10.5. The First Program

Description

A program is a list of commands telling the robot what to do. For most tasks, programming is done entirely using the PolyScope software. PolyScope allows you to teach the robot arm how to move using a series of waypoints to set up a path for the robot arm to follow.

Use the Move tab to move the Robot Arm to a desired position, or teach the position by pulling the Robot Arm into place while holding down the Freedrive button at the top of the Teach Pendant.

You can create a program can to send I/O signals to other machines at certain points in the robot's path, and perform commands like **if...then** and **loop**, based on variables and I/O signals.

To create a simple program

1. On PolyScope, in the Header **File Path**, tap **New...** and select **Program**.
2. Under Basic, tap **Waypoint** to add a waypoint to the program tree. A default MoveJ is also added to the program tree.
3. Select the new waypoint and in the Command tab, tap **Waypoint**.
4. On the Move Tool screen, move the robot arm by pressing the move arrows. You can also move the robot arm by holding down the Freedrive button and pulling the Robot Arm into desired positions.
5. Once the robot arm is in position, press **OK** and the new waypoint displays as Waypoint_1.
6. Follow steps 2 to 5 to create Waypoint_2.
7. Select Waypoint_2 and press the Move Up arrow until it is above Waypoint_1 to change the order of the movements.
8. Stand clear, hold on to the emergency stop button and in the PolyScope Footer, press **Play** button for the Robot Arm to move between Waypoint_1 and Waypoint_2. Congratulations! You have now produced your first robot program that moves the Robot Arm between the two given waypoints.

NOTICE

1. Do not drive the robot into itself or anything else as this may cause damage to the robot.
2. This is only a quick start guide to show how easy it is to use a UR robot. It assumes a harmless environment and a very careful user. Do not increase the speed or acceleration above the default values. Always conduct a risk assessment before placing the robot into operation.

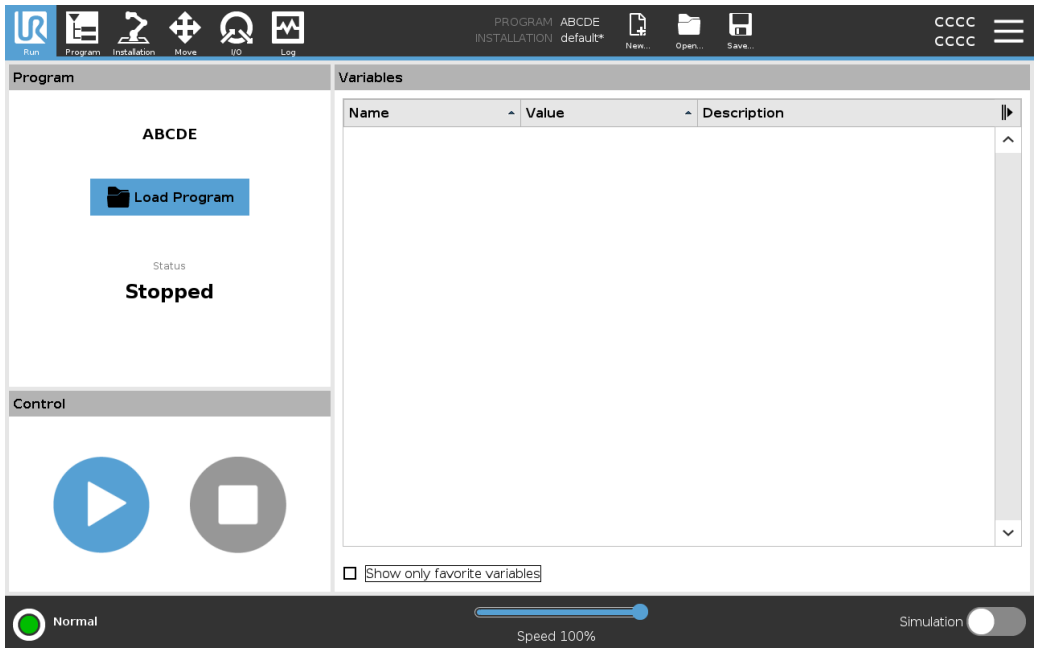
WARNING

Keep your head and torso outside the reach (workspace) of the robot. Do not place fingers where they can be caught.

10.5.1. Run Tab

Description

The **Run** tab allows you to do simple operations and monitor the state of your robot. You can load, play, pause and stop a program, as well as monitor variables. The Run Tab is most useful when the program is created and the robot is ready for operation.



Program

The Program pane displays the name and status of the current program.

To load a new program

1. In the Program pane, tap **Load Program**.
2. Select your desired program from the list.
3. Tap **Open** to load the new program.

   The variables, if present, are displayed when you play the program.

Variables

The Variables pane displays the list of variables used by programs to store and update values during runtime.

- Program variables belong to programs.
- Installation variables belong to installations that can be shared among different programs. The same installation can be used with multiple programs.

All program variables and installation variables in your program are displayed in the Variables pane as a list showing the Name, Value and Description of the variable.

Variable descriptions

You can add information to your variables by adding variable descriptions in the Description column. You can use the variable descriptions to convey the purpose of the variable and/or the meaning of its value to operators using the Run tab screen and/or other programmers.
Variable descriptions (if used) can be up to 120 characters, displayed in the Description column of the variables list on the Run tab screen and the Variables tab screen.

Favorite variables

You can display selected variables by using the **Show only favorite variables** option.
To show favorite variables

1. Under Variables, check the **Show only favorite variables** box.
2. Check **Show only favorite variables** again to show all variables.

You cannot designate favorite variables in the Run Tab, you can only display them. Designating favorite variables depends on the variable type.

To designate favorite program variables

1. In the Header, tap **Program**.
   The variables are listed under **Variable Setup**.
2. Select the desired variables.
3. Check the **Favorite variable** box.
4. Tap **Run** to return to your variable display.

To designate favorite installation variables

1. In the Header, tap **Installation**.
2. Under General, select **Variables**.
   The variables are listed under **Installation Variables**.
3. Select the desired variables.
4. Check the **Favorite variable** box.
5. Tap **Run** to return to your variable display.

Collapse/expand the Description column

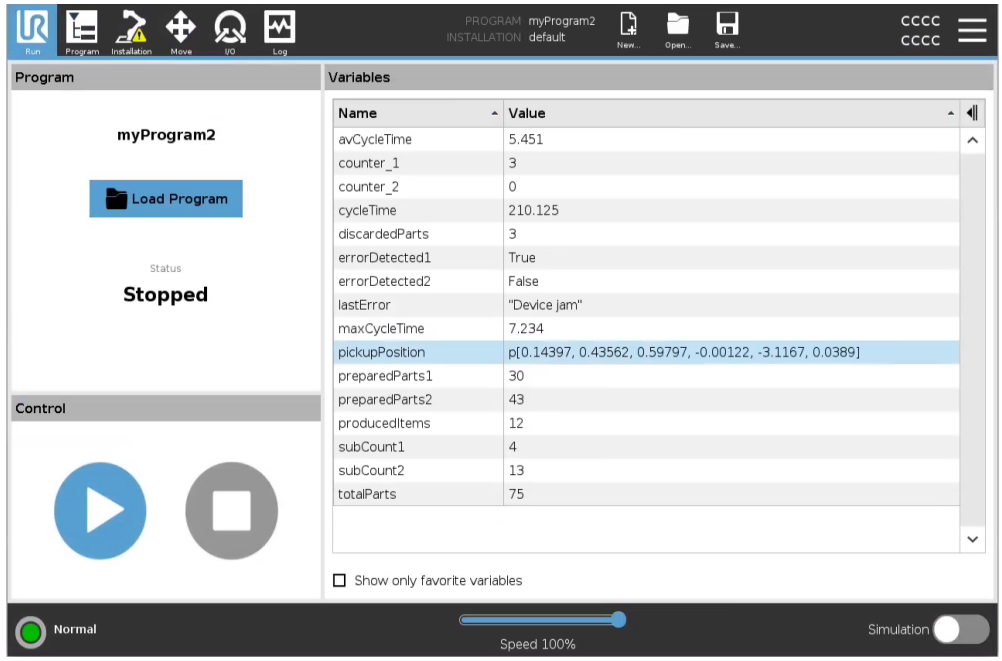
A variable description spans multiple lines to fit the width of the Description column if necessary. You can also collapse and expand the Description column by using the buttons shown below.

To collapse/expand the Description column

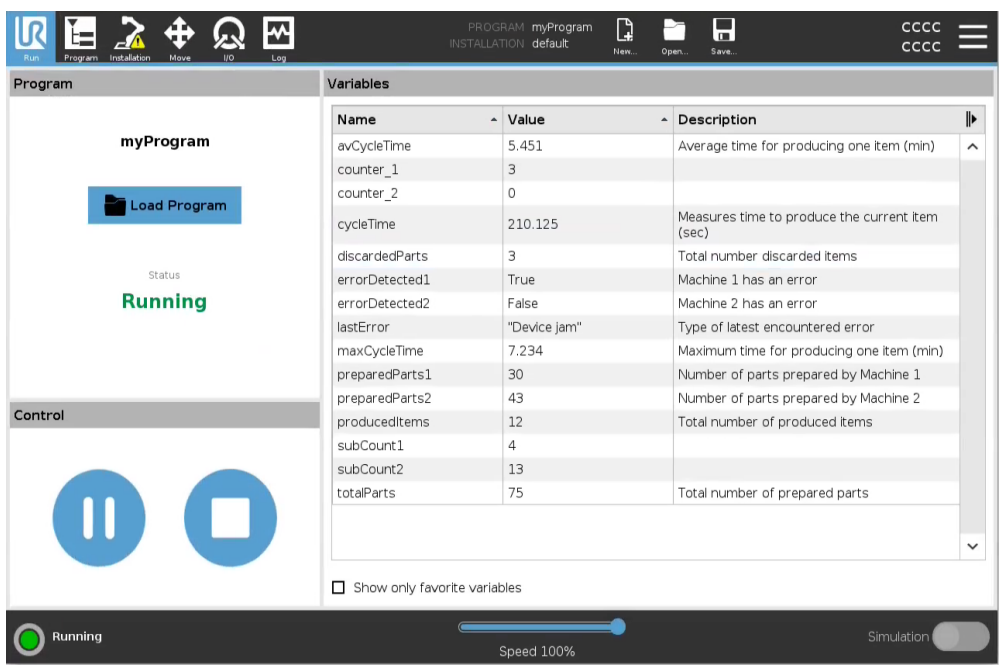
1. Tap  to collapse the Description column.
2. Tap  to expand the Description column.

here

Collapsed Description column



Expanded Description column



Control The Control pane allows you to control the running program. You can play and stop, or pause and resume a program, using the buttons listed in the table below:

- The Play button, Pause button and the Resume Button are combined.
- The Play button changes to Pause when the program is running.
- The Pause button changes to Resume.

Button		Function
Play		To play a program 1. Under Control, tap **Play** to start running a program from the beginning.
Resume		To resume a paused program 1. Tap **Resume** to continue running the paused program.
Stop		To stop a program 1. Tap **Stop** to stop the running program You cannot resume a stopped program. You can tap **Play** to restart the program.
Pause		To pause a program 1. Tap **Pause** to pause a program at a specific point. You can resume a paused program.

10.5.2. Move Robot into Position

Description

Access the **Move Robot into Position** screen when the Robot Arm must move to a particular start position before running a program, or when the Robot Arm is moving to a waypoint while modifying a program.

In cases where the **Move Robot into Position** screen cannnot move the Robot Arm to the program start position, it moves to the first waypoint in the program tree.
The Robot Arm can move to an incorrect pose if:

- The TCP, feature pose or waypoint pose of the first movement is altered during program execution before the first move is executed.
- The first waypoint is inside an If or Switch program tree node.

Accessing the Move Robot into Position Screen

1. Tap the Run tab in the header.
2. In the **Footer**, tap **Play** to access the **Move Robot into Position** screen.
3. Follow the on-screen instructions to interact with the animation and the real robot.

Move robot to

Hold down **Move robot to:** to move the Robot Arm to a start position. The animated Robot Arm displayed on-screen shows the desired movement about to be performed.

NOTICE

Collision can damage the robot or other equipment. Compare the animation with the position of the real Robot Arm to ensure the Robot Arm can safely perform the movement without colliding with any obstacles.

Manual

Tap **Manual** to access the **Move** screen where the Robot Arm can be moved by using the Move Tool arrows and/or configuring Tool Position and Joint Position coordinates.

10.5.3. Using the Program Tab

Description

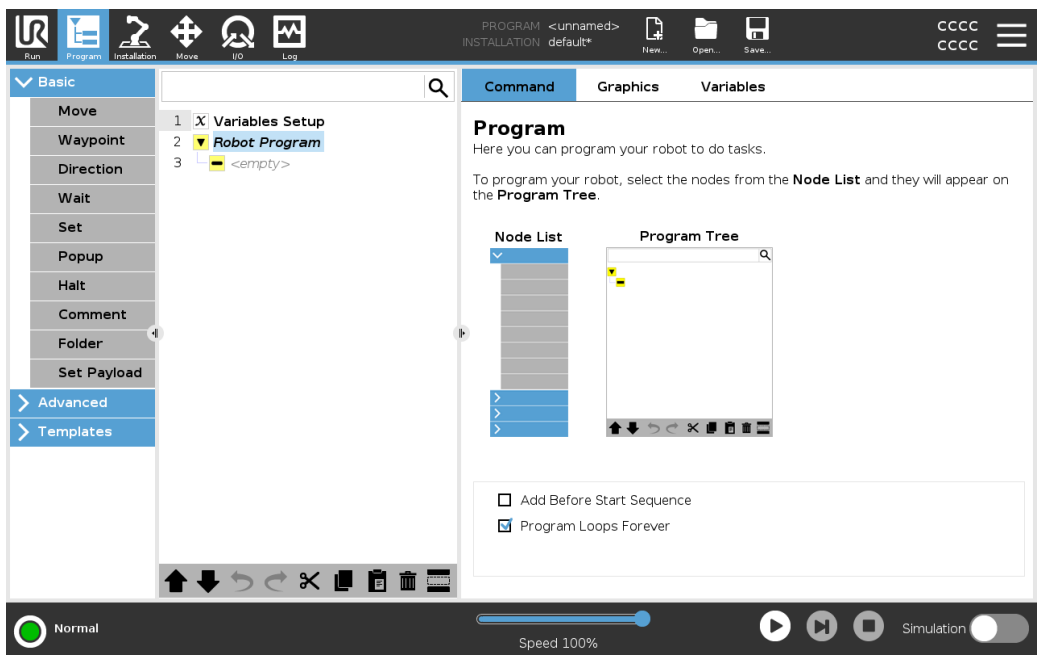
The Program tab is the where you create and edit robot programs. There are two main areas:

- The left side contains the program nodes you can add to your robot program.

  You can use the Basic, Advanced and Template dropdowns to the very left.

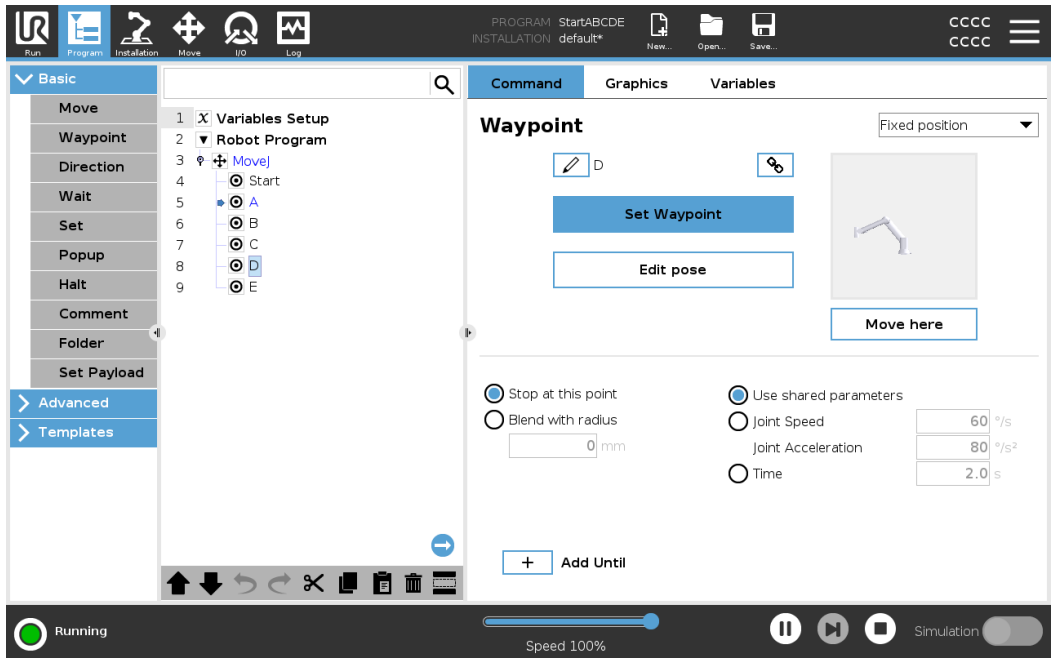
- The right side contains the configuration of the program nodes you can add to your program.

  You can use Command, Graphics and Variables options.



Program Tree

The program tree is built as you add program nodes to your program.
You can use the Command tab to configure the functionality of the added program nodes.

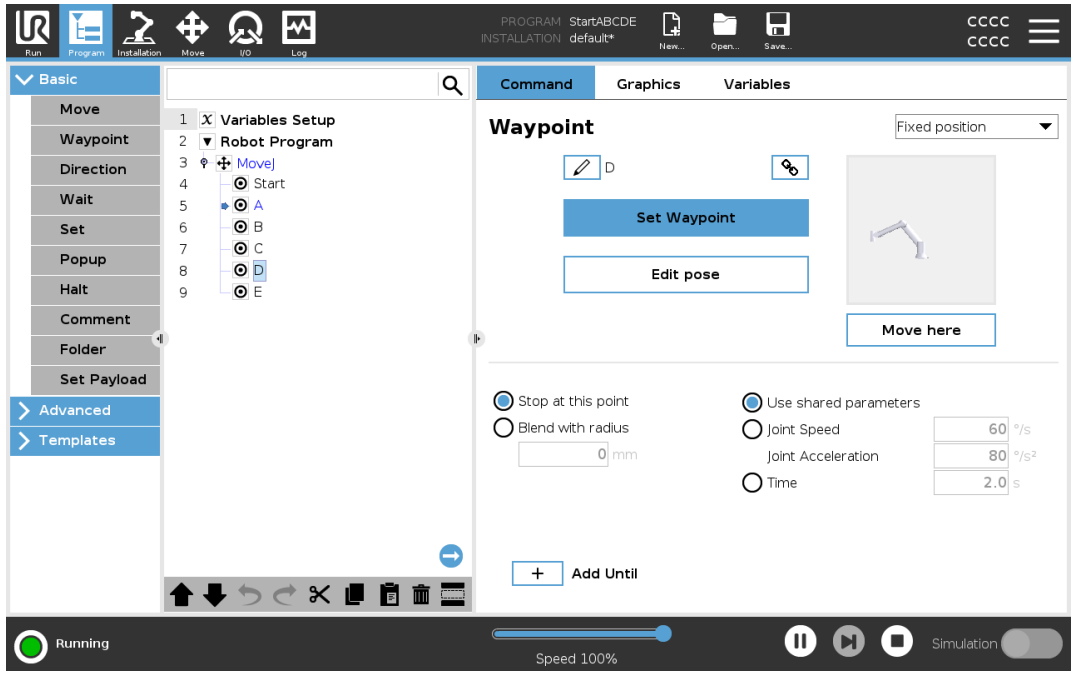


Adding program nodes

- You cannot run an empty program tree or a program containing incorrectly configured program nodes.
- Incorrectly configured programs nodes are higlighted in yellow.
- Correctly configured program nodes are highlighted in white.

Program Execution Indication

Robot programs often become quite long, so order to be able to see the flow of the robot program, you can look at what program node is active.



When the program is running, the program node currently being executed is indicated by a small icon next to that node.
The path of execution is highlighted with blue arrow .

Tapping the icon at the corner of the program allows it to track the command being executed

Search Button

You can also search for a specific command/program node. This is useful when you have a long program with many different program nodes.

10.5.4. Program Tree Toolbar

Description

You can work with the program nodes that have been added to the program tree by using the icons in the bottom of the program tree.

Icons in the Program Tree toolbar

Use the toolbar at the base of the Program Tree to modify the Program Tree.

Undo & Redo		undo and redo changes to commands.
Move Up & Move Down		changes the position of a node.
Cut		cuts a node and allows it to be used for other actions (e.g., paste it on other place on the Program Tree).
Copy		copies a node and allows it to be used for other actions (e.g., paste it on other place on the Program Tree).
Paste		pastes a node that was previously cut or copied.
Delete		removes a node from the Program Tree.
Suppress		suppresses specific nodes on the Program Tree.
Search Button		search in the Program Tree. Tap the  icon to exit search.

10.5.5. Using Selected Program Nodes

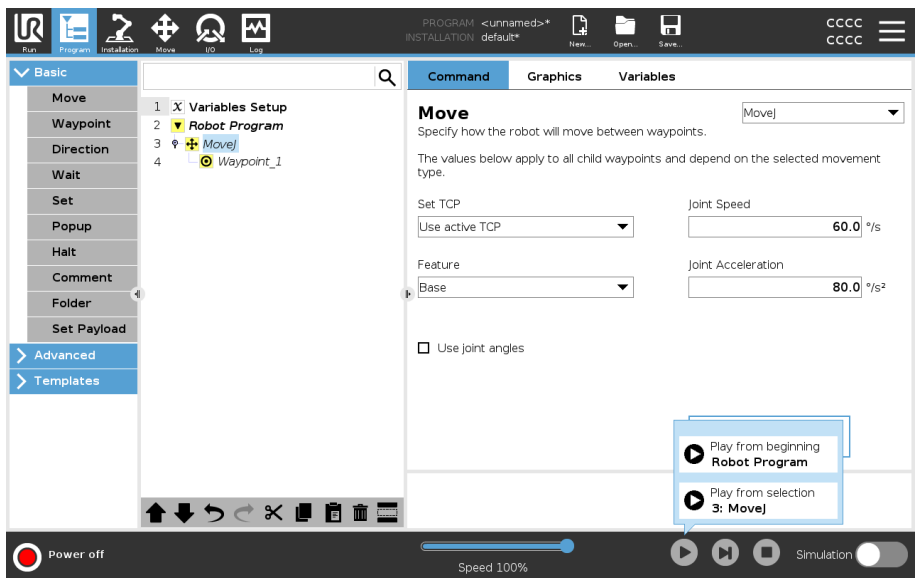
Description

You can start your robot program from any program node in the program tree. This is useful when you are testing your program.

When the robot is in Manual Mode (see Operational Modes), you can allow a program to start from a selected node or you can start the entire program from the beginning.

Play From Selection

The Play button in the Footer provides options for how to start the program.
In the image below, the **Play** button is selected and **Play from Selection** is displayed.



- You can start a program only from a node in the robot Program tree. The **Play from Selection** stops if a program cannot be run from a selected node.

  The program also stops and displays an error message if an unassigned variable in encountered while playing a program from selected node.
- You can use **Play from Selection** in a subprogram. The program execution halts when the subprogram ends.
- You cannot use **Play from Selection** with a thread because threads always start from the beginning.

To play a program from a selected node

1. In the Program tree, select a node.
2. In the Footer, tap **Play**.
3. Select **Play from Selection** to run a program from a node in the program tree.

Example

You can start a stopped program again from a specific node.

10.5.6. Using Basic Program Nodes

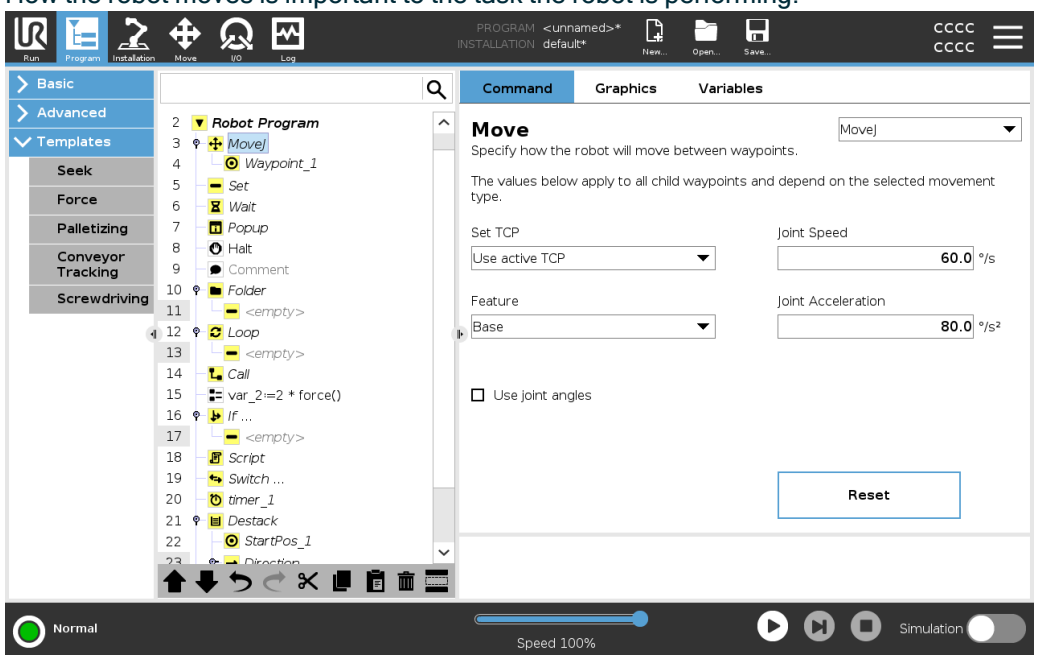
Description

Basic program nodes are used to create simple robot applications. Some basic program nodes are also used to organize your robot program and create comments in your robot program. This can be quite useful, if it is large robot program.

10.5.7. Basic Program Nodes: Move

Description

The Move command allows the robot to move from point A to point B.
How the robot moves is important to the task the robot is performing.



When you add a Move to your program tree, the Move pane appears to the right of the screen.

The Movecommand controls the robot's motion via waypoints.
Waypoints are automatically added when you add Move commands to a program.
Read more about Waypoints.
You can also use Moves to set acceleration and speed for the robot arm's movement between waypoints.

The robot moves using four Move commands. See the Move command types below:

MoveJ

The MoveJ command creates a movement from point A to point B that is optimal for the robot.
The movement may not be a direct line between A and B, but optimal for the start position of the joints and the end position of the joints.

Add a MoveJ command

1. In your robot program, select the place where you wish to add a Move.
2. Under Basic, tap **Move** to add a waypoint to the robot program together with a Move node.
3. Select the move node.
4. Select the MoveJ in the drop-down menu.

Detail

MoveJ makes movements that are calculated in the robot arm joint space. Joints are controlled to finish their movements at the same time. This movement type results in a curved path for the tool to follow. The shared parameters that apply to this movement type are the maximum joint speed and joint acceleration, specified in *deg/s* and deg/s^2, respectively. If it is desired to have the robot arm move fast between waypoints, disregarding the path of the tool between those waypoints, this movement type is the preferable choice.

MoveL

The MoveL command creates a movement that is a direct line from point A and point B.

Add a MoveL command

1. In your Robot Program, select the place where you wish to add a Move.
2. Under Basic, tap **Move** to add a waypoint to the robot program together with a Move node.
3. Select the move node.
4. Select the MoveL from the drop-down menu.

Detail

MoveL moves the Tool Center Point (TCP) linearly between waypoints. This means that each joint performs a more complicated motion to keep the tool on a straight line path. The shared parameters that can be set for this movement type are the desired tool speed and tool acceleration specified in *mm/s* and mm/s^2, respectively, and also a feature.

MoveP

The MoveP command creates a movement with a constant speed between the waypoints. Blend between waypoints is enabled to ensure constant speed. (See Blending).

Add a MoveP command

1. In your Robot Program, select the place where you wish to add a Move.
2. Under Basic, tap **Move** to add a waypoint to the robot program together with the Move node.
3. Select the move node.
4. Select the MoveP from the drop-down menu.

Detail

MoveP moves the tool linearly with constant speed with circular blends, and is intended for some process operations, like gluing or dispensing. The size of the blend radius is by default a shared value between all the waypoints. A smaller value will make the path turn sharper whereas a higher value will make the path smoother. While the robot arm is moving through the waypoints with constant speed, the robot control box cannot wait for either an I/O operation or an operator action. Doing so might stop the robot arm's motion, or cause a robot stop.

MoveCircle

The MoveCircle command creates a circular movement, by creating a half circle. You can only add CircleMove via a MoveP command.

Add a MoveCircle command

1. In your Robot Program, select the place where you wish to add a Move.
2. Under Basic, tap **Move**.

   A waypoint is added to the robot program together with the Move node.
3. Select the move node.
4. Select the MoveP from the drop-down menu.
5. Tap **Add circle move**
6. Select the orientation mode.

Detail

The robot starts the circular movement from its current position, or start point, and moves through a ViaPoint specified on the circular arc, to an EndPoint that completes the circular movement.
A mode is used to calculate tool orientation, through the circular arc.
The mode can be:

- Fixed: only the start point is used to define the tool orientation.
- Unconstrained: the start point transforms to the EndPoint to define tool orientation.