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5. SINGLE ENDED HEAVY DUTY MOTOR/BASE MODULE

5.1 DESCRIPTION (Figure 5.1)

The Single Ended Heavy Duty 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 Pump Module, the displacement adjustment mechanism and the cable 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 for the cable from the Controller Module.

WARNING

Never remove a safety cover while the motor is running. Moving parts are located under these covers. Physical harm to individuals is possible.

The Motor/Base Module measures 4.625" (117.5mm) wide and 5.69" (144.5mm) high with feet and weighs approximately 10 pounds (4.54 kilograms). The length depends on the motor type and the length of each motor type is shown in Figure 5.2.

5.2 OPERATION

The Motor/Base Module includes a thumbwheel for adjusting the calibration of the pump, a spindle rotation sensor and a drive spindle to move the piston.

5.2.1 Thumbwheel

The thumbwheel is used to change the angular relationship of the Pump Module axis to the drive spindle axis. The greater the angle, the greater the volume of liquid dispensed for each revolution. A vernier scale is located on the Motor/Base Module to provide a setting reference. Setting the angle to “0” provides minimum output and “20” provides maximum output. The thumbwheel contains 0.156" (3.9mm) holes for inserting a rod for fine adjustments.

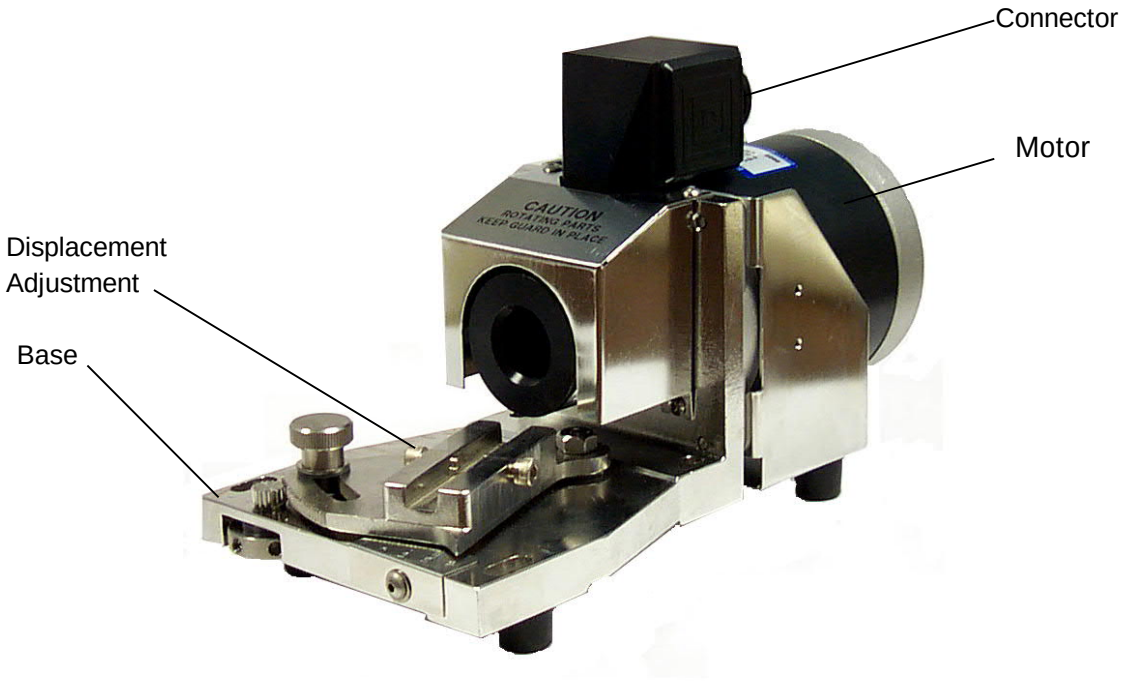

Figure 5.1 Single Ended Heavy Duty Motor/Base Module

5.2.2 Spindle Sensor

A sensor detects the rotation 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. (Refer to Chapter 3 for more information)

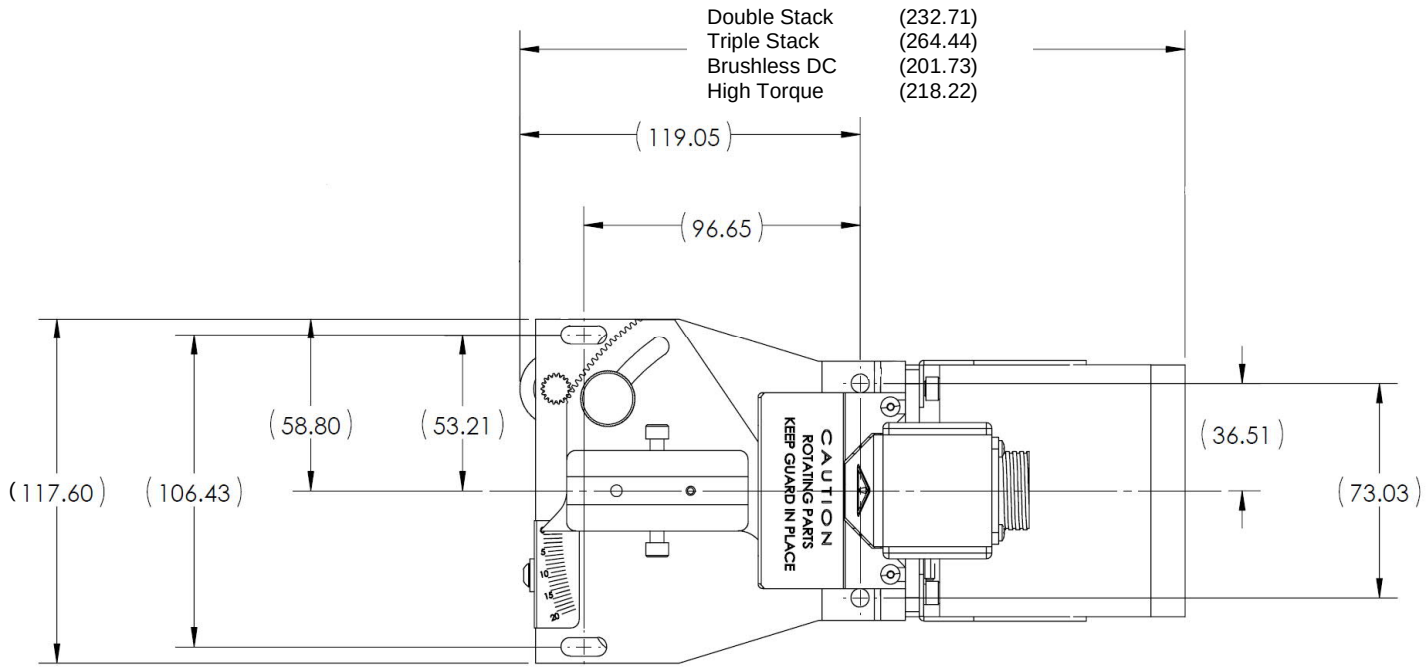

Figure 5.2 Single Ended Heavy Duty Motor/Base Module Dimensions

5.2.3 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.

5.3 INSTALLATION

The Motor/Base Module includes four mounting holes (Figure 5.2). 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.

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. Please contact IVEK Corporation if there are any questions.

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 Motor Type

This Motor/Base is also available with a Double Stack Unipolar Stepper, Triple Stack Unipolar Stepper, Brushless DC or High Torque Bipolar Stepper motor.

CAUTION

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

These options provide reduced or increased motor torque needed to pump different density liquids or against elevated output pressure. The motor is determined based on the specific application.

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

The Controller Module must be adjusted at the factory when changing between standard and optional torque Motor/Base Modules.

5.4.2 Dial Indicator

The dial indicator option is used for precise pump calibration. A dial provides a precise reference for setting of the pump's displacement. If the pump displacement is changed, just return to the reference. Minor adjustments may still be necessary.

5.4.3 Micrometer

The micrometer is mounted to the end of the base plate on the Motor/Base Module. This device is designed to aid in dispensing small volumes of material for applications requiring a high degree of accuracy and repeatability.

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.

5.5.1 Assembly/Disassembly Procedures (Figure 5.3)

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

- **Vernier Scale (23)**
- **Thumb Screw (18)**
- **Thumb Wheel (19)**
- **Swing Plate Fabrication (2)**
- **Pinion Gear (21)**
- **Sensor End Shield (4)**

5.5.1.1 Vernier Scale (Figure 5.2 Items 23)

Disassembly

1. Remove the #8 - 32 x .25" button head socket cap screw and #8 flat washer securing vernier scale (23) to base (1).
2. Remove vernier scale (23).

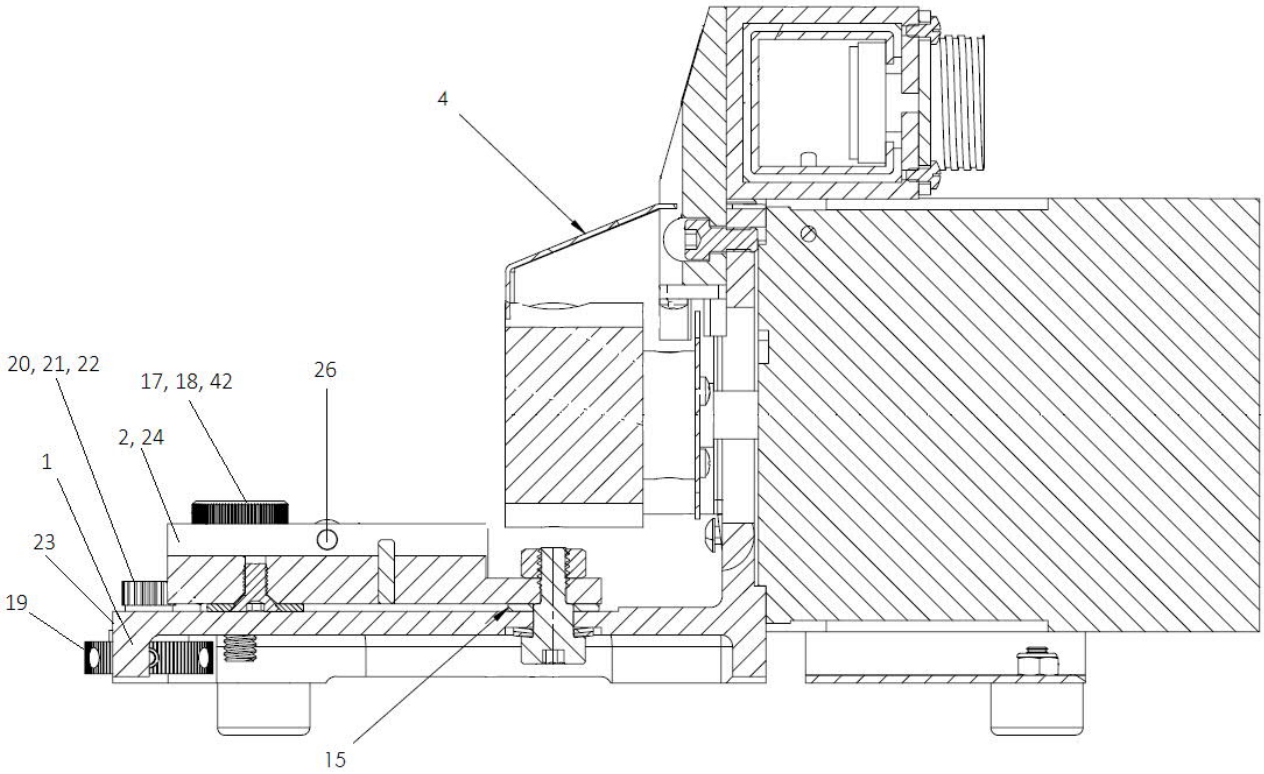

Figure 5.3 Single Ended Heavy Duty Cast Motor/Base Module

Assembly

1. Position vernier scale (23) on base (1).
2. Secure using #8 - 32 x .25" button head socket cap screw and #8 flat washer.

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

5.5.1.2 Thumb Wheel (Figure 5.3 Item 19) and Pinion Gear (Item 21) and Bearings

Disassembly

1. Remove the #10 - 32 x .25" socket set screw securing thumb wheel (19) to pinion gear (21) and remove pinion gear (21).
2. Remove thumb wheel (19), pinion gear (21) and plain bearing (20).
3. Using a 1/4" (6.35mm) diameter center punch, push flange bearing (22) out of base (1).

Assembly

1. Position flange bearing (22) over bore in base (1) with the flange end up and press into position.
2. Insert pinion gear (21) with the gear on top into flange bearing (22).
3. Install plain bearing (20) around bottom end of flange bearing (22).
4. Install thumb wheel (19) over bottom of pinion gear (21).
5. Align the set screw in the thumb wheel (19) with the flat on the side of pinion gear (21).
6. Secure thumb wheel (19) to pinion gear (21) using the #10 - 32 x .25" socket set screw.

5.5.1.3 Thumb Nut (Figure 5.3 Item 18) and Bearings

Disassembly

1. Remove thumb screw (18) by turning in a counterclockwise direction.
2. Remove plain bearing (42) and .25" ID flat washer.
3. Pivot swing plate fabrication (2) to gain access to .06" thick plain bearing (17).
4. Remove .06" thick plain bearing (17).

Assembly

1. Position .06 thick plain bearing (17) over threaded hole on base (1).
2. Position plain bearing (42) then 18 - 8 x .25" ID flat washer on top of swing plate fabrication (2) and align holes with .06" thick plain bearing (17) and threaded hole in base (1).
3. Install thumb nut (18) through 18 - 8 x .25" ID flat washer, plain bearing (42), swing plate fabrication (2) and .06" thick plain bearing (17) and secure to base (1).

5.5.1.4 Swing Plate (Figure 5.3 Item 2) and Bearings

Disassembly

1. Remove the Pump Module (Refer to Chapter 7) and two mounting screws (26).
2. Remove thumb screw (18) by turning in a counterclockwise direction.
3. Remove plain bearing (42) and .25" ID flat washer.
4. Slide swing plate fabrication (2) to gain access to .06" thick plain bearing (17).
5. Remove the 1/4 - 20 hex nut, shoulder screw and two belleville washers securing swing plate (2) to base (1).
6. Remove .06" thick plain bearing (17).
7. Remove #10 - 32 x .25" flat head socket cap screw, on swing plate bottom, securing C'sink plain bearing (24) to swing plate (2).

Assembly

1. Position C'sink plain bearing (24) on bottom of swing plate (2) and secure with #10 - 32 x .25" flat head socket cap screw.
2. Position .06" thick plain bearing (17) on top of base (1).
3. Align threaded pivot hole on swing plate (2), inside diameter of .06" thick plain bearing (17) and pivot hole in base.
4. Place two belleville washers on the shoulder screw in series, insert screw from bottom through pivot hole in base machining (1), .06" thick plain bearing (15), and thread into swing plate (2).
5. Tighten shoulder screw to flatten belleville washers then back off 1/4 turn. (Swing plate should slide, but with some resistance. Lock in place with 1/4-20 hex nut.
6. Position .06" thick plain bearing (17) over hole on base machining (1).
7. Position plain bearing (42) then 18 - 8 x .25" ID flat washer on top of swing plate fabrication (2) and align holes with .06" thick plain bearing (17) and hole in base (1).
8. Install thumb SCREW (18) through 18 - 8 x .25" ID flat washer, plain bearing (42), swing plate fabrication (2) and .06" thick plain bearing (17) and secure to base (1).
9. Install Pump Module and secure with two mounting screws.

5.5.1.5 Sensor End Shield (Figure 5.3 Item 4)

Disassembly

1. Remove the top two #6 - 32 x .25" button head socket cap screw securing sensor end shield (4) to base (1).

NOTE

The lower two screws are assembled with a liquid thread lock and should not be removed.

2. Lift sensor end shield (4) straight up and remove.

Assembly

1. Slide lower tabs of sensor end shield (4) over screws mounted in base (1).
2. Secure using two #6 - 32 x .25" button head socket cap screw.

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
Double Motor:	General:	
	Step Motor, Size 34	
	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:	31.77 V/KRPM

Triple Motor:

General:
Step Motor, Size 34

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:	7.1 AMPS
Resistance:	0.35 OHMS
Inductance:	2.5 mH
Voltage Constant:	31 V/KRPM

Brushless DC Motor:

Performance:

Peak Torque:	175 Oz-In
Motor Constant:	12.64 Oz-In/Sqrt (Watt)
Power at Peak Torque:	192 Watt
Damping Factor:	1.2 Oz-In/Rad/Sec
Thermal Resistance:	2.84 ^{0}C/W
Max Allowable Winding Temp:	1.55 ^{0}C
Electrical Time Constant:	1.14 Millisecond
Rotor Inertia:	0.00095 Oz-In-Sec^2
Weight (Max):	26 Oz
Maximum Speed:	4200 RPM
Computation Sensor Zero-Cross Accuracy:	+/- 5 ^{0}Electrical

Winding:

Resistance:	3.50 Ohm +/- 12.5%
Torque Sensitivity:	24.0 Oz-In/Amp +/- 10%
Back EMF:	0.170 Volts/Rad/Sec +/- 10%
Inductance:	3.80 Millihenry +/- 30%
Current at Preak Torque:	7.29 Amp
Voltage at Peak Torque:	25.5 Volt
Maximum Rated Voltage:	75 Volt

High Torque Motor:

General:
Step Motor, Nema Size 34

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:	0.8 VDC
Current:	5.0 AMPS
Resistance:	0.16 OHMS
Inductance:	1.35 mH
Voltage Constant:	35 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 located in the Title Page section of this manual.

092117 - # # # #

Pulse Damper
- **0** - No Pulse Damper

Adjustment and Gauge
- **0** – Thumbwheel Adjust w/o Gauge
- **1** – Thumbwheel Adjust w/ Analog Gauge
- **2** – Micrometer Adjust w/ Digital Gauge
- **3** – Micrometer Adjust w/o Gauge
- **4** – Thumbwheel Adjust w/ Digital Gauge

Motor Type
- **2** – Double Stack Unipolar Stepper
- **3** – Triple Stack Unipolar Stepper
- **4** – Brushless DC
- **5** – High Torque Bipolar Stepper

Flag Orientation
- **0** - Standard Orientation
- **1** - 120° CCW Flag Orientation

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 power. Remove Pump Modules from Motor/Base Module. Inspect and verify the Pump Module pistons are moving freely. Turn on Controller Module and try again. If the motor operates correctly, the Pump Module may need to be cleaned or serviced. If none of the above solves the problem, contact IVEK technical support for assistance.
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. Return complete Controller, Motor/Base and Pump Modules to IVEK Corporation for repair.
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 replace faulty cable.
Motor turns 3 times, stalls and repeats.	Sensor problem	Contact IVEK technical support for assistance.
Thumb wheel does not operate smoothly.	Dirt in gear tooth	Clean.
Low volume noise during operation.	Sensor End Shield vibrating.	Tighten end shield.

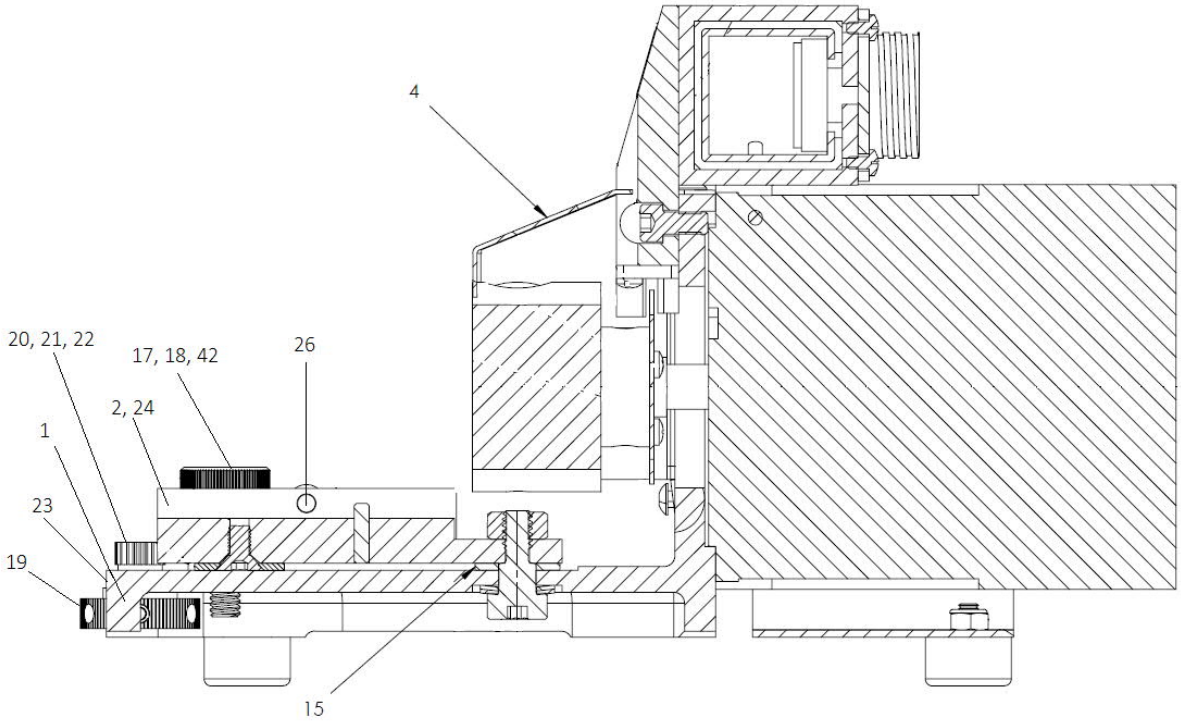

Figure 5.4 Single Ended Heavy Duty Motor/Base Module (Sheet 1 of 5)

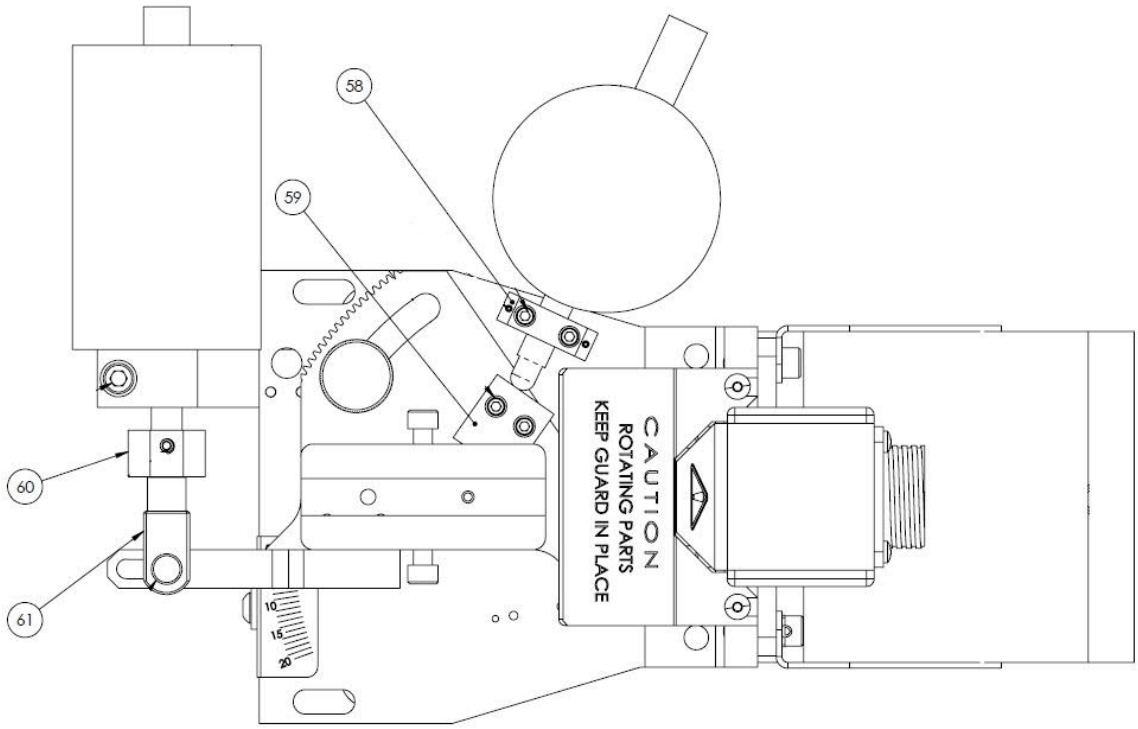

**Figure 5.4 Single Ended Heavy Duty Motor/Base Module (Sheet 2 of 5)
with Optional Analog Micrometer**

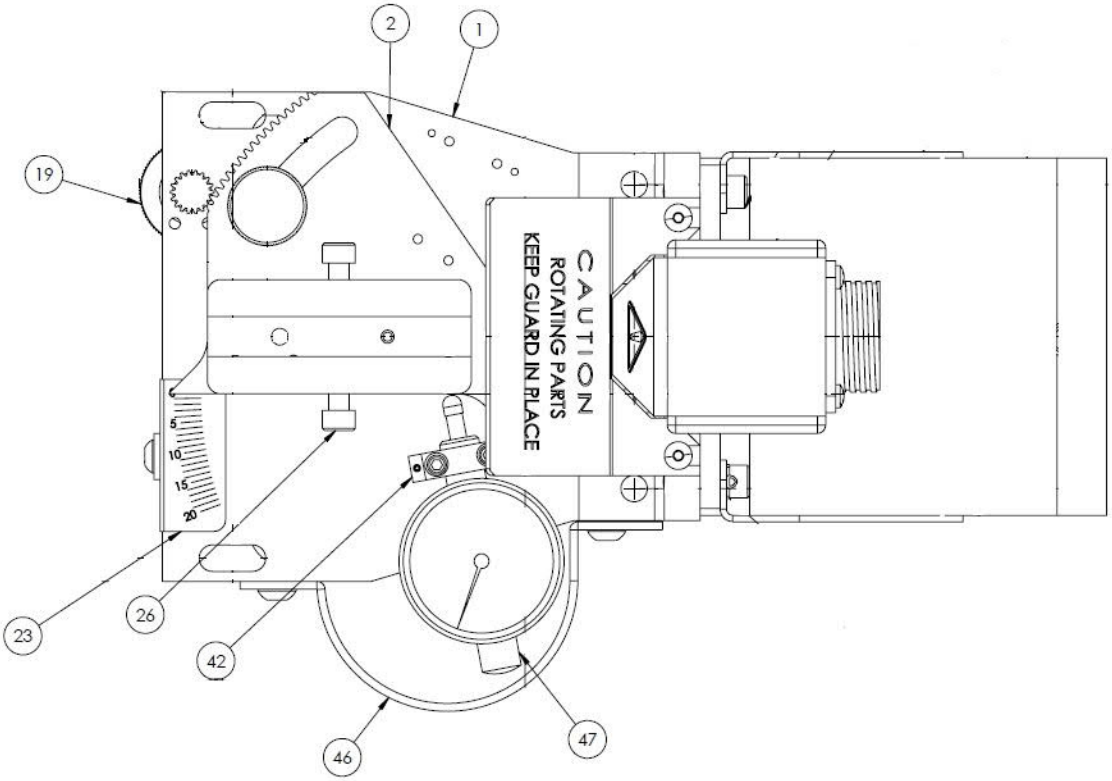

Figure 5.4 Single Ended Heavy Duty Motor/Base Module (Sheet 3 of 5)

	NUMBER	DESCRIPTION	PER ASSY
	092117-####	Single Ended Heavy Duty Motor/Base Module	1

Model # Tab	Dwg Index #	Part #	Description	Qty
	4	092106	Shield, Sensor End	1
	15	092242	Plain Bearing, 0.060 Thick	1
	17	092240	Plain Bearing, 0.062 Thick	2
	18	092115	Thumb Nut	1
	23	092107	Vernier Scale	1
092117	**# # # # #**	**CALIBRATION GAUGE OPTION**		
0	1	092111	Base, Hvy Duty, 34 Frame Motor/Base	1
0	2	092120-001	Swing Plate Fabrication	1
0	19	092100	Thumb Wheel	1
0	20	092243	Plain Bearing	1
0	21	092096	Pinion Gear	1
0	22	092099-001	Flange Bearing	1
1	1	092111-1	Base, Hvy Duty, 34 Frame Motor/Base: W/Indicator Option	1
1	2	092120-001	Swing Plate Fabrication	1
1	19	092100	Thumb Wheel	1
1	20	092243	Plain Bearing	1
1	21	092096	Pinion Gear	1
1	22	092099-001	Flange Bearing	1
1	42	092225	Indicator Block	1
1	46	092230	Indicator Guard	1
1	47	092229	Calibration Indicator	1
2	1	092111-2	Base, Hvy Duty, 34 Frame Motor/Base; W/Micrometer Adj	1
2	2	092120-002	Swing Plate Fabrication, Fabrication	1
2	34	092329-001	Bracket, Micrometer Holder, Heavy Duty Motor/Base	1
2	50	092328-001	Bracket, Clevis Slide, Heavy Duty Motor/Base	1
2	58	092305-001	Clamp Block, Indicator Gauge	1
2	59	092330-001	Stop, Indicator Gauge, Heavy Duty Motor/Base	1
2	60	092331-001	Adapter, Micrometer to Clevis	1
2	61	092332-001	Clevis, Plastic, with Pin and Clip	1
2	70	092334-00100	Indicator, Gauge, Digital, Style A; 12.7 Range, No Output	1
3	34	092329-001	Bracket, Micrometer Holder, Heavy Duty Motor/Base	1
3	50	092328-001	Bracket, Clevis Slide, Heavy Duty Motor/Base	1
3	60	092331-001	Adapter, Micrometer to Clevis	1
3	61	092332-001	Clevis, Plastic, with Pin and Clip	1
4	19	092100	Thumb Wheel	1
4	20	092243	Plain Bearing	1
4	21	092096	Pinion Gear	1
4	22	092099-001	Flange Bearing	1
4	58	092305-001	Clamp Block, Indicator Gauge	1
4	59	092330-001	Stop, Indicator Gauge, Heavy Duty Motor/Base	1
4	70	092334-00100	Indicator, Gauge, Digital, Style A; 12.7 Range, No Output	1

Figure 5.4 Single Ended Heavy Duty Motor/Base Module (Sheet 4 of 5)

092117	# # # #	**MOTOR SIZE OPTION**		
1	11	092129	Motor, 34 Frame, Step, Single Stack, Single End	1
2	11	092130	Motor, 34 Frame Step, Double Stack, Single End	1
3	11	092131	Motor, 34 Frame Step, Triple Stack, Single End	1
4	11	800037-01R	Motor, 34 Frame Single End, BLDC w/ Hall Sensors, 4 Pole	1
5	11	800049-01	Motor, 34 Frame Step, High Torque, Single End, Style 3	1

Figure 5.4 Single Ended Heavy Duty Motor/Base Module (Sheet 5 of 5)