STC1202/2002

Series High Speed Servo Motor



PUSHCORP

Manual

Do NOT overheat the servo motor. Maintain a temperature below 176 °F (80 °C).

Torque M5x0.8 push-lock fittings to 1.2 N-m. Do NOT overtighten

Do NOT start or stop the servo motor instantaneously. Doing so will damage the motor and power amplifier.

All *PushCorp* 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.

!CAUTION!
Do NOT apply air pressure to release the Collet while the servo motor is rotating. The servo motor spindle must be *FULLY STOPPED* before actuating the Collet.

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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* product or component to PushCorp 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 workflow at the service center and depending on the availability of replacement parts. Purchasers requiring quicker repair may receive such with payment of a *PushCorp* 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 the PushCorp STC1202 & STC2002 Servo Motors. The STC1202 can produce up to 2 horsepower and spin up to 12,000 RPM; the STC2002 can produce up to 2 horsepower and spin up to 20,000 RPM This motor provides a convenient and effective means to spin and alternate between any number of different media types to support a fully automated work cell.

The Servo Tool Changer (STC) automatic tool-changing model actuates pneumatically to secure an ISO20 style holder.

The STC model uses a ISO20 taper to grip a toolholder. This 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 STC 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 when the air pressure is un-expectantly lost. Likewise, applying air pressure to a single input port via a simple manual or electrically operated valve opens the gripper and releases the Toolholder. Additionally, a tool present sensor is standard in the STC1202/2002 to provide validation that the tool change was performed successfully. This sensor provides a convenient 24V signal only when a tool holder is gripped in the shaft assembly. In addition, all PushCorp motors use sealed bearings to ensure a long life. The bearings have additional contamination protection from a shaft seal. This seal eliminates the need for constant purge air.

During operation the motor generates considerable heat due to the high torque and compact size. Excessive operating temperatures will significantly reduce the life of the motor. Water Cooling is recommended for high duty cycle applications at higher toques 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 unit above 176 °F (80 °C) will cause the rotor to de-magnetize 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* 1202/2002 Servo Motor line a rugged, state-of-the-art tool capable of providing flexible, cost-effective operations.

3.0 INSTALLATION & OPERATION

3.1 Mounting to a PushCorp AFD Compliant Tool

The STC1202/2002 is designed to attach to the Carriage of any *PushCorp* AFD310/70 & AFD120/60 Force Device. There are two standard attachment options: parallel and perpendicular.

3.1.1 Mounting to AFD310/70: Parallel Configuration

The parallel-axis configuration with the AFD310/70 is shown in Figure 1, where the motor attaches to the AFD Carriage with a hoop bracket and foot bracket. The hoop bracket is positioned on the carriage and attached using the two (2) supplied M6x1x20mm socket head cap screws. The motor is then attached to the foot bracket, as shown, with two (2) M4x1x50mm socket head cap screws mounted at the front of the motor housing. The foot bracket is then mounted to the carriage via two (2) M6x1x20mm socket head cap screws. Finally, tighten the M5x.8x20 cap head screw at the top of the hoop bracket. The fasteners must be tightened to the torque specified in Section 4.0.



FIGURE 1: PARALLEL MOUNT - AFD310/70

3.1.2 Mounting to AFD310/70: Perpendicular Configuration

To attach the motor to an AFD310/70 in a perpendicular-axis configuration, position the motor and the required perpendicular mounting plate over the carriage as shown in Figure 2. Then, mount the adapter plate to the carriage with four (4) M6x1x16 cap head screws. The motor can then be mounted to the adapter plate with four (4) M4x.7x50 cap head screws. Tighten the fasteners to the torque specified in Section 4.0.



FIGURE 2: PERPENDICULAR MOUNT - AFD310/70

3.1.3 Mounting to AFD120/60: Parallel Configuration

The parallel-axis configuration with the AFD120/60 is shown in Figure 3, where the motor attaches to the AFD Carriage with a hoop bracket and foot bracket. The hoop bracket is positioned onto the front of the carriage and attached using the two (2) supplied M6x1x18mm socket head cap screws. The motor is then attached to the foot bracket, as shown, with two (2) M4x.7x100mm socket head cap screws mounted at the front of the motor housing. The foot bracket is then mounted to the carriage via two (2) M4x.7x18mm socket head cap screws. Finally, tighten the M5x.8x20 cap head screw at the top of the hoop bracket. The fasteners must be tightened to the torque specified in Section 4.0.

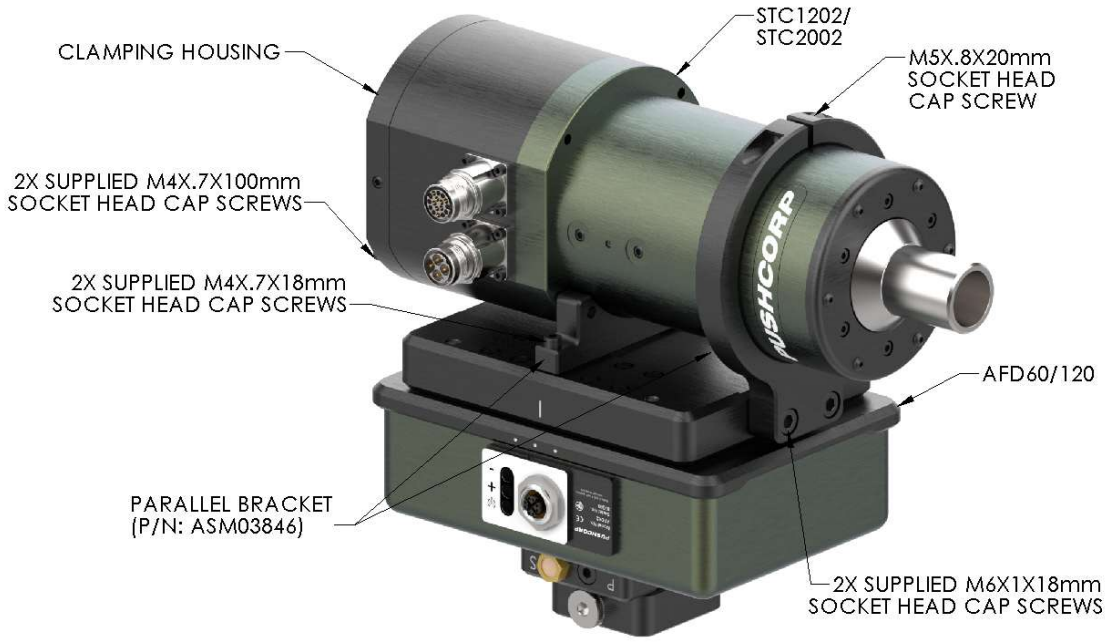


FIGURE 3: PARALLEL MOUNT - AFD120/60

3.1.4 Mounting to AFD120/60: Perpendicular Configuration

To attach the motor to an AFD120/60 in a perpendicular-axis configuration, position the motor and the required perpendicular mounting plate over the carriage as shown in Figure 4. Then mount the adapter plate to the carriage with four (4) M4x.7x12 cap head screws. The motor can then be mounted to the adapter plate with four (4) M4x.7x50 cap head screws. Tighten the fasteners to the torque specified in Section 4.0.



FIGURE 4: PERPENDICULAR MOUNT - AFD120/60

CAUTION: Make sure that the M6x1 fasteners do not exceed a depth of 0.40" (10 mm) into the AFD Carriage Helicoils or damage will occur.

3.2 Mounting Directly to a Robot

For some processes, force control is not required. The motor can be mounted directly to the robot. A few example applications utilizing this configuration are routing plastic and wood, as well as deflashing.

The motor can be attached to the robot mounting flange using a customer supplied mounting plate. For direct mounting, it is recommended that a breakaway clutch is installed. The breakaway clutch will help protect the motor in the event of a robot crash.

To mount the motor, first attach the customer supplied Mounting Plate to the Robot Mounting Flange or to the Breakaway Clutch, per the manufacturer's specifications. Once the Mounting Plate is secured, place the motor against the Mounting Plate and install (4) four, M4x.7, Socket Head Cap Screws (See Figure 5). Tighten the fasteners to the torque specified in Section 4.0.

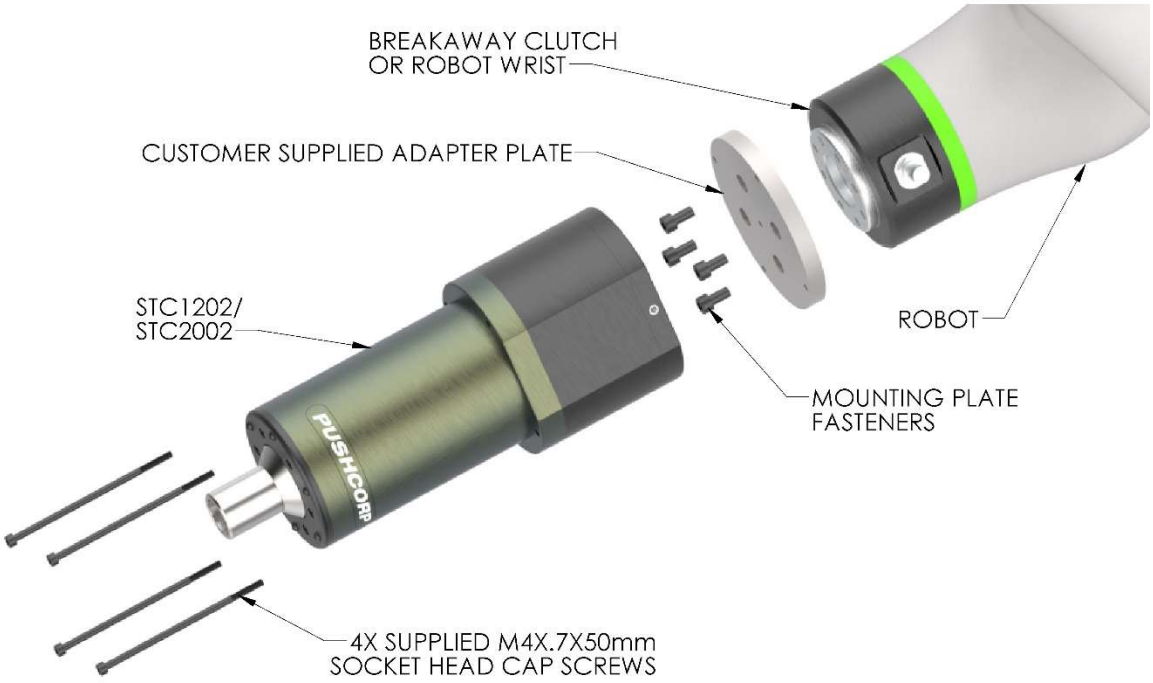


FIGURE 5: RIGID MOUNT - STC1202

To assist with designing the adapter plate, refer to Figure 6.

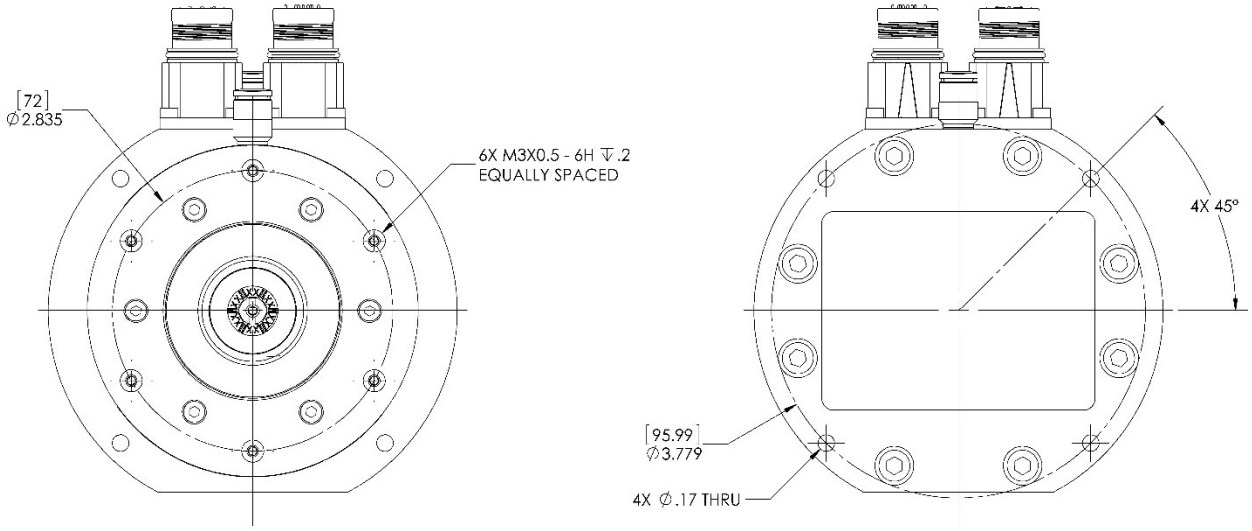


FIGURE 6: FRONT & REAR MOUNTING PATTERNS

3.3 Toolholder Specification

The STC1202/2002 motor is designed to grip an ISO20 toolholder. The ISO20 toolholder is a machine tool style and may be purchased from several sources including PushCorp. The customer can also make their own ISO20 toolholder to handle special media - see Figure 7 for toolholder dimension.

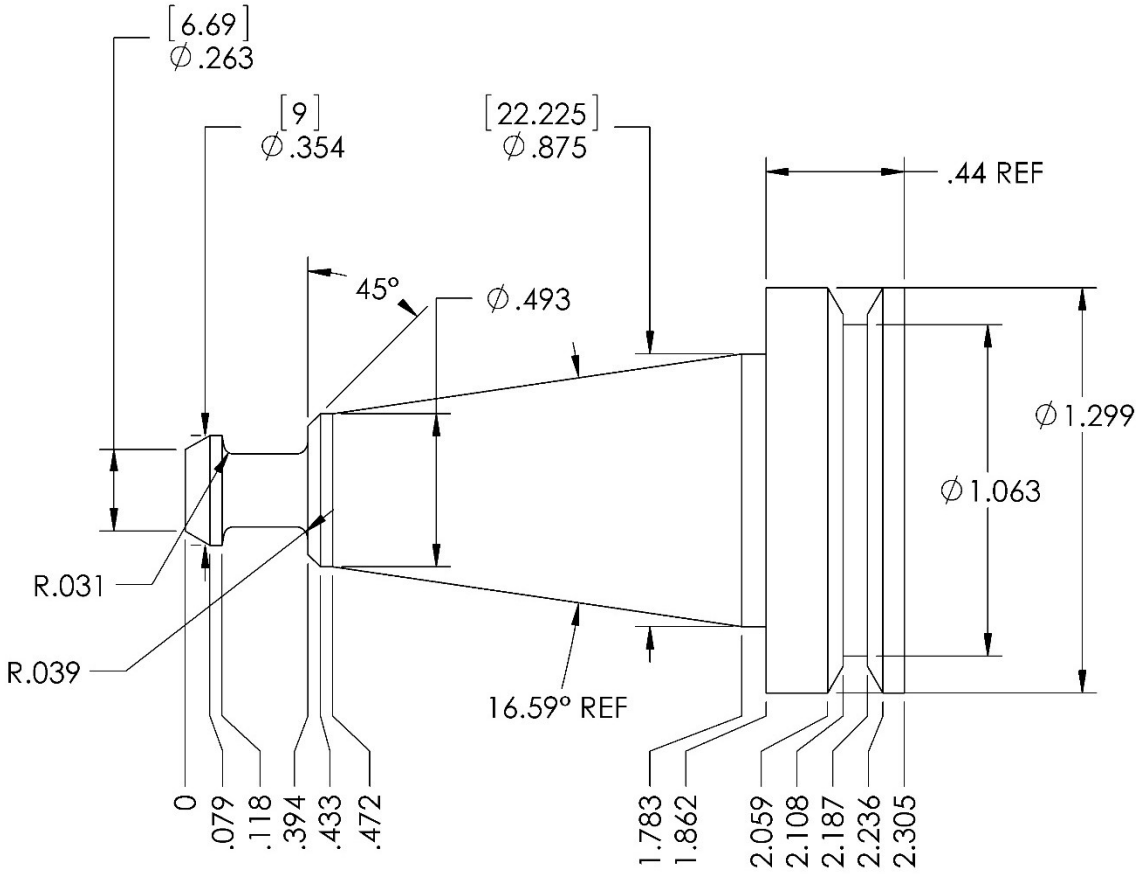


FIGURE 7: ISO20 TOOLHOLDER DIMENSIONS

3.4 Pneumatic Connection

The motor requires a dry, non-lubricated, filtered air supply, with a minimum pressure of 90 psi (6.2 bar) and a maximum pressure of 100 psi (6.9 bar). Failure to provide supply air to these specifications can degrade performance and will void any warranty repairs concerning pneumatic components. If the supply air pressure is too low, then the unit will be unable to fully release the Toolholder. Exceeding the maximum air pressure could result in permanent damage to the STC.

The pneumatic supply system should be configured as shown in Figure10. A manual or electrically operated valve may be used to energize the STC for Toolholder release, but the valve must exhaust ALL line pressure when unenergized. PushCorp **highly recommends the installation of a quick exhaust valve** in the Supply Line to the STC; the quick exhaust valve should be mounted as close to the STC unit as possible. This will minimize the distance exhaust air needs to travel, thus decreasing the time needed for the unclamp cylinder to actuate. Pressure in the line will cause internal components to come into contact. This will either cause the motor not to spin, or cause very high internal forces, eventually friction welding components together. A pressure sensor capable of sensing below 0 psi should be installed in the supply line between the exhaust valve and the STC. PushCorp recommends the pressure sensor from IFM (PN: 7694); it has the capability to sense a pressure range of -14.5 psi – 145 psi.

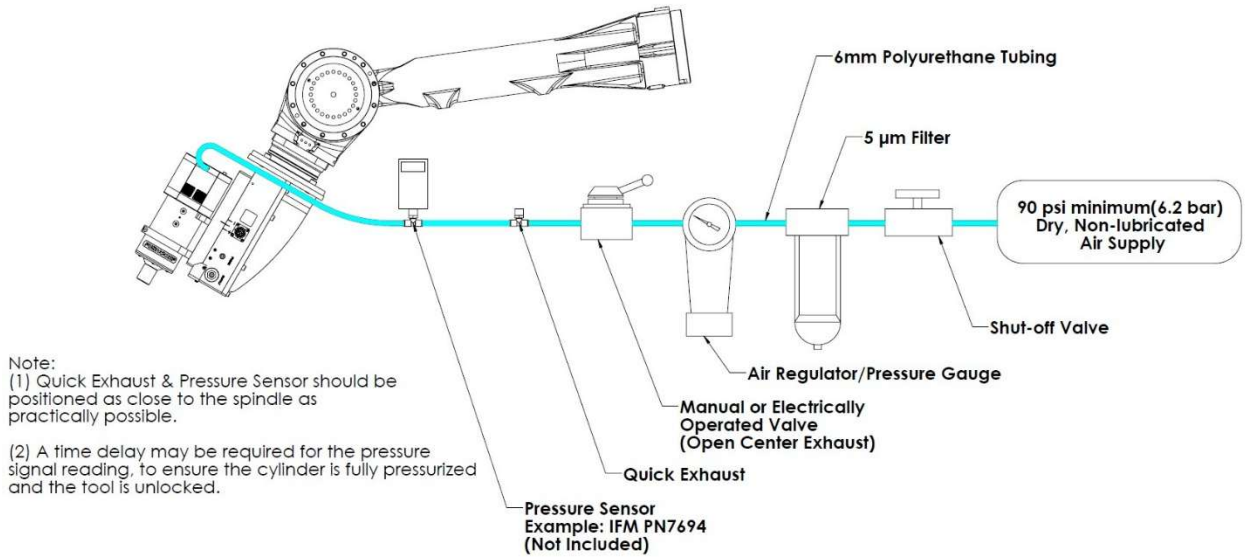


FIGURE 8: PNEUMATIC CONNECTIONS

The STC-ISO20 motors are provided with 6 mm diameter tubing push-lock fittings for installation in the M5x0.8 (Metric) Unclamp Port located on the top of the Clamping Housing (See Figure 9). Remove the shipping plug and install the push-lock fitting with **1.2 Nm of torque**. If another type of fitting is desired, unscrew the existing fitting and replace it with any fitting having an M5x0.8 (Metric) thread. Be sure to use a thread seal product and do not over tighten the fitting.

The Unclamp Supply Line to the device should be 6 mm diameter flexible polyurethane tubing. The tubing should be routed to the device such that there are no kinks and that there is plenty of slack to allow for manipulator motion. Before inserting the tubing into the STC air fitting, open the

Shut-Off Valve to blow out any contaminates which may be in the Unclamp Supply Line. The tubing can now be pushed into the self-locking fitting located on the Clamping Housing as shown in Figure 9. Charge the Unclamp Supply Line with compressed air and verify that there are no air leaks and that there is a minimum of 90 PSI (6.2 bar) at the STC. If a minimum air pressure cannot be achieved, then an auxiliary air compressor or booster pump must be installed.

NOTE: PushCorp recommends SMC quick exhaust valves, part number AQ-3- 40F-06-00 for 6 mm diameter tubing.

NOTE: PushCorp highly recommends the use of flexible polyurethane tubing as opposed to nylon tubing. This is because nylon tubing tends to crimp shut when it is bent.

To remove the Unclamp Supply Line for service, make sure the air pressure is discharged, then while pushing inward on the fitting's plastic ring, simultaneously pull the tubing out. Cover or plug the self-locking fitting any time the Unclamp Supply Line is not connected. This will keep contaminants from entering.

3.5 Electrical Connections

The 1202/2002 servo motor has two electrical connections, the Motor Power and Motor Feedback (See Figure 9).

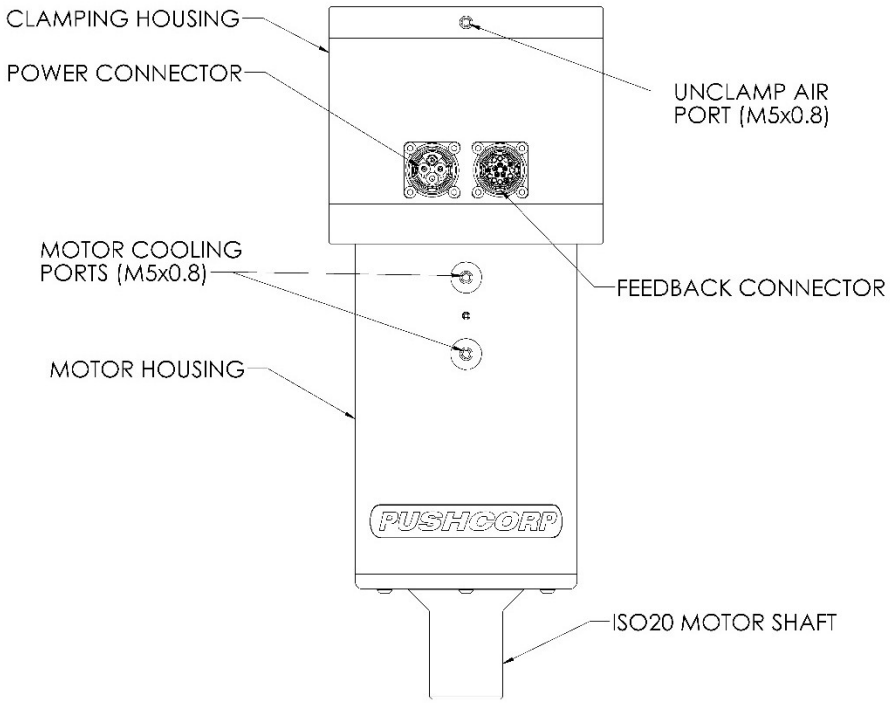


FIGURE 9: STC1202 EXTERNAL FEATURES

3.5.1 Tool Change Sensor

The STC1202/2002 motor is equipped with an internal sensor that monitors if an ISO20 toolholder is properly engaged. The sensor is wired into the feedback connector on the spindle. The spindle package comes with the cable shown in Figure 10. This cable splits into a high-density D-SUB connector that plugs into the amplifier and an M12 A code 4 position male connector to interface with the sensor. The sensor is powered by supplying 24V to the M12 connector shown in Figure 11. This same connection is used to monitor the 24V output. There are three states for the gripper: (1) an ISO20 tool is clamped, (2) the gripper is unclamped, (3) or the gripper is retracted without a tool present. The output will turn on only when scenario 1 is true. This allows the user to check the status and proceed with confidence.

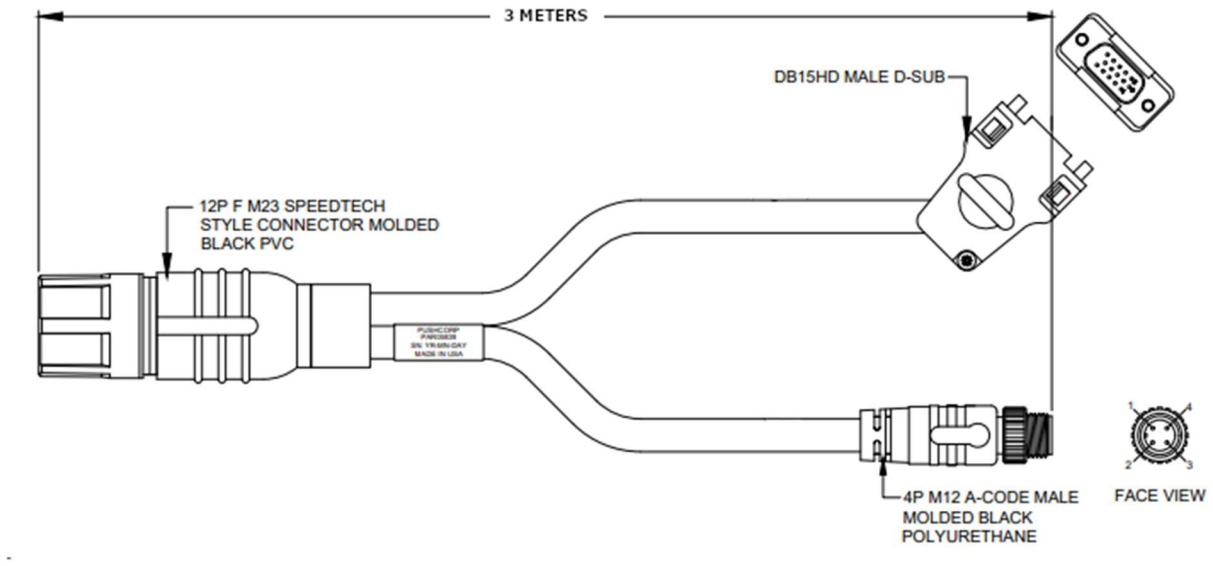
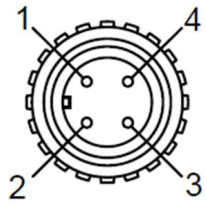


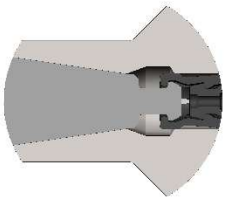
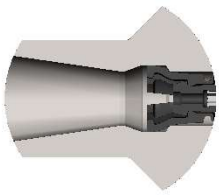
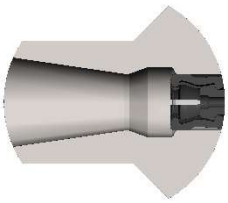
FIGURE 10: PAR05839 - *M23 TO DA-15P & M12A CODE 1 METER*



FACE VIEW

FIGURE 11: M12 A-CODE 4 POSITION CONNECTOR

Pin	*Power*	*Output*
1	24V	
2	NC	
3	0V	
4		Tool Sensor

Condition	**Toolholder Visual**	**Signal**
Clamp		24V
Unclamp		0V
No Tool		0V

3.6 AKD2G Servo Amplifier – Default Electrical Connections

This amplifier is already properly configured for a PushCorp spindle. No further configuration is required.

Analog Interface

Connector	Pin	Function
X21	A1	Analog-In 1+ : +/-10VDC Command Velocity
X21	A2	Analog-In 1- : +/-10VDC Command Velocity
X21	B1	Analog-Out 1 : 0 - 10VDC Velocity Monitor
X21	B2	AGND : Analog GND
CASE		Shield

Digital Interface

Connector	Pin	Function
X21	A3	Digital-In 1 : Fault Reset Input
X21	A4	Digital-In 2 : Run Input
X21	A5	Enable : Enable Drive Input
X21	B3	+24VDC : Digital Output Supply
X21	B4	DGND : Digital I/O Common
X21	B5	BTB/RTO : Ready To Operation (Dry Contact)
X21	B6	BTB/RTO : Ready To Operation (Dry Contact)
X21	B7	Digital-Out 1 : Motor Overload Warning
X21	A11	STO-A-A1 : Safety Torque Off A Input
X21	B11	STO-B-A1 : Safety Torque Off B Input

For more information an instruction manual is available at:

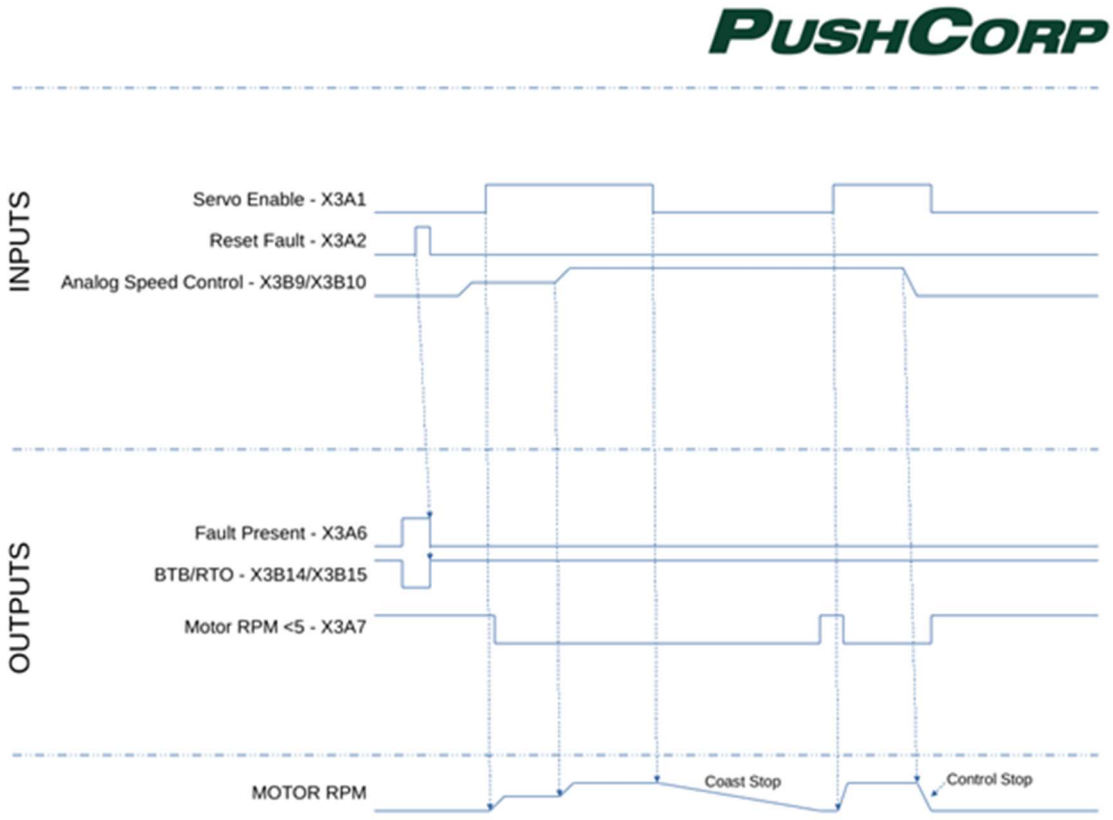
AKD2G-instruction-manual.pdf

For all other questions please contact:

PushCorp Tech Support: 1.972.840.0208, 8am – 5pm Central Time

Kollmorgen Tech Support: 1.540.633.3545, 8am – 5pm Eastern Time

3.7 Resolver Motor Timing Chart



3.8 Motor Cooling

The STC1202/2002 is designed to operate below a temperature of 176 °F (80 °C). The optimal motor temperature range is 122 – 140 °F (50 – 60 °C). The motor contains cooling channels in the Motor Housing surrounding the motor stator. These channels allow liquid cooling to efficiently remove heat. The coolant enters and exits the Motor Housing through two Motor Cooling Ports. Either of these motor cooling ports can be used as an input, the other would then become an output.

A closed-loop water cooling system must be used and requires a separate cooling unit per spindle that circulates water through the Motor Housing to remove the heat. Typical cooling units are comprised of a pump, liquid to air heat exchange, and a fan. These units are commercially available from several manufacturers (e.g. Miller Coolmate 3, www.millerwelds.com). The cooling unit should be sized based on the motor power output of the motor being used with an overall motor efficiency of 90% and the motor load conditions. See section 4.0 of this manual for motor output ratings for the motor being used. In the case of a closed-loop water cooling system, all the coolant is recirculated in the system, and no continuous supply of discharge is required. Our standard offering is the Miller Coolmate 3, PC PN PAR03962. In this case the return line is the bottom connection; it is recommended that a flow sensor is installed in line with this port and wired back as part of the control circuit. PushCorp recommends the IFM flow sensor (PN SBG12IF0FRKG). This will ensure the coolant is circulating completely through the motor and back to the cooler. Domestically, PushCorp provides Miller's pre-mixed glycol base aluminum protecting coolant (Miller PN 043-809 – PCI PN PAR04028). Any coolant which matches the parameters of this coolant may be used.

NOTE: Connecting two motors to a single Coolmate could yield inadequate cooling and reduce the life of the servo unit. The life of the motor is directly related to the operational temperature, so proper cooling is critical.

3.9 Monitor Motor Temperature

As previously stated, the motor is designed to operate below a temperature of 176 °F (80 °C) and within an optimal range of 122-140 °F (50-60 °C). In many situations it is desirable to monitor the internal motor temperature to ensure that the maximum temperature rating is not exceeded, and that the optimal temperature range is maintained. To facilitate this, the motor has a thermistor that is embedded in the motor windings. The thermistor connection is provided on the Motor Feedback Connector. The thermistor temperature signal is a logarithmic function of the output resistance.

The motor also contains a thermal cutoff switch. If the temperature exceeds 212 °F (100 °C) the motor will stop running until it has cooled off. **This feature should not be used to control the motor temperature.** The thermal cutoff is designed to operate only when all other precautions have failed.

The following equation can be used to calculate the motor temperature based on the measured thermistor resistance:

$$T = \frac{14.362 + \ln(\frac{R}{20})}{4282} - 273.15$$

$T = temperature$ (℃)

$R = reistance\ of\ thermistor$ $(k\Omega)$

$\ln(x) = natural\ logarithmic\ function\ (Base\ e)$

Given Values:

$R_0 = 20k\Omega - The\ R_{25} value\ from\ the\ thermistor\ data\ sheet$

$\beta = 4282\ (B\ Value\ from\ the\ thermistor\ data\ sheet)$

$T_0 = 298.15\ K\ (reference\ temperature\ in\ Kelvins\ from\ the\ thermistor\ data\ sheet)$

NOTE: Thermistor type – Semitec 203GT-2

3.10 Motor Acceleration/Deceleration

Servo Motors can start and stop very quickly. If the motor does not overheat and the amplifier does not exceed the allowable current input, the motor will continue to operate. However, the motor and amplifier can experience excessive current spikes with rapid acceleration and declaration. Media or tooling with a large mass or large diameter (i.e., high moment of inertia) increases this current surge.

Therefore, acceleration time to reach the desired speed or stop directly effects the life of the motor. A smooth, linear velocity ramp with a *minimum* period of two seconds is required to accelerate to full speed or to decelerate to zero speed. The minimum two-second-acceleration period must be increased if larger, higher inertia tools are used to prevent servo amplifier faults and avoid long-term damage.

If using the Kollmorgen servo amplifier, the acceleration/deceleration ramp times are preprogrammed by PushCorp into the drive.

Should you have any questions or need clarification on if you need to add a ramp to your servo motor control logic contact PushCorp Inc. Technical Support.

4.0 TECHNICAL SPECIFICATIONS

4.1 STC1202

Category	Specification
Power	2.0 hp (1.5 kW)
Continuous Stall Torque	Air Cooled: 0.74 lb-ft (1.0 N-m) Liquid Cooled: 1.33 lb-ft (1.8 N-m)
Speed Range	STC1202: 0-12,000 RPM
Speed Regulation	5% (Reversible)
Weight	STC1202: 10.5 lb (4.8 kg)
Operating Temperature	Optimal: 122-140F (50-60C) Max: 176F (80C)
Max Coolant Pressure	60 psi (4.1 bar)

POWER

Supply Voltage	Max Speed
480 VAC, 3-Phase	12,000 RPM

COLLET

Parameter	Value
Holding Torque	10 lb-ft (20.3 N-m) minimum
Toolholder	ISO20

CABLE AND TUBING

Cable Diameter	1193 – 9.1 mm (.36 in) 811, A8, & A4 – 7.6 mm (.30 in) 4684 & X8- 6.6 mm (.26 in) 4936 – 7.7 mm (.30 in) 5867 – 8.8 mm (.35 in)
Cable Bending Radii	1193, 811, 5867, A8, & A4 flexing ~ 7.5x cable ø fixed installation ~ 4x cable ø4936, 4684, & X8 flexing ~ 10x cable ø fixed installation ~ 5x cable ø
Max Temperature	Flexing: - 4° to 176 °F (20 °C to +80 °C) fixed: - 40° to 176 °F (40 °C to +80 °C)
Certifications	RoHS
Airline OD	6mm
Airline ID	4mm

4.2 STC2002

Category	Specification
Power	2.0 hp (1.5 kW)
Continuous Stall Torque	Air Cooled: 0.74 lb-ft (1.0 N-m) Liquid Cooled: 1.33 lb-ft (1.8 N-m)
Speed Range	STC2002: 0-20,000 RPM
Speed Regulation	5% (Reversible)
Weight	STC2002: 10.5 lb (4.8 kg)
Operating Temperature	Optimal: 122-140F (50-60C) Max: 176F (80C)
Max Coolant Pressure	60 psi (4.1 bar)

POWER

Supply Voltage	Max Speed
208 VAC, 3-Phase	20,000 RPM
110 VAC, 1-Phase	10,000 RPM

COLLET

Parameter	Value
Holding Torque	10 lb-ft (20.3 N-m) minimum
Toolholder	ISO20

CABLE AND TUBING

Cable Diameter	1193 – 9.1 mm (.36 in) 811, A8, & A4 – 7.6 mm (.30 in) 4684 & X8- 6.6 mm (.26 in) 4936 – 7.7 mm (.30 in) 5867 – 8.8 mm (.35 in)
Cable Bending Radii	1193, 811, 5867, A8, & A4 flexing ~ 7.5x cable ø fixed installation ~ 4x cable ø4936, 4684, & X8 flexing ~ 10x cable ø fixed installation ~ 5x cable ø
Max Temperature	Flexing: - 4° to 176 °F (20 °C to +80 °C) fixed: - 40° to 176 °F (40 °C to +80 °C)
Certifications	RoHS
Airline OD	6mm
Airline ID	4mm

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

5.0 PREVENTATIVE MAINTENANCE SCHEDULE

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

PUSHCORP SPINDLES			
Maintenance	**Weekly**	**Monthly**	**3 Months**
Wipe shaft (inside and out) and tool holders with a lint free cloth until clean and no debris remains. Use denatured alcohol if there is any grime or coatings.	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	

Agency/Organization:_____

*Date Completed:*_____