



HI 2160RC^{PLUS}
Rate Controller
Operation and Installation Manual

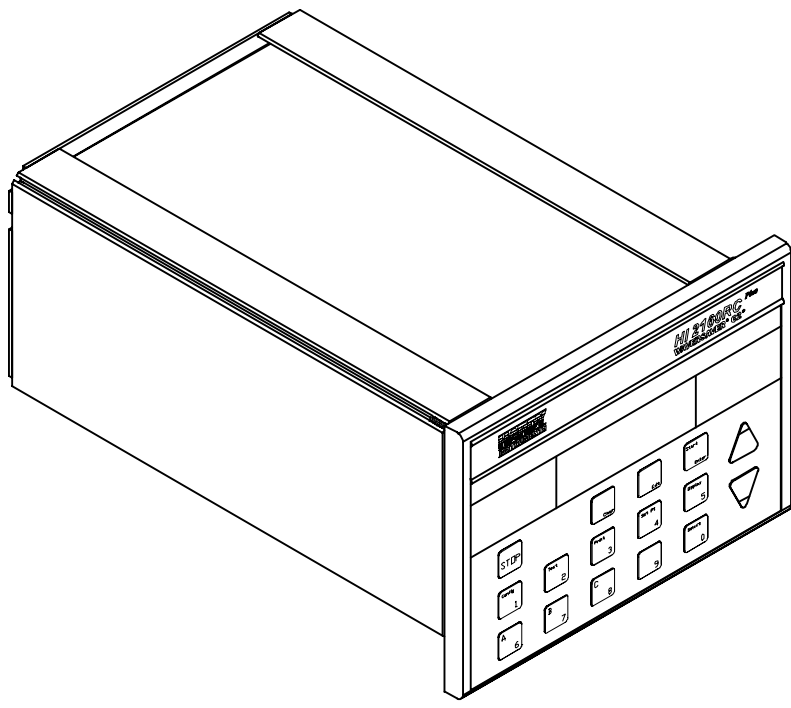


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CHAPTER 1 - OVERVIEW

About Chapter 1

This manual provides the user and service personnel with a description of the operating procedures, specifications, installation procedures, setup and configuration, maintenance and troubleshooting procedures for the Hardy Instruments **HI 2160RC^{PLUS} Rate Controller** with **WAVERSAVER[®]** (A Registered Trademark of Hardy Instruments, Inc.) To get the maximum service life from this product, users should use this instrument in accordance with recommended practices either implied or contained in this manual. The user and maintenance personnel should read and understand all cautions, warnings, and safety procedures, referenced or explicitly stated in this manual, to ensure the safe operation of this product. Hardy Instruments appreciates your business. Should you not understand any information in this manual or experience any problems with the product, please contact our Customer Service Department at:

Phone: (858) 278-2900

FAX: (858) 278-6700

Web Site: www.hardyinst.com

Support e-mail address: support@hardyinst.com

About Hardy Manuals

Every Hardy Installation and Operation manual is organized into easily referenced chapters, that are almost always the same:

- **Chapter One** - Provides an introduction to the instrument and an Overview of the equipment and its capabilities.
- **Chapter Two** - Provides a complete list of Specifications.
- **Chapter Three** - Contains information needed to Install the HI 2160RC^{PLUS} (both standard equipment and optional equipment) and the HI 215IT series Junction Box.
- **Chapter Four** - Provides complete hardware Configuration instructions for setting dip switches and jumpers.
- **Chapter Five** - Pertains to the firmware Setup and preparation procedures to calibrate and operate the instrument.
- **Chapter Six** - Provides Calibration instructions.
- **Chapter Seven** - pertains to the Operation of the HI 2160RC^{PLUS}.
- **Chapter Eight** - Pertains to the Troubleshooting procedures for repair of the instrument.

Description

The **HI 2160RC^{PLUS}** is a compact, single ingredient Loss-In-Weight controller. The rate controller is used in a variety of material flow applications for example auger, belt, and vibration based feeders. The HI 2160RC^{PLUS} measures the flow rate from a feeding device located on a process weighing scale. The rate is measured by calculating the loss of weight over a very short period of time. The rate controller compares the actual rate of flow to the desired rate of flow, computes the appropriate change(s) and transmits a signal (0-30 Millivolts) to either speed

up or slow down the driver of the feeding device thereby achieving the desired flow rate. The user simply enters the flow parameters via the key touch pad (See Fig. 1-1) or standard bi-directional serial port or optional Interface and the HI 2160RC^{PLUS} rate control algorithm automatically calculates and adjusts the tuning parameters thereby maintaining the desired flow rate. The analog to digital converter in the rate controller is capable of greater than 1,000,000 counts of resolution, detecting the smallest fluctuations in rate of flow.

NOTE:

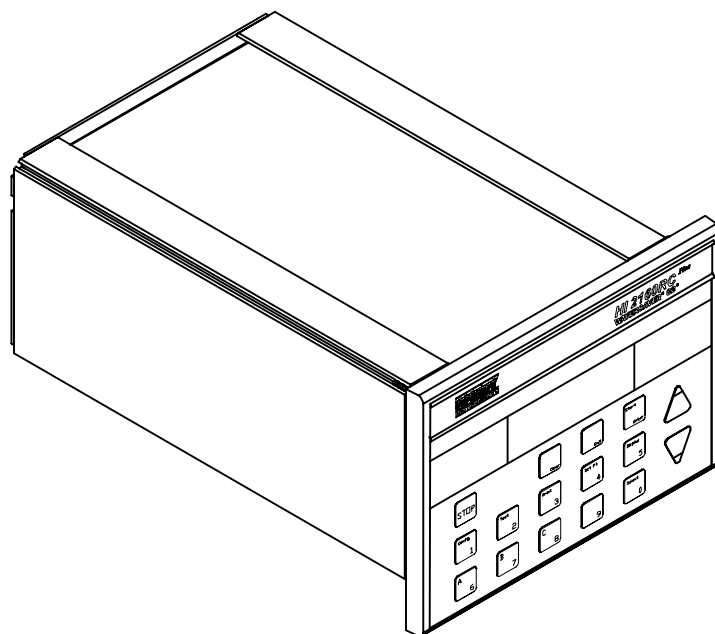
Manual adjustment of the tuning parameters is typically not necessary, but can be done.

WAVERSAVER[®]

Typically, mechanical noise (from the feeders and plant environment) is always present and much larger when compared with the detection and control of small changes in weight. The HI 2160RC^{PLUS} is fitted with WAVERSAVER[®] technology which ignores mechanical noise present in all material flow applications. WAVERSAVER[®] enables the rate controller to decipher actual weight data from mechanical noise and blocks the mechanical noise transmitted from the load cell.

ALARMS

The HI 2160RC^{PLUS} is fitted with two alarms to detect exceptions to the desired flow rate. The **Rate Tolerance Alarm** is configured to monitor a tight guard band around the desired flow rate. The guard band is user selectable. The alarm is triggered when the desired flow rate exceeds the selected guard band tolerance for a selected period of time. The Rate Tolerance alarm is connected to a relay which can activate a visual or sound alarm. This alarm is used for small changes in the desired flow rates. The **Rate Exception Control (REC) Alarm** uses a broader guard band tolerance than the Rate Tolerance Alarm. The alarm is triggered by an out of tolerance flow rate. The controller in REC Alarm state continues to control the flow rate while trying to bring the exceptional flow rate into tolerance. The REC is a user selectable alarm which can display an "REC" at the bottom left corner of the controller display and/or shut down the feeder system.

FIG. 1-1 HI 2160RC^{PLUS} RATE CONTROLLER

Capabilities

Automatic Control Mode	Automatically corrects for variations in desired flow rates.
WAVERSAVER[®]	Ignores plant and process vibration for more accurate measurement of feed rates.
Manual Control Mode	Use the up and down arrows to manually control the flow rate. Convert to automatic mode when proper flow rate is achieved.
Continuous or Batch Modes	User selectable operating modes for continuous or batch processing.
Automatic Refill	User selectable refill points to start and stop the refill process. HI and LO alarms to detect a refill failure.
Manual Refill	Allows for manual refill at anytime.
Automatic Tuning (Auto Rate Calibration)	Provides the user with automatically calculated parameters or the user can manually enter their own derived values.
Operation Displays	Single button selection of Predefined operating displays such as, Rate, Current Weight, Totalized Weight, and Batch data.
Secure Memory Module	Provides for stored critical data to be transferred to a replacement HI 2160RC PLUS. Conveniently located on the rear panel, replacement

takes only a few seconds. Does not require recalibration of the scale. Maximizes up time for the feed systems.

Control Output

Electrically and optically isolated, user selectable 0-20 mA, 4-20 mA, 0-5 VDC, or 0-10 VDC output.

Front Panel

5" x 7" Waterproof when mounted in a NEMA 4 enclosure.

Serial Communications

Bi-directional serial port (RS 232) allows reading of data and downloading of feed rate instructions.

Hardy Link Communications

Assigns addresses to each instrument so they can share the same Serial Chain.

Self Test

User can easily troubleshoot the controller by implementing the internal self test.

Reports

Automatically prepares batch performance reports.

C2[®] Second Generation Calibration

Electronic method for calibrating a scale.

Remote Operation

The HI 2160RC^{PLUS} is fitted with a bi-directional serial port, an optional Allen Bradley I/O card or PROFIBUS Interface, which allow for remote operation of the controller.

Multiple Configuration Storage

Stores up to twelve different complete system configurations allowing fast and easy transition to a new material, auger or entire feeder.

Two Sigma

The 2 Sigma Test feature is used to measure the feed rate performance for any given feeder system. The 2 Sigma Test can be run on demand during all feed cycles.

Interpreting the Model Code Number

Model Code Breakdown

- The model code number can be found on a label that is attached to the top panel of the HI 2160RC^{PLUS}.
- The model code number starts with the base model number (HI 2160RC^{PLUS}). The dash alphanumeric designations indicate the capabilities of the rate controller. For example: A model HI 2160RC-PM-A1-B1 is a Panel Mount controller with 4-20 milli-amp control output and RS-232 to RS-422 converter. (See Fig. 1-2)

HI 2160RC-PM-A1-B1-C1-D1-E1

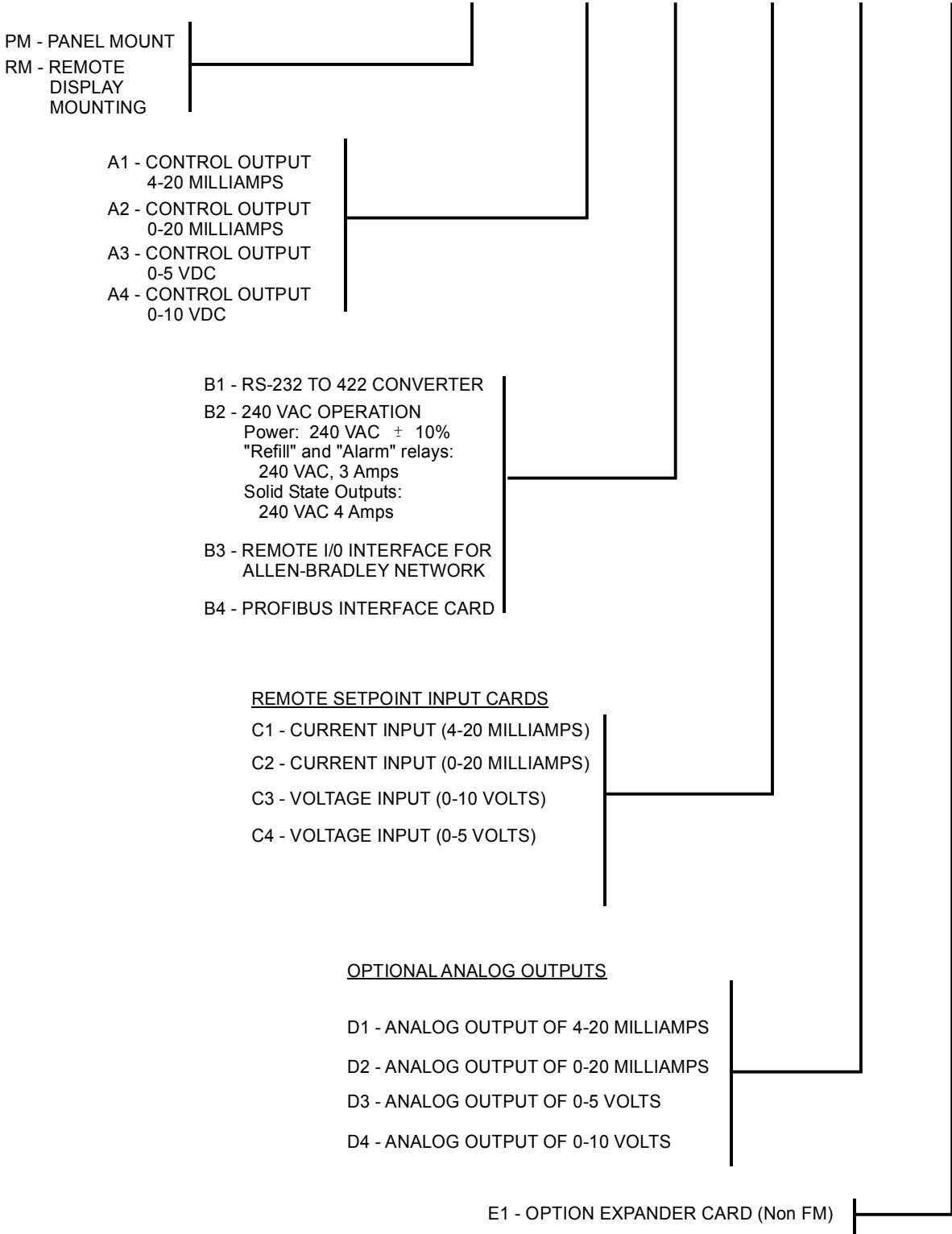


FIG. 1-2 MODEL CODE BREAKDOWN

- Optional Expander Box (Non FM) (See Fig. 1-3)

The dash number for the expander box is:
-HI216EX

If the expander box is configured for 240 VAC Operation the dash number is:
-B2

NOTE:

Requires the -E1 option expander card to be installed in the main rate controller.

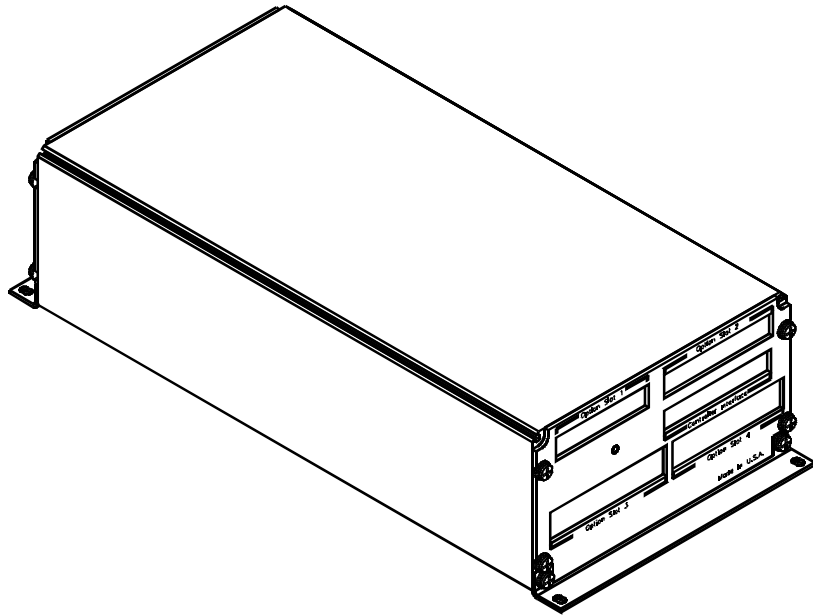


FIG. 1-3 OPTIONAL EXPANDER BOX (NON-FM)

CHAPTER 2 - SPECIFICATIONS

About Chapter 2

Chapter 2 lists the specifications for the HI 2160RC^{PLUS} rate controller. Specifications are listed for the standard instrument and for instruments fitted with optional equipment. The specifications listed are designed to assist in the installation, operation and troubleshooting of the instrument. All service personnel should be familiar with this section before attempting an installation or repair of the instrument

HI 2160RC^{PLUS} Specifications

Input	Up to 4 (four) 350 ohm load cells (10 volt excitation) Full Wheatstone Bridge, Strain Gauge Load Cells
Output	Control Out - Isolated Outputs, user selectable <ul style="list-style-type: none">• 4-20 Milliamp• 0-20 Milliamp• 0-5 Volt DC• 0-10 Volt DC
Storage	<ul style="list-style-type: none">• Battery Backed RAM• Secure Memory Module Calibration Data
Instrument Resolution	<ul style="list-style-type: none">• Display: 1:985,000 (for 3 mv/v)• Internal: 1:1,048,576
Remote Control Options	<ul style="list-style-type: none">• Allen Bradley Programmable Logic Controller (PLC)• Profibus (Various PLCs)• Serial Port - RS-232C (Standard)• Serial Port - RS 422/485• Remote Set Point (Analog)
Alarms (Relays)	<ul style="list-style-type: none">• Rate Tolerance Alarms• Refill Alarms• Rate Exception Control Alarm (REC)• Shut Off• ON/OFF
Analog to Digital Specifications	<ul style="list-style-type: none">• Conversion Rate: 20 updates per second• Averages: 1 to 200 selectable in increments of 1• Rate of Change Time Base: 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 30, 40, 50, 60, 100, 120 (seconds)• Non-Linearity: 0.0015% of Full Scale• Common Mode Rejection: 100 dB at or below 60Hz• Common Mode Voltage: 300 VAC or VDC maximum (with respect to earth ground)

Output Display Specifications

- Liquid Crystal Display (LCD) - 80 characters
- Display Format: 4 line x 20 character full ASCII (5 x 7 dot matrix)
- Display Increments: 1,2,5,10,20,50,100,200,500 counts selectable by keypad. Corresponding weight is dependent on decimal point location.

NOTE:

Only the weight display increments are effected by graduations

Reports

- Automatic Batch Reports
- Print Screen Available
- Two Sigma

Power and Utility Requirements

- 120 VAC (47-63 Hz) Standard from factory.
- 240 VAC (47-63 Hz) (Optional) Installed at factory with power and relay modifications.

Environmental Requirements

- Operating Temperature Range: -10 to 50 C (14 to 122 F)
- Storage Temperature Range: -20 to 85 C (-4 to 185 F)
- Temperature Coefficient: Less than 0.005% of full scale per degree C for zero and span.

Physical Characteristics

- Overall Size - 7"W x 4.88"H x 10.04"L
- Weight: 6 pounds (2.72 Kilograms)

Enclosure Rating

- NEMA 4 & 4x Seal when placed in a NEMA 4 & 4X Enclosure.

Approvals

- UL Certification
- CSA Certification
- Factory Mutual (FM) Approval

Connectors

- Relays: Phoenix 12 pin connector
- RS-232: Phoenix 6 pin connector (Standard)
- Alarm Relays: Phoenix 6 pin connectors
- Load Sensors: Phoenix 8 pin connectors

Options

Remote Set Point Input Option - Basic Function

1. Reads analog input signals from a master controller, Programmable Logic Controller (PLC), or from a main ingredient flow meter device.
2. Changes the rate of flow set point to proportionally track the master controller's flow rate.
3. Changes the rate of flow set point to a new fixed rate, downloaded by the PLC via analog signal, if the input trigger is pulsed
4. Interface to the 2160 Rate Controller - Selectable 0-20 mA, 4-20 mA, 0-5 VDC, 0-10 VDC analog input signal.

RS422/485 (Serial Port Option) - Basic Function

1. Converts the Standard Serial Port from RS 232 to RS 422/485 signals.

	<ol style="list-style-type: none">2. Same function as standard serial port but with the capability to run in multidrop mode and handle long distance (50-1000 ft.) communications.3. Interfaces to the 2160 Rate Controller - RS422/485 serial communications with a comprehensive ASCII command set for bi-directional and multidrop communications over a long range.
ALLEN BRADLEY Remote I/O Option - Basic Function	<ol style="list-style-type: none">1. Allows the Allen Bradley PLC to fully configure, monitor, and control the HI2160RC via the AB Remote I/O Interface.2. Processes both Discrete and Block Transfer commands.3. Interfaces to the 2160 Rate Controller - Communications on the Allen Bradley (AB Remote I/O network utilizing a complete and comprehensive discrete and block transfer command set. Uses three-wire "Blue Hose" cable to interface with Allen Bradley.
PROFIBUS Interface Option Card	<ol style="list-style-type: none">1. Allows the Profibus to fully configure, monitor and control the HI 2160RC PLUS.2. Interfaces to the HI 2160RC PLUS rate controller. Enables communications on the Profibus network utilizing comprehensive block and operator selectable output.
Quad Option Expander Box - Basic Function (See Fig. 1-3)	<ol style="list-style-type: none">1. Expands the capability of the HI 2160RC PLUS.2. Houses up to four option cards in its own enclosure.3. Interfaces to the 2160 Rate Controller - TTL interfacing between the HI 2160RC PLUS and the quad option box via quad interface card, installed in the HI 2160RC PLUS option slot, and a 40 pin ribbon cable.
Analog Output Option Card	<p>The analog output option outputs Gross, Batch, Rate of Change (ROC), and total weight as 0-5 V, 0-10V, 0-20 mA or 4-20 mA (or the reverse of these values via the front panel). The analog output option makes it possible to span these ranges over a portion of the weight data.</p> <ul style="list-style-type: none">• Resolution: 16,000 counts or limited by the resolution calibrated on the display.• Voltage Out <p>Maximum Volts: 0-5 or 0-10 Temperature Stability 10 ppm/C or 5 mV total from 30 to 120 F</p> <ul style="list-style-type: none">• Current Out <p>Maximum Current: 0-20mA or 4-20mA Temperature Stability: 20 ppm/C or 20 microampere total from 30 to 120 F</p>

- Either Output

Linearity - 0.01%

NOTE:

With one (1) average selected.

Response Time After Update

1 millisecond
Isolation from Main Board

300 VAC or 450VDC
Update Rate

50 milliseconds (20 times/second)

**RS-232 to RS-422
Converter Board
Option**

The RS-232 to RS-422 Converter Board Option converts RS-232C standard signals to RS-422 4 wire format signals.

- RS-232 Connector Required Input Signals

<u>PIN</u>	<u>SIGNAL</u>
Control Lines:	
1	CTS
2	RTS
Data Lines:	
3	/Rxd
4	Txd
6	Signal GND

Board Power (not isolated)

5 +5v

RS-422 Connector Output Signals

<u>PIN</u>	<u>SIGNAL</u>
Data Lines:	
2	Txd
3	/Txd
4	Rxd
5	/Rxd

NOTE:

We recommend that the RS-422 cable shield connection be terminated to frame ground on the HI 2160RC^{PLUS} rear panel.

CHAPTER 3 - INSTALLATION

About Chapter 3

All information contained in Chapter 3 pertains to unpacking, cabling, interconnecting and installing the HI 2160RC^{PLUS} rate controller. Alternatives to any specifications contained or implied in this section are not recommended. It is very important that the user and service personnel be familiar with the procedures contained in this chapter, before installing or operating the HI 2160RC^{PLUS} rate controller.

Unpacking

- Step 1. Before signing the packing slip, inspect the packing for damage of any kind.
- Step 2. Report any damage to the carrier company immediately.
- Step 3. Check to see that everything in the package matches the bill of lading. You should normally have:

- 1 - HI 2160RC^{PLUS} instrument with mating connectors installed.
- 1 - Mounting Rail Kit (Prt. # 0551-0287-01)

4 - mounting Rails

4 -6-32 UNC phillips panhead machine screws.

1 - Installation and Operation Manual

NOTE:

The HI 2160RC^{PLUS} comes in two configurations: Panel Mount and Remote Mount. Depending on the configuration purchased, some additional hardware such as rack mounts may be included.

- Step 4. If any items are missing, damaged, or there are any questions, please contact Customer Support at:

Hardy Instruments

3860 Calle Fortunada

San Diego, CA 92123-1825

Phone: (858) 278-4900

FAX: (858) 278-6700

Web Site: <http://www.hardyinst.com>

Customer Support e-mail: support@hardyinst.com

- Step 5. Record the model number and serial number of the Rate Controller. Store in a convenient, secure location for reference when contacting Hardy Instruments Customer Service Department or to buy parts or firmware upgrades.

Installing the HI 2160RC PLUS in a Panel

Mechanical Installation

Panel Cutout Specifications

Enclosure Size Requirements.

- Overall depth of the enclosure must be a minimum of 11.75" to allow for the 2" clearance between the rear panel of the HI 2160RC^{PLUS} and the inside surface of the rear panel of the enclosure. (See Fig. 3-1)
- There must be a 1" clearance completely around the bezel and other installed units. (See Fig. 3-2)

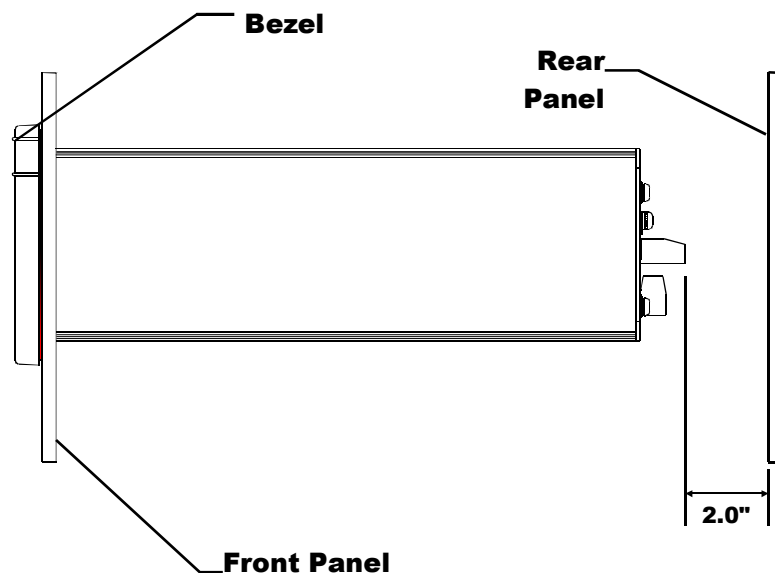


FIG. 3-1 2" CLEARANCE REQUIREMENT

Dimensions of the enclosure cutout (See Fig. 3-3)

- 6.35" ± .06 (161.3mm ±1.50) Wide
- 4.09" ± .06 (103.9mm ±1.50) High
- All cutout surfaces must be deburred before installation of the controller.

WARNING

DO NOT MOUNT THE HI 2160RC^{PLUS} RATE CONTROLLER NEAR A HIGH MAGNETIC FIELD OR HIGH VAC POWER SOURCE. TO DO SO WILL EFFECT THE PERFORMANCE OF THE CONTROLLER AND MAY RESULT IN PROPERTY DAMAGE.

Installing the HI 2160RC^{Plus} Panel Mount

- Step 1. Make sure that all Electrostatic Discharge (ESD) precautions have been taken, before installation.
- Step 2. The controller comes with a NEMA 4 rated compression gasket. Make sure the gasket is properly seated in the bezel before installation.

- Step 3. Gently slide the controller into the cutout in the enclosure.
 (See Fig. 3-4) Be sure to secure the controller with both hands when installing.

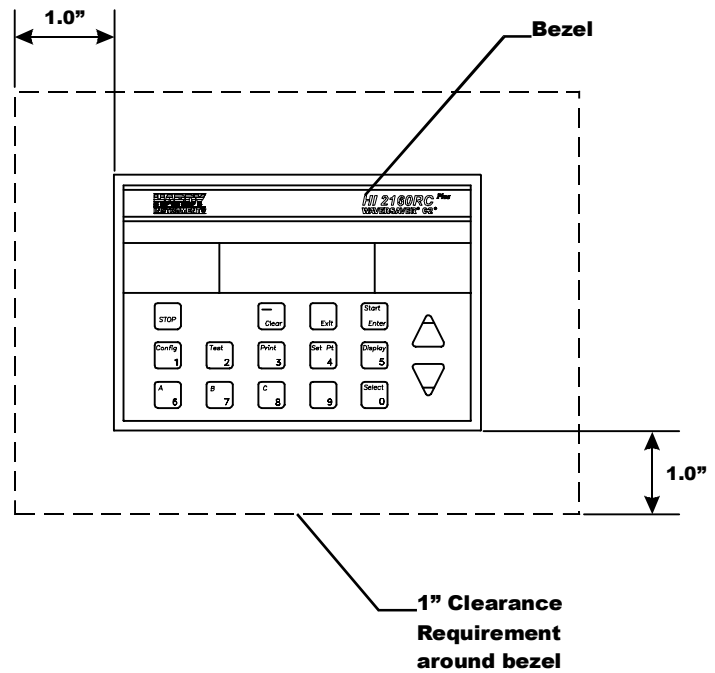


FIG. 3-2 1" CLEARANCE REQUIRE AROUND BEZEL

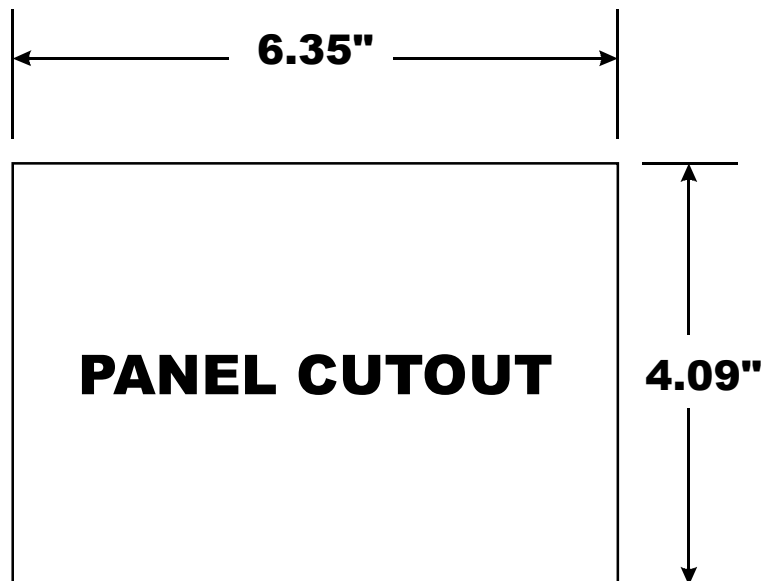


FIG. 3-3 PANEL CUTOUT DIMENSIONS

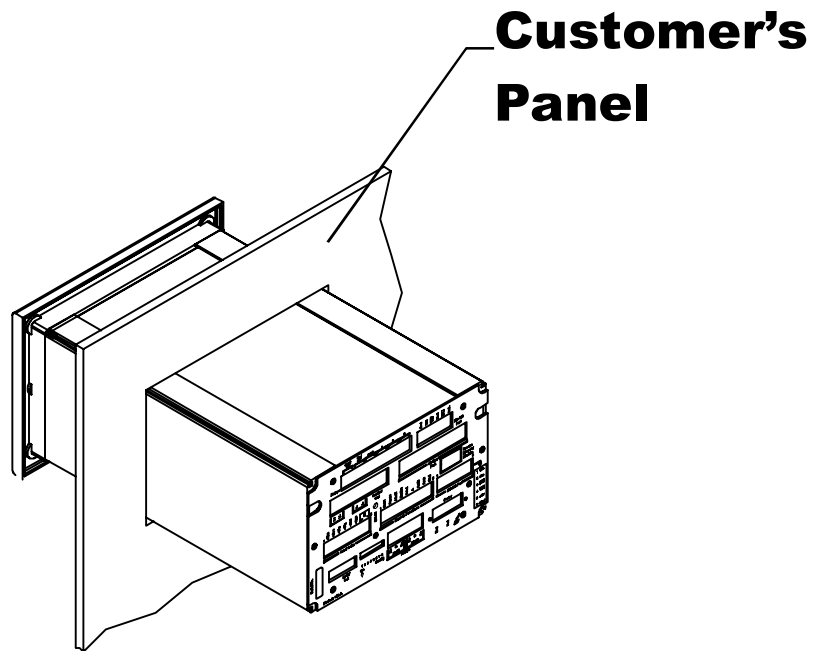


FIG. 3-4 MOUNTING CONTROLLER IN PANEL

- Step 4. Slide the controller into the panel cutout until the NEMA 4 gasket is flush against the front panel of the enclosure. (See Figs. 3-5, 6, & 7)

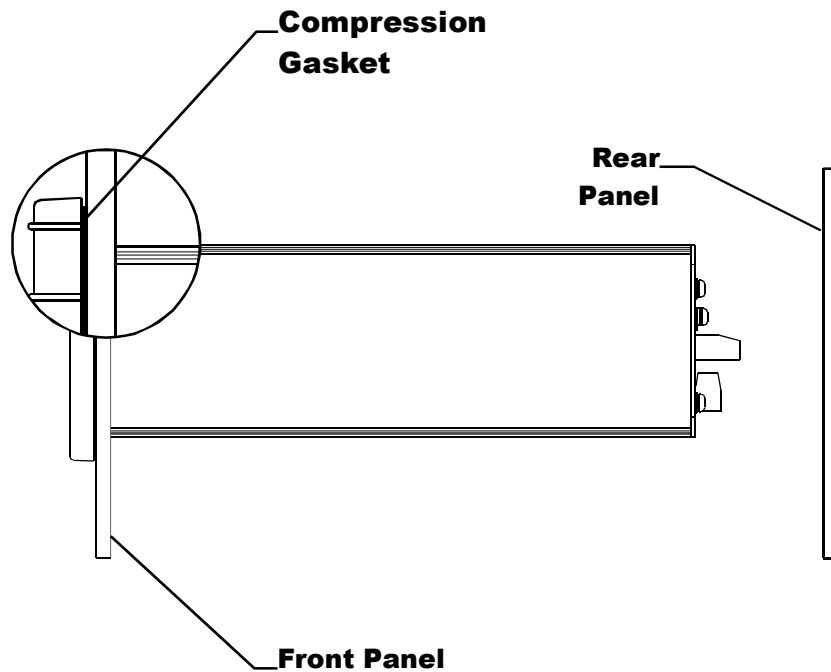


FIG. 3-5 NEMA 4 GASKET FLUSH AGAINST THE FRONT PANEL

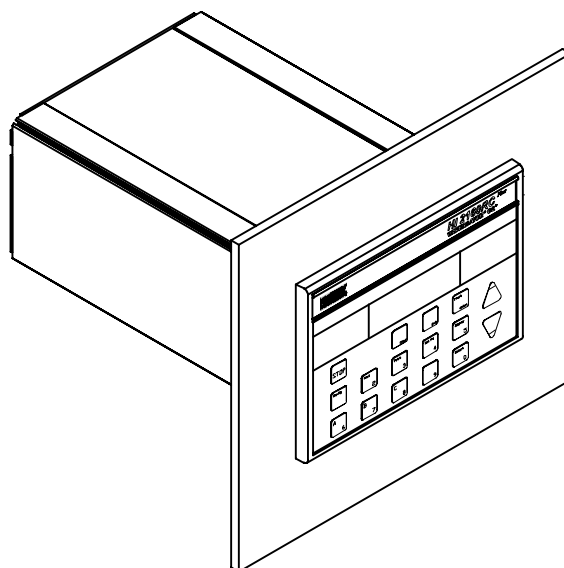


FIG. 3-6 CONTROLLER FLUSH TO FRONT PANEL/FRONT VIEW

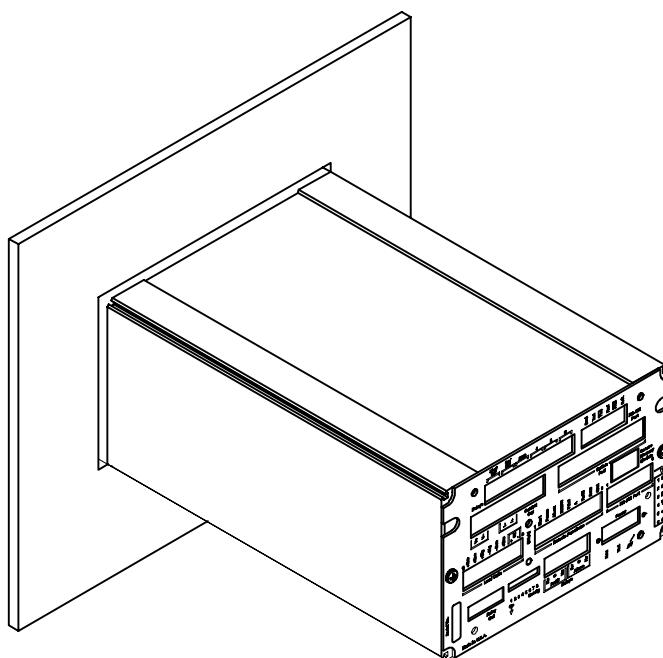


FIG. 3-7 CONTROLLER FLUSH TO FRONT PANEL/REAR VIEW

Step 5. Install the four (4) mounting bars. (See Fig. 3-8)

- Slide each of the mounting bars into the slots at the rear of the controller.
- One end of the mounting bar is recessed. Make sure you install the bars from this end. (See Fig. 3-8)
- Check to be sure the mounting bars are flush against the inside surface of the front panel. (See Fig. 3-9)

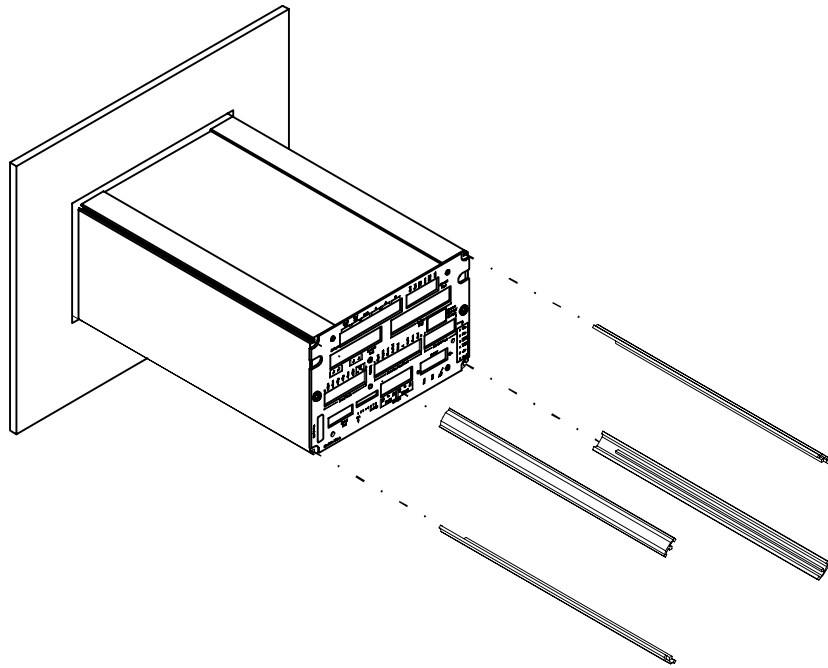


FIG. 3-8 INSTALLING MOUNTING BARS

- Install the four (4) 6-32 pan head machine screws into the threaded slots at each corner of the controller. (See Fig. 3-9)

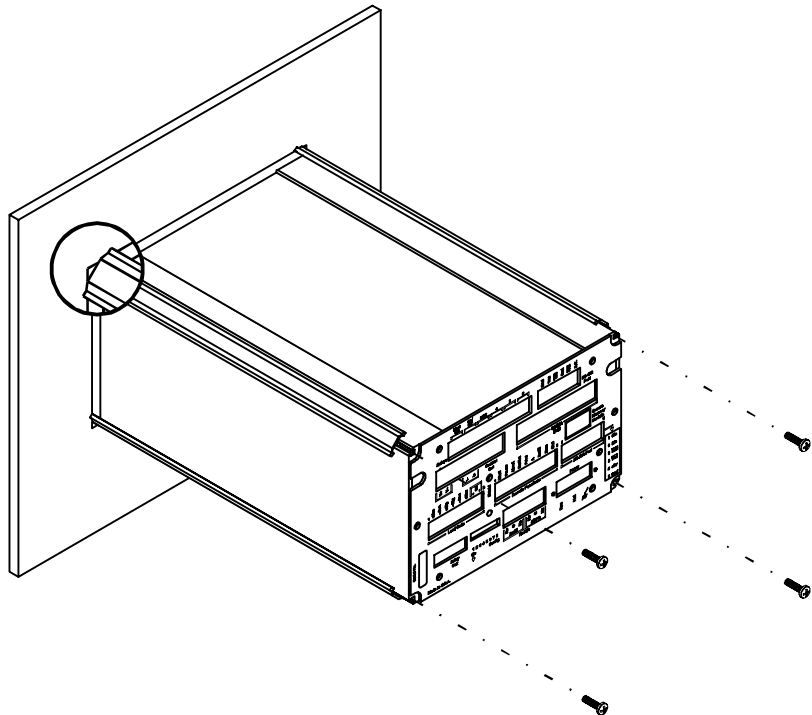


FIG. 3-9 INSTALLING 6-32 MACHINE SCREWS

- Hold the controller so that it is aligned and flush against the enclosure front panel throughout the entire tightening process.
- Facing the rear panel of the controller, tighten each screw in a clockwise direction from corner to corner until each screw is finger tight. (See Fig. 3-11)

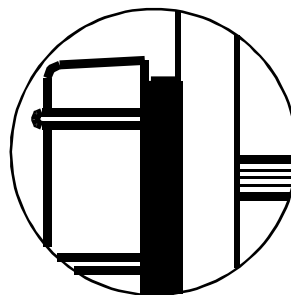
NOTE:

If the machine screws should come loose, use a thread lock compound when reinstalling. See the Troubleshooting Section for recommended thread lock compounds.

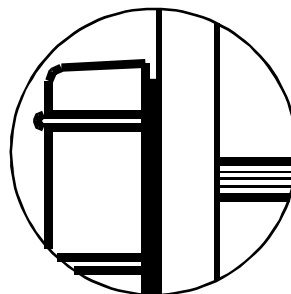
- Using a phillips screw driver, continue the clockwise direction and partially tighten each screw until the NEMA 4 bezel gasket is completely compressed and the bezel is flush against the front panel of the enclosure. (See Fig. 3-10 & 3-11) Do not tighten one screw down completely and then go on to the next screw. Each screw must be tightened a little before going on to the next to maintain the alignment between the controller and the front panel of the enclosure.

CAUTION

DO NOT OVERTIGHTEN THE MACHINE SCREWS. OVERTIGHTENING CAN DEFLECT THE BEZEL SO THAT IT WILL NOT BE WATER TIGHT AND/OR BREAK OFF THE CORNERS OF THE BEZEL.



Before tightening the mounting bars



After tightening the mounting bars

FIG. 3-10 NEMA 4 GASKET BEFORE AND AFTER TIGHTENING THE MOUNTING BAR FASTENERS

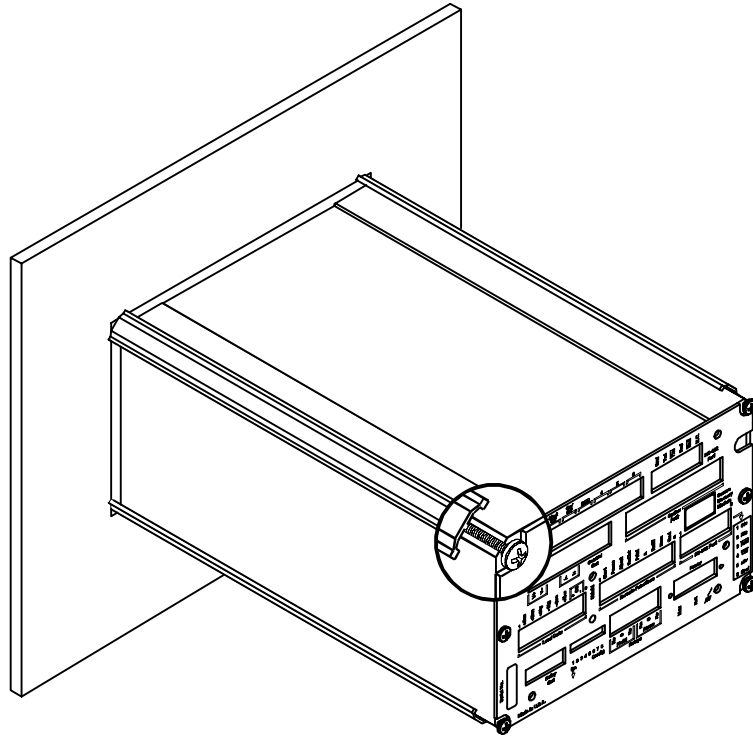


FIG. 3-11 MOUNTING BARS AND MACHINE SCREWS INSTALLED

Step 6. The Panel Mount installation is complete.

Installation of HI
2160RC^{Plus} - RM
Remote Panel
Model

NOTE:

See Figure 3-3 for information about the panel cutout.

- Step 1. Make sure that all Electrostatic Discharge (ESD) precautions have been taken, before installation.
- Step 2. The controller comes with a NEMA 4 rated compression gasket. Make sure the gasket is properly seated in the bezel before installation.
- Step 3. The front panel comes with two (2) mounting brackets mounted on the bezel. (See Fig. 3-12)
- Step 4. Remove the nuts that fasten the brackets to the bezel. (See Fig. 3-13)
- Step 5. Remove the brackets.
- Step 6. Gently slide the front panel into the enclosure cutout until the gasket is seated against the front of the enclosure. (See Fig. 3-14)

NOTE:

The nuts on the mounting studs barely clear the cutout. It might take a little adjusting to get the bezel into the cutout.

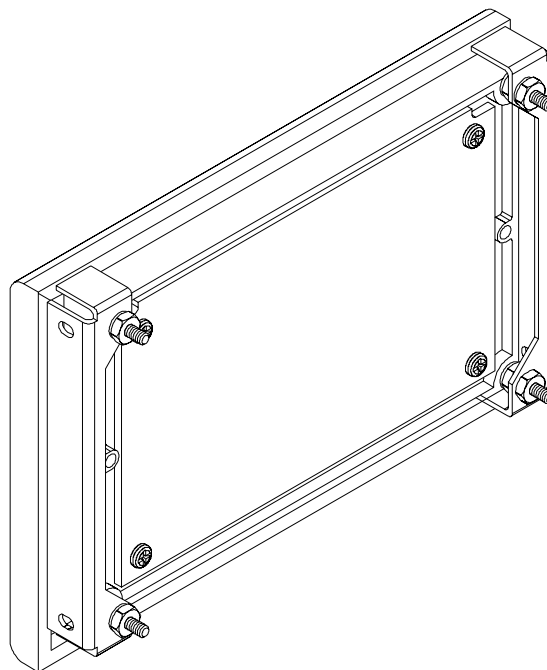


FIG. 3-12 FRONT PANEL WITH BRACKETS FROM FACTORY

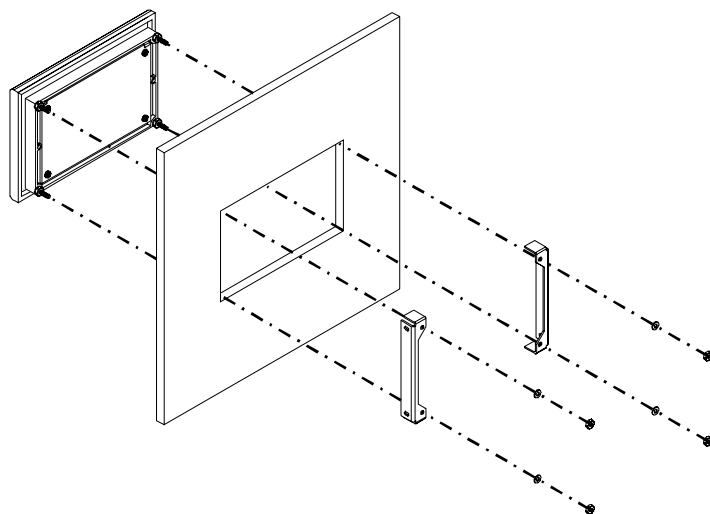


FIG. 3-13 BEZEL INSTALLATION DIAGRAM

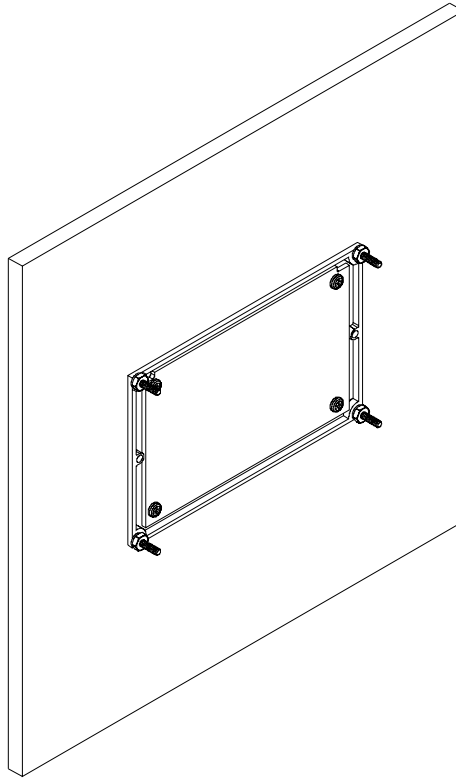


FIG. 3-14 SLIDING BEZEL INTO THE PANEL CUTOUT

- Step 7. Place the brackets, #6 flat washer, lock washer and hex nut on the four (4) bezel studs. (See Fig. 3-13)
- Step 8. Make sure that the bezel is centered in the cutout.
- Step 9. Tighten the #6 hex nuts finger tight.
- Step 10. Use a nut driver or box end wrench and tighten the nuts in turn so that the bezel is flush against the front surface of the enclosure front panel. (See Fig. 3-15)

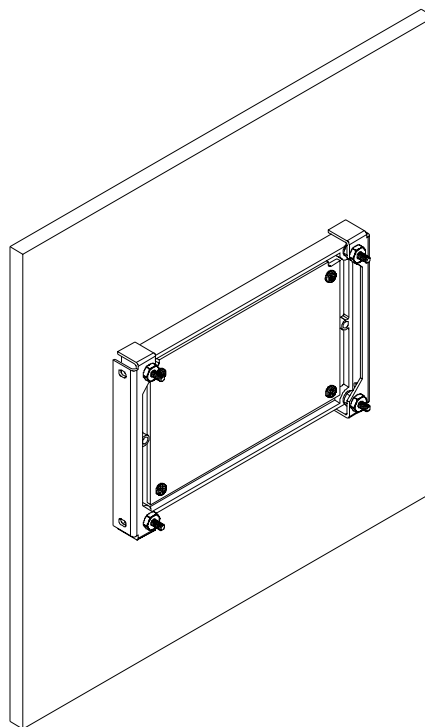


FIG. 3-15 REMOTE PANEL INSTALLED

CAUTION

DO NOT OVERTIGHTEN THE HEX MACHINE SCREWS. OVERTIGHTENING CAN DEFLECT THE BEZEL SO THAT IT WILL NOT BE WATER TIGHT AND/OR BREAK OFF THE CORNERS OF THE BEZEL.

Step 11. To mount the electronics to the back plate in the enclosure you will need to drill a .156 inch tapped or thru hole and use a 6-32 pan head machine screw to fasten the electronics to the panel. (See Fig. 3-16)

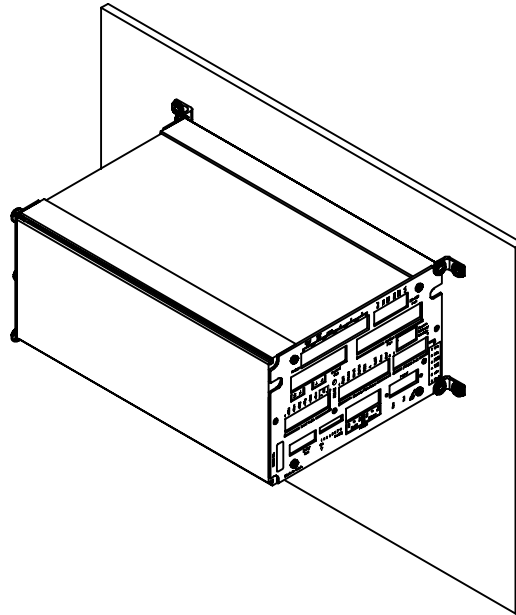


FIG. 3-16 ELECTRONICS MOUNTED TO ENCLOSURE REAR PANEL

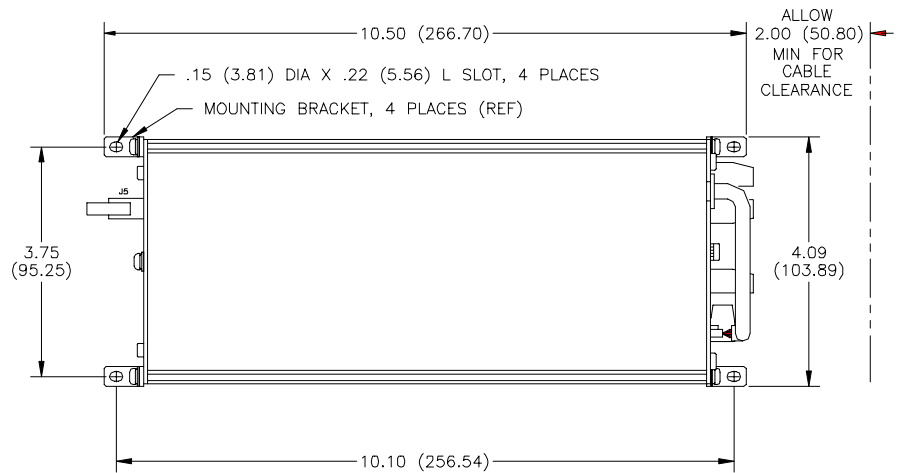


FIG. 3-17 DIMENSIONS DIAGRAM FOR REMOTE MOUNT

Step 12. Connect the 60 inch, 40 pin ribbon cable (See Fig. 3-18) to the 40 pin connection (J5) on the electronics and the 40 pin connection (J4) at the rear of the front panel display.

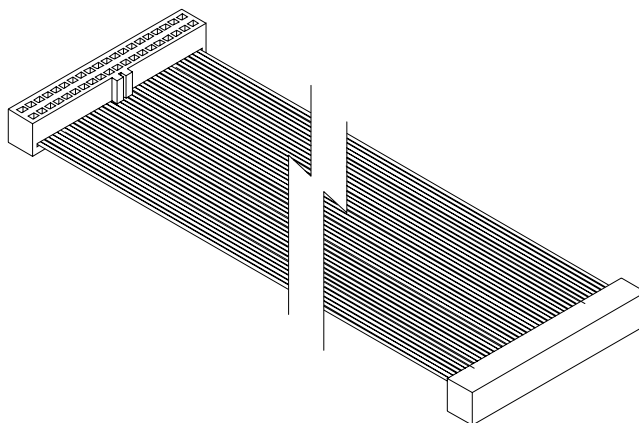


FIG. 3-18 PIN CABLE ASSEMBLY HI 2160^{PLUS} REMOTE PANEL

Step 13. Remote panel mechanical installation is complete.

NOTE:

The electronics can be mounted on either side, or on either end.

Installation of the HI
216EX Quad
Expander Box

WARNING

DO NOT MOUNT THE HI 2160RC PLUS RATE CONTROLLER NEAR A HIGH MAGNETIC FIELD OR HIGH VAC POWER SOURCE. TO DO SO WILL EFFECT THE PERFORMANCE OF THE CONTROLLER AND MAY RESULT IN PROPERTY DAMAGE.

- Step 1. Make sure that all Electrostatic Discharge (ESD) precautions have been taken, before installation.
- Step 2. The Quad Expander box comes with an AC Power Cord (Prt. #6006-0008), a 60 inch, 40 pin controller interface ribbon cable (Prt. #0509-0451) and four (4) mounting brackets (Prt. #0505-0264)
- Step 3. Drill and tap four (4) holes in the rear panel of the enclosure for four (4) 6-32 pan head machine screws, #6 lock washers, #6 flat washers. (See Fig. 3-19).
- Step 4. Place the expander box over the holes and install the four fasteners and washers. (See Fig. 3-19)
- Step 5. Connect the 40 pin controller interface ribbon cable to the J1 on the expander box and to the option port on the HI 2160RC^{PLUS} Rate Controller.
- Step 6. If the PROFIBUS Option card is installed with the quad option, see the PROFIBUS Operation and Installation Manual (Doc. # 0596-0211) for installation instructions.
- Step 7. Connect the AC power cord to the Quad Expander Box and to a 10A-125VAC power source.

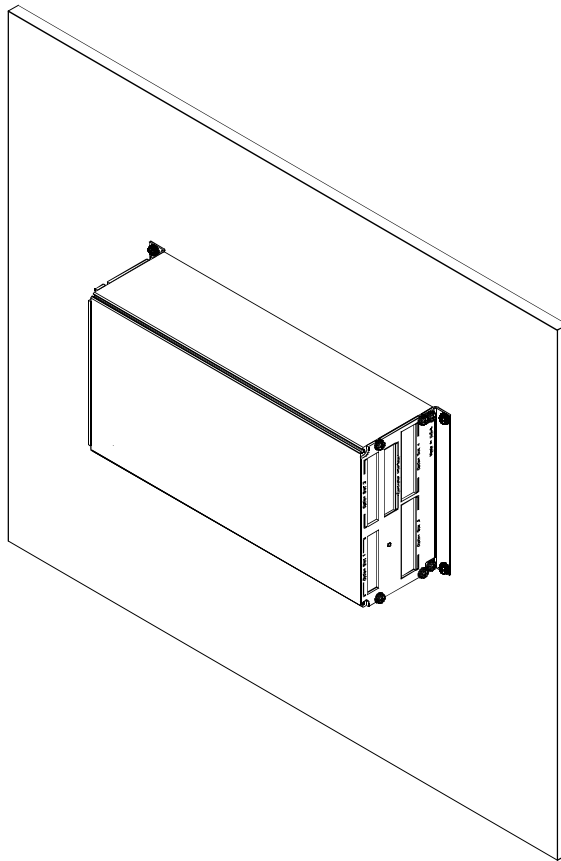


FIG. 3-19 QUAD EXPANDER INSTALLED

Electrical Installation

Cabling and Interconnecting

Recommended Installation Procedures

- Carefully plan the cable runs and wiring connections before routing, cutting and trimming cables and wires.

CAUTION

INSTRUMENT POWER AND RELAY WIRES SHOULD BE ROUTED AWAY FROM ALL OTHER SIGNAL CABLES TO AVOID ELECTRICAL INTERFERENCE.

- All cabling should be neatly bundled, tied, and dressed.
- Use a 6 inch service bend to relieve stress on the connectors and to ease servicing the unit.
- Make sure that all plugs are firmly in place.
- Be sure to secure the power cord with the two (2) captive screw-on clips.
- All connections are made at the rear panel of the rate controller. (See Fig. 3-20)

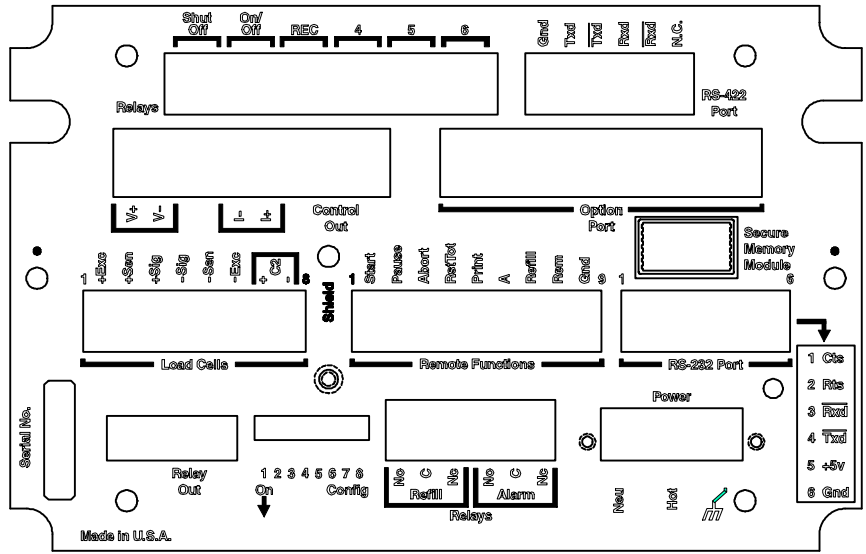


FIG. 3-20 REAR PANEL

Output Relay Wiring Diagram (See Fig. 3-21)

- Solid State Relay Contact Rating:
120/240 VAC
4 AMPS
- Fuse Rating: 5 AMPS
- Wire Size: 14 AWG
- Relay 4 used for Optional Batch Complete Signaling
- Relays 5,6 are not used.

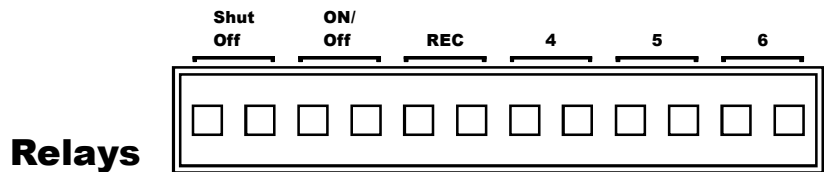


FIG. 3-21 OUTPUT RELAY CONNECTION

Speed Control Output Wiring Diagram (See Fig. 3-22)

- Wire Size:
Maximum - 12 AWG
Minimum - 22 AWG

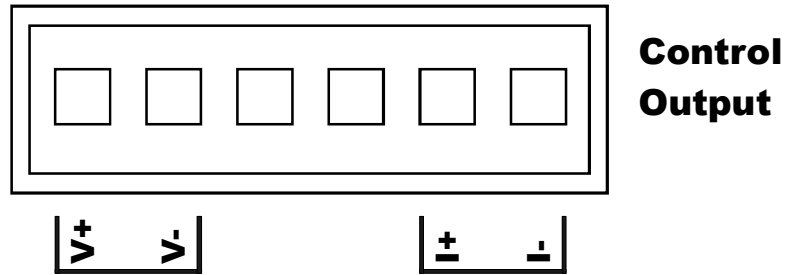


FIG. 3-22 MOTOR CONTROL OUTPUT

Refill and Alarm Relays Diagram (See Fig. 3-23)

- Wire Size: 14 AWG
- No (Normally Open), C (Coil), Nc (Normally Closed)

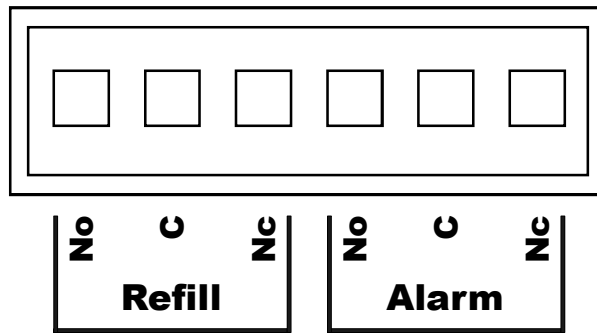


FIG. 3-23 REFILL AND ALARM RELAYS

RS 232 Port Wiring Diagram (See Fig. 3-24)

- Wire Size:
Maximum - 12 AWG
Minimum - 22 AWG

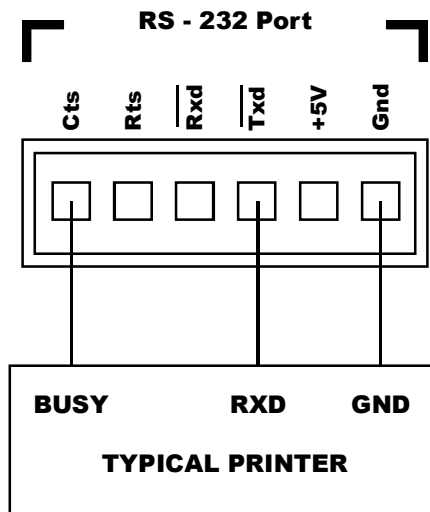


FIG. 3-24 RS 232 WIRING DIAGRAM

Remote Functions
Wiring Diagram
(See Fig. 3-25)

- Wire Size: (Twisted Pair Shielded)
Maximum - 12 AWG
Minimum - 22 AWG
- Momentary Functions require 100 mSEC or greater to ground for proper activation. Use remote functions ground only for activating remote functions.
- Use twisted pair shield cable only. Maximum length 60 inches.

CAUTION

REMOTE FUNCTIONS ARE NOT ISOLATED. DO NOT BUNDLE WIRING FROM REMOTE FUNCTIONS WITH POWER CABLE, RELAY CABLE OR WITH ANY OTHER HIGH ENERGY CABLES.

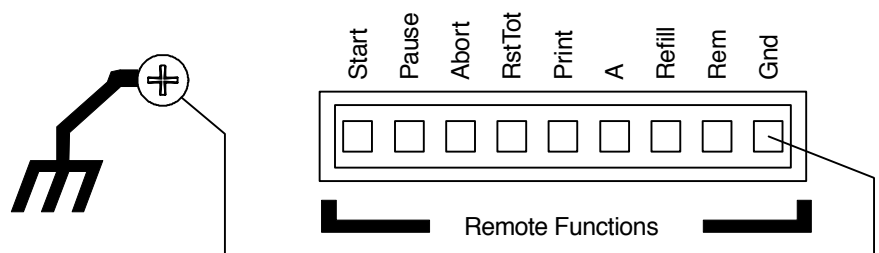


FIG. 3-25 REMOTE FUNCTIONS WIRING DIAGRAM

Input Power Wiring
Diagram (See Fig.
3-26)

WARNING

DO NOT OPERATE WITH INCORRECT LINE VOLTAGE. TO DO SO WILL RESULT IN PROPERTY DAMAGE OR PERSONAL INJURY. CHANGING THE INPUT VOLTAGE RATING BETWEEN 120 AND 240 VAC REQUIRES MODIFICATIONS TO THE POWER/RELAY CIRCUIT BOARD AND RELAY OUTPUT BOARD. THIS PROCEDURE SHOULD ONLY BE DONE BY AUTHORIZED PERSONNEL. FOR FURTHER ASSISTANCE CONTACT HARDY INSTRUMENTS, CUSTOMER SUPPORT.

NOTE:

Remote functions wires carry very low voltage signals. They operate on TTL ground levels. The Remote Functions wires should be shielded and routed away from the relay output wires and all other AC voltage lines to prevent electrical induction and false ground triggering. Maximum length 60 inches.

- The HI 2160RC^{PLUS} is factory configured to operate from either 120 or 240 VAC, 50 or 60 Hz power. Check the model number of your unit to verify the voltage. If the unit is configured for 240 VAC, a "B2" will be printed on the name plate.
- The power and relay circuit card filters conditions AC power. However, for noisy power lines, external conditioning may be required. Contact Customer Support for more information.
- The AC power should be supplied by a "clean" primary line, directly from the power panel. This line should not supply any other

equipment, including the feeding unit, and should be supplied with a minimum 10 amp breaker.

- To connect power to the controller, assemble a 3-wire, 14 to 20 AWG power cord to the 3-pin terminal block connector. (See Fig. 3-26)
- Wire Size:

Maximum - 14 AWG
 Minimum - 20 AWG

- Fuse: 5 AMP Slow-Blow

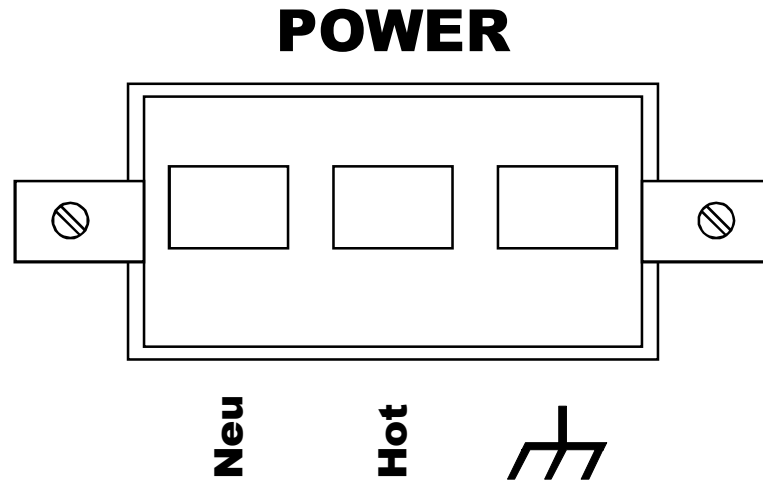


FIG. 3-26 POWER CONNECTION WIRING DIAGRAM

Remote Setpoint
 Option Wiring
 Diagram (See Fig.
 3-27)

- Wire Size:
 Maximum - 12 AWG
 Minimum - 22 AWG

RS-422 Converter
 Option Wiring
 Diagram (See Fig.
 3-28)

- Wire Size:
 Maximum - 12 AWG
 Minimum - 22 AWG

Analog Output
 Option Wiring
 Diagram (See Fig.
 3-28)

- Wire Size:
 Maximum - 12 AWG
 Minimum - 22 AWG

Remote Setpoint Option

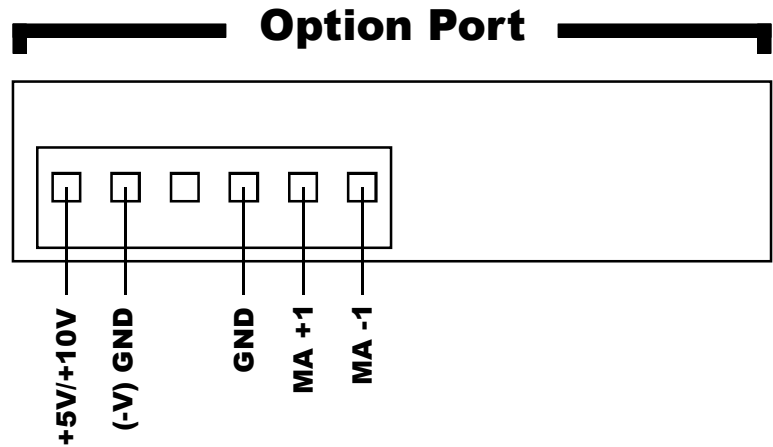


FIG. 3-27 REMOTE SETPOINT OPTION WIRING DIAGRAM

RS-422 Converter Option

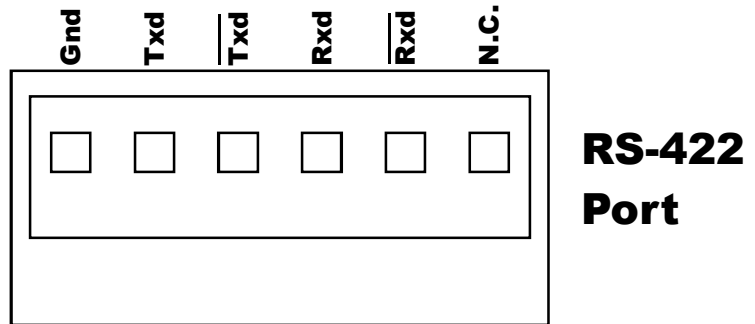


FIG. 3-28 RS-422 CONVERTER OPTION WIRING DIAGRAM

Analog Output Option

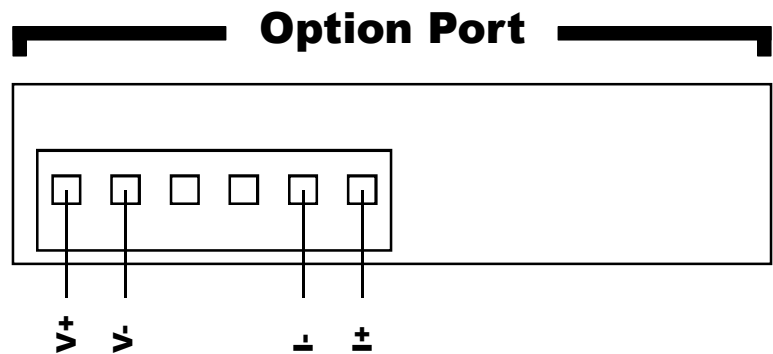


FIG. 3-29 ANALOG OUTPUT OPTION WIRING DIAGRAM

Load Cell Wiring
Diagram (See Fig.
3-30, 31, 32)

- Attach the Load Cell Cable Shield to the ground screw. (See Fig. 3-30)
- Recommended load cell cable lengths:
 - C2 cable - 50 feet (12.7 meters) or more Hardy Instruments Prt. #6002-0001, .340 (8.6) Diameter, shielded 8 cond, 22 AWG.
 - 50 feet (12.7 meters) or less (Non C2) - Hardy Instruments Prt. # 6005-0072 (.205 (5.2) Diameter, shielded 4 cond., 22 AWG.
- Factory installed jumpers must remain in place for four (4) wire load cell connection. (See Fig. 3-31)
- Factory installed jumper must be removed for six (6) wire load cell connection and all C2 installations. (See Fig. 3-30)

CAUTION

DO NOT RUN A LOAD CELL CABLE PARALLEL TO, OR IN THE SAME CONDUIT WITH POWER WIRING.

CAUTION

NEVER SPLICE, SHORTEN OR CUT LOAD CELL CABLES.

- Do not splice load cell cables.
- If load cell cables are too long do not shorten the cable(s), coil the excess cable and place it out of the way.
- If load cables are too short, select an appropriate summing junction box.
- The HI 2160RC^{PLUS} is capable of powering up to four, 350 ohm load cells. When using more than four load cells, an external power supply is required. Contact Hardy Customer Support for details.

NOTE:

Load cell wires carry very low voltage signals: ± 10 VDC Excitation voltage and 0-30mVdc Signal voltage. The load cell wires should be routed in their own conduit, if possible, and away from the relay output wires and all other AC voltage lines to prevent electrical induction and erratic weight indications.

- The load cell cable shield should be grounded to the instrument chassis and left open at the other end for optimum performance and protection from electrical noise.
- When using a summing junction board, connect the load cell cable shield to the summing board, along with all of the cable shields coming from each cell, so that all the shields are routed back to the instrument chassis ground. Use Hardy's conductor C2 shielded cable between the instrument and the summing junction board for optimum performance. (See Fig. 3-30, 31, 32)

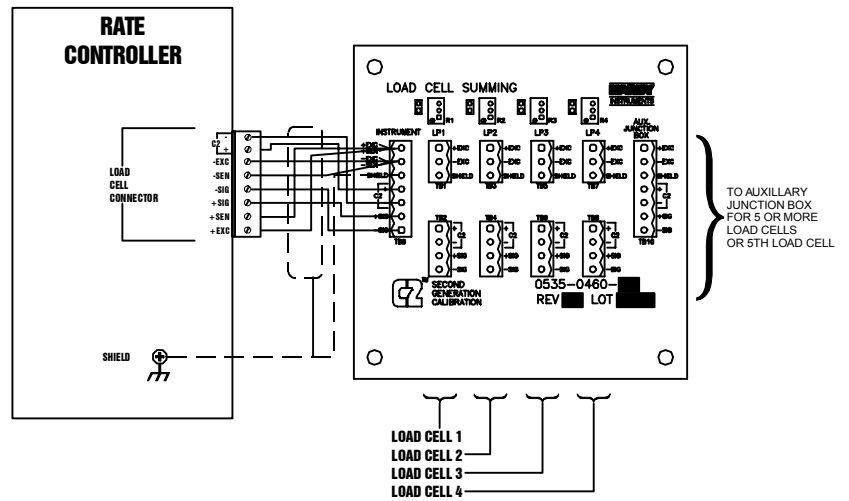


FIG. 3-30 C2 LOAD CELL WIRING DIAGRAM

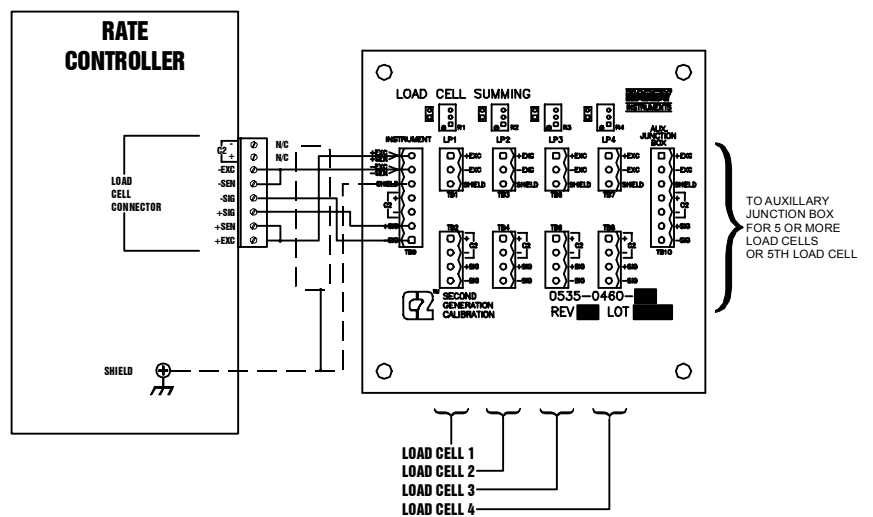


FIG. 3-31 4 CONDUCTOR LOAD CELL WIRING DIAGRAM (NON C2 LOAD CELLS)

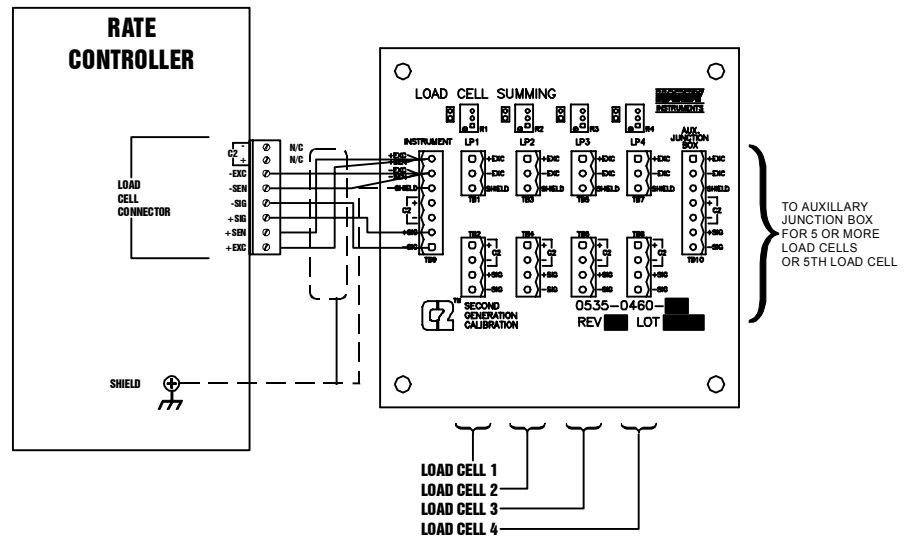


FIG. 3-32 6 CONDUCTOR LOAD CELL WIRING DIAGRAM (NON-C2 LOAD CELLS)

Remote I/O Interface for the Allen Bradley Network

For installation instructions for the Allen-Bradley Remote I/O, please refer to Manual Part Number 0596-0175.

PROFIBUS Interface Option

For installation instructions for the PROFIBUS Interface Option Card, please refer to Manual Part Number 0596-0199.

NOTE:

If an RIO or Profibus option is added to a previously configured instrument all configuration must be re-entered.

Computer Clean Power Requirement

- Good earth ground close to the equipment.
- All equipment grounds are to a common point.
- All piping is grounded to the tank to reduce static discharge of material during filling and dispensing operation.
- Install ground straps to by-pass the load cells.
- Install active filters to trap power transients and AC noise. (See Fig. 3-34)

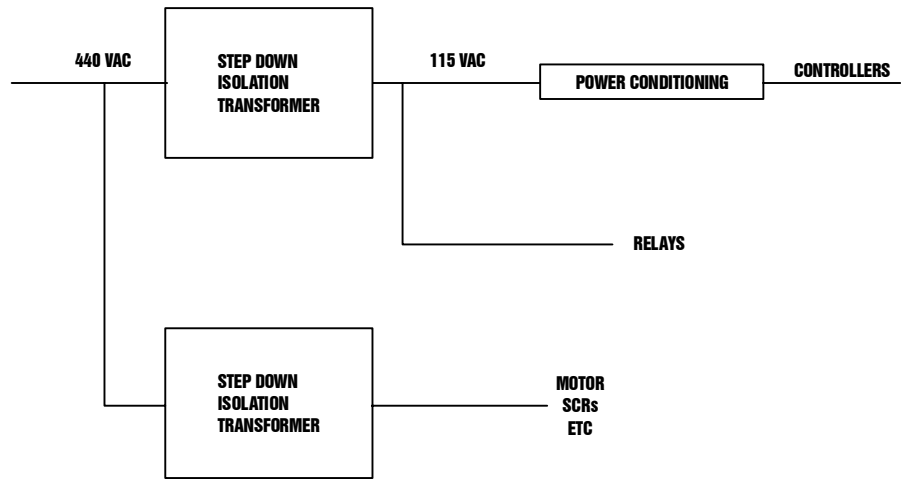


FIG. 3-34 COMPUTER CLEAN POWER DIAGRAM

Installing the Secure Memory Module

- Step 1. When replacing an HI 2160RC^{PLUS} controller or adding a controller with the same operating parameters, transferring the Secure Memory Module (SMM) from the existing controller is a fast way to calibrate and setup a new instrument. The user should make a back up SMM when setting the operating parameters for the original equipment.
- Step 2. Make sure that the module has the notch facing up. (See Fig. 3-35)
- Step 3. Slide the module with the notch up into the module housing.
- Step 4. Press the module in until it stops.
- Step 5. To remove the module pull the module straight out of the housing. (See Fig. 3-36)

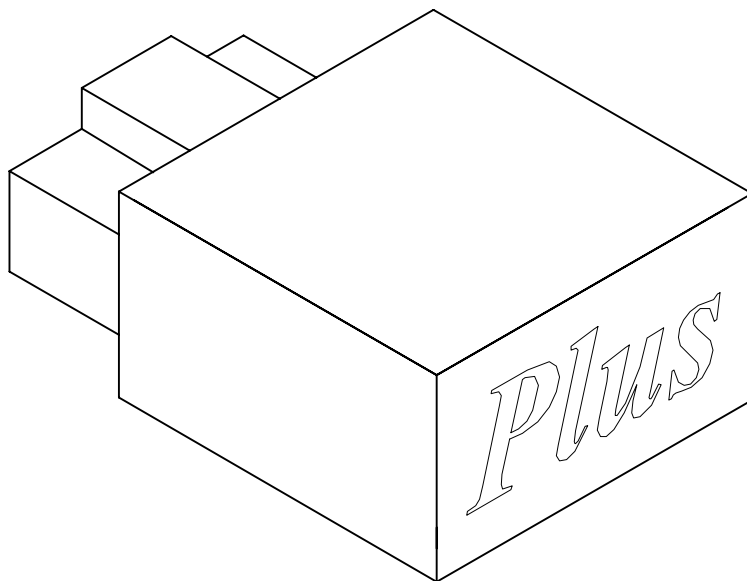


FIG. 3-35 SECURE MEMORY MODULE

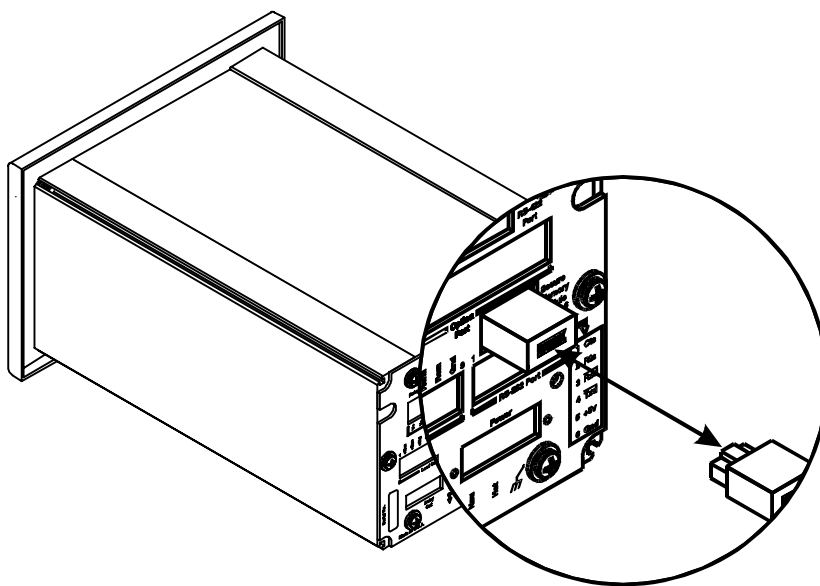


FIG. 3-36 INSTALLING/REMOVING SECURE MEMORY MODULE

CHAPTER 4 - CONFIGURATION

About Chapter 4

Chapter 4 consists of all the procedures for configuring the HI 2160RC^{PLUS} rate controller. We recommend that maintenance personnel be familiar with this chapter before configuring the rate controller. Alternative configuration procedures are not recommended.

Output Relay Configuration

Refill and Alarm Relays

The Refill and Alarm relays can be wired as Normally Open or Normally Closed contacts. (See Chapter 3 for instructions)

Solid State Relays

- The Factory default setting for the solid state relays is normally open.
- For configuration purposes, the solid state relays can be configured as normally open or normally closed. To set the relays as normally open or normally closed change the dip switch position. (See Fig. 4-1)

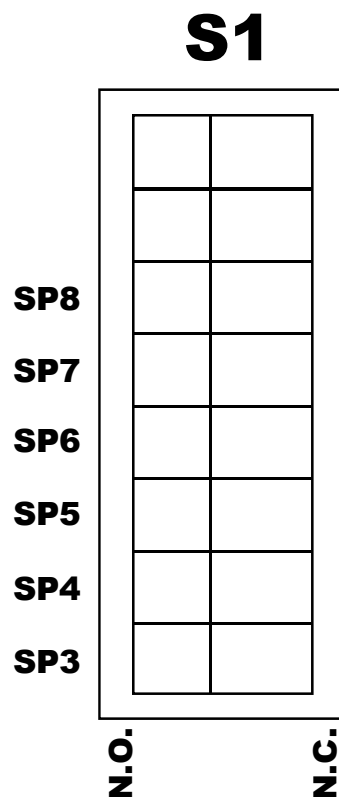


FIG. 4-1 SOLID STATE RELAY DIP SWITCHES (PRT. #0535-0417)

Dip Switch Configuration

- SP3 = Shutoff
- SP4 = On/Off
- SP5 =Rate of Exception Control (REC)
- SP6 = Batch Complete (Batch Mode only)

Speed Control Output Card (Prt. #0535-0406)

- 4.The dip switch is located on the underside of the top panel.
- The control output card transmits the Rate of Change (ROC) current and voltage signals to the motor controller.
- Both the current and voltage outputs are simultaneously available and can be used for different devices. There is a restriction however, one of the outputs must be dedicated to the feeder motor control and must be configured to match the inputs of the motor control.
- Jumper Settings: (See Fig. 4-1)

JUMPER CONFIGURATION CHART			
Current Selection		Voltage Selection	
Configuration	Jumper	Configuration	Jumper
0 - 24 mA	W1	0 - 5 VDC	W3
4 - 24 mA	W2	0 - 10 VDC	W4

TABLE 4-1: CONTROL OUTPUT JUMPER SETTINGS

- Potentiometers
 - Voltage Zero - R4
 - Voltage Span - R16
 - Current Span - R5
 - Current Zero - R19
- The potentiometers are calibrated and adjusted at the factory. No further adjustment is necessary.
- Should additional adjustments be desired, contact Hardy Instruments Customer Service Department for adjustment information.
- See Chapter 3 for installation instructions.

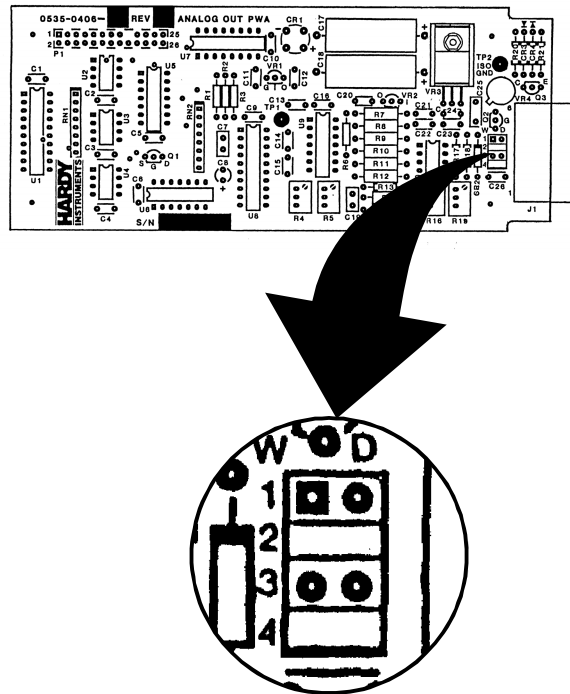


FIG. 4-2 JUMPER SETTINGS FOR CONTROL OUTPUT BOARD

NOTE:

The Control Output Card and the Analog Output Card Option have the same part number. However, they perform a completely different function. The Control Card outputs signals to a motor controller. The Analog Output Card Option can be used as a controller itself, outputting to a display, PLC, Computer etc.

**Analog Output Card
Option Configuration
(Prt.# 0535-0406)**

**About the Analog
Output Card Option**

The analog transmitter outputs to a receiving device (PLC, Computer, or another rate controller). The transmitter outputs Gross, Batch, Rate of Change (ROC), Peak or Total Weight as 0-5V, 0-10V, 0-20mA, or 4-20mA (via the front panel you can reverse the voltage and current ranges 5-0V, 10-0V, 20mA-0mA, or 20mA-4mA, See the Setup Chapter for procedures). The receiving device must be capable of accepting one of the analog signals. When configuring the Analog Output Card, both the receiver and the HI 2160RC^{PLUS} must be in the same mode (e.g. Gross, Batch, Rate of Change (ROC) Peak or Total Weight). The analog card can also span the voltage or milliamp ranges over a portion of the weight data. The outputs are electrically and optically isolated from the main board. The Analog Output Card is adjusted at the factory. The procedures contained in this section are recommended when you need closer weight tolerances.

There are two (2) jumpers and four potentiometers located on the Analog Output Card. One jumper selects the current output range, and the other selects the voltage output range. (See Table 4-2 for configuration

information. (See Fig. 4-6 for jumper locations) Both outputs are available simultaneously. The four potentiometers are used to adjust the Zero and Span for both the current and voltage outputs. (See Fig. 4-6 for their locations.)

CAUTION

WHEN OPENING THE BACK OF THE HI 2160RC PLUS, MAKE SURE THAT YOU USE PROPER ELECTROSTATIC DISCHARGE PROCEDURES TO PREVENT DAMAGE TO THE INSTRUMENT.

Setting the Jumpers

Setting The
Jumpers in the HI
2160^{PLUS}

- Step 1. Disconnect the power cord.
- Step 2. Use a phillips screw driver and remove the two (2) pan head machine screws that fasten the rear panel to the extrusion. (See Fig. 4-3)
- Step 3. Gently pull out the rear panel with the top and bottom panel and printed circuit boards attached.
- Step 4. Remove the two (2) pan head machine screws that attach the top panel to the rear panel. (See Fig. 4-4)
- Step 5. On the Analog Output Card, set the jumper that matches the system's feedback voltage or current configuration. (See Table 4-2)
- Step 6. Attach the top panel to the rear panel by replacing the two (2) pan head screws.
- Step 7. Gently slide the rear panel back into the extrusion.
- Step 8. Replace the pan head machine screws that attach the rear panel to the extrusion.
- Step 9. Connect the power cord.

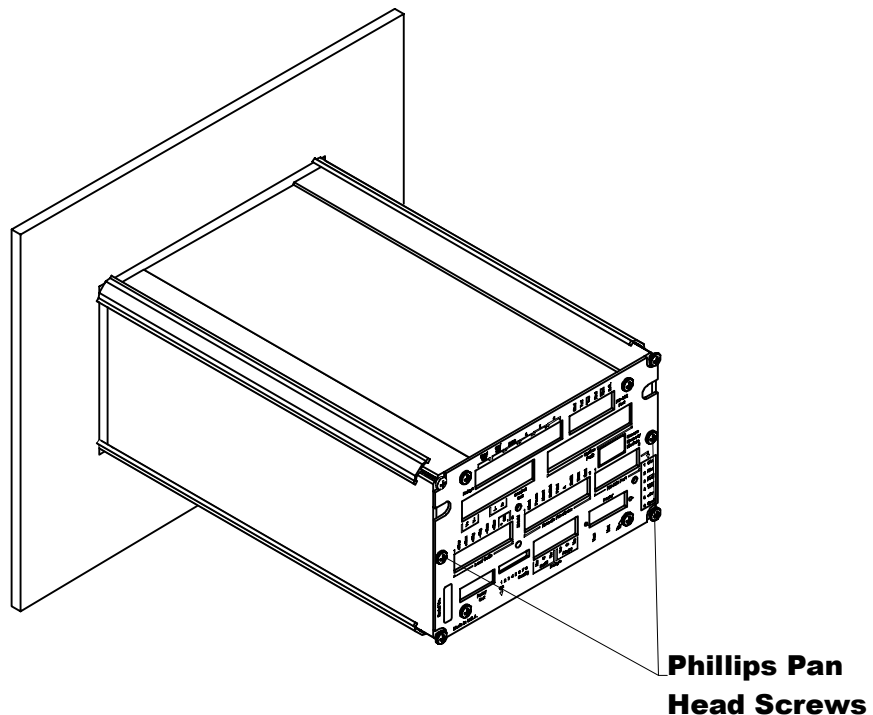


FIG. 4-3 REMOVAL OF REAR PANEL

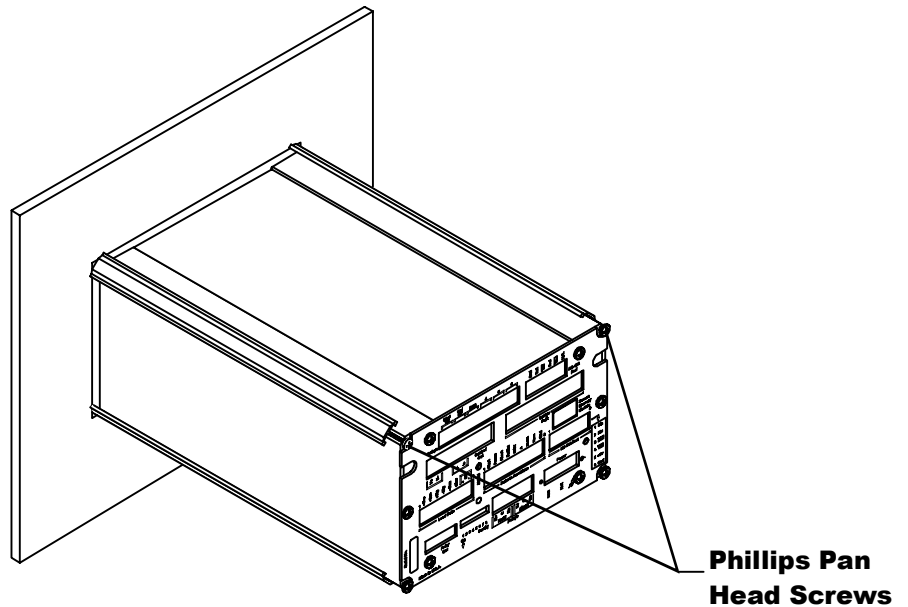


FIG. 4-4 REMOVAL OF TOP PANEL

Setting the Jumpers
in the Optional
Quad Expander Box

- Step 1. a.Disconnect the power cord.
- Step 2. Use a phillips screw driver and remove the four (4) pan head machine screws that fasten the rear panel to the extrusion. (See Fig. 4-5)
- Step 3. Gently pull out the rear panel with the printed circuit boards attached.
- Step 4. On the Analog Output Card, set the jumper that matches the system's feedback voltage or current configuration. (See Table 4-2)
- Step 5. Gently slide the rear panel back into the extrusion.
- Step 6. Replace the pan head machine screws that attach the rear panel to the extrusion.
- Step 7. Connect the power cord.

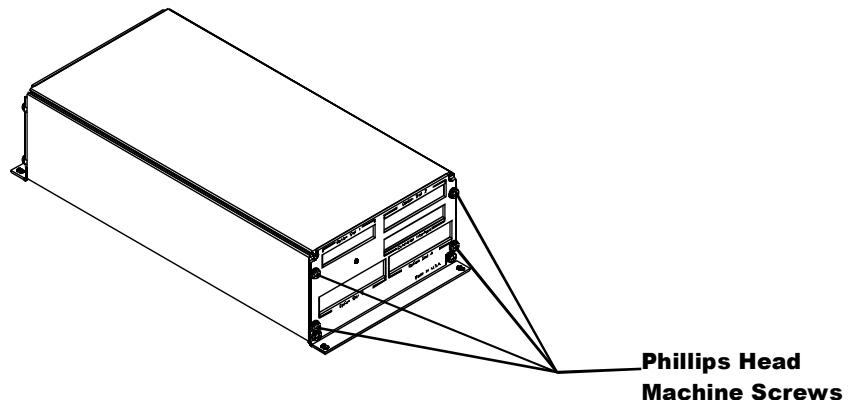


FIG. 4-5 REMOVING REAR PANEL IN QUAD EXPANDER BOX

Jumper
Configuration Chart

JUMPER CONFIGURATION CHART		
Output Configuration	Configuration	Jumper
Remove 4mA offset	0 - 20 mA	W1
Set current span to 16 instead of 20mA	4 - 20 mA (Default)	W2
Change voltage out scale to 5V	0 - 5V	W3
Change voltage out scale to 10V	0 - 10V (Default)	W4

TABLE 4-2:

Connector Pins for
Current and Voltage
Output

- The connector pins number from 1-6, left to right when facing the rear panel of the HI 2160RC^{PLUS}. (See Fig. 4-6) The connector pins number 1-6 right to left if installed in option slots 3 or 4, when facing the rear panel of the Quad Expander Box. (See Fig. 4-5)
- Pins 1&2 are used for Voltage output. (See Fig. 4-6)
- Pins 5&6 are used for Current output. (See Fig. 4-6)
- Both current and voltage outputs are available simultaneously. They must be configured with both the HI 2160RC^{PLUS} and the receiving device in the same mode (for example: HI 2160RC^{PLUS} - Gross Mode) when configuring the PLC it should also be labeled Gross Mode.

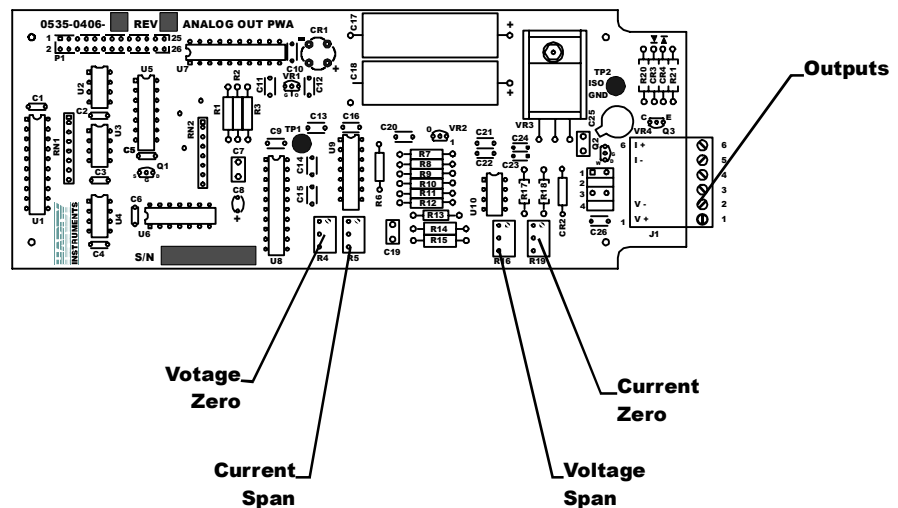


FIG. 4-6 ANALOG OUTPUT OPTION CARD

NOTE:

To fine tune the zero and span, contact you local representative or Hardy Instruments, Customer Service.

Remote Function Inputs

- The remote function inputs are at 5TTL levels. These levels are pulled to digital ground to activate the corresponding function. (See Fig. 4-7) The contact must be made for at least 100 milliseconds in order for the switch to function. Wiring the remote function creates

a switch, when activated performs the Start, Pause, Abort, Rst Tot (Reset totalizer), Print and Refill functions. A is Alarm Clear.

CAUTION

THE START INPUT OVERRIDES THE FRONT PANEL STOP KEY.

- The remote function provides for easily accessed switches for PLC's other than Remote I/O or Profibus and provides an alternative to the keypad on the front panel of the controller. All switch configurations are momentary except for the Remote Set Point Option which must be maintained.
- The Remote Set Point Option enables the HI 2160RC^{PLUS} to read the current analog input signal when activated. It is used to download set point values. The Rate Set point remains at the same rate until the Remote pin is grounded again. If the Remote pin is kept shorted to the ground pin, it tracks the analog input signal and constantly updates the Rate Set point value.

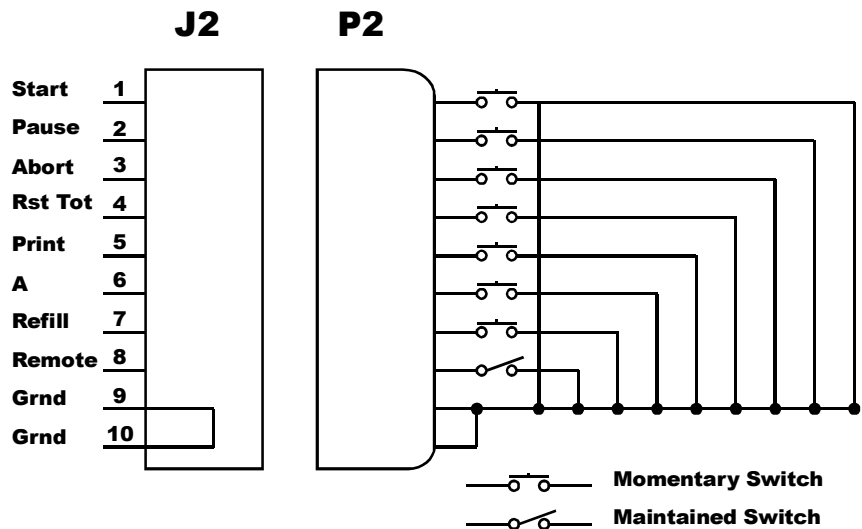


FIG. 4-7 REMOTE FUNCTION OPTION

Remote Set Point Input Option Card Configuration (Prt. #0535-0410)

About Remote Set Point Input Option (Analog In)

The Remote Set Point Input Option card enables the HI 2160RC^{PLUS} to receive an analog input signal from any device capable of an analog output. The configuration of the Remote Set Point Input Option sets the instrument up to match the analog input signal to the analog output signal of another device. The Set Point Option enables a device to remotely set the Set Rate, Set Point. The HI2160RC^{PLUS} is capable of receiving the following analog signals:

- | | |
|--------|---------|
| 0-20mA | 0-5VDC |
| 4-20mA | 0-10VDC |

Setting the Jumpers

Setting the Jumpers
in the HI
2160RC^{PLUS}

- Step 1. Get the analog signal information from the analog output device documentation.
- Step 2. Disconnect the power cord.
- Step 3. Use a phillips screw driver and remove the two (2) pan head machine screws that fasten the rear panel to the extrusion. (See Fig. 4-3)
- Step 4. Gently pull out the rear panel with the top and bottom panel and printed circuit boards attached.
- Step 5. Remove the two (2) pan head machine screws that attach the top panel to the rear panel. (See Fig. 4-4)
- Step 6. f.Set the jumper that matches the system's feedback voltage or current configuration. Select one only. (See Fig. 4-8) (See Tables 4-3, 4-4, 4-5)
- Step 7. Attach the top panel to the rear panel by replacing the two (2) pan head screws.
- Step 8. Gently slide the rear panel back into the extrusion.
- Step 9. Replace the pan head machine screws that attach the rear panel to the extrusion.

FUNTION	DESCRIPTION	JUMPER
INPUT TYPE SELECT	0 - 5 VDC	W1
	0 - 10 VDC	W2
	CURRENT	W3

TABLE 4-3: INPUT SELECTION

INPUT RANGE SELECT	
4-20 mA Range	W5
0-20 mA or 0-5, 0-10 VDC	W8

TABLE 4-4: CURRENT RANGE SELECTION

CURRENT SENSE	
SINGLE UNIT CURRENT SENSE	W6
MULTI UNIT CURRENT SENSE, MID UNIT CURRENT LOOP. LAST UNIT HAS W6 INSTALLED	W7

TABLE 4-5: CURRENT SENSE SELECTION

Setting the Jumpers
in the Optional
Quad Expander Box

- Step 1. Get the analog signal information from the analog output device documentation.
- Step 2. Disconnect the power cord.

- Step 3. Use a phillips screw driver and remove the four (4) pan head machine screws that fasten the rear panel to the extrusion. (See Fig. 4-5)
- Step 4. Gently pull out the rear panel with the printed circuit boards attached.
- Step 5. Set the jumper that matches the system's feedback voltage or current configuration. (See Fig. 4-8) (See Tables 4-3, 4-4, 4-5)
- Step 6. Gently slide the rear panel back into the extrusion.
- Step 7. Replace the pan head machine screws that attach the rear panel to the extrusion.

Connector Pins for Input Voltage and Current Input

- The connector pins number from 1-6, left to right when facing the rear panel of the HI 2160RC^{PLUS}. (See fig. 3-5) The connector pins number 1-6, right to left if installed in Option slots 3 or 4, when facing the rear panel of the Quad Expander Box. (See Fig. 4-5)
- Pins 1&2 are used for Voltage input. (See Fig. 4-9)
- Pins 5&6 are used for Current input. (See Fig. 4-9)
- Only one of analog input signals can be configured and used for Remote Set Point Input.
- The current input is protected by a 31 mA plug in fuse.

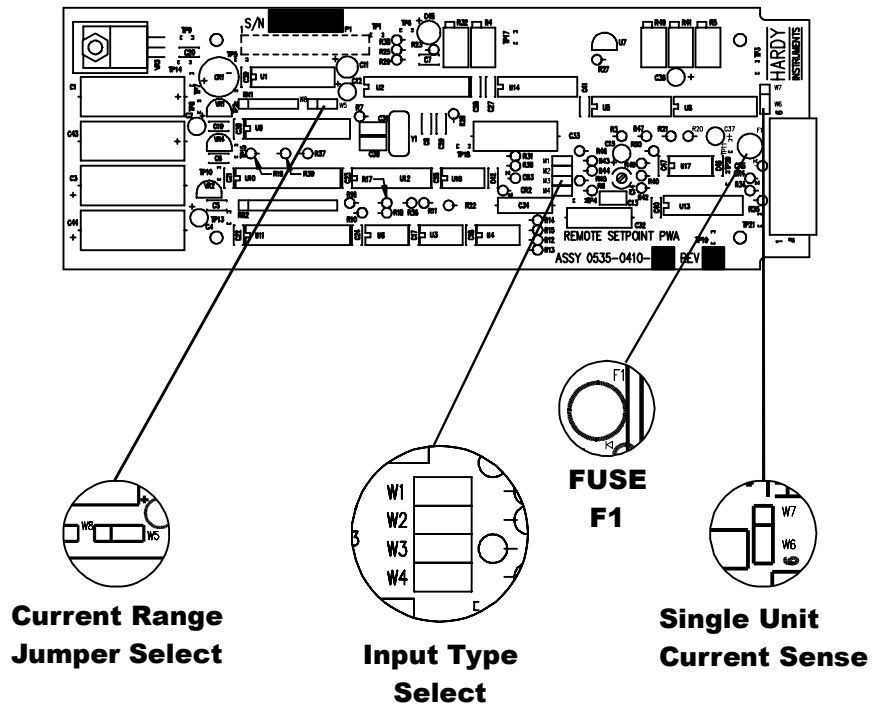


FIG. 4-8 JUMPER SETTINGS FOR ANALOG INPUT PWA AND F1 FUSE

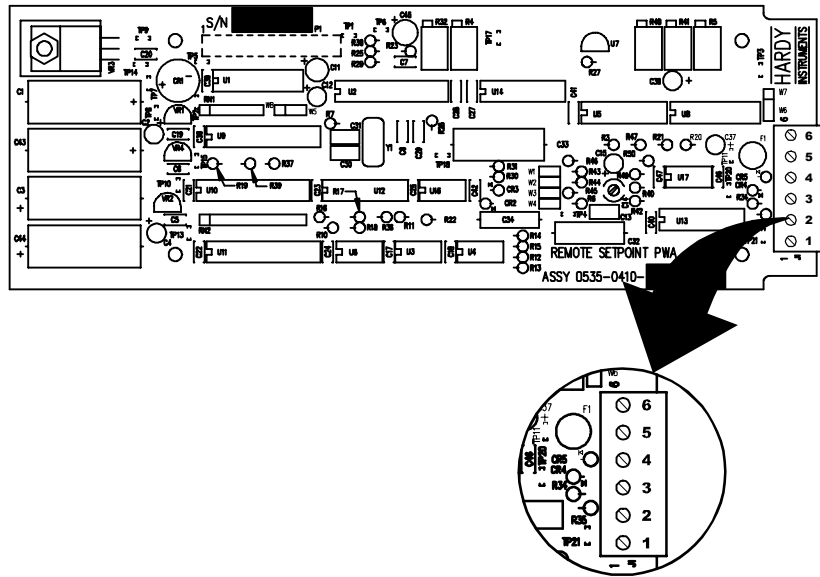


FIG. 4-9 CONNECTOR PINS FOR ANALOG INPUT PWA

Grounding the Remote Pin to read the Remote Set Point Input

- Momentary Reading of the Analog Input Signal.
 - The installer must put a contact or switch between the ground and remote positions on the remote functions connector J2. The switch must momentarily close when you want to read the input level grounding the remote pin. This automatically sets the Rate Set Point.
- Continuous Reading of the Analog Input Signal.
 - In the Remote Functions connector, Install a jumper wire between the ground and the remote. (See Fig. 4-10)

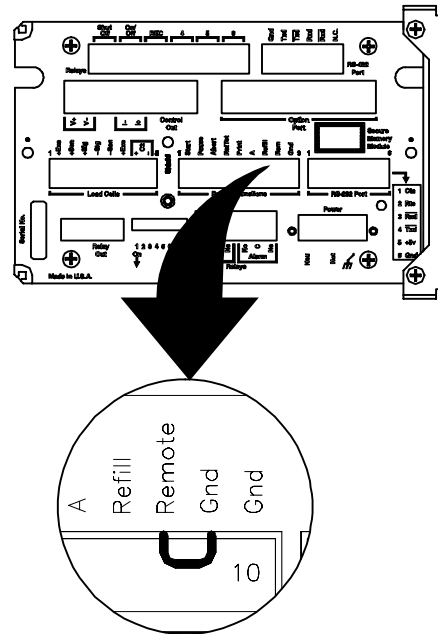


FIG. 4-10 GROUND JUMPER TO READ ANALOG INPUT

Remote I/O Interface for the Allen Bradley Network Option (-B2)

For configuration instructions for the Allen-Bradley Remote I/O, please refer to Manual Part Number 0596-0175.

PROFIBUS Interface Option (-B4)

For configuration instructions for the PROFIBUS Interface Option Card, please refer to Manual Part Number 0596-0199

Changing the RS-422 Converter Port Option (-B1)

Setting the Dip Switches (See Fig. 4-11)

S1/S3	ON	Enable 1 K ohm - RS-422, /Txd pullup/pulldown resistors.
	OFF	Disconnect Txd, /Txd pullup/pulldown resistors from circuit
S2	ON	Enable RS-232 RTS control of RS-422 output Txd, /Txd signal tri-stating. RTS = hi = enable Txd, /Txd
	OFF	RTS not controlling Txd, /Txd.
S4	ON	Enable Txd, /Txd at all times.
	OFF	See Note Below

TABLE 4-6: JUMPER SETTINGS FOR RS-422 CONVERTER

NOTE:

Either SW2 or SW4 must be on. Both switches can not be on at the same time.

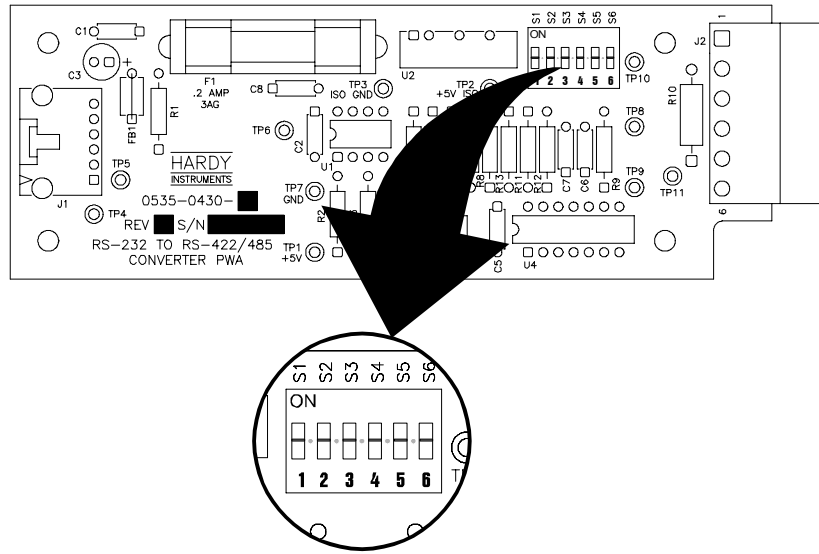


FIG. 4-11 RS-422 CONVERTER DIP SWITCHES

**Rear Panel Config.
Option Dip Switch
Settings**

**Option
Configuration Dip
Switch (See Fig. 4-
12)**

- The default setting is OFF or in the up position.
- The Configuration Dip Switches enable/disable certain functions as indicated below.
- Assigned functions:
 - Enable Multi-Drop
 - Disable Screen Print from the front panel "Print" button or remote "Print" input.
 - Disable Batch Report Print at end of batch.
 - Enable Continuous Scale Weight Output to the Serial Port.
 - Ignore Incoming Checksums.
 - OFF = 1 second; ON = 1/20 second transmission.
 - OFF = Gross Weight; ON = Counts
 - Not used.

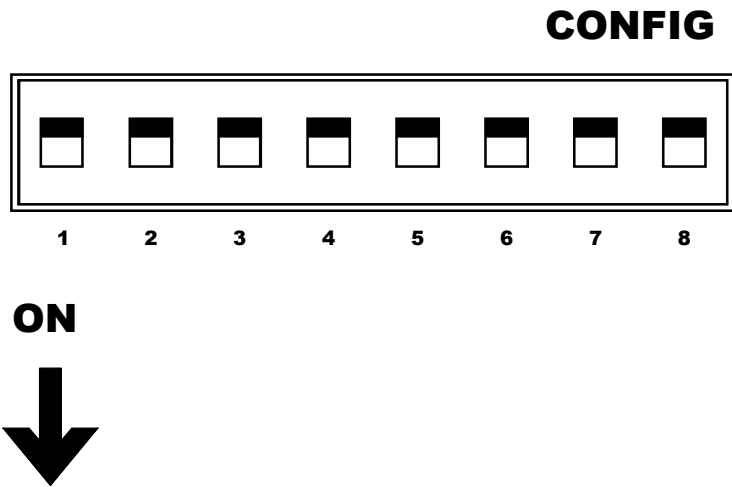


FIG. 4-12 CONFIG DIP SWITCHES REAR PANEL

Power Up Process

NOTE:

Complete these procedures after ALL the wiring and connections have been installed.

Pre Power Up Check Procedures

- Step 1. **AC Power Lines** - Check to see that HOT, NEUTRAL, and GROUND are properly wired at the outlet receptacle and the rear panel POWER connector. Use a Volt Meter and verify that the AC power is correct either 110 or 220 VAC.
- Step 2. **Load Cell Cable** - Check to see the load cell connections match the color code given for their respective model number.
- Step 3. **Feeder Control Lines** - Check to see that the correct analog output is used for your particular feeder (current or voltage control).
- Step 4. **Relay Output Wires** - Check to see if devices controlled by these outputs are operational (Exercise valves, indicators, etc.)
- Step 5. **Analog and Serial Communications Cable** - Check to see that the proper cable connections are being used and proper configuration.
- Step 6. **Remote Functions Wiring** - Check to be sure all wires are tight and routed away from high voltage switching or high magnetic fields.
- Step 7. Apply power to the HI 2160RC^{PLUS} Controller.
- Step 8. Turn on the feeder.

NOTE:

Always connect the power source to the HI 2160RC^{PLUS} first, before turning on the feeder. This insures proper feeder motor control.

Proper Power Up Indicators

- The screen displays the word "WAIT"
- The controller begins the self-test count up sequence.
- The screen momentarily displays "WS = X (1.2.3.4 or 5) (Waver-saver jumper position) (Factory Default is 4)

- Finally Operational Display #1, Current Weight appears. (See Fig. 4-13)

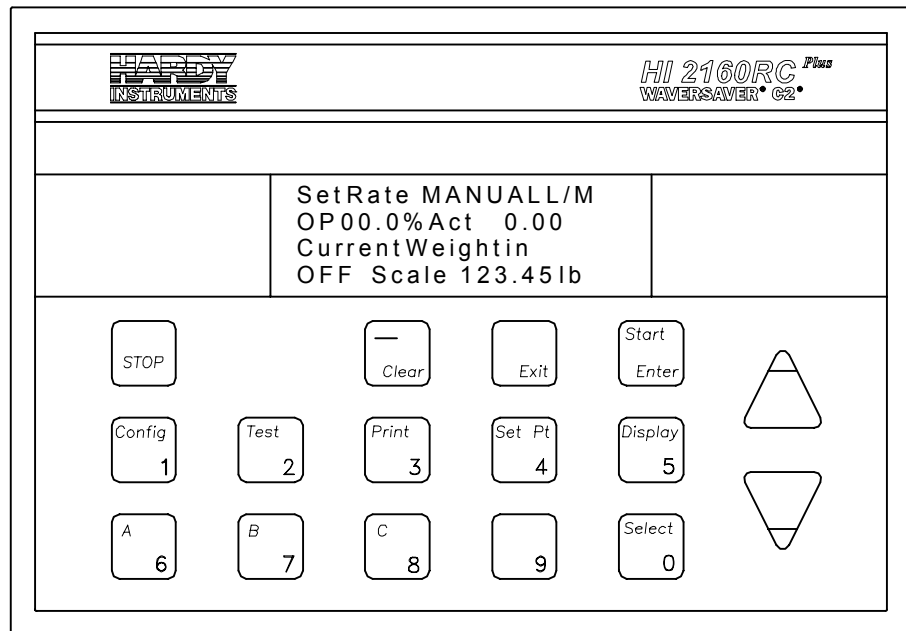


FIG. 4-13 OPERATIONAL DISPLAY #1 CURRENT WEIGHT

WAVERSAVER[®]

NOTE:

WAVERSAVER[®] is a registered Trademark of Hardy Instruments, Inc.

Effects of Vibration on a Scale

- Plants have a lot of machinery operating around the clock. In this environment, machinery generates a considerable amount of vibration of varying frequencies. Weigh process electrical equipment is no exception. Vibration is transmitted by the load sensor(s) as voltage to the controller. The result is inexact weight readings.
- WAVERSAVER is a combination of hardware and firmware which effectively eliminates the effects of vibration (voltage). WAVERSAVER rejects the effects of vibration (.025 Hz and above) and extracts the true weight signal. WAVERSAVER performs these functions at high speed and can be adjusted to reject signals above 7.5 with virtually instantaneous response.

Configuring WAVERSAVER

- Step 1. The Default Jumper Setting is W4.
- Step 2. Disconnect the power cord.
- Step 3. Make sure that all ESD precautions have been taken before working on the controller.
- Step 4. Use a phillips screw driver and remove the two (2) pan head machine screws that fasten the rear panel to the extrusion. (See Fig. 4-14)
- Step 5. Gently pull out the rear panel with the top and bottom panel and printed circuit boards attached.

- Step 6. Remove the two (2) pan head machine screws that attach the top panel to the rear panel. (See Fig. 4-15)

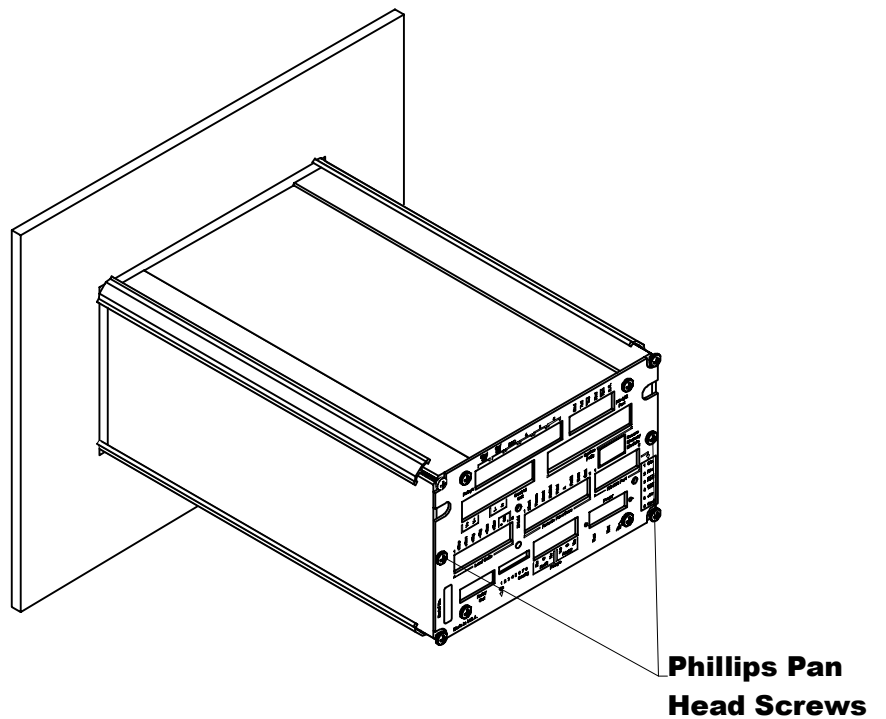


FIG. 4-14 REMOVAL OF REAR PANEL

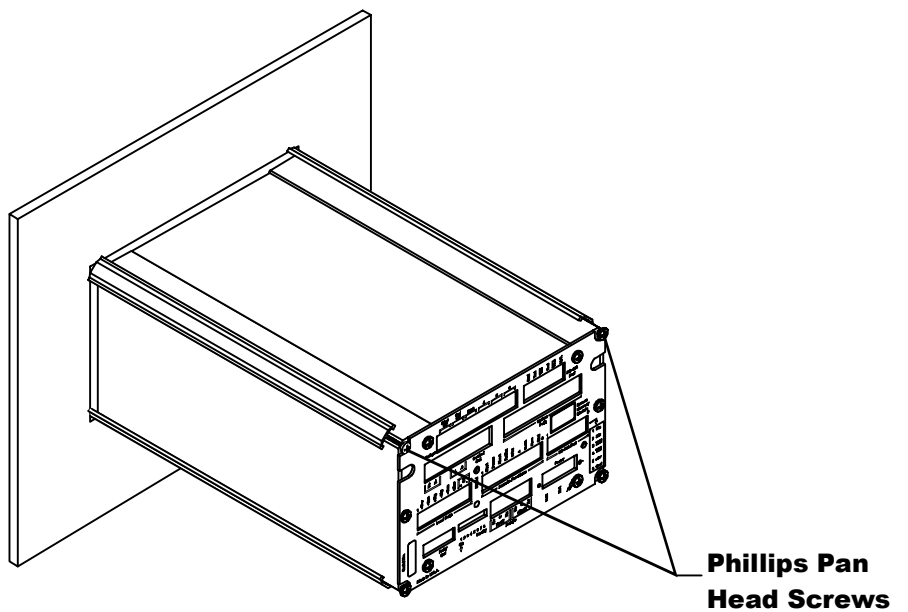


FIG. 4-15 REMOVAL OF TOP PANEL

- Step 7. Secure the printed circuit card with one hand and gently pull the jumper off. (See Fig. 4-16)

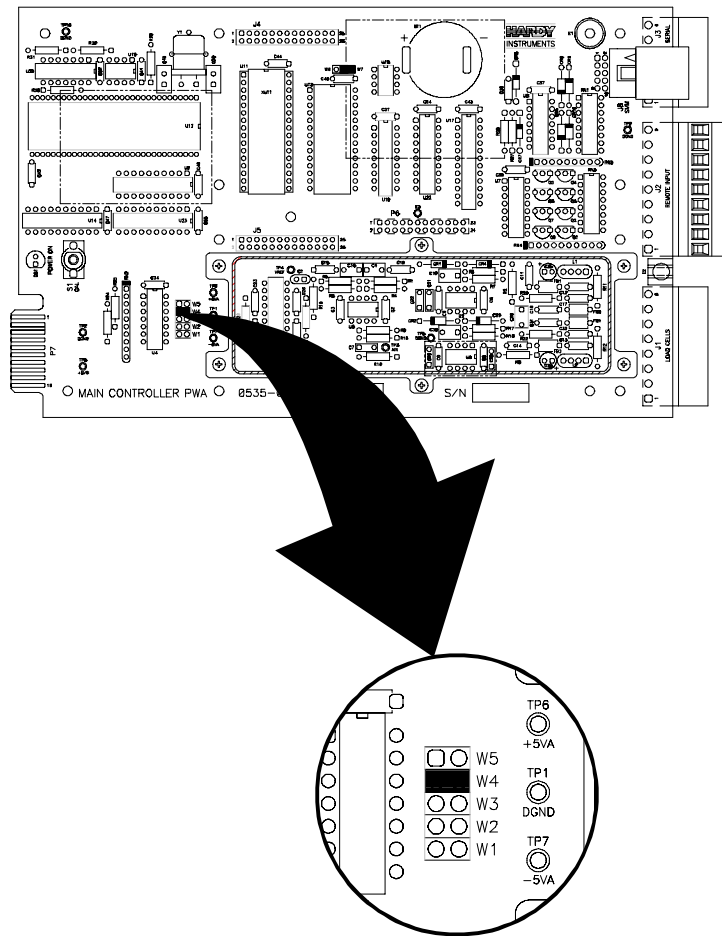


FIG. 4-16 SETTING WAVERSAVER JUMPERS

- Step 8. Install the jumper at the required position. (See Table 4-6)
- Step 9. Attach the top panel to the rear panel by replacing the two (2) pan head screws.
- Step 10. Gently slide the rear panel back into the extrusion.
- Step 11. Replace the pan head machine screws that attach the rear panel to the extrusion.
- Step 12. Connect the power cord.
- Step 13. Run the system. Check to see if the weight readings are stable.
- Step 14. If the weight readings are not stable and/or the response time is not what you want, repeat steps 2-13, this time putting the jumper in another position.
- Step 15. W1 provides the fastest response time but eliminates less vibration. W5 provides the slowest response time but eliminates the most vibration.
- Step 16. If the weight readings are stable and the response time is where you want it, the configuration is complete.

NOTE:

Re-calibration is not necessary after moving jumpers W1 through W5.

Some Things to Remember When Changing the Jumper Settings

- The number of averages selected in the Tuning/Control menu adds to the read time.
- For example: With the jumper set in the W4 position and the number of averages set at 20, the final weight reading would not be reached until 2 seconds (1 second for the WAVERSAVER and 1 second for 20 averages at 20 updates per second).
- See Table 4-7 when changing jumpers for the setting best suited for your application requirements.

JUMPER	MINIMUM FREQUENCY	APPROXIMATE RESPONSE TIME
W1	7.5 Hz	Least vibration immunity. Fastest time to reach the final weight reading (approximately 20mS).
W2	3.5 Hz	100 mS to reach the final weight reading.
W3	1.0 Hz	500 mS to reach the final weight reading.
W4	0.5 Hz	Default setting from the factory. Very good vibration immunity requiring approximately 1 second to reach the final weight reading.
W5	0.25 Hz	Best vibration immunity requiring approximately 2 seconds to reach the final weight reading.

TABLE 4-7: JUMPER SETTINGS AND RESPONSE TIME

CHAPTER 5 - CALIBRATION

About Chapter 5

All information contained in Chapter 5 pertains to the Calibration of the HI 2160RC^{PLUS} Rate Controller. We recommend that the processes and procedures contained in this section be followed to insure that the Rate Controller is properly calibrated. The controller can be calibrated one of two ways. C2 Calibration is a calibration using a reference point and does not require calibrated test weights. Hard CAL requires the scale to be calibrated utilizing both ZERO and SPAN, a two point calibration using calibrated test weights. In addition a RATE calibration is performed to calibrate the feeder to the material being fed. Other calibration methods are not recommended. All calibration processes must be completed before setting up the controller. The weight calibration must be done before the rate calibration. All maintenance personnel and users should be familiar with the calibration information before operating the system.

Pre-Calibration Procedures

Mechanical Check Procedures

Checking the Load Cell Installation

- Step 1. Check to determine if the load cells have been installed properly.
- Step 2. Refer to your load cell O&M manual for proper installation instructions.
- Step 3. On some single and double ended shear beam load cells there is an arrow that indicates the direction of the applied load. If the arrow is pointing in the wrong direction, change the position of the load cell so that it is mounted in the direction of the applied load.

Check for Binding on the Load Cell

CAUTION

BINDING ON A VESSEL OR LOAD CELL DOES NOT ALLOW THE LOAD CELL FREE VERTICAL MOVEMENT AND MAY PREVENT THE INSTRUMENT FROM RETURNING TO THE ORIGINAL ZERO REFERENCE POINT.

- A load cell must be mounted in such a way that 100% of the load (Vessel w/Contents) is vertically passed through a load cell. (See Fig. 5-1)
- Check to see that nothing is binding the load cell. This means that the platform scale or feeder is mounted so that 100% of the load is vertically passed through a load cell. Check to see that nothing is located underneath the load cell that blocks any vertical downward movement.

Check for Binding
on Platform Scale/
Feeder

- Check for binding on the platform scale/feeder and appurtenances also see your platform scale manual.
- Check to see that nothing is draped across the platform scale/feeder such as a hose, electrical cord, tubes, or appurtenances.
- Check to see that nothing is coming in contact with the platform scale/feeder other than service wires and piping that have been properly mounted with flexible connectors.

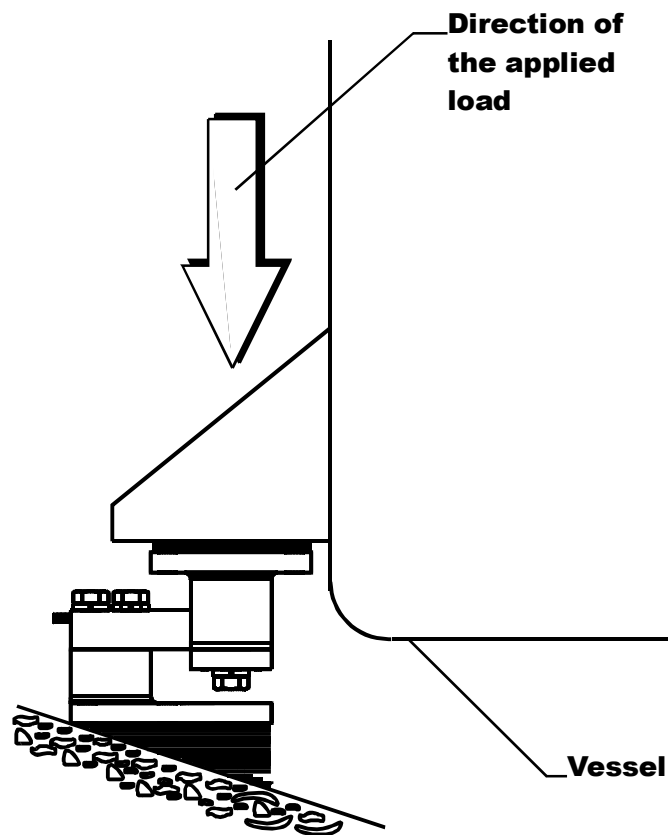


FIG. 5-1 PROPERLY INSTALLED LOAD CELL W/NO BINDING

**Electrical Check
Procedures**

- Step 1. Check to see that there is power to the controller.
- If there is power to the controller The front panel display should be lit.
- Step 2. Allow the controller to warm up for about 15 minutes before performing the calibration procedures.

Load Check

- Step 1. Place a load (weight) on the scale or feeder.
- Step 2. Check to see if the weight reading changes on the display in the proper direction. (e.g. if the display reads 100 pounds and a 20 pound load is placed on the vessel or scale, the display should read 120 or some value over 100. If it reads 80 pounds the reading is going in the wrong direction and indicates some problem with the system)

- Step 3. If the display is reading improperly or shows no change there is something wrong either with the configuration or installation.
- Step 4. If the display changes in the proper direction move onto the calibration of the controller.

Weight Calibration Process

Calibration Setup Procedures

- Step 1. Press the "Config" button. The security display appears.
- Step 2. If the unit is being calibrated for the first time, use the numeric keys and enter the default high code value numbers "1 2 3 4".
- Step 3. If a high code value other than the default number has been entered use that number.

NOTE:

You can press the "Enter" button, but it may only permit read only access to all the calibration parameters you want to change. We highly recommend using the High Code number.

- Step 4. Press the Enter button. The Main Menu appears.
- Step 5. Press the down arrow ↓ button until the cursor is next to the "Calibration" sub-menu.
- Step 6. Press the Enter button. The Mass Units sub-menu appears.

Setting the Mass Units

- Step 1. Press the "Select" button to scroll through all the Engineering (weight and volume) Mass Unit selections which are:

- LBS = pounds Default
- OZS = ounces
- TNS = tons
- KGS = kilograms
- GLS = gallons
- LTR = liters
- MLT = milliliters
- GRM = grams

- Step 2. When you have scrolled to the selection you want, press the Enter button. The entry accepted is briefly flashed on the display.
- Step 3. The Mass Units are used in the displays and on reports.

NOTE:

The HI 2160RC^{PLUS} Rate Controller does not perform conversions between the various mass units. To change the mass units, a weight re-calibration of the controller is required.

- Step 4. Press the down arrow ↓ button until the cursor is in front of the Time Unit sub-menu.

Setting the Time Units (Rate of Flow)

Step 1. Press the "Select" button to scroll through all the Time Unit selections which are:

- HR = hours
- MIN = minutes (Default)
- SEC = seconds

Step 2. When you have scrolled to the selection you want, press the Enter button. The Time Unit selection is accepted. Entry accepted flashes.

NOTE:

After initial calibration you can change the Time Units and the set point rate will automatically be converted and does not require re calibration. If you change the time unit from minutes to hours, the controller will automatically change the display to read the hourly rate. For example, 2 lbs/minute will change to 120 lbs/hour.

Step 3. Press the down arrow ↓ button until the cursor is in front of the Rate Decimal Point sub-menu.

Setting the Rate Decimal Points

NOTE:

Always use the maximum number of decimal points possible without exceeding the six digit display. For example if the rate range is 1 - 999, place the decimal point three (3) places to the left (e.g. 999.999). If the rate range is 1000 - 9999, use two (2) decimal places to the left (1000.00).

Step 1. Press the Select button to select the decimal point placing. The choices are 0,1,2,3,4.

Step 2. When you have scrolled to the selection you want, press the Enter button. The Rate Decimal Point selection is accepted.

Step 3. Press the down arrow button until the cursor is in front of the Batch Decimal Point sub-menu.

Setting the Batch Decimal Point

- The Batch Decimal Point must be the Rate Decimal point. For example if the rate decimal point is 3, the batch decimal point must be 3 or less.

Step 1. Press the Select button to select the decimal point placing. The choices are 0,1,2,3,4.

Step 2. When you have scrolled to the selection you want, press the Enter button.

Step 3. If the decimal point is greater than the Rate Decimal Point, when you press the Enter button a warning !!NOT ALLOWED!! appears momentarily.

- The display returns to the Batch Decimal Point menu with the incorrect value displayed.

Step 4. Use the Select button and select another value ≤ the Rate Decimal Point value.

- Press the Enter button.

- If the decimal point placing is \leq the Rate Decimal Point the Batch Decimal Point selection is accepted.

Step 5. Press the down arrow ↓ button until the cursor is in front of the Total Decimal Point sub-menu.

Setting the Total Decimal Point

- The Batch Decimal Point must be greater than or equal to the Rate Decimal point. For example if the rate decimal point is 3, the batch decimal point must be 3 or less.

Step 1. Press the Select button to select the decimal point placing. The choices are 0,1,2,3,4.

Step 2. When you have scrolled to the selection you want, press the Enter button.

Step 3. If the decimal point is greater than the Rate Decimal Point, when you press the Enter button a warning !!NOT ALLOWED!! appears momentarily.

- The display returns to the Total Decimal Point menu with the incorrect value displayed.
- Use the Select button and select another value \leq the Rate Decimal Point value.
- Press the Enter button.

Step 4. If the decimal point placing is \leq the Rate Decimal Point the Batch Decimal Point selection is accepted.

Setting the Graduations

Step 1. Press the down arrow ↓ until the cursor is next to the Graduation sub-menu.

Step 2. Press the Select button to select the graduation level. The graduations levels are:

- 1 (Default) 2, 5, 10, 20, 50, 100, 200, 500

Step 3. The recommended graduation level is 1 to maximize the display resolution.

Step 4. If the least significant number(s) to the right of the decimal point) is/are flickering, or changing all the time, you might want to select a graduation level that eliminates the flicker. Graduation level 10 is recommended. The reading is the same but the last two digits due to the decreased graduation are not flickering.

Step 5. Press the Enter button to accept the graduation level selection.

NOTE:

If your system has C2 load sensors perform "Step 6" below and then the C2 Calibration Process. (See the C2 Calibration Process below)

Step 6. Press the down arrow until the cursor is directly in front of LC CnT (C2).

NOTE:

If your system does not have C2 load sensors perform "Step 7" below and then the Hard Calibration Process.

C2[®] Calibration Process

Step 7. Press the down arrow button until the cursor is in front of the "ZERO" sub-menu.

Step 1. Make sure the Pre-Calibration and Calibration Setup processes are completed before performing the C2 Calibration process.

Step 2. Press the "Config" button. The security display appears.

Step 3. 3.If the unit is being calibrated for the first time, use the numeric keys and enter the default high code value numbers "1 2 3 4".

Step 4. If a high code value other than the default number has been entered use that number.

NOTE:

You can press the "Enter" button, but it may or may not permit access to all the calibration parameters you want to change. We highly recommend using the High Code number.

Step 5. Press the Enter button. The Main Menu appears.

Step 6. Press the down arrow ↓ button until the cursor is next to the "Calibration" sub-menu.

Step 7. Press the Enter button. The Mass Units sub-menu appears.

Step 8. Press the down arrow ↓ button until the cursor is next to REFPT (C2) Reference Point C2.

NOTE:

The reference point is any known "live weight" found on the scale. This value can be zero or any known weight up to the scale capacity.

Step 9. If the value is 000.000 (Feeder is empty)

- Press the Enter button.
- Wait until the display stabilizes (about 12 seconds), i.e. when the numbers stop changing.
- Press the Enter button to accept the value and calibrate the instrument.

Step 10. If the value is anything other than zero (Feeder has material)

- Press the Clear button.
- Use the numeric keys and enter the live weight that is currently on the scale.
- Press the Enter button.
- Wait until the display stabilizes (about 12 seconds), i.e. when the numbers stop changing.
- Press the Enter button to accept the value and calibrate the instrument.
- The C2[®] Calibration is complete. The controller functions as a scale at this point.

Hard Calibration Process (With Calibrated Test Weights)

NOTE:

You must perform the calibration setup procedures before performing the Hard Calibration procedures.

- Step 1. Make sure to measure the dead load only.
- Step 2. Remove all material from the feeder.
- Step 3. Turn off all motors, agitators and any machinery that produces vibration.

CAUTION

THE ZERO AND SPAN CALIBRATION PROCEDURES MUST BE PERFORMED TOGETHER. IF EITHER IS ALTERED, BOTH MUST BE RE-ENTERED.

ZERO Calibration Procedures

- Step 1. The ZERO calibration measures the dead load of the feeder system in millivolts.
- Step 2. Press the Enter button.
- Step 3. An information message appears asking you to wait for the system to stabilize. Wait for at least 12 seconds.

CAUTION

IF THE DISPLAY IS NOT STABLE, THE WRONG ZERO VALUE WILL BE ACCEPTED WHEN YOU PRESS THE ENTER BUTTON. MAKE COMPLETELY SURE THAT THE SYSTEM IS STABLE TO YOUR SATISFACTION BEFORE PRESSING THE ENTER BUTTON OR THE SYSTEM WILL NOT BE CALIBRATED CORRECTLY.

- Step 4. Press the Enter button.
- Step 5. The instrument has entered the gross weight (the millivolt signal) of the system to this point of the calibration process.

SPAN Calibration Procedures

- Step 1. Place a span test weight equal to 80% to 100% of the scale capacity on the scale.

NOTE:

If you do not have a span weight equal to your anticipated live load, use a weight equal to 80% of the scale capacity.

- Step 2. Press the Clear button to erase the displayed span weight and use the numeric key pad to enter the total weight of the test weights being used.
- Step 3. An information message appears asking you to wait for the system to stabilize. Wait for at least 12 seconds for the system to stabilize.

CAUTION

IF THE DISPLAY IS NOT STABLE, THE WRONG SPAN VALUE WILL BE ACCEPTED WHEN YOU PRESS THE ENTER BUTTON. MAKE COMPLETELY SURE THAT THE SYSTEM IS STABLE TO YOUR SATISFACTION BEFORE PRESSING THE ENTER BUTTON OR THE SYSTEM WILL NOT BE CALIBRATED CORRECTLY.

- Step 4. Press the Enter button.

- If the span weight is greater than the zero weight, the controller accepts the span weight.
- If the span weight is \leq the zero weight a warning message momentarily appears. **!!NOT ALLOWED!!**

See Chapter 9 Troubleshooting.

If this problem persists contact Hardy Instruments, Customer Support Department for assistance.

- Step 5. The Hard Calibration is complete. The system functions as a scale at this point.
- Step 6. Press the Exit button two times to return to the Operational Display.

Setting the Sticker Value

- Step 1. The sticker value normalizes each instrument and should only be changed when replacing the Secure Memory Module (SMM) or when the sticker value is lost.
- Step 2. When calibrating the controller for the first time, or when you are sure the sticker value displayed is correct do not change the sticker value.
- Step 3. Press the Enter button menu.

CAUTION

IF YOU ARE NOT SURE IF THE STICKER VALUE IS CORRECT OR HAVE TRANSFERRED THE SECURE MEMORY MODULE (SMM) TO A NEW SYSTEM, DO THE FOLLOWING PROCEDURES:

NOTE:

The C2 Calibration uses the sticker value. If the SMM is replaced or the sticker value is lost and you are using C2 calibration, you will need to use this process to enter the new sticker value.

- Step 4. Check the sticker number of the A/D PCB (Prt. # 0535-0445).
- Step 5. Disconnect the Power Cable from the unit.
- Step 6. Remove the four pan head machine screws that fasten the rear panel to the extruded enclosure. Gently pull the rear panel out until you can see the Sticker Number (six digit number that begins with 3XXXXX) Write this number down.
- Step 7. Reassemble and connect the Power Cable to the unit.
- Step 8. Re-enter the Configuration Calibration Menu and press the arrow buttons to get to the sticker value selection.
- Step 9. If the sticker number in the sticker sub-menu matches the sticker value of the A/D PCB (Prt. # 0535-0445), press the Enter button.
- Step 10. If the sticker number in the sub-menu does not match the sticker number on the A/D PCB (Prt. # 0535-0445), or reads "0", use the numeric keys to enter the correct sticker number.
- Step 11. Press the Enter Button.

Rate Calibration Process

Feeder System Verification Procedures

- The instrument is now calibrated and can be operated in "Manual Mode". Manual mode controls the speed of the feeder motor which is essential to verify that the Control Output has the proper range of control for your process and that the feeder is operating properly before performing the rate calibration.

Step 1. Press the 'Set Pt/4" button. The security message appears.

Step 2. Press the Enter button. The Set Point Menu appears with the cursor next to the Rate sub-menu.

Step 3. Setting the Rate

- Press the "Select" button to scroll through all the rate selections which are:

Manual

Mass Units/Time Units (e.g. 5.00 LB/M)

Remote (Remote Input Option Only)

- Select Manual. Press the Enter button.
- Press the down arrow ↓ to select the Amount sub-menu.

Step 4. Setting the Amount

- Press the "Select" button to scroll through all the rate selections which are:

Continuous

000.000 Mass Unit (LB, KG, GL, etc.)

- Select Continuous. Press the Enter button.
- Press the Exit button. The operational display appears. (See Fig. 5-2)
- If the operational display does not appear (See Fig. 5-2), press the "Display" button until it does appear.

Step 5. Verify that the feeder is loaded.

Step 6. Verify that there is a container to hold the displaced material from the feeder.

Step 7. Turn on the feeder.

Step 8. Turn on the agitators if equipped.

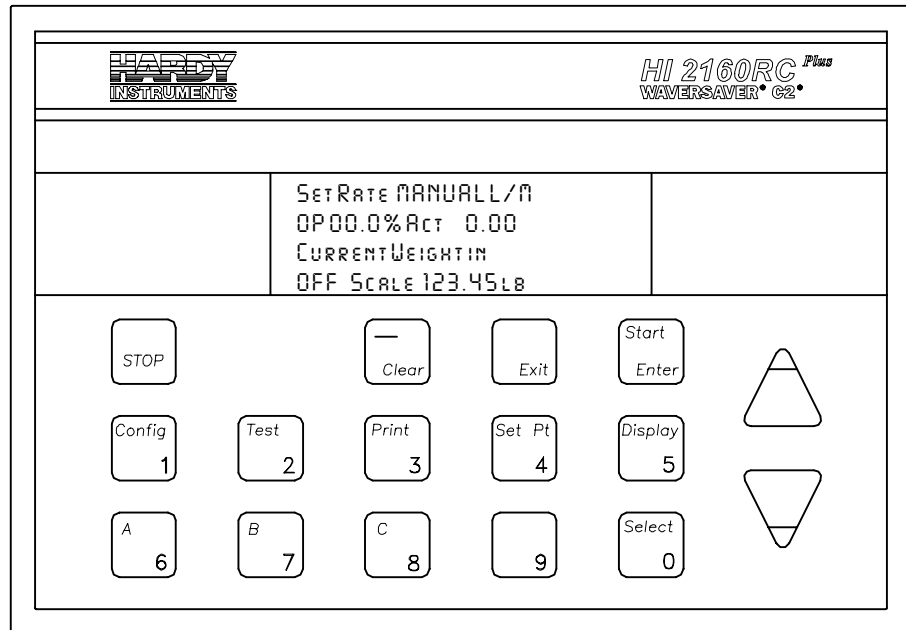


FIG. 5-2 OPERATIONAL DISPLAY/NOT RUNNING

CAUTION

MAKING THE FOLLOWING ADJUSTMENT WILL ACTIVATE THE FEEDER.

- Step 9. Press the "Start/Enter" button.
- Step 10. If you are operating the unit for the first time after powering up, or if a security code number is in use, the instrument will prompt you for a security code number.
 - If a security code number has been assigned to the controller, use the numeric keys to enter the security code. Press the Enter button.
 - If a security code number has not been assigned, press the Enter button.
- Step 11. The unit is operational and at the lower left corner of the screen you will see that the status is "ON". (See Fig. 5-3)
- Step 12. Adjusting the OP% (Operating Percentage) output signal percentage
 - Initially the OP% reads 00.0% with the digit to the right of the decimal point (the least significant digit) is flashing. The flashing means that the value can be changed.
 - Press the up arrow ↑. The flashing number changes from 0 to 1. (See Fig. 5-4)

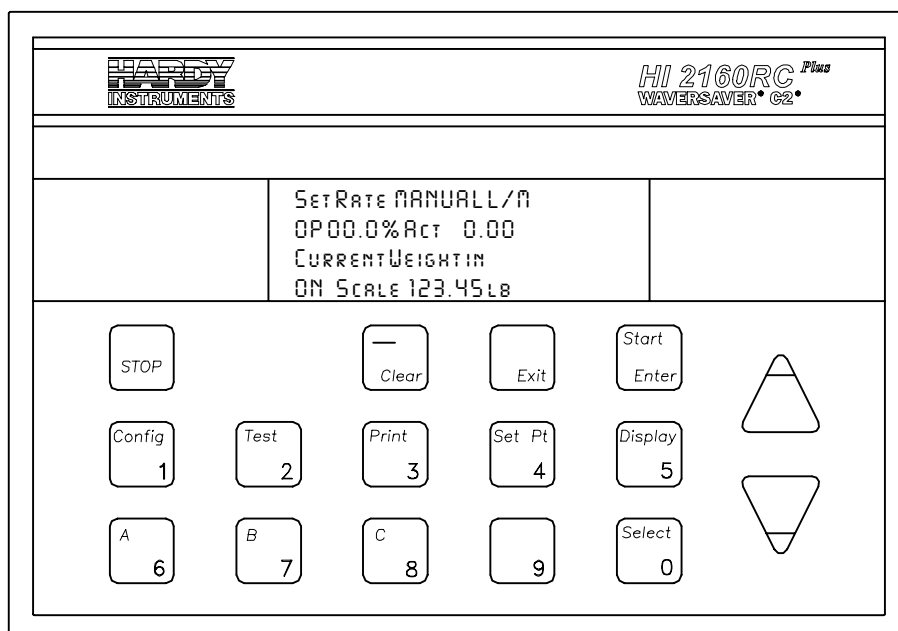


FIG. 5-3 OPERATIONAL DISPLAY RUNNING

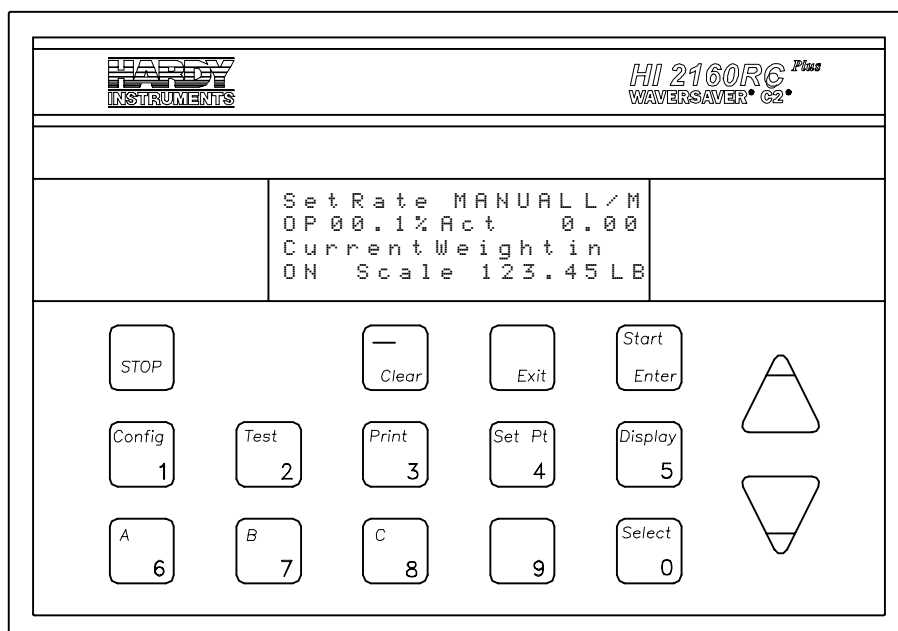


FIG. 5-4 OUTPUT SIGNAL IN 00.1% INCREMENTS

- Increasing/Decreasing the OP output signal by increments of .1%.

Press the up arrow ↑ to increase the output signal percentage (driver RPM) in increments of 00.1% and down arrow ↓ to decrease the output signal percentage (driver RPM) in increments of 00.1%.

- Increase/Decrease the OP output signal by increments of 1%.

Press the Select/0 button. The number to the left of the decimal point begins flashing.

Press the up arrow ↑ to increase the output signal percentage (driver RPM) in increments of 01.0% and down arrow ↓ to decrease the output signal percentage (driver RPM) in increments of 01.0%.

- Increase/Decrease the OP output signal by increments of 10%. (See Fig. 5-5)

Press the Select/0 button. The number to the left of the decimal point begins flashing.

Press the up arrow ↑ to increase the output signal percentage (driver RPM) in increments of 10.0% and down arrow ↓ to decrease the output signal percentage (driver RPM) in increments of 10.0%.

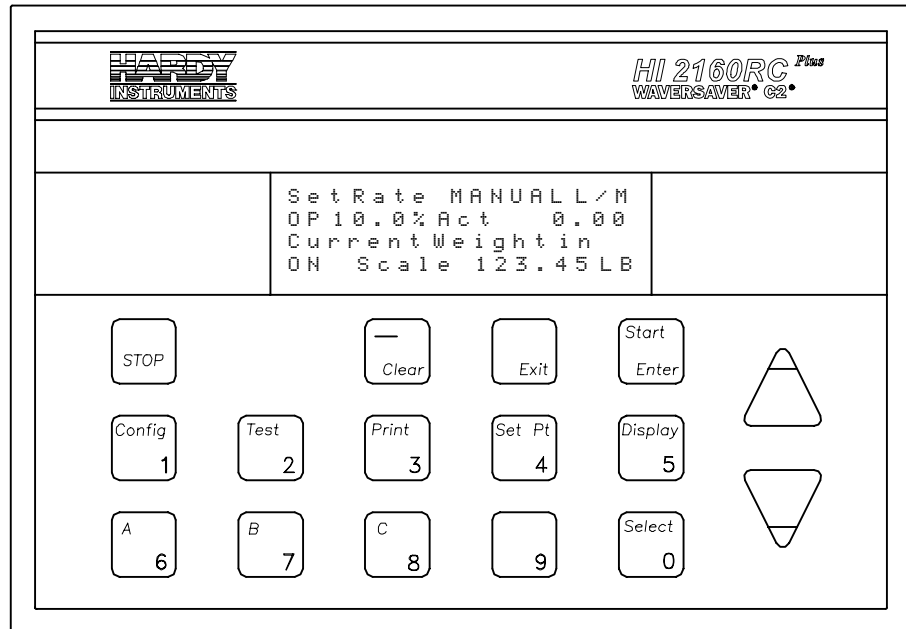


FIG. 5-5 OUTPUT SIGNAL IN 10% INCREMENTS

- Step 13. Set the Operating Percentage for 10% increments.
- Step 14. Press the up arrow ↑ a few times and down a few times to see if the feeder is increasing and decreasing the material feed rate.
- Step 15. To pause the feeder press the Stop button.
- Step 16. At the lower left corner of the screen you will see that the status is "HLD". (See Fig. 5-6)

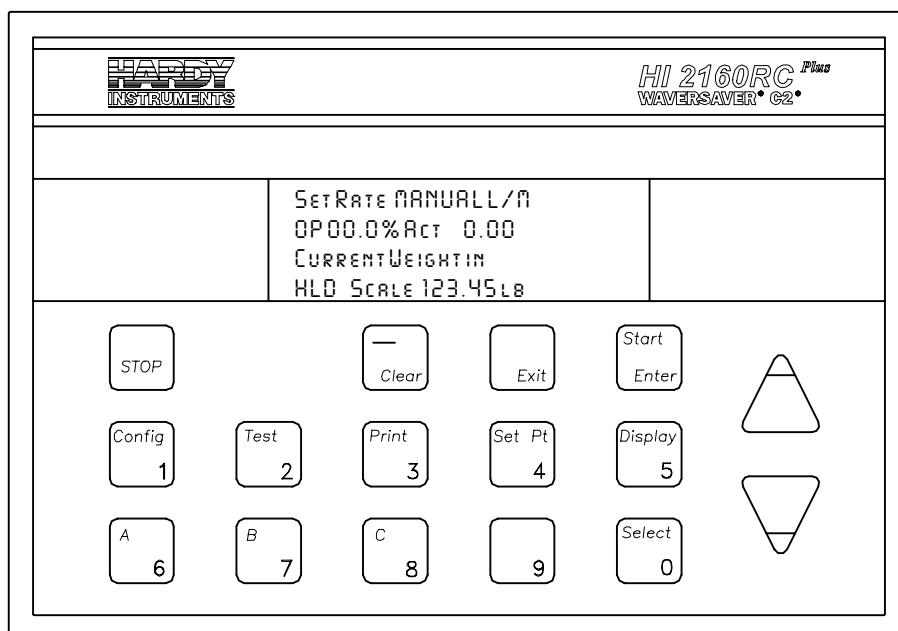


FIG. 5-6 OPERATIONAL DISPLAY UNIT PAUSED

- Step 17. To Stop the feeder press the Stop button again and the status changes to OFF. (See Fig. 5-7)
- Step 18. If the feeder system is not responding correctly check the system to see if there are problems with the installation.
- Step 19. If the feeder system is responding correctly, go on to the Rate Calibration procedures.

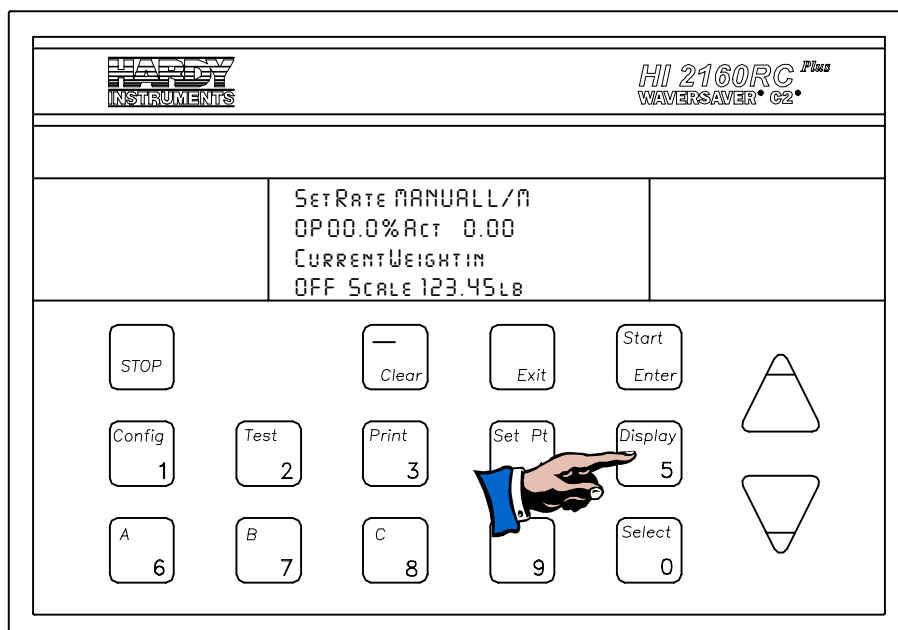


FIG. 5-7 OPERATIONAL DISPLAY OFF

Automatic Rate Calibration Procedures

NOTE:

If the density of the material changes significantly, a new rate calibration should be performed.

WARNING

MAKE SURE THAT THE SYSTEM IS READY TO BE CALIBRATED. AS SOON AS THE START/ENTER BUTTON IS PRESSED THE FEEDER WILL TURN ON AND CALIBRATE ITSELF.

- Complete all Pre-Calibration, Calibration Setup and Feeder Verification Procedures FIRST.

Setting REC to Zero

- Step 1. Press the Config/1 button. The Sequence display appears.
- Step 2. If the instrument is being calibrated for the first time, use the numeric keys and enter the default High Code Value numbers "1,2,3,4".
- Step 3. If there is a High Code Value other than the default number, enter that number.
- Step 4. Press the Enter button. The main menu appears.
- Step 5. Press the down arrow ↓ button until the cursor is next to the Tuning/Control sub-menu.
- Step 6. Press the Enter button.
- Step 7. Press the down arrow ↓ button until the cursor is next to the REC LEVEL.
- Step 8. Press the -/Clear button. The REC level should display 0.
- Step 9. Press the Enter button. Entry accepted flashes momentarily on the display.
- Step 10. Press the exit button to exit the Tuning/Control sub-menu.

Enter the PAUSE TIME Value

- Step 1. Press the down arrow ↓ until the cursor is next to the Rate Calibration sub-menu
- Step 2. Press the Enter button. The Rate Calibration sub-menu appears.
- Step 3. Press the down arrow ↓ until the cursor is next to the PAUSE TIME sub-menu.
- Step 4. The Default setting is 5 seconds.
- Step 5. The Pause Time can be a value between 1-999.
- Step 6. All values are in seconds.
- Step 7. Pause Time is the time you want the feeder to wait between auto rate calibration cycles. If necessary more material may be added to the feeder.

NOTE:

If a feeder is manually paused before a cycle starts, or during a cycle, when the cycle is restarted it will run for the full feed time.

- Step 8. Press the Clear button to clear the Pause Time value.
- Step 9. Use the numeric keys to enter the new Pause Time value.
- Step 10. Press the Enter button to accept the new value.

Step 11. Press the down arrow ↓ until the cursor is next to the PRIME TIME sub-menu.

NOTE:

When you enter a value, for example 15 seconds, the display reads 015. When you press the down arrow, the display changes to read 15.

Enter the PRIME TIME Value

- Step 1. The Default setting is 5 seconds.
- Step 2. The Prime Time value can be a number between 1-999.
- Step 3. All values are in seconds.
- Step 4. Prime Time is the time it takes for the feeder to prime the feeding system and for the feeding system to smoothly feed product at an OP% selected rate.
- Step 5. Press the Clear button to clear the Prime Time value.
- Step 6. Use the numeric keys to enter the new Prime Time value.
- Step 7. Press the Enter button to accept the new value.
- Step 8. Press the down arrow ↓ until the cursor is next to the FEED TIME sub-menu.

Enter the FEED TIME Value

- Step 1. The minimum time that can be entered is 30 seconds.
- Step 2. The default setting is 30 seconds.
- Step 3. The Feed Time value can be a number between 30-999.
- Step 4. All values are in seconds.
- Step 5. Press the Clear button to clear the Feed Time value.
- Step 6. Use the numeric keys to enter the new Feed time value.
- Step 7. Press the Enter button to accept the new value.

NOTE:

Make sure there is enough material for the feeder to dispense during this time period.

AUTO RATE CALIBRATION From the Front Panel

- Step 1. Press the down arrow ↓ until the cursor is next to the AUTO RATE CAL sub-menu.
- Step 2. The Default setting is NO which appears on the display.
- Step 3. Press the Select button to select YES.
- Step 4. Press the Enter button.
- Step 5. A message appears that says: ****RUNNING RATE CAL****.
- Step 6. To view the process, press the Exit button two times to get to the Operational Display #1.

NOTE:

The Auto Rate Cal will prime the system and then run for the selected feed time at 20%, pause for the selected pause time, then continue for feed rates at 30%, 40%, 50% and 80% with the selected pause times in between.

AUTO RATE CALIBRATION Using a Serial Command

- Step 1. Enter the Pause Time, Prime Time, and Feed Time parameters from the front panel of the HI 2160RC^{PLU} Rate Controller.
- Step 2. Enter the Serial Command: S RCS (Initiate auto rate cal)
- Step 3. Press the Enter button.

The Instrument Does the Following

- 1. When the Auto Cal Rate starts it Sets the low rate percentage values to 10% and the high rate percentage values to 90%.
- 2. To determine if an automatic rate calibration is in progress you can look at these values in:

- Front Panel of the controller. (See Fig. 5-8)
- Look at these values over the Serial Port.
- Look at these values over the Allen Bradley Remote I/O.
- Runs for the pre set Prime Time.
- Runs at OP 20% for the pre set Feed Time.
- Pauses for the pre set Pause Time.
- Runs at OP 30% for the pre set Feed Time.
- Pauses for the pre set Pause Time.
- Runs at OP 40% for the pre set Feed Time.
- Pauses for the pre set Pause Time.
- Runs at OP 50% for the pre set Feed Time.
- Pauses for the pre set Pause Time.
- Runs at OP 80% for the pre set Feed Time.
- The unit stops. An OFF should appear in the lower left corner of Operational Display #1, Current Weight.
- Automatically calculates the Rate values.
- If the auto rate calibration fails, the low% reads 20% and high% reads 80% and can be viewed in the Configuration, Rate Calibration Screen from the:

Front Panel of the controller. (See Fig. 5-8)

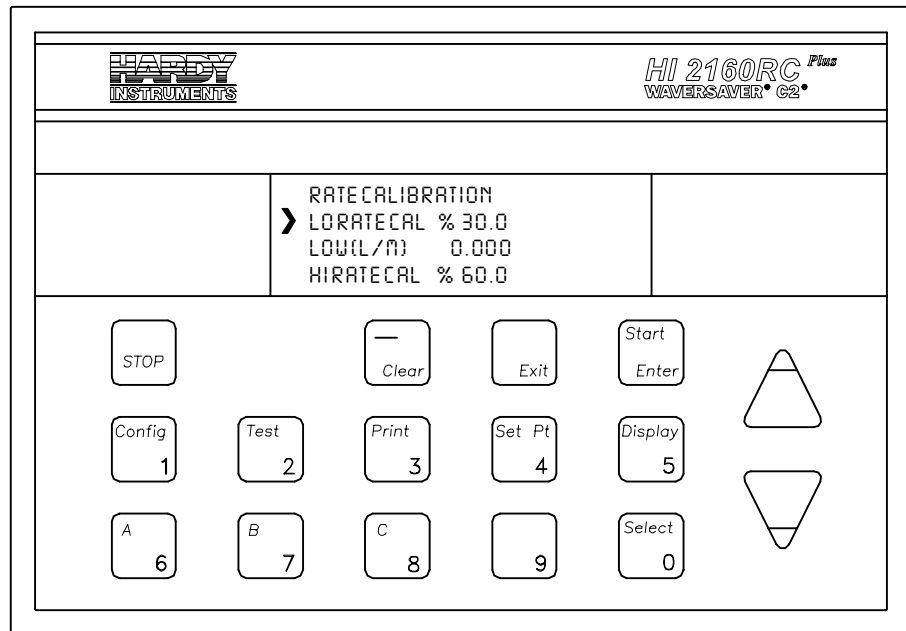


FIG. 5-8 AUTO RATE CALIBRATION PASSED

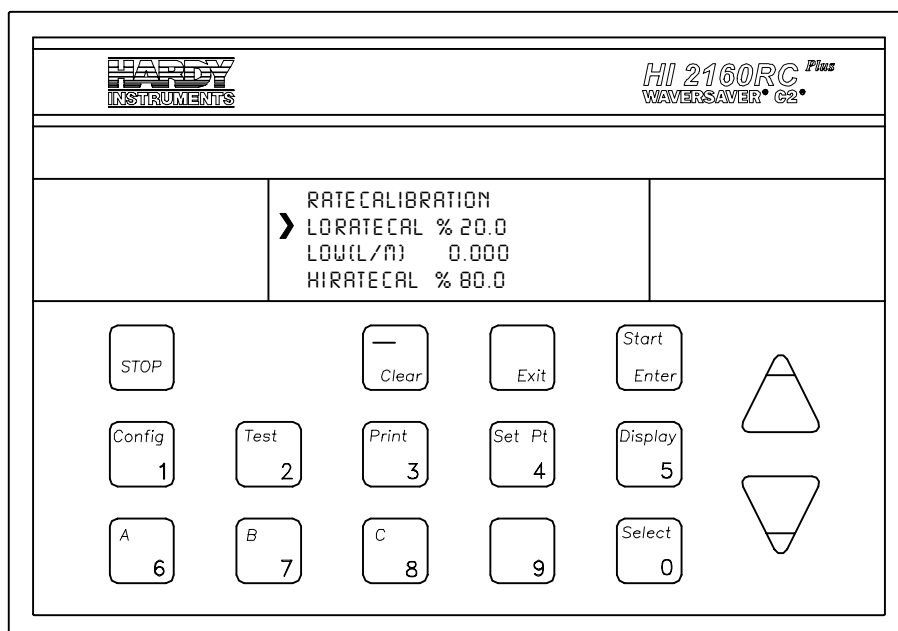


FIG. 5-9 AUTO RATE CALIBRATION FAILED

3. If the auto rate calibration passes, the low% reads 30% and high% reads 60% and can be viewed in the Configuration, Rate Calibration Screen from the:
 - Front Panel of the controller.
4. If any one of the points reads zero (0), rate calibration fails. Do the following:
 - Reset the Time Base (See Chapter 6 for instructions). Double the Time Base value and repeat the Auto Rate Calibration process.
 - If any one of the points reads zero (0) again, the rate calibration fails. Contact your local dealer or Hardy Instruments, Customer Support for further instructions.
 - To view a percent of deviation from the calibrated norm at each of the five calibrated percentages. Press the Test button, scroll to the SELF TEST, press the Enter button and scroll down until the “OP@” data is viewable.
5. Set the REC to a working value. (See Setting REC to Zero above for instructions)
6. The Automatic Rate Calibration is complete.

Manual Rate Calibration Procedures

NOTE:

If the density of the material changes significantly, a new rate calibration should be performed.

Step 1. Complete the Feeder Verification Procedures.

Step 2. Set the Rate Exception Control (REC LEVEL) to 0.0

- a. Press the "Config" button.
- b. Enter the security code number.
- c. Press the Enter button.
- d. Press the down arrow ↓ until the cursor is next to the Tuning Control sub-menu.
- e. Press the Enter button.
- f. Press the down arrow ↓ until the cursor is next to the REC LEVEL sub-menu.

- If the REC LEVEL is not 0.0.

Press the Clear button.

Enter 0.0.

Press the Enter button.

- If the REC LEVEL reads 0.0.
- Press the Exit button to return to the Main Menu.
- Press the Exit button to return to the Operational Display.

Step 3. Setting the Totalizer to Zero if you do not have a scale available to weigh the samples.

- In the Operational Display #1, (See Fig. 5-10) press the Clear button.
- Enter the security code number. A "Clear Total NO" message appears.
- Press the Select button to select YES.
- Press the Enter button to Zero the Totalizer. The Operational Display automatically appears.
- Press the Display button until the Scale Display appears. (See Fig. 5-11)
- You can now use the HI 2160^{PLUS} as a scale to weigh the material dispensed by the feeder into the container.

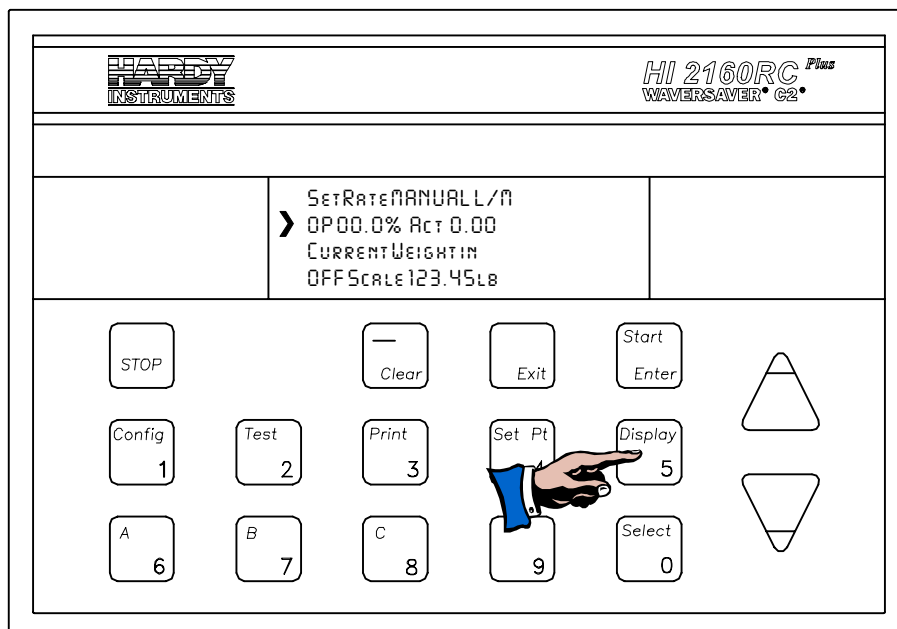


FIG. 5-10 OPERATIONAL DISPLAY #1 CURRENT WEIGHT

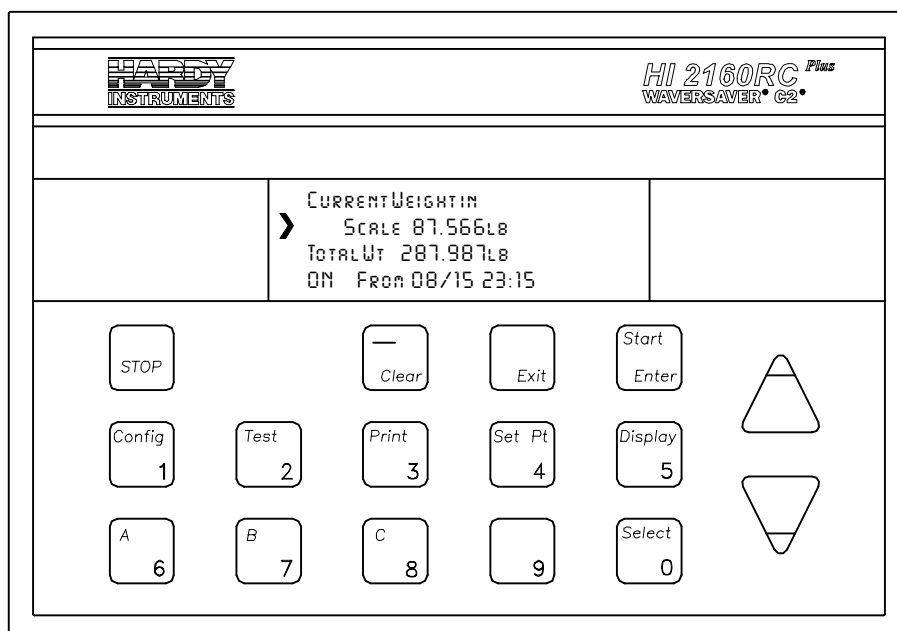


FIG. 5-11 SCALE DISPLAY

Step 4. If you have a scale.

- Check the scale with a known weight to see if it is accurate.
- Weigh the container(s) that will catch the sample from the feeder.

- Write down the weight of the container(s) for reference when taking samples.

Gathering Rate
Calibration Data
Method #1

Materials
Required

- Rate Calibration Data Gathering Form. (Appendix A)
- One minute timer or stop watch.
- Container to catch the material that is dispensed in one minute from the feeder.

Step 1. Set the Operational Percentage (OP%) to 20.0% or a percentage below the expected operational range. (See Feeder Verification Procedures, Paragraph 5.3.1, sub paragraph 12 d for instructions)

Step 2. Press the Start button. Allow the feeder to run until there is a smooth even flow of material.

Step 3. Empty the container you are using to catch the material.

Step 4. Performing the LOW RATE data sampling.

- Clear Totalizer to Zero.
- Set the Operational Percentage (OP%) to a percentage point below the expected operational range. For Example: 30-40% anticipated operating range (OP%). Set the OP% for the low rate samples at 20% which is your LOW RATE CAL% on the form. (See Feeder Verification Procedures, Paragraph 5.3.1, sub paragraph 12 e for instructions)
- Simultaneously press the start and the timer at the same time. This procedure can be done with one person, but is best done with two people, one operating the controller and the other timing the sample run.
- Allow the feeder to run for exactly one (1) minute.
- Stop the feeder by pressing the Stop button on the controller.
- Check the weight by weighing the sample on the scale or if you don't have a scale checking the total weight on the Scale Display. (See Fig. 5-11)
- Write the OP%, Weight, and date in LOW RATE CAL% Reading # 1.
- Repeat this procedure for Readings #2, and #3. This will insure a higher degree of accuracy.

Step 5. Performing the HIGH RATE data sampling.

- Clear Totalizer to Zero.
- Set the Operational Percentage (OP%) to a percentage point above the expected operational range. For Example:

30-40% anticipated operating range. Set the OP% for the high rate samples at 50% which is your HIGH RATE CAL% on the form. (See Feeder Verification Procedures above for instructions)

- Simultaneously press the start and the timer at the same time. This procedure can be done with one person, but is best done with two people, one operating the controller and the other timing the sample run.
- Allow the feeder to run for exactly one (1) minute.
- Stop the feeder by pressing the Stop button on the controller.
- Check the weight by weighing the sample on the scale or if you don't have a scale checking the total weight on the Scale Display. (See Fig. 4-9)
- Write the OP%, Weight, and date in HIGH RATE CAL% Reading # 1.
- Repeat this procedure for Readings #2, and #3. This will insure a higher degree of accuracy.

NOTE:

If you want to confirm the low and high readings are accurate throughout the operating range, run the samples at 30% and 40% or any of the rates between the anticipated low and high feed rates.

Step 6. If the results are consistent between samples, enter the rate data into the Rate Calibration sub-menu. (See Automatic Rate Calibration Procedures above)

Gathering Rate Calibration Data Method #2

Materials Required

- Rate Calibration Data Gathering Form. (Appendix A)
- Timer or stop watch.
- Two (2) Containers to catch the material that is dispensed from the feeder.
- A Calibrated Scale

Slow Feed Rate

- Step 1. Set the Operational Percentage (OP%) to a percentage point below the expected operational range. For Example: 30-40% anticipated operating range (OP%). Set the OP% for the low rate samples at 20% which is your LOW RATE CAL% on the form. (See Feeder Verification Procedures, Paragraph 5.3.1, sub paragraph 12 e for instructions)
- Step 2. Start the feeder.
- Step 3. Allow the feeder to run until the material is flowing smoothly into one of the containers.
- Step 4. Divert the material stream to a second container for a selected period of time.
- Step 5. When the time period is up, divert the material flow back to the first container.

- Step 6. Weigh the material in the second container.
- Step 7. Divide the weight by the sample time in minutes to get your calibration weight.
- Step 8. Write the OP%, Weight, and date in LOW RATE CAL% Reading # 1.
- Step 9. Repeat this procedure for Readings #2, and #3. This will insure a higher degree of accuracy.

High Feed Rate

- Step 1. Set the Operational Percentage (OP%) to a percentage point above the expected operational range. For Example: 30-40% anticipated operating range (OP%). Set the OP% for the high rate samples at 50% which is your HIGH RATE CAL% on the form. (See Feeder Verification Procedures, Paragraph 5.3.1, sub paragraph 12 e for instructions)
- Step 2. Start the feeder.
- Step 3. Allow the feeder to run until the material is flowing smoothly into one of the containers.
- Step 4. Divert the material stream to a second container for a selected period of time.
- Step 5. When the time period is up, divert the material flow back to the first container.
- Step 6. Weigh the material in the second container.
- Step 7. Divide the weight by the sample time in minutes to get your calibration weight.
- Step 8. Write the OP%, Weight, and date in HIGH RATE CAL% Reading # 1.
- Step 9. Repeat this procedure for Readings #2, and #3. This will insure a higher degree of accuracy.

Entering the Calibration Values

Entering the rate data into the Rate Calibration sub-menu

- Step 1. Press the Config button.
- Step 2. Enter the Security Code Number. Press the Enter button. The Main Menu appears.
- Step 3. Press the down arrow until the cursor is next to the Rate Calibration sub-menu
- Step 4. Press the Enter button. The Rate Calibration sub-menu appears.
- Step 5. Press the down arrow until the cursor is next to the "LOW RATE CAL % 00.0".
- Step 6. Entering the Lo Rate Calibration data.
- Step 7. Press the Clear button.
- Step 8. Enter the Low Rate OP% value used in the low rate sampling runs. In our example% 20.0 (Default is 20.0%)
- Step 9. Press the Enter button to accept the value.
- Step 10. Press the down arrow ↓ until the cursor is next to the "LOW (L/M)"
- Step 11. Press the Clear button.

- Step 12. Enter the weight value taken during the timed (one minute) low rate sampling runs. For example 2.000 Lbs/Minute. (Default is .300 lbs/Minute)
- Step 13. Press the Enter button to accept the value.

CAUTION

IF THE CONTROLLER DOES NOT ACCEPT THE VALUE YOU HAVE ENTERED FOR THE LOW RATE. SET THE HIGH RATE FIRST AND COME BACK TO SET THE LOW RATE.

- Step 14. Press the down arrow ↓ until the cursor is next to the "HI Rate CAL% 00.0".

Entering the
High Rate
Calibration Data

- Step 1. Press the Clear button.
- Step 2. Enter the High Rate OP% value used in the high rate sampling runs. In our example% 50.0. The Default is% 80.0)
- Step 3. Press the Enter button to accept the value.
- Step 4. Press the down arrow until the cursor is next to the "HIGH (L/M)"
- Step 5. Press the Clear button.
- Step 6. Enter the weight value taken during the timed (one minute) high rate sampling runs. For example 6.000 Lbs/Minute. (The Default setting for High Rate L/M is 1.7)
- Step 7. Press the Enter button to accept the value.
- Step 8. Press the Exit button two times to return to the Operational Display.

The Manual Rate
Calibration is
Complete

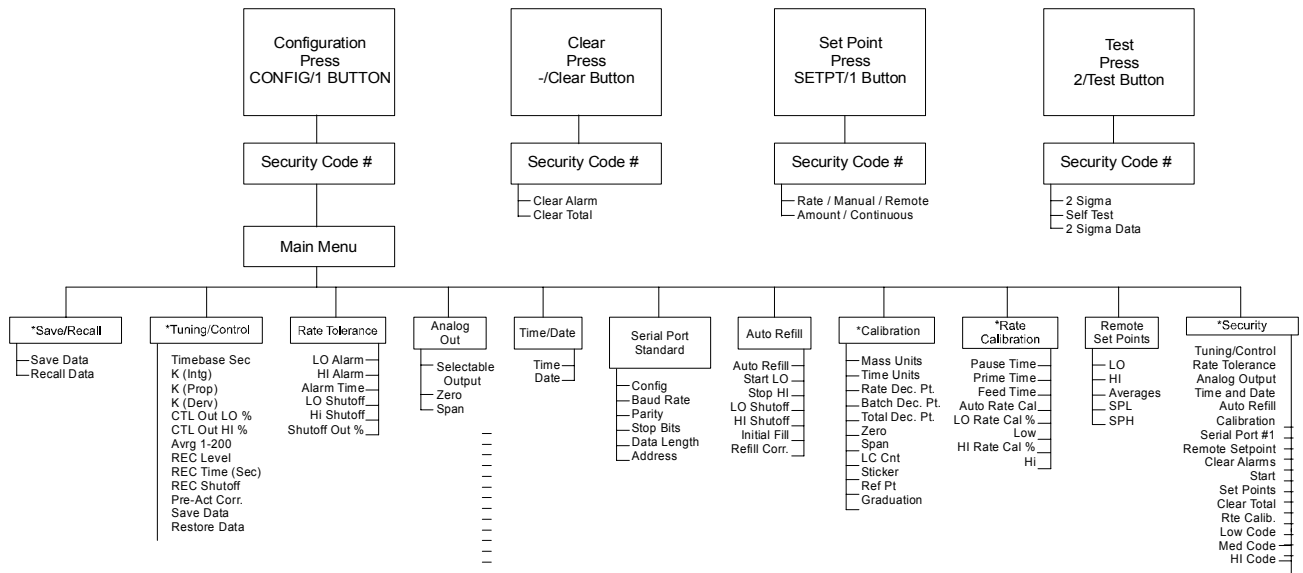
CHAPTER 6 - SETUP

About Chapter 6

All information contained in Chapter 6 pertains to the Firmware Setup of the HI 2160RC^{PLUS} Rate Controller. We recommend that the processes and procedures contained in this section be followed to insure the Rate Controller is properly setup. All setup processes must be completed before operating the Rate Controller. All maintenance personnel and users should be familiar with the setup information before operating the controller.

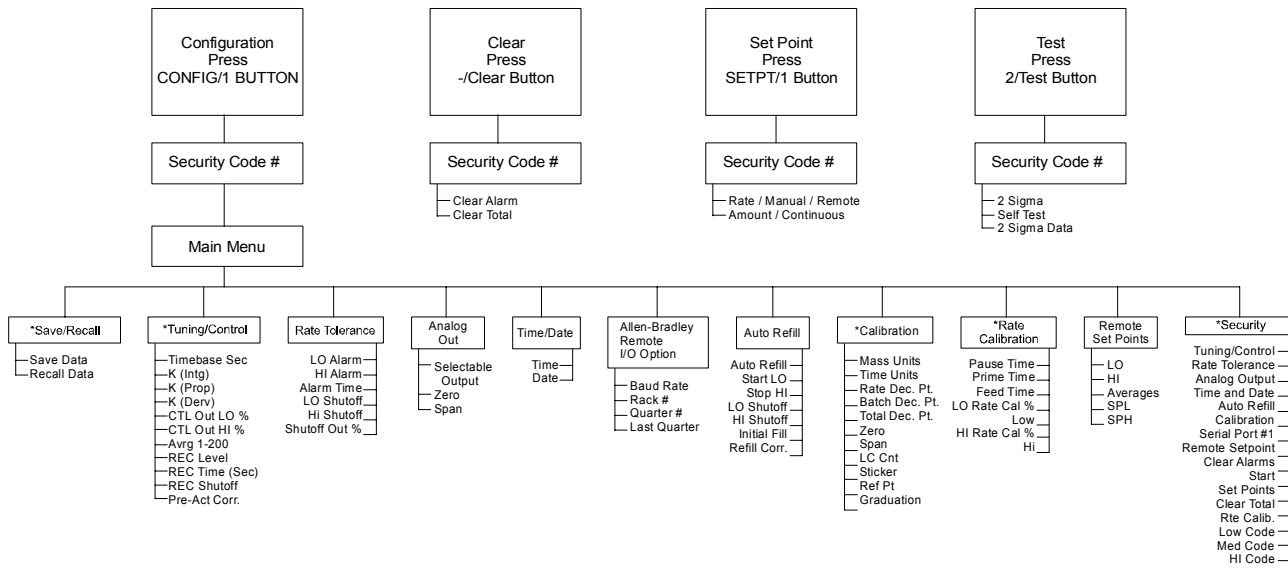
Display Menu Trees

Display Menu Flow Chart with Standard Serial Port



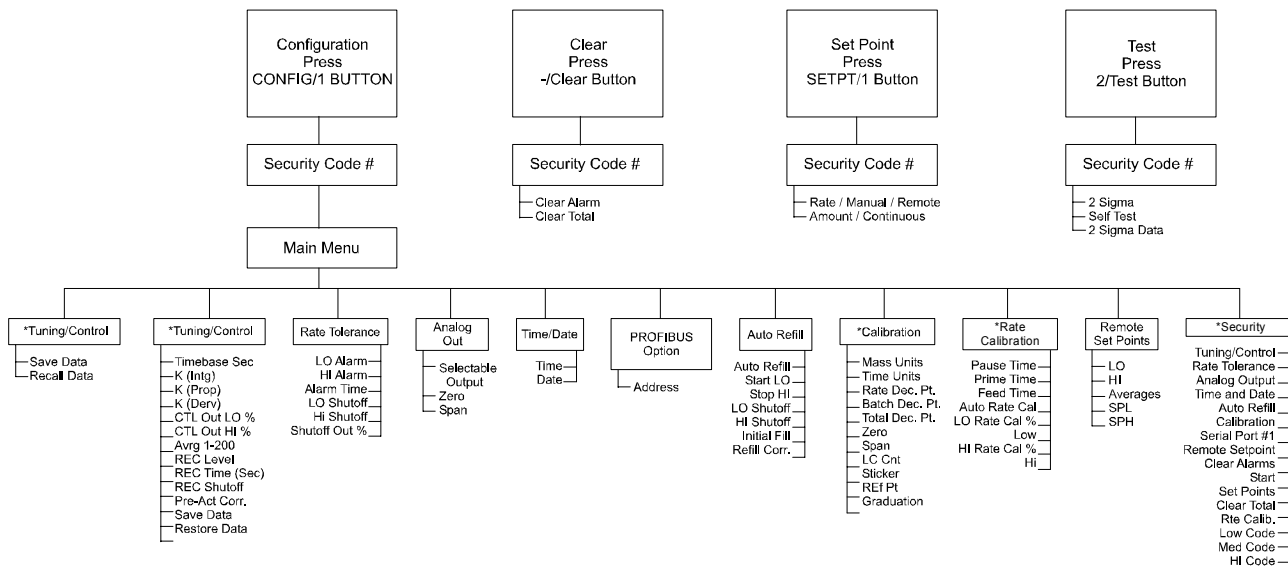
* Information (data) stored in the SMIM during a save operation

Display Menu Flow Chart with Allen Bradley Remote I/O Option



* Information (data) stored in the SMM during a save operation

Display Menu Flow Chart with PROFIBUS Interface Option



* Information (data) stored in the SMM during a save operation

Front Panel Display

- The Front Panel Display is a backlit liquid crystal display consisting of four lines with 20 characters per line.
- Various displays can be selected by pressing the Display/5 button. See Chapter 8 for detailed descriptions of the displays.
- In the Configuration, Test and Set Point menu displays, a cursor is used to select the menu items.

Function/Numeric Buttons

Config/1 Button

1. The Config/1 button opens the Main Menu.
2. The Main Menu consists of the following Sub-Menus:
 - Save/Recall
 - Tuning/Control
 - Rate Tolerances
 - Analog Out
 - Time and Date
 - Auto Refill
 - Calibration
 - Rate Calibration
 - AB Remote I/O or PROFIBUS I/O (will appear in the Main Menu if you have the options installed)
 - Serial Port #1
 - Remote Set Point
 - Security

Security Sub-Menu

NOTE: *The Allen Bradley I/O and the PROFIBUS Interface options have their own security systems. However, many of the functions still must be assigned a level access and code number from the front panel.*

NOTE: *The Allen Bradley I/O and PROFIBUS Interface options can setup parameters remotely and the HI 2160^{PLUS} security system will not interfere or prevent this transfer of data.*

Security Access Levels

- Access Levels
 - Factory default settings: All parameters are set for Low Access.
 - “0000” code number is the same as pressing the Enter Button.
 - Low (0000) - Functions used by an operator such as: Clear Alarms, Start Batch, Set Points and Clear Total
 - Medium (0123) - Functions used by maintenance technicians such as: Rate Tolerance, Analog Output, Time/Date, Auto Refill, Serial Port and Remote Set Point.
 - High (1234) - Functions used by supervisory personnel such as: Tuning/Control, Calibration, Rate Calibration and Security Code.

NOTE: *Codes shown are factory defaults and can be changed by using the high security code.*

Step 1. Press the Config/1 button. (See Fig. 6-1)

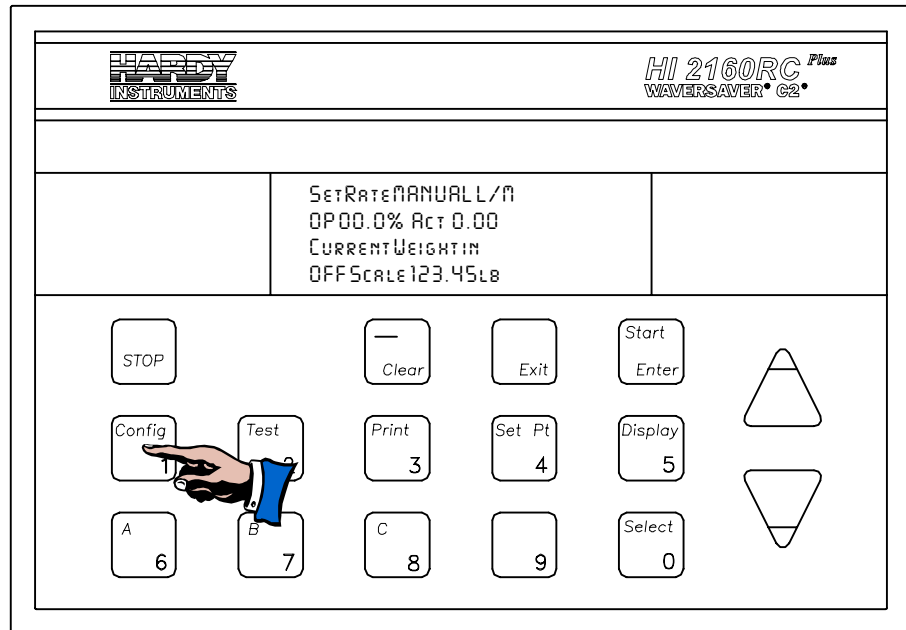


FIG. 6-1 PRESS CONFIG/1 BUTTON TO GET TO THE MAIN MENU

Step 2. Enter the HI access security code number (1234). (See Fig. 6-2)

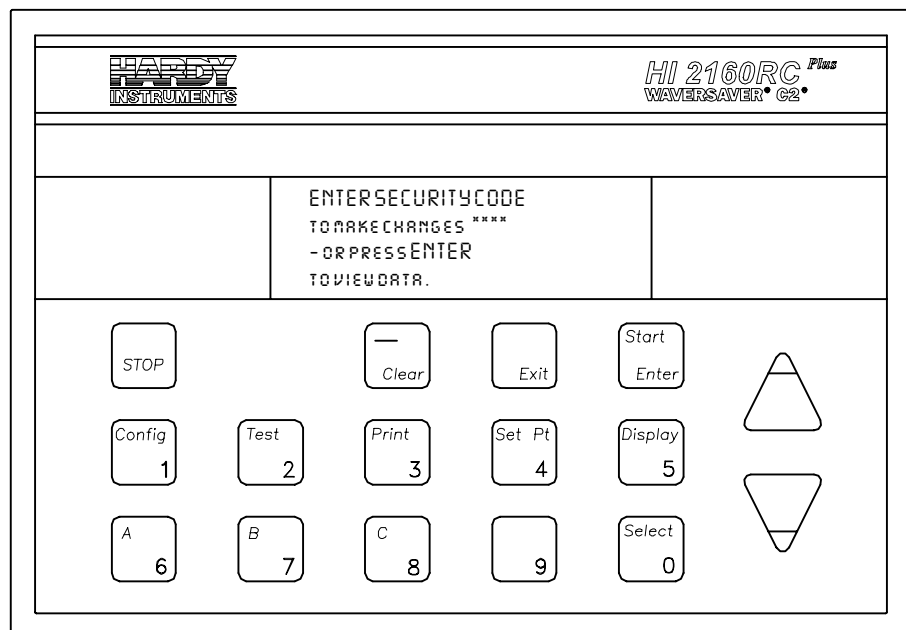


FIG. 6-2 SECURITY CODE ENTRY DISPLAY

Step 3. Press the Enter button. The Main Menu appears. (See Fig. 6-3)

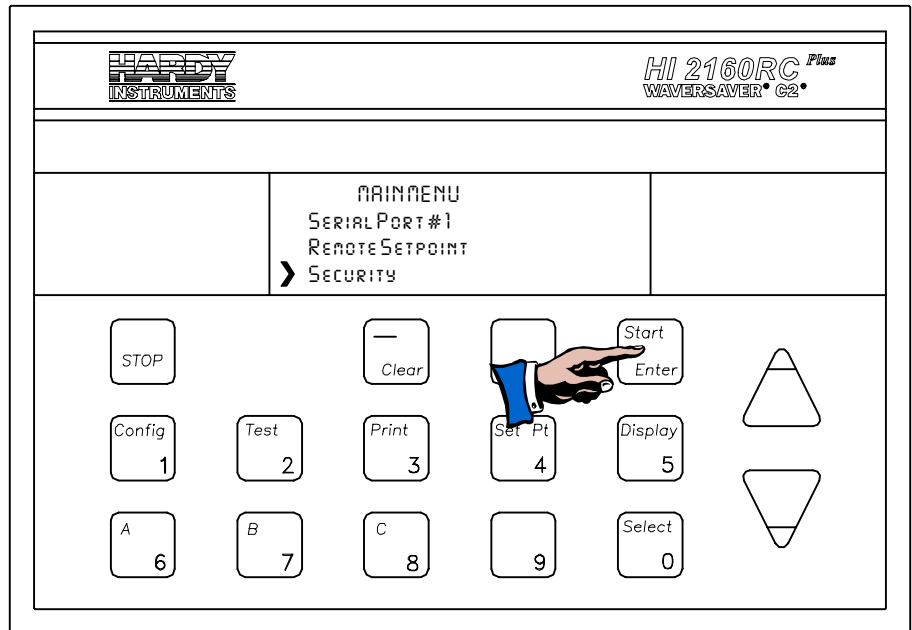


FIG. 6-3 SELECTING SECURITY SUB-MENU

- Step 4. Use the down arrow ↓ to select the Security Sub-Menu.
 Step 5. Press the Enter button. The Security Menu appears. (See Fig. 6-4)

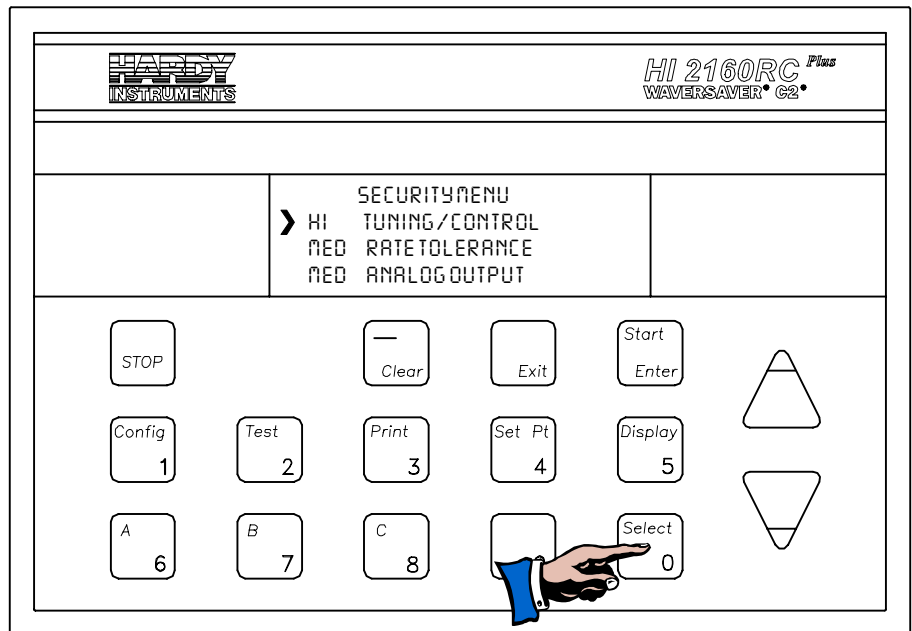


FIG. 6-4 SECURITY MENU, SELECTING ACCESS LEVELS

Setting the Security Access Levels

- You must enter the HI access security code number that is currently in the controller, in order to change the access levels.

- You can view the access levels by pressing the Enter button when prompted for a security code number.

Step 1. Use the up and down arrows ↑↓ to move the cursor to the parameter you want to change.

Step 2. With the cursor in front of the first parameter “Tuning/Control”, press the Select button until the level (LO, MED, HI) you want appears in the display.

NOTE:

When viewing the access codes only, the Select button does not operate.

Step 3. Press the Enter button to accept the level selection.

- Here is a recommended access level selection:

HI	Tuning/Control
MED	Rate/Tolerance
MED	Analog Output
MED	Time and Date
MED	Auto Refill
HI	Calibration
MED	Serial Port #1
MED	Remote Setpt.
LOW	Clear Alarms
LOW	Start
LOW	Setpoints
MED	Clear Total
HI	Rate Calibration
LOW CODE	XXXX
MED CODE	XXXX
HI CODE	XXXX

Setting the Security Code Numbers

- You must know the HI access security code number that is currently in the controller in order to change the code numbers.

Step 1. Use the down arrow ↓ to select the LO, MED or HI. (See Fig. 6-5)

Step 2. Press the Clear button to clear the previous entry or defaults.

Step 3. Use the numeric keys to enter the new security code number.

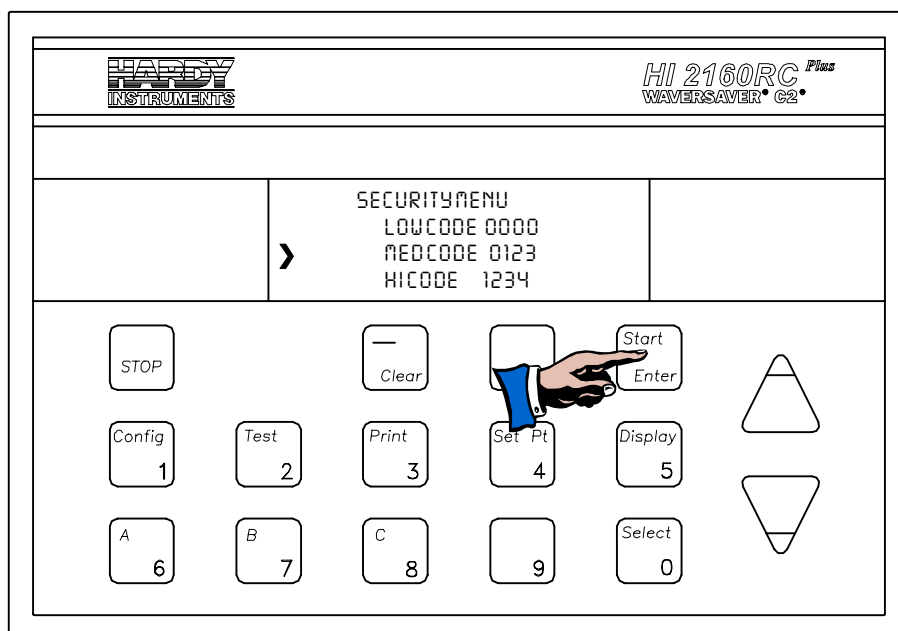


FIG. 6-5 SECURITY MENU, ENTERING LEVEL VALUES

NOTE:

It is highly recommended that the HI access security code numbers be written down and placed in a secure location in the event the numbers are lost, or users forget the code numbers.

Step 4. Press the Enter button to accept the new code numbers.

Step 5. Some recommendations for number selections:

- Don't use two number together (e.g. 55, 77, 22, 11)
- Don't use number in sequence (e.g. 3456, 4567)
- Don't use telephone numbers, social security numbers, or drivers license numbers which can be easily deciphered.

What to do if
You Lose the HI
Security Code
Number

- Contact your local Hardy Representative or Hardy Instruments Service Center.

When to Use the
Select Button

- When the Sub-Menu text is in upper and lower case for example: Time Base (Sec) use the Select button to move through the selections.
- When the Sub-Menu text is in upper case for example: K(INTG.) use the numeric key pad to enter values.

When to Use the
Clear Button

- When a numeric value is added to a sub-menu selection.
- Use the Enter button to accept the numeric value. A brief statement "ENTRY ACCEPTED" appears if the numeric values are accepted.
- A "NOT ALLOWED" statement appears if the values are not accepted. The "NOT ALLOWED" statement appears briefly and

then the Sub-Menu display appears again waiting for the user to correct the problem by adjusting the values.

How to Exit a Sub-Menu Without Changing the Values

- Step 1. Press the Exit button. You can exit the Sub-Menu without changing a thing.
- An example: You wanted to enter 547 and you entered 457. Simply press the Exit button to exit without entering the wrong value.
- Step 2. If you set a new parameter value and want to move to another parameter without changing the old value. Press the up ↑ or down ↓ arrow. The original value is restored.
- An example: You are changing the MED Access Code number but really wanted to change the LOW Access Code number. Use the up ↑ arrow to leave the MED Access parameter without changing the value.

Tuning and Control Sub-Menu

- This Sub-Menu allows the user to view the factory default parameters and constant values used by the HI 2160RC^{PLUS} for optimal control flow rates. The Sub-Menu also allows the user to change the default settings and calculate new constants if the user believes the settings do not create optimal flow rates for their particular process.
- The Default Settings are:

Time Base (Sec.)	4
K (INTG)	*
K (PROP)	*
K (DERV)	*
CTL OUT LO%	0
CTL OUT HI%	100
AVRG	1
REC.LEVEL	2.0
REC TIME (Sec.)	30
REC SHUTOFF	NO
Pre-Act Corr.	32
Save Data	NO
Restore Data	NO

NOTE:

** These parameters are determined by performing a Rate Calibration.*

- The factory set Tuning/Control default parameters, when used in conjunction with the K(p), K(i), K(d) values computed by the HI 2160RC^{PLUS}, work correctly with a vast majority of feeders and ingredients currently on the market. In most cases there is no need to change any values in the Tuning/Control Sub-Menu. In the event that the Tuning/Control factory default parameters are not optimal

for particular process conditions, go through the manual Tuning/Control process described below.

CAUTION

CHANGING THE CONSTANTS AND THE TUNING/CONTROL PARAMETERS MAY IMPROVE OR DEGRADE PERFORMANCE.

Tuning/Control
(Sec) Parameter
Definitions

- TIME BASE (Sec) - The time base is the length of time in seconds between two weight readings that are subtracted to determine the flow rate.
- DERIVED LOSS OF WEIGHT SLOPE (Interpreted as GAIN-IN-WEIGHT) graph. (See Fig. 6-7)
 - This graph shows the “worst-case” slope derived from weight readings taken at the beginning and end of the Timebase Period. The first reading was taken at a low spike while the second reading was taken on a high spike. As a result, the HI 2160RC^{PLUS} interprets this information as “GAIN-IN-WEIGHT” data instead of ‘LOSS-IN-WEIGHT’ data. On the Action display an ↔ graphic appears. (See Fig. 6-6) The arrow appears only when trying to run the feeder at low feed rates, where the weight variations exceed the amount of weight lost within the TIMEBASE period.

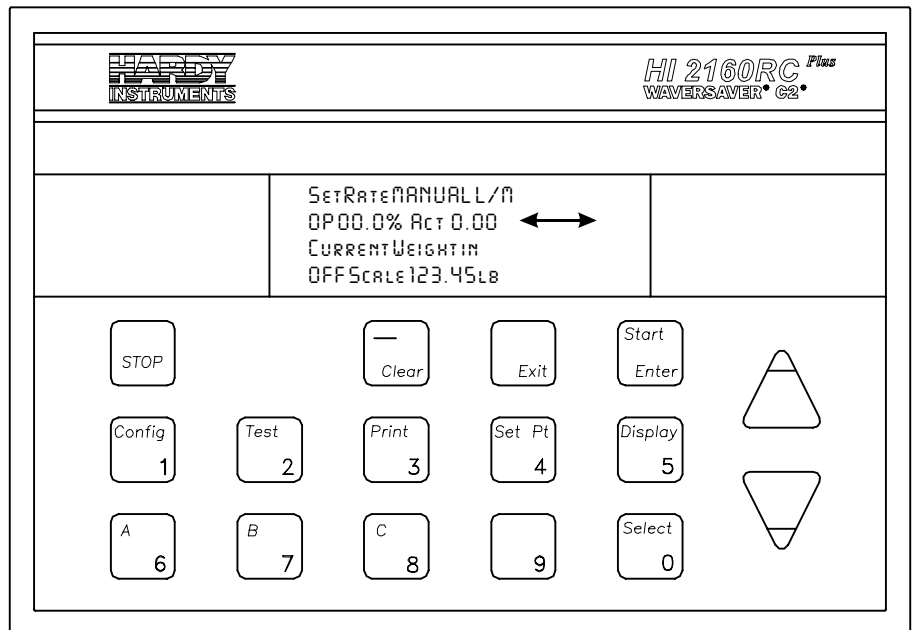


FIG. 6-6 ACT BLANK TIMEBASE ERROR

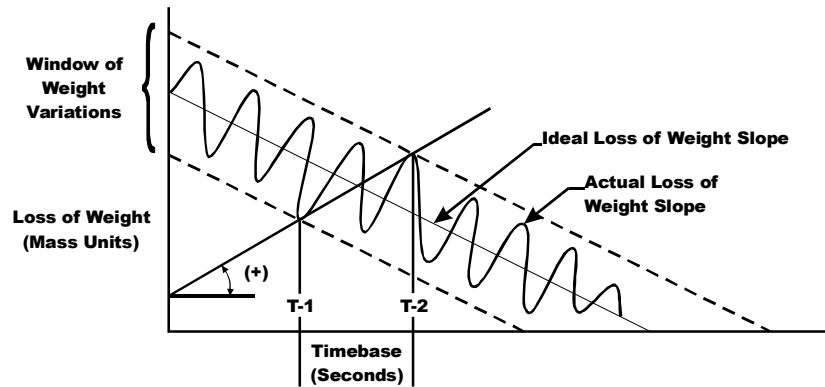


FIG. 6-7 DERIVED LOSS OF WEIGHT SLOPE (INTERPRETED AS GAIN-IN-WEIGHT)

- Derived Loss of Weight Slope (Interpreted as NO-CHANGE-IN-WEIGHT) graph. (See Fig. 6-8)

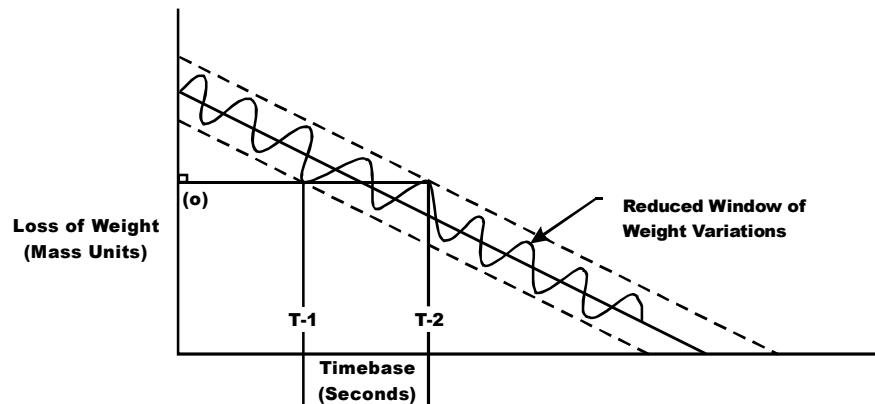


FIG. 6-8 DERIVED LOSS OF WEIGHT SLOPE (INTERPRETED AS NO CHANGE-IN-WEIGHT)

- By INCREASING the AVERAGES in the Tuning/Control Menu, you effectively reduce the “Window of Weight Variations” which effects the Derived Slope of the weight readings taken at the beginning and end of the TIME-BASE period. This may improve the performance of the controller, but in some cases may not be enough to obtain adequate control at very low feed rates.
- Derived Loss of Weight Slope (Interpreted as LOSS-IN-WEIGHT) graph. (See Fig. 6-9)

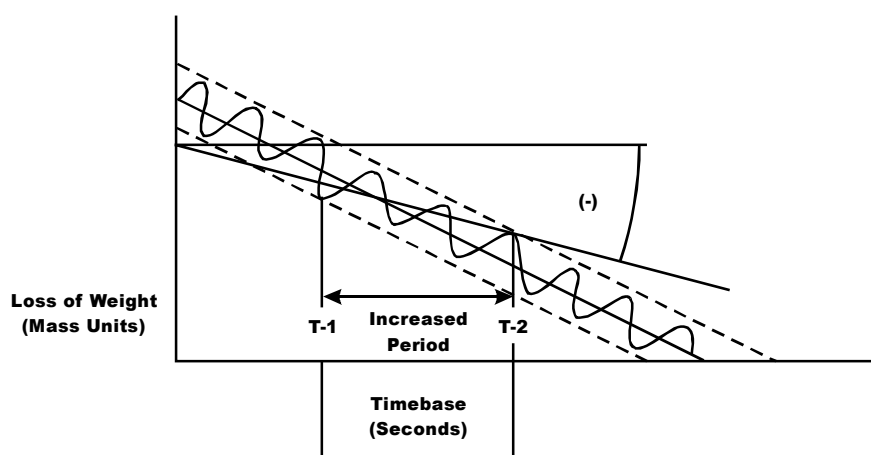


FIG. 6-9 DERIVED LOSS OF WEIGHT SLOPE (INTERPRETED AS LOSS-IN-WEIGHT)

- By INCREASING the TIMEBASE in the Tuning/Control Menu, you increase the time between weight readings. This allows more material to be dispensed during the TIMEBASE period. As a result, the HI 2160RC^{PLUS} interprets this as valid LOSS-IN-WEIGHT information. This should eliminate the ↔ ACT blank from being displayed when running at lower feed rates. Once the ↔ ACT blank is eliminated, the HI 2160RC^{PLUS} can accurately control at all feed rates.
- Kk(INTG), (PROP), (DERV) - The control constants which are used to control the feeder to maintain the required feed rate. These values are determined either by performing a Rate Calibration or by the use of mathematical formulas.
- CTL, OUT LO (%) - control output Low sets the lower limit of the analog output to the feeder's speed control circuits, for minimum feeder speed.
- CTL OUT HI (%) - Control output High sets the upper limit or the analog output to the feeder speed control circuits, for maximum feeder speed.
- AVR (1-200) - Averages represent the number of samples taken to obtain a stable weight reading. For fastest response, use the smallest number that results in stable rate readings.
- REC LEVEL - Rate Exception Control is used to determine the percentage of error allowed before the HI 2160RC^{PLUS} jumps from closed loop control to the REC operation mode. Lower values yield a higher sensitivity.
- Use a moderate REC value to avoid frequent inadvertent jumps to the REC mode.

- From the Front Panel Display check the OP% values while running a batch from the feeder. Calculate REC as follows:

$$\text{REC Level} = (\text{High OP\%} - \text{Low OP\%}) \times .01 \div 2$$

- REC TIME (Seconds) - Rate Exception Control Time used to determine the time the HI 2160RC^{PLUS} must remain in the REC mode to initiate an alarm condition, energizing the alarm relay.
- REC Shutoff - Rate Exception Control Shutoff. If “yes” is chosen, the feeder stops if the controller stays in the REC mode for the amount of time chosen in REC TIME. If “no” is chosen, the feeder will continue to run in the REC mode with the alarm relay energized.
- Pre-Act Corr. - The Pre-Act Correction compensates for in flight material when the feeder shuts off in batch operations.
- Save Data - Stores Configuration, Calibration and Setup parameters in the Secure Memory Module (SMM).
- Restore Data - Restores data from the Secure Memory Module (SMM) to the controller’s conventional memory.
- If you feel that the automatically calculated control constants can be improved, enter your own control constants in the way you would enter a numerical value in any Sub-Menu. The Manual Tuning Control is a step-by-step process to arrive at the control constants for your specific application. The values calculated automatically by the instruments provides optimum values for almost all applications. Because there are any number of variations from one application to the next there are a few applications when the HI 2160RC^{PLUS} will not provide optimum values to control your process. Be sure that new control constants are needed before Manual tuning process. Once you determine the new constants, write them down in a secure location because they will be replaced automatically the next time a rate calibration takes place.
- Manual tuning control is a process used to calculate the three constants: K(p), K(i), K(d) which is a two step process:

Manual
(Calculating
Parameters)
Tuning Control
Process

NOTE:

The tuning process is basically trial and error. There are only two values you need to adjust: Timebase and Averaging. To insure the changes are going in the right direction, change one parameter at a time and make incremental changes only. For example when changing the Timebase Parameter, change it from 4 to 5, check performance (Increase Timebase if the expected rate is above 100 mass units/time unit). If the performance improves, go from 5 to 6, 6 to 7, and so on until the performance begins to degrade. At the level where performance begins to degrade, step back one level for optimal performance level setting. Conversely when changing the Timebase Parameter, change from 5 to 4, check performance. If the performance improves, go from 4 to 3, 3 to 2, and so on until the performance begins to degrade. At the level where performance begins to degrade, step back one level for optimal performance level setting. If performance improves move onto the next parameter. Do the same process for changing Averages. (Increase Averages if the weight varies 1% of full scale).

Setting Up the Controller for Manual Tuning

- Step 1. Press the Config button. The Security Message displays.
- Step 2. Enter the HI security code number.
- Step 3. Press the Enter button. The TUNING/CONTROL MENU appears with the cursor to the left of Timebase (sec). (See Fig. 6-10)

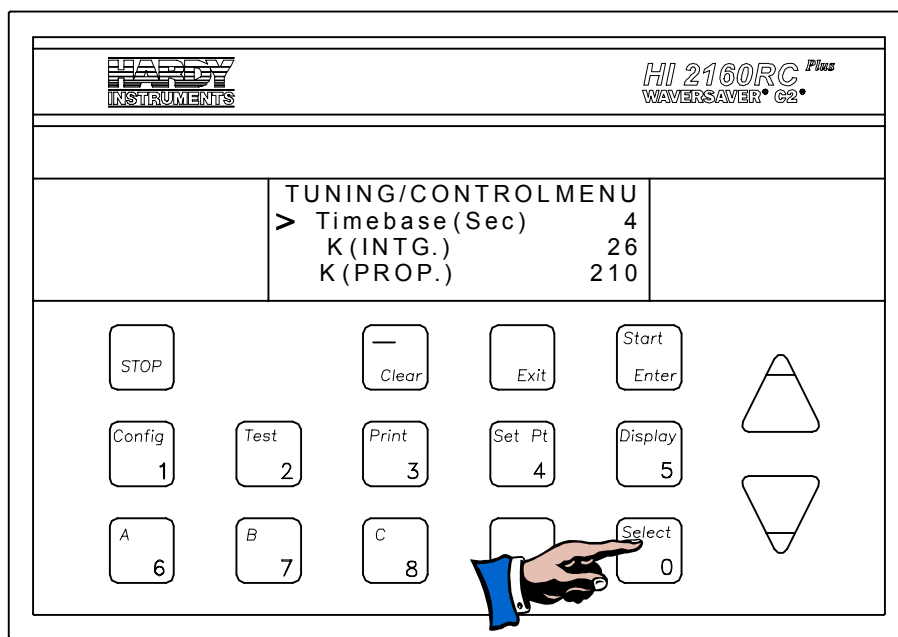


FIG. 6-10 ENTERING TIMEBASE PARAMETER

- Step 4. The default setting for Timebase is 4 seconds. Press the Select button until a new value appears. (1 min, 120 max)
- Step 5. Press the Enter button to accept the new value setting.
- Step 6. Press the down arrow ↓ until the cursor is next to the AVR.G. Sub-Menu. (See Fig. 6-11)

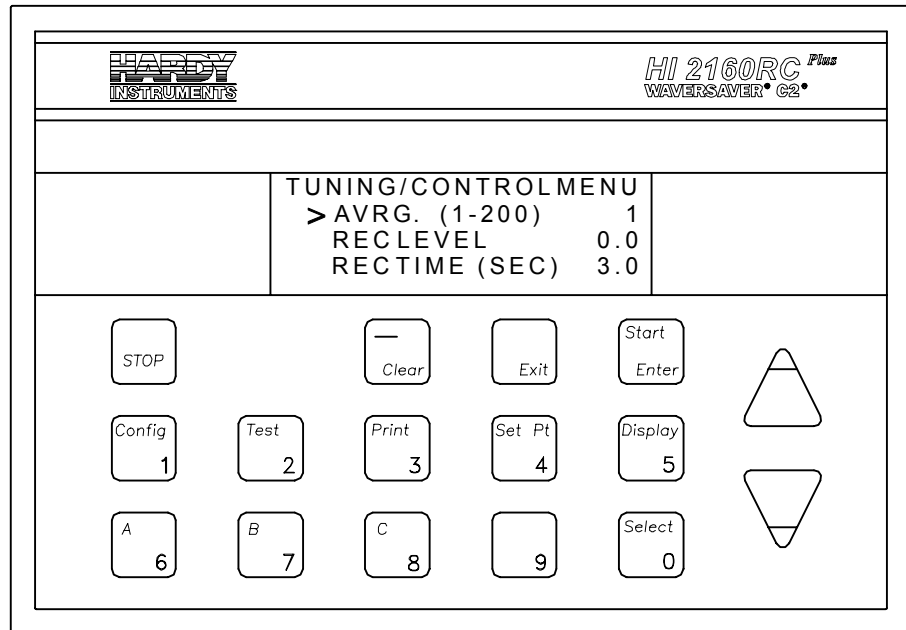


FIG. 6-11 SETTING THE AVRG AND REC LEVELS

Step 7. Press the Clear button to clear the AVRG. value.

NOTE:

When you enter a value that is less than three digits, a zero appears before the digit entered (e.g. 002, 014). When you press the down arrow button to move to the next Sub-Menu the zero(s) disappear (e.g. 2, 14).

Step 8. Press the Enter button to accept the new value.

Step 9. Press the down arrow ↓ until the cursor appears to the left of the REC LEVEL Sub-Menu.

Step 10. Press the Clear button to clear the REC LEVEL value.

Step 11. Use the numeric keys to enter 0.0. Entering 0.0 prevents alarms during the data gathering procedures.

Step 12. Press the Enter button to accept the 0.0 value.

Step 13. Press Exit twice to get to the Operations Display.

Step 14. Press the Set Pt button. The security message displays.

Step 15. Enter the HI security code number.

Step 16. Press the Enter button. The Set Point Sub-Menu appears.

Step 17. With the cursor next to RATE, press the Select button until MANUAL appears.

Step 18. Press the Enter button to accept the MANUAL selection.

Step 19. With the cursor next to AMOUNT, press the Select button until CONTINUOUS appears.

Step 20. Press the Enter button to accept the CONTINUOUS selection.

Step 21. The controller is now in the MANUAL operating mode.

Step 22. Press the Exit button to return to the Operations Display.

Set the OP% to 99.9%

- Step 1. The OP% reads 00.0% with the digit to the right of the decimal point (the least significant digit) flashing. The flashing means that the value can be changed.
- Step 2. Press the up arrow ↑ until the number 9 appears.
- Step 3. Press the Select button to move to the units digit which begins flashing.
- Step 4. Press the up arrow ↑ until the number 9 appears.
- Step 5. Press the Select button to move to the next digit to the left (the IDs position).
- Step 6. Press the up arrow ↑ until the number 9 appears.

Gathering Data

- Step 1. Press the Start button to run the feeder.
- Step 2. Run the feeder until the Act Rate stabilizes and the material flows consistently as determined by the user.
- Step 3. Push the Stop button to stop the feeder.
- Step 4. Press the Display button until the Operating Display/Total Weight appears. (See Fig. 6-12)

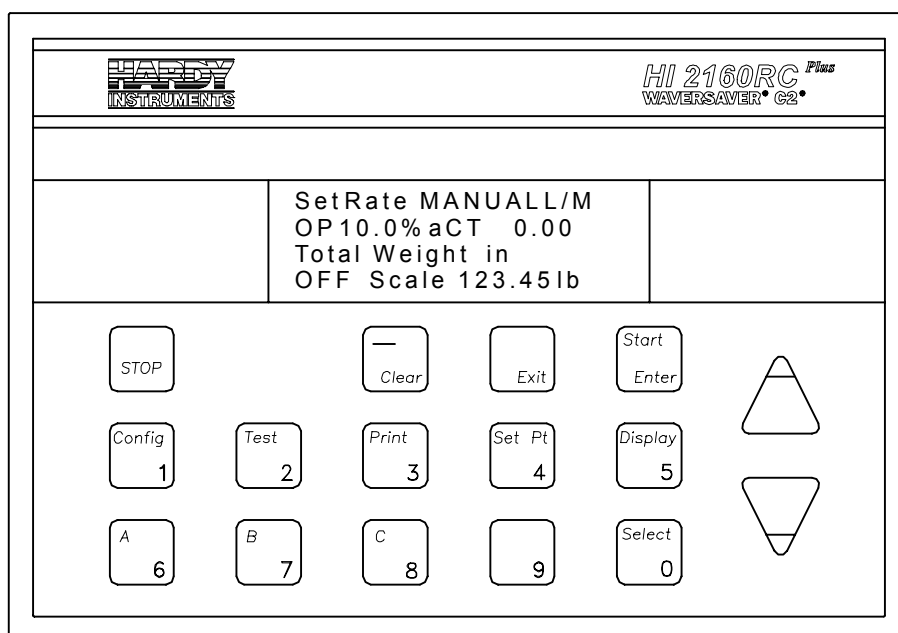


FIG. 6-12 OPERATING DISPLAY TOTAL WEIGHT

- Step 5. Press the Clear button to clear the total weight. The security message appears.
- Step 6. Enter the HI level security code number.
- Step 7. Press the Enter button.
- Step 8. A “Clear Total No” message appears.
- Step 9. Press the Select button to select Yes.
- Step 10. Press the Enter button to clear the total.
- Step 11. Get a one minute timer or stop watch to measure the material dispensed in one minute.

- Step 12. Start the feeder and immediately start the timer. Material begins to flow out of the feeder.
- Step 13. Stop the feeder after one minute.
- Step 14. Check how much material was dispensed in one minute by looking at the total weight on the display.
- Step 15. Clear the total weight and repeat the data gathering process until you are sure the gathered data is accurate.
- Step 16. Calculate the average feed rate value.
- Step 17. The average feed rate is the value you need to calculate the K(p), K(i) and K(d).
- Step 18. End of data gathering.

Calculate the K(pu) value (initial K(p))

- Formula:

$$K(pu) = 1500(\text{Max. Feed Rate: lbs/min or } 900,000/(\text{Max. Feed Rate: lbs/hr}))$$

Calculate the Ultimate Oscillation Cycle Time (Tc)

- Formula:

$$Tc = \text{Timebase} + \text{Averages}/20 + .08$$

Calculate the Time of Repeat (Tr)

- Formula:

$$Tr = Tc \times 20/\text{Timebase}$$

Calculate the Three (3) Control Constants: K(p), K(i) and K(d)

- Formulas:

$$K(p) = K(pu)/1.67$$

$$K(i) = 2 \times K(p)/Tr$$

$$K(d) = 4 \times K(i)$$

Enter the new Control Constants

- Step 1. Press the Config button. The security message displays.
- Step 2. Enter the HI Security Code number.
- Step 3. Press the Enter button. The Main Menu appears.
- Step 4. Press the down arrow ↓ button until the cursor is to the left of the TUNING/CONTROL Sub-Menu.
- Step 5. Press the Enter button. The TUNING/CONTROL Sub-Menu appears.
- Step 6. Press the down arrow ↓ button until the cursor is to the left of the first constant K(i). (See Fig. 6-13)
- Step 7. Use the numeric keys to enter the calculated constant value for K(i).
- Step 8. Press the Enter button to accept the new K(i) value.

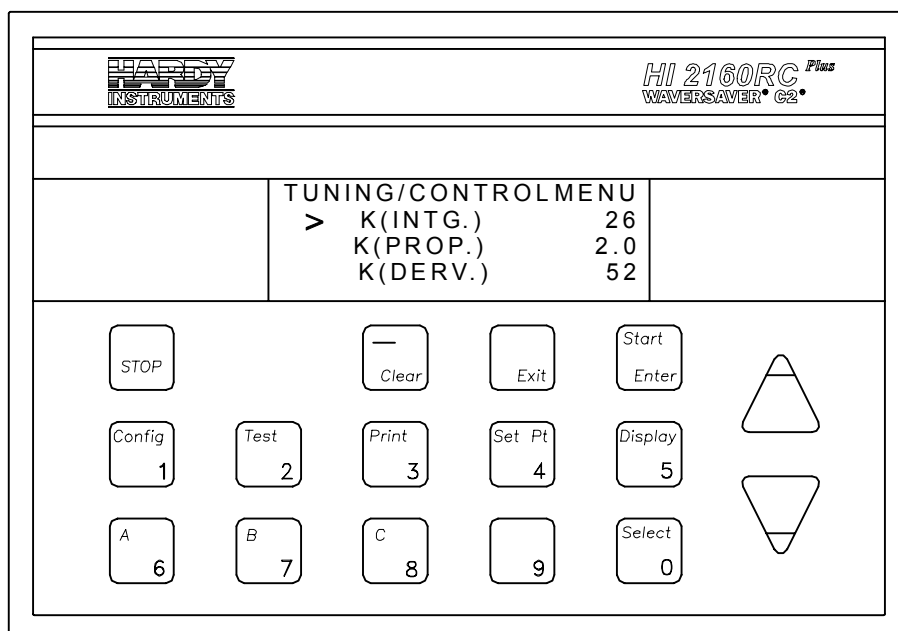


FIG. 6-13 ENTERING CALCULATED CONSTANT VALUES

- Step 9. Press the Clear button to set the value to 0.
- Step 10. Press the down arrow ↓ button to go to the next constant K(p). Clear the old value and enter the K(p) calculated value.
- Step 11. Press the Enter button to accept the new K(p) value.
- Step 12. Press the down arrow ↓ button to go to the next constant K(d). Clear the old value and enter the K(d) calculated value.
- Step 13. Press the Enter button to accept the new K(d) value.
- Step 14. Press the down arrow ↓ button until the cursor is to the left of the REC LEVEL Sub-Menu.
- Step 15. Initially change the REC LEVEL to 2.0.
- Step 16. Press the Enter button to accept the REC setting.
- Step 17. Press the Exit button twice to get to the operational display.

Manual Tuning Control Process (Cont'd)

- Step 1. Make sure the feeder is on.
- Step 2. Press the Set Pt button.
- Step 3. Enter the Security code number.
- Step 4. Press the Enter button. The Set Point Menu appears with the cursor to the left of the RATE Sub-Menu.
- Step 5. If the Rate display shows “MANUAL” or “REMOTE”, press the Select button to select the Value display.
- Step 6. Press the Clear button to clear the values.
- Step 7. Use the numeric keys to enter the new flow rate.

NOTE:

Enter a flow rate that will be used in the application.

- Step 8. Press the Enter button to accept the new rate.
- Step 9. Press the Exit button to return to the operating display.

Step 10. Press the Start button. You will notice that the Rate Exception Control (REC) momentarily appears in the lower left corner of the display. (See Fig. 6-14)

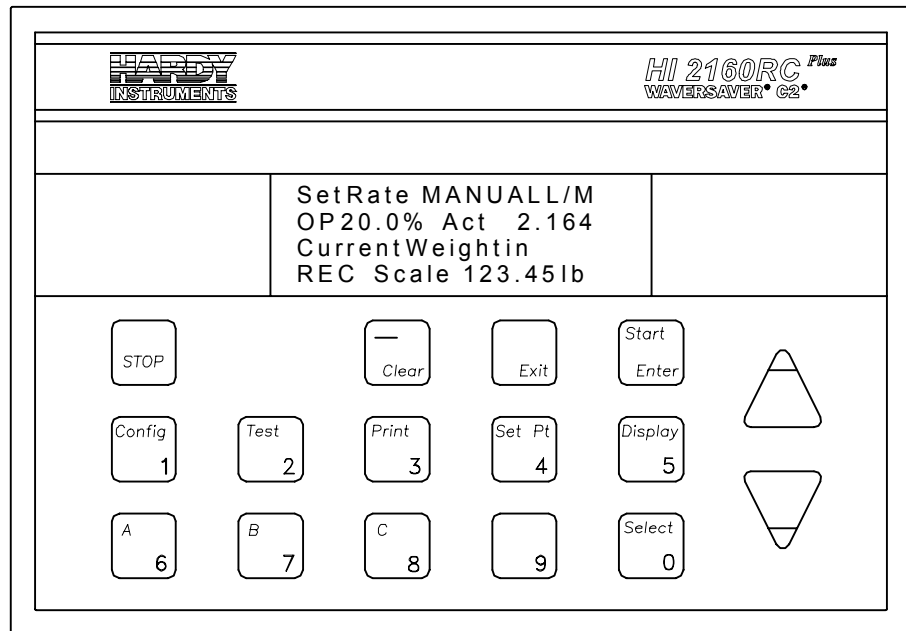


FIG. 6-14 OPERATIONAL DISPLAY/REC STATUS

Step 11. If the REC does not go away, stop the feeder and increase the REC LEVEL value.

- Restart the feeder.
- Continue this process until the REC goes away and ON appears.

Step 12. If the REC disappears, begin to monitor the display to see if the REC appears again. If REC appears more than once in 30 seconds without external disturbances, stop the feeder and increase the REC LEVEL.

Step 13. Continue this process until the REC displays only once in 30 seconds, or doesn't display at all.

Step 14. Monitor the OP% values for excessive drifts, $\pm 10\%$.

Step 15. If the feeder appears to drift excessively, try reducing all constant values by half until adequate control is achieved.

Step 16. If adequate control cannot be achieved by using the procedures in Manual Tuning, contact your local Hardy representative or the Hardy Instruments Service Center for assistance.

NOTE:

It is recommended that the supervisor assign a HI Level Security Code number to the Rate Calibration Menu to prevent accidentally recalculating the control constants.

Step 17. If the feeder does not drift and manual tuning achieves the desired feeder performance, record the following controller parameters for future reference:

- Averages
- Timebase
- K(p)
- K(i)
- K(d)
- REC LEVEL

Step 18. Enter the recorded controller parameters in the Tuning and Control Menu.

Rate Tolerance Sub-Menu

- The Rate Tolerance Sub-Menu allows the user to set the Rate Tolerance Alarm parameters.
- The default settings are:

LO ALARM	0.020
HI ALARM	0.020
ALARM TIME (Sec)	60
LO SHUTOFF	0.100
HI SHUTOFF	25.00
SHUTOFF OUT (%)	0

HI and LO alarm values are entered as positive (+) and negative (-) deviations from the setpoint flow rate. This allows you to simply change the desired setpoint rate and the alarm tolerance bands follow the new setpoint automatically. The Alarm levels notify you of unacceptable rates of flow.

Setting the LO ALARM Tolerance

NOTE:

The LO Alarm value must be \leq the Lowest Set Point Value.

Step 1. Press the down arrow ↓ button until the cursor is to the left of the LO ALARM Sub-Menu. (See Fig. 6-15)

- The LO ALARM is a tolerance parameter that is set below the set point rate.

Step 2. Press the Clear button to clear the value.

Step 3. Use the numeric keys to enter the tolerance for the lowest set point in the process. (For example: If you have a low set point of 3 lbs/min, and want a LO ALARM at 2.5 lbs/min, set the LO ALARM value to 0.50.

Step 4. Press the Enter button to accept the new values.

Setting the HI
ALARM
Tolerance

Step 5. Press the Exit button if you don't want to change the values or entered an incorrect value.

Step 1. Press the down arrow ↓ button until the cursor is to the left of the HI ALARM Sub-Menu.

- The HI ALARM is a tolerance parameter set above the high set point rate. (See Fig. 6-15)

Step 2. Press the Clear button to clear the value.

Step 3. Use the numeric keys to set the tolerance for the highest set point in the process. For example: If you have a high set point of 8 lbs/min, and want a HI ALARM at 8.5 lbs/min, set the HI ALARM value to 0.50.

Step 4. Press the Enter button to accept the new value.

Step 5. Press the Exit button if you don't want to change the values or entered a wrong value.

Setting the
ALARM TIME
(Sec.)

- The ALARM TIME is the time that the actual rate is outside either the HI ALARM tolerance or the LO ALARM tolerance before the alarm condition begins.
- Set the ALARM TIME so that the value is long enough to ignore momentary out of tolerance flow rates and short enough to provide a responsive alarm.
- When an Alarm condition exists for longer than the allowed period, the "Alarm" relay energizes and the top line of the operations display reads "***LO RATE ALARM****" or "***HI RATE ALARM****" and if an audio or visual alarm has been connected to the controller that alarm is energized alerting the operator that an alarm condition exists. For Remote I/O systems a bit is set and the alarm is indicated on the display of the PLC or computer.

NOTE:

It is highly recommended that the user install a visual or audio alarm to the alarm relay at the rear panel of the HI 2160RC^{PLUS} in order to determine when the process is in an alarm condition. See Chapter 3 - Installation for more information.

- The Alarm message does not clear itself if the process adjusts itself out of the alarm condition.
- To clear the alarm from the front panel:
 - Press the Clear button. The security message appears.
 - Enter the LO or MED level security code number.
 - Press the Enter button. A "Clear Alarm No" message appears.
 - Press the Select button to select YES.
 - Press the Enter button. The alarm relay is reset. The alarm message is cleared from the display. the audio or visual alarms are turned off.
- To clear the alarm using a remote I/O.

- Use the serial “Clear” message.
- To clear the alarm from the Remote Functions Connector.
 - Momentarily ground the “A” pin on the Remote Functions connector located on the rear panel. (See Fig. 6-15)

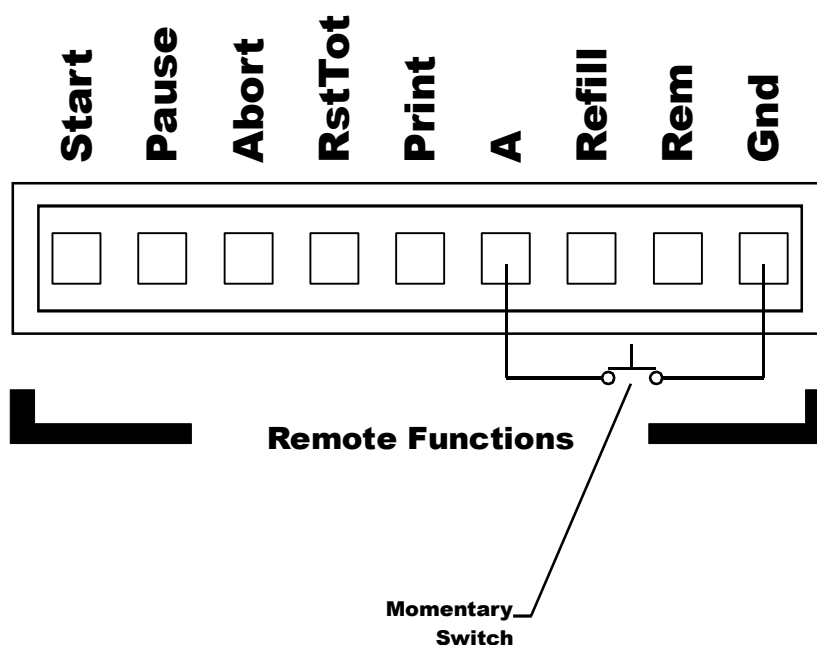


FIG. 6-15 GROUNDING THE “A” PIN TO CLEAR ALARM

Setting the HI and LO Shutoff

- HI and LO shutoff values are entered as absolute rates of flow so that critical limitations of the process remain firm and fixed.
- Shutoff levels are utilized to stop a potentially dangerous or expensive error.

Step 1. Press the down arrow ↓ button until the cursor is to the left of the LO SHUTOFF Sub-Menu. (See Fig. 6-16)

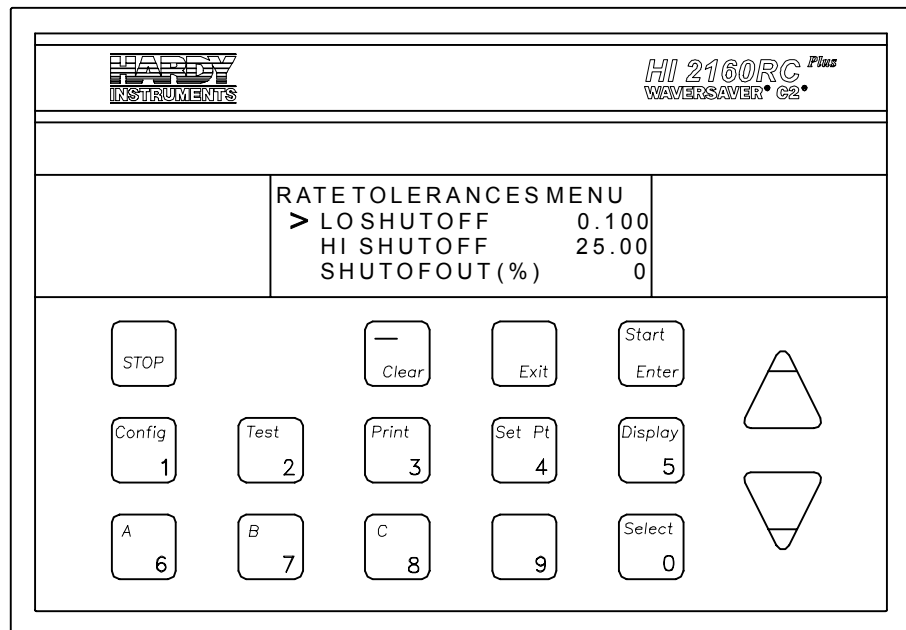


FIG. 6-16 RATE TOLERANCES MENU/SHUTOFF SETTINGS

- Step 2. Press the Clear button to clear the entry.
- Step 3. Use the numeric keys to enter the actual Shutoff low flow rate value.
- Step 4. Press the Enter button to accept the new value.
- Step 5. Press the down arrow ↓ button until the cursor is to the left of the HI SHUTOFF Sub-Menu.
- Step 6. Press the Clear button to clear the entry.
- Step 7. Use the numeric keys to enter the actual Shutoff high flow rate value.

Setting the Shutoff Out Percentage

- If the process must continue to operate at a some percentage at all times, set the Shutoff Out percentage to that value. The HI 2160RC^{PLUS} automatically goes into the manual mode and the control output goes to the output percent (OP%) value entered.
- If a process does not have to operate at a certain percentage at all times use the default percentage of 0%.
- When a shutoff condition exists:
 - The “Shutoff” relay is energized and a ****LO SHUTOFF ALARM**** or ****HI SHUTOFF ALARM**** message appears at the top of the display.
 - The controller goes to manual mode and the control output changes to the output value entered in the Shutoff Out Percentage. For example the Shutoff Out Percentage is set at 25%. In a shutoff alarm condition the controller automatically reverts to a constant 25% control output signal.

NOTE:

This is **NOT** a percent of the set point Feed Rate.

- If the default setting was selected (i.e. 0%), in a shutoff alarm condition the controller goes to 0% of span output signal which de-energizes the ON/OFF relay and shuts off the feeder.

NOTE:

The controller shuts of the feeder only, it does not close valves or de-activate other machinery.

- Step 1. Press the down arrow ↓ until the cursor is to the left of the SHUTOFF OUT (%) Sub-Menu.
- Step 2. To accept the default of 0%, press the Enter button to accept the default percentage.
- Step 3. Press the Clear button to clear the entry.
- Step 4. Use the numeric keys to enter the Shutoff Out percentage.
- Step 5. Press the Enter button to accept the new value.

Process
Example using
Rate Tolerances
(See Fig. 6-17)

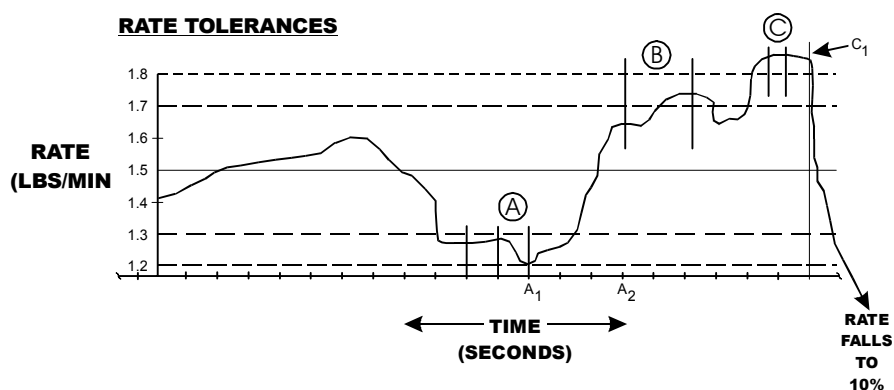


FIG. 6-17 PROCESS GRAPH USING RATE TOLERANCES

- Set Point Rate: 1.5
- Rate Tolerance Settings:
 - LO ALARM .2
 - HI ALARM .2
 - ALM TIME (SEC) 3
 - LO SHUTOFF 1.2
 - HI SHUTOFF 1.8
 - SHUTOFF OUT% 10%
- Condition A:
 - The rate went below the “LO ALARM” level for more than 3 seconds.
 - The alarm output became active at point A₁ and stayed active until cleared by the operator at point A₂.

- Condition B:

- The rate went above the “HI ALARM” level but did not exceed 3 seconds.
 - The alarm output was not activated.
- Condition C:
 - The rate went above the HI SHUTOFF level for over three (3) seconds which meets a shutdown condition effective at point C₁.
 - The control output drops to 10% and into the manual mode.

Auto Refill Sub-Menu

About the Auto Refill Sub-Menu

Auto refill is a function that energizes the Auto Refill Relay when a user selectable LO (Start) weight condition occurs in the feeder. This function assures that the feeder will not run out of material during the dispensing process. When the relay is energized it can turn on an audio or visual alarm indicating a refill condition exists and the operator needs to replenish the feeder. The energized relay can also actuate a solenoid which in turn can open a valve or start a driver to automatically load more material into the feeder. The refill relay remains energized until the feeder receives enough material and meets the user selectable HI (Stop) weight condition at which time the relay is de-energized. (See Fig. 6-18)

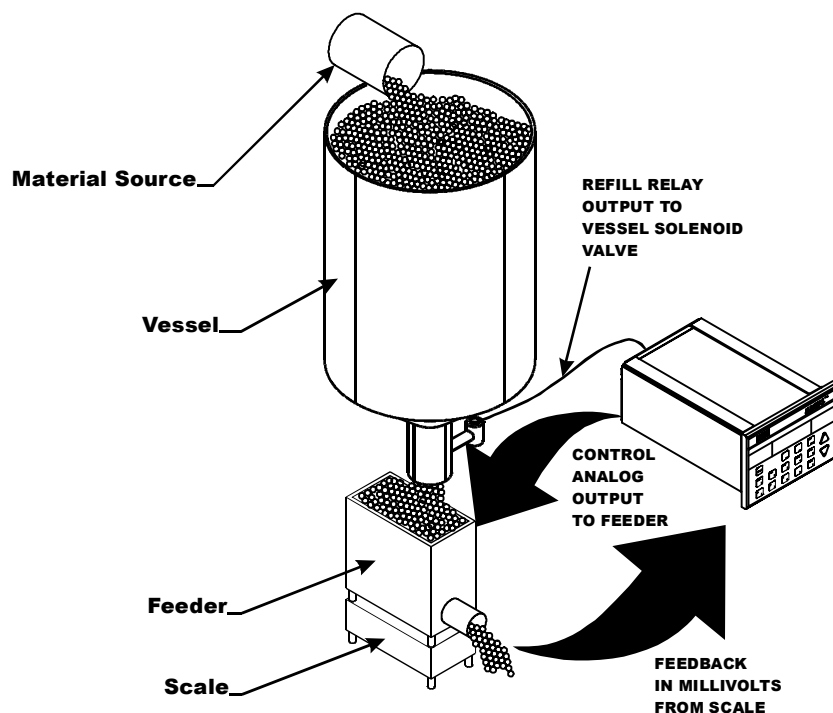


FIG. 6-18 AUTO REFILL OUTPUT RELAY

- The default settings are:

• Auto Refill	NO
• START (LO)	2.000
• STOP (HI)	40.000
• LO SHUTOFF	1.000
• HI SHUTOFF	50.000
• Initial Fill	YES
• RFL CORR	0.0

Selecting the Auto Refill Function

NOTE:

The Rate Exception Control must be turned on when enabling the automatic refill.

- Step 1. Press the Config button and enter the Main Menu.
- Step 2. Press the down arrow ↓ button until the cursor is to the left of the AUTO REFILL Sub-Menu.
- Step 3. Press the Enter button. The AUTO REFILL Menu appears. (See Fig. 6-19)

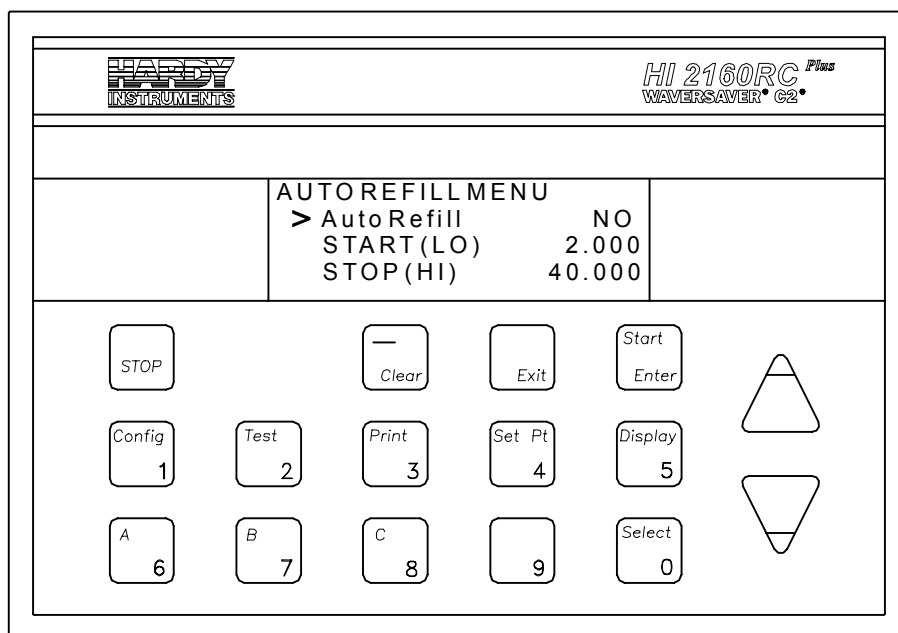


FIG. 6-19 AUTO REFILL MENU/START AND STOP SETTINGS

- Step 4. Press the down arrow ↓ button until the cursor is to the left of the AUTO REFILL Sub-Menu.
- Step 5. Press the Select button to select YES.
- Step 6. Press the Enter button to accept the selection.

NOTE:

When setting the START limit, make sure that the limit is adequate to allow the operator or the system plenty of time to begin filling the feeder before the feeder runs out of material. Conversely, when setting the STOP limit, make sure that the limit is ade-

quate to allow the system plenty of time to stop filling the feeder before the feeder hopper overflows.

Setting the
START (LO) and
STOP (HI)
Parameters

- Setting the START (LO) Weight
 - The START (LO) settings are in mass units (actual weight). The START (LO) begins the Auto Refill Cycle.

Step 1. Press the down arrow ↓ button until the cursor is to the left of the START (LO) Sub-Menu.

Step 2. Press the Clear button to clear the entry.

Step 3. Use the numeric keys to enter the new value.

Step 4. Press the Enter button to accept the new value.

- Setting the STOP (HI) Weight.
 - The STOP (HI) settings are in mass units (actual weight). The STOP (HI) ends the Auto Refill Cycle.

Step 1. Press the down arrow ↓ button until the cursor is to the left of the STOP (HI) Sub-Menu.

Step 2. Press the Clear button to clear the entry.

Step 3. Use the numeric keys to enter the new value.

Step 4. Press the Enter button to accept the new value.

Setting the LO
SHUTOFF and
HI SHUTOFF
Alarm Weight
Parameters

- HI and LO SHUTOFF values are entered as absolute weights so that critical limitations of the process remain firm and fixed.
- Shutoff levels are utilized to stop a potentially dangerous or expensive error.
- The setting for LO must be below the START value. The setting for HI must be above the STOP value.
- Set the weight value low or high enough to provide a responsive alarm.
- When an Alarm condition exists, the “Alarm” relay energizes stopping the feeder and the top line of the operations display reads ****REFILL LO SHUTOFF**** or ****REFILL HI SHUTOFF****. If an audio or visual alarm is connected to the controller, that alarm is energized alerting the operator that an alarm condition exists. For Remote I/O systems a bit is set and the alarm is indicated on the display of the PLC or computer.
- Setting the LO SHUTOFF Weight:

Step 1. Press the down arrow ↓ button until the cursor is to the left of the LO SHUTOFF Sub-Menu. (See Fig. 6-20)

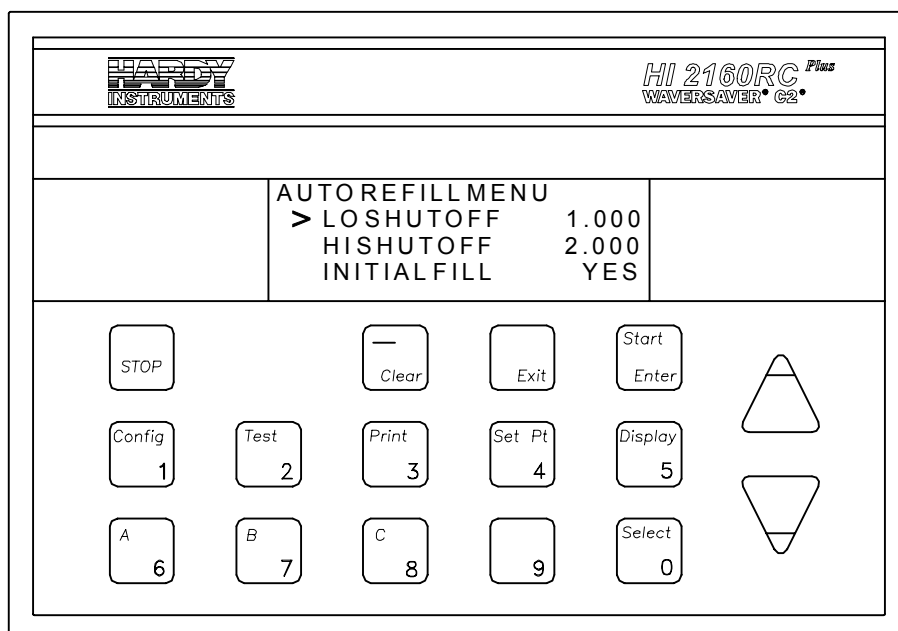


FIG. 6-20 AUTO REFILL MENU/LO SHUTOFF SETTINGS

- Step 2. Press the Clear button to clear the entry.
- Step 3. Use the numeric keys to enter a new weight value.
- Step 4. Press the Enter button to accept the new value.
- Step 5. If the values are not accepted a message appears “NOT APPROVED”. The value entered is above the START (LO) value. Clear the entry and enter a value that is lower. Press the Enter button to accept the corrected value.
- Setting the HI SHUTOFF Weight:

Step 1. Press the down arrow ↓ button until the cursor is to the left of the HI SHUTOFF Sub-Menu. (See Fig. 6-21)

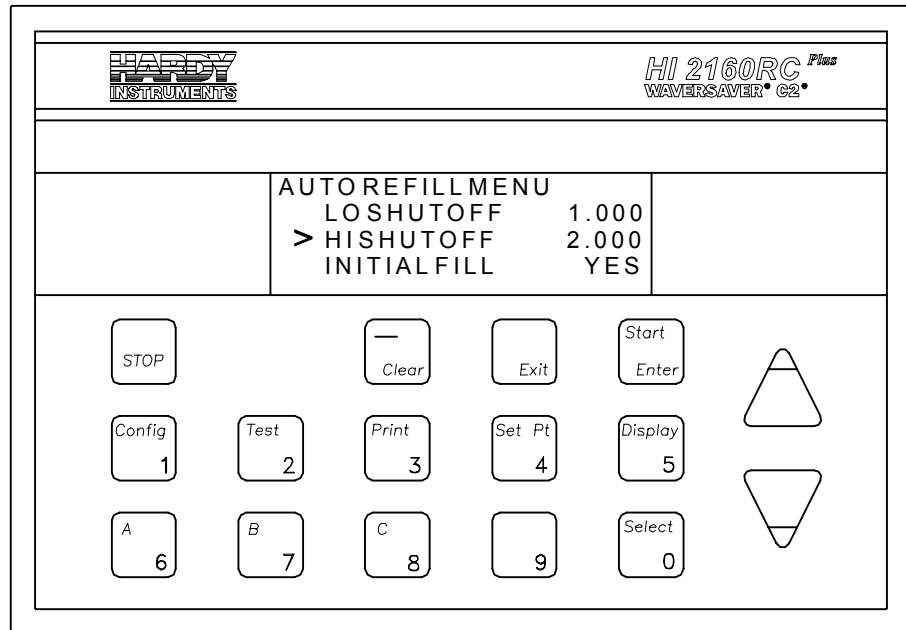


FIG. 6-21 AUTO REFILL MENU/HI SHUTOFF SETTINGS

- Step 2. Press the Clear button to clear the entry.
- Step 3. Use the numeric keys to enter a new weight value.
- Step 4. Press the Enter button to accept the new value.
- Step 5. If the values are not accepted a message appears “NOT APPROVED”. The value entered is below the STOP (HI) value. Clear the entry and enter a value that is higher. Press the Enter button to accept the corrected value.

Selecting the Initial Fill Function

- The Initial Fill function tops off the feeder hopper (loads the feeder to the STOP HI weight) whenever the user pushed the “Start/Enter” button on the front panel of the HI 2160RC^{PLUS}. The function makes sure that the feeder has enough material at the beginning of a process and can prevent refills in the middle of a dispensing process. (See Fig. 6-21)

- Step 1. Press the down arrow ↓ button until the cursor is to the left of the INITIAL FILL Sub-Menu.
- Step 2. Press the Select button to select YES.
- Step 3. Press the Enter button to accept the selection.

NOTE:

The Initial Fill can be disabled to speed up batch processes. Just press the Select button until the NO appears and press the Enter button to disable the function.

About the Refill Correction Factor

- Forces related to material entering the feeder during a refill can sometimes effect the flow rate of the material being dispensed by the feeder. The Refill Correction Factor can be used to offset this effect.

- A correction factor is often not necessary but if needed must be determined by trial and error. A negative value (percentage of up to -10%) will decrease the flow rate, and a positive value (percentage up to +10%) will increase the flow rate.
- Setting the Refill Correction Factor to decrease to decrease flow rate:

- Step 1. Press the down arrow ↓ until the cursor is next to RFL CORR. (See Fig. 6-22) The percentage range is -10% to +10%.
- Step 2. Press the -/Clear button one time for negative sign to appear before the percentage value. Press the -/Clear button two times for a positive sign to appear before the percentage value.
- Step 3. Use the numeric keys to enter the percentage value.

NOTE:

Disregard the decimal point. An entry of .1 is 1%, 1.0 IS 10% AND SO ON.

- Step 4. Press the Enter button to accept the value.

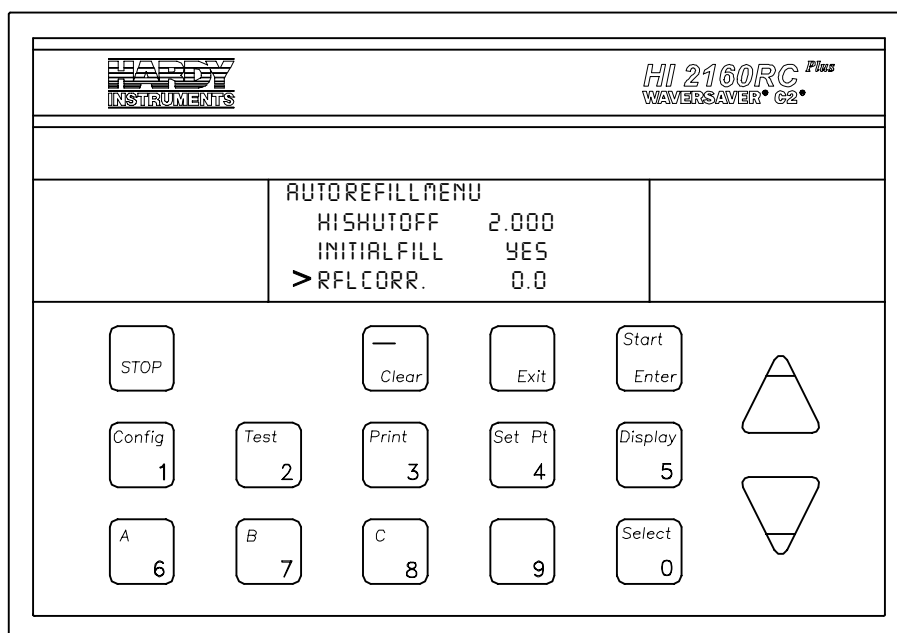


FIG. 6-22 AUTO REFILL MENU/SETTING THE REFILL CORRECTION FACTOR

Force Refill

- This function allows the user to refill the feeder hopper to the “STOP (HI)” level at any time.
- To force a refill, momentarily short the Remote Functions REfill Pin to ground. (See Fig. 6-23)
- During the refill a ****FORCE REFILL**** message appears on the display and returns to the previous display when the refill is complete.

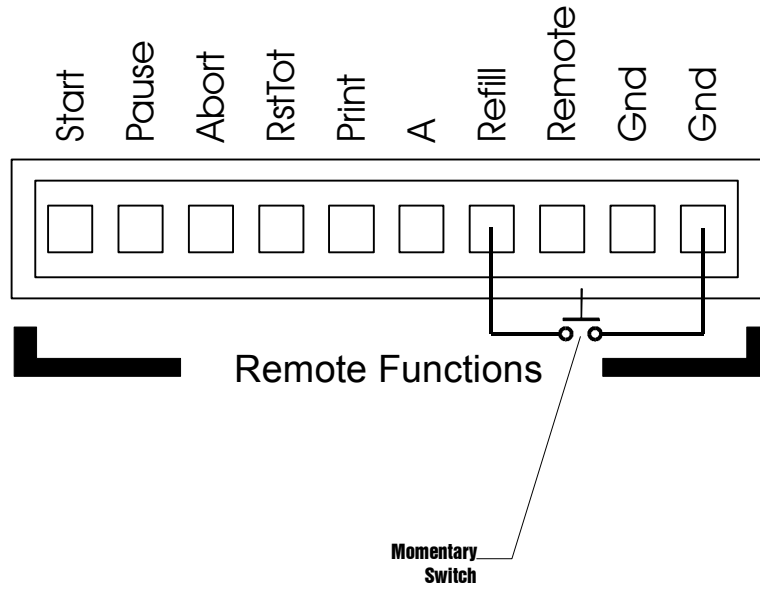


FIG. 6-23 GROUNDING REFILL FOR FORCED REFILL

Time and Date Sub-Menu

Setting the Time

- Set the time according to the 24 hour clock format. (1:00 AM is 01:00, 2:00 AM is 02:00 etc., 1:00 PM is 13:00, 2:00 is 14:00 etc.)

Step 1. Press the down arrow ↓ button until the cursor is to the left of the Time and Date Sub-Menu. (See Fig. 6-24)

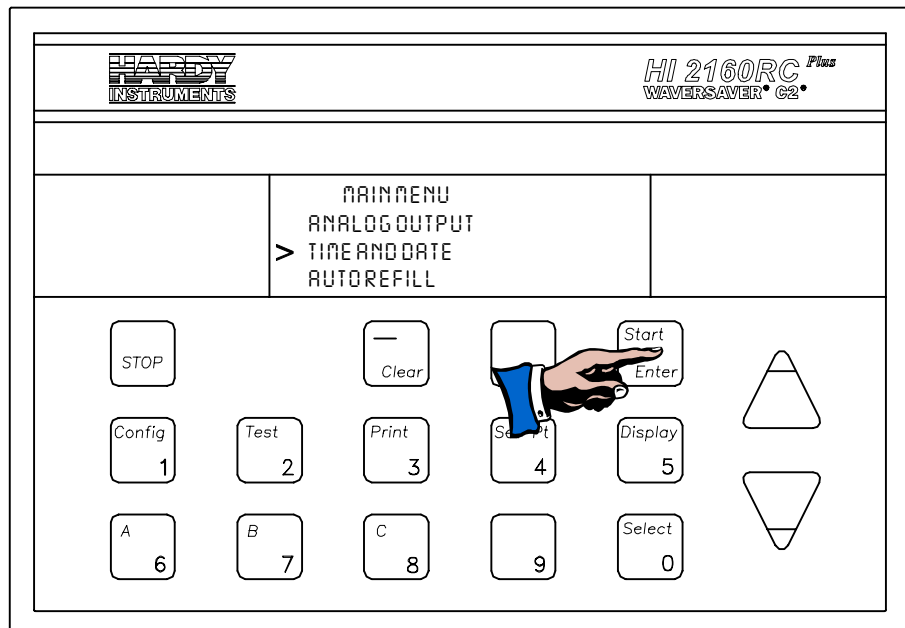


FIG. 6-24 MAIN MENU/SETTING TIME AND DATE

Step 2. Press the Enter button. The Time and Date Menu appears with the cursor to the left of the Time Setting. (See Fig. 6-25)

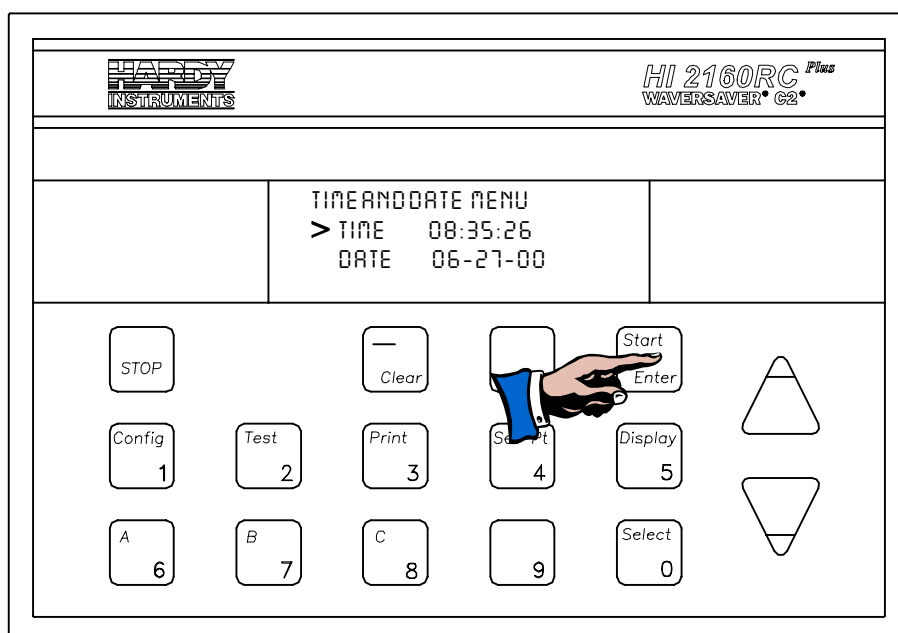


FIG. 6-25 TIME AND DATE MENU/SETTING TIME AND DATE

Step 3. Press the Clear button to clear the time entry.
 Step 4. The Time setting is: hh/mm/ss
 Step 5. Use the numeric keys to enter the time.
 Step 6. Press the Enter button to accept the time setting.

Setting the Date

Step 1. Press the down arrow ↓ button until the cursor is to the left of the Date Setting.
 Step 2. Press the Clear button to clear the date entry.
 Step 3. The Date setting is: mm/dd/yy
 Step 4. Use the numeric keys to enter the date.
 Step 5. Press the Enter button to accept the date setting.

Serial Communications/
 Serial Port #1 Sub-Menu (For RS-232C Specifications See Chapter 2)

- This Sub-Menu allows the user to setup the serial port as a Printer Port or a Bi-Directional Port. The Serial port is an RS-232C and can be fitted with an optional RS-422 converter. The RS-422 is recommended for long distance bi-directional communication (greater than 50 feet). For jumper setting information see Chapter 4.
- The Default Settings are:
 - Config. PRINTER
 - Baud Rate 1200
 - Parity NONE
 - Stop Bits ONE
 - Data Length EIGHT
 - ADDRESS 0

Step 1. Press the down arrow ↓ button until the cursor is to the left of the Serial Port #1 Sub-Menu. (See Fig. 6-26)

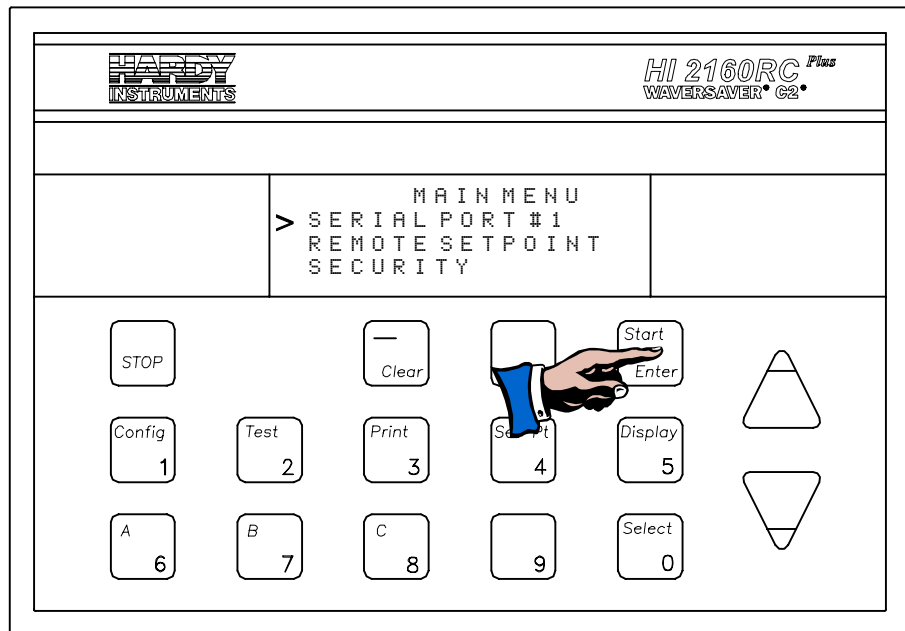


FIG. 6-26 MAIN MENU/SELECTING SERIAL PORT #1

Step 2. Press the Enter button. The Serial Port #1 Sub-Menu appears with the cursor to the left of the Config. (See 6-27)

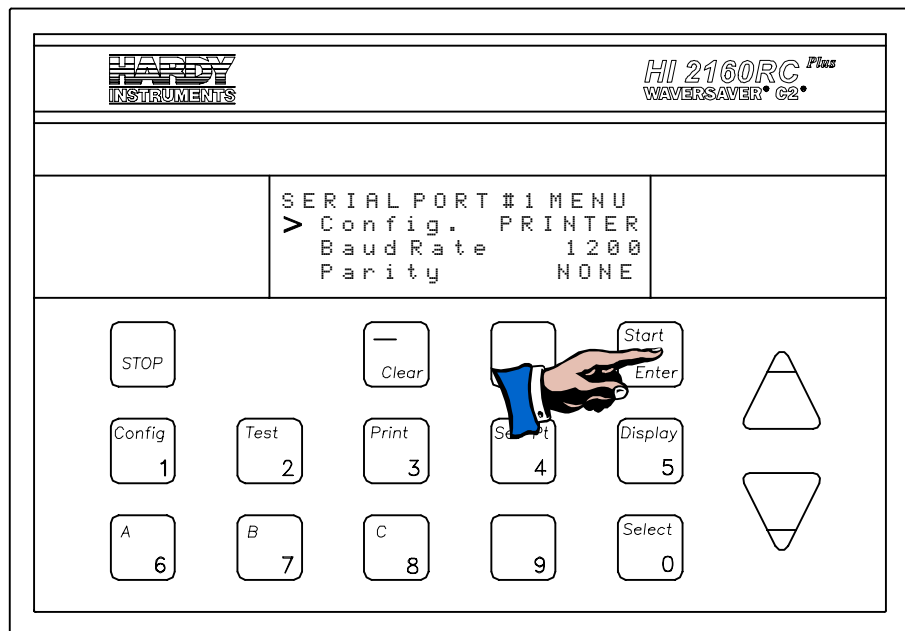


FIG. 6-27 SERIAL PORT #1 CONFIGURATION

Step 3. Press the Select button to toggle between Printer and Bi-Directional (BI-DIR) communication.

Step 4. Printer Setup

- If the default settings match the printer's requirements, the printer is set and ready to go. Simply press the Print button to print any of the operational displays.
- The controller prints only operational displays. (See Fig. 6-28)

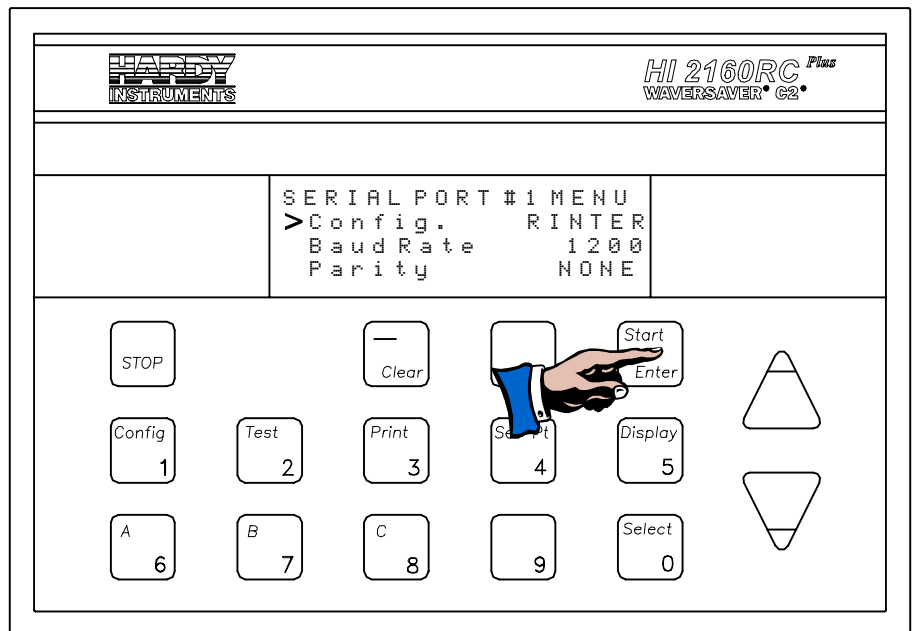


FIG. 6-28 SERIAL PORT #1 CONFIGURATION

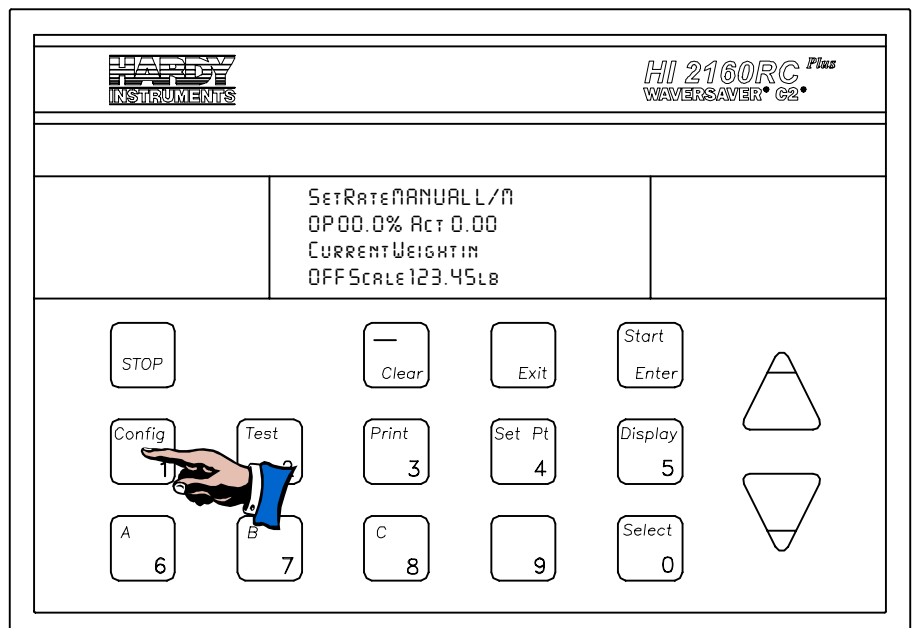


FIG. 6-29 OPERATIONAL MENU

Step 5. If the default settings (See Default Settings above) do not match the printer's requirements do the following:

- Press the down arrow ↓ button until the cursor is to the left of the Baud Rate Sub-Menu.
- Press the Select button to select one of the following Baud Rate settings:

600, 1200 (Default), 2400, 4800, 9600, 19200

- Press the Enter button to accept the new Baud Rate setting.
- Press the down arrow ↓ button until the cursor is to the left of the Parity Sub-Menu.
- Press the Select button to select one of the following Parity settings:

NONE
EVEN
ODD

- Press the Enter button to accept the new Parity setting.
- Press the down arrow ↓ until the cursor is to the left of the Stop Bits Sub-Menu.
- Press the Select button to select one of the following Stop Bit settings:

ONE
TWO

- Press the Enter button to accept the new Stop Bit setting.
- Press the down arrow ↓ button until the cursor is to the left of the Data Length Sub-Menu.
- Press the Select button to select one of the following Data Length settings:

EIGHT
SEVEN

- Press the Enter button to accept the new Data Length setting.
- Press the Exit button to return to the operational display.

Disabling the Front Panel Print Button

- On the Rear Panel there is a Config. connector with 8 dip switches.
- The default for the Config. dip switches is up or OFF.
- Switch the #2 dip switch from OFF (up) to ON (down). (See Fig. 6-30)
- This also disables the remote functions print input.

NOTE:

If the Allen Bradley RIO or the PROFIBUS option is installed in the HI 2160RC^{PLUS} the printer will still work from the front panel. The Bi-directional function is disabled.

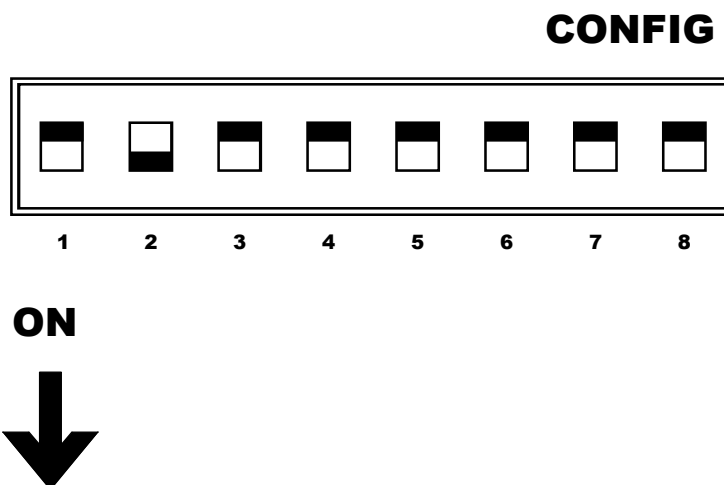


FIG. 6-30 DISABLING THE PRINT FUNCTION

Printing Batch Reports

- The controller will automatically print out a Batch Report if the controller is in the Batch Mode of operation (See Chapter 8 for detailed information).
- The Batch Report is triggered when the actual amount dispensed reaches the batch amount requested.
- An example of a batch report:

BATCH REPORT

START: 08/22/04
10:32:12

STOP: 08/22/04
10:33:11

BATCH TIME: 00:00:59

BATCH AMOUNT

REQ: 5.000LB

ACT: 5.003LB

RATE DATA

SET POINT 5.000 L/M

AVERAGE 5.087 L/M

- To disable the Batch Report function, move Config. dip switch #3 to the ON position. (See Fig. 6-31)

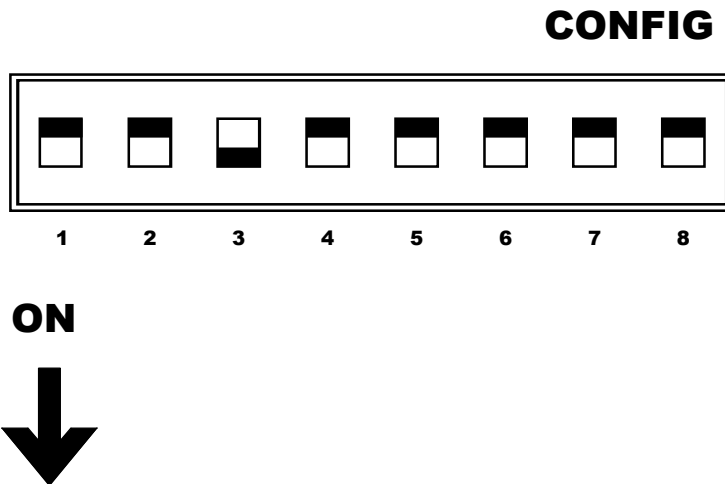


FIG. 6-31 CONFIG DIP SWITCH #3/DISABLING BATCH REPORT PRINTING FUNCTION

Bi-Directional Port Setup

- Step 1. Press the down arrow ↓ button until the cursor is to the left of the Serial Port #1 Sub-Menu. (See Fig. 6-26)
- Step 2. Press the Enter button. The Serial Port #1 Sub-Menu appears with the cursor to the left of the Config. (See Fig. 6-27)
- Step 3. Press the Select button to select the bi-directional setting (BI-DIR)
- Step 4. Press the Enter button to accept the BI-DIR port setting.
- Step 5. To setup the Bi-Directional Port:
 - Press the down arrow ↓ button until the cursor is to the left of the Baud Rate Sub-Menu.
 - Press the Select button to select one of the following Baud Rate settings:

600, 1200 (Default), 2400, 4800, 9600, 19200
 - Press the Enter button to accept the new Baud Rate setting.
 - Press the down arrow ↓ button until the cursor is to the left of the Parity Sub-Menu.
 - Press the Select button to select one of the following Parity settings:

NONE
EVEN
ODD
 - Press the Enter button to accept the new Parity setting.
 - Press the down arrow ↓ button until the cursor is to the left of the Stop Bits Sub-Menu.

- Press the Select button to select one of the following Stop Bit Settings:

ONE
TWO

- Press the Enter button to accept the new Stop Bit setting.
- Press the down arrow ↓ button until the cursor is to the left of the Data Length Sub-Menu.
- Press the Select button to select one of the following Data Length settings:

EIGHT
SEVEN

- Press the Enter button to accept the new Data Length setting.
- Press the down arrow ↓ button until the cursor is to the left of the ADDRESS Sub-Menu.
- Use the numeric keys to enter an address from 0 - 99.
- Press the Enter button to accept the new address setting.
- Press the Exit button to return to the operational display.

Saving to the Secure Memory Module (SMM)

NOTE:

All the configuration, calibration, and setup parameters are automatically saved to the battery backed up internal memory of the HI 2160RC^{PLUS}, when the Enter button is pressed to accept the parameters.

When to Save

1. Upon completion of a Configuration, Calibration or Setup Procedures.
2. Anytime you change any of the Configurations, Calibrations or Setup Information.

Saving to the Secure Memory Module (SMM)

- Step 1. Press the Stop button two times to stop the feeder.

NOTE:

The Save/Recall Menu appears only if the feeder is in the STOP mode. If the feeder is in the ON or HOLD mode when the Enter button is pressed, an error message "ERROR STOP FEEDER" appears for two seconds on the display, then the Save/Recall Data Sub-Menu appears again.

- Step 2. Press the Config. button.
- Step 3. Enter the Security Code Number.
- Step 4. Press the Enter button. The Main Menu appears with the cursor to the left of the SAVE/RECALL SUB-MENU. (See Fig. 6-32)
- Step 5. Press the Enter button. The SAVE/RECALL SUB-MENU appears. (See Fig. 6-33)

Step 6. Press the down arrow ↓ button until the cursor is to the left of the Save Data Sub-Menu. (See Fig. 6-33)

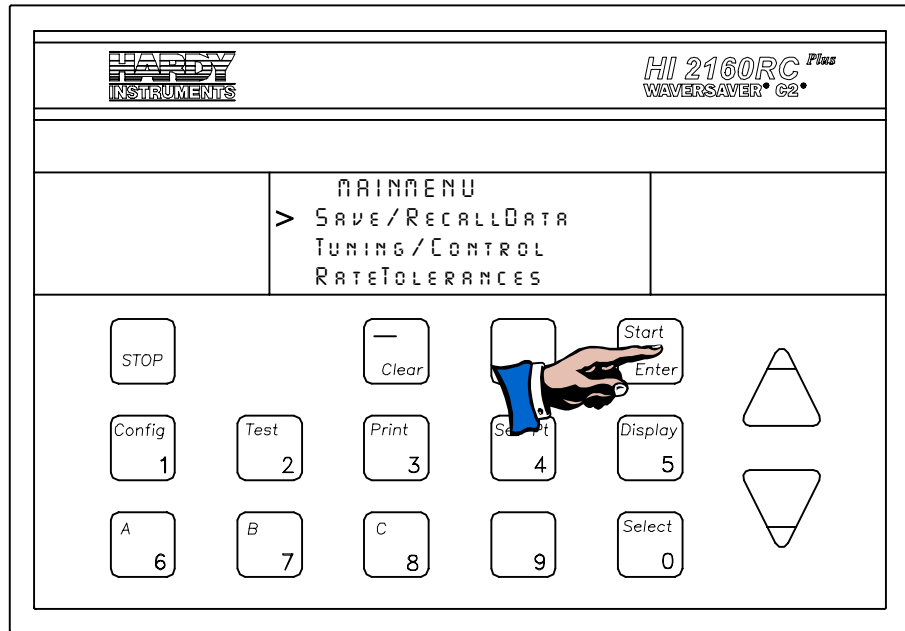


FIG. 6-32 SAVING TO SECURE MEMORY MODULE

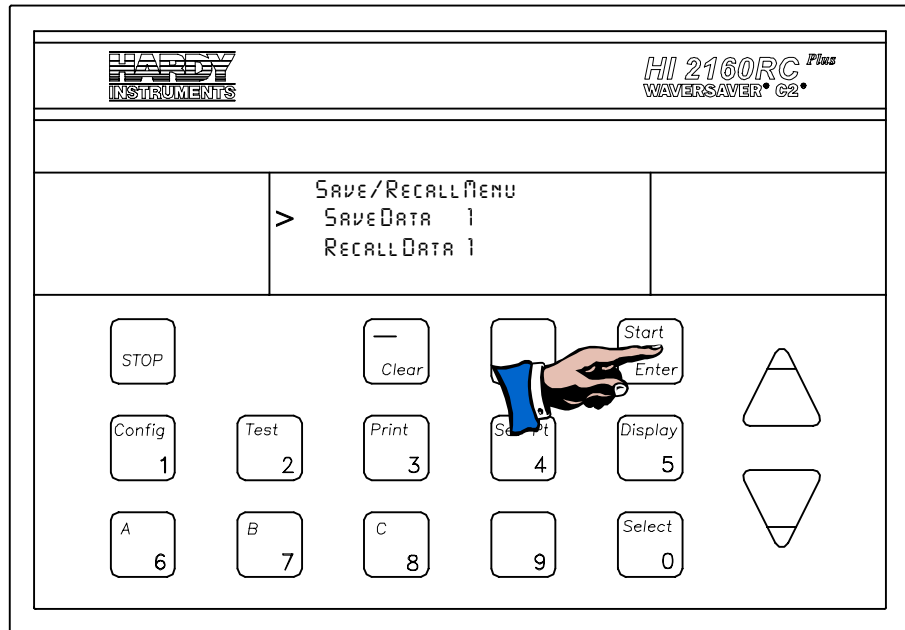


FIG. 6-33 SAVE/RECALL MENU

Step 7. Press the 0/Select button to select the number for the current data set. (Default is 1)

- You can save from 1-12 data sets in the SMM. By giving each data set a number you can recall the data set for the process you want to use again.
- It is a good idea to write down the number and process for each data set saved.

Step 8. Press the Enter button.

- If this data set already has data, a message appears “OVERWRITE DATA NO”. In the event that you press the Enter button with “NO” selected a “NOT SAVED” error message appears.

CAUTION

WITH THE PROFIBUS COMMUNICATION CARD INSTALLED THE “OVERWRITTEN DATA NO” MESSAGE DOES NOT APPEAR. WHEN PRESSING THE ENTER BUTTON THE PREVIOUSLY SAVED DATA WILL BE OVERWRITTEN.

Step 9. Press the 0/Select button until “YES” appears. The 0/Select button toggles between NO and YES.

Step 10. Press the Enter button to save the data. A message appears “SAVING . . . WAIT” then the message changes to SUCCESSFUL, then ENTRY ACCEPTED for 1 second when the display returns to SAVE DATA 1.

Step 11. Press the Exit button to return to the Main Menu.

Step 12. Press the Exit button to return to the Operating Display.

Data Saved in the Secure Memory Module

- All data in the Tuning/Control Menu
- All data in the Rate Tolerances Menu
- All data in the Auto Refill Menu
- All data in the Calibration Menu
- All data in the Rate Calibration Menu
- All data in the Set Point Menu
- All data in the Test Menu

NOTE:

All other data is NOT saved in the Secure Memory Module (SMM).

Restoring Data Saved in the Secure Memory Module

Data Recall Procedures

Step 1. Press the Stop button two times to stop the feeder.

Step 2. Press the Config. button.

Step 3. Enter the Security Code Number.

Step 4. Press the Enter button. The Main Menu appears with the cursor to the left of the SAVE/RECALL SUB-MENU.

Step 5. Use the down arrow ↓ button until the cursor is to the left of the Recall Data Sub-Menu. (See Fig. 6-34)

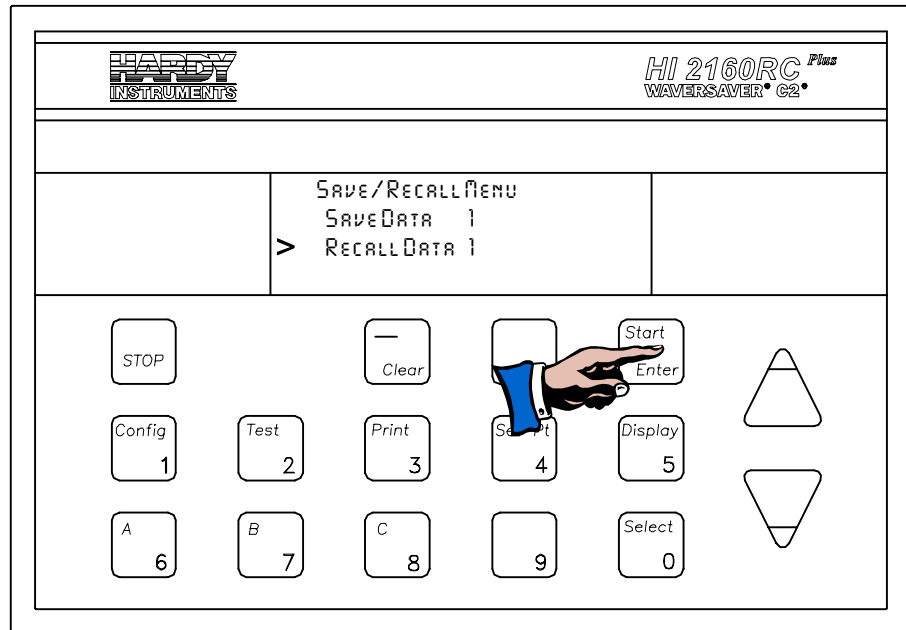


FIG. 6-34 RECALL SUB-MENU

- Step 6. Press on the Select button to select the number of the data set you want to recall. (Default is 1) You can recall from 1-12 data sets stored in the SMM. Refer to your written list of data sets to determine which data set you want to recall.
- Step 7. Press the Enter button. A message appears “RESTORING . . .” then the SAVE/RECALL menu reappears.
- Step 8. Press the Exit button to return to the Main Menu.
- Step 9. Press the Exit button to return to the Operating Display.

- Parameters Restored are:

- All data in the Tuning/Control Menu
- All data in the Rate Tolerances Menu
- All data in the Auto Refill Menu
- All data in the Calibration Menu
- All data in the Rate Calibration Menu
- All data in the Set Point Menu
- All data in the Test Menu

- Step 10. For information on installing the Secure Memory Module, See Chapter 3, Installing the Secure Memory Module.

Setting the Control Out LO% and Control Out HI%

Setting the Control Out LO%

- The Default Setting is 0%.

- In almost every application there is no requirement to change the default setting. However, in cases where flow does not actually occur until the output signal reaches a certain percentage of the operating span, or when equipment damage might occur when rates are set below the Control Out LO%, it is recommended the Control Out LO% be set. The Control Out LO% is a low operating limit where lower settings are not allowed. (See Fig. 6-35)

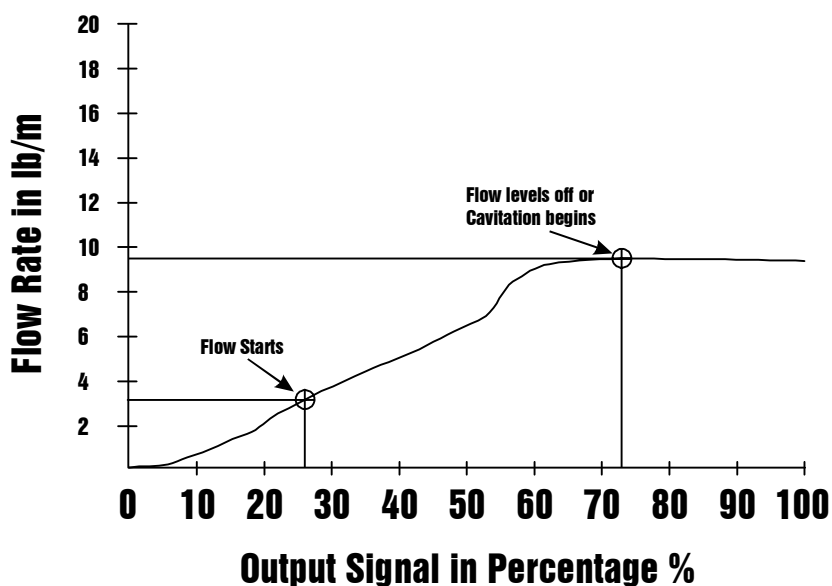


FIG. 6-35 CONTROL OUT% GRAPH

- Step 1. To establish what the Control Out LO% setting should be, a graph indicating the flow rate and output percentage (OP%) must be prepared. This graph shows the operating characteristics of a particular application.
- Step 2. Click on the Set Pt. Button.
- Step 3. Enter the Security Code Number.
- Step 4. Press the Enter button. The Set Point Menu appears.
- Step 5. Press the Select button to set the Rate to Manual.
- Step 6. Press the Select button to set the Amount to Continuous.
- Step 7. Press the Exit button to return to the Operating Display.
- Step 8. Set the OP% for the application to either, .1%, 1% or 10%. (See Chapter 5)
- Step 9. Press the Start button to start the feeder.
- Step 10. Press the up arrow \uparrow button to increase the speed of the feeder motor.
- Step 11. Watch the feeder to see when actual dispensing first occurs and not down the OP%. In Fig. 6-35 graph above, the actual flow starts at about 26% of output span and the rate is about 3.6 lbs/m.
- Step 12. Run the feeder completely through the operating range plotting the rates at 10%, 20%, 30% etc. More will be said about setting the Control Out HI% settings.

- Step 13. Stop the feeder.
- Step 14. Press on the Config. button. The security prompt appears.
- Step 15. Enter the Security Code Number and press the Enter button. The Main Menu appears.
- Step 16. Press the down arrow ↓ button until the cursor is to the left of the Tuning/Control Menu.
- Step 17. Press the Enter button. The Tuning/Control Menu appears.
- Step 18. Press the down arrow ↓ button until the cursor is to the left of the Control Out LO% Sub-Menu. (See Fig. 6-36)

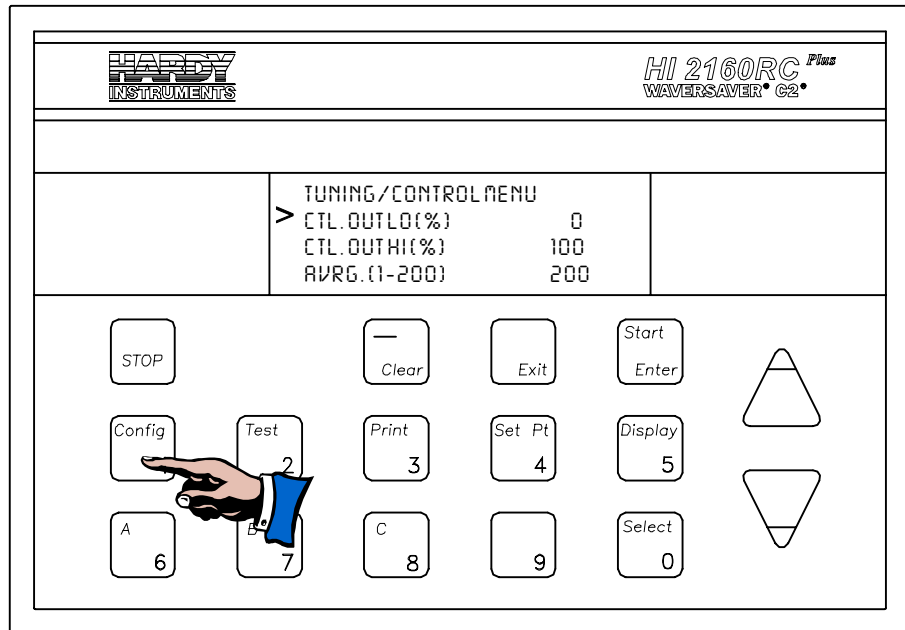


FIG. 6-36 TUNING/CONTROL MENU/SETTING CONTROL OUT LO PERCENTAGE

- Step 19. Press the clear button to clear the value.
- Step 20. Use the numeric keys to enter the new percentage, in our example we entered the value 26. (See Fig. 6-37)

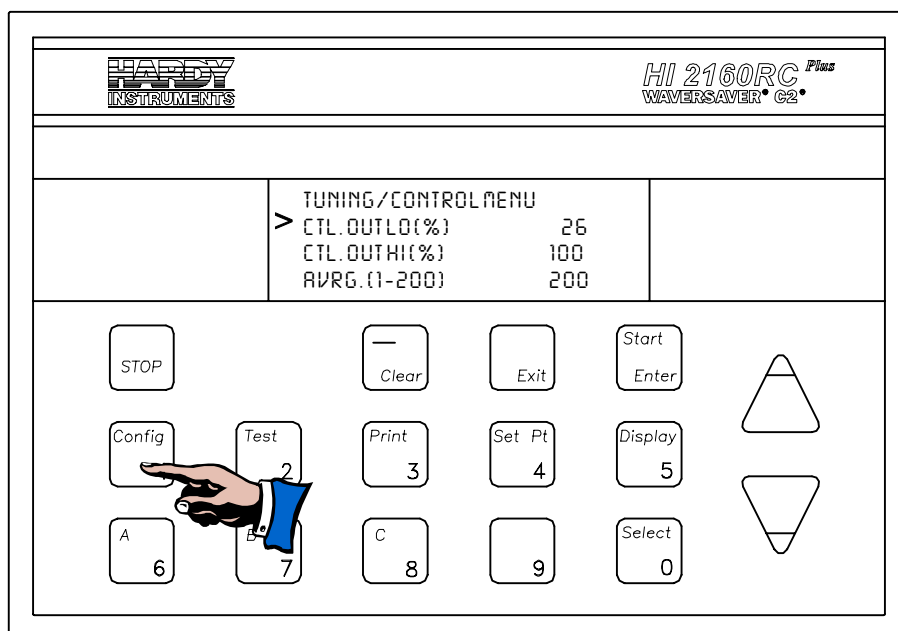


FIG. 6-37 TUNING/CONTROL MENU/ SETTING CONTROL OUT LO PERCENTAGE TO 26

- Step 21. Press the Enter button to accept the new value.
- Step 22. The operator cannot set a flow rate lower than the 26% of full span which equates to 3.6 lbs/m in our example. If a flow rate is entered lower than 3.6 lbs/m an error statement appears “SETTING TOO LOW”.
- Step 23. Press the down arrow ↓ button until the cursor is to the left of the Control Out HI% Sub-Menu. (See Fig. 6-38)

Setting Control Out HI%

- The Default Setting is 100%.
- In almost every application there is no requirement to change the default setting. However, in cases where flow levels off when the output signal reaches a certain percentage of the operating span, or when equipment damage might occur (e.g. cavitation in pumps) when rates are set above the Control Out HI%, it is recommended the Control Out HI% be set. The Control Out HI% is a high operating limit where higher settings are not allowed.

- Step 1. To establish what the Control Out HI% setting should be, a graph indicating the flow rate and output percentage (OP%) must be prepared. This graph shows the operating characteristics of a particular application.
- Step 2. Click on the Set Pt. button.
- Step 3. Enter the Security Code Number.
- Step 4. Press the Enter button. The Set Point menu appears.
- Step 5. Set Rate to Manual.

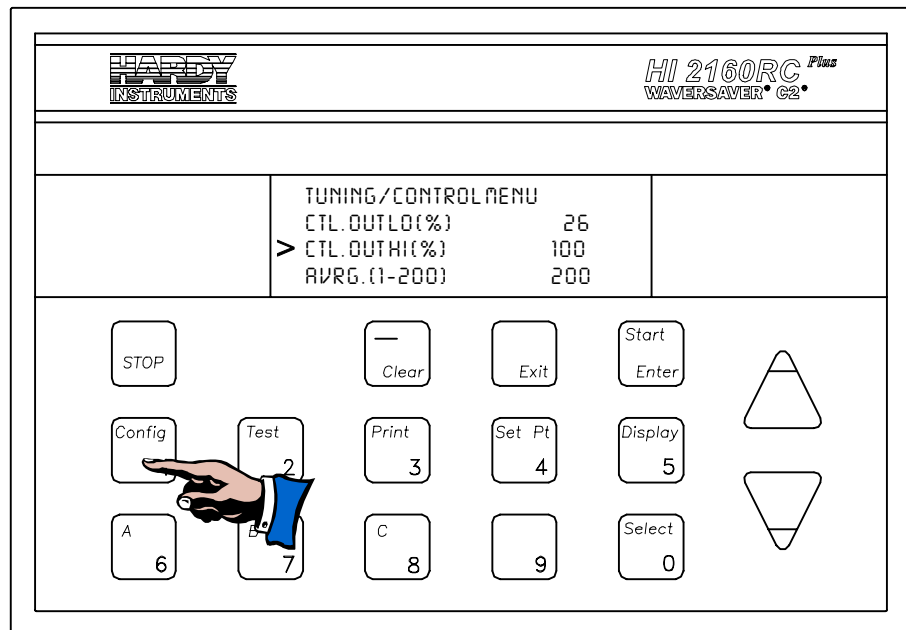


FIG. 6-38 TUNING/CONTROL MENU/SETTING CONTROL OUT HI PERCENTAGES

- Step 6. Set the Amount to Continuous.
- Step 7. Press the Exit button to return to the Operating Display.
- Step 8. Set the OP% for the application to either .1%, 1% or 10% (See Chapter 5)
- Step 9. Press the Start button to start the feeder.
- Step 10. Press the up arrow ↑ to increase the speed of the feeder motor.
- Step 11. Watch the feeder to see when flow rate starts to level off or when cavitation first occurs and not down the OP%. In Fig. 6-35 the graph above the flow starts to level off at about 74% of output span and the rate is about 11.6 lbs/m.
- Step 12. Stop the feeder.
- Step 13. Press on the Config. button. The security prompt appears.
- Step 14. Enter the Security Code Number and press the Enter button. The Main Menu appears.
- Step 15. Press the down arrow ↓ button until the cursor is to the left of the Tuning/Control Menu.
- Step 16. Press the Enter button. The Tuning/Control Menu appears.
- Step 17. Press the down arrow ↓ button until the cursor is to the left of the Control Out HI% Sub-Menu. (See Fig. 6-38)
- Step 18. Press the Clear button to clear the value.
- Step 19. Use the numeric keys to enter the new percentage In our example (See Fig. 6-39) we entered 74.

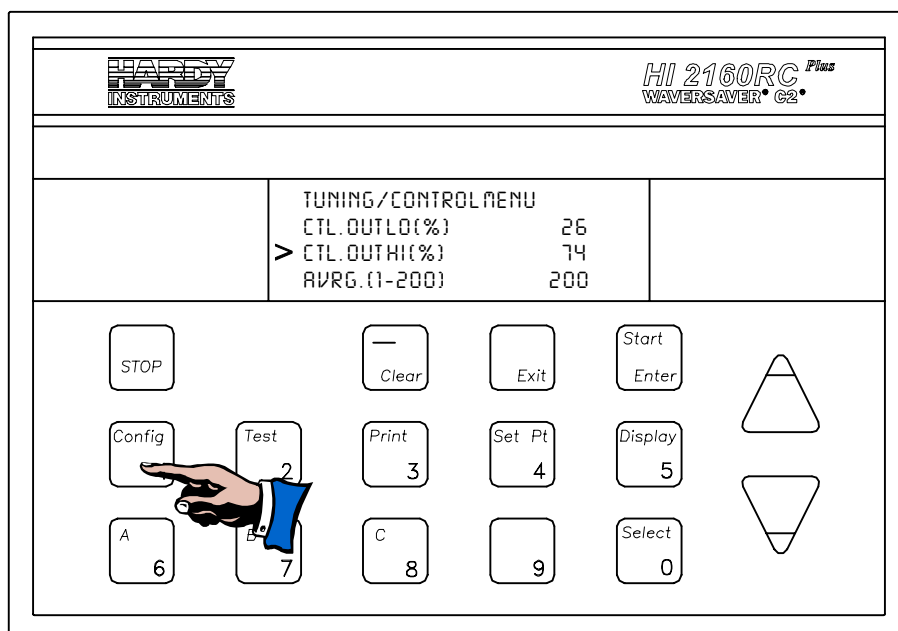


FIG. 6-39 TUNING/CONTROL MENU/SETTING CONTROL OUT HI PERCENTAGE/74

- Step 20. Press the Enter button to accept the new value.
- Step 21. The operator cannot set a flow rate higher than 74% of full span which equates to 11.6 lbs/m in our example. If a flow rate is entered higher than 11.6 lbs/m an error statement appears “SETTING TOO HIGH”.
- Step 22. Press the Exit button to return to the Main Menu.
- Step 23. Press the Exit button to return to the Operating Display.

Setting Up the Analog Output Option

- The Analog Output Option contains user-scaled calibration data used to transmit information to a PLC, recorder, remote display, or similar devices accepting analog input signals.
- Step 1. From the Main Menu press the down arrow ↓ button until the cursor is to the left of the Analog Output Sub-Menu. (See Fig. 6-40)

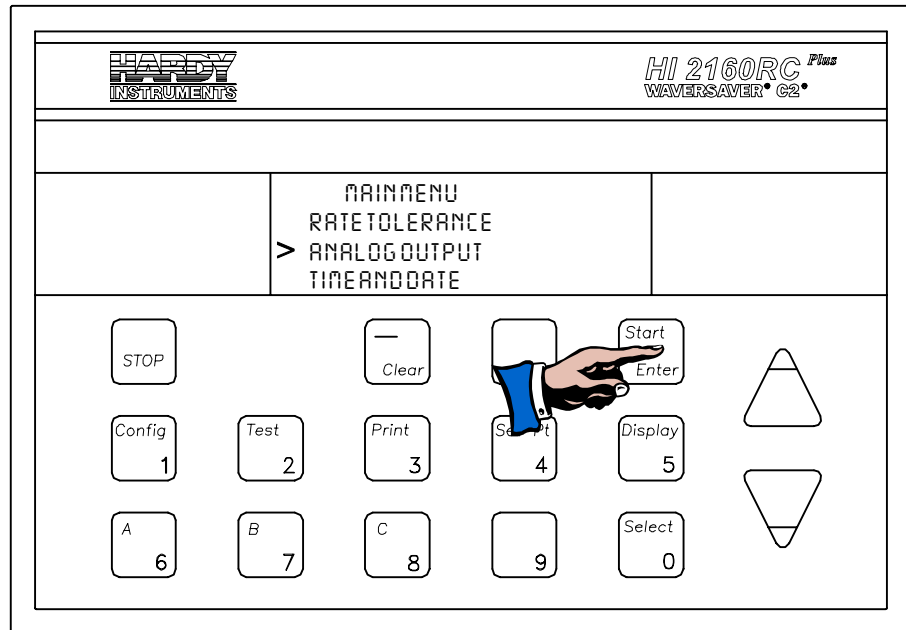


FIG. 6-40 MAIN MENU/ANALOG OUTPUT

Step 2. Press the Enter button. The Analog Output Menu appears with the cursor to the left of Analog Output - Main. (See Fig. 6-41)

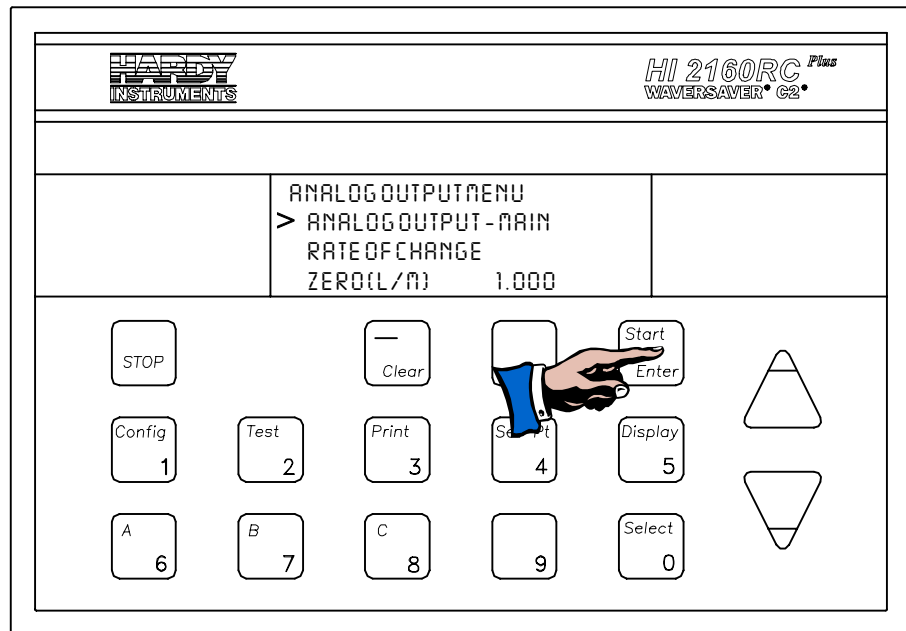


FIG. 6-41 ANALOG OUTPUT MENU

Analog Output Main

Step 1. The Main indicates where the analog output option card is located. In our example it is located on the Main Board in the

instrument. The analog output option card can be installed in the instrument or the quad expander enclosure.

- Step 2. Press the Enter button, an “ENTRY ACCPETED” appears momentarily.
- Step 3. Press the down arrow ↓ button until the cursor is to the left of the next parameter, which is the information type parameter.

The Information Type Parameter Setting

- The Information Type Parameter setting selects the type of information that will be sent. There are four (4) selections:

Rate of Change
Gross Weight
Batch Weight
Total Weight

- Step 1. Press the Select button to select the type of information you want to send.

NOTE:

Both voltage and current outputs are simultaneously available for the selected output data.

- Step 2. When the information type appears, press the Enter button to accept the selection.

- Step 3. Press the down arrow ↓ button until the cursor is to the left of the ZERO output reference voltage. (See Fig. 6-42)

ZERO Output Reference Voltage and Current

- The ZERO output reference parameter sets the zero output reference voltage and current.
- Range: 0000 to 9999 lbs/min or LBS.
- Units are automatically defaulted depending on the selected output. Actual values depend on the decimal place.
- Default Setting: 1.000 lb/min or LBS.

NOTE:

Set to the lowest expected value for the selected output.

NOTE:

ZERO can be larger than SPAN having the effect of reversing the direction of increase of the output.

- Step 4. Press the Clear button to clear the entry.

- Step 5. Use the numeric keys to enter the new value.

- Step 6. Press the down arrow ↓ button until the cursor is to the left of the SPAN output reference voltage. (See Fig. 6-42)

SPAN Output Reference Voltage and Current

- The SPAN output reference parameter sets the ZERO output reference voltage and current.
- Range: 0000 to 9999 lbs/min or LBS.
- Units are automatically defaulted depending on the selected output. Actual values depend on the decimal place.
- Default Setting: 5.000 lb/min or LBS.

NOTE:

Set to the highest expected value for the selected output.

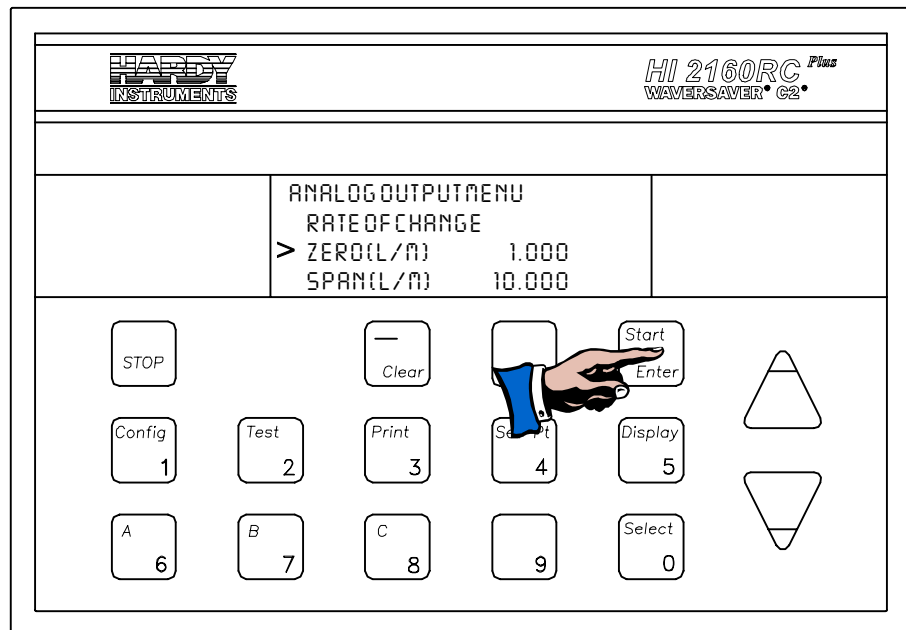


FIG. 6-42 ANALOG OUTPUT MENU/ZERO AND SPAN VOLTAGE SETTING

- Step 7. Press the Clear button to clear the entry.
- Step 8. Use the numeric keys to enter the new value.
- Step 9. Press the Enter button to accept the new value.
- Step 10. If the SPAN value is equal to the ZERO value an error prompt appears. Change the SPAN value so that ZERO and SPAN are not equal.
- Step 11. Press the Enter button to accept the new setting.
- Step 12. Press the Exit button until you reach the Operational Display.

CHAPTER 7 - SERIAL COMMUNICATIONS

About Chapter 7

All information contained in Chapter 7 pertains to serial communications for the HI 2160RC^{PLUS} Rate Controller. This chapter includes System Network Configuration, Serial Protocol and Serial Commands. We recommend that the operator use the serial commands included in this chapter. Although we don't recommend unauthorized changes to the firmware, there are occasions when firmware changes enhance the communication between the host and the Hardy controllers. Hardy Instruments welcomes any suggestions that might enhance our products and would appreciate your informing Hardy Customer Service of your requests. All maintenance personnel and users should be familiar with the information in this chapter before trying to communicate with the controllers from the host.

System Configuration

Host Functions

1. A host can be a Programmable Logic Controller or a Computer or both.
2. The host provides a single operator interface to an entire process blending or batching system.
3. The host saves recipes, calculates a variety of parameters, adjusts formulation based on other process parameters and prints comprehensive reports.

Serial Protocol

Hardy Link

Hardy Link is an ASCII command protocol and command set which runs most efficiently in a RS-422 multidrop configuration, although the commands may be transmitted over RS-232C.

Multidrop Configuration (See Fig. 7-1)

- Multidrop is a method of interconnecting instruments in such a way that there are multiple HI 2160RC^{PLUS}s connected to a host computer.
- Each HI 2160RC^{PLUS} receives and sends data through a unique address.
- Multidrop configuration uses the RS-422 option board with excellent noise immunity and drive capability supporting long cable runs.

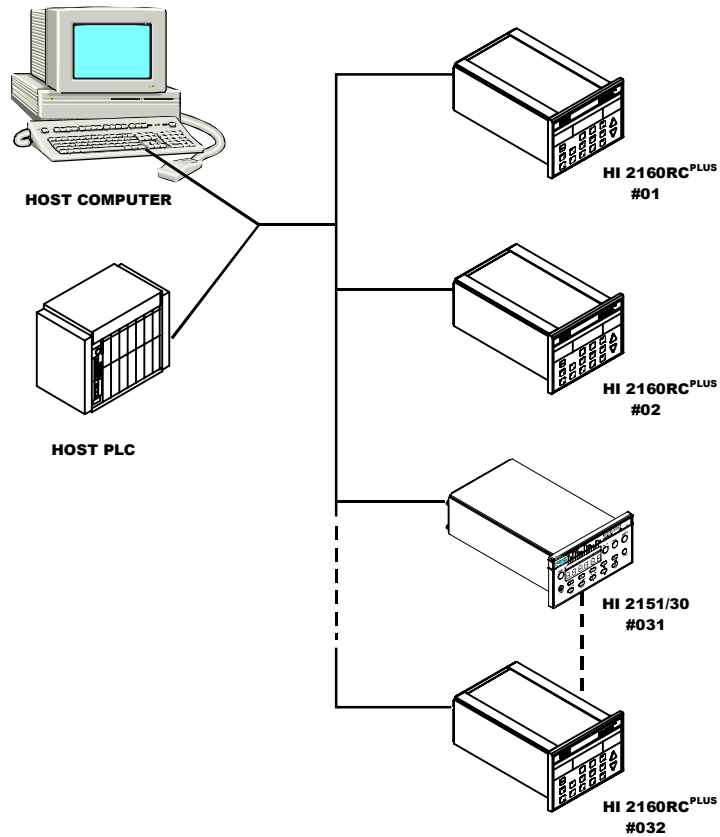


FIG. 7-1 MULTIDROP CONFIGURATION WITH HOST AND CONTROLLERS

NOTE:

The 2100 Series batch, rate and weight controllers are intelligent front ends to a distributed system, therefore, network speed is normally is not critical.

Serial Commands

- Serial commands are transmitted to the instrument in ASCII format. Each command has a single letter corresponding to the command.
- The instrument accepts command strings up to 40 characters (the 40th character will internally default to a carriage return).

Serial Command Lists

1. Set Commands (S)

COMMAND	SUB-CMD	DATA FORMAT	DESCRIPTION OF COMMAND
S	AH	XXXXXX	Set Auto Refill HI Shutoff (up to 6 digits; include decimal point if used).
S	AI	Y OR N	Set Initial Fill (Y for ON; N for OFF).
S	AL	XXXXXX	Set Auto Refill LO Shutoff (up to 6 digits; include decimal point if used.)
S	AP	XXXXXX	Set Auto Refill Stop Level (up to 6 digits; include decimal point if used.)
S	AR	XXXXXX	Set Auto Refill Start Level (up to 6 digits; include decimal point if used.)

TABLE 7-1: S (SET) COMMANDS LISTED ALPHABETICALLY WITHIN SUB-COMMAND

COMMAND	SUB-CMD	DATA FORMAT	DESCRIPTION OF COMMAND
S	AT	0	Set Accumulated Total to 0 (clear total register)
S	BA	XXXXXX	Set Batchpoint Batch Amount (must be set mode to BATCH instead of Continuous).
S	CA		Clear Alarms
S	D1	XX.X YYY	Run at Manual Output of xx.x% for yyy seconds (leading zeros required).
S	D2	XX.X YYY	Run at Manual Output of xx.x% for yyy seconds (following S D1 command).
S	D3	XX.X YYY	Run at Manual Output of xx.x% for yyy seconds (following S D2 command).
S	D4	XX.X YYY	Run at Manual Output of xx.x% for yyy seconds (following S D3 command).
S	D5	XX.X YYY	Run at Manual Output of xx.x% for yyy seconds (following S D4 command).
S	DX		Clear all previous data-logging commands.
S	DX		Clears all previous data logging commands (D1-D5).
S	KD	XXXXX	Set K Derivative Tuning Parameter (leading zeros required).
S	KI	XXXXX	Set K Integral tuning Parameter (leading zeros required).
S	KP	XXXXX	Set K Proportional Tuning Parameter (leading zeros required).
S	KT	XXX	Set Timebase (selections: 1-6, 8, 10, 12, 15, 20, 30, 40, 50, 60, 120; leading zeros required).
S	MD	MMDDYY	Set Date in Month-Day-Year Format (leading zeros required).
S	MO	X	Set Setpoint Mode (Selection: 1-6, See Data Transmission format for X M command).
S	RAH	XXXXXX	Set Rate Tolerance HI ALARM (up to 6 digits, include decimal point if used).
S	RAL	XXXXXX	Set Rate Tolerance LO ALARM (up to 6 digits, include decimal point if used).
S	RAT	XXXX	Set Rate Tolerance Alarm Time in Seconds (0000-0999 seconds, leading zeros required).
S	RCHP		Rate Calibration High Percentage
S	RCHR		Rate Calibration High Rate
S	RCLP		Rate Calibration Low Percentage
S	RCLR		Rate Calibration Low Rate.
S	RSH	XXXXXX	Set Rate Tolerance HI SHUTOFF (up to 6 digits, include decimal point if used).
S	RSL	XXXXXX	Set Rate Tolerance LO SHUTOFF (up to 6 digits, include decimal point if used)
S	SP		Set 2160 Status to STOP (OFF).
S	SS	XXXXXX	Set Setpoint Rate in Automatic Mode (up to 6 digits, include decimal point if used).
S	ST		Set 2160 Status to START (ON).
S	SU		Set 2160 Status to PAUSE (HLD).

TABLE 7-1: S (SET) COMMANDS LISTED ALPHABETICALLY WITHIN SUB-COMMAND

- Request Commands (Xmit) for data from the controller.

COMMAND	SUB-CMD	DATA FORMAT	DESCRIPTION OF COMMAND
X	A	XXXXXX	Xmit Accumulated Total.
X	BA	XXXXXX	Xmit Current Batch Amount.
X	BS		Xmit Batch Setpoint.
X	BS		Xmit Batch Setpoint Value.
X	C		Xmit Current Rate of Change (ROC).
X	DI	XX YY	Xmit DIP Switch Status (See Data Transmission format for S DI command for explanation).
X	G	XXXXXX	Xmit Current Gross Weight Reading.
X	I	XXXXXX	Xmit Current Averaged Load Cell Input Counts.
X	KD	XXXXXX	Xmit K Derivative Tuning Parameter.
X	KI	XX.XXX	Xmit K Integral tuning Parameter.
X	KP	XXXXX	Xmit K Proportional tuning Parameter.
X	KT	XXX	Xmit Time Base Parameter.
X	M	X	Xmit Setpoint Mode Status (selections: 1-6; see Data Transmission format.
X	Q	113 BYTES	Xmit Query Data Block (see Data Transmission format for X Q command).
X	RAH	XXXXXX	Xmit Rate Tolerance HI Alarm.
X	RAL	XXXXXX	Xmit Rate Tolerance LO Alarm.
X	RAT	XXXX	Xmit Rate Tolerance Alarm Time in Seconds.
X	RCHP		Transmit Rate Calibration High Percentage.
X	RCHR		Transmit Rate Calibration High Rate.
X	RCLP		Transmit Rate Calibration Low Percentage.
X	RCLR		Transmit Rate Calibration Low Rate.
X	REL	XX	Xmit Relay Status (See Data Transmission format for X REL command and explanation).
X	REM	XX	Xmit Remote functions Status (See Data Transmission format for X REM command and explanation).
X	RSH	XXXXXX	Xmit Rate Tolerance HI SHUTOFF.
X	RSL	XXXXXX	Xmit Rate Tolerance LO SHUTOFF.
X	RST	XXX	Xmit Current 2160 Status (ON, HLD, OFF, REC, RFL).
X	SS	XXXXXX	Xmit Displayed SET RATE value (for Automatic and Remote Setpoint modes only).
X	TD	HHMMSS, MMDDYY	Xmit time and Date Information.
X	TY	2160	Xmit Instrument Model Type (2160).
X	V	X	Xmit Firmware Revisions Level.
!			Reset Serial Port Buffer.

Data Transmission Format

1. Mnemonics for outgoing command format.

NOTE: *Some of the mnemonics are optional.*

MNEMONIC	MEANING	NUMBER OF ASCII BYTES
CMD	Command	1
SUB-CMD	Sub-Command	1 to 3
DATA-n	Data Byte n	1 to 6
MODE	Mode	1
CR	Carriage Return	1

TABLE 7-2: OUTGOING COMMAND FORMAT

- a. Serial commands are transmitted from the host to the controller (in ASCII bytes) in the format used in the example below:

START CHAR	INSTRUMENT ADDRESS	CMD	SUB-CMD	6 BYTE DATA D6 ... D1	MODE	CR	2 BYTE CHECKSUM		EOT
							CHK-1	CHK-2	
>	10	X	G			CR	CHK-1	CHK-2	EOT

NOTE: *The example uses decimal and mnemonic abbreviation format for clarity; however, the actual data would be in ASCII format.*

- b. There is one space (20 hex) required between each type of data following the INSTRUMENT ADDRESS. The outgoing command represented in hex format would be:

3E313020582047200D364404

- This Represents:

3E 31 30 20 58 20 47 20 0D 36 44 04
 -For-
 > 1 0 X G CR 6 D EOT

- The checksum is computed by totaling the bytes in the command stream starting with the INSTRUMENT ADDRESS through (and including) the CR and then subtract 256 from the total until the remainder is less than 256 (to achieve a one byte maximum).
- The result is then represented as two ASCII bytes and appended to the command, followed by an EOT (04)
-

<u>VALUE</u>	<u>DESCRIPTION</u>
31	address - instrument number 10 - ASCII "1"
30	address - instrument number 10 - ASCII "0"
20	Space
58	X
20	space
47	G
20	space
0D	CR

= 16Dhex total (365 decimal)
 - 100 hex minus 256 decimal (one byte maximum)

 = 6Dhex total checksum (109 decimal) represented in ASCII
 as 36hex (for 6), 44 hex (for D)

2. Serial commands transmitted from the controller to the host in the form they were received from the host with the return data (and units) added to the message and a LF added to the CR.
3. Continuing the example, the return data would be:

START CHAR	INSTRUMENT ADDRESS	CMD	SUB-CMD	6 BYTE DATA D6 ... D1	MODE	CR	2 BYTE CHECKSUM		EOT
							CHK-1	CHK-2	
>	10	X	G	D6 ... d1 LB/KG*		CRLF	CHK-1	CHK-2	EOT

NOTE: "LB" or "KG" follow data.

a. Data Formats

1) Weight/Rate Data Format

a) Weights are transmitted according to the following rules:

- Positive Numbers:

Maximum of 6 numbers + decimal point.

- Negative Numbers:**

Maximum of 5 numeric + minus sign + decimal point.

2) Examples of transmitted weights:

TRANSMITTED	CORRECT?	RECEIVED	REASON
-123.45	Y	-123.45	5 NUMERICS + MINUS SIGN + DECIMAL POINT((**) above)
1234.56	Y	1234.56	6 NUMERICS + DECIMAL POINT (*) above)
-12345	Y	-12345	5 NUMERICS + MINUS SIGN (**) above)
-123456	N	-12345	The "6" WOULD BE TRUNCATED SINCE ONLY 5 NUMERICS + THE MINUS SIGN IS LEGAL (**) above)
1234x.67	N	1234x.6	The "7" WOULD BE TRUNCATED SINCE ONLY A MAXIMUM OF 6 NUMERICS + DECIMAL POINT IS LEGAL (*) above)

3) When return data is not valid for the command, an "A" is returned by the instrument. For example:

START CHAR	INSTRUMENT ADDRESS	CMD	SUB-CMD	6 BYTE DATA D6 ... D1	MODE	CR	2 BYTE CHECKSUM		EOT
							CHK-1	CHK-2	
>	10	A				CRLF	CHK-1	CHK-2	EOT

Command Sets

- X (Xmit) Command
 - Xmit is issued with a sub command. Only one sub command per command is allowed.
 - Transmit data specified in SUB-CMD as follows:

SUB-CMD	MEANING
REL	Relay (This command transmits relay status)

RECEIVED DATA	RELAY NUMBER	RELAY FUNCTION
01	5	REC
02	4	ON/OFF
04	3	SHUTOFF
08	1	REFILL
10	2	ALARM
20	8	(RESERVED)
40	7	(RESERVED)
80	6	BATCH COMPLETE

SUB-CMD

MEANING

REM

Remote Function Status

RECEIVED DATA	PIN NUMBER	PIN FUNCTION
01	7	FORCE REFILL
02	8	READ REMOTE SET POINT
04	5	PRINT SCREEN
08	6	(RESERVED)
10	3	ABORT
20	4	CLEAR TOTAL
40	1	START
80	2	PAUSE

SUB-CMD

MEANING

DI

DIP Switch Status

- Data is returned in the format X_DI_XX_YY, where XX are the External DIP switches and YY are the Internal DIP switches.

(XX)	RETURNED DATA	INTERNAL DIP NUMBER	DIP SWITCH FUNCTION
	01	2	DISABLE PRINT
	02	4	ENABLE DATA LOGGING
	04	5	IGNORE INCOMING CHECKSUM
	08	7	OFF = GROSS WEIGHT ON = COUNTS
	10	8	(RESERVED)
	20	6	OFF = 1 SEC. ON = 1/20 SEC.
	40	3	DISABLE BATCH REPORT
	80	1	ENABLE MULTI-DROP

Description	Bytes	Var	ASCII	Bytes	
		Format (inside quotes)		From	To
C. Time/Date	12	"X TD HHMMSSMMDDYY"		33	50
D. Relay Status	2	"X REL xx"		51	59
E. Remote Functions Stat	2	"X REL xx"		60	58
F. Rate of Change Value	3	"X C xxxxxxxx nnn"		69	85
G. Batch Amount	4	"X BA xxxxxxxx"		86	99
H. Set Point Value	3	"X SS xxxxxxxx"		100	113

XG 103.721 XI 492763 XTD 100705081591 X REL 00 S REM 00 XC
0.060 L/S X BA 2.252 X SS 2.00

SUB-CMD MEANING

I Load cell input command. Used primarily to check the load cell input section of the unit. The command will return the number of averaged counts that is currently being read from the load cell input.

S (Set) Command

COMMAND MEANING

S Set specified SUB-CMD data as follows:

SUB-CMD MEANING

C HHMM Set Clock. HHMM represents hours and minutes.

MD MMDDYY Set Date. MMDDYY represents month, day and year.

Error Codes

- The codes are decimal codes returned in response to receiving a command from the Host.
- General Communication Return Codes:
 - Response Code 'A': Acknowledge good data received.
 - Response Code 'N': Negative Acknowledge, error code will follow.
 - Response #23: Illegal command while in Hold Mode.
 - Response #24: Negative value not allowed.
 - Response #25: Invalid interrupt status.
 - Response #26: Framing error.
 - Response #27: Parity error.
 - Response #28: Overrun error.
- Specific Response Error Codes

1. Tuning and Control

- Response Code #08:Invalid Time Base
- Response Code #09:K factor out of range

2. Auto Refill

- Response Code #31:Refill low set point out of range
- Response Code #32:Refill high set point out of range.
- Response Code #33:Shutoff low set point out of range.
- Response Code #34:Shutoff high set point out of range.

3. Rate Tolerance

- Response Code #40:Rate alarm low set point out of range.
- Response Code #41:Rate alarm high set point out of range.
- Response Code #42:Shutoff low set point out of range.
- Response Code #43:Shutoff high set point out of range.
- Response Code #44:Alarm time out of range.

4. Status, Force Functions, Weight and Rate Parameters

- Response Code #80:Invalid ROC set point.
- Response Code #81:Invalid set point mode.
- Response Code #83:Batch amount out of range.
- Response Code #84:Output percentage value out of range.

5. General Communications

- Response Code #97:Checksum error.
- Response Code #99:Illegal command.

CHAPTER 8 - OPERATION

About Chapter 8

All information contained in Chapter 8 pertains to the operation of the HI 2160RC^{PLUS}. This section includes instructions for selecting operating displays, ratio control, setting operating parameters and 2 Sigma Testing. We recommend that maintenance personnel and users read and understand this chapter before operating the controller. Make sure that all configuration and setup procedures are completed before operating the controller. Alternatives to the instructions, either explicit or implied, contained in this chapter are not recommended.

Operational Displays

Selecting Operational Displays

There are three Continuous Rate Displays

- Any display can be selected at any time.
- Selecting displays will not effect the currently running process.
- To select a display, press on the Display Button until you reach the desired display.
- Rate & Current Weight Display (Default Display). (See Fig. 8-1)

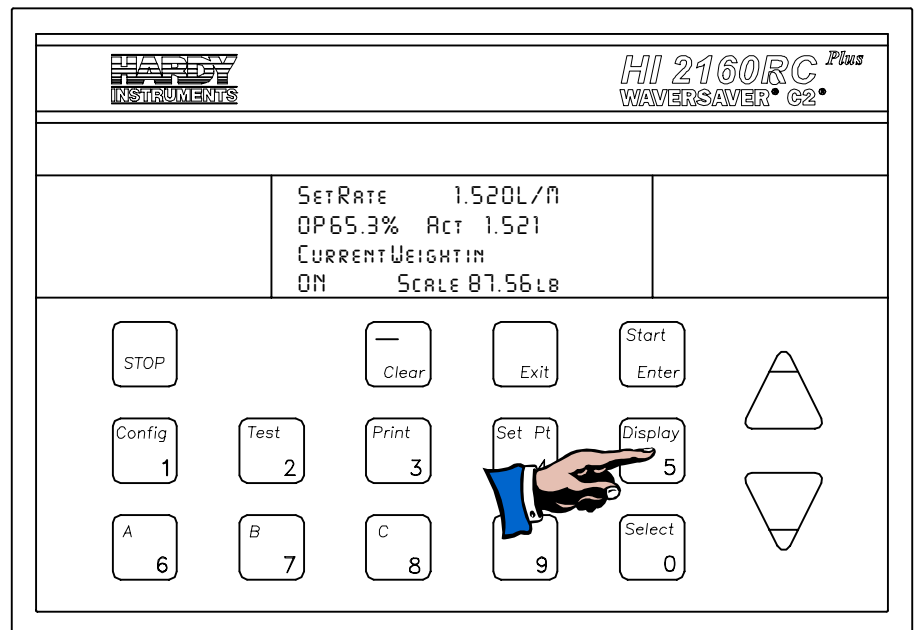


FIG. 8-1 RATE & CURRENT WEIGHT DISPLAY (DEFAULT DISPLAY)

- Rate and Total Weight Display. (See Fig. 8-2)

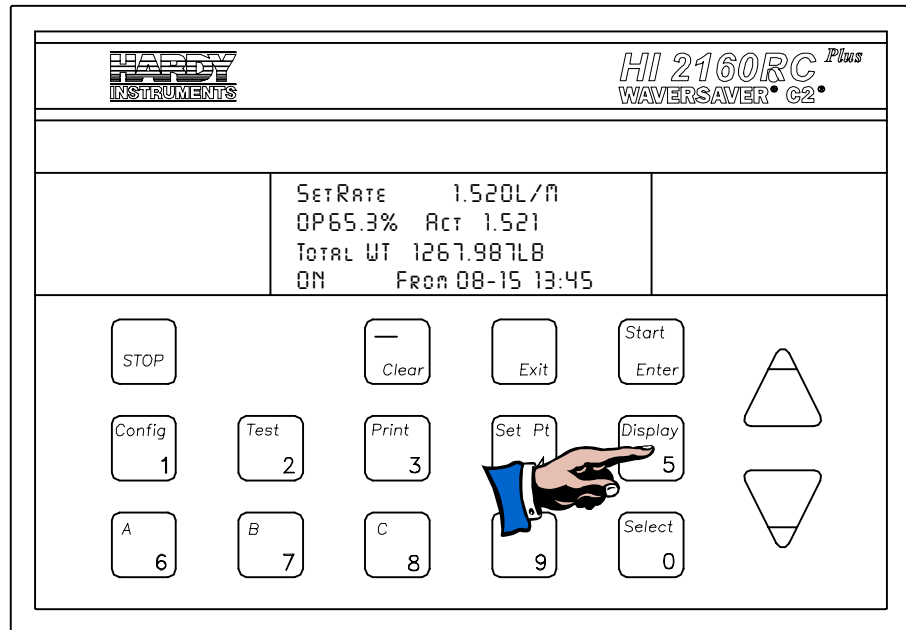


FIG. 8-2 RATE & TOTAL WEIGHT DISPLAY

- Current Total Weight Display. (See Fig. 8-3)

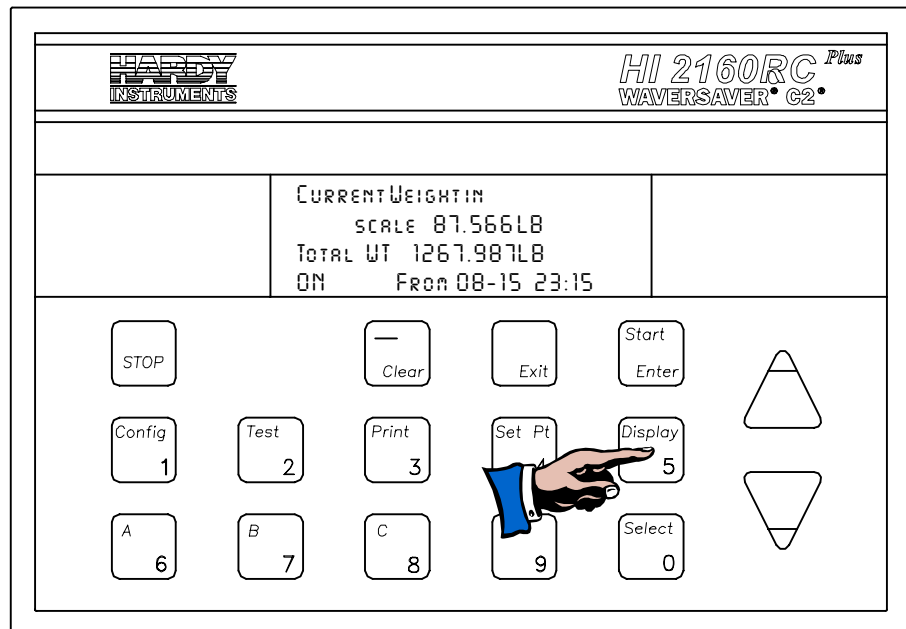


FIG. 8-3 CURRENT TOTAL WEIGHT DISPLAY

- The displays are divided into two sections. (See Fig. 8-4)
 - Rate Section
 - Weight Section

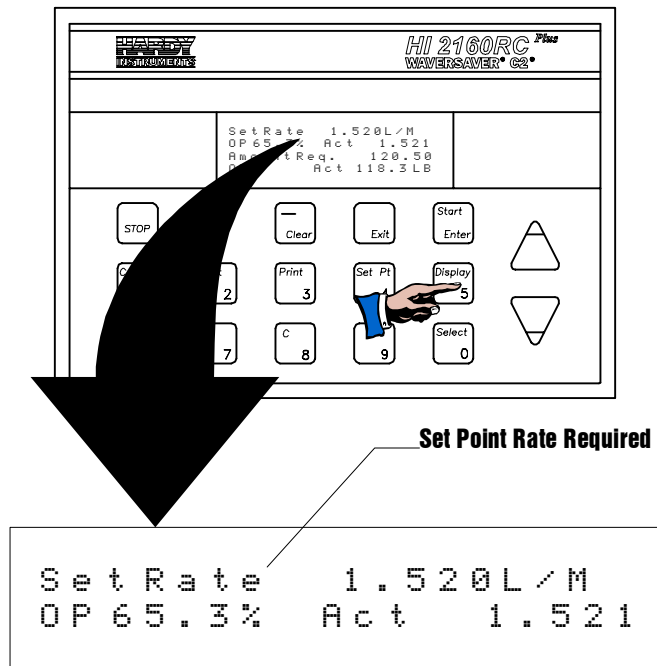


FIG. 8-4 RATE DISPLAY

The Rate Section

- The Set Rate shows the required Set Point rate at 1.520 pounds per minute.
- The current Output Signal Level shows 65.3% of the available output signal driving the feeder.
- Act Rate shows the actual flow rate of 1.521 pounds per minute.

The Weight Section

- Current Weight Display (See Fig. 8-5)

The current weight display shows that the actual weight of the ingredient currently in the feeder or scale is: 87.566 lbs

- Total Weight Display (See Fig. 8-6)

Displays the accumulated weight total that has passed through the feeder from a start date and time to the present date and time.

In the example display, the total amount of ingredient which has passed through the feeder since 3:35 PM, June 16th is 1,267.987 pounds.

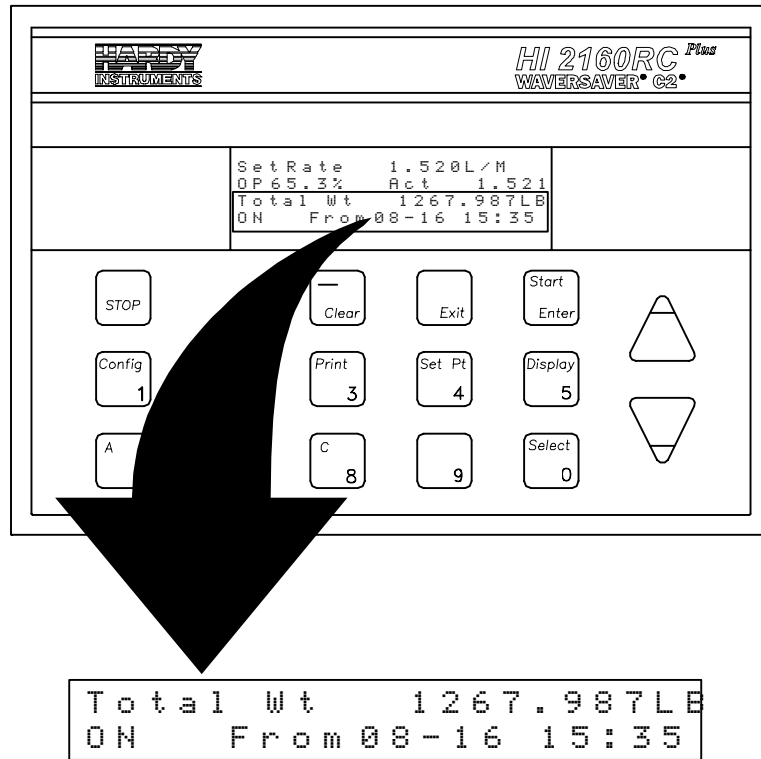


FIG. 8-5 TOTAL ACCUMULATED WEIGHT

NOTE:

This display is extremely useful in continuous operations.

Current Weight
Total Display.
(See Fig. 8-6)

- Displays the Current weight in the feeder or on the scale.
- Displays the Total Accumulated weight that has passed through the feeder since 11:15 PM, August 15th.

NOTE:

The continuous displays appear in continuous mode or in batch mode. However, the Batch displays do not appear when the controller is in Continuous mode.

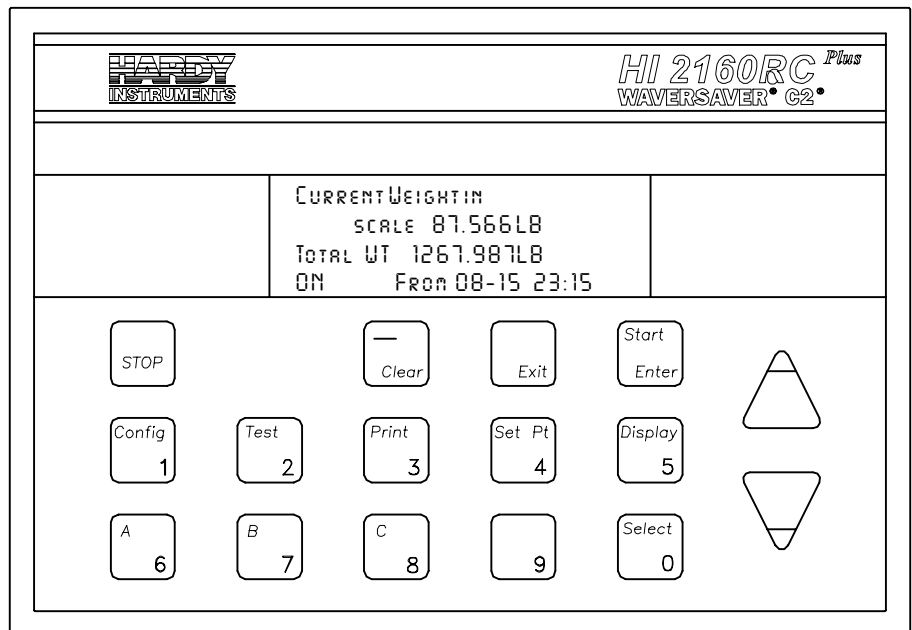


FIG. 8-6 CURRENT AND ACCUMULATED TOTAL WEIGHT DISPLAY

Batch Displays

Selecting Batch Displays

- Step 1. From the Operating Displays press the Set Point button.
- Step 2. Enter the security code number.
- Step 3. Press the Enter button. The Set Point Menu appears. (See Fig. 8-7)

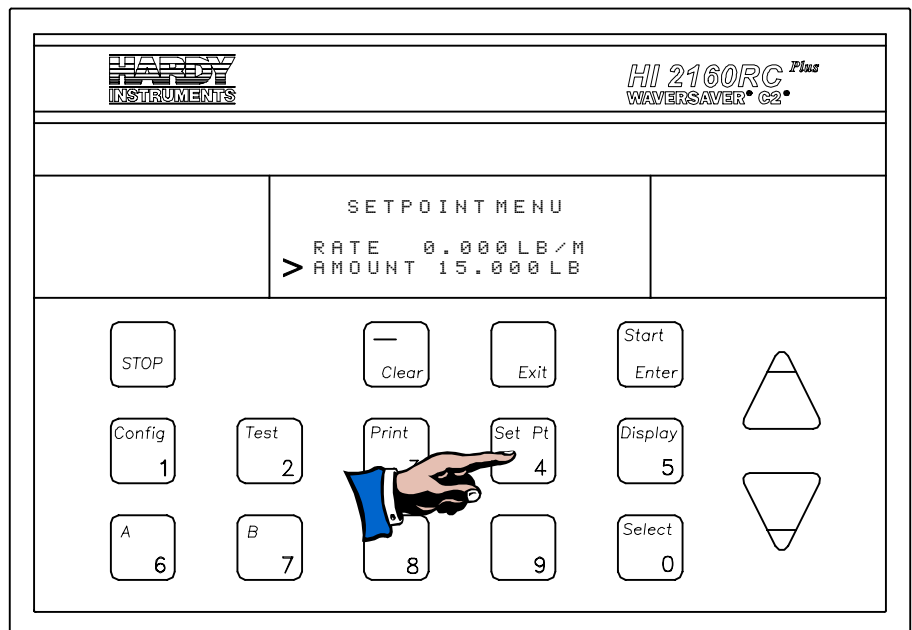


FIG. 8-7 SET POINT MENU/SELECTING BATCH MODE

- Step 4. Press the down arrow ↓ until it is to the left of the Amount sub-menu.
- If "Continuous" is displayed, press the Select button. A value appears.
 - When a value displays in the amount sub-menu, you are in the Batch Mode of Operation.
 - If a value is displayed, you are already in the Batch mode.
- Step 5. Press the Enter button to accept the value.
- Step 6. Press the Exit button to return to the Operating Display.
- Step 7. To select a display, press on the display button until you reach the desired display.
- Step 8. There are three Batch Rate Displays:
- Batch Amount and Rate Display. (See Fig. 8-8)

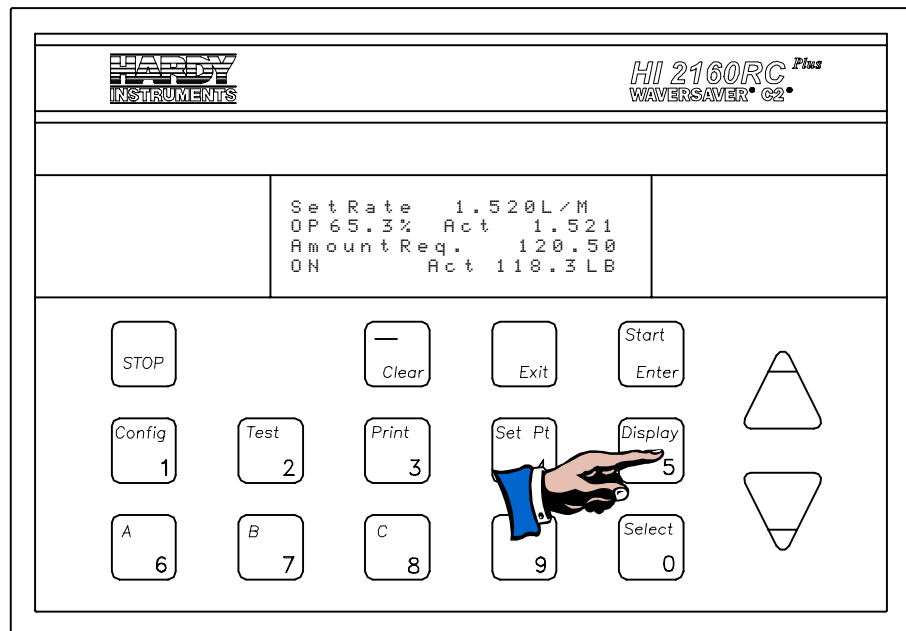


FIG. 8-8 BATCH AMOUNT AND RATE DISPLAY

- The Batch Amount Display shows the amount of ingredient requested (the set point amount) and the actual amount delivered since the start of the batch.
 - Our example display shows 120.50 pounds requested. 118.3 pounds actually delivered.
 - The Rate is also displayed.
- Batch Amount Current Weight Display. (See Fig. 8-9)

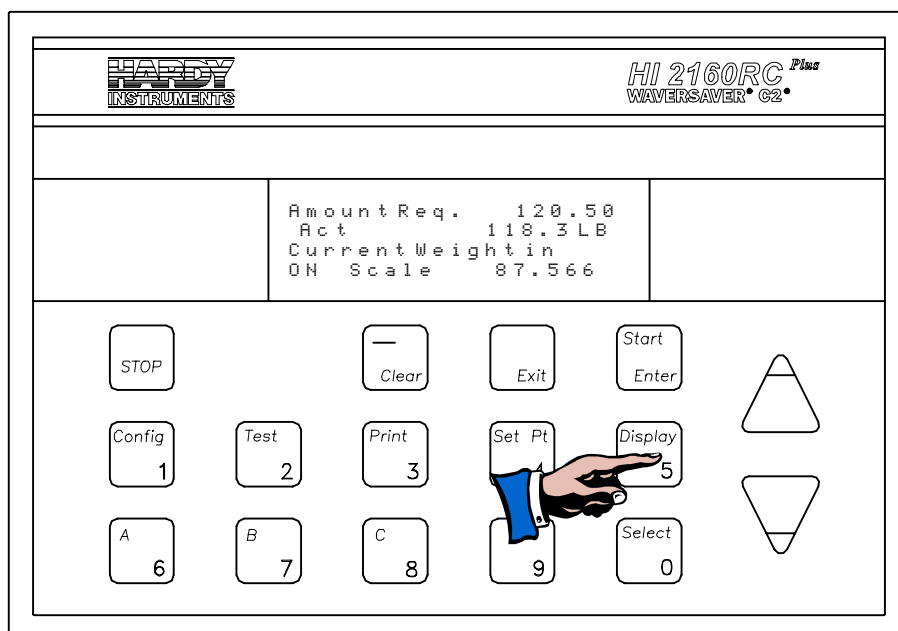


FIG. 8-9 BATCH AMOUNT/CURRENT WEIGHT DISPLAY

- The Batch Amount Display shows the amount of ingredient requested (the set point amount) and the current weight of the ingredient in the feeder.
- Our example display shows 120.50 pounds requested. 118.3 pounds actually delivered. 87.566 pounds of ingredient currently in the feeder.
- Batch Amount and Total Weight Display. (See Fig. 8-10)
 - This display shows the amount of ingredient requested (the set point amount) and the current weight of the ingredient in the feeder.
 - Our example display shows 120.50 pounds requested. 118.3 pounds actually delivered. The Total Accumulated weight that has passed through the feeder since 9:53 AM June 15th.

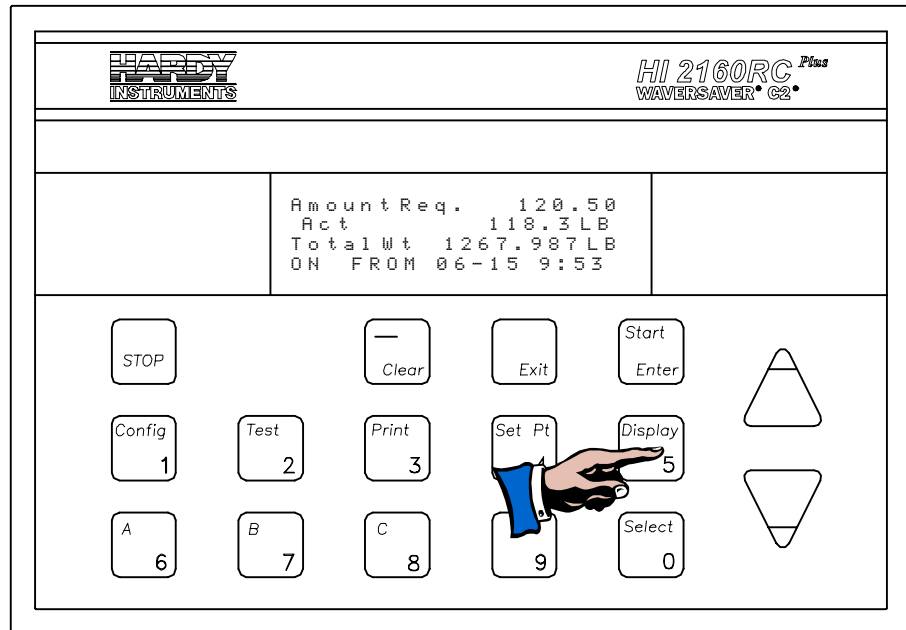


FIG. 8-10 BATCH AMOUNT AND TOTAL WEIGHT DISPLAY

Display Parameters

Rate\Current Weight Display Parameters (See Fig. 8-11)

1. **Rate Set Point** is set in the Set point, Host, or Remote Set point Menus. L/M = pounds per minute (Mass Unit /Time Unit) and can be changed in the Calibration Sub-Menu. (See Chapter 5)
2. **Actual Rate** an ingredient is being dispensed.
3. **Output Percentage** of the total available motor control output applied to the feeder motor controller.

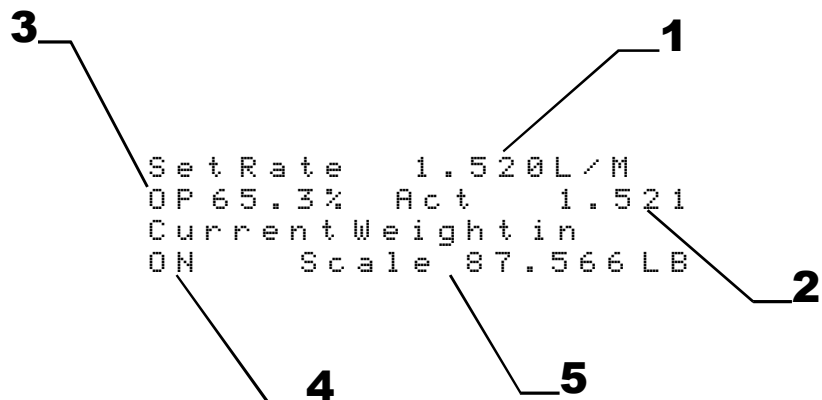


FIG. 8-11 SET RATE/CURRENT WEIGHT DISPLAY PARAMETERS

4. **Controller Operating Status** indicates the operating status of the controller.

- ON -Initiated by pushing the START button. Indicates the control output signal is active.
- HLD -Initiated by pushing the STOP button once. Indicates the control output is inactive and pausing.
- OFF - Initiated by pushing the STOP button twice. Indicates the control output is inactive.
- REC -Initiated when the controller is active (ON) and in a Rate Exception Control Condition.
- RFL -Displays while the controller is in the Refill Mode.
- ONr -Controller is configured to be controlling to a remotely entered set point.

5. Scale displays the weight of the material currently in the feeder.

**Current\Total
Weight Display
Parameters (See
Fig. 8-12)**

1. From displays the date and time the Total Register (Totalizer) was cleared. (month, day, hour, minute)

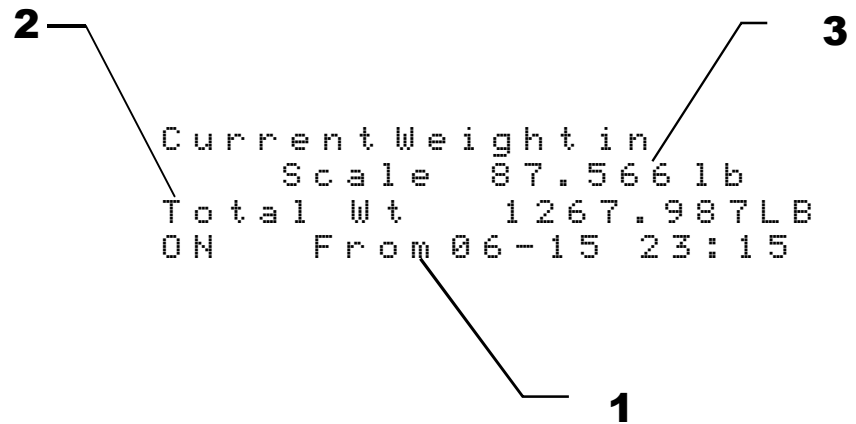


FIG. 8-12 CURRENT/TOTAL WEIGHT DISPLAY PARAMETERS

Clearing the
Total Register
(Totalizer) from
the Front Panel
(See Fig. 8-13)

- Step 1. Press the Clear button. The Security display appears.
Step 2. Enter the Security Code number.

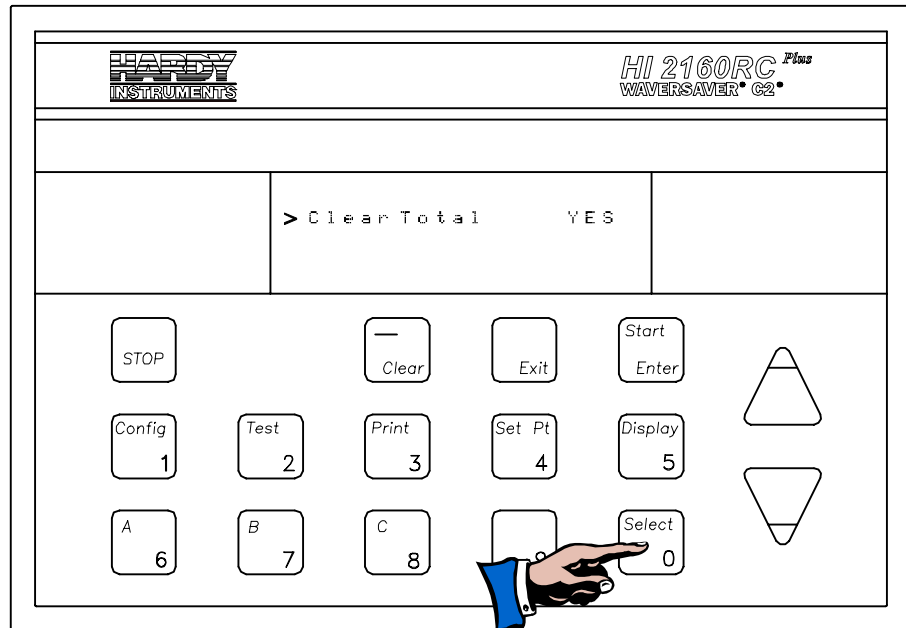


FIG. 8-13 CLEARING THE TOTAL REGISTER FROM THE FRONT PANEL

- Step 3. Press the Enter button. The Clear Sub-Menu appears.
- Step 4. Press the Select button to select "YES"
- Step 5. Press the Enter button to clear the total register. The display automatically returns to the Operational Display.

Clearing the Total Register from the Rear Panel (See Fig. 8-14)

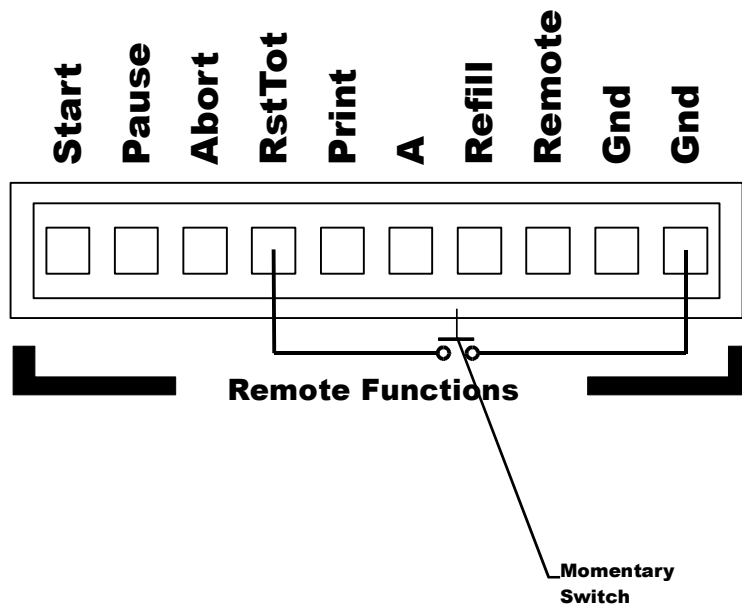


FIG. 8-14 CLEARING TOTAL REGISTER FROM THE REAR PANEL

- Step 6. Momentarily ground the Reset Total ("RstToT") on the Remote functions Connector located on the rear panel.

2. Total Wt displays the accumulated total weight that has passed through the feeder since the Total Register was cleared.
3. Current Weight in displays the weight of the ingredient currently in the feeder.

Setting the Flow Rate

NOTE:

Complete all Configuration, Setup, and Calibration procedures before setting the Flow Rate Modes.

Rate Modes

Setting the Manual Rate Control Mode (Volumetric Mode)

NOTE:

The Manual Control Mode is used when the user wants to control the rate of flow manually from the front panel. The Exception Control (REC LEVEL) is ignored during Manual Control Mode.

NOTE:

The OP% can be adjusted with the unit ON or OFF.

- Step 1. Press the 'Set Pt/4" button. The security message appears.
- Step 2. Enter the security code number or press the Enter button. The Set Point Menu appears with the cursor next to the Rate sub-menu.
- Step 3. Setting the Rate
 - Press the "Select" button to scroll through all the rate selections which are:

Manual
Remote (Optional)
Mass Units/Time Units (e.g. 5.00 LB/M)
 - Select "Manual". Press the Enter button.
 - Press the down arrow to select the Amount sub-menu.
- Step 4. Setting the Amount
 - Press the "Select" button to scroll through all the rate selections which are:

Continuous
000.000 Mass Unit (LB, KG, GL, etc)
 - Select Continuous. Press the Enter button.
 - Press the Exit button. The operational display appears. (See Fig. 8-15)
- Step 5. Always verify that the feeder is loaded.

- Step 6. Always verify that there is a container to hold the displaced material from the feeder.
- Step 7. Adjusting the OP% (Operating Percentage) output signal percentage.
- Initially the OP% reads 00.0% with the digit to the right of the decimal point (the least significant digit) flashing. The flashing means that the value can be changed. (See Fig. 8-15)
 - Press the up arrow \uparrow . The flashing number changes from 0 to 1. (See Fig. 8-16)

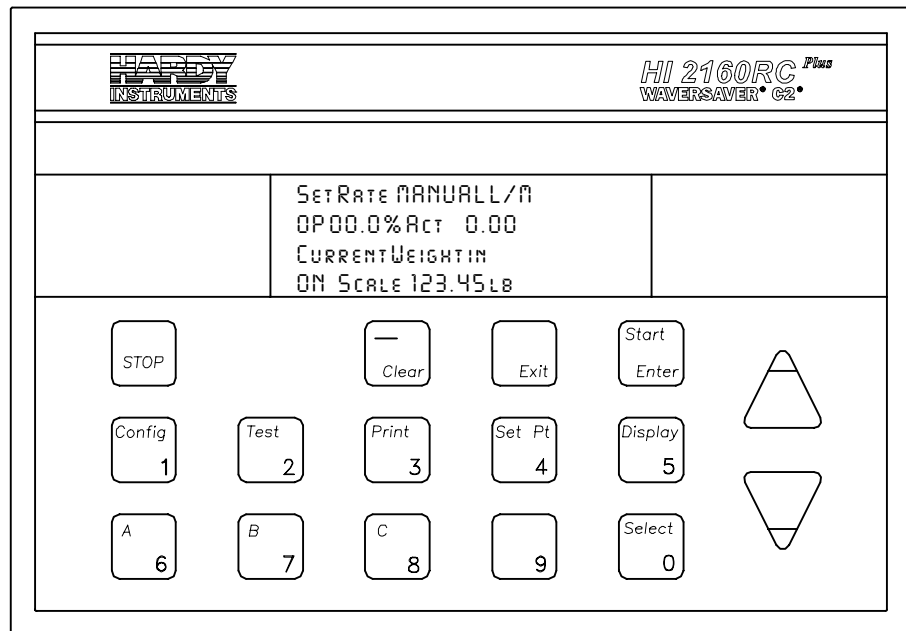


FIG. 8-15 OPERATIONAL DISPLAY RUNNING

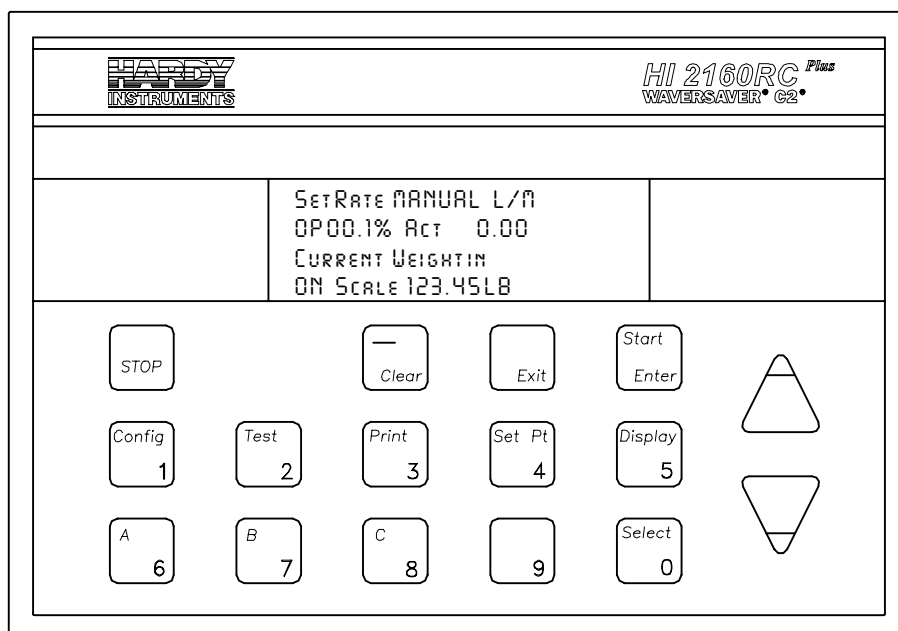


FIG. 8-16 OUTPUT SIGNAL IN 00.1% INCREMENTS

Increasing/
Decreasing the
OP% output
signal by
increments of
.1%

- Step 1. Press the up ↑ arrow to increase the output signal percentage increased (driver RPM) in increments of 00.1% and down arrow ↓ to decrease the output signal percentage (driver RPM) in increments of 00.1%.
- Step 2. Increase/Decrease the OP% output signal by increments of 1%.
- Press the Select/0 button. The number to the left of the decimal point begins flashing.
 - Press the up arrow ↑ to increase the output signal percentage increased (driver RPM) in increments of 01.0% and down arrow ↓ to decrease the output signal percentage (driver RPM) in increments of 01.0%.
- Step 3. Increase/Decrease the OP% output signal by increments of 10%. (See Fig. 8-17)
- Press the Select/0 button. The number to the left of the decimal point begins flashing.
 - Press the up arrow ↑ to increase the output signal percentage increased (driver RPM) in increments of 10.0% and down arrow ↓ to decrease the output signal percentage (driver RPM) in increments of 10.0%.

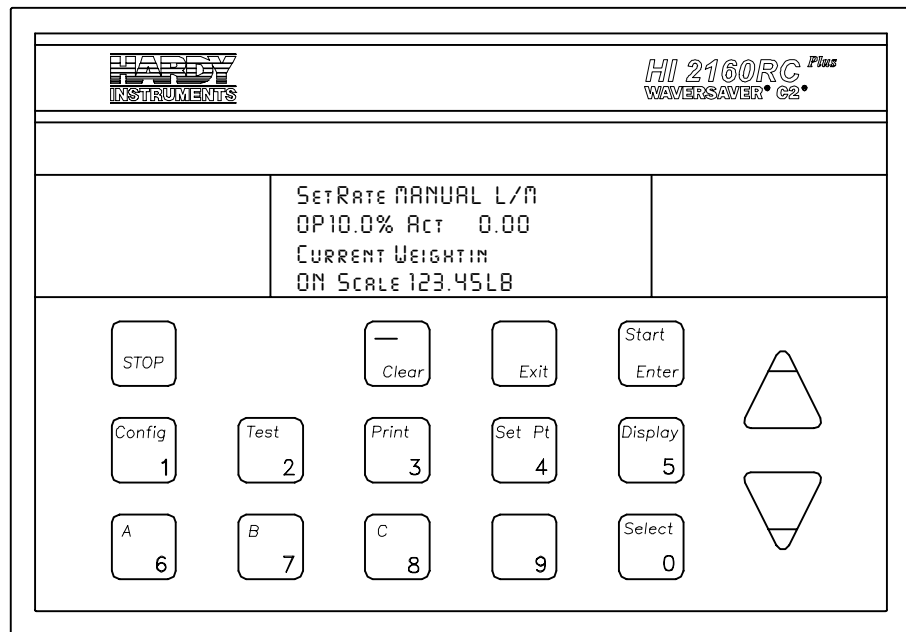


FIG. 8-17 OUTPUT SIGNAL IN 10% INCREMENTS

Set the Operating Percentage for 10% increments

- Step 1. If the unit is in the ON mode, press the up arrow ↑ a few times and the down arrow ↓ a few times to see if the feeder is increasing and decreasing the material feed rate.
- Step 2. Turn on the feeder and agitators.
- Step 3. Press the "Start/Enter" button.
- Step 4. Use the up arrow to increase the feeder motor speed.
- Step 5. Use the down arrow to decrease the feeder motor speed.
- Step 6. To Pause the feeder, press the STOP button once.
- Step 7. To Stop the feeder, press the STOP button twice.

Setting the Remote Set Point Input Mode

- The Remote Set Point Input Mode requires the Remote Set Point Input Option Board (Prt. #0535-0410).
- The Remote Set Point Input Mode of operation is used if the operator wants to control the rate of flow remotely via Analog Input from a Host Controller, Flow Meter or other device. The rate is governed by the analog inputs supplied by the host and can be scaled to a ratio of the Host Controller.

- Step 1. Press the Set Pt button.
- Step 2. Enter the Security Code Number.
- Step 3. Press the Enter button. The Set Point Menu appears with the cursor to the left of the RATE sub-menu. (See Fig. 8-18)
- Step 4. Press the Select button to select the Remote Operation Control Mode.
- Step 5. Press the Enter button to accept the mode selection.
- Step 6. Press the Exit button to return to the operating display.

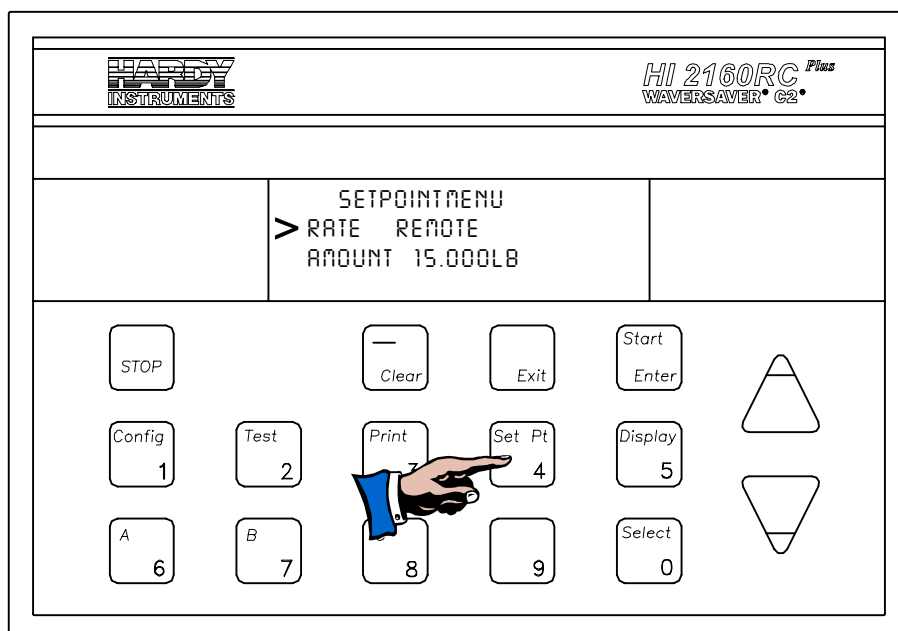


FIG. 8-18 SELECTING THE REMOTE MODE OF OPERATION

Setting the Automatic Rate Control Mode (Gravimetric Mode)

- The operator can still select the batch amount or continuous operation from the controller's front panel. The desired Flow Rate is set by the Remote Set Point Input Option Card.
- The operation of the HI 2160RC^{PLUS} is controlled by the Host.
- The Automatic Rate Control Mode is used if the operator wants to set a rate of flow to a pre-determined rate.
- The rate is set in mass units/time units. For example LBS/M (pounds per minute), LBS/H (pounds per hour) etc.

- Step 1. Press on the Set Pt button.
- Step 2. Enter the security code number.
- Step 3. Press on the Enter button. The Set Point Menu appears with the cursor to the left of the RATE sub-menu. (See Fig. 8-18)
- Step 4. If the Rate display shows "MANUAL" or "REMOTE", press on the Select button to select the Value display. (See Fig. 8-19)

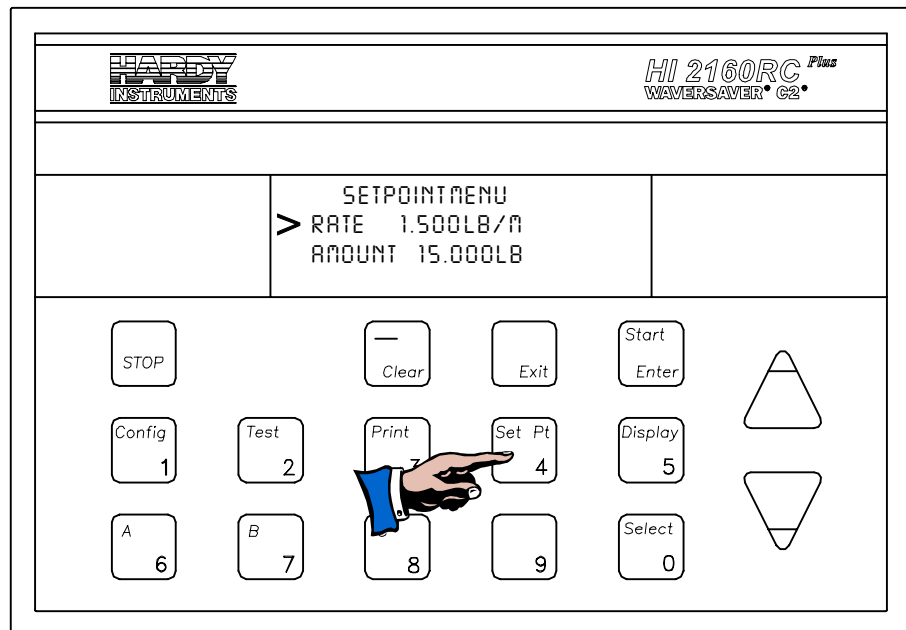


FIG. 8-19 SETPOINT MENU/SELECTING AUTOMATIC MODE

- Step 5. Press the Clear button to clear the values.
- Step 6. Use the numeric keys to enter the new flow rate.
- Step 7. Press the Enter button to accept the new rate.
- Step 8. Press the Exit button to return to the operating display.

Amount Modes

Setting the Set Point Amount Batch Mode

- The Set Point Amount Batch Mode allows the user to set a predetermined amount of material to be dispensed by the feeder.
- The amount is set in Mass Units/Time Units.
- The Mass Units are expressed as LB (pounds), OZS (ounces) etc. (See Chapter 5 for instructions on how to set the Mass Units)
- The Time Units are expressed as HR (hours) MIN (minutes) SEC (seconds). (See Chapter 5 for instructions on how to set the Time Units)
- The controller automatically stops the feeder when the target weight (batch) is reached.

- Step 1. f.Press on the Set Pt button.
- Step 2. Enter the security code number.
- Step 3. Press on the Enter button. The Set Point Menu appears.
- Step 4. Press the down arrow ↓ until the cursor is to the left of the Amount sub-menu.
- Step 5. If the Amount sub-menu shows "Continuous", (See Fig. 8-20) press the Select button to change to the value display.

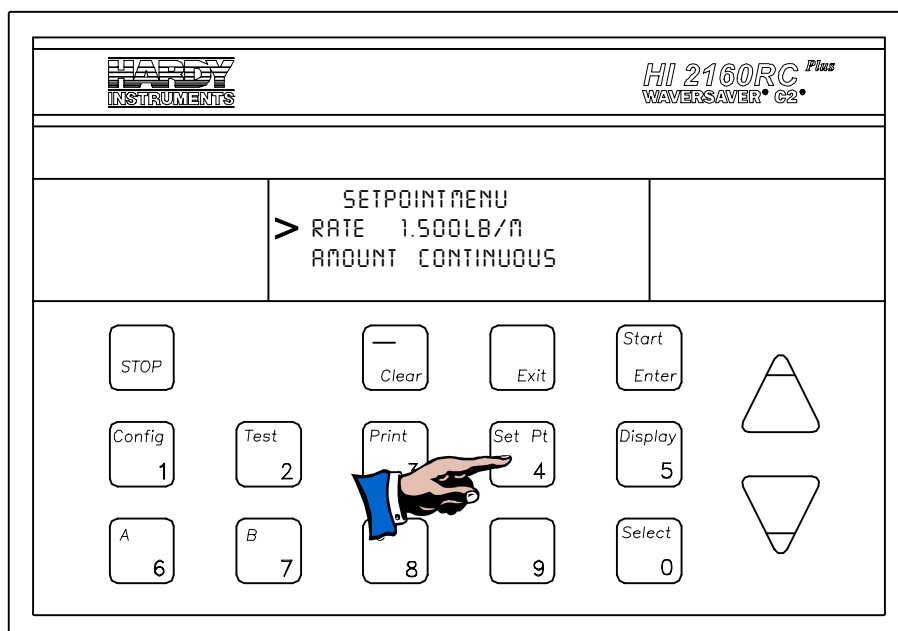


FIG. 8-20 SETPOINT MENU/CONTINUOUS AMOUNT MODE

Step 6. Press the Clear button to clear the entry.

Step 7. Use the numerical keys and enter the new amount. In our example display, 15.000LB (pounds).

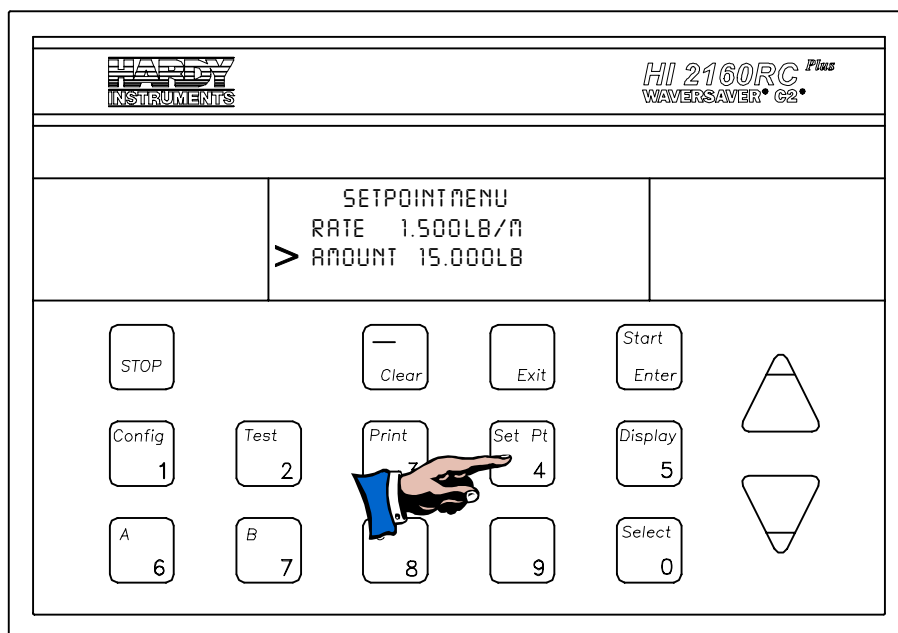


FIG. 8-21 SETPOINT MENU/SET POINT AMOUNT BATCHING

Step 8. Press the Enter button to accept the new amount.

Step 9. Press the Exit button to return to the operating display.

Setting the Continuous Operation Mode

- The Continuous Operation Mode allows the user to continuously dispense from the feeder until instructed to stop by the operator or the host controller.
- Step 1. Press the Set Pt button.
 - Step 2. Enter the security code number.
 - Step 3. Press the Enter button. The Set Point Menu appears.
 - Step 4. Press the down arrow ↓ until the cursor is to the left of the Amount sub-menu.
 - Step 5. If the Amount sub-menu is set to Continuous, press the Exit button to return to the operating display.
 - Step 6. If the Amount sub-menu is set to a value, press the Select button to select "Continuous". (See Fig. 8-20)
 - Step 7. Press the Enter button to accept the selection.
 - Step 8. Press the Exit button to return to the operating display.

NOTE:

When using the Continuous Mode, the batch process runs until told to stop by the host or the operator.

Ratio Control (Master/Slave)

Description of a Ratio Controlled System

- The Host Controller monitors and/or controls the flow rate of the main ingredient (Ingredient #1). The process requires that ingredient #2,#3,#4 etc. be fed into the main ingredient or vessel at a certain percentage (proportion) of the flow rate of ingredient #1.
 - For example, if ingredient #1's flow rate is 10 gallons/minute and the process requires that ingredient #2 be fed at 10% of the flow rate of ingredient #1; ingredient #2 must be fed at a flow rate of 1 gallon/minute (a 10/1 ratio). However, ingredient #1's flow rate is not constant. The rate controller for ingredient #2, must maintain the 10% proportional feed rate no matter what the flow rate of ingredient #1 may be.

Ratio Process Control System (See Fig. 8-22)

- The Host Controller is fitted with an Analog Output Option card that generates a 0-5 VDC, 0-10 VDC, or 4 to 20 milliamp output signal that is proportional to the actual flow rate of ingredient #1.
- The Slave Controller is fitted with a Remote Set Point Analog Input Option card to receive a 0-5 VDC, 0-10 VDC, or 4 to 20 milliamp signal. The slave controller receives the signal from the host and adjusts the output signal to the feeder motor to maintain the 10% (10/1 ratio) flow rate of ingredient #2.
- The flow rates of all ingredients can be monitored by Host (PLC or Computer). If an Allen-Bradley PLC5 is used this data can be continuously transferred via Discrete Transfers or upon request via Block Transfers.
- New desired flow rates should not be continuously transferred to the Rate Controllers via the Remote I/O. When new rate information is received, existing rate information in memory is written over

and the instrument will not enter closed loop control for a minimum of two Time base periods plus the averages (20 averages per second). The Timebase is normally set for four seconds.

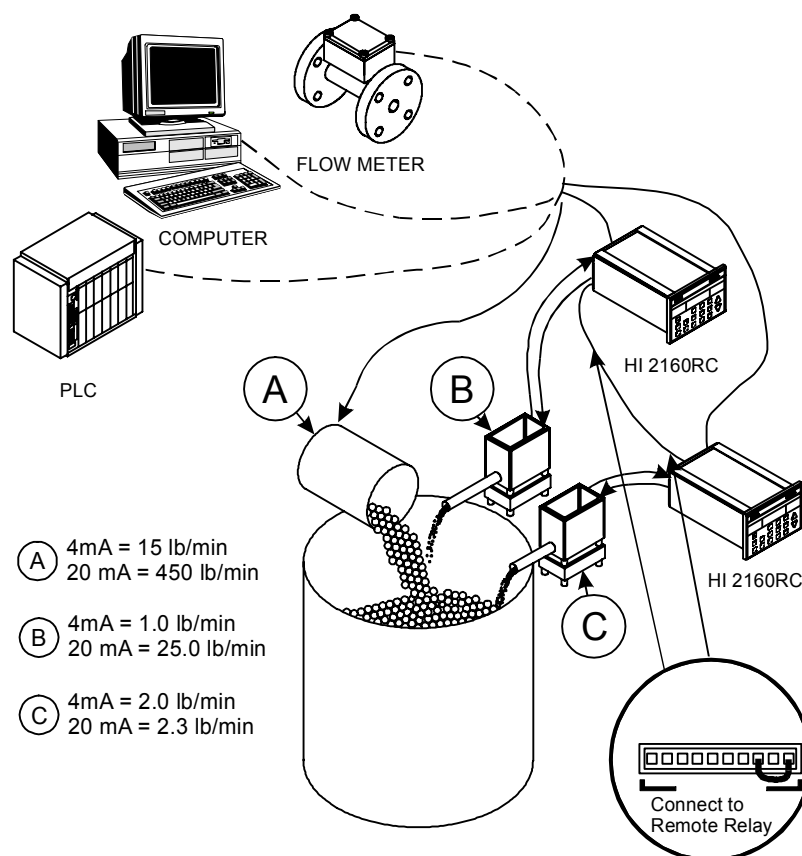


FIG. 8-22 PROCESS CONTROL SYSTEM/RATIO CONTROL

- "A" is the Master Ingredient where the actual flow is measured and transmitted. A signal can come from a variety of Host Controllers including a flow meter.
- "B" and "C" are the Slave ingredients which track the flow of "A". The remote set point to "B" and "C", from "A", is setting the desired rate set point.
- The Remote Set Point Input Option enables the user to set a range which is used to receive rate set point values from another unit's analog outputs. The Set Point parameters can be set remotely from the Allen Bradley Remote I/O and PROFIBUS Interface Card but cannot be remotely set via the serial communication.

Remote Set Points Option for Ratio Control Applications

- Step 1. Place a jumper wire between the Remote Connector and the ground pin on the Remote Functions Connector. (See Fig. 8-23)
- Step 2. Select the Remote Mode in the Set Point Menu. (See Rate Modes above for instructions)

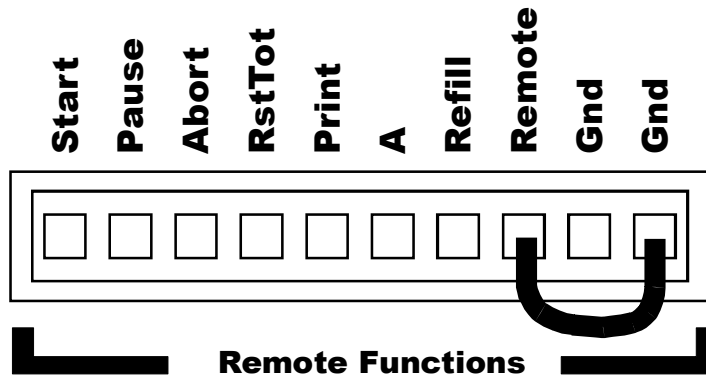


FIG. 8-23 REMOTE SET POINT JUMPER

NOTE:

The Remote Set Points will not work without the jumper installed.

Step 3. Setting the LO Output Signal Parameter.

- The LO setting is the minimum signal output to be referenced as 0.000 lbs/min (Default Setting). Depending on the output option board purchased the output signal range could be 0-20 milliamps, 4-20 milliamps, 0-5 volts, 0-10 volts. The LO setting corresponds to 0 output.
- Normally the setting is 0.000 mass units/time units but other settings can be used to match process requirements. When using a value other than 0.000, the value must be below (less than) the HI value setting.
- Press the Config button. The Main Menu appears.
- d.Press the down arrow until the cursor is to the left of the Remote Set Point sub-menu.
- Press the Enter button. The Set Point Menu appears with the cursor next to the Percentage parameter. More will be said later about setting percentages. (See Fig. 8-24)
- Press the down arrow until the cursor is to the left of the LO setting sub-menu.
- Press the Clear button to clear the old value.

NOTE:

If the old value is Zero, enter a new number. If the old value is not Zero, press the Clear button two times, then enter the new number.

- Use the numeric keys to enter the new value.
- Press the Enter button to accept the new value.
- Press the down arrow until the cursor is to the left of the HI.

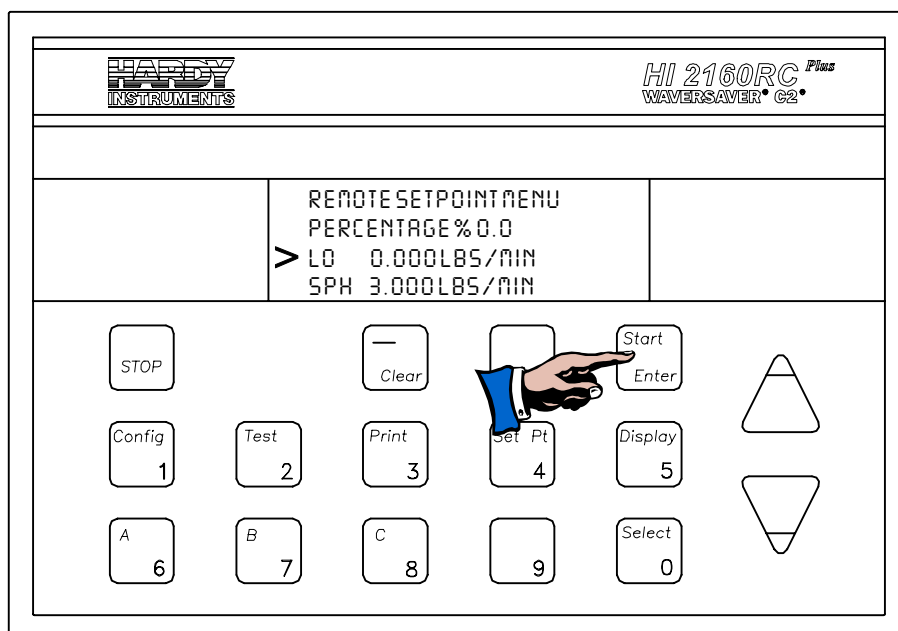


FIG. 8-24 SETTING LO AND HI SIGNAL OUTPUT PARAMETERS

Step 4. Setting the HI Output Signal parameter

- The HI setting is the maximum signal output to be referenced as 3.000 lbs/min (Default Setting). Depending on the output option board purchased the output signal range could be 0-20 milliamps, 4-20 milliamps, 0-5 volts, 0-10 volts. The HI setting corresponds to 20 milliamp or 5 or 10 volts output.
- The Default setting is 3.000 mass units/time units. The value must be higher than the LO value setting.
- Press the down arrow until the cursor is to the left of the HI setting sub-menu.
- Press the Clear button to clear the old value.

NOTE:

If the old value is Zero, enter a new number. If the old value is not Zero, press the Clear button two times, then enter the new number.

- Use the numeric keys to enter the new value.
- Press the Enter button to accept the new value.
- Press the down arrow until the cursor is to the left of the Averages sub-menu.

Step 5. Setting the Averaging parameter (See Fig. 8-25)

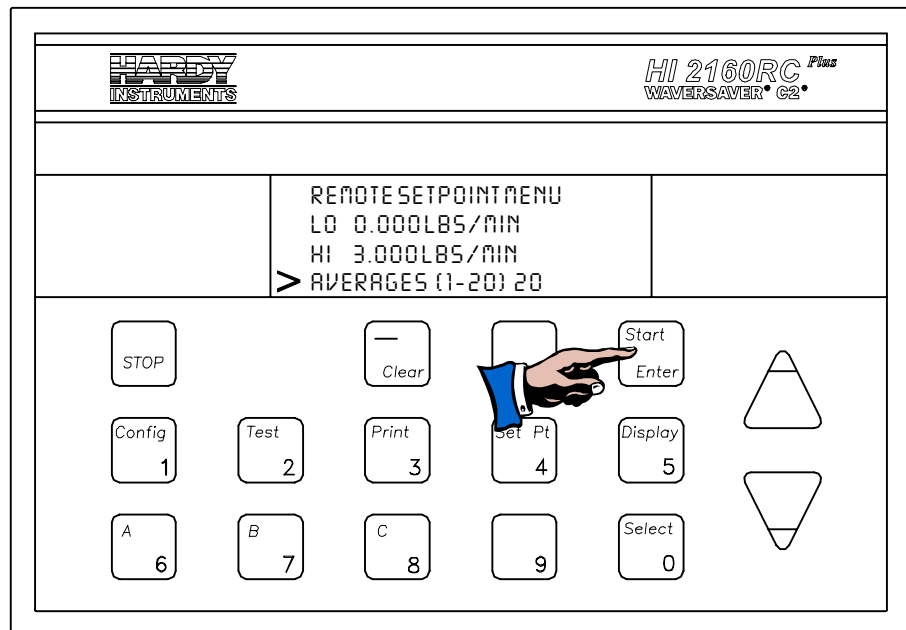


FIG. 8-25 REMOTE SETPOINT MENU/SETTING AVERAGING

- The averaging parameter is most often set when using any device that outputs an erratic signal (e.g. a flow meter). The averaging function takes a number of input (voltage or amperage) readings and averages the input signal to improve stability. The improvement in stability however, is at the expense of response time. A setting of 1 average takes 50 milliseconds. A setting of 20 averages takes 1 second.
- b.The averaging function is a running average, where the input signals are totaled and the total is divided by the number of set averages (1-20). The Default setting is 20. The instrument reads one new signal plus the last 19 signals and repeats the averaging process again.
- c.For example:

An averaging setting of 20. The instrument reads 20 of the most current input signals (amps or voltages), totals the signals, divides by 20, drops down one, reads one new signal along with 19 of the old readings, totals the signals, divides by 20, drops down one, etc.

- Be careful when setting averaging parameters. Set the smallest value that provides the most stable set point readings.
- Press the Clear button to clear the value.
- Use the numeric keys to set the new value.
- Press the Enter button to accept the new value.

Step 6. Setting a Percentage of the HI Output Signal. (See Fig. 8-24)

- The HI 2160RC^{PLUS} Percentage Function allows the operator to quickly change the HI Output Signal in order to reduce the flow rate, without changing the HI Output Signal. For Example:

The HI output signal setting is 10.00 LBS/MIN. The process slows down and the feed rate required is only 9 LBS/MIN. You can set the Set Point Percentage at 90% of the HI output signal and the HI 2160RC PLUS slows the feeder rate to 9 LBS/MIN. If the process requires 5.7 LBS/MIN, set the percentage for 57%, 6.3 LBS/MIN, set the percentage for 63%, etc.

- Press the Config button. The Main Menu appears.
- Press the down arrow ↓ until the cursor is to the left of the Remote Set Point sub-menu.
- Press the Enter button. The Set Point Menu appears with the cursor next to the Percentage sub-menu. (See Fig. 8-25)
- Press the Clear button to clear the value. A setting of 0.00 = 100% output signal.
- Use the numeric keys to enter the new percentage parameter.
- Press the Enter button to accept the new percentage.

Step 7. Setting the Set Point Low (SPL) parameter. (See Fig. 8-25)

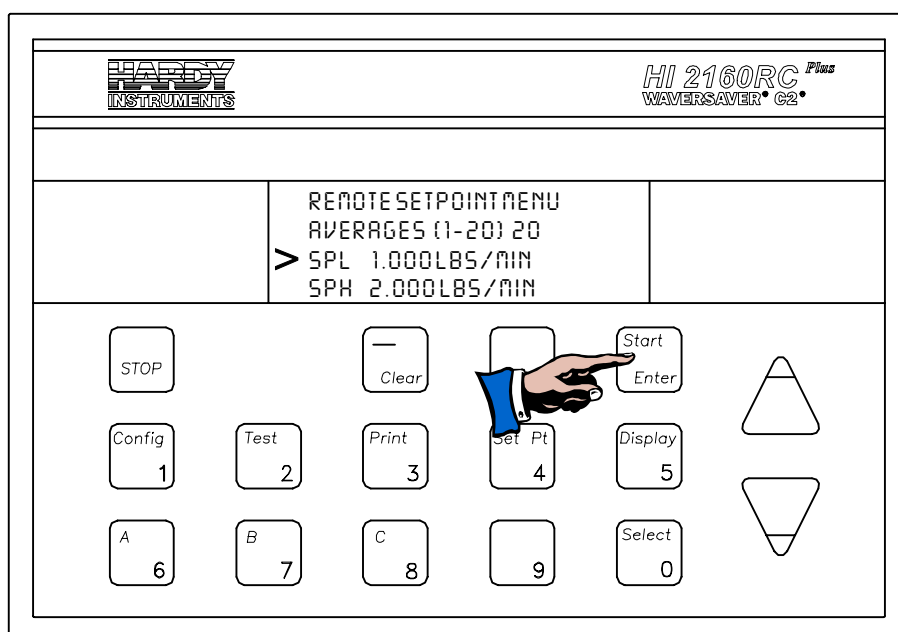


FIG. 8-26 REMOTE SETPOINT MENU/SETTIN SPL & SPH

- The Set Point Low (SPL) setting is the lowest rate in the process flow rate range that the instrument will operate in gravimetric mode. As you will recall gravimetric mode is when the controller is in closed loop operation, where the controller actually controls the rate of flow.

NOTE:

It is important to understand that at start up the feed rate will not be within the feed rate range. The system operates in the (Volumetric) Rate Exception Mode (REC) until the feeder is dispensing at the selected feed rate range at which time rate control begins.

- For Example:

An HI 2160RC^{PLUS} is controlling the feed rate of a vibration feeder with a feed rate range of 3 - 6 lbs/min. When the vibration feeder first starts, it only dispenses about ½ lb/min. At this operating point the feeder does not need control and is operating in volumetric mode or open loop. Once the feeder starts to dispense material in the range of the set point rates, the controller automatically switches from volumetric mode to gravimetric mode and begins again to control the flow rate.

- Press the Clear button to clear any values.
- Use the numeric keys to enter the new value. Enter any value as long as it is lower than the SPH (Set Point High) value.
- Press the Enter button to accept the new value.
- Press the down arrow ↓ until the cursor is to the left of the Set Point High (SPH) sub-menu.

Step 8. Setting the Set Point High (SPH) Parameter. (See Fig. 8-27)

- The Set Point High (SPH) setting is the highest rate in the process flow rate range that the instrument will operate in gravimetric mode. As you will recall gravimetric mode is when the controller is in closed loop operation, where the controller actually controls the rate of flow. For Example:

An HI 2160RC PLUS is controlling the feed rate of a vibration feeder with a feed rate range of 3 - 6 lbs/min. From time to time the vibration feeder exceeds 6 lbs/min. At this operating point the feeder is not controlled and is operating in volumetric mode or open loop. Once the feeder starts to dispense material in the range of the set point rates, the controller automatically switches from volumetric mode to gravimetric mode and begins again to control the flow rate.

- Press the Clear button to clear any values.

- Use the numeric keys to enter the new value. Enter any value as long as it is higher than the SPL (Set Point Low) value.
- Press the Enter button to accept the new value.

10. Press the Exit button to return to the Main Menu.

11. Press the Exit button again to return to the Operating Display.

Ratio Control Application Example

Application

- Material A - Controlled by the Host at a rate of 100 lbs/hr.

Host 4-20 milliamp analog output signal.

4 milliamps = 0 lbs/hr

12 milliamps = 100 lbs/hr

20 milliamps = 200 lbs/hr

- Material B - Controlled by an HI 2160RC^{PLUS} Rate Controller.

Blended into Material A at a rate of 20% of the full flow rate of Material A (i.e. 200 lbs/hr).

- Material C - Controlled by an HI 2610RC Rate Controller.

Blended into Material A at a rate of 10% of the full flow rate of Material A (i.e. 200 lbs/hr).

NOTE:

Note that the settings for Material "B" and Material "C" are the same as the full flow rate of Material A. This is necessary so that the feed rates for B and C are proportional for the entire output span of Material A.

Setup

- Material B

Step 1. Set the LO Output Signal (4 milliamps) to 0.00. Now 4 milliamps = 0 lbs/hr. (See Remote Set Points Option for Ratio Control Applications, Setting The LO Output Signal Parameter above)

Step 2. Set the HI Output Signal (20 milliamps) to 200.0 lbs/hr. (See Remote Set Points Option for Ratio Control Applications, Setting the HI Output Signal Parameter above)

Step 3. Set the Percentage at 20%. (See Remote Set Points Option for Ratio Control Applications, Setting a Percentage of the HI Output Signal above)

- Material C

- Step 1. Set the LO Output Signal (4 milliamps) to 0.00. Now 4 milliamps = 0 lbs/hr. (See Remote Set Points Option for Ratio Control Applications, Setting The LO Output Signal Parameter above)
- Step 2. Set the HI Output Signal (20 milliamps) to 200.0 lbs/hr. (See Remote Set Points Option for Ratio Control Applications, Setting the HI Output Signal Parameter above)
- Step 3. Set the Percentage at 10%. (See Remote Set Points Option for Ratio Control Applications, Setting a Percentage of the HI Output Signal above)

Down Loading Rate Set Points Via Analog Signal for PLC's that are not Equipped with PROFIBUS or Allen Bradley Remote I/O

- Equipment Required for the PLC
 - Analog Output Module
 - Relay Module
- Equipment Required for the HI 2160RC^{PLUS}
 - Remote Set Point Option Card that matches the Analog Output Signal of the PLC.

- 0-20 Milliamps
- 4-20 Milliamps
- 0-5 Volts
- 0-10 Volts

- Step 1. Set the jumpers for the amperage or voltage range that matches the analog signal of the analog output module in the PLC. (See Chapter 3 for Instructions)
- Step 2. Set the Current Sense jumper for single controller, or multiple controllers. (See Chapter 4 Current Sense Selection Table)
- Step 3. Typical system incorporating a PLC and three (3) HI 2160RC^{PLUS} rate controllers with remote set point capability. (See Fig. 8-27 and 8-28)

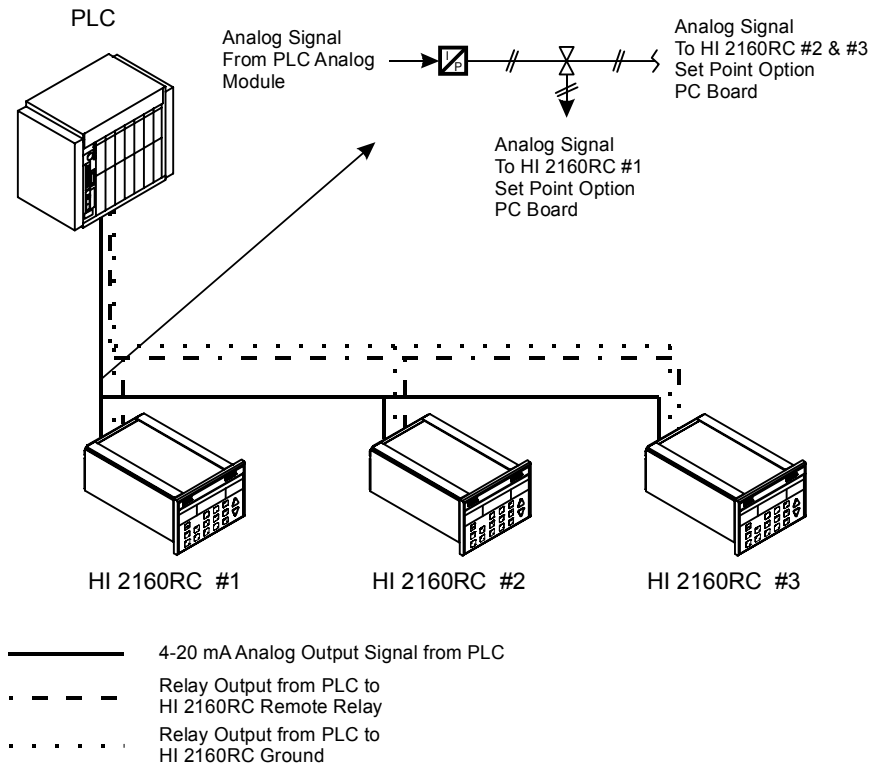


FIG. 8-27 ANALOG SIGNAL CONFIGURATION DIAGRAM

Step 9. The remote set point is set for 4-20 mA and a single analog output from the PLC controls all three HI 2160RC^{PLUS} s.

Step 10. Downloading Set Points (See Fig. 8-27 & 8-28))

- Download the set point information to the 4-20 milliamp output line.
- Close the Relay for the selected controller, in this case HI 2160RC^{PLUS} #1
- Open the Relay for the selected controller, in this case HI 2160RC^{PLUS} #1.
- The set point is downloaded.

Step 11. To download the set point information for the other controllers, (up to sixteen (16) per relay module) repeat Downloading Set Points above.

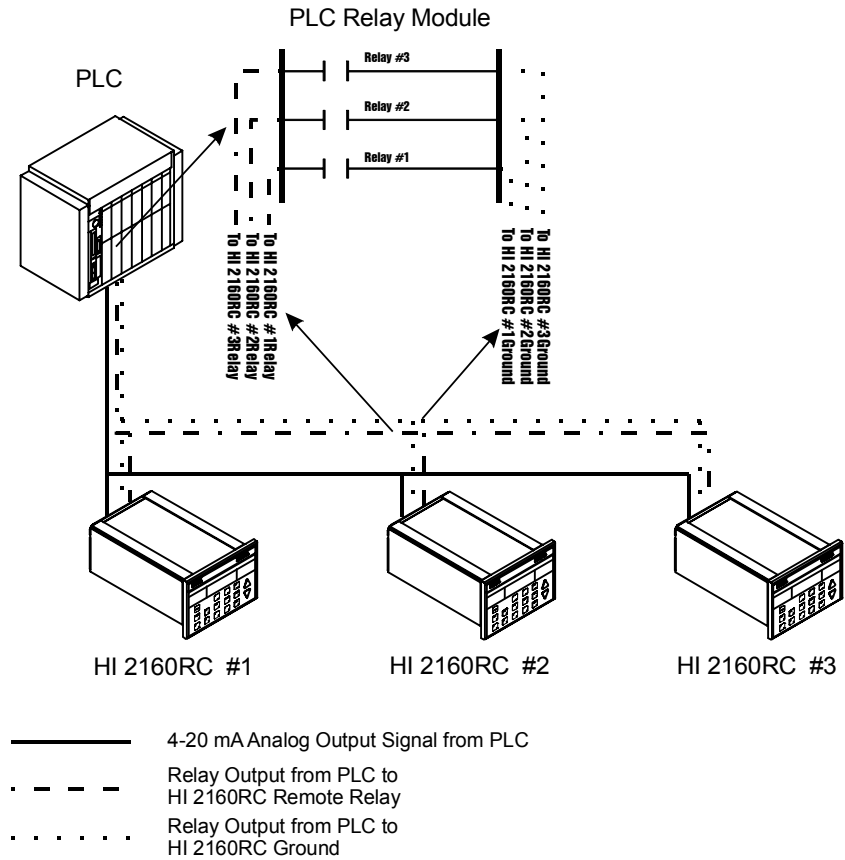


FIG. 8-28 DOWNLOADING SET POINTS, RELAY WIRING CONFIGURATION

Rate Exception Control

Definition

- Rate Exception Control is a method of quickly detecting a disturbance and changing operation from gravimetric to volumetric until the disturbance has been eliminated.
- Formula for determining when the HI 2160RC^{PLUS} detects an REC condition.

$$\text{ROCSP} \times \text{REC} \times 0.1 = \text{DEV}$$

ROCSP = Rate of Change Set Point (Desired Flow Rate)

REC = Rate Exception Control Level

DEV = Acceptable Deviation.

If the instantaneous "Rate of Change" (Flow Rate), exceeds the acceptable deviation an REC condition will exist.

- Example:

ROCSP = 5 pounds per minute

REC = 2.0 (20%) (Default Level)

NOTE:

1% = .1, 10% = 1.0, 100% = 10.0, on the front panel display.

5 x 2 x 0.1 = 1 pound per minute acceptable deviation.
 ROCSP + DEV = High Rate
 ROCSP - DEV = Low Rate

- Setting the Rate Exception Control Parameters.
 - REC LEVEL - is used to determine the percentage of error allowed before the HI 2160RC^{PLUS} jumps from closed loop to REC mode. Lower values yield a higher sensitivity. Monitor the OP% value while running a batch. Calculate the REC LEVEL by using this formula:

$$(\text{High OP\%} - \text{Low OP\%}) \times 0.1/2 = \text{REC LEVEL}$$

NOTE:

Use a moderate range to avoid frequent inadvertent jumps into REC mode.

b. Rate Exception Control Time - Used to determine the time the unit must remain in the REC mode to get an alarm condition.

c. Rate Exception Control Shutoff - If "YES" is selected, the feeder will stop at the completion of the REC time. If "NO" is selected the feeder will continue to run in REC mode with the alarm relay energized.

- Setting the Rate Exception Control (REC LEVEL)
 - Step 1. Press the Config button.
 - Step 2. Enter the security code number.
 - Step 3. Press the Enter button.
 - Step 4. Press the down arrow ↓ until the cursor is to the left of the Tuning Control sub-menu.
 - Step 5. Press the Enter button.
 - Step 6. Press the down arrow ↓ until the cursor is to the left of the REC LEVEL sub-menu.
 - Step 7. Use the numeric keys to enter an REC LEVEL calculated in the formula above.
 - Step 8. Press the Enter button to accept the entered value.
 - Step 9. Press the down arrow ↓ until the cursor is to the left of the REC TME (SEC) sub-menu.
 - Step 10. Press the Clear button to clear the time.
 - Step 11. Use the number keys to enter a new REC time.
 - Step 12. Press the Enter button to accept the REC time.
 - Step 13. Press the down arrow ↓ until the cursor is to the left of the REC Shutoff sub-menu.
 - Step 14. Press the Select button to select YES or NO.
 - Step 15. Press the Enter button to accept the selection.
 - Step 16. Press the Exit button two times to return to the operational display.

Test Procedures

**Sigma Test -
Definition**

The 2 Sigma Test feature is used to measure the performance of the feeder system. The 2 Sigma Test can be run on demand during all feed cycles. The test measures the decreasing weight on a scale by sampling a user selected number of samples over a user selected time period. The HI 2160RC^{PLUS} stores the amount of weight that left the scale for each time interval and time and date stamps the sample. The mean value of the total selected readings is calculated. The standard deviation is calculated and multiplied by two (2) then divided by the mean value to determine the 2 sigma accuracy of the feeder system under test. If the feed cycle is interrupted in any way (system malfunction, operator pause, REC mode or refill mode) an invalid test alarm is displayed and the test is aborted. Once the test is complete the results are kept in the 2 Sigma Data memory and can be displayed by selecting the 2 Sigma Data sub-menu in the Test Menu. The 2 Sigma accuracy test of a feeder is the repeatability of the feed rate expressed as a percentage of the Mean feed rate.

- You can perform the 2 Sigma Test at any time when in Continuous mode. When in Batch mode it is recommended that you choose the parameters so that the test can be completed by the end of the batch process. Otherwise you will not get valid test data. It is recommended that the parameters be selected so that no interruptions occur during the test.

Step 1. Press the 2/Test button. (See Fig. 8-29) The Test Menu Appears. (See Fig. 8-30)

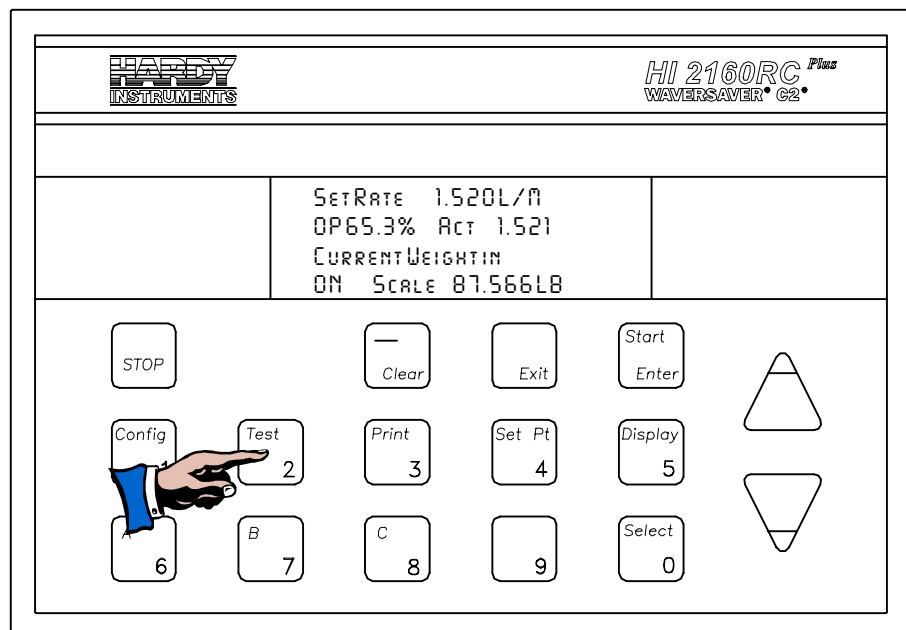


FIG. 8-29 SELECTING TEST MENU

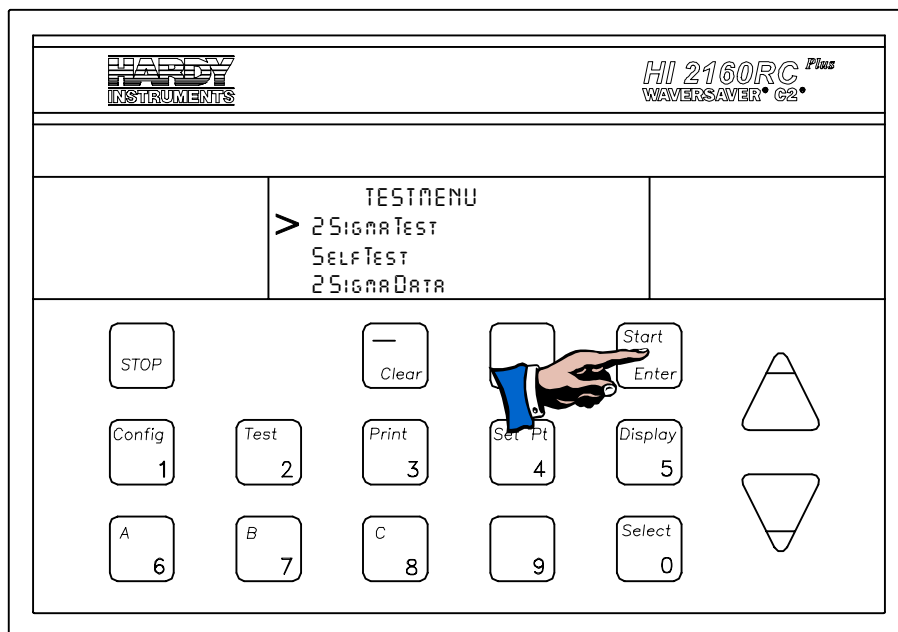


FIG. 8-30 TEST MENU

- Step 2. The default position of the cursor is next to 2 Sigma Test. If you are in the menu you need to press the down arrow ↓ or up arrow ↑ until the cursor is next to 2 Sigma Test.
- Step 3. 4. Press the Enter button. The 2 Sigma Test Menu appears. (See Fig. 8-31)

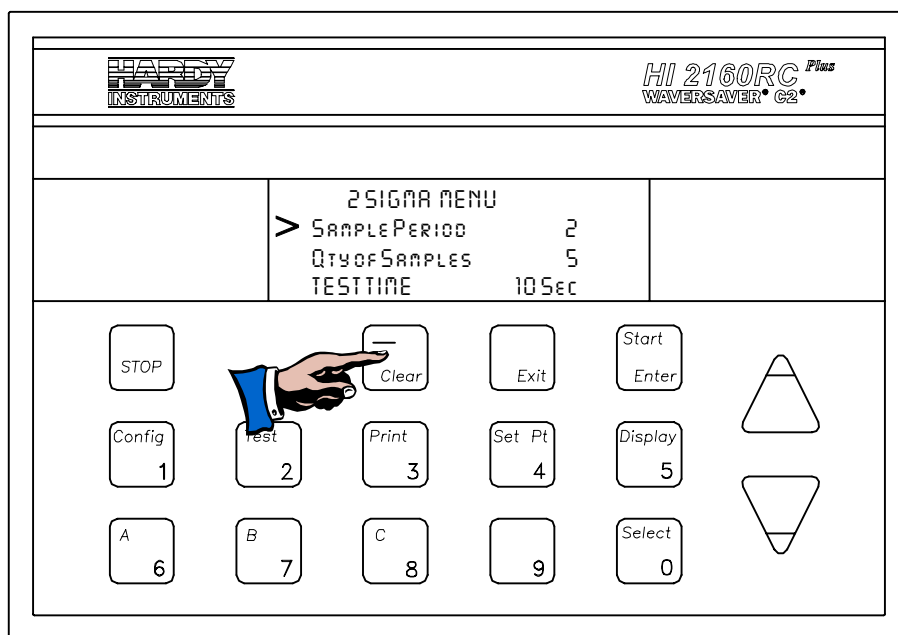


FIG. 8-31 2 SIGMA TEST MENU

- Step 4. Press the down or up arrows ↓↑ to move from one category to another. Move the cursor in front of the Sample Period.
- Step 5. Set the Sample Period (the selection is from 1 to 60 seconds) by first pressing the clear button to clear all existing values.
- Step 6. Use the key pad to enter the new values. In our example we used 01 second. This means that one sample will be taken every second.
- Step 7. Press the down arrow ↓ to move to the Qty of Samples you want to use for the 2 Sigma Test.
- Step 8. Use the key pad to enter the new values. In our example we used 20 samples. This means that one sample will be taken every second for 20 seconds for a total of 20 samples.

NOTE: *Even though the samples number from 1-20, Hardy Instruments recommends samples 5 samples.*

- Step 9. The TEST TIME is automatically calculated for you. You will notice that the Test Time is the product of the Sample Period and Qty of Samples. For example if we selected 20 seconds for the Sample Period and set the Qty of Samples for 20 samples, the Total Test Time is 400 seconds.

NOTE: *The examples are provided for clarification only. The user can set their own values for the system under test.*

NOTE: *It is important to note that the more samples taken over a longer period of time provides more accurate statistical information about the feeder system under test.*

- Step 10. Press the down arrow ↓ to move the cursor in front of the 2 Sigma Test. (See Fig. 8-32) The 2 Sigma Test defaults to NO.

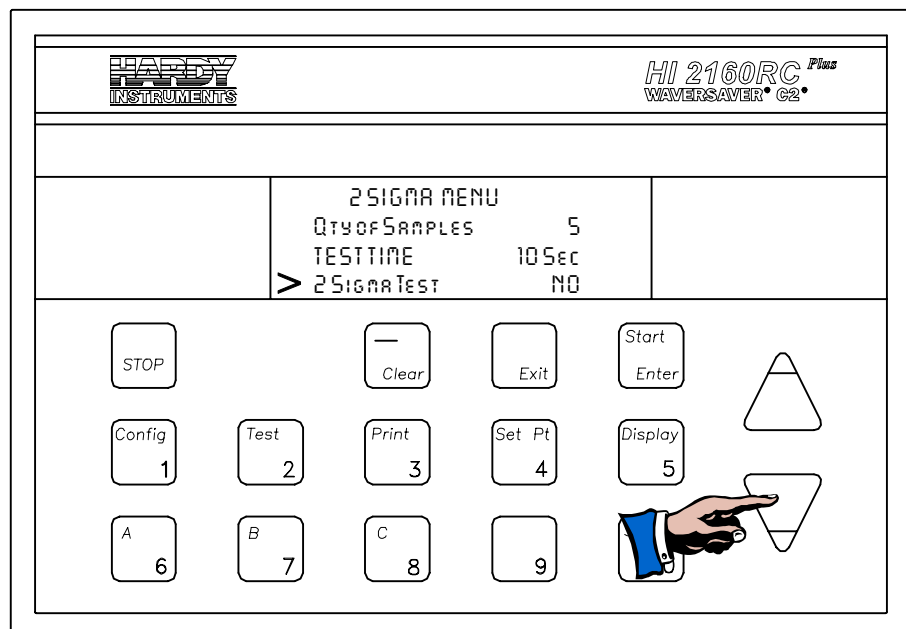


FIG. 8-32 2 SIGMA TEST MENU/SELECTING THE TEST

Step 11. Press the 0/Select button to toggle to YES. (See Fig. 8-33)

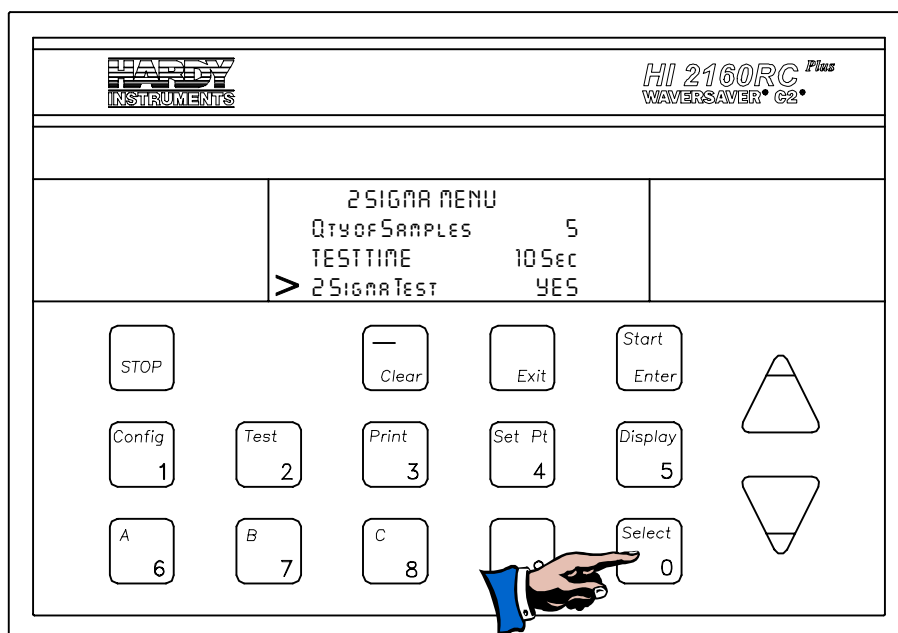


FIG. 8-33 2 SIGMA TEST MENU/SELECTING YES

Step 12. Press the Start/Enter button to start the test.

- The instrument immediately determines if there is enough material in the feeder hopper to complete the test based on the 2 Sigma Test parameters selected. If there is not enough material in the hopper a message "NOT ENOUGH MATERIAL" appears. For continuous feed processes, wait until you think there is enough material in the feeder hopper then start the test. Keep in mind a valid test requires that there be no interruptions during the test cycle so plan accordingly. For batch processes make sure that the test parameters are selected so that the test finishes before the batch ends.
- If the Feeder is not running, a message appears "FEEDER MUST BE ON". Start the feeder then start the test.

Step 13. The last operating display appears. If you want to see the elapsed time of the test, click on the Display button until the 2 Sigma Running Display appears. (See Fig. 8-34)

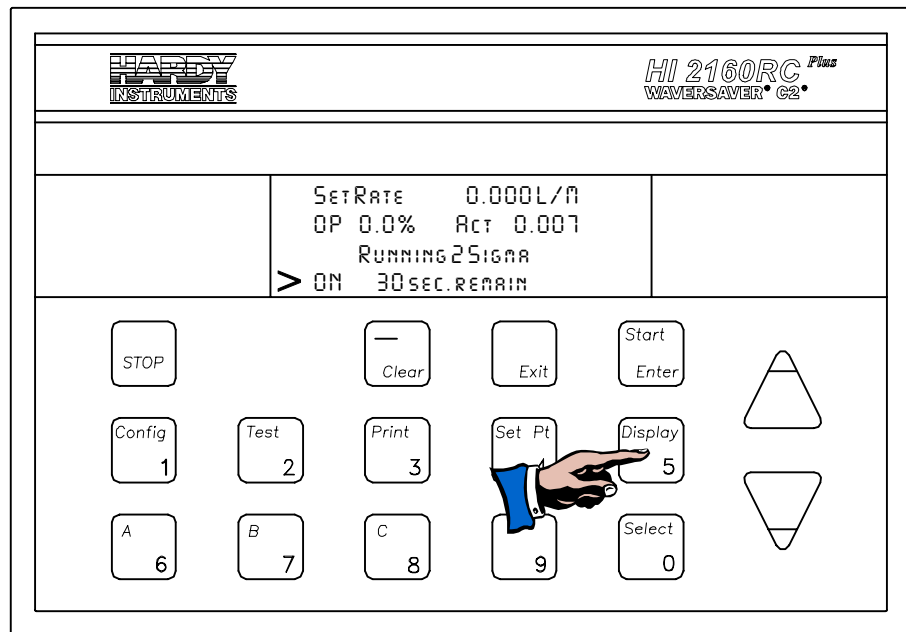


FIG. 8-34 SELECTING RUNNING 2 SIGMA DISPLAY

Sigma Data - About 2 Sigma Data

- 2 Sigma Data display allows the user to view the results of the 2 Sigma test. The 2 Sigma test value is expressed in percentage and indicates the repeatability accuracy of the feeder system. The accuracy will vary depending on the type of feeder.

- Step 1. Click on the 2/Test button. The Test Menu appears.
- Step 2. Press on the down arrow ↓ until the cursor is to the left of 2 Sigma Data. (See Fig. 8-35) The 2 Sigma Data Display appears. (See Fig. 8-36)
- Step 3. The 2 Sigma Test value indicates the repeatability accuracy of the feeder system under test.
- Step 4. The number of Samples for the test and the Period is the time in seconds between samples.
- Step 5. The Mean is the sum of all the selected sample values divided by the number of samples. This is displayed with the number of digits to the right of the decimal point that the unit has been set up for. The units (LBS) are also displayed. You can also select KGS for the test as well. The units are chosen in the calibration menu for the instrument being tested.
- Step 6. Time and Date Stamp. This is the time and date that the 2 Sigma Test was completed. This is based on the time & date entered in the time and date sub-menu.

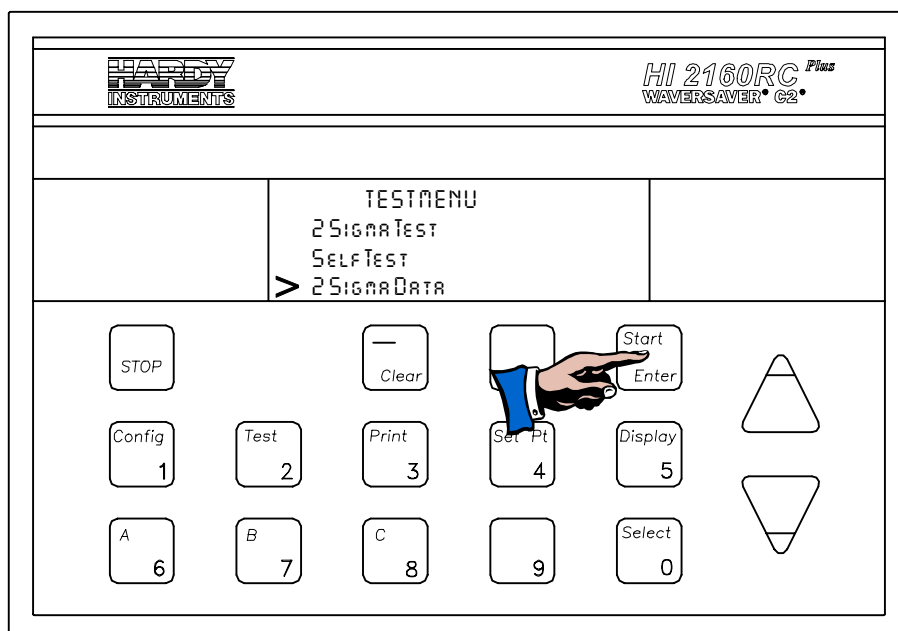


FIG. 8-35 SELECTING 2 SIGMA DATA

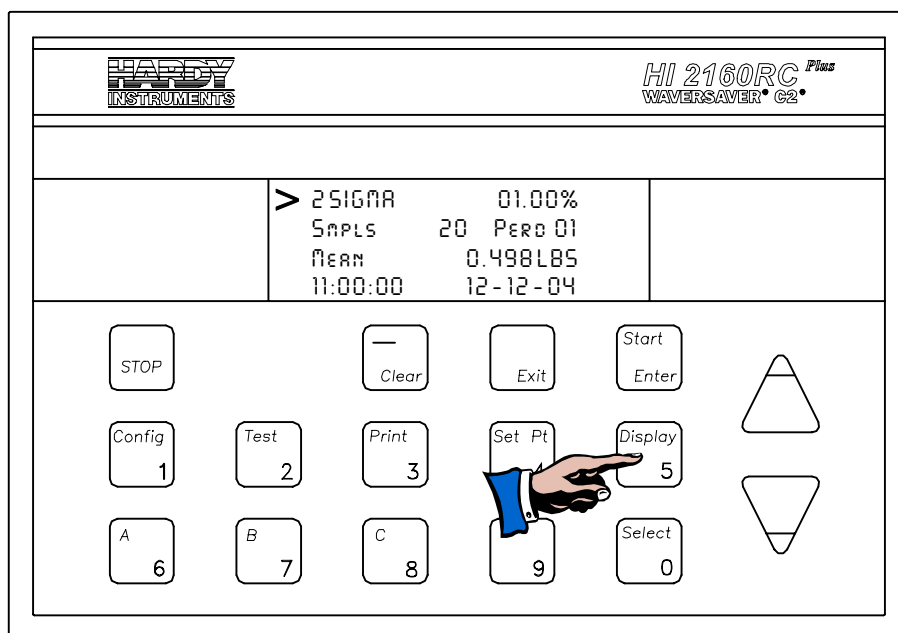


FIG. 8-36 2 SIGMA DATA DISPLAYED

- Step 7. To exit these displays press the Exit button.
- Step 8. The last Test Data is automatically stored in the Secure Memory Module and can be displayed on the front panel at any time.
- Step 9. To print the Test Data, press the Print button.

CHAPTER 9 - TROUBLESHOOTING AND REPAIR

About Chapter 9

Chapter 9 consists of all the procedures for troubleshooting and repairing the HI 2160RC^{PLUS} rate controller. It lists the cause and remedy for each of the troubles you may encounter. Adequate equipment is required to make repairs and a thorough understanding of the configuration, calibration, setup and operation is essential to diagnose improper operation. To make sure the HI 2160RC^{PLUS} rate controller is repaired correctly, all maintenance personnel should be familiar with the troubleshooting information before attempting any repairs.

Disassembly and Reassembly Notes & Cautions

- Disconnect the power cord before disassembling.
- Make sure that any disassembly is done in a clean, well ventilated, properly controlled static environment.
- Place all small fasteners, connectors and electrical parts in closed containers so as not to lose parts during reassembly.
- Read all the disassembly instructions before starting disassembly. Be sure that you are familiar with all the procedures. If any of the instructions for disassembly are unclear, contact: **Hardy Instruments Inc., Service Center for additional information and assistance.**
- Make sure that the proper tools are used when disassembling, reassembling or installing the HI 2160RC^{PLUS} or options.
- Check all external connectors first to be sure they are securely fastened before disassembling the controllers.
- Do not disconnect any electrical plug, connector or terminal unless an identification tag is present or one is attached. Always note where the connector or plug was attached to the electrical component or wiring harness.
- Always install complete hardware groups (Screws, Flat Washer, Lock Washers, Spacers, Etc.) back to the original point of removal.
- Always replace broken or damaged parts immediately!
- Always check to be sure that no loose parts are sitting on printed circuit boards or electrical connectors or wires when disassembling or reassembling.
- Always protect printed circuit boards from electrostatic discharge (ESD). Always use approved ESD wrist straps and anti-static pads when working with the printed circuit boards.
- Always store printed circuit boards in approved ESD bags.
- Always follow proper safety procedures when working on or around the HI 2160RC^{PLUS}.
- No special tools are required to repair the controller.
- Always check for loose wiring, connections or simple problems that might cause a malfunction first.
- Recommended thread lock compound: LocTite[®] 290

Start Up

TROUBLE	PROBABLE CAUSE	REMEDY
Unit does not power on.	Power cord is not connected.	Connect the power cord to the correct power source.
	Power cord is loose.	Reconnect the power cord to the rear panel of the HI 2160RC ^{PLUS} so that it is securely fastened.
	Power Source is incorrect or at Zero energy.	Check to see what power source is required for the unit. The voltage configurations are: 110 VAC - Single Phase 240 VAC - Single Phase Make sure that the proper voltage is being supplied. If the voltage of the power source is incorrect, change it to the correct voltage.
Operating Display does not appear.	Memory Failure	Contact Hardy Instruments, Service Center for assistance.
Operating Display appears but the information is not correct or the display itself appears not to be correct. The Key Pad still responds.	Memory Failure	Perform the Auto Clear Ram Memory Procedures in Chapter 8.

**Auto Clear Ram
Memory Procedures**

- Step 1. Press on the Config. button.
- Step 2. Enter the High security code number.
- Step 3. Press the Enter button. The Main Menu appears.
- Step 4. Press on the down arrow ↓ until the cursor is to the left of the Security sub menu.
- Step 5. Press on the Enter button. The Security sub menu appears.
- Step 6. Press on the down arrow ↓ until the cursor is to the left of the LOW CODE selection.
- Step 7. Press the clear button to clear the entry.
- Step 8. Use the numeric keys and enter the number "7321".
- Step 9. Press the Enter button. This returns all settings to their default settings. The controller resets and goes to the Operational Display.
- Step 10. Restore the data from the Secure Memory Module (SMM). (See Chapter 6, for Tuning and Control instructions)

System Troubleshooting

Drift

TROUBLE	PROBABLE CAUSE	REMEDY
Drift Weight Indications	1. Load Cell causing the problem. 2. Internal software or hardware problem	Install a Resistor Shunt Bridge to determine if external or internal problem. See Chapter 8 for instructions.

Checking if Drift Problem is Internal or External

- Step 1. Disconnect the power cord from the power source.
- Step 2. Disconnect the load cell connector at the rear panel.
- Step 3. Install a Resistor Shunt Bridge. (See Fig. 9-1)

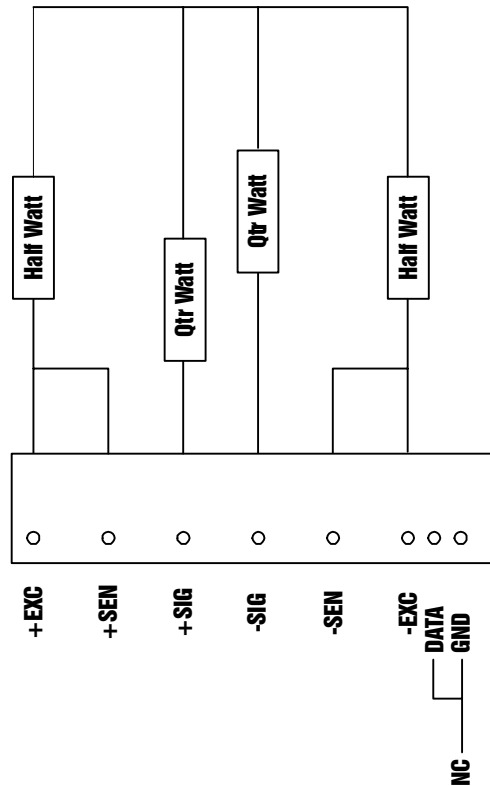


FIG. 9-1 RESISTOR SHUNT BRIDGE DIAGRAM

NOTE:

Use four resistors of the same value. Resistance between 120 and 350 ohms.

- Step 4. Connect the power cord to the power source.
- Step 5. Wait 5 minutes.
- Step 6. Check for stability.

Result 1. If the weight still drifts, the problem is internal. Contact your local representative or call Hardy Customer Service for assistance.

Result 2. If the weight is stable, the problem is external. Check your load cell manual troubleshooting section or contact the Hardy Service Center for assistance.

NOTE:

When checking multiple load cells, disconnect all the load cell signal outputs from the summing box and check them one at a time.

System Lock Ups

- Shielding for EMI (Electro-Mechanical Interference) & RFI (Radio Frequency Interference).

TROUBLE	PROBABLE CAUSE	REMEDY
System will not function, erratic weight read outs, memory corruption, large fluctuation in status readouts.	<ol style="list-style-type: none"> 1. Load cell cable shields are not grounded at the controller. 2. Load cell shields are grounded at the summing box 	<ol style="list-style-type: none"> 1. Use an ohm meter and check to see if the shield is grounded only at the controller. 2. Disconnect the shield at the controller and check for an open circuit toward the load-cells. 1. Check to see that the shield is not connected to ground at the summing box. (See Chapter 2 for wiring diagrams) 2. Load cell cable shields only pass through the summing boxes and are not connected to ground at that point.

TROUBLE	PROBABLE CAUSE	REMEDY
System will not function, erratic weight read outs, memory corruption, large fluctuation in status readouts.	<ol style="list-style-type: none"> 1. Ground by-pass straps are not installed around the load cells. 	<ol style="list-style-type: none"> 1. Attach flexible braided cables from just above to just below the load cell. 2. This provides a path of least resistance for static & EMI/RFI noise to ground.

- Moisture in Cabling or Load Cell

TROUBLE	PROBABLE CAUSE	REMEDY
Intermittent malfunction of the controller, erratic weight readouts	Moisture in load cell cable. Moisture sets up stray capacitance charges in cables and causes ground currents.	Replace the cable and load cell immediately.

- Improper Cable Routing

TROUBLE	PROBABLE CAUSE	REMEDY
Controller locks up. Instability in readouts and performance of the rate controller.	Low Voltage Cable, (Load Cell Cable, Serial Port Cable, Analog Output Cable, Remote Function Cable) located too close to a high voltage cable, strong electro-magnetic field, Silicon Control Rectifiers (SCR), motor control or relay bank.	<ol style="list-style-type: none"> Relocate the low voltage and/or high voltage cable so that there is a minimum of 3 inches separation between the low voltage cable and the high voltage cable. Increase the separation between the low voltage cable and a high electro-magnetic field. Move the cable until the problem goes away. Relocate the cable so that the cable is a minimum of 14 inches from SCRs, Motor Controls, and Relay Banks. Use a premium Load Cell cable (8 conductor) with heavy shielding.

- Troubleshooting with a Simple Ground Test.

Step 1. Apply a static charge to the vessel or cabling.

Step 2. Check the weight reading. The weight reading should not vary.

Result 1. If the reading changes radically, or the controller locks up, the grounding is not correct.

Result 2. If the reading does not change the grounding is not the problem.

- Power Spikes

TROUBLE	PROBABLE CAUSE	REMEDY
Controller locks up or memory is corrupted.	Power Spikes	Controller should be isolated from power spikes. Provide computer clean power. (See Chapter 2 for instructions)

- Power Surges

TROUBLE	PROBABLE CAUSE	REMEDY
Controller locks up or memory is corrupted.	Power Surge. Noise produced by relays	Install surge suppression. The solenoids operated by the internal relays of the controller must be fitted with surge suppression. A resistor and a capacitor across the coil of the solenoid prevents a sudden surge of current when the relay energizes. (See Fig. 9-2)

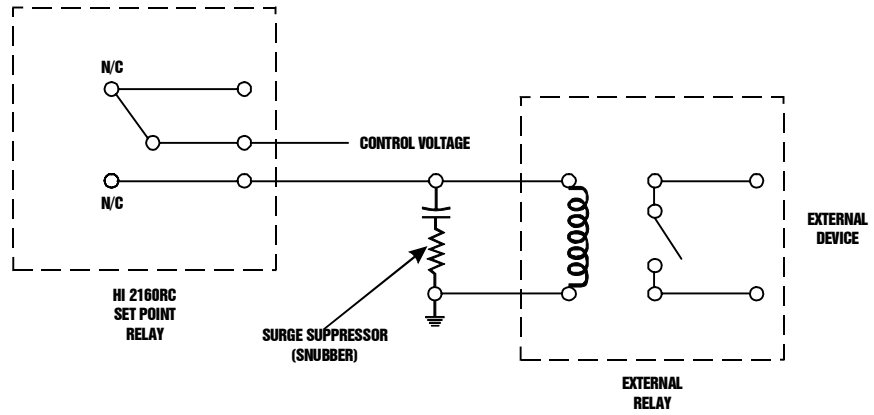


FIG. 9-2 SURGE SUPPRESSION RESISTIVE/CAPACITIVE CIRCUIT PRT.
#4802-0002

- Power Brown Outs or Black Outs

TROUBLE	PROBABLE CAUSE	REMEDY
1. Loss of Memory	Frequent Power brown outs/black outs	1. Restore data from the Secure Memory Module. (See Chapter 3 for installation instructions) (See Chapter 5 for Memory Restore instructions.
2. Controller locks up or very erratic controller performance		2. Install a power surge suppressor. (See Chapter 6 for instructions)

- Weight Readings are Unstable, Modulate Excessively

TROUBLE	PROBABLE CAUSE	REMEDY
Weights continuously modulate up and down.	Excessive vibration in the process facility.	Set WAVERSAVER to W4 or adjust until you reach stable weight readings (See Chapter 3 for instructions)

Weights Displayed are Incorrect

After Calibration Display Weight Reading is Incorrect

TROUBLE	PROBABLE CAUSE	REMEDY
The Weight Display indicates zero with a weight on the scale. The Weight Indication does not change.	Input from the Load Cell is negative. Load cell correct input should always be between 0 and +30 mV DC.	Check the current counts. Measure pins 3 & 4 for the millivolt load cell output.

- Checking the Current Count

Step 1. Push the Test Button on the Front Panel. The Test Sub-menu appears.

Step 2. Press the down arrow ↓ until the cursor is to the left of the current count (Current Ct.) sub-menu. (See Fig. 9-3)

Result 1. If the Current Count is correct, contact your local representative or Hardy Instruments, Service Center for assistance.

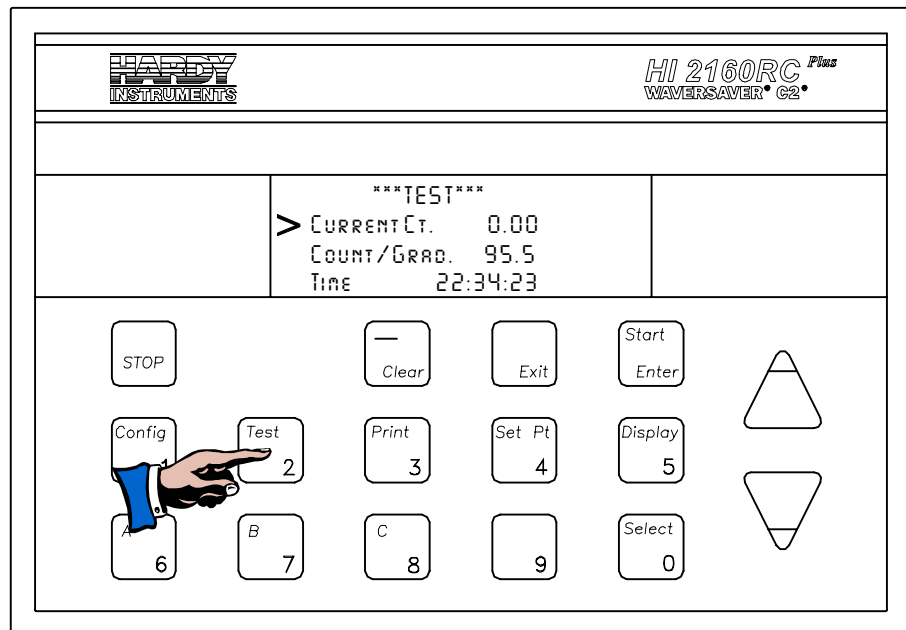


FIG. 9-3 TEST SUB-MENU/CHECKING CURRENT COUNT

Result 2. If the Current Count is zero, the input from the load cell may be negative. Go onto to Step Four.

Step 3. Check to see if the load cell wiring is correct. Check to see that the load cell wiring is not loose or that the connector at the rear panel is not loose.

NOTE:

When checking multiple load cells, disconnect all the load cell signal outputs from the summing box and check them one at a time.

- If the wiring is not correct for the application make the correction.
- If there is a loose connection, make sure the connector is plugged in correctly or replace the connector.

Step 4. Use a volt meter and check the voltage between +SIG and -SIG on the load cell connector. (See Fig. 8-4)

Result 1. If the volt meter reads between 0 and +30mVDC the load cell voltage is in range go onto Step Six.

Result 2. If the volt meter does not read between 0 and +30mVDC the problem is external to the HI 2160RC^{PLUS}. Check the load cells and cables. Check your load cell manual for troubleshooting information.

Step 5. With the volt meter probes in place, add or subtract weight from the feeder. The volt reading should go up if you add weight or down if you subtract weight.

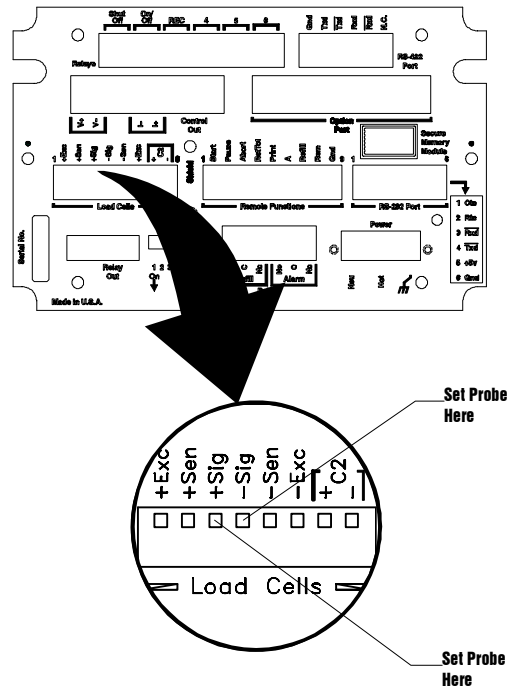


FIG. 9-4 USING A VOLTMETER TO CHECK LOAD CELL VOLTAGE

- Result 1. If the voltage fluctuates with the weight the problem is external.
- Result 2. If the voltage does not fluctuate with the weight, call your local representative or Hardy Instruments, Inc., Customer Support Department.

Feeder Motor Won't Start

TROUBLE	PROBABLE CAUSE	REMEDY
When pushing the Start button it does not activate the motor controller (Analog Control) on the feeder.	<ol style="list-style-type: none"> 1. Wiring to Analog Control Connector is incorrect. 2. Output configuration jumpers are not set correctly for the feed back signal. 3. Feeder motor malfunction. 	<ol style="list-style-type: none"> 1. Check the wiring to the Control Output connector: (See Fig. 9-5) For Jumper Settings See Chapter 4) Pin 1 = +Voltage Pin 2 = -Voltage Pin 5 = -Current Pin 6 = +Current 2. Check the jumper settings on the Control Output board. (Prt. #0535-0406) (See Fig. 9-6) 3. Switch the controller to manual operating mode. (See Chapter 7 for instructions)

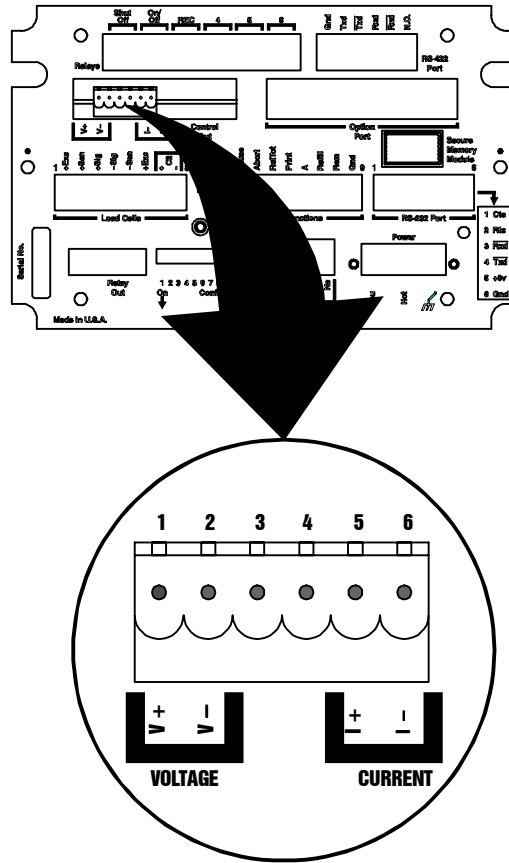


FIG. 9-5 CONNECTOR WIRING DIAGRAM FOR CONTROL OUTPUT CARD

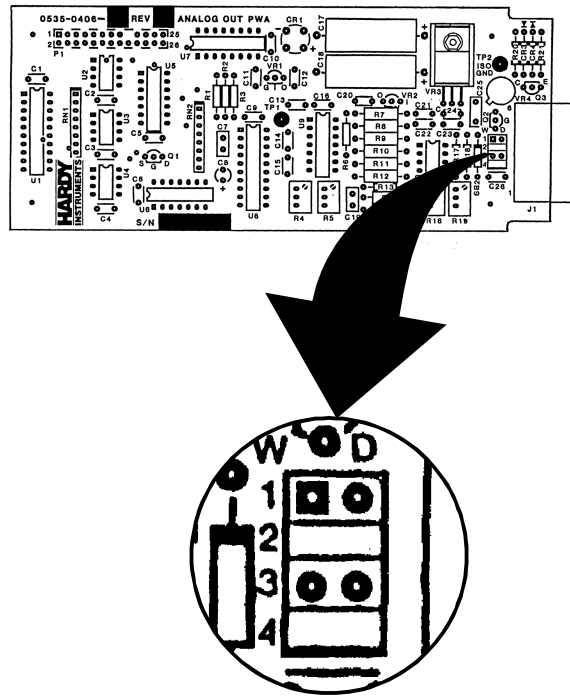


FIG. 9-6 JUMPER SETTINGS FOR CONTROL OUTPUT CARD

TROUBLE	PROBABLE CAUSE	REMEDY
When pushing the Start button it does not activate the motor controller (Analog Control) on the feeder.	4. Batch Set Point Amount is set too low.	4. Raise the Batch Set Point Amount Setting. If the batch set point is too low the instrument does not have time to see it and thinks it has already met or exceeded the condition. (See Chapter 7 for instructions.
	5. Control Out HI (%) is set too low. "NOT ALLOWED" statement appears, preventing the feeder motor from starting.	5. Raise the Control Out HI (%). the CTL Out HI (%) setting is located in the Tuning/control Sub-Menu. (See Chapter 5 for instructions)

Erratic Actual Rate Readings

TROUBLE	PROBABLE CAUSE	REMEDY
Erratic Actual (Act.) Readings	<ol style="list-style-type: none"> 1. Time base or Averages setting is incorrect either too high or too low. 2. Tuning and Control parameters are not correct. 3. Counts/Grad (counts per displayed graduation) set too low. 4. Improper or incorrect Rate Calibration 	<ol style="list-style-type: none"> 1. Change the Time base or Averages until the readings are correct and stable. (See Chapter 5 for instructions) 2. Change the Tuning and Control parameters until the readings are accurate and stable. (See Chapter 5 for instructions) 3. The larger the Counts/Grad the stabler the display. Change the load cell to a capacity closer to the weight of a fully loaded feeder or use a counter balance scale to increase the live load counts. 4. Re-Accept Rate CAL parameters or Rerun the Rate Calibration.

Rate Exception Control (REC) Alarm Appears too Often

TROUBLE	PROBABLE CAUSE	REMEDY
Rate Exception Alarm appears too often.	<ol style="list-style-type: none"> 1. Rate Calibration Error. 2. REC level too small or too large. 3. Averages or Time Base settings too long or too short. 4. Mechanical Problems with the scale which is disturbing the weight reading. (e.g. binding on the system) 5. Poor Rate Calibration. 	<ol style="list-style-type: none"> 1. Run or check the Rate Calibration. 2. Adjust the REC level. 3. Adjust the Averages or Time Base settings until the problem stops. 4. Physically check the system for mechanical disturbances that might disturb the weight readings. 5. Re-do the Rate Calibration. (See Chapter 5 for instructions)

**Readings on the Display
are Not Correct**

TROUBLE	PROBABLE CAUSE	REMEDY
Readings are not correct.	Improper Setup/Calibration	<p>Press the "Test" button to display the following data:</p> <ol style="list-style-type: none"> 1. Firmware 2. Revision 3. Check Sum 4. Zero Count 5. Span Count 6. Span Weight 7. Current Count 8. Count/Grad 9. Time 10. Date 11. Rear Dip Switch 12. Internal Dip Switch 13. Relay Status 14. WAVERSAVER Status <p>Review the data and correct the incorrect setting(s). If several of the parameters are incorrect, recalibrate the instrument, and go through the Setup procedures again.</p>

Remote Setpoint Input Card

TROUBLE	PROBABLE CAUSE	REMEDY
<p>System slow to change or reach requested speed.</p>	<ol style="list-style-type: none"> 1. The Setpoint low (SPL) and Setpoint high (SPH) are set too broad. 2. The REC setting may be too small. 	<ol style="list-style-type: none"> 1. Bracket the typical run rate with the SPL and SPH. 2. This gives control in the normal run range and allows a fast change during startup and abnormal flow rates. 1. A larger REC setting allows a larger correction in motor speed. this also reduces control during refill and rate expectation. Finding the balance is a matter of trial and error: <ol style="list-style-type: none"> a. If the typical range is 25 to 30/min and that correlates to an output percentage of 35 to 50%. This would be a variation of 15%. b. The REC level should be set to 1.5. This allows an OP% change allowance of the 15% within the acceptable gravimetric feed range. c. Changes that require more than 15% motor out speed change within one timebase will be subjected to being locked in REC and not change. d. The registers will need to be reset and filled with the new rate information. This can be done by pressing the Enter button, or have a large REC value, or slower changes.

TROUBLE	PROBABLE CAUSE	REMEDY
The feeder does not shut off completely at 4mA, or zero level.	The Rate Calibration slope is subject to the ability for the material to move at a given rate. If it requires more energy to move the material at a low motor speed than at a high motor speed. The zero point will not pass through zero and have a positive feed rate at zero feed rate. If the material tuns easier at the low rate, the controller will have a negative feed rate at zero and will not feed material at the low signal level.	<ol style="list-style-type: none"> 1. Since the feed rate slope insures that material is flowing as requested, the stopping and starting of the feed control must be controlled. 2. This can be done via RIO or PROFIBUS communication commands or using the remote input connections. <ol style="list-style-type: none"> a. The input connector is located on the rear panel of the controller. b. The connection must be a dry contact between the action and the ground pin (#9). c. The start is a momentary contact of approximately 500 ms. This allows the stop button on the key pad to stop the process. d. The abort (stop) can be held to insure there will not be any unauthorized starts using the key pad. e. The cable length must be a twisted pair shielded cable less than 60" inches in length and routed away from high voltage.

Allen-Bradley RIO error codes for C2 Calibration

- 07 = C2 LC count did not match # read.
- 17 = C2 Reference point < 0 or > scale capacity.
- 93 = No C2 load sensors found.
- 94 = The load sensor capacities or sensitivities did not match.
- 95 = C2 check sum failure.
- 96 =Current decimal point location is to far to the left for the current C2 range value.

Allen-Bradley RIO Error Codes for Rate Calibration

- 73 =Low% High%
- 74 =High rate cal% out of range
- 75 =Low rate cal High rate cal
- 76 = High rate cal value out of range
- 77 =Negative values not allowed
- 78 =System must be OFF to run auto rate calibration.

PROFIBUS Error Codes for C2 Calibration

- 07 = C2 LC count did not match number of cells.
- 17 = C2 Reference point < 0 or greater than scale capacity.
- 93 = No C2 load sensors found.
- 94 = The load sensor capacities or sensitivities did not match.

95 = C2 check sum failure.
 96 =Current decimal points for the C2 value.

**PROFIBUS Error Codes
 for Rate Calibration**

73 =Low rate Calibration percentage High percentage
 74 =High rate Calibration percentage out of range
 75 =Low rate cal High rate cal
 76 = High rate Calibration percentage out of range
 77 =Negative values not allowed
 78 =Feed Time out of range

**HI 2160RC^{PLUS} Error
 Messages**

NOTE:

These messages appear in the display when an error occurs.

MESSAGE	SUB-MENU	DESCRIPTION
!!MOTION!!	CALIBRATION	1. Scale is in motion while entering the Zero or Span Value. 2. Zero or Span value is trying to be entered before the controller has accumulated and averaged 200 readings. When calibrating the scale, feeder and agitator motors must be off and you must wait at least 12 seconds before entering Zero and Span. 3. Remove the source of the scale motion and then re-calibrate Zero and Span. 4. Too many decimal points selected.
MAXIMUM = 100	TUNING/CONTROL	Control output HI (%) or Control Output LO (%) value was more than 100%. Enter a value of 100% or lower.
MAXIMUM = 200	TUNING/CONTROL	Value entered for Averages was more than 200. Enter a value of 200 or lower.
MAXIMUM = 999	TUNING/CONTROL	Value entered for Timebase was more than 999. Enter a value of 999 or lower.

MESSAGE	SUB-MENU	DESCRIPTION
!!NOT ALLOWED!!	RATE TOLERANCE	<ol style="list-style-type: none"> 1. A minus (-) value has been entered as the LO ALARM, HI ALARM, LO SHUTOFF or HIGH SHUTOFF. Press the Clear button to indicate a positive (+) value. 2. The value entered for SHUTOFF OUT (%) is more than 100. Enter a value between 0 and 100.
	TIME/DATE	<p>An invalid entry in the Time and Date has been entered. Time and Date format is:</p> <p>Time: HH:MM:SS (H=hours, M=minutes, S=Seconds) Date: MM/DD?YY (M=month, D=Day, Y=Year)</p>
	AUTO REFILL	<ol style="list-style-type: none"> 1. A minus (-) value has been entered as the START (LO), STOP (HI), SHUTOFF (LO), or SHUTOFF (HI). Press the Clear button to indicate a positive (+) value. 2. HI SHUTOFF value is less than the STOP (HI) value. The LO SHUTOFF value must be less than the START (LO) value.
	RATE CALIBRATION	<ol style="list-style-type: none"> 1. The value entered for LO RATE CAL% is higher than the existing HI RATE CAL% value. 2. The value entered for the HI RATE CAL% is lower than the existing LO RATE CAL% value. Enter the other RATE CAL% first depending on which parameter is incorrect.
	REMOTE SET POINT	<ol style="list-style-type: none"> 1. A minus (-) value has been entered as the LO or HI value. Press the Clear button to indicate a positive (+) value. 2. LO value is greater than the HI value. Enter a LO value that is less than the HI value. 3. Value entered for Averages was less than one (1) or more than twenty (20). Enter a value between 1 and 20.
!! RATE TOO LOW!!	RATE SET POINT	<p>Value entered for RATE too low resulting in a negative rate of flow or NEGATIVE OP%.</p> <ol style="list-style-type: none"> 1. Enter a larger value for RATE. 2. Perform a Rate Calibration at LOWER OP% rates in order to get a better slope at the lower end. <p>1. The unit has a capability of a 10 to 1 turn-down for rate speeds. Avoid trying to control higher turndown ratios.</p>
SYSTEM MUST BE OFF	CALIBRATION	The rate controller batch must be STOPPED, as indicated by the "OFF" displayed on the bottom left part of the display.
RATE EXCEPTION ALARM	TUNING/CONTROL	<p>The Rate Exception Control mode was entered during a batch for the entire duration of the REC Time set in the Tuning/Control Menu.</p> <p>Possible Causes:</p> <ol style="list-style-type: none"> 1. The scale or feeder had been bumped. 2. See "Possible Causes" for HI RATE ALARM.

MESSAGE	SUB-MENU	DESCRIPTION
LO RATE ALARM	RATE TOLERANCE	The rate of flow dropped below the LO ALARM setting in the RATE TOL. menu for the specified "ALARM TIME". Possible Causes: <ol style="list-style-type: none"> 1. Out of material in the feeder. 2. Faulty auger motor (frozen). 3. Binding scale or feeder (no change in weight). 4. Bridging material. 5. Change in consistency of material (got thicker or chunks blocked path) 6. Damaged auger (rod broken) 7. Analog control output faulty. 8. Weight applied to scale.
HI RATE ALARM	RATE TOLERANCE	The rate of flow rose above the "HI ALARM" setting in the RATE TOL. menu for the specified "ALARM TIME". Possible Causes: <ol style="list-style-type: none"> 1. Faulty auger motor (too fast) 2. Result of bridge material release 3. Change in consistency of material 4. Analog control output faulty 5. Weight removed from scale.
LO SHUTOFF ALARM	RATE TOLERANCE	The rate of flow dropped above the "LO SHUTOFF" setting in the "RATE TOL." menu causing the analog control output to be forced to the "SHUTOFF OUTPUT" setting. (See "Possible Cause" for LO RATE ALARM)
HI SHUTOFF ALARM	RATE TOLERANCE	The rate of flow dropped below the "HI SHUTOFF" setting in the "RATE TOL." menu causing the analog control output to be forced to the "SHUTOFF OUTPUT" setting. (See "Possible Cause" for HI RATE ALARM)
BATCH TOLR ALARM	BATCH TOLERANCE	S2 on the MAIN POWER 7 RELAY board has Switch #1 turned on without an ANALOG INPUT option board installed. Switch #1 should be OFF if there is an ANALOG INPUT Option board installed.

Operational Display Messages

MESSAGE	DESCRIPTION
AIN <----->	Analog Input Error Possible Causes: Timebase Setting is too low, it needs to be increased.
REFILL LO SHUTOFF	A refill did not occur when the AUTO REFILL "START" set point was reached. Possible Causes: <ol style="list-style-type: none"> 1. Faulty refill gates and solenoids. 2. Bridging at the refill gate. 3. Faulty AUTO REFILL START relay. 4. Faulty output relay connection or wires. 5. Out of material in refill silo.

MESSAGE	DESCRIPTION
REFILL HI SHUTOFF	<p>A refill did not stop when the AUTO REFILL "STOP" set point was reached. (Refill will continue in that instance)</p> <p>Possible Causes:</p> <ol style="list-style-type: none">1. Faulty refill gates and solenoid.2. Faulty AUTO REFILL "STOP" relay.3. Faulty output relay connections or wires.

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SYSTEM DATA WORKSHEETS

To: Hardy Instruments Inc. From: _____

ATTN: Hardy Service Center Company _____

FAX No. (858) 278-6700 Date: _____

When the HI 2160RC^{PLUS} is processing to your specifications, record all parameters on the following pages. Retain a copy and store in a convenient location that is safe and secure. Documenting the performance parameters creates a hard copy backup. The hard copy is very convenient in the event that replacement of the controller with a spare is necessary or when you require assistance by our local representative or Hardy Instruments Inc., Customer Support Department.

Date of Installation: _____ Model # _____ S/N _____

SELF-TEST PROGRAM RESULTS

(Perform Self Test by Press the Test Button)

Parameter	Example	1	2	3
Firmware	0650-0045			
Revision	B			
Checksum	OB OB PASS			
Zero Count	36780			
Span Count	992000			
Span Weight	10.00			
Current Count	484688			
Count/Grad	95.52			
Time	00:00:15			
Date	00-00-00			
REAR SW	00000000			
INT. SW.	00000000			
REMOTE	00000000			
RELAYS	00000000			
WAVERSAVER®	4			

Scale Make/Model No: _____ mV/V Rating: _____

Feeder Make/Model No: _____ Max. Feed Rate: _____

NOTE: Parameters in UPPER-CASE require numeric inputs, lower case use the SELECT button.

Tuning/Control Menu

Parameter	Default Values	1	2	3
TIMEBASE (SEC)	4			
K(INTEGRAL)	26			
K(PROPORTIONAL)	210			
K(DERIVATIVE)	52			
CTL OUT LO (%)	0			
CTL OUT HI (%)	52			
AVRG. (1-200)	1			
REC LEVEL	0.0			
REC TIME (Sec.)	30			
REC Shutoff	00-00-00			
REAR SW	No			
Pre-Act. Corr..	32			

Rate Tolerances Menu

Parameter	Default Values	1	2	3
LO ALARM	0.020 Lbs/Min			
HI ALARM	0.020 Lbs/Min			
ALARM TIME (Sec.)	60			
LO SHUTOFF	0.100 Lbs/Min			
HI SHUTOFF	25.00 Lbs/Min			
SHUTOFF OUT (%)	0			

Auto Refill Menu

Parameter	Default Values	1	2	3
AUTO REFILL	NO			
START (LO)	2.000 Lbs			
STOP (HI)	40.000 Lbs			
LO SHUTOFF	1.000 Lbs			
HI SHUTOFF	50.000 Lbs			
INITIAL FILL	YES			
RFL CORR.	0.0			

Calibration Menu

Parameter	Default Values	1	2	3
Mass Units	LBS			
Time Units	MIN			
Rate Decimal Pt.	3			
Batch Decimal Pt.	3			
Total Decimal Pt.	1			
ZERO	No Value			
SPAN	10.000 Lbs			
Graduation	0.001			

Rate Calibration Menu

Parameter	Default Values	1	2	3
LO RATE CAL%	20.0			
LOW (L/M)	0.300			
HI RATE CAL%	80.0			
HIGH (L/M)	1.700			

Serial Port #1

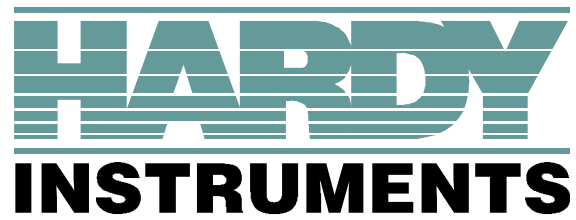
Parameter	Default Values	1	2	3
Configuration	PRINTER			
Baud Rate	1200			
Parity	NONE			
Stop Bits	One			
Data Length	Eight			
ADDRESS	0			

Remote Set Point Menu

Parameter	Default Values	1	2	3
PERCENTAGE	% 0.0			
LO	0.000 Lbs/Min			
HI	3.000 Lbs/Min			
AVERAGES (1-20)	20			
SPL	1.000 Lbs/Min			
SPH	2.000 Lbs/Min			

Security Menu

Parameter	Default Values	1	2	3
Tuning/Control	LOW			
Rate Tolerance	LOW			
Analog Output	LOW			
Time and Date	LOW			
Auto Refill	LOW			
Calibration	LOW			
Serial Port #1	LOW			
Remote Setpoint	LOW			
Clear Alarms	LOW			
Start	LOW			
Setpoints	LOW			
Clear Total	LOW			
Rate Calibration	LOW			
LOW CODE	****			
MED CODE	****			
HI CODE	****			



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