HI 2151/20WC
Weight Controller

OPERATION AND INSTALLATION MANUAL

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PREFACE

Read all safety, installation and operating instructions before the unit is operated. Warnings and cautions indicate possible hazards that may result in injury. Follow all instructions and retain the manual for future reference.

NOTE

All specifications herein are for the unit only. Our instrument is UL recognized. Please be advised the NEMA 4 waterproof front panel has not yet been tested by UL, but should be completed in the near future.

CAUTION

This unit contains components sensitive to damage by Electrostatic Discharge (static electricity). Electrostatic Discharge (ESD) precautions are recommended when removing the instrument chassis from the enclosure (i.e., wear an ESD wrist strap connected to ground, ESD protective apparel, and/or have grounded work stations).

Dangerous voltage is present within the enclosure of the unit and presents the risk of electrical shock. ALWAYS unplug the unit before opening it for servicing. Installation and servicing of this unit should be performed by authorized and qualified service personnel only.

PROPRIETARY NOTICE

PATENT PENDING

WAVERSAVER® is a registered trade mark symbol of Hardy Instruments, Inc.

SECTION 1

INTRODUCTION

1.1 HOW TO USE THIS MANUAL

This manual provides operational and installation instructions for the HI 2151/20 Weight Controller with WAVERSAVER® (see Figure 1-1 HI 2151/20 Weight Controller). The manual is divided into six sections as follows:

Section 1 provides an introduction to the instrument, as well as an overview of the equipment and its capabilities.

Section 2 contains information needed to install your new unit and bring it to a power on condition.

Section 3 covers calibration procedures. Quick Calibration instructions are also provided for fast setup and periodic re-calibration.

Section 4 explains the configuration, serial communication, hardware configuration and options.

Section 5 guides you through troubleshooting and maintenance for the unit.

Section 6 contains Appendices A through F. The appendices include quick references such as keypad, dipswitch and remote function definitions, as well as system data survey sheets, display messages, error messages, NTEP operation specifications, and glossary of terms.

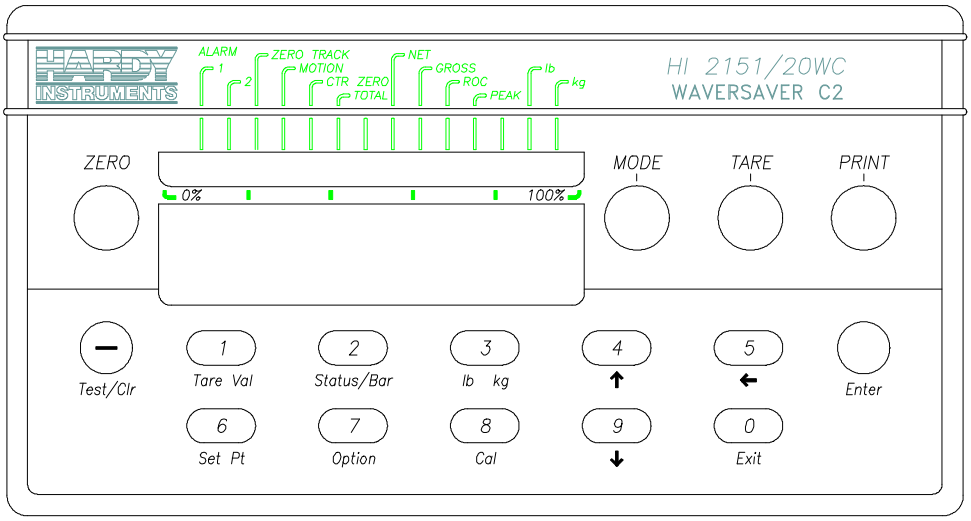


Figure 1-1. Hardy Instruments' HI 2151/20 Weight Controller

1.2 EQUIPMENT OVERVIEW

The Hardy Instruments HI 2151/20WC with WAVERSAVER® is a multipurpose, microprocessor based weight converter/controller. Able to perform precise weight measurement even in environments with vibration, the HI 2151/20WC's exclusive WAVERSAVER® quickly rejects noise with frequencies above 0.25 Hz. Response time for stable readings is less than one second. For frequencies above 7.5 Hz, the response time is even faster.

In addition, the HI 2151/20WC provides 985,000 displayed counts of resolution and accepts millivolt signals of up to 30 millivolts from up to eight strain gage load cells/points for display and process control by weight. The unit can also convert the millivolt-level load cell/point signal to an optional 4 to 20 mA, 0 to 20 mA, 0 to 10 or 0 to 5 Vdc analog signal providing noise immune transmission of weight, or to an optional Binary Coded Decimal (BCD) format for parallel communication.

The HI 2151/20WC digitizes the the load cell/point signals for indication on its front panel, six-digit, light emitting diode (LED) display and 30 segment bar graph. The bar graph can be set to display either instrument status or an optional bar graph representation of one of five weight parameters. Common language prompts lead you through the entire operation and calibration of the instrument. Data is entered using the front panel keypad, which features a definite tactile feel for positive operator control. In addition, parts of the keyboard can be locked to limit operator access and protect data.

Data is also protected with the HI 2151/20WC's unique Secure Memory Module (SMM). The SMM stores and protects critical information from corruption such as calibration data, configuration of the setpoints, the standard RS-232C serial port, and various options. All data except for Peak Hold is stored automatically. In addition, data stored in one HI 2151/20WC may be restored in another by simply transferring the Secure Memory Module.

C2™ Second Generation Calibration allows a scale system to be quickly calibrated on site without the use of test weights, material substitution, or force calibration.

The HI 2151/20WC can be used in a multitude of industrial and commercial applications requiring weight, level, or mass flow data. It can be used as a stand-alone unit or may be integrated into a process control system by utilizing an extensive serial command set. The instrument provides bi-directional communication over its standard RS-232C port or, optionally, over RS-232C or RS-422/485 serial ports (with the purchase of option boards). Multiple instruments (in RS-422 "multidrop" configuration) may be accessed from a host computer, Programmable Logic Controller (PLC), or any other controlling computer.

Under license from Allen-Bradley, Hardy Instruments Inc. has developed a remote I/O Interface for the HI 2151/20 weight controller. Each weight controller represents a quarter (1/4) rack of the PLC and supports both discrete I/O and block transfers.

GENERAL SPECIFICATIONS

Table 1-1. Specifications

Analog Section	
Conversion Rate:	100 updates per second
Resolution (displayed):	1:985,000 (for 3 mv/v) 1:656,000 (for 2 mv/v)
(internal):	1:1,048,576
Averages:	1 to 200 selectable in increments of 1
Display Increments: (graduations)	1, 2, 5, 10, 20, 50, 100, 200, 500 counts selectable by keyboard. Corresponding weight is dependent on decimal point location.
Non-Linearity:	0.0015% of Full Scale
Common Mode Voltage Range:	+/- 2.5 Vdc
Temperature Coefficient:	less than 0.0005% per degree C for zero and span
Temperature Range:	-10° to 50°C (14° to 122°F)
Storage Temperature Range:	-20° to 85°C (-4° to 185°F)
Inputs	
Power:	120 or 240 VAC +/- 10% 10 watts maximum with options installed from 47-63 Hz. 240 VAC operation requires factory installed jumpers on the Power board.
Load Cells/points:	Up to eight 350 ohm load cells/points at 10 volt excitation. (Maximum input = 31 mvdc.)
Physical Characteristics	
Panel Mount	
Enclosure Rating:	None: Front Panel Bezel Nema 4
Depth:	10" (254 mm)
Panel Cutout:	3.09" x 5.75" (78.4 x 146 mm)
Weight:	4.5 lbs (2.1 kg)
Wall Mount	
Enclosure Rating:	NEMA 4X (stainless steel)
Dimensions:	14.25"H x 12.25"W x 6.00"D 361.95H x 311.15W x 152.4D (mm)
Weight:	19.8 lbs (9 kg)

SYSTEM BLOCK DIAGRAM

Refer to Figure 1-2 for standard setup.

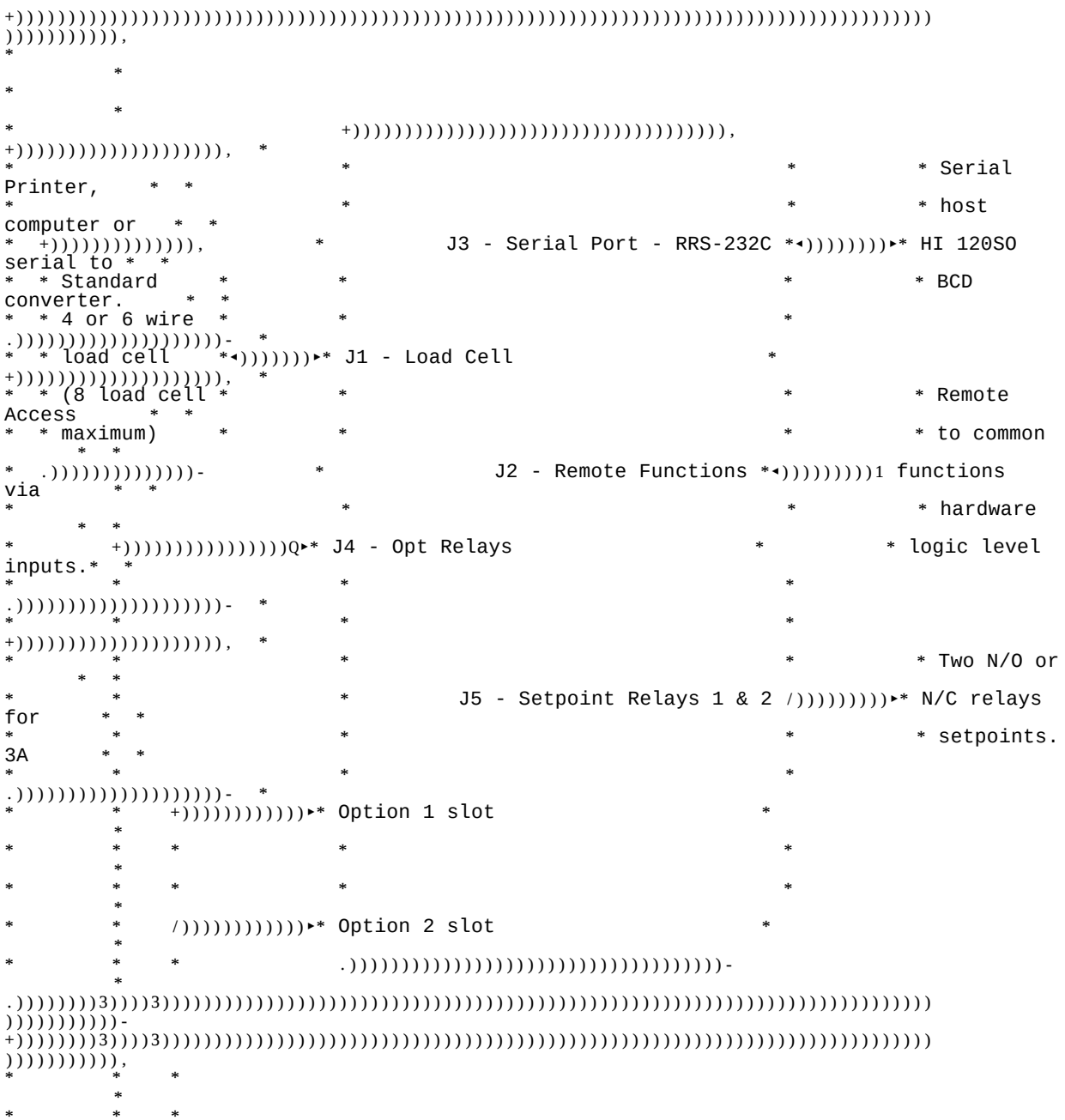


Figure 1-2. HI 2151/20WC Standard and Optional Configurations

1.3 STANDARD FEATURES AND OPTIONS

The basic HI 2151/20WC incorporates many quality features as standard, plus it offers a wide assortment of hardware and software options to accommodate various types of process weighing applications.

The configuration of your unit and options furnished with it (if ordered) are depicted by the model number on the label on the top of the enclosure. The features, options, and model numbers are explained below:

Standard Features

The basic weight controller, Model HI 2151/20WC, is provided with the following as standard features:

- Six digit display, 1:985,000 display resolution
- Display type: 0.6" seven segment red LED
- WAVERSAVER®
- Secure Memory Module (SMM)
- C2™ Second Generation Calibration
- 3 modes of Calibration, C2®, Soft, Hard
- Update rate: 20 readings per second
- Gross or net modes of operation
- Menu driven digital calibration
- Front panel diagnostics
- Averages of up to 200 readings in 1 unit increments
- Powers up to eight 350 ohm strain gage load cells/points
- Auto zero tracking
- Motion detection
- NTEP Certified Class III/IIIL (purchase of optional kit required)
- UL/CSA Registered
- Waterproof keyboard and weight display (NEMA 4)
- Bi-directional RS-232C port
- Two relay contact set points (SPDT, 3A, 115 VAC)
- Panel mount enclosure with waterproof, gasketed bezel (mounting hardware included)
- Remote functions connector
- Tactile keypad

The HI 2151/20WC's resolution and range are as follows:

Resolution	Load Cell/Point Sensitivity and Excitation	Load Cell/Point Signal Output
Utilizes 985,000 counts	3 mV/V with 10 Vdc excitation	0 to 30 mvdc maximum L/C output
Utilizes 656,667 counts	2 mV/V with 10 Vdc excitation	0 to 20 mvdc maximum L/C output

Figure 1-3. HI 2151/20WC Range and Excitation Voltages

Models Available

HI 2151/20WC	Panel Mount Unit
HI 2151/20WC-WS	Wall Mount Unit (NEMA 4X Stainless Steel, 12.25"W x 14.25"H x 6"D)
HI 2151/20WC-RM	Remote Mount Unit (This display mounts separately from instrument body via a 5 foot flat ribbon cable.)*
HI 2151/20WC-BR	Blind Remote Unit (Display is not included. An output option or portable display must be purchased with this unit.)

CAUTION

* The flat ribbon cable for the remote mount version should not be run along side any AC power wiring from the keyboard/display to the instrument!

Optional Features

The options available with your HI 2151/20WC are:

OUTPUTS

- B1. Analog Output (voltage and current)
- B2. BCD Data Output Tri-Stated (includes 37 pin D-subminiature connector and 6-inch cable)
- B3. RS-232C/Current Loop
- B4. RS-422/485
- B5. BCD Data Output Tri-Stated (60" cable to B6 and B7 termination board options)
- B6. BCD Single Termination Board (used with B5)
- B7. BCD Quad Termination Board (used with B5)
- B8. Remote I/O interface for the Allen Bradley Network
- B9. BCD 24" inch cable (wall mount version only)
- B10. RS-232C/Modbus (RTU)
- B11. RS-422/485/Modbus (RTU)
- B12. PROFIBUS Interface Option

CONTROL OPTIONS

- C1. Peak Hold
- C2. Rate-of-Change
- C3. Hardy Link Communications
- C6. Weight Totalization
- C7. Bar Graph

SETPOINT OPTIONS

- D1. Six TTL level outputs with mating connector and 60-inch unterminated cable
- D2. D1 +a solid state relay card with a 60" inch cable.
- D3. D1 +a solid state relay card with a 6" inch termination cable.

HARDWARE OPTIONS

- E2. 240 VAC 50/60 Hz operation
- E3. NTEP Certification Kit
- E4. Portable Display (For Blind Remote unit only)
- F1. Intrinsic Barriers (internally mounted in wall mount version only)

NOTE

Two slots are available for output option boards (B1 through B5, B8 and B9).
Only one option board, B3, B4 or B8 can be used in the instrument at any one time.

The B2, B5 or B9 option boards can only be mounted in option slot two.
Two B1 options can be mounted in the Instrument.
The B8 option can only be mounted in option slot one.

INTERPRETING YOUR MODEL NUMBER

Optional outputs and control hardware options are depicted by the model number on your unit, as shipped from the factory. For example, an HI 2151/20WC with RS-232C/current loop output, rate-of-change, six TTL level outputs, NTEP Certification Kit:

HI 2151/20WC-B3-C2-D1-E3

NOTE

If your unit has a model number "-E2", it is configured for 240 VAC input power; however, if your model number does not show "-E2", then it is configured for 120 VAC.

SECTION 2

INSTALLATION

2.1 UNPACKING

The unit is enclosed in a protective foam insert inside a carton. Carefully open and remove the package contents.

Inspection for Damage

Inspect the unit and accessories for any damage. If any damage is noted, immediately file a claim with the carrier and notify Hardy Instruments' Customer Support (refer to Section 5).

Taking Inventory

Packed inside the carton are the following items:

a. Instrument (with mating connectors installed)
b. Mounting Hardware
c. HI 2151/20WC Operation and Installation Manual

Ensure all parts and accessories are unpacked. Save the protective foam insert for possible reshipment at some future date. Ensure that any options ordered have been received and/or installed by referring to your model number label. Record the data on the System Data Survey Sheet in Section 6, Appendix B.

2.2 MECHANICAL INSTALLATION (PANEL MOUNT ONLY)

The unit fits a 3.09 inches by 5.75 inches panel cutout. Refer to Figure 2-1, HI 2151/20WC Installation Details for cutout dimensions. Mounting is through the cutout and the unit is held in place by four mounting bars and retaining screws, which are installed from the rear of the mounting panel.

Enclosure Mounting Instructions

When locating the panel cutout, allow a minimum of 1 inch on all sides of the bezel and any adjacent units. This will provide approximately 2.34 inches between the left and right sides, and 1.65 inches between the top and bottom of the unit's enclosure and adjacent equipment on the interior of the mounting panel.

WARNING

Allow a minimum separation of 18 inches between weight controller and any 480 VAC power devices or magnetic sources.

Allow a minimum of 2 inches between the unit's rear panel and the back of the mounting panel enclosure for connector and cable clearance. That is, overall depth of the panel mounting enclosure must be a minimum of 11-3/4 inches.

Perform the following steps to install the unit:

a. Carefully locate, mark, and make the cutout in the mounting panel, then deburr the cutout.

NOTE

A NEMA 4 waterproof gasket is applied to the back of the unit's bezel at the factory. Ensure that this gasket is in place and flush against the bezel before installation.

b. Slide the unit into the mounting panel until the NEMA 4 gasket contacts the panel.

c. From inside the mounting panel enclosure, slide a mounting bar along each slotted corner of the unit's case until it contacts the back of the mounting panel. See Figure 2-1 HI 2151/20WC Installation Details. Insert the four furnished #6 Phillips screws into the threaded ends of the four slotted corners.

d. While supporting the back of the unit with one hand and aligning it flush against the mounting panel, partially tighten each of the four screws while going from corner-to-corner around the case.

e. Gradually tighten each screw so the unit is firmly held against the mounting panel. The NEMA 4 waterproof gasket should be completely compressed between the unit's bezel and the front of the mounting panel when the unit is fully tightened down.

f. Inspect the installation to ensure that the gasket is flush and evenly compressed behind the bezel.

NOTE

If instrument is removed from the panel, a new NEMA 4 waterproof gasket (P/N 0524-0011) must be installed prior to re-installation.

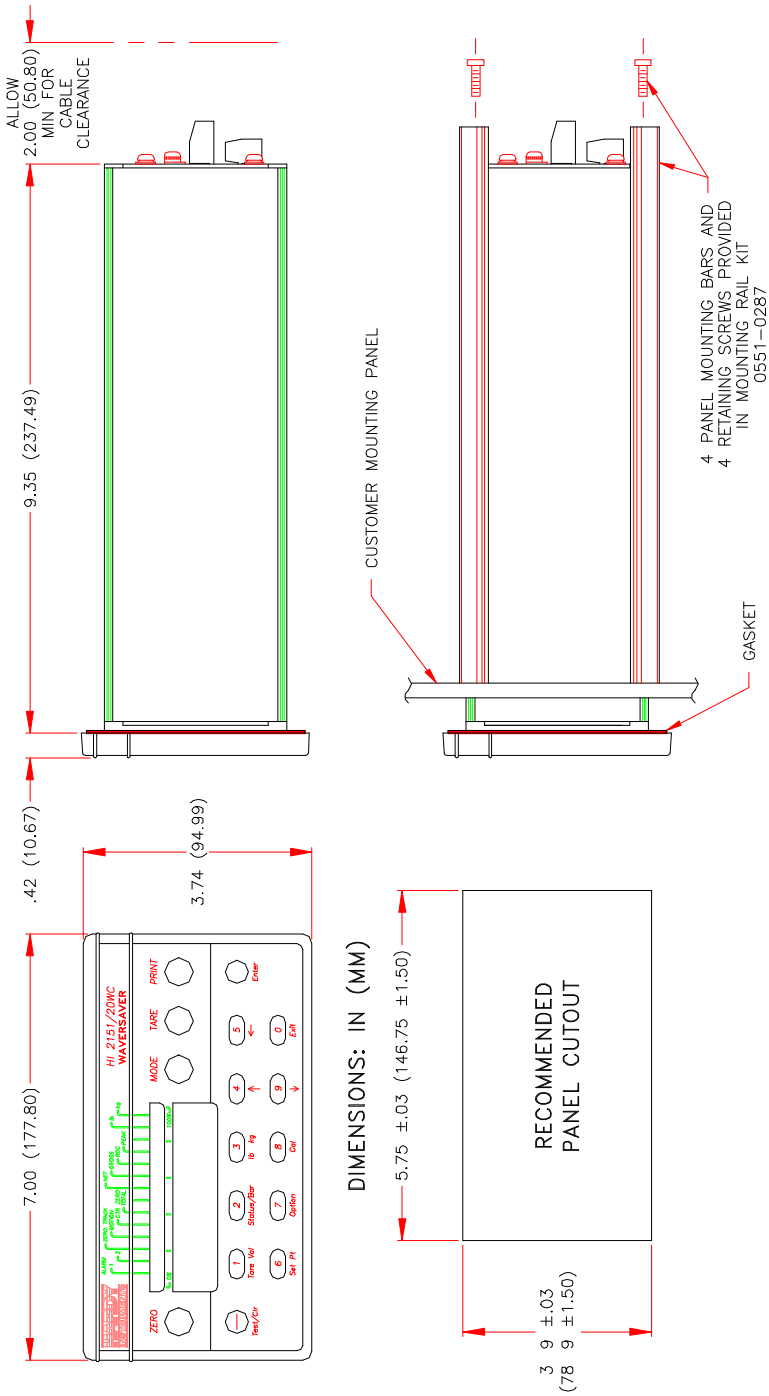


Figure 2-1. HI 2151/20WC Installation Details.

2.3 CABLING AND CONNECTIONS

Carefully plan your cable runs and wiring connections prior to routing, cutting, and trimming cables and wires. Cables carrying 120/240 VAC primary and relay switched power (J2, J5 and J6) should be routed away from all other signal cables and load cell/point cables to avoid electrical interference. All cabling to the rear panel should be neatly bundled, tied, and dressed with a 6-inch service bend in order to relieve stress from the connectors and to facilitate servicing the unit.

All cabling and electrical connections are made to the jacks on the rear panel of the unit (see Figure 2-2 HI 2151/20WC Rear Panel Connections). Mating plugs are furnished for all standard rear panel jacks and are installed at the factory. Plugs are terminal block type with captive screws for fastening cable wiring. Plugs are keyed so they fit only one way into the jacks on the rear panel.

NOTE

All plugs are held by a firm friction fit except J6, Power, which is held with two captive clips. However, proper cable dress and a 6-inch service bend are especially important in a high vibration environment to avoid connectors from working loose. All low level cables should use shielded cable.

CAUTION

Once the unit is installed properly, label the mating connector or cable with the connector number to preclude plugging the connector in the wrong jack and possible damage to the instrument. J3, and J5 are interchangeable.

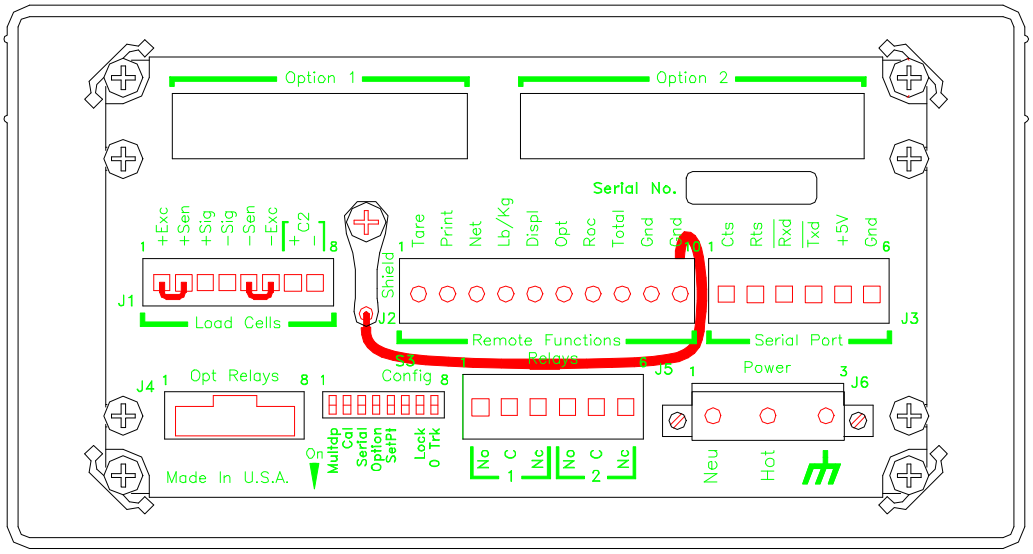


Figure 2-2. HI 2151/20WC Rear Panel Connections.

Load Cell/Point Connections (J1)

The unit is capable of powering a maximum of eight 350-ohm load cells/points. If more than eight load cells/points are used, an external power supply is required. Figure 2-3 Load Cell/Point Connections (J1) shows how to connect a full six-wire hookup, a four-wire hookup, and an external excitation supply. Load cell/point cables are connected to J1 through a furnished mating plug, P1.

In order to ensure a "clean" signal from the load cells/points, the following precautions should be taken:

a. Load cell/point cables MUST be run separate from all other cables and in their own conduit. Load cell/point cable shield should be attached to ground screw on rear panel only.

NOTE

Do not ground the other end of the shielded load cell/point cable.

b. Six-wire, shielded load cell/point cable should be used for lengths of 50 feet or more, or if intrinsic safety barriers are used.

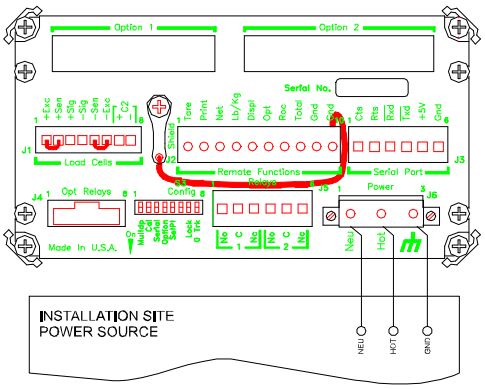
c. Avoid load cell/point cable splices. If cables are longer than needed, coil up and tape excess cable. If cables are short, use an appropriate junction box. When terminal lugs are installed on load cell/point cables, Hardy Instruments recommends the lug be crimped and soldered.

d. When connecting the HI 2151/20WC weight controller to the HI 215JB junction box using C2 load cell/point cable (6020-0001), use the following color code:

Load Point Model	+EXC	+SEN	+SIG	-EXC	-SEN	-SIG
HI LPH	GRN		WHT	BLK		RED
HI LPS	RED		GRN	BLK		WHT
HI LPD	RED		GRN	BLK		WHT
HI LPT	RED		GRN	BLK		WHT
J-BOX	GRN	ORN	YEL	BLK	BLU	RED

Input Power Connections (J6)

This instrument requires at least 14 AWG power wiring.



AC POWER WIRING DIAGRAM

WARNING

DO NOT operate at incorrect line voltage; the unit will be damaged. Changing the input voltage rating between 120 VAC and 240 VAC requires modifications at the factory. For further help contact Customer Support (refer to Section 5).

A system ground wire has been installed between pin number 10 of the Remote Functions connector and the shield screw. This wire ties the instruments analog/digital ground to the instrument chassis ground. If grounding is required elsewhere in your system, this wire can be disconnected.

The power and relay circuit card filters and conditions ac power. However, for noisy power lines, external conditioning may be additionally required; consult Customer Support (refer to Section 5) for more information. The ac power should be taken from a "clean" primary line directly from the power panel. This line should not supply any other equipment and should be supplied with a minimum 10 amp breaker.

Additional Cabling and Connections

It may be convenient at this point to install the remainder of the cabling for serial port(s), setpoint relays, remote functions, or other options that are installed on the 2151/20WC. Please refer to the appropriate sections for pin-out descriptions.

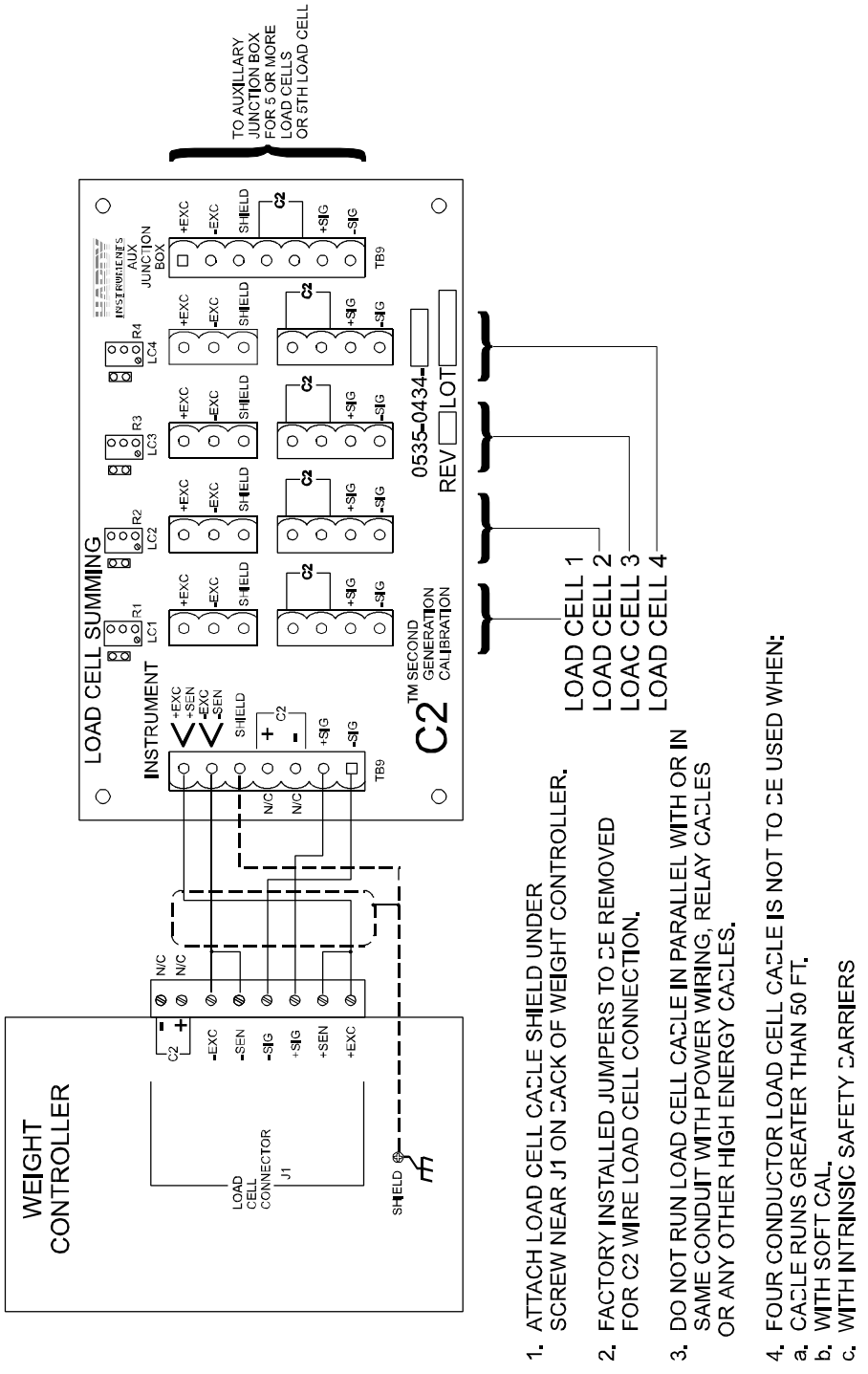


Figure 2-3a. 4 Conductor Load Cell/Point Connections (J1).

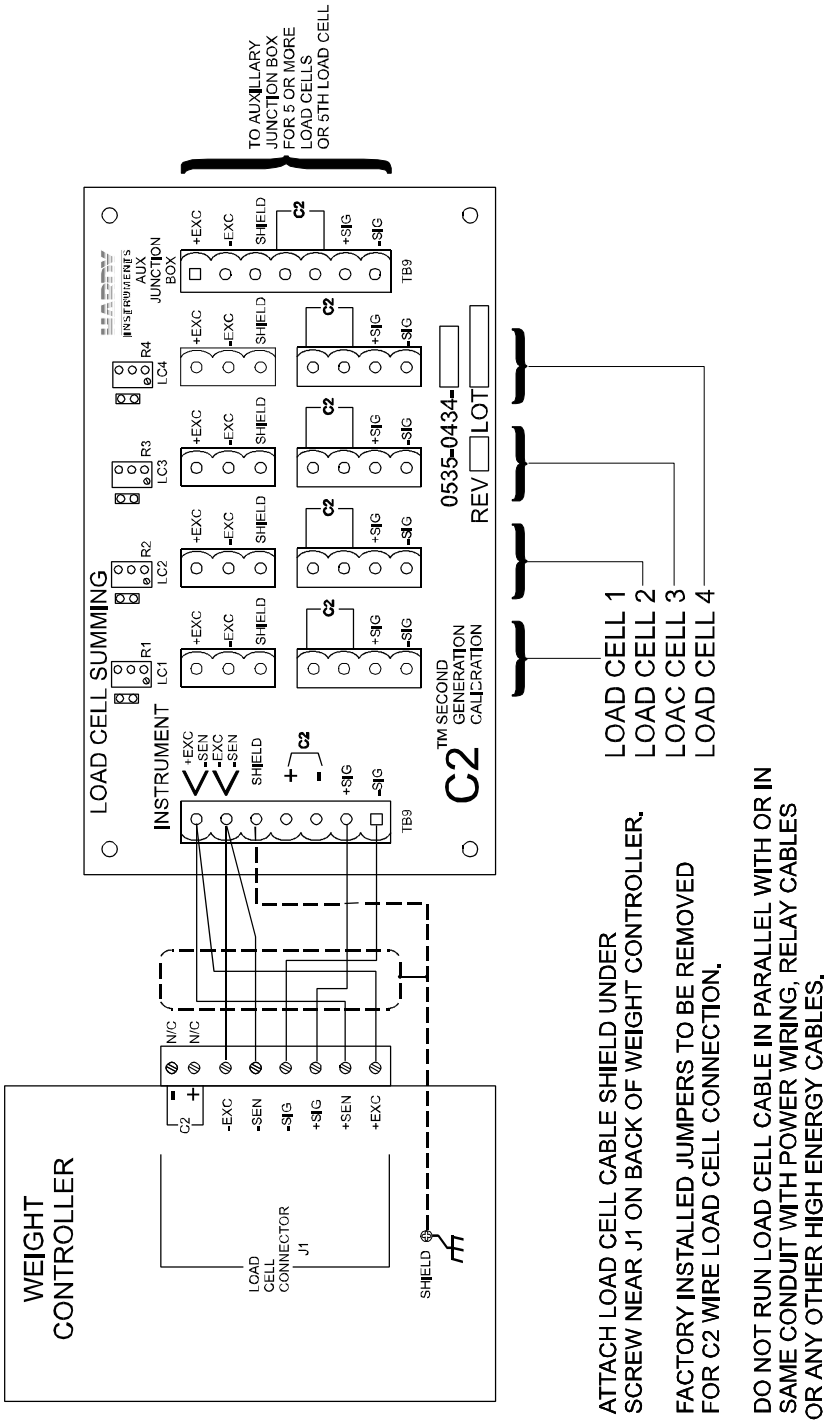


Figure 2-3b. 6 Conductor Load Cell/Point Connections (J1).

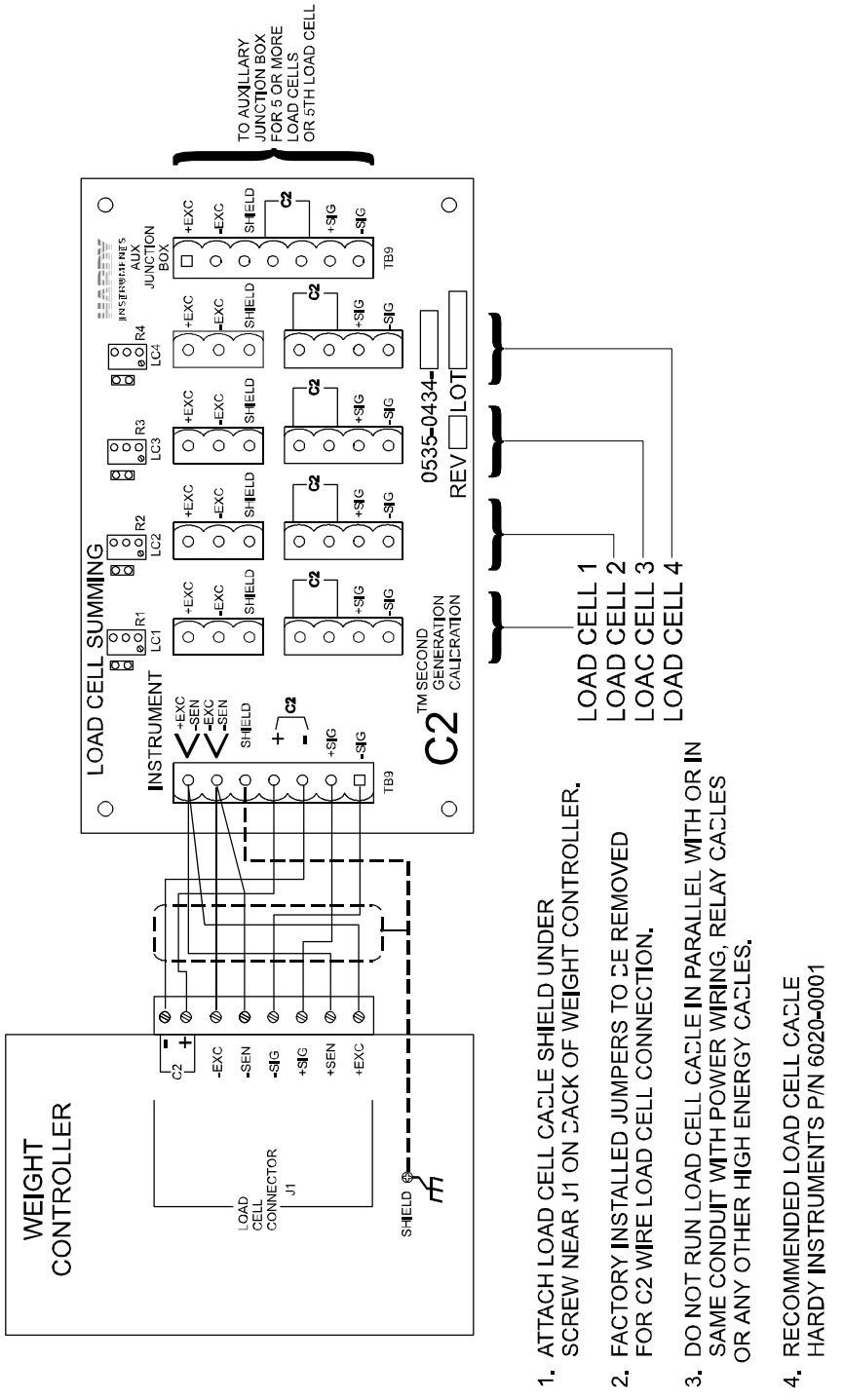


Figure 2-3c. C2 Load Cell/Point Connections (J1).

2.4 INITIAL SYSTEM POWER-UP

When the unit has been satisfactorily cabled into the load cells/points, the next step is to plug the unit in and proceed to Section 3 Scale Calibration.

SECTION 3

SCALE CALIBRATION

3.1 INTRODUCTION

This section contains a detailed calibration description, full calibration procedures and quick calibration instructions. Quick calibration instructions are not meant to replace a full calibration of the instrument, but instead provide a limited calibration of the zero and span parameters. This is useful in situations where only re-calibration is necessary. This section also explains the Secure Memory Module.

3.2 PRE-CALIBRATION PROCEDURES

When the installation has been completed and the unit is successfully powered up, allow a minimum of a 15 minute "warm-up" period prior to calibrating the instrument. Proceed with the following paragraphs prior to calibrating the instrument.

Vessel/Scale System Inspection

"System" performance and overall accuracy are a combined function of the unit, load cells/points, mechanical interface, and environmental conditions. To optimize accuracy and repeatability, the system must have minimal binding and maximum flexibility. Inspect the system for any binding that may cause the vessel to fail to return to the original zero reference point. In addition, all cables, tubes, lines, etc., attached to the vessel must be inspected for ample flexibility. This will ensure accurate and linear weight readings throughout the calibrated span. Consult our Customer Support or our Applications Engineering Department for additional applications information or recommendations.

Load Cell/Point Installation Inspection

Load cells/points must be mounted properly to avoid costly damage. Refer to load cell/point documentation for installation instructions. (Some load cells/points, i.e. some single and double ended shear beam, have an arrow (↓) indicating that the load cell/point should be mounted with the arrow pointing in the direction of the applied load.)

Typical Load Cell/Point Input/Output Measurements (EXC & SIG Outputs)

The HI 2151/20WC is designed to supply 10 vdc excitation to as many as eight load cells/points. The expected output from each load cell/point depends on the mV/V rating of the load cell/point. For example, a 2 mV/V load cell/point will respond with a maximum of 20 mVdc at full capacity. If the load cell/point capacity is rated at 500 pounds, the load cell/point output will be 20 mvdc at 500 pounds. The zero reference varies from system to system depending on the "Dead Load" of the vessel.

NOTE

Load cell/point measurements are checked with a digital volt meter at the summing junction box or the J1 connector on the rear panel of the HI 2151/20WC.

Description of Front Panel

The front panel contains 16 tactile membrane keys for operator control and calibration, and a large, six digit, seven-segment LED display. There are also 30 dedicated status indicator LEDs that function as a bar-graph display (optional).

Keys are arranged into two functional areas. The four large, circular keys across the top are dedicated to those repetitive functions typical of process weighing. These are ZERO, MODE, TARE, and PRINT. The remaining keys are utilized for setup of various option boards, instrument parameters and calibration. The Enter key is similar to ENTER on a computer keyboard, and is dedicated to parameter selections. The remaining keys perform combination numerical 0 - 9 and secondary functions, such as options, setpoints, etc.

Figure 3-1 Front Panel depicts the HI 2151/20WC and gives a brief description of the front panel. Following Figure 3-1 are sections which describe each function in detail. Please refer to Appendix A for a detailed explanation of each key function.

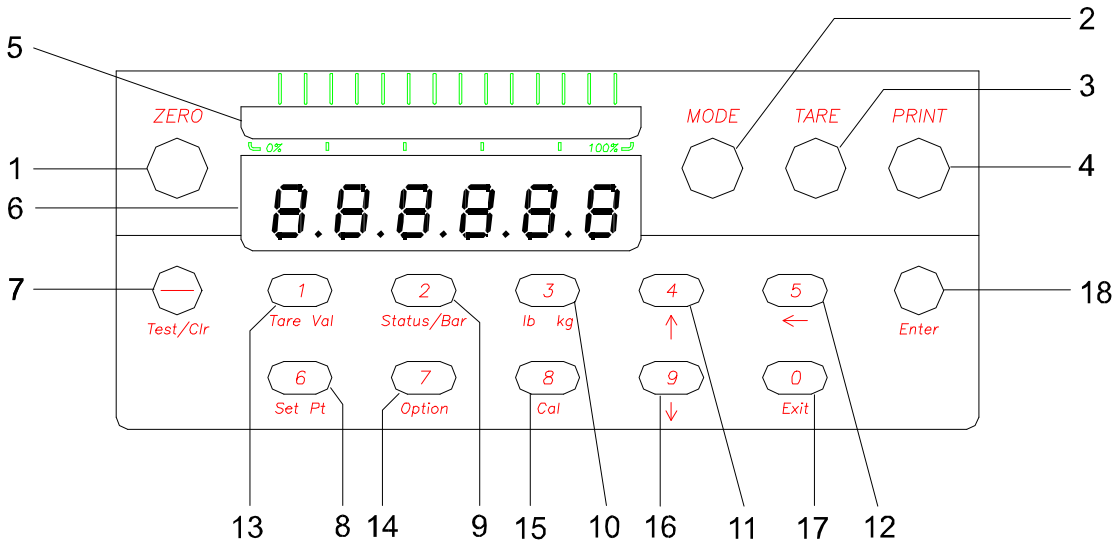


Figure 3-1. Front Panel

PROCESS WEIGHING FUNCTION KEYS

ITEM	LABEL	BRIEF DESCRIPTION (refer to Section 6, Appendix A for details)
1.	ZERO	Sets current count as new zero reference. The ZERO key will only zero up to the zero tolerance value entered in the calibration menu. Also exits a numeric entry in a menu.
2.	MODE	Toggles between net/gross/rate-of-change*/peak hold* and total display modes*
3.	TARE	Captures current gross weight; places value in tare register. Sets display to zero in net mode.
4.	PRINT	Outputs to designated printer port (NOT used with multidrop).
		OPERATOR DISPLAY
5.	N/A	Dual function display. Displays either weight controller status or bar-graph representation of selected weight display mode.
6.	N/A	Seven-segment LED display for displaying menus, operator inputs and selected weight displays.
		SET-UP AND CALIBRATION KEYS (see Section 6, Appendix A, Keypad Descriptions for details)
7.	-/Test/Clr	Initiates self test, clears display of digits in any menu, and also enters negative values. In CAL mode, reverts back to unit sub-menu from any other sub-menu heading.
8.	1/Tare Val	Enters digit 1; also displays current value in tare register, allowing it to be changed.
9.	2/Bar/Status	Enters digit 2; also selects bar-graph display mode* or status indicators.
10.	3/lb kg	Enters digit 3; also toggles display units between pounds and kilograms.
11.	4/↑	Enters digit 4; also advances menu to next parameter.
12.	5/←	Enters digit 5; also moves selectable decimal point one position left.
13.	6/Set Pt	Enters digit 6; also selects setpoint menu.
14.	7/Option	Enters digit 7; also selects option menu.
15.	8/Cal	Enters digit 8; also selects calibration setup menu to set calibration parameters.
16.	9/↓	Enters digit 9; also resets menu to previous parameter.
17.	0/Exit	Enters digit 0; also exits from current menu or sub-menu.
18.	Enter	Enters data and advances menu item.

* Operational only if this option is installed.

Seven Segment Display

The LED display is a six-digit, seven segment display with selectable decimal placement. The display can show positive values up to 999999 and negative values down to -99999. The LED display shows operational status messages as well as actual numeric values.

Combination Status Indicator/Bar-Graph LEDs (optional)

There are 30 discrete LEDs above the seven segment display that function as status indicators and bar-graph display. To switch between status and bar graph display, press the Status/Bar key. In the status mode, LEDs will light to indicate the following weight controller conditions:

DISPLAY	MEANING
CTR ZERO	Indicates when the sensed weight is within 1/4 of a display grad of calibrated zero.
MOTION	Indicates when the variation in consecutive weight readings exceeds the calibrated motion tolerance.
ZERO TRACK	Indicates when the zero track function is activated. Zero track is toggled on or off by the 0 Trk dipswitch (S3) on the rear panel.
ALARM 1	The status alarm LED flashes when the respective setpoint value has been reached. Indication is only for the standard, internal setpoints.
ALARM 2	The status alarm LED flashes when the respective setpoint value has been reached. Indication is only for the standard, internal setpoints.
GROSS/NET/ TOTAL/ROC/ PEAK	Indicates the mode of the measured value on the display.
lb/Kg	Indicates U.S. or metric unit-of-measure of the weight parameter on the display.

The bar-graph menu is used to select which parameter the bar-graph displays. This is explained in Section 4, Bar-Graph Menu Setup Procedure.

3.3 DETAILED CALIBRATION DESCRIPTION (This is a description only, refer to section 3.4 Full Calibration Procedures for step by step instructions).

To enter the Calibration (CAL) Menu, the instrument must be in the gross mode. On the Panel Mount and Remote Mount versions Config Dipswitch S3-CAL, found on the rear of the instrument, must be toggled (changed from previous position). On the Wall Mount version Remote Cal Access Switch S1 must be pressed. When the front panel Cal key is pressed, the display will read CAL for a moment and then read UNIT. Menu items are displayed sequentially each time the Enter key is pressed.

Editing a menu item is accomplished two ways: 1) press the Enter key and enter the new value or, 2) press Enter and then use the up/down arrow keys to select a displayed value. Calibration values can be entered using the numeric keys. Pressing the Enter key will set the new value. The Enter key must be pressed to seal the calibration when the display reads ENDCAL.

The calibration data for the instrument consists of the following parameters (refer to Section 3-4 Full Calibration Procedure for step by step instructions):

a. Units (1b/kg)
b. Decimal point position
c. Total Decimal Point (optional)
d. Motion tolerance
e. Graduation size
f. Zero Tolerance
g. Number of readings averaged
h. Scale capacity
i. Cal type
    (1) C2™ Second Generation Calibration
        (a) Load point detection
        (b) Reference point
        (c) Return
    (2) Software calibration
        (a) Sensitivity
        (b) Range
        (c) Sticker
        (d) Reference point
        (e) Return
    (3) Hardware calibration
        (a) Zero
        (b) Span
        (c) Linear Correction
        (d) Return
j. End Calibration

NOTE

When the desired calibration menu item is being displayed, press the Enter key to view the current numeric value. To clear the current value, press the -/Test/Clr key, and use the numeric keys to enter new values. If an error is encountered when entering the new value, refer to Appendix C for error message definitions.

The number of readings averaged automatically changes to 200 every time the CAL Menu is entered. (This will not be noticed by the user because the previously entered averages will be displayed.) This changes the response delay (averaging time) to approximately 12 seconds. If the scale weight is changed for any reason, wait at least 12 seconds before performing zero, span, or linear correction. After exiting the CAL Menu, the previously set number of averages will be automatically restored.

a. Units. With the display indicating "unit", press the Enter key so that the display indicates a unit of measure ("lb" or "kg"). Press the up arrow to select pounds or kilograms, then press the Enter key to accept the units. Note that the unit of measure can be changed during normal operation. Selection of the unit is needed prior to calibration so that the values entered can be interpreted in the proper unit-of-measure. The calibration units will be the units upon which all setpoints are based.

b. Decimal Point Position. Change the decimal point position by pressing Enter when the display indicates "DECPNT". The display will then show six eights. Pressing the left arrow key moves the decimal point to the left one digit. When the desired position is reached, press the Enter key to set the position.

c. Total Decimal Point (Option). The Total Decimal Point feature is operational only when used in conjunction with the optional weight totalizer. The Total Decimal Point must be less than or equal to the standard decimal point position. Change the total decimal point position by pressing Enter when the display indicates "tot dp". The display will then show six eights. Pressing the left arrow key moves the decimal point to the left one digit. When the desired position is reached, press the Enter key to set the position.

d. Motion Tolerance. This is the tolerance value used to determine if the scale is in motion. The default motion tolerance is three graduations. The instrument indicates motion whenever a change in the displayed (averaged) reading is outside the value entered. The -/Test/Clr key may be used to clear previous tolerance values. To enter new values, use the numeric keys.

NOTE

When the motion value is exceeded, the unit will not transmit data to printer.

e. Graduation Size. Press Enter. This is the minimum increment computed and displayed by the instrument. It may be increased or decreased by pressing the up or down arrow keys when "GRAD" is displayed. Acceptable graduation sizes are:

1	50
2	100
5	200
10	500
20	

The graduation size is recalculated each time the instrument is calibrated for span. The graduation size can then be changed if desired.

f. Zero Tolerance. This value is the zero tracking window. When the auto zero tracking function is enabled, any weight within tolerance of zero and not in motion will cause the display to indicate zero. The default zero tolerance is 10 graduations. Weight can accumulate up to the value entered for the zero tolerance, and the instrument will still display 0. Zero

tolerance can also be used with the round ZERO key to zero the display. (See Figure 1-1 Hardy Instruments' HI 2151/20WC Weight Controller). Set a new zero tolerance value when "0TOL" is displayed, press the Enter key and use numeric keys to enter the new value. Press the Enter key to set the value. The maximum Zero Tolerance number that can be entered is 32766.

g. Number of Readings Averaged. This sets the number of weight readings which will be used to compute the displayed weight. The average will be a running (or sliding) average so that a new average is available for display at every reading. The default number of readings per average is 100. Any number from 1 to 200 can be entered. Enter a new value when "AVRAGE" is displayed. Press the Enter key, the -/Test/Clr key, and use the numeric keys to enter the new value. Press the Enter key to set the new value.

h. Scale Capacity. This value represents the nominal operating capacity of the scale. If the weight should exceed 105% of this value, the display will indicate an over capacity condition "HI". The value entered, in most cases, should be the lesser of the scale capacity or the combined value of the load cells/points. To enter a new scale capacity value, press the Enter key with SC CAP displayed. Press -/Test/Clr and use the numeric keys to enter the new value. Press the Enter key to set the value.

i. Cal. This menu allows access to C2™ Second Generation Calibration, Software Calibration and Hardware Calibration sub-menus. Pressing the enter key with CAL displayed prepares the instrument for the C2™, Soft-Cal or Hard-Cal routine. Pressing the up or down arrow key will display all of these menus for selection.

(C2™ Second Generation Calibration. C2™ will only work with Hardy Instruments Load Points. It does not require any test weights. To enter this routine, press the Enter key.

(a) Load Point Detection. It will automatically read how many Hardy Load Points that are installed.

(b) Reference Point. This is usually zero, but can be a known "live" weight on the scale. Press the Enter key. A previously set reference point will be displayed. Erase this value by pressing -/Test/Clr key. Next, use the numeric keys to enter the data. Press the enter key to set the value.

(c) Return. Pressing the Enter key takes the instrument to End Calibration. The up arrow key will take the instrument back to L/C Count. The down arrow key will return the instrument to Reference Point.

(2) Software Calibration. Soft-Cal uses parameters found on the manufacturer's load cell/point calibration certificate for each load cell/point and one reference point (usually zero). It does not require any test weights (refer to section 3.6). To enter this routine, press the Enter key.

(a) Sensitivity. This is the full scale output in mV/V, as found on the load cell/point calibration certificate. Press the enter key and then the -/Test/Clr key to clear the display. Next, use the numeric keys to enter the data. Press the enter key to set the value.

(b) Range. This is the total capacity of the load cells/points as specified on their calibration certificates. Press the Enter key to clear the display. Next, use the numeric keys to enter the data. Press the Enter key to set the value.

(c) Sticker. This is the factory normalized value of the instrument. This value should only be changed during a Secure Memory Module change. Press the up arrow to move to the next parameter.

(d) Reference Point. This is usually zero, but can be a known "live" weight on the scale. Press the Enter key. A previously set reference point will be displayed. Erase this value by pressing -/Test/Clr key. Next, use the numeric keys to enter the data. Press the enter key to set the value.

(e) Return. Pressing the Enter key takes the instrument to End Calibration. The up arrow key will take the instrument back to Zero. The down arrow key will return the instrument to Reference Point.

(3) Hardware Calibration. Hard-Cal is the traditional way of calibrating a scale requiring a reference point and the physical placement of test weights on the scale. To enter this routine, press the Enter key.

(a) Zero. With the display indicating "ZERO," remove all weight from the scale. When all weight has been removed, press the Enter key. Press -/Test/Clr, then wait 12 seconds and press Enter. The current deadload load cell/point signal reading will be accepted as the zero calibration value.

(b) Span. Place a test weight (such as a certified test weight) on the scale and with "SPAN" displayed, press the Enter key. Press -/Test/Clr and use the numeric keys to enter the value of the test weight. Ideally the test weight added to the dead load should be the typical weight to be measured in the application. After waiting 12 seconds, press the Enter key to set the span.

(c) Linear Correction. This parameter corrects for non-linearity in the load cells' output; however, in most applications, this is not necessary. The midpoint linearity value default is set to zero. To set a value other than zero, first test for accuracy by placing a test weight on the scale. Keep adding weight until the discrepancy between actual weight and test weight is greatest. Use the numeric keys to enter the test weight value and press Enter.

(d) Return. Pressing the enter key takes the instrument to End Calibration. The up arrow key will take the instrument back to Zero. The down arrow key will return the instrument to Linear correction.

j. End Calibration. This item seals all calibration changes. Press the Enter key when "ENDCAL" is displayed to set the calibration values and exit the calibration menu.

3.4 CALIBRATION SETUP PROCEDURE

This procedure is an example of how to calibrate all features of the unit from the Calibration Menu. To enter the calibration menu, configuration dipswitch S3-CAL on the rear panel must be toggled prior to pressing the Cal Key (panel and remote mount). For the wall mount, the calibration button inside the enclosure should be pressed. The unit must also be operating in the Gross Mode (press Mode key to change modes). For the sake of examples using this full calibration procedure, the parameters will be set per the following list (use the appropriate parameters for your particular application):

1. UNIT = lbs.
2. DECIMAL POINT POSITION = 2 places
3. TOTAL DECIMAL POINT = 2 places
4. MOTION = 2.00
5. GRADUATION = 2
6. ZERO TOLERANCE = 1.00
7. AVERAGE = 10
8. SCALE CAPACITY = 500.00

NOTE

To correct a mistake during calibration, or to return to a previous calibration parameter, press the down arrow. To bypass parameters, press the up arrow.

Table 3-1. Calibration Setup Procedure
(To be done for all calibration types)

PROCEDURE	KEY	DISPLAY
1. Enter Calibration Menu.		
NOTE: If "error 8" is displayed re-toggle config dipswitch S3-CAL. If "error 5" is displayed select gross mode.		
a. Press Cal key.	Cal	**SEtUP ***
2. Select units (lbs. or kgs.).		**Unit**
a. Press Enter key.	Enter	**Lb**

* Display Momentarily Flashes

Table 3-1. Calibration Setup Procedure - Continued

PROCEDURE	KEY	DISPLAY
b. Press Up or Down arrow key to toggle display units between pounds (LB), or kilograms, (Gr).	↑ ↓	**Lb**
c. When desired unit value is displayed, press the Enter key.	Enter	**Good** *
3. Enter decimal point.		**DecPnt**
a. Press Enter key.	Enter	**888888**
b. Press LEFT arrow (select/digit) key until the decimal point is at the desired position.	←	**8888.88**
c. Press Enter key.	Enter	**Good** *
4. Enter Total Decimal Point. (only used with the optional totalizer feature)		**tot dP****
a. Press Enter key.	Enter	**888888**
b. Press LEFT arrow (select/digit) key until the decimal point is at the desired position.	←	**8888.88**
c. Press Enter key.	Enter	**Good** *
5. Enter Motion Tolerance.		**motion**
NOTE: Previously set motion tolerance value will be displayed. A motion tolerance of 2.00 will be set in the following example.		
a. Press Enter key.	Enter	**0.03**
b. Press -/Test/Clr key.	-/Test/Clr	**0.00**
c. Press the corresponding number keys	2 0 0	**2.00**

** Displayed only if TOTALIZER option is enabled.
* Display momentarily flashes good if value is a valid entry.

Table 3-1. Calibration Setup Procedure - Continued

PROCEDURE	KEY	DISPLAY
d. Press Enter.	Enter	**Good** *
6. Enter Graduation size.		**grAd**
a. Press Enter key.	Enter	**1**
NOTE: Previously set graduation size value will be displayed. For this example, a graduation size value of 2 will be set.		
b. Press Up or Down arrow key until desired graduation size is displayed.	↑ ↓	**2**
c. Press Enter Key.	Enter	**Good** *
7. Enter Zero Tolerance.		**0 toL**
a. Press Enter key.	Enter	**0.10**
NOTE: Previously set zero tolerance value will be displayed. For this example, a zero of 1.00 will be set.		
b. Press -/Test/Clr key.	-/Test/Clr	**0.00**
c. Enter desired zero tolerance value.	1 0 0	**1.00**
d. Press Enter key.	Enter	**Good** *
8. Enter Number of Readings Per Average.		**AVrAgE**
a. Press Enter key. (Example)	Enter	**100**
NOTE: Previously set number of readings per average value will be displayed. For this example, an average of 10 will be set.		
b. Press the -/Test/Clr key.	-/Test/Clr	**000**

* Display momentarily flashes good if value is a valid entry.

Table 3-1. Calibration Setup Procedure - Continued

PROCEDURE	KEY	DISPLAY
c. Enter desired number of readings per average value.	1 0	**10**
d. Press Enter key.	Enter	**Good** *
9. Enter Scale Capacity.		**Sc CAP**
a. Press Enter key.	Enter	
NOTE: Previously set scale capacity value will be displayed. For this example, a scale capacity value of 500 will be set.		
b. Press -/Test/Clr key.	-/Test/Clr	**0.00**
c. Enter new scale capacity.	5 0 0 0 0	**500.00**
Note: Three or more digits must be used. For low capacities use decimal points.		
d. Press Enter key.	Enter	**Good** *
10. Continue with one of the following calibration steps:		**CAL**

Section 3.5, Table 3-1a: C2™ Second Generation Calibration procedures.
Section 3.6, Table 3-1b: Soft Calibration Procedures.
Section 3.7, Table 3-1c: Hard Calibration Procedures.

3.5 C2™ SECOND GENERATION CALIBRATION

C2™ Second Generation Calibration (C2) automatically calibrates a scale system without the use of test weights, material substitution, or force calibration. Unlike Hard-Cal, the vessel does not have to be empty to calibrate as long as the weight of material inside the vessel is known. Later, when the vessel is empty, you can set zero as the new reference point for calibration to provide a better reference. Unlike Soft-Cal, C2 calibration eliminates the potential human errors that may occur from manually entering the load cell data, to obtaining and maintaining files for this data for future use. The C2 Menu can't be entered while in the NBS mode.

A C2 certified weighing system consists of up to eight load points, a junction box, interconnect cable and an instrument with C2 capabilities, like the HI2151/20WC.

Hardy Instruments C2 certified Load Points contain digital information detailing the unique performance characteristics of each individual load point. These load points are available as single-ended or double-ended shear beams, or "S" beam types with capacities ranging from 40 LBS to 250,000 LBS. Each load point has C2 certified cable that should never be cut or spliced. C2 cannot be performed unless All load points in the system are C2 certified.

Hardy Instruments C2 certified Junction Box contains circuitry in a waterproof NEMA 4X painted steel, stainless steel, or fiberglass enclosure. The circuitry transfers excitation voltage to each load point, sums up to four load point signals, and transfers the weight signals and digital C2 information back to the weight controller. Two junction boxes can be cabled together to handle up to eight load points. Its unique multiple connector design allows for easy voltage and resistance measurement during troubleshooting. Each box comes with five pre-drilled holes, up to five cable grip fittings, and three packaged hole plugs to accommodate cables with 3/8" (0.375) to 1/2" (0.5) O.D.

Hardy Instruments C2 certified Load Point Interconnect Cable is a 22 AWG, 8-conductor, shielded cable designed to easily handle the low voltages found in weighing systems as well as the load point performance characteristics. The braided shield protects the load point signals from EMI/RFI interference. The Gray and Violet, twisted pair wires are assigned to the C2 connector terminals.

Hardy Instruments 2151/20 Weight Controller is a C2 certified instrument that detects the quantity of C2 certified load points in the system and reads the unique performance characteristics of each individual load point. It then can be calibrated by simply entering a reference point reflecting the current weight on the scale, from zero to scale capacity. Hard-Cal and Soft-Cal are also included as alternate calibration methods that can be used as well.

Theory of Operation: When power is applied to the unit, the C2 certified HI2151/20WC polls the load points searching for C2 information. When a C2 certified load point is detected, the performance characteristics of that load point are read and stored in the instrument. The HI2151/20WC then searches for additional C2 certified load points in the system and stores their unique performance characteristics in memory. This is all completed during the power up sequence.

Calibration: To calibrate a system for the first time, physically inspect the scale system looking for and correcting any mechanical binding problems, potential motion constraints as weight is added, and verify that the weight is applied vertically on the load points. Next, check all load point cables for proper color-code wiring and secure connections. (Refer to figure 2-2 REAR PANEL CONNECTIONS for connector pin assignments)

Make sure that you have followed the Calibration setup steps in Table 3-1. Calibration Setup Procedure, then follow the procedure outlined below on Table 3-1a. C2™ Second Generation Calibration Procedure. After the initial setup, calibration can be repeated at any time as long as the approximate weight on the scale is known.

Table 3-1a. C2™ Second Generation Calibration Procedures

PROCEDURE	KEY	DISPLAY
1. Enter Calibration mode.		CAL
a. Press Enter key.	Enter	Hd CAL
b. Press Down Arrow key.	↓	C2 CAL
c. Press Enter key.	Enter	LC Cnt
2. Verify the number of load points detected by C2 calibration matches the actual number of load points installed in the system.		
a. Press Enter key. * Up to 8 load points can be detected.	Enter	1 *
b. Press Enter key.	Enter	rEF Pt
3. Enter Reference Point.		
NOTE: This example uses 50.00 LBS as a reference point with 2 decimal places, but any known weight within the scale range can be used. The recommended and default value is zero.		
a. Press Enter key.	Enter	-
b. Press -/Test/Clr key.	-/Test/Clr	0.00
c. Enter the Reference weight on the scale, or press Enter if zero reference weight is used.	5000	50.00

Table 3-1a. C2™ Second Generation Calibration Procedures - Continued

PROCEDURE	KEY	DISPLAY
d. Press Enter key.	Enter	Good* rEturn
4. Go to EndCal.		
a. Press Enter key.	Enter	EndCAL
5. Exit Calibration Menu.		
a. Press Enter key.	Enter	__**__

** Display shows actual weight on scale.
* Display momentarily flashes good if value is a valid entry.

3.6 SOFTWARE-CALIBRATION (SOFT-CAL)

Soft-Cal allows a scale system to be quickly calibrated on-site without the use of test weights, material substitution, or force calibration. This process uses the certified, full scale mV/V output (sensitivity, input resistance and range) of each load cell/point which is mathematically combined with a measured reference point (which is usually, but not restricted to, zero) to calibrate the scale. The certified, full scale mV/V data is found on the calibration certificate which is shipped with each load cell/point. This process assumes a consistent center of gravity on the scale with even distribution. The load cells/points must be installed correctly and there must not be any binding in the mechanics of the scale. The load cell/point cable must be the same length as supplied by the load cell/point manufacturer. The cables must not be cut. For multiple cell/point systems where a junction box is used, balance potentiometer and resistors must be zero. The Soft-Cal menu cannot be entered while in the NBS mode.

For multiple load cell/point systems, an additional software program is available through our service department. This allows users to enter data for up to eight load cells/points from their respective calibration certificates. The program returns one equivalent sensitivity value and one range value. The data entered for the load cells/points is the maximum weight (range) from the data sheet of one of the load cells/points (they should all be the same), the serial number for each load cell/point, the full scale value for each load cell/point, and the input impedance for each load cell/point.

Make sure that you have followed the Calibration setup procedures in Table 3-1. Calibration Setup Procedure, then follow the procedure outline on below on Table 3-1b. Software Calibration Procedure. After the initial setup, calibration can be repeated at any time as long as the approximate weight on the scale is known.

Table 3-1b. Software Calibration Procedure

PROCEDURE	KEY	DISPLAY
1. Enter Calibration mode.		**CAL**
a. Press Enter key.	Enter	**HdCAL**
b. Press Up Arrow key.	↑	**S CAL**
c. Press Enter key.	Enter	**SnStUy**
2. Enter the load cell/point full scale output in mV/V as found on the load cell/point calibration certificate.		
a. Press Enter key.	Enter	**-**
b. Press -/Test/Clr key.	-/Test/Clr key	**0**
c. Use numeric keys to enter full scale output. Use DOS utility program to compute total full scale output sensitivity for more than one load cell/point. NOTE: You must enter five digits. If load cell is listed at less than five digits make data the unlisted least significant digits zero.	29998	**29998**
d. Press Enter key.	Enter	**good***
3. Enter the scale RANGE (capacity).		
a. Press Enter key.	Enter	**rAnGE**
b. Press Enter key.	Enter	**10000**
c. Press -/Test/Clr key.	-/Test/Clr key	**0**

* Display flashes "good" when accepted

Table 3-1b. Software Calibration Procedures - Continued

	PROCEDURE	KEY	DISPLAY
	d. Use the numeric key pad to enter the sum of the rated capacities of all the load cells/points being used on this scale.	50000	**500.00**
	e. Press the Enter key.	Enter	**StickR**
4.	Sticker. This is the value which normalizes each instrument and should only be changed when replacing the Secure Memory Module (SMM). Refer to Section 3.7.		
	a. Press Up arrow key once.	↑	**rEFPt**
5.	Enter Reference Point.		
	NOTE: This example uses zero as a reference point but any known weight within the scale range can be used. The Zero point is recommended.		
	a. Press the Enter key. *The previously set reference point will be displayed.	Enter	**-**
	b. Press the -/Test/Clr key.	-/Test/Clr key	**0.00** **good***
	c. Press the Enter key.	Enter	**rEtUrn**
6.	Go to EndCal.		
	a. Press the Enter key.	Enter	**EndCAL**
7.	Exit Calibration Menu.		
	a. Press Enter key to seal calibration.	Enter	__**__
	NOTE: All calibration parameters are updated in the cal menu and are saved to the Secure Memory Module when EndCal is entered.		

* Display flashes "good" when accepted.

3.7a HARD CALIBRATION

Make sure that you have followed the Calibration setup procedures in Table 3-1. Calibration Setup Procedure, then follow the procedure outlined below on Table 3-1c. Hard Calibration Procedure.

Table 3-1c. Hard Calibration

PROCEDURE	KEY	DISPLAY
1. Enter Calibration Mode.		**CAL**
a. Press Enter key.	Enter	**Hd CAL**
b. Press Enter key.	Enter	**ZEr0**
2. Enter Zero.		
NOTE: Remove weight from scale to bring load cell/point output to the lowest reading.		
a. Press Enter key.	Enter	**-**
b. Press -/Test/Clr key.	-/Test/Clr	**0.00**
c. Wait 12 seconds.		
d. Press Enter key.	Enter	**Good** *
3. Enter Span.		**SPAn**
NOTE: Any calibrated weight can be used to set span. It is recommended that a weight greater than 80% of the scale capacity be used. For this example, a 250 pound weight will be used.		
a. Place 250 lb. weight on scale.		
b. Wait 12 seconds.		
c. Press Enter key.	Enter	**-**
d. Press -/Test/Clr key.	-/Test/Clr	**0.00**
NOTE: Previously set span value will displayed.		

Table 3-1c. Hard Calibration Procedure - Continued

PROCEDURE	KEY	DISPLAY
e. Press -/Test/Clr key.	-/Test/Clr	**0.00**
f. Enter new span value.	2 5 0 0 0	**250.00**
g. Wait 12 seconds.		
h. Press Enter key.	Enter	**Good** *
4. Enter Midpoint Linearity.		**LinCor**
NOTE: Only non-linear load cell/point applications require midpoint linearity calibration. Follow this calibration procedure if you have a non-linear load cell/point application.		
a. Test accuracy by placing a test weight on the scale. An inaccurate weight will be displayed.		
b. Wait 12 seconds.		
c. Keep adding weight until you notice the greatest discrepancy between actual and displayed weight (about1/2 of the load cells' capacity, or midpoint).		
d. Press the Enter key.	Enter	**0.00**
e. Use the numeric keys to enter the test weight. (50 pounds will be used for this example) .	5 0 0 0	**50.00** (example)
f. Press Enter key.	Enter	**Good** * **rEturn**

Table 3-1. Hard Calibration Procedure - Continued

PROCEDURE	KEY	DISPLAY
5. Go to EndCAL.		**rEtUrn**
a. Press Enter key.	Enter	**EndCAL**
6. Exit Calibration Menu.		**EndCAL**
a. Press Enter key to seal calibration.	Enter	*

* Display shows actual weight on scale.

NOTE

All calibration parameters are updated only in the cal menu and are saved to the Secure Memory Module when EndCAL is entered.

3.7b QUICK SETUP PROCEDURES FOR HARD CALIBRATION

This procedure will allow calibration of zero and span only. All other menu items are eliminated. To enter the calibration menu, dipswitch S3-CAL on the rear panel must be toggled prior to pressing the Cal button, and the unit must be operating in the Gross Mode. If the Cal switch is not toggled the display will read ERR8. You may simply review these calibration values without changing them. Press the Test key and the calibration values will be displayed. To change the calibration values, toggle the CAL switch and press the Cal button.

Table 3-2. Quick Setup Procedures for Hard Calibration

	PROCEDURE	KEY	DISPLAY
1.	Press Cal key.	CAL	**Unit***
2.	Press the UP arrow key until CAL prompt is displayed.	↑	**CAL**
3.	Press Enter key.	Enter	**HdCAL**
4.	Press Enter key.	Enter	**ZEr0**
5.	Press Enter key.	Enter	**-**
6.	Press -/Test/Clr key. Remove weight from scale to bring load cell/point input to lowest reading.	-/Test/Clr	**0**
7.	Wait 12 seconds.		
8.	Press Enter key. Zero is set and menu proceeds to span. Place test weight on scale to bring the load cell/point input to full range.	Enter	**SPAn**
9.	Press Enter key.	Enter	**-**
10.	Press -/Test/Clr key.	-/Test/Clr	**100.00**
11.	Press -/Test/Clr key again. Enter the desired weight value for span using the number keys.	-/Test/Clr	**0.00**

* SETUP flashes momentarily.

Table 3-2. Quick Calibration Procedure for HI 2151/20WC - Continued

PROCEDURE	KEY	DISPLAY
12. Wait 12 seconds.		
13. Press Enter key, span is now set.	Enter	**LinCor**
14. Remove test weight from scale. Use the up arrow to advance to RETURN.	↑	**rEtUrn**
15. Press Enter.	Enter	**EndCAL**
16. Press Enter to seal calibration.	Enter	*
NOTE: Calibration data is automatically saved to the Secure Memory module (see Section 3.7).		

* Display shows actual weight on the scale.

3.8 ENHANCED SECURE MEMORY MODULE (SMM)

The enhanced Secure Memory Module is a secure, non-volatile device. The SMM stores all calibration data, the configuration of Setpoints (all), and the standard RS-232C Serial Port. It will also store the configuration of all the options except for Peak Hold (-C1). All data is stored automatically. During system operation when a new parameter is entered, the enhanced SMM automatically updates that value in its memory. The enhanced Secure Memory module, a DS1205, replaces the old DS1201 memory device.

Transferring the Secure Memory Module

CAUTION

These instruments contain static-sensitive components and require careful handling. Use a static wrist strap for proper grounding protection or touch a grounded surface prior to sliding the boards out of the case.

NOTE

If the HI2151/20WC is in a wash down area, it is recommended that the front panel gasket be replaced.

A. From One Enhanced HI2151/20WC to Another
To transfer the Secure Memory Module from one enhanced unit to another, follow the steps below:

1. Unplug the enhanced unit.
2. Detach all interconnect cabling and remove the enhanced HI2151/20WC from its mounting.
3. Remove the four screws holding the rear panel.
4. Slide the rear panel, including all the boards, out of the case.
5. The enhanced Secure Memory Module is labeled U19, and is located towards the front of the top main board.
6. Unfasten the securing strap, and pull the Secure Memory Module off the board.
7. Carefully install this module in socket U19 of the new enhanced HI2151/20WC. Match the beveled edge of the SMM with the diagram on the board. If Soft-Cal is to be used, copy down the Sticker value found on the hand-written label near U19.
8. Re-install the boards, hardware, and re-attach the cabling.
9. The original data is restored to the new unit upon power-up.

B. From One Enhanced HI2151/20WC to an Older HI2151/20WC
To transfer the Secure Memory Module from an enhanced unit to one not enhanced also requires transferring the E-prom U11. Follow these steps:

1. Unplug the enhanced unit.
2. Detach all interconnect cabling and remove the enhanced HI2151/20WC from its mounting.
3. Remove the four screws holding the rear panel.
4. Slide the rear panel, including all the boards out of the case.
5. The enhanced Secure Memory Module is labeled U19 (Chip P/N: DS1205), and is located towards the front of the top main board.
6. Unfasten the securing strap, and pull the Secure Memory Module off the board.
7. Carefully install this module in socket U19 of the older HI2151/20WC. Match the beveled edge of the SMM with the diagram on the board.

Transferring the Secure Memory Module - Continued

B. From One Enhanced HI2151/20WC to an Older HI2151/20WC - Continued

8 Use a small, flat-blade screwdriver, to gently pry up the Eprom U11, separating it from its socket on the board.
9. Position the EPROM from the enhanced unit over the socket labeled U11 on the replacement unit making sure that the notch on the EPROM matches the diagram beneath the socket.
10. Gently insert one row of pins partially into the socket to align the chip. Now, carefully work the other row of pins into place and gently press the EPROM into the socket.
11. Inspect the pins and verify that there are no bent or misaligned pins as a result of the installation.
12. Re-install the boards, hardware, and re-attach the cabling.
13. The original data is restored to the new unit upon power up.

C. From an Older HI2151/20WC to an Enhanced HI2151/20WC
This sequence only allows the manual transfer of calibration data from the old SMM to the new unit, and then the new SMM will be re-installed. The setpoint and option menu data must be re-established and manually re-entered.

1. Unplug the older version instrument.
2. Detach all interconnect cabling and remove the older HI2151/20WC from its mounting.
3. Remove the four screws holding the rear panel of both instruments.
4. Slide the rear panel, including all the boards, out of their cases.
5. The Secure Memory Module is labeled U19, and is located towards the front of the top main board.
6 Unfasten the securing strap, and pull the Secure Memory Module off the board.
7. Carefully install the older version module in socket U19 of the newer HI2151/20WC. Match the beveled edge of the SMM with the diagram on the board.
8. Re-install the boards, hardware, and re-attach the cabling (power and load cell) to the newer unit.
9. Energize the newer instrument. The display should momentarily show Old Tag (OLD tG)and then continuously sequence through the following parameters at a rate of one per second:

   UNIT
   GRAD
   ZERO COUNTS
   SPAN
   FULL SCALE COUNTS
   SCALE CAPACITY
   ZERO TOLERANCE
   MOTION
   AVERAGES

   Note

   You will need to write the parameters down before continuing with the installation.

10. De-energize the instrument; remove the old Secure Memory Module and re-install the newer version.
11. Re-install the boards, hardware, and all the cabling.

Transferring the Secure Memory Module - Continued

C. From an Older HI2151/20WC to an Enhanced HI2151/20WC- Continued

12. Energize the newer instrument and enter the Calibration menu. In the Set-up portion, enter the parameters which were copied in step 9.
13. At the Hd CAL prompt press the Mode key. The display will read Zr cnt (zero counts); press the Enter key followed by the -/Test/Clr key. Using the numeric keys, enter zero counts written down in step 9.
14. Press the Enter key; the display will read SPAn. Press the Enter key followed by the -/Test/Clr key. Using the numeric keys, enter the span written down from step 9.
15. Press the Enter key. The display will read FS cnt (full scale counts). Press the Enter key followed by the -/Test/Clr key. Using the numeric keys, enter the full scale counts written down from step 9.
16. Press the Enter key. The display will read rEtUrn. Press the Enter key two more times to return to the weighing mode. The scale is now calibrated.
17. Enter the SETPOINT Menu and input all recorded values.
18. Enter the OPTIONS Menu and input all required parameters.
19. The instrument is now ready for operation.

Table 3-3. Restoring Data from the Secure Memory Module (SMM)*

PROCEDURE	KEY	DISPLAY
1. Press numeric keys 9, 5, and the Enter key.	9 5 Enter	**rESEt**
2. Press Enter key.	Enter	**no**
3. Press up arrow.	↑	**YES**
4. Press Enter key. (It will pause for about 3 seconds before resetting)	Enter	**Good** ** **CF = 1** ***

NOTE

Numeric key entries will not be displayed on LED indicator when restoring data from the Secure Memory Module.

When restoring information from one Secure Memory Module to another, the HI 2151/20WC will be within .75% of the original calibration. If closer tolerances are required, a complete re-calibration with test weights should be performed.

* This procedure is available for transferring SMM, or restoring existing RAM.

** Display momentarily flashes good if value is a valid entry.

*** Display will count and momentarily flash the Corner Frequency value. This value varies depending on the Corner Frequency Jumper selected (W0, W1, W2, W3, or W4).

3.9 WAVERSAVER®

WAVERSAVER® is proprietary technology developed by Hardy Instruments, Inc.

WAVERSAVER® is a combination of hardware and firmware which effectively eliminates the effects of vibration on a scale, to arrive at the true weight. WAVERSAVER® not only rejects the effects of vibration and extracts the true weight signal, but it performs these functions at high speed. This allows the accurate weighment of ingredients, including flow cut-off.

The HI 2151/20WC can be configured to reject the signals generated by vibration of frequencies above 0.25 Hz and respond within one second with stable readings. For applications with higher frequency components, WAVERSAVER® can be adjusted to reject signals above 7.5 Hz with virtually instantaneous response.

NOTE

To configure the HI 2151/20WC to NTEP specifications, refer to Section 6 Appendix E - NTEP Operation.

If you would like a faster performance from the HI 2151/20WC after calibration has been completed you can move the jumper from W4 to W3. If weight readings are still stable, move the jumper from W3 to W2. Continue with this method until satisfied with the performance and stable weight readings. Remember that position W1 provides the fastest final weight reading but the least amount of vibration immunity. This is important for those applications where it is critical to reach the final weight reading as quickly as possible. Re-calibration is not necessary after moving jumpers W1 through W4 and W0. (For a description of WAVERSAVER® Jumper Selections, see Table 3-4 WAVERSAVER JUMPER SETTINGS).

Also, the number of averages selected in the calibration menu adds to this time, and increasing or decreasing will also stabilize weight readings or affect performance. For example, with the jumper 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).

Table 3-4 WAVERSAVER JUMPER SETTINGS
Jumpers are provided for selecting vibration immunity configurations as follows:

JUMPER	MIN 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	100mS to reach the final weight reading.
W3	1.0 Hz	500mS to reach the final weight reading.
W4*	0.5 Hz	Very good vibration immunity requiring approximately 1 second to reach the final weight reading.
W0	0.25 Hz	Best vibration immunity requiring approximately 2 seconds to reach the final weight reading.

* Factory configuration (default) is with the jumper in position W4.

Instructions for changing the jumpers:

1. Remove power from the unit
2. Remove the four screws from each corner of the rear panel
3. Slide the rear panel and internal circuit cards from the extrusion/display assembly
4. Set the jumpers for your application. The jumpers are located toward the front of the top main board.
5. Slide the rear panel and internal circuit cards to the extrusion/display assembly
6. Replace the four screws for each corner of the rear panel
7. Restore power to the unit

WARNING

Dangerous voltage is present within the enclosure of the unit and presents the risk of electrical shock. Always unplug the power cord before opening and servicing the unit. Follow Electrostatic Discharge (static) procedures when opening the unit.

3.10 AUTO ZERO TRACKING

Auto Zero Tracking will cause the display to indicate zero, as long as any "live weight" on the scale is below the set zero tolerance and the scale is not in weight motion. This feature allows the instrument to ignore material build-up in the weigh system within the set zero tolerance. The time the module must see these conditions is based on the sum of a constant and the number of averages set by the user. The minimum time-frame with one average is 2.1 seconds. This time is calculated as follows:

2 seconds + (Number of Averages + 1) (0.05 seconds)

This feature is enabled when switch eight of S3 (the configuration dipswitch), labeled Config on the instrument's rear panel, is in the on position.

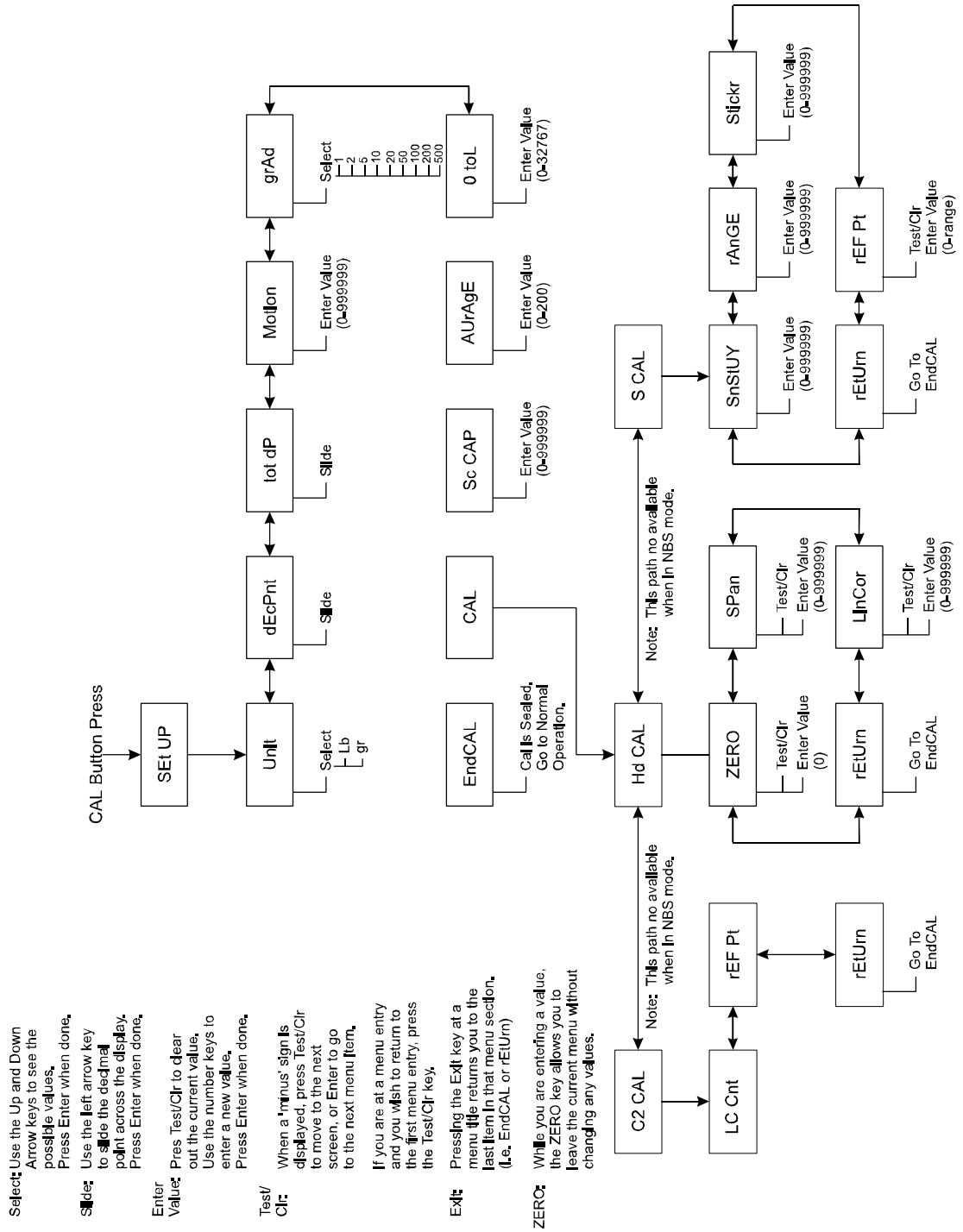


Figure 3-2. HI 2151/20WC Calibration Menu Structure

SECTION 4

OPERATION AND CONFIGURATION

4.1 INSTRUMENT CONFIGURATION OVERVIEW

This section provides instructions for installing, configuring, and operating the option boards and the control options which are available for your HI 2151/20WC.

There are three main menus - Setpoint, Calibration and Option. To enter any of these menus, press the respective key. Once in a particular menu, use up and down arrow keys to scroll through the choices of that menu. Some of the menus have sub-menus. To select an item for viewing and/or changing, press Enter while that menu item is being displayed; the current value or status of that menu item will now be displayed.

To alter values, use the number keys to change values or press the Exit key for no change. Use the -/Test/Clr key when a value is shown on the display to clear the display to all zeros. When clearing the display, the unit will always keep the decimal location intact by putting zeros to the right and one zero to the left of the decimal point.

Some menu selections can be toggled using the ↑ and ↓ keys. Pressing the arrow keys will display all available selections for the menu item. Whether altering a value or not, when you are ready to stop viewing this parameter and go on to the next, press the Enter key to accept the value or press the exit key to keep the original value. This will save the parameter as shown on the display.

The unit will also verify that the value entered is a logical choice. If your parameter has been entered correctly, "Good" will be displayed and the display advances to the next item in the menu. If it is desirable to view and/or change this parameter, push Enter. To view a value without changing it, press the Enter key. If changing a value and then deciding to retain the original value, press the ZERO key instead of the Enter key. This will save the original value and advance to the next parameter.

Saving Your Configuration Parameters

Option menus are used to set parameters for the various option boards. All option parameters except for Peak Hold are automatically saved and updated in the Secure Memory Module. The following sections describe menu operation.

NOTE:

Do not modify ANY Sub menus, while the serial interface or A-B RIO are attempting to modify information.

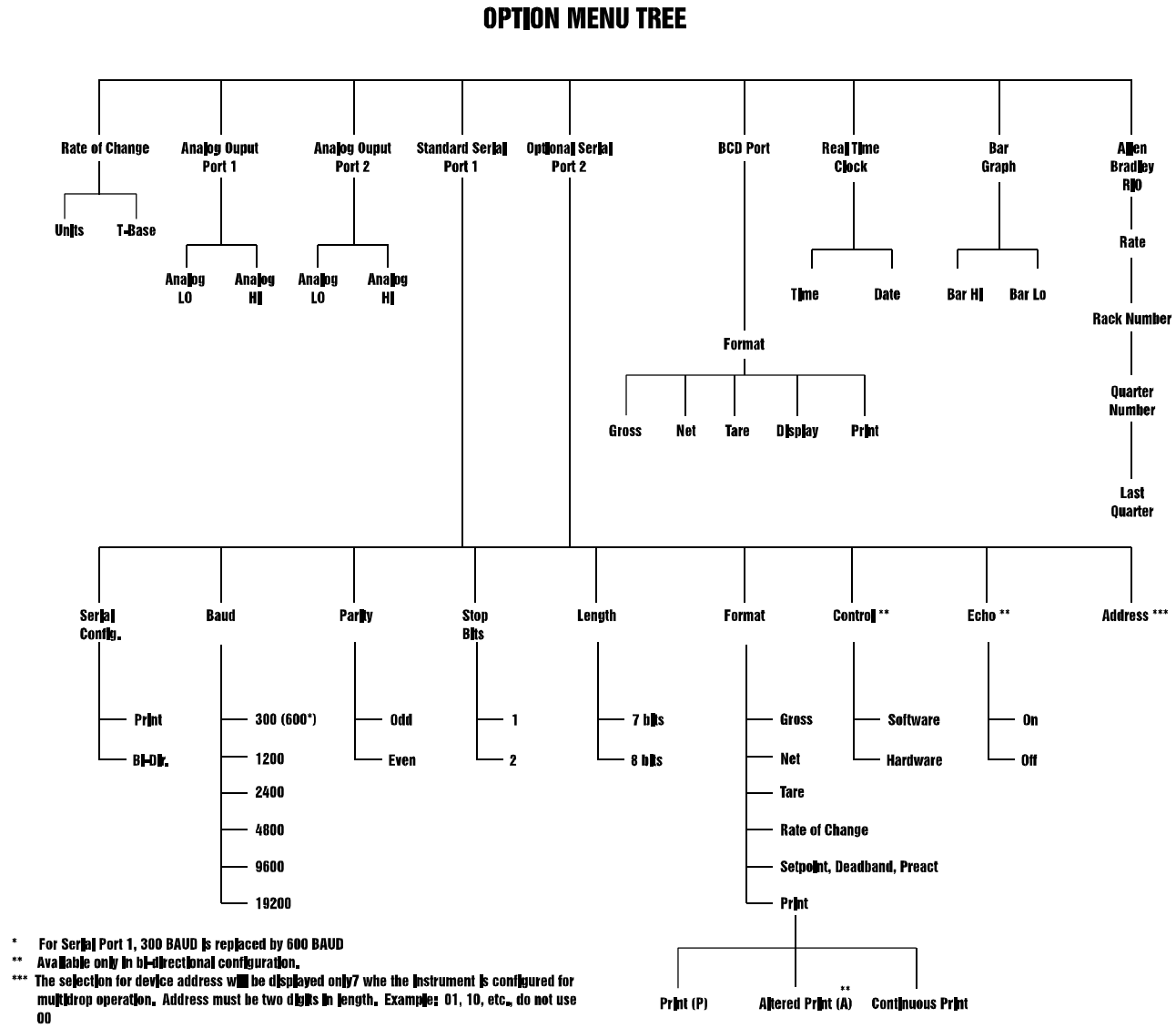


Figure 4-1. Optional Menu Tree

This section provides instructions for installing, configuring, and operating the option boards and the control options which are available for your HI 2151/20WC.

4.2 OPTION BOARDS

The Hardy Instrument option boards add capabilities beyond the standard HI 2151/20WC instrument. They are easily installed into the option board slots, labeled Option 1 and Option 2 on the back of the instrument.

General Information

NOTE

If your options have already been installed at the factory, move on to section 4.3 Setpoints.

The options are implemented by installation of the appropriate optional circuit board onto the main analog/digital board in the instrument (top board). In some cases, the specific option is then implemented by installing a custom Secure Memory Module on the main board.

The following option boards are available for the HI 2151/20WC:

OPTION BOARDS

1. Analog Output board (voltage and current; outputs Net, Gross, Total*, ROC*, or Peak Hold*). P/N 0551-0326, model HI2151/20xx-B1.
   (* if ordered)

2. Parallel BCD board, tri-stated. With 6" cable P/N 0551-0327, model HI2151/20xx-B2. With 24" cable P/N 0509-0389-02, model HI 2151/20xx-B9. With 60" cable P/N 0551-0330, model HI2151/20xx-B5.

3. Serial (RS-232C or 20 mA Current Loop) board. P/N 0551-0328, model HI2151/20xx-B3.

4. Serial (EIA-422/485) board. P/N 0551-0329, model HI2151/20xx-B4.

5. Allen-Bradley RIO. P/N 0551-0351, model HI2151/20xx-B8.

Refer to Section 4.4 Hardware Option Boards - RS-232C through Section 4.5 Parallel BCD Communication for a description of all option boards.

Option slots are labeled on the top circuit board as follows:

READ PANEL LABEL	26 PIN CONNECTOR NUMBER
Option 1	J5
Option 2	J4

Output Option Boards may be ordered and installed into these slots as follows:

BOARD	QUANTITY	OPTION SLOT
Analog	2	1 and/or 2 (Position 1 is preferred due to option cover compatibility)
BCD	1 only	2
RS-232C or EIA-422/485	1 only	1 or 2
A-B RIO	1 only	1

Only one RS-232C, RS-422/485, or AB RIO may be installed at a time.

WARNING

Dangerous voltage is present within the enclosure of the unit and presents the risk of electrical shock. Always unplug the power cord before opening and servicing the unit.

CAUTION

Installation and servicing of this unit should be performed by authorized and qualified service personnel only. Follow Electrostatic Discharge (static) procedures when opening unit.

4.2.1 OUTPUT OPTION BOARD INSTALLATION:

1. Unplug the enhanced unit.
2. Detach all interconnect cabling and remove the enhanced HI2151/20WC from its mounting.
3. Remove the four screws holding the rear panel.
4. Slide the rear panel, including all the boards, out of the case.
5. Remove the appropriate option cover from the rear panel (Option 1 or 2 cover) as required. Option 1 cover has two perforations as shown in Figure 4-2 Optional Label Cover to allow removal for different options.
6. Refer to Figure 4-3 Output Option Board Installation for installation details of Option Boards. Each Option Board is furnished with four mounting screws to secure it to the main board. The main board has pre-mounted standoffs which accept any of the Option Boards in either position. Note however, the BCD board may be installed only in the Option 2 slot which is sized for the BCD connector.

(Continued on page 4-7)

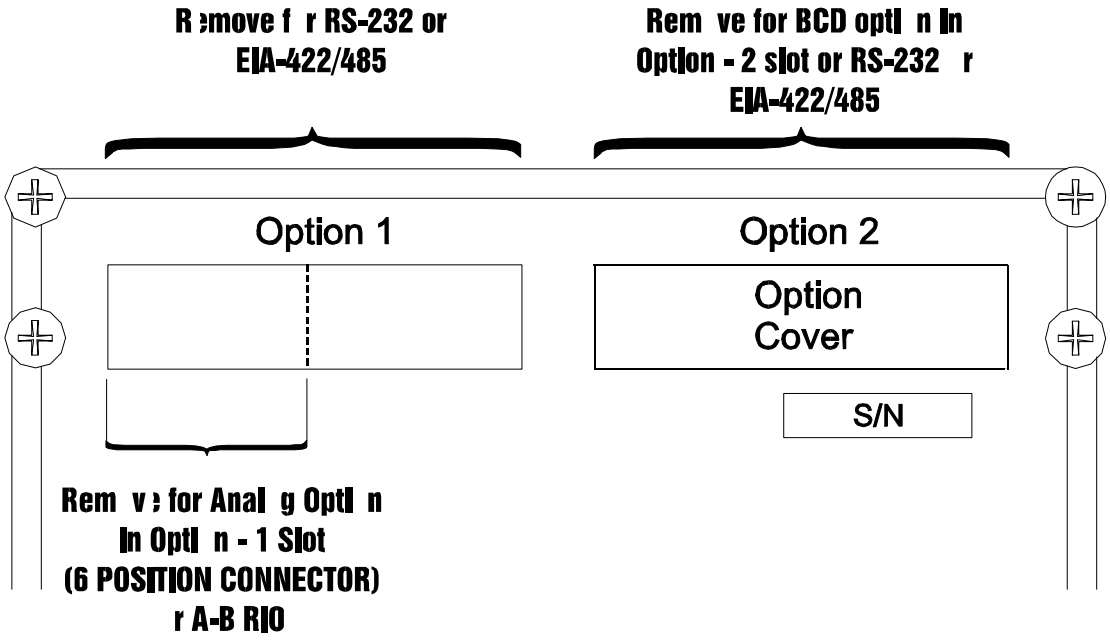
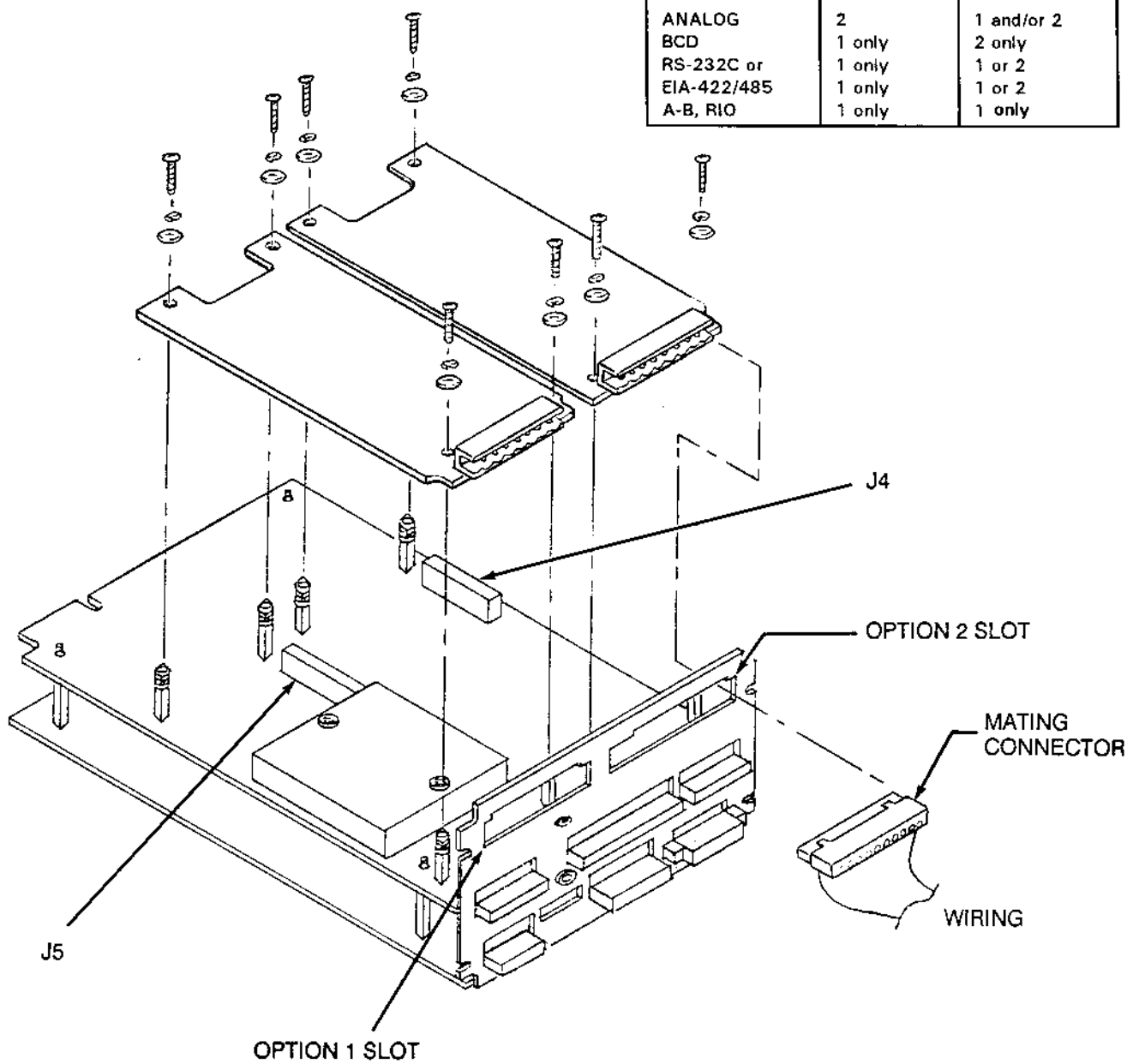


Figure 4-2. Option Label Cover

OPTION CARDS/OPTION SLOT POSITIONS		
CARD	QUANTITY	OPTION SLOT
ANALOG	2	1 and/or 2
BCD	1 only	2 only
RS-232C or	1 only	1 or 2
EIA-422/485	1 only	1 or 2
A-B, RIO	1 only	1 only



NOTE: Pin number 1 will always be on the left side of the unit (when facing the rear panel) except for the parallel BCD board.

Figure 4-3. Output Option Board Installation

OUTPUT OPTION BOARD INSTALLATION - CONTINUED

7. Position the Option Board over the standoffs and carefully align the mating connector pins of the Option Board with the appropriate socket position, J4 or J5, on the main board. Ensure that the connector pins are guided straight into the socket.
8. Push down on option board to seat option connector pins into the socket on main board. Visually verify that all of the pins have been properly seated into the mating connector.
9. With the option board resting on top of the 4 standoffs on main board, install the four screws, lock washers, and flat washers.
10. Finally, re-install the main board set into the instrument.

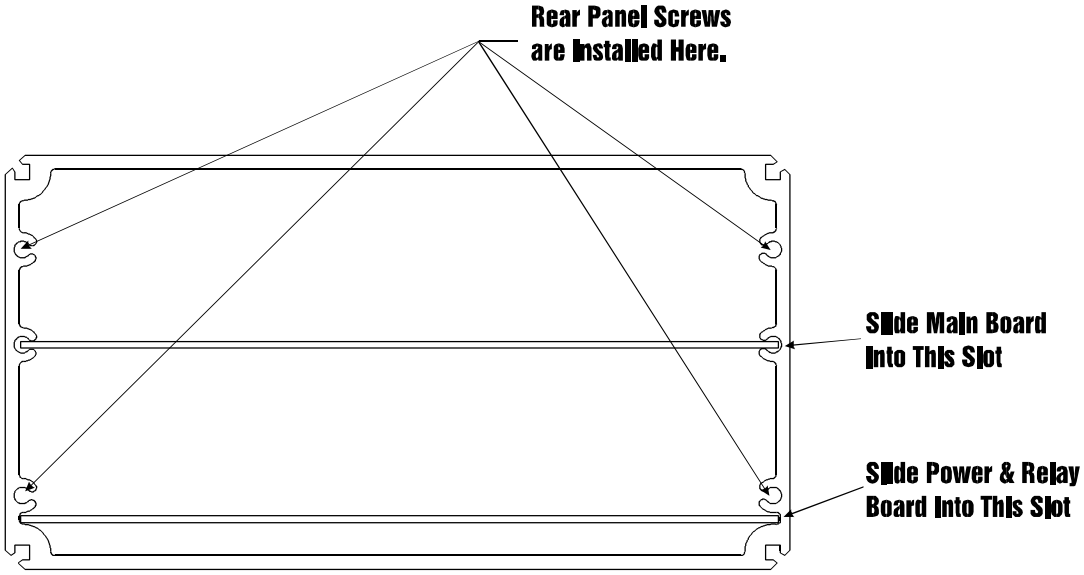


Figure 4-4. HI 2151/20WC Housing for Main Board, Power and Relay Board Alignment

4.3 SETPOINTS

Each instrument contains 2 standard setpoint relays. These are SPDT (3 Form C) relays internally mounted on the power and relay board.

Six additional TTL outputs, rated at 300 ma per line, are available as a software option. Six triac relays are also available on an externally mounted option card. The relays used on the setpoint relay option board (Figure 4-5 Setpoint Relay Option Board) are 115 VAC, solid state triacs. Each relay has a fuse on the board rated at 5 amperes. The relays are rated at 3 amperes continuous duty and 5 amperes intermittent duty. The minimum load current is 20 milliamperes. Each relay may be configured by a dipswitch (on the board) either normally open or normally closed. The interface to the relays must draw a minimum of 20 ma.

WARNING

The contacts on the solid state relay will open if a power failure occurs. A lit LED indicates that the relay has been activated.

This board is equipped with six relay outputs. All relays operate in the same manner. There are three values associated with each relay. They are the setpoint value, the preact value, and the deadband value. These values are set using the setpoint menu.

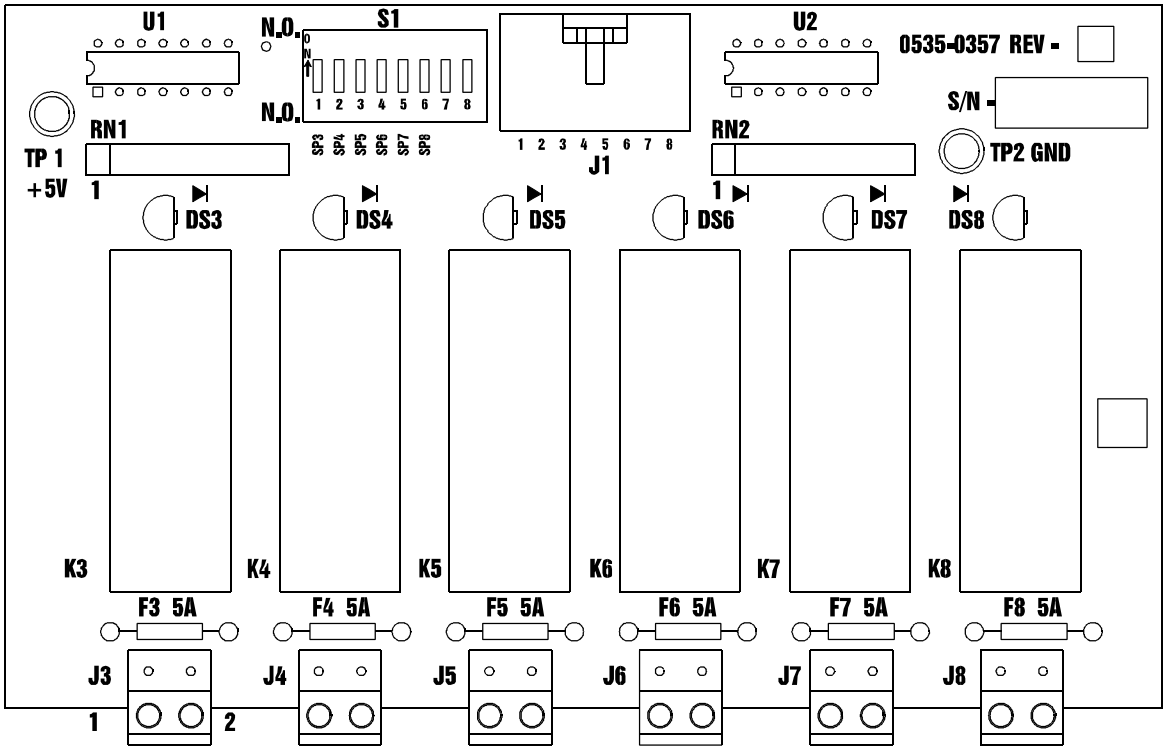


Figure 4-5. Setpoint Relay Option Board

The setpoint value is the target weight or level. It may be set in either net, gross, ROC, total, or peak hold weight units. When entering this value, the corresponding LED flag will appear on the display. The operator may toggle this flag to the desired mode using the MODE key. Refer to the Setpoint Limits section following installation for a description of setpoint limits.

Setpoint Relay Installation:

The setpoint relay option board must be installed outside of the HI 2151/20WC as follows:

a. Locate a clear, flat mounting area within five feet cable distance of the HI 2151/20WC.
b. Use the measurements shown in Figure 2-1 HI 2151/20WC Installation Details to make four mounting holes.
c. Drill 3/16-inch holes where marked.
d. Install four P/N 2815-0063 standoffs in holes.
e. Install relay option board on standoffs.
f. Connect P/N 0509-0390 ribbon cable between relay option board jack J1 and J4 on the rear panel of the HI 2151/20WC (refer to Figure 2-2 HI 2151/20WC Rear Panel Connections).

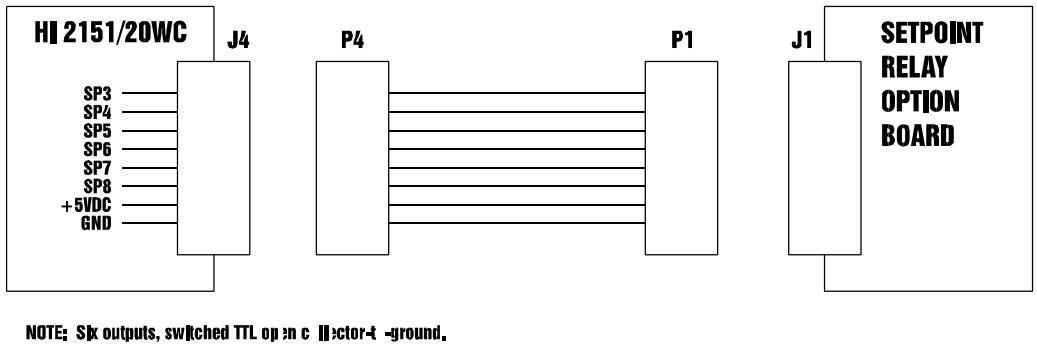


Figure 4-6. Setpoint Relay Option Board Installation and Wiring

SETPOINT LIMITS

The deadband value can be set as a positive or negative value. It is used to prevent relay chatter once the setpoint is reached. For example: if a setpoint value was 1000 pounds and the deadband was set to -5 pounds, the relay would close at a 1000 pounds but not open until the weight dropped to 995 pounds. This would be used if a setpoint is a high trip limit. A positive deadband would be used for a low trip limit. Examples are shown in Figure 4-7 Low and High Trip Limits. Using a setpoint of 1,000 pounds and a deadband of -800 pounds will cause the level to remain between 200 and 1,000 pounds.

NOTE

The deadband should be numerically larger then the preact.

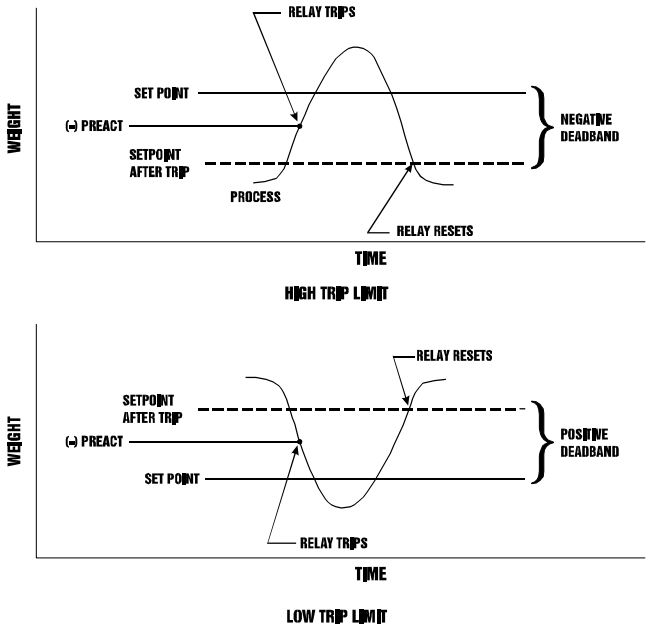


Figure 4-7. Low and High Trip Limits

The preact value is the number of units below (negative value) or above (positive value) the setpoint value at which the relay will trip. It can be used as an "in-flight" compensation value when filling a vessel. If set to zero, there will be no compensation. This would be the normal setting if a setpoint were used as a level indication.

SETPOINT MENU (For Standard and Optional Setpoint Configuration)

This menu is used to enter the setpoint, deadband, and preact values for the two standard internal relays. It is also used to enter the associated values for the six optional, external relays when installed.

NOTE:
To scroll forward or reverse through the Setpoint Menus, press the Up or Down arrow keys.

PROCEDURE	KEY	DISPLAY
1. Enter Setpoint Menu		
NOTE: Previously assigned setpoint value will be displayed. For this example, the setpoint value will be set to 500.		
a. Press 6/SetPt key to select setpoint menu.	6/Set Pt	**rLy-1**
b. Press Enter key to select setpoint #1.	Enter	**SPnt-1**
c. Press Enter Key to select setpoint value.	Enter	**100**
NOTE: The mode status display indicator flashes on the present setpoint mode. To change modes, press the round mode button until the desired mode display flashes.		
d. To enter a new setpoint value, press -/Test/Clr key.	-/Test/Clr	**0**
e. Press the number keys to enter new setpoint value.	5 0 0	**500**
f. Press Enter key.	Enter	**Good** *

* Display momentarily flashes good if value is a valid entry.

Setpoint Menu - Continued

PROCEDURE	KEY	DISPLAY
2. Enter Deadband Tolerance		**dbnd-1**
a. Press Enter key to select deadband #1.	Enter	**-0.01**
b. To enter a new deadband value, press the -/Test/Clr key.	-/Test/Clr	**0**
c. Press the -/Test/Clr key for a negative value.	-/Test/Clr	**-0**
d. Press number keys to enter new deadband value.	1 2 5	**-125**
e. Press Enter key.	Enter	**Good** *
3. Enter Preact value.		**PrE - 1**
a. Press Enter key to select preact value.	Enter	**0.00**
NOTE: Previously set preact value will be displayed. For this example, the preact value will be set to 20.		
b. To enter a new value, press -/Test/Clr key.	-/Test/Clr	**0**
c. Press the -/Test/Clr key for a negative value.	-/Test/Clr	**-0**
d. Press number keys to enter new preact value.	2 0	**-20**

* Display momentarily flashes good if value is a valid entry.

Setpoint Menu - Continued

PROCEDURE	KEY	DISPLAY
e. Press Enter key.	Enter	**Good** * **Spnt- 1**
f. Press 0/Exit key to advance to relay 2.	Exit	**rLy-2**
g. Repeat above procedure to enter relay 2 parameters.		
h. IF the option for 8 relays is active, enter relay 3-8 at this time.		
i. Press Exit key to resume normal operation or enter parameters for optional relays.	Exit	**-**

4.4 SERIAL COMMUNICATIONS

The standard serial port is compatible with RS-232C signals and may be configured as a printer output port or as a bi-directional communication port. Transmission speed is selectable from 600 to 19.2K baud and may be configured for a continuous data output mode. The port allows host computer control using ASCII character commands and supports multiple weight controllers via the multidrop configuration.

RS-232C SPECIFICATIONS

SPECIFICATION	DESCRIPTION
High Level Output	+11V at 5 mA
Low Level Output	-11V at -5 mA
High Level Input	+4V to +15V
Low Level Input	+1.6V to -15V (Schmit trigger input disallows logic changes with voltages between these ranges.)
Slew Rate	15V per microsecond maximum
Input Impedance	20K ohms
Clear to Send	(Input) A high level indicates the receiving device is ready to accept data. In the (J3-1) print mode, CTS must be wired to printer BUSY. Connecting RTS and CTS is insufficient. In the bi-directional mode a CTS signal (high level) must be furnished by the receiving device.
Request to Send	(Output) A high level indicates the instrument is ready to receive data.
RXD (Data In)	Accepts RS-232C data signals.
TXD (Data Out)	Between characters, the transmission level will show a start bit or binary 0.
GND	SIGNAL GND
Update Time	10 updates/sec.

Serial port connections are made to J3, located on the rear panel, through the mating plug P3. The pin-out designations are:

PIN	SIGNAL NAME
1	CTS
2	RTS
3	$\overline{\text{RXD}}$
4	$\overline{\text{TXD}}$
5	+5v
6	GND

The standard RS-232C port is located on the main board inside the unit and may be configured through the option menu. It is identified as SER P1. Refer to Section 4 Serial Port 1 (Standard) and Port 2 (Optional) Menu Setup Procedure for menu operation.

4.4.1 BI-DIRECTIONAL COMMUNICATIONS

HARDWARE OPTION BOARDS - RS-232C

Description

One RS-232C Option Board (Figure 4-9 RS-232C Board) may be installed in either Option Slot 1 or 2 (an RS-422/485 or A-B RIO Option Board may not be installed in the other Option Slot, only one optional serial communication board per unit). This Option Board supports RS-232C serial data transmission and current loop communications. The board is user-selectable as a print-output only port or as a bi-directional control port through the Option Menu. The outputs are electrically and optically isolated from the main board.

RS-232C SIGNALS	DESCRIPTION
High Level Output	11 volts at 5 milliamperes
Low Level Output	-11 volts at -5 milliamperes
High Level Input	+2 volts to +15 volts with 20k ohms input resistance
Low Level Input	+0.8 volts to -15 volts with 20k ohms input resistance
Slew Rate	15 volts per microsecond maximum
Isolation	300 VAC or 450 vdc

RS-232C SIGNALS	DESCRIPTION
Clear to Send	A high level input indicates the receiving device is ready to accept data, connecting RTS and CTS is insufficient.
Request to Send	A high level out indicates the instrument is ready to receive data.
TXD (Data Out)	Between characters it is in a mark condition: LOW. A start bit or binary 0 bit in a character will be logic HIGH at this pin.
RXD (Data In)	Accepts RS-232C data signals

CURRENT LOOP SIGNALS	DESCRIPTION
I Out	Marks at 20 mA minimum with compliance of 10 volt (at 500 ohms maximum). Logic 0 current is less than 20 microamperes.
I In	Accepts from 10 to 50 mA as logic 1. Logic 0 is less than 3 mA. Moving the RCV jumper from the W3 to the W4 position enables current input for transmitted data.
DIS (Transmit Disable)	If TREN jumper W1 is installed, positions 2, 3, 4, and 5 will only be active when a TRANSMIT DISABLE signal is present at position 6. If TREN jumper W2 is installed, the TRANSMIT DISABLE signal at position 6 will not affect the output of positions 2, 3, 4, and 5.

Installation

Follow the instructions in Section 4 General Installation for board installation.

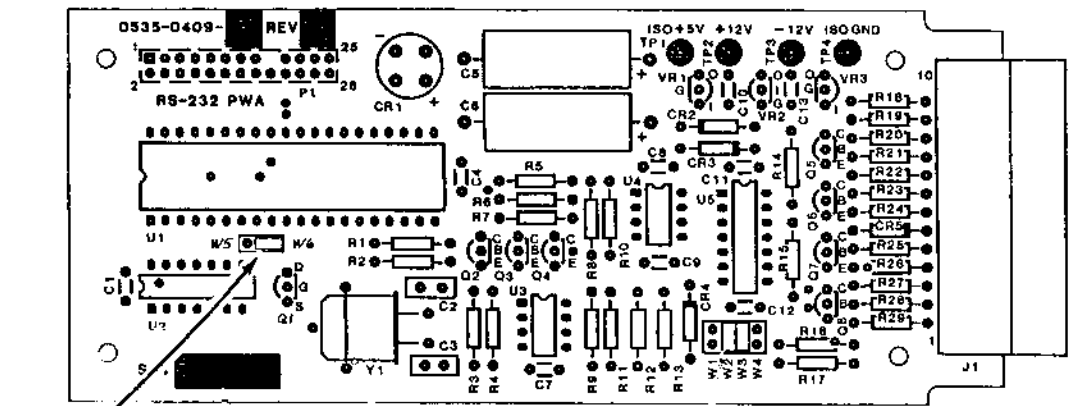
The cable is connected to the RS-232C option board at P1 (Figure 4-9 RS-232C Board). The connector can be pulled off the header posts for ease in connecting the cable. The pinouts for serial and current loop transmission are:

SERIAL TRANSMISSION

PIN	SIGNAL NAME
1	GND
2	TXD
3	RXD
4	RTS
5	CTS
6	DIS (Transmit Disable)
8	Ground
9	Ground

CURRENT LOOP TRANSMISSION

PIN	SIGNAL NAME
5	CTS tied HI
7	Current Out (Transmit)
8	Return
9	Return
10	Current In (Receive)



W1	= Transmit disable	Enables the receiving device to disable transmit.
W2	= No transmit disable	Not used
W3	= No current loop received	Disable 20 mA current loop.
W4	= Current loop received	Enables 20 mA current loop.
W5	= No CTS	No handshake
W6	= CTS on	Handshaking enables.

Figure 4-8. RS-232C Board

Operation

The RS-232C board is configured through the Option Menu. The option board will always be SER P2 in the menu. After entering the Serial Port 2 menu, the board can be set up for the appropriate application. (For Menu Set-Up Procedure, see Section 4.4 Serial Communications)

HARDWARE OPTION BOARDS - RS-422/485

Description

The RS-422/485 option board (Figure 4-10 RS-422/485 Option Board) may be installed in either option slot 1 or 2 and will act as the second serial port in the HI-2151/20WC. It may be configured to meet RS-422 or RS-485 requirements providing drive over long distances. With the Hardy Link option, two way multidrop communication can take place between any of the Hardy Instruments series 2100 controllers and a host computer. This option board is electrically and optically isolated from the main board to provide a more reliable communications port.

Installation

Refer to Section 4.2 Output Option Board Installation.

Operation

Operation of the RS-422/485 option board consists of properly configuring the board and executing commands over the port. Commands available and their actions are identical to the commands for the RS-232C board and are described in Section 4.4 Instrument Serial Communications.

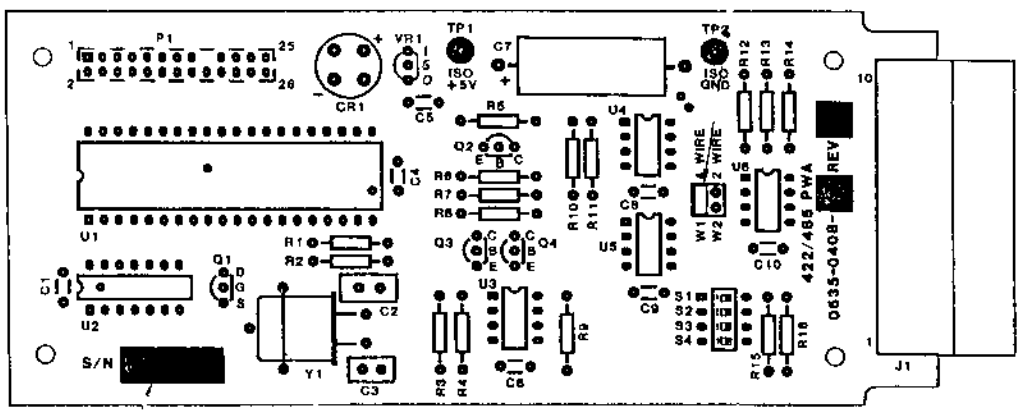


Figure 4-9. RS-422/485 Option Board

Description of 422/485 Transmission Modes Available

Many devices available today are called RS-422/485 because their electrical signals meet or exceed both specifications. This does not necessarily mean they both meet the strict intent of RS-485 to provide for two wire multidrop networks. They are instead multidrop RS-422 or four wire RS-485 networks. This option board is jumper selectable two or four wire communication. In addition, S4 on the option board allows the board's transmitter to always be enabled (**S4 off**) or selectively tri-stated (**S4 on**). S1 and S3 are 1k ohm Tx+ pull up and Tx- pull down resistors, typically switched ON for the last unit in a multidrop "chain."

The following table describes transmission mode switch settings:

Table 4-1 RS-422/485 Option Board Mode Configuration

MODE	JUMPERS W1 4 WIRE	JUMPERS W2 2 WIRE	S4 MULTIDROP	DIP SWITCHES S1 & S3 Tx+/- PULL UP/DOWN
INDUSTRY STANDARD "EIA" MODES				
EIA-485 2 wire multidrop		X	ON	ON (one unit only)
EIA-422 4 wire singledrop	X		OFF	ON (one unit only)
ADDITIONAL NON-STANDARD TRANSMISSION MODE				
Used most frequently. Only one "host" permitted.				
EIA-485 4 wire / EIA-422 multidrop	X		ON	ON (one unit only)

INDUSTRY STANDARD "EIA" MODES

EIA-485

The option board will be operating in true RS-485 mode when configured as two wire (2 wire jumper) with the transmitter enabled (S4 off).

EIA-422

If the board is in the four wire (4 wire jumper) mode with the transmitter always enabled (S4 off), then the board operates in a true RS-422 mode. This flexibility allows compatibility between the host computer and the HI 2151/20WC.

ADDITIONAL NON-STANDARD TRANSMISSION MODE

Used most frequently. Only one "host" permitted.

Four wire RS-485 or multidrop RS-422 mode

When configured in four wire mode with the transmitter selectively tri-stated (S4 on), the board is operating in a four wire RS-485 or multidrop RS-422 mode. This configuration doesn't meet either specification but can be easier to program than either true specification.

RS-422/485 Wiring and Electrical Specifications

Serial communication signal configuration and wiring is dependent on how the board is configured. The following notes are typical methods of connection. It should be realized that these methods vary and are only furnished to offer a starting point for configuration:

SIGNAL GROUNDS

A direct connection between signal grounds of the different devices is not desirable, rather a connection with approximately 100 ohms of resistance is recommended. This resistor is provided in the HI 2151/20WC circuit. Signal ground should NOT be used as a shield.

EARTH GROUND CABLE SHIELD

Typically, cable shields are tied to ("frame") ground at the end that is the best earth ground.

Pick up frame ground on the HI 2151/20WC with the phillips head screw on the rear of the instrument labeled Shield.

CABLE TYPE

The Tx+/Tx- and Rx+/Rx- wires are twisted pair (with outer shield).

SERIAL CONNECTOR

Each function is wired to two pins to allow only one wire to be put in each terminal position. (The same electrical signal is routed to pins one and two on the board.)

EIA-422/485 CONFIGURATION WIRING

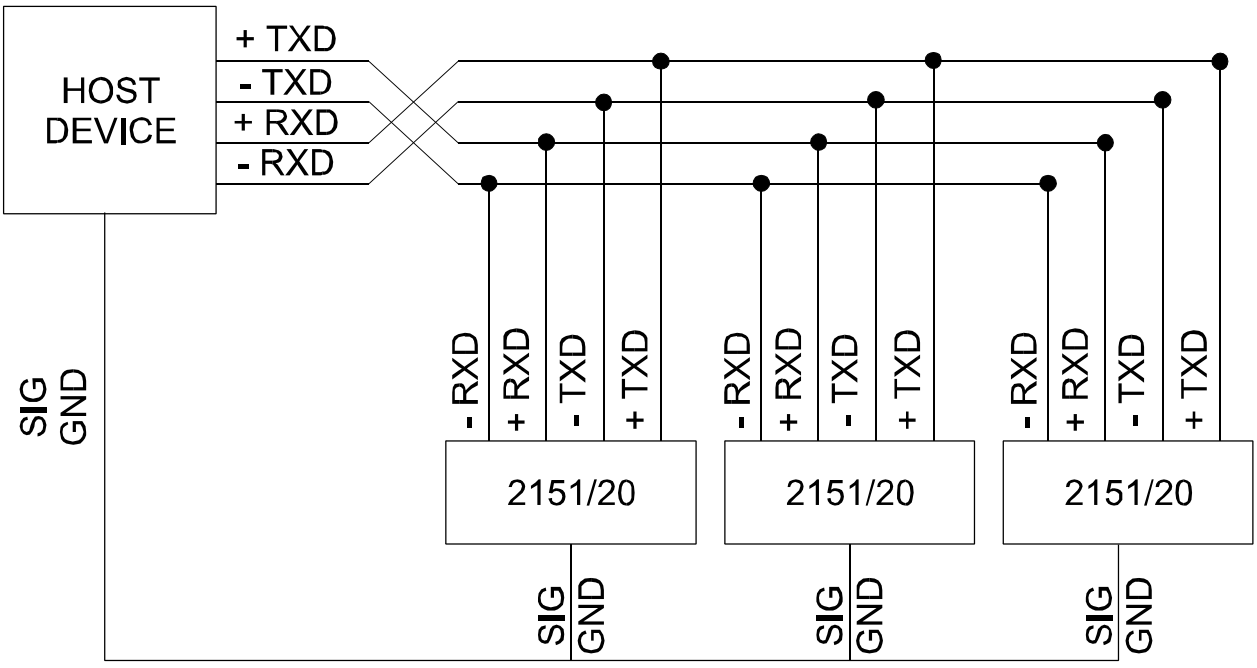
OPTION CONNECTOR PINS	TWO WIRE	FOUR WIRE
1, 2	Tx- & Rx-	Tx-
3, 4	Tx+ & Rx+	Tx+
5, 6	Not Used	Rx-
7, 8	Not Used	Rx+
9, 10	SIGNAL GROUND	SIGNAL GROUND

See the diagram on the next page.

EIA-422/485 ELECTRICAL SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Receiver Impedance	12 k ohm
Receiver Common Mode Range	+12 to -7 V
Maximum Input Threshold	+200 mv
Minimum Input Hysteresis	50 mv
Driver Output Capability	+60 ma at 2 V differential
Driver Short Circuit Limit	250 ma to +12 or -7 V
Bus Loading By Unpowered Board	One Receiver Load

For menu setup procedure, see Section 4.4 Serial Communications.



INSTRUMENT SERIAL COMMUNICATIONS

The HI 2151/20WC's serial options provide the user with a full complement of RS-232C, current loop RS-422, and RS-485 communications. There is a standard RS-232C serial port on the main board which may be configured as an output only port to drive a printer or similar device, or as a bi-directional port for both status and control. Additionally, a RS-232C or RS-422/485 serial option board may be installed in the instrument.

PRINTER OUTPUT

Below is an example of the printout with the weight controller formatted for Gross, Net and Tare.

```
>
 GROSS    1.430 LB
 NET   0.430 LB
 TARE  1.000 LB
```

SERIAL PROTOCOL - RING AND MULTIDROP MODES

Hardy Instruments' 2100 family of weight and batch controllers employ an ASCII command protocol and accompanying command set, described in the following paragraphs. The protocol is via RS-232 or RS-422 hardware, with the network being called Hardy Link. Hardy Link supports a ring or multidrop configuration.

Serial Protocol - Multidrop Mode

Multidrop is a configuration denoting that there are multiple HI 2151/20WC units connected to a host computer whereby each HI 2151/20WC receives and sends data through a unique address. The fastest possible instrument response will be from the multidrop configuration. The multidrop configuration also lends itself well to host computer control of multiple weight and batch controllers. An RS-422/485 option board is utilized and provides excellent noise immunity and drive capability supporting long cable runs.

NOTE:

The 2100 family of weight and batch controllers contain intelligent front ends to a distributed system, therefore network speed is not usually critical.

Serial Protocol - Ring Mode

The ring mode configuration is an RS-232C optional configuration whereby the HI 2151/20WC relays each serial message received onto the next unit. This configuration is not as flexible as the multidrop configuration, and is typically used only when requiring a simple printed output from two or more instruments.

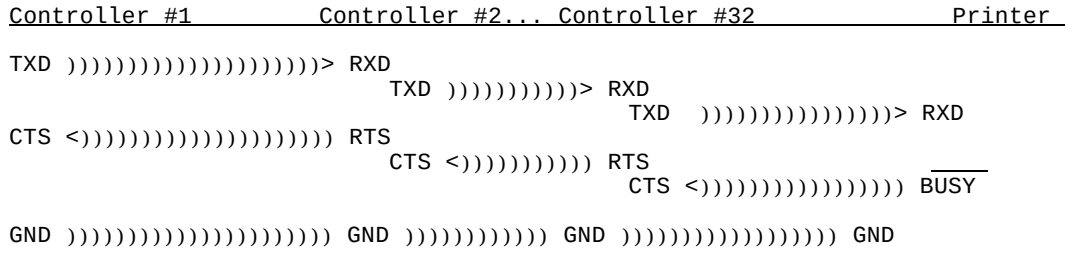
To send a command to the third controller in a ring of five controllers, the command must be passed on by the first two controllers. The third controller receives the command, acts on it and transmits the response to the fourth controller. The response then gets passed to the fifth controller, then finally back to the host.

It is advisable to limit periodic requests to commands that will result in short responses. For instance, if gross and net are both required, the format on the HI 2151/20WC could be set up as GN and the request made with an X (transmit) command.

The time to complete a request is approximately (time of transmission + 0.1 sec) X (number of units). The 0.1 second is the approximate internal worst case processing time of each received and transmitted message.

The ring configuration may utilize the standard Serial port or the optional RS-232C option. The wiring configuration for multiple controllers sharing a printer would be as follows:

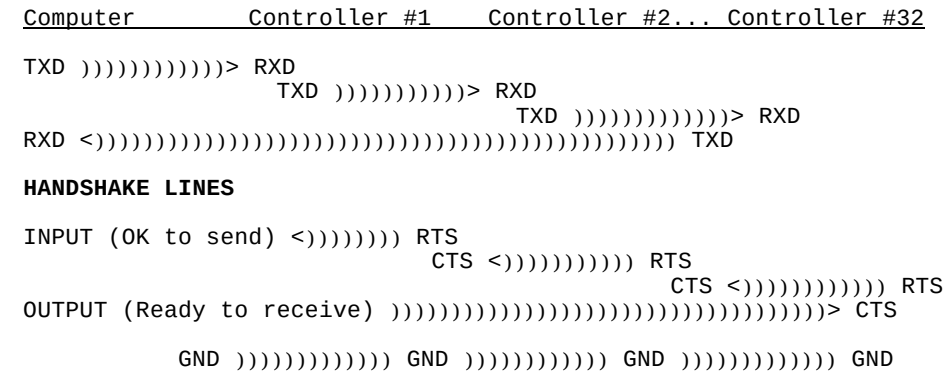
MULTIPLE CONTROLLER CONNECTION TO SERIAL PRINTER - RING CONFIGURATION



The last controller is configured to strip all checksums and End Of Text bytes before passing information to the printer. This configuration is accomplished in the serial port format menu by specifying an "A" in the print location.

The wiring configuration for a host computer communicating with multiple controllers in a ring configuration would be as follows:

HOST COMPUTER CONNECTION TO MULTIPLE CONTROLLERS - RING CONFIGURATION



DATA FORMATS

Relays, dip switches and LED data along with weight data have their own special format for transmission. These formats are described in the following two sections.

Data Formats - Binary Representation

Relay, dipswitch and LED numbers are represented by the binary bit position. In the case of a relay, 0 disables the relay and a 1 enables the relay.

binary bit position:	7	6	5	4	3	2	1	0
relay, dipswitch or LED number (binary bit position +1):	7	6	8	1	2	3	4	5
For example, to enable relays 4 and 8, the following would be the binary representation:	0	0	1	0	0	0	1	0

This would be 22 hex, hence the command to enable relays 4 and 8 would be E 22.

Data Formats - Weight Data Format

Weights are transmitted according to the following rules:

A. Positive numbers: Maximum of 6 numeric + decimal point.

B. Negative numbers: Maximum of 5 numeric + minus sign + decimal point.

EXAMPLES:

TRANSMITTED	CORRECT?	RECEIVED	REASON
-123.45	Y	-123.45	5 numerics + minus sign + decimal point (B above).
1234.56	Y	1234.56	6 numerics + decimal point (A above).
-12345	Y	-12345	5 numerics + minus sign (B above)
-123456	N	-12345	The "6" would be truncated since only 5 numerics + the minus sign is legal (B above).
12345.67	N	12345.6	The "7" would be truncated since only a maximum of 6 numerics + decimal point is legal (A above).

SERIAL COMMANDS

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

The front panel serial port menu allows setup of serial communication parameters, i.e. BAUD, parity, etc. Refer to Section 4.4 Serial Port 1 (Standard) and Port 2 (Optional) Menu Setup Procedure for details.

Serial Commands - Data Transmission Format

The following table uses the following mnemonics corresponding to the outgoing command format (some of which are optional):

MNEMONIC	MEANING	NUMBER OF ASCII BYTES
CMD	Command	1
SUB-CMD	Subcommand	1 to 3
DATA-n	Data byte n	1 to 7
MODE	Mode	1
CR	Carriage return	1

Serial commands are transmitted from the host to the instrument (in ASCII bytes) in the format:

Control characters are transmitted in HEX. (See the ASCII to HEX table in Appendix G)

An example using the "x" transmit command with Hardy Link and an address of 10 is:

START CHAR	INSTRUMENT ADDRESS	CMD	SUB-CMD	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. A leading zero (i.e. 01) is required for single digit addresses for serial port #2.

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

3E	31	30	20	58	20	47	0D	34	44	04
>	1	0		X		G	CR	4	D	EOT

An example using the "x" transmit command without Hardy Link is:

START CHAR	CMD	SUB-CMD	CR	2 BYTE CHECKSUM		EOT
				CHK-1	CHK-2	
>	X	G	CR	CHK-1	CHK-2	EOT

Serial Commands, Command Set

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).

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

= 14d	
- 100	

= 4d	

Serial commands are transmitted from the instrument back to the host in the format they were received from the host with the return data (and units) added to the message and a LF added to the CR.

Using the above example, the return data would be:

START CHAR	INSTRUMENT ADDRESS	CMD	SUB-CMD	7 BYTE DATA D-7 ... D-1	MODE	CR	2 BYTE CHECKSUM		EOT
							CHK-1	CHK-2	
>	10	X	G	D-7 ... D-1	Lb or Kg*	CR**LF**	CHK-1	CHK-2	EOT

* Lb or Kg follow data.

Serial Commands, Command Set - Continued

In the case where return data is appropriate for the command, an A is returned by the instrument in the form of:

START CHAR	INSTRUMENT ADDRESS	CMD	SUB-CMD	CR	2 BYTE CHECKSUM		EOT
					CHK-1	CHK-2	
>	10	A		CR**LF**	CHK-1	CHK-2	EOT

In the case of an error, the message returned would be:

START CHAR	INSTRUMENT ADDRESS	CMD	CMD	SUB	CR	2 BYTE CHECKSUM		EOT
						CHK-1	CHK-2	
>	10	N	9	9	CR**LF**	CHK-1	CHK-2	EOT

where 99 is the error number (see Section 6 Appendix D Error Codes and Definitions for a breakdown of error codes).

NOTE

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

The following section describes all of the instrument's serial commands. Commands new to the HI 2151/20WC and unavailable in the HI 2151WC are marked "---> NEW TO HI 2151/20WC".

COMMAND MEANING

X Xmit. When this command is issued without a subcommand, the type of data specified in the format command will be transmitted to the port issuing the request. When this command is issued with a subcommand only, the subcommand data will be transmitted. Only one subcommand per command is allowed.

Transmit data specified in SUB-CMD as follows:

SUB-CMD	MEANING
none	Default to data setup by the format command
A	Accumulated total
G	Gross
N	Net
T	Tare
DE	Deadband
P	Preact
S	Setpoint
DI	Dipswitch
L	LED Status
REL	Relay
REM	Remote
C	ROC

Serial Commands, Command Set - Continued

X Xmit - Continued

SUB-CMD	MEANING
REL	Relay

Bit	RELAY
01	5
02	4
04	3
08	1
10	2
20	8
40	7
80	6

SUB-CMD	MEANING
L	The L command returns a two-byte status, each bit describing the LED status.

The values returned are the hex values of the two bytes.

Byte 1: LED STATUS, BYTE 1	Byte 2: LED STATUS, BYTE 2
Bit 0 - Pounds led	Bit 0 - Rate of change led.
Bit 1 - Zero track led	Bit 1 - Alarm #2 led.
Bit 2 - Not used	Bit 2 - Alarm #1 led.
Bit 3 - Center zero led	Bit 3 - Peak led.
Bit 4 - Motion led	Bit 4 - Total led.
Bit 5 - Gross led	Bit 5 - Not used
Bit 6 - Net led	Bit 6 - Not used
Bit 7 - Kilograms led	Bit 7 - Not used

SUB-CMD	MEANING
DI	The HI 2151/20WC will return two bytes for the dip switches. Dip switch #1 is the one on the rear panel and Dip Switch #2 is internal to the unit located on the bottom power relay board.

Serial Commands, Command Set - Continued

X Xmit - Continued

SUB-CMD MEANING

DI - continued

Dip Switch #1 (S3)

Position	Bit	Function ("ON" position)	
1		80	Multi-drop
2		01	Calibrate toggle (Non NBS applications)
3		40	Serial command lockout (Requests OK)
4		02	Option menu lockout
5		04	Setpoint menu lockout
6		20	Spare
7		08	Lb/Kg, N/G, Tare and Zero lockout
8		10	Zero track

Dip Switch #2 (S2)

Position	Bit	Function ("ON" position)	
1		08	Ignore incoming checksums
2		10	On is averaged peak hold, Off is instantaneous peak hold
3		20	NBS
4		04	NBS Re-Cal toggle switch
5		40	Spare
6		80	Spare
7		02	Spare
8		01	Spare

SUB-CMD MEANING

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

SUB-CMD MEANING

REM Level status of the Remote Input connector (J2) pins.

Bit	Remote Function	Bit	Remote Function
01	Rate of change	10	Net
02	Totalizer	20	Lbs/Kgs
04	Display Hold	40	Tare
08	Option Hold	80	Print

Serial Commands, Command Set - Continued

X Xmit - Continued

SUB-CMD	MEANING
Q	The query command obtains a block of information as follows:

A. Gross weight (6 bytes plus label)
B. Net weight (6 bytes plus label)
C. Peak gross value reached (6 bytes plus label)
D. Internal counts (6 bytes)
E. Total net accumulation (6 bytes plus label)
F. Rate of change value (6 bytes plus label)
G. Not Used (6 bytes set to 000000)
H. Not Used (6 bytes set to 000000)
I. LED status (4 bytes)
J. Relay status (2 bytes)

COMMAND	MEANING
F	Format the output data. Used to configure data to be sent on a TRANSMIT or PRINT request. The SUB-CMD letters can be issued in any combination or order and are as follows:

SUB-CMD	MEANING
G	Gross
N	Net
T	Tare
R	ROC
S	Setpoint, Deadband, Preact

The last (6th) position is one of the following (must be accompanied by at least one of the above SUB-CMDs):

- Continuous printing.
P Key on front panel "triggers" output.

The default FORMAT is GNTRSP.

M Monitors the specified SUB-CMD data as follows by requesting a report whenever a change in the type of status occurs.

CAUTION:
Do not use this command if the system is configured in ring or multidrop modes. If used in multidrop mode, it will cause data transmission problems. It is intended only for single units.

Serial Commands, Command Set - Continued

M Monitors - Continued

SUB-CMD	MEANING
R xx	Relay number where xx is a two ASCII digit value.
D xx	Dipswitch number where xx is a two ASCII digit value.
L xx	LED number where xx is a two ASCII digit value.

This command is used to request a report whenever a change in status occurs in the subcommand selected. You may request the status of the Relays, Dipswitches, or LED's. Only one MONITOR subcommand may be issued per command. After the command is received, the instrument immediately sends back the present status of the subcommand requested followed by a # sign and a bell character (cntrl G). This can be used to mark the beginning of the MONITOR command. To select which particular Relays, Dipswitches, or LED's you want to monitor, enter the appropriate 2 byte Hexadecimal number after the subcommand. To shut off a MONITOR command; enter MONITOR command, subcommand and Hex 00.

COMMAND MEANING

S Set specified SUB-CMD data as follows:

SUB-CMD	MEANING
S y xxxxxxx	Setpoint value.
D y xxxxxxx	Deadband value.
P y xxxxxxx	Preact value.

xxxxxxx is up to a seven digit ASCII value.
y is the Setpoint Relay number.

Note that the above xxxxxx data may be followed by a MODE as follows:

Mode	Meaning	Mode	Meaning
N	Net	T	Total
G	Gross	P	Peak
R	ROC		

Serial Commands, Command Set - Continued

For example, to set setpoint one to 1000 Lbs gross on instrument number 10, the outgoing command would be as follows:

START CHAR	INSTRUMENT ADDRESS	CMD	SUB	CMD	7 BYTE DATA D-7 ... D-1	MODE	CR	2 BYTE CHECKSUM		EOT
								CHK-1	CHK-2	
>	10	S	S	1	1000	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.

COMMAND MEANING

C Allows you to change modes between Net/Gross, lb/kg, or Hold/Unhold Display.

SUB-CMD	MEANING
M	Toggles between Net and Gross weight mode.
U	Unit (toggles between Lbs. and Kg.)
H	Toggles between display hold and unhold.

A Used to auto tare or auto zero the instrument.

SUB-CMD	MEANING
T	Auto tare the instrument. (Scale must not be in motion.)
Z	Auto zero the instrument.(Scale must not be in motion and mode must be set to Gross)

P Print command. Functionally the same as the print key on the keyboard.

The data setup through the format command will be sent to the port configured as a printer.

Serial Commands, Command Set - Continued

COMMAND **MEANING**

P1 or **P2** **Print** to either ports **1** or **2**.

An optional "subcommand" of up to 37 ASCII characters may be entered and will be printed before the formatted data.

SUB-CMD **MEANING**

37 ASCII characters maximum.

H The ASCII characters supplied in the subcommand (maximum of 20 characters) will be printed as a **heading** and saved for each subsequent **X** - transmit or **P** - print command requested. Heading is not stored in the Secure Memory Module.

To remove the heading, transmit H with no subcommand.

H1 or **H2** The ASCII characters supplied in the subcommand (maximum of 20 characters) will be printed as a **heading** and saved for each subsequent **X** - transmit or **P** - print command requested.

To remove the heading, transmit H1 or H2 with no subcommand.

N Adds the current **net** weight to the accumulated total.

E A two ASCII digit hex number is transmitted with this command to **enable** a relay to be under the control of it's setpoint value. The power-on default is all relays enabled.

! This command is used to **reset** instrument communication. It is typically used when an error or unintelligible response is received from the instrument and should used sparingly. It is recommended that it not be used during "normal" communication retries (i.e. unintelligible response), but instead be used as a last resort (no response after retries are exhausted). Internally, it performs the same operations as done on instrument power-up. Refer to the REL Sub-Command under the X (Xmit) Serial Commands Command Set.

SERIAL PORT 1 (STANDARD) AND PORT 2 (OPTIONAL) MENU SETUP PROCEDURE

The standard and optional serial ports are configured through the option menu and are identified as SER P1 or P2 respectively. Following is a brief description of each parameter, followed by details on menu operation.

DISPLAY	MEANING
SERCON	Serial port configuration. The port can be used as either a print output port or as a bi-directional communication port.
BAUD	Baud rate selection. The baud rates that can be selected are: 300, 600, 1200, 2400, 4800, 9600, or 19,200 with the following exceptions: The standard port cannot communicate at 300 BAUD. The option port cannot communicate at 600 BAUD. (Using 300 and/or 600 baud communications may cause intermittent errors)
PARITY	Parity selection for transmission error detection. Allows parity to be set at even, odd, or no parity.
STOPS	Stop bit selection. Sets number of bits used to indicate end of a transmission frame. The number of stop bits can be set to 1 or 2.
LENGTH	Word length selection. Sets the number bits for each data word. Word length can be set to 7 or 8 bits.
FORMAT	Formats the serial data output. To configure the output use the left arrow key to select the code letter corresponding to the specific parameter(s). When the letter is flashing use the up or down arrow keys to toggle the code letter on the display. To enable a specific parameter, the code letter must be shown on the display. Pressing the -/Test/Clr key will restore all code letters. The codes are: G Gross Weight N Net Weight T Tare Value R Rate of Change (ROC) S Setpoint, Deadband, Preact Values
PRINT	Selects print mode. P sets print trigger and "-" sets continuous print.
BI-DIR	Selects bi-directional mode. The bi-directional codes are: A Altered print (removes checksums) P Bi-directional with print trigger - Bi-directional without print trigger.
ADDRESS	Selects the instrument address. This is a two digit value, being 01 to 99.

Serial Port 1 (Standard) and Port 2 (Optional) Menu Setup Procedure - Continued

DISPLAY	MEANING
ECHO	Selects whether instrument commands are returned or displayed. Echo can be turned on or off. If the (bi-directional only) Echo is turned on, commands sent to the instrument are returned. If turned off, only data transmitted from the instrument will be displayed.
CONTRL	Selects hardware and software handshaking control. The hardware mode controls Request to Send (RTS) lines. In this mode the receiving device must set Clear to Send (CTS) lines to high to enable transmission. The software mode controls the transmission by the following control codes: XOFF - (CTRL-S) halt transmission XON - (CTRL-Q) resume transmission When a serial port is configured for bi-directional communication with a Print Trigger format, the control port will respond to the remote function print or serial print command just like a print port.

COMMAND LOCKOUT

The following commands/functions may be disabled via the dipswitch labeled S3 Config on the instrument rear panel:

1. Format
2. Set
3. Change
4. Auto

Set dipswitch S3, position 3 (labeled Serial) to the ON position (down) to lockout the commands from the serial interface.

NOTE

If you have a problem with weight readings not changing or not being able to exit from a menu, check to see that the instrument has not been set in the Display Hold mode by a serial command. A C H (change hold) command will toggle between Hold and Unhold. There is no visual indication showing the present mode.

Serial Port 1 (Standard) and Port 2 (Optional) Menu Setup Procedure - Continued

PROCEDURE	KEY	DISPLAY
1. Enter Option Menu Setup by pressing 7/Option key.	7/Option	**R O C** *
2. Press up arrow until the desired serial port (1 or 2) is displayed on the screen.	↑	**SER P1** or **SER P2**
3. Press Enter key.	Enter	**SERcon**
4. Press Enter key (bi-directional or Print will be displayed).	Enter or	**bi - dir** **Print**
5. Use up or down arrows to choose between bi-directional or print. Use bi-directional for the example.	↑ ↓	**bi - dir**
6. Press Enter key.	Enter	**bAUd**
7. Press Enter key.	Enter	**9600**
8. Use up or down arrow keys to select 300, 600, 1200, 2400, 4800, 9600, or 19,200 with the following exceptions: The standard port cannot communicate at 300 BAUD. The option port cannot communicate at 600 BAUD. This example uses 19,200 BAUD.	↑ ↓	**19200**
9. Press Enter key.	Enter	**PARIty**

* Display may show an option other than "ROC", depending upon the options installed. The HI 2151/20WC will show the first available option, in this case, ROC.

** The current preset BAUD rate is displayed.

Serial Port 1 (Standard) and Port 2 (Optional) Menu Setup Procedure - Continued

PROCEDURE	KEY	DISPLAY
10. Press Enter key (none, even, or odd will be displayed).	Enter	**nonE** or **EVEn** or **odd**
11. Use up or down arrow keys to select (no parity for the example).	↑ ↓	**nonE**
12. Press Enter key.	Enter	**StoPS**
13. Press Enter (1 bit or 2 bits will be displayed).	Enter	**1 bit** or **2 bitS**
14. Choose either 1 or 2 stop bits by pressing up or down arrows (1 bit is used for the example).	↑ ↓	**1 bitS**
15. Press Enter key.	Enter	**LEnGtH**
16. Press Enter key (7 or 8 bits will be displayed).	Enter	**7 bitS** or **8 bitS**
17. Choose either 7 or 8 by pressing up or down arrows **8 bitS** (8 bits are used for the example).	↑ ↓	
18. Press Enter key.	Enter	**FORmAt**
19. Press Enter key.	Enter	**GntrSP**
a. Use up arrow to select "P" (to print on demand), or "_" (to print continuously).	↑	**GntrSP** or **GntrS -**

Serial Port 1 (Standard) and Port 2 (Optional) Menu Setup Procedure - Continued

	PROCEDURE	KEY	DISPLAY
b.	Use left arrow to move cursor one space to the left so that the "S" is flashing.		**GntrSP**
c.	Use up arrow to select "S" (to send setpoints to the printer), or "_" (setpoints will not be sent to the printer).	↑	**GntrS_P** or **Gntr_P**
d.	Use left arrow to move cursor one space to the left so that the "r" is flashing.		**GntrSP**
e.	Use up arrow to select "r" (to send rate of change to the printer), or "_" (rate of change will not be sent to the printer.	↑	**GntrSP** or **Gnt_SP**
f.	Use left arrow to move cursor one space to the left until the "t" is flashing.		**GntrSP**
g.	Use up arrow to select "t" (to send tare value to the printer), or "_" (tare value will not be sent to the printer).	↑	**GntrSP** or **Gn_rSP**
h.	Use left arrow to move cursor one space to the left until the "n" is flashing.		**GntrSP**
i.	Use up arrow to select "n" (to send net weight to the printer, or "_" (net weight will not be sent to the printer).	↑	**GntrSP** or **G_trSP**
j.	Use left arrow to move cursor one space to the left until the "G" is flashing.		**GntrSP**
k.	Use up arrow to select "G" (to send gross weight to the printer), or "_" (gross weight will not be sent to the printer).	↑	**GntrSP** or **_ntrSP**
	NOTE: At least one of the letters "G", "n", "t", "r", or "S" must be selected or an Error 54 will be displayed.		

Serial Port 1 (Standard) and Port 2 (Optional) Menu Setup Procedure - Continued

PROCEDURE	KEY	DISPLAY
20. Press Enter key.	Enter	**ContrL***
21. Press Enter key. (software or hardware control will be displayed).	Enter	**SOFtrE** or **HArdrE**
22. Choose either parameter by pressing up or down arrows (example: software control).	↑ ↓	**SoftrE**
23. Press Enter key.	Enter	**ECHo*** **OFF**
24. Press Enter key. (on or off will be displayed).	Enter	**On** or
25. Choose either parameter by pressing up or down arrows (off is used for the example).	↑ ↓	**OFF**
NOTE: If the Hardy Link configuration is enabled, the address selection appears, otherwise skip to item 30:		
26. Press Enter key.	Enter	**AddrES****
27. Press Enter key. *(the current two digit address will be displayed).	Enter	*
28. Press -/Test/Clr key to clear the display.	-/Test/Clr	**0**
29. Enter the desired instrument address, 99 maximum (unit 10 is used for this example).	10	**10**
30. Press Enter key.	Enter	**good** **SErcon**
31. Press Exit key.	Exit	**SEr P1** or **SEr P2**
33. Press Exit key again to return to normal operation.		

* Available only when "Bi-dir" mode is selected, ** and the HardyLink option has been enabled.

4.5 PARALLEL BCD COMMUNICATION

Description

The BCD option board (Figure 4-11 Parallel BCD Board) is installed in option slot 2 and will provide parallel output of the sensed gross, net, or tare weight.

The board connector is a 40 pin right angle connector terminating to either a 37 pin D-subminiature assembly (option B-2) or a 40 pin connector and a 60-inch cable (option B-5). The B-5 option provides flexibility of terminating BCD signal lines to the terminal board options B-6 and B-7.

The pin designations for the BCD output are noted in Table 4-2 Cable Pinouts - Parallel BCD Board Connector to BCD Connector. All data outputs have a drive capability of 15 LSTTL loads (6 mA total) and use positive true logic. PRINT/NOT-PRINT has a drive capability of 10 LSTTL loads (4mA). This option board is electrically and optically isolated from the main board.

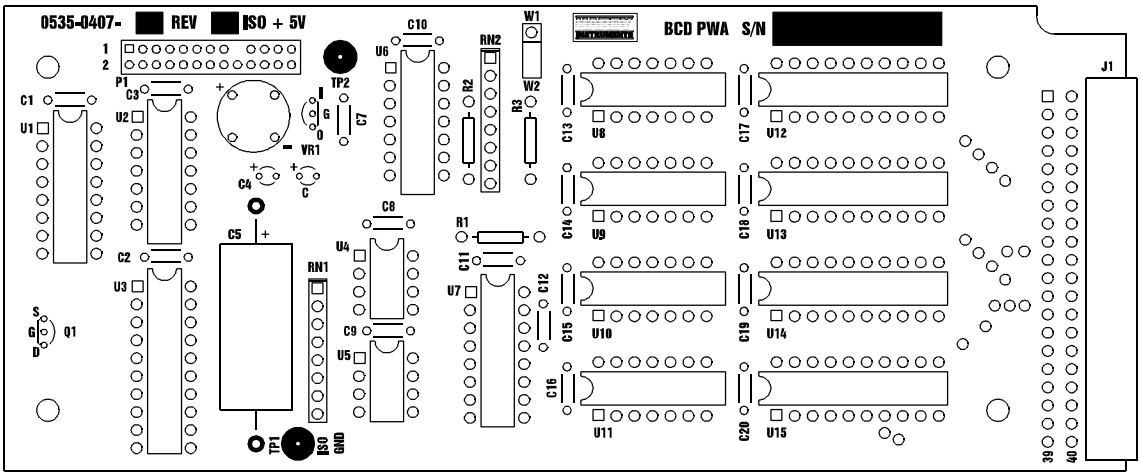


Figure 4-11. Parallel BCD Board

NOTE:
To transmit BCD signals more than 50 feet, order the HI 120S0 Serial to BCD Converter.

Installation

Refer to Section 4.2.1 Output Option Board installation.

Operation

This option is configured by first entering the Option Menu and selecting the BCD menu. Refer to Section 4.5 BCD Menu Setup Procedure for detailed menu operation. The menu will show a combination of "Gntd P" (G = gross, n = net, t = tare, d = display, p = print). The user may select which data will be present at the output. If the "P" or print flag is selected, the data will only change at the output once the PRINT key is pressed or the remote functions print has been activated. Otherwise, the output will be continuous.

The output can be triggered by any one of the following methods:

1. By pressing the PRINT key.
2. By sending a command over the serial port.
3. By connecting the remote functions print to the remote functions ground.

The output can be tri-stated if the OUTPUT DISABLE is brought low. This is useful for multiple parallel outputs to be connected to the same device. Once this input is brought high, the latched data will be accessible again. The PRINT output is normally low and goes high for 25 milliseconds. If the opposite polarity (normally high, pulsed low) is desired, move jumper from W1 to W2.

BCD PRINT

The weight select mode tells the output device which type of data is present. The user selects which type of data is desired by toggling "Gnt" under the option BCD sub-menu. If all three types of data are requested, then all three will appear on the output one after the other, 10 milliseconds apart. If "d" is selected, the output will follow the mode being displayed.

CONNECTOR REQUIREMENTS

The BCD interface requires a 40 pin right angle connector. One cable assembly with a 37 pin D-Subminiature connector is supplied with each BCD option board when option B-2 is ordered. Option B-5 provides a 60-inch cable terminated to a 40-pin connector. The pin out signals are identical to the Parallel BCD PWA P1.

TIMING CONSIDERATIONS

When the BCD is in the continuous print mode the data will be updated on an average of every 100 milliseconds. Additional considerations are shown on BCD Timing Diagram (Table 4-2).

OUTPUT DISABLE

Data output is discontinued if the OUTPUT DISABLE, pin 22 on the PWA (pin 30 on the D-Subminiature connector), is low. The data pins will be tri-stated even though print pulses will be sent.

Table 4-2 BCD Timing Diagram

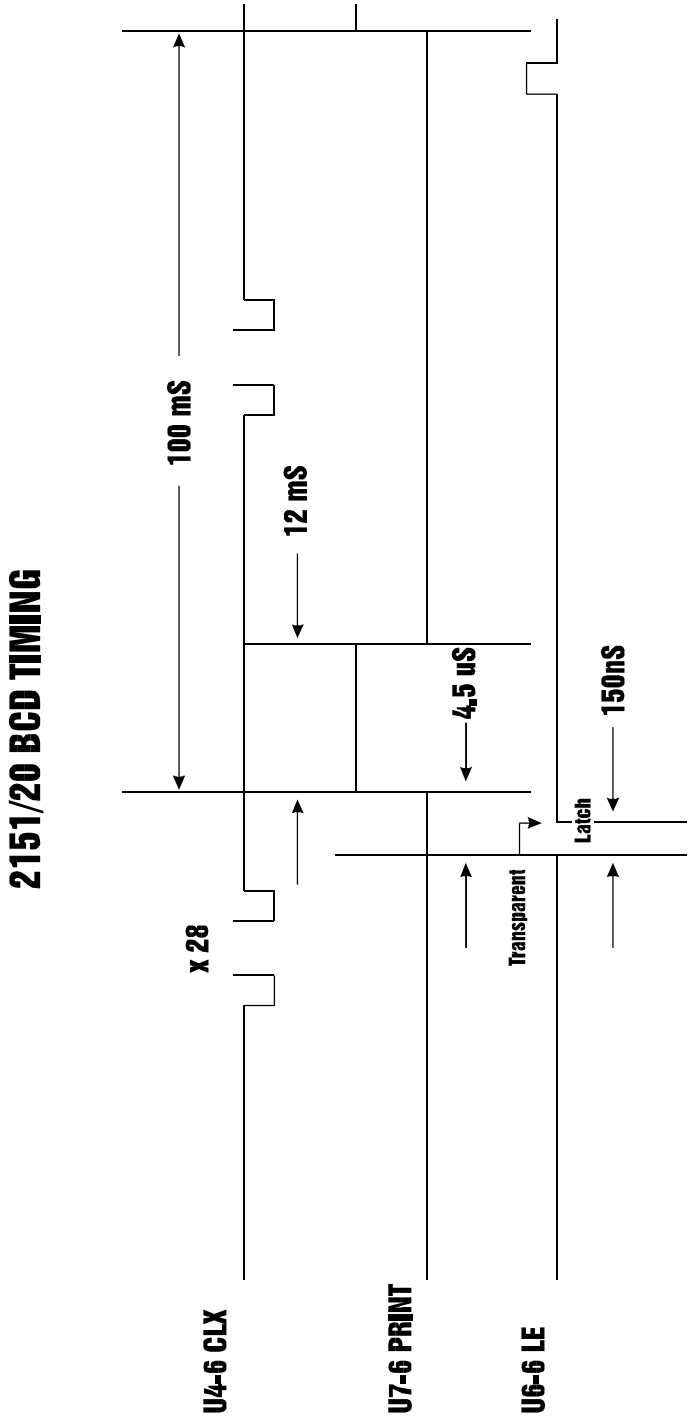
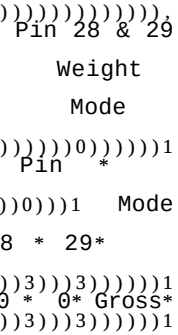


Table 4-3 Cable Pinouts - Parallel BCD Board Connector to DB Connector

	BCD BOARD	DB CONNECTOR	SIGNAL	VALUE
	1	1	GND	
	3	2	BCD digit 1, bit 0	1 x 10
	5	3	BCD digit 1, bit 1	2 x 10
	7	4	BCD digit 1, bit 2	4 x 10
	9	5	BCD digit 1, bit 3	8 x 10
	11	6	BCD digit 2, bit 0	1 x 10^1
	13	7	BCD digit 2, bit 1	2 x 10^1
	15	8	BCD digit 2, bit 2	4 x 10^1
	17	9	BCD digit 2, bit 3	8 x 10^1
	19	10	BCD digit 3, bit 0	1 x 10^2
	21	11	BCD digit 3, bit 1	2 x 10^2
	23	12	BCD digit 3, bit 2	4 x 10^2
	25	13	BCD digit 3, bit 3	8 x 10^2
	27	14	BCD digit 4, bit 0	1 x 10^3
	29	15	BCD digit 4, bit 1	2 x 10^3
	31	16	BCD digit 4, bit 2	4 x 10^3
	33	17	BCD digit 4, bit 3	8 x 10^3
	35	18	BCD digit 5, bit 0	1 x 10^4
	37	19	BCD digit 5, bit 1	2 x 10^4
	2	20	BCD digit 5, bit 2	4 x 10^4
	4	21	BCD digit 5, bit 3	8 x 10^4
	6	22	BCD digit 6, bit 0	1 x 10^5
	8	23	BCD digit 6, bit 1	2 x 10^5
	10	24	BCD digit 6, bit 2	4 x 10^5
	12	25	BCD digit 6, bit 3	8 x 10^5
	14	26	+/- (- = +5V) (+ = OV)	
	16	27	OVR	
	18	28	WEIGHT SELECT - LSB {SEE CHART BELOW}	
	20	29	WEIGHT SELECT - MSB {SEE CHART BELOW}	
	22	30	OUTPUT DISABLE	
*	24	31	not used	
*	26		not used	
*	28	33	MOTION (+5V = in motion)	
	30	34	PRINT/PRINT	
*	32		not used	
*	34	36	LB/KG	
*	36	37	GND	
	38-40		not used	



Hardware Option Boards - Parallel BCD Option Boards - BCD Termination Board

The HI 2151/20WC Binary Coded Decimal (BCD) terminal boards provide easy termination of signal lines from the -B5 BCD option. The option boards may be ordered to provide termination of a single BCD port (-B6 option) or termination of four discrete BCD ports (-B7 option) in a tri-state configuration. The terminal boards consist of one to four connector sockets (depending on which board is ordered) ready to receive the cables from the -B5 option board in the HI 2151/20WC. All terminal positions will accept cable sizes 20 to 26 gauge. Additional terminal boards may be interconnected to allow multiple BCD ports to exist in the tri-state arrangement.

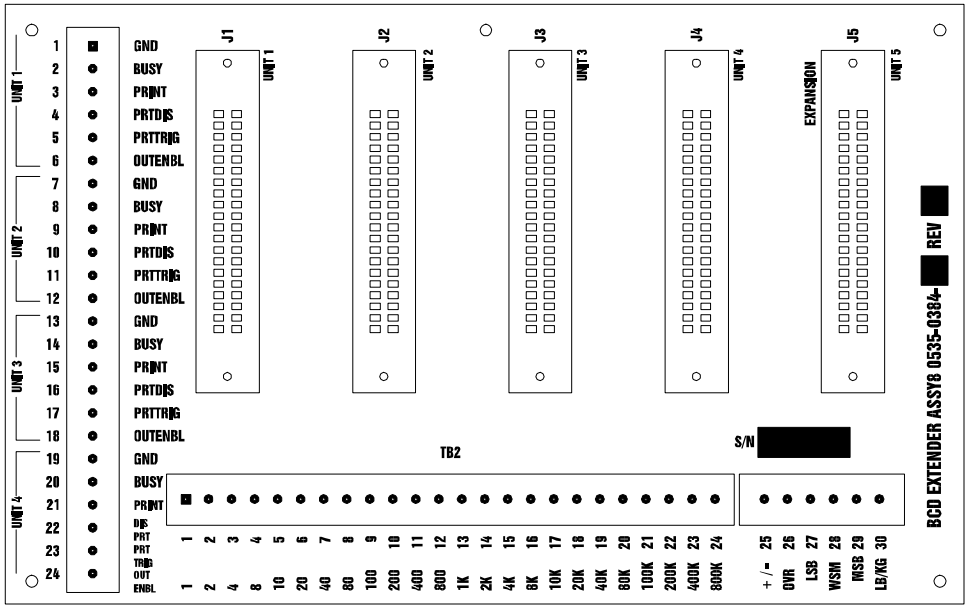


Figure 4-12. BCD Quad Termination Board Option (P/N 0535-0384-1 shown)

The BCD terminal board is an interconnect board that contains no active components. Ribbon cables, P/N 0509-0389-01, route signals from the HI 2151/20WC BCD outputs to BCD board jacks J1 through J4. Control lines from the computer are routed to BCD board terminal block TB1. Data from the HI 2151/20WC is returned to the computer through TB2. For installations with more than four HI 2151/20WC units, a second BCD terminal board can be added to connect four additional HI 2151/20WCs. In these installations the expansion jacks on both BCD boards must be connected using a P/N 0509-0389-02 ribbon cable. Figure 4-13 BCD Termination Board Installation Block Diagram shows a block diagram of an installation using two BCD terminal boards to interface eight HI 2151/20WCs with a computer.

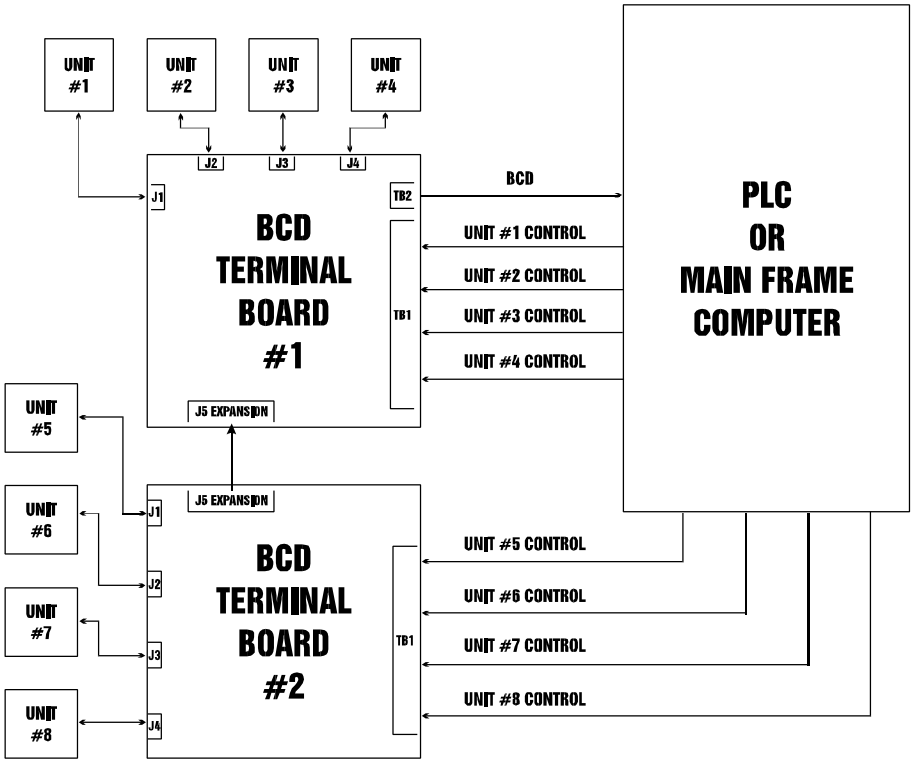


Figure 4-13. BCD Termination Board Installation Block Diagram

Installation

Install BCD termination board as follows:

1. Locate a clear, flat mounting area within five feet of all HI 2151/20WCs.
2. Use the measurements shown in Figure 4-14 BCD Termination Board Installation Drill Template Illustration or P/N 0596-0117 drill template to mark five mounting holes.
3. Drill 3/16-inch holes where marked.
4. Install five P/N 2815-0053 standoffs in holes.
5. Install BCD terminal board on standoffs.
6. Connect P/N 0509-0389-01 ribbon cables between the BCD output (option 2) of up to four HI 2151/20WCs and BCD terminal board jacks J1 through J4.
7. Connect control lines from computer to TB1.
8. For installations with more than four HI 2151/20WCs, proceed as follows:
   a) Install a second BCD terminal board within two feet of installed BCD terminal board. Refer to steps a through g.
   b) Connect P/N 0509-0389-02 ribbon cable from J5 on one BCD terminal board to J5 on the other BCD terminal board.
9. Connect data/status lines from BCD terminal board to computer.

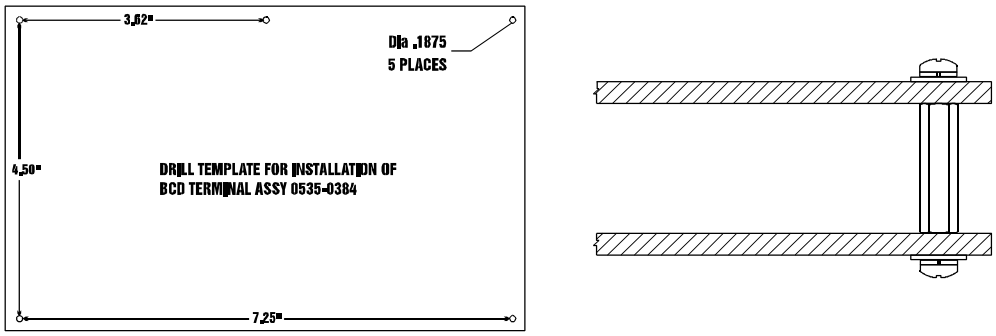


Figure 4-14. BCD Termination Board Installation Drill Template Illustration

Control lines on TB1 are arranged as follows: terminals 1 through 6 are for HI 2151/20WC unit 1, terminals 7 through 12 are for unit 2, terminals 13 through 18 are for unit 3, and terminals 19 through 24 are for unit 4. Each set of control lines has the following signals:

CONTROL LINE	DESCRIPTION
GND	Signal ground
BUSY	not used
PRINT	A pulse which indicates when data is changing in the output register
PRTDIS	not used
PRTTRIG	not used
OUTENBL	Enables HI 2151/20WC BCD data output.

Only one HI 2151/20WC can be selected at a time. The data from the selected HI 2150/20WC is output through BCD board TB2. TB2 terminals 1 through 24 contain the BCD format data. TB2 terminals 25 through 30 contains status information for the selected HI 2151/20WC. TB2 terminal signal values are as follows:

BCD TERMINAL BOARD - BCD DATA FORMAT

TB2	BCD BIT POSITION	VALUE
1	BCD digit 1, bit 0	1 x 10
2	BCD digit 1, bit 1	2 x 10
3	BCD digit 1, bit 2	4 x 10
4	BCD digit 1, bit 3	8 x 10
5	BCD digit 2, bit 0	1×10^1
6	BCD digit 2, bit 1	2×10^1
7	BCD digit 2, bit 2	4×10^1
8	BCD digit 2, bit 3	8×10^1
9	BCD digit 3, bit 0	1×10^2
10	BCD digit 3, bit 1	2×10^2
11	BCD digit 3, bit 2	4×10^2
12	BCD digit 3, bit 3	8×10^2
13	BCD digit 4, bit 0	1×10^3
14	BCD digit 4, bit 1	2×10^3
15	BCD digit 4, bit 2	4×10^3
16	BCD digit 4, bit 3	8×10^3

BCD TERMINAL BOARD - BCD DATA FORMAT- continued

TB2	BCD BIT POSITION	VALUE
17	BCD digit 5, bit 0	1×10^4
18	BCD digit 5, bit 1	2×10^4
19	BCD digit 5, bit 2	4×10^4
20	BCD digit 5, bit 3	8×10^4
21	BCD digit 6, bit 0	1×10^5
22	BCD digit 6, bit 1	2×10^5
23	BCD digit 6, bit 2	4×10^5
24	BCD digit 6, bit 3	8×10^5
25	+ or -	
26	Overload (OVR)	
27	Weight Selected LSB	
28	Weight Selected MSB	
29	Motion Tolerance (MOTION)	
30	Pounds or Kilograms Display (LB/KG)	

BCD Menu Setup Procedure

	PROCEDURE	KEY	DISPLAY
1.	Enter Option Menu Setup by pressing 7/Option key.	7/Option	**ROC** *
2.	Press up arrow until BCD is displayed on the screen.	↑	**bcd P1**
3.	Press Enter key.	Enter	**Gntd_P**
	a. Use up arrow to select "P" (to print on demand), or "_" (to print continuously).	↑	**Gntd_P** or **Gntd__**
	NOTE: Only ONE letter of "G","n","t", or "d", should be turned on for an output of that value. If continuous output is desired, select "_".		
	b. Use left arrow to move cursor one space to the left so that the "d" is flashing.		**Gntd_ P**
	c. Use up arrow to select "d" (to send BCD data as registered on the HI 2151/20WC display), or "_".	↑	**Gntd_P** or **Gnt _ _ P**
	d. Use left arrow to move cursor one space to the left so that the "t" is flashing.		**Gntd_P**
	e. Use up arrow to select "t" (to send tare to the printer), or "_" (tare will not be sent to the printer.)	↑	**Gntd_P** or **Gn _ d _ P**
	f. Use left arrow to move cursor one space to the left until the "n" is flashing.		**Gntd _ P**
	g. Use up arrow to select "n" (to send net weight to the printer, or "_" (net weight will not be sent to the printer).	↑	**Gntd _ P** or **G_td _ P**

* Display may show an option other than "ROC", depending upon which options were installed. The HI 2151/20WC will show the first available option, in this case, ROC.

BCD Menu Setup Procedure - Continued

	PROCEDURE	KEY	DISPLAY
	h. Use left arrow to move cursor one space to the left until the "G" is flashing.		**Gntd_P**
	i. Use up arrow to select "G" (to send gross weight to the printer), or "_" (gross weight will not be sent to to the printer).	↑	**Gntd_P** or **_ntd_P**
4.	Press Enter key.	Enter	**BCD P1**
5.	Press Exit key to return to normal operation.	Exit	**SER P1** *
6.	Press Exit key again to return to normal operation.		

* Display may show an option other than "SER P1", depending upon which option boards were installed.

4.6 ANALOG OUTPUT

Description

The analog output option allows the user not only to output gross, net, ROC, Peak, or total weight as 0-5V, 0-10V, 0-20 mA or 4-20 mA (or the reverse of these via the front panel), but makes it possible to span these ranges over a portion of the weight data. A full analog output is obtained over the range desired. Resolution of the analog out is 16,000 counts, or the number of display counts available in the range selected, whichever is less. All of this is accomplished via the front panel or the serial port. Two analog option boards may be installed in each unit.

Installation

Refer to Section 4.2.1 Output Option Board Installation.

Operation

The analog transmitter (Figure 4-15 Analog Output Board) will output an analog representation of either net, gross, ROC, total, or peak hold weight data. The transmitter has over 16,000 counts of resolution limited to the resolution calibrated on the display. The outputs are electrically and optically isolated from the main board.

VOLTAGE OUT

Maximum Current	5 mA (2K ohm load at 10 V)
Temperature Stability	10 ppm/C or 5 mV total from 30 degrees F to 120 F

CURRENT OUT

Maximum Voltage (compliance)	12 V allowing 0-600 ohm load at 20 mA
Temperature Stability	20 ppm/C or 20 microampere total from 30 to 120 F

EITHER OUTPUT

Linearity	0.01%*
Response Time After Update	1 millisecond
Isolation from Main Board	300 VAC or 450 Vdc
Update Rate	50 milliseconds (20 times/sec)

* with 1 average selected.

The analog board has one output connector. The connector, J1, uses pins 1 and 2 for voltage outputs and pins 5 and 6 for current outputs. Both current and voltage outputs may be used. The output is selected by configuring the jumper block "W" (Figure 4-15 Analog Output Board) which determines the selection of one current range and one voltage range. To select the range desired, position the jumper plugs as follows:

OUTPUT CONFIGURATION	JUMPER CONNECTION
Remove 4 mA offset	W1 (0-20 mA)
Set current span to 16 instead of 20 mA	W2 (4-20 mA, default)
Change voltage out scale to 5 V	W3 (0-5V)
Set voltage output scale to 10 V	W4 (0-10V, default)

A reversed output (i.e. 20-4 mA) can be selected via the menu by setting the Lo weight to a higher value than the HI weight, for example: Lo = 5000 lbs, HI = 3000 lbs.

Once the board is installed, the analog parameters can be set through the option menu. The analog output can represent a window of the span set in the CAL MENU. For example, if the cal span is 5000 lbs, the analog output span can be set for 1000 lbs.

The Analog Menu is accessed through the OPTION MENU key. When in the menu, select ANOUT 1 or ANOUT 2 and then press the Enter key. (ANOUT 2 will only appear if a second analog board is installed). Values for analog Lo and analog HI can be entered at this time. The NET/GROSS mode is selected while in the Option Menu (the mode can be changed anytime before the Enter key is pressed). To select net, gross, peak, rate of change, or total output press the MODE key until the appropriate LED status indicator is lit.

Analog Card Adjustment

Slight adjustment may be necessary to insure that the display on your Programmable Logic Controller reads precisely with the display on your weight controller. Use the procedure below which corresponds to the input card in your PLC.

Ensure the Analog Option card is programmed correctly prior to performing any adjustments.

Voltage

If 0 volts represents other than empty put weight on your load cells equal to your 0 volt selection. Otherwise, with the hopper empty adjust R4 for the correct reading.

Put weight on your load cells equal to your 10 volt selection. Adjust R16 for the correct reading.

Current

Put weight on your load cells equal to your 4 ma selection, if 4 ma represents other than empty. Adjust R19 for the correct reading.

Put weight on your load cells equal to your 20 ma selection. Adjust R5 for the correct reading.

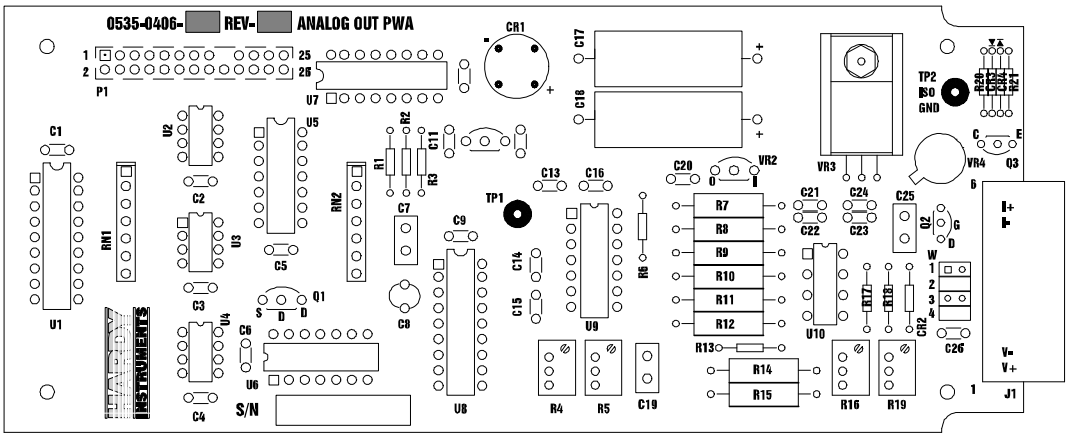


Figure 4-15. Analog Output Board

Analog Output Menu Setup Procedure

	PROCEDURE	KEY	DISPLAY
1.	Enter Option Menu Setup by pressing 7/Option key.	7/Option	**ROC** *
2.	Press up arrow until Analog Output 1 or 2 is displayed.	↑	**AnOut 1**
3.	Press Enter key.	Enter	**An - Lo**
4.	Press Enter key.	Enter	**0** **
5.	Press -/Test/Clr key. a. Enter numerical value desired. (Enter (-) for loss-in-weight systems.) b. The value displayed will equal 4 milliamps, 0 milliamps, or 0 volts, depending on which output and configuration is used. c. Use mode button to select which mode is to be sent out: GROSS, NET, ROC, TOTAL, OR PEAK.	-/Test/Clr	
6.	Press Enter key.	Enter	**Good** *** **An - HI**
7.	Press Enter key.	Enter	**35000**
8.	Press -/Test/Clr key. a. Enter numerical value desired. (Enter (-) for loss-in-weight systems.) b. The value displayed will equal 20 milliamps, 10 volts, or 5 volts, depending on which output and configuration is used.		
9.	Set mode by pressing MODE key until cursor is flashing under desired option. Select from total, gross, net, ROC, or peak. The default is gross.	Mode	
10.	Press Enter key.	Enter	**Good** *** **An - Lo**
11.	Press Exit key.	Exit	**AnOut 1**
12.	Press Exit key again to return to normal operation.	Exit	

* Display may show an option other than "ROC", depending upon the option boards installed.
** Previously set numerical value will be displayed. "0" is the default.
*** Display momentarily flashes good if value is a valid entry.

4.7 BAR-GRAPH

PROCEDURE	KEY	DISPLAY
1. Enter Option Menu Setup by pressing 7/Option key.	7/Option	**ROC**
2. Press up arrow until "bar Gr" is displayed.	↑	**bar Gr**
3. Press Enter key.	Enter	**bAr - Lo**
4. Press Enter key.	Enter	**0.00** *
5. If you need to change this number, press -/Test/Clr key.	-/Test/Clr	**0.00** *
6. Enter lowest numerical value to be displayed on bar-graph.		
7. Press Enter key.	Enter	**Good** ** **bAr - HI**
NOTE: MODE may be selected at this point by pressing MODE key (total, gross, net, ROC, or peak) and viewing the status LEDs. Default is gross.		
8. Press Enter key.	Enter	**10,000** *
9. Press -/Test/Clr key to change this number.	-/Test/Clr	**0.00**
11. Enter highest numerical value to be displayed on bar-graph.		
12. Press Enter key to end Bar-Graph Option Setup, and to return to the first menu option.	Enter	**Good** ** **SEr P1** ***

* Previously set numerical value will be displayed. "0" is the default.
** Display momentarily flashes good if value is a valid entry.
*** Display may show an option other than "SER P1", depending upon the option boards installed.

4.8 RATE OF CHANGE (ROC)

The Rate of Change Option is to measure the rate at which a material enters or is dispensed from a vessel over a given period of time.

To develop ROC data, a Register is used that is 21 entries in length. New weight is inputed to the register at the rate of 1/20th of the Time Base. The 1st register is subtracted from the 21st register. The 21st register is one Time Base older than the 1st register. The results of this subtraction are divided or multiplied, as necessary, to equal the appropriate measurement time for display, U-SEC, U-MIN, U-HOUR.

In the example below, the units of display are units per minute (U-Min) with a Time Base of 10 seconds. New data is inserted into the 1st register every 1/2 second and all old data is shifted down one register. The 1st register is subtracted from the 21st register and the results are multiplied by 6 to make the Time Base results of 10 seconds correspond to Units per Minute.

```
          ROC REGISTER
1st        +))))))))),100
           /))))))))))102
           /))))))))))104
           /))))))))))106
           /))))))))))108
           /))))))))))110
           /))))))))))112
           /))))))))))114
           /))))))))))116
           /))))))))))118
           /))))))))))120
           /))))))))))122
           /))))))))))124
           /))))))))))126
           /))))))))))128
           /))))))))))130
           /))))))))))132
           /))))))))))134
           /))))))))))136
           /))))))))))138
           .))))))))))-140
```

[21ST - 1ST (x) 6 = ROC]

140 - 100 = 40 (x) 6 = 240

At time one there is 100 lbs on the scale. One half second later there is 102 lbs one the scale. At time twenty one, 10 seconds later there is 140 lbs on the scale. A 40 lb change in 10 seconds converts to 240 lbs per minute.

Rate of change data can be transmitted through the standard or optional serial ports or the analog output. It can also be displayed numerically or as a bar graph.

To select Rate of Change Mode: Push the MODE key until the ROC indicator is illuminated.

4.8 RATE OF CHANGE (ROC) - Continued

PROCEDURE	KEY	DISPLAY
1. Enter Option Menu Setup by pressing the 7/Option key .	Option	**Option** **R0C** *
2. Press Enter key.	Enter	**UnitS**
3. Press Enter key. NOTE: Previously set time value will be displayed. For this example, the time value will be set to seconds.	Enter	**U-Sec**
4. Press up or down arrow key to select appropriate measurement of time (seconds, minutes, or hours).	↑ ↓	**U-Sec** **U-min** **U-HoUr**
5. Press Enter key.	Enter	**t-bASE**
6. Press Enter key.	Enter	**1**
7. Use up or down arrow to select time base from one of the following: 1, 2, 3, 4, 5, 6, 10, 12, 15, 30, 60, 120, 240, 450, 900, or 1800.	↑ ↓	
8. Press Enter key.	Enter	**UnitS**
9. Press Exit key to end Option Menu setup and go to the next available menu option, in this case, Serial Port 1.	Exit/0	**SEr P1**

* Display may vary depending on which options were installed in your instrument. The HI 2151/20WC will show the first available option, in this case, ROC.

4.9 PEAK HOLD MODE

Peak Hold Option, when selected, will display the highest gross value that has been measured or the averaged peak gross value. (Highest gross or averaged gross is selectable on dip switch S1 position number 2, located internally on the power/relay board.) Peak does not need to be displayed in order to capture the peak value.

To display PEAK HOLD: Press the MODE key until the "PEAK" indicator is illuminated. The value displayed is the highest gross value that has been measured since last RESET.

To reset the Peak Value to zero: With the Peak Value displayed, press the TEST/CLR key.

To exit Peak Hold mode: Press the MODE key until desired mode is indicated.

4.10 TOTALIZER MODE

When Total Option is selected, the display will indicate the accumulated total net weight stored in the total register.

To set up TOTAL: Via the Calibration Menu (Section 3), select the desired decimal point position.

To add weight value to the Total Register: The current net weight displayed will be added to the net weight accumulated in the total register when the total remote function input is detected (this is accomplished by providing a momentary switch to the remote function connector between J2, Pin 8 and J2, Pin 9 or 10.

To display the Total Value: Press MODE key until the "TOTAL" indicator is illuminated. The value displayed is the total accumulated net weight.

To print the Total Value: With the Total displayed, press the PRINT key.

To clear the Total: With the Total displayed, press the TEST/CLR key. The Total Register will now be reset to zero.

To exit the Total Mode: Press the MODE key until the desired mode is indicated.

NOTE: The Peak Hold and Totalizer modes do not support the LB/KG key or LB/KG remote input. They will display and transmit only the mode the instrument was calibrated in.

4.11 ALLEN-BRADLEY REMOTE I/O

Refer to Installation and Operation Manual (P/N 0596-0173)

SECTION 5

TROUBLESHOOTING AND MAINTENANCE

5.1 INTRODUCTION

This section provides instructions for running and interpreting the self-test diagnostics, and locating possible causes of minor malfunctions.

Instrument malfunctions are due to any of the following:

1. Internal malfunction of the equipment. Return unit to Hardy Instruments for repairs.

2. Faulty external cabling connections and/or peripheral devices which interface with the HI 2151/20WC. Assistance from Customer Support may be required.

3. Operator Error. This may occur with the start-up of the new system, or when the user is required to re-configure or enter new parameters in the Setpoint, Calibration, or Option menus. Refer to the manual to gain a better understanding of the instrument.

Any problems which cannot be resolved by using the following instructions should be referred to Hardy Instruments' Customer Support (refer to Section 5.4 Customer Support).

5.2 SYSTEM INTEGRITY CHECK AND FAULT DETERMINATION

To determine if an instrument or cabling problem exists, verify the basic operation of the system by performing the following system checks.

Self-Test

Self-test can be entered only from the net, gross or rate of change operating modes. To initiate self-test, press the -/Test/Clr key on the keypad. The name of each test is displayed for about 2 seconds after which the result is displayed for another 2 seconds. The self-test program automatically steps through each test and continues through any failed tests until all are completed. When the self-test program has completed all tests, the instrument returns to the keyboard test, which can be ended by pressing the 0/exit button.

Speed up the self-test by holding down the UP arrow key. Pause the self-test display by pressing the down arrow key. To resume the self-test, press the up arrow key. To exit the self-test at any time, press the exit key.

Write down the test results and compare them to Section 6 Appendix B System Data Survey Sheet. Determine if any differences are due to system modifications, and update Appendix B.

Following are the sequential tests conducted by the self-test program:

Table 5-1. Self-Test Program

DISPLAY	TEST	FAILURE SOLUTIONS
tESt	Indicates beginning of self-test.	--
0650-0062	Part number of EPROM installed.	--
VEr 1.10	Version of EPROM installed.	--
8.8.8.8.8.8	Display Test - All segments and words on display turned on.	1. Main card not seated properly in display board. 2. Contamination on connector pins. 3. LED display not functioning.
ramtSt	Ram Test - Writes to each location in RAM & reads back and verifies data. Test is non-destructive.	--
PASS or **FAIL**	Indicates whether RAM test passed failed.	1. With most RAM failures system will not operate. 2. Check that EPROM (U13) on main board is seated. 3. Consult for help.
C SUm	Checksum Test - indicates that EPROM checksum is being calculated.	--
OE OE (example)	Two hex numbers displayed; right one is actual checksum, left one is calculated from test. The two numbers must match. For each revision to EPROM numbers will be different.	Discrepancy between two numbers indicates EPROM faulty.
PASS or **FAIL**	If the two numbers matched, test will pass; otherwise fail is indicated. It is possible for EPROM to loose one or more bits & still operate.	If failed, replace EPROM. (If this doesn't eliminate the problem, there could be a BUS problem.)
OPt ID	Option ID - Checks for and displays status of the two option slots.	--

Table 5-1. Self-Test Program - Continued

DISPLAY	TEST	FAILURE SOLUTIONS
SLOt 1	Indicates next display is for slot 1.	--
nOnE or **SerIAL** or **AnOUt**	Indicates which type of option card is installed in slot 1, if any.	1. Check connector for proper mating. 2. Try card in other slot.
SLOt 2	Indicates next display is for slot 2.	--
nOnE or **SerIAL** or **AnOUt** or **bCd**	Indicates which type of option card is installed in slot 2, if any.	1. Check connector for proper mating. 2. Try card in other slot. 3. Swap with spare option card.
CALdAt	Calibration Data Test - The contents of the user-calibrated parameters are displayed. The display first shows the heading of each parameter and then the value or configuration at which it is set.	If value or calibration is other than desired, re-enter value into menu and retest.
CALtyP	How instrument was calibrated	
H CAL	Hardware Calibration	
S CAL	Software Calibration	
C2 CAL	C2™ Second Generation Calibration	
UnitS	Indicates next parameter will be units of measure.	--
Gr or **LB**	Kilograms or pounds.	Default is Lb.
CF = 4	Indicates Corner Frequency jumper position (W0, W1, W2, W3, or W4).	Default is 4.
GrAD	Indicates next parameter will be graduation size.	--

Table 5-1. Self-Test Program - Continued

DISPLAY	TEST	FAILURE SOLUTIONS
1 or 2 or 5 etc.	Graduation size calibrated in unit (least significant digit on display will change by this amount).	Default is 1.
SPAn	Indicates next parameter will be Span.	--
10000 (example)	Span value calibrated in unit.	Default is 10,000.
Zr Cnt	Indicates next parameter will be A to D counts representing the Zero Count.	--
36780 (example)	A to D counts that indicate the calibrated Zero.	Default is 36780.
FS Cnt	Indicates next parameter will be Full Scale Count. 0 in most significant digit indicate value >1,000,000.	--
992000 (example)	A to D counts that indicate the Calibrated Span Value.	Default is 992000.
Sc CAP	Indicates next parameter will be Scale Capacity.	--
999999 (example)	Scale capacity value calibrated in unit.	Default is 10,000.
0 tOL	Indicates next parameter will be Zero Tolerance.	--
10 (example)	Zero Tolerance value calibrated in unit.	Default is 10.
mOtion	Indicates next parameter will be motion value.	-- --
3 (example)	Motion value calibrated in unit.	Default is 3.

Table 5-1. Self-Test Program - Continued

DISPLAY	TEST	FAILURE SOLUTIONS
AVrAGE	Indicates next display will be number of values set in the running average table (1 - 200).	--
100 (example)	Number of values set up to be averaged.	Default is 100.
LIncor	Indicates next display will be single point linear correction.	--
0 (example)	If 0, linear correction is not used. Number other than 0 indicates single-point calibrated value.	Default is 0.
SthVAL 330,000 (example)	Sticker Value. Instrument normalization number for C2™ Second Generation Calibration and Soft CAL.	
dIP 1	Indicates next display will be settings of rear panel Config dipswitch S3 segments. Settings represented by hexadecimal notation.	If value is other than desired, reset dipswitch segment and retest.
00 thru **FF**	SWITCH POSIT. / VALUE / ON / OFF	
	2 / 01 / Cal toggle	Cal toggle
	4 / 02 / Opt menu lock	No opt menu lock
	5 / 04 / S.P. menu lock	No S.P. menu lock
	7 / 08 / Tare, lb/kg, N/G, zero lock	Keys not locked
	8 / 10 / Zero track on	Zero trk off
	6 / 20 / Spare	Spare
	3 / 40 / Serial requests only	All serial I/O
	1 / 80 / P2 multidrop	Not multidrop
dIP 2	Indicates next display will be settings of internal dipswitch S2 on power relay board. Settings represented by hexadecimal notation.	If value is other than desired, reset dipswitch segment and retest.

Table 5-1. Self-Test Program - Continued

DISPLAY	TEST	FAILURE SOLUTIONS
00 thru **FF**	Dip Switch #2	

SWITCH POSIT.	VALUE	ON	OFF
8	01	Spare	
7	02	Spare	
4	04	NBS Re-Call toggle switch	
1	08	Ignore incoming checksums	
2	10	On is averaged gross, Off is instantaneous gross	
3	20	NBS	
5	40	Spare	
6	80	Spare	

LC Cnt = 0-8

Sn1 xxxx-xxxx

Sn8 xxxx-xxxx

tAG 1 Indicates next display will be value of software control options. Settings represented by hexadecimal notation. If options are not as desired, another memory key must be ordered. Consult Customer Support.

00 thru FF

VALUE	ON	OFF
01	Bar-graph	No bar-graph
02	Rate of change	No ROC
04	Peak hold	No peak hold
08	Hardy link	No Hardy link
10	Optional relays	No optional relays
20	Real time clock	No real time clock
40	CAL SW override	Normal CAL mode
80	Totalizer	No totalizer

tAG 2 Indicates next display will be value of software control options.

00 thru **FF**

VALUE	ON	OFF
01	Spare	Spare
02	Remote clear total	No remote clear total
04	Remote clear peak	No remote clear peak
08	Spare	Spare
10	Spare	Spare
20	Spare	Spare
40	Spare	Spare
80	Spare	Spare

Table 5-1. Self-Test Program - Continued

DISPLAY	TEST	FAILURE SOLUTIONS
kEY - bd	Indicates next display will be the keyboard test. Ensure the keyboard operates properly by pressing each key, starting with the ZERO key in the upper left corner of the keypad and moving from left to right. The LED will display each key as it is pressed. Do not press the 0/exit key until you are ready to leave the keyboard test.	Consult Customer Support.

Check Cabling and Inputs

Moving the unit may cause loose or improperly installed cabling. Inspect all connectors and cabling for loose contacts or damage. Verify each wire is in its correct position on the connector, and each connector is in the right jack on the rear panel. See Table 5-2 Troubleshooting Solutions for additional troubleshooting assistance.

5.3 INTERPRETING DIAGNOSTIC/ERROR MESSAGES

This section lists some possible system problems along with recommended troubleshooting techniques. (Refer to Section 6 Appendix D Error Messages and Definitions for a listing of error messages). These techniques are limited to external observations. Checking of internal test points and voltages requires special test equipment and exposure of the circuit cards during normal operation. This should only be done by qualified technicians.

Overview of Typical Load Cell System

The typical system consists of one or more load cells/points, a summing junction box, and a weight controller (the HI 2151/20WC). See Figure 5-1.

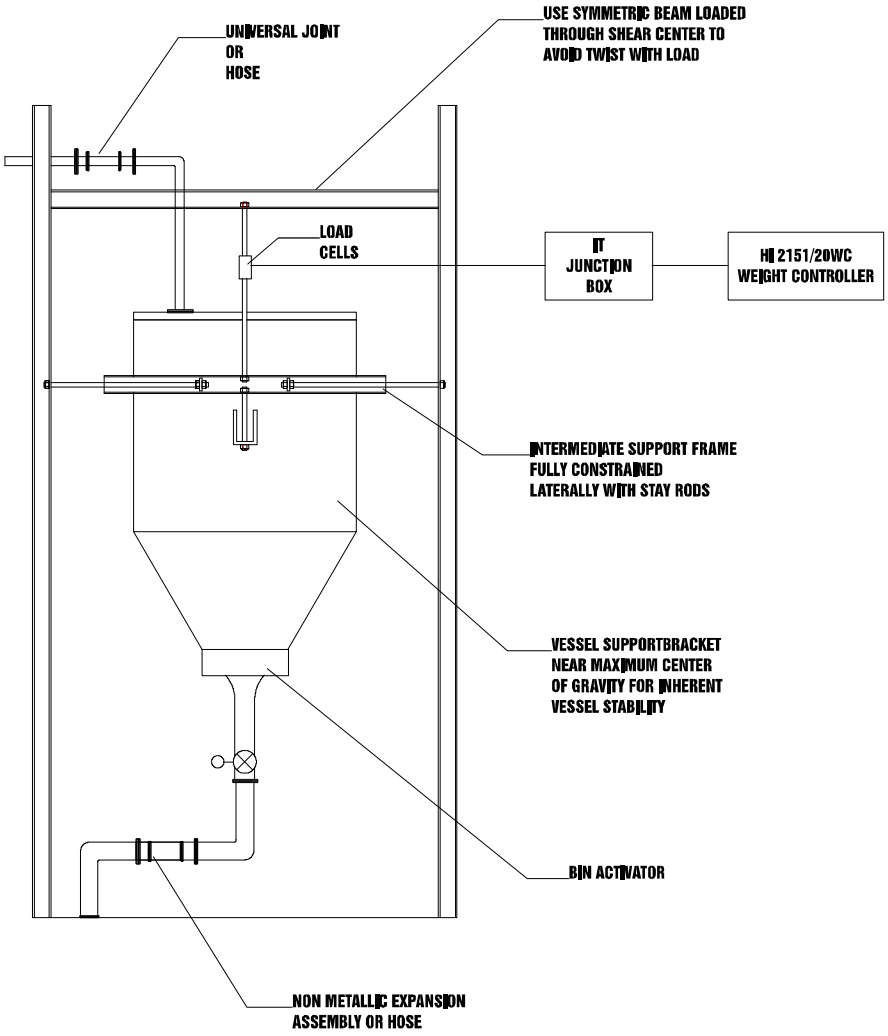


Figure 5-1. Typical Load Cell System

A. LOAD CELL/POINT is a force transducer, which generates an electrical signal proportional to the load applied to the scale. Load cells/points can be used any place a person needs to measure pressure, load, or torque. This can be accomplished by either Tension or Compression type load cells/points. The load cell/point takes as an input the 10 volts DC Excitation Voltage generated by the HI 2151/20WC, and depending upon how much weight is applied to the scale, generates a millivolt output (proportional to the weight, 0-20mv DC for 2mv/V load cells/points or 0-30mv DC for 3mv/V load cells/points).

B. SUMMING JUNCTION BOX provides a tie point for the cabling when the distance between the load cell/point and the weight controller exceeds the cable length provided with the load cell/point. Also, in applications where two or more load cells/points are required, it ties the load cells/points in parallel to give one output cable to the weight controller.

C. WEIGHT CONTROLLER is an electronic instrument which, among other functions, is used primarily to power the load cell(s)/point(s), take the millivolt signal output from the load cell(s)/point(s), and digitize, interpret, and display the results as a weight indication.

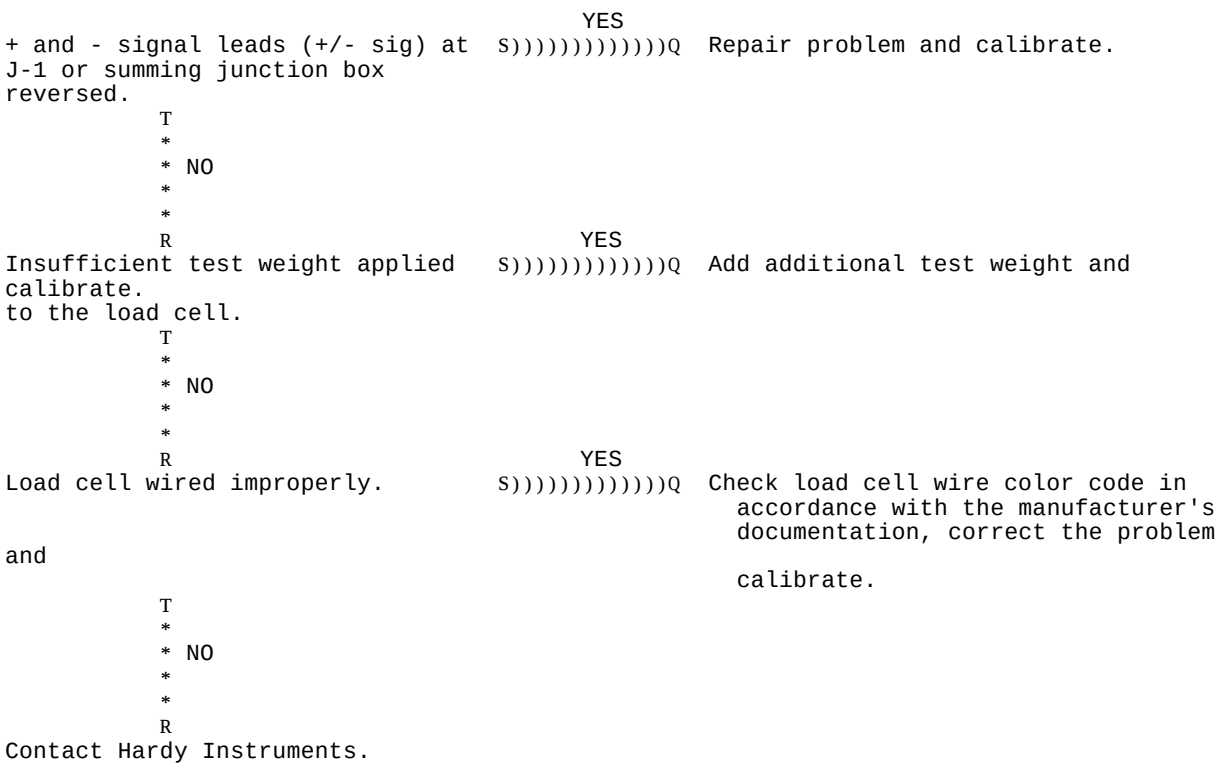
Please refer to the following pages which may be useful in troubleshooting Load Cell/Point Systems.

PROBLEM 1: NO DISPLAY

NOTE: Less than 30 mvDC for 3 mv/V load cells and
less than 20 mvDC for 2 mv/V load cells.

PROBLEM 2: ERROR 18

This error occurs when insufficient positive load cell/point signal change occurs during calibration between zero and span.



PROBLEM 3: DRIFTING WEIGHT INDICATIONS

Check for proper connections on + and - sense at J1.

BAD

Ensure the + and - sense are connected to the + and - excitation at either the back of the instrument, or in the junction box.

GOOD

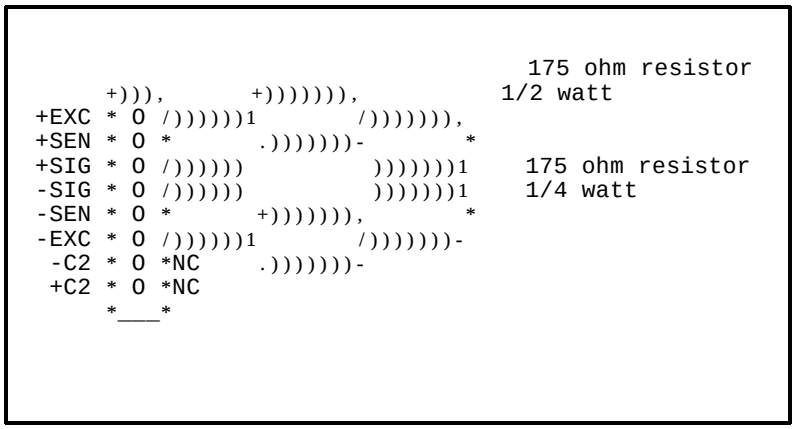
Install the jumper shown in Box 1. Is the display stable?

NO

Call Hardy Instruments Customer Support (619) 278-2900.

YES

If the display is stable, the cause of the problem is likely to be external to the HI 2151/20WC. Check the following:



BOX 1

1) Vibration may be causing the problem. Select another vibration immunity frequency. Refer to paragraph **3.7 for WAVERSAVER® JUMPER SELECTION**.

2) Load cells/points must make good electrical contact. Avoid splicing cables.

3) Use proper load cell/point cable shielding and connect shield to ground at only one end.

4) Use separate conduits for load cell/point cables.

5) Ensure vessels/hoppers/scales etc. are not binding. Piping and conduit that makes contact with the vessel or hopper should be flexible.

6) Cables that do not have anti-moisture wicking capabilities and may have been subjected to significant amounts of moisture, could have moisture inside the cable which can cause signal drift and erratic readings.

* NOTE: Ensure that you remove the jumper at the conclusion of this testing.

PROBLEM 4: WEIGHT INDICATION FROZEN

Weight indication reaches a value and does not increase as additional weight is added to the load cells/points.

With the weight indication locked, check millivolt reading at J1 Pin 3 to Pin 4.

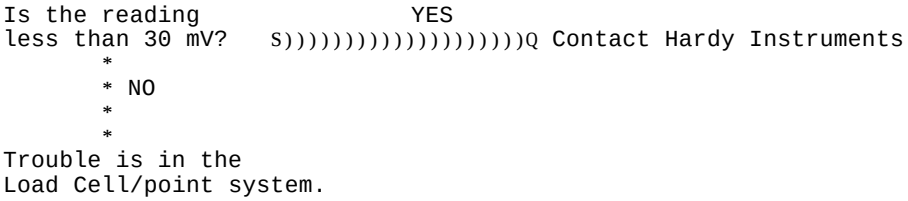


Table 5-2. Troubleshooting Solutions

SYMPTOM	POSSIBLE SOLUTION
NO POWER	Check power cord at J6 and at the power source outlet for loose connections.
NO DISPLAY	Check for blown fuse; replace if necessary.
INTERMITTENT DISPLAY	Check for dirty or loose connections or noise on ac power line.
NO KEYPAD OPERATION	1. Config dipswitch S3 set to keypad lockout; reposition switch. 2. Check for "HI" on display. Whenever "HI" is displayed, the keypad will be disabled except for the Cal Menu key.
"HI" ON DISPLAY	1. Check scale capacity. If gross weight is greater than 105% of calibrated scale capacity, this message will persist. Remove excess load from scale. 2. If calibrated span is greater than scale capacity, this message will also occur. Enter Cal menu to increase Scale Capacity value. 3. If "HI is still displayed, check ± EXC voltage on J1 for 10 vdc , and ± SIG for a voltage between 0-20 mvdc with a 2 mV/V load cell, or 0-30 mvdc with a 3 mV/V load cell.
REMOTE FUNCTIONS NON-OPERATIONAL	1. Check wiring at J2. 2. Ensure correct ground is used (J2 pins 9 or 10). 3. Check for correct setting of Config dipswitch S3 (Figure 6-1, Appendix A).

Table 5-2. Troubleshooting Solutions - Continued

SYMPTOM	POSSIBLE SOLUTION
SYSTEM NON-LINEARITY	1. Perform linearity check and verify displayed weight tracks actual weight added. 2. Check mechanical structures, piping, and material conveying components to ensure no appreciable or non-repeatable forces are added to the load cells. 3. Re-calibrate system and examine linearity plot. Plot a graph displaying weight versus mv readings from load cells. Make linearity correction at the point of maximum error. Reference full calibration table 3-1 to set midpoint linearity.

NOTE:
This piece of equipment, as with all microprocessor-based instruments, should have a quality power conditioning product installed between the HI 2151/20WC and the AC. Power source to lesson the likelihood of faults caused by poor or intermittent AC power.

5.4 OPERATION - USING SOLID STATE RELAYS WITH LIGHT LOADS (Optional Set Relays)

There have been installations where solid state relays have been used and failed to shut off a solenoid or relay when de-energized.

The actual problem comes from the internal snubbing network in parallel with the Silicon Controlled Rectifier (SCR) which does the actual switching. This network presents an impedance of 30K ohms, which means with 120 volts across, it will pass 4mA of AC current.

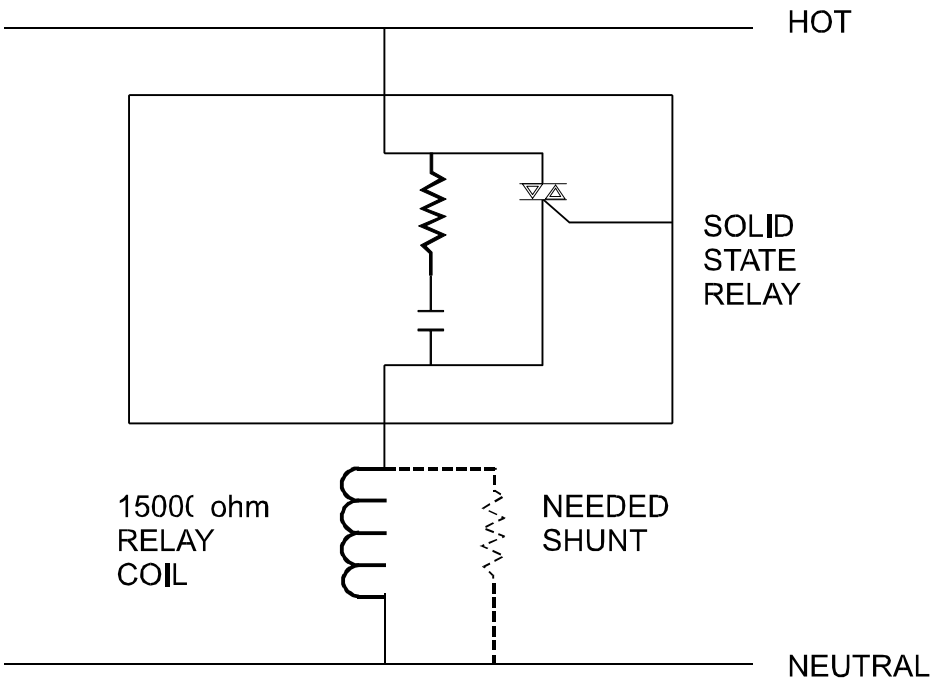


Figure 5-2. SCR Switching Load Circuit.

The SCR itself presents no leakage current. Some solid state relay manufactures specify 20mA minimum load. This is based on the presumption a relay or solenoid will drop out with only 4mA through it, which is not always true. That may not be true. When switching a light load with a solid state relay across the line, you must look at the rated drop-out current of the load, and if it is less than 4mA it may not turn off. The solution is to put a loading resistor in parallel with the light load, to be sure leakage current is sufficiently shunted away from the coil.

Assume a load like a relay with a coil of 15,000 ohms and of 5% of nominal drop-out. When the solid state relay is off, there will still be 1/3 of the line voltages across the relay, so it will not drop out. For the relay to have 5% of the line across it, it and a parallel shunt resistor must be 20 times less resistance than the 30K snubbing network, or 1.5K ohms. Use less than a 1.67K ohm parallel resistor and now total load is below 1.5K ohm or 80mA.

5.5 CUSTOMER SUPPORT

General Policies and Information

With over 70 years of industrial weighing experience and products in the field, Hardy Instruments continues to design, manufacture, install and support Hardy products worldwide. The following paragraphs describe Hardy's customer support services and equipment warranty.

System Support

Customer support is provided as follows:

1. New system start-up: Ensure that the installation is checked and correct; instruments are calibrated, and operators trained.

2. Service: Engineers are trained and qualified to provide on-site installation, calibration, and maintenance.

3. On-site training: A Hardy Support Representative can be scheduled to train your operations and maintenance personnel. This can be as simple as basic load cell theory or as complete as troubleshooting techniques which allow you to service your equipment.

Warranty

A warranty problem may be handled by returning the product to the factory for repair or replacement under warranty.

NOTE:

Before returning any product to Hardy Instruments, call the Customer Support Department listed below for a Return Authorization Number. Have your company name, address, telephone, equipment model number, S/N, and a brief description of the problem ready to give to him. In addition, please have Appendix A completed and ready to FAX to us before calling.

FOR FURTHER INFORMATION CONTACT:

Customer Support Manager
Hardy Instruments, Inc.
3860 Calle Fortunada, San Diego, CA 92123-1825
Telephone: (619) 278-2900
FAX: (619) 278-6700
Web Address: www.hardyinst.com

Ordering Replacement Parts

Consult the Hardy Instruments Sales Department to order replacement parts and option boards. Have your equipment model number ready, as well as your completed System Data Survey Sheet (Section 6 Appendix B System Data Survey Sheet).

SECTION 6

APPENDIX A

KEYPAD, DIPSWITCH AND REMOTE FUNCTION DEFINITIONS

6.1 KEYPAD DESCRIPTIONS.

KEY	KEY FUNCTION DESCRIPTION
ZERO	Used in the gross mode to zero the display within the zero tolerance level. The user may zero the instrument as many times as desired as long as the total does not exceed the value entered as the zero tolerance. A special function of ZERO is to exit a numeric entry in a menu in order to retain the original value.
MODE	Sets the display to gross or net weight and, if installed, this key will change to total, peak hold or rate of change optional modes. Note that the Remote Functions Connector on the rear of the instrument may also be used to trigger mode changes. See Section 6.4 Remote Functions Connector for details. Additional access to these modes is available through the serial ports. See Section 4.3 Instrument Serial Communications for details.

MODE	DESCRIPTION
Standard Modes	
Net/Gross Mode Change	Activating this function causes the instrument to change modes from net to gross or gross to net.
Optional Modes	
Total Mode	When the total mode is selected, the display indicates the accumulated total weight. The instrument adds the current net weight to the total net weight when a remote function input is entered. This value is then available for displaying, clearing or printing.

6.1 Keypad Descriptions - Continued

KEY	KEY FUNCTION DESCRIPTION	
MODE (cont.)	MODE	DESCRIPTION
	Peak Hold Mode (peak)	When the peak hold mode is selected, the display indicates the highest measured average gross weight. The peak value is continuously monitored and stored in any mode of operation. Reset is accomplished in the peak hold mode by pressing the clear key. The peak value is stored in memory but will not be retained in the event of power failure.
	Rate-Of-Change Mode (ROC)	When the ROC mode is selected, the display indicates the rate-of-change of the input with respect to a pre-selected time base. ROC unit and time base values can be configured as follows: Units: seconds, minutes, or hours Time-base seconds: 1, 2, 3, 4, 5, 6, 10, 12, 15, 30, 60, 120, 240, 450, 900, or 1800 ROC mode is useful for rate-by-weight applications, early warning fault conditions, such as clogged feeder tubes and trend indication.
TARE	Pressing this key allows the instrument to capture the current GROSS weight and place it in the tare register. The tare value is the difference between the NET and GROSS weights. For example, if your scale is at zero and you place 10 pounds on it and then press TARE, the instrument will store that 10 pounds in its tare register. Then in the net mode your display will now read zero, and in the gross mode it will read 10 pounds. NOTE: An identical TARE function may be obtained by activating the appropriate remote function pin. See Section 6.4 Remote Functions Connector for details.	

6.1 Keypad Descriptions - Continued

KEY	KEY FUNCTION DESCRIPTION
PRINT	Transmit data to the printer. This may be accomplished over the standard serial port, remote functions connector, or the optional serial and BCD ports. If this key is pressed and the ports have not been configured as a printer port, the action will be ignored. No printing will occur if the weight is "In Motion", or over scale capacity.
-/Test/Clr "Test" functional description	This function initiates the instrument's automatic self-test. The program automatically steps through each test until all are completed. When the self-test is complete the program will return to the operate mode. The down arrow key will pause the display until the up arrow key is pressed. To get out of the program before it has finished press the Exit key. The self-test does not stop on a failure, therefore the operator must watch the display while the test is being performed. Refer to Section 5.2.1 Self-Test for a description of the self-test.
-/Test/Clr "Clr" functional description	The clear function operates only when in one of the three menus (Setpoint, Option, or Calibration) and fills the display with zeros. Use this key to clear the display before entering a new value. In the CAL set up menu, pushing this key while a subheading is displayed will take the display back to the unit sub-menu heading.
-/Test/Clr "-" functional description	This function inserts a minus sign in preparation for entry of a negative value. This function operates only when the display reads a numeric zero.
1/Tare Val	Enters the digit "1". Also displays the current value stored in the tare register. To enter a new value press the clear key, enter the new value using the numeric keys, and then press enter.

6.1 Keypad Descriptions - Continued

KEY	KEY FUNCTION DESCRIPTION
2/Status/Bar	Enters the digit "2". Also changes 30 segment LED functions. Pressing this key will cause the 30 segment LEDs to indicate HI 2151/20WC status settings or display an optional bar-graph representation of a selected mode.
3/Lb kg	Enters the digit "3". Also selects between pounds and kilogram modes.
4/↑	Enters the digit "4". Also advances each step through a menu when pressed. Will wrap through the end step of a menu to the start step when reached.
5/←	Enters the digit "5". Also selects either of the following: a. decimal point position b. format position for the Serial Port and BCD options. c. enter time/date options
6/Set Pt	Enters the digit "6". Also displays the setpoint option menu. The setpoint menu is used to enter the setpoint, deadband, and preact values. This menu is used to enter values for the standard internal relays and optional relays. Successive pressing of the up arrow (↑) key causes the menu items to be displayed. To select one of the menu items, press the Enter key when it is displayed. The display will then show the value of the item. Use the numeric keys to enter a new value.
7/Option	Enters the digit "7". Also displays the option menu. The option menu items allow the operator to configure those standard features which require setup as well as any installed hardware and software options. The option menu items are: a. Rate-of-change b. Analog transmitter(s) c. Serial port(s) d. BCD port e. Bar-Graph f. Real time clock g. Remote I/O As the menus are advanced (up/down arrow keys), an option menu item will only show on the display if the respective option is installed.

6.1 Keypad Descriptions - Continued

KEY	KEY FUNCTION DESCRIPTION
7/Option (cont.)	Option numbers on the menu are determined in the order they are scanned by the instrument. You must be sure you configure the correct menu number to the proper option board. Lack of an option on the menu may indicate an improper installation of the option. Once the desired item is displayed, press the Enter key to view/modify the item. Some items require the entry of a number, whereas others require selection of one of several alternatives. The alternatives take the form of a sub-menu under the selected item. The options sub-menus are shown in Figure 4-1 Optional Menu Tree.
8/Cal	Enters the digit "8". Also opens the calibration set up menu. The CAL segment on the Config dipswitch (S3) on the rear panel must be toggled before entering the Cal Menu. If the CAL switch is not toggled, the display will read ERR8. When changing the dipswitch to the CAL mode, CTR ZERO, MOTION and ZERO TRACK will flash on the display to indicate that calibration is not sealed. To review the calibration values without changing them, press the -/Test/Clr key to begin displaying the calibration values. To change any calibration value, enter the gross mode, toggle the CAL dipswitch and press the Cal key.
9/	Enters the digit "9". Also steps backwards through menus. Will wrap through the start step of a menu to the end step when reached. Also chooses format in the serial and BCD menus, and pauses display in self-test.
0/Exit	Enters the digit "0". Also exits from menus and returns to normal operating mode. In a sub-menu the Exit key will display the next higher level. If the ZERO key is used during data entry, the new value will not be entered and the menu will advance to the next item.

6.1 Keypad Descriptions - Continued

KEY	KEY FUNCTION DESCRIPTION
Enter	Accepts the selection shown on the display.
	This selection may be a numeric value or a menu item selection. Whenever a value is changed, the Enter key must be pressed in order for the new value to be accepted.
	Also, for numeric values, once the Enter key is pressed, the message "Good" or "Err" will be displayed for one-half second, indicating the acceptance or rejection of the value by the instrument.
	In the case of "Good" being displayed, the display will then show the name of the next item in the menu.
	In the case of error, the value entered will be re-displayed so that the operator may correct the error. A listing of ERROR codes are in Appendix D Error Messages and Definitions.

6.2 DESCRIPTION OF REAR PANEL.

See Section 2.3 Cabling Connections for a description of the rear panel and electrical connections.

6.3 INSTRUMENT CONFIGURATION DIPSWITCH.

The Configuration dipswitch labeled Config on the instrument's rear panel (see Figure 2-2 HI 2151/20WC Rear Panel Connections) provides a means to configure the instrument to your needs by being able to lock out portions of the keypad from operator intervention and lockout calibration. Each of the dipswitch functions is described below: ("ON" position is down, and "OFF" is up):

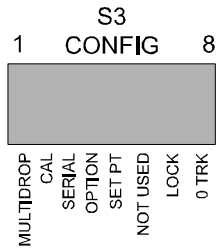


Figure 6-1. "Config" Dipswitch S3

NOTE:
For internal dip switch (S2) functions and settings, see table 5-1 located under dip switch 2 display.

SWITCH	PANEL LABEL	DESCRIPTION
1	MultDp	Multidrop. When the switch is ON, the multi-drop switch function is selected. The system must include the Hardy Link software option for this to apply. When OFF, the system defaults to the serial ring configuration. Multidrop is only available when using the EIA-422/485 option board.
2	Cal	Calibration Menu. This switch must be toggled (i.e., position changed) to enter calibration with the Cal key. (This dipswitch not used in wall mount version.)
3	Serial	Serial Port Lockout. When the switch is ON, the following commands: Format, Set, Change, Auto and Enable, cannot be executed over the serial interface. When OFF, those serial port commands are enabled.
4	Option	When the switch is ON, access to the option menu is denied. When OFF, the full option menu is available.
5	Setpt	Setpoint Menu. When the switch is ON, access to the setpoint menu is denied. When OFF the setpoint menu is available.
6		Not used.
7	Lock	Lockout. When ON, locks out the Tare, Mode, Zero, and lb/Kg keys.
8	0 Trk	Zero Track. ON enables the zero track feature, OFF disables the feature.

6.4 REMOTE FUNCTIONS CONNECTOR.

This section describes the control available by using the remote functions connections (labeled J2 Remote Functions on the rear panel of the instrument).

The functions assigned to the Remote Function connector pins are illustrated in Figure 6-2 Remote Function (J2) Connection. All of the function pins are normally-high CMOS levels.

A function is activated by connecting it with the remote functions ground pin.

NOTE:
The remote functions ground, J2-9 or 10, must be used.

Two ground pins are provided for your convenience. The power earth ground is entirely different and the option grounds are floating with respect to the remote function circuitry. Some functions are level conditions and some are activated by momentary grounding. Momentary functions must pull the desired pin low for at least 100 milliseconds (0.1 seconds). The following paragraphs give a detailed description of each remotely controlled function.

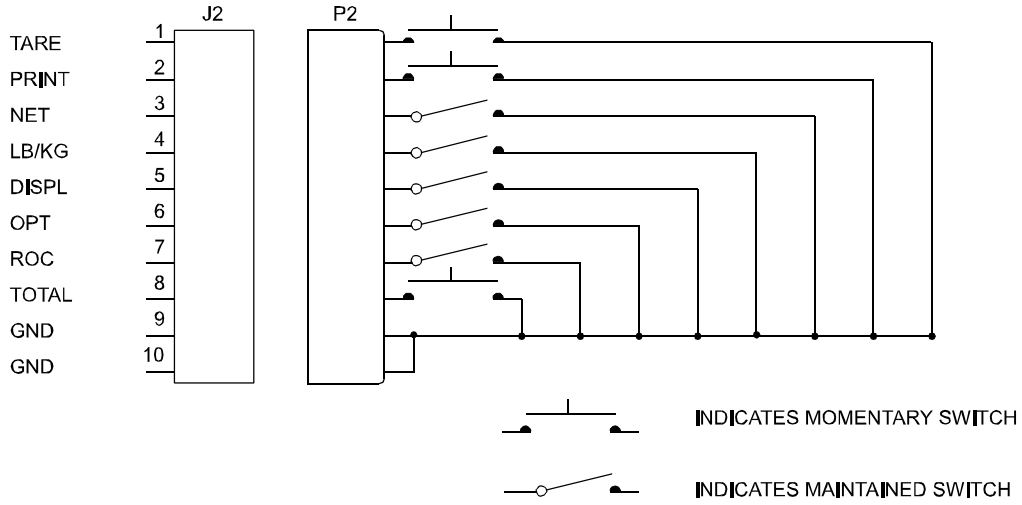


Figure 6-2. Remote Function (J2) Connection.

NOTE:
LB/KG for cal switch in wall mount unit.

REMOTE FUNCTION	PIN	DESCRIPTION
Tare	1	Activating this pin is exactly the same as pressing the Tare key on the front panel.
Print	2	Activating this pin is the same as pressing the PRINT key. Note that, as in the case of the PRINT key, the request for a print is only acknowledged while the unit is not already involved in a print cycle.
Net	3	Activating this pin causes the instrument to change modes from current mode to net. It is recommended that the NET/GROSS key on the keypad be disabled using Config dipswitch Lock (S3-7) when this remote function is being used.
Lb/Kg	4	Activating this pin causes the instrument to change modes from lb to kg or kg to lb. It is recommended that the lb/kg key on the keypad be disabled using the Config dipswitch Lock (S3-7) when this remote function is being used. Used for cal switch in the wall mount "WS" version.

REMOTE FUNCTION	PIN	DESCRIPTION
Displ	5	This function causes the display to be frozen. All outputs to options such as the BCD continue to be updated with new readings.
Opt	6	This function causes data to the option slots to be halted. If Pin 6 is grounded no new data will be sent to the option slots. In addition, two options are available to change the function of this pin. Only one of the following two options can be used: 1. Clear total accumulator from remote. 2. Clear peak value from remote. These functions must be activated at the factory.
Roc	7	Activating this pin causes the instrument to change mode from current mode to ROC.
Total	8	Activating this function causes the instrument to add the current net weight to the accumulated net weight. The level must go high and low again to add the next net weight.
Gnd	9,10	Remote functions ground. SEPARATE FROM AC OR OPTION GROUND!

6.5 INTERNAL DIP SWITCH.

The internal dip switch an eight position slide type is found on the power relay (lower) board.

SWITCH	DESCRIPTION
1	With this switch on incoming checksums are ignored.
2	When this switch is on, the Peak hold signal read is averaged. When in the off position the Peak hold signal is instantaneous.
3	In the on position the instrument is in the NBS mode of operation. Resolution is limited to 1:10,000 counts. In the off position is 1:985,000.
4	This switch must be toggled (i.e. position changed) to enter NBS calibration from the front panel CAL key.
5 - 8	Not used.

APPENDIX B

SYSTEM DATA SURVEY SHEET

TO: Hardy Instruments, Inc. FROM: _____

ATTN: Customer Support COMPANY: _____

FAX NO: 858-278-6700 DATE: _____

Retain a copy of this page in a safe place. This information will help us assist you if, for any reason, you need to consult Hardy Instruments.

DATE OF INSTALLATION: _____

INSTRUMENT MODEL NUMBER: _____

INSTRUMENT SERIAL NUMBER: _____
(located on the back of the instrument)

CORNER FREQUENCY SELECTED: _____

LOAD CELLS: _____

Model #: _____

Rated Capacity: _____

Number of Load Cells: _____

mv/V Rating: _____

Type of Vessel/Hopper: _____

Deadload or weight of vessel: _____

RESULTS OF SELF-TEST: Press the -/Test/Clr button on the keypad while in the operating mode, and record the results on the following page. Use the down arrow to pause the display, and the up arrow to resume the self-test.

Self-Test Program Results

Self-Test Display	*Your Results*
tESt	
VEr	
C SUM	
CALdAt:	
CALtyP	
UnItS	
CF =	
grAd	
SPAn	
Zr cnt	
FS cnt	
SC CAP	
0 tOL	
Motion	
AVrAgE	
LIncor	
SthVAL	
dIP 1	
dIP 2	
tAG 1	
tAG 2	

OPTIONS: Press the 7/Option key to enter the options menu and record the results. (The order of parameters may vary from this list, depending on which options were installed.)

Options

rOC

UnitS _____

tbASE _____

bArGr

bAr - Lo _____

bAr - HI _____

bcd

FOrMAt _____ _____ _____ _____ _____ _____

	An OUt 1	An OUt 2
An Lo	_____	_____
An HI	_____	_____
	SEr P1	**SEr P2**
SERcon	[ ] Print [ ] bi-dir	[ ] Print [ ] bi-dir
bAUd	_____	_____
PArIty	[ ] odd [ ] even [ ] none	[ ] odd [ ] even [ ] none
StoPS	[ ] 1 bit [ ] 2 bits	[ ] 1 bit [ ] 2 bits
LEnGtH	[ ] 7 bit [ ] 8 bits	[ ] 7 bit [ ] 8 bits
FOrMAt	))))))	))))))
ContrL	[ ] softre [ ] hardre	[ ] softre [ ] hardre
ECHo	[ ] On [ ] Off	[ ] On [ ] Off
AddrES	_____	_____

rIO

rAtE _____

rAC no _____

otr no

L-otr

SETPOINT MENU: Press the 6/Set Pt key to enter the Setpoint menu and record settings.

Setpoint Menu

SEtPnt/rLy	1	2	3	4	5	6	7	8
M0dE								
SPnt -								
dbnd -								
PrE -								

PRINTER INFORMATION

Make and Model #:_____

Baud Rate:_____

Parity:_____

Stop Bits:_____

Length:_____

Format:_____

MISCELLANEOUS INFORMATION

Format:_____

Control:_____

Echo:_____

* Address:_____

* Configured with Hardy-Link Option.

HARDY INSTRUMENTS

3860 Calle Fortunada
San Diego, CA 92123-1825

Phone: (619) 278-2900
FAX: (619) 278-6700

APPENDIX C

DISPLAY MESSAGES

DISPLAY	DEFINITION
AddrES	ADDRESS (only available in Hardy Link Applications)
AVrAgE	AVERAGE NUMBER OF READINGS
bArgr	BAR GRAPH
bar-Hi	BAR GRAPH HIGH END VALUE
bar-Lo	BAR GRAPH LOW END VALUE
bAUd	BAUD RATE
bcdP1	PARALLEL BCD PORT
bi-dir	BI-DIRECTIONAL
C2 CAL	C2™ SECOND GENERATION CALIBRATION
CAL	CALIBRATION MENU
CALdAt	CALIBRATION DATA
CF = 0, **1**, **2**, **3**, or **4**	CORNER FREQUENCY
Contrl	CONTROL
C SUM	CHECK SUM TEST

APPENDIX C - DISPLAY MESSAGES - Continued

DISPLAY	DEFINITION
dAtE	DATE
dbnd - 1	DEADBAND TOLERANCE #1 through #8 (Deadband #1 shown)
dEcPnt	DECIMAL POINT POSITION
dIP 1	DIPSWITCH #1 & #2 (Dipswitch #1 shown)
ECHo	ECHO
EndCAL	CALIBRATION COMPLETE
EntEr	ENTER
ERROR NUMBERS (see Appendix D - Error Messages and Definitions)	
EVEn	EVEN (PARITY)
FOrMAt	FORMAT
FScnt	FULL SCALE COUNT
GntrSA	GROSS, NET, TARE, RATE OF CHANGE, SETPOINT, ALTERED PRINT
	or
GntrSP	GROSS, NET, TARE, RATE OF CHANGE, SETPOINT, PRINT

APPENDIX C - DISPLAY MESSAGES - Continued

DISPLAY	DEFINITION
Good	GOOD
Gr	KILOGRAMS
grAd	GRADUATION SIZE
HArdrE	HARDWARE
kEy - bd	KEYBOARD
L - Otr?	LAST QUARTER?
Lb	POUNDS
LEnGtH	LENGTH
7 bitS	7 OR 8 BITS (7 bits shown)
LInCor	MIDPOINT LINEARITY CORRECTION
Motion	MOTION TOLERANCE
Mode	MODE
no	NO
nOnE	NONE (PARITY)
odd	ODD (PARITY)
OFF	OFF
On	ON
OPt	OPTION MENU

APPENDIX C - DISPLAY MESSAGES - Continued

DISPLAY	DEFINITION
OPt Id	OPTION ID
Otr no	QUARTER NUMBER
PArIty	PARITY
PASS	PASS
PrE - 1	PREACT #1 through #8 (Preact 1 shown)
Print	PRINT
rAC No	RACK NUMBER
rAMtSt	RAM TEST
rAnGE	LOAD CELL/S CAPACITY
rATE	RATE
rEF Pt	ZERO OR USER SELECTED VALUE FOR S-CAL
rEStOr	RESTORE DATA FROM SECURE MEMORY MODULE TO INSTRUMENT RAM.
rEv X	REVISION LEVEL X <R> (X denotes revision level of software)
rIO	REMOTE INPUT OUTPUT
rOC	RATE OF CHANGE
rLy - 1	RELAY #1 through #8 (Relay #1 shown. Relays #3 through #8 are external optional relays)

APPENDIX C - DISPLAY MESSAGES - Continued

DISPLAY	DEFINITION
SAVE	SAVE DATA FROM INSTRUMENT RAM TO SECURE MEMORY MODULE
S CAL	SOFTWARE CALIBRATION
Sc CAP	SCALE CAPACITY
SErcon	SERIAL CONFIGURATION
SEr P1	SERIAL PORT #1 & #2 (Serial Port #1 shown)
SEtPnt 1	SETPOINT #1 through #8 (Setpoint #1 shown)
SLOt 1	SLOT #1 & #2 (Slot 1 shown)
SnStUy	LOAD CELL FULL SCALE OUTPUT MV/V
SOFtrE	SOFTWARE
SPAn	SPAN
Stichr	INSTRUMENT NORMALIZATION VALUE
StoPS	STOP BITS
1 bit	1 & 2 BITS (1 bit shown)
TAG 1	TAG #1 & #2 (Tag #1 shown)
tAre	TARE
tbASE	TIMEBASE
tESt	TEST

APPENDIX C - DISPLAY MESSAGES - Continued

DISPLAY	DEFINITION
tiME	TIME
totAL	TOTAL
tot dP	TOTALIZER DECIMAL POINT
U-HOUr	UNITS IN HOURS
Units	UNITS (LB OR KG)
U-Min	UNITS IN MINUTES
U-SEC	UNITS IN SECONDS
yES	YES
ZErO	ZERO
Zr cnt	Zero Count
0 toL	ZERO TOLERANCE

APPENDIX D

ERROR MESSAGES AND DEFINITIONS

ERROR MESSAGE	DEFINITION
- - HI - -	Load cell/point signal represents a weight higher than scale capacity.
Error	Invalid character entry.
Err 1	Invalid grad size. Grad size must be 1, 2, 5, 10, 20, 50, 100, 200, 500.
Err 2	NTEP grad size error. Grad size must be greater than the full scale divided by the range.
Err 3	Average out of range. Average must be from 1 to 200.
Err 4	Instrument in motion when value entered.
Err 5	Not in Gross mode when trying to enter CAL menu.
Err 6	Invalid zero. Zero must be less than zero tolerance.
Err 7	Invalid grad size. Grad size must be greater than the full scale divided by the range minus one valid grad size.
Err 8	Unable to enter Calibration Menu without toggling ReCal segment on S3.
Err 9	Invalid zero. When the instrument is in NTEP mode, the zero must be within the zero tolerance.
Err 10	Invalid motion tolerance. Motion must be greater than 0 and greater then or equal to Grad Size.

APPENDIX D - ERROR MESSAGES AND DEFINITIONS - Continued

ERROR MESSAGE	DEFINITION
Err 11	Negative gross weight during acquire tare. (NTEP only)
Err 12	All decades after decimal point must be active. (NTEP only)
Err 13	Full scale calibration of zero or negative value not allowed.
Err 14	Scale capacity of zero or at negative value not allowed.
Err 15	Zero tolerance of zero or a negative value not allowed.
Err 16	Tare greater than span. (NTEP only)
Err 17	Acquire tare cannot be used with zero gross weight. (NTEP only)
Err 18	Difference between zero and span less then 100 counts.
Err 19	Occurs when configuring Serial Port 1 and entering a negative address.
Err 20	Option held when a print command was requested. Option hold active on remote functions TB when print command from serial port requested. (Serial Port only)
Err 24	Clock malfunction.
Err 25	Invalid total decimal point.
Err 26	Faulty time or date entry.

APPENDIX D - ERROR MESSAGES AND DEFINITIONS - Continued

ERROR MESSAGE	DEFINITION
Err 40	Software Cal sticker value too small.
Err 41	Software Cal reference point weight out of range.
Err 42	Software Cal load cell overloaded.
Err 43	Software Cal range is zero error.
Err 44	Sensitivity out of range.
Err 45	No Software Cal in NBS range.
Err 50	Too many BCD Options.
Err 52	Too many Serial Options.
Err 54	Invalid serial or BCD format entry. (_ _ _ _ _ _ P or _ _ _ _ _ _)
Err 55	Illegal analog weight span. Analog span weight minus analog zero weight must be larger than 2% of the calibrated span.
Err 60	The number of load points found did not match the number entered.
Err 61	No load points found.
Err 62	Load point capacities or sensitivities do not match.
Err 63	Check Sum Error on 1 or more load points.

APPENDIX D - ERROR MESSAGES AND DEFINITIONS - Continued

ERROR MESSAGE	DEFINITION
Err 64	Too many significant digits, after the decimal point, to be displayed.
Err 97	Checksum error.
Err 99	Bad command sequence. (Serial Port only)

APPENDIX E

NTEP OPERATION

This instrument has been approved for NTEP applications. An NTEP kit is available from the factory that includes special screws for sealing the instrument and NTEP labels. Consult the factory for further information on this kit.

There are some differences in how the instrument operates when in the NTEP mode.

1. To configure the instrument for NTEP mode, set DIP switch S2 position 3 to the ON position. This switch is inside the instrument located on the Power and Relay board (bottom board). Calibrate the instrument as follows:

    a. Remove power cable from HI 2151/20WC rear panel POWER jack J6.

    b. Slide HI 2151/20WC assembly from housing.

    c. Ensure DIP switch S2 position 3 is set to ON.

    d. Move DIP switch S2 position 4 to the opposite of its current setting. This is the Cal toggle switch.

    e. Slide HI 2151/20WC assembly into case as shown in Figure 3-4 HI 2151/20WC Housing for Main Board, Power and Relay Board Alignment.

    f. Ensure load cell or loading device cable is connected to jack J1.

    g. Connect power cable to rear panel POWER jack J6.

    h. Observe the center zero, motion, and zero track LED's flash.

    i. Calibrate HI 2151/20WC, refer to detailed calibration procedure Section 3.3 Full Calibration Procedure.

    j. Observe CTR ZERO, motion, and zero track no longer appear on display.

APPENDIX E - NTEP OPERATION - Continued

2. The "CTR ZERO" message indicator is illuminated when the weight reading is within one-quarter of a graduation of the calibrated zero value.

3. The maximum allowable resolution in the NTEP mode is 10,000 counts.

4. The following ERR codes are applicable to NTEP only.

ERROR MESSAGE	DEFINITION
Err 2	NTEP grad size error. Grad size must be greater than the full scale divided by the range.
Err 9	Invalid zero. When the instrument is in NTEP mode, the zero must be within the zero tolerance.
Err 11	(NTEP only) Negative gross weight during acquire tare.
Err 12	(NTEP only) All decades after decimal point must be active.
Err 16	(NTEP only) Tare greater than span.
Err 17	(NTEP only) Acquire tare cannot be used with zero gross weight.
Err 45	Soft-Cal not available in NTEP mode.

APPENDIX F

GLOSSARY OF TERMS

ACCURACY
Closeness of a reading to the actual value of the quantity being measured.

ALARM
Indication of a tolerance deviation.

ANALOG SHIELD CAN
A metal enclosure placed over the analog section of the electronics to prevent radio frequency interference.

ANALOG TRANSMITTER
An option card which outputs an analog representation of net, gross, total weight or rate of change data.

BAUD RATE
Baud rates are used as a measure of how fast serial data is transmitted, (BIT/SEC).

BCD
Binary Coded Decimal - a type of positional value code in which each decimal digit is binary coded into 4-bit "words".

BI-DIRECTIONAL
A capability used to transmit data in either direction at the same time, for example: to or from the instrument.

CLEAR KEY
A key used to clear data or formats entered into a menu.

CTS
Clear to send an RS-232C level signaling a readiness to accept data.

DEAD BAND
A value used to prevent relay chatter once the setpoint is reached.

DEAD LOAD
Weight of hopper assembly or platform assembly sitting on top of load cells.

APPENDIX F - GLOSSARY OF TERMS - Continued

DECIMAL POINT POSITION
Menu item used to set the decimal point position for all display readouts.

DIP-SWITCH
A switch installed in a circuit card with several individual switches built in. Used to set different options in a system.

DISPLAY
A device used to show information from the instrument.

ENGINEERING UNITS
Pounds or Kilograms

ELECTROSTATIC DISCHARGE (ESD)
Electrostatic Discharge is an electric charge (static electricity) which occurs when an electrically charged object, such as a person, touches the HI 2151/20WC. To avoid damage to personnel and to the unit, a grounded static control wrist strap should always be worn when opening and/or servicing the HI 2151/20WC.

ENTER KEY
This key is used to accept user input into the memory.

EPROM
Electrically programmable read-only memory.

ERROR
A message that indicates an unacceptable input has been entered.

EVEN
A parity configuration.

EXCITATION
D.C. voltage supplied to the load cell for power.

FULL-SCALE
Full scale input as defined by instrument and load cell parameters. Example: 3MV/V load cell @ 10 volts = 30mV full scale.

APPENDIX F - GLOSSARY OF TERMS - Continued

GRADUATION SIZE
Minimum increment displayed by the instrument.

GROSS WEIGHT
An overall weight exclusive of tare deductions. Weight of material plus container.

INPUT AVERAGE
The number of readings averaged into a displayed value.

KEYPAD LOCKOUT
A selectable switch used to prevent input from the keyboard.

KILOGRAMS
A unit of mass in the metric system. Equal to 1000 grams or 2.2046 pounds. "Gr" represents kilograms on the seven segment display.

LED
Light Emitting Diode. These are used in the front panel displays and indicators.

LOAD CELL
A device which produces output signal proportional to the applied weight or force.

MENU
A set of prompts used to configure the instrument.

MENU DRIVEN
Operational prompts supplied in common language statements via the system display to guide an operator through a procedure.

MICROPROCESSOR
A semiconductor device that performs control, input/output, arithmetic, and logical operations by executing instructions obtained from memory sources.

MIDPOINT LINEARITY CORRECTION
Allows operator to "BEND" the response of an instrument to match a non-linear input.

APPENDIX F - GLOSSARY OF TERMS - Continued

MOTION
The amount of allowable deviation between consecutive readings before a weighment is accepted as being complete.

NEMA 4
An enclosure that is watertight, dust-tight, and usable both indoors and outdoors. Will protect the enclosed equipment against splashing water, seepage of water, falling or hose-directed water, and severe external condensation.

NET WEIGHT
Gross Weight minus the Tare value.

NEXT KEY
A key used to step through menus or increase the value of a digit.

NON-LINEARITY
A deviation of an instrument response from a straight line.

NUMBER OF READINGS PER AVERAGE
The number of weight readings used to compute the displayed weight.

ODD
A parity configuration.

OPTION
A device not supplied with a basic instrument.

OPTION SLOT
A location on the main board used to install an option card.

PARITY
A binary digit error correction appended to an array of bits to make the sum of all the bits always odd or always even.

POUNDS
A unit of mass in the Avoirdupois System. Equal to 16 ounces or 0.4536 kilograms.

APPENDIX F - GLOSSARY OF TERMS - Continued

PREACT
The number of units above or below the set point value of which the relay will trip. Use as an "in flight" compensation value.

PREVIOUS KEY
A key used to step back through menus.

PROMPTS
Instructions or options presented, in a menu, by the instrument.

RAM
Random-Access-Memory. Read/write memory out of which the microprocessor can both write and read data.

RATE OF CHANGE
A measure of the rate at which weight is changing. For example, if 100 pounds were dispensed in 1 minute the rate of change would be 100 lb/minute.

RELAY SENSE SELECTION
Optional procedure which reverses the relay sense from normally energized to normally de-energized, or back again.

REMOTE FUNCTION
A function in the instrument that can be accessed away from the instrument.

REPEATABILITY
The maximum difference between readings for repeated readings under identical conditions.

ROM
Read-Only-Memory. This permanent, non-volatile memory gives the processor instructions and cannot be altered.

RTS
Request to send an RS-232C level, signaling a readiness to send.

RXD
Received data at a serial port. Accepts RS-232C data signals.

APPENDIX F - GLOSSARY OF TERMS - Continued

SCALE CAPACITY
The maximum amount of weight the scale is capable of supporting, (Live load plus deadload).

SECURE MEMORY MODULE (SMM)
The Secure Memory Module stores and protects vital information from corruption, including calibration, configuration of setpoints, RS-232C Serial Port, Optional Serial, BCD, Bar-graph, and Rate of Change. Also allows the transference of data from one unit to another, with no re-calibration or re-configuration necessary.

SET POINT
Ordered weight of a particular ingredient. Weight reading at which a relay will be actuated.

SPAN
The total amount of test weights used (placed on the scale) when performing a "Hard Calibration".

TAG
Another name for Secure Memory Module.

TARE
Artificial zeroing of the weight hopper so that a net weight can be displayed. Also, the action of adjusting out the known weight of the container from the total indicated weight, so that the indicator reads net weight directly.

TEMPERATURE COEFFICIENT
The change in indication due solely to a change in temperature from a reference temperature. Expressed as a percentage of span value for a specified temperature change.

TIME BASE
Time in seconds between values subtracted to determine rate of change.

TRANSMITTER SPAN
Value the transmitter puts out with the maximum weight on the load cell.

TRANSMITTER ZERO
Value the transmitter puts out with minimum weight on the load cell.

APPENDIX F - GLOSSARY OF TERMS - Continued

TTL
Transistor-transistor Logic

TXD
Transmit Data

UPDATE RATE
Number of times per second a new weight reading is taken.

ZERO
Weight reading once the dead load has been offset.

ZERO CALIBRATION
Offset of the value of the dead load of the weight hopper.

ZERO TOLERANCE
The number of graduations from zero that will be accepted as zero by the instrument.

ZERO TRACK
Logic command used to adjust the instrument automatically from small variances in zero readings.