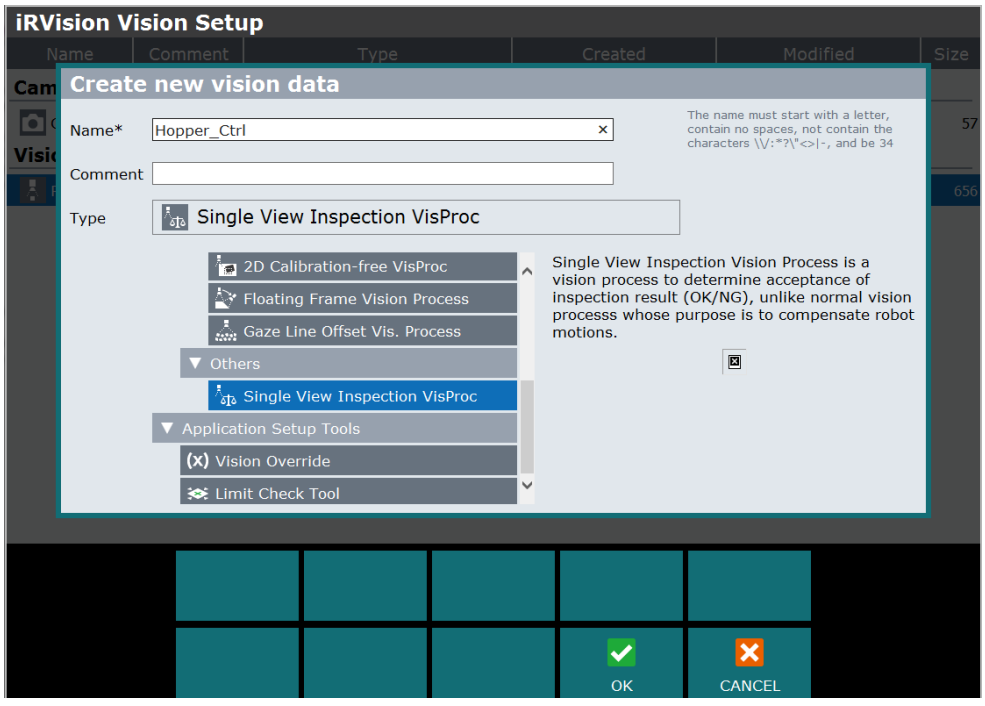
A control tool called “Single View Inspection VisProc” is used to distinguish whether the Flexibowl has enough pieces inside it or not.

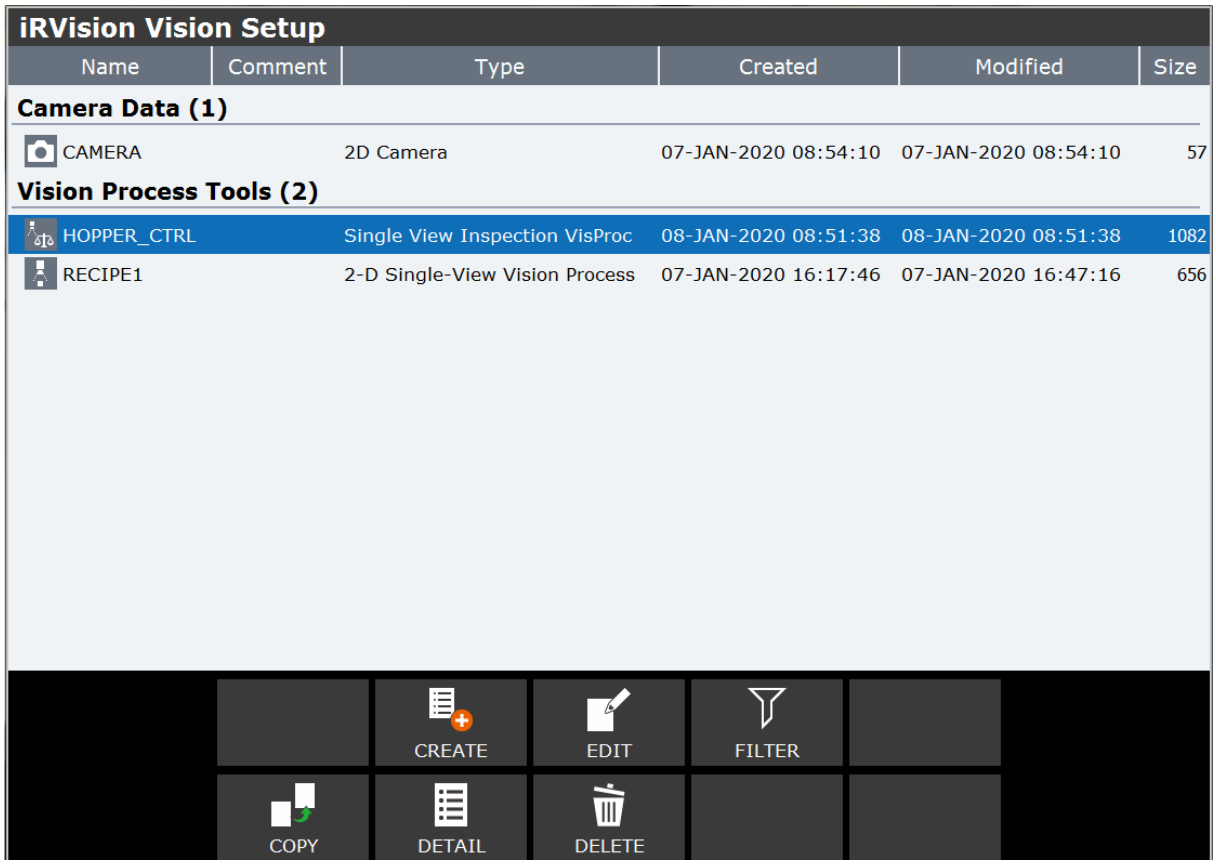
To access the vision menu you can use the robot's keypad (Teach Pendant) or connect via an Ethernet cable to the robot controller for convenience and quick programming.

Press Menu→IRVision→Vision Setup on the Pendant

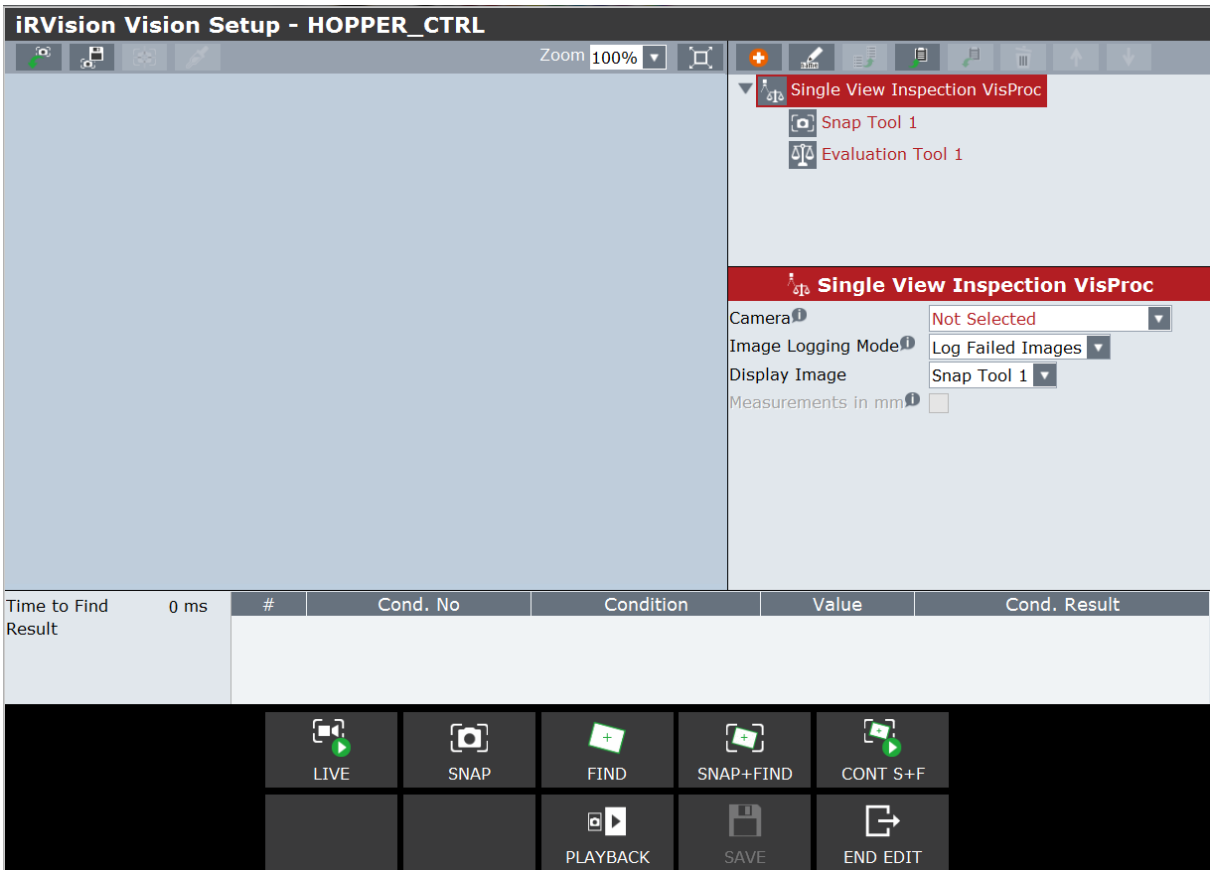


Use the “Create” button to add the vision process required for the control

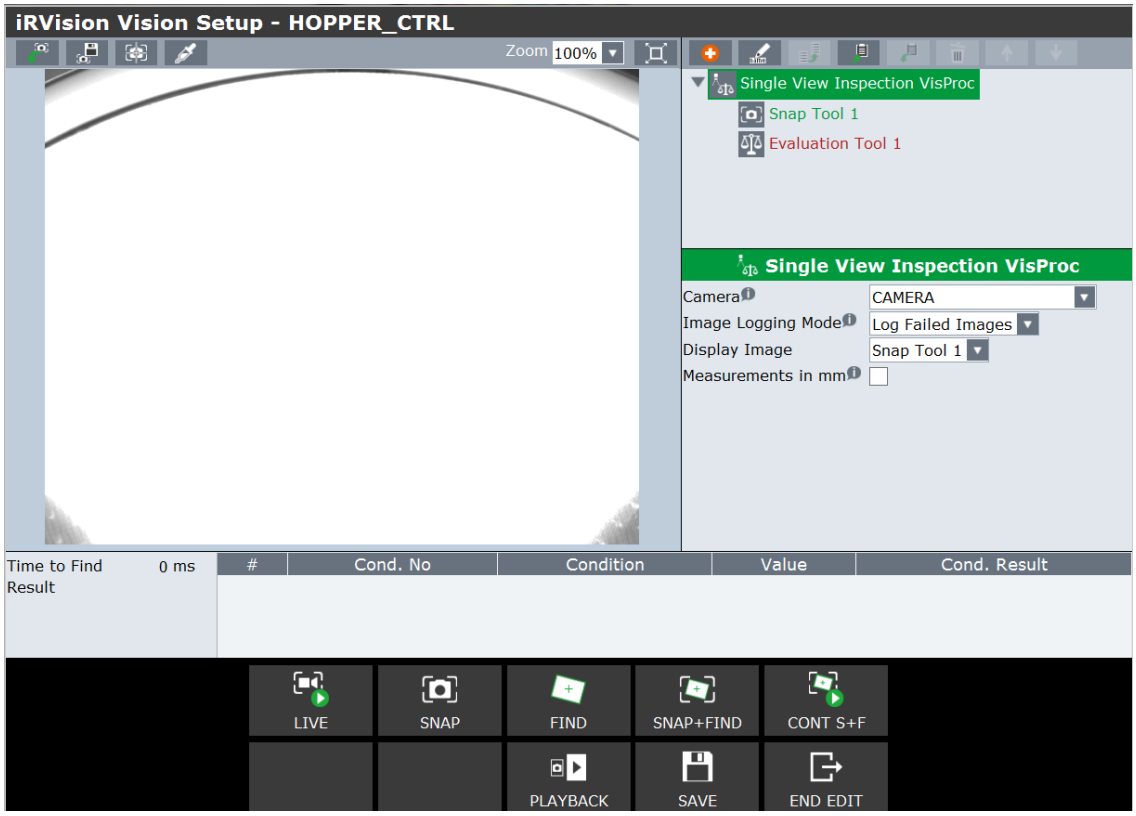




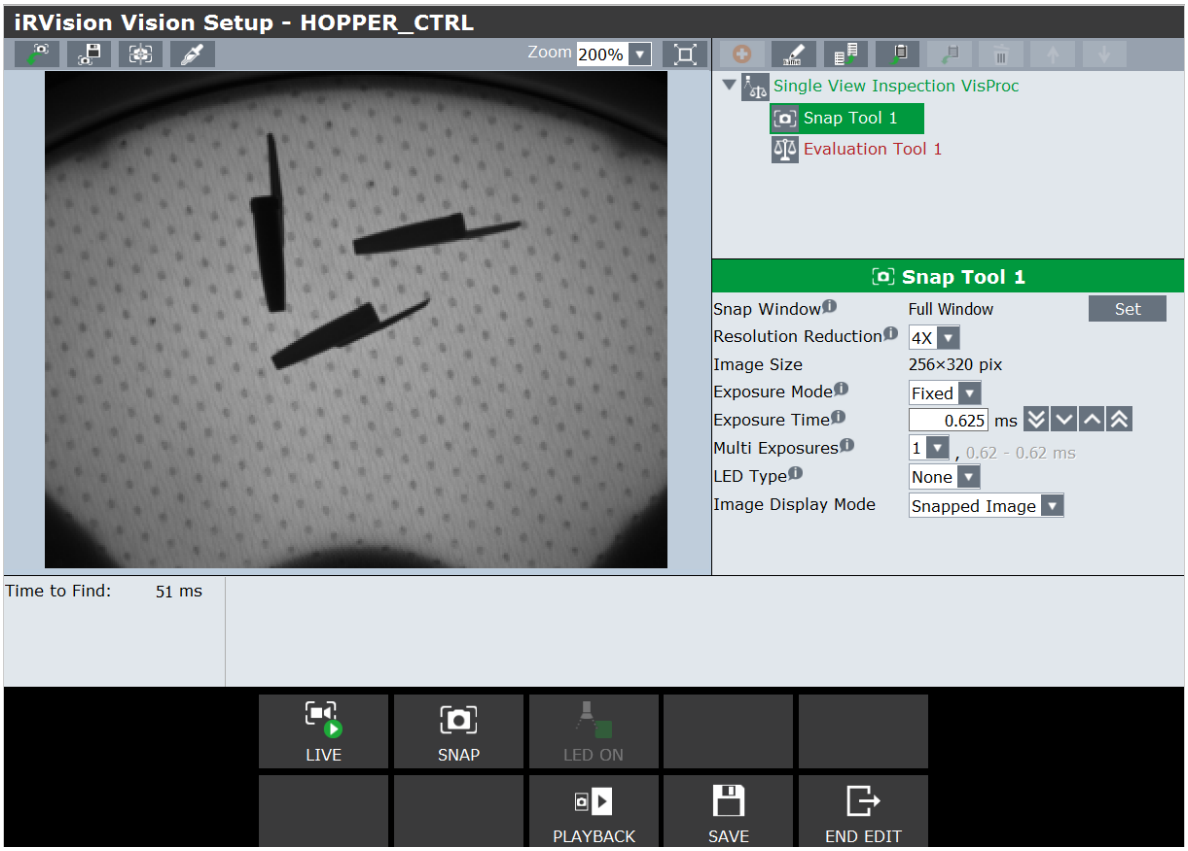
Press “Edit” to edit the process just created.



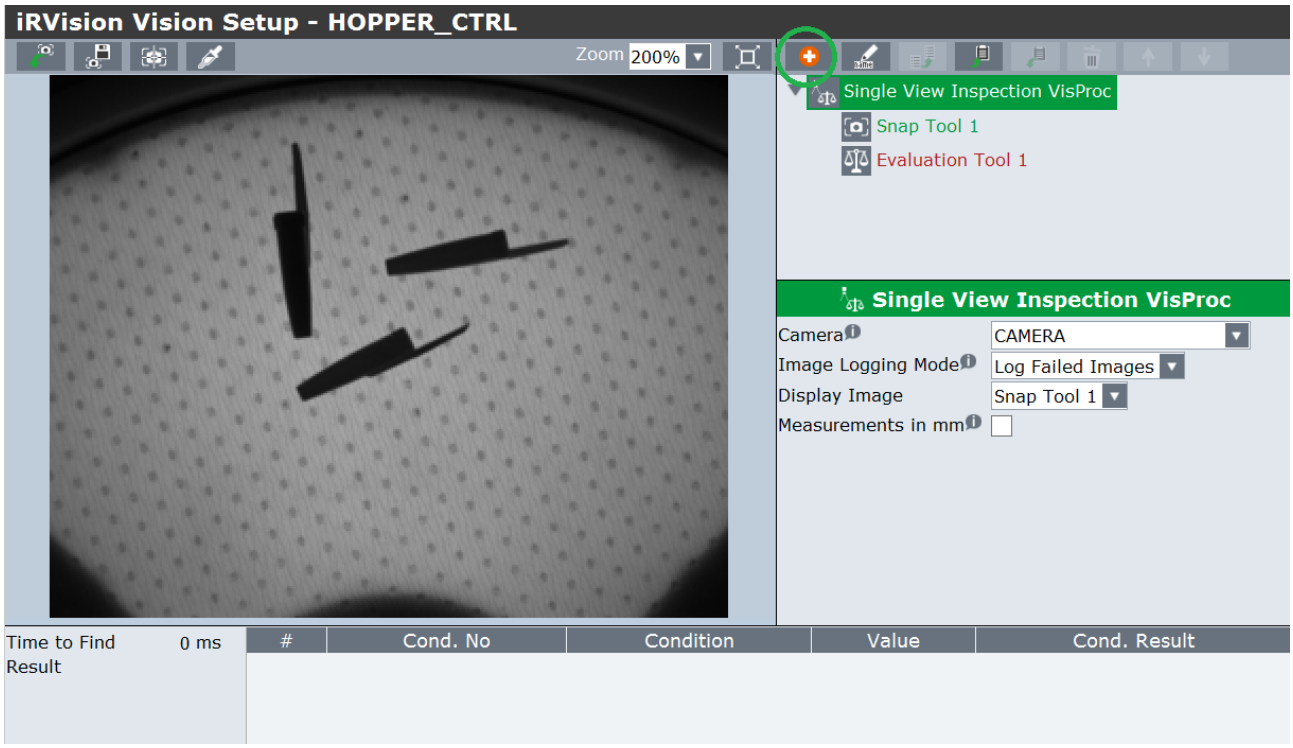
Select the camera

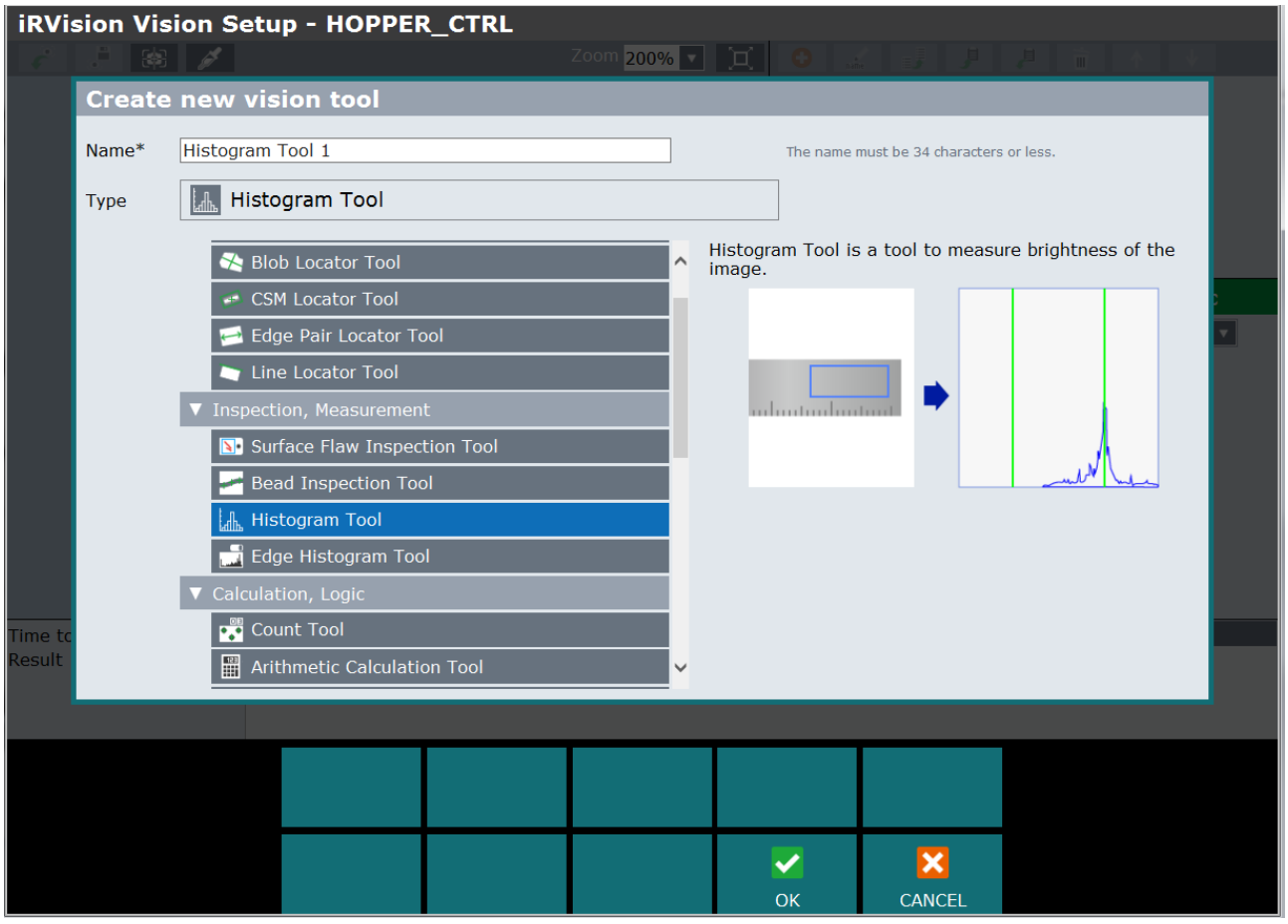


Select “Snap Tool 1” and adjust exposure and resolution; reduced resolution promotes faster control.



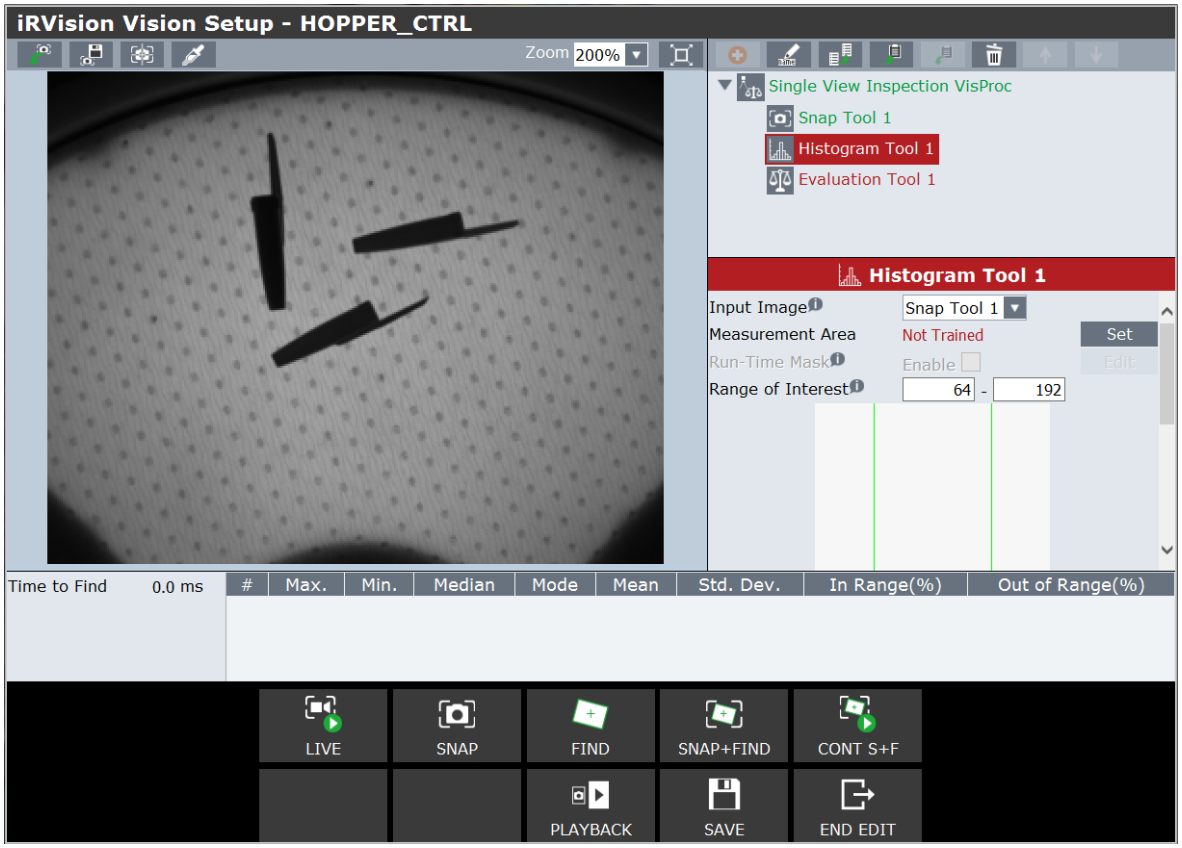
Select the “Single View Inspection VisProc” main vision process and press the red “+” button to add the control “Histogram Tool”.



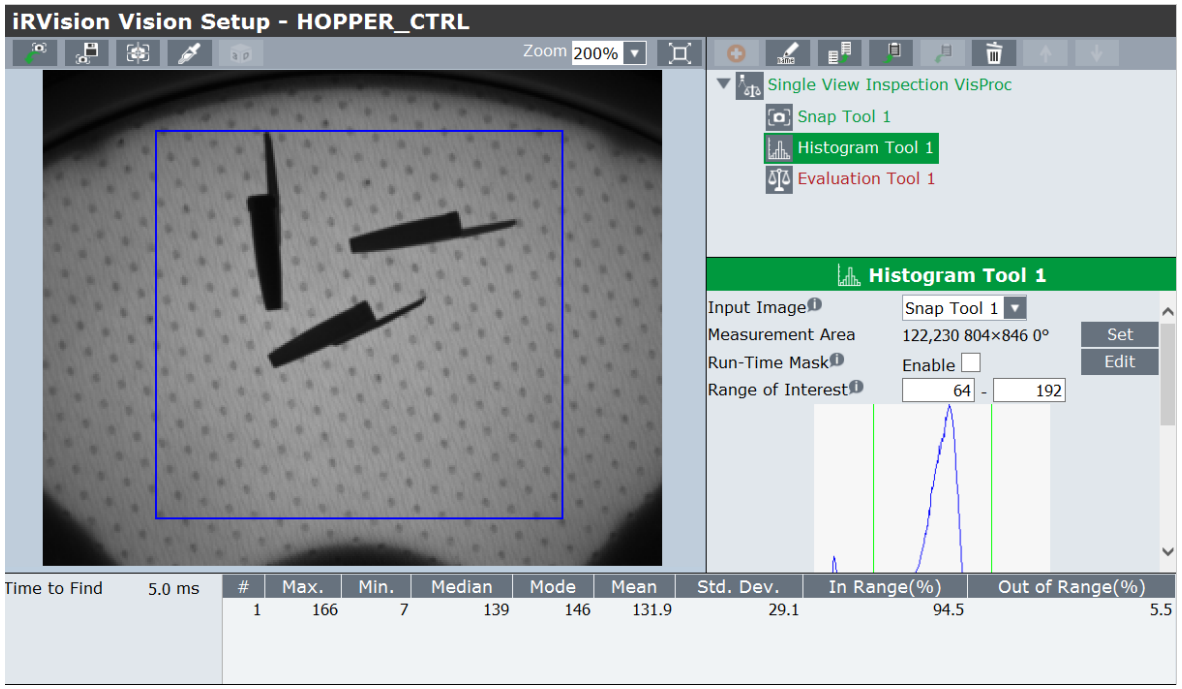


Press “Ok”

Select “Histogram Tool 1”



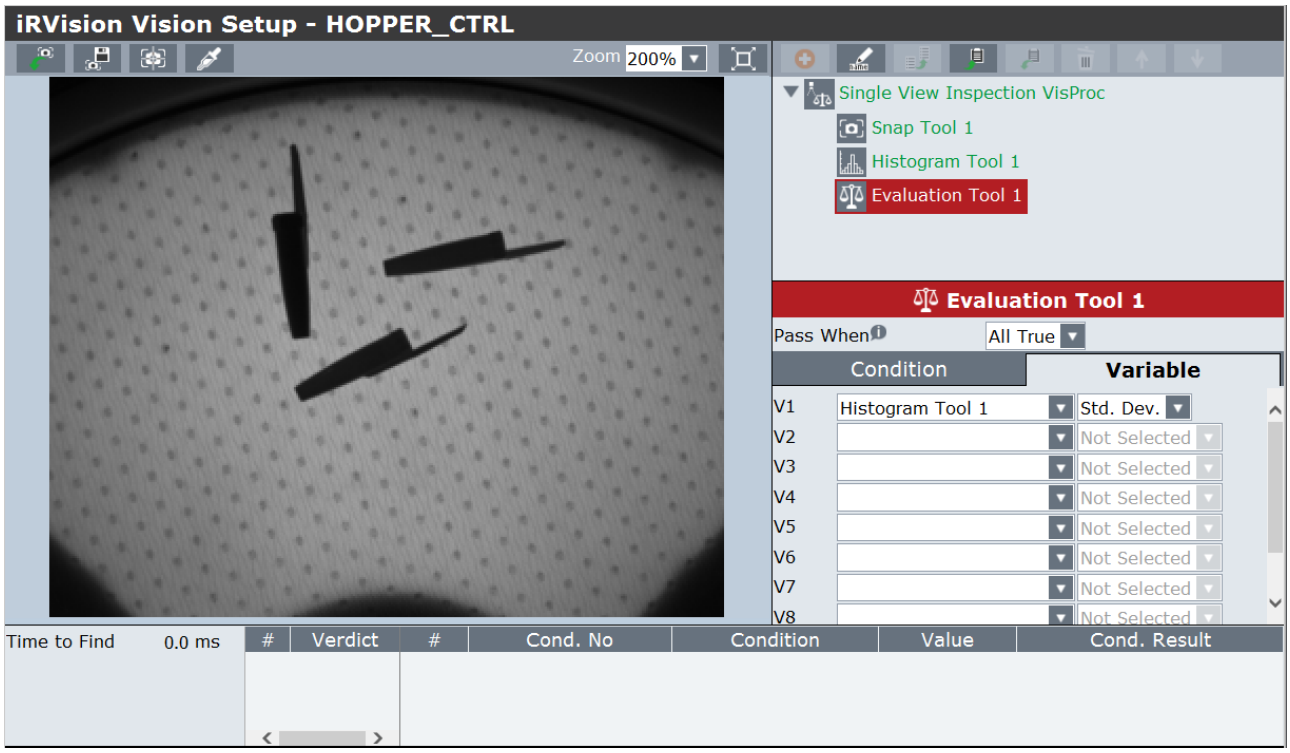
Press “Set” and define the control area as shown in the image below



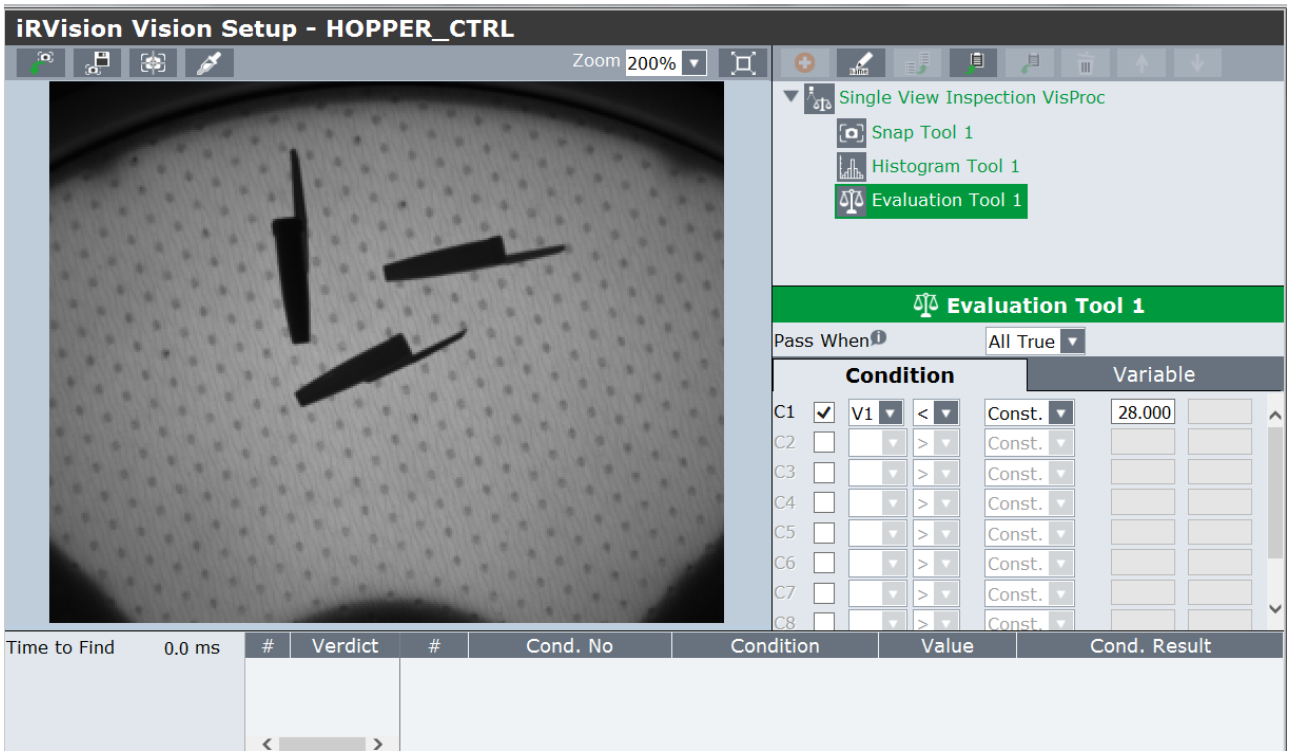
Pressing “Snap+Find” shows the values relating to the image; the value that can be used is the “Std.Dev.” Assuming that you will consider the Flexibowl area as filled correctly with more than 3 pieces, the threshold value you will use is 28.

Select “Evaluation Tool 1” and then select the “Variable” tab

Then associate variable V1 with the “Std. Dev” variable of “Histogram Tool 1”.

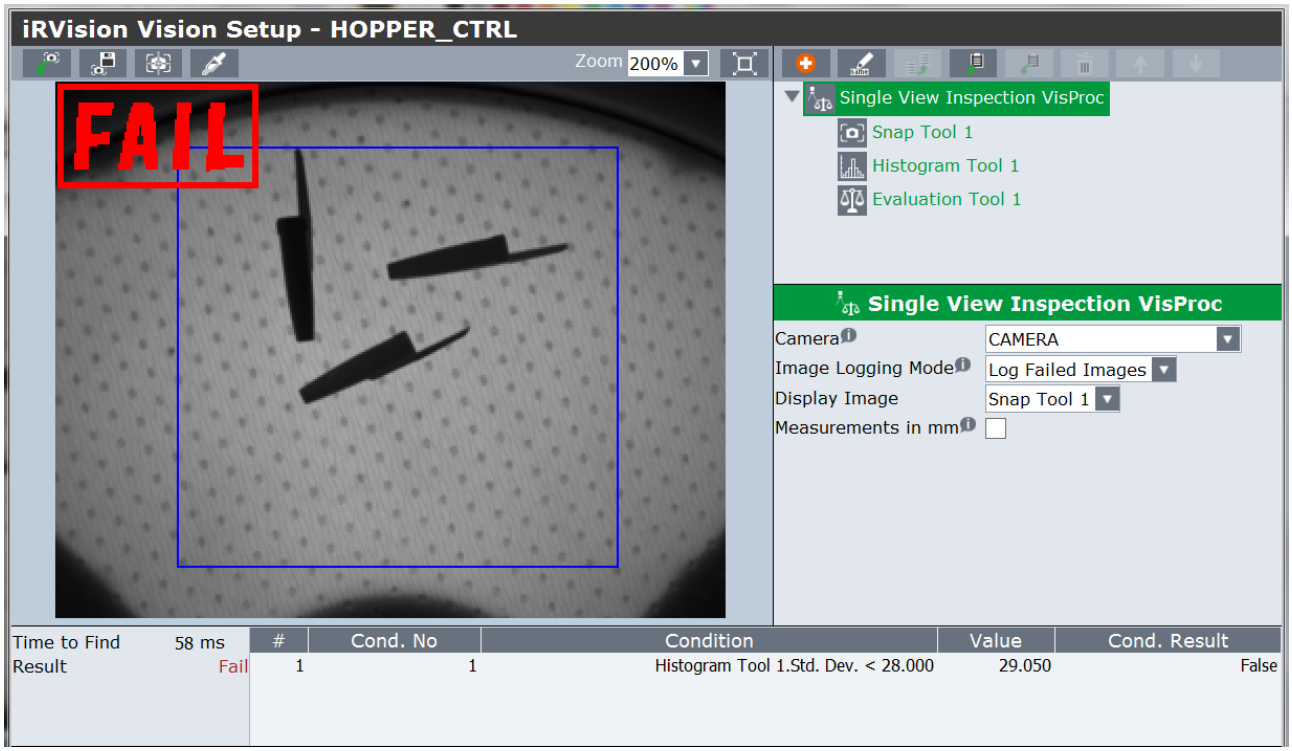


Then select the “Condition” tab and enable the “C1” condition: the control will only be successful if variable C1 is less than a constant, which specifies the threshold value.

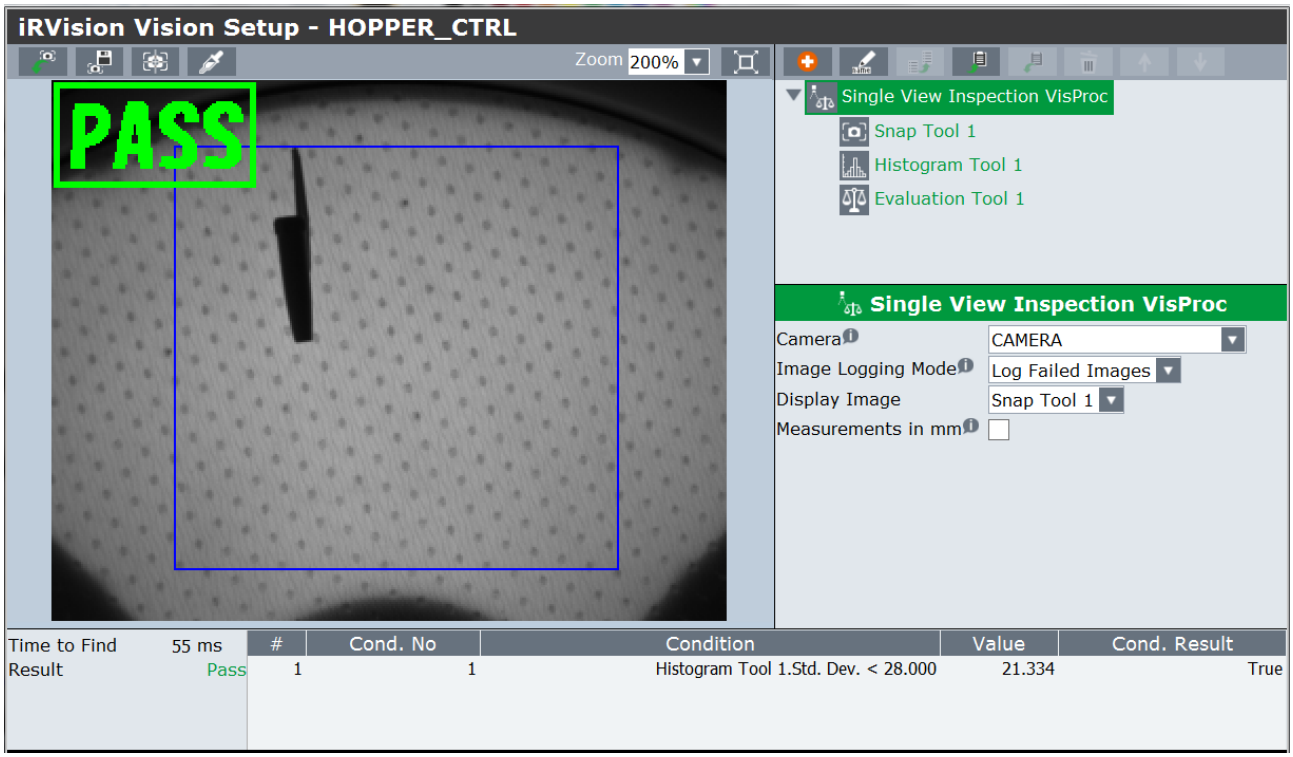


By selecting the main vision tool and pressing “Snap+Find”, you can check the outcome of the check.

3 pieces, area already filled correctly



1 piece, area with grey level less than the set threshold and therefore, to be loaded



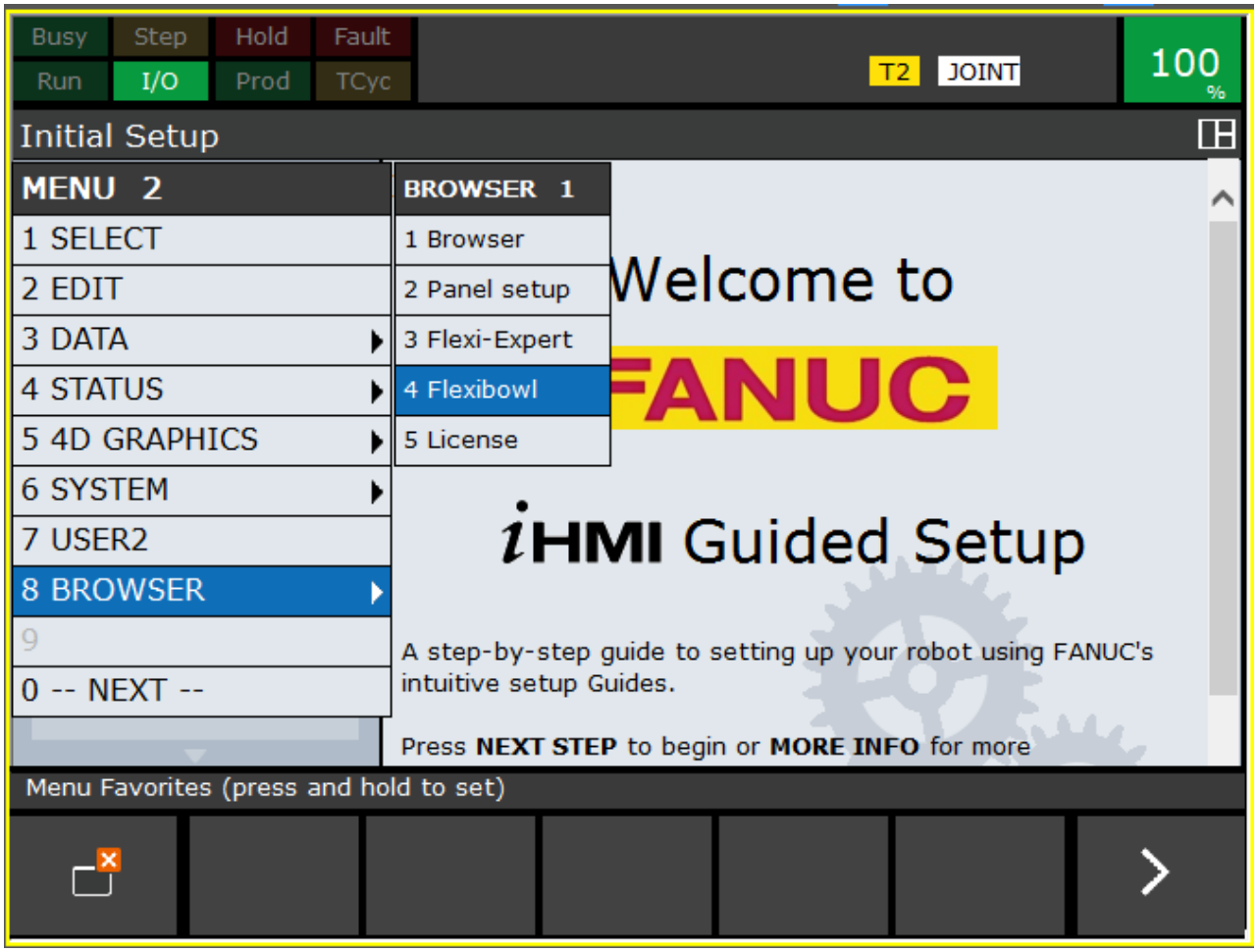
Flexibowl

This interface allows to set and test the parameters relative to FlexiBowl® by using the TCP/IP communication.

Before being able to use the interface, it will be necessary to:

- Power FlexiBowl® electrically and pneumatically.
- Set the IP addresses of the robot and FlexiBowl® in order to create a subnet to allow the communication.
- Connect FlexiBowl® and robot by an Ethernet cable.
- Having installed the FANUC “User Socket Messaging” option.

To access the Flexi-Expert interface for the FlexiBowl® parametrization from the FANUC pendant press: Menu→0→Browser→Flexibowl



Select the FlexiBowl® you intend to test or parametrize.

In the example shown below we will work with FlexiBowl 1, but everything that will be explained also counts for the pages relative to FlexiBowl 2.

Insert the IP address of the FlexiBowl you wish to configurate.

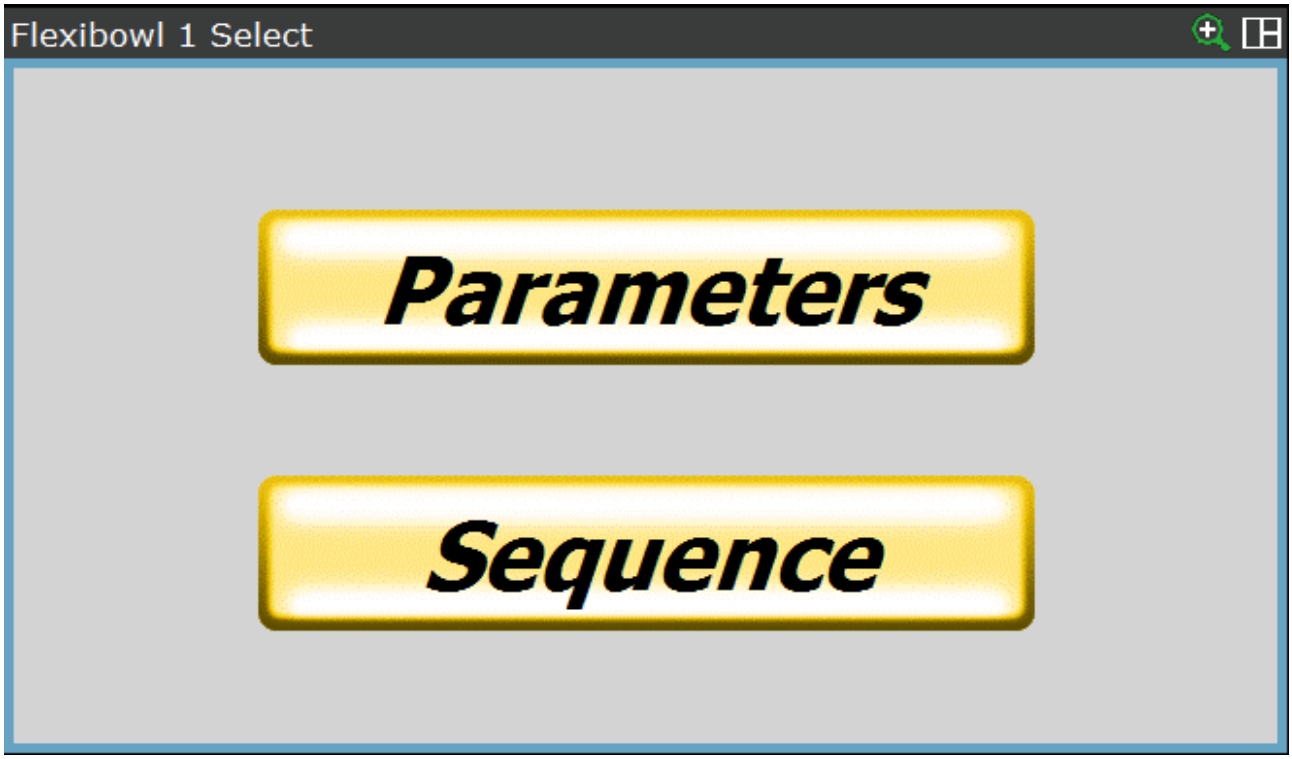
Once you have inserted the correct IP address, press “Set Up $Hostc_Cfg[7]” to configurate the communication client “C7”. During the configuration of FlexiBowl 2, client “C8” will be set.

It is necessary to restart the controller before being able to use the client set up as above.

Following the restart of the FANUC controller, you will be able to run a communication test.

By pressing “Test Communication”, if all operations were successful, the box indicationg the communication status will be green.

Press **“Next”** to move forward to the following page.



In the page shown above there are 2 choices:

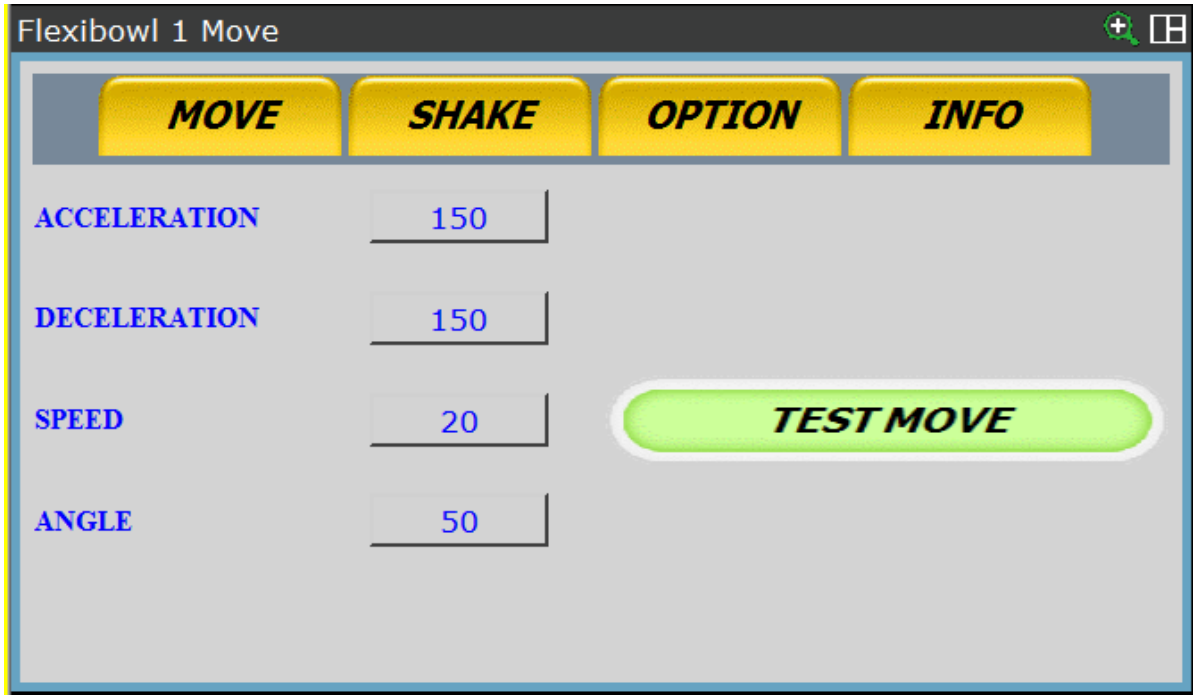
- Parameters →
  - It allows to set and check the movement parameters
  - It allows to set and check the single operations:
    - Backlight
    - Flip
    - Blow

- Sequence → It allows to set sequences of movements that can be recalled by the program.

Parameters

Inside the **"Parameters"** page there are 4 subpages:

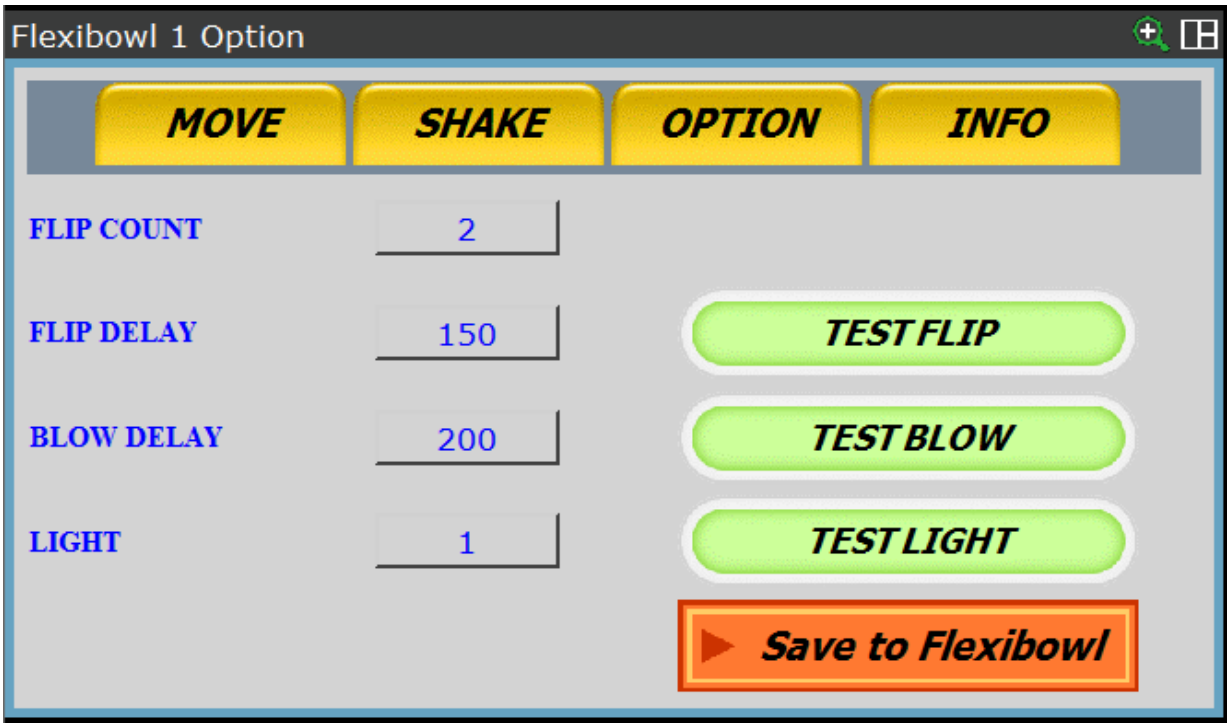
MOVE→ In here it is possible to set the parameters for the **"MOVE"** movement of FlexiBowl; through the **"TEST MOVE"** button is possible to check the set parameters.



SHAKE→ In here it is possible to set the parameters for the **"SHAKE"** movement of FlexiBowl; through the **"TEST SHAKE"** button is possible to check the set parameters.

OPTION→ Here it will be possible to set up the parameters relative to the options of FlexiBowl; through the **"TEST"** buttons is possible to check the set parameters.

With the **"Save to Flexibowl"** key all parameters will be transferred and saved inside FlexiBowl's memory.

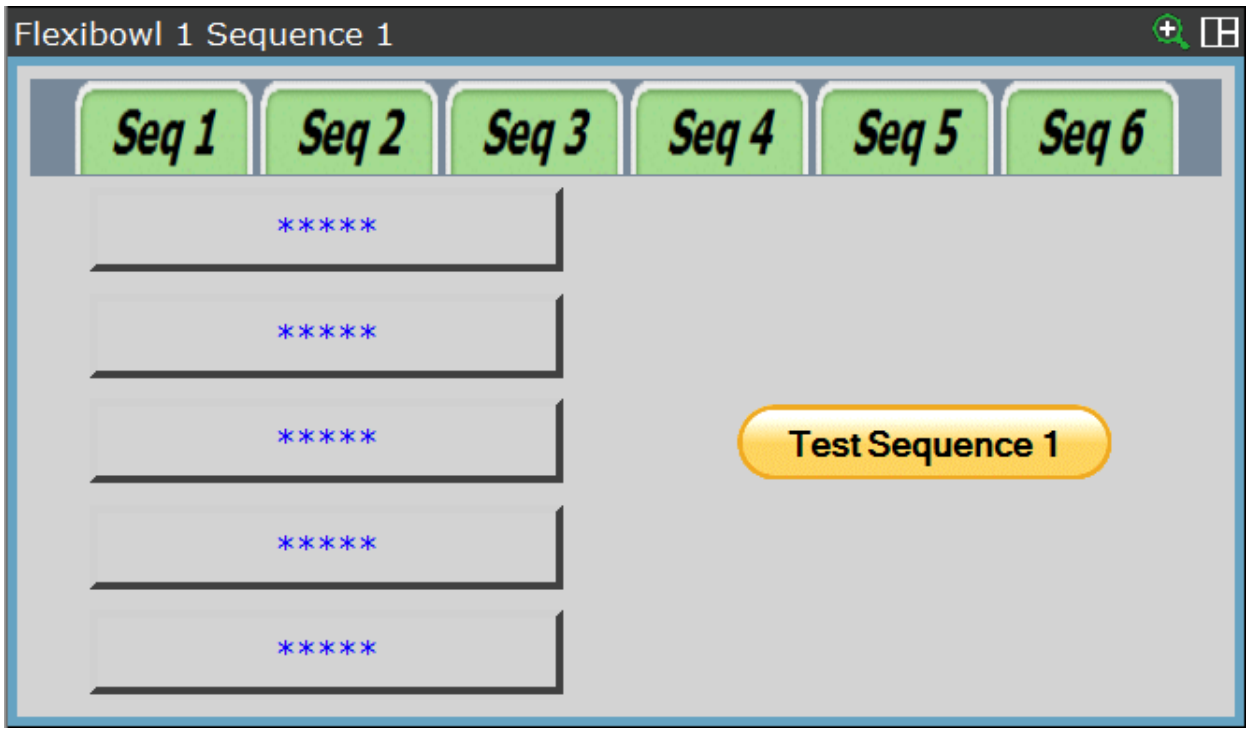


INFO

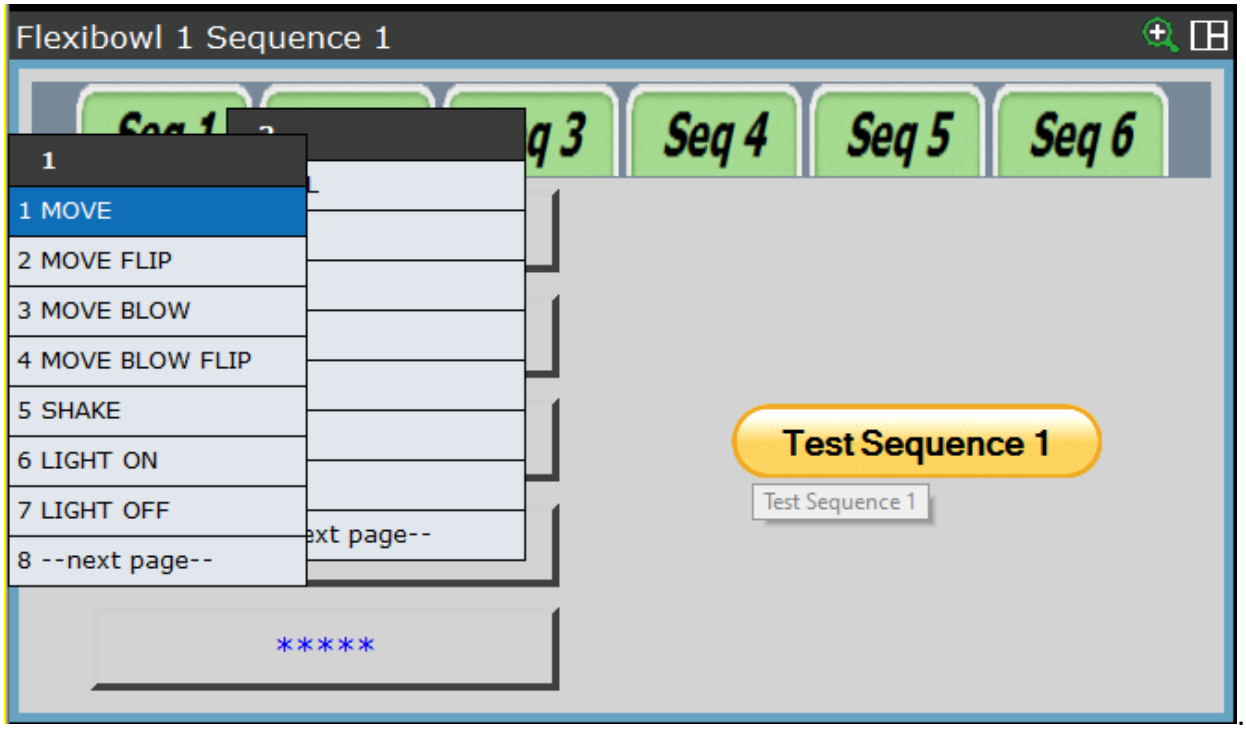
Sequence

Inside the page there are 6 sub-pages, all identical to one another; though these pages it is possible to create up to 6 movement sequences.

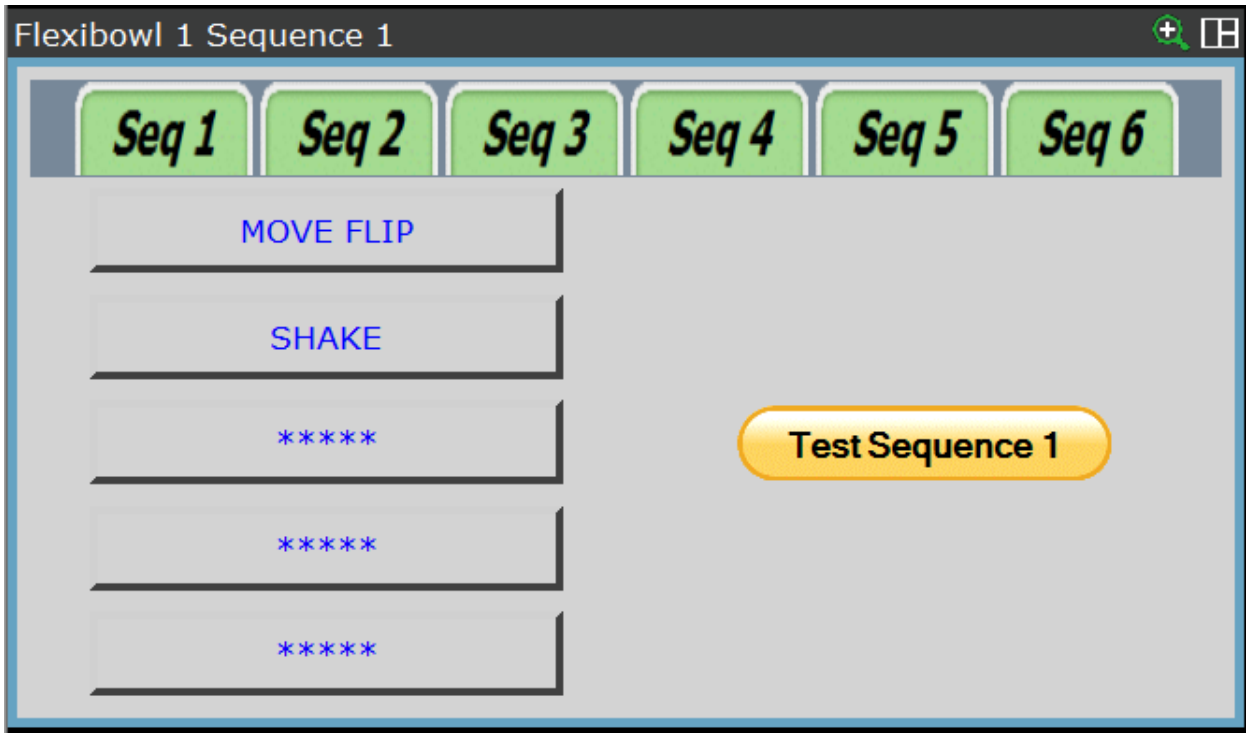
The example below shows the configuration of sequence 1, but everything that is explained is valid for the pages relative to other sequences as well.



Select the first box of the list and choose the desired movement from it; if necessary, proceed with assigning the second box, so that the desired sequence can be defined.



It is possible to verify if the sequence works by using the button **“Test Sequence”**



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