



Instrument Training Guide

Model 990X-MFC



Florite International, Inc.
Model 990X-MFC Instrument Training Guide
Mass Flow Controller

Signal acquisition uses digital signal processing to reject ambient noise and interference. Programmable excitation selections are available to power most sensors. Advanced signal output ports provide extremely stable voltages, currents, and supports isolated relay contacts.

1.0.5 Communication

The communication facilities provide data acquisition, command and control functions, and support information gathering and reporting, and alarm signaling. It has a built-in EIA-TIA232 standard interface, and is optionally configurable for EIA-TIA485 two wire multi-drop LAN operation. Wide Area Networking is supported by optional built-in modem, or optional 10/100 BaseT Ethernet.

WAN capabilities support collision avoidance and error control capabilities, and may be user set with multiple destination address used to send information to multiple computer. Communication is initiated by command (solicited), alarms (unsolicited), and real-time scheduled reporting using its internal Y2K compliant date-time clock.

1.0.6 Alarm Monitoring

Independent user-programmable alarm threshold limits are available for every measured value. Included in each port are two independent quantity accumulators, scalar value, process rate and service time. Alarms are programmable to activate local annunciation, local display alert, and drive relay or analog output, instigate local and remote computer communication.

1.0.7 Process Controls

Batch delivery, proportional blending, and closed loop PID control are readily achieved using either the front panel key controls or serial commands.

1.0.8 Operator Controls

The instrument has no power switch to be accidentally turned off. Operation may be completely controlled from its integral eight key pad used to view operation and programmed operation values. Key activations are single touch and repeat when the key is held. The key pad provides front panel splash proofing and environment protection.

1.0.9 Operator Indicators

The primary indicator is a large variable-brightness back lit liquid crystal graphic display - visible at a distance even in low light conditions for value viewing, programming, process state information, and alarm status. A built-in audio indicator annunciates alarm conditions and key activations.

1.0.10 Diagnostic Capabilities

Powerful automatic built-in tests support easy installation and ensure a long, trouble-free operating life. Tests include scans of all memory facilities, peripheral input-output status, communication adapter status, clock and data logging operation, keypad tests, and proper operation of the display and audio indicator.

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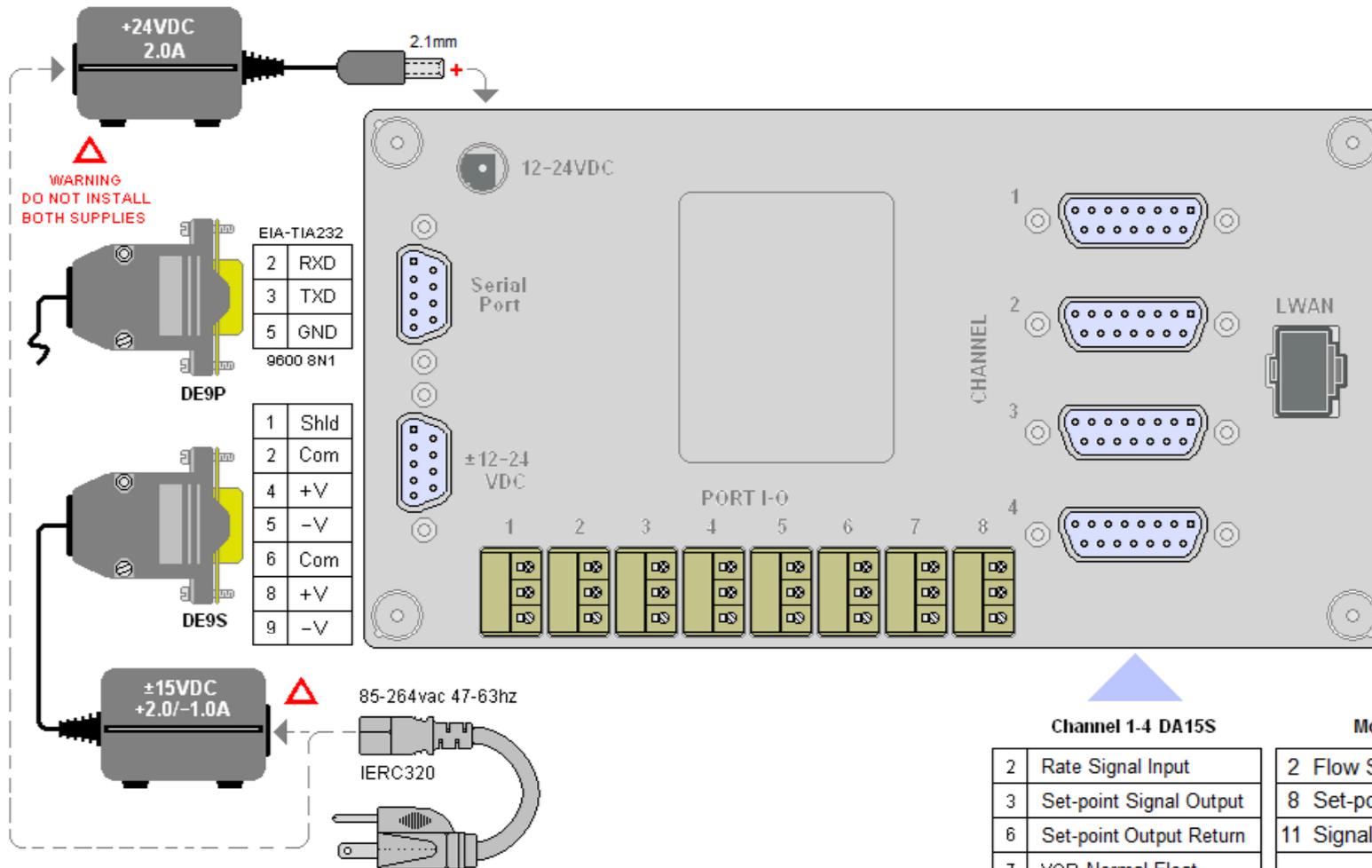
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2.0 Installation and Accessories

This section describes the various system electrical wiring requirements, and provides information on the various available mounting accessories including table top, panel and rack.

990x Signals and Wiring Installation

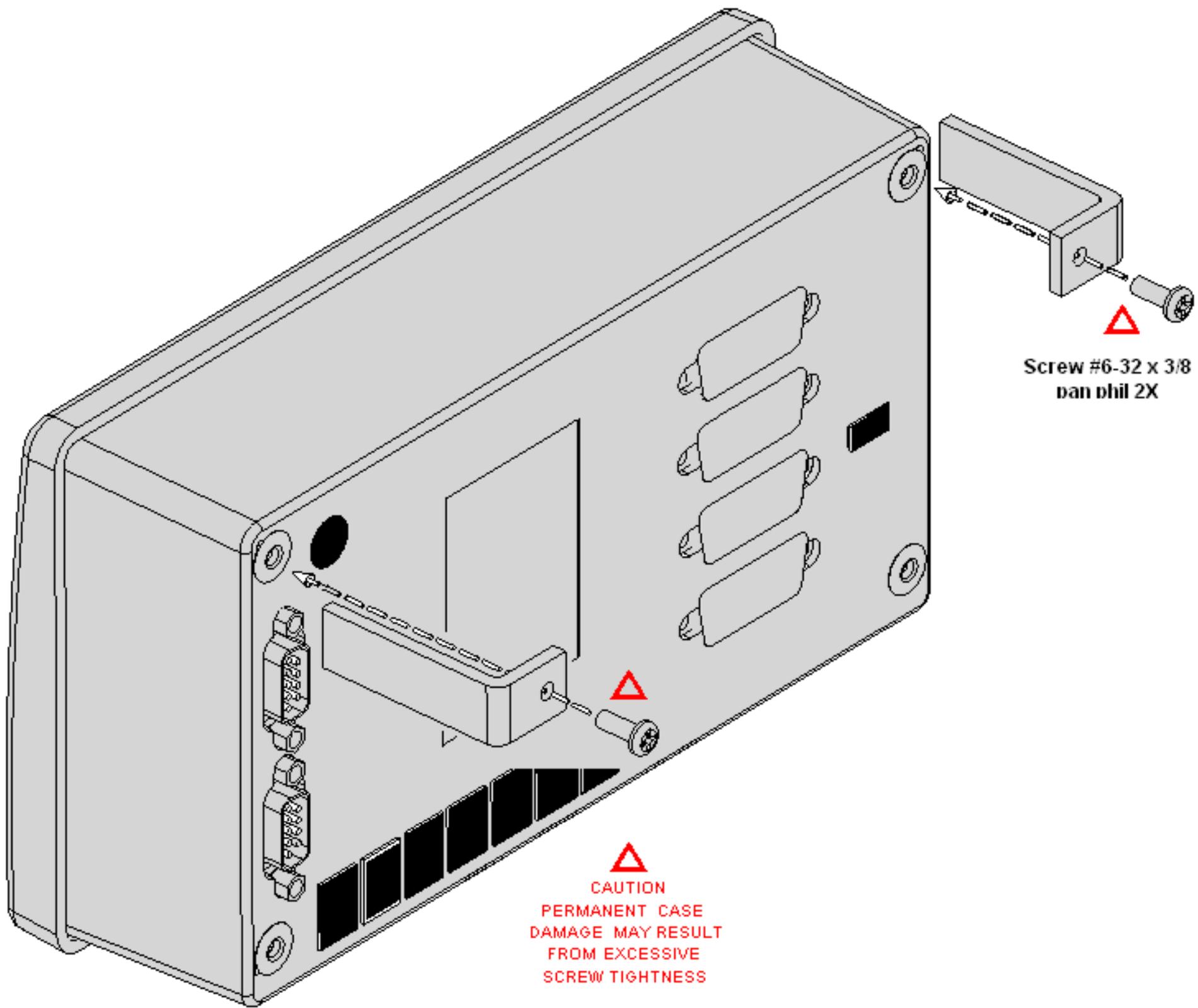


Channel 1-4 DA15S

2	Rate Signal Input
3	Set-point Signal Output
6	Set-point Output Return
7	VOR Normal Float
	Closed < -4.0VDC
	Open < +8.0VDC
8	Rate Input Return
9	Input Excitation
12	Power Common
13	15-24VDC
14	-15VDC

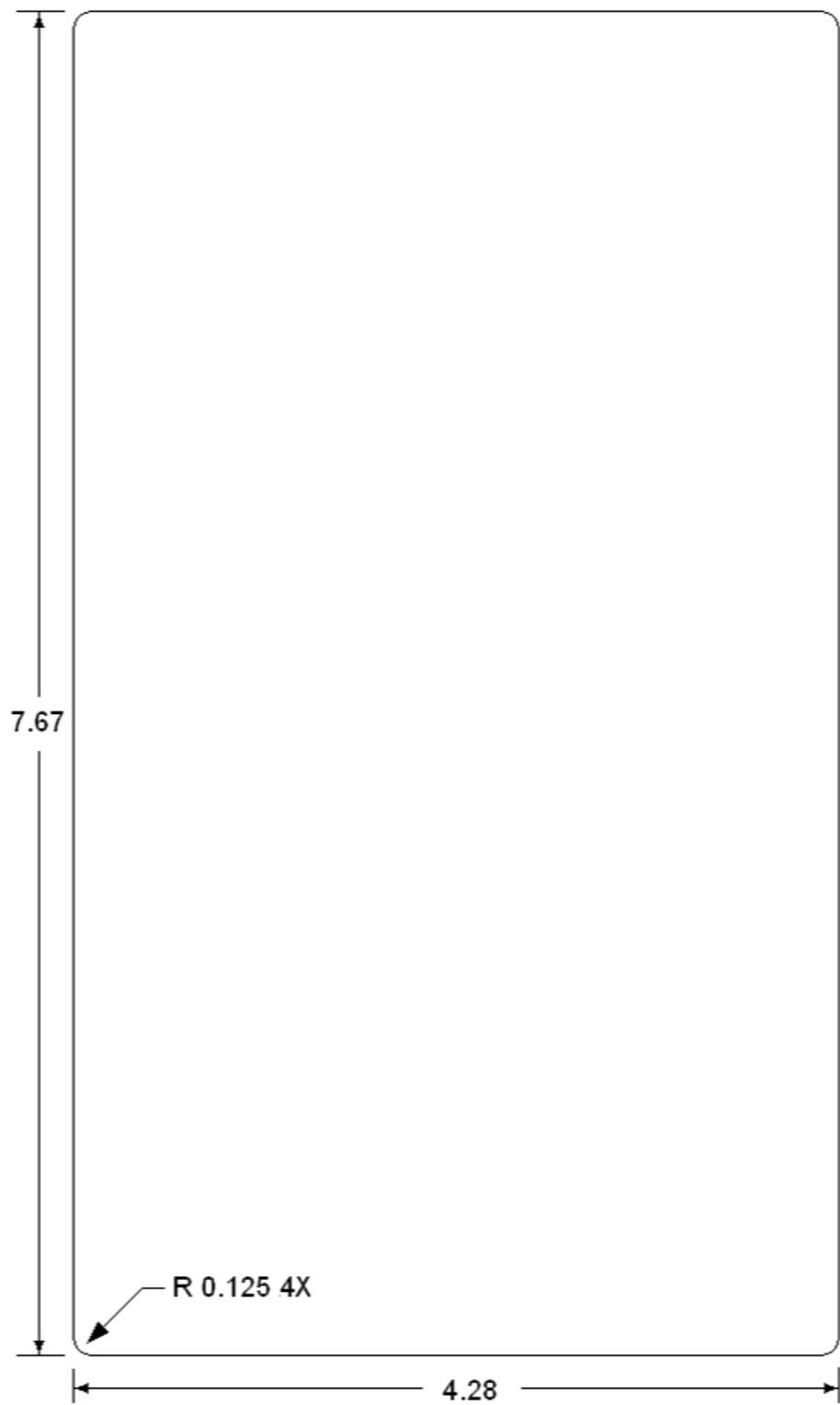
Model Signal B Connector D15P

2	Flow Signal Output 0-5VDC into >10K ohm
8	Set-point Signal Input 0 to +5VDC
11	Signal Common
3	Valve Close -5 to -15VDC or ground
4	Valve Open +5 to +15VDC
12	Signal Common
7	Pwr +15 to +25VDC
5	Pwr common and digital ground



Screw #6-32 x 3/8
pan phil 2X

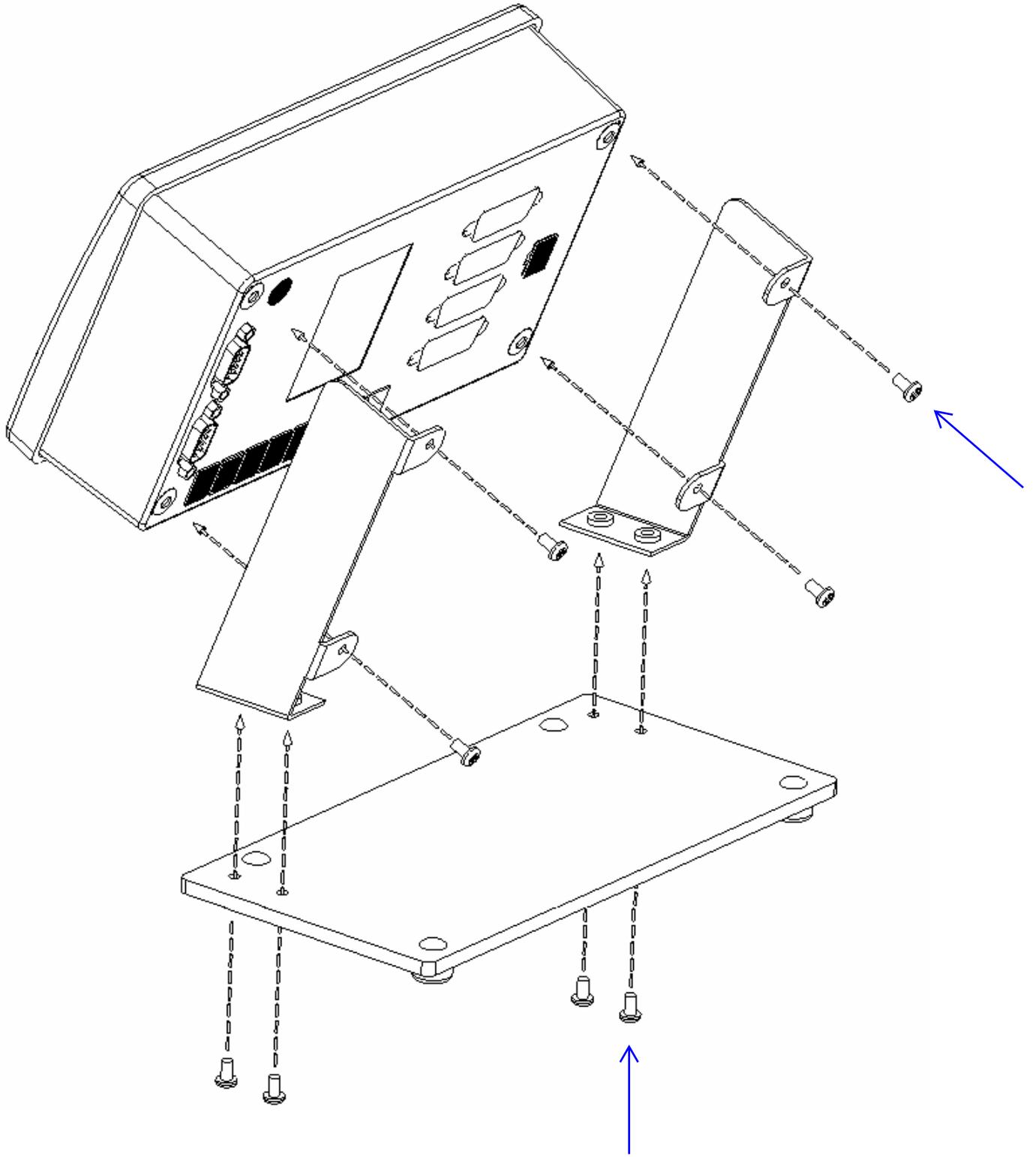
CAUTION
PERMANENT CASE
DAMAGE MAY RESULT
FROM EXCESSIVE
SCREW TIGHTNESS

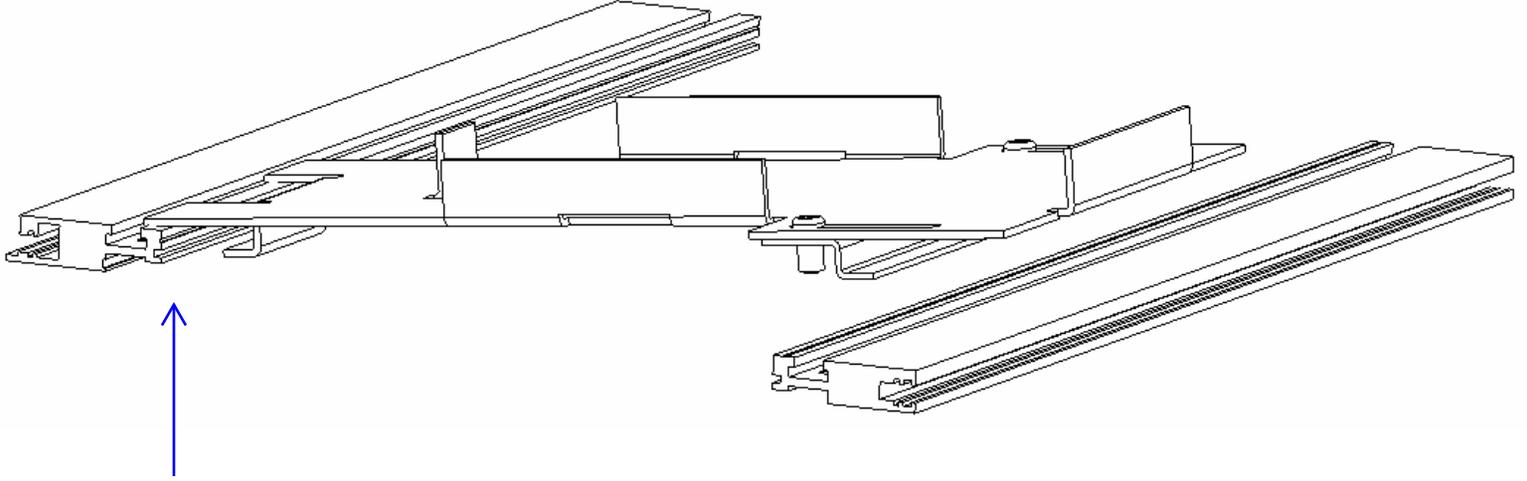
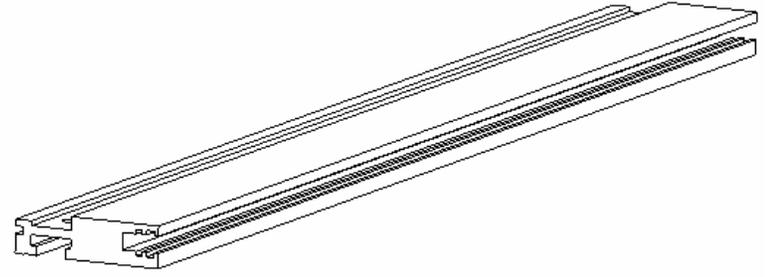
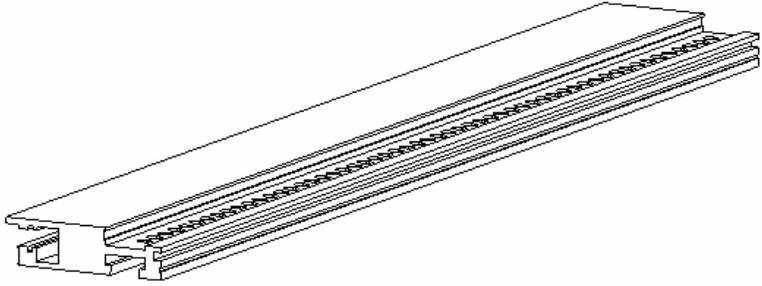


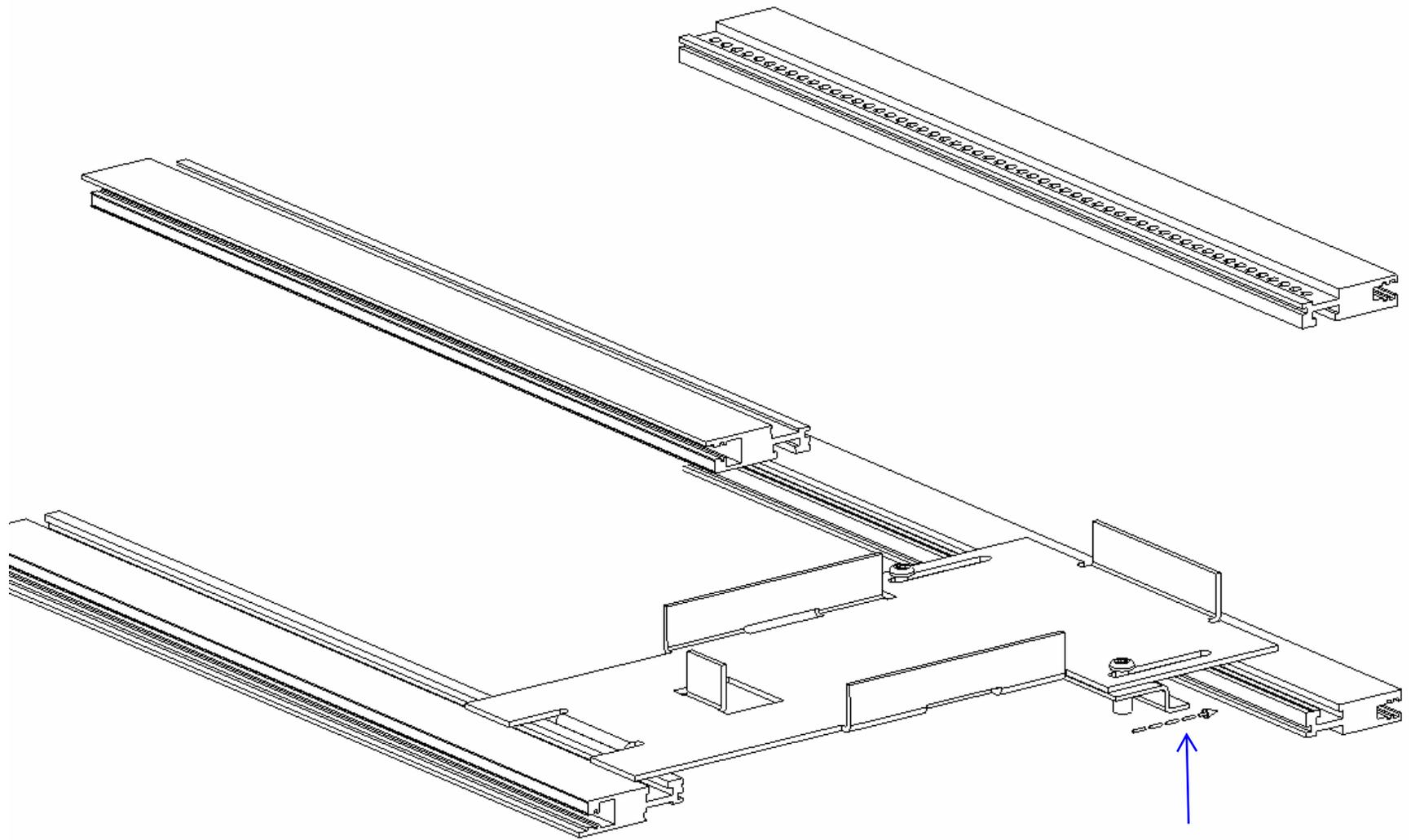
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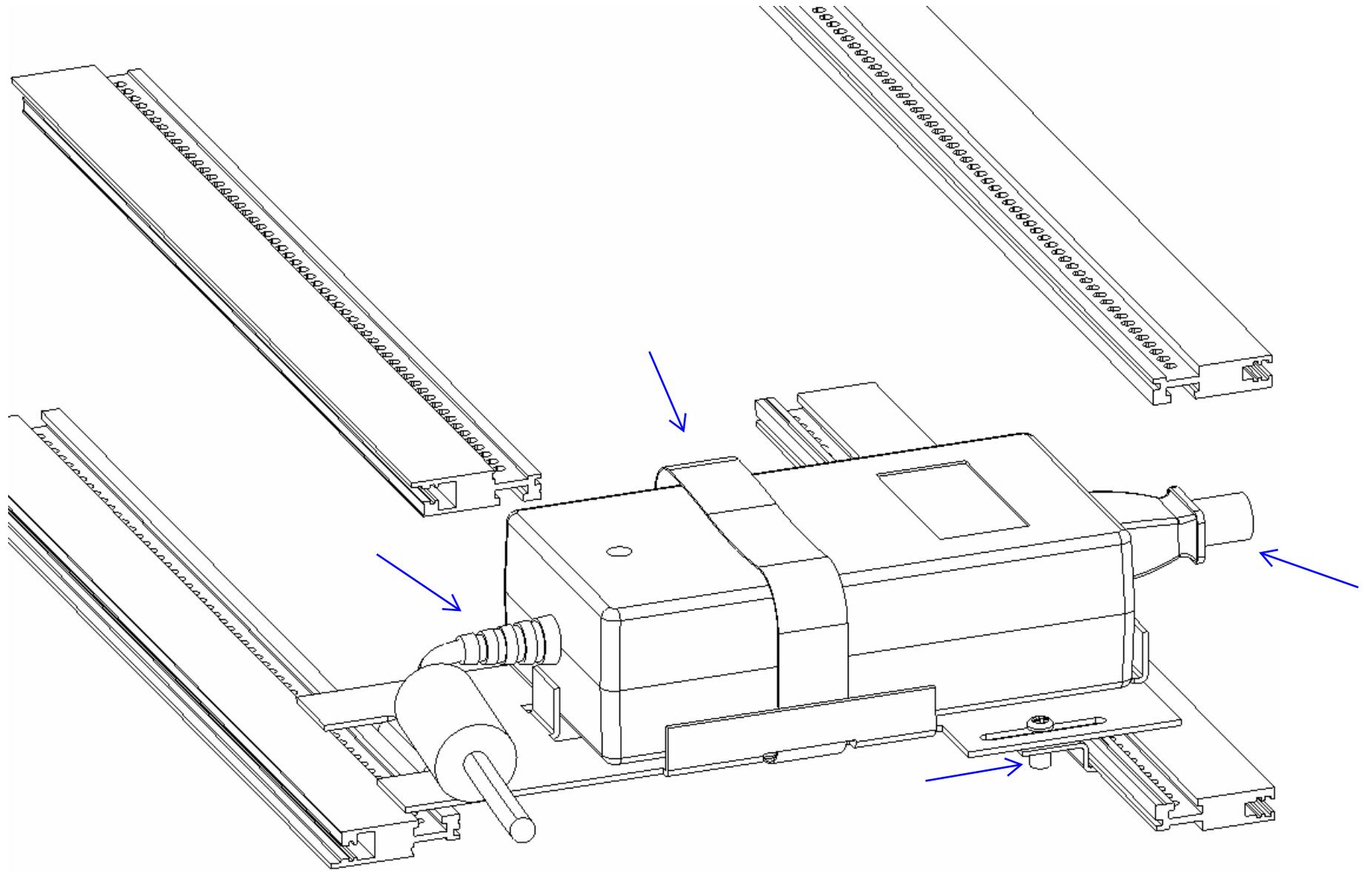
R 0.125 4X

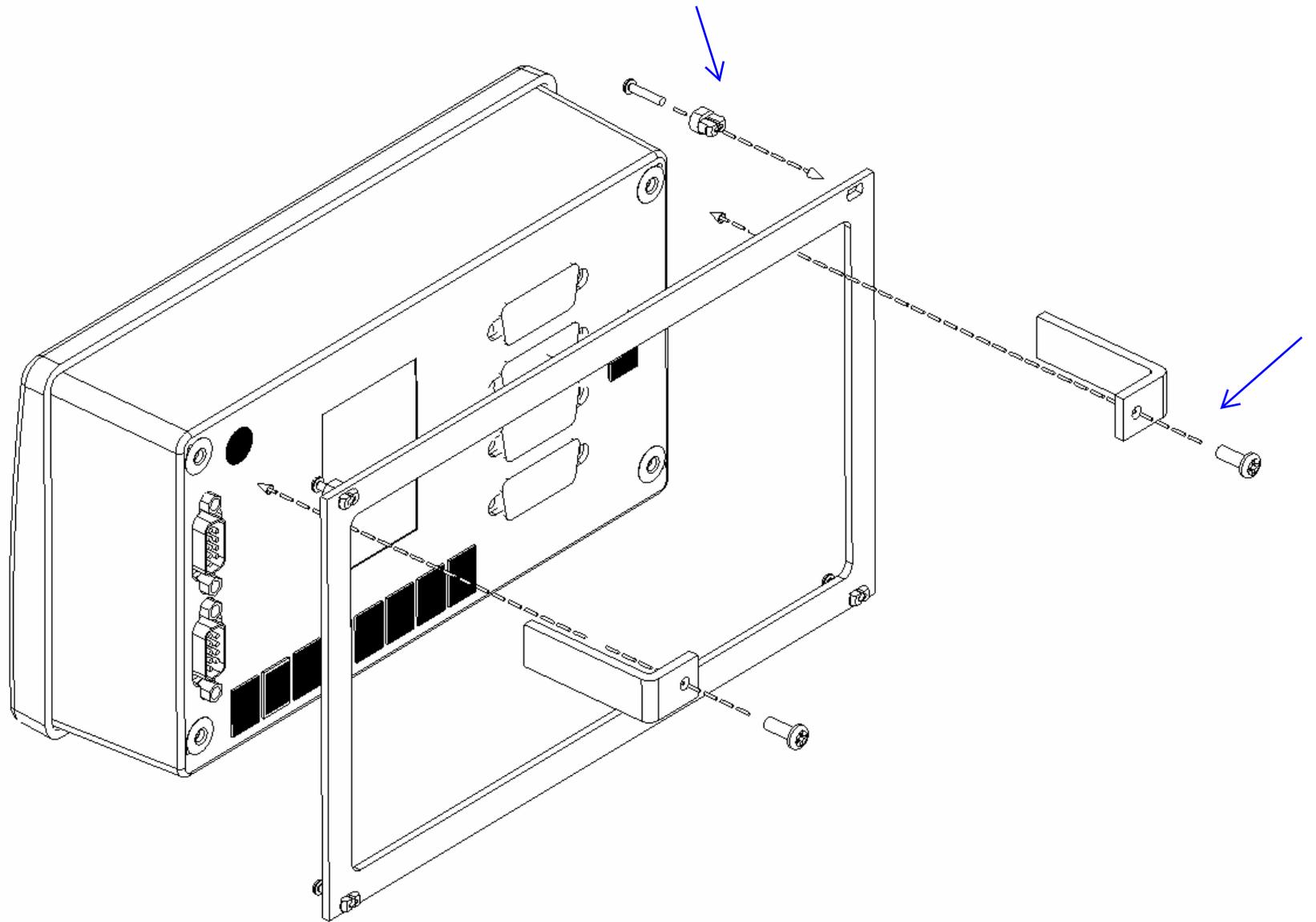
4.28

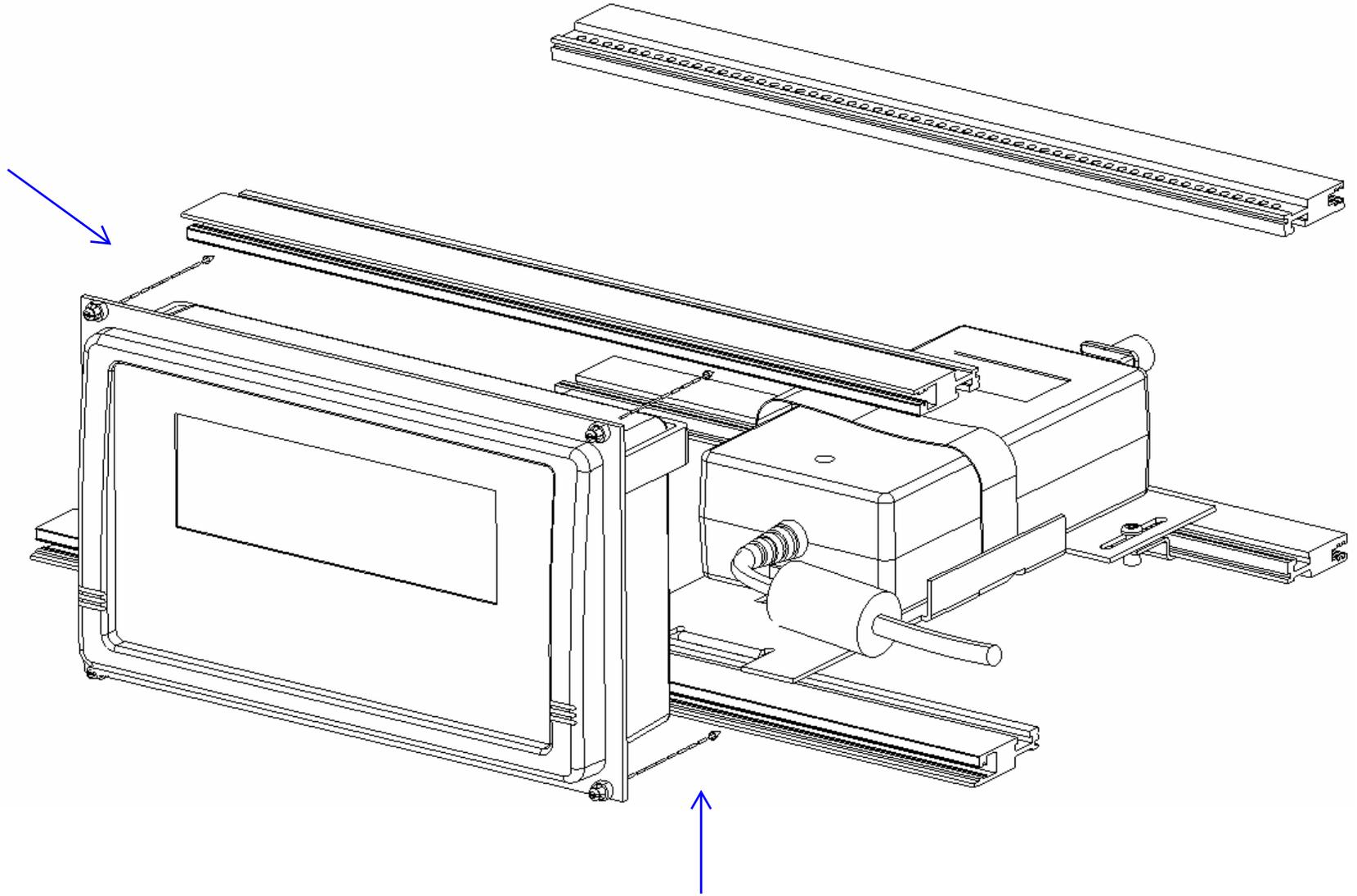






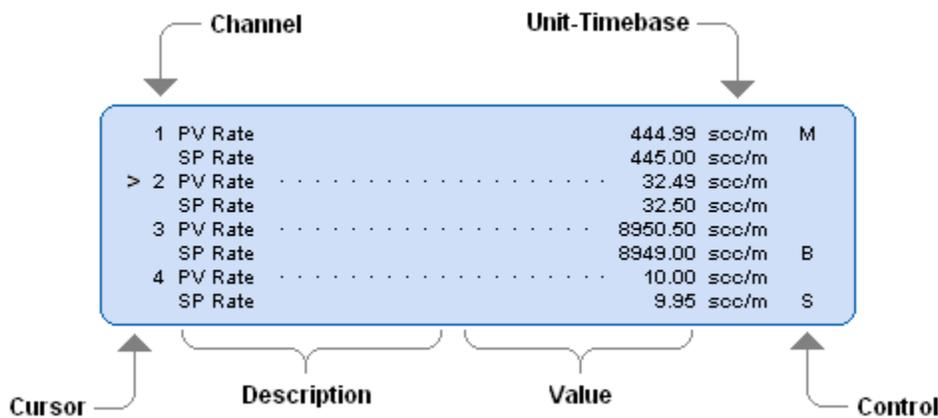
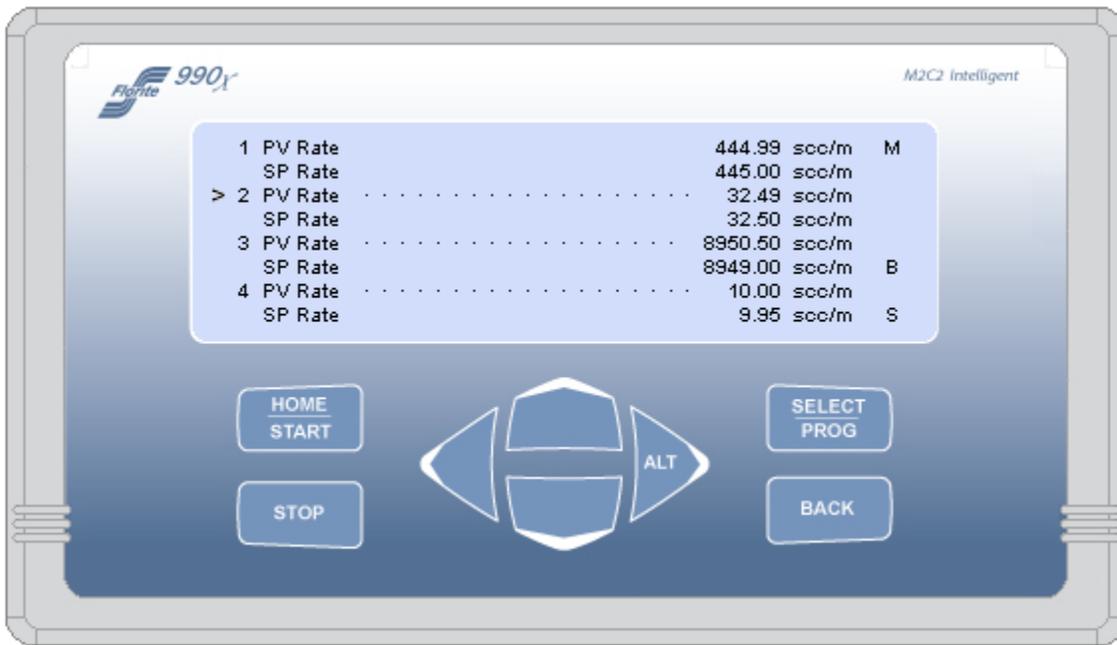






3.0 Indicators

The home screen is the instruments central information and navigation indicator. The home screen is presented following initial power application, and automatically follows the make-model screen banner. It provides an over-all view of instruments operation.

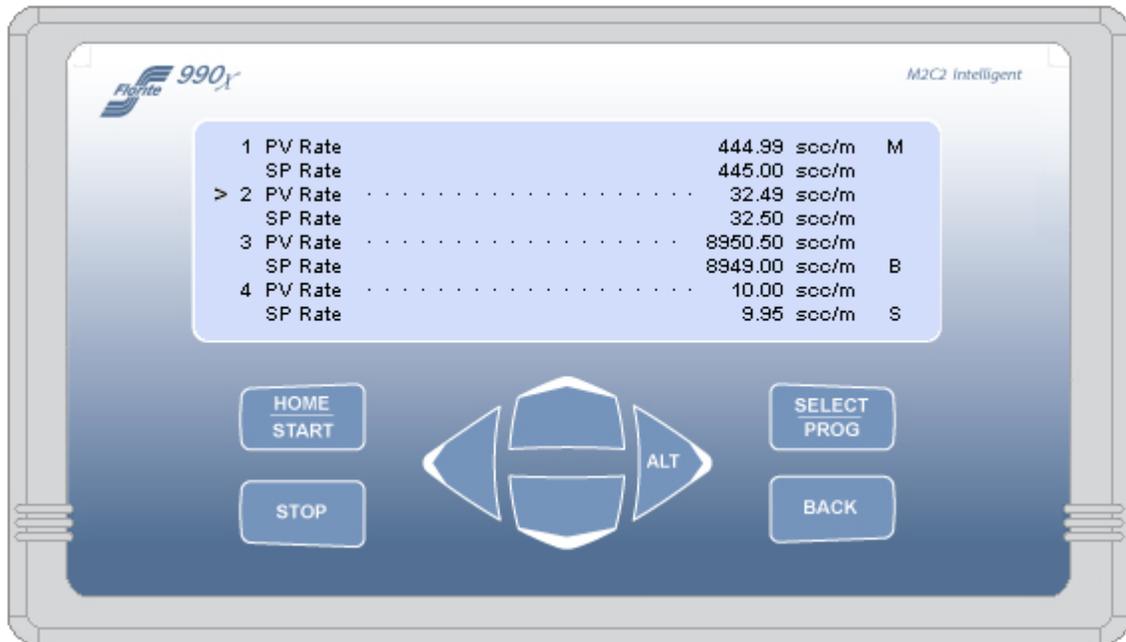


3.1 Display - home screen fields

- 3.1.1 Cursor - points to channel even when channel is Off
- 3.1.2 Channel - numbers 1-4
- 3.1.3 Description - process value text
- 3.1.4 Value - numeric process value
- 3.1.5 Unit / Time-base - combined measure units and rate time-base
- 3.1.6 Control - process control state indicators

4.0 System Controls

The primary instrument controls consists of eight front panel tactile snap-action keys - and a serial communication capability. Every function that can be accomplished by using the keys can also be accomplished by serial communication commands - the aspects of which are described in the Protocol section.



4.1 Navigation functions performed from the home screen are follows:

- 4.1.1 Select a channel using the  and  keys
- 4.1.2 Select a channel process value to be shown show on the home screen
- 4.1.3 Change the value of a channel program variable
- 4.1.4 Enter the Global System Settings selection menus
- 4.1.5 Quickly navigate to certain special values requiring frequent change
- 4.1.6 Start and stop control functions
- 4.1.7 Select a blend control master
- 4.1.8 Perform analog signal calibration

Instructions for the using the above are described in their respective sections.

4.2 The control function of the keys is dependant on the context of the function that has been requested to be accomplished as follows:

4.2.1  Home Screen - navigates to channel function screen
Port I-O Screen - selects view or program
View Screen - selects home screen value
Program Screen - programs value cursor points to - then saves the value

4.2.2  Home Screen - press 3X to enter Global System Settings
NOT Home Screen - navigates immediately to previous screen

4.2.3  Home Screen - press 3X to start batch and-or blend controls operation
Power Down - press to restore power

4.2.4  Home Screen - terminates operating controls if any - otherwise
HOT navigates to change channel VOR state.

This key can be used to power-down the system when held depressed longer than three (3) seconds.

4.2.5  Cursor Control - move cursor up
Program Screen - increase blinking program selection to succeeding choice

4.2.6  Cursor Control - move cursor down
Program Screen - decrease blinking program selection to preceding choice

4.2.7  Cursor Control - move cursor left
Home Screen - select channel pointed to by cursor as blend master unless the channel is already the master in which case the existing master is deselected and no master is chosen
View Screen - zero PV Total when cursor points to PV Total
Program Screen - move blinking program selection to next left choice

4.2.8 

Cursor Control - move cursor right
Home Screen - **HOT** navigates to change channel set-point value

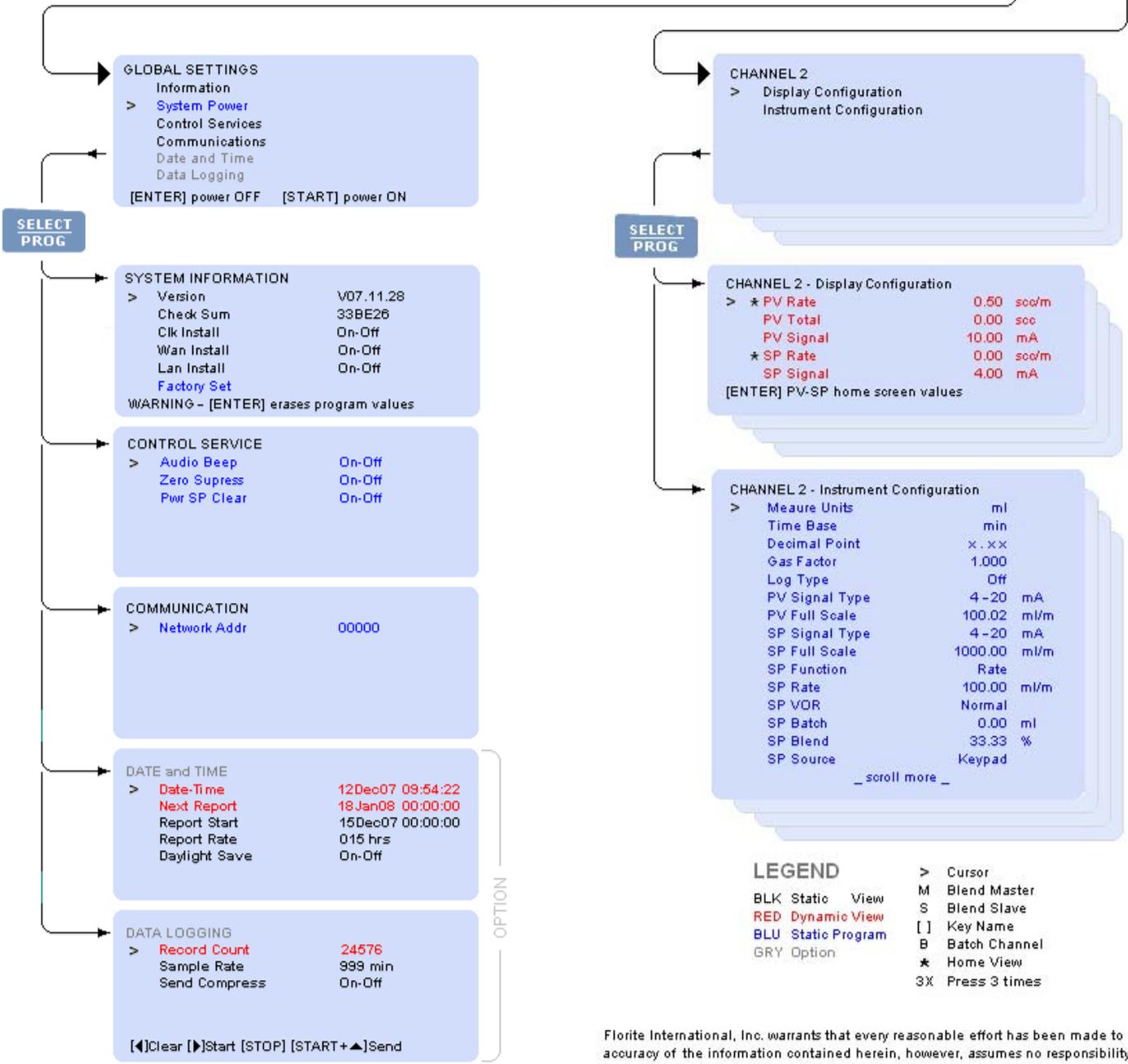
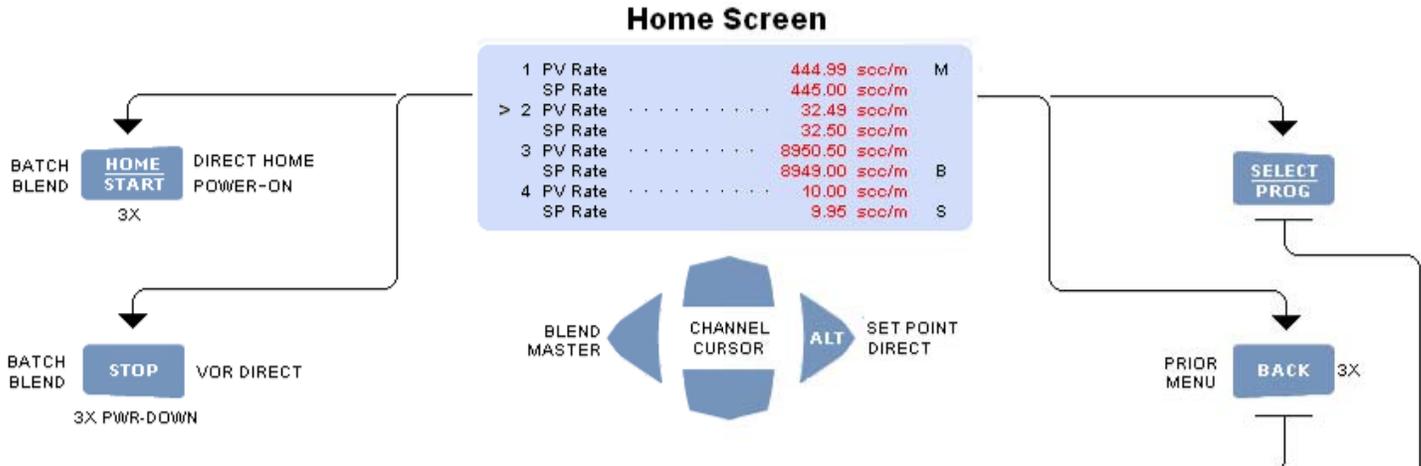
5.0 Navigation

This navigation section provides an overview of the various values that are available to set-up desired operating characteristics that establish how the instrument is desired to perform, and to review the operating state of the desired performance.

Although navigation is described for keypad operation - the same operating characteristics set using the keypad are supported by serial communication - for which a detailed description is contained [in the 990x Serial Protocol Document](#).

A complete system map is provided to support the overview of the instrument. It shows the entire organization of all of the instrument process values (PV), all set-point (SP) values, and all system global settings.

5.1 System Navigation 990x-MFC



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5.2 Navigate Select

The selection screen provides a secondary navigation layer for the operator to specify whether PV-SP Viewing (Display Configuration), or PV-SP Programming (Instrument Configuration) is desired for a channel. The screen shown below is displayed as a result of having pressed the [SELECT] key while viewing the home screen.

This screen shown is for Channel 2. Use the cursor keys to point to either Display Configuration to show the present PV Measurements and SP Status - or Instrument Configuration to program PV and SP values and then press [SELECT] to proceed to the desired selection.

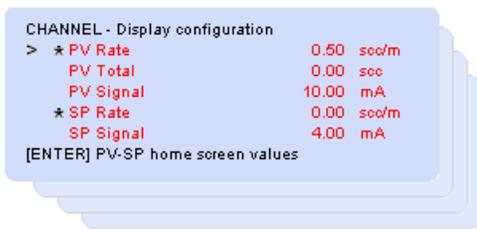


6.0 Process and Set-Point Values

This Process Values (PV) and Set-Point Values (SP) section provides a detailed description of the various system map values that are used to set-up the instruments desired operating characteristics that establish how the instrument is desired to perform, and discusses the various process values that show the operating state that are the outcome of the set-up.

6.1 PV MEASURES and SP STATUS VALUES

This section describes a combined screen for channel PV Measures and SP Status. It describes each of PV Measures and SP Status values for an input signal into the instrument, and output signal from the instrument.



6.1.1 Change Home Screen Value

The present PV and SP values shown on the home screen are indicated by a star (*) prefix. To change the PV displayed on the home screen - point the cursor to the desired PV value and press the [SELECT] key. To change the SP displayed on the home screen - point the cursor to the desired SP value and press the [SELECT] key. In both cases for PV and SP - note that the star indicator is now prefixed to a new PV or SP value.

6.1.2 PV Value Descriptions

6.1.2.1 PV Rate

This value is either a Rate, defined as quantity per unit time, or None, which is a scalar value not having a time associated attribute. Scalar measurements are not totalized. The value displayed is updated live as the value changes.

6.1.2.2 PV Total

This is a quantity accumulator for a rate value. The quantity values are displayed when the channel time base is NOT programmed for None. PV Total quantity is not accumulated for None values, and no PV Total will be shown on the screen. The value displayed is updated live as the value changes.

To clear an accumulated quantity to zero - point the cursor to PV Total and press the [◀] key. Note the value becomes zero.

6.1.2.3 PV Signal

This value is the measured electrical value being input into the instrument channel. It may be used to provide assistance in system installations, and is used to support instrument calibration. The value displayed is updated live as the value changes.

6.1.3 SP Value Descriptions

6.1.3.1 SP Set-Points

Separate set-points are provided for rate control (SP Rate), Batch quantity (SP Batch) and Blend proportion (SP Blend). The specific set-point shown on the screen is dependant on the SP Function control type that has been selected. The value displayed is updated live in real time as the value changes.

6.1.3.2 SP Signal

This value is the output signal being sent form the instruments channel, and is expressed in the appropriate analog signal type units of volts or mA.

6.2 PV and SP PROGRAM VALUES

This section describes the combined PV and SP programmable channel values. The programmed values determine how signal inputs into an instrument channel, and signal outputs from the instrument are serviced. Refer to the **Control Functions** section which describes in greater detail the set-up, operation and termination of control processes.

The PV and SP program values are used to determine basic channel fundamental attributes, gas type service, logging type, channel override signal, PV signal type and full scale range, SP signal type and full scale range, channel service function, channel override signal, SP set-point values, and SP programming source. The PV and SP values are static - and updated only after a value has been changed and saved.

6.2.1 Value Programming

6.2.1.1 Program a value by pointing the cursor to its line and pressing the [SELECT] key. Note a character or string (character-string) will be blinking - ready to be edited.

6.2.1.2 Edit the character-string as follows:

Change character-string to next value [▲] key - or previous value [▼] key

Move blinking character-string edit field left [◀] key - or right [▶] key

6.2.1.3 Edit completion

Press [SELECT] key to save the changed value - any other key causes the edited value to be ignored and not saved - and the original value to be edited will remain unchanged.

6.2.1.4 Edit Time Expired

When editing a character-field that is blinking - the program state will be terminated if a key is not detected within 30 seconds of the last detected key. In this case - the value edited will not be saved, and the original value to be edited will remain unchanged.



6.2.1 Measure Units

Measure units are a combination of symbols used to identify a physical engineering measurement. The measure units may be selected from a fixed set of customary strings. Measure Units have no arithmetic affect. Supported measure units are the following:

ml	mls	mln	l	ls	ln
cm ³	cm ³ s	cm ³ n	m ³	m ³ s	m ³ n
g	lb	kg	ft ³	ft ³ s	ft ³ n
scc	sl	bar	mbar	psi	kPa
Torr	atm	Volt	mA	oC	oK
oR	oF	g/cc	sg	%	lb/in ³
lb/ft ³	lb/gal	kg/m ³	g/ml	g/l	

6.2.2 Time Base

This selection is used to set the quantity per unit time rate measurement base as either Sec, Min, Hrs, or Days. The None time base selection is presumed not to have a time-quantity association and does not perform quantity accumulation.

6.2.3 Decimal Point

The decimal point for values may be freely selected for none, one, two, or three places. The decimal sets the number of measurement value digits that are to the right of the decimal point. Setting the decimal has an arithmetic function that when changed - automatically multiplies or divides an existing value so values continue to retain their power-or-ten value. The values so affected include PV and SP Full Scale, SP Rate, SP Batch.

6.2.4 Gas Factor

This value is a unit-less factor by which measured PV Signals are compensated by multiplication, and SP Signals corrected by division. This instrument performs the arithmetic compensation using the Gas Factor.

This capability makes it possible to compensate other gasses which are not the calibration gas - however, the existing Gas Factor must be known and then methodically changed. By knowing the present factor for the calibration gas, and desiring to control known gasses for which the TMF has not been calibrated, then just divide the [new gas factor] by the previously known [calibrated gas factor]. The result becomes the new Gas Factor.

6.2.5 Log Type

This selection selects PV Rate and PV Total values desired to be logged in real time. Such measured information values are periodically saved in the date-time stamped record log. Selections include PV Rate, PV Total and Off. When a channel is set to Off - no logging performed for that channel.

6.2.6 PV-SP Signal Types

6.2.6.1 Signal Selections - may be set for full scale ranges which include 0-20mA, 4-20mA, 0-5V, 1-5V, 0-10V 2-10V or OFF.

6.2.6.2 The OFF selection suspends service for either or both channel PV and/or SP signals. Inactive OFF is indicated on the home screen as a blank line.

When either or both the PV or SP parts of a channel are set to OFF - the instrument remembers the active type(s) prior to having been set to OFF. This enables the instrument to continue with the same PV and-or SP type that existed before being set to be OFF when returned to the On state. This

insures that the factory installed hardware module configuration in the instrument continues to remain properly operable.

6.2.7 PV-SP Full Scale

This value sets the maximum engineering unit range over which the Signal Type is valid. The minimum is always presumed to be zero. Full-Scale values are bipolar and are required to be set for positive values for control functions to perform correctly.

6.2.8 SP Function

The allowable set-point Functions are Rate, Batch or Blend. Set-point values are bipolar and are required to be positive values for correct control function performance.

6.2.8.1 Rate

This control type ignores the channel PV Rate. The value set in the SP Rate register is de-interpolated to a corresponding analog signal which is directly sent to the channel analog signal output.

6.2.8.2 Batching

Batching is a discontinuous control process that delivers the quantity set in the SP Batch register. This process is started using either the keypad or a serial communication command. Batching is terminated when the desired batch quantity has been delivered - or any time before delivery is complete by pressing the [STOP] key .

6.2.8.3 Blending

Blending is a continuous control process after having been started that delivers a rate proportion set in the SP Blend register, with is referred to the prevailing Blend Master input rate. This process is started using either the keypad or a serial communication command. Blending is terminated any time by pressing the [STOP] key from the home screen.

6.2.9 SP VOR

This value is set to Normal for standard TMF operation. VOR Normal causes a VOR signal output voltage to be disconnected - floating. The VOR function is used in TMF applications to override the normal analog command signals, and finds use for installation and system diagnostic purposes.

6.2.9.1 Valve Open

The VOR output signal is connected and provides a voltage $> 8.0\text{vdc}$ causing the TMF valve to be fully open.

6.2.9.2 Valve Closed

The VOR output signal is connected and provides a voltage $< -4.0\text{vdc}$ causing the TMF valve to be fully closed.

6.2.10 SP Source

This control enables selection of the source from which set-points may be entered as either Keypad or Serial. When set for Serial - changing a set-point using the keypad is prohibited.

7.0 Global Settings

This section provides a detailed description of the various system wide variables used to set-up and review the overall operating characteristics that establish how the entire instrument is desired to perform. The values include those provided only for review, those that can be selected, and those that invoke immediately action.

7.1 Information Screen

To enter the information service screen - point the cursor to Information on the Global Settings screen and press the [SELECT] key.

```
GLOBAL SETTINGS
  Information
  > System Power
  Control Services
  Communications
  Date and Time
  Data Logging
[SELECT] power OFF [START] power ON
```

This screen contains system information values and configuration states. These values are not programmable, with the only exception being the Factory Set immediate action selection described below which erases present programmed values and replaces them with factory default values.

```
SYSTEM INFORMATION
> Version          v07.11.28
  Check Sum        33BE26
  Clk Install      On-Off
  Wan Install      On-Off
  Lan Install      On-Off
  Factory Set
WARNING - [SELECT] erases program values
```

7.1.1 Version

This is the date the firmware was last upgraded represented as year, month and day, and is only for review.

7.1.2 Check Sum

This value is the hexadecimal double word sum of the instruction read only memory used for factory quality assurance, and is only for review.

7.1.3 Start Vector

This is the address in hexadecimal at which the firmware begins operating following a power-up reset, and is only for review.

7.1.4 Clk (Clock) Install

This state indicates whether the real time clock is installed and operating which is detected immediately after a power-up reset. The clock is used for scheduling data or log reports, and for date-time stamping logged records.

7.1.5 Wan Install

This state indicates whether the wide area network modem adapter is installed and operating which is detected immediately after a power-up reset. This adapter supports public switched telephone network (PSTN) data communication.

7.1.6 Lan Install

This state indicates whether a local area network adapter is installed and operating which is detected immediately after a power-up reset. This adapter detects local area EIA-TIA485 or 10/100 BaseT Ethernet data communication support.

7.1.7 Factory Set

When the cursor is pointing to Factory Set, a pop-up warning displays "WARNING - [SELECT] erases program values" at the bottom of the display. Pressing [SELECT] will cause all user program values

to be immediately erased and over-written with factory standard default values. Factory Set does NOT erase factory pre-set calibration values which continue to be retained.

7.2 System Power Control

To enter the System Power function - point the cursor to System Power on the Global Settings screen and press the [SELECT] key. This is an immediate action selection.



A screenshot of a menu titled 'GLOBAL SETTINGS'. The menu items are: Information, System Power (highlighted with a blue bar and a right-pointing arrow), Control Services, Communications, Date and Time, and Data Logging. At the bottom of the menu, there are two options: '[SELECT] power OFF' and '[START] power ON'.

7.2.1 System Power

The System Power functions allows the user to cause power to equipment connected to the instrument to be placed in an Off state, allowing the user to conduct installation services and diagnostics. The power off state is also useful for placing the instrument and connected equipments in an un-powered state when the instrument is expected to remain unused for extended periods.

7.2.1.1 The pop-up at the bottom of the display is shown on the screen only when the cursor is pointing to System Power.

7.2.1.2 Power OFF - press the [SELECT] key with the cursor pointing to System Power. This will cause entry into the power down state, the screen to become blank with its back-light off, and all signals and power to be removed from connected equipment.

7.2.1.3 Power ON - press the [START] key to restore normal system operation.

7.3 Control Service Screen

To enter the Control Services screen - point the cursor to Control Services on the Global Settings screen and press the [SELECT] key.

```
GLOBAL SETTINGS
Information
> System Power
Control Services
Communications
Date and Time
Data Logging
[SELECT] power OFF  [START] power ON
```

These Control Service settings are programmable but are not live updated. They establish operation of the several system level operating controls.

```
CONTROL SERVICE
> Back Light           Low-Medium-High
Audio Beep            On-Off
Zero Suppress         On-Off
Pwr SP Clear          On-Off
Keypad Secure         On-Off
Port Lock             On-Off
```

7.3.1 Back Light

This control selects the display back light intensity to have intensity values of Low, Medium or High.

7.3.2 Audio Beep

When this control is selected ON - allows normal audio annunciation for alarms and key activation - otherwise all audio indications remain disabled.

7.3.3 Zero Suppress

When this control is selected ON - numeric measured values are displayed with leading zeros suppressed.

7.3.4 Pwr SP Clear

When this control is selected ON - power restoration causes every channel SP value to be erased and made zero.

7.3.5 Keypad Secure

When this control is selected ON - all program values are prohibited from being changed.

7.3.6 Port Lock

When this control is selected ON - Port Type or SP Signal Type changes are prohibited - and remain locked.

7.4 Communications Screen

To enter the Communications service screen - point the cursor to Communications on the Global Settings screen and press the [SELECT] key. The communication variables are programmable selections.

```
GLOBAL SETTINGS
  Information
  > System Power
  Control Services
  Communications
  Date and Time
  Data Logging
  [SELECT] power OFF  [START] power ON
```

The Communications settings are programmable and are used to establish the instruments communication parameters that control the systems three serial ports to send alarm, log, or data reports. The communication parameters are not live updated.

When the DATE and TIME clock is not installed - only the Network Addr (address) is shown on the service screen.

```
COMMUNICATION
> Network Addr      00000
  Alarm Phone      000000000000000000
  Report Phone     000000000000000000
  Answer Rings     003
  Error Control    On-Off
  LWan Test        On-Off
```

7.4.1 Network Address

This address is a unique identification for the instrument operating in a network environment. **It is factory pre-set and not customer programmable.**

7.4.2 Alarm Phone

This number is used as the destination address to which alarm information is to be sent. The WAN interprets the number as a PSTN dial number. The LAN interprets the number as an internet-protocol (IP) destination.

7.4.3 Report Phone

This number is used as the destination address to which log or data information is to be sent. The WAN interprets the number as a PSTN dial number. The LAN interprets the number as an internet-protocol (IP) destination.

7.4.4 Answer Rings

This value is used when communicating by WAN and determines the number of detected rings that must occur before answering the line.

7.4.5 Error Control

This state is selected to be ON to conduct data communication with error control.

7.4.6 LWAN Test

This state is selected to be ON when operating with WAN and LAN communications to test that network communication is established and is suitable.

7.5 Date and Time (OPTION)

DATE and TIME is an option. When the option is not installed - the Global Settings will not list it as an available choice, and the service screen will not appear.

When the option is installed - enter the service screen by pointing the cursor to DATE and TIME on the Global Settings screen and press the [SELECT] key.

```
GLOBAL SETTINGS
Information
> System Power
Control Services
Communications
Date and Time
Data Logging
[SELECT] power OFF [START] power ON
```

The Date and Time service screen settings enable real-time operation of data logging, report sending, and local enabling daylight-savings time service.

```
DATE and TIME
> Date-Time 12Dec07 09:54:22
Next Report 18Jan08 00:00:00
Report Start 15Dec07 00:00:00
Report Rate 015 hrs
Daylight Save On-Off
```

7.5.1 Date and Time

This is a real-time live update programmable value set by the user to the users local date-time.

7.5.2 Next Report

This is a real-time live update view value indicating the date-time in the future that a report of logged or selected data values for each input port or channel are to be sent either from the local RS232 serial port, or Lan serial port, or Wan serial port.

7.5.3 Report Start

Report Start is set by the user for a desired future, or past, date-time when it is desired that log or data reporting is to begin being sent - and continue thereafter at the programmed Report Rate below.

7.5.4 Report Rate

Report Rate is set by the user to establish the exact elapsed time between successive reports.

7.5.5 Daylight Savings

When this selection is ON - instrument will adjust the real-time clock for daylight savings time.

7.6 Data Logging (OPTION)

DATA LOGGING is an option which requires the DATE and TIME option to additionally be installed. When either option is not installed - the Global Settings will not list DATA LOGGING as an available choice, and the service screen will not appear.

When the option is installed - enter the service screen by pointing the cursor to DATA LOGGING listed on the Global Settings screen and press the [SELECT] key.



```
GLOBAL SETTINGS
Information
> System Power
Control Services
Communications
Date and Time
Data Logging
[SELECT] power OFF [START] power ON
```

Data Logging settings control the operation of the built-in logging function - which stores date-time stamped records for later download, review and processing.

The logging function is used to sequentially acquire periodic samples in real-time of channel PV or Input Port values. Event logging is an additional option for taking samples based on one or more events having occurred instead of samples being taken on a periodic sample rate. Contact factory for custom event logging application requirements.

The service screen provides a pop-up of the loggers operating keys. Refer to the Serial Protocol section for serial logger operation.



```
DATA LOGGING
> Record Count      24576
  Sample Rate      999 min
  Send Compress    On-Off

[◀]Clear [▶]Start [STOP] [START+▲]Send
```

[◀]Clear causes the Record Count to become zero, [▶]Start causes logging to begin, [STOP] halts periodic sample acquisition, and [START+▲] causes all log records to be sent from the RS232 serial port.

7.6.1 RECORD COUNT

This value is the number of records that have been acquired. The acquired records may be erased when the cursor is pointing to record count and the [◀] key is pressed.

7.6.2 SAMPLE RATE

This value has a numeric part, and a units part. The combination sets the time between sequential value acquisitions - programmable from 0-999 seconds, minutes, hours, days or months. Periodic logging is disabled when the numeric portion of sample rate is zero.

When event logging has optionally been installed in the instrument - the numeric part of the Sample Rate must remain set to zero.

7.6.3 SEND COMPRESS

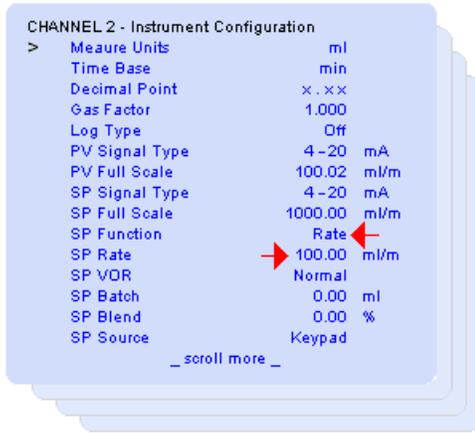
This state when Off causes log records to be sent as ASCII serial values, and when On, causes the value portion of log records to be sent as straight eight bit binary.

8.0 Process Controls

This section provides a detailed description and operation of the instruments various control functions.

8.1 Rate Control (manual set-point)

Rate control is a continuous manually oriented process - performed on a channel-by-channel basis. This control type causes an SP Rate signal programmed by the operator to be output to a controller. Independently - the controller's delivery rate signal is monitored separately and indicated as the channel PV Rate.



8.1.1 Set-Up

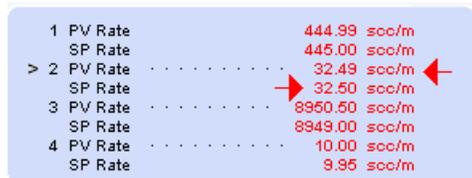
The operator programs values shown above for each channel desired to perform Rate control.

8.1.1.2 SP Function - select Rate

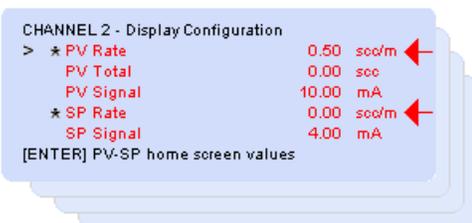
8.1.1.1 SP Rate - desired delivery rate

8.1.2 Start Rate Control

This control type is continuous - requiring no start action to be taken by the operator.



The delivery process can be monitored as shown on the live update screens above and below, observing that the SP Rate is the same as the monitored PV Rate.

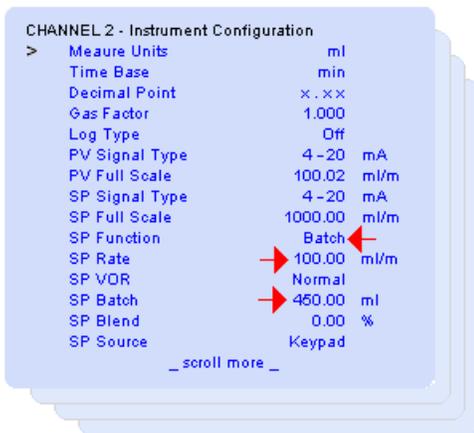


8.1.3 Terminate Rate Control

When the operator sets the channel SP Rate to zero - the process is off.

8.2 Batch Control

Batch processing is a non-continuous process that is started, conducted, and terminated when a desired quantity has completed delivery. The operator may stop batch delivery at any time prior to completion.



8.2.1 Set-Up

The operator programs values shown above for each channel desired to perform batch delivery.

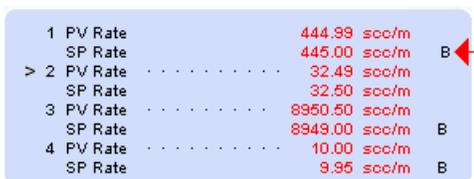
8.2.1.2 SP Function - select Batch

8.2.1.1 SP Rate - set desired batch delivery rate

8.2.1.3 SP Batch - set desired delivery quantity

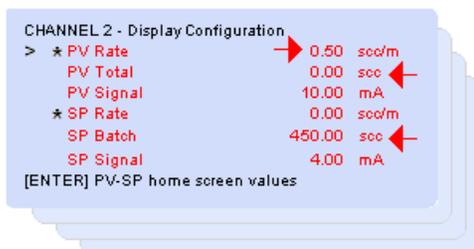
8.2.2 Start Batch

8.1.2.1 Return to home screen - note home screen indicates a 'B' control indicator for all channels selected to perform batching.



8.2.2.2 Press [START] key three (3) times - and note 'B' indicators now blinking to indicate channels with batch now in process.

8.2.2.3 The delivery process can be monitored as shown on the screen below observing that the PV Total increases toward the SP Batch amount, and verifying that the PV Rate properly indicates the desired delivery rate. The screen below is updated real-time live. Since the SP Function was set for Batch - the SP Batch quantity appears on this screen.



8.2.3 Terminate Batches

8.2.3.1 Batching for each channel set for batch will automatically terminate when each batch channel PV Total has reached or exceeded their programmed SP Batch set-point.

8.2.3.2 The operator may terminate any channels that continue with batching remaining in process by first returning to the home screen, then pressing the [STOP] key once. Note that the 'B' control indicators on the home screen stop blinking indicating that all batch processes are stopped.

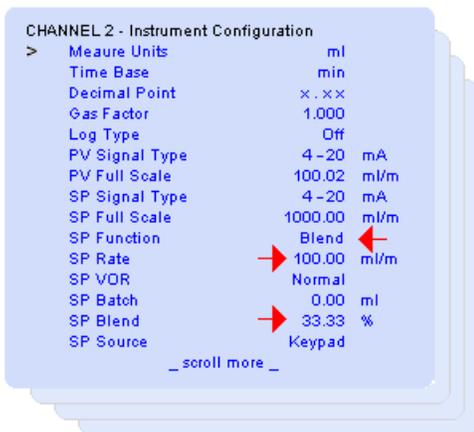
8.3 Blend Control

Blending is a continuous process that when started, causes slaves SP Rates to be a proportion of the actual rate being delivered by the master.

CAUTION
Blend parameters are saved when power is lost allowing blending to continue after power is restored unless Pwr SP Clear is selected to be ON

See Global Settings - Controls Section

The operator selects a master channel and sets its delivery SP Rate. One or more Slave channels are then selected, and the process is started from the home screen. Once started - blending will continue and may ONLY be terminated by the operator.



8.3.1 Set-Up

The operator programs the above values for master and slave channels desired to perform blending.

8.3.1.1 Select Blend Master

From the home screen - point to a channel desired to be the master and presses the [◀] master blend key. This causes the home screen to show an 'M' indicating master channel. Should the operator press the master key again at that moment - the 'M' control indicator will no longer be present - no master is then selected - and blending will not be conducted.

To de-select a blend master - point to the present master channel and press the [◀] master blend key. Note the 'M' control indicator is no longer present and the master has been de-selected.

1	PV Rate	444.99 scc/m	M
	SP Rate	445.00 scc/m	
> 2	PV Rate	32.49 scc/m	S
	SP Rate	32.50 scc/m	
3	PV Rate	8950.50 scc/m	
	SP Rate	8949.00 scc/m	
4	PV Rate	10.00 scc/m	
	SP Rate	9.95 scc/m	S

8.3.1.2 Master Channel Set-up

The operator navigates to the channel to the master programming screen, first shown above, and sets the desired master SP Function to Rate, and sets the SP Rate to a desired value.

8.3.1.3 Slave Channels Set-up

The operator navigates to each desired slave channel and sets each SP Function to Blend, then sets the desired SP Blend rate percentage referenced to the master channels actual delivery rate. Note the home screen shows 'S' indicating selected blend slave channels.

NOTE

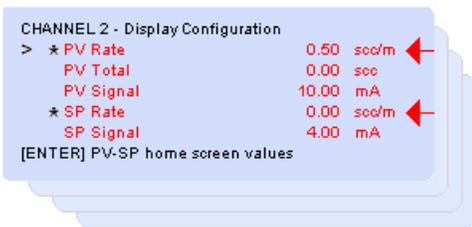
Once a slave channel is set to Blend
SP Rate programming is prohibited
for both keypad and serial command

8.3.2 Start Blend

8.3.2.1 Return to the home screen

8.3.2.2 Press {START} key three (3) times - and note the 'M' and 'S' suffix now blinking to indicate channels with blend now in process.

8.3.2.3 The blending process can be viewed on the screen below observing that the SP Rate is the programmed proportion of the master rate.



8.3.3 Terminate blend in-process

Once the operator has started blending - it will continue unless specifically terminated by the operator. To terminate - return to the home screen and press the [STOP] key. Observe that the 'M' and 'S' process indicators no longer blink.

NOTE

Terminating a blend in-process
causes the blend master channel
SP Rate value to be cleared to zero

9.0 Signal Calibration

WARNING - EXPERTS ONLY **Incorrect Calibration Will Cause Defective Operation**

This section describes the operation of the various manual signal calibration functions. The purpose of calibration is to adjust the PV and SP signals to be in agreement with secondary standards. The calibration tool is invoked by the operator to become actively supplementary, and co-resident, operating simultaneously along with all other normal instrument functions.

Calibration is performed for the channel to which the home cursor is pointing. The channel selected for calibration may be changed to another channel at any time. The tool employs a dual-key methodology to cause operation of the desired calibrate function. Support is included to enable laboratory calibration to secondary standards of the National Institute of Standards.

9.1 Warranty Affectivity

The various calibrate functions may be useful by field personnel to achieve support for special installation requirements or verifications; however, should non-factory calibration be conducted - it will be detected by the instrument, and result in the instrument becoming ineligible to receive factory warranty calibration service.

9.2 Factory Confirmation

A factory conformance document may be serially sent from the instruments RS232 port using the front panel keys shown below in Fig 9.2a. The serial data may be viewed on-screen of a computer running a suitable serial communication program set to receive American Standard Code for Information Interchange (ASCII), 8 bit characters sent at 9600 bits per second, no parity, with at least one stop bit. The confirmation is pre-formatted with comma-delimits enabling direct import into Microsoft Excel™, or most other such data base programs.

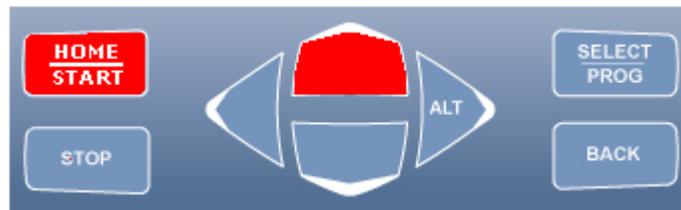


Fig 9.2a

```
Title: Conformance                               Standard: Agilent 34401A
Format: V(±0.004) mA(±0.015)                     Cal Agent: factory
Serial: 06010
Model: 0254

CH 1
, 0.000, 0.500, 1.001, 2.002, 3.000, 3.999, 4.999
, 0.002, 0.501, 1.001, 1.998, 5.002, 7.998, 10.999, 14.997, 20.001

CH 2
, 0.001, 0.500, 1.000, 1.999, 2.999, 3.999, 5.000
, 0.002, 0.504, 1.004, 2.005, 5.003, 8.001, 11.002, 15.003, 19.999

CH 3
, 0.000, 0.501, 1.000, 2.000, 3.000, 4.001, 5.000
, 0.002, 0.501, 1.001, 2.000, 4.999, 8.001, 11.001, 15.001, 20.003

CH 4
, 0.000, 0.500, 1.000, 2.000, 3.000, 4.000, 5.000
, -0.001, 0.498, 0.998, 1.998, 4.998, 7.998, 10.997, 14.997, 20.001
```

Fig 9.2b

The numeric data for the various channels, shown in Conformance Fig 9.2b, are the factory analog calibration value results from looping the SP output to the PV input while being verified against the indicated standard instrument. The calibration conformance data is permanently retained in the instrument, and may not be edited or deleted. The "Cal Agent" entry indicates the most recent calibration authority that has modified any of the instruments calibrate coefficient values - indicated either as "factory" or "non-factory".

9.3 Calibration Equipment and Verification Requirements

A standard measurement instrument shall be selected to meet accuracy and precision measurement requirements insuring that such measurements are acceptably valid.

9.3.1 Accuracy

Accuracy is the measure of the degree to which measurements are compared to a standard. The standard verify-calibrate instrument shall be manufacturer specified to perform with an accuracy two (2) times greater than the measured value required to be verified-calibrated. The standard shall have been calibrated to such accuracy by a third party laboratory certified to conduct such calibrations, and be within the standard instrument manufacturer's specified calibration period.

9.3.3 Precision

Precision is the degree to which a measurement is made which is a count of the number of decimal digits meant to represent the measurement. The standard verify-calibrate instrument incorporate inherent precision ten (10) times greater than the measured value required to be verified-calibrated. This application of standard engineering practice insures digital truncate<or>rounding by the standard instrument do not contribute adverse errors that would otherwise be presumed as an inaccuracy attributable to the devise being verified. Standard instrument manufacturers manual documents specify truncate<or>rounding limitations.

9.3.4 Verification Rounding

Engineering standard rounding techniques shall be employed to compensate verify-calibrate measurements by the standard instrument which adjusts the magnitude of the digit immediately right of the verification least significant digit (LSD). Such compensation shall increase the measured LSD value by one (1) when the standard digit immediately right of the required LSD indicates a value of five (5) or greater. Otherwise the LSD shall be the standard instrument measured value.

9.4 Start Calibration Tool

To start the manual calibrate tool - the operator simultaneously depresses both keys highlighted in red, shown in Fig 9.4a, EXACTLY five (5) times, with less than 2 sec between consecutive depressions. The tool is active when "Cal" appears in the top-right position of the display as shown in Fig 9.4b.



Fig 9.4a

1	PV Rate	444.99	sc/m	Cal
	SP Rate	445.00	sc/m	
> 2	PV Rate	32.49	sc/m	
	SP Rate	32.50	sc/m	
3	PV Rate	8950.50	sc/m	
	SP Rate	8949.00	sc/m	
4	PV Rate	10.00	sc/m	
	SP Rate	9.95	sc/m	

Fig 9.4b

9.5 Select Calibrate Signal

Analog milliamp (mA) and volt signals are supported. The signal type may be changed at any time.

9.5.1 Calibrate mA Signals - depress the keys shown highlighted in red on Fig 9.5.1a. Note the display will appear approximately as shown in Fig 9.5.1b.



Fig 9.5.1a

1	PV Signal	0.000	mA	Cal
	SP Signal	0.000	mA	
> 2	PV Signal	20.000	mA	
	SP Signal	20.000	mA	
3	PV Signal	0.000	mA	
	SP Signal	0.000	mA	
4	PV Signal	0.000	mA	
	SP Signal	0.000	mA	

Fig 9.5.1b

9.5.2 Calibrate Volt Signals - depress the keys shown in Fig 9.5.2a. Note the display will appear approximately as shown in Fig 9.5.2b. PV Signal and Vcomp signals are simultaneously calibrated.

The home screen display is observed to alternate every two seconds between indicating one of two volt input values shown as "PV Signal" and "Vcomp". "PV Signal" is the primary PV channel measurement - with the "Vcomp" signal being the Return signal, equal for both Rate Return and Command Return.

The Return "Vcomp" signal enables measuring voltage drop occurring between the power supply and the powered instrument, and are used to resolve the actual PV and SP volt signals.

It is required that both the PV and Return signals be equal during offset and span calibration, and the operator observes and compares both signals verifying they are equal to within ± 1 least significant digit.



Fig 9.5.2a

> 1	PV Signal	10.000 V	Cal
	SP Signal	10.000 V	
2	PV Signal	0.000 V	
	SP Signal	0.000 V	
3	PV Signal	0.000 V	
	SP Signal	0.000 V	
4	PV Signal	0.000 V	
	SP Signal	0.000 V	

Fig 9.5.2b

9.6 Calibrate Functions and Controls

Calibrating a PV (input) signal is fundamentally different from calibrating a SP (output) signal - besides the fact that the two signals go different directions with respect to the instrument. Calibration service is available for each channel for zero offset and full scale over analog ranges of 0-20.000 mA, and 0-10.000 volts.

9.6.1 PV - Input Signals

These signals are calibrated by presenting a signal to the input - then pressing appropriate keys that instruct the instrument to capture and interpret the observed signal as either offset or span. These are quick-cal processes.

9.6.1.1 PV Signal Offset

Connect no signal to the PV input. Depress the keys shown Fig 9.6.1.1a. Note on the home screen that the PV Signal value becomes zero confirming the calibration was successful.

9.6.1.2 PV Signal Span

Connect a 5.0000 volt <or> 20.0000 mA signal to the PV input. Depress the keys shown in Fig 9.6.1.1b. Note on the home screen that the PV Signal value becomes either 5.000±0.001 volt <or> 20.000±0.002 mA confirming the calibration was successful.

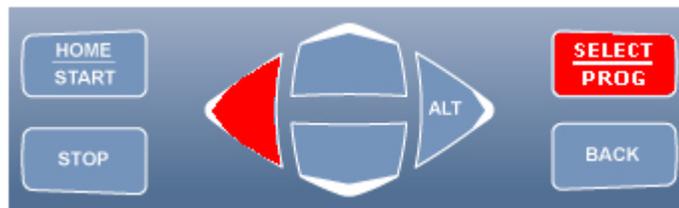


Fig 9.6.1.1a



Fig 9.6.1.1b

9.6.2 SP - Output Signals

These signals are calibrated by presenting their signal to the standard measurement instrument - then pressing appropriate keys that instruct the instrument revision to modify appropriate coefficients that change the present value up or down to a new value. These are tweek processes.

9.6.2.1 SP Signal Offset

Connect the SP output to the standard instrument set either to volts or mA as appropriate. Using the keys of Fig 9.6.2.1a below, press the BACK and UP keys to increase the output value, or BACK and DOWN keys decrease the output value. The calibrate value for volts is zero, and for mA is 0.2000 accordingly.

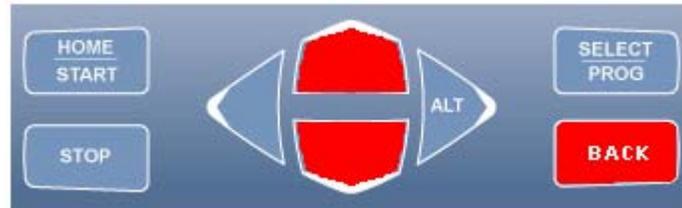


Fig 9.6.2.1a

9.6.2.2 SP Signal Span

Connect the SP output to the standard instrument set either to volts or mA as appropriate. Using the keys of Fig 9.6.2a below, press the BACK and UP keys to increase the output value, or BACK and DOWN keys decrease the output value. The calibrate value for volts is 5.0000, and for mA is 20.0000 accordingly.

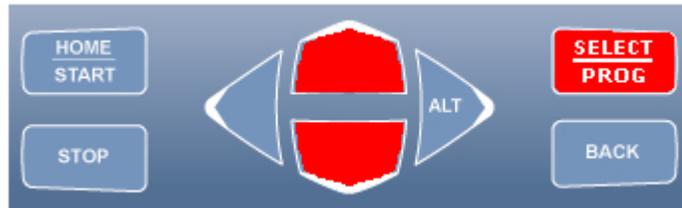


Fig 9.6.2a

9.7 Stop Calibration Tool

Termination deactivates the calibrate tool operation which may be accomplished in several ways.

9.7.1 Keypad Terminate

Depress both of the highlighted red keys of Fig 9.3.1 below at the same time. This action causes the "Cal" indicator in the upper right corner of the home screen display to disappear indicating that the calibrate tool has been deactivated.



9.7.2 Power Off Terminate

Place instrument in the Power Down state by either of the following:

9.7.2.1 Enter Global Configuration, scroll down to "System Power" and depress the [ENTER] key, or

9.7.2.2 Depress the [STOP] key consecutively three times.

When the instrument is in the "Power Down" state - it may be restored to normal operation by depressing the [START] KEY. Note that when Power is restored - the home display is restored and the "Cal" indicator is no longer present.

9.7.3 Power Disconnect Terminate

Remove and then re-apply power to the instrument by removing the power plug from the rear apron. The calibrate state is not remembered - so on power re-application - the calibrate function is no longer active.

SERIAL COMMUNICATION PROTOCOL

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6.0

Serial Value Programming

6.1	Read Programmed Value
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6.3	Input Port Values
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6.5	Global Value Settings

Note:

All text in blue has been added to this document as of November 2nd 2012. This is literary data only; no functional changes have been made to the firmware.

1.0 Revision History

<u>Effective Date</u>	<u>Revision Enhancement</u>
25Dec2007	1. Initial edit conversion of source Protocol Document
28Jul2008	1. Initial release complete
26Feb2009	1. Edited content with respect to application based on use premise
06Mar2009	1. Edit recent anomaly observations highlighted red
12Mar2009	1. Edit sections 6.3, 6.4 describing affect-result of interrogating Port Type
16Sep2009	1. Instruct meaning of "Half-Duplex"; edit unit address to be aaaaa , port sub-address to be .p or .pp - incorporated in twenty-two different numbered sub-sections of master sections: 4.0, 5.0, and 6.0.
19Oct2012	1. Edits to from Section 2.0 to 6.0 to improve customer understanding such as for example shown by bolded items in the text immediately above for 16Sep2009
02Nov2012	1. Updated Sections: 2.0 Serial Port Parameters, 5.2.1 Measure String 96ms Send Latency

2.0 Purpose

The purpose of this document is to describe in detail the various aspects of providing 0254 instrument commands and responses that result in operating value programming - fundamental to employing the system for acquiring and communicating measured information - and providing for process control output.

The serial port rate is fixed at 9600 bits per second (bps) rate, no parity, and one stop bit minimum.

3.0 System Overview

3.1 Structure - this instrument is a general platform into which are installed certain standard and special operating modules. This document focuses on standard universal input-output module offerings. The platform supports input signal measures; and control output signals. The platform supports various communication facilities.

3.2 Channels and Ports - the instrument is comprised of pairs of ports comprised of an input and output to form a channel. The basic instrument is comprised of four channels.

4.0 Serial Command Organization

4.1 Command Structures

This protocol was selected to service the need for serial error control while operating in local or wide area networks to transfer information between a unit and host computer.

4.1.1 Elements

The command format is a free form variable entry implementation, enabling expeditious economic means of achieving required programming results. Commands are comprised of the following structural elements:

4.1.1.1 Block Pre-limiter - sentinel indicating start of multiple packets message

4.1.1.2 Packet Pre-limiter - sentinel indicating start of a packet message

4.1.1.3 Information Frame - contains comma pre-limited fields which start with the first character immediately following the message pre-limiter and includes all successive characters up to and including a comma which immediately precedes the first ASCII hexadecimal checksum character.

4.1.1.4 Checksum - is two ASCII hexadecimal characters created for a mod256 negated sum of all message characters used to check message packet validity, incorporated within the more widely used transfer protocol known as "Intel Hex".

4.1.1.5 Packet delimiter - sentinel indicating end of a packet message which must be received by the host prior to sending a subsequent command.

4.1.1.6 Block Delimiter - sentinel indicating end of multiple packets message

4.1.2 Transfer - all messages are serial half duplex send-response types; besides numerous operational attributes; the most important being that both parties insure that only one party is authorized to talk to the other party at any one time.

4.1.3 Mastering - the protocol initiator or originator is the master. The master is responsible for managing the communication link connection.

4.2 Command Addressing

4.2.1 The 0254 unit is assigned a unique aaaaa address from 0 to 65535 which must be pre-programmed in the instrument prior to deployment in a network environment. An instruments ports used to comprise channels are designated as ".p" or ".pp" port sub-address.

4.2.2 The five digit address may be omitted when operating a single un-network unit - but must be used in multiple unit networks to differentiate the units from each other.

4.2.3 Command arguments are single ASCII alpha non-case sensitive characters, FOR EXAMPLE:

HOST SEND

```
AZ      aaaaa      .pp      K      <cr>
|        |          |        |        |
|        |          |        |        + -- message delimiter
|        |          |        +-- command argument
|        |          +-- port sub-address
|        +-- unit address
+-- message prelimiter
```

AZ .pp <argument> <cr> Non-networked sub-addressed port

AZ aaaaa.p <argument> <cr> Networked sub-addressed port

RESPONSE - <argument> dependent

5.0 Command Operation

5.1 General Commands

These commands are general basic utility types not described in any particular order.

5.1.1 Command Synchronize

This command string terminates commands that may be presently in process and resets the command state machine operation to the initial ready state. It can be sent to instruments in a network to provide command state machine synchronization.

HOST SEND

```
<esc>AZ<cr>
```

RESPONSE – none

5.1.2 Menu Command

This command is provided for terminal oriented use and causes display of a menu listing the basic available command arguments, make, model, code version and object code start vector.

FIELDS

AZ	Pre-limiter
,00000	Unit address
,4	Response type
,Brooks Instrument	Make
,Model 0254	Model
,08	Port provision count
,V09.01.30	Code version date yy-mm-dd
,FE00	Start vector
,<sum>	Negated mod256 sum
<cr><lf>	Delimiter

5.1.5 Message Serial Character Pacing Controls

These commands provide for terminal or host to suspend character sending, or to re-enable the sending to continue. This facility is particularly useful when unit sends large data amounts such as logged information.

5.1.5.1 Serial Character Pacing

This command acts as an XOF to temporarily suspend unit from sending further characters.

HOST SEND	
AZH<cr>	Non-network
AZ aaaaa <cr>	Network

RESPONSE – none

This command acts as an XON to allow or re-enable unit to continue sending characters.

HOST SEND	
AZS<cr>	Non-network
AZ aaaaa S<cr>	Network

RESPONSE – none

5.1.6 Serial Message Error Control

Commands provide for error control of information packets sent by the unit. This is particularly useful when transferring information over wide area networks, and causes the unit to continue to send the next packet, or to resend a previous sent packet.

The send-resend is determined by the receiving host based on having computed a checksum from the received characters - then comparing it with the checksum sent by the unit. The unit must be pre-configured to enable the error control protocol.

5.1.6.1 Positive Acknowledge Command

This command must be issued by the receiving host to enable the unit to send its packet which is next eligible. Should the unit not receive positive acknowledgement within four seconds, it will resend the previous packet up to four times before abandoning the send

session.

HOST SEND	
AZA<cr>	Non-network
AZ aaaaa A <cr>	Network

RESPONSE – none

5.1.6.2 Negative Acknowledge Command

This command may be issued from the terminal or host to cause the unit to resend its previous packet. Should the unit not receive negative acknowledgement prior to a lapse of four seconds - it will automatically resend the previous unacknowledged packet up to four times before abandoning the send session.

HOST SEND	
AZN<cr>	Non-network
AZ aaaaa N <cr>	Network

RESPONSE – none

5.2 Channel Input Port Commands

5.2.1 Measured Channel Values

This command is used to gather measured information from one or all channel input ports. Protocol responses are compatible to existing published protocol formats. Frames noted below as low case 'x' remain <reserved> regardless of frame content.

HOST SEND	
Non-Networked	
AZ .pp K <cr>	Send one channel input ports values

Networked	
AZ aaaaa.pp K <cr>	Send one channel input port values

RESPONSE - ONE CHANNEL INPUT PORT MESSAGE

AZ,00909.00,2,xxxxxxxx.xx,00162871.43,-0000003.27,xxxxxxxx.xx,xxxxx,X,X,X,X,X,<sum><cr><lf>

Transmission of the above string requires 96ms, which immediately follows receipt of the host request string terminator.

5.2.2 Send Channel Input Port Programmed Values

This command enables a terminal operator or host to acquire the present state of input port programmed values.

HOST SEND	
AZ .pp V <cr>	Non-network
AZ aaaaa.p V <cr>	Network

RESPONSE

PROGRAM VALUES - Channel 1 - Port 01

<04>	Measure Units	ml
<10>	Time Base	min
<03>	Decimal Point	x.xx
<27>	Gas Factor	1.000
<28>	Log Type	Off
<00>	PV Signal Type	0-20mA
<09>	PV Full Scale	20.00 ml/m

5.2.3 Program Channel Input Port Values

Each of the input port programmed operating values can be individually queried or changed in accordance with Section 6.0 using the <xx> value index.

5.2.4 Clear Accumulated Values

This command allows any one channel input port accumulated value to be independently reset to zero, or all unit programmed values to be set to factory default.

HOST SEND

AZ .pp Z n <cr>	Non-network
AZ aaaa.pp Z n <cr>	Network

n=0,2,3,5,6 <reserved>

n=1 Measured Quantity for one channel input port

n=4 Set all channels to be set to Factory default program values

RESPONSE – none

5.3 Channel Output Port Control Commands

5.3.1 Channel Control Output Port Values

This command enables terminal operator or host to acquire the present state of a channel output port programmed values.

HOST SEND

AZ .pp V <cr>	Non-network
AZ aaaa.p V <cr>	Network

RESPONSE

PROGRAM VALUES - Channel 1 - Port 02

<00>	SP Signal Type	0-20mA
<09>	SP Full Scale	20.00 ml/m
<02>	SP Function	Rate
<01>	SP Rate	0.00 ml/m

<29> SP VOR	Normal
<44> SP Batch	0.00 ml
<45> SP Blend	0.000 %
<46> SP Source	Keypad

5.3.2 Program Channel Output Port Values

Each channel output port programmed operating values can be individually queried or changed in accordance with Section 6.0 using the ".pp" value index.

5.3.3 Batch and Blend Control Commands

These commands are provided to conduct output port control operations that require starting and stopping.

5.3.3.1 Batch Command

This command is used to start a new batch quantity process, or stop a batch process that may currently be in processing.

5.3.3.1.1 Bulk Batching

Bulk batching starts all qualified batch processes for all qualified channel ports at the same time.

Qualified channel output ports [Control Function] must be programmed to [Batch] and [Batch Quantity] set greater than zero; with [Link] to the channel input port programmed to accumulate quantity.

HOST SEND

AZ F*<cr>

start all channel batches

AZ F<cr>

stop all channel batches

RESPONSE(S)

AZ, aaaaa.pp ,5 ,FOK, DA, <cr><lf>

batch started and in process

AZ, aaaaa.pp ,5 ,FDONE, 4E, <cr><lf>

batch(s) completed

AZ, aaaaa.pp ,5 ,FERROR,5D, <cr><lf>

command error

5.3.3.2 Blend Command

This command is used to select a blend master channel and thereafter start the desired blending operation. At least one, or more, slaves output rates are controlled to be a proportion of the selected masters delivery rate.

Qualified channel output port must have its [Control Function] set to [Blend].

The required master channel input port is specified in the start command by having inserted its port sub-address ".pp" in the command, and must be one of the following:

Channel	Sub-Address
1	1
2	3
3	5
4	7

```

HOST SEND
  AZ .pp B<cr>           Start blending
  AZF<cr>               Stop blending

RESPONSE – none

```

5.4 Global Settings Services

5.4.1 Global Setting Values

This command enables terminal operator or host to acquire the present state of the Global programmed values. The Global Settings port number is one greater than the maximum number of available ports which is nine (9) for an 0254 instrument.

```

HOST SEND
  AZ .09 V <cr>           Non-Network
                        <or>
  AZ .9 V <cr>

  AZ aaaa.09 V <cr>      Network
  AZ aaaa.9 V <cr>

```

RESPONSE

PROGRAM VALUES - Channel Global

```

<39> Audio Beep      On
<32> Zero Supress    On
<33> Pwr SP Clear    Off
<43> Record Count    000000 (view only)   log option
<25> Sample Rate     535 sec              log option
<22> Date-Time       00Jan00 00:00:00     log option
<17> Network Addr    00000

```

5.4.2 Set Global Settings Values

Each of the system port programmed operating values can be individually queried or changed in accordance with Section 6.0 using the <xx> value index.

5.5 Communication Message Basics

Messages between host and unit are either polled (solicited) or un-polled (un-solicited), where the host is normally the polling (soliciting) party.

5.5.1 Message Structure

A packet is a group of information from channel input ports. A group of packets sent together are a block message as shown in examples below. Protocol responses are compatible to existing published protocol formats. Frames noted below as low case 'x' remain <reserved> regardless of frame content.

MESSAGE

AZ,00909.00,2,xxxxxxxx.xx,00162871.43,-0000003.27,xxxxxxxx.xx,xxxxx,X,X,X,X,X,<sum><cr><lf>

5.5.2 Message Format

BLOCK PRELIMITER

<dle><stx>

Start of multi-port block

PACKET PRELIMITER

AZ

Start of a port packet

ADDRESS - unit and port(s) providing the information

,xxxxx

unit address

.xx

port sub-address

TYPE - message purpose

Un-pollled Types

,0

<reserved>

,1

<reserved>

,2

<reserved>

,3

<reserved>

,6

<reserved>

Polled Types

,4

Information request response

,5

Control batch status

,6

<reserved>

,7

<reserved>

,8

<reserved>

,9

<reserved>

MEASURE - channel input port values - sign convention as (+), space(+), or minus (-)

,xxx

<reserved>

,QTY

Quantity

,RATE

Rate-Value

,xxx

<reserved>

,xxx

<reserved>

CHECKSUM

,<sum>

Negated mod256 sum

PACKET DELIMITER

<cr><lf>

Packet end - must be detected by host before sending next command

BLOCK DELIMITER

<dle><etx>

Block end

6.0 Serial Value Programming

This section is organized into reading and programming values. The <index> value is a numeric designator unique to each programmable value - except Port Type.

6.1 Read a Programmed Value

HOST SEND

AZ .pp	P <index> ? <cr>	Non-network
AZ aaaaa.pp	P <index> ? <cr>	Network

RESPONSE

<200ms delay>
 AZ,xxxxx.xx,4,Pyy,<present value>,<cksm><cr><lf>

A received response indicates that no error was detected.

EXAMPLE

AZ,00123.08,4,P08,04.000,DF<cr><lf>

6.2 Program a New Value

HOST SEND

AZ .pp	P <index> = <new value> <cr>	Non-network
AZ aaaaa.pp	P <index> = <new value> <cr>	Network

RESPONSE

<200ms delay>
 AZ,aaaaa.pp,4,Pyy,<new value>,<cksm><cr><lf>

A correct received response indicates that no error was detected. It is recommended that host software validate the responding message check-sum, followed by the unit message address, port number, value index, and new programmed value to be certain that the desired value change was programmed successfully.

6.3 Channel Input Port Values

Port Type is the input signal type and is the first serial character received when programming a new Type. An optional second character may be received after Port Type with a range from 0-2 and has no operational effect. The second character is always returned when Port Type is serially interrogated.

Index	Value Title	Value	Range	Notes
-------	-------------	-------	-------	-------

0	Port Type			1 or 2 ascii chars with second char range 0-2 not affecting proper operation
		0	Off	
		1-6		<reserved>
		7	0-20mA	1 ascii char
		8	4-20mA	
		9	0-10V	
		:	2-10V	
		;	0-5V	
		<	1-5V	
	Excitation Type			1 ascii char optional
		0-2	<reserved>	
Measurement magnitude range				
3	Decimal Point	0	xxx.	1 ascii char
		1	xx.x	
		2	x.xx	
		3	.xxx	
Character string identifying the physical measurement type				
4	Measure Units			fixed indexed strings
		0	ml	
		1	mls	
		2	mln	
		3	l	
		4	ls	
		5	ln	
		6	cm^3	
		7	cm^3s	
		8	cm^3n	
		9	m^3	
		10	m^3s	
		11	m^3n	
		12	g	
		13	lb	
		14	kg	
		15	ft^3	
		16	ft^3s	
		17	ft^3n	
		18	scc	
		19	sl	
		20	bar	
		21	mbar	

22	psi
23	kPa
24	Torr
25	atm
26	Volt
27	mA
28	oC
29	oK
30	oR
31	oF
32	g/cc
33	sg
34	%
35	lb/in^3
36	lb/ft^3
37	lb/gal
38	kg/m^3
39	g/ml
40	kg/l
41	g/l

Analog interpolator representing the engineering units of the greater measured signal

9	PV Full Scale	xxxxxx	0 to ±999.999	1-7 ascii chars var dp
---	---------------	--------	---------------	------------------------

Measurement per unit time relationship

10	Rate Time Base	0	none (Scalar)	1 ascii char
		1	sec	
		2	min	
		3	hrs	
		4	day	

Scale Factor by which interpolated channel units are multiplied

27	Gas Factor	xxx.xxx	0 to ±999.999	1-7 ascii chars fix dp
----	------------	---------	---------------	------------------------

6.4 Channel Output Port Values

Port Type is the output signal type and is the first serial character received when programming a new Type. An optional second or third character may be received after Port Type with a range of 0-99 and has no operational effect. These characters represent port number of the linked input and are always returned when Port Type is serially interrogated.

Index	Value Title	Value	Range	Notes
0	Port Type			1 or 3 ascii chars with second

or third chars range 0-99 not affecting proper operation.

0	Off	1 ascii char min
1	0-20mA	
2	4-20mA	
3	0-10V	
4	2-10V	
5	0-5V	
6	1-5V	

Link Input Port 0-99 1 or 2 ascii char optional

Rate (Manual) output set-point

1 SP Rate xxxxxx 0 to ±999.999 1-7 ascii char var dp

Select output control service

2	SP Function	1	Rate	1 ascii char
		2	Batch	
		3	Blend	

Analog De-Interpolate representing the engineering units of the greatest signal allowed

9 SP Full Scale xxxxxx 0 to ±999.999 1-7 ascii chars var dp

Valve Override valve state selection

29	SP VOR	0-2	1 ascii char
		0	Normal
		1	Closed
		2	Open
			tri-state
			vo < -4v
			vo > +8v

Batch Delivery Set-Point

44 SP Batch xxxxxx 0 to ±999.999 1-7 ascii chars var dp

Blend Mixing Set-Point

45 SP Blend xxxxxx 0 to ±999.999 1-7 ascii chars var dp
(% units automatic)

Set-Point Programming Source

46	SP Source	0-1	1 ascii char
		0	Keypad
		1	Serial
			keypad prohibit

6.5 Global Setting Values

These settings affect all aspects of the system - not port or channel associated.

Index	Value Title	Value	Range	Notes
Zero Suppression - ON suppresses leading value zero values				
32	Zero Suppress	0	Off	1 ascii char
		1	On	
Power Set-Points Clear - ON causes all channel set-points to become zero				
33	Pwr SP Clear	0	Off	1 ascii char
		1	On	
Audio Annunciate Control - ON enables annunciate key activation and alarms				
39	Audio Beep	0	Off	1 ascii char
		1	On	

Technical Specifications

Control Functions	Rate (manual), Batch, and Blend	Process Rate	0.00±9,999,999.99 unit/time-base
Measure Type	Rate-Total, Scalar	Totalize Range	0–99,999,999.99 units
Process Input	Volt, mA	Process Output	Volt, mA
Programmable Values			
Channel Ranges	Off, 0-20mA, 4-20mA, 0-10V, 2-10V, 0-5V, 1-5V		
Measure Units	ml, mls, mln, l, ls, ln, cm ³ , cm ³ s, cm ³ n, m ³ , m ³ s, m ³ n, g, lb, kg, ft ³ , ft ³ s, ft ³ n, scc, sl, bar, bar, psi, kPa, Torr, atm, Volt, mA, oC, oK, oR, oF, g/cc, sg, %, lb/in ³ , lb/ft ³ , lb/gal, kg/m ³ , g/ml, kg/l, g/l		
Network Address	0–65,535		
Date–Time Clock	Day/month/year, Hours/minutes/seconds (with data logging option)		
Periodic-Log Frequency	0–999 sec-min-hrs-day-month		
Global Settings	Instrument Information, System Power (on/off), Control Services, Communication, Data/Time, and Data Logging		
Indicators			
Display	Graphic, backlit, LCD 8x40		
Keypad	8-key metal dome tactile		
Audio	2.0 KHz, 85 db @ 10 cm		
Channel Interface			
Input	Channel Isolation	>85 dbv (nom)	
	Interface	DA15S	
	Analog Voltage	0–10.000 V ±0.075% Zi–10.0K sense compensated	
	Analog Current	0–20.000 mA ±0.075% Zi 100 ohm	
Output	Interface	DA15S	
	Analog Current	0–20.000 mA ±0.075% Zo–infinite sourcing	
	Analog Voltage	0–10.000 V ±0.024% Zo–1.0 ohm sense compensated	
	VOR Control	-4.0 to +8.0V @ +/-4.0mA max	
	TMF Power Control	Dual 24V at 2.0A	
Serial Port	EIA-TIA232D full duplex D9S Load 4.7K max standard		
Value Memory	Non-volatile ram 8Kx8 Non-volatile eeprom parallel 100 yr retention 512x8 Non-volatile eeprom serial 100 yr retention 256Kx8 Static ram parallel 1Kx8 Static ram serial 32x8 battery-backed		
Self Diagnostics	Memory checksum, installation, local and remote serial communication		
Power Required	12–24 VDC 65–33 mA 0.8w		
Jack Unipolar	2.1 mm 2A center pos UL/CSA		
Plug Bipolar	DE9P 5A rated UL/CSA		
Consumption	2.0 watts		
Battery	3.0V lithium 12mm 35 mA-hr ~9 yr required with data log option		
Operating Environment			
Operation	0–55°C 0–95% RH non-condensing		
Ship-Storage	–20° to +85°C 0-95% RH non-condensing		
Warm Up	1 min typ to rated accuracy		
Enclosure			
Mounting	Panel, Desk Top, Rack and Cassette		
Panel Cutout Size	7.67 x 4.275 (4X R0.125)		
Material	GE Cyclocac Resin FR23, PBB, PBDE, DBDE		
Weight	615 gm		
Compliances	CE Mark EN61326-1, FCC Part15 Class A, FCC Part 68, RoHS		

12.1 Bio-Medical Alert

NOTICE

WRITTEN AUTHORIZATION BY THE PRESIDENT OF FLORITE INTERNATIONAL, INC. IS REQUIRED PRIOR TO USING ANY FLORITE PRODUCTS OR SERVICES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS.

12.1.1 A critical component is any component of a life support device or system whose failure to perform can reasonably be expected to cause the failure of the life support device or system, or affect its safety or effectiveness.

12.1.2 Life support devices or systems are devices or systems which are as follows: Intended for surgical implant into the body; or Intended to support or sustain life; and in any case, whose failure to perform when properly used in accordance with the instructions provided in the labeling or operators manuals, can reasonably be expected to result in significant life threatening injury.

12.2 Federal Communications Commission Compliances

12.2.1 Part 15 Compliance

12.2.1.1 This equipment has been tested and found to comply with the limits for **Class B Class A** digital device pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in **[residential] [commercial-industrial]** environment. This equipment generates, uses, and can radiate frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

12.2.1.2 Notice To User

This equipment complies with FCC Part governing limitations for radio frequency emissions. Operation is subject to two conditions as follows: (1) this device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.

12.2.1.3 Equipment Modification

Changes or modifications not expressly approved by the party responsible for compliance will void the user's authority to operate the equipment.

12.2.2 Part 68 Notice

12.2.2.1 A Federal Communication Commission (FCC) compliant telephone cord with modular plug is provided with your equipment to connect it to the public switched telephone line using a Universal Order Service Code (USOC) RJ-11 jack. Do not connect to party or coin lines. The sum of the REM numbers printed on the telephone line device for ALL devices connected to the telephone line, shall not exceed 5.0. This insures that each device connected to the line may respond properly when the line rings

12.2.2.2 You must provide the FCC Part 68 compliance registration information from the equipment label when requested by the telephone company.

Registrant: Florite International, Inc.
Number: 5TUUSA-23969-DT-E

12.2.2.3 The telephone company will notify you of network changes that may affect proper functioning of your equipment, and may temporarily discontinue service, or require the equipment to be disconnected from the line, if it is suspected of causing harm to the network. You will be informed by your telephone company of your rights to file complaints with the FCC.

12.3 EU Compliances

12.3.1 EMC Directive (CE Mark)

The European Union directive on electromagnetic compatibility (2004/108/EC) requires a non-European manufacturers to designate an authority representative in the Union-Community. Our European representative is

Compatible Electronics, Inc.
2337 Troutdale Dr.
Agoura, CA 91301

12.3.2 Waste Electrical and Electronic Equipment Directive (WEEE)

The European directive WEEE aims to minimize the impact of electrical and electronic equipment waste on the environment and human health. For proper treatment, recovery, and recycling, return the equipment to your local supplier upon the purchase of equivalent new equipment, or dispose of it in designated collection points. For further information - visit www.recyclethis.com.

12.4 Hazardous Waste

12.5.1 Florite instruments may incorporate real-time clock operation which is supported by a 3.0 volt, 35 milliamp-hour lithium battery during periods during which the instruments power is disconnected. the battery is not a user serviceable component, and is guaranteed for a period of nine (9) years from the date the original purchaser purchased the instrument.

12.5.2 Contact Florite International, Inc. to return the instrument for battery replacement service should it be observed that the clock time is affected following instrument power loss. The battery is exclusively a factory replacement component, and in no case shall the original product purchaser attempt to remove or replace the battery, which requires the instrument to be opened, which will immediately void the terms and conditions of the instruments Limited Warranty. Prior to sending the instrument to Florite for service, contact www.florite.com, Service Department, who will issue a return-materials-authorization number. The instrument must return a copy of the original purchase invoice to receive service.

12.5.3 In no circumstance will Florite be responsible for customer expenses associated with the need for battery replacement, such as, but not limited to, unit de-installation, re-installation, or in all cases, irrespective of the instruments Warranty status.

12.5.4. Returned instrument for battery replacement shall be shipped by the customer return freight prepaid. Instruments beyond the original Warranty period are subject to a battery service charge in the 50% of the prevailing clock option list price.

Proper Care and Handling of the 990X

The 990X does not require special care or handling to operate successfully. There are however several important guidelines which must be followed to insure the unit maintains its structural and electrical integrity for optimal performance:

- Be sure to unplug all power and signal cabling to the 990x unit before cleaning.
- Use a clean, damp, soft cloth to remove dirt and dust from unit and screen.
- Use a dry cloth to remove any residual moisture from the unit surface.
- Never use any kind of abrasive pad or scouring power to remove dirt.
- Never spray water directly onto the unit. Water may drip inside and cause malfunctions.
- Do not use any kind of detergent or strong chemical solvent to clean unit.
- Never immerse unit in any fluids including water. 990X is NOT dishwasher safe.
- Unplug unit immediately if any fluids should accidentally get into the 990X.
- Only use attachments/accessories provided the manufacturer.

12.5 Legal Notices

12.6.1 Trademarks and Patents

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12.6.2.2 This publication may contain examples of screen captures and reports used in daily operation. Any such examples may include fictitious names of individuals and companies. Any similarity to names and addresses of actual businesses or persons is entirely coincidental.

12.3.2.2 This equipment contains no user serviceable internal constituents. Opening the equipment case voids the original product Limited Warranty terms and conditions.

12.6.3 Intended Equipment Use

This product shall be used only for the purpose it was designed and manufactured; refer to the product Data Sheet and user documentation. For the latest product information, contact your local supplier, or visit us online at www.florite.com.

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