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5. SINGLE ENDED ROTARY ADJUST MOTOR/BASE MODULE

5.1 DESCRIPTION (Figure 5.1)

The Single Ended Rotary Adjust Motor/Base Module, hereafter referred to as the Motor/Base Module, is comprised of the motor to drive the Pump Module, the base to support the motor, the displacement adjustment mechanism, the Pump Module mounting assembly and the cable w/connector. The motor provides accurate control. The displacement adjustment mechanism changes the angle between the axis of the motor and the axis of the Pump Module thus changing the pumped volume. The cable connector provides a connection point to the Controller Module.

The Motor/Base Module measures 2.25" (57.2mm) wide, 5.39" (136.9mm) long and 3.53" (89.7mm) high with feet and weighs approximately 2.25 pounds (1.02 kilograms). Dimensions and weight listed are with no options.

5.2 OPERATION

The Motor/Base Module includes a graduated rotary dial for adjusting the calibration of the pump, a spindle sensor and a spherical bearing to move the piston. In dispensing operations, a dispense cycle consists of a specific number of revolutions. The Controller Module controls the number of revolutions. The volume per revolution is adjusted on the Motor/Base Module using the rotary dial.

Figure 5.1 Single Ended Rotary Adjust Motor/Base Module

5.2.1 Rotary Dial

The rotary dial when rotated clockwise will decrease the pump output, and when rotated counterclockwise will increase the pump output. The rotary dial can only be turned 4.5 times in the counterclockwise direction from the 0 displacement setting. Additional turns in that direction will cause the rotary dial to be removed from the module.

5.2.2 Spindle

A spindle, containing a spherical bearing, is mounted on the motor shaft. When the Pump Module is mounted with its drive pin inserted into the spherical bearing, the spindle drives the piston in a motion that combines rotation and reciprocation.

When the Pump Module is mounted on the Motor/Base Module, the pin extends through the center bore of the spherical bearing. At zero pump displacement, the axis of the piston aligns with the axis of the spindle and motor shaft. As the motor turns, the spindle drives the piston in a purely rotational motion. Introducing an angle between the axis of the spindle and the axis of the piston adds a reciprocating motion to the rotation of the piston. The magnitude of the reciprocating motion is a function (sinusoidal) of the angle between the axis of the piston and the axis of the spindle.

5.2.2 Spindle Sensor

A sensor detects the position of the spindle, and is used to count revolutions, stop the pump during the intake stroke and detect stalls.

5.2.2.1 Volume Strokes

The spindle sensor allows the Controller Module to count the revolutions of the spindle to ensure the requested number of revolutions (volume strokes) has been completed. Just prior to reaching the required count, the sensor signals the stepper motor drive circuitry to decelerate.

5.2.2.2 Stopped Location

The Controller Module decelerates the motor and stops the piston during the intake stroke of the pump. The sensor signals the stepper motor drive circuitry to decelerate, thereby ensuring the position at the end of the dispense is based on a sensed position, and not on the accumulation of motion commands to the motor drive circuitry.

If the piston is at a random position, such as after reassembly due to cleaning, the piston will be properly indexed to stop during the intake stroke following the completion of the first dispense cycle (with no faults). By stopping during the intake stroke, variations in the exact stopping position will not affect dispense accuracy.

5.2.2.3 Stall Detect

Motor stalls are detected if a signal from the spindle sensor is not detected for each revolution commanded to the motor. In a stepping motor system, a stall has occurred if more than the 200 required steps for a revolution have been commanded without a subsequent signal from the spindle sensor. A small margin above 200 steps is allowed to prevent minor variations from incorrectly signaling a fault. If an error is detected, the system can be designed to either inhibit further dispensing, alert the operator or provide a reject signal for integrated process control. In a brushless DC motor system, a timer is used in conjunction with the sensor to detect a stall. (Refer to Chapter 3 for more information)

5.3 INSTALLATION

The Motor/Base Module includes two 10-32 threaded mounting holes. These mounting holes can be used for mounting onto various apparatuses. The orientation of the Pump Module should be considered when mounting the Motor/Base Module. Plan the mounting so the intake and discharge tubing and the end cap which holds the Pump Module's cylinder in place can be easily accessed. Additional consideration should be taken regarding the fluid flow. Always keep the discharge of the Pump Module even with or higher than the intake and never mount the Motor/Base Module so the Pump Module's cylinder end cap faces upward. Refer to Figure 5.2 for the mounting hole locations. If Mounting to a solid surface, remove the four rubber feet.

Some Motor/Base Modules are designed to work with certain Controller Modules. Make sure the Motor/Base Module is used with the Controller Module with which it was shipped or a comparable model. Please contact IVEK Corporation if there are any questions.

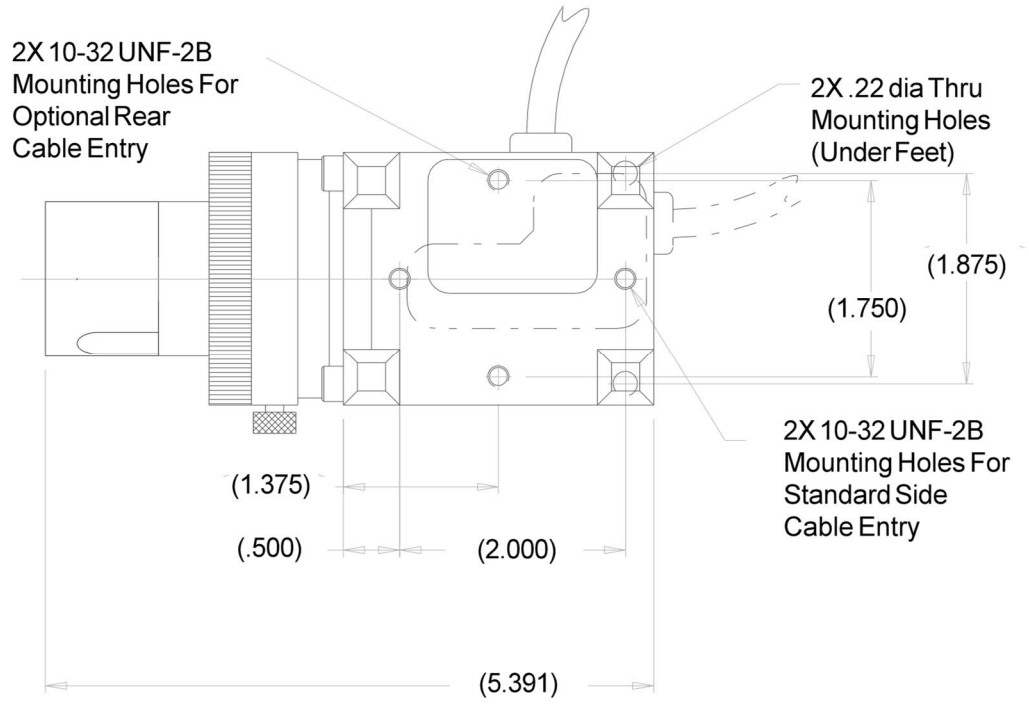


Figure 5.2 Single Ended Rotary Adjust Motor/Base Module Dimensions

5.4 OPTIONS

IVEK Corporation offers a variety of options to best meet the customers' needs. Following is a list and description of available options for the Motor/Base Module. Refer to the Title Section of this manual for the list of options provided with this system.

5.4.1 Rare Earth Stepping Motor

This option replaces the standard stepping motor with a rare earth stepping motor. The rare earth stepping motor provides improved acceleration/deceleration and torque characteristics.

IVEK Corporation provides application assistance in determining which motor works best for each application.

CAUTION

The Controller Module must be adjusted at the factory when changing between standard stepping motors and rare earth stepping motors.

5.4.2 Positive Stop

The positive stop option is a reference plate which enables the pump displacement to be increased, allowing better priming, then returned to the calibrated volume for dispensing or metering operation.

5.4.2.1 Positive Stop Adjustment

Loosen the screws which hold the triangular stop to the top of the Motor/Base Module and slide the stop away from the Pump Module.

Calibrate the pump displacement for dispensing or metering operation.

Loosen the collar on the adjustment dial. The collar is held by a knurled thumb screw. Turn the collar (only the collar, not the pump displacement adjustment) so the index pin is at the top, and just to the left of the notch in the tip of the triangular stop. While lightly pushing the collar toward the motor, temporarily tighten the screw holding the collar.

Slide the triangular stop toward the Pump Module so the end of the stop is even with the edge of the index pin toward the Pump Module. Securely tighten the screws holding the stop.

Loosen the screw holding the collar to the adjustment dial. While lightly pushing the collar toward the motor, and rotating the collar so the index pin is touching the stop, securely tighten the screw which holds the collar to the adjustment dial.

5.4.2.2 Operation

Before priming the pump, turn the displacement adjustment counterclockwise to increase displacement. As the displacement dial rotates, it will move on threads away from the motor, allowing the index pin to move past the triangular stop.

After priming the pump, turn the displacement adjustment clockwise until the index peg touches the triangular stop.

NOTE

If excessive force is used, the collar may slip on the adjustment dial, requiring re-calibration of the dispense displacement, and readjustment of the positive stop.

5.4.3 DC Brushless Motor

This option replaces the standard stepping motor with a DC brushless motor. The DC brushless motor provides higher speed and quieter characteristics.

IVEK Corporation provides application assistance in determining which motor works best for each application.

CAUTION

A stepping motor Controller Module cannot be used with a DC brushless motor Controller Module. The opposite is also true.

5.5 MAINTENANCE

CAUTION

Never connect or disconnect the cable from the Motor/Base Module connector while power is on. Damage to the equipment may result.

Minimal maintenance is necessary for this Motor/Base Module. If the rotary dial assembly becomes loose in calibration, or the pump becomes difficult to calibrate, or tends to vary, please contact IVEK Corporation. Refer to Chapter 7 for the piston fabrication lubricating instructions.

5.5.1 Assembly/Disassembly Procedures (Figure 5.3)

This section contains assembly/disassembly procedures for the following parts.

- **Knurled Collar (3)**

5.5.1.1 Knurled Collar

Disassembly

NOTE

Step 1 is only necessary if the Pump Module diameter is larger than end cap (1) diameter.

1. Remove the Pump Module. (refer to Chapter 7 Disassembly Procedures)
2. Rotate the knurled collar (3) counterclockwise and remove.

NOTE

It may be necessary to press against half collar (2) to allow for removal of knurled collar (3).

Assembly

1. Side knurled collar (3) over half collar (2) and turn clockwise approximately three turns.

NOTE

It may be necessary to press against half collar (2) to allow for assembly of knurled collar (3).

2. Install the Pump Module (refer to Chapter 7 Assembly Procedures).

Set the vernier scale position (calibrate) fluidically by setting the pump for zero liquid displacement and position the vernier scale "0" under the pointer.

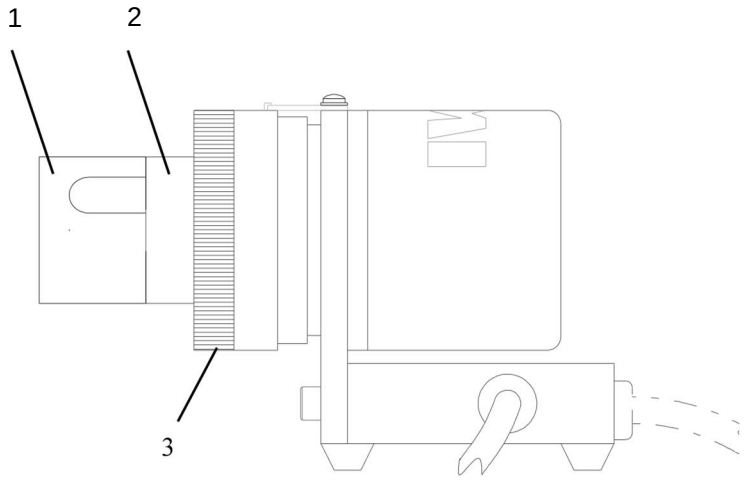


Figure 5.3 Single Ended Rotary Adjust Motor/Base Module

5.6 PROBLEM GUIDE

Table 5.1 contains a list of possible problems, causes and solutions for the Motor/Base Module.

5.7 SPECIFICATIONS

Hall Effect Sensor:
- Supply Voltage 6-24 VDC
- Supply Current 13mA
- Output Voltage 0.4 VDC
  - Open Collector Output Signal
- Output Current 20mA

Rare Earth Motor:

General:
- Step Motor, Size 23
- Insulation: UL Recognized Class B, 130° C
- Protection Class: IP40
- Step Angle: 1.8°

Electrical:
- Unipolar, 6-wire
- Per Phase:
  - Rated Voltage: 2.5 VDC
  - Current: 4.55 AMPS
  - Resistance: 0.55 OHMS
  - Inductance: 2.5 mH
  - Voltage Constant: 24.81 V/KRPM

Brushless DC Motor:

General:
- Housing: Aluminum Extrusion
- Endcap Material: Machined Aluminum
- Finish: Black Wrinkle

Electrical:
- Winding:
  - Resistance: 3.50 Ohms +/- 12.5%
  - Torque Sensitivity: 24.0 Oz-In/Amp +/- 10%
  - Back EMF: 0.170 Volts/Rad/Sec+/- 10%
  - Inductance: 3.80 mH +/- 30%
  - Current at Peak Torque: 7.29 Amps
  - Voltage at Peak Torque: 25.5 Volts
  - Maximum Rated Voltage: 75 Volts

High Torque Motor:

General:
- Step Motor, Nema Size 23
- Housing Color: Black
- Step Angle: 1.8°
- Step Accuracy (Non Accumulative): 5%
- Insulation Coil Wire: UL Class B = 130° C
- Protection Class: IP30
- Operating Temperature: -20°C to 40°C

Electrical:
- 6 Lead Bipolar
- Insulation Voltage Rating: 500V
- Per Phase:

Rated Voltage: 2.8 VDC
Current: 2.0 AMPS
Resistance: 1.4 +/- 10% OHMS
Inductance: 1.8 mH +/- 20%
Voltage Constant: 14.9 V/KRPM

High Torque Motor: General:

Step Motor, Nema Size 23
Housing Color: Black
Step Angle: 1.8°
Step Accuracy
(Non Accumulative): 5%
Insulation Coil Wire: UL Class B = 130° C
Protection Class: IP30
Operating Temperature: -20°C to 40°C

Electrical:

4 Lead Bipolar
Insulation Voltage Rating: 500V
Per Phase:
Rated Voltage: 0.62 VDC
Current: 3.0 AMPS
Resistance: 0.21 +/- 10% OHMS
Inductance: 0.75 mH +/- 20%
Voltage Constant: 9.9 V/KRPM

5.8 MODEL NUMBER

The model number provides important information about the specifics of your Motor/Base Module. Refer to this number when calling IVEK Technical support. The model number for your Pump Module is in the Title Page section of this manual.

102009 - # # # #

Motor
2 – Rare Earth Unipolar
3 – Brushless DC
4 – High Torque Unipolar
5 – High Torque Bipolar

Positive Stop Tab
1 – Without
2 – With

Cable Entry
1 – Side
2 – Rear

Cable Assembly
1 – 8 Foot, Standard Connector
2 – 8 Foot, Flange Connector
3 – 1 Foot, Metal Flange Connector

5.9 ILLUSTRATED PARTS BREAKDOWN

The illustrated parts breakdown (Figure 5.4) contains the information required for identifying and ordering replacement parts.

Table 5.1 Common Operational Problems And Solutions

PROBLEM	PROBABLE CAUSE	POSSIBLE SOLUTION
Power is on, Controller Module accepts trigger, motor spindle fails to rotate, and motor makes a sound that fluctuates in tone. * This condition does not harm the system.	Motor spindle binding.	Turn off Controller Module power. Remove Pump Module from Motor/Base Module. Turn on Controller Module and try again.
Controller Module power on and operational, but will not actuate Motor/Base Module.	Controller Cable	Check connection of cable between Controller Module and Motor/Base Module. Inspect and repair faulty cable.
Power is on, Controller Module accepts a trigger, (START indicator illuminates, STOP indicator does not), motor spindle fails to rotate, and motor is silent.	A motor malfunction can cause this problem.	Turn off Controller Module power. Check to ensure Motor/Base Module is properly connected to Controller Module. Turn on Controller Module and try again. If the motor operates incorrectly, servicing may be necessary to the motor or the Controller Module. Return complete Controller, Motor/Base, and Pump Modules to IVEK Corporation for repair.
Motor turns 3 times, stalls, and repeats.	Sensor problem.	Contact IVEK technical support for assistance.
Displacement adjustment not operating smoothly.	Dirt in thread.	Disassemble knurled collar (see 5.5.1.1), clean.

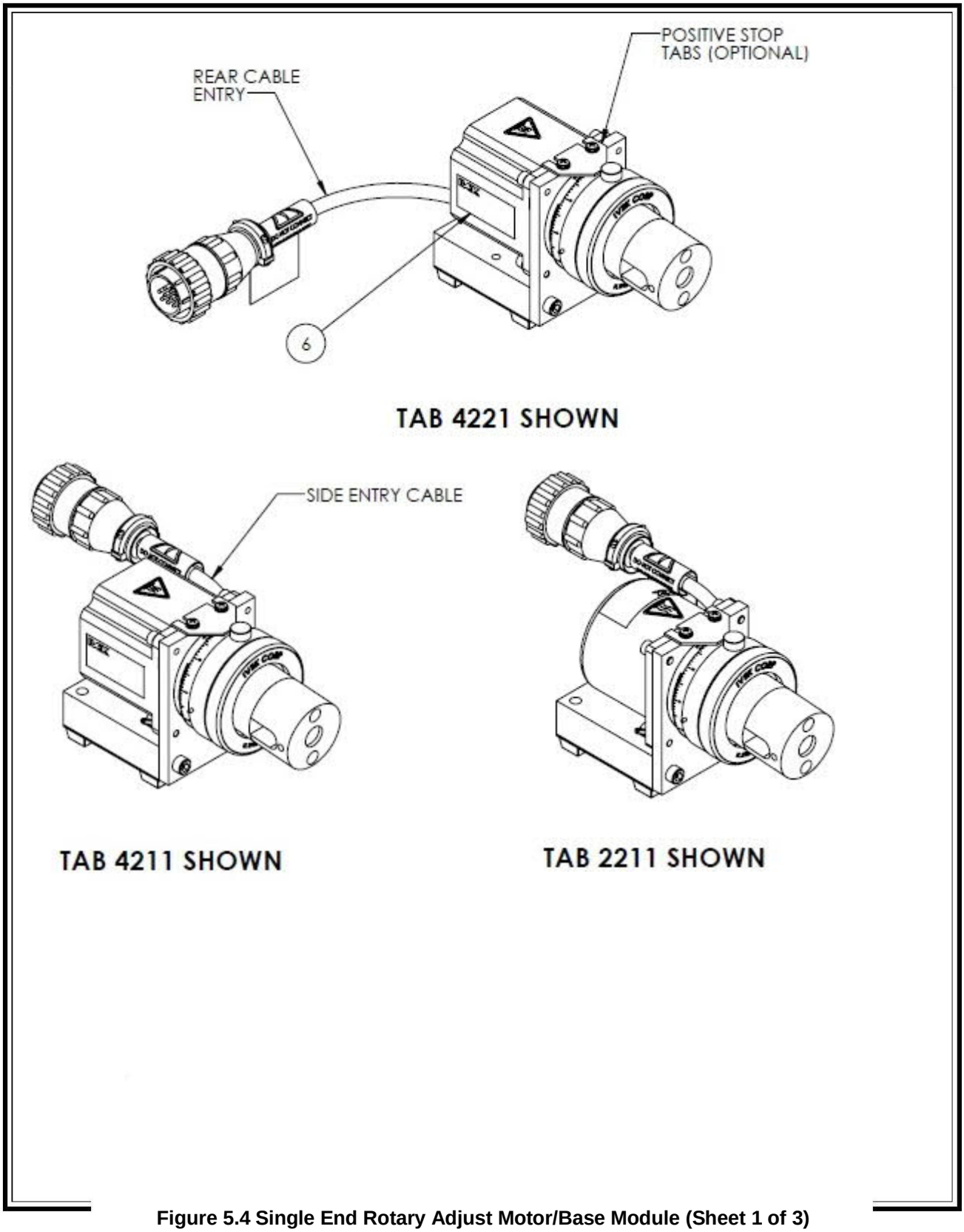
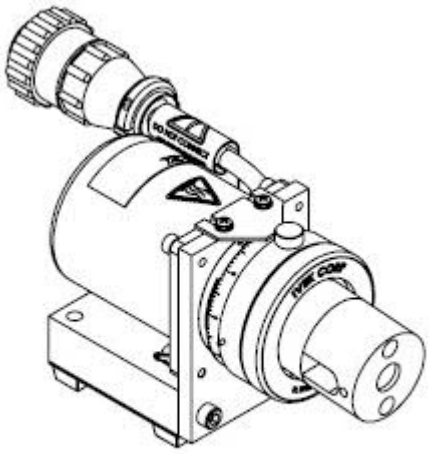


Figure 5.4 Single End Rotary Adjust Motor/Base Module (Sheet 1 of 3)



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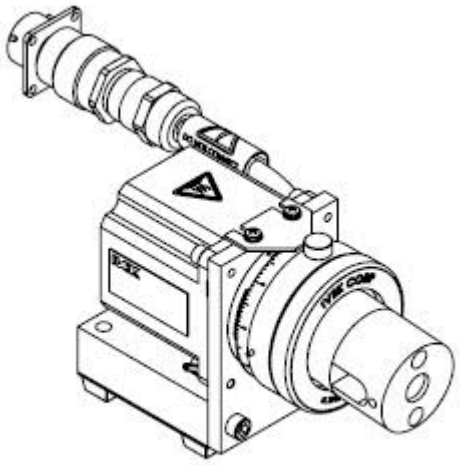

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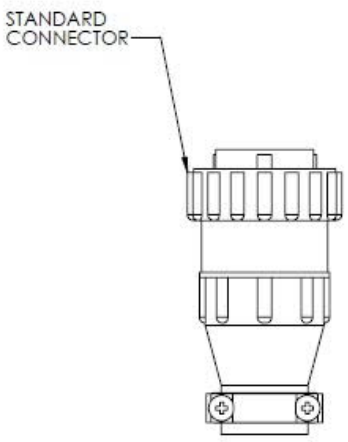

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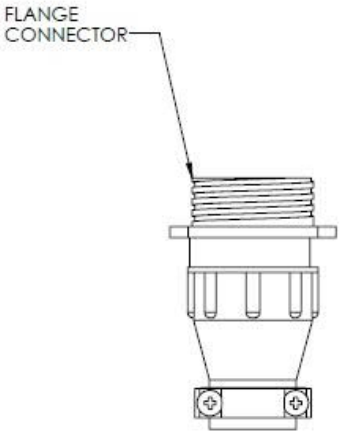

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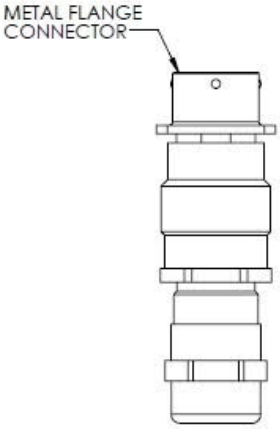

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CONNECTORS

Figure 5.4 Single End Rotary Adjust Motor/Base Module (Sheet 2 of 3)

	NUMBER	DESCRIPTION	UNITS PER ASSY
	102009-####	Single Ended Rotary Adjust Motor/Base Module	1

Model # Tab	Dwg Index #	Part #	Description	Qty
	6	102000	End Cap	1
	7	102090	Microspense Vernier Assembly	1
	13	102085	Spindle & Bearing Fabrication	1
	14	102184	Hub/Magnet, Microspense, Fab	4
	19	092181-01R	Bumper, Square Tapered	4
	20	682001	Strain Relief Grommet	1
102009 [#] # # # MOTOR OPTION				
2	1	102015-002	Single End Motor/Hall Sensor Fabrication, Rare Earth Stepper	1
3	1	102015-003	Single End Motor/Hall Sensor Fabrication, DC Brushless	1
4	1	102015-004	Single End Motor/Hall Sensor Fabrication, High Torque Unipolar	1
5	1	102015-004	Single End Motor/Hall Sensor Fabrication, High Torque Bipolar	1
102009 # [#] # # POSITIVE STOP TAB				
2	2	102028	Positive Stop Tab	1
2	10	102025-00	Tall End Plate, Without Positive Stop Holes	1
1	10	102025-01	Tall End Plate, With Positive Stop Holes	1
102009 # # [#] # CABLE ENTRY				
1	3	001273	Mounting Base	1
2	3	072093	Base, Microspense, Rear Power Entry	1
1	4	102192	Plate, Cover, Mounting, Rotary Adjust	1
2	4	072094	Plate, Cover	1
102009 # # # [#] CABLE ASSEMBLY				
1	5	540138-08A	Cable Assembly, 8 Feet Long, Stepper Motor	1
1	5	540159-08A	Cable Assembly, Flange Connector, 8 Feet Long, Stepper Motor	1
2	5	540138-08B	Cable Assembly, 8 Feet Long, Brushless DC Motor	1
2	5	540159-08B	Cable Assembly, Flange Connector, 8 Feet Long, Brushless DC Motor	1

Figure 5.4 Single End Rotary Adjust Motor/Base Module (Sheet 3 of 3)

CHAPTER REVISIONS

C 01/07/22 DCRN 21330 – 1. Section 5.4, Options, add options for High Torque Unipolar and High Torque Bipolar. Make the text identical to the text for these options in P05R007.

2. Consider adding additional sections and making as much consistent as possible with P05R007.