

V E R S A B U I L T
R O B O T I C S



Robot2CNC - Basic Edition
Universal Robots - Fanuc Focas
Installation and Operation

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Safety Warnings

DANGER: The Robot2CNC is an industrial control product designed to be operated by trained personnel only. The Robot2CNC is capable of starting the CNC, actuating clamping devices and making changes to the CNC's operating parameters. Before deploying the Robot2CNC, a safety risk assessment must be completed in accordance to local, state and/or federal requirements. When using the Robot2CNC all CNC safety interlocks must be maintained. Additional safety measures may be required to ensure the Robot2CNC device does not create a safety hazard when deployed.

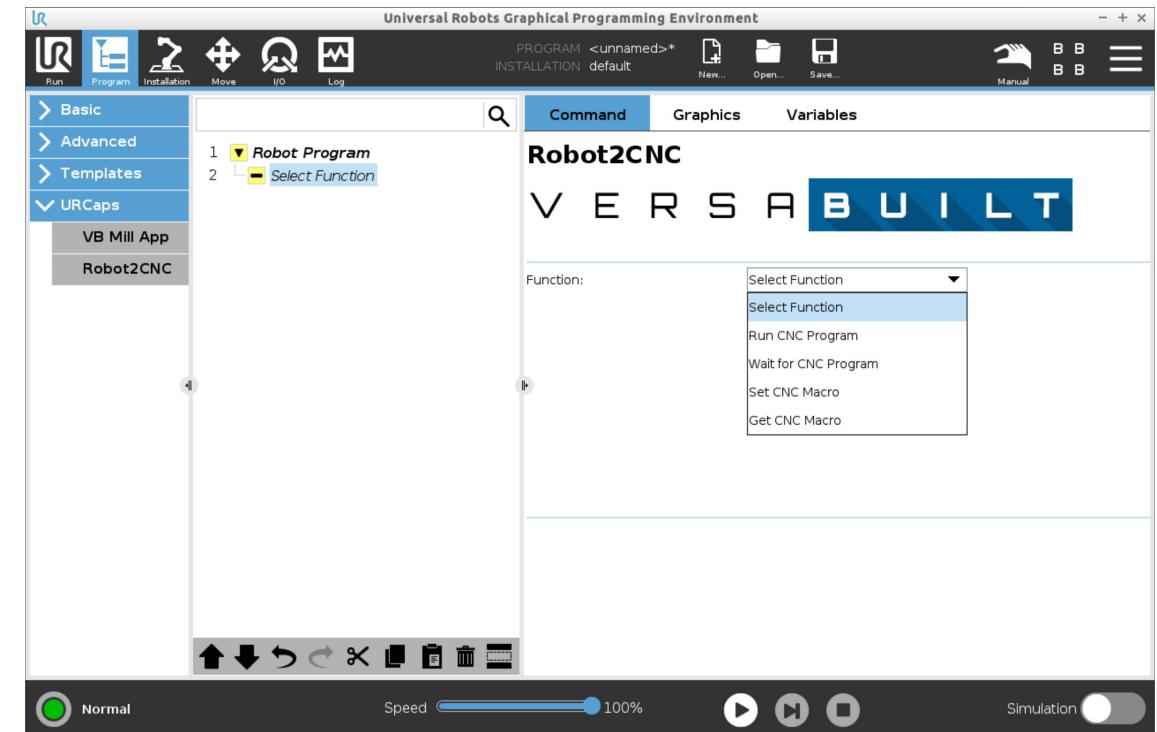
The Robot2CNC should only be used by trained operators.

How it Works

Robot2CNC communicates with a Fanuc-based CNC using the Fanuc FOCAS2 protocol. FOCAS2 protocol allows the Robot2CNC to read and write macro variables on the CNC. Values in the macro variables are used to communicate information and commands between the Robot and the CNC machine. When used with the provided VersaBuilt CNC programs, the Robot2CNC allows the robot to select and run any program stored on the CNC and be notified when the program completes.

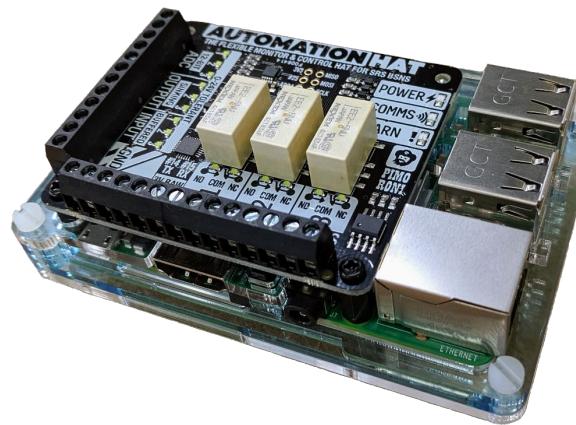
In the Robot2CNC Basic edition, the following commands are available:

1. Run CNC Program (CNC Program Number)
2. Wait for CNC Program
3. Set CNC Macro Variable
4. Get CNC Macro Variable



In the Box

- Robot2CNC Computer
- VersaBuilt USB drive
- 2 x Long Ethernet cables
- 1 x Short Ethernet cable
- 1 x 5-port Ethernet switch
- Cycle Start Wiring



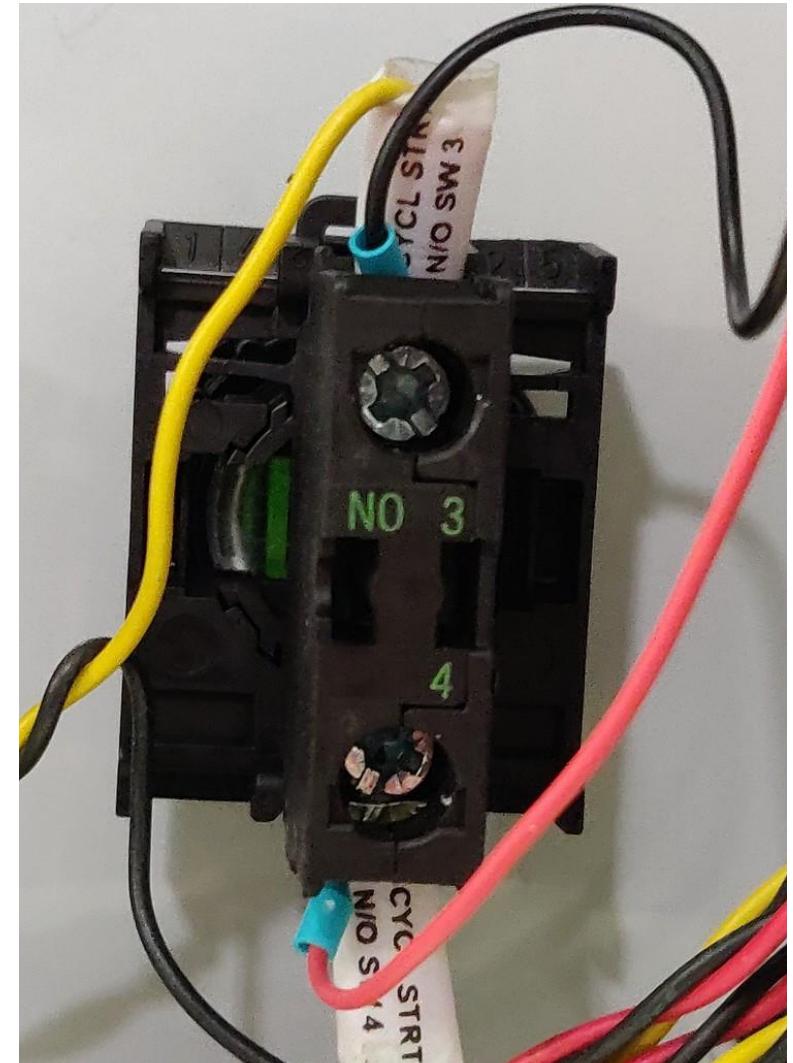
Installation Steps

1. Install Cycle Start Wires to CNC
2. Mount Robot2CNC Computer and the 5-port Hub in the CNC Cabinet
3. Connect Cycle Start Wires to Robot2CNC
4. Connect Ethernet Cable between Robot and Robot2CNC
5. Connect Ethernet Cable between CNC and Robot2CNC
6. Configure CNC Settings
7. Install VersaBuilt Gcode Files on CNC
8. Configure UR Robot Settings
9. Install UR Robot Software
10. Install Script File and Validate Robot2CNC

Step 1: Install Cycle Start Wires to CNC

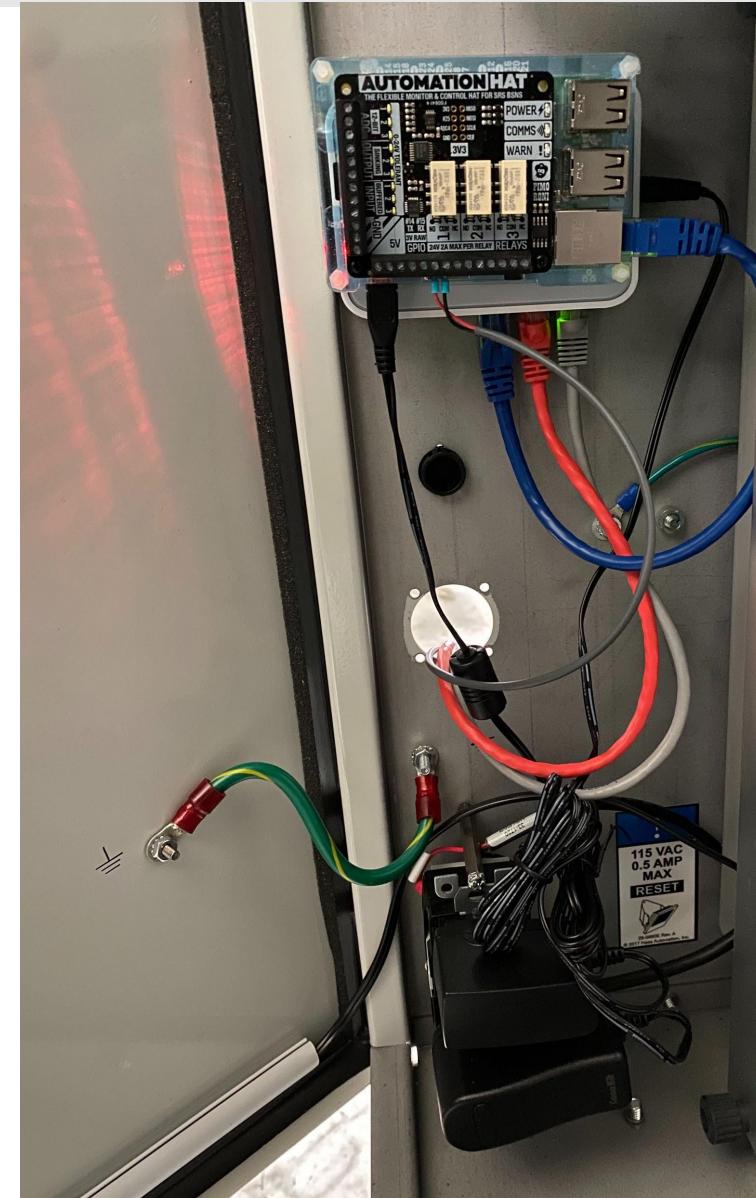
Installing the Cycle Start Wires to a Fanuc-based CNC is machine builder dependent. The Cycle Start Wires can be attached at the CNC cycle start button or the termination point of the CNC cycle start wires in the CNC cabinet. Refer to the CNC documentation to determine the best location to attach to the CNC cycle start button.

The polarity of the Cycle Start Wires is not important. The Robot2CNC cycle start circuit is normally open and is momentarily closed when the Robot2CNC runs a CNC program.



Step 2: Mount Robot2CNC Computer

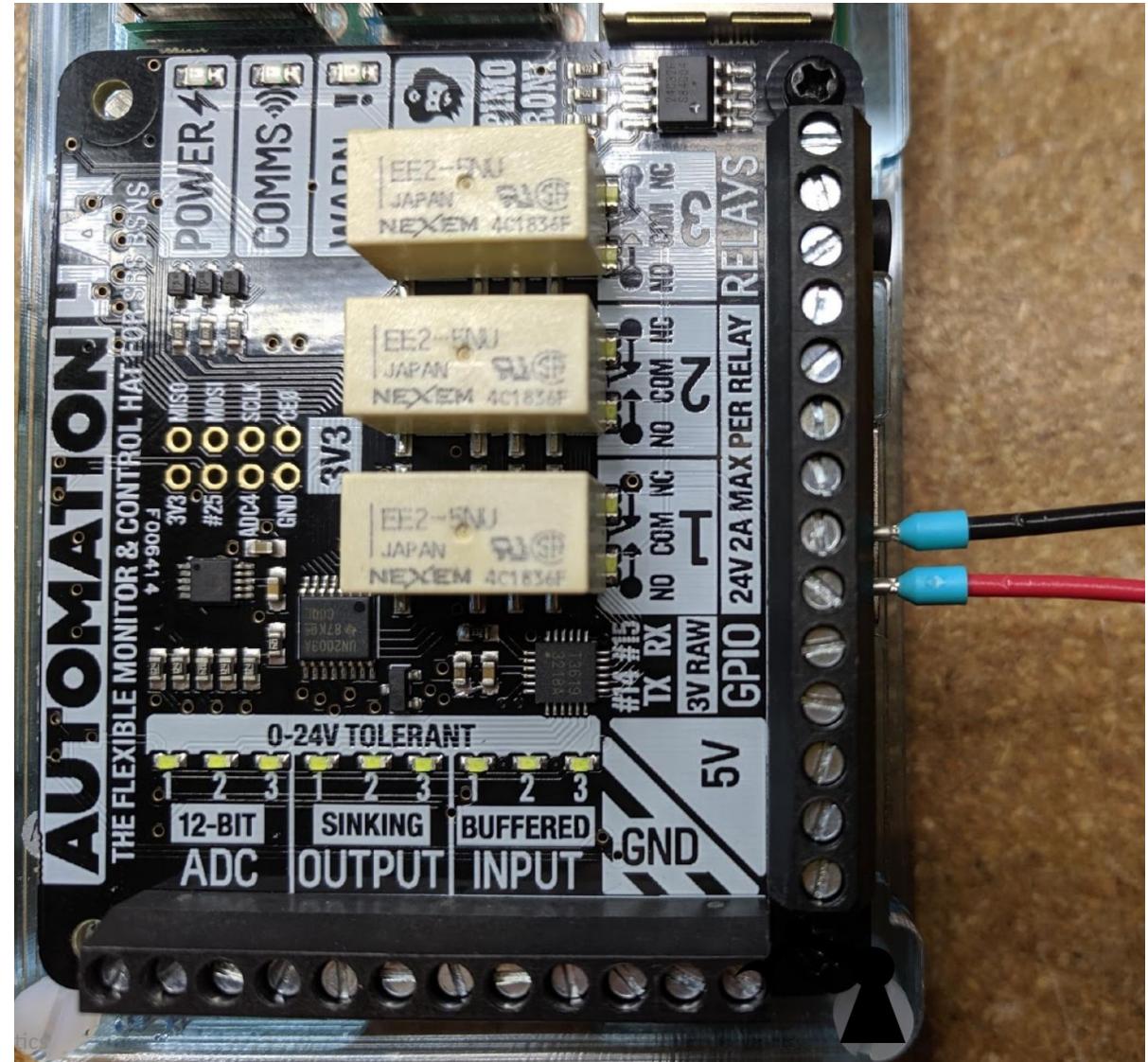
1. Turn-off power at the breaker to the CNC
2. Open CNC cabinet doors
3. Place Robot2CNC and Network Hub on the bottom shelf of the CNC cabinet away from exposed electrical wires
4. Optionally bond Robot2CNC and Network Hub with included double-sided tape
5. Connect power supplies to Robot2CNC and Network Hub
6. Connect 1-foot long Ethernet cable between Robot2CNC and Network Hub



Step 3: Connect Cycle Start Wires to Robot2CNC

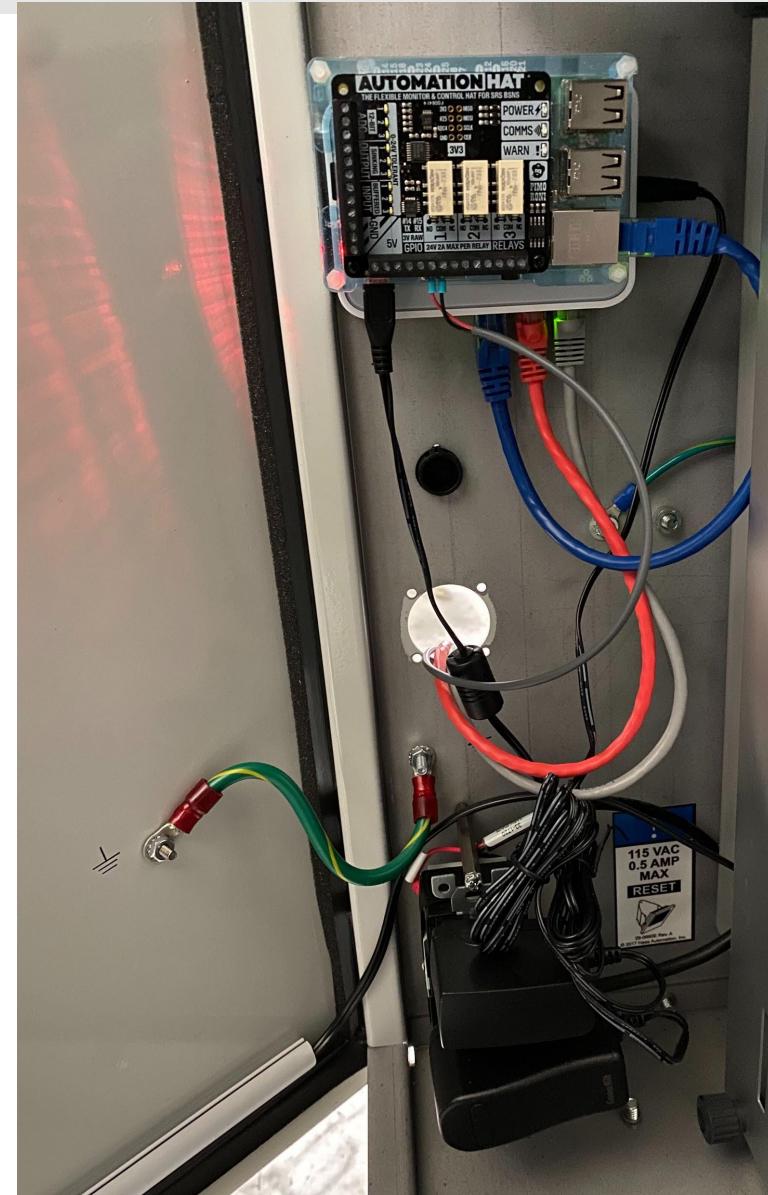
Tools Needed: 1/16" flathead screwdriver

1. Route wires down to the Robot2CNC Computer in the CNC cabinet
2. Locate relay 1 on the Robot2CNC
3. Using the flathead screwdriver, loosen the terminal marked NO and connect the red wire and tighten it down
4. Repeat the process for the black wire in the terminal marked COM



Step 4: Connect Ethernet Cable to CNC

- Location of the CNC's Ethernet port on a Fanuc-based CNC is machine builder dependent
- The CNC's Ethernet port is most typically located in the CNC cabinet at the back of the machine
- Plug the Ethernet cable into the CNC's Ethernet port and route the other end of the Ethernet cable to the 5-port Ethernet switch



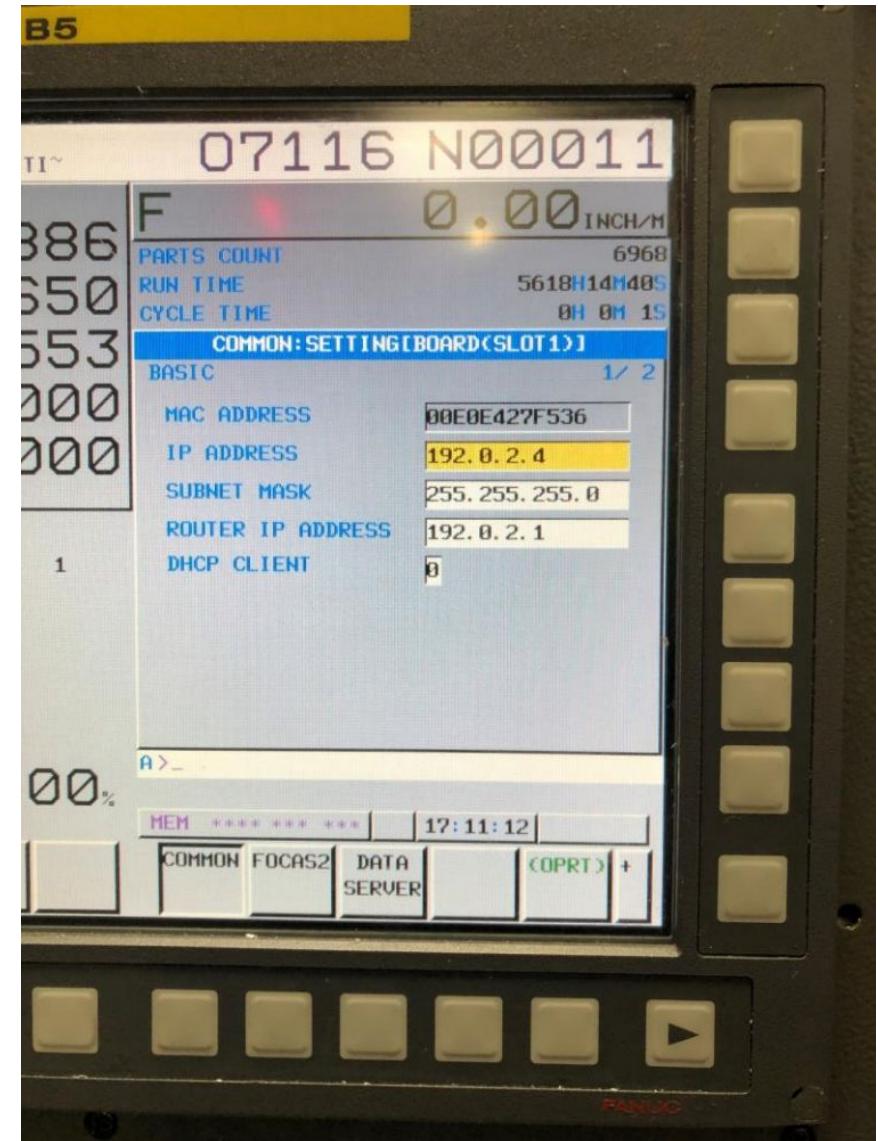
Step 5: Connect Ethernet Cable to Robot

1. Lay the UR Controller on it's back, remove a round access hole plug from the bottom of the controller
2. Route one end of the Ethernet cable through the access hole and into the UR controller
3. Plug the Ethernet cable into the Ethernet port of the UR controller
4. Route the other end of the Ethernet cable into the CNC cabinet
5. Plug the Ethernet cable into the 5-port Ethernet switch



Step 7: Configure CNC Settings

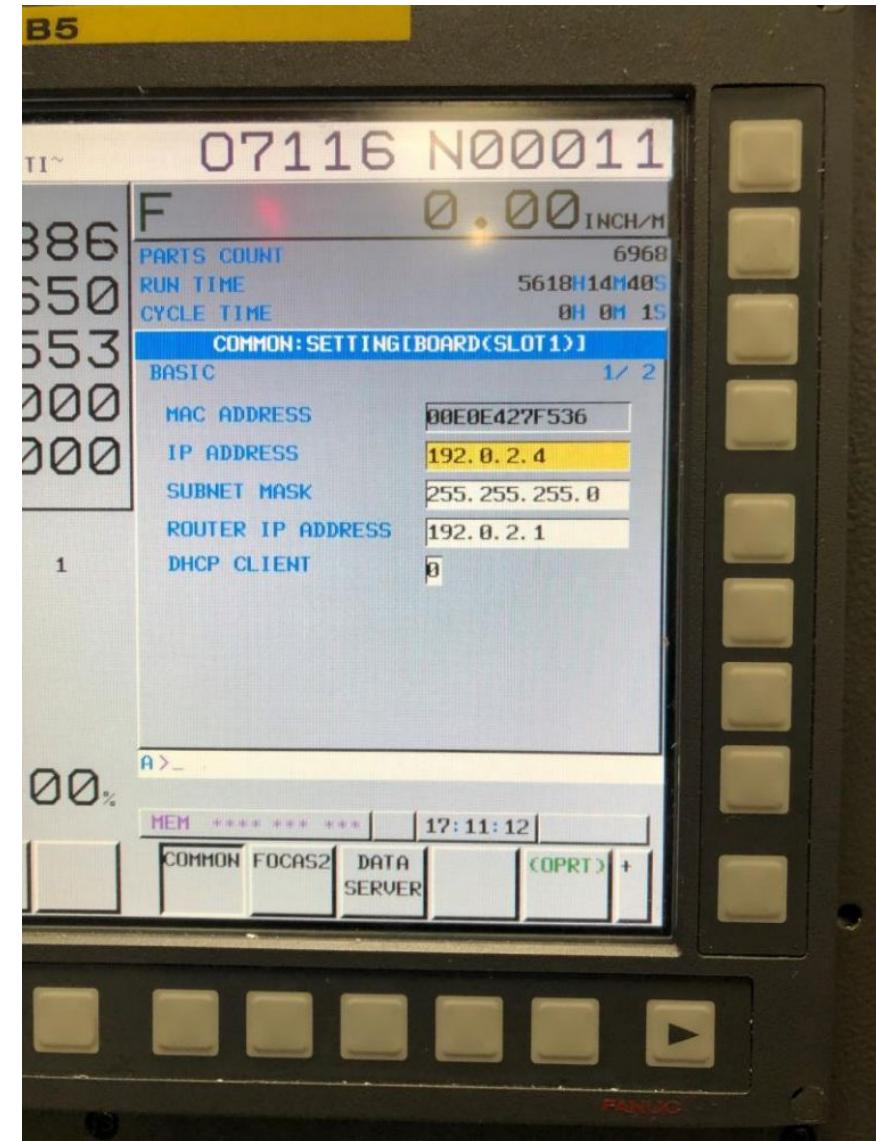
- On the Fanuc control, press the System button
- Press the right arrow until the Ethernet soft key appears
- Press the Ethernet soft key



Step 7: Configure CNC Settings

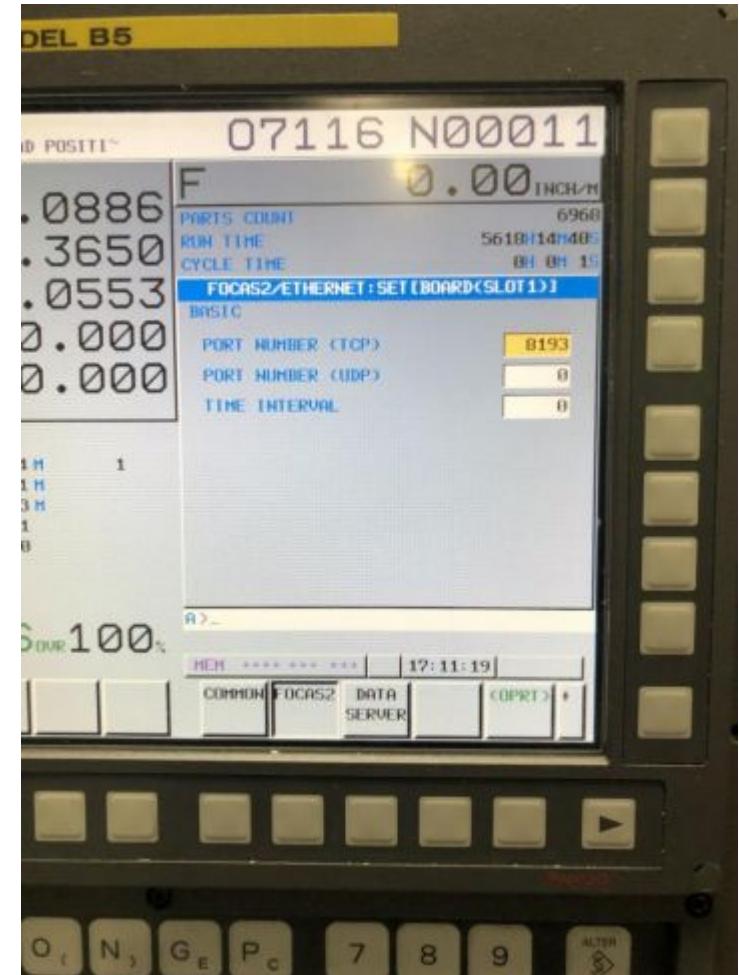
Set the following CNC Network settings:

IP Address	192.168.2.3
Subnet Mask	255.255.255.0
Router IP Address	192.168.2.1
DHCP Client	0



Step 7: Configure CNC Settings

- Press the FOCAS2 soft key
- Set the Focas2 TCP port to 8193
- The other settings can be left alone



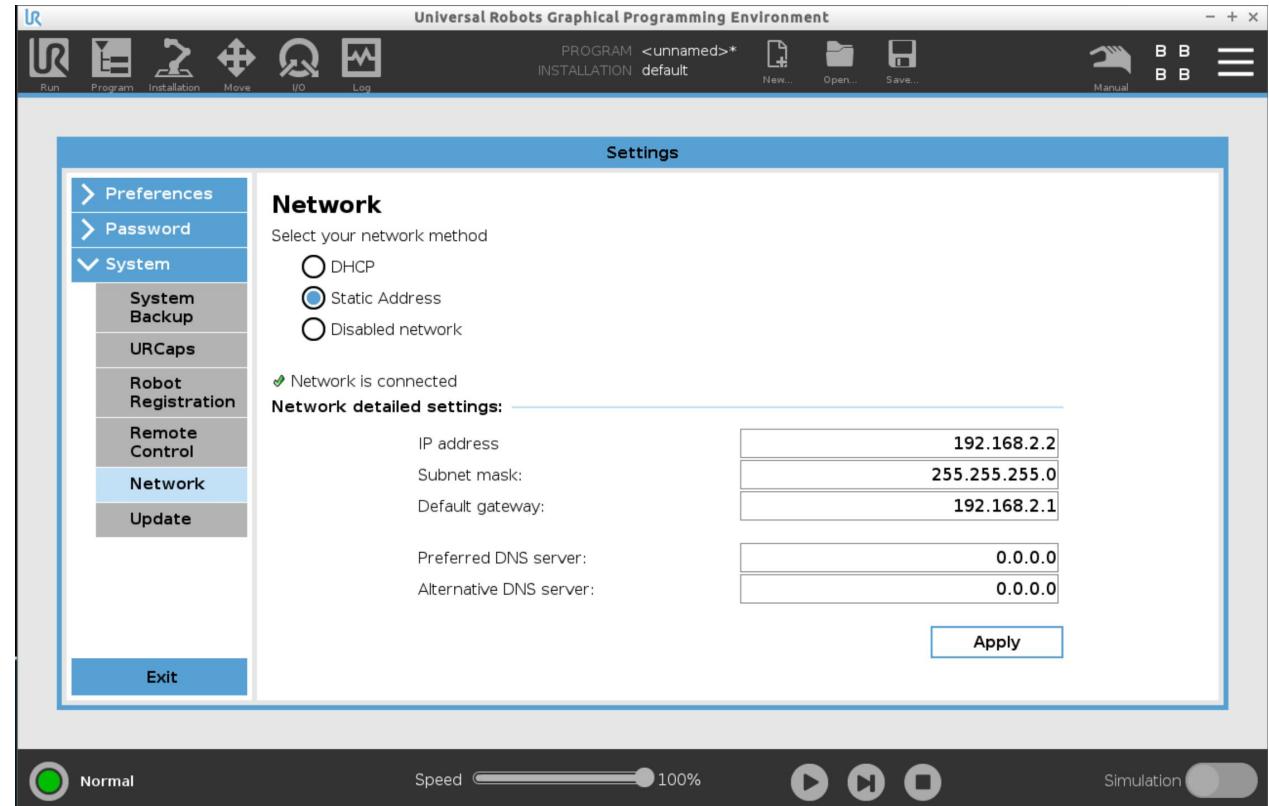
Step 8: Install VersaBuilt Gcode Files on CNC

1. Insert VersaBuilt USB drive into the Fanuc USB port
2. Navigate to the Fanuc FOCAS directory on the VersaBuilt USB drive
3. Copy the 9000.nc and the 9004.nc programs onto the Fanuc CNC control



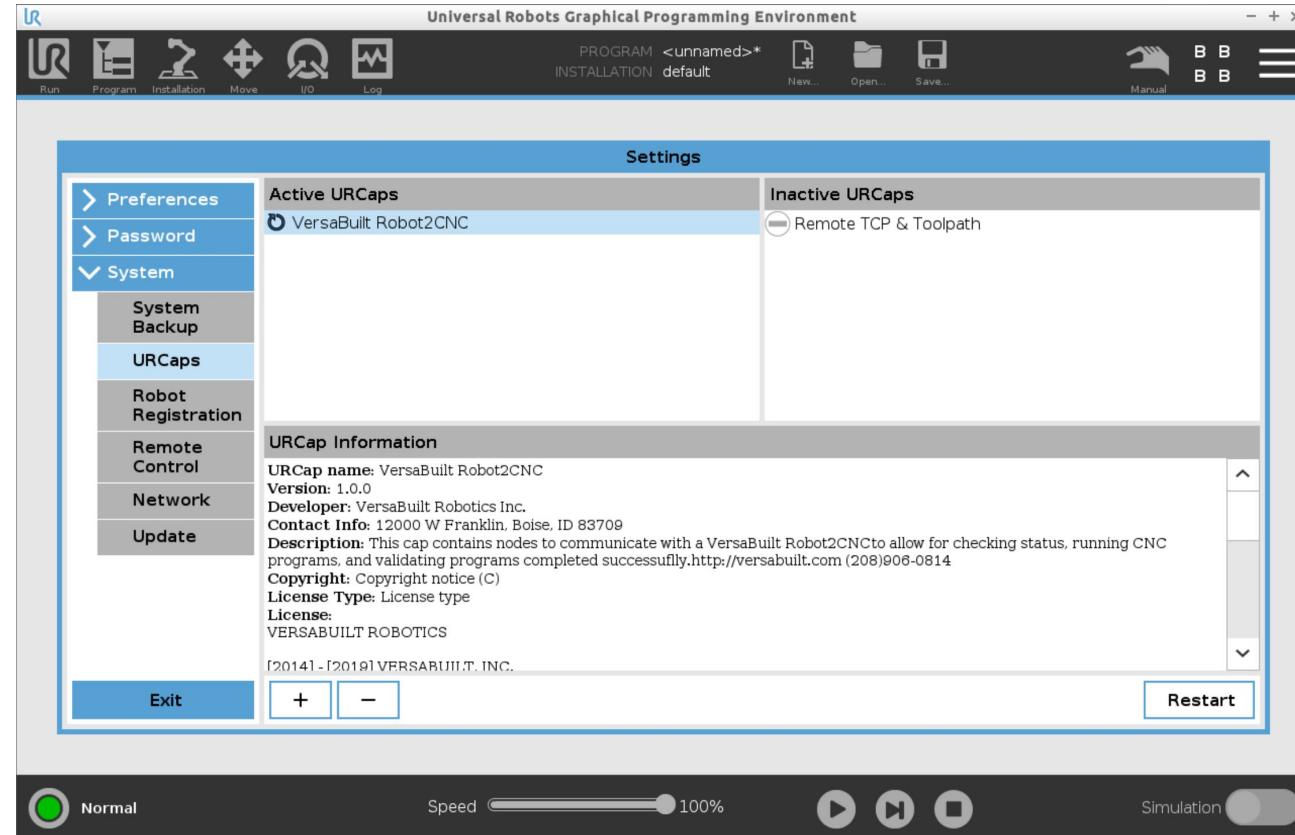
Step 9: Configure Robot Settings

1. Click on the 3 horizontal bars in the upper right-hand corner of the UR teach pendant and select Settings
2. On the Settings page, select System -> Network
3. Select Static Address
4. Enter the Network detailed settings as shown



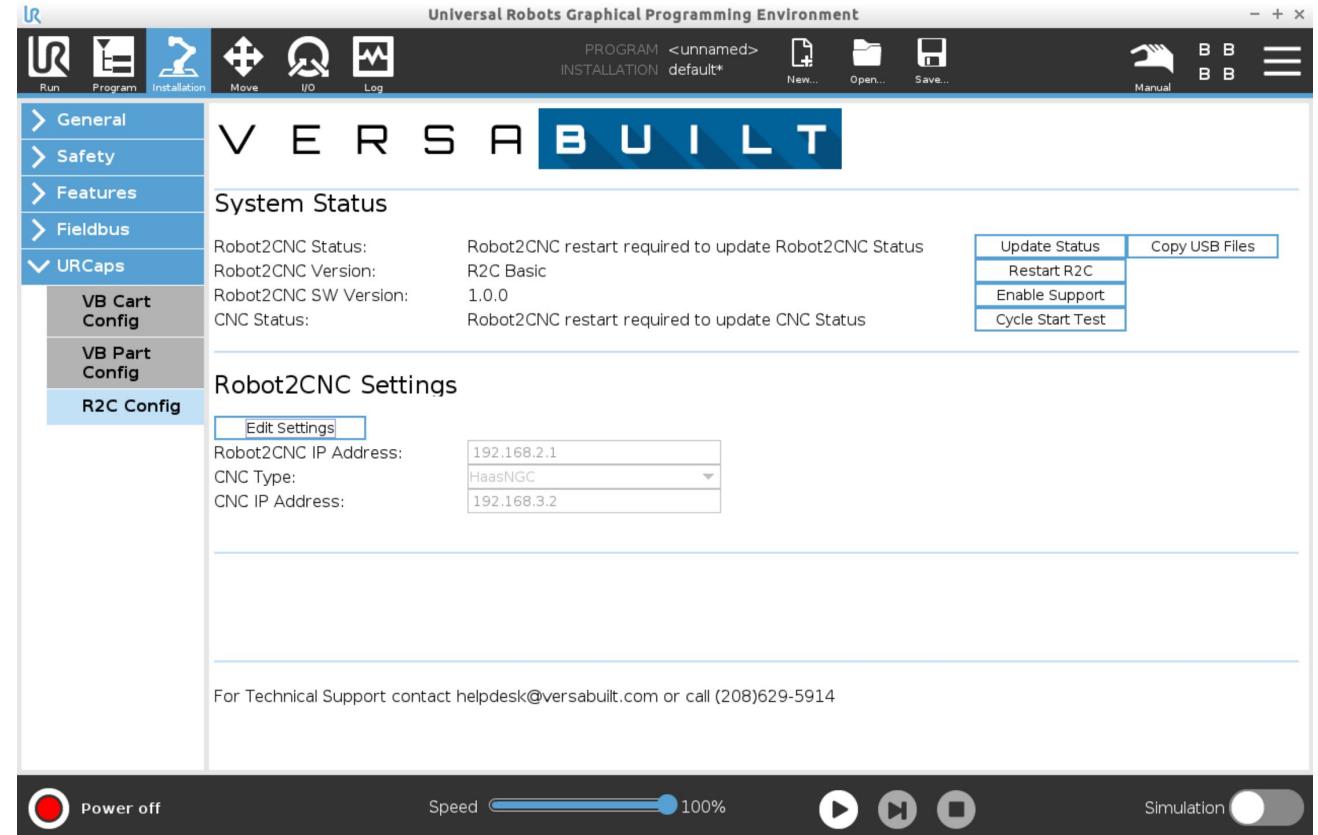
Step 10: Install UR Robot Software

1. Insert the VersaBuilt USB drive into the UR Teach Pendant
2. Click on the 3 horizontal bars in the upper right-hand corner of the UR teach pendant and select Settings
3. On the Settings page, select System -> URCaps
4. Press the + button in the lower left of the Settings page to add a URCap
5. Navigate to the usbdisk and select the robot2cnc-2.0.urcap file (note: file name may be different)
6. Press the Restart button in the lower right corner of the Settings page



Step 11: Configure and Test Robot2CNC

1. Insert the VersaBuilt USB drive into the UR Teach Pendant
2. Click on the Installation icon near the top left of the UR teach pendant then select URCaps -> R2C Config
3. Click on the Copy USB Files button
4. Press the Update Status button
5. Confirm Robot2CNC Status: UP
6. Confirm CNC Status: IDLE
7. On CNC, select program 9000, place CNC in memory mode and close CNC door
8. Press Cycle Start Test button
9. Confirm CNC Status: CNC Cycle Start Test Passed

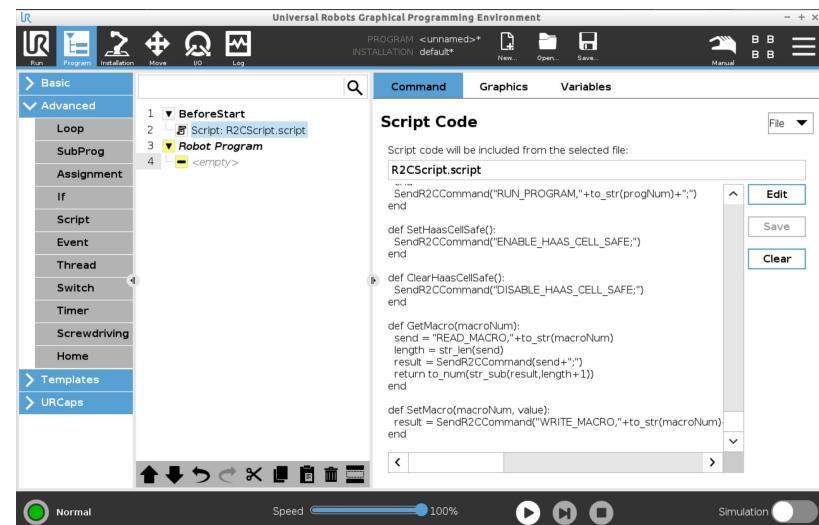
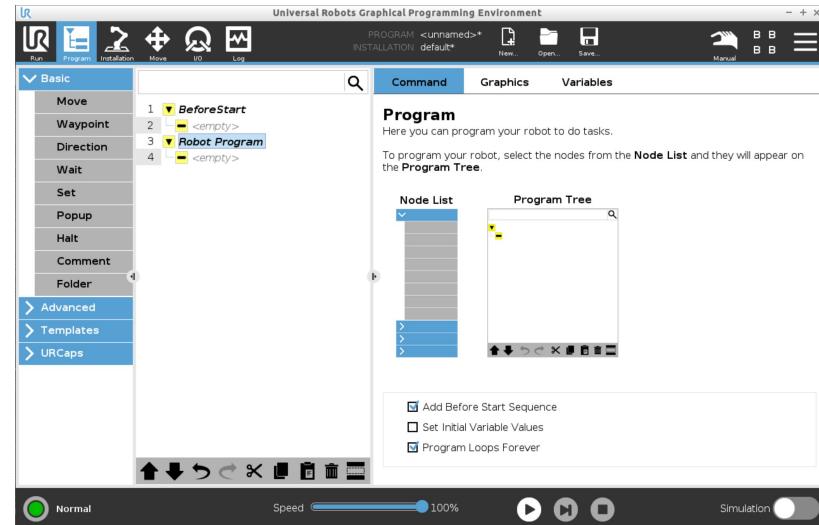


Note: if any test fails, see Appendix A Troubleshooting

UR Robot Programming with the Robot2CNC

Before using Robot2CNC in a UR Polyscope program, the R2CScript.script file must be added to the Before Start Sequence:

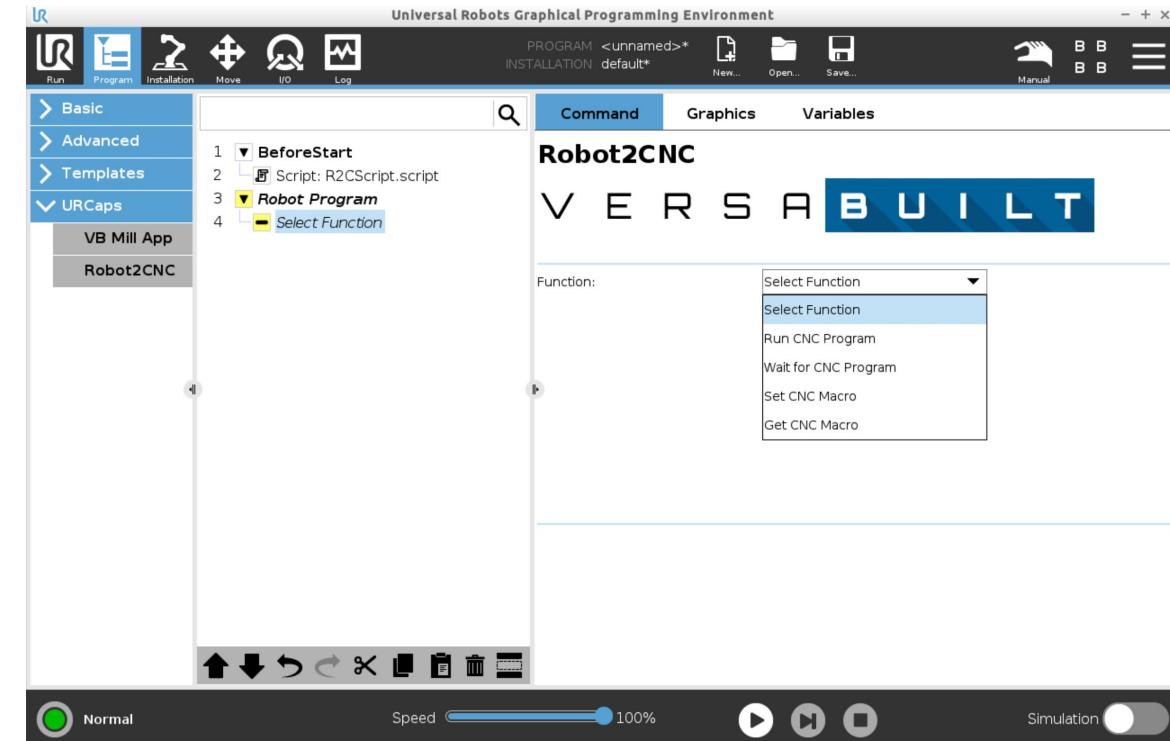
1. From the Program page, click on the **Robot Program**
2. Click on the Add Before Start Sequence checkbox
3. Click on the line marked <empty> below the **BeforeStart**
4. Click > Advanced -> Script
5. In the upper right, select File
6. Click on the Edit button
7. Click the Open button then navigate to the VersaBuilt folder and select R2CScript.script and press the Open button
8. Click the Exit button



Programming with Robot2CNC

Robot2CNC commands can be added into the Polyscope programming tree via the Robot2CNC program node accessible in the URCaps section. To add a Robot2CNC command to a program do the following:

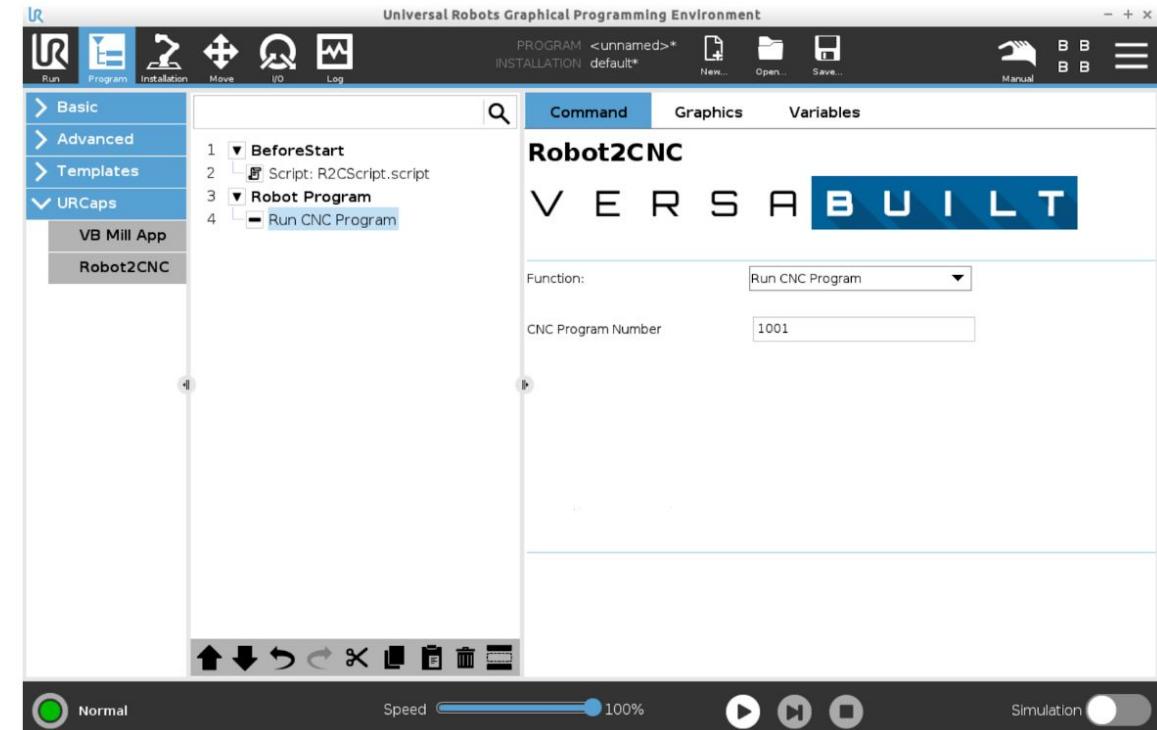
1. Click in the program tree where the Robot2CNC command is required
2. Select > URCaps -> Robot2CNC
3. Click Select Function
4. Select the required function from the list



Robot2CNC Commands

Run CNC Program

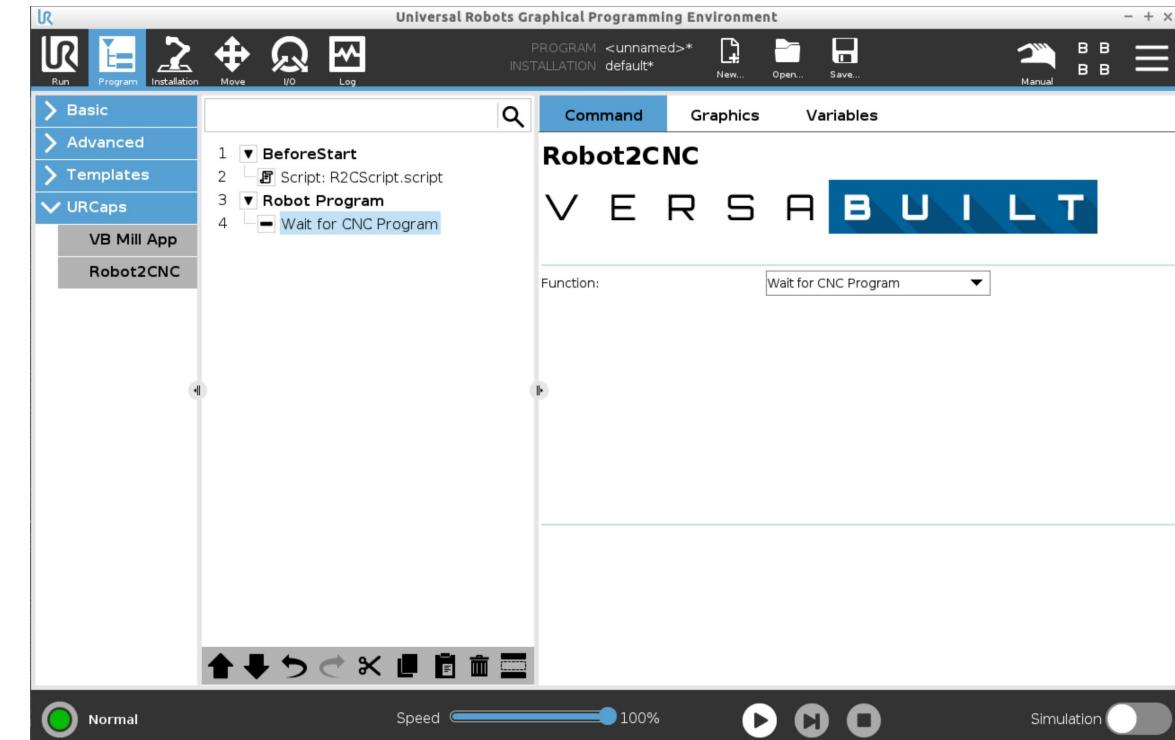
Runs the CNC program number entered in the CNC Program Number field. CNC program number must be in the CNC memory and the CNC must be in memory mode with the CNC door closed. CNC program completion can be detected with the Wait for CNC Program command.



Robot2CNC Commands

Wait for CNC Program

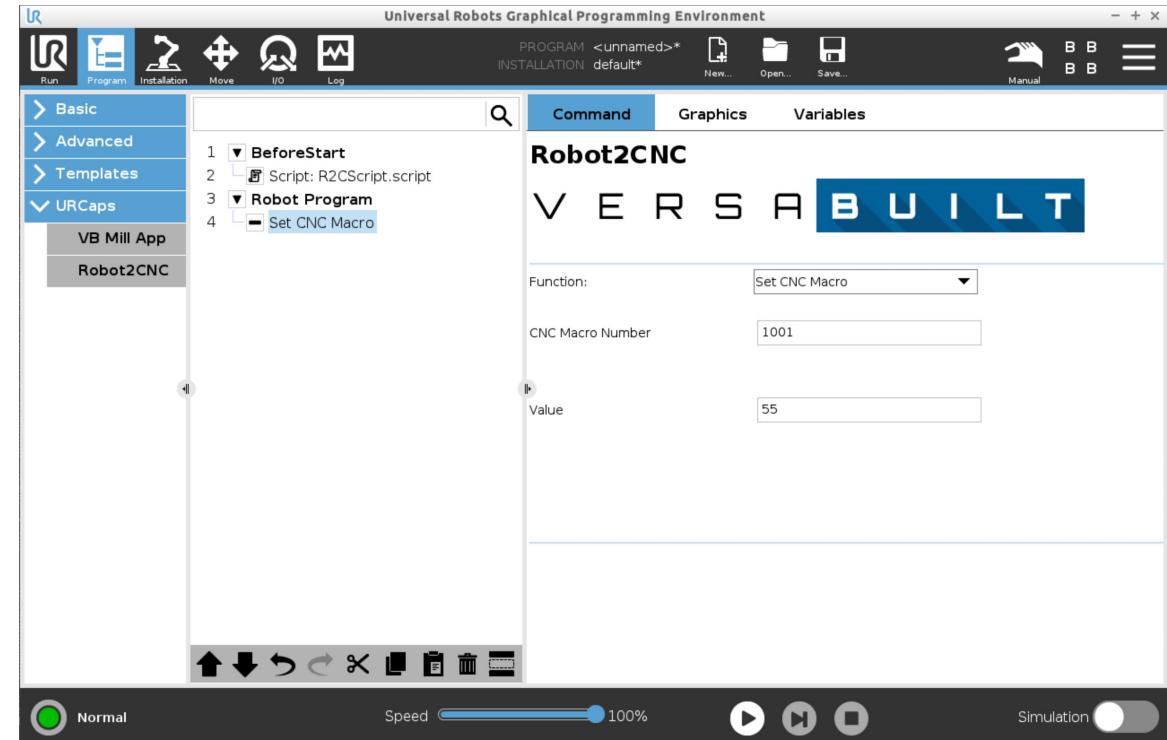
Waits for the currently executing CNC program to complete. If the CNC program completes successfully, Polyscope program execution continues. If an error occurs in the CNC program, a popup message is displayed with information about the error and allowing the operator to stop or continue processing.



Robot2CNC Commands

Set CNC Macro

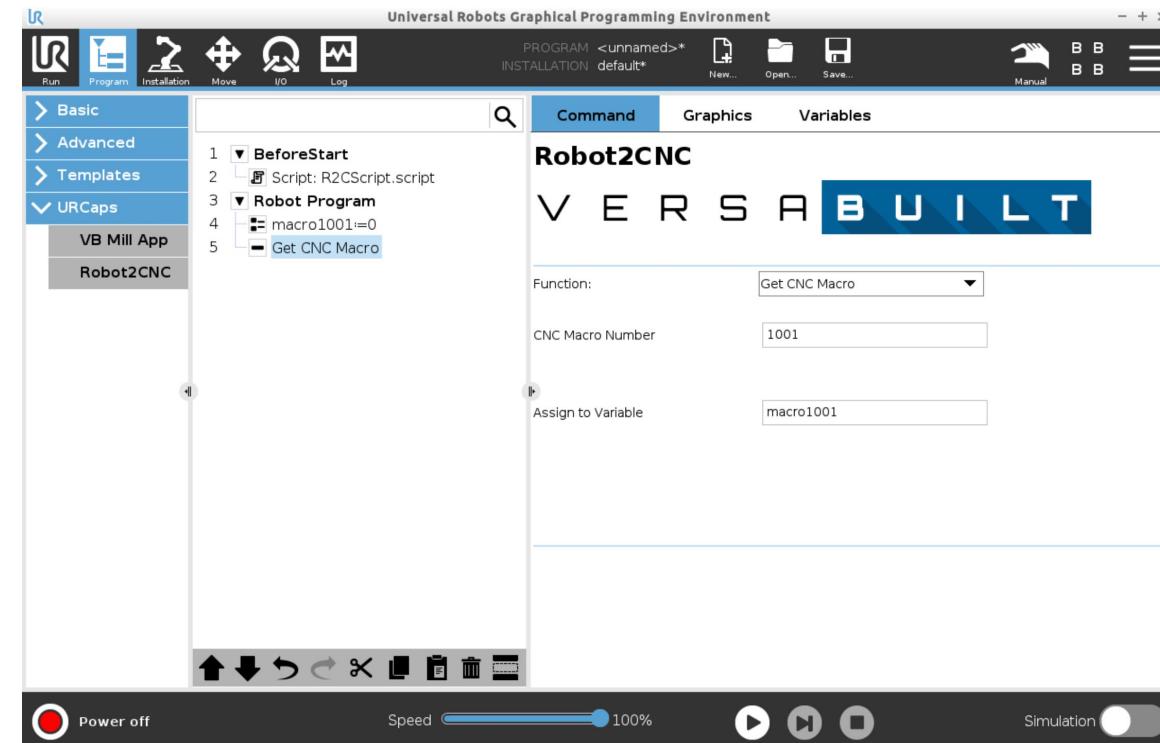
Sets the CNC Macro Number entered to the Value entered. The CNC Macro Number parameter must be a valid macro variable number on the Haas CNC control.



Robot2CNC Commands

Get CNC Macro

Gets the CNC Macro variable specified by the CNC Macro Number parameter and stores it in the Polyscope variable entered in the Assign to Variable parameter. The Assign to Variable must be a valid Polyscope variable, typically created with a Polyscope Assignment program node



Modifying CNC Programs for Robot2CNC

- Robot2CNC requires a hand-shake signal from the CNC. This signal is set by the 9004 program that was installed on the CNC
- All programs that will be run by the Robot2CNC must end with a call to the 9004 program
- Insert an M98 P9004 just before the M30
- The M98 9004 line is safe to use, even when the CNC program is not being executed by the Robot2CNC
 - Tip: place the call to the M98 P9004 in your CAM post processor

...

...

M98 P9004

M30

%

Appendix A: Troubleshooting

Robot2CNC Status: ERROR, Unable to Connect

The UR robot cannot communicate with the Robot2CNC over the Ethernet network. Check the following:

1. The link status LED is on for each port of the 5-port Hub with an ethernet cable plugged in
2. The IP Address of the robot is set to according to the Step 8 in this manual
3. Connect to the Robot2CNC using a portable computer or smart phone and verify Robot2CNC network settings (see Appendix B)

CNC Status: ERROR, Unable to Connect

The Robot2CNC computer cannot communicate with the CNC over the Ethernet network. Check the following:

1. Make sure the Robot2CNC Status: Up; CNC Status is not valid until Robot2CNC Status: Up
2. The link status LED is on for each port of the 5-port Hub with an ethernet cable plugged in
3. The IP Address of the CNC is set to according to the Step 7 in this manual
4. Connect to the Robot2CNC using a portable computer or smart phone and verify Robot2CNC network settings (see Appendix B)

Appendix A: Troubleshooting

CNC Status: Refused

The Robot2CNC is able to communicate with the CNC but Focas2 application is either not configured or the Focas2 TCP port is not set to 8193

1. Make sure the Focas2 TCP port is set to 8193

CNC Status: CNC State must be IDLE for Cycle Start Test

The CNC is not in a state that allows it to be cycle started. Check the following and try again:

1. CNC Door is closed
2. CNC is in memory mode, program 9000 is selected and CNC is not alarmed
3. Press the reset button

Appendix A: Troubleshooting

CNC Status: CNC Cycle Start Test failed

Likely causes to the failure:

1. The CNC is not in memory mode; verify CNC is in memory mode, retry Cycle Start Test
2. 9000 program is not selected; select 9000 program then retry Cycle Start Test
3. CNC door is not closed; make sure the CNC door is closed then retry Cycle Start Test
4. Cycle Start Wiring problem
 - a. To confirm wiring problem, press the Cycle Start Test button on the R2C Config URCap page of the teach pendant, then press the Cycle Start button on the CNC within 15 seconds; if the test passes, the wiring problem is confirmed
 - b. Confirm the Cycle Start Relay wires are secure
 - c. Put an ohmmeter across the the Cycle Start relay contacts on the Robot2CNC, the contacts should be open
 - d. While monitoring the Cycle Start Relay contacts with the ohm meter, have a partner press the Cycle Start Test button, the ohmmeter should show a momentary closing of the contacts; if it does not, contact VersaBuilt for warranty exchange of the Robot2CNC
 - e. Put an ohmmeter across the the Cycle Start relay contacts at the Cycle Start button in the back of the CNC, the contacts should be open
 - f. While monitoring the Cycle Start Relay button with the ohm meter, have a partner press the Cycle Start Test button, the ohmmeter should show a momentary closing of the contacts; if it does not, contact VersaBuilt for warranty exchange of the Cycle Start Relay wires

Appendix A: Troubleshooting

Compile error when running program with Robot2CNC URCap

- The R2CScript.script file has not been added to the Before Start sequence of the UR Polyscope program
- See Section 5 of this manual for instructions on how to add the R2CScript.script file to your program



Appendix B: Robot2CNC Web Configuration Interface

The Robot2CNC includes an advanced interface that allows advanced settings to be configured and allows the Robot2CNC to connect to the Internet for remote support or to download software updates. To connect to the Robot2CNC Web Configuration Interface do the following:

- Using a laptop computer or a smartphone with wi-fi, goto wifi settings and connect to a network titled vbrXXXXX (where XXXXX is the serial number of the Robot2CNC). The wifi password is: versabuilt . Open a web browser and enter the address:
192.168.4.1:9001
- Alternatively, plug a computer into the Robot2CNC 5-port Hub. Configure the computer's Ethernet adapter for the IP address 192.168.2.4, open a web browser and enter the address: 192.168.2.1:9001

