

Program Template **EXPLAINED**

Surface Finishing Application



ROBOTIQ
eLearning

PROGRAM TEMPLATE

Surface Finishing Application

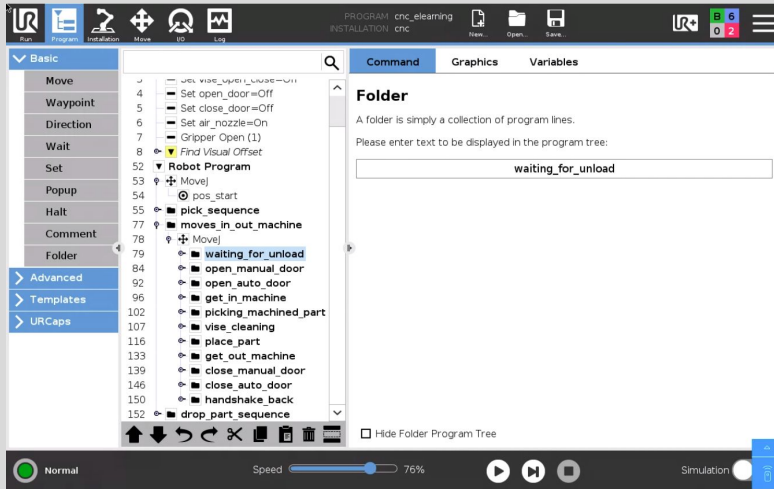




Description

Use this document to help you program your application using the template for the Finishing Application. You can learn more about the steps on how to program your Finishing application using the available videos for this course.


Visit elearning.robotiq.com for more details.



What you will need

- Robotiq Surface Finishing Kit
- Latest URcap - Finishing Copilot URcap
- Universal Robot UR5e, UR10e, or UR16e
- Program Template: **finishing_elearning.urp**

Folders in UR Programs

To insert a folder in your program, go to **Basic** → **Folder**. Once the folder is in the program, you can add nodes in it to build your program. In order to run only a certain part of the program, you can suppress the folders you do not want to run by selecting the folder and pressing on .

Folders in UR Programs

In the UR program tree, it is possible to insert a **folder** node in the program. This allows to separate your program into smaller sections and is very useful for:

- Making the program clearer and easier to understand
- Testing smaller sections of the program
- Reusing the same code throughout your program

We highly recommend you use this tool since it will make your life easier when building your application.

How to use the template

This template contains all the steps to process a basic part that has two set ups. The part used here is part of a wooden chair that is curved, but it can be used to process any other part.

This template is meant to be a guide for you to build your own application. You can use the whole program or only part of it. You will need to change the points and add some instructions, but the flow of the program should be similar and use the same functions.

Remember, when building your program, split it in different sections for each section of the part. This will make it much easier to test and debug.



Robot Program

PROGRAM chaise_elearning*
INSTALLATION default

Run Program Installation Move I/O Log

New... Open... Save...

Manual 3 F 5 0

Basic
Advanced
Templates
URCaps
Mirka
Insights
Collision Detection
Apply Contact Of
Find Conta Offset
Find Surfac
Finishing Tool Contre
Force Even
Force Cont
Insertion
Path Generator
Multipoint

1 Robot Program
2 MoveJ
3 Home_pos
4 Back_of_chair
31 Popup: Back completed. Flip part.
32 Inside

Command Graphics Variables

Program
Here you can program your robot to do tasks.
To program your robot, select the nodes from the **Node List** and they will appear on the **Program Tree**.

Node List
Program Tree

Add Before Start Sequence
 Set Initial Variable Values
 Program Loops Forever

Normal Speed 100% Simulation

1 **Robot Program** is the section of the program where the main loop of the program is located. In our case, we are not using a **Before Start** sequence, but it may be useful if you have variables to set for instance.



Robot Program

The screenshot shows the Robotiq software interface. The top menu bar includes 'Run', 'Program', 'Installation', 'Move', 'I/O', and 'Log'. The main window is divided into several sections:

- Left Panel:** A sidebar with a search bar and a list of categories: Basic, Advanced, Templates, URCaps, Mirka, Insights, Collision Detection, Apply Contact Offset, Find Contact Offset, Find Surface, Finishing Tool Control, Force Even, Force Control, Insertion, Path Generator, and Multipoint.
- Program Tree:** A tree view showing the program structure:
 - 1 Robot Program
 - 2 Move
 - 3 Home_pos
 - 4 Back_of_chair (highlighted with a red circle and the number 2)
 - 31 Popup: Back con
 - 32 Inside
- Command Panel:** Contains tabs for 'Command', 'Graphics', and 'Variables'. The 'Command' tab is active, showing the 'Program' section with instructions: 'Here you can program your robot to do tasks. To program your robot, select the nodes from the Node List and they will appear on the Program Tree.' Below this are two panes: 'Node List' and 'Program Tree'. The 'Node List' contains several greyed-out items, and the 'Program Tree' shows a yellow icon representing the selected node. At the bottom of the Command panel are three checkboxes: 'Add Before Start Sequence', 'Set Initial Variable Values', and 'Program Loops Forever'.
- Bottom Panel:** A control bar with a 'Normal' status indicator, a 'Speed' slider set to 100%, and playback controls (play, stop, pause). A 'Simulation' button is also visible.

2 **Folders** are used for the different sections of the part. Here we use one for the **Back** of the chair and another for the **Inside** of the chair.



Robot Program

3

4

3 The robot start at a **home position** in order to make sure the robot is in a safe position before approaching the part.

4 This popup is used to let the operator know that the back of the part is done. It also stops the program to give time to the operator to flip the part.



Robot Program

PROGRAM: chaise_elearning*
INSTALLATION: default

Run Program Installation Move I/O Log

New... Open... Save...

Manual 3 F 5 0

Basic
Advanced
Templates
URCaps
Mirka
Insights
Collision Detection
Apply Contact Of
Find Contact Offset
Find Surface
Finishing Tool Control
Force Even
Force Control
Insertion
Path Generator
Multipoint

1 Robot Program
2 MoveJ
3 Home_pos
4 Back_of_chair
31 Popup: Back completed. Flip part.
32 Inside

Command Graphics Variables

Program
Here you can program your robot to do tasks.
To program your robot, select the nodes from the **Node List** and they will appear on **Program Tree**.

5

Node List
Program Tree

Add Before Start Sequence
 Set Initial Variable Values
 Program Loops Forever

Normal Speed 100% Simulation

5 If you are using a tower light or another type of information display, you can use it between the sections of the part to let the operator know that the process is finished.



Back of the chair

The screenshot shows the Robotiq software interface. The left sidebar contains a tree view of the robot program, with the 'Back_of_chair' folder selected and highlighted with a red circle containing the number '6'. The main window displays the 'Set' action configuration panel, which includes options for 'No Action', 'Set Digital Output' (set to 'vacuum' and 'Low'), 'Set Analog Output' (set to '<An.Output>' and '4.0 mA'), 'Set <Output>' (set to 'f(x)'), 'Set Single Pulse' (set to '<Di.Output>' and '0.500 s'), and 'Increment installation variable by one' (set to '<Variable>'). There are also checkboxes for 'Set Total Payload' (0.00 kg), 'Use active TCP as center of gravity', and 'Set TCP'. A 'Test' button is visible at the bottom right of the configuration panel. The bottom status bar shows 'Normal' mode, a speed slider at 100%, and a 'Simulation' button.

- 6** The back of the chair is processed like this:
- Approach the point above the starting point of the path generator.
 - Start the tool and vacuum.
 - Find surface.
 - Path.
 - Relative linear move.
 - Move back to home position.



Back of the chair

PROGRAM chaise_elearning*
INSTALLATION default

Run Program Installation Move I/O Log

Command Graphics Variables

1 Robot Program
2 Move]
3 Home_pos
4 Back_of_chair
5 Approach_point1
6 Start tool
7 Set vacuum=On
8 Find Surface
9 Add Stop conditions from th
10 Force Control
11 6-Point Path
12 6-Point Path
13 6-Point Path
14 MoveL
15 Waypoint_1
16 Stop tool
17 Set vacuum=Off
18 Move]
19 Waypoint_3
20 Popup: Back completed. Flip part.
21 Inside

7

Set
Select the action you wish the robot to perform at this point in the program. You can also specify changes in the robot's payload.

No Action
 Set Digital Output vacuum Low
 Set Analog Output <An.Output> 4.0 mA
 Set <Output> f(x)
 Set Single Pulse <Di.Output> 0.500 s
 Increment installation variable by one: <Variable>

Set Total Payload 0.00 kg
 Use active TCP as center of gravity
 Set TCP

Test

Normal Speed 100% Simulation

7 The **Approach Point** is set over the first point of the **Path Generator**.

To set it, simply go to the first point of the **Path Generator** and move in the -Z direction in the tool frame of reference.



Back of the chair

The screenshot shows the Robotiq software interface. The top menu bar includes 'Run', 'Program', 'Installation', 'Move', 'I/O', and 'Log'. The main window is divided into a left sidebar with a tree view, a central command editor, and a bottom status bar. The tree view shows a program structure with steps 1 through 32. Step 7, 'Set vacuum=On', is circled with a large '8'. The 'Set' command editor on the right shows options for 'No Action', 'Set Digital Output' (selected), 'Set Analog Output', 'Set Single Pulse', and 'Increment installation variable by one'. The 'Set Digital Output' section is configured with 'vacuum' as the output and 'Low' as the level. The status bar at the bottom shows 'Normal' mode, a speed slider at 100%, and a 'Simulation' button.

8 The **Start tool** and **Set vacuum** commands are used before touching the surface.



Back of the chair

The screenshot displays the Robotiq software interface for a robot program titled "Back of the chair". The program is structured as follows:

- 1 Robot Program
- 2 Move]
- 3 Home_pos
- 4 Back_of_chair
- 5 Approach_point1
- 6 Start tool
- 7 Set vacuum=On
- 8 Find Surface (highlighted with a circled '9')
- 9 Add Stop condition from the
- 10 Force Control
- 11 6-Point Path
- 18 6-Point Path
- 25 MoveL
- 26 Waypoint_1
- 27 Stop tool
- 28 Set vacuum=Off
- 29 Move]
- 30 Waypoint_3
- 31 Popup: Back completed. Flip part.
- 32 Inside

The "Set" configuration panel for the "Find Surface" node is shown on the right. It includes the following options:

- No Action
- Set Digital Output: vacuum, Low
- Set Analog Output: <An.Output>, 4.0 mA
- Set <Output>, f(x)
- Set Single Pulse: <Di.Output>, 0.500 s
- Increment installation variable by one: <Variable>
- Set Total Payload: 0.00 kg
- Use active TCP as center of gravity
- Set TCP: [Dropdown]

A "Test" button is located at the bottom right of the configuration panel. The bottom status bar shows "Normal" mode, a speed slider at 100%, and a "Simulation" button.

9 The **Find Surface** node is used to contact the surface before the **Path Generator**.

The **Find Surface** force threshold should be set at the force used to process the surface in the **Force Control** node.



Back of the chair

The screenshot displays the Robotiq software interface. The left sidebar shows a tree view of the robot program, with the 'Force Control' node highlighted and circled in red. The main window shows the 'Force Control' configuration panel. The 'Feature' is set to 'Tool'. The 'Enable control' section has checkboxes for x, y, z, Rx, Ry, and Rz, with 'z' checked. The 'Force/Torque' section shows values for Fx (0 N), Fy (0 N), and Fz (30 N). The 'Stiffness' section shows values for Rx, Ry, and Rz (all 100%). The 'Deviation range' section shows values for x, y, and z (all -100 to 100 mm). The 'Apply force based on' section has radio buttons for 'Targeted position' (selected) and 'Current position'. The 'Enable adaptive stiffness' checkbox is checked. The bottom status bar shows 'Normal' mode, 'Speed' at 100%, and 'Simulation' mode.

Enable control	Force/Torque	Stiffness	Deviation range
x <input type="checkbox"/>	Fx 0 N	100 %	-100 100 mm
y <input type="checkbox"/>	Fy 0 N	100 %	-100 100 mm
z <input checked="" type="checkbox"/>	Fz 30 N	100 %	-100 100 mm
Rx <input type="checkbox"/>	Mx 0 Nm	100 %	-20 20 °
Ry <input type="checkbox"/>	My 0 Nm	100 %	-20 20 °
Rz <input type="checkbox"/>	Mz 0 Nm	100 %	-20 20 °

10 The **Force Control** node is used to apply the proper force when processing the surface. Most of the time, the force will be in the +Z direction of the tool reference frame.

If your path is precise enough, you can use the **Targeted Position** option of the force control. This offers a better control of the force and trajectory.



Back of the chair

The screenshot displays the Robotiq software interface. On the left, a menu lists various functions like 'Mirka', 'Insights', and 'Path Generator'. The central tree view shows a robot program for 'Back_of_chair' with a '6-Point Path' selected. The 'Path Generator' panel on the right is configured with 'Tool speed' at 85 mm/s, 'Spacing' at 30 mm, and 'End path on' set to 'Point 6'. The 'Curved passes' option is selected. A 3D model of a chair back is shown with six numbered points and a curved path. A circled '11' is placed over the '6-Point Path' entry in the tree view.

11 The **6-Point Path** is used to generate the trajectory required to process the surface.

Here we use the 6 points because the surface is curved in one direction.

Since the grain of the wood is in the direction of the curve, we use the **curved passes** option.



Back of the chair

The screenshot shows the Robotiq software interface. The left sidebar contains a menu with options like Basic, Advanced, Templates, URCaps, Mirka, Insights, Collision Detection, Apply Contact Offset, Find Surface, Finishing Tool Control, Force Even, Force Control, Insertion, and Path Generator. The main area displays a tree view of the robot program with a callout '11' pointing to 'Point 6' under the '6-Point Path' section. The 'Path Generator' configuration panel on the right shows settings for tool speed (85 mm/s), spacing (30 mm), and end path on (Point 6). A 3D model of a chair back is shown with a blue path and numbered points 1 through 6. The bottom status bar shows 'Normal' speed at 100% and a simulation button.

11 The final point is point 6 since it will be the closest to the first point of the next path generator.

Doing that reduces the cycle time and can let you continue seamlessly on the other path generator without leaving the surface of the part.



Back of the chair

The screenshot shows a robot programming software interface. On the left is a navigation pane with categories like 'Basic', 'Advanced', 'Templates', and 'URCaps'. The main area displays a 'Robot Program' tree with nodes such as 'Home_pos', 'Back_of_chair', 'Approach_point1', 'Start tool', 'Set vacuum=On', 'Find Surface', 'Force Control', '6-Point Path', 'MoveL', 'Waypoint_1', 'Stop tool', 'Set vacuum=Off', 'Waypoint_3', and 'Inside'. A red circle with the number '12' highlights the 'Waypoint_1' node. The right panel is titled 'Waypoint' and shows configuration options for 'Waypoint_1'. It includes a 'Relative position' dropdown, 'Set Point' and 'Move here' buttons, and fields for 'Distance' (42.69 mm) and 'Angle' (0.0 degrees). Below these are radio buttons for 'Stop at this point' (selected), 'Blend with radius', 'Use shared parameters', 'Tool Speed' (250 mm/s), 'Tool Acceleration' (1200 mm/s²), and 'Time' (2.0 s). An 'Add Until' button is at the bottom.

12 A linear relative move is added after the **Force Control** node. It moves in the -Z direction in the tool frame of reference.

This ensure that the robot will move away of the surface once the operation on the surface is done.



Back of the chair

The screenshot shows a robot programming software interface. The main window is titled "Waypoint" and displays configuration options for "Waypoint_1". The "Relative position" dropdown is set to "Relative position". The "Distance" is 42.69 mm and the "Angle" is 0.0°. The "Stop at this point" radio button is selected. The "Tool Speed" is 250 mm/s, "Tool Acceleration" is 1200 mm/s², and "Time" is 2.0 s. A circled "13" is overlaid on the "Waypoint_1" entry in the program tree.

13 Once the tool is no longer on the surface, we turn it off and stop the dust collector.



Back of the chair

The screenshot displays the UR Robot Studio interface. The left sidebar shows a tree view of the robot program, with 'Waypoint_1' selected and highlighted by a red circle containing the number 14. The main panel shows the configuration for 'Waypoint_1', including relative motion, distance (42.69 mm), and angle (0.0 degrees). The bottom status bar shows 'Normal' mode, 'Speed' at 100%, and 'Simulation' mode.

14 Finally we move back to the home position to clear the part.



Back of the chair

The screenshot shows a robot programming software interface. The main window displays a 'Popup' dialog box with the text 'Back completed. Flip part.' and a 'Preview Popup' button. The number '15' is circled in the dialog box. The software interface includes a menu bar, a toolbar, a left sidebar with a tree view, and a bottom status bar with a speed slider and simulation controls.

15 In this example, a **Popup** is used to let the operator know that the back of the chair is done. Once the setup is changed, the operator can continue the program through the teach pendant.

For your application, this is where you would put something like a tower light or other system to inform the operator that the process is over. Many options are available, simply find the one best suited for your application.



Back of the chair

The screenshot displays the ROBOTIQ software interface. On the left, a tree view shows the assembly structure with the 'Back of the chair' folder expanded. A red circle highlights 'Waypoint_4' with the number '16'. The main panel shows the 'Force Control' configuration for this waypoint. The 'Enable control' section is active, and the 'z' axis is selected. The 'Force/Torque' table is as follows:

Enable control	Force/Torque	Stiffness	Deviation range
<input type="checkbox"/>	Fx 0 N	100 %	-100 100 mm
<input type="checkbox"/>	Fy 0 N	100 %	-100 100 mm
<input checked="" type="checkbox"/>	Fz 30 N	100 %	-100 100 mm
<input type="checkbox"/>	Mx 0 Nm	100 %	-20 20 °
<input type="checkbox"/>	My 0 Nm	100 %	-20 20 °
<input type="checkbox"/>	Mz 0 Nm	100 %	-20 20 °

Additional settings include 'Enable adaptive stiffness' checked, 'Apply force based on' set to 'Targeted position', and 'Apply force based on' set to 'Targeted position'. The bottom status bar shows 'Normal' mode, 'Speed' at 100%, and 'Simulation' mode.

16 The **Inside** folder processes the inside of the chair. The whole process is exactly like the back of the chair, but with 3 **6-Point Path** nodes instead of 2.



More Templates Available!



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ROBOTICS



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