Table Of Contents

3. MAINTAINER CONTROLLER MODULE

3.1 DESCRIPTION

The Maintainer Controller Module, hereafter referred to as the Controller Module, contains all the control, monitoring, and interface components for the pumping operations. The Controller Module measures 14 3/4" wide, 11 3/4" deep, 5 1/4" high (feet included) and weighs approximately 17 pounds. The operator controls are located on the front panel and the interface connections are located on the rear panel.

3.1.1 Front Panel Controls & Indicators (Figure 3.1)

The front panel contains the switches and pushwheel for controlling the system. The following standard items are located on the front panel.

1 SET POINT Pushwheel
2 SRF MULTIPLIER Switch
3 AUTO/MAN Switch
4 DIR/INV Switch
5 SLOPE MULTIPLIER Pushwheel
6 1/0 (On/Off) Switch

3.1.1.1 SET POINT Pushwheel (Figure 3.1 Item 1)

This 3-digit pushwheel switch sets the signal level at which the Controller Module will stop the motor. (Refer to Section 3.2.2.1)

Pressing the "+" will increase the selected number by 1 and pressing the "-" will decrease the selected number by 1. This allows the user to select any setting from "000" to "999".

3.1.1.2 SRF MULTIPLIER Switch (Figure 3.1 Item 2)

This 4-position selector switch sets the SRF (system response factor). (Refer to Section 3.2.2.3)

An amber indicator illuminates on the active setting.

3.1.1.3 MAN/AUTO Switch (Figure 3.1 Item 3)

This 2-position illuminated rocker switch selects the operating mode; Manual or Auto. (Refer to Section 3.2.3 & 3.2.4)

A yellow indicator in the switch illuminates on the active switch setting.

3.1.1.4 DIR/INV Switch (Figure 3.1 Item 4)

This 2-position illuminated rocker switch selects the process signal direction (raise or lower). (Refer to Section 3.2.2.2)

A yellow indicator in the switch illuminates on the active switch setting.

3.1.1.5 SLOPE MULTIPLIER (Figure 3.1 Item 5)

This 3-digit pushwheel determines the slope setting. (Refer to Section 3.2.2.4)

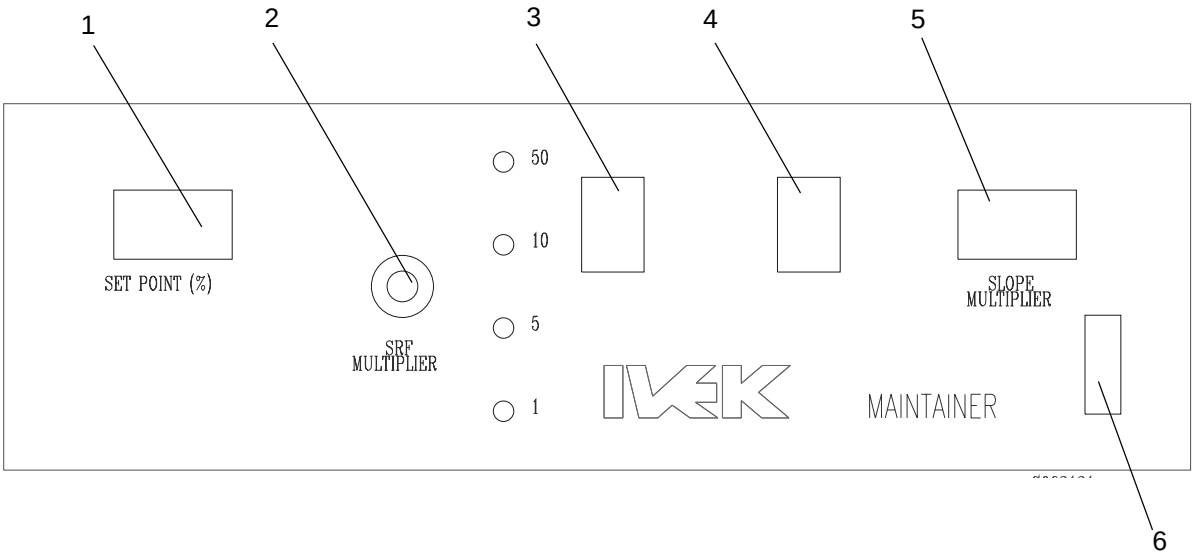

Figure 3.1 Maintainer Controller Module Front Panel

Pressing the "+" will increase the selected number by 1 and pressing the "-" will decrease the selected number by 1. This allows the user to select any setting from "000" to "999".

3.1.1.6 1/0 Switch (Figure 3.1 Item 2)

This 2-position illuminated rocker switch turns the Controller Module main power (AC input) "ON" (1) and "OFF" (0).

A green indicator in the switch illuminates when Controller Module power is "ON".

3.1.2 Rear Panel Detail (Figure 3.2)

The rear panel contains the interface connections for the system. The following components are located on the rear panel.

1 Power Entry Module
2 TRIGGER IN Terminal Strip
3 Cable Connector

3.1.2.1 Power Entry Module (Figure 3.2 Item 1)

The power entry module contains a receptacle for a standard IEC power cord, a voltage selector switch and main fuse holder.

CAUTION

Before plugging in the system, insure the line voltage setting appearing in the window agrees with the available line voltage. Damage to the equipment could result if the two voltages do not match.

Refer to the Title Page section of this manual to determine the power connection and fuse specifications for this Controller Module.

The design of the power entry module requires the line cord be disconnected before either the voltage select switch is changed or a line fuse is removed. Perform the following steps if it is necessary to change the setting of the line voltage select switch. (Refer to Figure 3.4)

1. Disconnect the line cord at the power entry module and open its cover.

2. Remove the selection cam from the unit and replace it oriented so the desired voltage will appear in the window when the cover is closed.

CAUTION

Rotating the voltage select cam while it is in the module may damage the module.

3. With the voltage select cam in the proper position, close the cover and replace the line cord. If the cover does not completely close, open the cover and slightly reposition the voltage select cam.

3.1.2.2 TRIGGER IN Terminal Strip (Figure 3.2 Item 2)

This terminal strip has two screw terminals (+/-) used to connect a Trigger In signal. In AUTO mode, the Controller Module modifies this signal depending on the process signal level and the settings of the other front panel switches. This

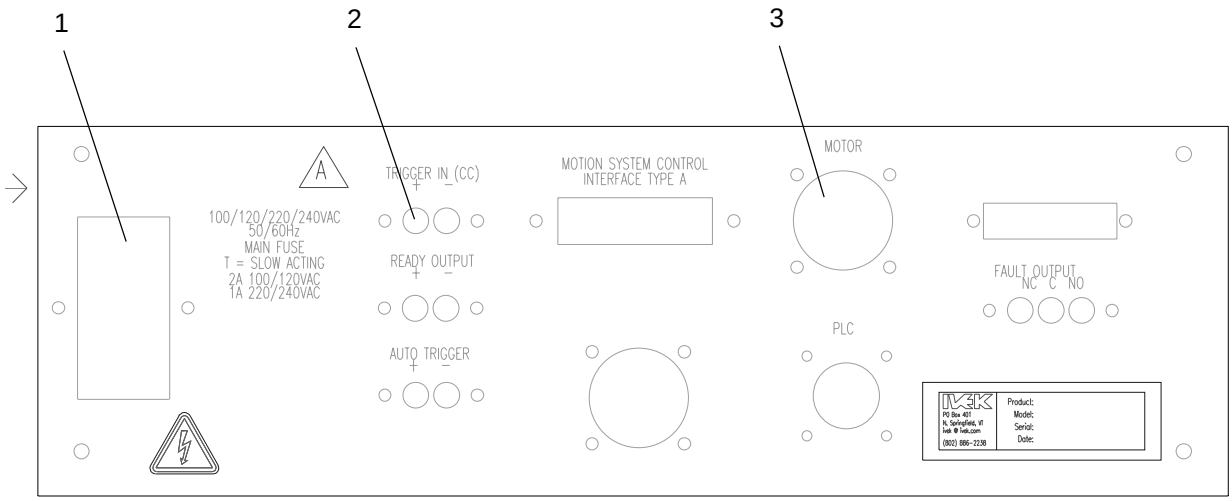

Figure 3.2 Maintainer Controller Module Rear Panel

modified signal is sent to a stepping motor drive section producing a digital pulse train to correctly advance the motor. Options are available for different connectors and voltages.

The input signal is not optically isolated.

The input signal common terminal (-) is connected to the Controller Module's analog ground.

The input signal is usually configured for 4-20 mA or 0-5 VDC (see the specification section which is located inside the front cover of this manual).

The 0-5 VDC input requires a maximum of 25 mA.

3.1.2.3 Motor Connector (Figure 3.2 Item 3)

The Motor connector (Amp Series One CPC 14 pin) is used for making the electrical connections to the Motor/Base Module.

CAUTION

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

3.2 OPERATION

The basic function of the Controller Module is to meter a quantity of fluid in proportion to the differential between the set-point value and the analog process signal. In this manner, the fluid will be pumped at a rate which maintains the process signal from the sensing transducer at the set-point value. This system is often used to maintain pH or conductivity at a desired level.

The electronic circuitry in the Maintainer series provides all the control, monitoring, and interface functions for the pumping operations. Controlled acceleration and deceleration of the stepping motor, and rotation monitoring are some of the functions required to properly drive the precision metering pumps.

An external analog signal controls the unit activation circuit which is enabled on power-up. This allows the motor to accelerate, run at constant RPM, decelerate, or stop. The response of the motor to the external analog process signal depends on other parameters of the unit. The parameters of the unit can be set by the operator by means of switches located on the front panel. The modified signal is sent to a stepping motor drive section producing a digital pulse train to correctly advance the motor.

The Controller and Motor/Base Modules are electrically connected together by a cable. The pump is activated when an external analog process signal is received through the terminal strip. The operation of the controller is divided into four sections; Motor Control, Front Panel Settings, Auto mode and Manual mode.

3.2.1 Motor Control

The rotation of the piston within the Pump Module is monitored by a spindle sensor that provides one function; Stall Detect. The sensor is mounted on the frame of the Motor/Base Module and detects a target mounted on the spindle.

3.2.1.1 Stall Detect

A motor stall condition is generated 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 steps than the 200 required 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 stall.

When a stall occurs, you will hear the motor starting, but then it will stop. It will continue to start then stop until the power is turned off.

3.2.2 Front Panel Settings (Figure 3.3)

The following section describes the operation of the SET POINT pushwheel, DIR/INV switch, SRF MULTIPLIER switch and SLOPE MULTIPLIER pushwheel.

3.2.2.1 SET POINT Pushwheel

This Controller Module will adjust the flow rate to maintain the signal from the process sensor at the setpoint. The exact signal level set point can be calculated by multiplying the SET POINT pushwheel setting (with an added leading decimal point) by the specified span of the process signal (see the specification section which is located inside the front cover of this manual) and adding that result to the minimum process signal level. For example, a thumbwheel setting of 600 on a Controller Module which is specified for 4-20 mA would result in a set point of 13.6 mA (the span of the signal is 16 mA, [(600/999 x (20-4)] + 4 = 13.6mA.

3.2.2.2 DIR/INV Switch

The DIR/INV switch allows the operator to select one of two modes of operation, namely DIRECT or INVERSE.

DIR is used when adding fluid using the Controller Module will raise the process signal level (see Figure 3.3). The pump will continue to operate when the process signal is below the set point.

INV is used when adding fluid using the Controller Module will lower the process signal level (see Figure 3.3). The pump will continue to operate when the process signal is above the set point.

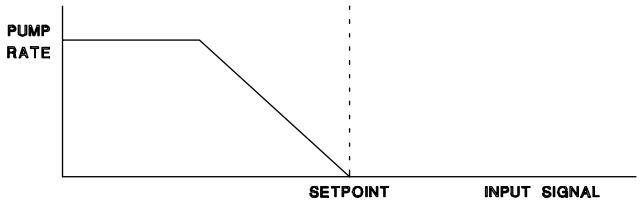

Figure 1a DIRECT

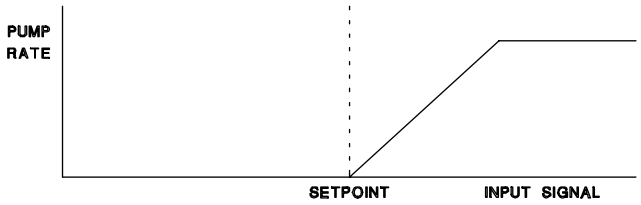

Figure 1b INVERSE

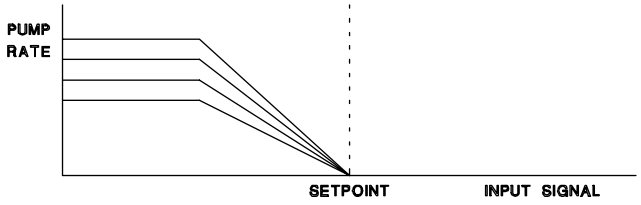

Figure 1c SLOPE MULTIPLIER

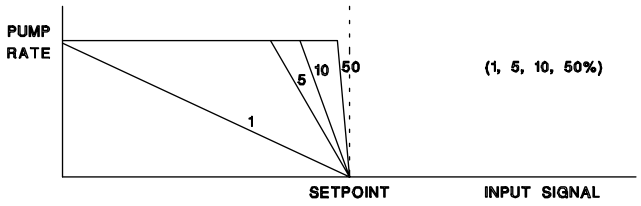

Figure 1d SRF MULTIPLIER

Figure 3.3 Control Functions

MANUAL mode disables DIRECT and INVERSE mode.

3.2.2.3 SRF MULTIPLIER Switch

The SRF MULTIPLIER is adjusted to maximize the response to changes in the process signal, and minimize overshoot.

This switch, with its associated indicators, allows the operator to select how gradual the Controller Module slows down the speed of the motor as the external analog process signal level approaches the set point signal level. The greater the multiplier value is of the SRF MULTIPLIER setting, the faster the motor speed will be for a given differential between the external analog process signal level and the set point signal level (see Figure 3.3).

The SRF Multiplier is equal to the percent of selected maximum rate (using SLOPE MULTIPLIER) for each percent difference between the input signal and the setpoint. With the following settings (660 RPM, 800 SLOPE MULTIPLIER), an SRF MULTIPLIER setting of 5 will result in a rate of 660 x 0.8 x 5% = 26.4 RPM for each percent difference between the input signal and the setpoint. If this system controls pH, when the difference between the setpoint and the measurement is 1 pH, the pump will run at
26.4 RPM x ((1 pH /14 pH) x 100%) = 188.6 RPM.

The SRF provides the proportional band control, with a small SRF providing a wide proportional band, and a large SRF producing a narrow proportional band.

3.2.2.4 SLOPE MULTIPLIER Pushwheel

The slope multiplier pushwheel limits the maximum motor RPM's as a percentage of the maximum available RPM. (Refer to the Title Page section of this manual for the maximum available RPM) The RPM of the motor determines the rate of flow. The percentage is calculated by placing a decimal point in front of the right most digit. A pushwheel setting of "500" would be 50% of the maximum RPM. The maximum value of the slope multiplier is “999”.

The following steps are a guide to determine the Slope multiplier setting. In step 1, a displacement of 75% was used as a general starting point, your application may require a different displacement and slope multiplier setting. If cavitation occurs refer to Chapter 2 for possible solutions.

A higher pump displacement will increase the amount of liquid added with each revolution of the motor.

Fluidic pulsations can be reduced with a lower displacement and higher slope multiplier. This decreases the amount of liquid added with each revolution of the motor.

NOTE

The maximum flow rate required should be known.

	Example Results
1. Set the pump displacement at approximately 75% of maximum. (Refer to Chapter 7 for more information)	Max Required = 50ml/min
2. Set the slope multiplier to "999", select Manual mode and run a measured test to determine the pump output in ml/min.	75ml/min
3. If this number is larger than the maximum rate required, go to step 5.	yes
4. Increase the pump displacement and repeat steps 2 and 3.	
5. Divide the maximum rate required by the measured pump output. (make sure the values used are expressed in the same units ie. ml / ml)	50ml/min ÷ 75ml/min
6. Multiply this number by 1000.	.67 x 1000
7. Set the multiplier pushwheel to this number.	= 670

3.2.3 Auto Mode

In Auto mode, an external analog signal controls the unit activation circuit which is enabled on power-up. This allows the motor to accelerate, run constant RPM, decelerate or stop. The response of the motor to the external analog process signal depends on other parameters of the unit. The parameters of the unit can be set by the operator by means of switches located on the front panel. The modified signal is sent to a stepping motor drive section producing a digital pulse train to correctly advance the motor. The following sections describe operating in Auto mode.

3.2.3.1 Controller Setup

Set the switches on the front panel to the following settings:

- The 1/0 power switch to "0".
- The AUTO/MAN switch to "AUTO".
- The SLOPE MULTIPLIER pushwheel to the required setting.
- The SRF selector switch to the required position.
- The SET POINT pushwheel to the required setting.
- The DIR/INV switch to the required position.

3.2.3.2 Auto Mode Operation

Switch the 1/0 power switch to "1".

Start metering by applying an external analog input signal at the terminal strip.

The external analog signal controls the unit activation circuit which is enabled on power-up. This allows the motor to accelerate, run at constant RPM, decelerate, or stop. The response of the motor to the external analog process signal depends on other parameters of the unit. The parameters of the unit can be set by the operator by means of switches located on the front panel. The modified signal is sent to a stepping motor drive section producing a digital pulse train to correctly advance the motor.

3.2.4 Manual Mode

In MANUAL mode, the motor will start and continue to operate at a rate determined by the SLOPE MULTIPLIER thumbwheel setting until the MAN/AUTO switch is moved to the AUTO position. The process signal, DIR/ INV, SRF MULTIPLIER, and SET POINT, do not effect the operation of the Controller Module in this mode. If Sensor Fault Detect On/Off option is installed see section 3.4.2.

3.2.4.1 Controller Setup

Set the switches on the front panel to the following settings:

- The 1/0 power switch to "0".
- The AUTO/MAN switch to "MAN".
- The SLOPE MULTIPLIER pushwheel to the required setting.

3.2.4.2 Manual Mode Operation

Switch the 1/0 power switch to "1" to start the manual operation.

The motor will start and continue to operate at a rate determined by the SLOPE MULTIPLIER thumbwheel setting until the MAN/AUTO switch is moved to the AUTO position.

3.3 INSTALLATION

General operating practices provide the best guidelines for locating the components of the system. The Controller Module should be located for ease of use during all phases of operation and maintenance.

3.4 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 Controller Module. Refer to the Title Section of this manual for the list of options provided with this system.

3.4.1 Forward / Reverse

This 2-position, illuminated rocker switch provides the ability to pump liquid in both directions. In the FORWARD position, liquid is pumped from left to right as viewed from the Pump Module end of the Motor/Base Module. In the REVERSE position, liquid is pumped from right to left as viewed from the pump end of the Motor/Base Module.

A yellow indicator illuminates in the switch for the active setting.

3.4.2 High / Low Sensor Fault Detect

This option includes a SENSOR FAULT On/Off switch, with its associated indicators, HIGH/LOW LED indicators, and a PRESET pushwheel. They are usually located on the front panel. When "ON" they add the capacity to cause the motor (pump) to run at an operator selectable speed if a system malfunction occurs that causes the external analog process signal to become unusually high (ninety-nine percent or greater of signal span specification) or low (one percent or less of signal span specification). This is a very useful feature if the pumping application requires the motor to run at particular speed if the external analog process signal becomes disconnected from the Controller Module.

In Manual mode, the PRESET pushwheel replaces the function of the SLOPE MULTIPLIER pushwheel described in Section 3.2.4.

3.4.2.1 SENSOR FAULT On / Off Switch

This switch, with its associated indicators, switches the Sensor Fault Detect mode either On or Off.

3.4.2.2 HIGH / LOW Indicators

The HIGH LED indicator will illuminate if the external analog process signal level becomes ninety-nine percent or greater of the signal span specification. For example, if the signal span specification is 4-20mA, then this level is 19.84mA (16 x 99%) + 4), or if the signal span specification is 0-5V, then this level is 4.95V (5 x 99%).

The LOW LED indicator will illuminate if the external analog process signal level becomes one percent or less of the signal span specification. For example, if the signal span specification is 4-20mA, then this level is 4.16mA (16 x 1%) + 4), or if the signal span specification is 0-5V, then this level is 0.05V (5 x 1%).

These LED indicators will function regardless of whether the SENSOR FAULT ON / OFF switch is in the ON or OFF position.

3.4.2.3 PRESET Thumbwheel

This thumbwheel switch is used to select the rotational speed of the motor if a process signal fault is detected. The exact rotational speed can be calculated by multiplying this setting (with an added leading decimal point) by the specified speed of the controller (see the specification section which is located inside the front cover of this manual). For example, a thumbwheel setting of 800 on a controller which is specified for 660 RPM would result in a motor speed of 528 (0.800 x 660).

A process signal fault condition occurs if the external analog process signal becomes unusually high (ninety-nine percent or greater of signal span specification) or low (one percent or less of signal span specification).

For PRESET to function, the MANUAL / AUTO switch must be in the AUTO position, and the SENSOR FAULT ON / OFF switch must be in the ON position.

In Manual mode, the PRESET pushwheel replaces the function of the SLOPE MULTIPLIER as described in Section 3.2.4.

3.4.3 Set Point LCD Display

This option adds a three and one-half digit liquid crystal display (LCD) that displays the exact set point which can be adjusted by using the SET POINT Pot. It can be configured to display in units of pH or percent (0-100).

The LCD is not battery powered. It is powered by a power supply inside the Controller Module.

3.4.3.1 pH

The LCD will display the set point value in units of pH (00.0-14.0).

3.4.3.2 Percent (0-100)

The LCD will display the set point value in units of percent (00.0-100.0).

3.4.4 Overrange

This LED indicator illuminates if an overrange condition occurs.

An overrange condition occurs if the external process signal exceeds the maximum signal level of the specified process signal span (see the specification section which is located inside the front cover of this manual). When this happens, the Controller Module automatically switches to an overrange mode which does not allow the motor to exceed the maximum RPM specified (see the specification section which is located inside the front cover of this manual). Once the process signal decreases to a level that is within the specified range, the Controller Module resumes normal operation and this LED turns off.

3.5 MAINTENANCE

No periodic maintenance is required on the Controller Module, beyond standard practices for electronic equipment.

3.5.1 Assembly/Disassembly Procedures

The Controller Module contains the following replaceable parts.

- Switch LED's
- Main Power Fuse

3.5.1.1 Switch LED's (Figure 3.1 Items 3,4)

The LED's in the AUTO/MAN and DIR/INV switch are replaceable.

Disassembly

1. Use your fingers to remove the switch cover. (Image 1 to 2 in Figure 3.4)
2. Locate the metal pull tab and pull out slowly until the LED comes out. (Image 2 to 3)

Assembly

1. Locate the "+" side of the bulb (upper LED sockets have the "+" on the right and lower LED sockets have the "+" on the left) and place into the socket. (Image 4)
2. Snap the switch cover into place. (Image 1)

3.5.1.2 Main Power Fuse (Figure 3.2 Item 1)

The main power fuse, located in the power entry module on the rear panel, is replaceable. The proper fuse value is described in the Title Page section of this manual. (Refer to Figure 3.5)

Disassembly

1. Remove the power cord.
2. Using a small flat blade screwdriver, open the power entry module's cover.
3. Slide the fuse tray out and remove the fuse.

Assembly

1. Install the new fuse into the fuse tray and slide the tray in. The arrow on the fuse holder should point to the right.
2. Close the power entry module's cover.
3. Connect the power cord.

3.6 PROBLEM GUIDE

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

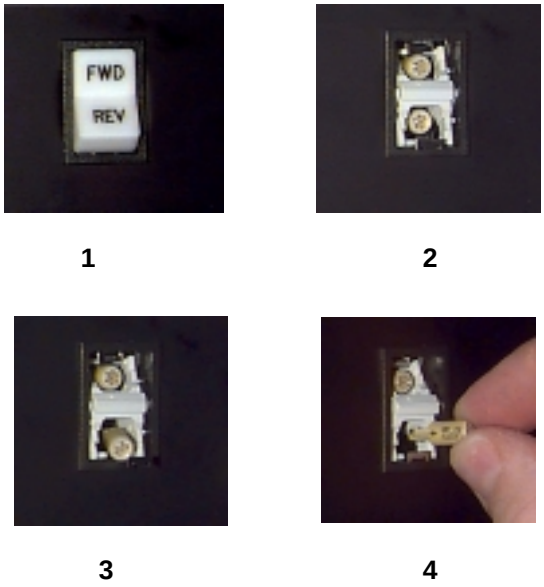

Figure 3.4 LED Disassembly/Assembly

WARNING

Hazardous voltages exist inside the Controller Module. Under no circumstances should the Controller Module be opened. There are no user serviceable parts inside. Any unauthorized access to the inside will void the warranty.

3.7 SPECIFICATIONS

Input Signal Requirements: (Standard)	4 - 20 mA 50 Ohms Impedance
Input Signal Requirements: (Option)	0 - 5 VDC @ 25mA max

3.8 MODEL NUMBER

The model number provides important information about the specifics of your Controller Module at time of order. Refer to this number when calling IVEK Technical support. The model number for your Controller Module is located in the Title Page section of this manual and on the rear of the Controller Module.

520096 - # # # # #

Motor/Base
- **A** - Microspense AP Single End
- **B** - Microspense AP Dual End
- **C** - Microspense AP Rare Earth Motor
- **E** - Heavy Duty 1 Stack
- **F** - Heavy Duty 2 Stack
- **G** - Heavy Duty 3 Stack

Enclosure Finish
- **A** - Powder Coat
- **B** - Stainless Steel

Motor Speed
- **A** - 165 RPM
- **B** - 660 RPM
- **C** - 1155 RPM

Front Panel
- **A** - No Front Panel Options
- **B** - Fwd / Rev Switch & High/Low Fault
- **C** - Setpoint Display
- **D** - Process Signal Display
- **E** - RPM Display
- **F** - B and C
- **G** - B and D
- **H** - B and E

Line Cord & Agency Approval
- **A** - US Cord
- **B** - International Cord
- **C** - US Cord & CE Approval
- **D** - International Cord & CE Approval

NOTE

A 'Z' in the model number or a model number not listed indicates a custom option and will be described in either the Title Page or Chapter 4.

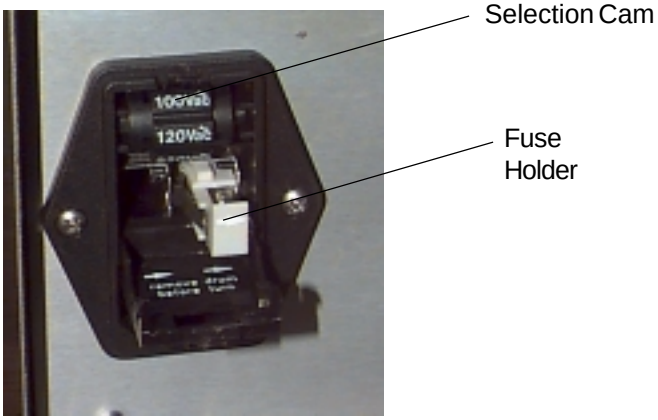

Figure 3.5 Power Entry Module

3.9 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
No power, nothing works.	AC power may be absent or inadequate. Unit not plugged in.	Ensure AC power cord is plugged into a properly grounded three-prong outlet capable of supplying the voltage listed in the Title Page section of this manual.
	Fuse is blown.	Unplug main power cord from outlet. Remove fuse from rear panel fuse holder. Test fuse conductivity. Install good fuse in rear panel fuse holder.
	Supply Breaker is tripped.	Check or reset breaker at panel.
Power is on, motor spindle fails to rotate and motor makes a sound that fluctuates in tone. * This condition does not harm the system.	A Pump Module or motor malfunction can cause this problem.	Turn off Controller Module power. Remove Pump Module from Motor/Base Module. Turn on Controller Module and try again. If the motor operates correctly, the pump may need to be cleaned or serviced.
Power is on, 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.
Controller Module power on and operational, but will not actuate motor.	I/O Cable	Check the cable connection between the Controller Module and Motor/Base Module. Inspect and repair faulty cable. **If none of the above solves the problem, contact IVEK technical support for assistance.**

INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY
		Standard Multispense Controller Module	**1**
1	662039-08	Pushbutton Lens, For 662027, Legend, Auto/Man	1
2	662029-005SY	LED, Wedge Based, Multichip, 5 VDC, Std Yellow	4
3	662039-06	Pushbutton Lens, For 662027, Legend, Dir/Inv	1

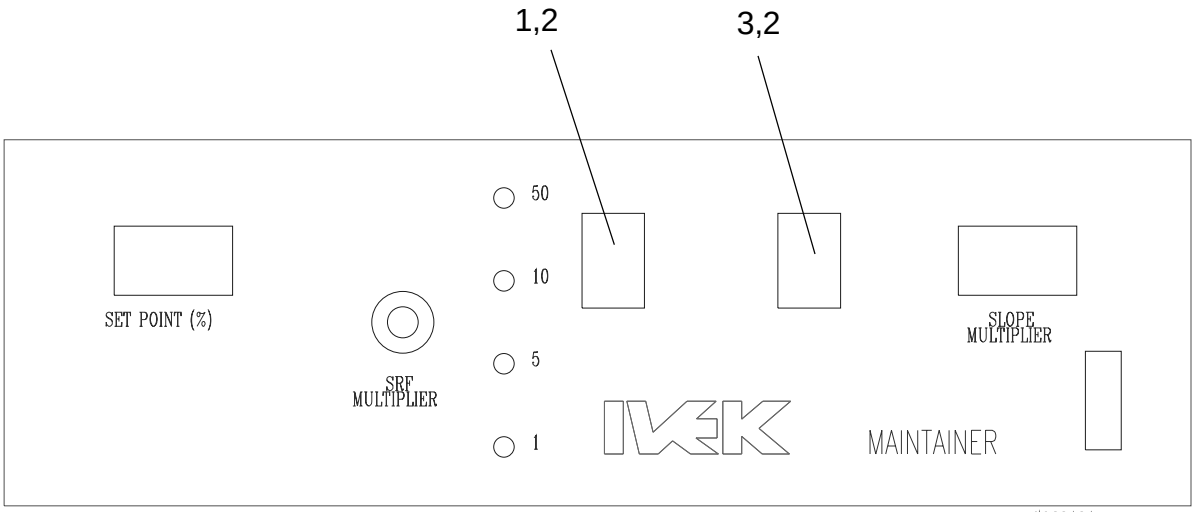

Figure 3.6 Multispense Controller Module (Sheet 1 of 1)