GETTING STARTED

PLOC2D URCap

Robot Guidance Systems

SICK
Sensor Intelligence.

Described product

PLOC2D URCap

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Legal information

Original document

This document is an original document of SICK AG.

Contents

1 About this document 4
1.1 Prerequisites 4
1.2 Explanation of symbols 4

2 Network settings 5

3 PLOC2D URCap installation 7
3.1 Upload and enable 7
3.2 Connect to PLOC2D device 8

4 PLOC2D and UR robot alignment 9
4.1 Static mounted sensor 9
4.2 Robot frame 10

5 Job configuration 12
5.1 PLOC2D job configuration 12
5.1.1 Static mounted sensor 12
5.1.2 Define regions 12
5.1.3 Set the pick position 13
5.2 PLOC2D URCap job configuration 14

6 Run configuration 15

7 Robot template program 16

1 About this document

This manual describes how to set up the SICK PLOC2D URCap on a Universal Robots (UR) robot, and connect it with a SICK PLOC2D device. The last chapter includes how to create a robot guidance program.

NOTE
PLOC2D with software version 2.6 or higher is required.

Go through the chapters in the specified order to get started with the system. For further details on how to setup and program the PLOC2D or the UR robot see their respective manuals.

1.1 Prerequisites

To perform the instructions in this PLOC2D URCap document, the following is required:

- PLOC2D robot guidance system.
  - Static mounted device and completed installation and calibration according to the configuration workflow in the **PLOC2D Operating instructions**, see www.sick.com/PLOC2D.
- UR Robot.
- PLOC2D URCap plugin, see www.sick.com/PLOC2D.
- Alignment target.

1.2 Explanation of symbols

Warnings and important information in this document are labeled with symbols. The warnings are introduced by signal words that indicate the extent of the danger. These warnings must be observed at all times and care must be taken to avoid accidents, personal injury, and material damage.

DANGER
... indicates a situation of imminent danger, which will lead to a fatality or serious injuries if not prevented.

WARNING
... indicates a potentially dangerous situation, which may lead to a fatality or serious injuries if not prevented.

CAUTION
... indicates a potentially dangerous situation, which may lead to minor/slight injuries if not prevented.

NOTICE
... indicates a potentially harmful situation, which may lead to material damage if not prevented.

NOTE
... highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

2 Network settings

Firstly, we need to make sure that the computer and the UR robot are on the same network as the PLOC2D device.

The PLOC2D device has default IP adress: 192.168.0.1.

NOTE
Use the IP adress of the PLOC2D device that is being configured. The instructions are based on the default IP adress.

Computer network settings

IP properties for the computer can be found in the computer's network settings, for example see figure 1, page 5.

1. Select that you want to set the IP address manually.
2. Set **IP address** to 192.168.0.3
   - The last digit is optional, provided it is not the same as the robot or the PLOC2D device.
3. Set **Subnet mask** to 255.255.255.0

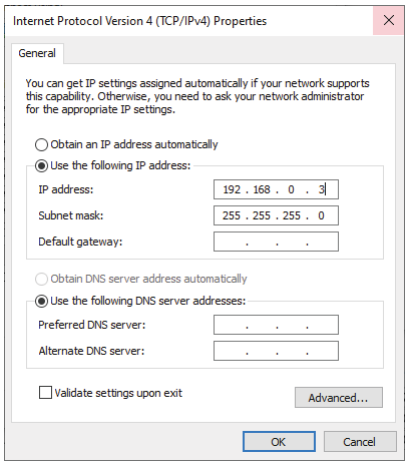

Figure 1: Example of computer IP settings

UR robot network settings

Robot network settings is found in the UR robot user interface **Settings** menu , **System**/**Network** tab, see figure 2, page 6.

1. Select **Static Address**.
2. Set **IP address** to 192.168.0.2
   - The last digit is optional, provided it is not the same as the computer or the PLOC2D device.
3. Set **Subnet mask** to 255.255.255.0

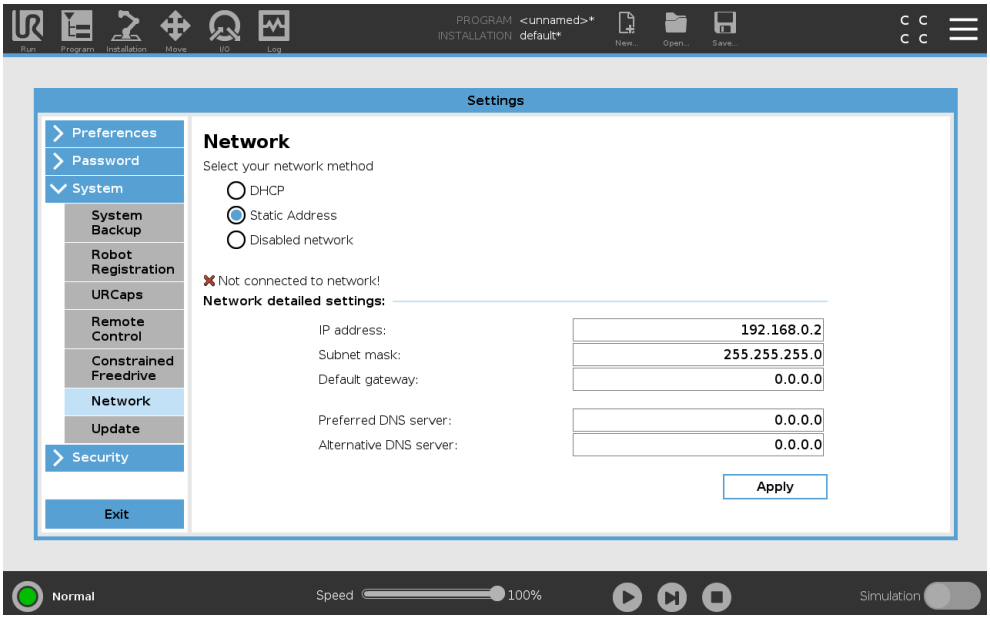

Figure 2: UR Robot user interface, network settings

3 PLOC2D URCap installation

Now that the network settings are set up, we need to upload and enable the PLOC2D URCap plugin. Then, connect the plugin to the PLOC2D device.

The plugin can be downloaded from www.sick.com/PLOC2D to a USB memory stick.

3.1 Upload and enable

Upload the PLOC2D URCap

Remain in the UR robot user interface, **Settings** menu.

1. Select the **System**/**URCaps** tab, see figure 3, page 7.
2. Click the + button and upload the PLOC2D URCap from a USB memory stick.
3. Click **Restart**, to complete the upload and restart the robot.

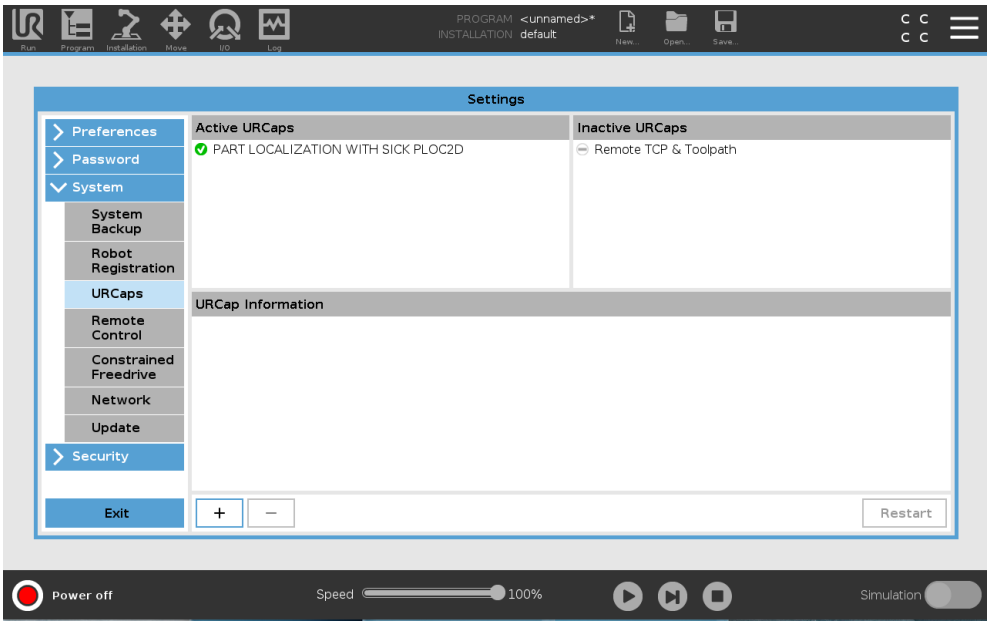

Figure 3: UR Robot user interface, URCaps upload

Enable the PLOC2D URCap

Wait for the robot to restart and initialize again.

1. Enter the **Installation** section, see figure 4, page 7.
2. Select the **URCaps**/**PLOC2D HELP** tab.
3. Click the **Off** button to toggle it to **On** (green).

✓ The PLOC2D URCap is now enabled.

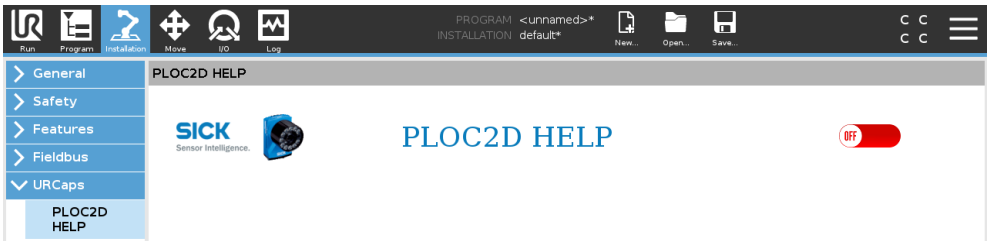

Figure 4: UR Robot user interface, PLOC2D help

3.2 Connect to PLOC2D device

Remain in UR Robot user interface.

1. Enter the **Program** section, see figure 5, page 8.
2. Select the **URCaps/PLOC2D** tab.

✓ A **PLOC2D** item was added to the current robot program.

3. Click the **PLOC2D** item, to view the PLOC2D URCap settings in the **Command** window to the right.
4. In the **System** tab, click the **Find PLOC2D Devices** button.

✓ URCap will scan the network for any connected PLOC2D devices. All found devices are shown in the list.

- If a device is not found on the network, enter the IP address of the PLOC2D device (preset: 192.168.0.1) in the **IP adress** text field.
- Click **Check connection** to establish a connection.

✓ On the bottom left corner of the **System** tab a PLOC2D device connection image is shown.

- Green checkmark: a connection has been established to the robot.
- Red cross: check if something is blocking the connection, firewalls etc. Then retry establishing a connection.

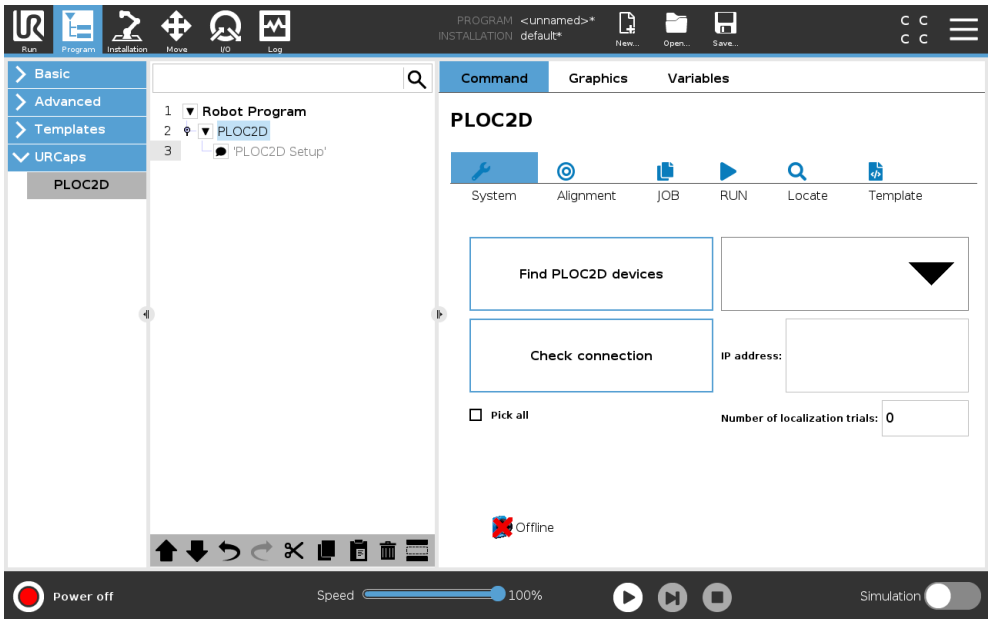

Figure 5: UR Robot user interface, connect to the PLOC2D device

Settings

- **Pick all**: enable to pick all located objects before triggering a new image.
- **Number of localization trials**: number of trials before the robot program exits the PLOC2D node (step in program) and continues. For each trial the sensor will trigger a new image and try to locate the objects.
- Repeat steps to add another PLOC2D sensor. The PLOC2D URCap allows for multiple unique PLOC2D program nodes and therefore the user can have multiple PLOC2D sensors connected to the same robot using the PLOC2D URCap.

4 PLOC2D and UR robot alignment

Now we have made sure that the PLOC2D URCap and the PLOC2D device are connected. This chapter guides you to align the PLOC2D device with the help of an alignment target. Then, align the UR robot with the same alignment target to create the robot frame.

To start, go the PLOC2D user interface:

1. Open Google Chrome.
2. Type the PLOC2D IP address (default: 192.168.0.1).
3. Click on the user symbol in the upper right corner of the user interface.
4. Login with user level **Maintenance** (password: main).

4.1 Static mounted sensor

If you use a static mounted sensor, the coordinate systems are aligned to one or more predefined work planes. The alignment procedure requires that the robot is manually jogged to specified points on the alignment target. The result will be expressed in coordinates relative to the defined work plane.

Align to a work plane

You can align the sensor to 16 different work planes.

1. In the user interface, go to the **Alignment** page.
2. Click **Auto adjust exposure** in the **Advanced** section to update the image exposure settings.
3. In the **Alignment of** list, click the work plane you want to align the sensor to.
4. In the **Alignment target** list, click the alignment target you are using.
5. Place the alignment target on the target surface in the same plane and at the same height as the parts to be located.
6. Position the alignment target to allow the robot to measure the work frame as defined by the coordinate system on the target. The target should be completely visible in the camera image.
7. Click **Align** to acquire an image and align the sensor coordinate system with the alignment target.
8. If alignment fails, adjust the exposure settings and **Pixel size** to obtain a clear image.
9. Repeat steps 6. – 8. until an "Alignment successful" message is displayed in the user interface.

NOTE
Do not remove or reposition the alignment target after sensor alignment until the robot work plane has been defined.

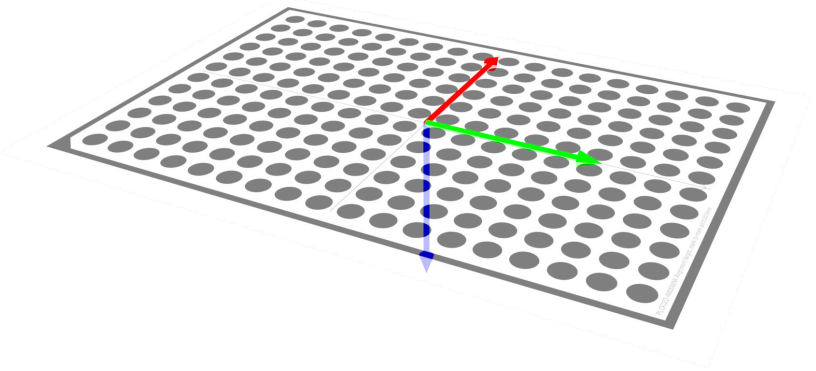

Figure 6: Work plane alignment base

Results

When the sensor is aligned to the work plane, an image of the alignment target is displayed in the image window. The displayed image is rectified, that is, projected onto the defined work plane. A blue circle, representing the position and the direction of the alignment target, is displayed on top.

The aligned sensor coordinates are displayed in the **Results** section.

4.2 Robot frame

Go to the UR robot user interface and the **Alignment** tab in **Program/Command**.

1. Click **Create Robot Frame** to enter the alignment wizard.
2. Select the tool you are using for the alignment in the **TCP** list, see figure 7, page 11.
3. Enter a self-selected robot frame name in the **Robot Frame Name** text field.
4. Move the robot tool tip to the center of the alignment target.
5. Click the **Set Position** button.
6. Click **Next** to continue.

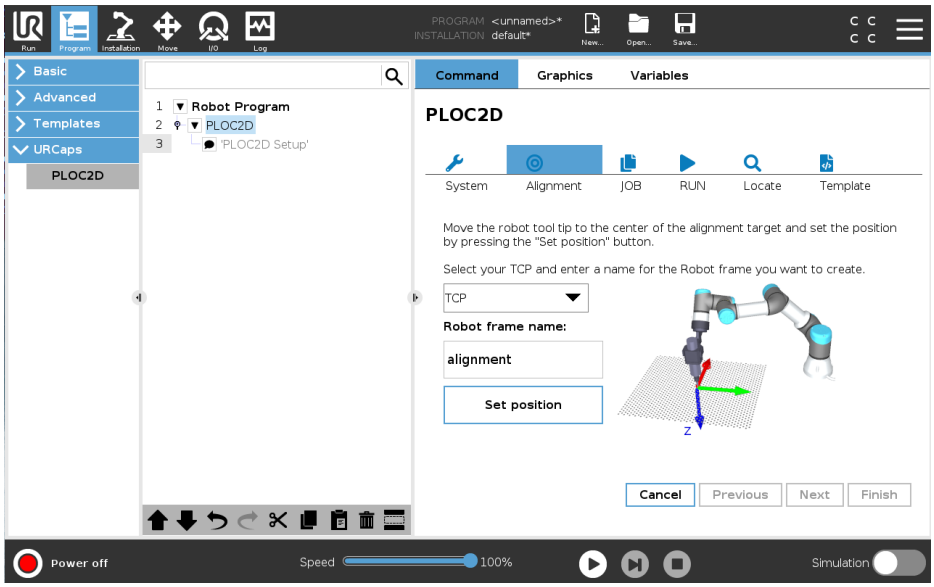

Figure 7: UR Robot user interface, set center position in alignment

7. Move the robot tool tip along the y-axis and position it as far away as possible on the alignment target, see figure 8, page 11.
8. Click the **Set Position** button.
9. Click **Next** to continue.
10. Repeat to set position for x-axis.
    - If the three above defined points are too close to each other, a warning will be shown: “Warning: The points are not sufficiently diverse. Please change the selected points.”
        - Then, repeat steps with new positions.
11. Click **Finish** to create the robot frame.

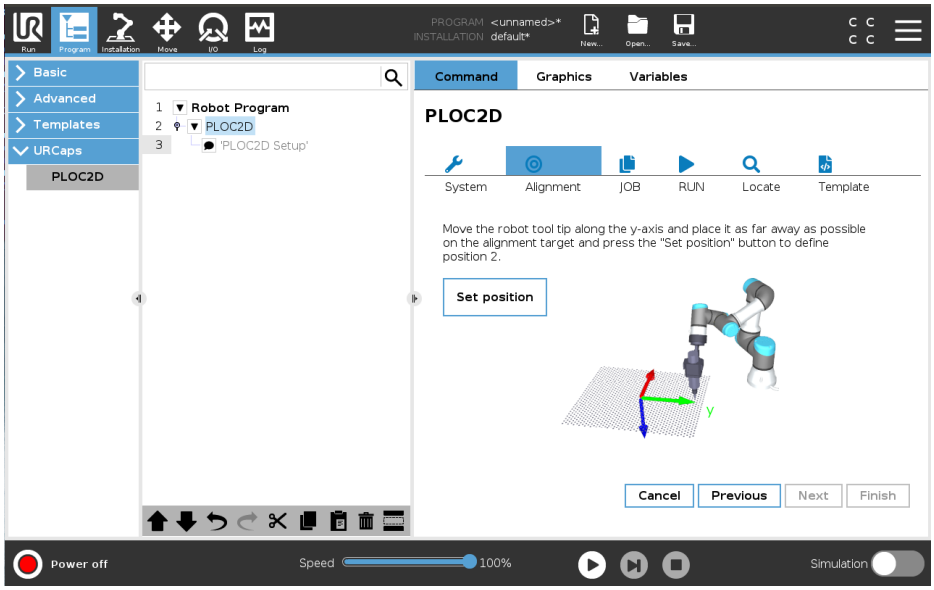

Figure 8: UR Robot user interface, set y-axis position in alignment

5 Job configuration

Now that we have aligned the PLOC2D device and the UR robot, we need to teach the PLOC2D what job to locate and what pick position to use. This is done in the PLOC2D user interface. After that, we need to import the job to the PLOC2D URCap.

5.1 PLOC2D job configuration

For each job configuration, a reference image is captured, and a reference part is located. A maximum of 64 jobs can be configured for the PLOC2D URCap.

Go to the PLOC2D user interface.

5.1.1 Static mounted sensor

Job configuration

1. In the user interface, go to the **Job** tab.
2. Select a job in the **Job** list.
3. Select a work plane in the **Work plane** list.
   - Use the same work plane as the alignment for this job, see "Align to a work plane", page 9.
4. Adjust **Score threshold** if needed.
   - The PLOC2D sensor assigns a percentage score to each located part. Only parts with scores above the score threshold will be reported.
5. Click **Auto adjust exposure** in the Advanced section to update the image exposure settings.
6. Place the reference part in the camera's field of view.
7. Click **Acquire** to acquire a reference image.

✓ The displayed reference image is rectified, that is, projected onto the selected work plane.

8. Define a part shape region, see Draw a part shape region.
9. Set a pick position, see The part reference point tool.

5.1.2 Define regions

Draw a part shape region

The part shape regions define features of the reference part image that the RG-system will locate.

- Click **Brush** to draw a region that covers a feature of the reference part. See figure 9.
  - Use the mouse scroll wheel or the **+** and **-** keys to adjust the size of the **Brush** tool.
  - Zoom by pressing **Shift+Up arrow** or **Shift+Down arrow**.
  - Pan the zoomed view with the arrow keys.
  - Click **Clear** to remove the applied region.

✓ When the system locates the part, a "Job configured" message is displayed in the user interface and the part contours are highlighted in the image window. See figure 10.

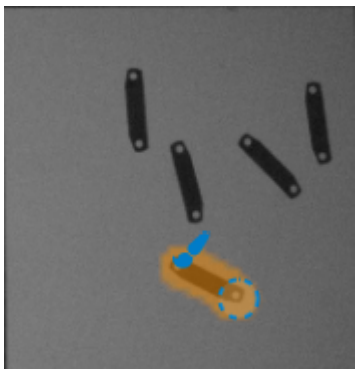

Figure 9: Draw a part shape region

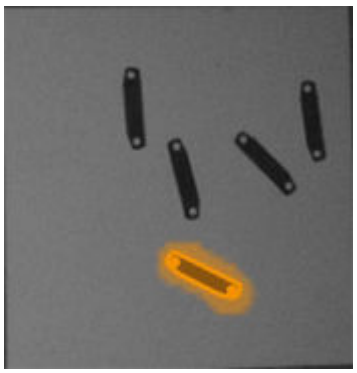

Figure 10: Highlighted part contours

- If needed, click **Eraser** to manually erase regions that do not belong to the reference part. See figure 11.
  - Use the mouse scroll wheel or the **+** and **-** keys to adjust the size of the **Eraser** tool.
  - Zoom by pressing **Shift+Up arrow** or **Shift+Down arrow**
  - Pan the zoomed view with the arrow keys.

Figure 11: Left image: Creating a part shape region over the entire part. Right image: Using the eraser to exclude holes from the part shape region.

5.1.3 Set the pick position

The part reference point tool

To set the pick position for the part somewhere else than the origin, use the part reference point tool.

1. Click **Part reference point** to start the part reference point tool.

✓ The part reference point is highlighted.

2. Drag the part reference point from its position at the origin to a position relative to the detected shape. It can, for example, be at the center of the shape or at a corner.
   - To position the part reference point with high accuracy, zoom in on the part.
   - To rotate the part reference point, use its rotation handle.
   - To reset the part reference point to the origin, click **Reset** at the upper left corner of the image.
   - To center the part reference point based on the edges of the detected shape, click **Center** at the upper left corner of the image.
     - If the shape is almost circular, the rotation is fixed when the part reference point is centered.
     - If the shape is elongated, the rotation is adapted so the x-axis is parallel to the longer side when the part reference point is centered.

✓ This position is now the reference position of the part. All pick positions defined by the robot are defined relative to this position.

5.2 PLOC2D URCap job configuration

Go to the UR robot user interface and the **Job** tab in **Program/Command**.

The list shows the 64 possible jobs from the PLOC2D user interface.

1. Optional: Click **Get job image** button to see images of the configurated jobs, see figure 12, page 14.
2. Select the jobs to be used.

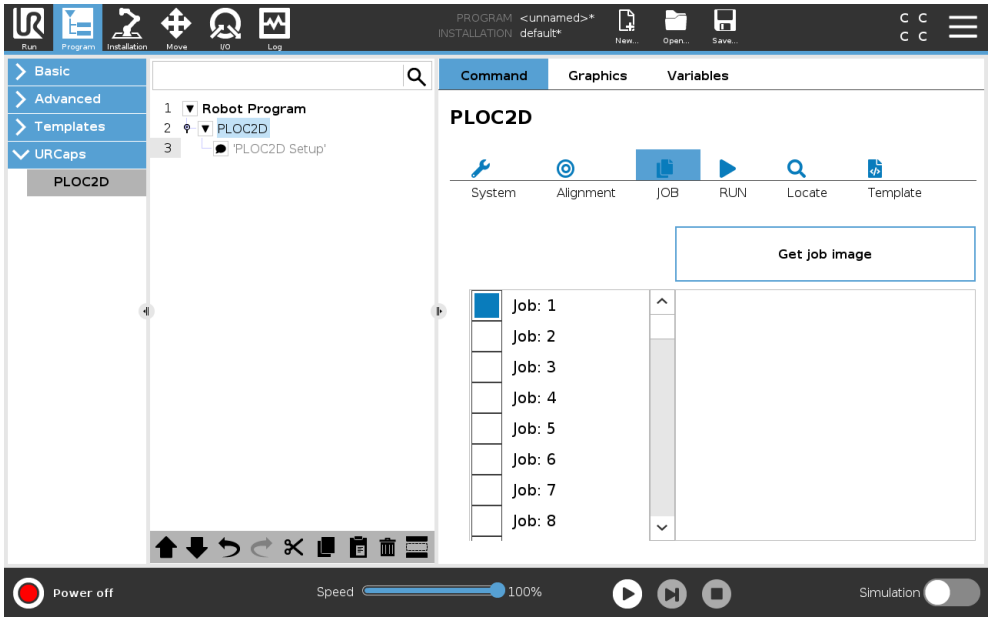

Figure 12: UR Robot user interface, job configuration

Pick pose

For each pick pose set from the PLOC2D job configuration, the PLOC2D URCap node will automatically save two additional absolute positions, see table 1, page 14. These variables can be used in any move commands in the robot program.

Table 1: Pick pose variables

Variable	Description
`PLOC_pick`	Pick pose set in job configuration for the current job
`PLOC_prepick`	100 mm above the set pick pose
`PLOC_clear`	100 mm above the set pick pose

6 Run configuration

We have now taught the system what part to locate and how to pick it. Next, we need to configurate the UR robot how to position the robot arm before picking the part. This is so the angle of the joints on the robot does not exceed its limits when running a program.

Robot reference position

A reference position is needed for the robot to start the pick pose from.

Remain in the UR Robot user interface and go to the **Run** tab in **Program/Command**.

1. Select the tool to be used in the **TCP** list, see figure 13, page 15 .
2. Move the robot so the joint angle of J6 is set to an adequate value with the tool on the part.
   - This is needed to prevent the angle of the joints to exceed the limit when working the program.
3. Click **Set reference position**.
4. An optional offset to the pick pose variables can be added.

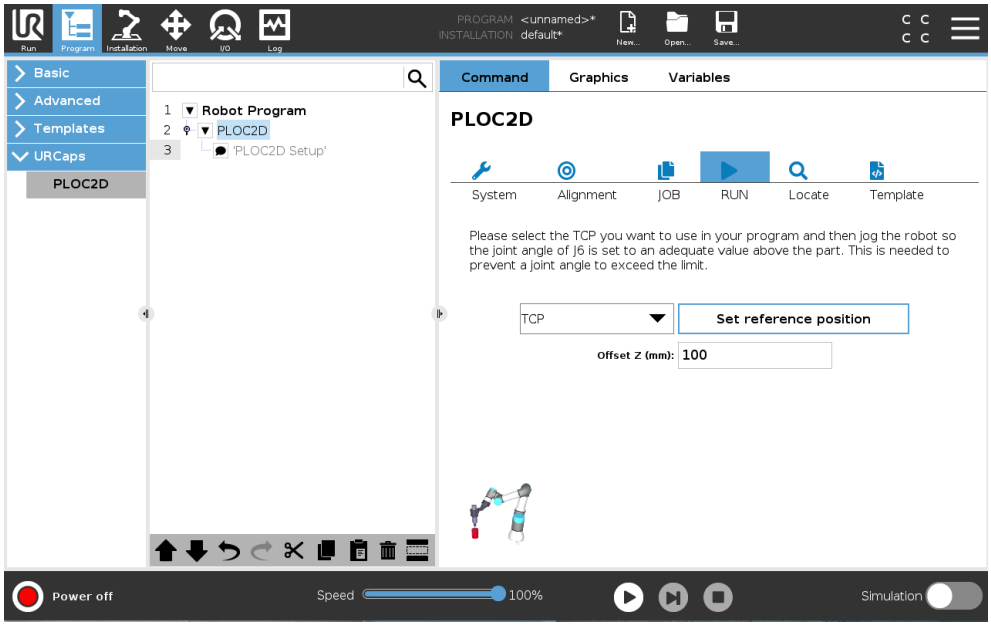

Figure 13: UR Robot user interface, run configuration

7 Robot template program

Your PLOC2D URCap is now configured. To test the configuration, the next step is to create simple robot program, and if necessary, make adjustments in the configuration for the program to work as intended.

Template program

Use the PLOC2D URCap template program to create a simple pick and place program. Available variables can be found in the UR robot user interface, **Program/Variables** window.

Remain in the UR robot user interface and go to the **Template** tab in **Program/Command**.

1. Click the **Pick and Place** button, see figure 14, page 17.

✓ The **Robot program** list fills with nodes for the steps in the program.

2. Click the **MoveJ/Start** node to set the starting point
3. Click **Set waypoint**.
4. Move the robot to the starting point.

NOTE
The starting point needs to be out of the PLOC2D sensor's field of view.

5. Click **OK**.
   - Before the **MoveJ/Start** command a node to open a gripper can be added if needed.
   - After the **PLOC_pick** command a node to close a gripper can be added if needed.
6. Click the **MoveJ/Place** node to set where to drop the part.
7. Click **Set waypoint**.
8. Move the robot to where to drop the part.
9. Click **OK**.
   - After the **MoveJ/Place** command an open gripper node can be added to drop the part if needed.

✓ The Robot template program is now complete. Next step is to run the program to verify that the configuration of the system is correct.

10. Use the control buttons on the bottom to start, paus, stop, and restart the program.
    - If needed, stop and adjust the configuration then restart the program, until it works as intended.

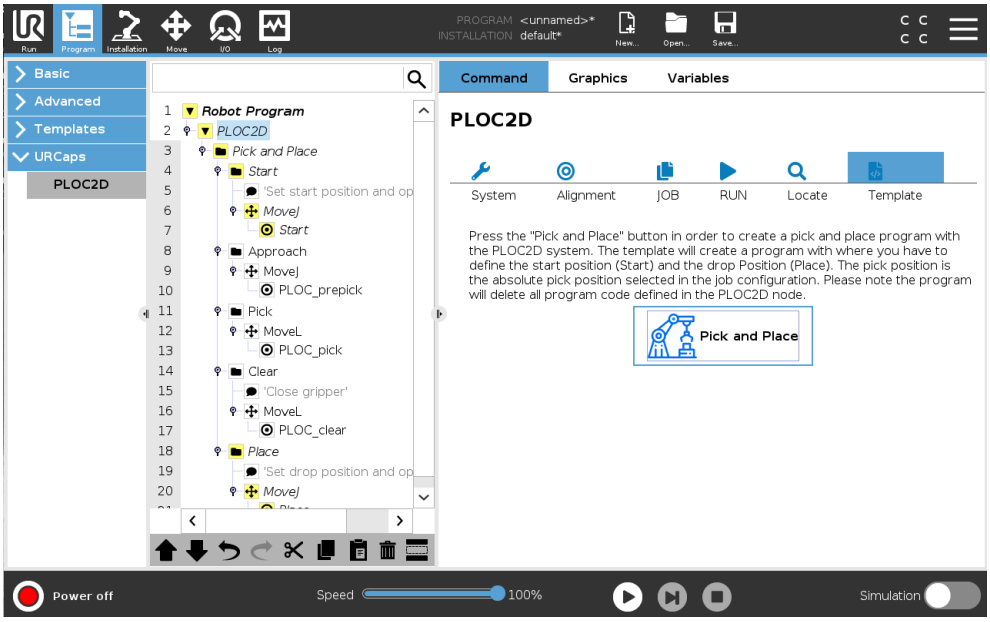

Figure 14: UR Robot user interface, template program

PLOC2D URCap/v. 1.0/2021-12/en

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