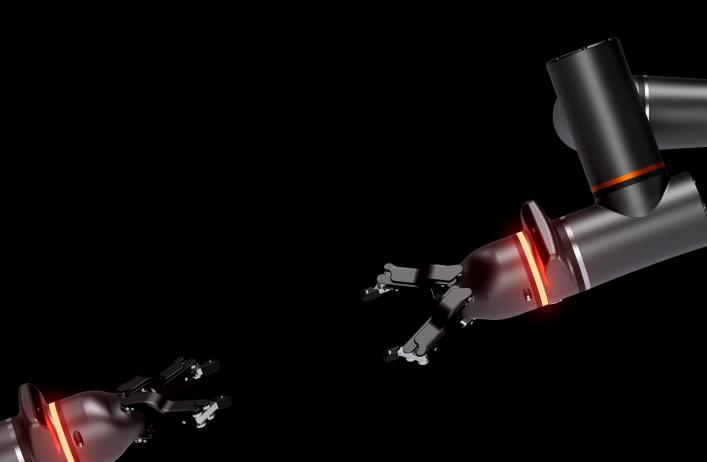
RO1 Collaborative Robot

User Manual





RO1 User Manual

Standard Bots

Revised May 22, 2025

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Chapter 1

Introduction

1.1 Welcome!

Congratulations on your new RO1 collaborative robot.

At Standard Bots, we believe robots can elevate people's lives — but only if people can use them. We created the RO1 to be an affordable robot that anyone can use, yet is still capable of tackling the toughest, most complex challenges.

This manual is meant to include everything needed to get you up and running. But if you ever need help, we're here to assist!

1.2 Contacting Standard Bots Support

- Email: support@standardbots.com
- Phone: 1-888-9-ROBOTS
- Address: Standard Bots, 35 Garvies Point Rd, Glen Cove, NY 11542

1.3 Intended Use & Limitations

The Standard Bots RO1 robot and control box are intended to be used in applications where products need to be picked and placed or applications where a repetitive process can be completed with compatible tooling. The RO1 robot and controller are intended to be used within the environmental constraints outlined in this manual. The RO1 robot and controller are intended to be implemented together, the robot is not intended to be used with any other controller and the controller is not intended to be used with any other robot.

The RO1 robot provides various safety settings and measures that, when implemented correctly and evaluated with a risk assessment, allow the robot to work in an unguarded collaborative environment in close proximity to humans.

The RO1 robot is not designed to work in applications outside the bounds of this manual and any implementation violating the indented use shall be deemed misuse. These applications include but are not limited to:

- Medical applications
- Applications in an explosive environment
- Applications where ingress protection above IP54 is required
- Applications with improper safety integration or where a risk assessment has not been created and evaluated
- Applications requiring a high degree of food safety

Standard Bots expressly denies any liability or expressed or implied warranty claims arising from intentional or unintentional misuse.

1.4 Warnings & Risks

1.4.1 Introduction

This manual is not a comprehensive guide to designing and installing a robot cell. This manual does not cover the selection and integration of 3rd party components that may be required to complete a safe installation. The solution must be designed according to the standards provided by the governing body in the country where the solution will be installed. Standard Bots is not responsible for ensuring the installation of the robot meets the standards for any given installation. The integrator assumes all responsibility for ensuring the robot installation meets all applicable standards and safety guidelines.

1.4.2 Installation

- Make sure to install the robot and all electrical equipment according to requirements and specifications in this manual (see Chapter 2).
- The RO1 control box should only be connected to secure networks.
- **Risk Assessment**: The RO1 is provided as a partially completed machinery. As such, the robot should only be used as part of a cell after a comprehensive risk assessment has taken place.
 - Aside from the robot itself, such a risk assessment may consider the robot's payload, pinching hazards, any toxic or hazardous substances in the cell, and risks involved with sharp end effectors.
 - Risk assessments must cover the entire scope of the integration, including components provided by other suppliers.
 - The risk assessment will help determine any speed or force limits to set up on the robot and what safety accessories (like light curtains or area scanners) can be used. These settings are covered in Chapter 4.
 - Anti-gravity (hand-guided) mode should only be used if risk assessment approves its use.

- Refer to ISO 10218-2 and ISO/TS 15066 for comprehensive guidelines.
- Only trained, instructed, and otherwise qualified personnel may conduct cleaning, maintenance and repair of the robot.

1.4.3 Operator Safety

- Always ensure that the robot is well-maintained and in good mechanical condition before operating it. Always inspect it before use.
- Don't wear jewelry or loose clothing when working with the RO1. Tie back any long hair.
- Never open the control box cabinet door during operation. Never feed wires through the door; feed them through the rubber slot on the bottom of the box.
- Don't expose the robot to strong magnetic fields. This may damage the robot or cause malfunctions.
- Depending on other noise in the environment where the robot is used, hearing protection may be required.
- Never attempt to make any repairs, adjustments, or inspections while the robot is running.
- Operators should stay alert and focused when operating the robot. Avoid distractions and keep attention on the task at hand.

1.4.4 Transportation

WARNING - Proper Transportation Required

To prevent damage during transport, the RO1 robot **must be placed in the supplied Pelican case** with all joints positioned in the **designated "box position."** Transporting the RO1 outside of these conditions may result in damage to the robot .

1.4.5 Cybersecurity

The Standard Bots RO1 is able to connect to both wired and wireless internet in order to facilitate remote access, troubleshooting and software updates. It is imperative to follow best cybersecurity practices, as you would with any industrial device capable of being accessed online.

- 1. Secure communication: Make sure the communication channels used by your robot are encrypted and secure, so that unauthorized individuals cannot access the robot's data or control its actions.
- 2. Strong passwords: Set strong passwords for your robot's user accounts and ensure that they are changed regularly. Use a password manager to help you create and manage secure passwords.
- 3. Regular updates: Keep your robot's software and firmware up-to-date, as updates often contain security patches that address vulnerabilities.
- 4. Physical security: Ensure that physical access to the robot and tablet is restricted, and that the robot is stored in a secure location when not in use.
- 5. Network security: Keep your robot on a separate network or VLAN, and restrict access to that network to only authorized users.

6. Regular testing: Conduct regular security testing to identify any vulnerabilities and ensure that your robot is secure.

By following these best practices, you can help ensure the security of your robot and protect it from potential cybersecurity threats.

Chapter 2

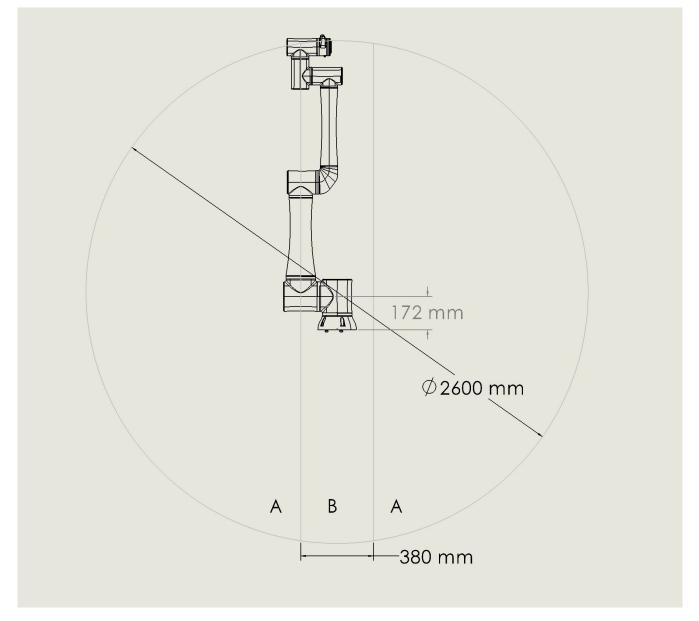
Hardware Overview

- 2.1 Arm
- 2.1.1 Overview



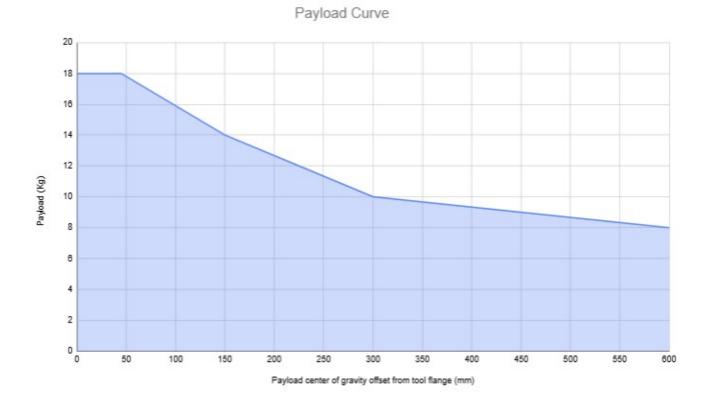
The RO1's arm contains 6 joints connected by a CAN bus. Each joint has two encoders, two different methods to sense torque, and fail-safe brakes that provide emergency braking torque when power is removed from the arm.

2.1.2 Reach



The RO1 robot can reach 1300 mm (51 in) in a radius from the center of the base (A). There is a radius from the center base of 190 mm (7.5 in) (B) where the robot cannot reach due to it's structure. Tools added to the robot end of arm will impact the reach of the robot.

2.1.3 Payload Chart

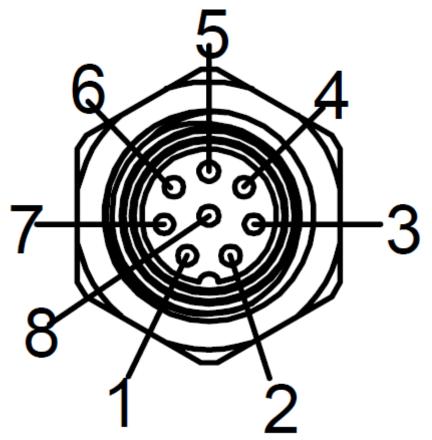


Footnotes:

- a) At payloads above 16kg, the maximum speed of the robot will be reduced to 25% of the default speed settings. The default tooltip speed is .75 m/s.
- b) At payloads above 16kg, the weight limit may be reduced if the routine includes stops with the arm near full extension.
- c) The above chart assumes near ambient room temperature. Running the robots in warmer environments will reduce the payload capacity.

2.1.4 Tool Flange Pinout

The current limit on the 24V DC line of the flange is 3 amps. The flange is capable of PNP or NPN operation and is auto switching. The pinout at the end of the Tool Flange is laid out as shown:



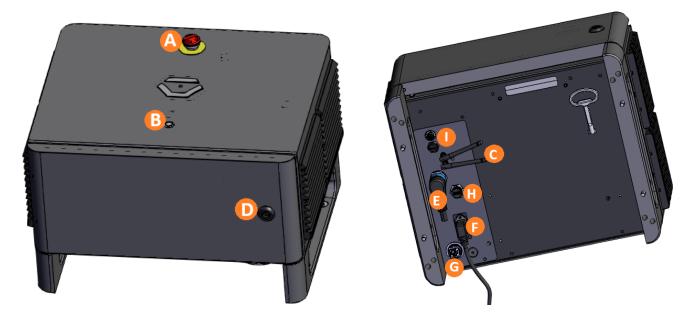
Pin #	Output
1	RS485+
2	RS485-
3	DIG IN 1
4	DIG IN 0
5	POWER 24V
6	DIG OUT 1
7	DIG OUT 0
8	GND
•••	

2.1.5 LED Colors

The robot end of arm has an LED status light for assisting in determining the robot status. The color codes are as follows:

Robot State	Color	
Idle or Paused	Solid Green	
Bootup / Startup	Color Cycle	
Full Speed (above collaborative threshold in Safety Settings)	Yellow Ring Pattern	
Reduced Speed (below collaborative threshold in Safety Settings)	Solid Yellow	
Antigravity Mode	Solid Blue	
Firmware Update	White Ring Pattern	
Recoverable Error	Red Pulsing	
Fatal Error	Braked	

2.2 Control Box

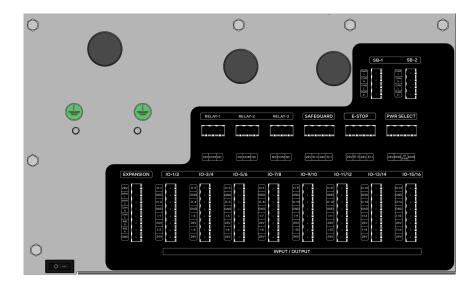


There are several features to note on the control box:

Item	Name	Description
A	E-Stop	Pressing the E-stop button initiates an emergency (category 1)
		stop, cutting power to the arm. Twist the button to reset it.
В	Button Control	Turn on button
С	Bluetooth & Wi-Fi	The R01 ships with two antennas that can be screwed into the
	Antennae	top to give the control box access to Bluetooth and Wi-Fi.
		Bluetooth is used to pair the tablet.
D	Lock & Key	The RO1 includes a key that can be used to lock the control box
		door.
E	Arm data + power	This links the control box to the arm. Power to the arm runs at
	connection	48V
F	Power	The control box accepts 120V through a power supply module
		already certified to IEC 62368-1 and FCC EMI limits.
G	Ethernet (RJ45)	This can be used to communicate with other devices in the cell,
		or to the tablet for programming
Н	USB-A port	
I	USB-C port	This links the control box to the camera on the robot arm

2.2.1 Front Panel

Inside the front panel are many ports that can be used to connect the robot to other equipment in the cell:



Section	Port Labels	Description
I/O - 1 and 2	DI, 24V, GND	This section includes 16 24V I/O ports which can be used to control other equipment in the cell. They are also safety-rated and can be used in pairs to activate safety functions of the robot via the Safety I/O feature.
Relay	RL-1, RL-2, RL3	The relays can be closed to form a circuit and can be used to control equipment in the cell.
Safeguard	-	Unsupported.
E-Stop	-	This can be hooked up to an external E-stop button. When the input is low, it will force the robot to stop. If no external E-stop button is in use, these ports should have jumpers installed.
Motor:	M-1, M-2	Unsupported.
Remote On/Off	ROFF, RON, GND, 24V	Unsupported.
Comms	PWR, GPIO 1+2, CAN H, CAN L, 485 A, 485B	Unsupported. Future software will enable communication with other equipment in cell over serial ports.

2.3 Specs

Performance		
Power consumption	Depends on program and payload. Generally 2-3 amps at 120V.	
	Does not exceed 15 amps at 120V.	
Collaboration operation	Speed & force limiting per ISO/TS 15066, collision detection, and	
	other safety features	
Ambient temperature range	0-55°C	
Humidity	90%RH (non-condensing)	

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Payload capacity	18kg (39 lbs) maximum. See chart below.
Reach	1.3m (51.2 in)
Max joint speed	435° /s
Degrees of freedom	6 degrees

Physical		
Footprint	Ø 200 mm	
Materials	Aluminum, steel, plastic	
Tool connector type	M8 8-pin & M8 4-pin	
Cable length, robot arm	2m (79 in)	
Weight, including cable	32.5 kg (71.6 lbs)	

Robot Features		
IP54		
Depends on program; typically less than 58dB		
Floor mount		
Digital In: 2 (24V tolerant, 1A max open-drain), Digital Out: 2,		
tolerant), RS-485 / UART Max data rate: 10mbps		
12V/24V, 3A continuous max		
-		

Control Box	
IP classification	IP54
Ambient temperature range	0-55°C

Control Box

I/O ports	Digital In: 16 (24V Tolerant), Digital Out: 16 (24V 0.7A Out continuous)	
Internal I/O power supply	24V, 3A max continuous.	
External I/O power supply	12A Maximum	
Communication	24V I/O, Modbus TCP, APIs over Ethernet	
Power source	90 ~ 264VAC, 47-63Hz	
Humidity	90%RH (non-condensing)	
Control box size	483 mm x 385 mm x 270 mm(19.03 in x 15.19 in x 10.65 in)	
Weight	18.5kg (41 lbs)	
Materials	Powder-coated steel	

Movement	
Repeatability	+/- 0.025 mm
Shoulder 1 & 2	Working range: ±360°, Maximum speed: ±287°/sec
Elbow	Working range: ±360°, Maximum speed: ±335°/sec
Wrist 1, 2 & 3	Working range: ±360°, Maximum speed: ±435°/sec
Typical TCP speed	1 m/sec (39.4 in/sec)
Maximum TCP speed	3 m/sec (No payload)

2.4 Hazardous Energy

2.4.1 Overview

Stored energy is a potential source of danger in many industrial settings. When energy is stored in machines or equipment, it can cause serious injury or death if it is released unexpectedly. This type of hazard is commonly known as hazardous stored energy, and it can take many forms, including electrical, hydraulic, pneumatic, chemical, and mechanical energy.

Some common examples of hazardous stored energy include:

- A compressed air cylinder that has not been properly vented before maintenance or repair work is performed
- A hydraulic cylinder that has not been properly locked out before maintenance or repair work is performed
- A battery that is still connected to a piece of equipment, even though the equipment has been shut down
- A piece of machinery that is still moving, even though the power has been turned off

To protect workers from hazardous stored energy, it is important to follow proper lockout/tag-out procedures. Lockout/tag-out procedures involve shutting off the energy source, isolating the equipment, and securing it with a lock or tag to prevent accidental startup. Before any maintenance or repair work is performed on equipment, workers should always verify that the equipment is properly locked out/tagged out.

/pagebreak

Additionally, workers should receive proper training on lockout/tag-out procedures and the potential hazards associated with hazardous stored energy. They should understand the importance of following these procedures to prevent injuries and fatalities. Employers should also regularly review and update their lockout/tag-out procedures to ensure that they are effective and up-to-date with the latest safety standards.

Remember, hazardous stored energy can be deadly if not properly controlled. By following proper lockout/tag-out procedures and receiving proper training, workers can stay safe on the job and prevent accidents from occurring. /pagebreak

2.4.2 Hazardous Energy in Standard Bots System

Several types of stored energy can exist in a system utilizing a Standard Bots robot:

Electrical: The Standard Bots control box utilizes 120 VAC power as a primary means of power. The control box utilizes electrical devices such as capacitors which store electrical energy even after the control box has been unplugged from the power source. There are no serviceable parts inside Standard Bots control box and it should not be opened except by trained Standard Bots Employees.

Additionally, the Standard Bots RO1 robot also contains capacitors to store electrical energy. The robot should not be opened except by Standard Bots personnel. In some cases it may be required to open the joint caps of the robot. This should only be done after the control box power source has been unplugged for at least 2 minutes, and should only be done while following explicit instructions from Standard Bots personnel.

Mechanical: The Standard Bots RO1 is capable of lifting 39 lbs (18kg). If the robot is stopped mid cycle and currently has a workpiece in the end of arm tool, a hazard will be present as the workpiece could unexpectedly fall if the source providing the clamping force is de-energized. Always exercise caution and remove the workpiece from the end of arm tool when approaching the robot.

Pneumatic: The RO1 is compatible with a variety of pneumatic accessories. Stored energy exists in the form of compressed air in pneumatic systems. Bodily or hearing injury can occur from accidentally releasing compressed air from pneumatic systems while performing maintenance. Unexpected motion can occur from components when working on energized pneumatic systems. All compressed air should be removed from the system before performing maintenance on any pneumatic system.

2.4.3 Performing a Lockout

Should a lockout of the Standard Bots RO1 be required, unplug the AC input cord and use a plug lockout with appropriate lock. Follow all standard lockout tag-out procedures.

If applicable, also lock out any compressed air sources to devices integrated with the RO1 using standard lockout tag-out procedures.

2.5 Anti-Gravity Mode

The RO1 has functionality allowing the user to move the robot to a desired position by manually moving the physical robot instead of jogging the robot with the pendant.

When Anti-Gravity mode is engaged, the robot will compensate for its own weight and set payload to maintain its position without the brakes applied. Additionally, the robot will sense external feedback from the user moving the robot and assist with moving in the desired direction. Provided the payload is set correctly, the robot will move with minimal force applied by the user.

The procedure for using the anti-gravity mode is as follows:

- 1. Ensure you have the desired tooling connected to the robot.
- 2. Navigate to the Move Robot view on the user interface.
- 3. If the robot brakes are not currently applied, click the hexagon icon in the bottom right, then select the "Brake Robot" button.
- 4. Set the payload to the current payload.
- 5. Save the payload.
- 6. Click "Unbrake Robot".
- 7. Depress the raised button on the end of the robot arm:



- 8. Gently manually maneuver the robot into the desired position while depressing the button.
- 9. In the "Move Robot" view, go to the Space area in the bottom left menu. The icon is a square.
- 10. Click the plus button to add a position.
- 11. Give the position a name.
- 12. Click "Set" to set the position to the current robot position.

The current robot position is now saved and ready to be used in the routine.

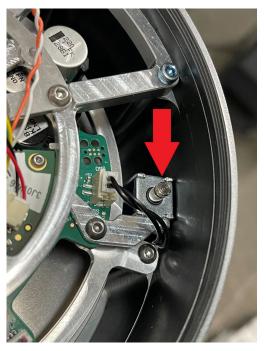
2.6 Movement Without Drive Power

Do not attempt to move the RO1 robot without drive power unless instructed by Standard Bots personnel, otherwise damage could occur.

The RO1 is a collaborative robot, and is designed to work in environments alongside humans. As such, under normal circumstances moving the robot without drive power is not required. Should the robot position need to be changed, simply use pendant to jog the robot into the required position.

Should you be instructed to move the robot without drive power by Standard Bots personnel, the below procedure can be used on each joint individually to adjust the robot position:

- 1. Unplug the robot.
- 2. Remove the cover on either Joint 0 or Joint 1 (bottom 2 joints, shown in attached image) by twisting it off.
- 3. Press the brake release button (shown in below image) and hold down while moving joint.



- 4. Move the robot away from the collision a short distance.
- 5. Release brake button.
- 6. Replace joint cap.
- 7. Plug the robot back in.
- 8. Confirm proper robot operation.

Chapter 3

Assembly & Setup

3.1 Requirements

The RO1 has the following utilities requirements:

Utility	Requirement
Electrical	90 ~ 264VAC, 47-63Hz, 15 A maximum at 120VAC.
Internet	Wi-Fi or RJ45 (Ethernet) wired connection for remote updates and support.
Floor	200 PSI capacity rating. Depending on application a floor capable of supporting
	lagging may be required.

3.2 Lifting the RO1

Proper lifting techniques should be observed when lifting the RO1 robot or controller. Improper lifting can cause strains, sprains, and other serious injuries to the back, neck, shoulders, and other parts of the body.

To lift properly, start by standing close to the object with your feet shoulder-width apart. Bend at the knees and keep your back straight as you lift with your legs, not your back. Hold the object close to your body and avoid twisting your body while lifting or carrying the object. If the object is too heavy, ask for help or use equipment such as a dolly or forklift.

Remember to always warm up before lifting and take breaks when necessary to avoid fatigue. It's also important to wear appropriate clothing and footwear that provides adequate support.

By following these guidelines and using proper lifting techniques, you can reduce your risk of injury and stay safe while handling heavy objects.

3.3 Setting Up the Base

Follow the steps below to set up the base for your Standard Bots robot.

3.3.1 Required Tools

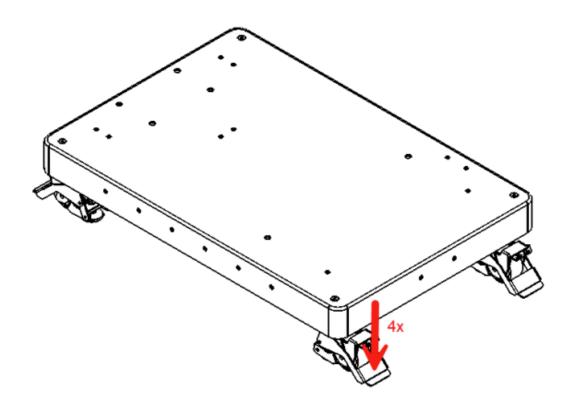
4mm hex

6mm hex

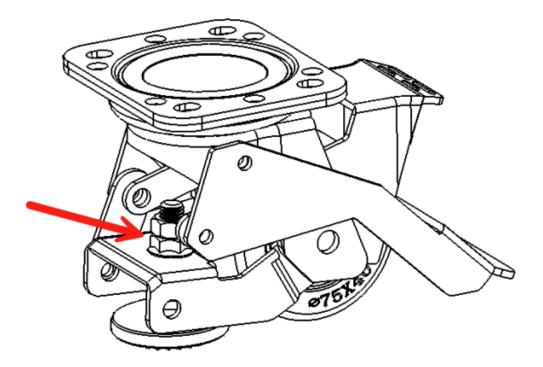
10mm hex

3.3.2 Assembly Procedure

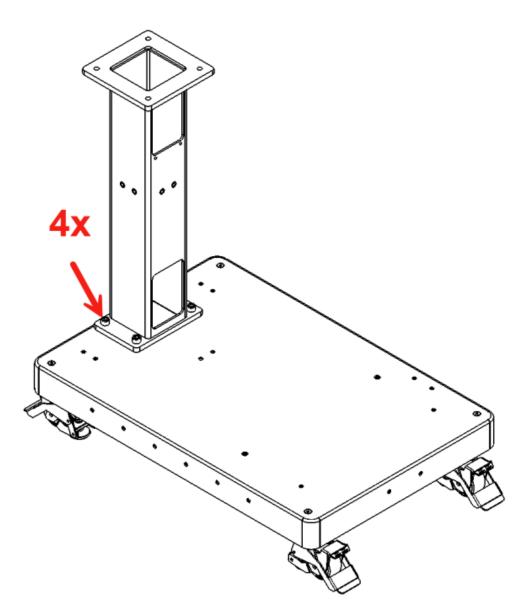
1. Lock the casters of the base (SBPN 428-00020-E) by stepping down on the caster lock levers.



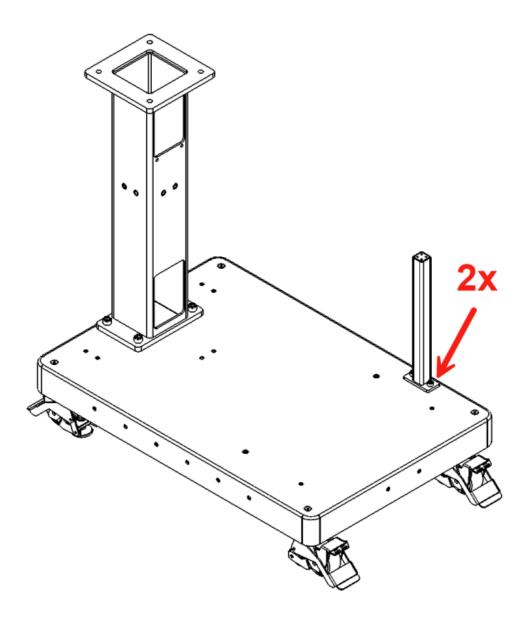
2. The caster feet can be adjusted to level the base. Make sure all 4 feet contact the ground.



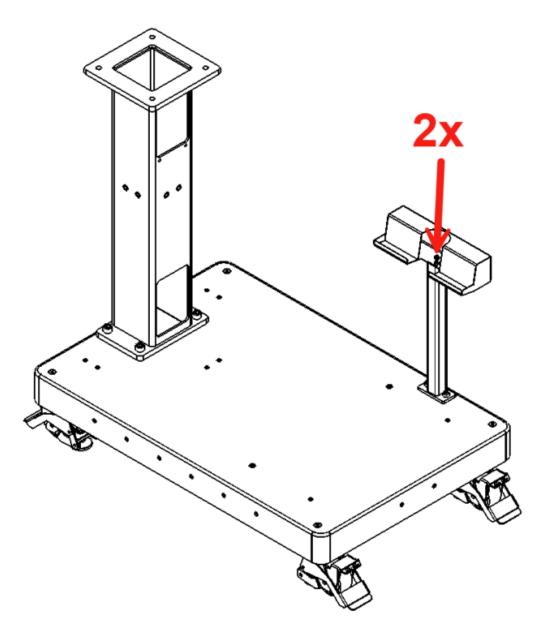
3. Mount the robot pedestal (SBPN 428-00021-D) where shown using 4x M12 x 1.75, 25 mm Hex Socket Head Screws (SBPN 465-02059-A). Tighten to 55Nm. Confirm the orientation of the pedestal matches the image below.



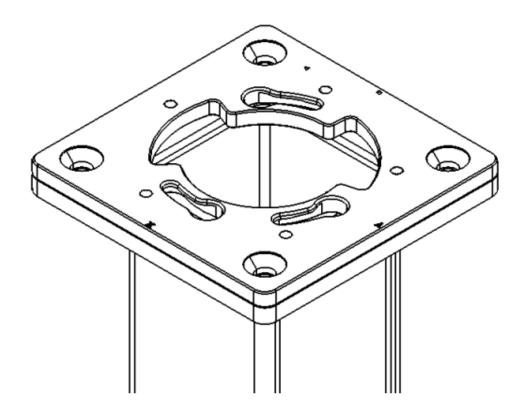
4. Mount the tablet pedestal (SBPN 408-00023-D) where shown with 2x M8 x 1.25, 20 mm, Hex Socket Head Screws (SBPN 465-01555-A). Tighten to 6Nm.



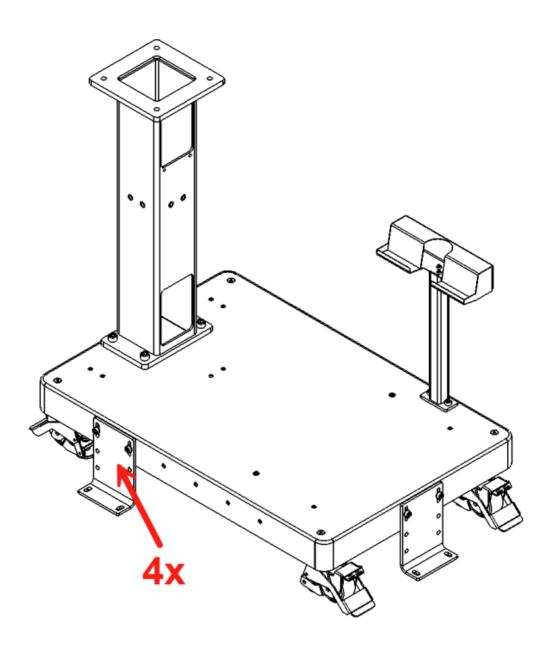
5. Mount the Tablet Pedestal Bracket (SBPN 402-00037-C) where shown with 2x M5 x 0.8, 20 mm, Hex Socket Head Screws (SBPN 465-01177-A). The Tablet Bracket can be rotated to mount in 4x directions, choose whichever orientation is most convenient for your application. Tighten to 4 Nm.



6. Install the Arm Mount Plate (SBPN SB-0192-F) on the Pedestal with 4x M14 x 2.0 x 30 mm Hex Flat Head Screws (SBPN 410-00049-A). Tighten to 55 Nm. The Arm Mount Plate can be oriented in 4x directions to position the Robot. For help, consult Standard Bots Application Engineering to determine the best orientation for your application.



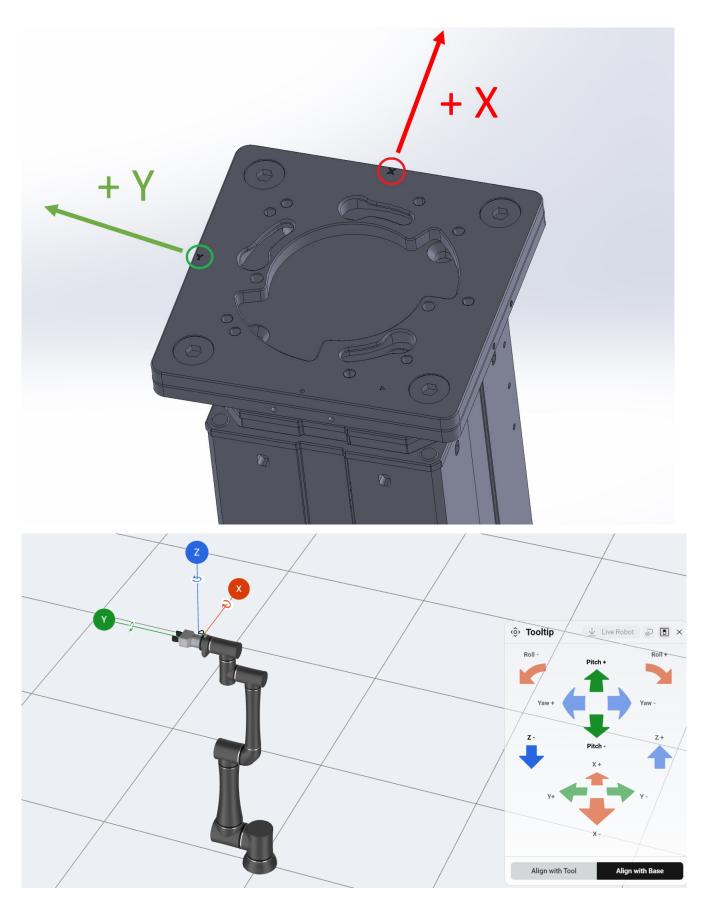
7. Optional: Install the Floor Brackets as needed. For large payloads and work envelopes, it is recommended to install 4x Floor Brackets approximately as shown. Use floor anchors to fix the brackets to the floor. Consult Standard Bots Application Engineering for details about your applications.



3.4 Connecting Control Box, Mounting and Unmounting Arm

3.4.1 Orientation

The RO1 only attaches to the base in one orientation. The orientation is shown by the X and Y markings on the baseplate, which line up with the tooltip orientation in the Move Robot view as shown:



It is possible to rotate the robot in 90 degree increments by rotating the base plate.

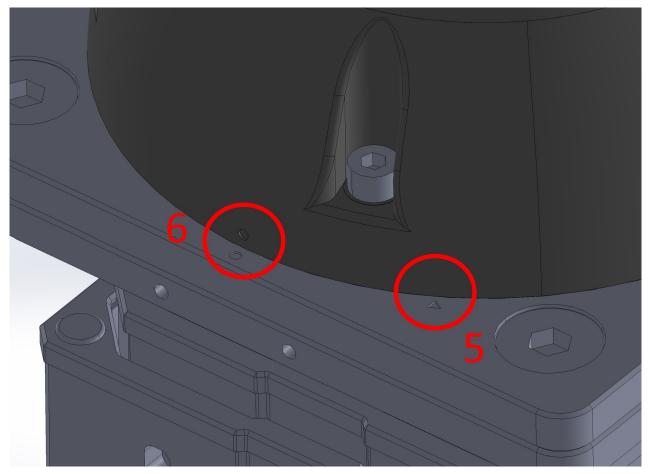
3.4.2 Video

To watch a video to accompany the steps below, go to https://youtu.be/y55gQTWBXWs.

3.4.3 Steps

To connect the control box and mount the arm on the base:

- 1. First, ensure the leveling feet have been raised on the base.
- 2. Lift the control box (with feet attached)
- 3. Hook the control box onto the base bracket.
- 4. Carefully lift the RO1 onto the base.



- 5. Place onto the pillar with the "O" on the robot base lined up with the triangle indicator shown above.
- 6. Rotate it clockwise until the "O" on the robot base lines up with the matching "O" indicator shown above.
- 7. Secure the RO1 base joint using five M8 30mm screws.
- 8. Connect the RO1 USB-C cable to the base joint. Connect the RO1 power and data cables to the base joint.

Note: there is a different style power cable used than what is shown in the video for newer made control boxes and robot arms. Same steps apply.

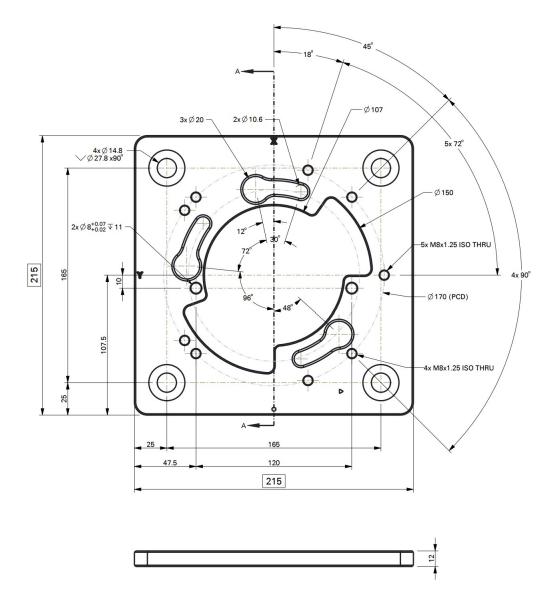


- 9. Use cable ties to restrain the cables to the pillar.
- 10. At the bottom of the control box, connect the RO1 power and data cables to the control box, as well as the USB cable. Connect the IEC (power) cable and lock it with the clip.
- 11. Turn on the power switch that is located behind the door on the lower left corner.



12. Press the power button on the top of the control box to start the RO1.

3.4.4 Mounting Base Diagram:



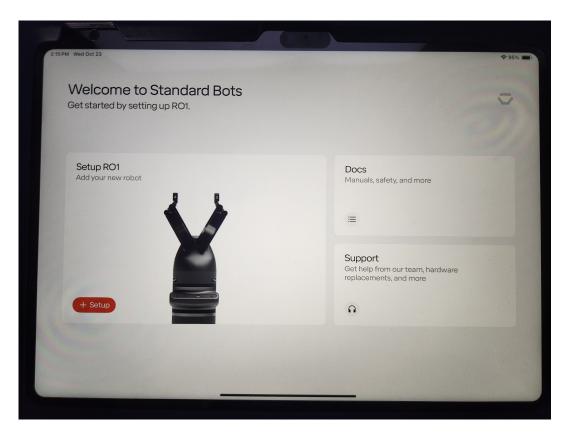
3.5 Setting up Tablet

The included iPad is used to configure, control, and program the RO1. Here's how to get it set up: 1. Take the iPad out of the box and turn it on.

- 2. If prompted at any point, enter the default passcode of "0000".
- 3. Open the "Settings" app on the iPad, then configure your network. If you are using Wi-Fi, there is a "Wi-Fi" section. If you are using an Ethernet adapter, an additional option to configure Ethernet should appear in the right sidebar.
- 4. Navigate to the home screen (by pressing the bottom button, if the iPad has one, or swiping up from the bottom, if it doesn't). Open the Standard Bots app.
- 5. Open the Standard Bots app.



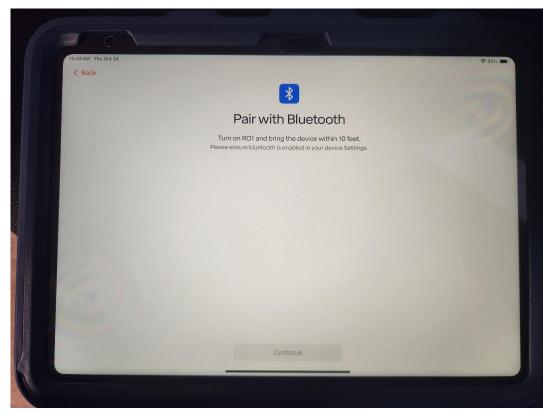
6. You will be brought to the home screen of the Standard Bots app. Here you will see three blocks. The top right named Docs will bring you to the Standard Bots manual. The bottom right block, named Support, will bring you to a tab that shows how to reach Standard Bots support line. It shows the support email, the support phone number, as well as the address of Standard Bots office. The large block on the left is where you will go to add your new robot.



- 7. Tap "+Setup" on the home screen.
- You will be brought to the Getting Started page. Here you can also find guides for how to assemble the robot base as well as how to establish connection between the robot arm and the control box. Once ready, press the Continue button

10:44 AM Thu Oct 24 Cancel		२ 939
Cancer		
	U	
	Getting started	
	Start by connecting RO1 to its control box and mount it on the base. View the docs below for assembly and setup instructions.	
	Setup guides	
	Assemble the static base >	
	Connect the arm and control box	

9. The Pair with Bluetooth page will appear where the iPad will search for the robot over Bluetooth. Make sure the RO1 is turned on and has the included antennae screwed on. Once the RO1 shows up, choose it from the list and proceed.



- 10. The app will ask you to enter your network credentials again. You can configure the robot to connect over Wi-Fi or Ethernet, regardless of how your tablet is connected.
- 11. The app will also walk you through setting a PIN and choosing a name for your RO1.
- 12. After setup is completed, you can connect to your bot.
- 13. Once connect you can reset the estop (if required), unbrake, and begin jogging the robot. Refer to Section 5 for more details on operating the robot and constructing routines.

3.6 Unmounting & Transporting

3.6.1 Warnings

- Do not attempt to move the arm while it has power unless you are utilizing the any-gravity mode.
- Do not force the robot into a position while power is off, doing so may damage the robot.
- Only lift the RO1 arm with 2 people.
- The RO1 robot has a locking feature in the base of the robot. Do not attempt to force the robot straight off of the mounting structure.

3.6.2 Before transportation:

- Ensure the robot is in the desired position for transportation.
- If needed, the robot can be put into the position required for the original box by:
 - Navigating to the Move Robot view
 - Go to the Robot menu in the upper right
 - Select "Settings"
 - Select "Box Robot"
 - Set the Payload
 - Save and confirm the Payload
 - Click and hold down the "Move Live Arm To Visualizer Position" button. The robot will move into the packing pose.
- Click the hexagon button in the bottom right of the Move Robot view
- Select "Brake Robot"
- Unplug the control box from the AC power source
- Wait 30 seconds for stored power to dissipate
- Unplug the connector between the arm and robot buy twisting the locking mechanism and pulling down on each end
- Disconnect any inputs and outputs from the control box

The RO1 control box has an integrated handle for ease of transportation. Ensure all cables are disconnected from the RO1 control box before moving or shipping the control box. Ensure RO1 control box is well packaged, preferable in the original packaging, before shipping the RO1 control box.

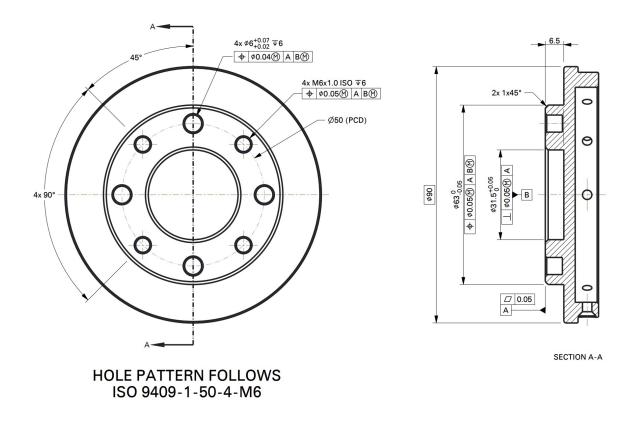
3.6.3 Unmounting the Arm From Base

- 1. Ensure the robot is powered off, unplugged and in the desired position before removing, if needed follow the above instructions to get the robot in the proper position.
- 2. Have 1 person steady the robot while the other removes the bolts.
- 3. Use a 4mm Allen key, remove the 5 M8 top down bolts around the robot base.
- 4. Ensure the robot is support, then have both people lightly twist the robot counter clockwise.
- 5. The robot will unlock from the base

3.7 Connecting End Effectors

3.7.1 Mechanical Connection

The RO1 robot uses a modified version of the standard ISO 9409-1-50-4-M6 50 mm ISO robot flange pattern. The RO1 offers four locations for the locating pin, where the ISO 9409-1-50-4-M6 standard offers 1 pin location. Any tool that follows the standard 50mm pattern will mount to the RO1 robot flange. A diagram of the mounting pattern is shown below.



3.7.2 Fully Integrated Tools

Standard Bots supports full integration with the following tools. These tools can be fully controlled using standard instructions in the Standard Bots Routine Editor.

- OnRobot 2FG7
- OnRobot 3FG15
- OnRobot Screwdriver
- OnRobot Dual Quick Changer
- OnRobot VGP20

Follow the instructions provided with the tooling to connect the tooling to the robot flange, and connect the wire to the provided connector at the end of the robot arm.

Be careful when attaching the m8 tool connector. Ensure that you line up the key with the receiver when you plug it in. Do not twist it, the pins are fragile and this can cause the pins to break.



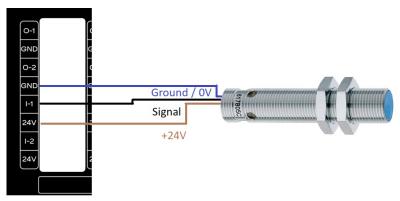
3.7.3 Other Supported Tools

In addition to the above tools, Standard Bots generally supports most tools that mount to the 50 mm flange and that support 24VDC discrete control. Please contact Standard Bots support for assistance with confirming tooling compatibility.

3.8 Control Box Inputs and Outputs

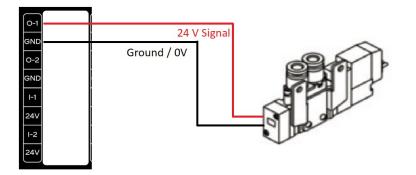
3.8.1 Digital Inputs and Outputs

The RO1 control box supports 16 24VDC digital inputs and 16 24VDC digital outputs. The signals are sourcing or PNP. The digital outputs support up to 0.7 amps of output, for larger capacity use the digital outputs from the robot to drive a relay coil to a separate power source.



Example of wiring a proximity sensor into the RO1 control box:

Example of wiring a pneumatic valve into the RO1 control box:



3.8.2 Analog Inputs and Outputs

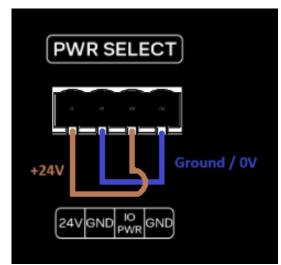
The RO1 control box has 4 analog outputs and 2 analog inputs available on the control box. These are currently unsupported.

3.8.3 I/O Power Select Feature

The RO1 control box enables users to manage input/output (I/O) functions using its integrated 24V power supply. Alternatively, an external 24V power supply can be used if preferred. The diagrams below illustrate both wiring configurations.

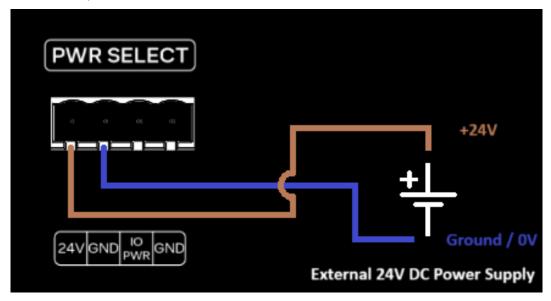
Integrated 24V Power Supply

The image below illustrates the wiring configuration for utilizing the **integrated** 24V power supply for I/O functionality.



External 24V Power Supply

The image below illustrates the wiring configuration for utilizing an **external** 24V power supply for I/O functionality.



Chapter 4

Safety

4.1 Overview of Safety Features

The RO1 robot includes many safety features for operating in either collaborative or industrial applications. The exact implementation of these features will depend upon the application and risk assessment. The final performance level of the system will depend on the integration and must be calculated by the integrator.

The RO1 has parameters for the below settings that can be fully customized for the end application and allow for integration with a wide variety of industrial safety components.

- Joint Collision Thresholds
- Joint Velocity, Acceleration, and Torque limits
- Emergency Stop Inputs
- Safety IO / OSSD

4.1.1 Response Time

	Worst Cast Detection	Worst Cast Power Off	Worst Case
Safety Input Event	Time	Time	Response Time
Internal Emergency Stop	50ms	600ms	600ms
External Emergency Stop	50ms	600ms	600ms
External Safety IO Slow Speed	50ms	N/A	600ms
Input			
External Safety IO Emergency	50ms	600ms	600ms
Stop			
Tablet or Browser E-Stop	1000ms*	1600ms*	1600ms*

The RO1 responds to safety events within the tolerances in the below chart:

*Network Latency Dependent

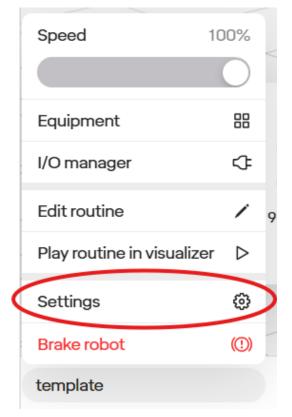
Safety Output Event	Worst Case Response Time
Robot E-Stop	50ms

4.1.2 Performance Level

The RO1 safety circuitry, including E-Stop circuitry and all digital inputs and outputs is PLe Cat 4.

4.2 Safety Settings

Safety Settings can be accessed by tapping the robot menu, then Settings > Safety.



Settings are locked by default; click the "Unlock" button and re-enter the robot PIN to make the settings here editable.

Safety settings do not take effect until you tap "Apply Settings."

4.2.1 Speed Limits

How Limits Work

The RO1 has several levels of limits; the robot is always gated to the **lowest** of all of these:

- **Global Limits**: defined in Safety settings, which affect tooltip speed and the acceleration, velocity, and torque of joints.
- **Speed Modifier % Slider**: the robot can be slowed down on an as-needed basis (for instance, to trial a routine) without requiring access to Safety Settings.
- **Step-Level Limits**: the robot can also apply an alternate set of speed limits only for the duration of a specific step.

All of these settings are described below.

Editing Global Limits

The first tab of safety settings allows setting limits on the speed and acceleration of both the tooltip and the joints of the robot.

Using Factory Presets By default, you will be presented with the choice of several presets.

The "default" (middle) setting restricts the robot to a tooltip speed of 0.75m/s, which is safe for most collaborative settings. Several others are available; if there are factors that may require more caution (such as the robot's payload or end effectors), it may be desirable to select a more conservative setting.

Remember that many factors can affect whether a given speed is safe. Before putting the robot into production, you should always conduct a full safety assessment per ISO 10218-2 to determine the proper values for these settings and any other mitigations required.

	ollisions			
Remember to co	nduct a full safety assessm	ent per ISO 10218-2 to verify lir	nits and safeguards requir	ed for application.
Use Factory	Preset			
Safest	Sa	afer D	efault	Faster
		where humans are trained an	d aware of the robot and t	he environment is free
of sharp or dangerou	is objects.			

To review the values set for these factory presets, you can scroll down.

Custom Limits To edit these limits, switch off "Use Factory Preset"; the limits should then become editable:

Limits I/O Collision	าร				
Tooltip	Full Speed		Slow Speed		
Max Velocity	0.75	m/s	0.5	m/s	7 66%
	0.75	111/5	0.5	11/5	8 00%
JO	Full Speed		Slow Speed		
Max Velocity	4.7	rad/s	2.35	rad/s	3 50%
Max Acceleration	1	rad/s²	1	rad/s ²	@ 100%
Max Torque	346	N·m	100	N∙m	3 28%

The following can be customized, both for when the robot operates at its full speed and in a "slow"

mode that can be triggered via Safety I/O settings:

- Tooltip Speed: This limits the speed of the tooltip in Cartesian space.
- Per joint:
 - Max velocity: This is the maximum angular change in the joint's position per second permitted.
 - Max acceleration: This affects the rate at which the joint can change speed. If this is too low, the may not be able to achieve the maximum velocity otherwise permitted during the course of a movement.
 - Max torque: The maximum torque that the motor in the joint can exert.

4.2.2 Speed Modifier % Slider

The robot can be slowed down from its maximum as needed inside the robot menu.

This is useful for trying out a routine before putting it into production.

Setting this slider only applies a cap to the maximum limits that would otherwise be set in Safety Settings; movements that were already slower than that are not affected.

Speed 10	00%
	O
Equipment	
I/O manager	\$
Edit routine	/
Play routine in visualizer	⊳
Settings	٥
Brake robot	(!)

4.2.3 Customizing Speed Limits For A Step

When editing a "Move" step, the "Motion Speed" shows the speed of this specific step. This is useful to notice for delicate movements or when required for safety. To change the speed, tap the "Edit Motion Limits" icon.

	Move arm	
Description		
moving arm to home position		
Target		
ن Manual	ලි From space	f x Expression
Position saved		0
Edit position		Clear position
Match joint angles specified	rdes in the position	
Path	Geo u u o bourou	
Move in a straight line		
Reduce motion smoothing (i)	
Motion speed		65% of robot max
	② Edit motion limits	

By tapping "Edit Motion Limits", several options are available. The motion can be restricted to percentage of the maximum (as with the global speed modifier in the robot menu), or to a new set of custom limits.

Note that these limits apply whether the robot is operating at full speed or at any "slow" speed mode defined in safety settings. The robot will always apply the lowest of all limits in effect. It is also not possible to set torque limits on a per-step basis.

Motion Limits		×
What limit should apply to the robot's motion speed during this step? Automatically choose motion speed (recommended) No specific limit for this step Imatinum of the percentage of robot maximum All maximums otherwise specified in Safety Settings will be capped to this percentage		
100%		
Fully customize limits for tooltip and all joints Custom limits entered here will still be gated by the top-level robot Safety Settings.		
Tooltip	Limit	
Max Velocity	0.75	3 100%
Joint 0	Limit	
Max Velocity	4.7	7 100%
Max Acceleration	1	@ 100%
Joint 1	Limit	
Max Velocity	4.7	3 100%
Max Acceleration	1	7 100%
Joint 2	Limit	
Max Velocity	5	7 100%
Save Changes Cancel		

4.3 Safety I/O

The "I/O" tab shows settings for Safety I/O, which allows you to configure safety devices like extra Estop buttons, area scanners, light curtains, and more.

At present, only **inputs** are supported here; support for safety outputs for controlling other devices will be added in a future software update.

Safety Settings		
Limits I/O Co	ollisions	
digital inputs on the	e control box and assign	E-stop buttons, and key switches can be connected to the 24V ned to safety functions here. Any inputs unassigned here can be afety assessment can determine which are needed for your
Digital Inputs	Current Value	Safety Function Assignment
IN 1 + IN 2	Low	Unassigned Auto-Reset
IN 3 + IN 4	Low	Unassigned Auto-Reset
Last Updated: 6/22/20	23, 2:46:58 PM	Cancel Apply Settings

4.3.1 Configuring Safety Inputs

The sixteen 24V inputs on the control box are all safety-rated and can be used in pairs. Safety devices are connected in pairs to eliminate the possibility of a stray signal keeping the robot operating while actually in an unsafe condition. Therefore, if either of the paired inputs is below 24V, it will be treated as a "low" signal.

The following options are available:

- Safety Function Assignment: Any ports can be assigned to:
 - Emergency Stop when low: Triggers a category-0 stop that brakes robot and cuts power to arm.
 - Pause when low or when high: Pauses the currently-running routine but does not brake the robot.
 - Slow Speed when low: Makes the robot observe the "Slow Speed" set of limits defined in the "Limits" tab. This is useful, for instance, with an area scanner, to force the robot to move at a collaborative speed when people are nearby.
 - Reset Safeguards When High: This will reset the effects of any safeguard that does not have auto-reset (see below). This has no effect on emergency stop.
- Auto-Reset: This controls whether the effect of the function, once triggered, should go away (i.e. when we move back from low to high) or whether it requires a separate, explicit Reset. This is useful, for instance, with a sensor on a door to a fence around the robot: one would not want the robot to re-engage or speed up if the door is closed behind someone.



4.4 Collisions & Protective Stops

When the robot is running a routine and encounters a collision, it will stop. The routine can be re-started with the "Play" button in the top toolbar. Every time a collision occurs, it will also log the time and force measured, which can be reviewed in the Notification (bell) section.

Collisions are detected with two methods: 1) by monitoring the current coming out of the joint motor to measure torque and find discrepancies, 2) by monitoring an IMU (accelerometer) inside each joint.

4.4.1 Adjusting Collision Sensitivity

Depending on the environment and safety requirements, it may be desirable to change the sensitivity of collision detection. This can be done in the "Collisions" section of Safety IO.

This allows adjusting the thresholds used for both methods: the torque shock threshold (in newtonmeters) and the acceleration threshold used by the IMU (in m/s^2).

Safety Settings			
Limits I/O Co	llisions		
Remember to con	duct a full safety assessm	ent per ISO 10218-2 to verify limits and safe	guards required for application.
Collision Detecti	on		
	-	nen it detects a collision, either based	
detection.	on, as measured in eac	ch joint. Adjust the settings below to	change the sensitivity of collision
Joint	Torque Shock Th	nreshold	
OC	90	N·m – +	
.11	100	N·m – +	
Last Updated: 6/22/20	23, 2:46:58 PM		Cancel Apply Settings

4.5 Setting the Robot's Payload Mass

The robot's knowledge of its payload mass affects its ability to balance and sense collisions. It's important for overall safety to configure the payload as part of setting up a robot cell with the RO1. There are two ways to set the payload:

- 1. By adding a Set Payload step to a routine
- 2. By setting the payload parameter within an Actuate Gripper step. This is useful for situations where the payload changes as a result of the gripper.

The payload mass entered should account not only for the mass of the payload itself but also that of any attached end effectors. The spec sheet for the end effector should include this information.

Cancel Add	step	
Basic		
Move arm Specify a location that the robot should go to by defining the joint or gripper positions	Actuate gripper Open or close the gripper to pick up objects	
Set payload Sets the expected payload it the end of the arm		
Control		
Loop Perform steps repeatedly	Wait Wait for a condition such as time, IO input, or an event	
If Run substeps if condition is met	Restart loop Jump to beginning of a Loop	
Set variable Sets the value of an environment variable	Add offset Offset all movements within step	
Push mode Enable push mode maintain a pushing force against while performing substeps		
Interface with machines		
Set I/O output Sets the robot's I/O interface, allowing it to send messages	Press button Allows the robot to press a button on a machine, e.g. to	Payload
to external devices	start the next CNC cycle	Weight of object the gripper is picking up d

Weight of	object the	gripper is	picking u	up during t	this step

Chapter 5

Software Overview

5.1 Connecting to the Robot

The included iPad can be connected to multiple RO1 robots (if needed) after pairing with them.

The home screen of the Standard Bots app shows the list of paired robots and their connection status. Tapping on the "…" button for a robot allows you to: * delete that robot * re-configure it (i.e. to change its network settings, PIN, etc) * show a details screen that can allow you to troubleshoot connectivity issues.

If a robot is powered on but not showing up here, after confirming the tablet is on the same network, check its details and contact customer support.

To connect to your robot, enter your PIN to log in. The default PIN is 0000:

$\mathbf{\nabla}$
Log in to your robot
Passcode
Login

5.1.1 Home Page

The Home Page shows the routines, the current robot, and the end effector that is connected to the robot. In the "routines" tab, you are able to load, edit, and create new routines for the robot. In the tab that shows the connected robot, this is where you can go to move the robot.

	Home		
10	Routines	cb0066 100%	
	Locate Updated Jun 19		
	Classify Updated Jun 19		
	Vision Test Updated Jun 18		
	Every Step Updated Jun 18	🕂 Mave 💿 🔘	
	apostraphe Updated Jun 18		
	JG Test Updated Jun 17	Locate OnRobot 2FG7	
	+ New See all	Total time Cycles Avg. cycle Connected	
cb0066		⊘ E-Stop	Locate Loaded

5.1.2 Footer

Once connected to an RO1, the software has a set of global controls in the footer of every page:

template	€ ®	Ø E-Stop		Sample Code2

There are several important features worth calling out:

Element	Name	Description
([®]	Notifications	Contains a log of failures, errors, and other notifications that have occurred when running the robot. If there are unread items here, there will be a red dot
O E-Stop	E-Stop	on this icon. Trigger an emergency stop and brake the robot.
template	Robot Menu	See status of current robot and access settings (see below).
Sample Code2 Loaded	Loaded Routine	Shows what routine is loaded onto the robot.

Robot Statuses

The robot menu displays the name of the robot and may show several status indicators:

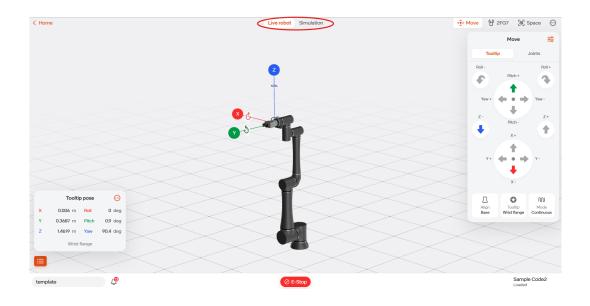
Status	Description
DISCONNECTED	The tablet is not able to connect to the robot.
LOADING	The tablet is trying to connect to the robot.
MOVING	The robot is being manually jogged now.
ANTI-GRAVITY	The robot is being moved in Anti-Gravity (hand-guided) mode.
RECOVERING	The robot has exceeded joint limits and can be moved back within limits now.
RUNNING	The robot is running a routine.
PAUSED	The robot is paused in a previously-running routine. You can press 'Play' to resume
	it.

Status	Description
E-STOP	The robot is in Emergency Stop mode. Reset the E-Stop button on the control box
	and any external E-stop buttons.
BRAKED	The robot is braked (either from having manually braked it or from a previous
	E-Stop). It can be unbraked in the Move screen.
FAILED	The robot has encountered a collision or has been affected by some other
	hardware issue.
(blue dot)	A software update is available. Check "Software Update" under "Settings".
INSTALLING	The robot is installing a software update.

5.2 Jogging the Robot

The "Move Robot" tab brings you into the Move page.

This shows a visualization of the RO1. The switch on the top allows you to switch between visualizing (and controlling) the real robot or a simulated robot.



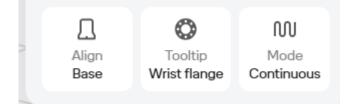
At the right of this screen are several useful tabs:

lcon	Tab Name	Description
 Move 	Move	Menu to access the "Joints" and "Tooltip" Tabs
Joints	Joints	Controls position of individual joints.
R	Gripper	Controls any connected gripper
ල් Space	Space	Allows defining points and grids that can be referenced in the routine
4	I/O	Shows the status of the I/O ports and allows manually toggling them. Hidden behind the three dots icon.
Tooltip	Tooltip	Jogs the robot's tooltip in Cartesian space

5.2.1 Jogging Tooltip

When jogging the tooltip, you are able to control the X, Y, Z coordinates of the tooltip, as well as the roll, pitch, and yaw.

This can be switched between "Base" (where the reference frame is the robot base) and "Tooltip" (where the reference frame is on the robot's tool flange). Moving to tooltip mode can be useful for maneuvering the tooltip in and out of tight spaces.



Selecting the "Mode" icon allows you to switch between continuous and incremental jogging. With continuous jogging, holding down a move robot icon will allow to robot to move as long as the icon is held down. With incremental jogging, when tapping on a move robot icon, the robot will only move a specified distance, this can be useful when fine tuning positions.

K Back	Mode	
Jog mod	e	
M Cor	ntinuous	
iļiļi Incr	emental	\checkmark
only move	mental jogging, once (by the sp time the jogging	ecified step
0.002	2 m	
(0.5°	

For safety, manually jogging the robot is always capped at a speed below the maximum that will apply when running. To make the robot jog even slower, you can change the global speed % slider in the robot menu.

5.2.2 Jogging Joints

The robot's joints can also be moved directly. This can be useful in avoiding collisions and in planning moves to minimize cycle time.

When moving the robot, there could be times when the robot cannot further move in a direction when the robot is not fully extended (certain actions will be grayed out). When this happens, check your Jog

Roll + Roll -Pitch + £ Э Yaw Z -Ζ+ Pitch Ļ Х+ Х-0 M Д Align Base Mode Continuous Tooltip Wrist flange

Joints tab to make sure there isn't a joint that is at it's joint limit.



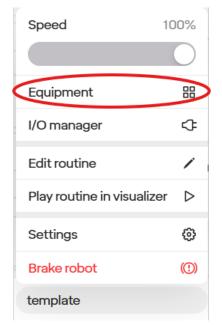
5.2.3 Entering Exact Values

When jogging in either mode, if you want to enter a more precise value, you can press the button in the top right. Once you've entered the values you want, hold down the "Hold to Apply Changes" button at the bottom of the panel.

⊡	Move	*	\odot		Move	
Toolti	ip Jo	pints		Tooltip		Joints
x	0.006	m	JO	-	0.2	+ 5
Y	0.3687	m	J1	-	0.2	+ 5
Z	1.4619	m	J2	-	0.2	+ 5
Roll Pitch	-0.0042	deg deg	J3	-	0.2	+ 5
Yaw	90.4366	deg	J4		0.2	+ 5
Move in a	a straight line		J5		0.2	+ 5
Snap to a	axis	>			,	
Hold	d to apply chang	jes		Hold	to apply ch	anges

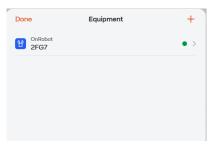
5.3 Managing Equipment

To manage equipment in the cell, including grippers, 7th axis devices, CNC machines, and more, open "Equipment" from the robot menu.



The equipment configured on the robot can be seen in the list on the left. To add new equipment, press the plus sign button in the upper right. Various settings for each connected device can be controlled

on the right.

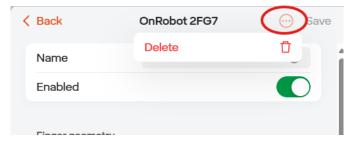


Currently, only one gripper can be added at a time (except when using the onRobot Dual Quick Changer). When adding a single tool on a single changer, you do not need to define a changer and instead simply add the tool.

Equ	ipment	(+)
	Gripper	w
	Built-in Wrist Camera	Ø
	Generic I/O	③

To remove equipment select the equipment that you would like to remove.

Then select the 'circle with the three dots' icon at the upper right of the tab to reveal the delete icon.



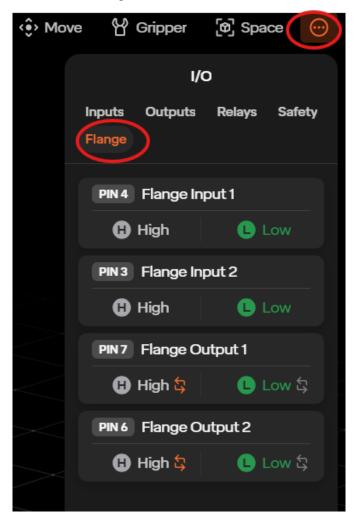
Certain m8 equipment will need access to the flange inputs and outputs. To make your customer gripper for this equipment, to go to the Equipment tab, select the robot's name in the lower left corner of the page and then select Equipment. Once here select the plus icon, then gripper, then custom gripper.

Done	Equipment	(÷ î
OnRobot	Gripper		ሞ
2FG7	Bu Cust	com Gripper	略
	G€ DH A	AG 105/145	쑴
	DH C	CGI 100/170	쌈
	DH F	PGC 300/60	쑵
	OnR	obot 2FG14	쑵
	OnR	obot 2FG7	쑵

In the custom gripper page, select Add Interface, and then change the Type to Tool Flange I/O. Here you can view the pin map, change the voltage from 24V to 12V and change the circuit type from PNP to NPN

K Back	Custom	Gripper	💮 Save
General	Tooltips (1)	Actions (2)	Sensors
Name	Custor	n gripper	⊗
Enabled			
Control Inter	face #1		\otimes
Туре		Tool flange	1∕0 ≎
Voltage		2	24∨ ≎
Circuit Type	;	F	PNP 🗘
(0 (0)	6 0 0 2	1 Unavailable 2 Unavailable 3 Digital Inpu 4 Digital Inpu 5 Power 6 Digital Out 7 Digital Out 8 Ground	t1 t2 put2

In the Tooltips tab you can add a new tooltip and adjust the TCP offset and rotation of the equipment. In the Actions tab you are able to control the actions such as actuate, reset, clamp, unclamp. You can also change the control from the control box I/O to the tool flange I/O. And in the sensors tab you can add sensors and change their input ports. To access the flange I/O in the move robot page, go to the three dots icon in the upper right, select I/O, then select Flange.



To access the flange outputs in the routine editor page, go to Add Step, then select the Set I/O Output step. On the right side of the page there will be a list of outputs to select. At the bottom of the list will be the flange outputs.

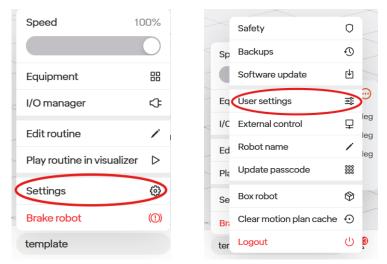
	Set I/O output	
Description		
Sets the robot's I/O interfac	ce, allowing it to send messages	to external devices
Select the outputs to set and the a connected to your robot, go to the	associated levels below. To name the Inpu 9 <u>I/O Manager</u>	ut and Output devices
Set Outputs		
Output		Select Output 🗘
	REL2 Relay 2	
	REL 3 Relay 3	
	Tool flange I/O	
	PIN7 Flange Output 1	
	Flange Output 2	-

You are able to access the flange inputs for routines as well. For example, in a wait step, select Rule, then I/O, then at the bottom of the list you can find the flange I/O. So in this wait step, the routine will wait until one of the flange I/O goes high or low.

	Wait		
Description			
Wait for a condition such as time, I	O input, or an event		
Time			
Condition			
Pause robot until time has passed or conditi	on is met.		
lf Rule			
Input 12			
IN 13 Input 13			
IN 14 Input 14		+ Or	
Input 15			
IN16 Input 16			
PIN1 Flange Input 1			
PIN2 Flange Input 2	7		

5.4 Robot Settings

Settings for the robot are accessed via the robot menu. User interface settings are accessed separately within settings via the hamburger menu.



The following options are available on the RO1:

Section Name	Description
Safety	Speed limits, configuration of safeguard devices connected to I/O ports, and
	collision sensitivity settings
PIN	Update the robot's PIN
Robot Name	Name displayed in UI to distinguish it from any other RO1s you may be using.
Software Update	Allows checking for and installing any available software updates
Backups	Allows making and restoring from backups via external disk connected to
	USB
Interface Settings	Allows switching between imperial and metric units for displaying lengths in
	the UI
Box Robot	Places robot into pose that allows it to fit in Standard Bots' provided foam
	case in case it needs to be returned.

5.5 Singularities

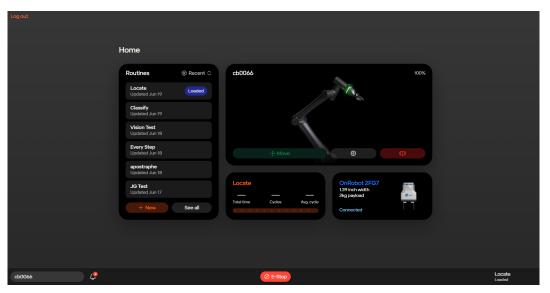
A singularity is a configuration in which the robot end-effector becomes blocked in certain directions. A robot is unable to maintain a constant velocity while passing one.

The RO1 handles this by never planning motion paths through singularities. If the robot is programmed in a manner in which it will encounter a singularity, the UI will display a "Motion Planning Failed" error and the robot will not attempt the movement.

To ensure routines are not created in which the robot will encounter a singularity, the user interface requires a play-through of any new routine in a simulation mode before running it on a real system. This ensures all motion plans are valid before running on a physical robot arm.

5.6 Routines

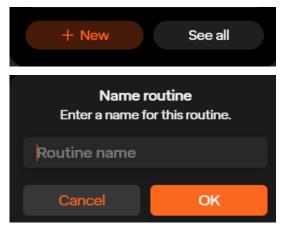
Standard Bots uses an intuitive "no-code" approach to programming the RO1 robot. The programs in the robots are referred to as "Routines". The routine reads as a story. Routines can be developed and tested in simulation without moving the actual robot. The robot can store multiple routines. Routines contain all information the robot needs to complete the programmed task including moves, speeds, setting/reading IO, communicating with external equipment and more.



5.6.1 Routine Creation Example

To get to the Routines area of the interface, return to the home page.

Existing Routines will be shown in the main window, and can be viewed and edited by clicking on them. To create a new routine select New.



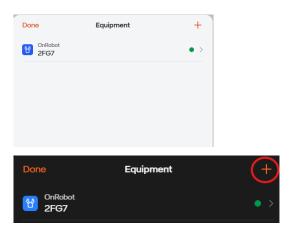
To create a new routine, give it a name under Routine Name.

< Home		💬 Edit
JG Test		
Space	Variables	
Stops		Variables: Off
1. Loop forever		\odot >
2. Move arm to manually specified position		\odot >
3. Wait for 3 seconds		\odot >
4. Move arm to manually specified position		2.40% 💮 >
5. Move arm to manually specified position		₹37K ⊕ >
6. Move arm to manually specified position		(730% ··· >
7. Move arm to manually specified position		(7 53%) ⊕ >
8. Move arm to manually specified position		(7 50%) ⊕ >
9. Move arm to manually specified position		(250%) 💮 🔿
10. Move arm to manually specified position		(<u>7:30%</u>)
11. Move arm to manually specified position		@ 45% (00) >
12. Move arm to manually specified position		(2:40%) (···) > ▼
cb0066		⊘ E-Stop

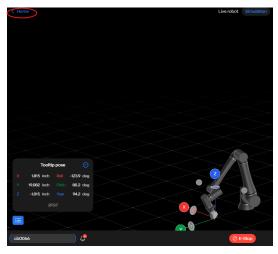
The routine interface is where you can add a description of your routine, and to edit and create steps.

Return to the Space.
 Return to Routine list.
 The Routine name.
 Go to the Space.
 Add variable to use in the Routine.
 Lock or unlock editing.
 Load this Routine onto the robot.
 Add a new Step into the Routine.
 List of Steps in the Routine
 List of Step types that can be added to the routine.

If you are using a Standard Bots-supported tool, first add it using the manage equipment button on the robot page. If you are not using a supported tool, no need to add it. It will be controlled over I/O directly.



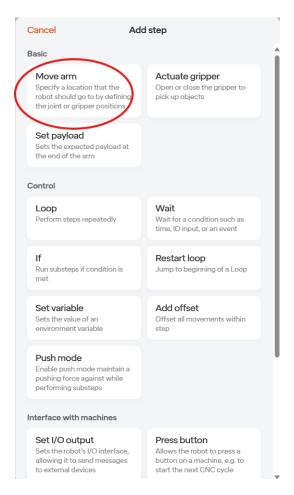
You will be directed back to the equipment tab to add the equipment. Click the +add to add the equipment. Select the equipment you have from the list. For our example, select OnRobot 2FG7. When adding a single tool on a single changer, you do not need to define a changer and instead simply add the tool.



Select the back arrow in the upper left to go to the Home Page and then select on your routine to return to the Routine Page.



Click Add Step to begin creating the routine.



The menu will show all available step types with descriptions. For the sample routine, we will start with a Move Arm Step. A Move Arm step is how you tell the robot to go to a position. Click the Move Arm step to add it to the Routine.



The Move Arm step will be added to the first line of the Routine. The yellow ! Indicates that an action is required for that step. Click the step to edit the step.

< Home		\bigcirc \equiv Reorder Done		Move arm	
UpdateManualPics			Description 1		
Description			Move arm to manually speci	fied position	
Space	Variables				
(a) Manage space	+ Add variable		Target 2	3	4
Steps		Variables: Off	(ê) Manual	[@] From space	4 f× Expression
1. Loop forever		$\land \odot \rightarrow$	Position saved		10 🕑
+ Add Step			- 5		
2. Move arm to manually specified position		\odot >	Edit position		Clear position
+ Add Step			Match joint angles specified		7 💽
			Path		
			Move in a straight line		6
			Reduce motion smoothing	0	8
			Motion speed		9100% of robot max
				Ø Edit motion limits	
template 25% L	(⊘ E-Stop			> Play routine

- 1. Editable description for this Step.
- 2. Specify the position for the robot to go to based on the current position.
- 3. Specify the position for the robot to go to based on a saved position from the Space.
- 4. Specify the position for the robot to go to based a math function and/or variables.
- 5. Edit the position for the robot to go to based on the current robot position.
- 6. Go to this position in a straight line (from the Tooltip perspective),
- 7. The robot can sometimes reach a point in multiple ways, this tells the robot to use this exact orientation when going to this point.
- 8. Reduces the motion smoothing like overshooting or false collisions.
- 9. Set the speed as a % of maximum defined in the Edit Motion Limits Settings.
- 10. Shows that the position has been saved.

Home		💮 🗮 Reorder Done	Move arr	n
JpdateManualPics			Description	
Description			Specify a location that the robot should go t positions	o by defining the joint or gripper
Space	Variables		positions	
(0) Manage space	+ Add variable		Target	
Steps		Variables; Off	÷ 💌	fx
1. Loop forever		\odot >	Manual From spar	
2. Move arm Specify a location that the robot s	hould go to by defining the joint or gripper positions	▲ ⊙ >	Target	Select space ≎
			Position	Cycle through list 🗘
+ Add Step			Space defines positions and objects around the robot th	at can be referenced across steps.
			@ Manage s	pace
			Match joint angles specified	
			The robot will match the exact joint angles in the positio	n.
			Path	
			Move in a straight line	
			Reduce motion smoothing (i)	
			Motion speed	100% of robot max
mplate 25% 🕼		Ø E-Stop		> Play rout

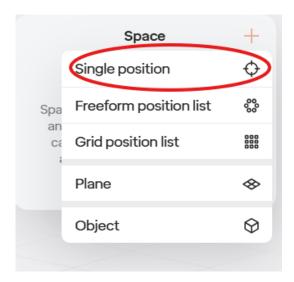
For our example we are going to select From Space. Defining a point in the Space allows you to use it in multiple places in the routine. Defining a point in the Space also lets you more easily modify the point in the future.

	Move arm		
Description			
Specify a location that the positions	robot should go to by defi	ning th	e joint or gripper
Target			
<. Manual	ຼີອງ From space		f x Expression
Target		1	Select space \diamondsuit
Position		C	cle through list 🗘
Space defines positions and objec	ts around the robot that can be r	eference	d across steps.
2	🔄 🕼 Manage space		
Match joint angles specifie	d		
The robot will match the exact join	it angles in the position.		
Path			
Move in a straight line			
Reduce motion smoothing	()		0
Motion speed			100% of robot max

- 1. The indicated drop down will have all the positions from the Space listed. We have not defined any yet.
- 2. Select the Manage Space button to go to the Move Robot view.

← Move template	Live robot Simulation	(i) Move 🍟 2FG7 👩 Space 💬
		Space +
		Space allows you to define positions and objects around the robot that can be referenced in notitines. To add items here, top the "Add" button above.
Tooltip pose 😔		
X 0.0055 m Roll 0 deg	\times] \times \times	\times \times \times
Y 0.3687 m Pitch 0.8 deg		
Z 1.4619 m Yaw 90.4 deg		
Wrist flange		
	\rightarrow	
template 25%	⊘ E-Stop	UpdateManualPics Loaded

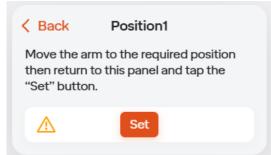
You will be brought back to the Move Robot view under the Space option in the upper right. Click the + button to add a new variable position.



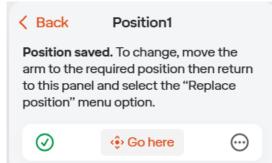
Select Single Position to create a new saved position.

< Back	New item	
Name <mark>1</mark>		
Description		
	Create	

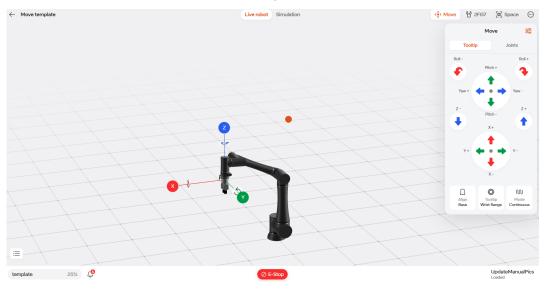
- 1. Give the position a name.
- 2. Select Create.



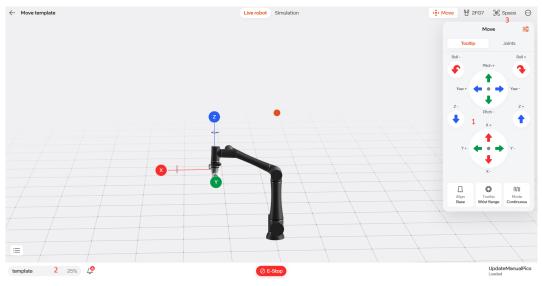
1. Set will set the position named "Position 1" to the current robot location.



2. Go Here will drive the robot to the saved position if held down.



- 3. Use the Tooltip jogging area to move the robot to the desired initial position.
- 4. We are going to set a safe position above our work area for the robot to go to every time we start the routine.



- 1. Jog the robot to the desired position using the arrows.
- 2. If needed, use the menu to change the robot speed.

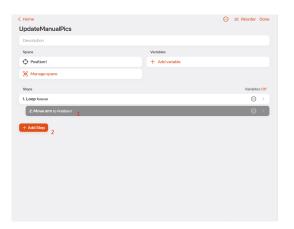
3. Once you are in the desired position, use the Space icon to return to the Space positions.

← Move template 2	Live robot Simulation	Back Po Position saved. To arm to the required to this panel and s position" menu op Ø Replace po	I position then re Nect the "Replac ion. So here sition d joint angles	he sturn ce ⊡
Tooltip pose X -0.6656 m Roll 1798 dvg Y 0.1821 m Pitch -882 dvg Z 0.7508 m Yaw 2.2 dvg Wrist flange				
template 25% 🕼	Ø E-Stop		UpdateManu Loaded	alPics

- 1. Set the position to the variable "Position 1".
- 2. Select the back arrow to go back to the routine.

	Move arm	
Description		
Move arm to Position1		
Target		
<€∙ Manual	ලි From space	<i>f</i> × Expression
Target	✓ ♦ Position1	♦ Position1 ♦
Space defines positions and object	s around the ropor that can be ref	ferenced across steps.
	්න් Manage space	
Match joint angles specified	i	
The robot will match the exact joint	angles in the position.	
Path		
Move in a straight line		
Reduce motion smoothing	0	
Motion speed		100% of robot max
	🕜 Edit motion limits	
		▷ Play routir

Select our new saved position "Position 1" from the drop down.

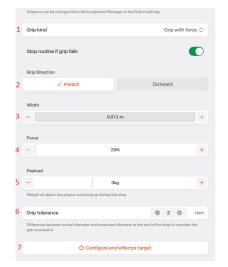


- 1. We now have our first step at the beginning of the routine.
- 2. Click + Add Step to add our next step.

Cancel	Add step	
Basic		
Move arm Specify a location that the robot should go to by definir the joint or gripper positions		
Set payload Sets the expected payload a the end of the arm	.t	

Often you will want to set your tool configuration at the beginning of the routine as you do not know how it will be left every time the robot stops. Select Actuate Gripper.

Select the Actuate Gripper the step to edit the step.



- 1. If we want to close the tool with some force select the Grip object with force checkbox. Since we are opening, we will change this option to Move To Position.
- 2. Set the GRIP DIRECTION to inward.
- 3. Set the gripper WIDTH, since we are opening, we will set it wide open

- 4. Set the FORCE to grip with. We will leave at 20N as we are opening.
- 5. Set the PAYLOAD for the target. Since we are just opening, this will be left at 0kg
- 6. Set the TOLERANCE for the gripper to be considered successful. This will be left at 2mm.
- 7. Click Configure End Effector Target.
- 8. The live robot page will open. Press the "Hold to Apply Changes" and then "Confirm End Effector Position" in the upper left. You'll then be brought back to the Routine page.

Cancel A	dd step
Basic	i
Move arm Specify a location that the robot should go to by defining the joint or gripper positions	Actuate gripper Open or close the gripper to pick up objects
Set payload Sets the expected payload at the end of the arm	
Control	
Loop Perform steps repeatedly	Wait Wait for a condition such as time, IO input, or an event
If Run substeps if condition is met	Restart loop Jump to beginning of a Loop
Set variable Sets the value of an environment variable	Add offset Offset all movements within step
Push mode Enable push mode maintain a pushing force against while performing substeps	
Interface with machines	
Set I/O output Sets the robot's I/O interface, allowing it to send messages to external devices	Press button Allows the robot to press a button on a machine, e.g. to start the next CNC cycle

- 1. Select + Add Step as we did for the last two steps to add another step.
- 2. Select Loop.
- 3. Click on the Loop step to be able to edit the step.

Loop	
Description	
Loop forever	
Loop forever	~
Loop specific number of times	
Use rules	
Main Loop	
Automatically assign main loop	\checkmark
Manually assign main loop	
Choose one loop in the routine to be the main loop. This loop will be used when counting the routine cycles.	e
Automatic defaults to the outermost loop in your routine. Manual overrides the default main loop assignment.	

For Loop under Basic Options you can choose to:

•Loop Forever: Loop until the program is stopped by the user.

•Loop specific number of times: Loop the number of times specified before going to the next step.

•Use Rules: Allows you to use math and variables to set the number of times the loop runs.

For our case leave as Loop Forever

•Under Main Loop you can choose:

•Automatically assign Main Loop: Set the loop that is to count the number of times the routine runs as the one index most left in the routine window.

•Manually assign Main Loop: Set the loop that is to count the number of times the routine runs manually in the Loop setting using the checkbox below.

For our case leave as Automatically assign Main Loop.

< Home	💬 🗮 Reorder Done
UpdateManualPics	
Description	
Space	Variables
Position1	+ Add variable
🐼 Manage space	
Steps	Variables: Off
1. Move arm to Position1	\odot >
2. Actuate gripper to 0.0709 m	\odot >
3. Loop forever	\land \odot \rightarrow
+ Add Step	
+ Add Step	

The Loop will have a warning that steps are required below it when first added to the routine. Steps

that are indexed to the right will loop according to what we set as the Loop parameters. If we add a step that is in line with our last Actuate Gripper instead of indexed over to the right, they would happen after the loop. Click Add Step in the transparent area below the loop to add a new step.

Cancel A	Add step
Basic	1
Move arm Specify a location that the robot should go to by defining the joint or gripper positions	Actuate gripper Open or close the gripper to pick up objects
Set payload Sets the expected payload at the end of the arm	
Control	
Loop Perform steps repeatedly	Wait Wait for a condition such as time, ID input, or an event
If Run substeps if condition is met	Restart loop Jump to beginning of a Loop
Set variable Sets the value of an environment variable	Add offset Offset all movements within tep
Push mode Enable push mode maintain a pushing force against while performing substeps	
Interface with machines	
Set I/O output Sets the robot's I/O interface, allowing it to send messages to external devices	Press button Allows the robot to press a button on a machine, e.g. to start the next CNC cycle

Often you want to approach a position from an offset based on the end position, for example when picking a part. If you do not set an in between point to ensure you approach the part from the top, you may approach it from the side and knock into it with the tool. Select Add Offset to add an offset to our next move in the loop. Click the step to edit our newly added Add Offset.

Add offset	
Description	
Offset all movement within step	
Offset by	
Unit	Meter 🗘
x	m 💮
Y	m 💬
z 0.1	m 💬
With respect to	Base 🗘
Offset will apply to any Move arm steps inside this one, adjusting the t	ooltip position.
Legend	

You can offset the part in X, Y or Z by a positive or negative offset.

We will be picking from above the part, so add a 0.1 meter offset in Z.

1. Move arm to Position1 > 2. Actuate gripper to 0.0709 m > 3. Loop forever > 4. Add offset Offset all movement within step > + Add Step 	Steps	Variables: Off
3. Loop forever 4. Add offset Offset all movement within step ▲ ↔	1. Move arm to Position1	\odot >
4. Add offset Offset all movement within step	2. Actuate gripper to 0.0709 m	\odot >
	3. Loop forever	\odot >
+ Add Stap	4. Add offset Offset all movement within step	$\triangle \odot \rangle$
(Add dep	+ Add Step	

The newly added Add Offset will have a warning that it requires another step below it to offset. Any move below and indexed to the right of our Add Offset will be offset by the .1 meters we set in positive Z. Select Add Step in the translucent step below Add Offset

Cancel	Add step
Basic	
Move arm Specify a location that the robot should go to by definin the joint or gripper positions	
Set payload Sets the expected payload a the end of the arm	ŧ

Select another Move Arm command. As we did in the first step, use the Space to move the robot to the pick position and create a new Single Position as a variable named Pick Position in the space.

Specify a location that the robot should go to by defining the joint or gripper positions!	Description				
Image: Space and objects around the robot that can be referenced across steps. Image: Space defines positions and objects around the robot that can be referenced across steps. Image: Space defines positions and objects around the robot that can be referenced across steps. Image: Space defines positions and objects around the robot that can be referenced across steps. Image: Space defines positions and objects around the robot that can be referenced across steps. Image: Space defines position and objects around the robot that can be referenced across steps. Image: Space defines position and objects around the robot that can be referenced across steps. Image: Space defines position and objects around the robot that can be referenced across steps. Image: Space defines position and objects around the robot that can be referenced across steps. Image: Space defines position and objects around the robot that can be referenced across steps. Image: Space defines position across the target. Path Image: Space defines define		robot should go to by defir	ning th	e joint or gri	oper
Image fx Manual From space fx From space Expression Target 4 ♀ Pick Position ♀ Space defines positions and objects around the robot that can be referenced across steps. Image space Image space Match joint angles specified 5 Move specific tooltip to target Automatic ♀ The robot will move "Wrist flange" to the target: Path Move in a straight line	Target	2			
Manual From space Expression Target 4 ♦ Pick Position ≎ Space defines positions and objects around the robot that can be referenced across steps. Image: Im					
Target 4 Pick Position Pick Space defines positions and objects around the robot that can be referenced across steps. Image space Match joint angles specified 5 Image Move specific tooltip to target Automatic Pick The robot will move "Wrist flange" to the target. Path Image Pick Move in a straight line Image Pick	<ê>	(0)		f×	
Space defines positions and objects around the robot that can be referenced across steps. Image space Match joint angles specified 5 Move specific tooltip to target Automatic <itext< td=""> The robot will move "Wrist flange" to the target. Path Move in a straight line Image specifies</itext<>	Manual	From space		Expressio	n
Manage space Match joint angles specified 5 Move specific tooltip to target Automatic ≎ The robot will move "Wrist flange" to the target. Path Move in a straight line	Target		4 (Pick Posi	ion 🗘
Match joint angles specified 5 Move specific tooltip to target Automatic \$ The robot will move "Wrist flange" to the target. Path Move in a straight line	Space defines positions and objec	ts around the robot that can be re	ference	d across steps.	
Match joint angles specified 5 Move specific tooltip to target Automatic \$ The robot will move "Wrist flange" to the target. Path Move in a straight line					
Move specific tooltip to target Automatic \diamond The robot will move "Wrist flange" to the target. Path Move in a straight line		[-] Manago space			
Move specific tooltip to target Automatic \diamond The robot will move "Wrist flange" to the target. Path Move in a straight line					
The robot will move "Wrist flange" to the target. Path Move in a straight line	Match joint angles specifie	d		5	\bigcirc
Path Move in a straight line	Move specific tooltip to tar	get		Auto	matic 🗘
Move in a straight line	The robot will move "Wrist flange"	to the target.			
Move in a straight line	Dette				
	Paul				
Reduce motion smoothing (i)	Move in a straight line				\bigcirc
	Reduce motion smoothing	()			
Motion speed 100% of robot max	Motion speed			100% of ro	bot max

- 1. Select another Move Arm command.
- 2. As we did in the first step, use the Space to move the robot to the pick position that you want, and create a new Single Position as a variable in the space.
- 3. Select From Space.
- 4. Set the target as our new position Pick Position.
- 5. Ensure Match Joint Angles Specified is not checked as this is not allowed inside of an offset.

Steps	Variables	s: Off
1. Move arm to Position1	\odot	>
2. Actuate gripper opening the gripper	\odot	>
3. Loop Perform steps repeatedly	\odot	>
4. Add offset Offset all movement within step	· · ·	
5. Move arm Specify a location that the robot should go to by defining the joint or gripper positions	\odot	>
6. Move arm to manually specified position	\odot	>
+ Add Step		

Next we want to add another Move Arm step. We want this step to be within our Loop, but not offset by our Add Offset so instead of clicking the +Add Step, select the three dot icon to the right of the Add Offset step, and select Add Step Below (you and also drag and move steps by selecting the orange "Reorder" icon at the top of the page).

Steps	Add step above	∱ <mark>∷Off</mark>
1. Move arm to Position1	Add step below	
2. Actuate gripper opening the gripper	Сору	
3. Loop Perform steps repeatedly	Rename	1
	Resume from step	
4. Add offset Offset all movement within step	Set speed	© >
5. Move arm Specify a location that the robot should go to by defining the joint or gripper positions	Delete	₫ >
6. Move arm to manually specified position		··· >
+ Add Step		

Next we will be adding another Actuate Gripper command.

- 1. Select the three dot icon on our new Move Arm Step.
- 2. Select Add Step Below.
- 3. Choose Actuate Gripper.

Grip kind	Grip with force	\$
Stop routine if grip fails		D
Grip Direction		
√ Inward	Outward	
Width		
-	0.05 m	+
Force		
-	80N	+
Payload		_
-	2kg	+
Weight of object the gripper is picking up durin	ng this step	
Grip tolerance	● 3 O r	mm
Difference between actual diameter and meas grip successful	ured diameter at the end of the step to consider the	9

Configure the tool as shown, which will close the tool on a part with 80N of force.

1. Move arm Move to home position	\odot >
2. Actuate gripper opening the gripper	\odot >
3. Loop Perform steps repeatedly	\odot >
4. Add offset of 0.1m in Z	\odot >
5. Move arm	\odot >
6. Move arm to Grab Position	\odot >
7. Actuate gripper close gripper	\odot >
8. Add offset of 0.1m in Z	\odot >
9. Move arm to Pick Position	\odot >

As we did before the pick, configure another offset move to move above the Pick Position. This will

ensure we do not drag the part before we move to the place. The routine should look like the image above.

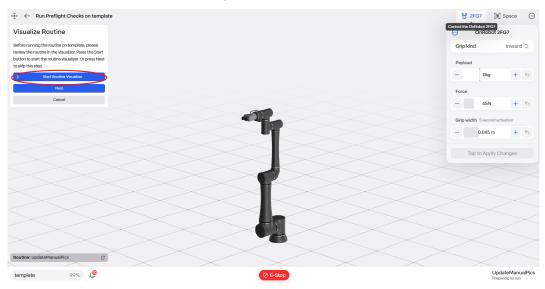
Steps	Variables	Off
1. Move arm Move to home position	\odot	>
2. Actuate gripper opening the gripper	$\overline{\cdots}$	>
3. Loop Perform steps repeatedly	\odot	>
4. Add offset of 0.1m in Z	\odot	>
5. Move arm	\odot	>
6. Move arm to Grab Position	$\overline{\cdots}$	>
7. Actuate gripper close gripper	$\overline{\cdots}$	>
8. Add offset of 0.1m in Z	$\overline{\cdots}$	>
9. Move arm to Pick Position	$\overline{\cdots}$	>
10. Add offset of 0.1m in Z	$\overline{\cdots}$	>
11. Move arm to #2 Pick Position	$\overline{\cdots}$	>
12. Move arm to Place Position	$\overline{\cdots}$	>
13. Actuate gripper open gripper	$\overline{\cdots}$	>
14. Add offset of 0.1m in Z	$\overline{\cdots}$	>
15. Move arm to Pick Position	\odot	>

As we did for the pick, configure another set of steps to go to an offset above a new position, Place Position, go to the Place Position, Actuate the tool, and go to an offset above the Place Position. The routine should look like the image above. This routine should now continuously pick and place until it is manually stopped.

5.6.2 Running Routines

f×
Expression
♦ Position1 ♦
l across steps.
_
0
100% of robot max
(

To test the routine, select the Play Routine icon.



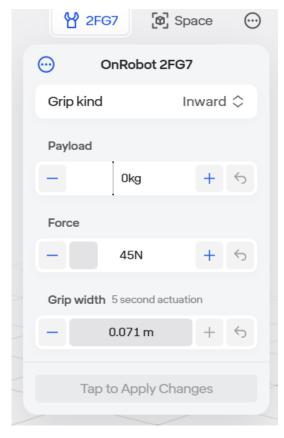
Select Start Routine Visualizer.

🔅 \leftarrow Run Preflight Checks on template	3	∮ 2FG7	[ඔ] Spac	ce 💬
Visualize Routine	····	OnRob	oot 2FG7	
"UpdateManualRcs" is currently running on the visualize: Click the Pause button to stop the routine visualizer any time.	Grip	kind	Inv	vard 🗘
Next	Payl			
Cancel		Okg		+ 5
	Forc	e		
LMove am Move to home position Actuate proper accenting the proper accentence to pro	1	451	-	+ 5
3.Loop Perform steps repeatedy	Grip	width 5 seco	and actuation	
4. Add offset of 01m h Z		0.047	2 m	+ 6
		Tap to Ap	ply Change	95
\times \times \times \times \times \times \times \times				
\times \times \times \times \times \times \times	>			>
			><	
$\overset{\bullet}{\longrightarrow} \overset{\bullet}{\longrightarrow} \overset{\bullet}{\to} \overset{\bullet}$				
Playing routinel × ^{liPics}		~~		
template 99% L [®] O E-Stop			UpdateM Preparing to	anualPics

- 1. The robot will start completing the routine in a virtual environment.
- 2. The step the robot is currently completing will show on the left side of the screen.
- 3. The value of all Variables is shown in the upper right.
- 4. The routine will only loop once the first time. If you hit the "resume routine" button again it will loop indefinitely.

← Run Preflight Checks on temp	2FG7
sualize Routine	
e routine completed successfully, click Next. I can run the visualizer again by pressing the	Outputs
aplay button. Otherwise, click Cancel to return to e routine.	Input 1
Next	High 🔓
Cancel	Input 2
Add offset of 0.1m in Z	High 🔓
Move arm to #2 Pick Position	Input 3
Move arm to Place Position 0	High 🛱
Actuate gripper open gripper	Input 4
Add offset of 0.1m in Z	High 🎝
	Input 5
	High 🞝
	Input 6
	High 🔓
imes $ imes$	Input 7
\sim	High 🔓
\sim	Input 8
outine: UpdateManualPics	tich 5
emplate 99% (

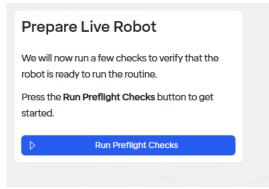
1. The **I/O** menu (hidden behind the three dot icon in the upper right) can be selected to show the IO values as the routine is running.



1. The **Gripper** menu can be selected to show the tool settings as the routine is running.

🔅 \leftarrow Run Preflight Checks on templa	ite
Visualize Routine	
If the routine completed successfully, click Next. You can run the visualizer again by pressing the Replay button. Otherwise, click Cancel to return to the routine.	
Next	
Cancel	
13. Actuate gripper open gripper	
14. Add offset of 0.1m in Z	
15. Move arm to Pick Position ()	
\times	

If the routine looks correct, it is ready to run on the physical robot. Select the blue **Next** button.



Select Run Pre-flight Checks.

🔅 \leftarrow Run Preflight Checks on template	업 21	FG7 [@]	Space (
Prepare Live Robot	\odot	OnRobot 2F	G7	
O Connected	Grip kin	d	Inward 🗘	
O Unbrake Robot	Payload			
📀 Ready to Run	-	Okg	+ 5	
6 Gripper at Start Position	Force			
Use the controls on the right to adult the pipper barlow starting the number of the "Continue" to prove the the height of backs.		45N	+ 5	
Cottinue	Grip widt	th 5 second act		
	EL.	0.045 m	+ 5	
	Ta	p to Apply Cł	nanges	
\longrightarrow				
		>>		
\times \times \times \checkmark \times \times	>			>~
		/	~	
template 99% 🖉 🖉		Upd Prepa	ateManualPie aring to run	ics

Ensure the tool is in an acceptable position based on the start of your program. In our case we start by opening, so ensure the gripper is empty if you don't want to drop the product.

Prepare Live Robot Connected Unbrake Robot Ready to Run Gripper at Start Position All preflight checks on template have completed successfully and the live robot is now ready for its test run of the routine.



Click the blue Test Run button.

\odot \leftarrow Run Preflight Checks on template	🖞 2FG7	🕼 Space	\odot
Test Routine on Live Robot			
For safety purposes we will now run UpdateManualHiss on the livetemplate robot at a lower speed.			
Mar Toothy Speed			
literes literes 1			
b Start Test Run on Live Robot			
2			
$\times \times \times \times \times \times \times \times \times$			
	\leq		
	\sim	~~~	
$<\!\!\times\!\!\times\!\!\times\!\!\times\!\!\times\!\!\times\!\!\times\!\!\times$		~	
		\sim	
	\sim		>
Routine: UpdateManualPics		$>\!$	
	\rightarrow		
template 99% 4 th ØF-Stop		UpdateManua Preparing to run	IPics 1

1.Select the maximum speed you want the end of the arm to move for the initial run by setting Max Tooltip Speed.

2.Click the Start Test Run on Live Robot button.

🔹 🔶 Run Preflight Checks on template	₩ 2FG7	[0] Space	\odot
Test Routine on Live Robot			
template has successfully completed its prelights checks and is ready to run the noutrine "Updataffitumaties". For setter reasons you will need to hold a button during the first arm movement.			
1. Move arm Nove to home position • I Hold to Nove Arm to Position			
2. Actuate gropper opening the gripper			
3.Loop Perform steps repeatedy			
	>>		
\times \times \times \times \times \times \times	~		
	\checkmark		<
		\sim	
	$>\!\!\!\!>$		>
Routine: UpdateManualPics		$>\!\!\!\!>$	
	\rightarrow		
	UpdateManua ② 00:00:02 ↔		

- 1. Click and hold the Hold to Move Arm to Position button to move the robot to the first position in the routine.
- 2. Watch the robot to ensure there are not going to be collisions during this move.
- 3. The routine will run at the specified reduced speed once and stop.
- 4. If the routine looks good, you can now play again with the "resume routine" icon that will appear in the upper right, and it will run at the speed specified in the menu in the lower left.

5.6.3 Accessing the Routine's Schema

In the Standard Bots UI, you are able to access the routine's schema. This allows you to copy, delete, and make changed to the schema of your desired robot routine.

- 1. To access the routine's schema, first go to the routine editor page of your desired routine.
- 2. Next, select the three dots icon at that is located at the top of the page.

< Home	Reorder Done
Reach Study	
Space	Variables
⇔ a	
🗘 Above Part A	
🗘 On Part A	
↔ leavingA1	
leavingA2	
Carrier Control Con	
+ Home Position	
c grid position 1	
Grid position 2	
c grid position 3	
Grid position 4	
sbove grid position 1	
above grid position 2	
above grid position 3	
template 🕼	⊘ E-Stop

3. Then select the Schema icon

< Home			
Reach Study		Schema	E
		Rename	
Space	Variables	Duplicate	G
⊗ a		Convert to template	
Above Part A			
🗘 On Part A			
leavingA1			
↔ leavingA2			
CLeaving A3			
Home Position			
grid position 1			
Grid position 2			
Grid position 3			
grid position 4			
above grid position 1			
above grid position 2			
above grid position 3			
template 🤤		(⊘ E-Stop

4. Once here you can access and make changes to the schema of your routine. At the bottom of the page are three buttons: Clear, Copy, and Update Routine. The Clear button deletes the schema, the Copy button copies the entire schema to your clipboard, and the Update Routine button saves the changes made to the schema. At the top of the page is a Create New Routine button. This allows you to create a separate routine with the changes you made instead of changing the existing routine.

E	dit schema			
Create new routine				
Routine name	Reach Study			
Schema				
<pre>{ "globals": ("globalSpace": []), "routine": { "space": [{ "description": "", "id": "a8c8b6dc-e4 62004b40adcd", "kind": "environme "name": "g", "positions": [], "global": false, "fileURL1": "/storage/869fcada7e 6167c9ec49f74042920 "fileName": "BRUN v22 -2.stt", "pose: ["xv*1</pre>	ntObject", ebdcd71be0c34 ed27b0989022	124de72 .bin'',		•
	⊗ c	Clear	Copy	/
		Update	e Routine	

5.7 Advanced Routine Functionality

5.7.1 Variables

Variables can be used to assist with a variety of tasks within a routine such as:

- Storing a part offset for use in multiple Add Offset steps.
- Keeping track of how many parts have been picked in a given row.
- Keeping track of how many layers have been placed on a pallet.

< Home				
UpdateManualPics				
Description				
Space	Variables			
Position1	+ Add variable			
Pick Position				
#2 Pick Position				
#2 Grab Position				
Place Position			Select a step to view its details	
[Ø] Manage space		l		
Steps		Variables: Off		
1. Move arm Move to home position		\odot >		
2. Actuate gripper opening the gripper		\odot >		
3. Loop Perform steps repeatedly		\odot >		
4. Add offset of 0.1m in Z		\odot >		
5. Move arm		\odot >		
6. Move arm to Grab Position				
template 99% 💭		⊘ E-Stop		▷ Play routine

To create a variable, locate the variables are in the routine editor.

Cancel	Variable	Save
Name	increment_size	8
Initial value	0.005	

When creating a variable, be sure to set an initial value. If no value is set, the variable will be set to 0. The value in the initial value box will be used set for the variable every time the routine is started.

Target				
<. Manua	al	P . From space	fx Expression	
				\odot
Expressions allow th and using math.	ne robot to dynamically	y determine the posit	Expressions Reference	()
and asing math.			Step Variables	≔
Match joint ang	les specified		Environment Variables	[×]
Move specific t	ooltip to target		IO Input Variables	€
The robot will move record the position.	"Wrist flange" or "2FG	97" to the target, dep	Equipment	88
			Space	6
Path				

To use a variable in the routine, click the "Fx expressions" button in the given area of the step. There are several sets of variables available.

Expressions Reference: Help menu on how to construct expressions

Step Variables: Data from each routine step that can be used, for example the number of times it has been executed in a loop.

Environmental Variables: Variables created by the user in the routine.

IO Input Variables: Access to each of the 16 24VDC inputs, 0 if off 1 if on.

Gripper State: For supported grippers, inputs based on current state, for example closed or open.

Space: Data set in the space, such as saved positions.

Note: If you are using a variable, you must add it using the "Fx expressions" button and then go to the three dots icon to find what variable you want to use (custom variables made will be found in "Environment Variables"). Do not manually type it in. Manually typing the variable will not include the correct prefix and will result in an error.

Here is an example of how to "add 1" to the value of a variable:

- 1. select the "set variable" step
- 2. select the variable you wish to add to (this example uses a variable named "index")

Choose the variable	
Variable	index 🗘
New value	\odot
Value is required	

3. select the three dots icon and click "environmental variables".

Variable	index	$\hat{}$
New value		
Value is required	Expressions Reference	()
The variable must first be created in your routine's environment	Step Variables	:=
	Environment Variables	[×
	IO Input Variables	
	Equipment	88
	Space	(0)

- 4. Then select the variable you wish to change, it should automatically appear in the value bar. Notice how it's shown as "Environment_...", typing in the name of your variable into the bar will not work.
- 5. Then put "+1" in the value bar.

Choose the variable			
Variable		index 🗘	
New value	Environment_index +1	\odot	
The variable must first be created in your routine's environment			

6. Now every time the routine gets to this step, the value of "index" will increase by one.

This doesn't have to be only for addition, other math functions can be done as well.

5.7.2 Javascript

The Standard Bots routine editor provides the necessary instructions that address the requirements for the majority of applications. Should you need to to incorporate more advanced functions, the routine editor allows you to write your own JavaScript into Loops, Add Offsets, Move Arm steps, and more.

Expressions Reference ×
How to use Expressions
Expressions allow you to dynamically define data based on the variables present in
your routine. Expressions support any expression from the JavaScript language,
which can be used to construct mathematical expressions, access lists of values, or
create values based on conditions.
Examples include:
loopCount * 12 to compute an offset of 12mm per loop count for stacking
<pre>• currentStep == 'left' ? leftPositionList : rightPositionList to use the left</pre>
position list if stacking boxes on the left, and the right one otherwise.
Math.sin(angle) * armLength to calculate the z offset along a circular path.
 positionList[loopCount] to access the entry in a position list corresponding to the loop
• positionList[0] to access the first step in a position list (lists in JavaScript start with 0).

You can access the above help menu by clicking "Fx" in any text window in the routine editor and selecting "Expressions Reference".

Loop		
Description		
Perform steps repeatedly		
Loop forever		
Loop specific number of times		
Use rules	~	
If fx Expression	×	
Environment_step4CurrentIteration < Environment_environment	tP ⊡	
+ And + Or		
Main Loop		
Automatically assign main loop	\checkmark	
Manually assign main loop		
Choose one loop in the routine to be the main loop. This loop will be used when counting the routine cycles.		
Automatic defaults to the outermost loop in your routine. Manual overrides the default mai assignment.	n loop	

In the above example, this loop will iterate until the loop has iterated more than the value set in an environmental variable, partsPerRow. After the loop has iterated more times than the value of partsPerRow, the routine will move to the next step after what is contained in this loop.

Loop			Lo	ор	
Description		D	Description		
Perform steps repeatedly		P	Perform steps repeatedly		
Loop forever		Lo	oop forever		
Loop specific number of times		Lo	oop specific number of times		
Use rules	~	U	Jse rules		\checkmark
If $f \times$ Expression	×	If	f fx Expression		×
Environment_environmentBoxCountOnPallet <= 16 && Environment_	\odot		tOnPallet <= 16 && Environment_en	vironmentBoxCountOnPallet > 8	\odot
+ And + Or			+ And	+ Or	
Main Loop					
			fain Loop		
Automatically assign main loop	~	A	utomatically assign main loop		~
Manually assign main loop		M	1anually assign main loop		
Choose one loop in the routine to be the main loop. This loop will be used when counting the routin cycles.	ne		hoose one loop in the routine to be the main loop. ycles.	This loop will be used when counting the routin	e
Automatic defaults to the outermost loop in your routine. Manual overrides the default main loop assignment.			utomatic defaults to the outermost loop in your rou ssignment.	tine. Manual overrides the default main loop	

In the above example, the code is checking if a variable boxCountOnPallet is less than or equal to 16 but more than 8. If the above condition is true, whatever is indented below the If statement in the routine will execute.

Some Examples of JavaScript Code are Below:

Command	Description
>	Greater Than

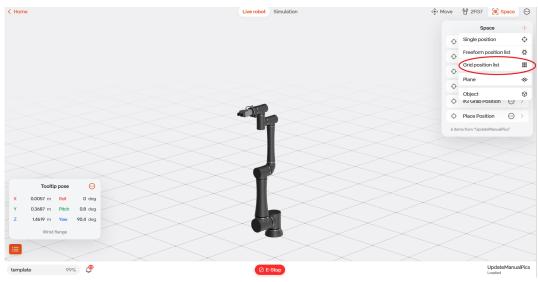
Command	Description	
<	Less Than	
>=	Greater Than or Equal To	
<=	Less Than or Equal To	
==	Equal To	
===	Strictly Equal To	
!=	Not Equal To	
!==	Strictly Not Equal To	

Basic Math Symbols Apply "+" for Addition, "-" for Subtraction, "*" for Multiplication, and "/" for Division.

Programming Example: We want to wait for Variable 1 to equal 18. That would be created in a If Fx Expression as follows: Environment_variable1 == 18 where Environment_variable1 is Variable 1 and we are waiting for it to be equal to 18 to continue the program.

5.7.3 Grid Position Lists

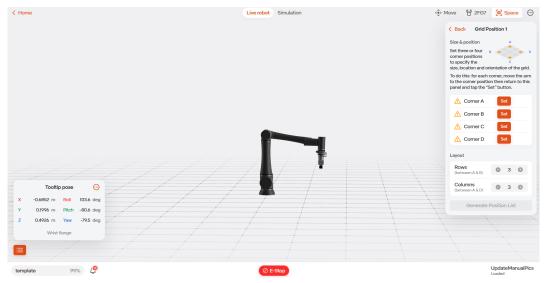
Grids are often used in robot programming when a large number of parts needs to be processed by a robot. Using the Grid Position List functionality when creating a routine can save significant time and effort.



To create a grid, go to the Move Robot area, go to the Space (square icon), select the Plus icon, and then select Grid Position List.

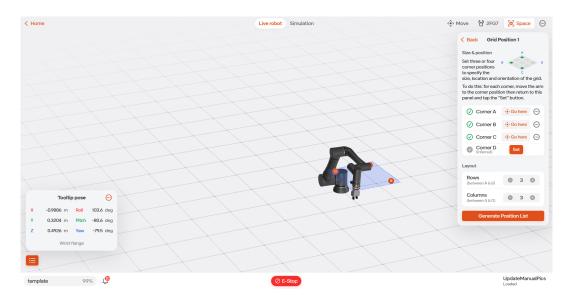
< Back	New item	
Name		
Description		
	Create	

Give a name to the Grid Position List.

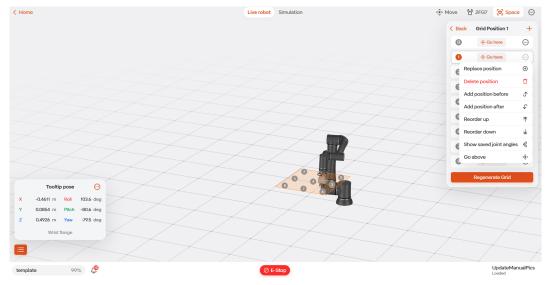


To create the grid, first drive the robot to a corner of the grid using the Jog Robot functionality in the Move Robot view. Set the position. Repeat for 3 corners of the grid.

Under Layout, select the number of rows and columns in the grid. This will be the layout of the parts within the grid.







After the grid is generated, you can go to the positions using "Go Here", tune them by using "Replace Position" (hidden behind the three dot icon), or exit.

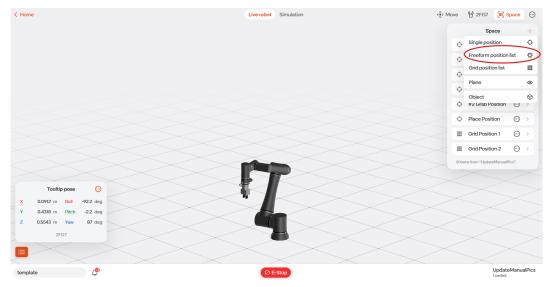
paatemanuaiPics		-		Move arm	
Description			Description		
Space	Variables		Move arm to the next positio	on in Grid Position 1	
Position1	+ Add variable				
Pick Position			Target		
🗘 Grab Position			<ê>	[0]	f×
🗘 #2 Pick Position			Manual	From space	Expression
#2 Grab Position			Target		Grid Position 1 🕻
Place Position			Position Space defines positions and objects	around the robot that can be	Cycle through list <
Grid Position 1					
[@] Manage space				[a] Manage space	
Steps		Variables: Off	Match joint angles specified		
. Move arm to manually specified position			The robot will match the exact joint a	angles in the position.	
2. Loop forever		⊙ >	Path		
3. Move arm to the next position in Grid Position 1		\odot >	Move in a straight line		C
4. Move arm to manually specified position		⊖ >	Reduce motion smoothing (D	C
+ Add Step			Motion speed		100% of robot r
emplate 99% 🚇		Ø E-Stop			D Play

To use the grid, use a Move Arm command within a loop and select the grid within the "From Space" option. The robot will move to the positions in the grid, in order, each time the loop executes.

To program a grid with multiple layers, use an "Add Offset" to set an offset to the grid positions based on the number of times the loop has executed.

5.7.4 Freeform Position Lists

A Freeform Position List is a list of positions in an array. This can be useful when programming if you need to go to positions in order in a loop that are not in a grid, or indirectly address positions.



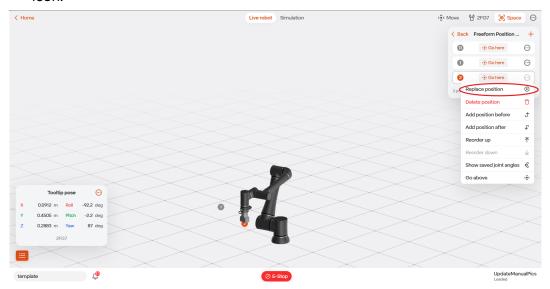
To create a Freeform Position List, go to the Move Robot area, go to the space (square icon), select the Plus icon, and then select Freeform Position List.

< Back	New item	
Name		
Description		
	Create	

Give the position list a name.

< Home	Live robot Simulation	<:> Move	업 2FG7 🛛 👩 Sp	ace 💮
		< Bac	k Freeform Position	h (+)
		0	🕀 Go here	
		0	🛞 Go here	\odot
		0	Go here	\odot
		3 positi	ons	
	\rightarrow			
		\sim		
Tooltip pose 😳		>		
X 0.0912 m Roll -92.2 deg		\searrow	\sim	<
Y 0.4506 m Pitch -2.2 deg Z 0.2883 m Yaw 87 deg		$\langle \rangle$		><
2FG7	\times	>	>	
		\sim	\sim	
		<	\sim	
template 🖉	⊘ E-Stop		Update! Loaded	/lanualPics

You can now drive to your first position using the Jog Robot functionality in the Move Robot view. Set the position. Repeat for the number of positions needed. Create the next position in the list using the "+" icon.



You can touch up the positions using "Go Here" and "Replace" (which is hidden behind the three dots icon). Once finished simply exit.

Move arm				
Description				
Move arm to the next positi	on in Freeform Position Li	ists 1		
Target				
< ê> Manual	්හ] From space	f x Expression		
Target	😵 Fr	eeform Position Lists 1 🗇		
Position		Cycle through list 🗇		
Space defines positions and object	is around the robot that can be re	eferenced across steps.		
	🕑 Manage space			
Match joint angles specified	ł			
The robot will match the exact joint angles in the position.				
Path				
Move in a straight line				
Reduce motion smoothing (i)				
Motion speed		100% of robot max		

To go to the positions in order, use a Move Arm command and select the list from the Space.

	Move arm	
Description		
Move arm based on expres [Evironment_index]	sion Space_freeformPosition	nLists1
Target		
<:>> Manual	[හි] From space	f x Expression
Space_freeformPosition	nLists1 [Evironment_index	
Expressions allow the robot to dyna using math.	amically determine the position to m	ove to, referencing variables and
Match joint angles specified	E	
The robot will match the exact join Path	t angles in the position.	
Move in a straight line		
Reduce motion smoothing	0	
Motion speed		100% of robot max
	© Edit motion limits	

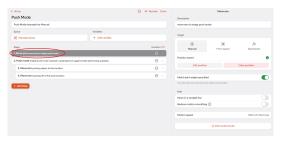
To access positions in the list not in order, use the "Expressions" option as shown. In this example we are going to the position in the list based off the environmental variable "index".

5.7.5 Push Mode

Push Mode allows you to perform actions while the robot is pushing against an object. The first move arm step will have the robot push against an object until the custom force requirement was reached. That step is finished once the force requirement is reached. Then the next step would be moving the robot away from the object. The steps are performed without the collision detection, allowing the robot to detect the needed amount of force.

Here is an example of implementing Push Mode into a routine:

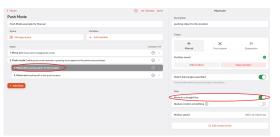
Step 1 in this example is used to move the robot into the initial position to push the object.



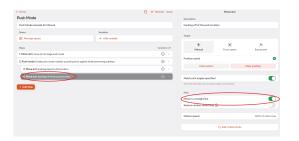
Step 2 in this example is enabling the push mode. Set the required amount of force for the robot to stop.



Step 3 in this example is the robot pushing the object to it's final position. The robot will stop when it detects the selected force percentage. It is required that "move in a straight line" is selected for this step to work.



Step 4 in this example is the robot arm backing away from the object. This step is done still under Push Mode because Push Mode turns off collision detection. Once the routine is out of Push Mode, collision detection is back on and if the robot is still pushed against the object an error will happen. "Move in a straight line" will still need to be selected for this step.



Once the robot is backed away from the pushed object, the steps after can leave Push Mode.

5.7.6 Machine Tending Application

Introduction:

Standard Bots offers machine tending solutions by the ability to add a CNC machine into your robot's equipment. If you are using a Haas machine and are interested in using the Haas Ethernet Integration system, go to chapter 5.7.6.

Required components:

- Vices/vice adapters
- Robot end effector
- conveyors/feeders (if needed)
- loading/unloading stations
- Safety devices (if needed)
 - Area scanners
 - Light curtains and mirrors
 - Safety rate start buttons
 - Fence interlocks

Integrating CNC Machine:

To add the CNC machine into your robot's equipment, tap on the robot's name at the lower left corner of the screen, tap the tab that's labeled Equipment, then in the equipment tab press the orange plus icon in the upper right. Here you will see the list of the different CNC machines (general lathe, general mill, Haas lathe, Haas mill).

Done	Equipment		(+)	
OnRobot 2FG7		Gripper		ሤ
		Built-in Wrist Camera		Ø
		CN	C Machine	卤
		Gŧ	Generic Lathe	ដ
			Generic Mill	白
			Haas Lathe	រា
			Haas Mill	卤

If you are using a generic lathe or mill, select the desired one. Once doing so you will be brought to the generals page. On the generals page you will be able to name your equipment, enable/disable your equipment, and add Modbus TCP and Haas NGC if desired.

< Back	CNC Machine	💮 Save
General	Cycle Control Door	Workholding
Name	Generic Lathe	8
Enabled		
	+ Add interface	
	Modbus TCP	
	Haas NGC	

You can then select Cycle Control which can be seen on the top of the page. To tend a machine, the robot requires the ability to start the machine and to know when the machine is finished.

If the machine and the robot cannot be connected directly, these tasks can be accomplished by manually pushing buttons and by reading screens/lights with the robot's camera.

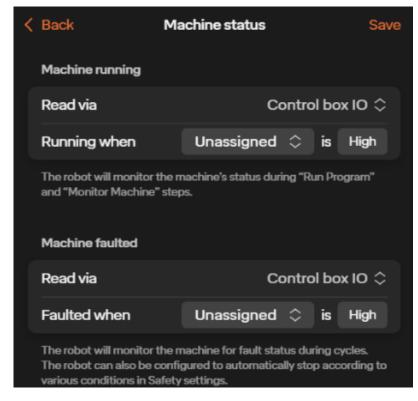
In the Cycle Control page you will see Start cycle and Machine status.

< Back	CNC Machine		\odot	Save
General	Cycle Control	Door	Workhol	ding
Cycle cont	rol			
+ Start	cycle	Note	configured	\rightarrow
+ Mach	nine status	Note	configured	\rightarrow

In the Start cycle page you will be able to choose which output or relay is used to start the machine's cycle as well as if it goes high or low. You will be able to choose whether the output is set or if it is just a pulse. If pulse time is chosen you will also be able to choose the length of the pulse time. At the bottom of the page you can test the start cycle as well as add more outputs if needed. Make sure to save any changes in the upper right

K Back	Sta	rt cycle		Save
Action				Start cycle
Control vi	a		Control	box IO 🗘
Pulse	Unassigned	≎ to	High	×
Pulse time	e			0. sec
A	dd output		Test Start (cycle

In the Machine status page you can set the inputs for machine running as well as machine faulting. For machine running, the robot will have assigned inputs which will monitor the machine's status during its routine. For machine faulted, the robot can have assigned inputs which will monitor the machine for a fault status.



You can then backout and select the Door icon which can be seen on the top of the page next to Cycle control. Here you can set outputs which can control the opening and closing of the machine's door. You will be able to choose whether the output is set or if it is just a pulse. At the bottom of the page you can add more actions if needed.

< Back	CNC Machi	ine	💮 Save
General Cycle	Control	Door	Workholding
Name	Autodoor		8
Action			Open 🗘
Control via		Control	box IO 🗘
Pulse Unass	igned 🗘	to High	×
Pulse time			0. sec
Add output	Test Open		Delete
Action			Close 🗘
Control via		Control	box IO 🗘
Pulse Unass	igned 🗘	to High	×
Pulse time			0. sec
Add output	Test Close		Delete
	+ Add actio	n	

Next, in the Workholding page, you can set workholding equipment in your machine which the robot can send outputs to. At the bottom of the page you can add more workholding equipment if needed.

<	Back	CNC Machine		💮 Save
	General	Cycle Control	Door	Workholding
	Workholdin	g		
	🕀 Chuck	c#1	Not co	onfigured >
		devices like vises, chu and used across routir		cks can be
		+ Add worl	kholding	

The actions for the workholding equipment are separated into Clamp and Unclamp. For each one you are able to choose the output from the control box, its state, and whether that state is a pulse or if it's set. You are able to add more outputs to each action if needed. At the bottom of the page you can add more actions if desired.

< Back	Workholding	Save
Name	Chuck #1	8
Action		Clamp 🗘
Control via	C	ontrol box IO 🗘
Pulse Unassi	igned 🗘 to	High ×
Pulse time		0. sec
Add output	Test Clamp	Delete
Action		Unclamp 🗘
Control via	C	ontrol box IO 🗘
Pulse Unassi	igned 🗘 to	High ×
Pulse time		0. sec
Add output	Test Unclamp	Delete
	+ Add action	

When done, make sure to save your machine. Your machine will now be shown in the equipment tab. To make any new changes to it, simply click on your machine's name.

Done	Equipment	+
Generic Generic Lathe		>
OnRobot 2FG7		• >

Accessing CNC Machine:

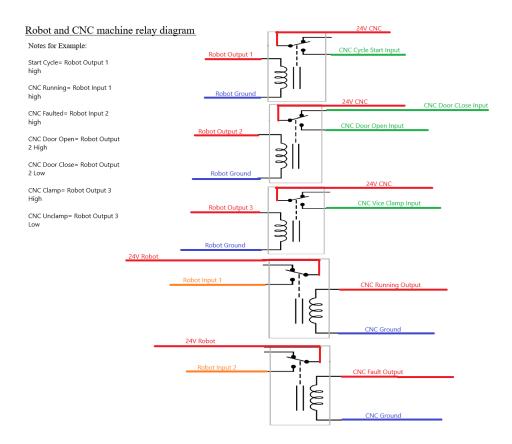
Once your machine is added to your equipment list, you are able to access it on your move robot page. Once there, go to the three dots icon in the upper right corner of the page and select your machine. Here you can see the status of your machine, as well as the ability to start the cycle, open and close the doors, and open and close your workholding equipment.

<. Move	🖌 Gripper	[අ] Space	\odot
	Generi	c Lathe	
	Status		
	Unki	nown	
	Cycle control		
	Start cycle		
	Autodoor		
	Open	Close	
	Chuck #1		
	Clamp	Unclamp	

Wiring Your Robot Control Box to a Generic CNC Machine:

If you are using a generic CNC machine then you will have to hard wire your robot's control box to your CNC machine. This will be done by utilizing your control box's and CNC's inputs and outputs. And due to both machines being on separate commons you will need the use of relays in order for them to successfully communicate with each other.

Here is an example of how to connect you robot's control box to your CNC machine with the use of relays:



Creating a Routine- Generic CNC Machine:

In the routine editor page you can find tasks that are made for a machine tending routine. These steps are: Monitor Machine, Operate Autodoor, Run Program, and Operate Workholding.

Interface with other devices Set I/O output Monitor machine Designate a section of the Sets the robot's I/O interface, allowing it to send messages routine as controlling a CNC to external devices machine Operate autodoor Operate workholding Operate the autodoor on a Operate the vise, chuck or CNC machine other workholding on a CNC machine Monitor Haas machine Run program Specify a section of the Run a program on a CNC routine as controlling a Haas machine machine accessible over Ethernet, being interrupted by errors from the device and sending a Cell Safe command Press button Run Haas program Allows the robot to press a Run a program on a Haas button on a machine, e.g. to device connected over start the next CNC cycle Ethernet

For the Monitor Machine step, you are able to choose the machine you created earlier. You dedicate this section of the routine to controlling your machine.

Monitor machine	
Description	
Designate a section of the routine as controlling a CNC mach	ine
Machine	Generic Lathe \diamondsuit
This step designates a section of the routine as controlling the machine.	

For the Operate Autodoor step, you can select the machine, as well as choose the action you want to perform with the door (open or close).

Operate autodoor	
Description	
Operate the autodoor on a CNC machine	
Machine	Generic Lathe 🗘
Action	Open 🗘

For the Operate Workholding step, you can select the machine, the workholding piece, as well as choose the action you want to perform with the workholding equipment (clamp or unclamp).

Operate workholding	
Description	
Operate the vise, chuck or other workholding on a CNC	machine
Machine	Generic Lathe 🗘
Workholding	Chuck #1 🗘
Action	Clamp 🗘

For the Run Program step, you are able to select your machine that you wish to run. You are also able to choose whether you want the robot's routine to pause until the machine is done.

Run program	
Description	
Run a program on a CNC machine	
Machine	Generic Lathe \diamondsuit
The action is not fully configured.	
Wait until complete	

Creating a Routine- Haas Machine:

There are also Haas specific steps you can use if you are using a Haas machine. These steps are Monitor Haas Machine and Run Haas Program.

The Monitor Haas Machine step specifies a section of the routine to control the Haas machine. Here you have to enter the ethernet endpoint for the Haas. Here you can also choose whether you want Cell Safe on and if you'd rather use RS232 serial instead of ethernet.

Monitor Haas machine
Description
Specify a section of the routine as controlling a Haas machine accessible over Ethernet, being interrupted by errors from the device and sending a Cell Safe command
Address
Address not specified Enter the ethernet endpoint over which the Haas device is accessible, e.g. http://192.168.1.50.5551. The haas-ip can be found in "Settings-Network" on the Haas control. The haas-port is the port set for "Machine Data Collection Port" (setting 148).
Cell safe
Send Haas cell safe signal when running nested steps. This allows the robot to control the Haas even when the door is open. For example, to open the door or open/close the chuck.
Use RS232 serial instead of ethernet

The Run Haas Program step runs a program on the Haas machine that's connected over ethernet. Here you will have to enter the program name for the Haas to call (ex: 900.nc). You will also have to once again enter the ethernet endpoint for the Haas. You can choose if you want Cell Safe on, to wait on this step until the Haas is complete, and if you'd rather use RS232 serial instead of ethernet.

Run Haas program

Description

Run a program on a Haas device connected over Ethernet

Program name

Enter the program name saved on the Haas to run, e.g. "900.nc". The programname must contain numbers only and end in .nc

Address

Address not specified

Enter the ethernet endpoint over which the Haas device is accessible, e.g. http://192.168.1.50.5551. The haas -ip can be found in "Settings>Network" on the Haas control. The haas -port is the port set for "Machine Data Collection Port" (setting 148).

Disable cell safe

Disable cell safe during this program. With cell safe disabled, the program will not run if the doors are open.

Wait until complete

If enabled, this step will not wait until the program is finished running before continuing the routine. If you disable this setting, use some way (such as a Wait step) to wait until the program completes before running a new Haas program.

Use RS232 serial instead of ethernet

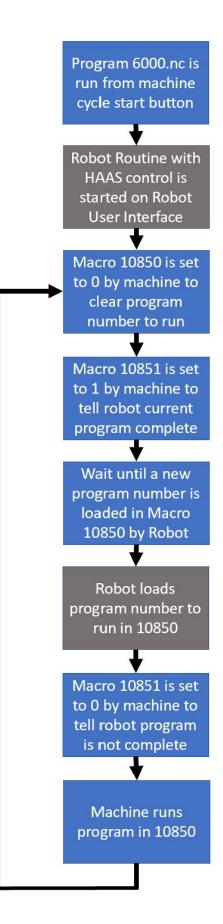
5.8 External IP Communication

5.8.1 Haas Ethernet Integration

Introduction

For Haas machines that support Next Generation control (generally 2017 or newer machines) Standard Bots provides a first-class integration suite that allows for ethernet communication between the Standard Bots robot and Haas machine. This allows for quicker setup and more flexibility with less wiring.

Standard Bots provides a set of sample .nc files to get started with an ethernet Haas integration. The integration works by running a main program on the Haas machine (in the example this program is 6000.nc). It then uses Macros 10850 and 10851 to complete handshaking between the Haas machine and Standard Bots robot as shown below:



Please be sure to review the comments in the sample code. G103 P1 is a required step in the 6000.nc main sample code to ensure the integration that happens through the macros functions correctly. Do not remove this step. If needed, add a G103 P0 as well as several empty lines after to the beginning the machine programs you create to run from the robot (called through macros from 6000.nc) to re-enable lookahead during those programs and ensure the fastest program speed. A P0 will disable block limiting, allowing the machine to look ahead as much as it wants. A number option will limit the number of blocks to look ahead.

Requirements:

- Haas machine with Next Generation control
- Network connection between machines (Either Wireless or Wifi)
- The "Cell Safe" signal must be held high using the "Monitor Haas Routine" step anytime the door is open. If the signal is dropped with the door open the Haas machine will go into Feed Hold and will need to be reset and then cycle start must be hit on the Haas again.
- HAAS sample programs located at: https://docs.google.com/document/d/1HYtyWCjeHh6-LjbQF4H48BQuOi488yxzRS0UnXByHUY/edit?usp=sharing
- Haas Test Schema locate at: https://docs.google.com/document/d/1br955z71rnvLtPXpn5EIDZ-FGeQi1ostgo20YAXcXaY/edit?usp=sharing

Network Configuration:

In order to ensure a reliable solution the network between the robot and Haas machine must be configured correctly. Setting a static address without consulting the router/network configuration can cause duplicate IP addresses and other issues which will result in the robot not being able to run the Haas programs remotely. The Haas machine must have a known set IP address reachable by the robot for the integration to work through power cycles. There are several acceptable methods to setup a network between the robot and Haas machine:

- Configure the Haas machine on a wireless network. The IP address must be set to static on the machine with an address outside of any DHCP range or must be configured to always have the same IP address through the router configuration.
- 2. Configure the Haas machine on a wired network with router. The IP address must be set to static on the machine with an address outside of any DHCP range or must be configured to always have the same IP address through the router configuration. Allow the robot to DHCP through the network router.
- Run a single cable between the robot and Haas machine. The Haas machine must have a static IP address set manually. Contact Standard Bots Support for assistance setting a static IP address on the robot on the same subnet as the Haas machine.

Integration:

- 1. Ensure program numbers 6000.nc-6005.nc are available on the Haas machine.
- 2. Load Standard Bots sample NC files onto the Haas machine.

raphics /ired Connec	Settings		Settings And Graphics					
(ired Connec		Network Notif	ications Rota	ry 🛛 Alias Codes				
	tion	Wireless Connection	Net Share					
Wired Netw	ork Inform	nation						
wired Netw		lation						
Host Name	3	HAASMachine	DHCP Server	r *				
Domain			IP Address	*				
DNS Serve	r	*	Subnet Masl	k *				
Mac Addre	SS		Gateway					
DHCP Enat	oled	OFF	Status	UP				
)			
		NAME			VALUE			
Wired Netwo	ork Enabl	ed		>	On			
Obtain Addr	ess Auto	matically		>	Off			
IP Address								
Subnet Mas								
Default Gat								
DNS Server								

- 3. If using a wired connection, run an ethernet cable from the Ro1 cabinet to the Haas machine cabinet. The ethernet port on the Ro1 box is on the underside of the IO connection points in the box. The ethernet port on the Haas for Machine Data Collect is usually on the upper left when looking at the back of it. To get to the ethernet settings on the Haas navigate to Settings->Network->Wired/Wireless Connection.
- 4. Set the Haas machine up to communicate with the robot. The robot and Haas machine must be on the same subnet (3rd set of numbers in IP address) and be on the same wireless or wired network to communicate with each other. To ensure Haas can talk to the robot even through a power cycle the Haas must be set to a static IP address (no DHCP) or have network provisions made to ensure it is always the same IP address.
- 5. Enable machine data collect on the Haas (settings 143) and set the port to 5551.
- 6. If you are using a wired connection without DHCP, use the Standard Bots tablet application to set the IP address. You may need to log out of the User Interface by going to robot name menu in the bottom left then selecting Logout.
- 7. Load the sample "haas test" program provided by Standard Bots into the routine editor by going to Actions-> Edit Routine Schema and pasting the contents of the text file in. Then select "Create

Routine".

← Step: Monitor Haas Machin	ne: so the robot can control the machine with the door 😢 Emergency Site		≦ ^C craig-remote	▶ Play	۵.
1. Monitor Haas Machine so the robot can control the	Monitor Haas Machine CRLL SAFE Send Haas Cell Safe signal while running nested steps. This allows the robot to Use RS232 Serial instead of Ethernet	ontrol the Haas (for example, to open the doc	or or open/close the chuck) even when	n the door is open.	
	ADDRESS Enter the determet endpoint over which the Haas device is accessible in the format http://haas-phi The haas-ip can be found in "settings-metwork" on the Haas control, and the haas-port is the port e http://192.168.215.175.5551		.50:5551		

- 8. Edit the first step of the sample routine. Leave the "Send Haas Cell Safe" button checked. This allows the robot to run routines with the door open, which is often required (IE, when you need to close the door).
- Update the IP address of the Monitor Haas Machine step to match the IP address of the Haas. Ensure the port remains at the end of the address. The format is: http://xxx.xxx.xxx.xxx.port . I.e., http://192.168.215.175:5551. Save the step.
- 10. Go back and edit Step 4, Run Haas Program.

← Step: Run Haas Program: t	o run the Haas test program (2020)	C Emergency Stop	$2^{\rm C}_{\odot}$ craig-remote	Y Play	≡ •
4. Run Haas Program to run the Haas test program	Run Haas Program Enter the step description to run the Haas test program (2020)				
	WAIT UNTIL COMPLETE	programs to run at full speed when the machine door is closed.	oox, you should use some other way (s	such as a Wait step) to	o wait
«		the format http://haas-jophaas-port, for example you might enter http://102.1 d the haas-port is the port set for "Machine Data Collection Port" (setting 148		Sa	ve Changes

- 11. The "haas test" program will attempt to run 2020.nc. In many Haas machines, this is the spindle warmup program. If needed, change this program number to a different program under "Program Name".
- 12. Leave "Wait until Complete" checked. This will ensure the routine stays at the current step until the Haas has completed the program sent above under "Program Name".
- 13. Update the IP address of the Monitor Haas Machine step to match the IP address of the Haas. Ensure the port remains at the end of the address. The format is: http://xxx.xxx.xxx.xxx.port . l.e., http://192.168.215.175:5551. Do not use 127.0.0.1 as that is the default loopback address. Save the step.
- 14. Start program 6000.nc on the Haas using the standard cycle start button on the Haas.

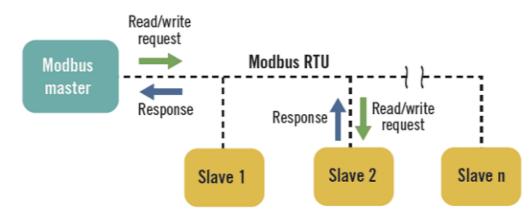
- 15. Start the sample program on the robot by running the routine.
- 16. The spindle warmup program (or alternative program chosen above) should now run. If it does not work verify the 10850 macro variable on the Haas is updating to the program number you put in the Run Haas Program step. If it is not, verify communication between robot and machine. The Haas machine must be running the 6000.ns]c program with no errors first, then you must start the robot program.

5.8.2 Modbus

One way for the robot to communicate with other devices is through Modbus, one of the oldest and most widely used communication protocols in industrial settings. Modbus provides a common language that enables different devices to communicate with each other (such as an Allen Bradley PLC talking to a Siemens PLC), allowing devices from different manufacturers to work together. A Modbus Controller initiates communication and manages the data exchange between the compatible devices.

Modbus can operate over various physical layers, including serial communication methods like RS-232, RS-485, and RS-422, as well as Ethernet. Modbus TCP allows Modbus communication to occur over TCP/IP networks, enabling it to coexist alongside other Ethernet protocols.

Modbus can be used to send commands to the Robot, which would allow the Robot to integrate into the automation system. Modbus uses master-slave architecture for communication. In this setup, the Modbus Controller sends requests to the slave devices (such as the Robot) and manages the communication flow. Each slave device responds to requests from the Controller, allowing for data exchange. This architecture simplifies the network.



5.8.3 Setting up Modbus

Utilize the following steps to setup Modbus.

Step1) To setup Modbus communication with your RO1 click on the menu in the bottom left corner and select equipment.

Log out		
	Home	
	Routines © Recent Machine_Tend Updated Jan 07 Londed	100.00%
Speed 100% Equipment BB I/O manager C3	Machine_Tend No g	(0) Iripper Equipment
Edit routine / Play routine in visualizer > Settings ③ Brake robot ①		
template	Ø E-Stop	Machine_Tend Loaded

Step 2) Click on add equipment, generic I/O, Modbus TCP Server.

Log out		
Home	Done Equipment	
Routines (© Recen		100.00%
Machine_Tend Updated Jan 07	Ĩ.	
	88	
	No equipment configured	
	M Gripper I d Detv Sbot Generic I/O O	
	Custom IO Device 🛞	
	Modbus TCP Server 🙄	
+ New	n Equipmer	
	< * *	
template 🖉	⊘ E-Stop	Machine_Tend

Step 3) Provide a Name for the Modbus TCP Server, IP Address, Port #, and Timeout.

Note: For this demonstration we will be using an IP address of 192.168.10.24, Port 502, as well as a 10 second timeout. This will vary based on your application.

Log out								
	Home	< Back	Modbus TCP Server		Save			
		Name	Modbus TCP Ser	rver	0		_	
	Routines (© Recen	Enabled			D		100.00%	
	Machine_Tend Updated Jan 09	IP address	192.16	58.10.24		1 Mills		
	DEMO 3 Updated Jan 03	Port	5	502				
		Timeout	•	10 s	sec			
	_	Fields (0)						
			+ Add field			©	(C)	
						gripper		
	+ New				1	n Equipment		
					- 1			
					- 1			
template 🔮			⊘ E-Stop					DEMO 3

Step 4) Click on add field and select the field type you would like to use. You can choose from the following types: Holding Register, Input Register, Status Coil, or Input Coil.

Log out					
	Home	K Back Modbus	TCP Server 💮 Save		
		Name Mod	bus TCP Server		
	Routines © Recen	Enabled		100.00%	
	Machine_Tend Updated Jan 09				
	DEMON	IP address		-	
	Updated Jan 03	Port	502		
		limeout	10 sec		
		Fields (1)			
		Name		@	
		Туре	Holding register 💲		
		Offset	✓ Holding register	ipper	
		Format	Input register		
	+ New	Re	move Status coil	Equipment	
			Input coil		
		+ A	dd field		
template 🕼		0	E-Stop		DEMO 3 Loaded

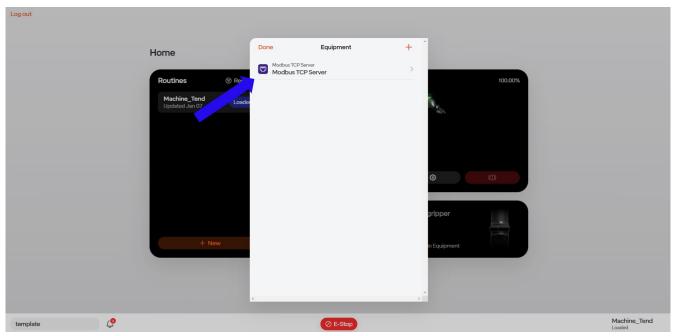
Note: For this demonstration we will be using a Holding Register.

Step 5) Provide a name for your field. When complete click save in the top right corner.Note: For this demonstration we will be naming the Field HR1 as we will be setting up a holding register. The offset will also remain zero for this demonstration.

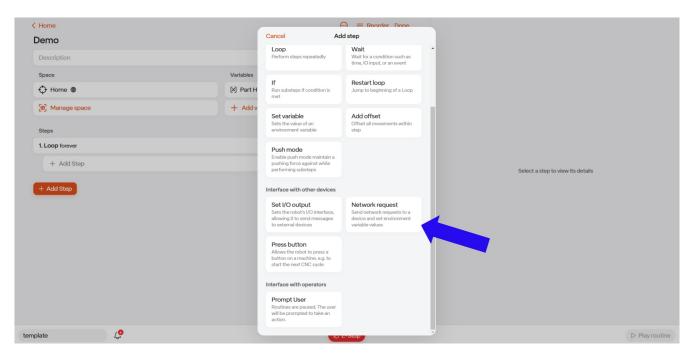
Home
Name Modbus TCP Server
Routines © Recen Enabled
Machine_Tend Updated Jan 09 IP address 192.168.10.24
DEMO 3 Loade Port 502
Timeout © 10 sec
Fields (1)
Name HR1
Type Holding register ≎
Offset 0 gripper
Format UInt16BE
+ New Remove n Equipment
+ Add field
с

Note: To add additional fields repeat steps 4 & 5 as desired.

Step 6) Once you have selected save you should see your modbus tcp server added to the equipment list.



Step 7) Once you have added a Modbus TCP Server to your equipment you can now utilize it in a routine. Open up the routine and add a new step. Select "Network Request".



Step 8) Select which Modbus server you would like to use.

Note: For this demonstration only one modbus server has been set up.

< Home	\odot \equiv Reorder Done	Network request	
test		Description	
Description		Network request to set to 0	
Space	Variables		
↔ Home ⊕	+ Add variable	Server Select a Modbus Server	\$
(a) Manage space			~
		Modbus TCP Server	
Steps	Variables: Off		
1. Loop forever	Θ >		
2. Network request to set to 0	$\mathbb{A} \hspace{.1in} \Theta \hspace{.1in} \hspace{.1in} \rangle$		
+ Add Step			
T Add Step			
		· · · · · · · · · · · · · · · · · · ·	
template 🕼	Ø E-Stop		▷ Play routine

Step 9) Select the type of Modbus function you would like to request. The user can select either Read holding register or write single register.

Note: For demonstration purposes we will be selecting "Write Single Register".

Step 10) Select what field you would like to write to, and what value you would like to write.

Note: HR1 was selected this was setup in step 4 & 5 We will be writing a value of 0 to HR1. This will be used to tell the external device that we are done with a particular step.

< Home	\bigcirc \equiv Reorder Done	Network request	
test		Description	
Description		Network request to set HR1 to 0	
Space	Variables	-	
🗘 Home 📾	+ Add variable	Server Modbus TCP Server	\$
ູ່ Manage space		Modbus for Server	~
Steps	Variables: Off	Request	
1. Loop forever		Modbus Function	Write Single Register 🗘
2. Network request to set HRI to 0	⊕ →]	Write Field Value	HR1 🗘
+ Add Step			
template (⊘ E-Stop		▷ Play routine

Step 11) Next we will repeat steps 7,8,&9 however this time we will setup a read holding register request. Our read field will be HR1 and we will want this to be sent to our "Receive In" variable.

Note: See Creating a Global Variable section for setting up variables.

Home		💮 🗸 Reorder Done	Netw	ork request
est			Description	
Description			Network request to save HR1 to variab	le Receive In
Space	Variables			
🗘 Home 🏽	[x] Receive In	/ 🖬	Server Modbus TCP Server	
🙆 Manage space	+ Add variable		Modbus TCP Server	
			Request	
Steps == 1. Loop forever		Variables: Off	Modbus Function	Read Holding Regist
= 2. Network request to set HR1 to 0			Read Field	ł
■ 3. Network request to save HR1 to variable Receive In		\odot >	To Variable	Receive
+ Add Step				
late 🖉		Ø E-Stop		⊳ Pla

5.8.4 Modbus Routine Examples

Reading from a Register Example

Note: This example demonstrates how Modbus can be employed to read a value from a single register and assign that data to a variable within the routine for subsequent use or decision-making. This approach proves beneficial later in the routine, as the value of the "vice status" variable can be leveraged to inform critical decisions.

Summary: Step 24 illustrates the process of reading the holding register, h1, following the closure of the vice in Step 22. The retrieved value is subsequently assigned to the Vice Status variable, as highlighted in Figure 1. *Note: Vice status variable was setup prior to adding the network request step.*

	U	^ Network request
12. Move arm Pick position	\odot >	Description
3. Move arm Move to pick position	\odot >	Network request to save h1 to variable Vise Status
4. Actuate gripper to grasp object	\odot >	
5. Add offset Above pick	\odot >	Server
16. Move arm to the next position in Machine tending grid	\odot >	Modbus TCP Server
7. Move arm Move to Outside Machine	\odot >	Request
3. Wait Wait for Door Open	\odot >	Modbus Function Read Holding Registers 🗘
9. Add offset Move above vice	\odot >	Read Field h1 🗇
20. Move arm Vise position	\odot >	To Variable Vise Status 🗘
1. Move arm Vise Position	\odot >	
2. Network request Close vise	\odot >	
3. Wait for a second	\odot >	
1. Network request to save h1 to variable Vise Status	\odot >	
5. Wait Wait	\odot >	-
26. Actuate gripper Open gripper	\odot >	
27. Add offset Move above vise	\odot >	

The retrieved value is then utilized in Step 31, in which the program is looking for the CNC Machine Door and Vice to be closed before continuing. For purposes of this example the value of 34 is used to indicate the vice is closed. This can be seen in Figure 2.

28. Move arm Vise position	\odot >	w	/ait
29. Move arm to OutsideMachine	\odot >	Description	
30. Set I/O output Close Door	\odot >	Wait for Door and Vice to be Closed	
31. Wait Wait for Door and Vice to be Closed	\odot >	Time	
32. Network request to set h1 to 320		Condition	
33. Wait for a second	\odot >	Pause robot until time has passed or condition is me	et.
34. Network request to set h1 to 64	\odot >	If IN 4 Door is Close	
35. Wait for 10 seconds	\odot >	is H High Current Value: Low	
36. Set I/O output Close Door to Low, Open Door to High	\odot >	and <i>f</i> × Expression	
37. Wait Wait for a condition such as time, IO input, or an event	\odot >	Environment_viseStatus==34	
38. Move arm to CleanStart	\odot >	+ And	+ Or
39. Network request Start blow off	\odot >		
40, Move arm CleanEnd	3 50% 💮 >		
41. Network request Stop blowoff	\odot >		
42. Add offset Above vise	\odot >		
43. Move arm to In vise	\odot >		
44. Move arm In vice	\odot >	*	

Writing to a Register Example

Note: This example illustrates a machine tending application, where Modbus is utilized to write a value to a single register for controlling an air blow-off nozzle mounted on the end effector. The primary function of the blow-off tool is to remove any debris from the part before the robot proceeds to pick up the finished component.

Summary: Steps 38-41 illustrate the process of writing a value to a holding register within a routine. This is clearly highlighted in Figure 1.

33. Wait for a second	\odot	>	Ne	twork request
34. Network request to set h1 to 64	\odot	>	Description	
35. Wait for 10 seconds	\odot	>	Start blow off	
36. Set I/O output Close Door to Low, Open Door to High	\odot	>	Server	
37. Wait Wait for a condition such as time, IO input, or an event	\odot	>	Modbus TCP Server	
38. Move arm to CleanStart	\odot	>	Request	
39. Network request Start blow off	\odot	>	Modbus Function	Write Single Register
40. Move arm CleanEnd	3 20%	\rightarrow	Write Field	h1
41. Network request Stop blowoff	\odot	>	Value	68
42. Add offset Above vise	\odot	>		
43. Move arm to In vise	\odot	>	1	
44. Move arm In vice	\odot	\rightarrow		
45. Actuate gripper to grasp object	\odot	>		
46. Network request to set h1 to 0	\odot	>		
47. Wait for 2 seconds	\odot	>		
48. Add offset Above vice	\odot	>		
49. Move arm to In vise	\odot			

In step 39 a value of 68 is written to the holding register, h1, to turn on the valve for the blow off tool.

This can be seen in Figure 2.

33. Wait for a second	· ● > Network request
4. Network request to set h1 to 64	Description
35. Wait for 10 seconds	Start blow off
36. Set I/O output Close Door to Low, Open Door to High	
37. Wait Wait for a condition such as time, IO input, or an event	↔ Modbus TCP Server
38. Move arm to CleanStart	
39. Network request Start blow off	→ Modbus Function Write Single
10. Move arm CleanEnd	2 sox 💬 >
41. Network request Stop blowoff	⊖ > Value
42. Add offset Above vise	Θ >
43. Move arm to In vise	$\Theta \rightarrow$
44. Move arm In vice	$\Theta \rightarrow$
45. Actuate gripper to grasp object	$\Theta \rightarrow$
46. Network request to set hi to 0	$\Theta \rightarrow$
47. Wait for 2 seconds	$\Theta \rightarrow$
48. Add offset Above vice	$\Theta \rightarrow$
49. Move arm to In vise	\odot \rightarrow \bullet

The robot arm then moves to its end location in step 40.

In step 41 a network request is then made again to shut the valve for the blow off tool off again. This is accomplished by writing a value of 0 to the holding register h1. This can be seen in Figure 3 below.

34. Network request to set h1 to 64 35. Wait for 10 seconds 36. Set I/O output Close Door to Low, Open Door to High	0 0 0		Description	
	\odot			
36. Set I/O output Close Door to Low, Open Door to High		>	Stop blowoff	
		>	Server	
37. Wait Wait for a condition such as time, IO input, or an event	\odot	>	Modbus TCP Server	\$
38. Move arm to CleanStart	\odot	>	Request	
39. Network request Start blow off	\odot	>	Modbus Function	Write Single Register 🗘
40. Move arm CleanEnd	⋧ 50%	>	Write Field	ht 🗘
41. Network request Stop blowoff	\odot	>	Value	0
42. Add offset Above vise	\odot	>		
43. Move arm to In vise	\odot	>		
44. Move arm In vice	\odot	>		
45. Actuate gripper to grasp object	\odot	>		
46. Network request to set hi to 0	\odot	>		
47. Wait for 2 seconds	\odot	>		
48. Add offset Above vice	\odot	>		
49. Move arm to In vise	\odot	> •		

5.9 API

All APIs should be treated as Beta software. While software that is controlling the robot through the API is being developed the robot should be safety guarded as a mistake in the software being developed can result in unexpected motion. Access to the API is granted on a case by case basis. Please contact support@standardbots.com to discuss access to the API.

5.10 Global Space & Variables

5.10.1 Introduction to Global Space Items.

(Note: section was written using software update version main 4608.)

The following section defines and explores use cases for global space items as well as global variable items.

Global Space Items

Global space items allow users the ability to access a saved robot position in space across all routines.

Types of Spaces

- Single Position
- Freeform Position List
- Grid Position List
- Plane
- Object

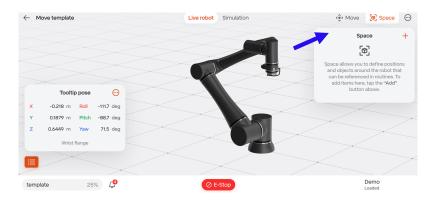
5.10.2 Creating a Global Space

Note: for this example we will be making a single position global.

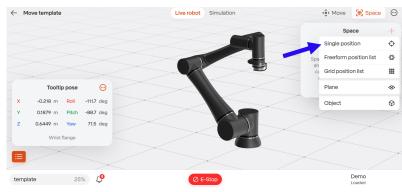
Step 1) In your routine click on "Manage Space"

		-			
< Home		\odot	≡ Reor	rder D	Don
Demo					
Description					
Space	Variables				
Manage space	+ Add variable				
Steps			Va	riables:	Off
1. Loop forever			Δ	\odot	>
+ Add Step					
+ Add Step					

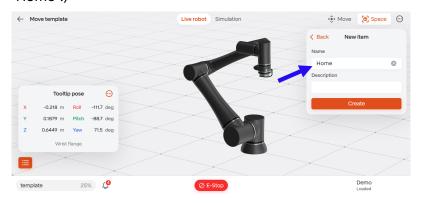
Step 2) Move the robot to the desired position and select "+" from there you will be prompted to choose the type of space you would like to add.



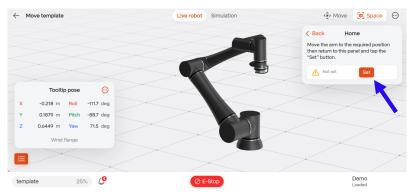
Step 3) Click "Single Position"



Step 4) You will be prompted to name your position. (For this example we will name the position "Home".)



Step 5) After naming the space you will be asked to set its position.

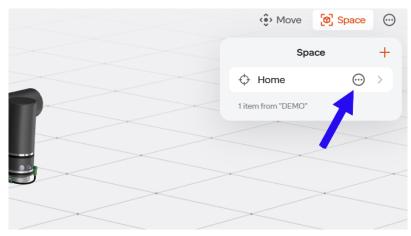


Step 6) Confirm the position was set, indicated by a green check mark that will appear on the left hand

side.

Move template		Live robot Simulation	< Move
			K Back H
			Position saved. To arm to the required to this panel and se position" menu opt
			 Ø %
Tooltip pose	\odot		1
-0.218 m Roll	-111.7 deg		
0.1879 m Pitch	-88.7 deg		
0.6449 m Yaw	71.5 deg		
Wrist flange			
			/

Step 7) Once the space has been set, hit BACK found in the top right corner. This will take you back to the main space menu. Once you have returned to the main space menu, locate the space you would like to make global and click on the options for that space. The options button will be indicated by the ellipsis menu icon.



Step 8) Once in the menu drop down select "Add to Globals" and this space will be able to be accessed across all routines.

\odot	[@] Space	<:> Move
+	ice	Spa
>	$\overline{\cdots}$	\leftrightarrow Home
	/	Rename
	Ū	Delete
	۲	Add to globals
>	ሇ	Anchor to

5.10.3 Creating a Global Variable

Step 1) In an open routine select add variable.

Home			Reorder Done	
Demo 2				
Description				
Space		Variables		
🔶 Home		[x] Part Height Offset	/ 🖸	
GridTableTop		[x] Positioning	/ 🖸	Select a step to view its details
♦ Start_Pos		+ Add variable		
GridTable				
Place in Board				
♦ Place_Pos				
Check Fivture/ Fit				
template 25%	L ¹⁰		E-Stop	▷ Play routine

Step 2) Provide a name and an initial value for your variable.

Note: In this example we are making a part height offset and our initial value will be 1.

lemo 2				
Description				
Space	Variables			
🗘 Home 🏾	Cancel	Variable	Save	
GridTableTop	Name	Part Height Offset	۲	Select a step to view its details
	Initial value	1.	Ø	
GridTable	Global		0	
Place in Board				
Place_Pos				

Step 3) To make this variable global click the switch that is labeled global. This should turn green. Click

Save. < Home Demo 2 Space 🗘 Home Cancel Variable Sa GridTableTop Part Height Offset Name 0 Ø \diamondsuit Start_Pos Initial value 1. Global GridTable Place in Board Place_Pos Check Fixture/ Fit L. template 25%

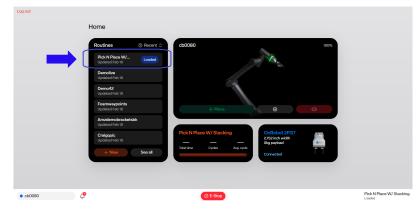
5.11 Exporting/Importing Routines

5.11.1 Introduction

This section provides a detailed guide on exporting and importing routines to and from your robot. These operations can be performed either through the Standard Bots App or by directly accessing the robot via its web address.

5.11.2 Exporting Routines

Step 1: Access the routine you wish to export. In this example, we will be exporting the routine titled "Pick N Place W/Stacking."



Step 2: After opening the routine, locate the "Options" button at the top of the page. Click this button to reveal a drop-down menu.

Wistacking Visitalitie Back Adjustment	ne		0.55	4
Veriables Back Adjuntment Adj veriables a Select a step to view its details a select a step to view its details a select a step to view its details b c select a step to view its details b c c c c c c c c c c c c			edit	
Stack Adjutment	N Place W/ Stacking			
Stack Adjustment + Adj variable a *	cription			
A Strumbble s Select a step to view vis details Select a step to view vis details	ce	Variables		1
s Select a step to view the details to transforme part a north pripper 150 Enver part a nort	Home	Stack Adjustment		
Select a step to view to dotain * Sent Position To forware part is not in gripper	Pick	+ Add variable		
Select a step to view to dotain * Sent Position To forware part is not in gripper	Place			
Valable Start Position © 5 Tio Envore part in not in pipper © 5 Interplate position © 5	Manage space			
start fination O > To Environment in on in pripper O > Co > > alle pick position O > m To Salta position O > alle pick position O > > n'to Salta position O > > n'to Ellick 20000 C >				Select a step to view its details
To finure part in not in gripper O > In the part is not in gripper O > affer pick position O > In to Sube position O > In to Block 298% O >	55			
afe jak position O > The Sele position O > afe jak position O > afe jak position O > The Sele oscillation O > Th	ove arm To Safe Start Position		$\Theta \rightarrow$	
anfersick position Image: Separation	ctuate gripper To Ensure part is not in gripper		$\Theta \rightarrow$	
m To Sub pusition	oop forever		$\Theta \rightarrow$	
afepiskposton O > .	4. Add offset Safe pick position		\odot >	
n Top Block	5. Move arm To Safe position		\odot >	
	6. Add offset Safe pick position		\odot >	
	7. Move arm Top Block		2305 🖂 🔿	
¢ − − − − − − − − − − − − − − − − − − −	0080 🗳		⊘ E-Stop	

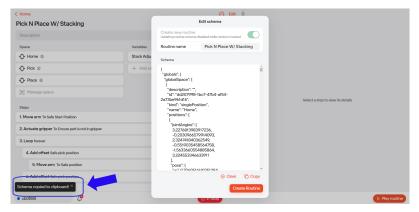
Step 3: From the drop-down menu, select "Schema."

Home Pick N Place W/ Stacking		Schema	5	Edit		
Description		Rename	/			
Space	Variables	Duplicate	0			
♦ Home ©	Stack Adjustment	Convert to template	ß			
∲Pick⊜	+ Add variable	Delete	0			
Place						
(b) Manage space						
iteps			Variable		Select a step to view its details	
Move arm To Safe Start Position				s Off		
2. Actuate gripper To Ensure part is not in gripper			0	~		
3. Loop forever			0	>		
4. Add offset Safe pick position			Θ	>		
5. Move arm To Safe position			Θ	~		
6. Add offset Safe pick position			Θ	<u></u>		
			-			
7. Move arm Top Block		7 30%	0	>		

Step 4: Once the Schema is open, locate and select the "Copy" button. This will copy the Schema text file to your clipboard.

< Home			💬 Edit 📋			
Pick N Place W/ Stacking			Edit schema			
Description		Create new routine Updating routine schem	a disabled while routine is locked	D		
Space	Variables	Routine name	Pick N Place W/ Stacking			
⇔ Home ⊜	Stack Adju	Schema				
♦ Pick ⊕	+ Add va	(i.		
		"globals": ("globalSpace": [
[@] Manage space			-1bc7-47b4-af54-			
Steps		2a73be961d16", "kind": "singleP "name": "Home			Select a step to view its details	
1. Move arm To Safe Start Position		"positions": [
2. Actuate gripper To Ensure part is not in gripper		"jointAngles": 3.227681398 -0.2030966	13917236,			
3. Loop forever		-0.2030988	362549,			
4. Add offset Safe pick position		-1.56336605 3.22455334	54885864,			
5. Move arm To Safe position		1 "pose": (11410251204			
6. Add offset Safe pick position			ⓒ Clear 🖺 Ci	ору		
7. Move arm Top Block			Create Rout	tine		
• cb0080			V) E-Stop			> Play routin

A confirmation message will appear in the lower-left corner of the screen once the selection is made.



At this point, you can paste the text file into any word processing software, allowing you to save and store the file for future use.

5.11.3 Importing Routines

Step 1: From the main dashboard, click the "+ New" button.

Routines	⊚ Recent ≎	cb0080			100%	
Pick N Place W/ Updated Feb 10	Losded			N. K.		
Demolive Updated Feb 10						
Demo42 Updated Feb 10			1			
Foamwaypoints Updated Feb 10			Move		(0)	
Amzdemobrackets Updated Feb 10	bk					
Craigquic Updated Feb 10		Pick N Plac	e W/ Stacking	OnRobot 2FG7 2.752 inch width Okg payload		
+ New	See all	Total time	Cycles Avg.cycle	Connected		

Step 2: Enter a name for your new routine and click "OK." For this demonstration, we will name the routine "Pick Routine."

Routines	© Recent ≎	cb0080		100%	
Pick N Place W/ Updated Feb 10	Loaded		A CONTRACT		
Demolive Updated Feb 10					
Demo42 Updated Feb 10		Name routine Enter a name for this ro	utine.		
Foamwaypoints Updated Feb 10		Pick Routine	 • 	0	
Amzdemobrackets Updated Feb 10	bk	Cancel	OK		
Craigquic Updated Feb 10		Pick N Place W/ Stack	ng OnRobot 2FG3 2752 inch width Okg psyload		
+ New	See all	Total time Cyclos	Avg. cycle Connected		
+ New	See all				

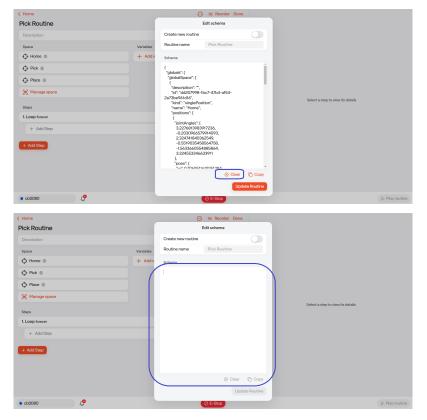
Step 3: With the new routine open, locate the "Options" button at the top of the page. Click this button to display a drop-down menu.

» Routine	_ ⊖		
cription			
0	Variables		
Home 🕀	+ Add variable		
Pick			
Place (1)			
Manage space			
			Select a step to view its details
s		Variables: Off	
op forever		▲ ⊙ >	
+ Add Step			
dd Stop			
		⊘ E-Stop	

Step 4) From the drop-down menu, select "Schema."

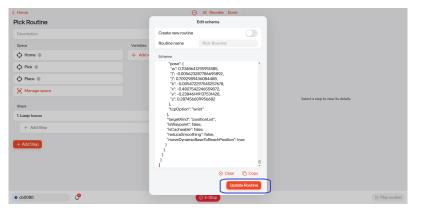
lome		💮 🔳 Reorder Done	
ck Routine	Schema	8	
Description	Rename	/	
ipace	Variat	Ð	
→ Home	+ A Convert to template	D	
⇒ Pick ⊕	Delete	٥	
Place ⊕			
a) Manage space			
teps		Variables: Off	Select a step to view its details
Loop forever		▲ ⊖ >	
+ Add Step			
+ Add Step			
00080 🧳		⊘ E-Stop	

Step 5: When the Schema is open, locate the "Clear" button at the bottom of the popup and select it.



Step 6: After the Schema has been cleared, paste the desired routine into the Schema window and click ${\sf S}$

"Update Routine."



Step 7: After clicking "Create," the routine will be updated, reflecting all spaces, variables, and steps from the imported schema. *Note:* In this example, global variables were used, which is why no visual change was observed.

ick Routine		💮 🔳 Reorder Done	
Description			
Space	Variables	7	
↔ Home ⊕	Stack Adjustment	/ 🖬	
	+ Add variable		
Manage space			
	_		Select a step to view its details
atops		Variables: Off	
1. Move arm To Safe Start Position		Θ >	
2. Actuate gripper To Ensure part is not in gripper		$\Theta \rightarrow$	
3. Loop forever		$\Theta \rightarrow$	
4. Add offset Safe pick position		$\Theta \rightarrow$	
		Θ >	
5. Move arm To Safe position		~	
5. Move arm To Safe position 6. Add offset Safe pick position		$\Theta \rightarrow$	

5.12 Waypoints

5.12.1 Updating Your Routine to Use V2 Move Steps

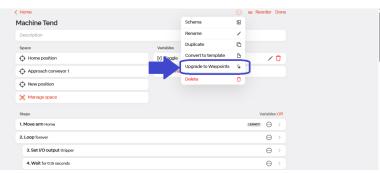
In this section we will discuss how to upgrade/migrate existing routines to use the improved waypoint functionality. *Note: This applies only to routines created prior to the release of the Waypoint Move feature V2. The Waypoint feature requires the feature flag to be enabled. If you need assistance activating it, or are unsure if it is already active please contact support at support@standardbots.com*

Step 1: Open the Routine Navigate to and open the routine you wish to upgrade. *Example: For this guide, we will use the routine titled "Machine Tend".*

Routines	Recent	sbRobot				100.00%
Machine Tend Updated Apr 07					No.	
Traveling Mailbox 2 Updated Apr 07	2					
PI Updated Apr 01	Loaded					
Demo Updated Mar 31					@	
Traveling Mailbox3 Updated Mar 11						
Tomo Updated Feb 19		PI	_	_	No gripper	
	See all	Total time	Cycles	Avg. cycle	Add in Equipment	

Step 2: Access Edit Options Click the **"EDIT"** button, then select the **"Options"** button located at the top center of the routine screen to open the dropdown menu.

< Home Machine Tend		💬 Edit
Description		1
Space	Variables	
Home position	[x] Toggle	
Approach conveyor 1	+ Add variable	
New position		
(@) Manage space		
Steps		Variables: Off
1. Move arm Home		LEGACY
2. Loop forever		
3. Set I/O output Gripper		\odot >
4. Wait for 0.15 seconds		\odot >
5. Move arm Approach in conveyor		LEGACY 💬 >
lome		💮 🔳 Reorder Done
achine Tend		A 44
escription		T
pace	Variables	
> Home position	[x] Toggle	/ 🖬
Approach conveyor 1	+ Add variable	
> New position		
a) Manage space		
teps		Variables: Off
Move arm Home		LEGACY >
Loop forever		\odot >
3. Set I/O output Gripper		\odot >
4. Wait for 0.15 seconds		
5. Move arm Approach in conveyor		LEGACY >



Step 3: Select Upgrade Option From the dropdown menu, choose "Upgrade to Waypoints".

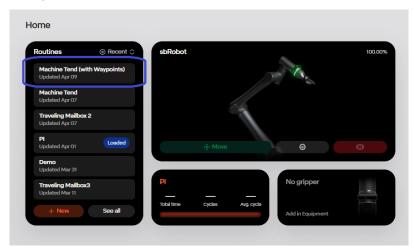
Step 4: Name the Upgraded Routine Enter a new name for the upgraded version of the routine.

Note: This process creates a duplicate of the original routine. The original will remain unchanged. Click **"OK"** to confirm.

Variables: Off
LEGACY .
Upgrade routine to Waypoints Create a copy of your routine with all Move Arm steps converted to use Waypoints. Your original routine will remain unchanged. Enter a new name for this routine. Machine Tend (with Waypo 🔇
Cancel OK
\odot >
LEGACY
\odot >
\odot >

Step 5: Locate the Upgraded Routine Return to the main dashboard. The newly upgraded routine will appear at the top of the routines list.

Note: If the original routine was created prior to the release of Waypoints V2, its steps may be labeled as "Legacy". These labels will be removed automatically after the upgrade is completed.



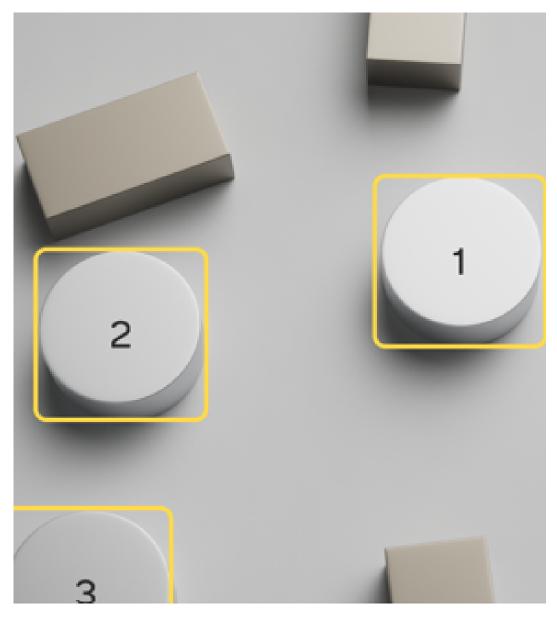
Chapter 6

Vision

Note: Vision is an optional paid feature. If you are interested in incorporating this into your robot, please contact Standard Bots for further assistance.

- Email: live-support@standardbots.com
- Phone: 1-888-9-ROBOTS

6.1 Locate



6.1.1 Use Cases

Standard Bots Locate feature is designed to locate items on a 2D flat plane to allow for picking and placing them using the integrated wrist camera. Items to be picked do not need to be organized but must be distinguishable from each other. Locate is not designed for 3D applications (stacked items). 3D functionality will be an optional upgrade provided at a later date. Locate accuracy is dependent on how far the robot is from the plane, but at closer distances +/- 1/8 in is possible depending on lighting and calibration.

6.1.2 Setup

Required Items

- Robot with Camera
- USB Cable connected between robot and camera. Cable will be located inside the control box from the factory.
- Calibration spike (Provided by Standard Bots or custom)
- Vision calibration grid: http://camera-calibration.standardbots.com/
- Accuracy Calibration Grid (Optional): http://accuracy-calibration.standardbots.com/
- Flat plane to pick from
- Items to pick
- Tooling to pick items

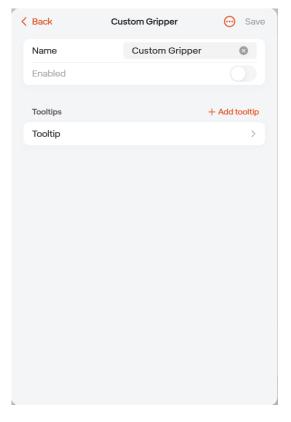
Camera Setup

- 1. Go to the Move Robot view, check to make sure that you are Live Robot mode not Simulation mode.
- 2. If needed, unbrake the robot.
- 3. Select the three dots icon in the upper right, then select the camera icon. If you do not have this icon, contact Standard Bots Support.
- 4. You should see the camera view. If you cannot. Ensure the provided USB cable is connected between the robot and control box. If it is, try rotating the orientation of the usb-c plug 180 degrees in the robot.
- 5. Go to "Equipment" in the robot menu (Menu has the robot name in it and is located in the lower left of the screen).
- 6. Click the "+" icon in the upper right of the window.
- 7. Add the Built-in Wrist Camera.
- 8. You do not need to perform any calibration here.
- 9. Click save in the upper right of the window.
- 10. Click done in the upper left of the window.

Calibration Spike Setup

- 1. Go to the Move Robot view (located in the upper right of the screen).
- 2. Go to "Equipment" in the robot menu (Menu has the robot name in it).
- 3. Click the "+" icon in the upper right of the window.
- 4. Select "Custom Gripper".
- 5. Select "Tooltip".

- 6. If using the Standard Bots provided spike, set the z height to 50mm. If using another spike, set the offsets accordingly.
- 7. Click save in the upper right.
- 8. Click save again in the upper right.

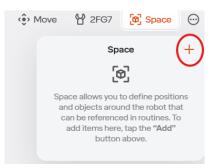


Space Setup

- 1. Create a new routine, or open the routine you want to run locate in.
- 2. Select "Manage Space".

Description		
Space	Variables	
(a) Manage space	+ Add variable	
Steps		Variables: Off
1. Loop forever		▲ 💮 >
+ Add Step		
+ Add Step		

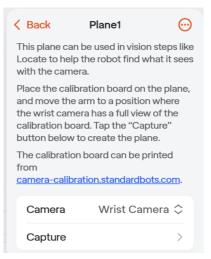
- 3. Go to "Space" in the Move Robot view (square icon located in the upper right of the screen).
- 4. Click the "+" icon in the upper right of the "Space" window in on the right side of the User Interface.



- 5. Select "Plane" in the list that appears. If you do not have this option contact Standard Bots Support.
- 6. Name the plane and select "Create".

<:>• Move	2FG7	[@] Space	\odot
< Back	New	item	
Name			
Plane1			8
Description	1		
	Cre	ate	

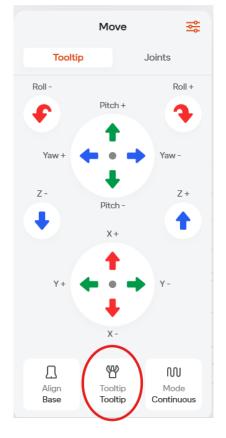
7. Select "Create with Camera" and then select "Capture".



8. Place the larger, full 8.5 x 11 size calibration board on your plane.



9. In the "Tooltip" jogging view, ensure the calibration spike custom tooltip is the current tooltip.



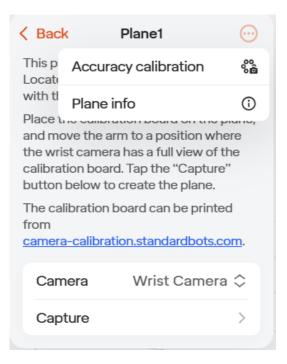
- 10. Drive the robot so you can see the calibration board with the camera. You can see the camera view while jogging by selecting the camera icon. Ensure the joint positions make sense and don't appear at risk of hitting your plane.
- 11. Under "Tooltip" jogging you can select the "Wrist Camera" frame. You can then select the slider Icon in the top right of the tooltip jogging view. Using "Snap to Axis" you can align the wrist camera to the robot base.



- 12. Once you have the calibration grid in view, get the robot as close to it as possible while still seeing the whole grid.
- 13. Go back to the "Space" in the bottom right.
- 14. Select "Create with camera".
- 15. Select "Capture" in the upper right of the window. If capture is greyed out ensure you can see the whole grid, it is the correct grid and the lighting is good enough. "Calibration Board Found" will appear on the screen.

Cancel	Create plane	Camera settings Capture
	Calibration board found.	
	plane from this surface.	
	12 13 14 14 14 14 14 14 14 14 14 14 14 14 14	
	r	

- 16. Click the 3 dot menu in the upper right of the plane calibration view.
- 17. Select Accuracy Calibration.



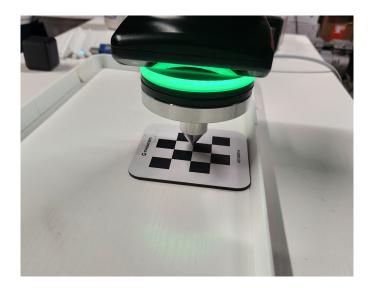
- 18. Jog the robot so you can see the whole work area. Ensure you have your custom tooltip selected in the bottom right of the tooltip jogging view.
- 19. Go back to the plane setup in the space view .
- 20. Click "Set" to create your home position in the plane view in space.

< Back	Accuracy ca	libration	
	 読 「 」 第 デ 「 」 満 「 」 	2 2 20 2	
	ne position whe as full view of th		
🔥 Ho	ome	Set	
Came	ra settings	>	
Calibra	tion entries (0)		
Place an accuracy calibration tile at a corner of the pickup area. Ensure the arm is at the home position. Tap the "Locate" button to find the calibration tile. Tap "Add" to add a locate result, then move the arm to the true position of the tile and tap "Set". Repeat for each corner of the pickup area.			
from		can be printed	
θı	ocate to add	new entry	

- 21. Place one of the smaller checkerboard calibration images in the robot view.
- 22. Select "locate to add new entry".
- 23. Add the entry. Ensure you do this before navigating away from the space window to jog.

Accuracy calibration			
- - -			
Set a home position where the wrist camera has full view of the plane.	ì		
Home 🔅 Go here 💮			
Camera settings			
Locate results (1) + Add			
Place an accuracy calibration tile at a corner of the pickup area. Ensure the arm is at the home position. Tap the "Locate" button to find the calibration tile. Tap "Add" to add a locate result, then move the arm to the true position of the tile and tap "Set". Repeat for each corner of the pickup area.			
Accuracy calibration tiles can be			
\bigcirc Locate to add new entry			

- 24. Hold down "Go Here". Robot will drive above the grid.
- 25. Jog the robot to the center of the grid with the point of the spike touching the center. You can do this via the UI or with Anti-Gravity. Ensure the grid does not move. It is best to do this with the robot going at a slow speed.



26. Go to the Space window again, and click "Set" for this position.

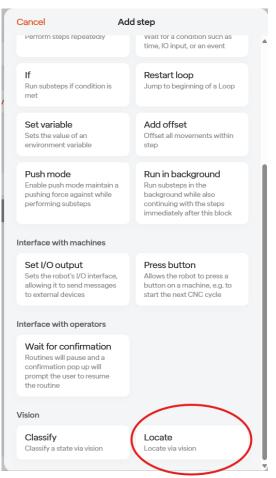
K Back Accura	acy calibratic	n		
Set a home positi camera has full vi			î	
Home	Go here	\odot		
Camera settir	ngs	>	l	
Calibration ent	ries (2)		l	
0	< Go here	\odot	I	
1 Set	🔅 Go here	\odot	l	
Place an accuracy calibration tile at a corner of the pickup area. Ensure the arm is at the home position. Tap the "Locate" button to find the calibration tile. Tap "Add" to add a locate result, then move the arm to the true position of the tile and tap "Set". Repeat for each corner of the pickup area. Accuracy calibration tiles can be				
Accuracy calibrat	ion tiles can be)	*	
€ Locate t	to add new ei	ntry		

- 27. Bring the robot view back to the home position an repeat at least 4 times around your work area.
- 28. The plane is now ready to use in a Locate step.

Routine Setup

- 1. Setup a tooltip or select a standard tool under equipment manager to use in your routine.
- 2. Go to the routine you created your plane in.
- 3. Leave the existing main loop and add all the below steps in this main loop.

- 4. Setup a Move To Position positioned such that the camera can see the work area.
- 5. Add a Locate step (found at the bottom of the "Add Step" window.



6. Under the Setup tab of the locate step, set a region of interest. This is the area you want to pick from.

Image source	
Camera	Wrist Camera 🗘
Region of interest	None Set 🗦
Workplane	Plane1 🗇

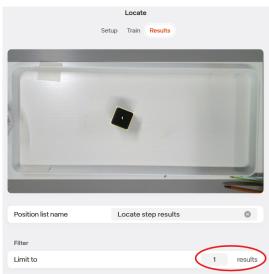
- 7. Under workplane, select the plane created in previous steps.
- 8. If needed adjust the camera settings so the items are visible. Generally the defaults are a good starting point.
- 9. Under the Train tab (located at the top of the Locate window), setup your blob or shape settings.

	Setup Train Pesults	
		1
	0	0
Method		2D Blobs 🗘
Blob analysis settings		
Min threshold ⑦	50	
Max threshold ⑦	220	0
Min area 🕜		25 px
Max area 💿		10000 px
Filter by Circularity ③		
Min circularity (?)	0.1	
		▷ Play routine

10. If using blobs, adjust the 0-255 Min and Max threshold greyscale value and Min and Max area values until just the items you wish to pick are indicated in the above image.

If using Shapes, Teach the image by taking an image and highlighting the items you wish to pick. Set the bounding box around the item. Adjust the % match required until all items you wish to pick are indicated in the above image.

11. Under results (located to the right of the Train tab), if needed limit the number of items locate should find.



- 12. If needed, in results set a transform to apply to the located position when the robot goes to pick. Generally, it is good to start with a larger z offset of 40mm or so and tune from there.
- 13. Add an if statement below the locate step.

14. Set the if statement to say "IF Objects located count greater than 0". Objects located count is automatically created for you when you add a locate step. This will ensure the robot only tried to pick if there are items to pick.

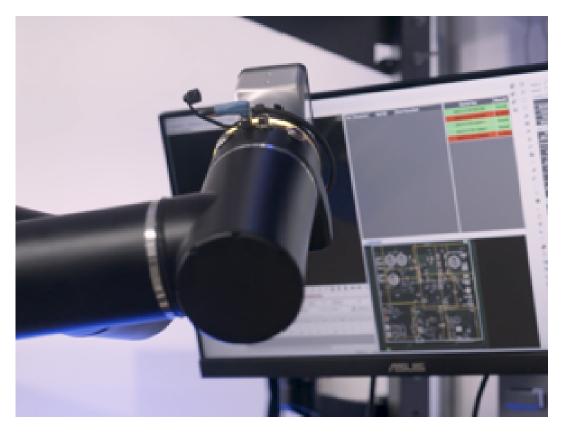


- 15. Add a Move Arm.
- 16. Select "From space" in the Move Arm command. Select "Locate Step Results". Set it to always pick 1. This will pick the first item in the locate step results list.

< Home		\bigcirc \equiv Reorder Done	1	Move arm
LocateExampleManual			Description	
Description			Specify a location that the robot she positions	ould go to by defining the joint or gripper
Space	Variables		positions	
♦ Plane1	+ Add variable		Target	
Sa Locate step results			(ê)	(e) f×
(@) Manage space				rom space Expression
Steps		Variables: Off	Target	🕼 Locate step results 😂
1. Loop forever			Position	Always pick 😂
2. Move arm Moving arm to home position so camera can see work a	ea		Always pick	0 1 9
3. Locate Locate via vision		<i>⇔</i> >	Space defines positions and objects around t	he robot that can be referenced across steps.
4. If Run substeps if condition is met			@ N	fanage space
5. Move arm Specify a location that the robot should go to by def	ning the joint or gripper positions	\odot >	Match joint angles specified	
+ Add Step			Move specific tooltip to target	Automatic 🗘
Add Step			The robot will move "2FG7" to the target.	
			Path	
			Move in a straight line	
			Reduce motion smoothing (i)	
cb0080 32% (⊘ E-Stop		▷ Play routine

17. Fill out the rest of the routine as desired. You likely will want to do an add offset to to the locate results item before driving to it, etc.

6.2 Classify



6.2.1 Use Cases

Standard Bots Classify feature is designed to allow the robot to look at an item and determine it's state by comparing the current view to reference images. Classify can be used to look at a light stack to determine the machine state or to look at a HMI screen to know when a program is finished. Classify is not suited for detailed inspection / metrology applications.

6.2.2 Setup

Required Items

- Robot with Camera
- USB Cable connected between robot and camera. Cable will be located inside the control box from the factory.

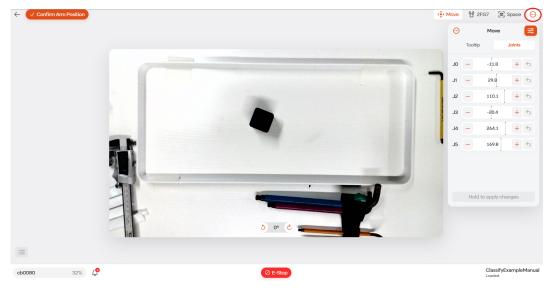
Camera Setup

- 1. Go to the Move Robot view, make sure the Robot view is in Live view and not Simulation.
- 2. If needed, unbrake the robot.
- 3. Select the three dots icon in the upper right, then select the camera icon. If you do not have this icon, contact Standard Bots Support.

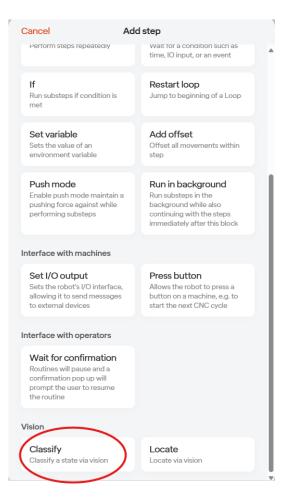
- 4. You should see the camera view. If you cannot. Ensure the provided USB cable is connected between the robot and control box. If it is, try rotating the orientation of the usb-c plug 180 degrees in the robot.
- 5. Go to "Equipment" in the robot menu (Menu has the robot name in it, located in the lower left of the screen).
- 6. Click the "+" icon in the upper right of the window.
- 7. Add the Built-in Wrist Camera.
- 8. You do not need to perform any calibration here.
- 9. Click save in the upper right of the window.
- 10. Click done in the upper left of the window.

Routine Setup

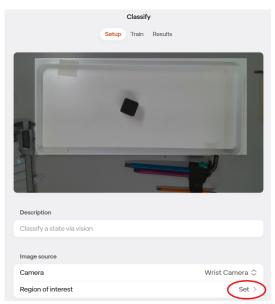
- 1. Create a new routine, or open the routine you want to run classify in.
- 2. Add a "Move Arm" step and set the position such that the camera can see the item you want to determine the state of. You can see the camera view while jogging by selecting three dots icon located in the upper right, then by selecting the camera icon.



3. Add a "Classify" step (located at the bottom of the Add Step Window).



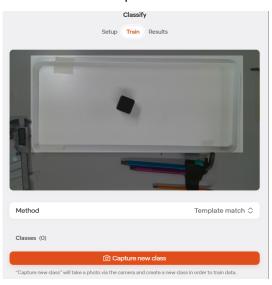
4. Under "Setup" set the Region of interest to be only the part of the screen that is going to change state. Move the box outline and when done select "Crop".



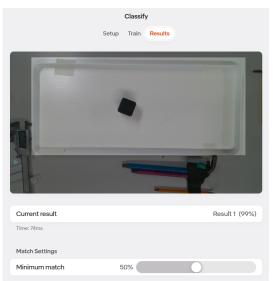
5. You can adjust camera settings if needed, but the defaults work for most applications.

Camera settings			← Reset
Automatic white balance			
White balance	4600.0		
Brightness	-35.0)	
Contrast	22.0)	
Exposure	76.0		
Sharpness	50.0	\bigcirc	
Hue	0.0	0	

6. Under "Train" in the Classify step (located at the top of the Classify window), Capture a new class for each state and provide it a name.



- 7. If desired, add a fallback class to default to if no state is matched.
- 8. Under "Results" (located at the top of the Classify window), test the different states to see if the right result is reported. Adjust the minimum match threshold as needed.



9. Add an IF statement below the Classify step. You can now adjust the IF to say "IF Classify Results is (State programmed in Classify)".

lf 3.	Classify: Latest result
is	Value

10. Create the rest of the program as desired.

Chapter 7

Maintenance

The RO1 robot and controller are designed for long life with minimal maintenance. If the robot is installed according to the intended use instructions the robot and controller will provide years of service.

7.1 User-Serviceable Parts

Part	Description	Part #	Replacement Interval
Control Box Fan	120mm Sq Nylon Mesh 8 Micron	SB-0596-	6 months, application
Filter	Filter	А	dependent

7.2 Replacement Procedures

7.2.1 Controller Fan

- 1. Stop the robot.
- 2. Apply the robot brakes through the Move Robot view in the user interface.
- 3. Unplug the controller.
- 4. Wait 30 seconds for power to dissipate.
- 5. Tape up the area as shown below to avoid damaging surface:



6. Measure from corner of fan shroud and mark tape at 1.5" and 4.5":



7. Insert a flat head screwdriver just past the lip of the shroud and pry one side out. You will hear a snap noise:



8. Repeat for the other side:



9. Pull shroud downward and remove shroud as shown:



10. Remove and replace filter:



11. Engage bottom of shroud with bottom of assembly:



- 12. Press in top of shroud with hand.
- 13. Remove tape.

7.3 Limited Product Warranty

Standard Bots Company (the "Company") warrants to the original lessor of the Standard Bots Robot (the "Original Purchaser" and the "Product", respectively) from the Company, that the Product shall be free from defects in materials and workmanship under normal use and in conformance with the Company's instructions, for so long as such Original Purchaser continues to lease the Product from the Company (the "Warranty Period").

If a defect arises during the Warranty Period, the Company will, at its option, (i) repair the Product at no charge, using new or refurbished replacement parts, (ii) exchange the Product with a refurbished or new product with equivalent functionality or (iii) provide the Original Purchaser with a replacement part accompanied by instructions on installation, and any requirements for the disposal of the replaced part. The Company shall not be responsible for any labor costs you incur relating to DIY parts service.

This warranty excludes (i) normal depletion of consumable parts such as batteries and (ii) defects caused by the user's fault.

This warranty is subject to your following the RMA process as may be in place at the Company from time to time. In order to obtain warranty service, please contact customer service at live-support@standardbots.com. It is your responsibility to backup any data, software or other materials you may have stored on the Product, as such data, software or other materials may be lost or reformat-ted during warranty service and the Company will not be responsible for such loss. In addition, it is your sole responsibility to delete all sensitive and personal information stored in, or in accessible form in, the Product prior to shipping the Product to us, and to disable or remove all security passwords.

Without derogation, this warranty does not apply in any of the following cases:

- Products not leased from the Company

- Damage caused by accident, abuse or misuse

- Products that have been dismantled, tampered with, modified or repaired by anyone other than the Company or a service provider authorized by the Company.

7.4 Return Merchandise Authorization

Should you believe you need to return a Standard Bots product please contact us through one of the below contact methods. Unauthorized returns will not be accepted.

Standard Bots Support: Phone: 888-976-1287 Email: live-support@standardbots.com

7.4.1 Updating an Offline Robot

To update your robot when it is offline, you will first need a USB drive that has the software version you wish to put onto your robot. You will need to contact the Standard Bots team. In doing so, we will send

you a file that has the software update. You will put that onto your USB drive and plug the USB drive into your robot's control box.

Once you are ready, go to your settings, which you can access by clicking on the lower left of your Move Robot screen. Once there, click on Software Update. Once in the Software Update page, select USB Update. Your update will then be downloading, once it is finished downloading you can install the update.

ancel	Software update			
Installed version: StandardOS 2025.01.28.10				
ONLINE UPDATE	No newer version available via internet.			
USB UPDATE	No drive connected			
USB UPDATE				

Chapter 8

Appendix A - Error List

Error	Reason	How to Fix Error
E-Stop was triggered	The E-Stop was pressed	The robot requires recovery.
		Navigate to the Routine Editor
		and press the Play button to
		access the Recovery Panel.
Internal communication failure		The robot requires recovery.
		Navigate to the Routine Editor
		and press the Play button to
		access the Recovery Panel.
Robot encountered a control	Failed to receive encoder	The robot requires recovery.
system issue	information for [Time in ms]	Navigate to the Routine Editor
		and press the Play button to
		access the Recovery Panel.
Failed plan joint motion	Joint is already at limit of	The joint can not move any
	relative joint motion and can not	further in the direction of travel.
	travers any further in that	The robot requires recovery.
	direction.	Navigate to the Routine Editor
		and press the Play button to
		access the Recovery Panel.

Error	Reason	How to Fix Error
Arm has encountered a collision	The arm collided with an object and stopped. The joint will be identified in the error, along with the detected Nm force and the threshold set force in Nm	The robot requires recovery. Navigate to the Routine Editor and press the Play button to access the Recovery Panel. Furthermore you can check the threshold settings and evaluate if the numbers are set correctly based on a safety study of the application
Unable to enter ANTIGRAVITY state		The robot requires recovery. Navigate to the Routine Editor and press the Play button to access the Recovery Panel.
CSI_collision detected	There was a collision detected. The threshold crossing limit will be displayed in m/s2	The robot requires recovery. Navigate to the Routine Editor and press the Play button to access the Recovery Panel. Furthermore you can check the threshold settings and evaluate if the numbers are set correctly based on a safety study of the application
Failed to run program: Already running program or robot-main is not running on Haas machine		Restart the robot or the CNC and verify the robot-main program is running on the CNC
Failed to receive encoder status	The E-Stop was pressed or the control box to robot cable is unplugged	Ensure Estop is not pressed and that cable between robot and control box is connected firmly
IO state timeout	The E-Stop was pressed or the control box to robot cable is unplugged	Ensure Estop is not pressed and that cable between robot and control box is connected firmly
Routine Invalid: Waypoint steps must have terminal Move Arm step Motion failed	Waypoints can only be used when the next step is a Move Arm Robot cannot plan a path between current position and target position, likely due to a singularity.	Uncheck "Treat as waypoint" or add Move Arm step after Waypoint step. Adjust starting position or target position.

Error	Reason	How to Fix Error
Torque Limit Exceeded	Too much torque was recorded on the joint named in the error	Reduce payload, speed or reach.
Joint Limit Exceeded	message Joint is already at limit of relative joint motion and can not traverse any further in that	The joint can not move any further in the direction of travel. The robot requires recovery.
	direction.	Navigate to the Routine Editor and press the Play button to access the Recovery Panel.
Error Loading Camera Feed	Vision camera does not disply video feed	Check camera connection to robot. Rotate USB-C cable 180 degrees and try camera again
EOAT Not Detected	The robot is not detecting the EOAT	Check the EOAT connection to the robot. Verify that you added the EOAT into Equipment after it was connected to the robot.
Ipad will not connect to robot	There is a wierless issue between the Ipad and the robot either over WiFi or Bluetooth	Make sure the Ipad and the robot are on the same network. Verify that Bluetooth is enabled on the Ipad.

Chapter 9

Appendix B - FAQ

Below is a list of common questions and answers for the Standard Bots system

Q: Do you need to have the robot connected to the internet to use the robot?

A: No, the robot can run on a local network or simply with a single ethernet cable connected between the robot and a PC or tablet. If the robot is not online it will still operate without issue, however remote diagnostics and automatic updates will not be available.

Q: Do you need to have the lpad connected to the robot to run a program?

A: No, the Ipad is only needed for setting the Network setting for the robot. Once the robot is connected to the network, you can use the Ipad to control the robot or a computer using Google Chrome or by using the 24V External Control Interface.

Q: How do I connect the robot to the network?

A: The robot can be connected to the network by going to the robot menu in the Ipad application and selecting the network icon. From there you can select the network you want to connect to and enter the password.

Q: How do I access my robot from a computer?

A: If the robot is on the internet: You can access the robot from a computer by entering the robot name into the address bar of Google Chrome. You will then be prompted to enter the password for the robot. This will be cbXXXX.sb.app where XXXX is the last 4 digits of the controller serial number. This number can be found inside of the controller door.

If the robot is not on the internet: Use the Ipad application to find the ip address of the robot. Then, in the broswer of a computer on the same local network of the robot type in the robot ip address port 3000 as shwon in the ipad application. Example: 192.168.110.20:3000.

Q: How do I access the network settings after initial setup?

A: To access the network settings of the robot, for example if you want to set a static IP address, use the Standard Bots application on the tablet. If you are already logged into the robot: In the User Interface on the tablet go to the Move Robot view. Go to the robot name menu in the bottom left and select "Logout". You will now be back to the tablet application main screen. On the left side you can select your robot. Once selected, the network settings will be on the right side.

Q: How do I connect my robot to a tablet or PC directly?

A: You will need an ethernet cable to go between the robot ethernet port and your pc or tablet. You may also need a usb c to ethernet or similar adapter.

If you are simply using a wire, there will not be a router to give both devices an IP address. This means you will need to set the address manually, and set them on the same subnet.

Using the Standard Bots application on the tablet, set an IP address on the wired port of the robot under the network settings in the application. Then set a static address on the pc or tablet. Generally the address follows the format of 192.168.x.y. x would be the subnet, and both the robot and pc or tablet need to have the same number for x. Y would be unique for each device. Ex, the robot could be 192.168.110.5 and the pc or tablet could be 192.168.110.6.

Then on the pc or tablet go to the robot address you assigned in a browser tab. The format is generally 192.168.x.y:3000.

Q: Why is an axis direction grayed when the robot is not fully extended?

A: When the robot has one or more joints that are at their limit, this can prevent the robot from moving in a certain direction in the XYZ plane. The robot does not need to be fully extended in one direction to cause this. It is simple to fix, go to your move joints tab, then rotate the joint that is at it's motion limit (the joint that is maxed out in the positive or negative direction). Once done the robot should be able to move with more freedom.

Q: How do I connect my robot to a tablet or PC without setting static IP address and wires but not have the robot on the internet?

A: You can setup a simple local network for the robot using a standard wireless router. You will need to purchase a wireless router. Ensure it is not just an access point, as an access point will not assign IP addresses.

Setup a standard wireless network on the router. Do not connect the router to your LAN or internet. Connect the tablet to the wireless network. Use the iPad application to connect the robot to the new wireless network. In the tablet, check the network status for the robot Ip address, which will be in the format xxx.xxx.xxx.3000. Any device on your new wireless network can access the robot using this address. The cbxxxx.sb.app link will not work if the robot is not online.

Q: Which end effectors work with the RO1?

A: The following tools are supported directly in the Standard Bots interface:

DH Robotics AG-105-145 Linkage Tool DH Robotics CGI-100-170 Centric Tool DH Robotics PGC-300-60 Parallel Tool Onrobot 2FG7 Parallel Tool Onrobot 2FG14 Parallel Tool Onrobot 3FG15 3 Finger Centric Tool Onrobot Dual Changer Schunk EGU

Standard Bots also supports any tools that are discrete IO driven, including Onrobot tools that are not listed above through the use of the OnRobot Compute Box.

Currently, Robotiq tools are not supported as they cannot be controlled over discrete IO.

Q: How do I change which tool I want to use on the RO1?

A: To change which tool is on the robot, go to the robot menu (has the robot name in an oval) and go to equipment. You can then add or delete tools.

Q: Which protocols does the RO1 support?

A: Currently, the RO1 supports 24V discrete IO and Modbus TCP. There is also a REST API, a python SDK and typescript API.

Q: What are the power requirements of the RO1?

A: The control box requires 90 ~ 264VAC, 47-63Hz. The robot draws less than 15 amps at 120V.

Q: How do I get started with a new RO1?

A: Please start the included iPad, open the Standard Bots application, and follow the instructions.

Q: What is the payload capacity of the RO1?

A: Depending on speeds and move types, the RO1 can carry up to 18 kg.

Q: What is the maximum speed of the RO1?

A: The RO1 joints can move up to 435 degrees / second.

Q: What is the maximum reach of the RO1?

A: 1.3 Meters

Q: What is the bolt pattern at the end of the arm?

A: ISO 50mm pattern. The pattern follows the standard and has 4 m6 bolts on a 50mm circle.

Q: How do I move a routine to a different robot?

A: Open the routine you would like to copy in the first robot. Select the ... menu, and select "schema". Copy the text in the window. Open up the second robot and create a routine. Again select the ... menu and "schema". Copy the text into the window, rename the routine and select "create routine".

Q: How do I import a model into the environment?

A: To import a model, go to the Move Robot view and go to the space area. The icon is in the bottom right of the view and looks like a square. In this view select the "+" to add an item, and select "Object". The UI will tell you which file formats are supported.

Q: How do I get a Developer API Token?

A: The developer API token and setting can be found in the robot menu. Go to the Move Robot page, click on the robot name, settings, Configure developer API.

Q: My robot says it is online but I cannot access it?

- A:
 - 1. Check the device you are accessing the robot from (Ipad, PC) is on the same network as the robot.
 - 2. Check that the network the robot is connected to does not have a "splash" page you need to log into. This is often the case with guest networks. The robot does not support web based logins like this.

Q: I imported a model as an object but I cannot see it?

A:

- Try changing the scale. The import is in Meters. Often you must convert to meters by setting the scale to .001.
- Check that the file is valid

Q: How do I get the robot back into the box or case?

- A:
 - 1. Ensure all tools are disconnected and that the robot has sufficient space to move
 - 2. Power on the robot
 - 3. Go to the Move Robot page of the interface (where you jog the robot)
 - 4. Click on the robot name menu (where the speed is)
 - 5. Go to Settings
 - 6. Go to Box Robot
 - 7. Hold the Prepare Robot For Shipping button down to bring the robot to the box position.

Q: What should I do if I forget my robot's passcode/PIN?

A: Please reach out to Standard Bots at live-support@standardbots.com. Be sure to provide the serial number of your robot controller (e.g., cbXXXX), which you can find inside the controller door.

Q: Why are the safety settings greyed out, and how do I unlock them?

A: The safety settings will appear greyed out until access is unlocked. To unlock them, click the padlock icon labeled "Unlock" in the top-right corner of the safety settings pop-up window. You will then be prompted to enter your passcode. Once the correct passcode is entered, the safety settings for the RO1 will become editable. Don't forget to click "Apply Settings" and confirm the changes to ensure they take effect..



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