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3. REPLENISHER CONTROLLER MODULE

3.1 DESCRIPTION

The Replenisher 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 OVERRANGE Indicator
2 REPLENISHMENT RATE Pushwheel
3 1/0 (On/Off) Switch

3.1.1.1 OVERRANGE Indicator (Figure 3.1 Item 1)

The Overrange indicator is a red LED and illuminates when the input signal is equal to or above the maximum input signal of 50mV (millivolts).

3.1.1.2 REPLENISHMENT RATE Pushwheel (Figure 3.1 Item 2)

This 3 digit, pushwheel switch determines the meter rate by directly controlling the speed of the stepping motor drive. The minimum is “0” and the maximum is the maximum RPM (revolutions per minute) of the motor. (see the Title Page section of this manual)

Example: A controller setting of “125” represents 12.5% of the motor’s maximum RPM.

Pressing the “+” will increase the selected number by 1 and pressing “-” will decrease the selected number by 1. This allows the user to select any motor speed, linearly, from “000” (0%) to “999” (99.9%).

3.1.1.3 1/0 Switch (Figure 3.1 Item 3)

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 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.

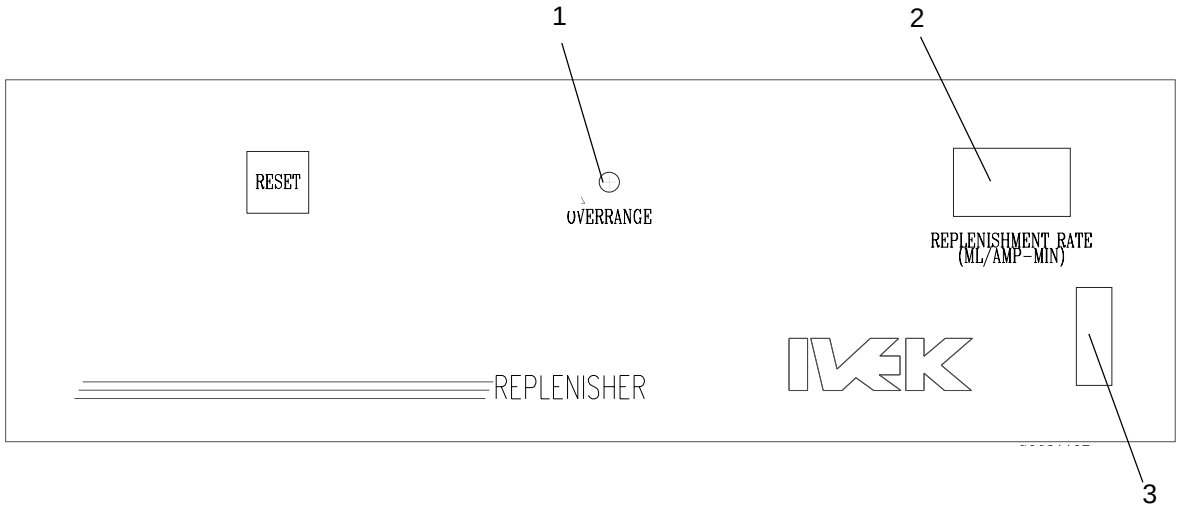

Figure 3.1 Replenisher Controller Module Front Panel

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 3.3)

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 Signal Terminal Strip (Figure 3.2 Item 2)

This Trigger In terminal strip has two screw terminals (+/-) used to connect the external analog process signal. The Controller Module modifies this signal depending on the process signal level and the settings of the other front panel switches. This 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 configured for 0 - 50 mV.

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 Controller Module sets the amount of replenishment added to plating baths. A terminal strip, located on the rear

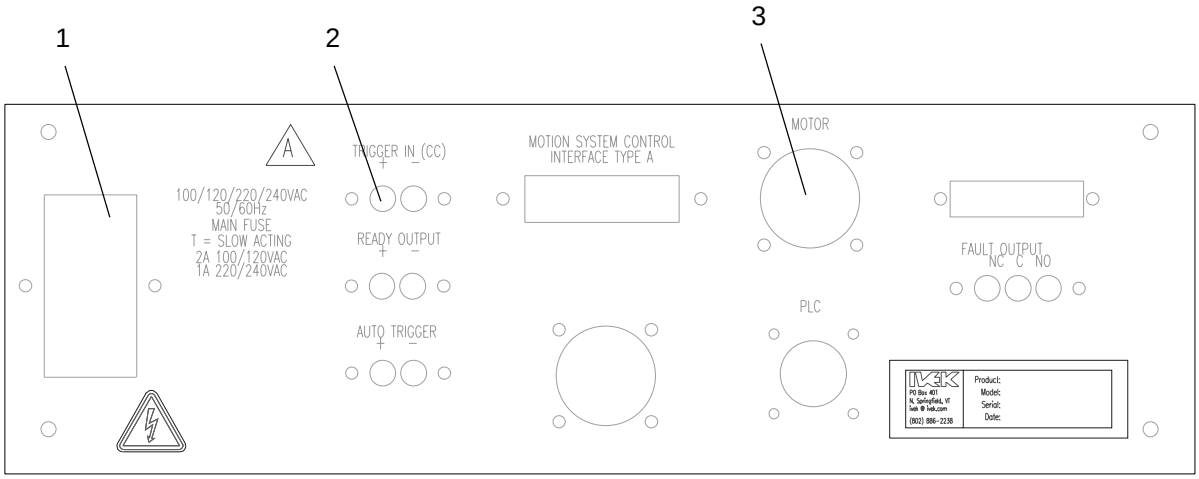

Figure 3.2 Replenisher Controller Module Rear Panel

panel, accepts a 0 - 50mV input signal that is proportional to the plating current. Replenishement is added at a flow rate proportional to the millivolt input signal.

The exact amount of replenishment added is based on Controller Module parameters set by the operator by means of switches located on the front panel. A signal, based on the input signal, is sent to a stepping motor drive section producing a digital pulse train to correctly advance the motor.

The electronic circuitry in the Replenisher 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.

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 following sections describe the motor control, setting the Replenishment Rate and operating in Normal 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 Setting the REPLENISHMENT RATE pushwheel

The Replenishment Rate 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 to the left of the right most digit. A pushwheel setting of "500" would be 50% of the maximum RPM. The maximum value of the Replenishment Rate pushwheel is “999”.

The following steps are a guide to determine the Replenishment Rate setting. In step 1, a displacement of 75% is used as a general starting point, your application may require a different displacement and Replenishment Rate 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 Replenishment Rate. This decreases the amount of liquid added with each revolution of the motor.

NOTE

The maximum 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 Replenishment Rate pushwheel to "999", 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 Replenishment Rate pushwheel to this number.	= 670

3.2.3 Normal Mode

CAUTION

The system will start operating once the Power switch is switched to the 1 (ON) position.

In Normal mode, the 0 - 50mV input signal controls the system operation. The system is idle if no signal is present or if the signal is 0mV. When the input signal goes above 0mV, the pump will start metering. The system will continue to meter as long as the input signal remains above 0mV. If the input signal goes above 50mV an Overrange condition occurs.

3.2.3.1 Overrange

If the input signal goes above 50mV the OVERRANGE indicator will illuminate and the pump will operate at the maximim rate as determined by the REPLENISHMENT RATE pushwheel. Once the process signal decreases to a level that is within the specified range, the Controller Module resumes normal operation and the indicator turns off.

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.

1. Reset Switch/Fault Indicator
2. Forward/Reverse Switch
3. Feedback Signals
4. Flow rate multiplier (0.01 0.1 1.0)
5. Digit display (input signal)

3.4.1 Reset Switch/Fault Indicator

The reset switch/fault indicator signals the operator when a stall fault has occurred. A fault is generated if four stalls of the motor are detected. When a fault occurs, the RESET switch illuminates and a fault output is generated.

The RESET switch illuminates when a fault has occurred. Pressing the switch, turns the RESET light off and resets the system. If the system immediately faults again, refer to Table 3 'Common Operation Problems and Solutions' in Chapter 2 'Operation'.

An output is provided that can be designed to either inhibit further dispensing, alert the operator, or provide a reject signal for integrated process control.

3.4.2 Forward/Reverse Switch

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.

3.4.3 Feedback

A 4-20mA feedback signal terminal block is supplied on the rear of the Controller Module. In Normal mode this signal provides a feedback current signal based on the input signal.

The Controller Module's efforts to restart the motor by stopping and ramping up to target speed will be reflected in this output signal. The output will drop to 4mA and ramp up to the level determined by the process signal input. If the restart attempts are not successful and the Controller Module faults, the output will indicate 0 speed (4mA).

3.4.4 Rate Multiplier

A 3-position rate multiplier rotary switch provides a reduction for the replenishment rate multiplier pushwheel. With the switch in the 1.0 position, the system will operate normally. If the switch is in the 0.1 position, the motor speed is reduced by one-tenth. If the switch is in the 0.01 position, the motor speed is reduced by one-hundreth.

3.4.5 Digital Display

A 3-1/2 digit LCD panel meter is located on the front of the Controller Module. The meter displays the input signal level.

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.

- Main Power Fuse

3.5.1.1 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 3.3)

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.

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.

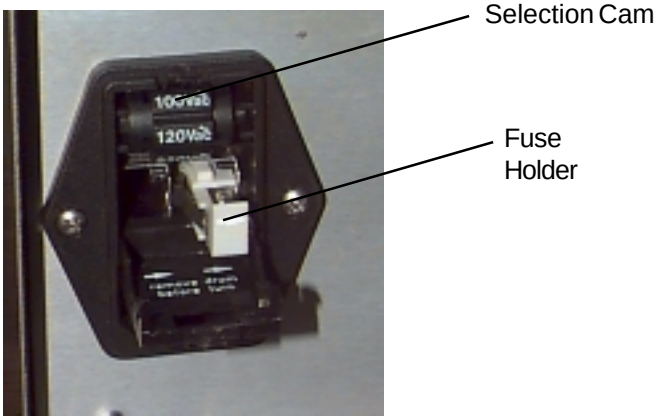

Figure 3.3 Power Entry Module

3.7 SPECIFICATIONS

Input Signal Requirements:	0 - 50 mV
(Standard)	50 Ohms Impedance

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.

520100 - # # # # #

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

Motor Speed
- **A** - 165 RPM
- **B** - 660 RPM
- **C** - 1155 RPM
- **D** - 20 RPM

Logic Interface
- **A** - None
- **B** - Fault Out (CC)
- **C** - Fault Out (OI)
- **D** - Fault Out & Spindle Pulse Out (24Vdc)
- **E** - Fault Out & Spindle Pulse Out (OI)

Front Panel
- **A** - No Front Panel Options
- **B** - Fwd / Rev Switch
- **C** - Fwd / Rev Switch & Rate Multiplier
- **D** - Process Signal Display
- **F** - C and D

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

3.9 ILLUSTRATED PARTS BREAKDOWN

Please contact IVEK Technical Support for information on ordering replacement parts for the Controller Module.

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. Contact IVEK technical support for information.
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.**