UR Setup Manual

PushCorp

CAUTION

Active Force Devices contain calibrated electronics. HANDLE WITH CARE DO NOT DROP

Do NOT USE LUBRICATED AIR.
This device requires a dry, non-lubricated 80-90 psi (5.5-6.2 bar) air supply filtered to 5 µm and 0.3 micron oil mist separator.
Non-compliacne with these requirements will void the manufacturer's warranty. (See Section 5.0 Pneumatic Connections)

All fasteners, mounting holes, and pipe threads on this tool are METRIC.

Refer to Table 11 for torque values unless otherwise specified

All *PushCorp, Inc.* electrical cables are rated for high twist and flex robotic applications with a minimum cable bending radius specification of 125mm (5 in). Cable damage resulting from failure to abide by this specification will not be covered under warranty.

Table of Contents

1.0 Limited Warranty

Duration:

One year from date of delivery to the original purchaser.

Who gives this warranty:

PushCorp
Telephone: (972) 840-0208

Corporate Address:
P.O. Box 181915
Dallas, Texas 75218

Shipping Address:
3001 W Kingsley Rd
Garland, Texas 75041

Who gives this warranty (purchaser):

The original purchaser (other than for purposes of resale) of the *PushCorp* product

What products are covered by this warranty:

Any *PushCorp* industrial equipment or accessory supplied of manufactured by the Warrantor.

What is covered under this warranty:

Defects in material and/or workmanship which occur within the duration of the warranty period

What is not covered in this warranty:

A. IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANT-ABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO ONE YEAR FROM THE DATE OF ORIGINAL PURCHASE. Some states do not allow limitations on how long an implied warranty lasts, so the above limitations may not apply to you.

B. ANY INCIDENTAL, INDIRECT, OR CONSEQUENTIAL LOSS, DAMAGE or EXPENSE THAT MAY RESULT FROM ANY DEFECT, FAILURE, MALFUNCTION OF THE *PUSHCORP, INC.* PRODUCT. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you.

C. Any failure that results from an accident, purchaser's abuse, neglect, unauthorized repair or failure to operate the products in accordance with the instructions provided in the owner's manual(s) supplied with the product.

Responsibilities of the Warrantor under this warranty:

Repair or replace, at Warrantor's option, products or components which have failed within the duration of the warranty period.

Responsibilities of the purchaser under this warranty:

A. Deliver or ship the *PushCorp, Inc.* product or component to PushCorp, Inc. Service Center, Dallas, TX. Freight and insurance costs, if any, must be borne by the purchaser.

B. Use reasonable care in the operation and maintenance of the product as described in the owner's manual(s).

When warrantor will perform repair or replacement under this warranty:

Repair or replacement will be scheduled and serviced according to the normal work flow at the service center, and depending on the availability of replacement parts. Purchasers requiring quicker repair may receive such with payment of a *PushCorp, Inc.* predetermined expediting fee.

This Limited Warranty gives you specific legal rights and you may also have other rights which vary from state to state.

2.0 General Overview

This manual will cover how to interface PushCorp tooling with Universal Robot's UR20 and UR30. This includes hardware and electrical connections, and software. PushCorp tooling is made up of two components, the force compliance device and the spindle.

The force compliance device applies a constant force to the part for applications such as grinding, sanding, deburring, and polishing. The two types of force compliance are Active and Passive. Active tools are electromechanical devices that adjust air pressure automatically based on the payload weight, the angle of the tool relative to gravity, and the desired force. For passive compliance the control force is set using external electronic regulators. It is up to the user to measure these parameters and enter them into the UR Cap (Section 8.2 Passive Force Compliance) in order to achieve correct force values. Because external regulators have a delay in changing/achieving pressure, active tools are preferred for applications where the tool changes orientations frequently and passive devices are best for flat and prismatic parts.

The second component we offer is spindles, which can be either electrically or pneumatically driven. These are industrial versions of common hand tools such as right-angle grinders, die- grinders, and random orbital sanders. These products mount directly to the force compliance tools and their main function is to spin the abrasive.

For the purpose of this manual we will focus on 6 products, the STC2002 servo spindle, the SM2002servo spindle, the AFD120 active force compliance device, the AFD62 passive compliance device, the RPS100 pneumatic random orbital sander, and commercially available pneumatic tools.

3.0 End of Arm Tooling (EOAT)

For additional details on specific tooling, please refer to the respective user-manuals at pushcorp.com

3.1 STC2002/SM2002

The 2002 servo spindle motors feature a powerful 2.0 hp (1.49 kW) servo motor that provides constant speed up to 20,000 RPM. It is designed to mount in a parallel or perpendicular orientation on the AFD120 & AFD60 force compliance devices. Together with a Force compliance Device, the STC2002/SM2002 has never been easier to program beautiful and consistent surface finishes. However, the STC2002/SM2002 may also be mounted directly to the robot with no force compliance device; this opens the door for rigid applications such as automated routing and deflashing. The STC2002 accepts an ISO20 tapered toolholder, while the SM2002 utilizes a 1/2IN collet. The "SM" model uses the same motor winding and housing as the STC, differing only in orbit capabilities and media attachment.

The STC2002 toolholder gripping design locks the tool in the ISO20 tapered shaft and resists pull-out forces. The shaft does not have locking keys, so motor indexing for tool change is not required. The motor is fail-safe, in that no air pressure is required to hold the toolholder. Therefore, the toolholder will remain held in the shaft even if the air-pressure is unexpectedly lost. To unclamp the tool, apply air pressure so a single input port and the toolholder will release. For toolholder confirmation, PushCorp has installed a sensor that provides a 24V signal only when a toolholder is gripped in the shaft assembly.

Figure 1: STC2002

The Servo Manual (SM) model has a manually tightened collet. The "SM" models use the same motor winding and housing as the sander, differing only in orbit capabilities and media attachment. The manual Collet is a standard ER-20 series collet designed to clamp a ½ inch (12.7 mm) diameter Toolholder. The user may choose different sized collets in the ER-20 series, ranging from .031-.500 inch (1mm – 13mm).
The sander model consists of a universal motor housing and orbit shaft assembly. PushCorp can provide 9 different orbit shaft assemblies consisting of pad sizes of 3- 3.5", 5", and 6", and orbit of 3/8", 3/16", and 3/32". The backup pad attachment is mounted via an orbit shaft with a 1/4-20 thread for the 3-3.5" pad, and 5/16-24 thread for the 5" and 6" pad. Each of these orbit shaft assemblies are compatible with the SM1202 Sander. PushCorp provides a dust shield for the SM1202 Sander with dust collection capabilities aiding to provide a clean workcell; there is a respective dust shield for each size of back up pad.

Figure 2: SM2002 (Left) & SM2002-ROS (Right)

During operation the motor generates considerable heat due to the high speed, and compact size. Excessive operating temperature will significantly reduce the life of the motor. Water cooling is recommended for high duty cycle applications at higher torques to keep the unit within the internal temperature operating range. The motor should never be allowed to exceed a temperature of 176°F (80°C). Continuously operating the spindle above this temperature will allow the rotor to demagnetize and the bearings to fail. High temperatures will also cause the gaskets that seal the cooling water channels to fail, possibly filling the motor with water. PushCorp has provided flow through water cooling on the motor to allow high duty cycles without overheating, and air cooling on the motor for lower duty cycles.

Simple reliable construction combined with high torque and precision speed-controlled servo technology makes the PushCorp 2002 Servo Motor line a rigged, state-of-the-art tool capable of providing flexible, cost-effective operations.

3.2 AFD62

The PushCorp, 62 Series AFD is a small, light weight passive compliance device. The 62 Series is a great fit for small to medium size robots. To reduce operating friction and increase force accuracy the 62 Series uses glass pneumatic cylinders with graphite pistons, and linear guide rails. The AFD62 incorporates an internal linear potentiometer that allows the monitoring of the carriage position during operation. It has two robot mounting configurations. The AFD62 can apply both positive and negative forces.

The 62 Series requires the user to supply at least one pressure regulator to control the force output. The device's low friction components mean that the force output resolution and repeatability is highly dependent on the regulator accuracy. The regulator can be adjusted manually or electronically based on the user's application requirements. If only one force level is required and the AFD orientation does not change, a manual regulator is sufficient. If the force and/or AFD orientation changes during the process, then an electrically controlled proportional regulator is required. In most cases the process equipment weight must be taken into account so that a constant force can be applied regardless of the AFD orientation. This situation requires calculation of the regulator pressure based on the process equipment weight and AFD orientation. To monitor the Carriage position the AFD62 must be connected to a DC power source and an analog input device through a PushCorp high-flex cable.

All these features combine to make the PushCorp 62 Series Adjustable Force Devices rugged, reliable devices capable of delivering consistent results in any number of industrial applications.

Figure 3: AFD62

3.3 AFD120

The PushCorp, 120 Series Adjustable Force Device is a small, light weight active compliance device. It is the smallest & lightest active tool in the line up. The 120 Series is a great fit for small to medium size robots. To reduce operating friction and increase force accuracy the 120 Series uses glass pneumatic cylinders with graphite pistons, and linear guide rails. The AFD120 incorporates an internal linear potentiometer that allows the monitoring of the carriage position during operation.

The 120 series can apply up to 27 lbs. (120 N) of force. The AFD contains an accelerometer that monitors orientation and allows the unit to automatically compensate for gravitational and inertial effects. A linear potentiometer is also present within the AFD to measure the position of the carriage.

The only external connection that is required to operate the 120 Series is filtered, nonlubricated 80-90 psi (5.5-6.2 bar) supply air provided through flexible tubing. An inline filter is required to prevent any moisture from entering the tool. The AFD120 features a purge port, which allows the user to connect an additional airline. The purge port provides additional airflow and internal positive pressure to help minimize the amount of contamination infiltrating the interior of the AFD. PushCorp highly recommends utilizing this feature to keep the inside cavity clean, which will prolong the life of the tool. The AFD's sliding carriage has threaded mounting holes to provide easy process equipment attachment.

All these features combine to make the PushCorp 120 Series Adjustable Force Device a rugged, state-of-the-art technology capable of providing reliable, precise, and consistent results in a variety of industrial applications.

Figure 4: AFD120-POE

3.4 RPS100

The RPS100 High Speed Pneumatic Sander enables light duty robotic sanding in a compact form factor. It is pneumatically powered and is operated by supplying 90 psi via 12mm tubing. PushCorp RPS100 available diameters include 3”, 5”, and 6” pads, and orbit sizes including 3/8”, 3/16”, and 3/32”; these different configurations can be achieved by simply swapping out the drop-in motors.

While this product is recommended, any pneumatic tooling can be mounted to a PushCorp compliance device, assuming it falls within the weight requirements.

Please refer to the tables below for the different combinations of orbit diameters and disc/pad sizes:

Orbit Diameter	1-¼"	3” Disc	5” Disc	6” Disc
3/8”	N/A	N/A	PAR04467	PAR04647
3/16”	PAR05686	PAR04648	PAR04649	PAR04650
3/32”	N/A	PAR04651	PAR04652	PAR04653

Orbit Diameter	3” x 4” Pad
1/8”	PAR05820

Figure 5: RPS100

3.5 Off-the-shelf Pneumatic Tools

PushCorp compliance devices have been designed to optimally operate when paired with the PushCorp RPS100. However, the AFD62 & AFD120 are capable of being used with a variety of off-the-shelf pneumatic tools; this allows the user to integrate force compliance while maintaining their current finishing solution.

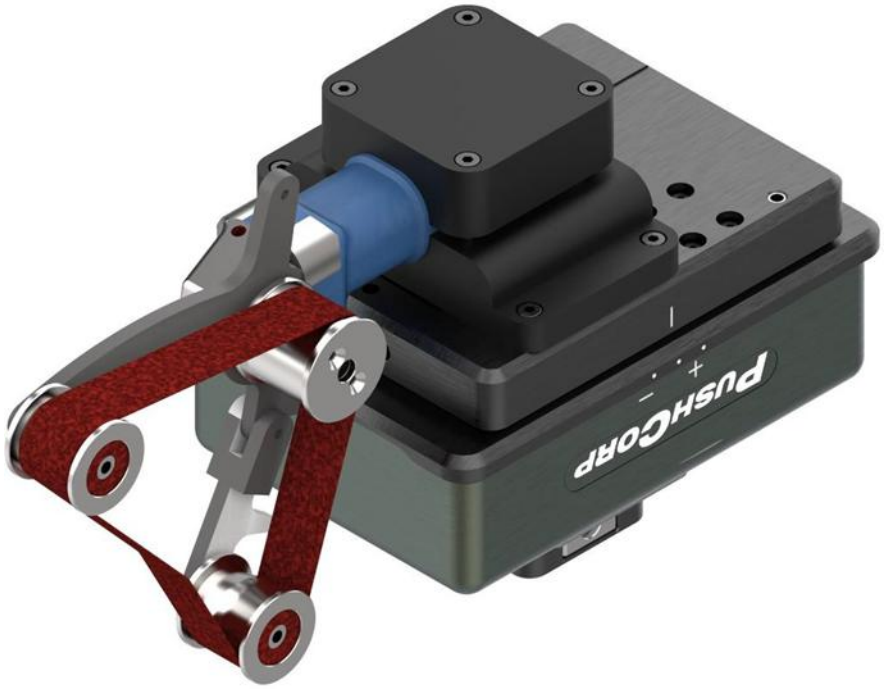


Figure 6: Example of Commercial-Off-the-Shelf Pneumatic Sander

4.0 Mounting

4.1 Mounting AFD62 & AFD120 Mount to UR20 & UR30

The AFD62 & AFD120 have been designed to mount to the UR20 and UR30 using the same adapter plate. Figure 7 provides an exploded view of the components provided by PushCorp that are used to mount the force compliance devices to both robots and the process for mounting can be found in Table 1.

Figure 7: AFD62/120 Mouning to Joint 6 of UR20/30

Table 1: Force compliance mounting procedure

Step 1:	*ASM03892* is secured to the faceplate of joint 6 using 6x M8x1.25x20 Cap Head Screws.
Step 2:	Mount the *AFD62/120 Joint 6 Mounting Bracket* to *ASM03892,* using *4x M6x1x18 Cap Head Screws*.
Step 3:	Mate the pilot piece of the AFD62/120 into the *AFD62/120 Joint 6 Mounting Bracket* until the holes are aligned.
Step 4:	Insert the *M8x1.25x10x35 Shoulder Bolt* into the aligned holes.

The mounting of the AFD62/120 to the mounting bracket is explained below for further clarity. Locate the mounting bracket over the pilot located at the top of the AFD with the counterbore holes facing the AFD.

Figure 8: Mounting Bracket - AFD62/120 Mate A

Next, align the holes and insert the shoulder bolt screw to fasten the mounting bracket to the AFD locating pilot (shown in red). Note that the block is not yet in compression (shown in yellow).

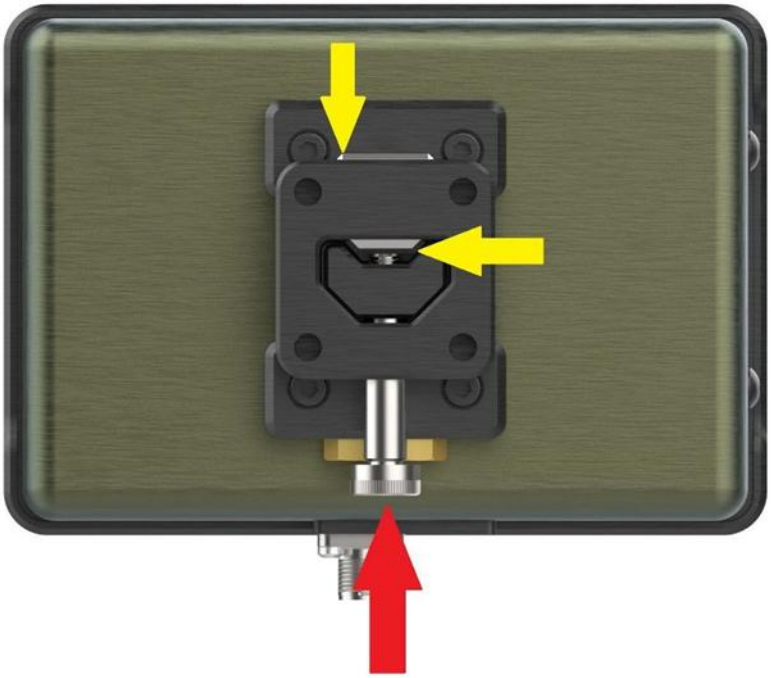


figure 9: Mounting Bracket – AFD62/120 Mate-B

Torque the shoulder bolt screw to the torque specified in Table 14; note that there is no longer a gap between the mating component's flats.

Figure 10: Mounting Bracket - AFD62/120 Mate-C

Below is a cross section that shows the stack up of components for clarity.

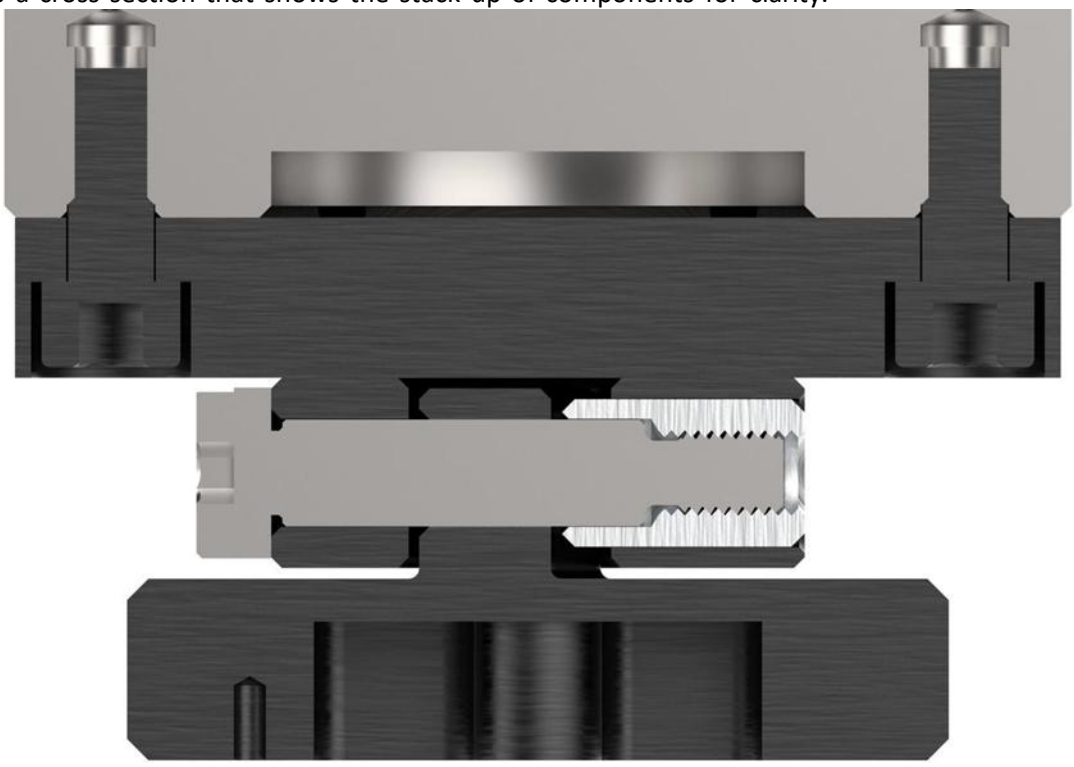


Figure 11: Mounting Bracket Mate Cross Section

4.2 Mounting STC2002/SM2002 to AFD62/120

The STC2002/SM2002 uses the same mounting hardware for both the AFD62 or the AFD120.

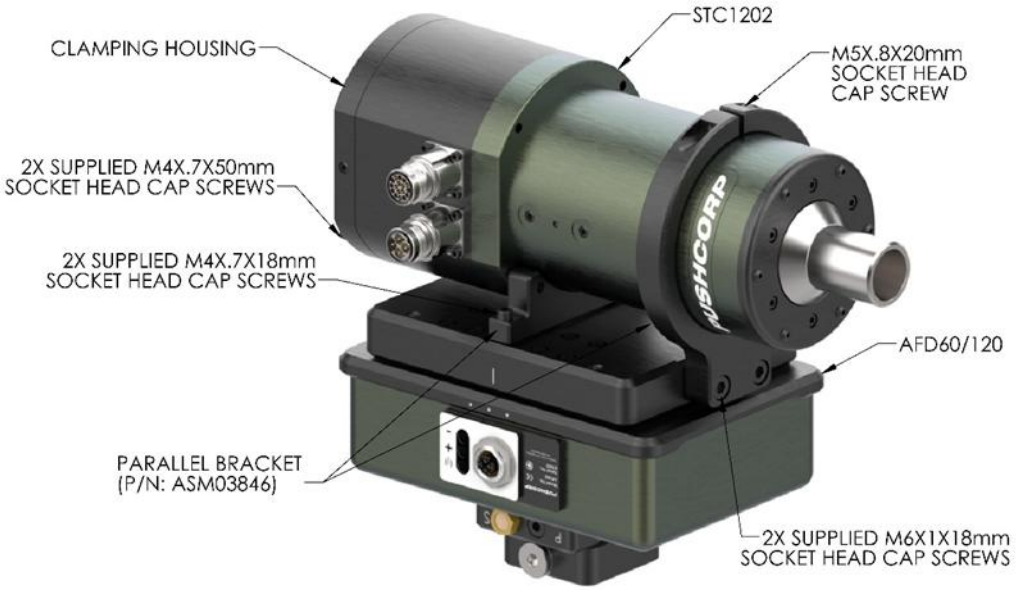


Figure 12: STC2002 Mounting to AFD62/AFD120

Table 2: Spindle Mounting Procedure

Step 1:	Mount the STC2002 to the *Parallel Bracket* via the *2x M4x0.7x50mm Cap Head Screws.*
Step 2:	Secure the *Parallel Bracket* to the AFD60/120 carriage via the *2x M4x.7x18mm Cap Head Screws.*
Step 3:	Slide the *Hoop Bracket* over the spindle and mount the *Hoop Bracket* to the *AFD60/120* carriage via the *2x M6 x1x18mm Cap Head Screws.*
Step 4:	Tighten the *M5x0.8x20mm* cap head screw to clamp the spindle within the hoop bracket

4.3 Mounting RPS100 to AFD62/AFD120

The RPS100 uses the same mounting hardware for both the AFD62 or the AFD120.

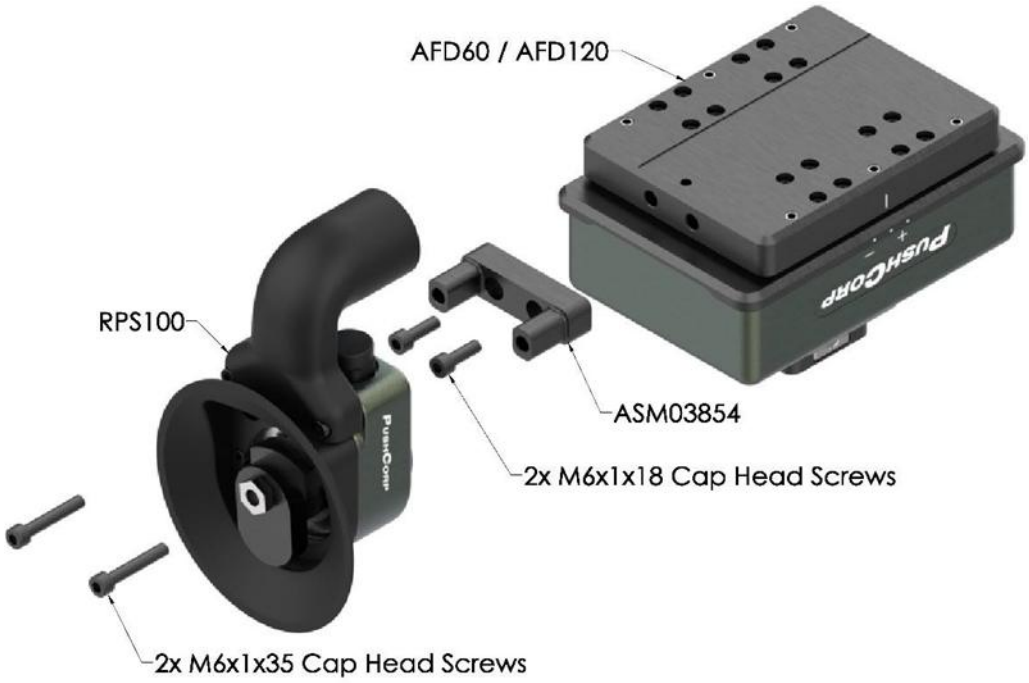


Figure 13: RPS Mounting to AFD62/AFD120

Table 3: RPS100 To AFD Mounting Procedure

Step 1:	Mount *ASM03854* to the *AFD62/120* Carriage via the *2x M6x1x18 Cap Head Screws*.
Step 2:	Mount the *RPS100* to *ASM03854* with *2x M6x1x35 Cap Head Screws*.

The 2x M6x1x35 Cap Head Screws are to be located in the holes shown below in Figure 14.

Figure 14: RPS100 Mounting Hole Locations

PushCorp recommends mounting the RPS100 in the orientation shown in Figure 15. This allows for the use of the PushCorp dust collection adapter, as well as locating the compliance force along the same plane as the force compliance carriage.

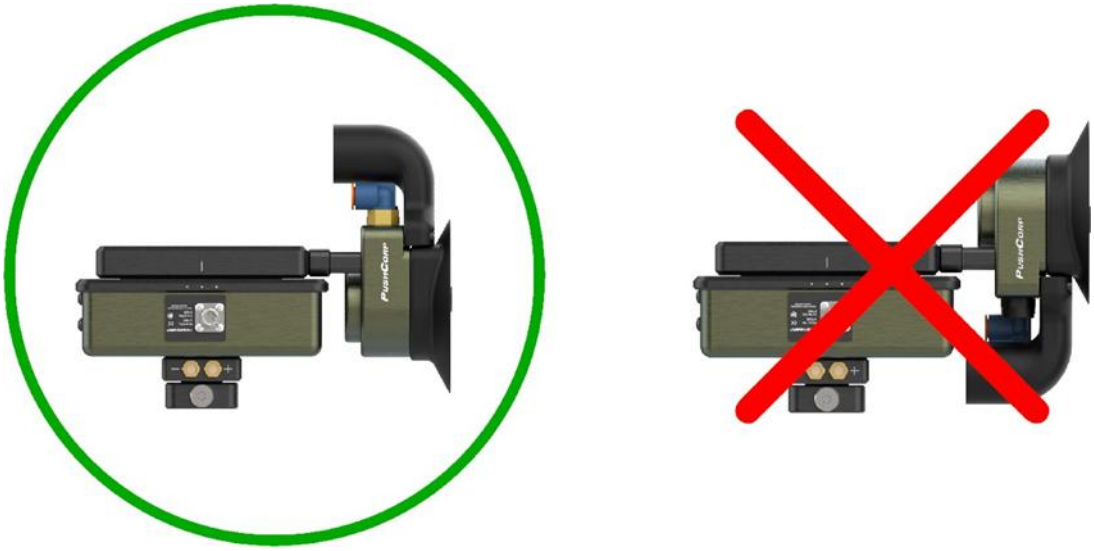


Figure 15: RPS100 Mounting Orientations

Refer to Table 4 for instruction for mounting the dust collection equipment to the RPS100.

Figure 16: PushCorp Dust Collection Adapters

Figure 17: Dust Shroud Tab Removal

Figure 18: Dust Collection Adapter Mounting

Table 4: Dust Collection Mounting Procedure

Step 1:	Depending on dress package configuration, select either the 90 degree, or straight dust collection adapter.(Figure 16)
Step 2:	Remove the tab from the dust shroud. (Figure 17)
Step 3:	Align the holes on the dust collection adapter with the tapped holes (yellow arrow indicated above), and torque the M5 screws to the torque value listed in Table 14 . (Figure 18)
Step 4:	If the next application does not require dust collection, remove the adapter and snap the tab back into place.

4.4 Mounting Off-the-Shelf Pneumatic Tool to AFD62/AFD120

PushCorp has designed the AFD62/AFD120 and RPS100 to mount together for optimum force compliant sanding. Users are able to program with their own or off the shelf pneumatic tooling. The user will need to fabricate custom brackets according to the pneumatic tool and mounted to the AFD carriage. The mounting hole pattern on both the AFD62 and AFD120 can be seen in Figure 19.

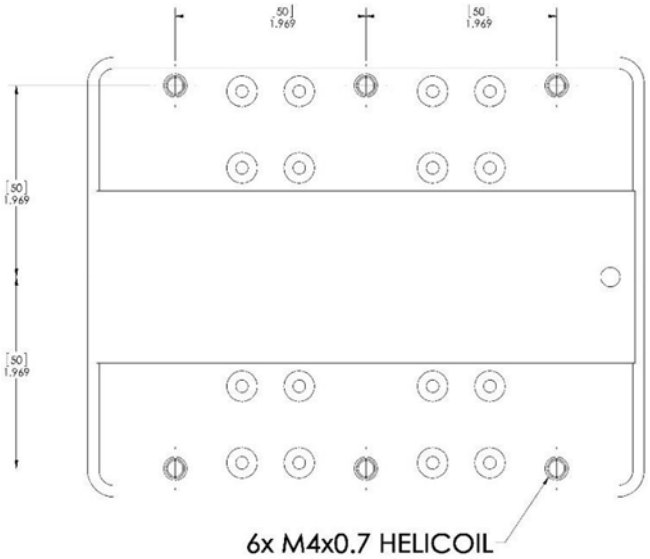


Figure 19: AFD62/120 CARRIAGE MOUNTING BOLT PATTERN

An example of a custom bracket stack up can be seen below:

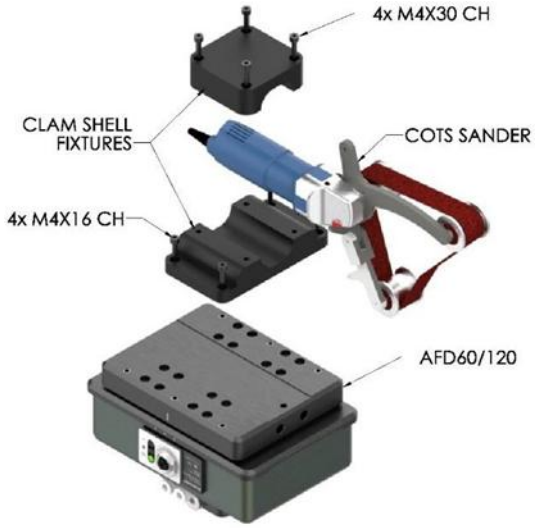


Figure 20: COTS Sander Force Compliance Mounting Example

5.0 Pneumatic Connections

PushCorp provides sample pneumatic diagrams so that users have the flexibility to specify components based on their current setup and/or preferences. To reduce the engineering effort, PushCorp has specified hardware for each product combination. Each has a configuration based on the requirements for the PushCorp equipment. We recommend you reach out to PushCorp technical support for assistance if you feel a deviation from this setup is necessary. The figures below represent each product or product pairing compatible with the UR20 and UR30.

Please refer to the table below for the required air conditions denoted by A, B, or C.

Table 5: Pneumatic Air Connections

Annotation	Air Requirements
A	• Pressure: 10-60 PSI (0.7-4.1 bar) • Flow Rate: 0.5-2.0 SCFM (14-56 l/min) • Conditions: Dry & Non-lubricated • Filtration: 20 microns • Tubing size: ø 6mm
B	• Pressure: 80-90 PSI (5.5-6.5 bar) • Flow Rate: 0.5-2.0 SCFM (14-56 l/min) • Conditions: Dry & Non-lubricated • Filtration: 5 microns • Tubing size: ø 6mm
C	• Pressure: 90 PSI (6.2 bar) maximum • Flow Rate: 17 SCFM (481 l/min) • Conditions: Filtered, Lubricated • Filtration: 5 microns • Tubing size: ø 12mm

5.1 AFD120 Active Force Compliance

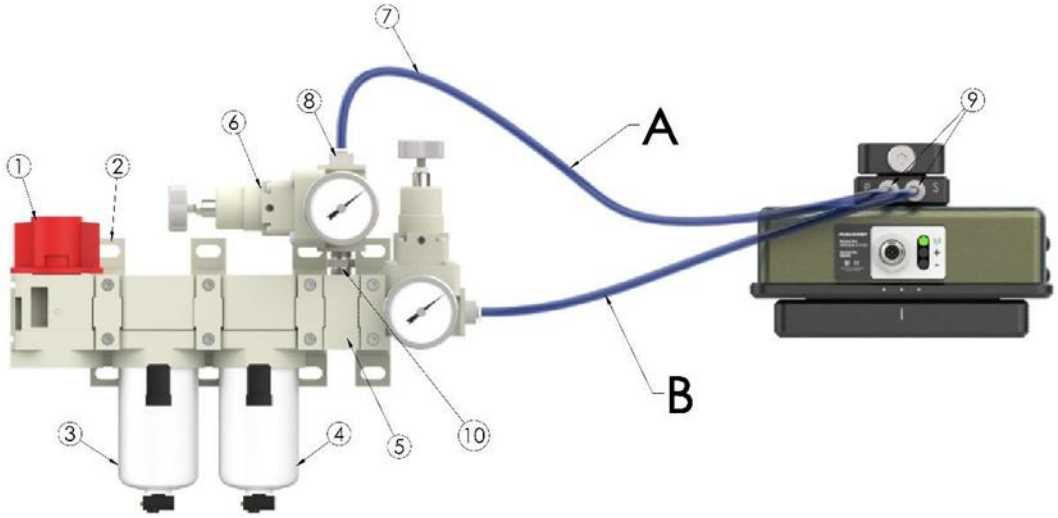


Figure 21: AFD120 Pneumatic Setup

Table 6: AFD120 Pneumatic Setup

Item No.	Vendor	Description	P/N	Qty.
1	SMC	Shut off valve	VHS30-N03-Z-D	1
2	SMC	Connector bracket	Y300T-D	4
3	SMC	Air Filter	AF30-N03C-Z-D	1
4	SMC	Oil/mist separator	AFM30-N03C-Z-D	1
5	SMC	T-bracket	Y310-02-D	1
6	SMC	0.8MPa Precision Regulator	IR2020-02-A	2
7	SMC	ø6mm OD Polyurethane Tubing	6MM Polyurethane Tubing	12 Feet
8	SMC	R1/4 to 6mm straight fitting	KQ2S06-02AS	2
9	SMC	R1/8 to 6mm straight fitting	KQ2S06-01AS	2
10	Grainger	R1/4 x R1/4 pipe connector	60VJ35	1

5.2 AFD62 Passive Force Compliance

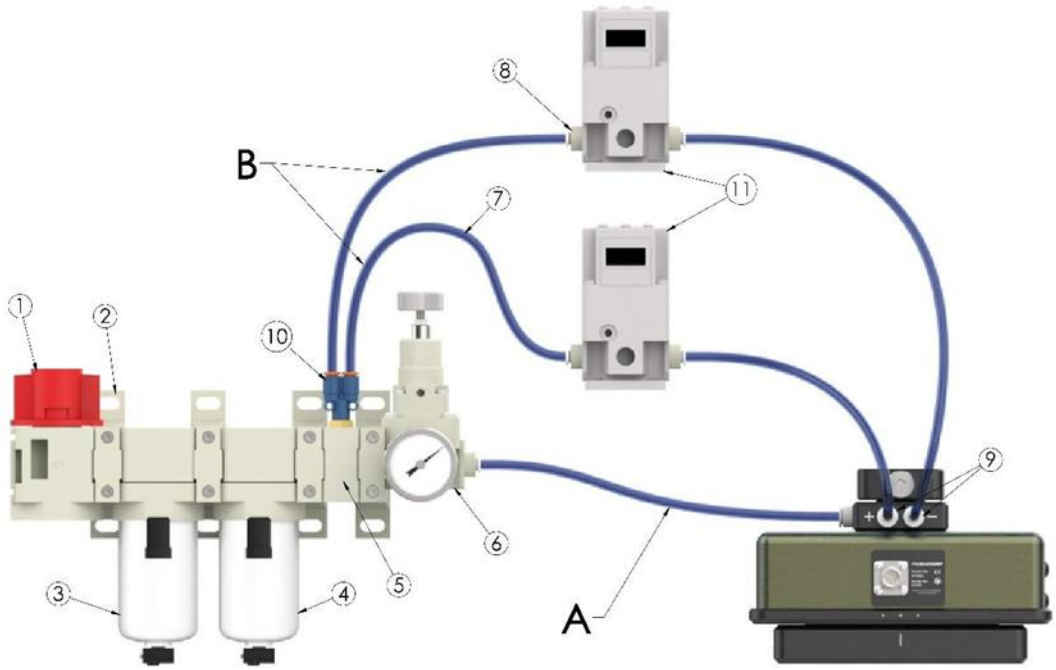


Figure 22: AFD62 Pneumatic Setup

Table 7: AFD62 Pneumatic Setup

Item No.	Vendor	Description	P/N	Qty.
1	SMC	Shut off valve	VHS30-N03-Z-D	1
2	SMC	Connector bracket	Y300T-D	4
3	SMC	Air Filter	AF30-N03C-Z-D	1
4	SMC	Oil/mist separator	AFM30-N03C-Z-D	1
5	SMC	T-bracket	Y310-02-D	1
6	SMC	0.8MPa Precision Regulator	IR2020-02-A	1
7	SMC	ø6mm OD Polyurethane Tubing	6MM Polyurethane Tubing	12 Feet
8	SMC	R1/4 to 6mm straight fitting	KQ2S06-02AS	5
9	SMC	R1/8 to 6mm straight fitting	KQ2S06-01AS	2
10	SMC	R1/4 to 6mm Y-Union	KQ2U06-02AS	1
11	SMC	0.5 MPa Electronic Precision Regulator	ITV2030-312L3	2

5.3 STC2002/SM2002 & AFD120 Active Force Compliance

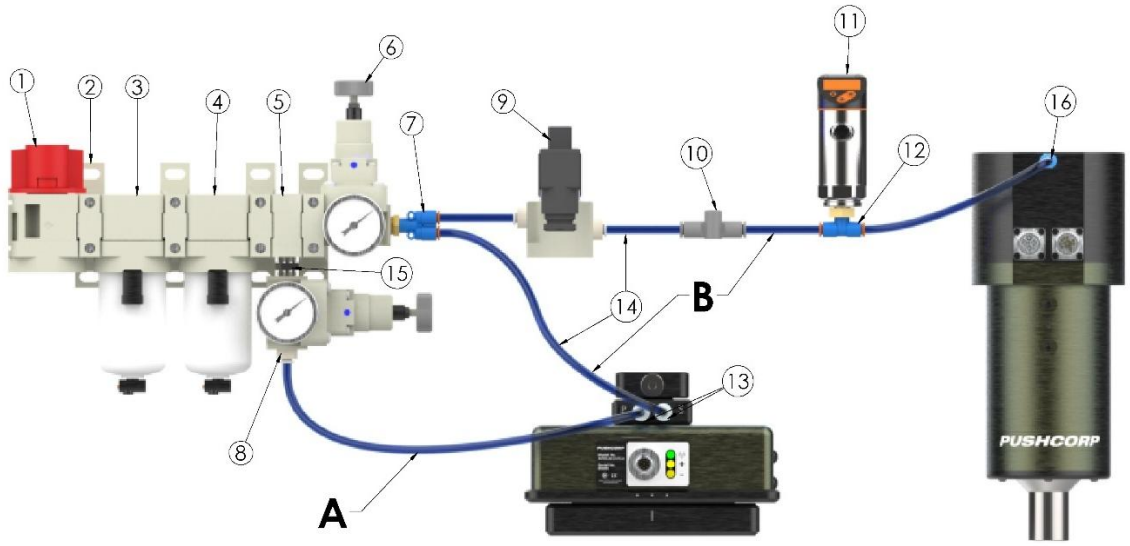


Figure 23: STC2002/SM2002-AFD120 Pneumatic Setup

Table 8: STC2002/SM2002 & AFD120 Pneumatic Setup

Item No.	Vendor	Description	P/N	Qty.
1	SMC	Shut off valve	VHS30-N03-Z-D	1
2	SMC	Connector bracket	Y300T-D	4
3	SMC	Air Filter	AF30-N03C-Z-D	1
4	SMC	Oil/mist separator	AFM30-N03C-Z-D	1
5	SMC	T-bracket	Y310-02-D	1
6	SMC	0.8MPa Precision Regulator	IR2020-02-A	2
7	SMC	R1/4 to 6mm Y-Union	KQ2U06-02AS	1
8	SMC	R1/4 to 6mm straight fitting	KQ2S06-02AS	3
9	SMC	Solenoid Valve	VT317-5DZ-02	1
10	SMC	Quick Exhaust Valve	AQ340F-06-00	1
11	IFM	Pressure Sensor	PN7094	1
12	SMC	G1/4 to 6mm Branch Tee	KQ2T06-G02A	1
13	SMC	R1/8 to 6mm straight fitting	KQ2S06-01AS	2
14	SMC	ø6mm OD Polyurethane Tubing	6MM Polyurethane Tubing	12 Feet
15	Grainger	R1/4 x R1/4 pipe connector	60VJ35	1
16	Festo	M5x6mm straight fitting	QSM-M5-6	1

5.4 STC2002/SM2002 & AFD62 Passive Force Compliance

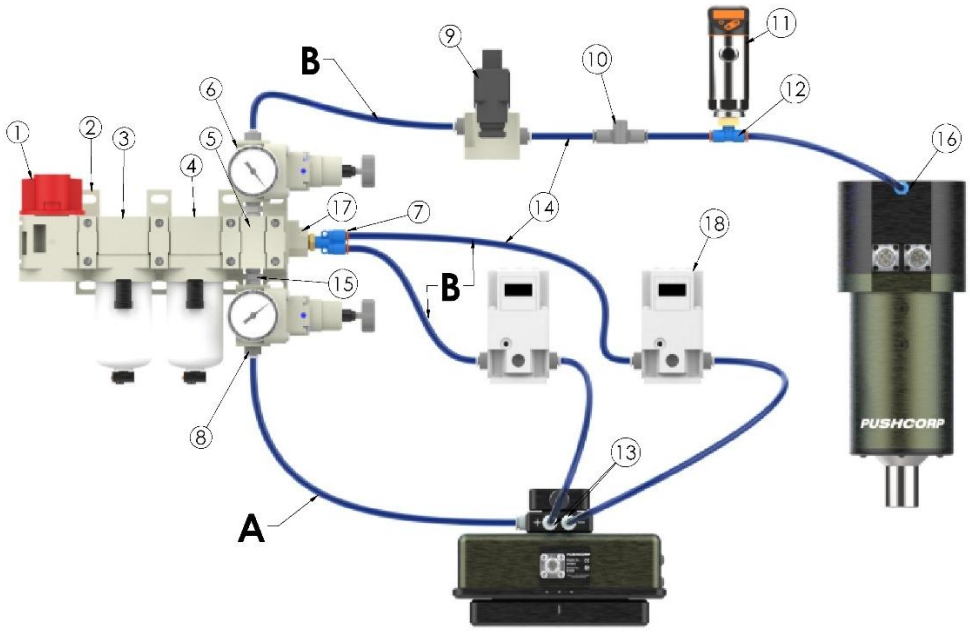


Figure 24: STC2002/SM2002 & AFD62 Pneumatic Setup

Table 9: STC2002/SM2002 & AFD120 Pneumatic Setup

Item No.	Vendor	Description	P/N	Qty.
1	SMC	Shut off valve	VHS30-N03-Z-D	1
2	SMC	Connector bracket	Y300T-D	4
3	SMC	Air Filter	AF30-N03C-Z-D	1
4	SMC	Oil/mist separator	AFM30-N03C-Z-D	1
5	SMC	T-bracket	Y310-02-D	1
6	SMC	0.8MPa Precision Regulator	IR2020-02-A	2
7	SMC	R1/4 to 6mm Y-Union	KQ2U06-02AS	1
8	SMC	R1/4 to 6mm straight fitting	KQ2S06-02AS	7
9	SMC	Solenoid Valve	VT317-5DZ-02	1
10	SMC	Quick Exhaust Valve	AQ340F-06-00	1
11	SMC	Pressure Sensor	PN7094	1
12	SMC	G1/4 to 6mm Branch Tee	KQ2T06-G02A	1
13	SMC	R1/8 to 6mm straight fitting	KQ2S06-01AS	3
14	SMC	ø6mm OD Polyurethane Tubing	6MM Polyurethane Tubing	12 Feet
15	Grainger	R1/4 x R1/4 pipe connector	60VJ35	2
16	Festo	M5x6mm straight fitting	QSM-M5-6	1
17	SMC	R1/4 Piping Adapter	E200-02D	1
18	SMC	0.5 MPa Electronic Precision Regulator	ITV2030-312L3	2

5.5 RPS100 & AFD120Active Force Compliance

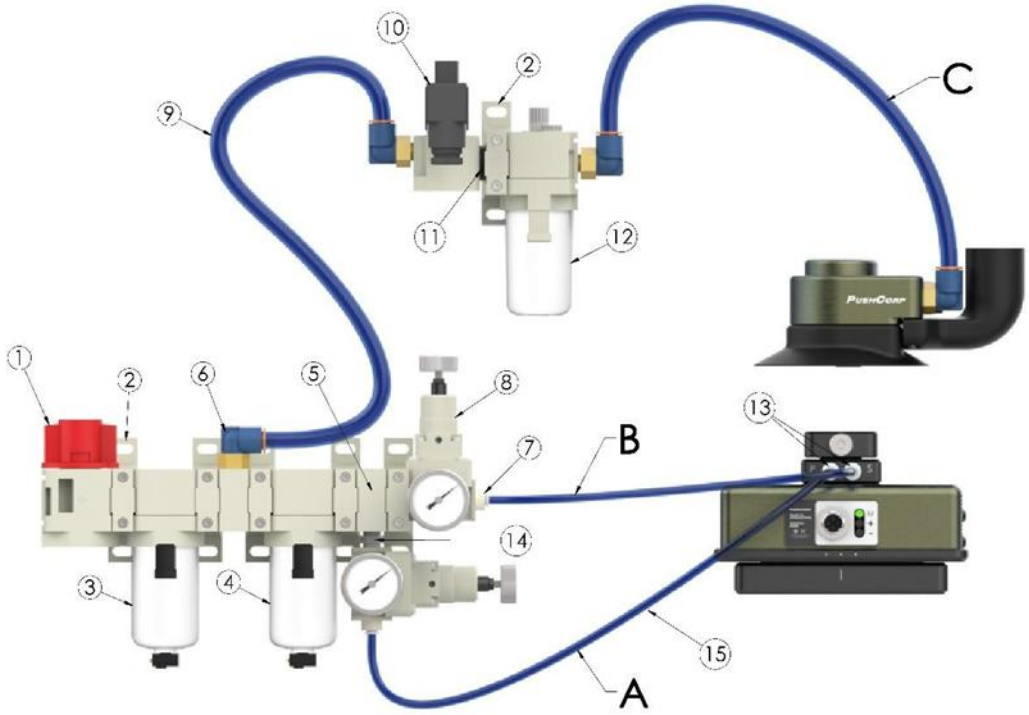


Figure 25: AFD120-RPS100 Pneumatic Set Up

Table 10: AFD120-RPS100 Pneumatic Set Up

Item No.	Vendor	Description	P/N	Qty.
1	SMC	Shut off valve	VHS30-N03-Z-D	1
2	SMC	Connector bracket	Y300T-D	4
3	SMC	Air Filter	AF30-N03C-Z-D	1
4	SMC	Oil/mist separator	AFM30-N03C-Z-D	1
5	SMC	T-bracket	Y310-02-D	1
6	SMC	R1/4 to 12mm elbow fitting	KQ2L12-02AS	4
7	SMC	R1/4 to 6mm straight fitting	KQ2S06-02AS	2
8	SMC	0.8MPa Precision Regulator	IR2020-02-A	2
9	SMC	Ø12mm OD Polyurethane Tubing	12MM Polyurethane Tubing	12 Feet
10	SMC	Solenoid Valve	VT317-5DZ-02	1
11	SMC	Modular Adapter	E310-U02	1
12	SMC	Lubricator	AL30-N03-Z-D	1
13	SMC	R1/8 to 6mm straight fitting	KQ2S06-01AS	2
14	Grainger	R1/4 x R1/4 pipe connector	60VJ35	1
15	SMC	ø6mm OD Polyurethane Tubing	6MM Polyurethane Tubing	12 Feet

5.6 RPS100 & AFD62Passive Force Compliance

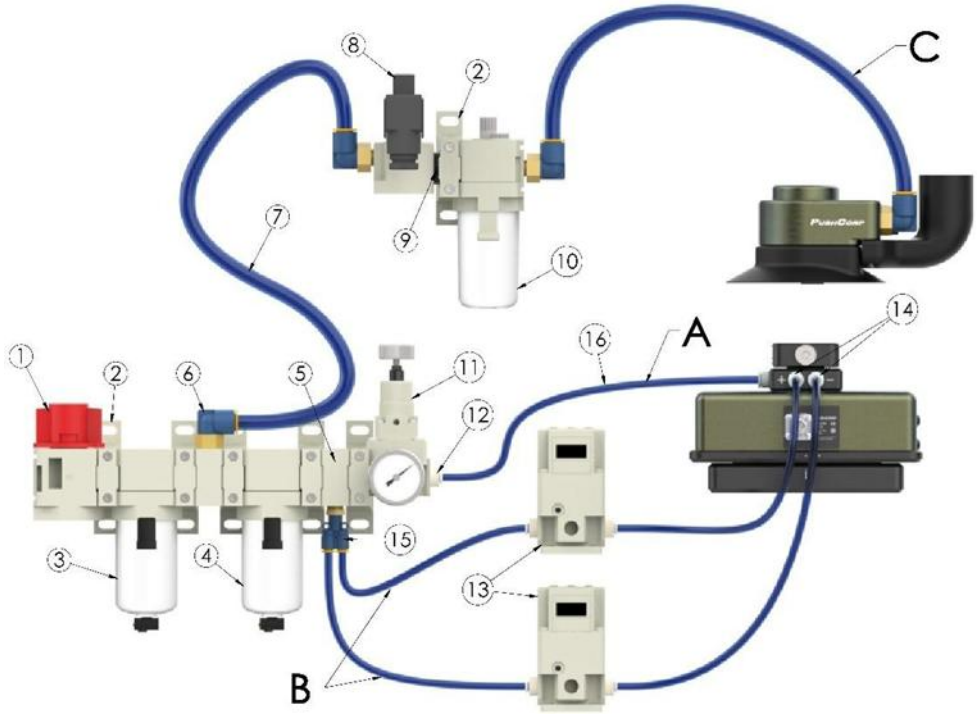


Figure 26: AFD62-RPS100 Pneumatic Set Up

Table 11: AFD62-RPS100 Pneumatic Set Up

Item No.	Vendor	Description	P/N	Qty.
1	SMC	Shut off valve	VHS30-N03-Z-D	1
2	SMC	Connector bracket	Y300T-D	4
3	SMC	Air Filter	AF30-N03C-Z-D	1
4	SMC	Oil/mist separator	AFM30-N03C-Z-D	1
5	SMC	T-bracket	Y310-02-D	2
6	SMC	R1/4 to 12mm elbow fitting	KQ2L12-02AS	4
7	SMC	Ø12mm OD Polyurethane Tubing	12MM Polyurethane Tubing	12 Feet
8	SMC	Solenoid Valve	VT317-5DZ-02	1
9	SMC	Modular Adapter	E310-U02	1
10	SMC	Lubricator	AL30-N03-Z-D	1
11	SMC	0.8MPa Precision Regulator	IR2020-02-A	2
12	SMC	R1/4 to 6mm straight fitting	KQ2S06-02AS	2
13	SMC	0.5 MPa Electronic Precision Regulator	ITV2030-312L3	2
14	SMC	R1/8 to 6mm straight fitting	KQ2S06-01AS	2
15	SMC	R1/4 to 6mm Y-Union	KQ2U06-02AS	1
16	SMC	ø6mm OD Polyurethane Tubing	6MM Polyurethane Tubing	12 Feet

6.0 Electrical Connections

6.1 Active Force Compliance – AFD120 Electrical Connections

The PushCorp AFD120, utilizes a Passive Power over Ethernet connection to interface with the UR20 & UR30. An example of this set up can be seen below in Figure 27.

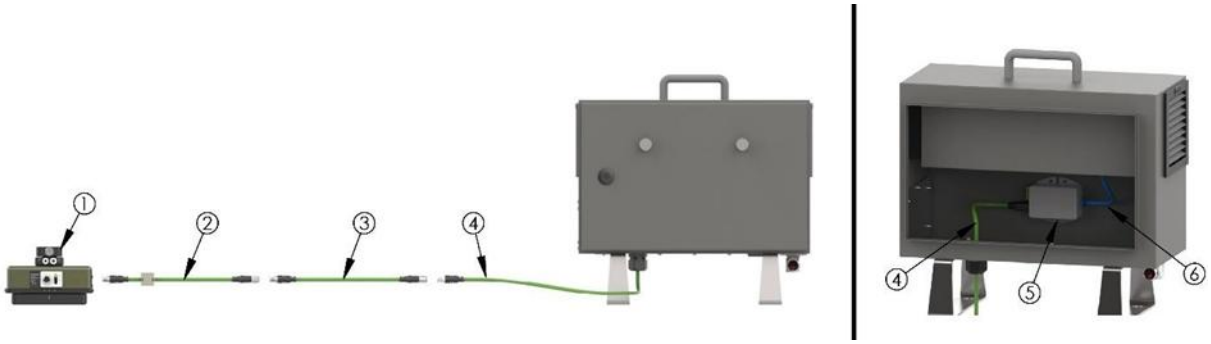


Figure 27: AFD120 Cable Set Up

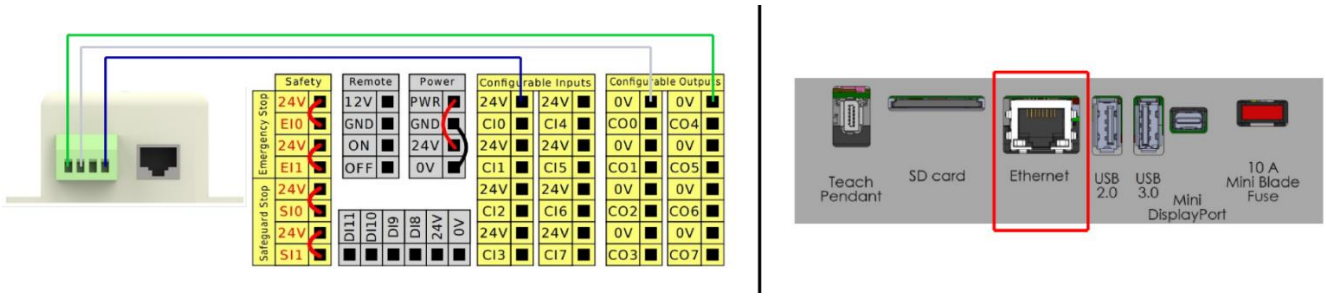


Figure 28: AFD120 Cable Pinout

Table 12: AFD120 Cable Set Up

Item No.	Vendor	Description	P/N	Qty.
1	PushCorp	AFD120	AFD120	1
2	PushCorp	M12 8P M/F STRAIGHT X-CODE 1 METER W/FERRITE	M12M-X8M1-M12F	1
3	PushCorp	M12 8P M/F STRAIGHT X-CODE 7 METER	M12M-X8M7-M12F	1
4	PushCorp	M12 8P M STRAIGHT X-CODE 7 METER FLYING LEAD	M12M-X8M7-RJ45	1
5	PushCorp	POE 24VDC Passive Power Injector	PAR04674	1
6	---	RJ45 Ethernet Cable ~1meter	---	1

Note that the M12M-X8M7-RJ45 cable gets inside the robot controller through a grommet where it mates to the POE injector. Refer to Figure 28 for the pin out from the POE injector to the UR Control Box power panel. Finally, connect the POE injector to the ethernet mating port (boxed in red).

The 8 pin M12 female connector (M12-X8M1-M12F) is plugged into the front panel of the AFD120; when the power is supplied via ethernet, the indicator light will turn green signaling connectivity shown in Figure 29.

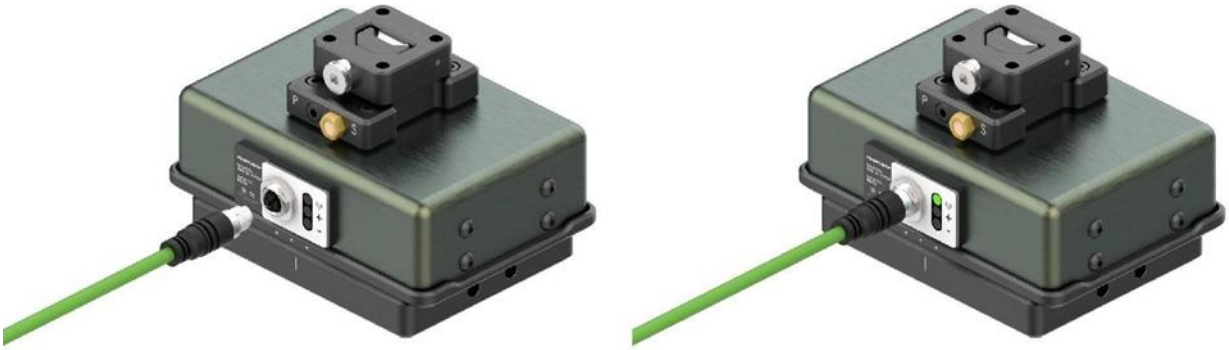


Figure 29: AFD120 POE - Cable Connection

6.2 Passive Force Compliance – AFD62 Electrical Connections

The AFD62 is controlled via electronic air regulators that control air to the positive (+) and negative (-) air supply ports on the force compliance device. The cable connection provides feedback through the UR robot, and can be seen in Figure 30 below.

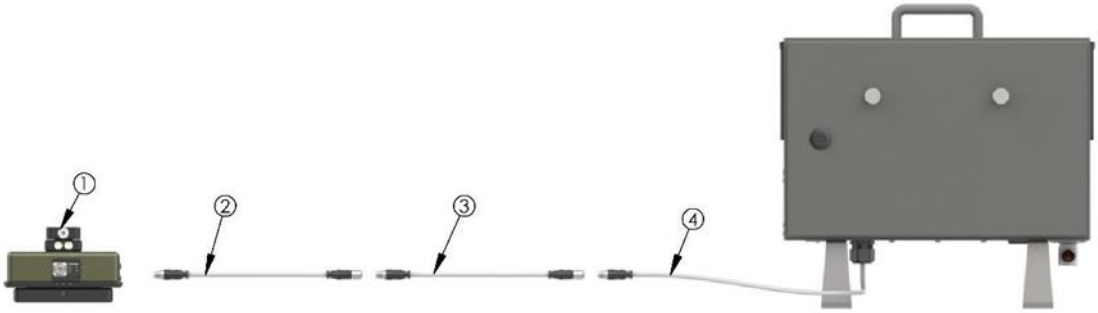


Figure 30: AFD62 Cable Setup

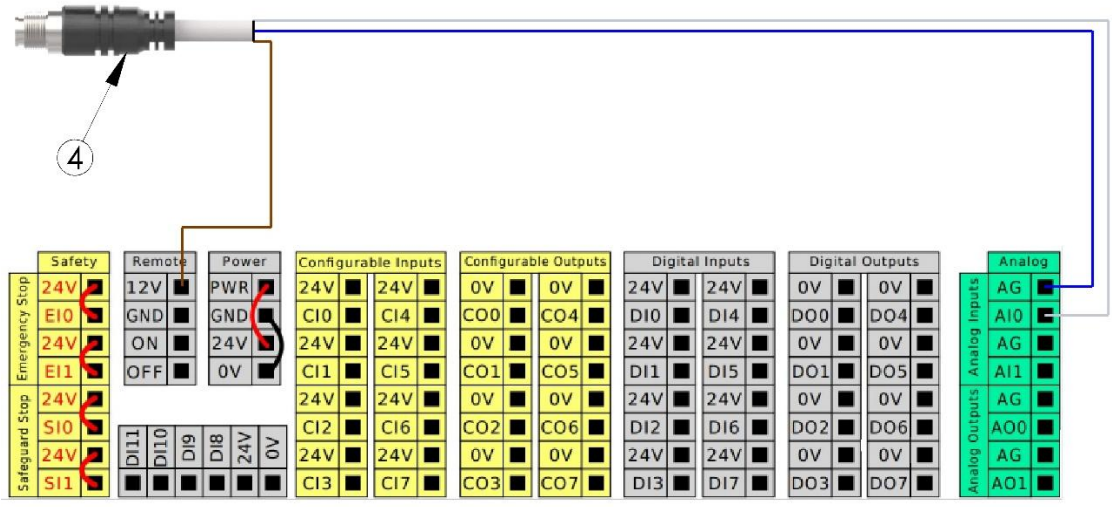


Figure 31: AFD62 Cable Pinout

Table 13: AFD62 Cable Set Up

Item No.	Vendor	Description	P/N	Qty.
1	PushCorp	AFD62	AFD62	1
2	PushCorp	M12 8P M/F STRAIGHT X-CODE 1 METER W/FERRITE	M12F-A4M1-M12M	1
3	PushCorp	M12 8P M/F STRAIGHT X-CODE 7 METER	M12F-A4M7-M12M	1
4	PushCorp	M12 4 Pin A-Code	XXXXXXX	1

6.2.1 Electronic Regulators

Please refer to the pin out shown in Figure 32 for the required electronic regulators for the AFD62.

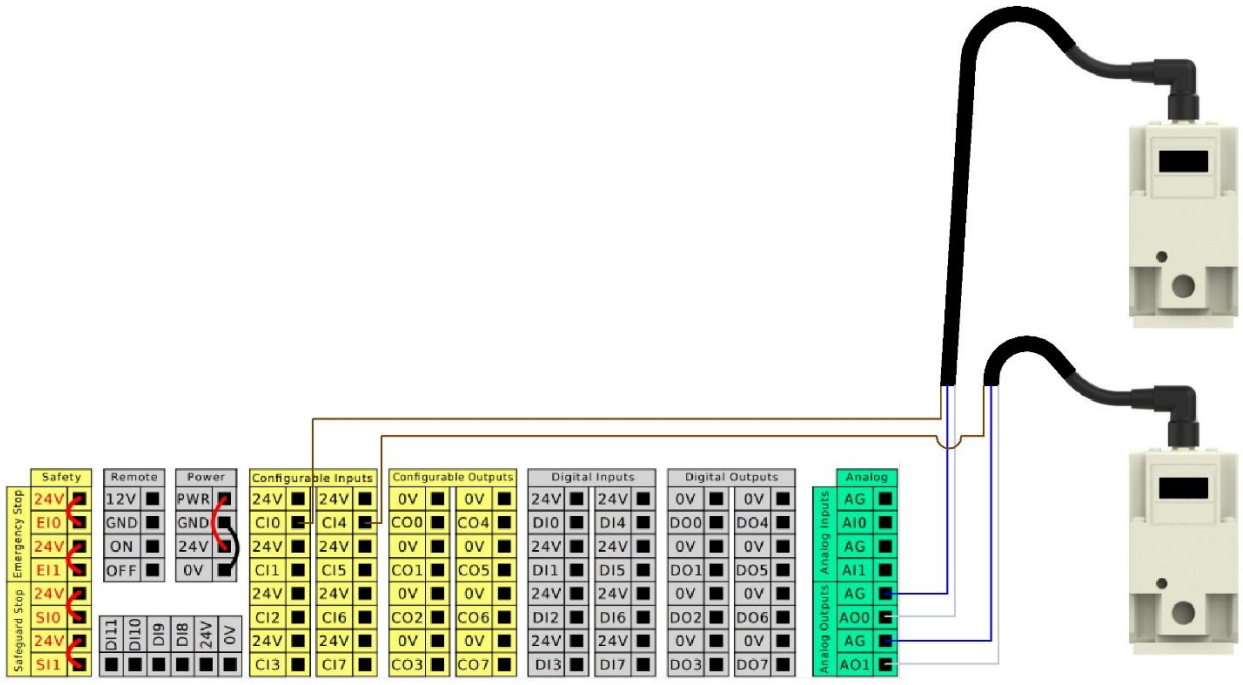


Figure 32: AFD62 Electronic Regulator Pin OUT

6.3 STC1202/2002 Electrical Connections

6.3.1 AKD2G Amplifier Power Requirements

The STC1202 & STC2002 requires a servo amplifier to communicate at which the speed of the spindle needs to operate. Refer to the pin outs shown in Figure 33 & Figure 34 for the proper configuration to power the amplifier.

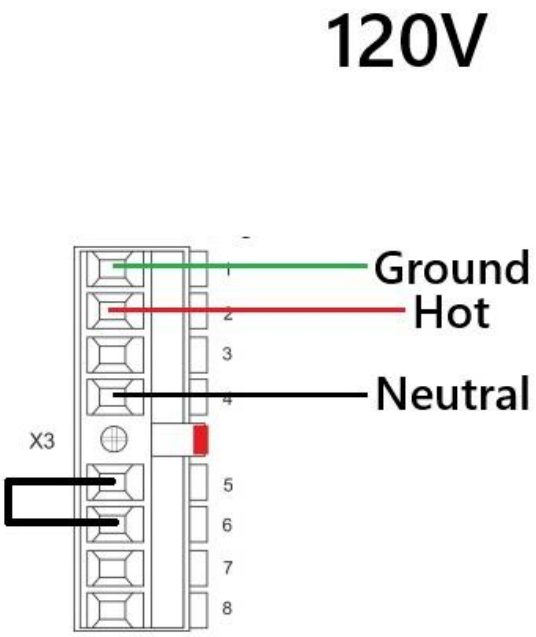


Figure 33: 120V Amplifier Power Pinout

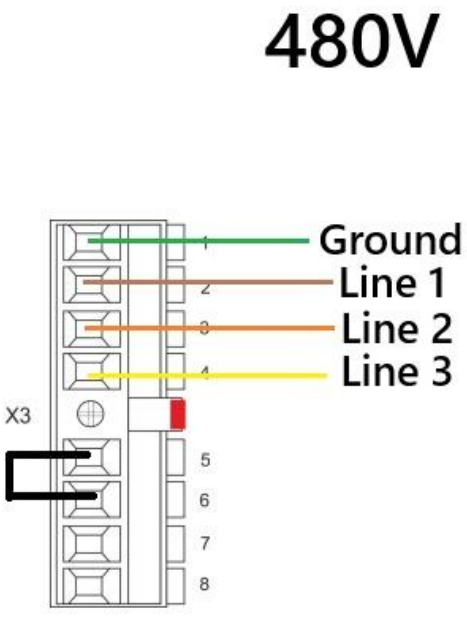


Figure 34: 480V Amplifier Power Pinout

6.3.2 Amplifier & Spindle Communication

For the amplifier to communicate to communicate properly with the spindle, please refer to the pinout seen in Figure 35

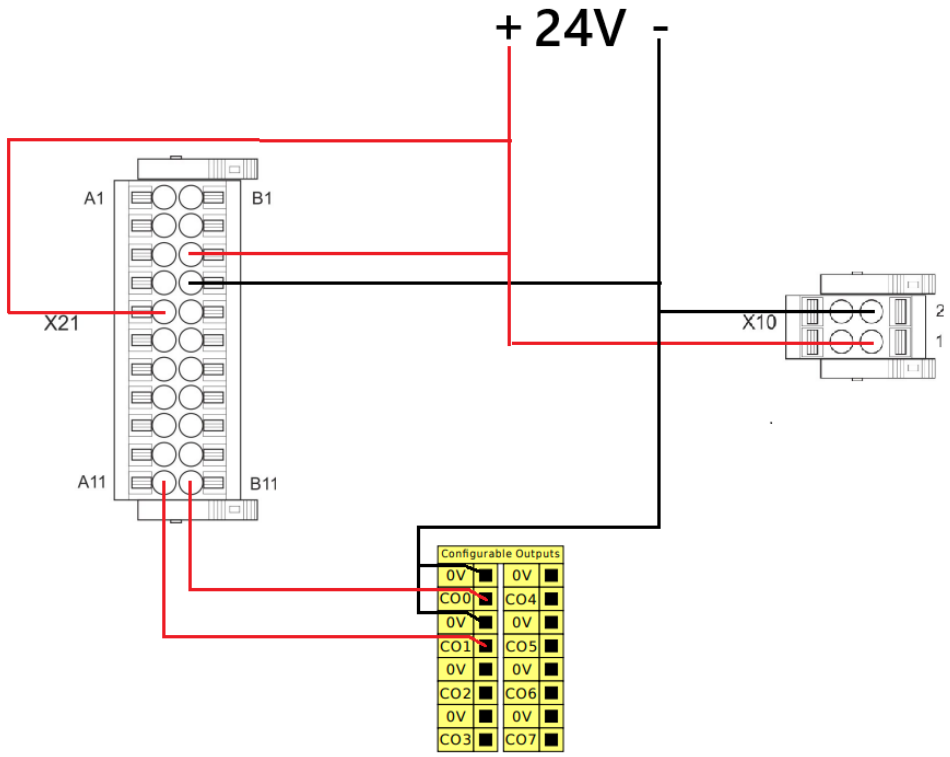
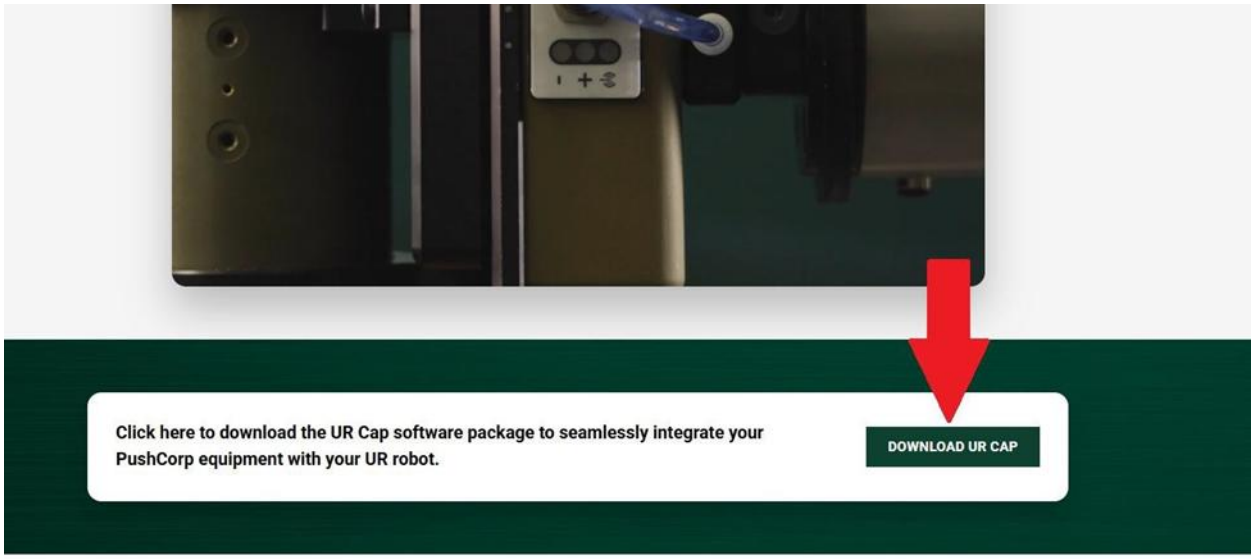


Figure 35: AKD2G - STC1202/STC2002 Communication

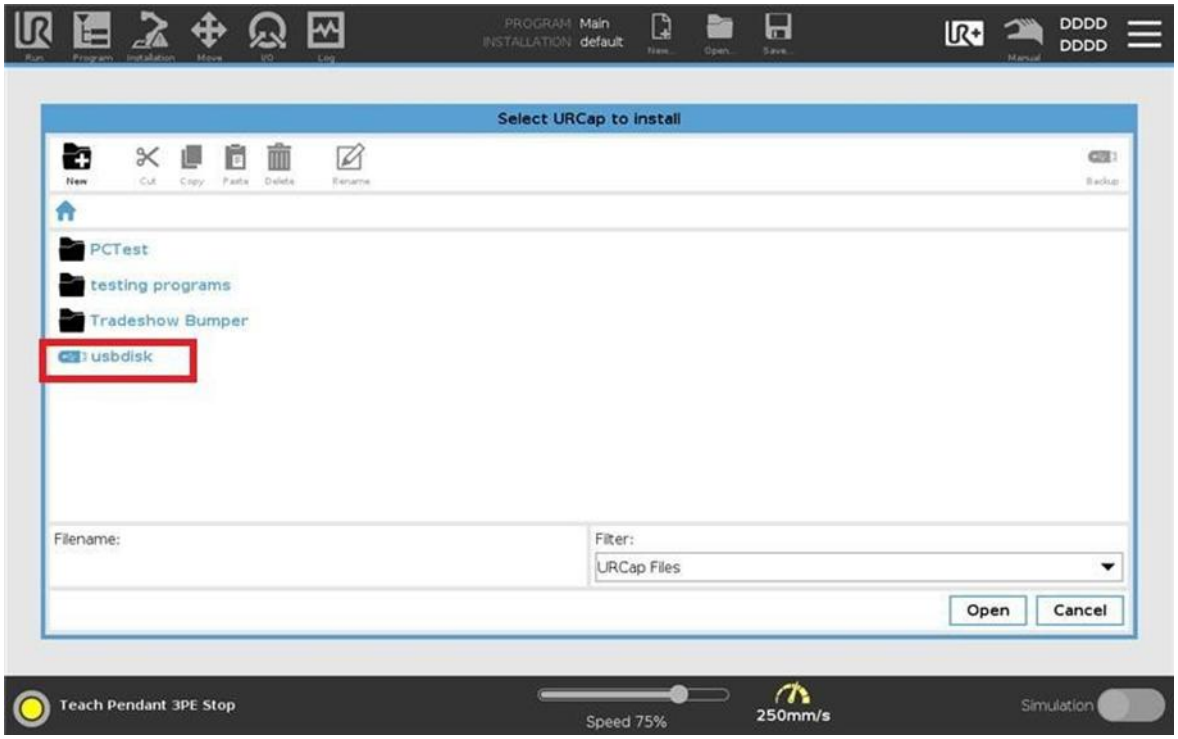
It is important to note that A11 & B11 both need constant 24V for the spindle to operate; any lapse in 24V to either terminal will result in the spindle stopping. If A11 & B11 Are provided with 24V and the pin out is as shown above, the user can now set the RPM and enable/disable the spindle.

7.0 UR Cap Installation

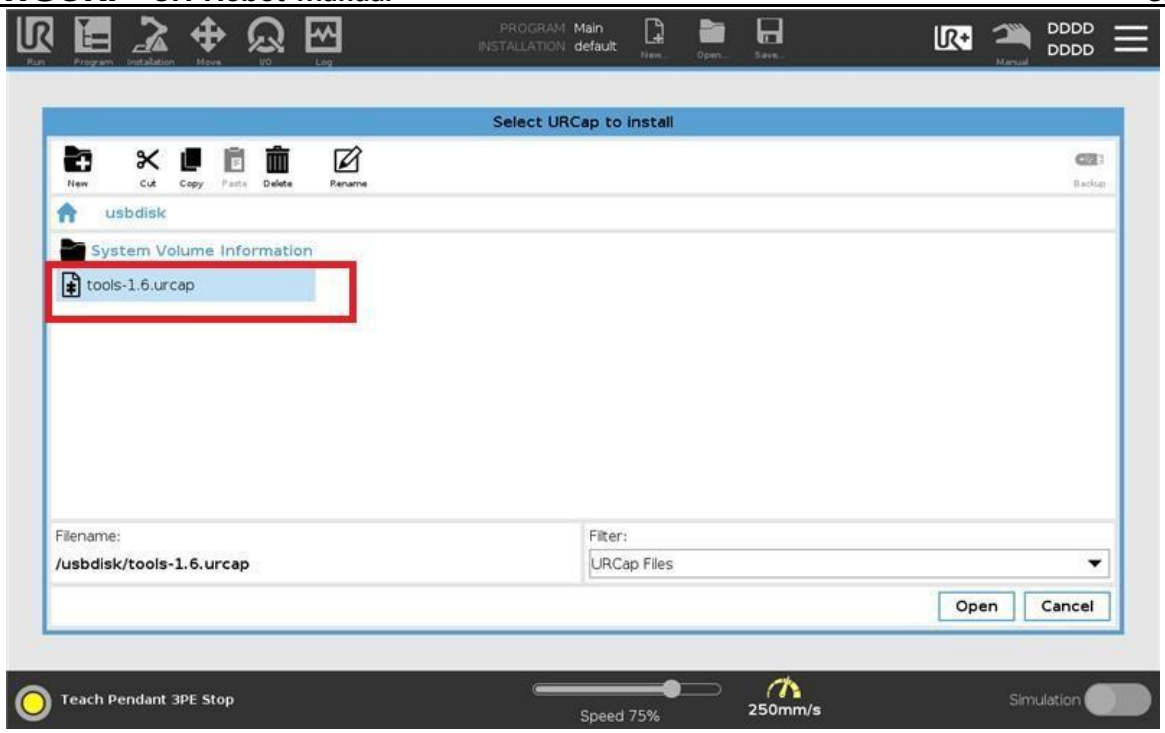
Download the UR Cap from the PushCorp website by visiting: https://pushcorp.com/ur/ and clicking the download button. Once download copy all files over to a USB drive.



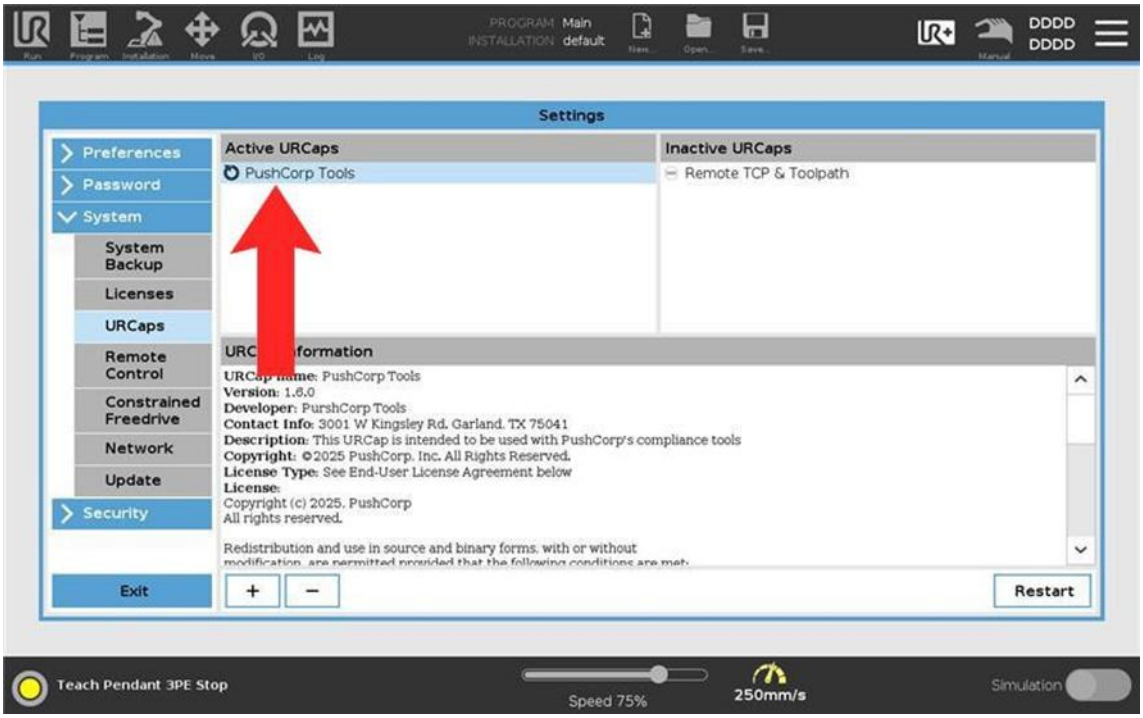
Insert the USB into the teach pendant of the UR Robot. On the user interface of the tablet, click **Settings->System->UR Caps.** From there, click on the plus sign to show the file manager as seen below. Click on your USB file location.



Next click on the file with the .urcap extension located in the USB folder.



Click on *PushCorp Tools* URCap, and click *Restart.* Doing this will open the prompt to *Save Changes.* Save the changes and the UR program will then restart with the URCap successfully installed on the robot.



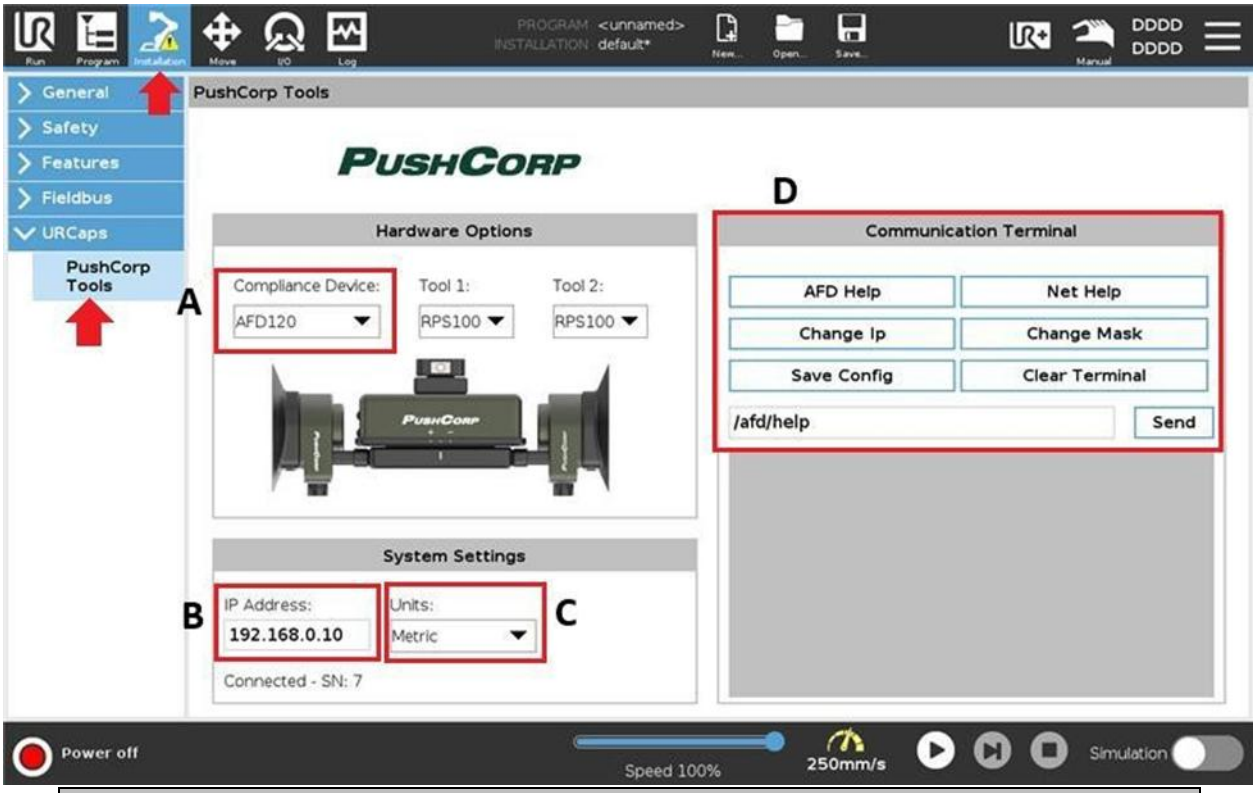
8.0 Operating the URCap

This section will cover the operation of the URCap. Refer to the respective section below depending on the tooling set up. The URCap user interface is primarily composed of 3 tabs for operation: *Installation, Program, and Toolbar.*

8.1 Active Force Compliance

This section will cover the URCap procedure for programming the AFD120.

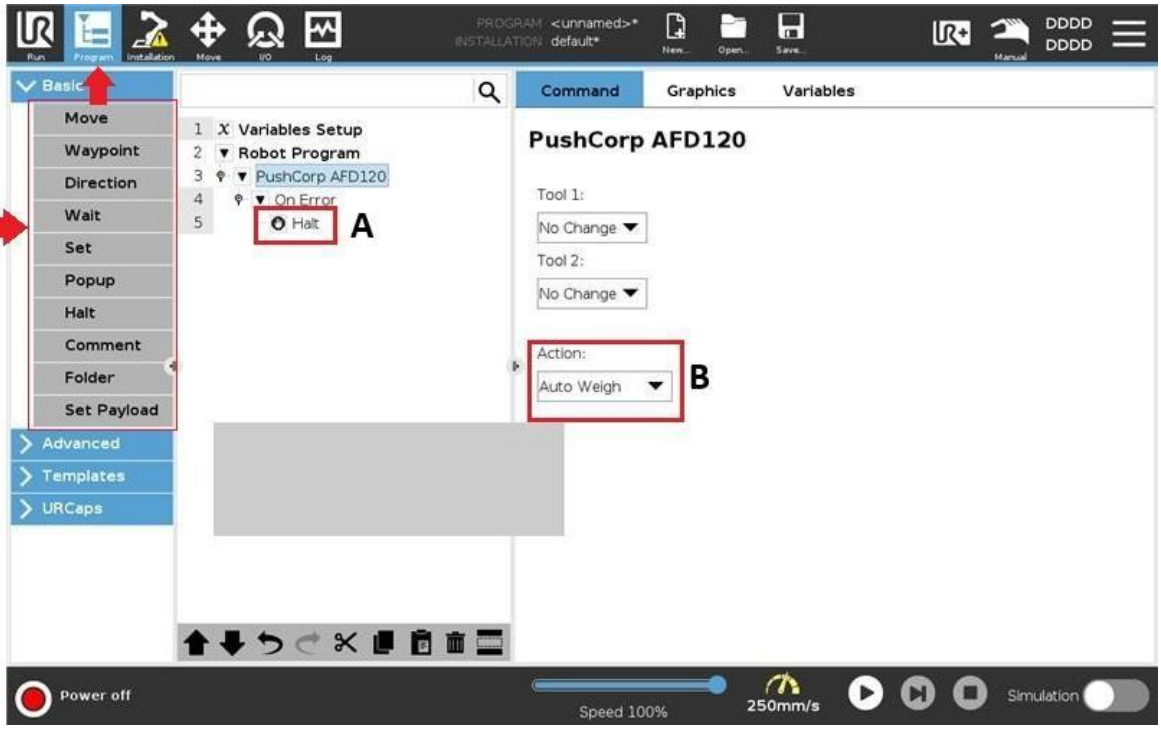
8.1.1 Installation



INSTALLATION	
A:	Compliance Device Selection
B:	IP Address*
C:	Unit Selection
D	Communication Terminal: This is designed for PushCorp Application engineers to help with technical support remotely. Please consult PushCorp technical support before using this feature.

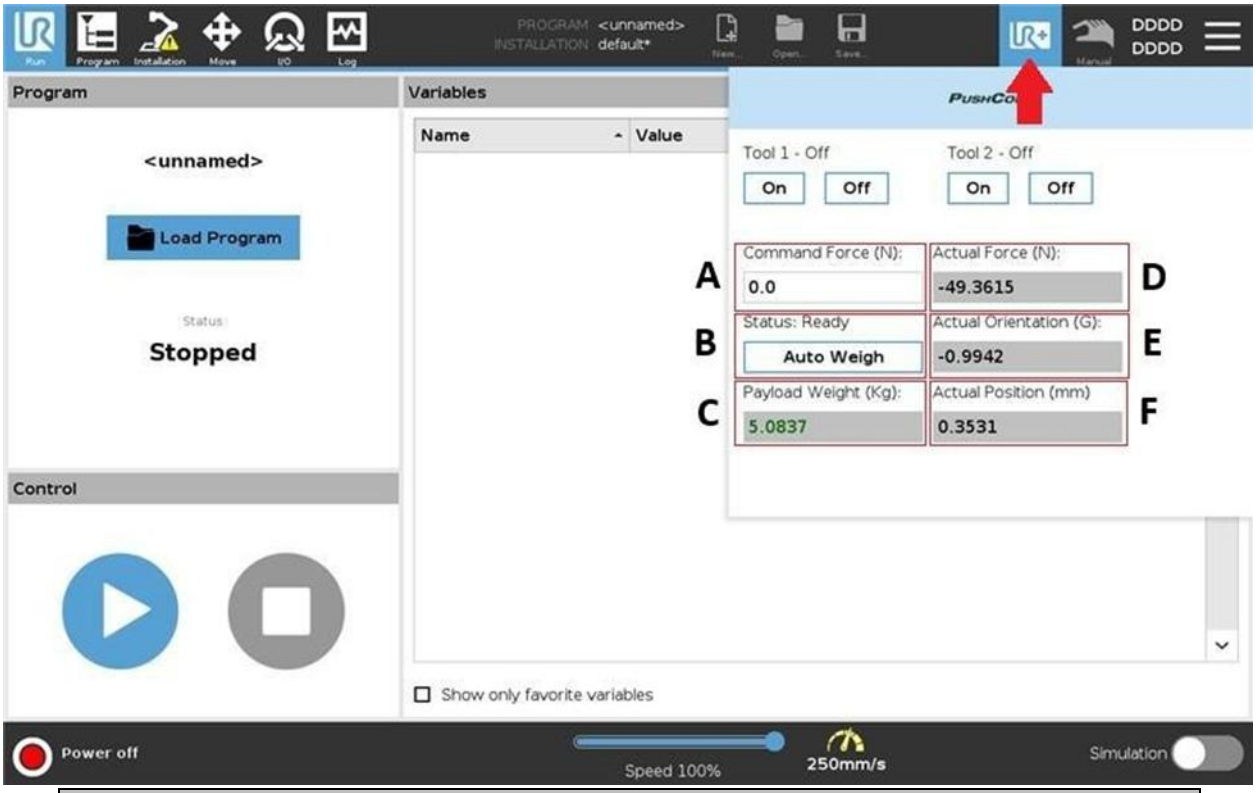
**If the tool does not connect with IP address 192.168.0.10 please reach out to PushCorp technical support for assistance.*

8.1.2 Program



PROGRAM	
A:	Select on the <empty> statement, and add a Basic function; the program ***WILL NOT WORK***, if there is no Basic function added. From here, it is possible to turn on/off the tools, and *Set the Force* or *Auto Weigh,* and to continue to program the UR robot.
B:	Action List: • Auto Weigh • Set Force

8.1.3 Toolbar

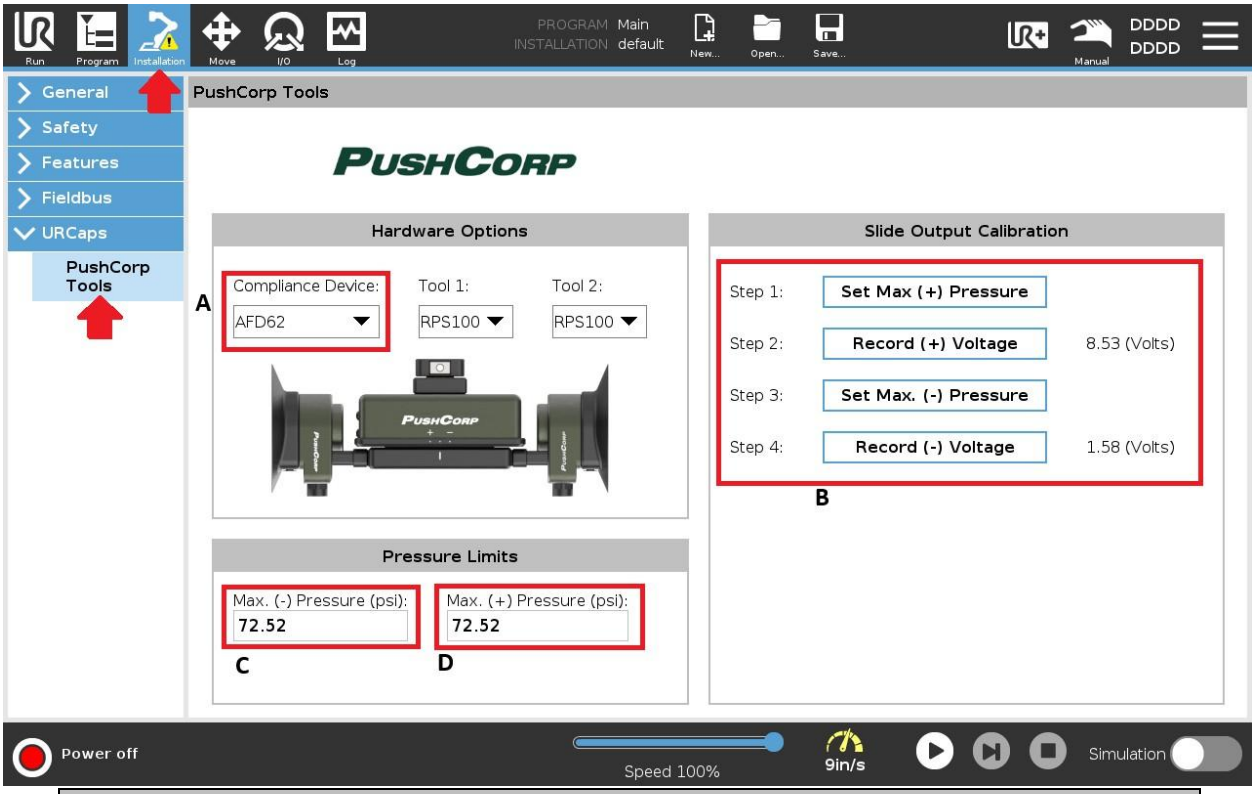


TOOLBAR	
A:	Command Force (N): User input of force compliance value
B:	**Auto Weigh** button: weighs the payload mounted on the AFD carriage
C:	Payload weight (kg): weight of the components mounted to the force compliance carriage that is calculated from the Auto Weigh
D:	Actual Force (N): This is a monitor of the actual force applied
E:	Actual Orientation: this value is the actual orientation relative to gravity
F:	Actual Position (mm): carriage location on force compliance device

8.2 Passive Force Compliance

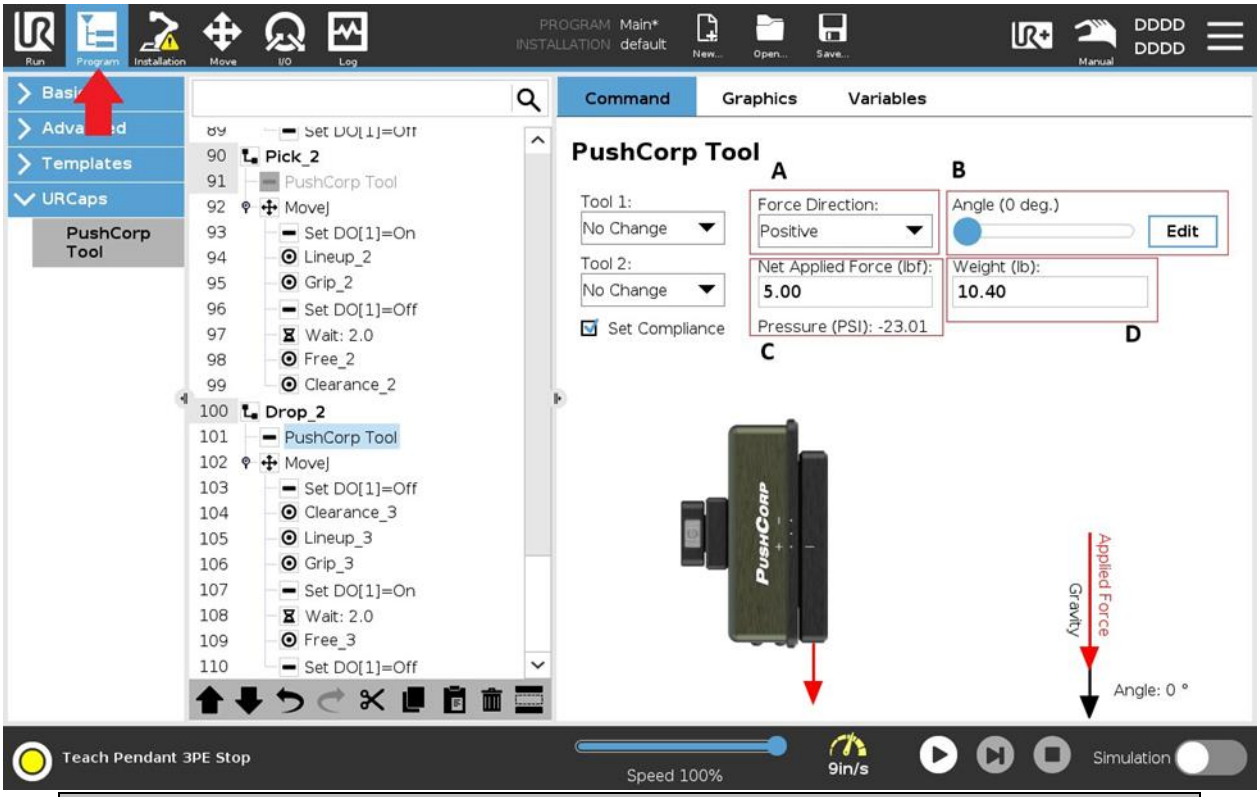
This section will cover the URCap procedure for programming the AFD62.

8.2.1 Installation



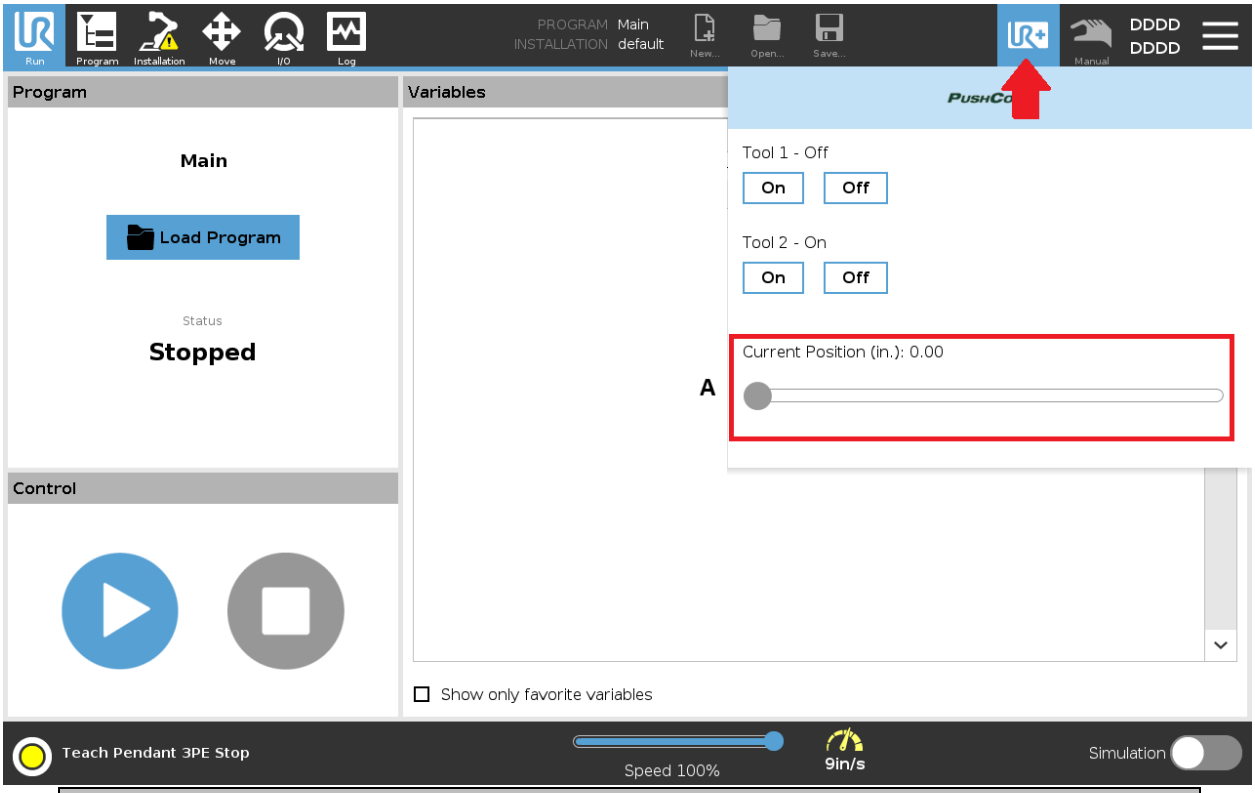
INSTALLATION	
A:	Compliance Device Selection
B:	<u>Slide Output Calibration Steps:</u> • Select 'Set Max. (+) Pressure' • Select 'Record (+) Voltage' ○ The recorded voltage should approximately 8.5 Volts • Select 'Set Max. (-) Pressure' • Select 'Record (-) Voltage' The recorded voltage should approximately 1.58 Volts
C:	Max (-) Pressure (psi): This is set based on the max pressure the Supply - electronic regulator is capable of. The default value should be 72.52
D:	Max (+) Pressure (psi): This is set based on the max pressure the Supply + electronic regulator is capable of. The default value should be 72.52

8.2.2 Program Node



PROGRAM	
A:	Force Direction: dictates the direction of force compliance as indicated on the force compliance device. Positive will apply force toward the + tick mark and negative will apply the force toward the – tick mark.
B:	Angle: This value is the carriage position relative to gravity. The user inputs this value based on the position during the application. Every orientation change will require a new angle to maintain a constant force
C:	Net Applied Force (lbf): This is the desired force that the user would like to apply
D:	Weight: the weight of the payload that is mounted to the carriage of the AFD

8.2.3 Toolbar



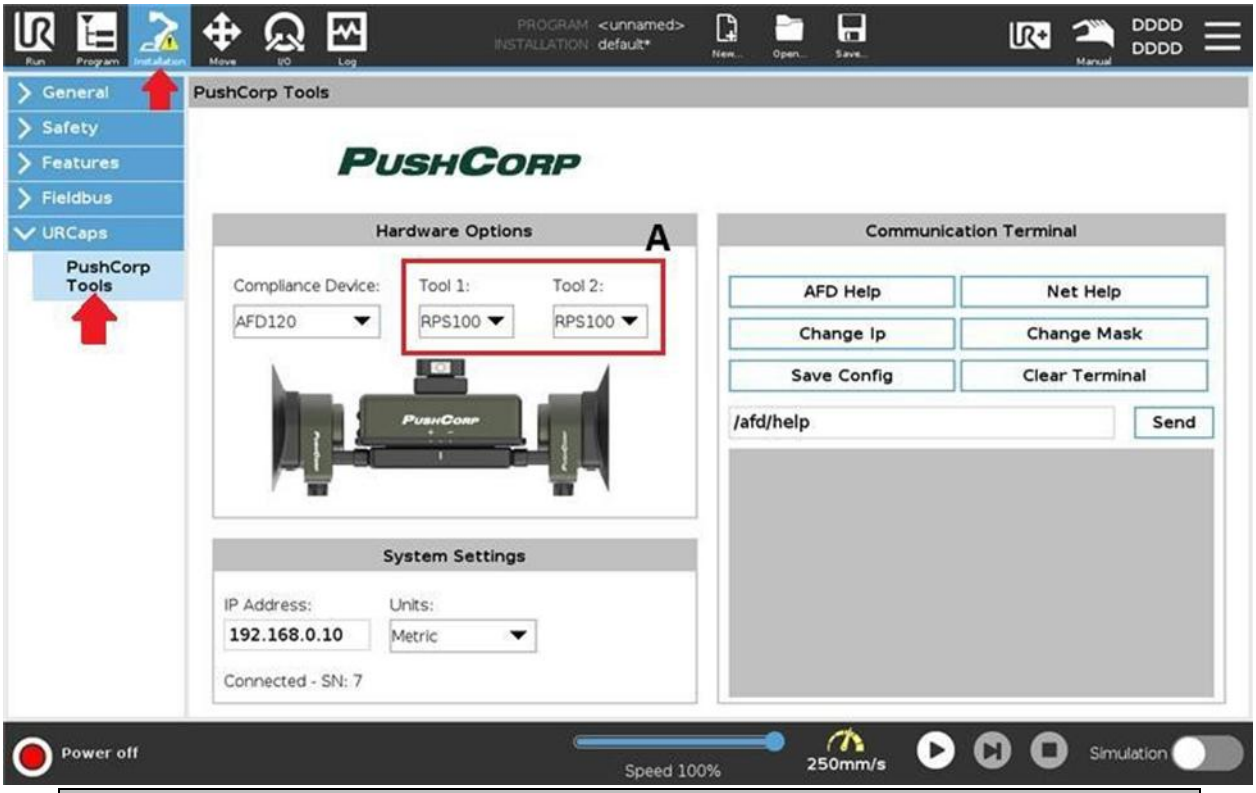
TOOLBAR	
A:	Current Position (in.): this display slider shows the carriage position of the force compliance device. This is calibrated by following the steps on the installation page.

8.3 RPS100 & Pneumatic Tools

This section will cover the URCap procedure for programming the RPS100.

NOTE: While PushCorp recommends the use of the RPS100, it is not required. Any instance of the RPS100 can be replaced with a commercial-off-the-shelf pneumatic sander.

8.3.1 Installation

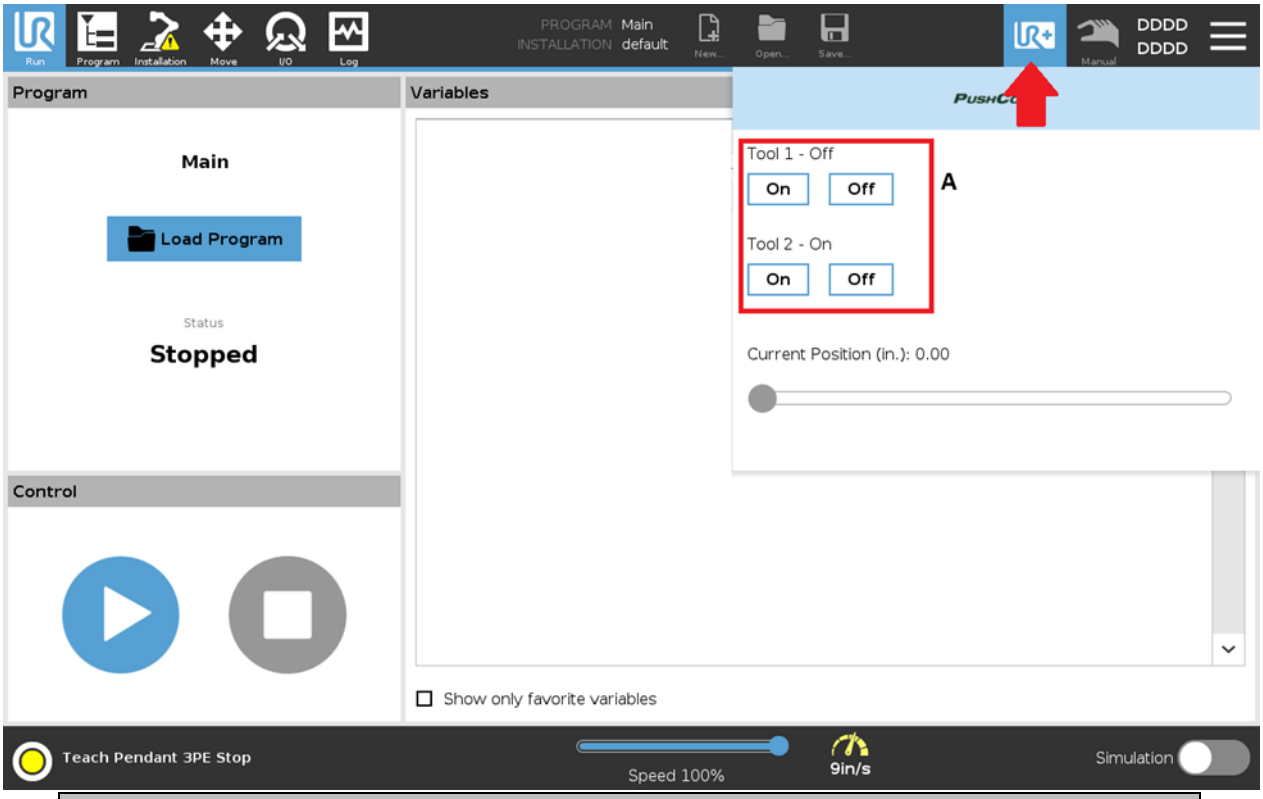


INSTALLATION	
A:	Pneumatic Sanding Tool Toggle

8.3.2 Program Node

PROGRAM	
A:	<u>Tool operation:</u> • On • Off

8.3.3 Toolbar



TOOLBAR	
D:	Tool 1 & Tool2 toggle ON/OFF

8.4 STC1202 & STC2002

This section will cover setting the speed of the STC1202 & STC2002, as well as ensuring that the E-Stop is properly configured.

8.4.1 STC1202 &STC2002 Speed Configuration and Enabling

To properly configure the MODBUS settings for the spindle RPM, please refer to the equations shown below:

$$SpRPM_H = \frac{1000 * (RPM)}{65536}$$

Take only the whole number of the result of the equation without any rounding up. Next subtract the whole number from the calculated value, leaving only decimal and plug it into the following equation:

$$SpRPM_L = (Decimal\ value) * 65536$$

For example, to configure the spindle to spin at 9000 RPM"

$$SpRPM_H = \frac{1000 * 9000}{65536}$$

$$SpRPM_H = 137.329102 \rightarrow 137$$

$$SpRPM_L = (0.329102) * 65536$$

$$SpRPM_L = 21568$$

To register the output of turning the spindle OFF, input the following under the I/O tab:

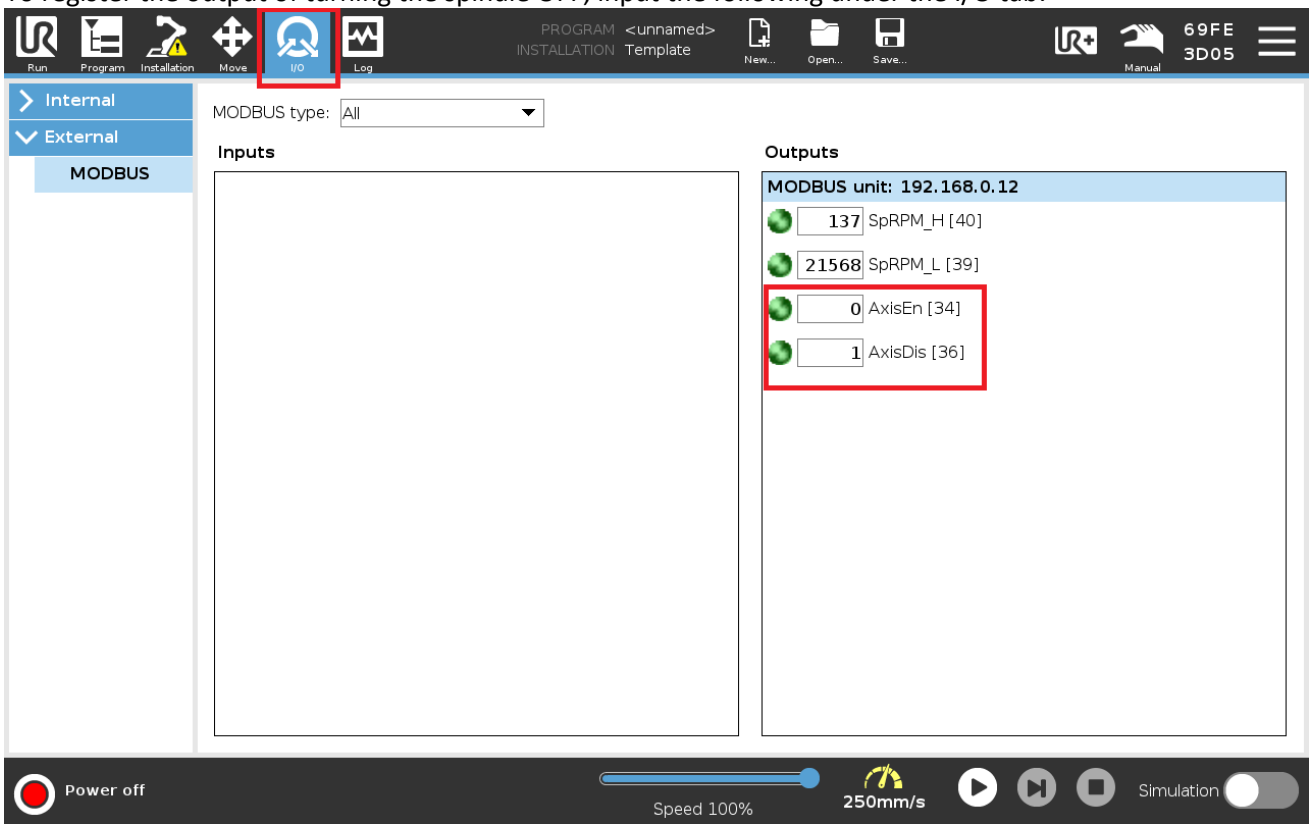


Figure 36: Disabling the Spindle

When inserted into the robot's program, these output commands will appear like the program shown in Figure 37.

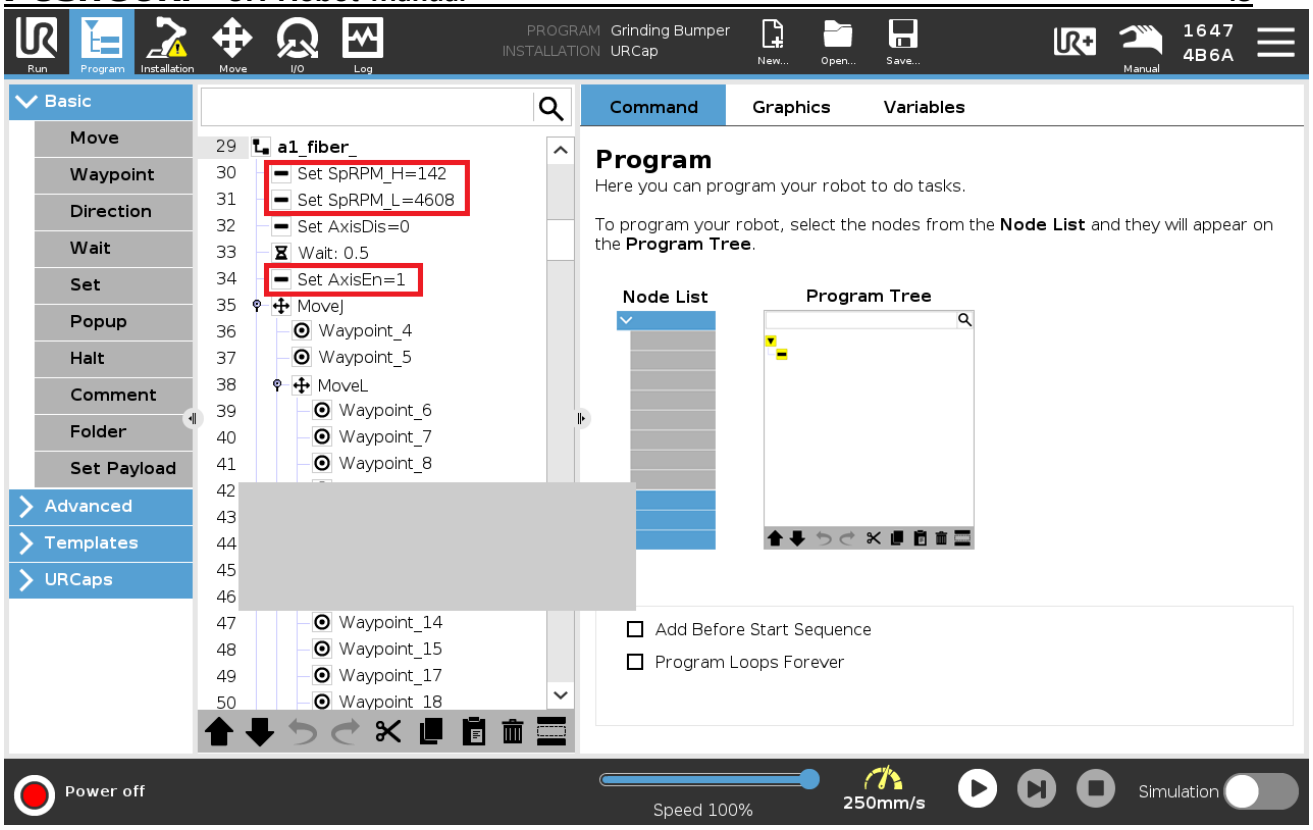


Figure 37: Program Example Showing Outputs

It is necessary to apply the following address locations to send the outputs to the proper location.

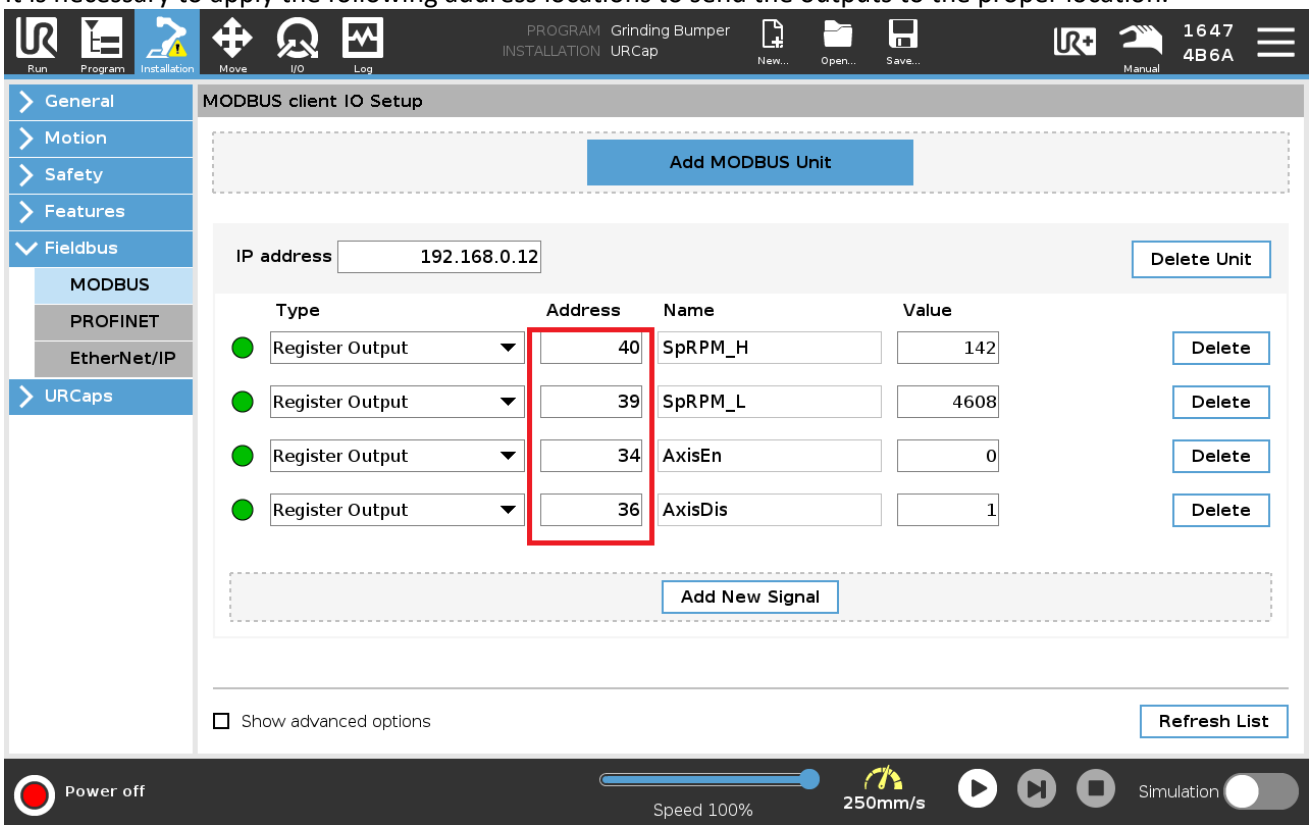


Figure 38: Address Locations

8.4.2 STC1202 &STC2002 E-Stop

To incorporate the emergency stop for the STC1202/2002, select ‘System Emergency Stop’ from the drop down menu shown in Figure 39.

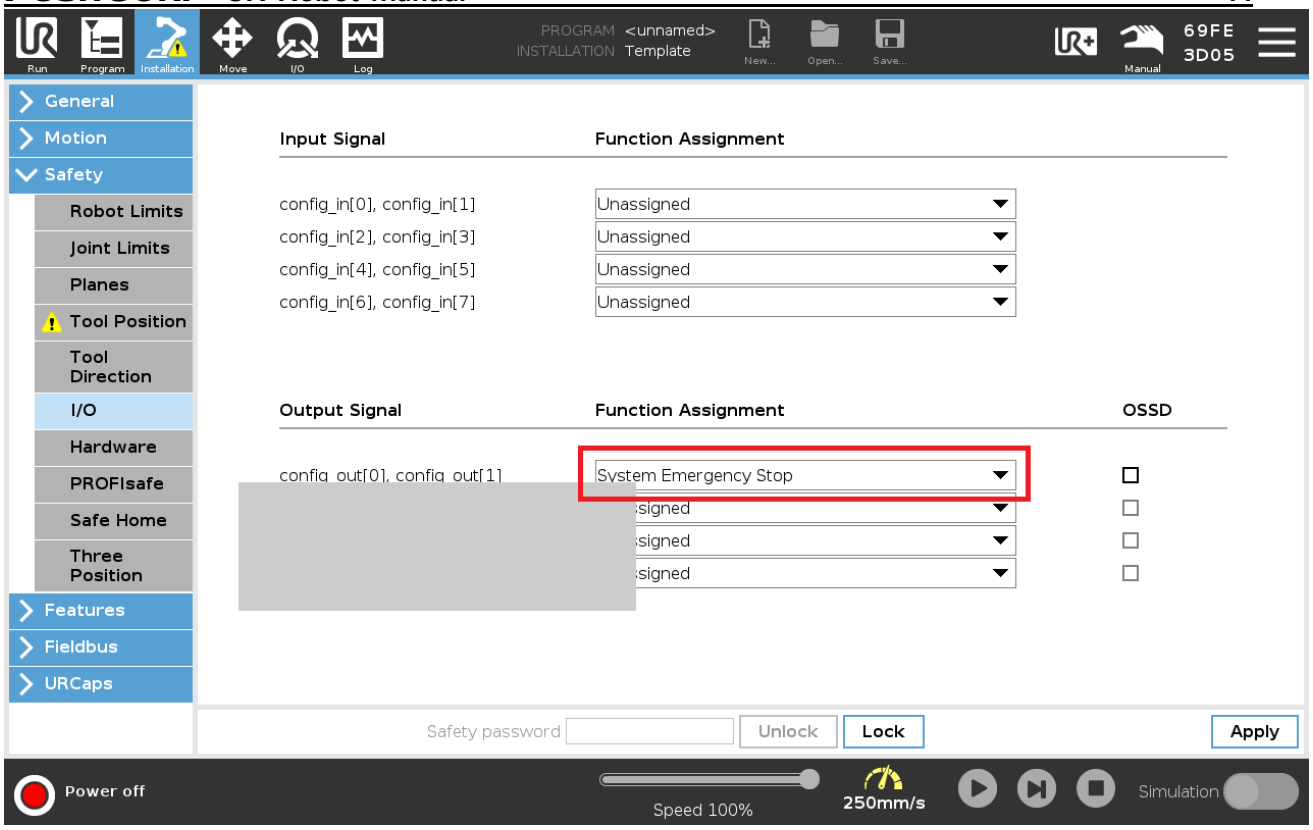


Figure 39: Emergency Stop Parameter Selection

To confirm that this selection functions correctly, navigate to the page shown in Figure 40 and confirm that the boxes shown in the red selection match.

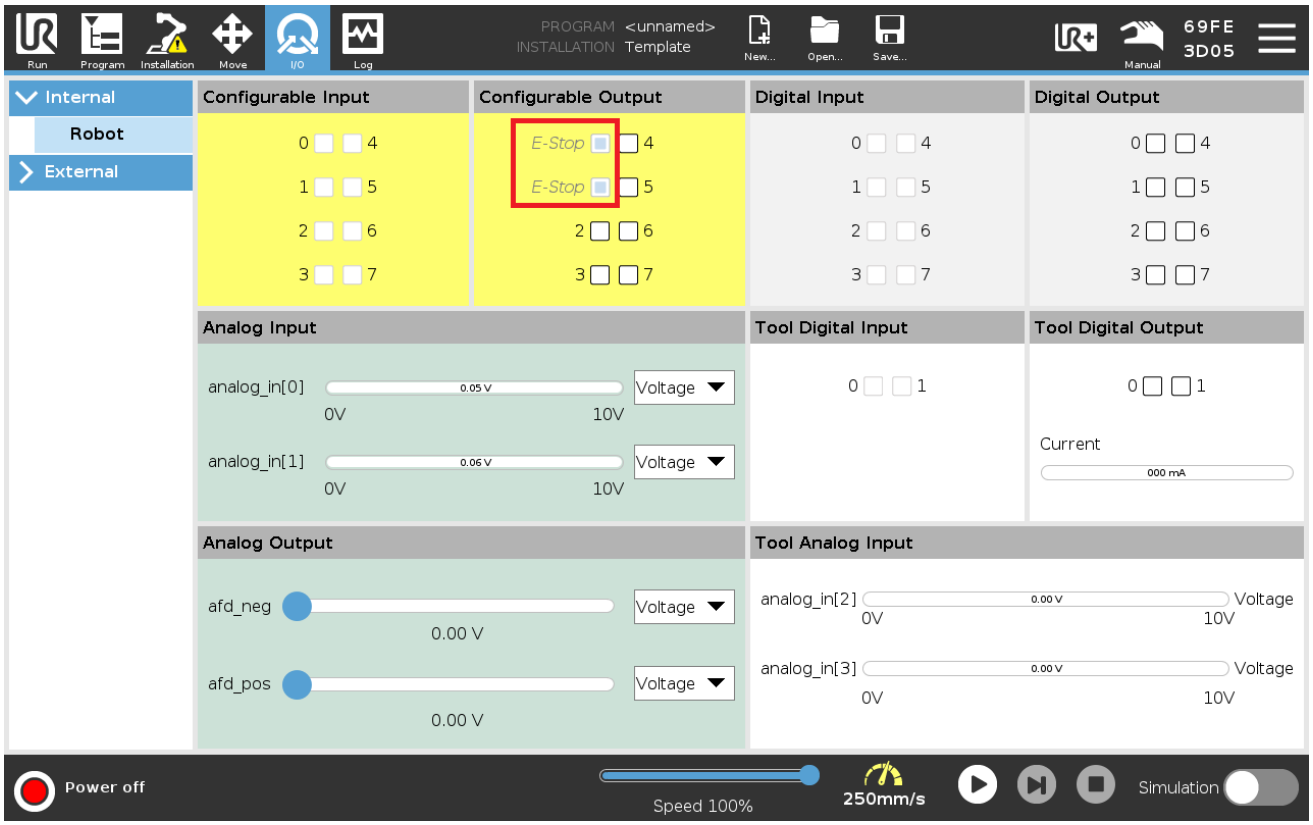


Figure 40: E-Stop Configurable Output

9.0 Technical Specifications

Please refer to the respective product user manuals found at www.pushcorp.com for technical specifications.

TORQUE SPECIFICATIONS:

Table 14: Torque Specifications

Fastener Tightening Torque Specs					
	Torque			Minimum Depth	
Fastener Size	in.-lbs.	ft.-lbs.	N·m	in.	mm
M4 x .7	50	4.2	5.6	0.17	4.3
M5 x .8	85	7.1	9.6	0.21	5.3
M6 x 1	140	11.7	15.8	0.25	6.3
M8 x 1.25	348	29.0	39.3	0.33	8.4
M10 x 1.5	600	50.0	67.8	0.41	10.5

10.0 Preventative Maintenance Schedule

It is highly recommended to adhere to the preventative maintenance schedule in order help extend the longevity of the specified PushCorp, equipment. Failing to do so could cause a loss in functionality as well as a decrease in product life. Please refer to the appropriate section below for the recommended maintenance schedule.

10.1 STC1202/SM1202

PUSHCORP SPINDLES			
Maintenance	**Weekly**	**Monthly**	**3 Months**
Remove chips from the ID of the shaft	X		
Remove debris from spindle/spindle housing	X		
Check that the connectors are not bent/damaged	X		
Check for flow in the motor cooling ports		X	

10.2 AFD62/AFD120

PUSHCORP AFD62/AFD120				
Maintenance	**Weekly**	**Monthly**	**3 Months**	**6 Months**
Remove debris from AFD	X			
Check that the connectors are not bent/damaged	X			
Check to see if the carriage moves back and forth easily	X			
Measure the supply and purge lines at the tool for recommended pressure/flow and ensure no losses in the pneumatic supply		X		
Check filters for contamination – replace if dark yellow/brown		X		
Replace filter cartridge(s)				X

10.3 RPS100

PUSHCORP RPS100			
Maintenance	**Weekly**	**Monthly**	**3 Months**
Check Supply Air		X	