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3. ELECTROSPENSE 23 CONTROL SYSTEM

3.1 DESCRIPTION (FIGURE 3.1)

The ElectroSpense 23 Control System contains a Motion Control Module and a Single Ended Microspense AP Motor/Base Module. The Motion Control Module and Single Ended Microspense AP Motor/Base Module when combined are referred to as the ElectroSpense 23 Control System. The Motion Control Module contains an integrated motor, driver, programmable controller and connectors. The Single Ended Microspense AP 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 Microspense AP 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 23 Control System measures 70mm (2.76") wide, 120mm (4.72") high and 160mm (6.30") deep and weighs approximately 1.4 kilograms (3.0 pounds). Dimensions and weight listed are without the Pump Module.

The ElectroSpense 23 Control System with Micrometer measures 70mm (2.76") wide, 120mm (4.72") high and 190mm (7.48") deep and weighs approximately 1.4 kilograms (3.0 pounds). Dimensions and weight listed are without the Pump Module.

This manual is divided into three main sections.

Section 3.2 describes the Motion Control Module
Section 3.3 describes the Single End Microspense AP 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.

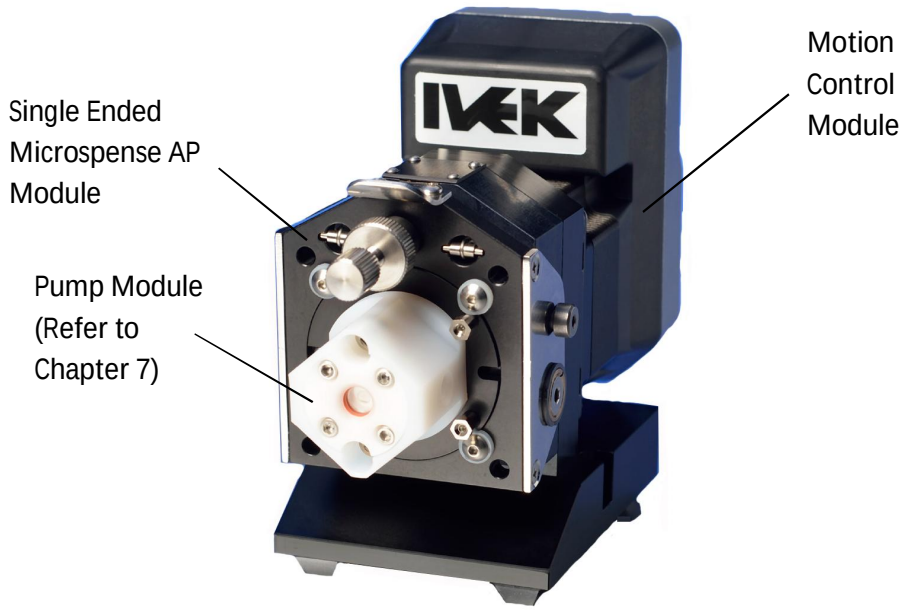

Figure 3.1 ElectroSpense 23 Control System

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.

3.2.2.1 Service Interface

The Service Interface for the standard system 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 A- Line
3	Plus Receive, Or Channel B+ Line
4	Isolated Communication Ground
5	Not Connected
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;

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

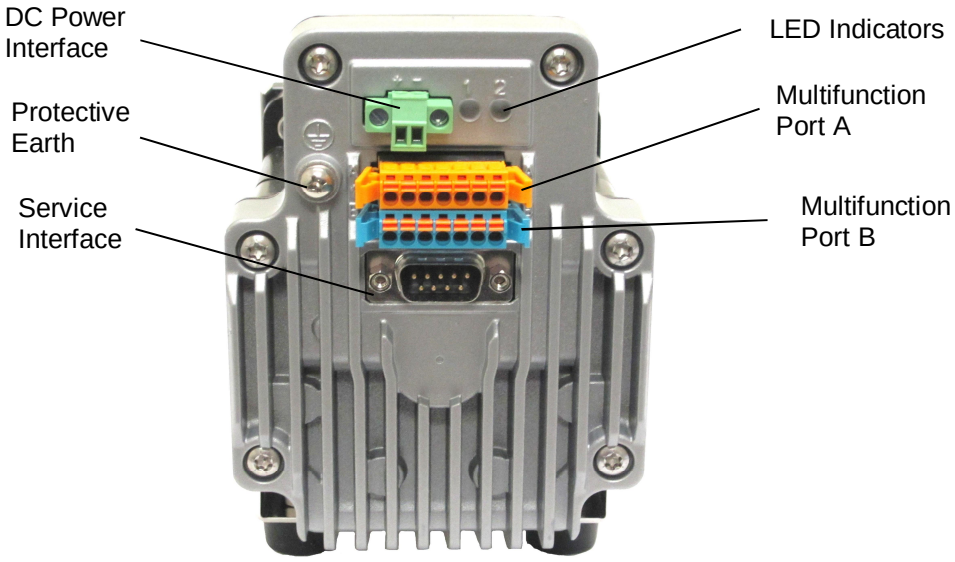

Figure 3.2 ElectroSpense 23 Main Components

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	[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 MICROSPENSE AP MOTOR/BASE MODULE

3.3.1 Description (Figure 3.3)

The Single Ended Microspense AP 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

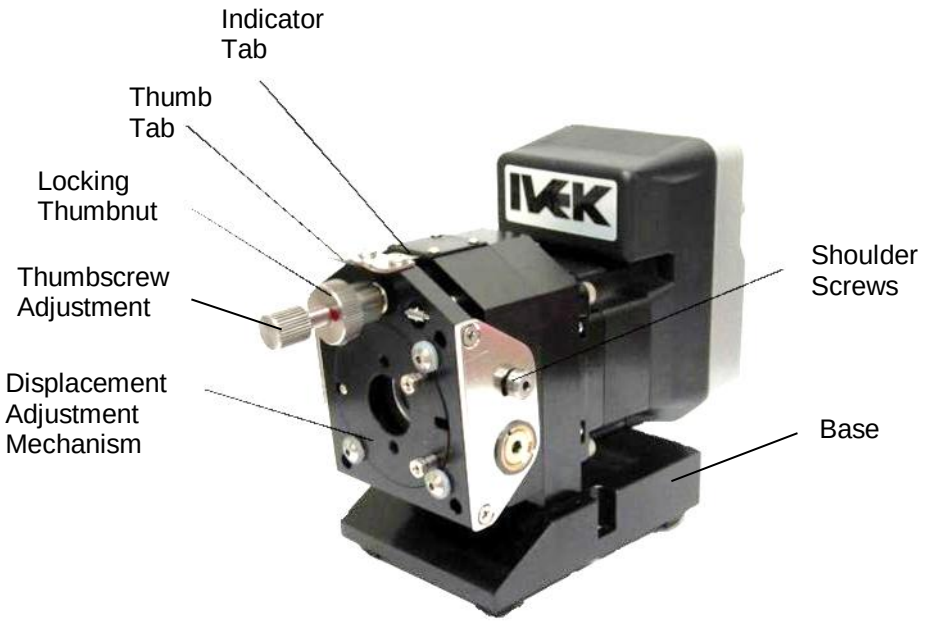

Figure 3.3 Single Ended Microspense AP Motor/Base Module

For the Single Ended Microspense AP Motor/Base Module the amount of liquid metered is controlled by the angle of the Displacement Adjustment Module and the number of revolutions. The Displacement Adjustment Module controls the angle and the Motion Control Module controls the number of revolutions. The volume per revolution is adjusted on the Displacement Adjustment Module using the displacement adjustment thumbscrew. The main components are shown in Figure 3.3.

3.3.2.1 Indicator Tab

A gauge is provided for reference when setting the Pump Module displacement. Setting the angle to "0" provides minimum output and "10" provides maximum output. The gauge is held in place by the thumb tab and slides under a plate mounted to the top of the Displacement Adjustment Module.

3.3.2.2 Displacement Adjustment (Figure 3.4)

The Displacement Adjustment Module contains a two position displacement adjustment mechanism. One position (maximum displacement) is used to fill and empty the system during priming and cleaning and the other position (calibrated displacement) is used during normal operation.

CAUTION

*If the piston is frozen in the cylinder, **do not** change the pump displacement by depressing the thumb tab. Damage to the piston may result. Use the optional Pump Extractor Tool kit IVEK Part # 072087 (Micro Rotary) or 250052 (Micro SR). (Refer to Section 2.4.8.1)*

To adjust the Displacement Adjustment Module for normal operation:

1. Loosen thumbnut (3)
2. Adjust angular position of displacement adjusting mechanism (1) by turning displacement adjustment thumbscrew (2). Turning the thumbscrew clock-wise will increase the pump displacement. Turning the thumbscrew counter clockwise will decrease the pump displacement.
3. After verifying the pump displacement is correct, lock the thumbscrew (2) in place by tightening the thumbnut (3). To adjust the Displacement Adjustment Module to fill or empty the system for priming or cleaning:

NOTE

During this procedure, do not move the thumbnut (3) or displacement adjustment thumbscrew (2).

1. Press down on the thumb tab (4) (see below) to tilt the displacement adjustment mechanism (1) into its maximum

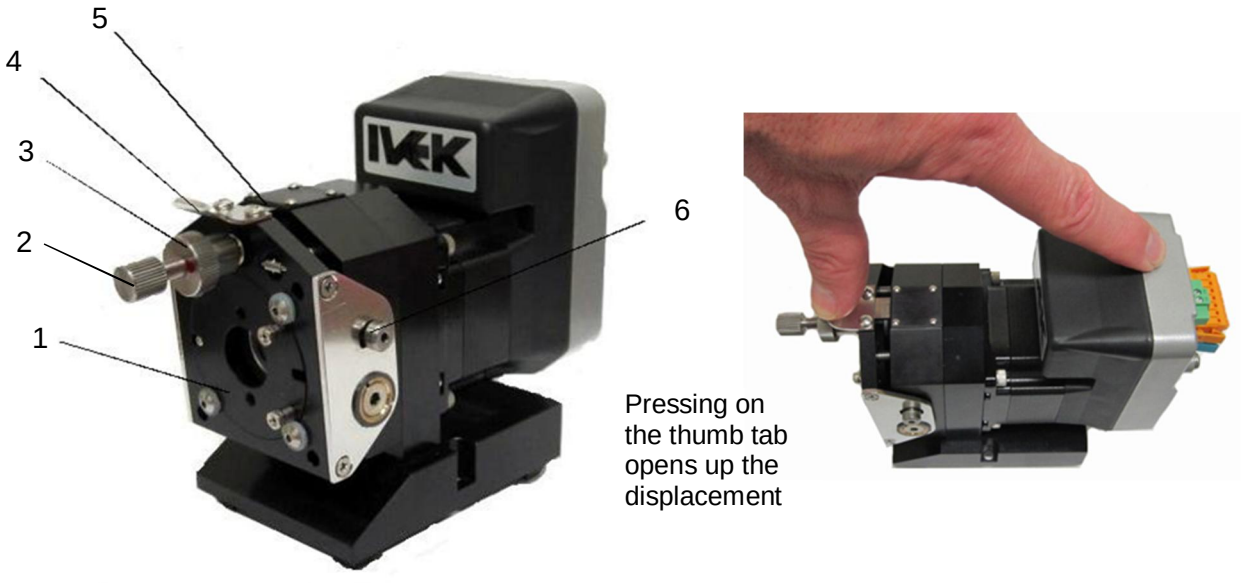

Figure 3.4 Single Ended Microspense AP Motor/Base Module Displacement Adjustment

displacement position.
2. While holding displacement adjustment mechanism (1) in its maximum displacement position, run the system in Meter mode.

After cleaning or priming is complete:

1. Slowly release the thumb tab (4) to allow the displacement adjustment mechanism to return to its calibrated position.

3.3.2.3 Fixed Displacement (Figure 3.4)

Fixed displacement is used when the displacement will not change for an extended period of time. To adjust the Motor Module displacement for fixed displacement:

1. Prime the system by metering in the forward direction.
2. Remove shoulder screws (6) from the Displacement Adjustment Module using a 3/32 Allen wrench.
3. Add two locking #8 (3/16") washers to screw (6) and replace. (do not tighten)
4. Loosen thumbnut (3) slightly.
5. Adjust angular position of displacement adjusting mechanism (1) by turning displacement adjustment thumbscrew (2). Turning the thumbscrew clock-wise will increase the pump displacement. Turning the thumbscrew counter clockwise will decrease the pump displacement.
6. Fluidically verify the pump displacement is correct, lock the thumbscrew (2) in place by tightening the thumbnut (3).
7. Tighten two shoulder screws (6) to lock the displacement adjustment mechanism in place. Reverify

3.3.2.4 Pump Stabilization (Figure 3.5)

Stabilization is a term used to describe the flow characteristics of the liquid being discharged at the tip or nozzle of a ElectroSpense Dispensing System. More specifically it is the manipulation of the displacement/time function of the piston and its relationship to the valve timing of the Pump Module. An ElectroSpense Dispensing System can be adjusted to either *neutralize* or *accelerate* the discharge pulse of a system.

This ability to stabilize the ElectroSpense can benefit the dispense characteristics of the pump in two ways. If the application requires a “touch off” of liquid from the dispense tip, neutralizing the discharge pulse will help in creating a uniform bead of liquid that will cling to the end of the tip or nozzle. In applications where it is more desirable to “fire off” a volume of liquid, accelerating the discharge pulse may enhance the ability to do this repeatedly with a clean liquid shear between each dispensed volume.

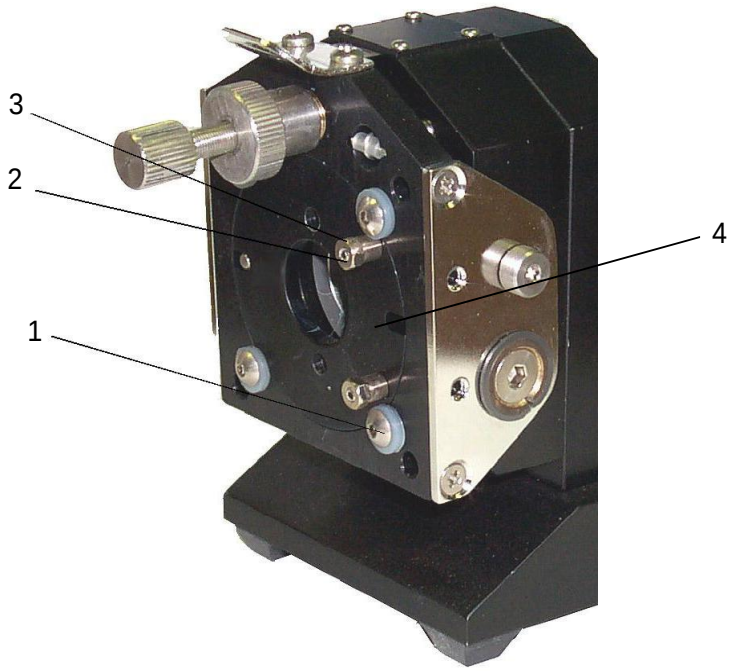

Figure 3.5 Single Ended Microspense AP Motor/Base Module Pump Stabilization

The pump stabilization adjustment is a feature that is used to fine tune the way liquid is separated from a dispensing tip. There are other aspects of the dispensing system which also effect this characteristic such as the rate of dispense, the tubing, and the dispense tip selection. The process of optimizing the dispensing operation includes experimentation with all of the variables until the desired result is achieved. When first experimenting with the pump stabilization feature, the user should start by adjusting the pump to a **neutral discharge** position (factory default). Once the user has determined that this position in combination with the other variables is not adequate, the **accelerated discharge** procedure should be attempted for applications requiring the "fire off" dispense.

There are two #4-40 x .38" long socket set screws (2) located on the front of stabilizing ring (4) for adjusting the stabilization. These screws are used to "neutralize" the liquid output of the pump head or "accelerate" liquid at the end of the dispense cycle.

Tools required (IVEK Tool Kit Part # 640040):

- 3/16 Open/Box End Wrench
- .050" Hex L-Key
- 5/64" Hex L-Key

NOTE

In most cases, IVEK dispensing systems are preset with pump heads stabilized in the neutral discharge position before shipping. The following procedure is intended to aid the end user if, for example, the Motor/Base Module (4) is replaced or there is a change in dispensing modes.

After the stabilization set screws are adjusted, verify the dispense volume calibration because pump displacement is effected by this setting.

Adjusting For Neutral Discharge

The position of the Pump Module is adjusted with two set screws (2). Gently loosening and tightening these screws allows the user to move the Pump Module with precision. Do not overtighten the set screws.
The following steps describe the procedure for adjusting the pump module for neutral discharge. In general, a neutral position is established when the pump module stabilizing ring is flush with the face plate. In this position, the set screws are not in contact with the face plate. (See Figure 2.6)

1. Meter (Prime) the system.
2. Loosen, do not remove, two stabilizing lock nuts (3) and back out (counterclockwise) the #4-40 x .38" long socket set screws (2) so they don't contact the stabilizing ring (4).
3. Loosen, do not remove, four #6-32 x .31" Long Button Head Socket Cap Screws (1) then retighten evenly to 10 in-lbs.
4. Turn each #4-40 x .38" long socket set screw (2) clockwise until it seats and tighten its corresponding stabilizing lock nut (3). Do not exceed 5 in-lbs. of torque when tightening stabilizing lock nuts (3).

NOTE

A neutral dispense position can be verified by viewing the fluid as it is dispensed slowly from a clean translucent dispense tip. The fluid will flow in the forward direction in a smooth even fashion and then stop. When not properly stabilized to neutral, the liquid can move backwards either at the beginning or at the end of the dispense.

Adjusting For Accelerated Discharge

When the Pump Module stabilizing ring (4) is angled from flush mount (neutral position) on the discharge side the accelerated discharge characteristic is created.

The position of the Pump Module is adjusted with two set screws. Gently loosening and tightening these screws allows the user to move the Pump Module with precision. Do not overtighten the set screws.

The following steps describe the procedure for adjusting the Pump Module for accelerated discharge. In general, an accelerated discharge position is established when the pump module stabilizing ring is angled from the face plate. In this position, the set screws (3) contact the face plate to create the angled position. These set screws can be adjusted to create a positive offset (0.04” (1.0mm) max.) between the pump module stabilizing ring and the face plate. (See Figure 2.7) The amount of fluidic acceleration is adjusted by changing this offset and can only be optimized through trial and error.

1. Meter (Prime) the system.
2. Loosen (1/4 turn) the two #6-32 x .31" long button head socket cap screws (1) on the discharge side of the Pump Module.
3. Loosen two stabilizing lock nuts (3) and turn #4-40 x .38" long socket set screws (2) until the set screw just touches the surface of the face plate.
4. Turn #4-40 x .38" long socket set screws (2) clockwise one additional turn.
5. Tighten two stabilizing lock nuts (3) in to lock the #4-40 x .38" long socket set screws (2) in place. Do not exceed 5 in-lbs of torque when tightening stabilizing lock nuts (3).
6. Tighten two #6-32 x .31" long button head socket cap screws (1) to 10 in-lbs (1.13 N-M) to lock the Pump Module stabilizing ring in position and fix the accelerated discharge adjustment.
7. Repeat steps 2 - 6 as necessary (do not exceed the 0.04” (1.0mm) maximum offset) until the desired amount of acceleration is achieved.

NOTE

An accelerated dispense position can be verified by viewing the fluid as it is dispensed slowly from a clean translucent dispense tip The fluid will flow in the reverse direction before it moves forward out of the tip and stops. The amount of reverse motion will correspond to the degree of angular offset created by the set screws (0-0.04” (1.0mm) as measured from the face plate to the Pump Module stabilizing ring. Experimentation of all dispensing variables is required to optimize the accelerated discharge stabilization feature.

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 sinusoidal function of the angle between the axis of the piston and the axis of the spindle.

3.3.4 Spindle Sensor

A sensor, mounted internal to the Motion Control Module, detects the rotation of the spindle, and is used to count revolutions, stop the pump and detect stalls.

3.3.4.1 Volume Strokes

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

3.3.4.2 Stopped Location

The Motion Control Module decelerates the motor and stops the spindle to position 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.

If the piston is at a random position, such as after reassembly due to cleaning, the spindle will be properly indexed to stop the piston 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.

3.3.4.3 Stall Detect

Motor stalls are detected internally on the Motion Control Module. If an error is detected, the system will generate a fault condition.

3.4 SYSTEM 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.

3.4.1 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 23. Make sure they click in place.
3. Connect the Power supply (Customer suppled) into the Power connector on the ElectroSpense 23.
4. Install tubing assemblies in intake and discharge ports as shown in Figure 2.1.
5. Apply power. Both LED's on the ElectroSpense 23 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.

3.4.2 Serial Interface (Service Interface)

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

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

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

The ElectroSpense 23 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 (0 to 10 VDC) 2 = mA (0 to 20 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

3.4.3 Installation

The ElectroSpense 23 Control System includes two clearance holes for #8-32 mounting screws. These holes can be used for mounting the ElectroSpense 23 Module onto various apparatuses. The orientation of the Pump Module should be considered when mounting the ElectroSpense Module. Plan the mounting so the intake and discharge tubing and the Pump Module can be easily accessed. Additional consideration should be taken regarding the fluid flow and access to the locking screws if manual displacement adjustment will be required for priming and cleaning. Always keep the discharge of the Pump Module even with or higher than the intake and never mount the ElectroSpense 23 Module so the Pump Module's cylinder end cap faces upward. If mounting to a solid surface, remove the four rubber feet.

3.4.4 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 ElectroSpense System. Refer to the Title Section of this manual for the list of options provided with this system.

3.4.4.1 IP65 Protection (Figure 3.6)

The M12 IP65 Protection option can be ordered when the system will be operating in a harsh environment. The connections are upgraded and protect the inside of the motor from water and dust. This option changes the three connectors on the rear of the system. Following is a list of the connectors and a description of each connector.

Connector	Function
P1	Power (+24 VDC)
P2	I/O & Multifunction
P3	Communication (Service Interface)

P1 - Power (+24 VDC)

The DC Power Interface provides a connection for the power source. The power source can be between +12 to +60 VDC. The function of each pin on the connector is as follows;

Connector Pin #	Function
1	Supply Voltage (+12 to +60 VDC)
2	0 VDC (Power Supply Return)
3	+12 to +24 Aux Power Input
4	0 VDC (Power Supply Return)

Figure 3.6 IP65 Connectors

P2 - I/O & Multifunction

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	[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

3	Biases The Input As Sinking Or Sourcing
4	General Purpose Programmable Input 1
2	General Purpose Programmable Input 2
5	General Purpose Programmable Input 3
1	General Purpose Programmable Input 4
6	Analog Input
7	Logic Ground (Non-Isolated)
10	Output 1 + Polarity
12	Output 1 and Output 2 - Polarity
11	Output 2 + Polarity
9	Output 3 + Polarity
8	Output 3 - Polarity

Factory Configured Connections

3	Customer Input Signal Bias
4	Initiate Dispense
2	Meter
5	Clear/Reference/(Stop Dispense)
1	Forward/Reverse
6	Analog Rate Input (optional setup, see "Y9" command)
7	Analog Rate Return (optional setup for analog rate applications)
10	Out 1 Ready +
12	Out 1 Ready and Out 2 Fault -
11	Out 2 Fault +
9	Not Used
8	Not Used

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.

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.

Connector Pin #	**Function**
1	General Purpose +5 To +24 VDC Programmable Input 4
2	General Purpose +5 To +24 VDC Programmable Input 2
3	Biases The Input As Sinking Or Sourcing
4	General Purpose Programmable Input With The Alternative Function Of Being A Dedicated Capture Input
5	General Purpose +5 To +24 VDC Programmable Input 3
6	Analog Input
7	Logic Ground (Non-Isolated) For Analog Input
8	High Speed Signal Output Emitter

Connector Pin #	Function
9	High Speed Signal Output Collector
10	Output 1 + Polarity
11	Output 2 + Polarity
12	Output 1 and 2 - Polarity

P3 - Communication (Service Interface)

The Service Interface for the standard system 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:

Connector Pin #	Function
1	Minus Transmit, Or Channel A- Line
2	Plus Transmit, Or Channel A+ Line
3	Plus Receive, Or Channel B+ Line
4	Minus Receive, Or Channel B- Line
5	Isolated Communication Ground

3.4.4.2 Displacement Adjustment with Micrometer

This option replaces the standard displacement adjustment and allows for more precise control. Adjust angular position of displacement adjusting mechanism by turning the micrometer adjustment mechanism.

The following steps describe he process for locking the Micrometer Adjust.

1. Loosen the lock nut on the micrometer (14).
1. Turn the micrometer (14) to the right to make desired setting.
2. Tighten the lock nut (15) in place.

3.4.5 Maintenance

Minimal maintenance is necessary for this module. Refer to Chapter 7 for the piston fabrication lubricating instructions.

CAUTION

Never connect or disconnect the cable from the ElectroSpense System connector while power is on. Damage to the equipment may result.

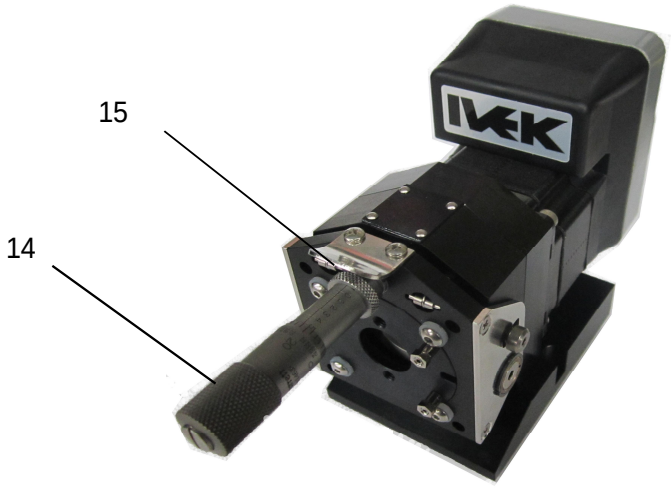

Figure 3.7 Displacement Adjustment

3.4.6 Assembly/Disassembly Procedures

Refer to Chapter 7 for the Pump Module assembly/disassembly procedures.

3.4.7 Indicator Tab Alignment (Figure 3.3)

The indicator tab requires alignment if replaced or removed. To align the indicator tab;

1. Prepare the system for operation.
2. Prime the system.
3. Set the displacement so there is no forward or reverse liquid flow.
4. Loosen the two button head cap screws securing the thumb tab to the Displacement Adjustment Module.
5. Set the scale so "0" is aligned to the reference edge.
6. Alternately and evenly tighten the two button head cap screws securing the thumb tab to the Displacement Adjustment Module.

3.4.8 Problem Guide

Table 3.1 contains a list of possible problems, causes and solutions for the ElectroSpense System.

3.4.9 Specifications

Power Supply:	24 VDC @ 3.5 Amps
Inputs and Outputs:	See Section 3.2.2.5

3.4.10 Model Number

The model number provides important information about the specifics of your ElectroSpense 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.

102274- **## # #**

Displacement Adjust Assembly
- **01** – Microspense AP
- **03** - with Micrometer

Motor Stack / Type
- **1** - 1 Stack / Stepper Motor

Interface Type
- **1** - RS-422/RS-485 Service
- **2** - IP65 Protection

3.4.11 Illustrated Parts Breakdown

The illustrated parts breakdown (Figure 3.5) 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.

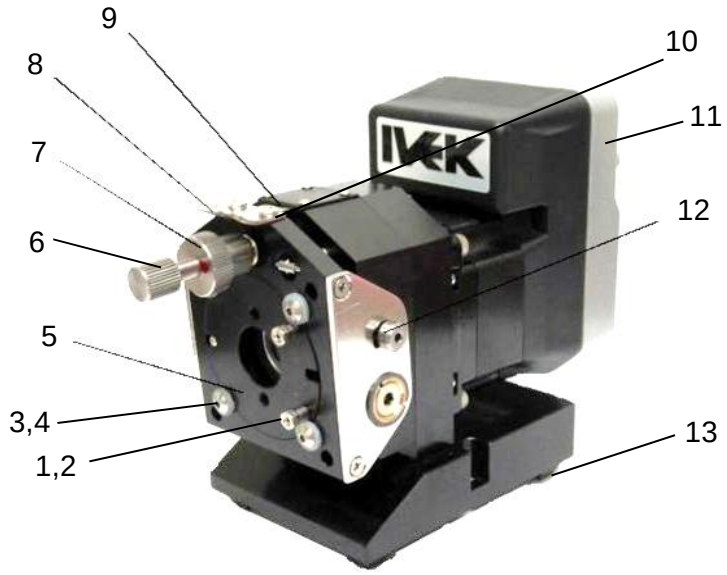

Figure 3.5 ElectroSpense 23 Control System (Sheet 1 of 3)

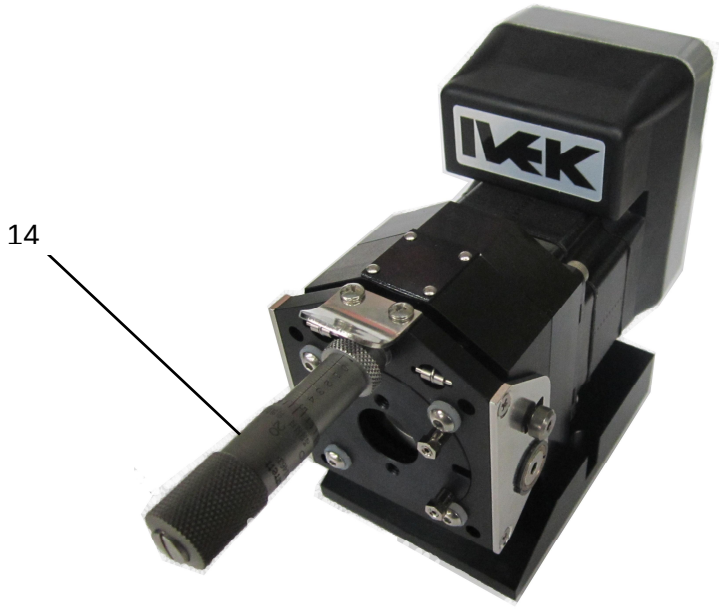

Figure 3.5 ElectroSpense 23 Control System (Sheet 2 of 3)

	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	102274-###	ElectroSpense 23 Control System	1

Dwg Index #	Part #	Description	Qty
1	102128	Stabilizing Lock Nut	2
2	182018-C04038	#4-40 x 3/8" Long Socket Set Screw	2
3	072090-001	Nylon Spacer	4
4	182005-C06031	#6-32 x .31" Long Button Head Socket Cap Screw	4
5	102117	Stabilizing Ring	1
6	102175	Thumb Screw Fabrication	1
7	102174	Locknut, AP Adjustment	1
8	102154	Thumb Plate	1
9	102165	Indicator Tab	1
10	182030-C04025	#4-40 x .25" Lg Phillips Pan Head Screw	2
11	800072-11	Motor, 23 Step, With Integrated MDC, Sty A; 1-Stk, RS-422	1
11	800072-12	Motor, 23 Step, With Integrated MDC, Sty A; 1-Stk, RS-422, IP65	1
12	102095-001	Shoulder Screw	2
13	092181-01R	Rubber Feet	4
14	102243	Micrometer Modification, Displacement Adjust	1

Figure 3.5 ElectroSpense 23 Control System (Sheet 3 of 3)