Table Of Contents

Section Description Page #

3. MULTISPENSE 2000 STYLE B CONTROLLER MODULE

3.1 DESCRIPTION

The Multispense 2000 Style B Controller Module, hereafter referred to as the Controller Module, contains all the control, monitoring, and interface components for the dispensing operations. The operator controls and interface connections are located on the front and rear panels.

3.1.1 Front Panel Controls & Indicators (Figure 3.1)

The front panel of the Controller Module is largely made up of the individual front panels of the Multispense Master Plug-In PCB (printed circuit board), hereafter referred to as the Master Plug-In and the Multispense 2000 Channel Plug-In PCB, hereafter referred to as the Channel Plug-In. The main power switch is located on the front panel.

3.1.1.1 Master Plug-In (Figure 3.1 Item 4)

Optically Isolated Serial Interface (1) – The RS232 interface provides control of all available functions and provides point-to-point communication. The hardware is configured as Data Communications Equipment (DCE) standard. Refer to section 3.5.1 for additional information.

USB Interface (2) – The USB Connector provides an interface to control a variety of functions. The connector is a type-B device connector. Refer to section 3.5.1 for additional information.

Serial Interface data Indicators (3) – An IN LED indicates data being received by the Master Plug-In, an Out LED indicates data being transmitted by the Master Plug-In.

3.1.1.2 Channel Plug-In (Figure 3.1 Item 5)

Enabled Indicator (6) - (green) illuminates while this channel is enabled for operation.

Disabled Indicator (7) - (red) illuminates while this channel is NOT enabled for operation.

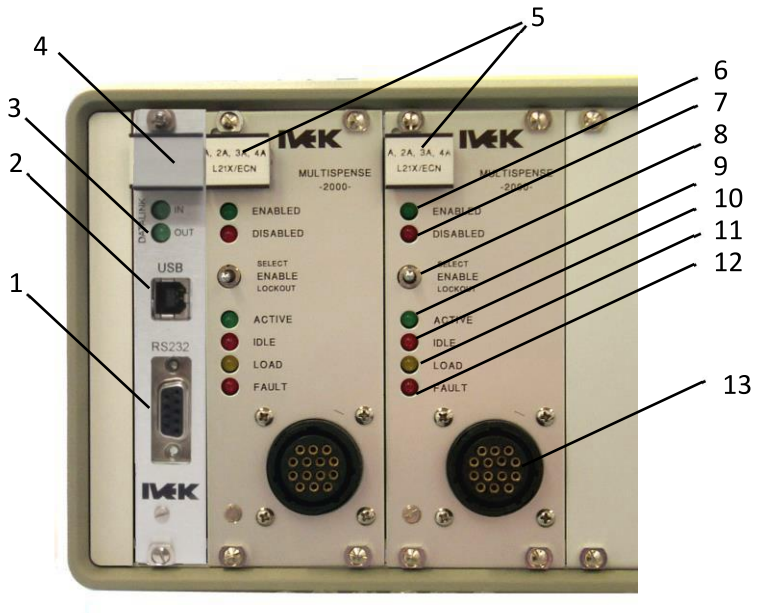

Figure 3.1 Multispense 2000 Style B Controller Module Front Panel

Enable Switch (8) - This switch allows this channel to be enabled or disabled without using the serial interface. The normal position will be the middle (maintained) position where the channel can be enabled or disabled via the serial interface. Moving the switch to the top (SELECT momentary) position will toggle the state between ENABLE and DISABLE. The bottom (LOCKOUT maintained) position will disable the channel and will not allow the serial interface to enable the channel. The lockout position is used to insure a particular Motor/Base Module will not be operated. If the channel is attempted to be enabled, a warning message will indicate the lockout condition.

Active Indicator (9) - (green) illuminates while pump is operating.

Idle Indicator (10) - (red) illuminates while pump is not operating.

Load Indicator (11) - (yellow) **-** This indicator illuminates while the pump requires a load cycle or while the pump is loading.

Fault Indicator (12) - (red) illuminates when there is any system or pump fault. The indicator illuminates orange when a motor voltage fuse is blown.

Actuator Module Connector (13) - A Channel Plug-In for an Actuator Module will have a 14 pin female connector. A Channel Plug-In for an Actuator Module with the encoder option will have a 16 pin male connector. (Refer to the Title section of this manual to see if the encoder option was purchased.)

3.1.2 Rear Panel Detail (Figure 3.2)

The rear panel of your Controller Module will look similar to either Figure 3.2A or Figure 3.2B. If your system is 4 or fewer channels it will look similar to Figure 3.2A. If your system is 5 or more channels it will look similar to Figure 3.2B.

3.1.2.1 Power Entry Module (Figure 3.2A 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.

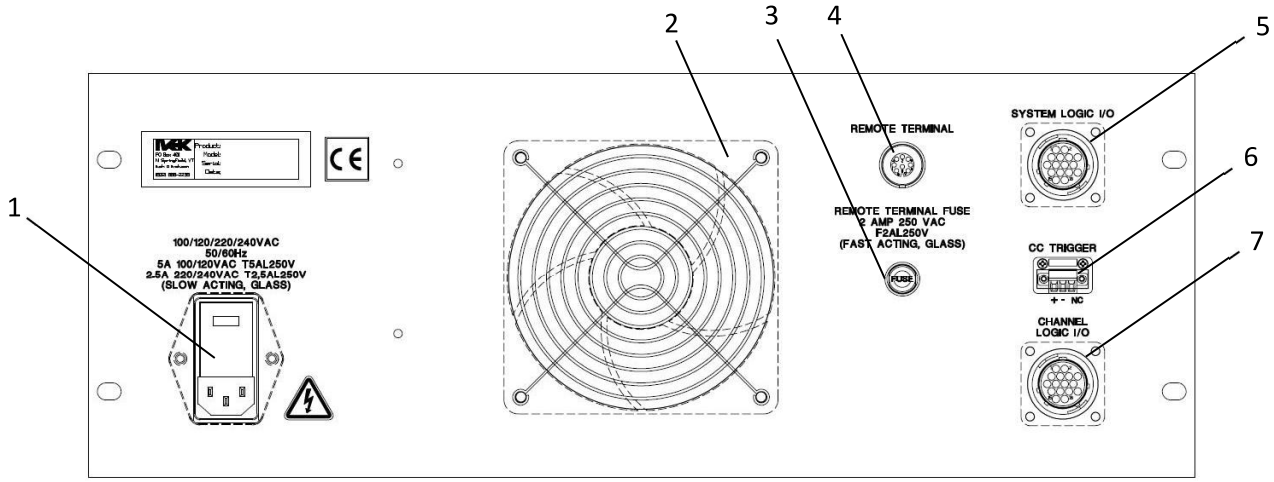

Figure 3.2A Multispense 2000 Style B 1 - 4 Channel Controller Module Rear Panel

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.

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 Fan (Figure 3.2A Item 2 and Figure 3.2B Item 3)

The fan cools the inside of the Controller Module when power is applied. Check the air filter on a regular basis to ensure it is not restricting the air flow.

3.1.2.3 Remote Terminal Fuse Holder and Fuse (Figure 3.2A Item 3 and Figure 3.2B Item 7)

The Remote Terminal Fuse Holder and Fuse is an option on this controller, but is not covered in this manual. Refer to the Multispense 2000 W/Touchscreen Controller Module manual.

3.1.2.4 Remote Terminal Connector (Figure 3.2A Item 4 and Figure 3.2B Item 5)

The Remote Terminal Connector is an option on this controller, but is not covered in this manual. Refer to the Multispense 2000 W/Touchscreen Controller Module manual.

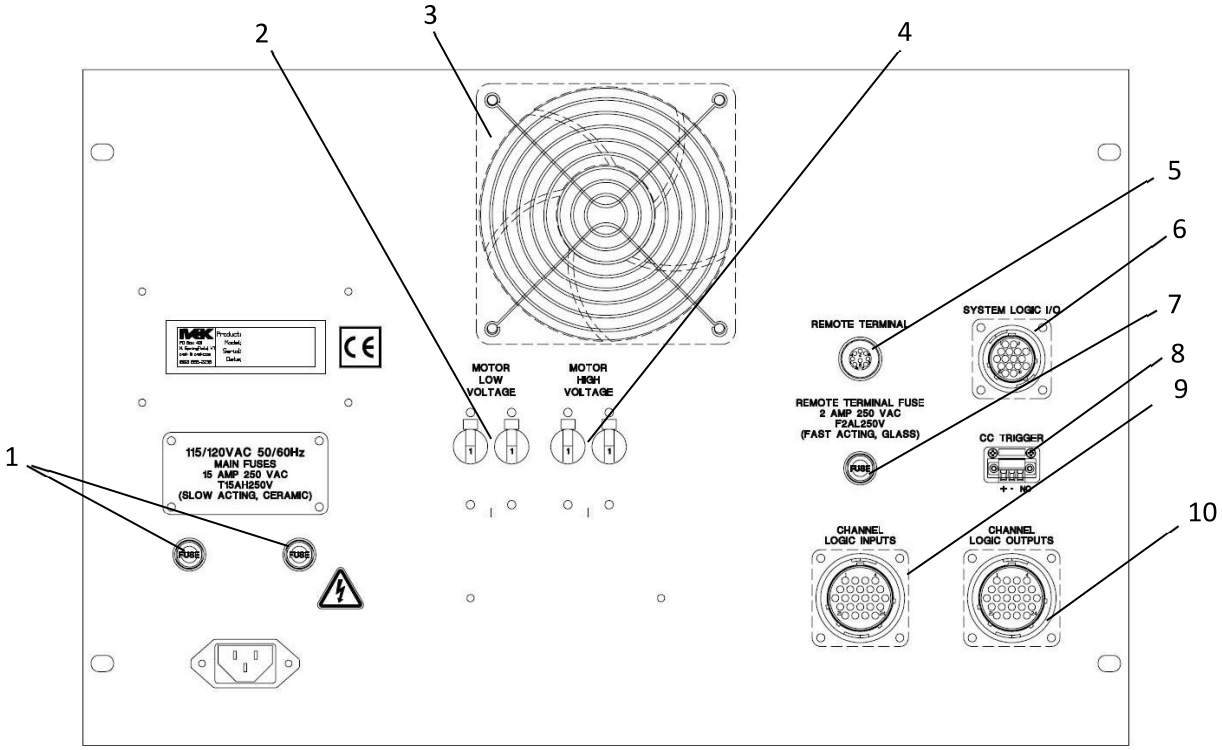

Figure 3.2B Multispense 2000 Style B 5 - 8 Channel Controller Module Rear Panel

3.1.2.5 System Logic I/O Connector (Figure 3.2A Item 5 and Figure 3.2B Item 6)

The System Logic I/O connector is used for making the electrical connection to the PLC Interface Device. Refer to section 3.2.2 for additional information.

3.1.2.6 CC Trigger Connector (Figure 3.2A Item 6 and Figure 3.2B Item 8)

The CC Trigger (Contact Closure) connector provides two inputs (labeled 1 and 2) and a common for triggering a variety of functions. Refer to section 3.4.5 for additional information.

3.1.2.7 Channel Logic I/O (Figure 3.2A Item 7) and Channel Logic Inputs and Outputs Connectors (Figure 3.2B Items 9 and 10)

The Channel Logic I/O connector contains the Independent Channel Trigger In signals and the Channel Ready Out signals. Refer to Sections 3.2.3 and 3.2.4 for additional information.

3.1.2.8 Power Cord, Main Fuse Holder and Fuse (Figure 3.2B Item 1)

The power cord is provided with large multiple channel systems. Separate system fuse holders and fuses are located near the power cord. The system is factory configure for the proper line voltage. To remove the fuse, push in slightly and turn in a counter-clockwise direction. Refer to the Title Page section of this manual to determine the power connection and fuse specifications for this Controller Module.

3.1.2.9 Motor Low Voltage Circuit Breaker (Figure 3.2B Item 2)

The Motor Low Voltage Circuit breaker protects the low voltage side of the motor from an over current condition. The circuit breaker should be in the up (ON) position during normal operation. If the breaker is not in the up (ON) position there may be a problem with the system. Push the breaker up, if it switches to the down (OFF) position call IVEK Technical Support.

3.1.2.10 Motor High Voltage Circuit Breaker(s) (Figure 3.2B Item 4)

The Motor High Voltage Circuit Breaker protects the high voltage side of the motor from an over current condition. Systems with more than 8 channels will have two Motor High Voltage Circuit Breakers. The circuit breaker(s) should be in the up (ON) position during normal operation. If the breaker(s) is not in the up (ON) position there may be a problem with the system. Push the breaker up, if it switches to the down (OFF) position call IVEK Technical Support.

3.2 OPERATION

The Controller Module provides the controls for producing liquid flow via a positive displacement pumping mechanism. The systems utilize solid-state electronics, stepping motor drives, and precision machined ceramic pump heads. These components combine to provide exceptional accuracy and precision (0.1% or less is achievable), high reliability, and low maintenance.

IVEK units have custom designed stepping motors and pumps sized to the specific dispensing application to provide the proper torque and speed.

3.2.1 Control

All operational parameters on the Controller Module are programmed through an RS-232 interface. Total electronic control allows for effortless, exacting calibration and full accountability of cumulative volumes dispensed. Software contained in the Controller Module's Master Plug-In allows configuration and operation on a system-wide or individual channel basis.

NOTE

The system does NOT have nonvolatile memory. If power is turned Off, all parameters must be re-initialized after power is restored.

All volume and rate commands use steps or steps per second where one step equals the displacement resolution of the pump head size in use.

3.2.2 System PLC Interface

The System PLC interface provides communications between the Controller Module and the customer's PLC. 'Trigger Input', 'Ready Out', 'Fault Out' and 'Load Required' signals are communicated to and from the PLC.

3.2.2.1 Signal Functions

System Trigger In - The 'System Trigger In' signal initiates a cycle. The trigger signal has no effect in Prime or Bubble Clear modes.

Dispense Mode - When the Controller Module is properly configured for Dispense mode, all channels are triggered at the transition when a signal is applied to the system trigger. If a channel is disabled, faulted, requires a reference, or requires a load, that channel is not triggered. (see section 3.2.3.2)

Meter Mode - When the Controller Module is properly configured for Meter mode, all channels are triggered as long as a signal is applied to the system trigger (until the pump chamber empties). If a channel is disabled, faulted, requires a reference, or requires a load, that channel is not triggered. (see section 3.2.3.3)

System Ready Out - The 'System Ready Out' signal indicates the active/idle state of the Controller Module. All channels must be ‘ready’ for this output to be "true". This output is false if any channel is not 'ready'. The ‘h’ command is used to define ‘ready’ for both the ‘system ready’ and ‘channel ready’ outputs.

System Fault Out - The 'System Fault Out' signal indicates that a fault has been detected in the operation of an Actuator Module. This output is complemented, i.e., the output is true when no fault exists on any channel, and is false when one or more channels are faulted.

System Load In - A signal applied to this input will initiate a load cycle. Operation is initiated at the rising edge of this signal, with any further activities on the signal ignored until the operation is completed.

System Load Out - The 'Load Out' signal indicates if any channel requires a load cycle. This output is 'true' when any enabled channel requires a load or is in process of loading. This output is 'false' when no enabled channel requires a load.

3.2.2.2 Signal Levels

All signals are optically isolated. The power for all signals is provided by the customer’s equipment.

All inputs accept a 24 VDC signal and require 20 mA.

All outputs conduct when the signal is ‘true’ and do not conduct when the signal is ‘false’ (see FAULT OUT). Outputs can switch a signal of up to 24 VDC and 50 mA. The output consists of the emitter and collector connections to an IC opto-isolator.

3.2.2.3 Connections

All connections are through a 16-pin circular plastic connector, with the mating connector and pins supplied with the unit. The connector has the pin layout as shown in Table 3.1.

Table 3.1 System I/O Interface

Pin Number	Signal	Pin Number	Signal
1	Key Hole	9	LOAD IN +
2	Key Hole	10	LOAD IN -
3	TRIG IN +	11	LOAD OUT +
4	TRIG IN -	12	LOAD OUT -
5	READY OUT +	13	Future Use
6	READY OUT -	14	Future Use
7	FAULT OUT +	15	Future Use
8	FAULT OUT -	16	Future Use

3.2.3 Channel Logic Inputs

Channel Logic Input signals for each channel are added to the PLC interface. The trigger input signals for each channel permit independent triggering of an individual channel using a logic signal rather than a command through the serial interface.

3.2.3.1 Signal Functions

Channel <n> Trigger In - The 'Channel <n> Trigger In' signal initiates a cycle for each channel. A signal applied to this input will trigger the selected channel if the channel has Dispense or Meter mode selected. A channel will not be triggered if it is in Setup, Prime, or Bubble Clear mode, is faulted, requires a reference, or requires a load cycle.

3.2.3.2 Signal Levels

All signals are optically isolated. The power for all signals is provided by the customer's equipment.

All inputs accept a 24 VDC signal and require 20 mA.

3.2.4 Channel Logic Outputs

The Channel Logic Output signals for each of the channels are added to the PLC interface. The ready output signals for each channel permit independent monitoring of the 'ready' versus 'busy' status of an individual channel using a logic signal rather than a command through the serial interface. This section describes the differences between the standard PLC Interface and this option.

3.2.4.1 Signal Functions

Channel <n> Ready Out - The 'Channel <n> Ready Out' signal indicates the active/idle state of each channel. The 'READY' state is configurable by and RS232 'h' command.

3.2.4.2 Signal Levels

All signals are optically isolated. The power for all signals is provided by the customer's equipment.

All inputs accept a 24 VDC signal and require 20 mA.

3.2.5 Connections

The following sections show the pin configurations for the different size Controller Modules.

3.2.5.1 Channel Logic Inputs/Outputs Connector Pinout (1-4 Channels)

All connections are through a 16 pin circular plastic connector, with the mating connector and pins supplied with the unit. Table 3.3 contains a list of each pin in the connector and its associated signal. If your Controller Module is less than 4 channels, the extra signals are not used.

Table 3.3 Channel Logic Inputs/Outputs Pin Configuration

Pin Number	Signal	Pin Number	Signal
1	Channel 1 Trigger In +	9	Channel 1 Ready Out +
2	Channel 1 Trigger In -	10	Channel 1 Ready Out -
3	Channel 2 Trigger In +	11	Channel 2 Ready Out +
4	Channel 2 Trigger In -	12	Channel 2 Ready Out -
5	Channel 3 Trigger In +	13	Channel 3 Ready Out +
6	Channel 3 Trigger In -	14	Channel 3 Ready Out -
7	Channel 4 Trigger In +	15	Channel 4 Ready Out +
8	Channel 4 Trigger In -	16	Channel 4 Ready Out -

The mating components for the connectors are supplied with the system. The IVEK part #'s are as follows.

Part	IVEK Part #
Pins	630023/F04
Plug	630029/F16
Shell	630025/S17

3.2.5.2 Channel Logic Input Connector Pinout (5-8 Channels)

All connections are through a 24 pin circular plastic connector, with the mating connector and pins supplied with the unit. The connector on the Controller Module is IVEK Spec No. N630021/M24. Table 3.4 contains a list of each pin in the connector and its associated signal. If your Controller Module is less than 8 channels, the extra signals are not used.

Install the keying plug in Pin 17 on the Controller Module end of the Channel Trigger In Cable.

Table 3.4 Channel Logic Inputs Pin Configuration

Pin Number	Signal	Pin Number	Signal
1	Channel 1 Trigger In +	13	Channel 7 Trigger In +
2	Channel 1 Trigger In -	14	Channel 7 Trigger In -
3	Channel 2 Trigger In +	15	Channel 8 Trigger In +
4	Channel 2 Trigger In -	16	Channel 8 Trigger In -
5	Channel 3 Trigger In +	17	Keying Plug Hole
6	Channel 3 Trigger In -	18	Keying Plug
7	Channel 4 Trigger In +	19	not used
8	Channel 4 Trigger In -	20	not used
9	Channel 5 Trigger In +	21	not used
10	Channel 5 Trigger In -	22	not used
11	Channel 6 Trigger In +	23	not used
12	Channel 6 Trigger In -	24	not used

3.2.5.3 Channel Logic Output Connector Pinout (5-8 Channels)

All connections are through a 24 pin circular plastic connector, with the mating connector and pins supplied with the unit. The connector on the Controller Module is IVEK Spec No. N630021/M24. Table 3.5 contains a list of each pin in the connector and its associated signal. If your Controller Module is less than 8 channels, the extra signals are not used.

Install the keying plug in Pin 7 on the Controller Module end of the Channel Ready Output Cable.

Table 3.5 Channel Logic Outputs Pin Configuration

Pin Number	Signal	Pin Number	Signal
1	not used	13	Channel 3 Ready Out –
2	not used	14	Channel 4 Ready Out +
3	not used	15	Channel 4 Ready Out –
4	not used	16	Channel 5 Ready Out +
5	not used	17	Channel 5 Ready Out –
6	Keying Plug	18	Channel 6 Ready Out +
7	Keying Plug Hole	19	Channel 6 Ready Out –
8	Channel 1 Ready Out +	20	Channel 7 Ready Out +
9	Channel 1 Ready Out –	21	Channel 7 Ready Out -
10	Channel 2 Ready Out +	22	Channel 8 Ready Out +
11	Channel 2 Ready Out –	23	Channel 8 Ready Out -
12	Channel 3 Ready Out +	24	Not used

The mating components for the two connectors are supplied with the system. The IVEK Part #'s are as follows:

Part	IVEK Part #
Pins	630023-F04
Plug	630029-F24
Shell	630025-S23
Keying Plug	630033

3.2.5.4 Channel Logic Inputs Connector Pinout (9-16 Channels)

All connections are through a 37 pin circular plastic connector, with the mating connector and pins supplied with the unit. The connector on the Controller Module is IVEK Spec No. N630021/M37. Table 3.6 contains a list of each pin in the connector and its associated signal. If your Controller Module is less than 16 channels, the extra signals are not used.

Install the keying plug in Pin 34 on the Controller Module end of the Channel Trigger In Cable.

Table 3.6 Channel Logic Inputs Pin Configuration

Pin Number	Signal	Pin Number	Signal
1	Channel 1 Trigger In +	20	Channel 10 Trigger In -
2	Channel 1 Trigger In -	21	Channel 11 Trigger In +
3	Channel 2 Trigger In +	22	Channel 11 Trigger In -
4	Channel 2 Trigger In -	23	Channel 12 Trigger In +
5	Channel 3 Trigger In +	24	Channel 12 Trigger In -
6	Channel 3 Trigger In -	25	Channel 13 Trigger In +
7	Channel 4 Trigger In +	26	Channel 13 Trigger In -
8	Channel 4 Trigger In -	27	Channel 14 Trigger In +
9	Channel 5 Trigger In +	28	Channel 14 Trigger In -
10	Channel 5 Trigger In -	29	Channel 15 Trigger In +
11	Channel 6 Trigger In +	30	Channel 15 Trigger In -
12	Channel 6 Trigger In -	31	Channel 16 Trigger In +
13	Channel 7 Trigger In +	32	Channel 16 Trigger In -
14	Channel 7 Trigger In -	33	Keying Plug
15	Channel 8 Trigger In +	34	Keying Plug Hole
16	Channel 8 Trigger In -	35	not used
17	Channel 9 Trigger In +	36	not used
18	Channel 9 Trigger In -	37	not used
19	Channel 10 Trigger In +		

3.2.5.5 Channel Logic Outputs Connector Pinout (9-16 Channels)

All connections are through a 37 pin circular plastic connector, with the mating connector and pins supplied with the unit. The connector on the Controller Module is IVEK Part # 630021-M37. Table 3.7 contains a list of each pin in the connector and its associated signal. If your Controller Module is less than 16 channels, the extra signals are not used.

Install the keying plug in Pin 4 on the Controller Module end of the Channel Ready Output Cable.

Table 3.7 Channel Logic Outputs Pin Configuration

Pin Number	Signal	Pin Number	Signal
1	not used	20	Channel 8 Ready Out +
2	not used	21	Channel 8 Ready Out -
3	not used	22	Channel 9 Ready Out +
4	Keying Plug Hole	23	Channel 9 Ready Out -
5	Keying Plug	24	Channel 10 Ready Out +
6	Channel 1 Ready Out +	25	Channel 10 Ready Out -
7	Channel 1 Ready Out –	26	Channel 11 Ready Out +
8	Channel 2 Ready Out +	27	Channel 11 Ready Out -
9	Channel 2 Ready Out –	28	Channel 12 Ready Out +
10	Channel 3 Ready Out +	29	Channel 12 Ready Out -
11	Channel 3 Ready Out –	30	Channel 13 Ready Out +
12	Channel 4 Ready Out +	31	Channel 13 Ready Out -
13	Channel 4 Ready Out –	32	Channel 14 Ready Out +
14	Channel 5 Ready Out +	33	Channel 14 Ready Out -
15	Channel 5 Ready Out –	34	Channel 15 Ready Out +
16	Channel 6 Ready Out +	35	Channel 15 Ready Out -
17	Channel 6 Ready Out –	36	Channel 16 Ready Out +
18	Channel 7 Ready Out +	37	Channel 16 Ready Out -
19	Channel 7 Ready Out -		

The mating components for the two connectors are supplied with the system. The IVEK Part #'s are as follows:

Part	IVEK Spec #
Pins	630023-F04
Plug	630029-F37
Shell	630025-S23
Keying Plug	630033

3.2.5.6 Channel Logic Input Connector Pinout (17-24 Channels)

All connections are through a 37 pin circular plastic connector, with the mating connector and pins supplied with the unit. Table 3.8 contains a list of each pin in the connector and its associated signal. If your Controller Module is less than 24 channels, the extra signals are not used.

Install the keying plug in pin 2 and pin 37 on the Controller Module end of the customer supplied Channel Logic Input cable.

Table 3.8 Channel Logic Inputs Pin Configuration

Pin Number	Signal	Pin Number	Signal
1	Keying Plug	20	Channel 18 Trigger In +
2	Keying Plug Hole	21	Channel 19 Trigger In +
3	Channel 1 Trigger In +	22	Channel 20 Trigger In +
4	Channel 2 Trigger In +	23	Channel 21 Trigger In +
5	Channel 3 Trigger In +	24	Channel 22 Trigger In +
6	Channel 4 Trigger In +	25	Channel 23 Trigger In +
7	Channel 5 Trigger In +	26	Channel 24 Trigger In +
8	Channel 6 Trigger In +	27	not used
9	Channel 7 Trigger In +	28	not used
10	Channel 8 Trigger In +	29	not used
11	Channel 9 Trigger In +	30	not used
12	Channel 10 Trigger In +	31	not used
13	Channel 11 Trigger In +	32	not used
14	Channel 12 Trigger In +	33	not used
15	Channel 13 Trigger In +	34	not used
16	Channel 14 Trigger In +	35	not used
17	Channel 15 Trigger In +	36	Channel Trigger In -
18	Channel 16 Trigger In +	37	Keying Plug Hole
19	Channel 17 Trigger In +		

The mating components for the two connectors are supplied with the system. The IVEK Part #'s are as follows:

Part	IVEK Part #
Pins	630023-F04
Plug	630029-F37
Shell	630025-S23
Keying Plug	630033

3.2.5.7 Channel Logic Output Connector Pinout (17-24 Channels)

All connections are through a 37 pin circular plastic connector, with the mating connector and pins supplied with the unit. Table 3.9 contains a list of each pin in the connector and its associated signal. If your Controller Module is less than 24 channels, the extra signals are not used.

Install the keying plug in pin 1 and pin 36 on the Controller Module end of the customer supplied Channel Logic Output cable.

Table 3.9 Channel Logic Output Pin Configuration

Pin Number	Signal	Pin Number	Signal
1	Keying Plug Hole	20	Channel 18 Ready Out -
2	Channel Ready Out +	21	Channel 19 Ready Out -
3	Channel 1 Ready Out -	22	Channel 20 Ready Out -
4	Channel 2 Ready Out -	23	Channel 21 Ready Out -
5	Channel 3 Ready Out -	24	Channel 22 Ready Out -
6	Channel 4 Ready Out -	25	Channel 23 Ready Out -
7	Channel 5 Ready Out -	26	Channel 24 Ready Out -
8	Channel 6 Ready Out -	27	not used
9	Channel 7 Ready Out -	28	not used
10	Channel 8 Ready Out -	29	not used
11	Channel 9 Ready Out -	30	not used
12	Channel 10 Ready Out -	31	not used
13	Channel 11 Ready Out -	32	not used
14	Channel 12 Ready Out -	33	not used
15	Channel 13 Ready Out -	34	not used
16	Channel 14 Ready Out -	35	not used
17	Channel 15 Ready Out -	36	Keying Plug Hole
18	Channel 16 Ready Out -	37	Keying Plug
19	Channel 17 Ready Out -		

The mating components for the two connectors are supplied with the system. The IVEK Part #'s are as follows:

Part	IVEK Part #
Pins	630023-F04
Plug	630029-F37
Shell	630025-S23
Keying Plug	630033

3.2.6 CC TRIGGERS Connector

The CC TRIGGER connector provides an optically isolated input to allow a contact closure source (such as a footswitch or relay) to initiate the system trigger signal. This signal is OR'd together with the Trigger In signal of the System Logic I/O connector. While both signals could be used simultaneously, it is recommended that only one of these signal be used in a system.

3.2.7 Operating Modes (Refer to Tables 3.3 and 3.4 for a listing of commands)

There are several different modes of operation which provide the Controller Module with its vast functional flexibility. The operational mode is selected using the 'm' command through the serial interface.

3.2.7.1 Prime

Prime mode produces a continuous cycle to pump fluid in one direction. Prime mode fills the system with fluid in preparation for actual operation, empties the system of fluid, and flushes the system for cleaning.

The current settings for the fluid direction ('d' command) and pumping port ('p' command) combine to determine the direction of fluid flow. Pumping cannot be started in this mode using the PLC inputs, only using the begin command ('b') through the serial interface. The pumping will continue until the end command ('e') is issued or up to a maximum time set with the 't' command. The time-out insures a communications problem won't result in the pumps operating indefinitely.

The flow rate for Prime mode is set with the 'u' command. The flow rate for Prime mode is also used in Bubble Clear mode and during load cycles.

Volume pumped during prime operation does not accumulate on the totalizer (viewed with the ‘g’ command).

3.2.7.2 Dispense

Dispense mode is used to deliver a specific volume of fluid at a specific rate. The current settings for the fluid direction (‘d’ command) and pumping port (‘p’ command) combine to determine the direction of fluid flow. Pumping can be started with the begin command (‘b’) using the serial interface, or with PLC inputs.

The dispense cycle will continue until the volume set using the ‘v’ command has been delivered, unless the *end* command (‘e’) is issued.

The flow rate for Dispense mode is set with the ‘r’ command.

The volume for Dispense mode is set with the ‘v’ command.

Volume pumped during dispense operation accumulates on the totalizer which is viewed with the ‘g’ command.

3.2.7.3 Meter

Meter mode is used to deliver fluid at a specific rate for a period of time determined by PLC input signals or commands through the serial interface. The most accurate and repeatable method to control metering operation uses the PLC inputs. Pumping will start when the trigger signal is present and will stop when the trigger signal is removed or the pump chamber empties. Pumping will also start with the *begin* command (‘b’) using the serial interface and stop with the *end* command (‘e’). The current settings for the fluid direction (‘d’ command) and pumping port (‘p’ command) combine to determine the direction of fluid flow.

The flow rate for metering is set with the ‘r’ command as in dispense.

Volume pumped during meter operation accumulates on the totalizer which is viewed with the ‘g’ command. Volume is limited to the available volume in the pump chamber.

3.2.7.4 Bubble Clear

Bubble clear is a sequence of volume displacement and valving used to dislodge air bubbles in the pump chamber and move them out through the discharge port. This is used when initially priming the system to aid in eliminating air bubbles **which have a detrimental effect on accuracy and repeatability**. The bubble clear cycle can only be initiated with the begin command ('b'), it cannot be started with the PLC inputs. The bubble clear cycle cannot be stopped with the end command ('e').

If the auto-load parameter (‘a’ command) is set to load ‘empty’ or load ‘every’, a load cycle will automatically be initiated when mode is changed to Prime, Dispense or Meter.

The flow rate for Bubble Clear mode is set with the ‘u’ command. The flow rate for Bubble Clear mode is also used in Prime mode and during load cycles.

3.2.7.5 Other Operating Sequences

Load - The load cycle is used to refill the pumping chamber with fluid after dispensing or metering. The piston will valve to the inlet port, fill the pump chamber with fluid, and valve back to the discharge port. Loading can be initiated ‘manually’ by using the *load* command (‘l’) or automatically. The system can be configured to automatically start a load cycle on either of two conditions; *empty* and *every,* which is set using the 'a' command.

When the system is configured for ‘load empty’, a load cycle will start when the pump is idle and the remaining volume in the pump chamber is less than the volume indicated by the ‘v’ parameter (dispense volume). The ‘v’ parameter is used for this function during both dispense and meter operation even though the ‘v’ parameter is not otherwise used during meter operation.

When the system is configured for ‘load every’, a load cycle will start at the completion of every dispense or meter operation.

The ‘a’ command is used to configure automatic loading for *manual* (no automatic loading), *empty*, or *every*.

Reference - The controller must complete a reference cycle when power is first applied or when a fault occurs. This is due to the Actuator Module having no sensors which send the absolute linear and rotary locations of the piston at all positions. The piston will first turn to find the rotary home (pump chamber open to port A), then move linearly to find the linear home.

A reference cycle (initiated with the ‘f’ command) is required after faults or after power is first applied and before any command resulting in motion of the Actuator Module is accepted (b, l, p).

NOTE

The system will not operate if a reference command has not been initiated. The system will only return warnings.

Drawback - Drawback is a controlled reverse flow at the end of a dispense or meter operation to improve volume repeatability when 'stringy' fluids are being dispensed. If no drawback is required, the drawback volume is simply set to "0". When drawback is used in Dispense mode, the dispense volume ('v' command) specifies the net fluid dispensed, the actual forward stroke is the sum of the specified dispense volume and the drawback volume. The flow rate during drawback and the dwell (time between the forward and reverse portions of the cycle) are specified in the same command ('w') as the drawback volume.

NOTE

After priming the fluid system, the first dispense will produce an incorrect volume when drawback is used.

3.2.8 Operating Parameters

Parameters are divided into a number of categories. This section provides a description of each command in the category that best fits its description.

3.2.8.1 Pump control

The following parameters control the specific operation of the Actuator Module. All of the following parameters are set in the individual channel for each Actuator Module. The channels can have the same or different values for each parameter.

Rate For Dispense And Meter Operation - One parameter is used to control the fluid flow rate for both Dispense and Meter mode. (‘r’ command)

Dispense Volume - While this parameter is used to specify the volume of fluid dispensed during dispense operation, it is also used to determine if a load cycle is required before another dispense or metering cycle can be initiated. (‘v’ command)

Rate For Prime, Load, And Bubble Clear Operation - This parameter is used to control the fluid flow rate for Prime, Load and Bubble Clear mode. (‘u’ command)

NOTE

The volume is set in steps and the rates are set in steps per second. Use the chart in Chapter 7 to convert to volume by multiplying the resolution per step for the Pump Module provided (refer to the Title Page section) times the number of steps.

Direction - The direction of the fluid flow is normally forward, but can be reversed to empty fluid back into the supply. Forward or reverse direction is defined at the selected port. (‘d’ command) Forward produces fluid exiting the selected port of the Pump Module.

Port - The selected port (normally considered the discharge port) can be changed to allow desired fluid flow direction for different mounting orientations of the Actuator Module. (‘p’ command)

Drawback - Three parameters are specified with one command to describe drawback operation. These are the drawback volume, the fluid flow rate during drawback, and the dwell (time delay) between the dispense and drawback portions of the cycle. ('w' command)

Auto Load - The pump can be set to automatically begin a load cycle when either the pump is ‘empty’ or after every dispensing or metering operation. Refer to 'Load' in section 3.2.3.5. (‘a’ command)

Keylock - This parameter is used to enable or disable a channel. This parameter can also be controlled using the ENABLE switch on the front panel of the Channel Plug-In. If the ENABLE switch is in the LOCKOUT position, the serial interface command will not be allowed to enable the channel. (‘k’ command)

Time Limit For Prime - In order to prevent a problem if the communications are interrupted during a prime operation, priming is limited to a duration specified by a parameter. (‘t’ command)

Valving Speed - The rotational speed of the piston during valving can be lowered if required to pump highly viscous fluids. (‘y’ command)

3.2.8.2 Interface Control

The following parameters control the interfaces (serial and PLC) to the Controller Module.

Terse/Verbose - The response to commands can be shortened if a high throughput or low overhead is required. In terse mode, the response consists of only the carriage return character, unless a fault or warning exists which generates the full response. In verbose mode, the full response is always returned. This command (‘h’) is issued to the Master Plug-In using channel number 99. (see section 3.2.6.4)

Hardwired Ready Signal - Both the hardwired (PLC) system ready output and the optional channel ready outputs can be configured by the customer. In all cases the output indicates ‘busy’ during a dispense, but may be configured to be either ‘busy’ or ‘ready’ when other conditions exist, such as during a load cycle or if a fault is detected. This parameter is set in the individual channel for each Actuator Module. (‘h’ command)

3.2.9 Status Information

3.2.9.1 General information

Additional information is available which may be used to confirm proper operation of the system.

Totalizer - A totalizer for each channel, which accumulates commanded steps during Dispense and Meter modes, can be read or reset to zero. The totalizer stops at a maximum value of 65,535. The value does not wrap around to 0 so it must be reset. (‘g’ command)

Ready/Busy - The active or inactive state of each channel can be read. (‘q’ command)

Volume Remaining - The remaining capacity of the pump chamber (in steps) for each channel can be read. (‘s’ command)

Software Version - The (somewhat encoded) software version on both the Master Plug-In and each Channel Plug-In can be read. (z command)

3.2.9.2 Faults

The response to all commands to a particular channel will respond with fault or warning information if applicable. The fault will be indicated until faults are cleared on that particular channel. Warnings will be indicated as long as they apply. A fault present on a channel other than the one addressed by the current command will be indicated, but neither the faulted channel address nor the exact type of fault will be indicated.

A fault is the result of improper operation of the Actuator Module being detected.

Warnings indicate an error in the command, or a condition which requires attention before operation can be initiated.

Clear Faults - After a fault, the clear faults command and reference command must be issued prior to any commands which would cause motion in the Actuator Module. The clear faults command responds with the identity of the fault being cleared and additional information for certain faults. (c command, f command)

3.2.10 Optically Isolated Serial Interface

CAUTION

Do not issue a motion command while the actuator is busy (while the actuator is in motion). Use the 'q' Ready/Busy command to determine the actuator's Ready/Busy status.

It is suggested the actuator NOT be run in the reverse direction for extended periods. Loss of the linear home position may result. If reverse direction is required, a periodic reference or load command should be issued to allow the actuator to reaquire the linear home sensor.

The optically isolated serial interface provides control of all functions available with electrical isolation between the RS-232 input signals and the internal control electronics. The hardware is configured as RS-232 Data Communications Equipment (DCE) standard with the pin configuration shown in Table 3.2.

Table 3.2 Connections (DCE, 9 pin D-sub female)

Pin Number	Signal	Direction
2	RD	From Controller Module
3	TD	To Controller Module
5	COM	
6	DSR	From Controller Module
7	DTR	To Controller Module

No hardware signals are currently used for handshaking.

The parameters of the communications interface must be set as follows.

- 9600 BAUD
- 8 BIT
- NO PARITY
- ONE STOP BIT

The USB is an alternate for the RS-232 interface. The USB connector is a type B connector. The USB connection is a device connection. The connection between the USB and the PC is a virtual serial port. The driver for the USB is included with the most recent versions of Windows.

3.2.10.1 Command Structure

The command is a string of ASCII characters. The use of the ASCII backspace or rub out characters as a means of entry correction is not supported.

Commands are not directly echoed as they are received. The terminal being utilized to send commands should be setup for half duplex or local echo mode.

After dispense or metering operation is triggered, the values for that operation are fixed. This allows new parameter values for the following operation to be downloaded before the current operation is complete.

The Controller Module serial interface does not 'broadcast' messages, such as fault conditions, but only responds when it receives a command.

<name>	Represents an argument
[ ]	Represents an optional argument
,	Field delimiter character for numerical arguments.
<CR>	End of command represented by ASCII carriage return character (no line feed).

The complete command form is:

[<chan>]<cmd>[<value1>[,<value2>[,<value3>]]]<CR>

<chan> Channel number.

All numerical characters beginning a command are evaluated as the channel number.
If omitted, previous value of channel remains in effect.

Value of zero will broadcast command to all channels. (see section 3.2.6.3)

All values greater than 99 will be evaluated as 99.

Master Plug-In is channel number 99.

Channel Plug-Ins have channel numbers from 1 to 31

<cmd> Command

First non-numerical character seen in the command string will be evaluated as the command character. All subsequent alphabetic characters will be ignored.
Command characters **ARE** case sensitive.

If no command is included (command string only consists of numerical characters), response will only be <CR> indicating unit is ready to accept new command string.

<value1> First numerical parameter

The first numerical character received after the command character begins evaluation of the first numerical parameter. All non-numeric characters with the exception of the field delimiter character will be ignored.
A field delimiter character after the command character and before the first numerical character will be ignored and will not delimit the first parameter to a value of zero. This means a zero character must be used to indicate an argument with value of zero for the first numerical parameter.

<value2> Second numerical parameter

All non-numerical characters with the exception of the field delimiter character will be ignored.
A null argument will be evaluated as a value of zero (no numerical characters between the field delimiter for the first parameter and a following field delimiter or end of command character).

<value3> Third numerical parameter

All non-numerical characters with the exception of the field delimiter character will be ignored.

A null argument will be evaluated as a value of zero (no numerical characters between the field delimiter for the second parameter and a following field delimiter or end of command character).

All values in the command string which are not required by the command specified will be ignored. Following are some examples of command strings.

2v89<CR> Channel 2, command v, one value of 89

0r400<CR> All channels, command r, one value of 400

e1<CR> Same channel as previous command, command e, one value of 1

1q<CR> Channel 1, command q, no values

NOTE

Transmission should stop when an ASCII carriage return character is sent and can resume when the ASCII carriage return of the response is received. The serial interface has a limited receive buffer. Information may be lost if multiple commands are sent together.

3.2.10.2 Response String

The response from the Controller Module has a format very similar to the command with the addition of an additional 'flag' and value if a fault or warning is active.

<name>	Represents an argument
[ ]	Represents an optional argument
,	Field delimiter character for numerical arguments.
*	Field delimiter character which precedes fault or warning value
<CR>	End of command represented by ASCII carriage return character (no line feed).

<chan><cmd>[<value1>[,<value2>[,<value3>]]]<CR>

The description for the response string above follows the structure of the command string previously described.

If a fault or warning exists, the normal value(s) are returned for the command, followed by the fault delimiter (in place of the normal field delimiter) and the fault number to indicate the problem. The fault delimiter and fault number will appear in all responses from that channel until the command to clear faults is sent to the faulted channel. If a command normally returns three values, the fault number will replace the third value. Following are some examples of command strings.

2c<CR> **Command:** Channel 2, command c

2c<CR> **Response:** Channel 2, command c, no values other than warnings are returned by command c.

1m1<CR> **Command:** Channel 1, command m, one value of 1

1m1<CR> **Response:** Channel 1, command m, one value of 1

u<CR> **Command:** Same channel as previous command (1), command u, no new value

1u2000<CR> **Response:** Channel 1, command u, one value of 2000

u3500<CR> **Command:** Same channel as previous command (1), command u, 1 value of 3500

1u3500<CR> **Response:** Channel 1, command u, one value of 3500

r0<CR> **Command:** Same channel as previous command (1), command r, 1 value of 0

1r1000*2 **Response:** Channel 1, command r, current value is 1000 (unchanged), warning 2 = value no good

3.2.10.3 Broadcasting

A command with a channel address of 0 will send that command to all installed channels. A subsequent command which does not indicate a new channel number will also be broadcast to both channels (previous channel number is retained as in single channel commands). The response from each channel will be sent by the Controller Module, with a semicolon separating the responses of the channels. An ASCII carriage return is sent by the Controller Module at the end of the response from the last channel.

1<cmd><value>;2<cmd><value><CR>

EXAMPLES

0m2<CR> **Command:** sets all channels to Dispense mode
1m2;2m2;3m2<CR>
Response: for a 3 channel system

0v54<CR> **Command:** sets all channels to a volume of 54
1v54;2v54;3v54<CR>
Response: for a 3 channel system

0l<CR> **Command:** loads all channels

1l;2l;3l<CR> **Response:** for a 3 channel system

3.2.10.4 Verbose/Terse Response

Responses from the Controller Module can be selected as 'verbose', with information from the command sent, or as 'terse', with only warning and fault information sent. Verbose or terse mode is selected using the 'h' command to the Master Plug-In (channel 99). This feature is included to improve communication throughput if many channels and parameters are being changed. The responses illustrated above show the verbose mode which is the default at power up. If current values are only being queried, not changed (i.e. no new value sent), verbose response must be used to receive the information.

EXAMPLES OF TERSE MODE

2c<CR> **Command:** Channel 2, command c
<CR> **Response:**

1m1<CR> **Command:** Channel 1, command m, one value of 1
<CR> **Response:**

u<CR> **Command:** Same channel as previous command (1), command u, no new value
<CR> **Response:** (verbose mode must be used)

u3500<CR> **Command:** Same channel as previous command (1), command u, 1 value of 3500
<CR> **Response:**

r0<CR> **Command:** Same channel as previous command (1), command r, 1 value of 0
1r1000*2 **Response:** Channel 1, command r, current value is 1000 (unchanged), warning 2 = value no good

0m2<CR> **Command:** sets all channels to Dispense mode
<CR> **Response:** for a multi channel system

0v54<CR> **Command:** sets all channels to a volume of 54
<CR> **Response:** for a multi channel system

0l<CR> **Command:** loads all channels
<CR> **Response:** for a multi channel system

3.2.10.5 Commands

There are two types of commands; master and channel. The master commands are sent to the Master Plug-In and control the overall settings of the system. The channel commands are sent to the Channel Plug-Ins and can either control one Channel Plug-In or all Channel Plug-Ins depending on the code sent. If a 0 is sent as the channel number, all Channel Plug-Ins will be affected. If the Channel Plug-In number is sent, (i.e. 1 for channel 1, 2 for channel 2) then only that Channel Plug-In will be affected. Tables 3.3 and 3.4 list the commands for the Master Plug-In and Channel Plug-In.

NOTE

Refer to previous description for complete command syntax ("COMMAND STRUCTURE").

Table 3.3 Master Plug-In Commands
(Precede command with 99)

Command	Response	Description
<ESC> => RESET		
<ESC>		Resets processor on Master Plug-In only. Any time an escape character is received, the Master Plug-In processor will be restarted without changing any setup parameters for the Master Plug-In. Neither a preceding channel number, nor a following carriage return is required for this command to be recognized and executed. As this is a software controlled reset, it is not guaranteed to work in all cases.
h => HARDWARE CONFIGURATION		
h	h<value1>	Returns the current configuration for the hardware.
h<value1>	h<value1>	Sets the hardware configuration. <value1>: 0 = Terse 1 = Verbose (default) Any nonzero number results in Verbose.
m => MODE		** Reserved For Digifeeder 2002 **
z => SOFTWARE VERSION		
z	z<value1>,<value2>,<value3>	Returns the software version. To properly decode this information, the first two values should be converted to 16 bit hexadecimal. The final 'readable' format is three uppercase letters followed by five decimal digits. value 1 high byte: first letter in ASCII value 1 low byte: second letter in ASCII value 2 high byte: third letter in ASCII value 2 low byte: fourth and fifth decimal digits as a hexadecimal value value 3: first, second, and third decimal digits as a hexadecimal value As an aid to determining relative age of different versions, the last two digits are the year and the previous three digits are the day in the year for that version.

Table 3.4 Channel Plug-In Commands
(Precede command with 0 for all channels or the individual channel number)

Command	Response	Description
a => AUTOLOAD		
a	a<value1>	Returns current autoload setting.
a<value1>	a<value1>	Sets the Autoload mode. <value1>: 0 = Manual (default) 1 = Empty 2 = Every
b => BEGIN		
b	b	Initiates a prime, dispense, meter, or bubble clear cycle according to the current 'mode' setting.
c => CLEAR FAULTS		
c	c<value1>	Clears all faults. Error number returned as value 1. Extended error information may be returned as value 2 and value 3 if applicable to that error number.
d => DIRECTION		
d	d<value1>	Returns current fluid direction setting.
d<value1>	d<value1>	Sets the liquid flow direction. <value1>: 0 = Reverse 1 = Forward (default) Any nonzero number results in Forward.
e => END		
e	e	Ends the current pumping cycle. In Prime mode, will continue until piston chamber full if direction is Forward and piston chamber empty if direction is Reverse.
f => REFERENCE		
f	f	References the piston in the home position for both the rotary and linear home.

NOTE

Do not send the 'f' command while the Actuator is in motion. Doing so may cause the piston to jam in the cylinder and require disassembly or repair.

g => TOTALIZER		
g	g<value1>	Returns current value, in pump steps, of the totalizer for dispensing and metering volume. <value1> represents a 5 digit decimal value. **MAX VALUE:** The totalizer will increment to a maximum value of 65,535 and stop. The totalizer will not 'wrap around'. The pump will continue to operate without incrementing the totalizer.
g0	g0	Resets the value of the totalizer to zero. This parameter can only be reset to zero.
h => HARDWIRED READY SIGNAL OPERATION		
h	h<value1>	Returns the current configuration for the hardwired ready signals.
h<value1>	h<value1>	Sets configuration for the hardwired ready signals <value1> represents a 3 digit decimal value.

The hardwired ready signals (SYSTEM READY and optional CHANNEL READY) are always false while the pump is active in dispense or metering operation. In addition, the ready signals can be configured to be false during other times by setting appropriate bits in this configuration value. In all other cases, the ready output will be true. Individual configuration information can be determined using binary decoding as follows:

bit	value	if bit set, SYSTEM READY also false
0	1	Valving
1	2	Loading, Priming, Bubble Clearing
2	4	Load Required
3	8	Any fault true, Ref Required
bit	**value**	**if bit set, CHANNEL READY also false**
4	16	Valving
5	32	Loading, Priming, Bubble Clearing
6	64	Load Required
7	128	Any fault true, Ref Required
	136	System or Channel not ready if fault or reference required (default)

k => KEYLOCK

k	k<value1>	Returns the current setting which inhibits or allows operation of the channel.
k<value1>	k<value1>	Enables or disables a channel. <value1>: 0 = Disabled <value1>: 1 = Enabled (default)

l => LOAD

l	l	Initiates a load cycle.

m => MODE

m	m<value1>	Returns the current mode.
m<value1>	m<value1>	Sets the operating mode. <value1>: 1 = Prime (default) 2 = Dispense 3 = Meter 4 = Bubble Clear 5 = Do not use (Digifeeder 2002 only)

p => PORT

p	p<value1>	Returns the current selected port.
p<value1>	p<value1>	Determines which port is the selected port. Combines with direction (fwd/rev) to determine fluid direction. In forward direction with B selected, pumping is from A to B. <value1>: 0 = Port A 1 = Port B (default)

q => READY/BUSY

q	q<value1>	Indicates READY/BUSY status. <value1> is 0 for READY and greater than 0 for BUSY. Individual operational information can be determined using binary decoding as follows:

bit	value	active if bit set
0	1	Any Motion
1	2	Dispense or Meter
2	4	Prime or bubble Clear

bit	value	active if bit set
3	8	Load
4	16	Valve
5	32	Referencing

r => DISPENSE RATE

r r<value1> — Returns the current dispense and metering flow rate in steps per second.

r<value1> r<value1> — Sets the Dispense or Metering flow rate in steps/sec.
<value1>: represents a 5 digit decimal number
Maximum: 4000
Minimum: 14
Default: 1000

s => STATUS

s s<value1> — Returns the volume remaining in the pump chamber. (units are steps)
<value1>: volume remaining

t => TIME LIMIT FOR PRIME

t t<value1> — Returns current limit on prime cycle in seconds.

t<value1> t<value1> — Sets the limit on prime cycles in seconds. Value of zero will allow priming for less than one second.
<value1>: represents a 3 digit decimal number Maximum: 255
Minimum: 0
Default: 120

u => PRIME, LOAD AND BUBBLE CLEAR RATE

u u<value1> — Returns the current prime, load, and bubble clear flow rate in steps/ second.

u<value1> u<value1> — Sets the Prime, Load, and Bubble Clear flow rate in steps/sec.
<value1>: represents a 5 digit decimal number
Maximum: 4000
Minimum: 14
Default: 1000

v => DISPENSE VOLUME

v v<value1> — Returns the current dispense volume in steps.

v<value1> v<value1> — Sets the dispense volume in steps. A volume of zero will not allow the unit to be triggered while in Dispense mode.
<value1>: represents a 5 digit decimal number
Maximum: 2000
Minimum: 0
Default: 400

w => DRAWBACK

w w<value1><value2><value3> — Returns the current drawback parameters.

w<value1> w<value1><value2><value3> — Sets the drawback parameters.
<value1>: Volume in steps
Maximum: 2000
Minimum: 0 (default)
<value2>: Rate in steps per second
Maximum: 4000
Minimum: 14 (default)

<value3>: Dwell in hundredths of a second
Maximum: 255
Minimum: 0 (default)

y => VALVING SPEED

y	y<value1>	Returns the current speed of the motor during valving in steps per second.
y<value1>	y<value1>	Sets the speed of the motor during valving in steps per second <value1>: represents a 5 digit decimal number Maximum: 1000 (default) Minimum: 14

NOTE

While the maximum speed for valving to port B is 1000, the maximum (and default) speed for valving to port A is 580. If the parameter set with this command is greater than 580, that value will be the speed for valving to port B, and 580 will be the speed for valving to port A. If the parameter is set less than 580, then both ports will use the same value.

z => SOFTWARE VERSION

z	z<value1>,<value2>,<value3>	Returns the software version. To properly decode this information, the first two values should be converted to 16 bit hexadecimal. The final 'readable' format is three uppercase letters followed by five decimal digits as seen in the lower left corner of this page. value 1 high byte: first letter in ASCII value 1 low byte: second letter in ASCII value 2 high byte: third letter in ASCII value 2 low byte: fourth and fifth decimal digits as a hexadecimal value value 3: first, second, and third decimal digits as a hexadecimal value

NOTE

As an aid to determining relative age of different versions, the last two digits are the year and the previous three digits are the day for that version

3.2.10.6 Warnings

Warnings indicate problems in the command received, or a state of the Actuator Module which prohibits immediate operation. An asterisk (*) precedes warnings in responses. An appropriate command (other than 'clear faults') may be required to operate the pump.

1 Command Not Valid - Response to any unrecognized command
2 Value Not Valid - Response to any out of range value
3 Load Required - Piston is empty or remaining volume is less than the current dispense volume.
4 Reference Required - Pump needs to locate linear and rotary reference position. Reference cycle, using 'f' command, this must be completed before continuing.
5 Mode Not Selected - (not used)
6 Number Format - (not used)
7 Channel Not Installed - No response from channel with that address.
8 Channel Locked Out - Switch on front panel of Channel Plug-In is in LOCKOUT position. Channel cannot be enabled via the serial interface with the 'k' command. The switch must first be moved to the middle position.
9 Channel Not Enabled - Specific channel triggered with 'begin' or 'load' commands but NOT enabled.
10 Channel Not Responding - Master Plug-In does not see response from Channel Plug-In during internal communications attempt. If condition persists, contact IVEK Technical Support for replacement.

11 Second Command Character - A second command character (alphabetic character) was seen in a single command (before <CR> character). Entire command is ignored.

3.2.10.7 Faults

Faults are a result of the system detecting improper operation of the pump actuator. All fault numbers will be greater than or equal to 1000. An asterisk (*) precedes warnings in responses. The 'clear faults' command must be used before any subsequent operation of the affected channel is performed.

1000 Fault On Other Channel - An unspecified fault has been detected on another channel. This error will not appear if a warning or fault condition exists in the channel for the command (won't replace warning or fault information from command's channel to indicate fault elsewhere). This error will not appear in a broadcast response.
1001 Linear Sensor Fault - "Home" position sensor for linear motion was not detected. Clear faults using 'c' command and re-reference using 'f' command.
1002 Rotary Sensor Fault - "Home" position sensor for rotary motion was not detected. Clear faults using 'c' command and re-reference using 'f' command.
1003 Linear Stall - Motor stall was detected during linear operation of the piston. **This requires the encoder option in the Channel Plug-In and in the pump actuator.**
1004 Rotary Stall - Motor stall was detected during rotary operation of the piston. **This requires the encoder option in the Channel Plug-In and in the pump actuator.**

3.2.10.8 Command Summary

The command summary section is almost identical to the Command section except it has been abbreviated into two pages. This will allow for copying to create a single front-and-back reference sheet.

Table 3.5 Master Plug-In Commands (Precede command with 99)

Command	Response	Description
<ESC>		Resets processor on Master Plug-In only.
h<value1>	h<value1>	Sets the hardware configuration <value1>: 0 = Terse 1 = Verbose (default)
m<value1>	m<value1>	** Reserved for Digifeeder 2002 **
z	z<value1>,<value2>,<value3>	Returns the coded software version.

Table 3.6 Channel Plug-In Commands

(Precede command with 0 for all channels or specific channel number)

Command	Response	Description
a<value1>	a<value1>	Sets the Autoload mode. <value1>: 0 = Manual (default) 1 = Empty 2 = Every
b	b	Initiates a pumping cycle.
c	c<value1>	Clears all faults.
d<value1>	d<value1>	Sets the liquid flow direction. <value1>: 0 = Reverse 1 = Forward (default)
e	e	Ends the current pumping cycle.
f	f	Sets the piston in the reference location.
g	g<value1>	Returns the total number of motor steps of the totalizer. (send 0 to reset)
h<value1>	h<value1>	Sets configuration for the hardwired ready signals

bit	value	if bit set, SYSTEM READY also false
0	1	Valving
1	2	Load, Prime, Bubble Clear
2	4	Load Required
3	8	Fault, Ref Required

bit	value	if bit set, CHANNEL READY also false
4	16	Valving
5	32	Load, Prime, Bubble Clear
6	64	Load Required
7	128	Fault, Ref Required
default:	*136*	*System or Channel not ready if Fault or Reference Required*

k<value1>	k<value1>	Enables or disables a channel. <value1>: 0 = Disabled 1 = Enabled (default)
l	l	Initiates a load cycle.
m<value1>	m<value1>	Sets the operating mode. <value1>: 1 = Prime (default) 4 = Bubble Clear 2 = Dispense 5 = Do not use 3 = Meter

Command	Response	Description
p<value1>	p<value1>	Sets the selected port. <value1>: 0 = Port A 1 = Port B (default)
q	q<value1>	Returns the Ready/Busy status. <value1>: 0 = Ready not 0 = Busy
r<value1>	r<value1>	Sets the Dispense or Metering flow rate in steps/sec. <value1>: represents a five digit decimal number Maximum: 4000 (we recommend 500 or less in Continuous Meter mode) Minimum: 14 Power up: 1000 (default)
s	s<value1>	Returns the volume remaining before the next load. <value1>: volume remaining
t<value1>	t<value1>	Sets the limit on prime cycles in seconds. <value1>: represents a three digit decimal number Maximum: 255 Minimum: 0 Default: 120
u<value1>	u<value1>	Sets the Prime, Load, and Bubble Clear flow rate in steps/sec. <value1>: represents a five digit decimal number Maximum: 4000 Minimum: 14 Default: 1000
v<value1>	v<value1>	Sets the dispense volume in steps. <value1>: represents a five digit decimal number Maximum: 2000 Minimum: 0 Default: 400
w	w<value1><value2><value3>	Returns the current drawback parameters.
w<value1>	w<value1><value2><value3>	Sets the drawback parameters. <value1>: Volume in steps Maximum: 2000 Minimum: 0 (default) <value2>: Rate in steps per second Maximum: 4000 Minimum: 14 (default) <value3>: Dwell in hundredths of a second Maximum: 255 Minimum: 0 (default)
y<value1>	y<value1>	Sets the speed of the motor during valving in steps per second <value1>: represents a five digit decimal number Maximum: 1000 (default) Minimum: 14
z	z<value1>,<value2>,<value3>	Returns the software version.

WARNINGS				FAULTS	
1	Command Not Valid	7	Channel Not Installed	1000	Fault On Other Channel
2	Value Not valid	8	Channel Locked Out	1001	Linear Sensor Fault
3	Load Required	9	Channel Not Enabled	1002	Rotary Sensor Fault
4	Reference Required	10	Channel Not Responding	1003	Linear Stall (Option)
5	(not used)	11	Second Command Character	1004	Rotary Stall (Option)
6	(not used)				

3.2.10.9 Typical Command Sequence

Following is a typical command sequence for operating the system. Your sequence may vary depending on your application.

	COMMAND	OUTCOME
1.	0f<CR>	References all actuators/pumps.

The Priming procedure fills the inlet tubing, pump head chamber, outlet tubing and nozzle with liquid.

2.	0u4000<CR>	Sets Prime/Load rate to (maximum) 4000 steps/sec.
3.	1m1<CR>	Puts channel no. 1 in Prime mode.
4.	1b<CR>	Begins Prime mode in channel no. 1.
5.	1e<CR>	Ends Prime mode in channel no. 1.

The bubble clear procedure clears the liquid path of air bubbles.

6.	1m4<CR>	Puts channel no. 1 in Bubble Clear mode.
7.	1b<CR>	Begins Bubble Clear in channel no.1.
8.	1b<CR>	The optional second cycle aids in eliminating air bubbles.

A second Priming procedure assures the inlet tubing, pump head chamber, outlet tubing and nozzle are filled with liquid.

9.	1m1<CR>	Puts channel no. 1 in Prime mode.
10.	1b<CR>	Begins Prime mode in channel no. 1.
11.	1e<CR>	Ends Prime mode in channel no. 1.

The procedure is complete when there are no air bubbles remaining in the inlet tubing, pump head chamber, outlet tubing and nozzle.

Prime the second channel in the same manner.

12.	2m1<CR>	Puts channel no. 2 in Prime mode.
13.	2b<CR>	Begins Prime mode in channel no. 2.
14.	2e<CR>	Ends Prime mode in channel no. 2.
15.	2m4<CR>	Puts channel no. 2 in Bubble Clear mode.
16.	2b<CR>	Begins Bubble Clear in channel no. 2.
17.	2b<CR>,	The optional second cycle aids in eliminating air bubbles.
18.	2m1<CR>	Puts channel no. 2 in Prime mode.
19.	2b<CR>	Begins Prime mode in channel no. 2.
20.	2e<CR>	Ends Prime mode in channel no. 2.

It is recommended that operators be able to individually start and stop the channels during prime operation. This allows them to efficiently clear bubbles from each fluid line. The following three steps set up the system for normal operation.

21.	0r250<CR>	Sets Dispense rate to 250 steps/sec.
22.	0v100<CR>	Sets the dispense volume for all channels to 100 steps.
23.	0m2<CR>	Sets all channels to Dispense mode.

For initiation of a dispensing cycle, a 24V input trigger is necessary.

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.

If both 20-pitch and 40-pitch Actuator Modules are used on a single Controller Module, insure the Actuator Module is connected to the correct Channel Plug-In. Refer to Figure 3.4 for the Channel Plug-In and Chapter 5 for the Actuator (or Chapter 6 for custom) identification information.

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 Encoder

The encoder option must be present in both the Channel Plug-In (in Controller Module) and in its corresponding Actuator Module, and requires a different cable between the Controller Module and the Actuator Module.

This option adds an encoder to the Actuator Module allowing the Channel Plug-In to verify all motions of the actuator. Any stall during fluid displacement or valving will immediately be sensed by the encoder and generate a fault condition. Without this option, only the linear and rotary home sensors can be used to detect a stall. The rotary home sensor detects valving to port A and can only generate faults if valving has been commanded to port A with no response from this sensor. The linear home sensor detects a piston withdrawn to full chamber capacity, and can only generate a fault during a load operation (when using standard operating methods).

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.

- Master Plug-In
- Channel Plug-In
- Main Power Fuse

3.5.1.1 Master Plug-In (Figure 3.4 Item 1)

CAUTION

This is an electrostatic sensitive device. Electrostatic discharge can damage the board if not handled properly.

Disassembly

1. Turn power OFF.
2. Remove the serial interface cable from the connector.
3. Loosen two captive screws securing the Master Plug-In to the chassis.
4. Grab the handle and slide the Master Plug-In straight out.

Assembly

1. Slide the Master Plug-In into the chassis making sure it goes into the rear connector and secure with the two captive screws.
2. Connect the cable to the connector.

3.5.1.2 Channel Plug-In (Figure 3.4 Item 2)

If both 20-pitch and 40-pitch Actuator Modules are used on a single Controller Module, insure the correct Channel Plug-In is used. Refer to the Channel Plug-In identification chart in section 3.3.

CAUTION

This is an electrostatic sensitive device. Electrostatic discharge can damage the board if not handled properly.

Disassembly

1. Turn power OFF.
2. Remove the cable from the connector.
3. Loosen four captive screws securing the Channel Plug-In to the chassis.
4. Grab the handle and slide the Channel Plug-In straight out.

Assembly

1. Slide the Channel Plug-In into the chassis making sure it goes into the rear connector. Secure with the four captive screws.
2. Connect the cable to the connector.

3.5.1.3 Main Power Fuse

For systems with 5 or more channels refer to section 3.1.2.12.

For all other systems the main power fuse located in the Power Entry Module (Refer to Figure 3.3) on the rear panel is replaceable. The proper fuse value is described in the Title Page section of this manual. Fuse holders are available from IVEK Corporation for conversion to 5mm by 20mm fuses.

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.

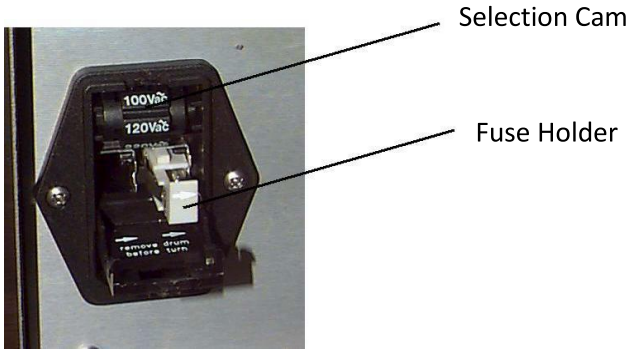

Figure 3.3 Power Entry Module

3.6 PROBLEM GUIDE

Table 3.9 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 the Controller Module. Any unauthorized access to the inside will void the warranty.

Table 3.9 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.
Power is on, Controller Module accepts trigger, piston fails to move and Actuator Module makes a sound.* This condition does not harm the system.	Circuit Breaker (if equipped) on rear of Controller Module tripped.	Ensure the circuit breaker (if equipped) on the rear of the Controller Module are in the ON (1) (Up) position.
	A Pump Module or motor malfunction can cause this problem.	Turn off Controller Module power. Remove Pump Module from Actuator 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, Controller Module accepts a trigger, (ACTIVE indicator illuminates), piston fails to move, and Actuator Module is silent.	Circuit Breaker (if equipped) on rear of Controller Module tripped.	Ensure the circuit breaker (if equipped) on the rear of the Controller Module are in the ON (1) (Up) position.
	Channel fuse is blown.	Unplug main power cord from outlet. Remove Channel PCB Plug-In. Remove fuses F4, F5 and F6 from fuse holders. Test fuse conductivity. Replace if necessary.
	A motor malfunction can cause this problem.	Turn off Controller Module power. Check to ensure Actuator Module is properly connected to controller. Turn on controller and try again. If the motor operates incorrectly, servicing may be necessary to the motor or the controller. Return complete controller, Actuator Module and Pump Modules to IVEK Corporation for repair.
Controller Module power on and operational, but will not activate Actuator.	I/O Cable	Check connection of cable between Controller Module and Actuator Module. Inspect and repair faulty cable.
Fault LED Illuminates Orange (all Channel Cards		Check motor High Voltage breaker(s) and Low Voltage breaker(s)
Fault LED illuminates orange (single Channel Card)		Remove power. Remove Channel Card and test on-board fuse conductivity.
		If none of the above solves the problem, contact IVEK technical support for assistance.

3.7 SPECIFICATIONS

Trigger Signal Requirements: 24 VDC @ 20mA

PLC Output Signals: Can switch maximum 24 VDC @ 50mA

Input Power Requirements: Refer to the Title Page section of this manual.

3.8 MODEL NUMBER

The model number provides important information about the specifics of your Controller Module at time of order. Model numbers for this Controller Module are divided into two sections; the first section is for the smaller enclosures containing a power entry module, the second section is for the larger enclosure that have AC voltage hard wired for a specific voltage. 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.

NOTE

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

1 - 2 Channel Enclosure	**520255 -**	**#**	**##**	**#**	**#**	**#**	**#**
3 - 4 Channel Enclosure	**520252 -**	**#**	**##**	**#**	**#**	**#**	**#**
5 - 8 Channel Enclosure	**520247 -**	**#**	**##**	**#**	**#**	**#**	**#**
9 - 16 Channel Enclosure	**520241 -**	**#**	**##**	**#**	**#**	**#**	**#**
17 - 24 Channel Enclosure	**520244 -**	**#**	**##**	**#**	**#**	**#**	**#**

Actuator/Encoder

- **A** – 40 Pitch, No Encoder
- **B** – 40 Pitch, Encoder
- **E** – 20 Pitch, No Encoder
- **F** – 20 Pitch, Encoder
- **J** – A-20 Pitch, No Encoder
- **K** – A-20 Pitch, Encoder

Number of Installed Channels

- **00 - 24**

Motor Voltage

- **A** - 2.5V Low, 90V High
- **B** – 5.0V Low, 90V High

Logic Interface

- **L** - PLC W/Load Input
  Independent Trigger In
  Independent Ready Out
  Contact Closure

Parameter Interface

- **H** – Local Terminal
- **I** – Remote Terminal

Line Cord & Agency Approval

- **C** - US Cord, 115/120 VAC, CE
- **D** - Intl Cord, 115/120 VAC, CE
- **G** - US Cord, 230/240 VAC, CE
- **H** - Intl Cord, 230/240 VAC, CE
- **I** - US Cord, 100 VAC, CE
- **J** - Intl Cord, 100 VAC, CE
- **K** - US Cord, 200/208 VAC, CE (not available on 1-4 Channel Modules)
- **L** - Intl Cord, 200/208 VAC, CE (not available on 1-4 Channel Modules)
- **M** - US Cord, 220 VAC, CE
- **N** - Intl Cord, 220 VAC, CE

3.9 ILLUSTRATED PARTS BREAKDOWN

The illustrated parts breakdown (Figure 3.4) contains replacement parts for the Controller Module.

INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY
	5202XX-######	Multispense 2000 Style B Controller Module	1

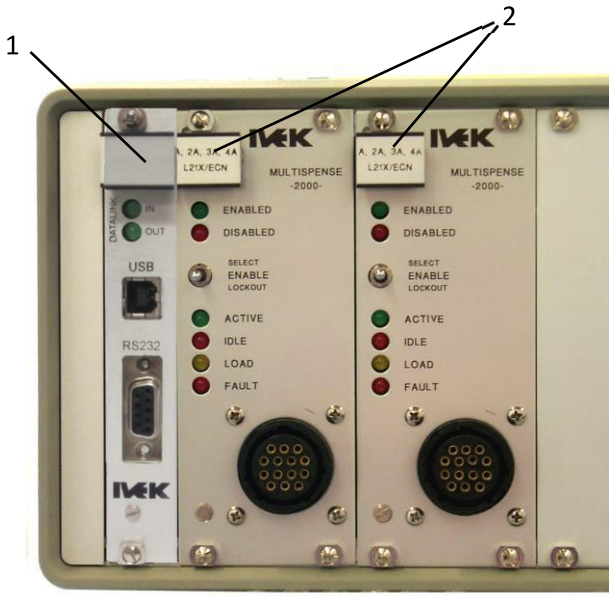

Figure 3.4 Multispense 2000 Controller Module (Sheet 1 of 2)