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3. ELECTROSPENSE 34 CONTROL SYSTEM

3.1 DESCRIPTION (FIGURE 3.1)

The ElectroSpense 34 Control System contains a Motion Control Module and a Single Ended Heavy Duty Motor/Base Module. The Motion Control Module and Single Ended Heavy Duty Motor/Base Module when combined are referred to as the ElectroSpense 34 Control System. The Motion Control Module contains an integrated motor, driver, programmable controller and connectors. The Single Ended Heavy Duty Motor/Base Module contains a base to support the Pump Module and the displacement adjustment mechanism.

The Motion Control Module provides accurate liquid metering. The Single End Heavy Duty Motor/Base Module changes the angle between the axis of the motor and the axis of the Pump Module piston thus changing the metered volume.

The standard ElectroSpense 34 Control System measures 117.6mm (4.63") wide, 135.9mm (5.35") high and 254.7mm (10.03") deep and weighs approximately 4.0 kilograms (9.0 pounds). Dimensions and weight listed are without the Pump Module.

This manual is divided into four main sections.

Section 3.2 describes the Motion Control Module
Section 3.3 describes the Single End Heavy Duty Motor/Base Module
Section 3.4 describes system information

3.2. MOTION CONTROL MODULE

3.2.1 Description (Figure 3.1)

The Motion Control Module is a fully programmable motion control system allowing for complex programs and I/O interaction. The Motion Control Module contains an integrated motor, driver, programmable controller and connectors. The Motion Control Module provides accurate liquid metering. The connectors provide a connection point for the power and control cables.

3.2.2 Operation

The Motion Control Module is programmed at the factory and does not require any additional programming. The main components are shown in Figure 3.2.

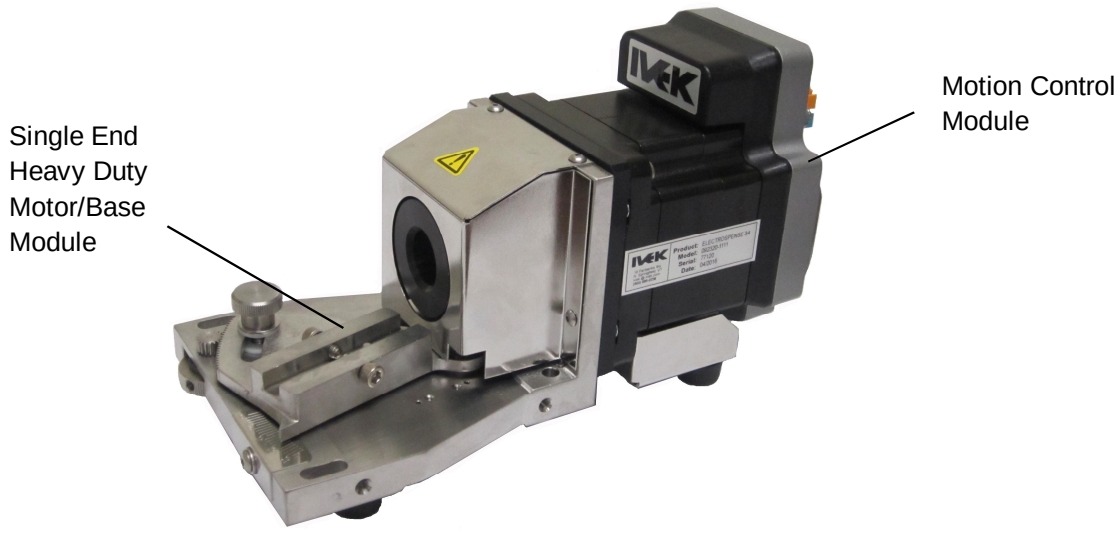

Figure 3.1 ElectroSpense 34 Control System

3.2.2.1 Service Interface

The Service Interface is an RS-422/485 serial communications bus used to program the Motion Control Module. The interface is typically used to program and setup the system at the factory. If you need to make changes to the factory settings you will need to order the Programming Adaptor IVEK Part # 550031-01. Also refer to the Terminal Emulator Bulletin TB-120 supplied on the Manual CD. Refer to section 3.4.4.2 for a list of available commands. The signal name of each pin on the connector is as follows;

Pin #	Function
1	Not Connected
2	Minus Transmit, Or Channel B+ Line
3	Plus Receive, Or Channel B+ Line
4	Isolated Communication Ground
5	Plus Transmit, Or Channel A+ Line
6	Isolated Communication Ground
7	Plus Transmit, Or Channel A+ Line
8	Minus Receive, Or Channel B- Line
9	Not Connected

3.2.2.2 Protective Earth

Protective earth provides a means of grounding the device chassis. This must be connected directly to the sites earth ground.

3.2.2.3 DC Power Interface

The DC Power Interface provides a connection for the power source. The power source is +24 VDC. The function of each pin on the connector is as follows;

Pin #	Function
1	Supply Voltage (+24 VDC)
2	Reference Potential To VDC

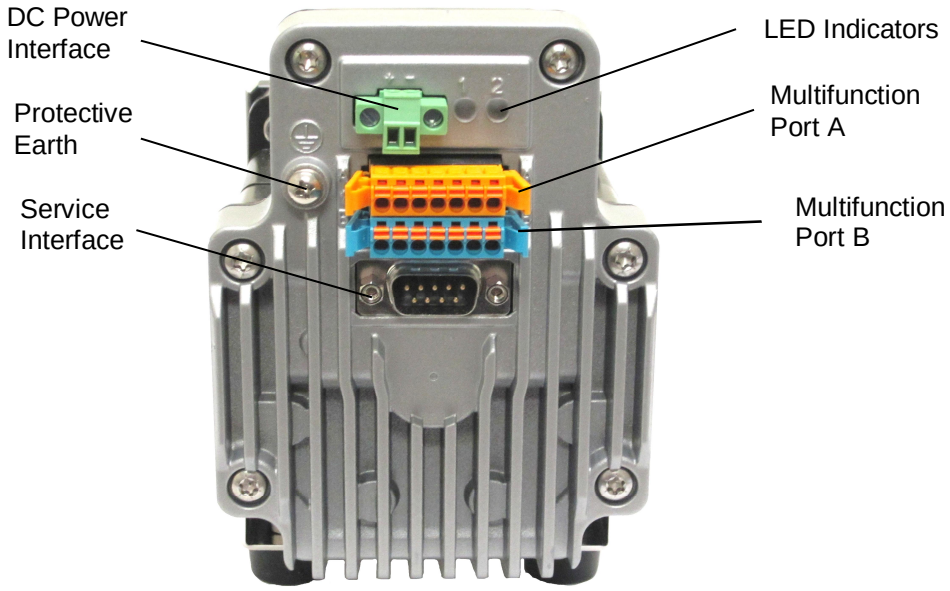

Figure 3.2 Motion Control Module Main Components

3.2.2.4 LED Indicators

There are two LED Indicators on the rear of the ElectroSpense Module; LED 1 indicates the power supply status and LED 2 indicates the attention state status. The status of each indicator is as follows;

LED 1 Power Indication

Color	Status
Off	No Power
Green	+VDC Supply In Range
Flashing Green	+VDC Off, Drive On AUX Power
Red	+VDC Supply Out Of Range
Flashing Red	+VDC off, Aux Power Out Of Range

NOTE

The system is intended to be used without aux (auxiliary) power.

LED 2 Status Indication

Color	Status
Off	Not Configured
Green	No Attention State Exists
Red	Attention State Exists

3.2.2.5 Multifunction Interface

The multifunction interface operates at the following signal levels:

- +12 to +24V Aux-Power input to supply power to logic circuits in the event of main supply loss.
- 24V input signals are opto-isolated
- 24V output signals are opto-isolated and current limited
- 12-bit analog signal is not isolated

The input signals are programmed at the factory. See below for their function.

Two 100mA/24 VDC power outputs are programmed at the factory. See below for their function. The third output is a 5.5 mA signal output which is presently not used.

The reference voltage or current is applied to the analog input can be used for a number of programmatically defined operations. These are typically factory set.

Signal inputs

The signal input functions are programmable in function. They may be used as sinking or sourcing based upon the bias of the INPUT_ REFERENCE.

Voltage Range	[+Vdc]	5 ... 24
Input Current (5V)	[mA]	8.7
Input Current (24V)	[mA]	14.6
Input Frequency	[kHz]	5
Isolation		Galvanic
Protection Class		III

Analog input (Optional Setup)

Voltage mode 0 - 10	[Vdc]	0 ... 10
Current loop mode	[mA]	0 ... 20
Impedance by mode		
0 - 10 V	[kOhm]	1.25
0 - 20 mA	[Ohm]	5
Isolation	None	

Power outputs

Voltage rating	[Vdc]	-24 ... +24
Current rating	[mA]	-100 ... +100
RDSON	[Ohm]	11 ... 14
TON (hardware)	[mS]	0.08 ... 2
TOFF (hardware)	[mS]	0.03 ... 0.5
O/C Level (±)	[mA]	230 ... 350
S/C Peak (+ or - @24V)	[mA]	2.2 (max)
Clamp voltage	[Vdc]	32 ... 38

Signal output

Voltage open-collector	[Vdc]	60
Voltage open-emitter	[Vdc]	7
Current open-collector	[mA]	5.5
Current open-emitter	[mA]	5.5
Isolation Galvanic		

Auxiliary (Aux) supply voltage VDC

Aux power is used to maintain power to the logic circuits and retain information stored in counters, registers and user variable in the event of system power loss. It is not a required connection and typically not used.

Limit values min/max	[+Vdc]	12 ... 24
Ripple at max voltage	[+Vpp]	2.4
Max. current input	[mA]	194

Multifunction Port a (Inputs)

1a	Biases The Input As Sinking Or Sourcing
2a	General Purpose Programmable Input 1
3a	General Purpose Programmable Input 2
4a	General Purpose Programmable Input 3
5a	General Purpose Programmable Input 4
6a	Analog Input
7a	Logic Ground (Non-Isolated)

Factory Configured Input Connections

1a	Customer Input Signal Bias
2a	Initiate Dispense
3a	Meter
4a	Clear/Reference/(Stop Dispense)
5a	Forward/Reverse
6a	Analog Rate Input (optional setup, see "Y9" command)
7a	Analog Rate Return (optional setup for analog rate applications)

Initiate Dispense - This parameter is used to trigger a dispense and occurs on the rising edge of the input signal

Meter - This parameter dispenses liquid at a continuous state.

Clear/Reference - The parameter clears any fault conditions and references the pump.

An additional function of stopping a dispense is included. This can be useful if the system is preprogrammed for large dispense volumes and needs to be stopped during operation.

Forward/Reverse - The direction of the fluid flow is normally forward, but can be reversed to empty fluid back into the supply.

Multifunction Port b (Outputs)

1b	0-24V Auxiliary Input
2b	Output 1 + Polarity
3b	Output 1 - Polarity
4b	Output 2 + Polarity
5b	Output 2 - Polarity
6b	Output 3 + Polarity
7b	Output 3 - Polarity

Factory Configured Connections

2b	Out 1 Ready +
3b	Out 1 Ready -
4b	Out 2 Fault +
5b	Out 2 Fault -
6b	Not Used
7b	Not Used

Out 1 Ready - This signal indicates the active/idle state of the system. The system must be ‘ready’ for this output to be "true". This output is false if the system is not 'ready'.

Out 2 Fault - This signal indicates a fault has been detected in the operation of the system. This output is complemented, i.e., the output is true when no fault exists and is false when there is a fault.

3.3 SINGLE ENDED HEAVY DUTY MOTOR/BASE MODULE

3.3.1 Description (Figure 3.1)

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 and the displacement adjustment mechanism. 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.

WARNING

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

3.3.2 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.

3.3.2.1 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.

3.3.2.2 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 insuring 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.

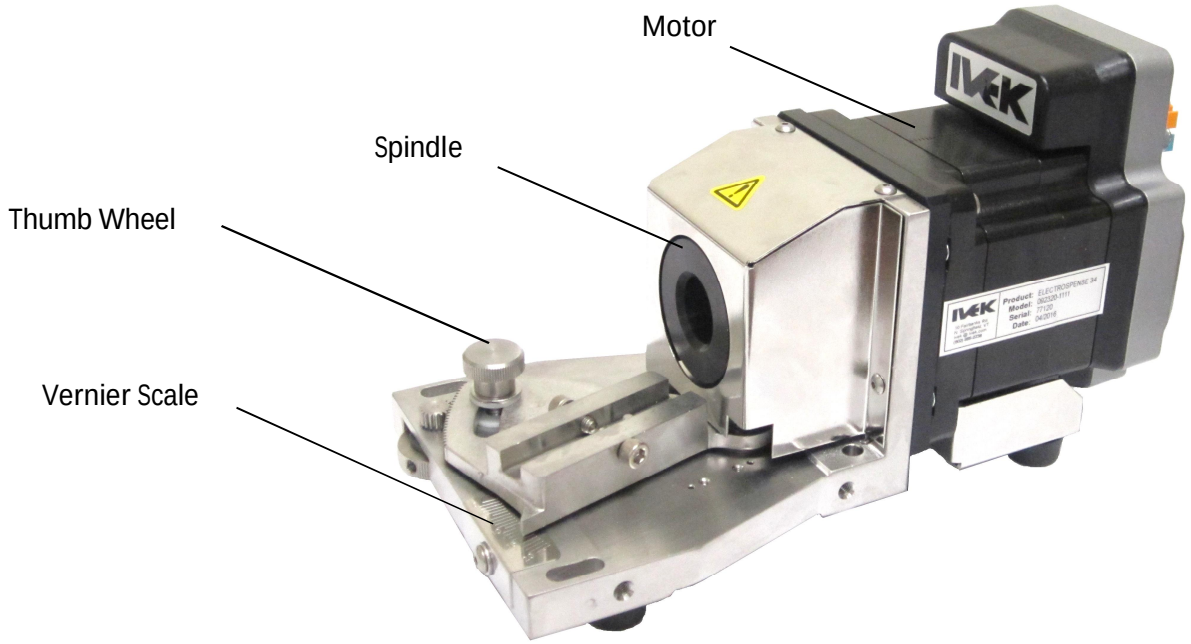

Figure 3.3 Single Ended Heavy Duty Motor/Base Module

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

3.3.2.3 Stall Detect

Motor stalls are detected if a signal from the internal 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.

3.3.3 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.

3.4 SYSTEM INFORMATION

The following sections provide information on the overall module and includes options, assembly/disassembly procedures, a problem guide, specifications, model number information and an illustrated parts breakdown.

3.4.1 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.

3.4.1.1 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.

3.4.2 Assembly/Disassembly Procedures (Figure 3.4)

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

- **Vernier Scale (1)**
- **Thumb Nut (4)**
- **Thumb Wheel (2)**
- **Swing Plate Fabrication (5)**
- **Pinion Shaft (3)**
- **Sensor End Shield (6)**

3.4.2.1 Vernier Scale (Figure 3.4 Item 1)

Disassembly

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

Assembly

1. Position vernier scale on base.
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.

3.4.2.2 Thumb Wheel (Figure 3.4 Item 2) and Pinion Gear (Item 3) and Bearings

Disassembly

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

Assembly

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

3.4.2.3 Thumb Nut (Figure 3.4 Item 4) and Bearings

Disassembly

1. Remove the thumb nut by turning in a counterclockwise direction.
2. Remove the plain bearing and .25" ID flat washer.
3. Pivot the swing plate fabrication to gain access to the .06" thick plain bearing.
4. Remove the .06" thick plain bearing.

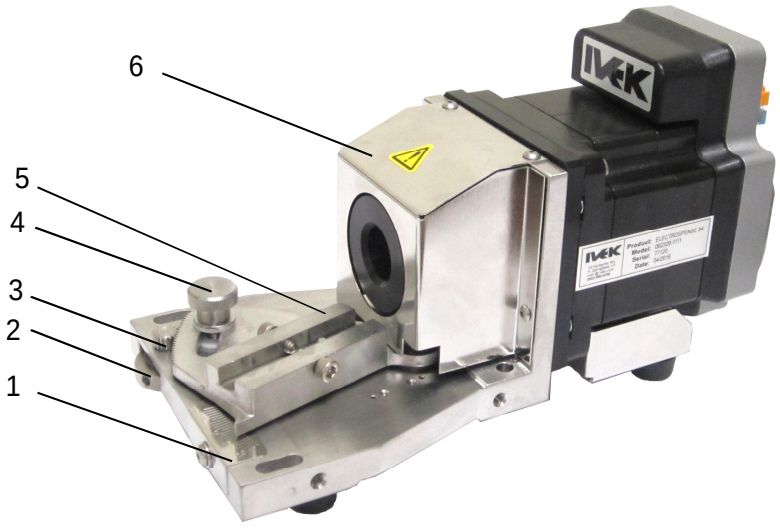

Figure 3.4 Single Ended Heavy Duty Motor/Base Module Replacement Parts

Assembly

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

3.4.2.4 Swing Plate (Figure 3.4 Item 5) and Bearings

Disassembly

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

Assembly

1. Position the C'sink plain bearing on bottom of the swing plate and secure with #10 - 32 x .25" flat head socket cap screw.
2. Position the .06" thick plain bearing on top of the base.
3. Align threaded pivot hole on the swing plate, inside diameter of the .06" thick plain bearing 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, and thread into the swing plate.
5. Tighten the 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 the .06" thick plain bearing over hole on the base.
7. Position the plain bearing then 18 - 8 x .25" ID flat washer on top of the swing plate fabrication and align holes with the .06" thick plain bearing and the hole in the base.
8. Install the thumb nut through 18 - 8 x .25" ID flat washer, plain bearing, swing plate fabrication and .06" thick plain bearing and secure to the base.
9. Install Pump Module and secure with two mounting screws.

3.4.2.5 Spindle End Shield (Figure 3.4 Item 6)

Disassembly

1. Remove the four two #6 - 32 x .25" button head socket cap screw securing the spindle end shield to the base.

Assembly

1. Position the spindle end shield on the base and secure using four #6 - 32 x .25" button head socket cap screws.

3.4.3 Installation

The Motor/Base Module includes four mounting holes (Figure 3.5). 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.

3.4.4 SETUP

The following sections will help with the initial setup of your system and instructions for using the Serial Interface if the factory set parameters need to be changed.

3.4.4.1 Initial Setup Instructions

1. The system comes preprogrammed and is ready for installation.
2. Connect the Multifunction cables (Customer supplied) into the Multifunction connectors on the ElectroSpense 34. Make sure they click in place.
3. Connect the Power supply (Customer suppled) into the Power connector on the ElectroSpense 34.
4. Install tubing assemblies in intake and discharge ports as shown in Figure 2.1.
5. Apply power. Both LED's on the ElectroSpense 34 should illuminate Green.
6. Verify the system is ready and not in a FAULT state.
7. Prime the system by applying a signal to Multifunction connector Pin 2a Meter. This will run the pump at the pre-programmed RPM until the signal is removed. Meter until properly primed. Pump is now ready for dispensing or metering.
8. Activate a dispense by applying a signal to Multifunction connector Pin 1a Dispense. Calibrate the pump manually using the thumb screw. Once the desired volume has been attained, lock the thumb screw with the locking nut.
9. Activate a REFERENCE to align piston.
10. The system is now ready to run.

3.4.4.2 Serial Interface (Service Interface)

The RS-422/485 serial interface can be used to change all of the following parameters;

Dispense Strokes	Dispense Rate*
Stopping Position	Meter Rate*
Acceleration/Deceleration	Analog Min**
Torque	Analog Max**
Rate Type	

* If Rate type is set to Program
** If Rate type is set to VDC or mA

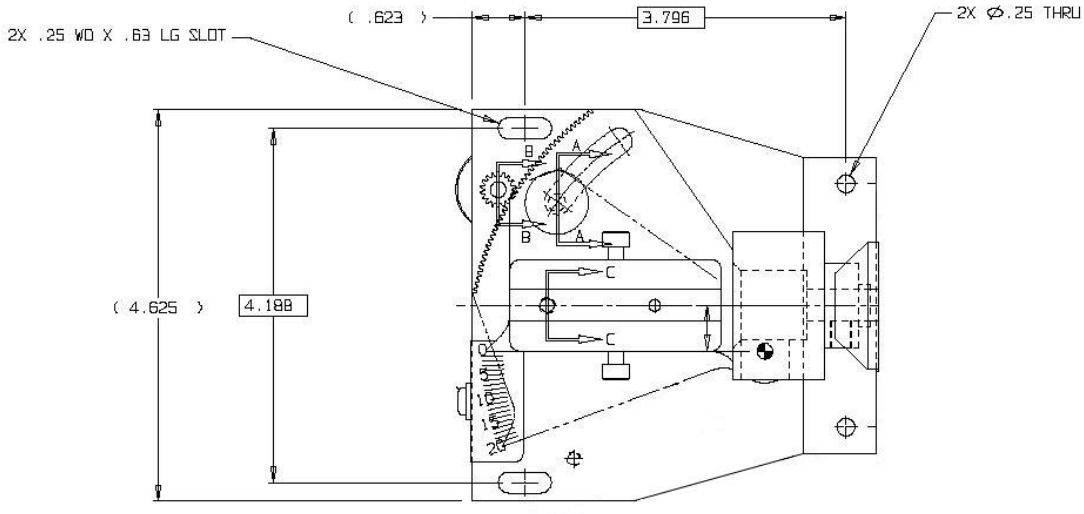

Figure 3.5 ElectroSpense 34 Mounting Locations

The ElectroSpense 34 uses a custom RS-422/485 interface (IVEK Part Number 550031-01) through a DB9 connector. Refer to Technical Bulleting TB-120 for additional information on setting up a terminal emulator.

Commands - A list of commands, responses and descriptions are shown on the following pages. Every command in the following chart must be followed by a CR (carriage return) and every reply is proceeded and followed by those characters as well.

Command	Response	Description
PR <variable>	PR <variable>	Returns current value for the selected variable. <value> (This is the best way to confirm a change)
EX PV	EX PV	Returns current configuration for all variables.
S		Saves changes to nonvolitle memory.
V0 => Dispense Volume		
PR V0	<value>	Returns current Dispense Volume in revolutions.
V0=<value>	none	Sets the Dispense Volume. <value>: 10,000 = Maximum 1 = Minimum (Default)
Y3 => Stopping Position		
PR Y3	<value>	Returns current Stopping Position in full steps.
Y3=<value>	none	Sets the Stopping Position. <value>: 200 = Maximum 0 = Minimum 50 = Default
Y0 => Accel/Decel Rate		
PR Y0	<value>	Returns current Acceleration/Deceleration Rate.
Y0=<value>	none	Sets the Acceleration/Deceleration Rate. <value>: 0 = Slow 1 = Medium (Default) 2 = Fast 3 = Fire Off
Y1 => Torque		
PR Y1	<value>	Returns current Torque value.
Y1=<value>	none	Sets the Torque value. <value>: 0 = Low (Default) 1 = Medium 2 = High
Y9 => Rate Type		
PR Y9	<value>	Returns current Rate Type.
Y9=<value>	none	Sets the Rate Type.(Refer to the following charts) <value>: 0 = Program (Default) 1 = VDC 2 = mA

If "Program" Rate Type (Y9) selected

COMMAND	RESPONSE	DESCRIPTION
U0=<value>	U0=<value>	Sets the Dispense Rate in full steps. Maximum: 4000 Minimum: 10 Default: 500
U1=<value>	U1=<value>	Sets the Meter Rate in full steps. Maximum: 4000 Minimum: 10 Default: 2000

If "VDC" or "mA" Rate Type (Y9) selected

COMMAND	RESPONSE	DESCRIPTION
U2=<value>	U2=<value>	Sets the Analog Minimum setting. Maximum: Must be less than U3 value Minimum: 10 Default: 10
U3=<value>	U3=<value>	Sets the Analog Maximum setting. Maximum: 4000 Minimum: Must be greater than U2 value Default: 4000

3.4.5 Problem Guide

Table 3.1 contains a list of possible problems, causes and solutions for the Motor/Base Module.

3.4.6 Specifications

Power Supply: 24 VDC @ 4.0 Amps (Model 092320-##1#)
Inputs and Outputs: See Section 3.2.2.5

3.4.7 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.

092320 - # # # #

Calibration Gauge
0 - No Calibration Gauge
1 - Calibration Gauge

Base Material
1 – Stainless Steel

Motor Size
1 - 1 Stack Stepper

Communication
1 – RS422/RS485

3.4.8 Illustrated Parts Breakdown

The illustrated parts breakdown (Figure 3.6) contains the information required for identifying and ordering replacement parts.

Table 3.1 Common Operational Problems And Solutions

PROBLEM	PROBABLE CAUSE	POSSIBLE SOLUTION
Power is on, ElectroSpense Module accepts trigger, motor spindle fails to rotate and motor makes a sound that fluctuates in tone. * This condition does not harm the system.	Pump Module piston is binding.	Turn off ElectroSpense Module power. ** Remove Pump Module from ElectroSpense Module. Do not try to free the Pump Module by changing the displacement. (See Caution in section 3.2.2) Turn on ElectroSpense Module and try again. If the motor operates correctly, the Pump Module may need to be cleaned or serviced. Refer to Chapter 7
Power is on, ElectroSpense Module accepts a trigger, motor spindle fails to rotate, and motor is silent.	Motor malfunction.	Turn off ElectroSpense Module power. Turn on ElectroSpense Module and try again. If the motor operates incorrectly, servicing may be necessary to the motor or the controller. Return complete ElectroSpense and Pump Modules to IVEK Corporation for repair.
Displacement adjustment thumbscrew does not operate smoothly.	Dirt on threads Threads damaged	Clean. Contact IVEK technical support for assistance.
Pump Module mounting plate does not pivot.	Lock washer installed and shoulder screw too tight or side plate damaged	Remove washers and loosen shoulder screw, if already loose, inspect side plate for damage, replace if necessary.

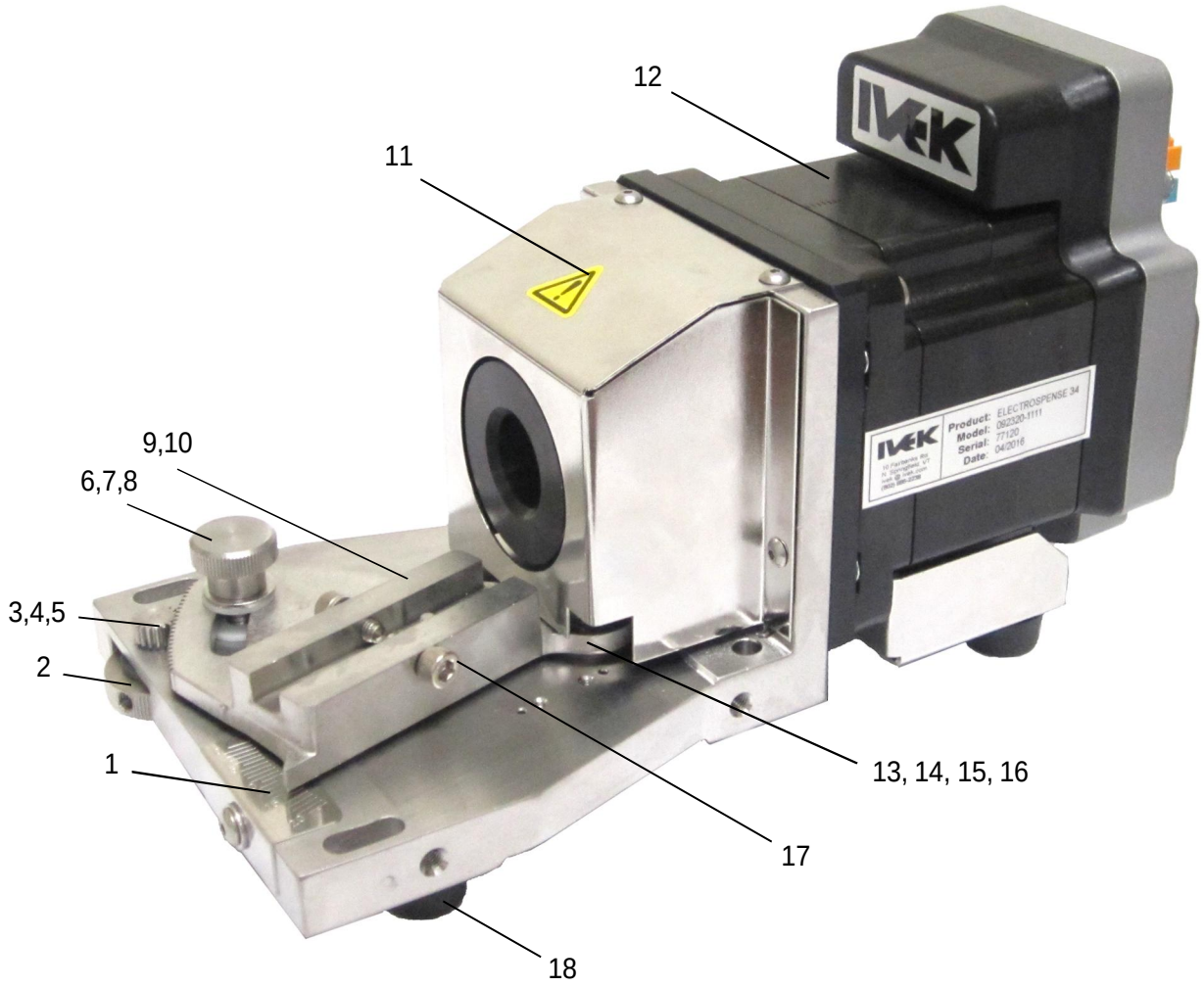

Figure 3.6 ElectroSpense 34 Control System (Sheet 1 of 2)

	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	092320-####	**ElectroSpense 34 Control System**	**1**

Model # Tab	Dwg Index #	Part #	Description	Qty
	1	092107	Vernier Scale	1
	2	092100	Thumb Wheel	1
	3	092243	Plain Bearing	1
	4	092096	Pinion Gear	1
	5	092099	Flange Bearing	1
	6	092240	Plain Bearing	2
	7	092115	Screw, Thumb, Swing Plate, HD 34 Frame Motor/Base	1
	8	182019-250	Washer, Flat, 18-8 Inch: ¼"	1
	9	092120	Swing Plate Fabrication	1
	10	092228	Bearing, Oilite, C'Sink	1
	11	092106	Shield, Sensor End	1
	12	800077-11	Motor, Size 34 Step, Lexium Drive W/Int Drive & Cont.	1
	13	092079	Washer, Spr, Belleville Disc. .317X.625X.032"Thk	1
	14	092078	Screw, Shldr, Pred, Soc Hd, SST, Dia 5/16X1/4" Lg, 1/4-20	1
	15	092242	Bearing Thrust Washer, 0.06 Thick	1
	16	182028-C25	Nut, Mach Scr Hex, 18-8, Inch; 1/4-20	1
	17	092238	Screw, Retaining	2
	18	192711-003	Rubber Foot	4
092320 - # ### CALIBRATION GAUGE OPTION				
0	11	092324-01	Shield, Spindle, ElectroSpense 34, HD; Char 01	1
1	11	092324-02	Shield, Spindle, ElectroSpense 34, HD; Char 02	1
1	NS	092225	Indicator Block	1
1	NS	092229	Calibration Indicator	1
1	NS	092230	Indicator Guard	1
1	NS	182004-06038	Pin, Spring, 18-8; 1/16 X 3/8"	2
1	NS	182011-C04062	Screw, Soc HD Cap, 18-8, Inch #4-40 X .62" Long	2

NS = Not Shown

Figure 3.6 ElectroSpense 34 Control System (Sheet 2 of 2)