Series V
Weight Converter

Operation and Installation Manual

Hardy Instruments Inc.

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Printed on Recycled Paper.

July 1984

0596-0054A

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SECTION 1

GENERAL INFORMATION

1.1 Purpose and Scope. This manual provides the information necessary for operating the Series V weight converter.

Organization of this Manual. This section (1) provides general information on the Series V unit. Section 2, Theory of Operation, describes the unit's external and internal characteristics and also briefly outlines basic operating procedures. Section 3 provides instructions for installing Series V. Section 4, Scale Calibration, enables the user to calibrate the scale. Operating the unit is covered in Section 5. Section 6 defines and describes operating procedures for the unit's available options. Specifications for Series V are defined in Section 7. Five reference guides, an error message table, and a glossary of terms are located at the end of the manual.

1.2 General Description. The Series V is a microprocessor-based weight converter. The standard unit is designed for applications ranging from basic vessel and platform weighing to complex process-oriented operations. The user performs all fine-tuning adjustments such as scale calibration via the keyboard. Other operational parameters including alarm points and increment size are also set via the keyboard. Series V has three modes of operation: Gross, Net and Rate-of-Change. LED (light emitting diode) indicators verify the mode of operation, the calibration step, and the status of control outputs. Two high or low limit alarms may be independently set to trip at a selected net, gross or rate of change.

1.3 Series V Features.

- Internal battery back-up automatically stores all programmed information upon power failure for up to 30 days.
- The system's diagnostic capability verifies instrument electronics, calibration and display modules.
- Fast sample/hold digitizing technique allows two auto-calibration readings and one signal reading to be taken every 25 milliseconds.
- Available options include bench-stand mounting, BCD output, RS-232-C output and an isolated analog output. In addition to the standard 120 VAC power, 240 VAC is also available.
- High resolution of 60,000 counts.
- Uses state-of-the-art silicon amplifiers with low noise coefficient.
- Complete level control system established using just one setpoint and its deadband.

S E C T I O N   2

T H E O R Y   O F   O P E R A T I O N

2.1 Introduction. This section of the manual describes the hardware and software which make up the Series V unit. The chief parts of this section are: (a) Hardware Description and (b) Operation Overview.

- o Hardware Description identifies the external and internal characteristics of the Series V.

- o Operation Overview provides a theory of operation and information on system configuration.

2.2 Hardware Description. The chief components of the Series V are the analog and digital boards. The Series V is a microprocessor-based system. The digital board contains:

  - o 8039 central processing unit

  - o EPROM (electrically programmable read-only memory) for program storage

  - o Battery protected RAM (random access memory) for storing system parameters

Figure 2-1 below is a photograph of the Series V front panel.

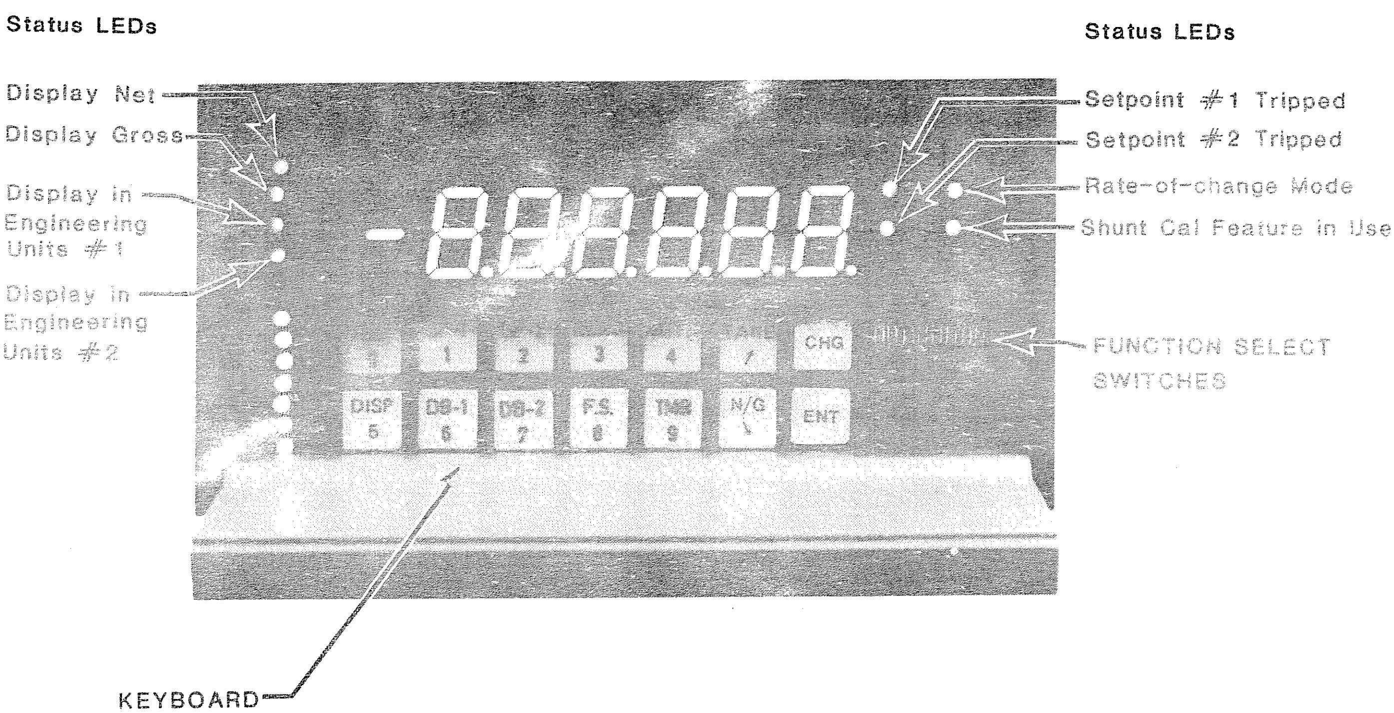


Figure 2-1. Series V Front Panel

2.2.1 Input/Output Devices. The following input/output devices are serviced by the system controller (the digital board).

- o Front Panel (keyboard)
- o System Display
- o Load Cell Power Supply and Amplifier
- o Control Interface to User Equipment (relay)
- o Analog Transmitter (option)
- o RS-232-C or BCD output port (option)

2.3 Operation Overview. The Series V unit has three internal subsystems. Refer to Figure 2-2. The subsystems are: (a) display and digital communications port, (b) set point relays, (c) analog transmitter.

These subsystems may operate within different modes. For example, the display and BCD output can monitor net weight while the analog transmitter is transmitting a weight rate-of-change. Simultaneously, one limit alarm can be set to trip at a minimum net (tank empty) weight, while the other limit alarm can be set to trip at a maximum gross weight.

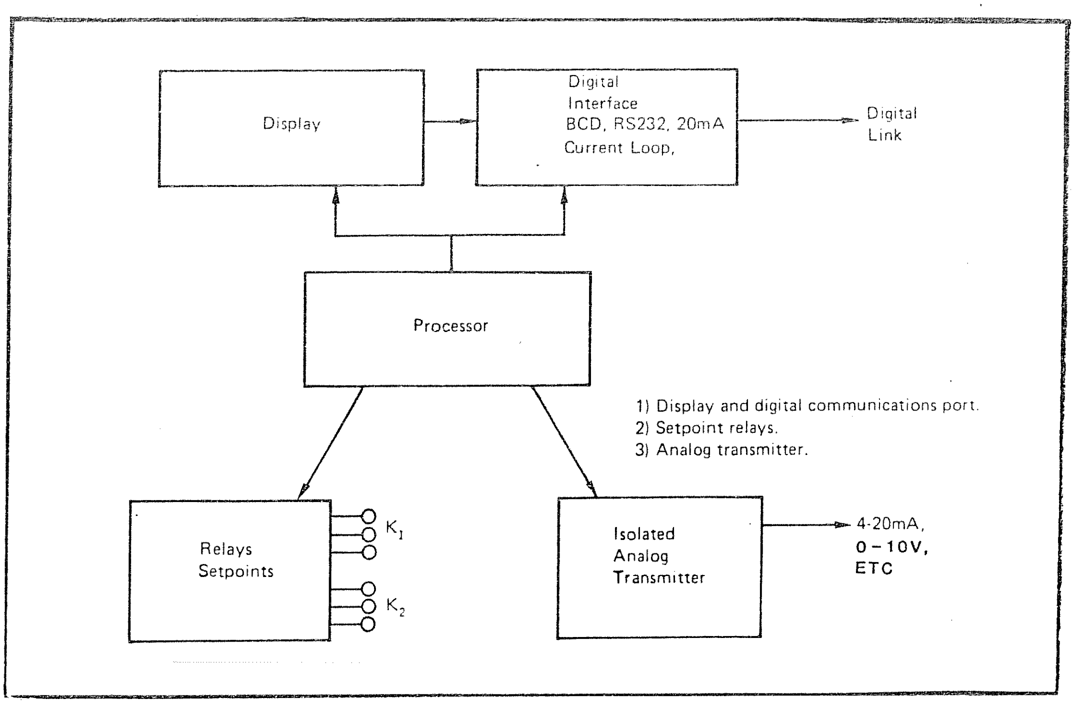


Figure 2-2. Basic Internal Subsystems

The Series V operates under control of the microprocessor. The analog section provides the microprocessor with an interface to the load cell. A load cell generates an electrical signal which is proportional to the amount of weight placed on the scale. The analog section then translates this electrical signal into a number the processor computes as gross, net, or weight rate-of-change. Computed values are then given to the display, digital interface, and analog transmitter according to the selected operation mode.

Three readings are taken during every 1½ line cycles. One of these readings is an output signal from the bridge. The other two readings are auto-calibration readings which eliminate the effects of thermally induced offset (zero) and gain (span) drift. The conversions take approximately - 8 1/3 milliseconds and are performed on a sampled signal.

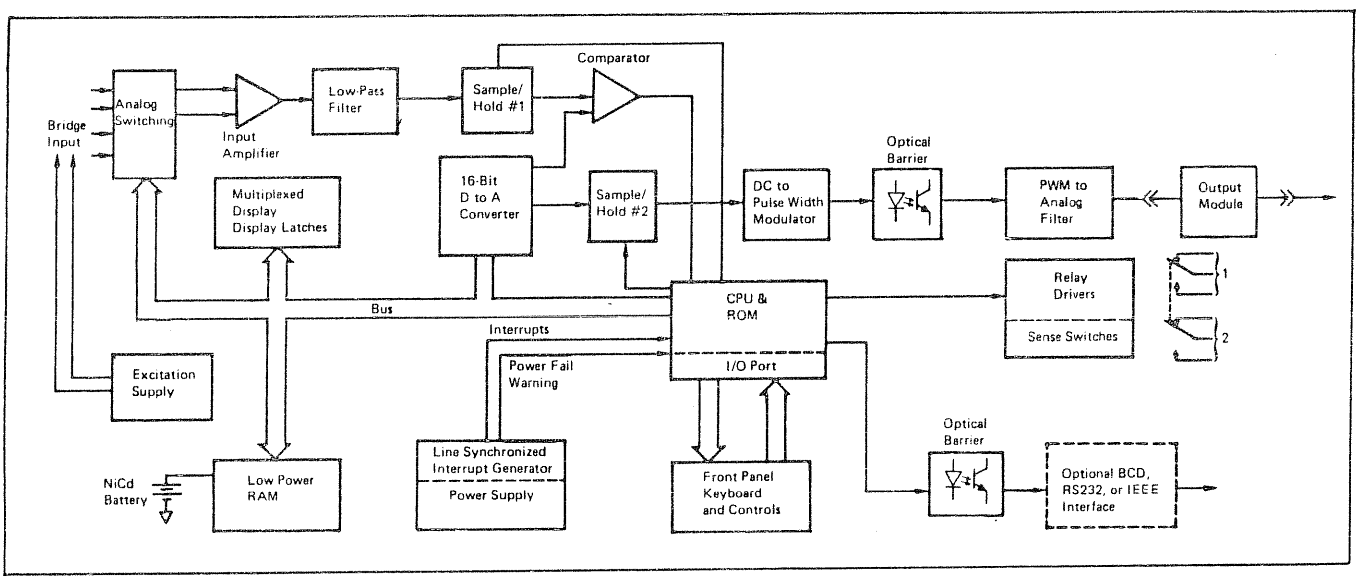


Figure 2-3. Series V Block Diagram

2.3.2 High Speed Data Acquisition. The Series V features a fast sample/hold digitizing technique. This technique allows two auto-calibration readings and one signal reading to be taken every 25 milliseconds. The timing of these readings is synchronized to the AC power line frequency, which provides related power line noise rejection. Series V provides the resultant data to its internal set points, to its analog output transmitter, and to any digital communication options such as the BCD and RS-232-C.

2.3.3 The Speed/Resolution Trade-Off. Basic theory states that the noise present in a system increases proportionally with the square-root of the bandwidth. Bandwidth is proportional to the reciprocal of the response time. Although the Series V uses state-of-the-art silicon amplifiers with a low noise coefficient, the speed/resolution trade-off must still be considered for some applications.

2.3.4 Speed Resolution Table. Refer to Table I when configuring the Series V for its particular applications.

NOTE: All applications may contribute noise from external sources.

Table I. Speed/Resolution

No. of Averages	Amplifier Noise (Referenced to Input) Peak to Peak	System Response Time (60Hz Line)*	**Maximum Recommended Display Counts (At Fullscale Input)
2	1 microV	25 mSec	10000
4	0.6 microV	75 mSec	15000
8	0.4 microV	175 mSec	25000
16	0.25 microV	375 mSec	40000
32	0.18 microV	775 mSec	60000--Up
64	0.13 microV	1.5 Sec	"
128	0.10 microV	3.2 Sec	"
256	0.07 microV	6.4 Sec	"
512	0.05 microV	13 Sec	"
1024	0.04 microV	25 Sec	"
2048	0.03 microV	51 Sec	"
4096	0.03 microV	102 Sec	"

*A/D conversions are synchronized to the line frequency. At 50Hz, the numbers in this column are multiplied by 1.2.

**Due to jitter; if the number of display counts programmed is greater than the internal resolution (60,000 counts), the display's uneven incrementing may be mistaken for jitter. This is based on an input signal of 30mV. Smaller signals will decrease the numbers in this column, larger signals will increase them. The Series V will not respond to inputs greater than 45mV. The input ranging module provides attenuation to limit the input to 45mV internally.

- Number of Averages: This column represents the total number of weight readings averaged to produce the value presented in the display, where the first reading to be averaged in is the previous display value.

- Amplifier Noise: A certain amount of noise or uncertainty is expressed in terms of a percentage of the maximum voltage rather than in pounds or kilograms. The maximum input voltage is always divided into 65,000 parts by the weight converter. Standard configuration is 3 mv/v with 15v excitation, so the maximum input will be 45mv, and 45 mv/65000 = .7 microvolts. If the uncertainty is averaged over several readings, it is statistically reduced. If a 2 mv/v cell is used, and full scale is 10,000 kg, every kg will result in 3 microvolt. So an averaging of 4 would leave an inherent uncertainty in the electronics of .2kg on top of any other problems.

- o System Response. This column refers to the speed at which new weight data is computed. The display updates at a fixed rate every 1/3 second.

- o Maximum Recommended Display Counts at Full Scale. The column refers to resolution, adjusted by changing the minimum increment.

2.3.5 Relay Sense The relay sense for both limit alarms is factory set for failsafe operation. During a failsafe operation, a power failure results in a tripped relay status. Internal relays are normally energized and are de-energized to reflect a tripped condition. The operator has the option of reversing the sense of the relays. To accomplish this, the instrument must be partially disassembled. For further information, refer to Section 6.

2.3.6 Instrument Configuration. Operation of the Series V is contingent upon how the unit is configured by the user. Following is a list of factors, which when selected, will determine operation of the Series V.

(a) Selection of optional peripheral devices, such as the analog transmitter, BCD, and RS-232-C.

(b) Scale calibration (specifying the operating range of the user's scale).

(c) Selected mode of operation: gross/net/rate-of-change.

(d) Limit alarms: net, gross and rate alarms, deadbands, latching operation, relay sense.

2.4 Using the Keyboard. The keyboard allows programmable variables to be entered or displayed. Programmable variables include: tare, set points and deadbands. The keyboard is also used in calibration of the instrument.

2.5 Battery Back-Up Default Values. If a battery back-up power failure occurs and power is turned off or interrupted, the unit uses default values. Refer to Table II (Default Values for Programmable Variables).

Table II. Default Values for Programmable Variables

VARIABLE	VALUE
Range (Eng. Units) 1	1.0 (Display = input counts for A/D)
Range (Eng. Units) 2	1.0
Setpoint 1	-65536
Setpoint 2	-65536
Deadband 1	0 (Low Trip)
Deadband 2	0
Xmtr:	Transmit Process
Zero	0
F.S.	65536
Tare	0
Rounding (minimum increment)	Set to '1'
Averages	16
Rate-of-Change Timebase (in seconds)	1
Decimal Point	None

* Default if battery back-up failure occurs and power is turned off or interrupted.

SECTION 3

INSTALLATION

3.1 Introduction. This section provides the general procedure for installation of the Series V system. This includes a description of each of the following:

(a) load cell connections

(b) external input and output connections

(c) power connections

3.2 General Installation Information. The Series V fits a 3-3/32" by 5-3/4" cutout. Cutout dimensions are shown in Figure 3-1. The operator may also refer to Figure 3-5, the Installation/Interconnection Diagram. This fold-out figure is located at the end of the manual.

In preparing the panel cutout area, at least six inches must be provided on all sides of the unit to provide adequate ventilation. In particular, the heat sink on the rear of the enclosure must not be in a restricted area. Refer to Figure 3-2. The procedure is as follows:

(a) Make cutout.

(b) Slide V in from front.

(c) Mount mounting brackets to side of Series V bezel.

(d) Insert set screws.

(e) Tighten set screws from rear until the instrument is pulled tight against panel.

3.3 Preparation for Use. The Series V requires a power source of 120, or 240Vac, as shown on the instrument label. Unless otherwise specified on the label, the instrument is set for 120 VAC operation. Connection for the bridge input is made via the rear-panel barrier terminal strip, as shown in figure 3-3.

WARNING: THIS INSTRUMENT OPERATES ON 120 VAC. USE CAUTION WHEN CONNECTING AND DISCONNECTING CONTROL AND POWER LINES. BE SURE THAT POWER IS REMOVED FROM THE INSTRUMENT WHEN THE CONTROL CIRCUITRY IS EXPOSED.

3.4 Connecting the Transducer. When connecting the load cell or cells, consideration must be given to the instrument's resolution (better than 0.25 microvolts per count). To ensure that the accuracy and noise figure of the instrument are not degraded, the following precautions must be taken:

a) Use a six-wire connection to the load cell or junction box. This will compensate for leadwire drops which can degrade span or fullscale accuracy.

b) Use well shielded cable and ground the shield at only one end. If the shield is not grounded at the transducer end, connect the shield to the -EXC terminal. This terminal is at circuit common potential.

c) Do not route the signal carrying cables near AC power wiring or other noise generating equipment.

If the excitation rating of the Series V is exceeded (more than four 350 ohm load cells, or 170mA), an external supply may be used. Precise voltage regulation is not critical, as the instrument automatically measures and ratiometrically compensates for the actual excitation voltage. Figures 3-4(a), 3-4(b), and 3-4(c) show connection of a full six-wire hookup, a four-wire hookup, and use of an external excitation supply.

3.5 Battery Back-up. The Series V features an internal nickel-cadmium battery which permits retention of the programmed setpoint, deadband, display zero and span, and transmitter zero and span data in the event of a power failure. The battery is able to continuously store all programmed values for a period in excess of thirty days.

Hardy Instruments, Inc. cannot guarantee the battery's charge state upon receipt by the customer and therefore stipulates that:

```
*************************************************************************
*    Upon receiving the Series V, a minimum 24-hour charge is required  *
*    to restore the battery to its full-charge state.                   *
*************************************************************************
```

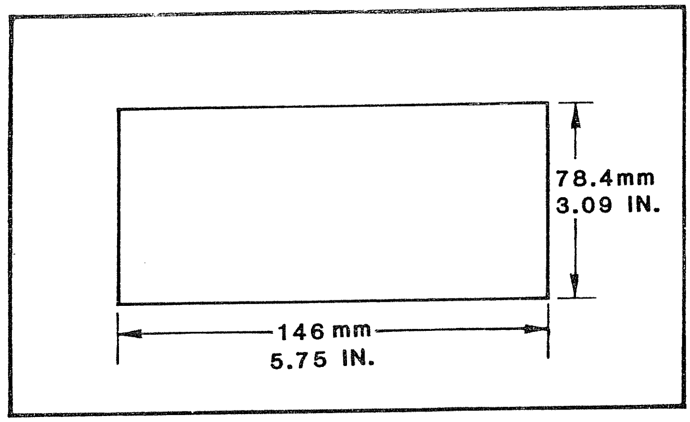


Figure 3-1. Mounting Dimensions

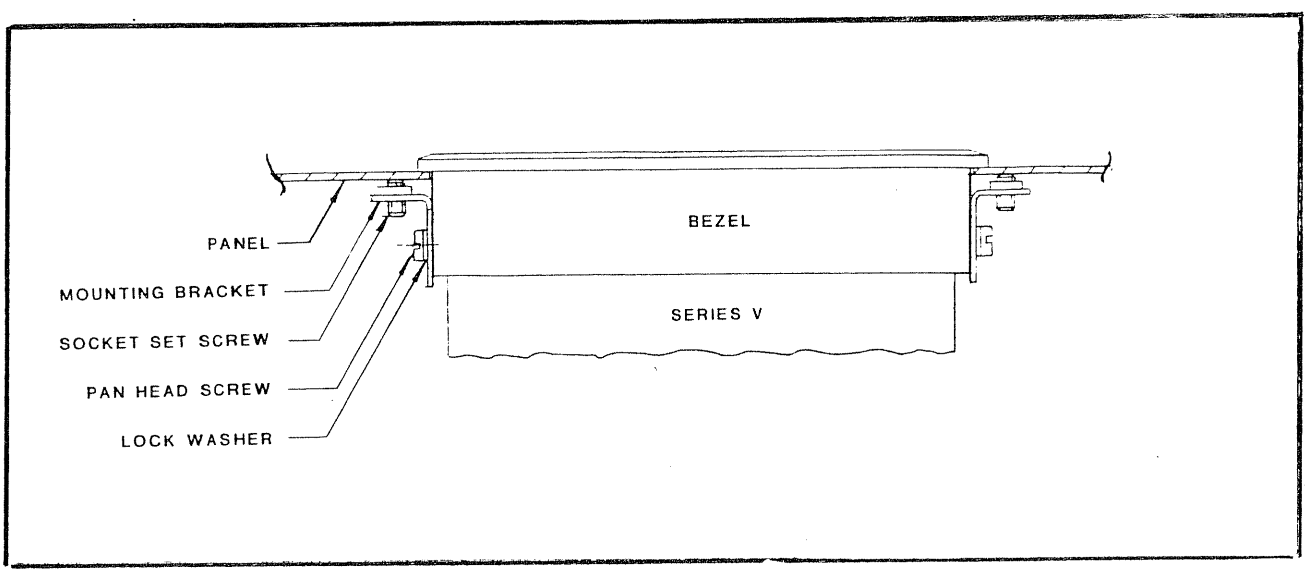


Figure 3-2. Affixing Instrument to Panel

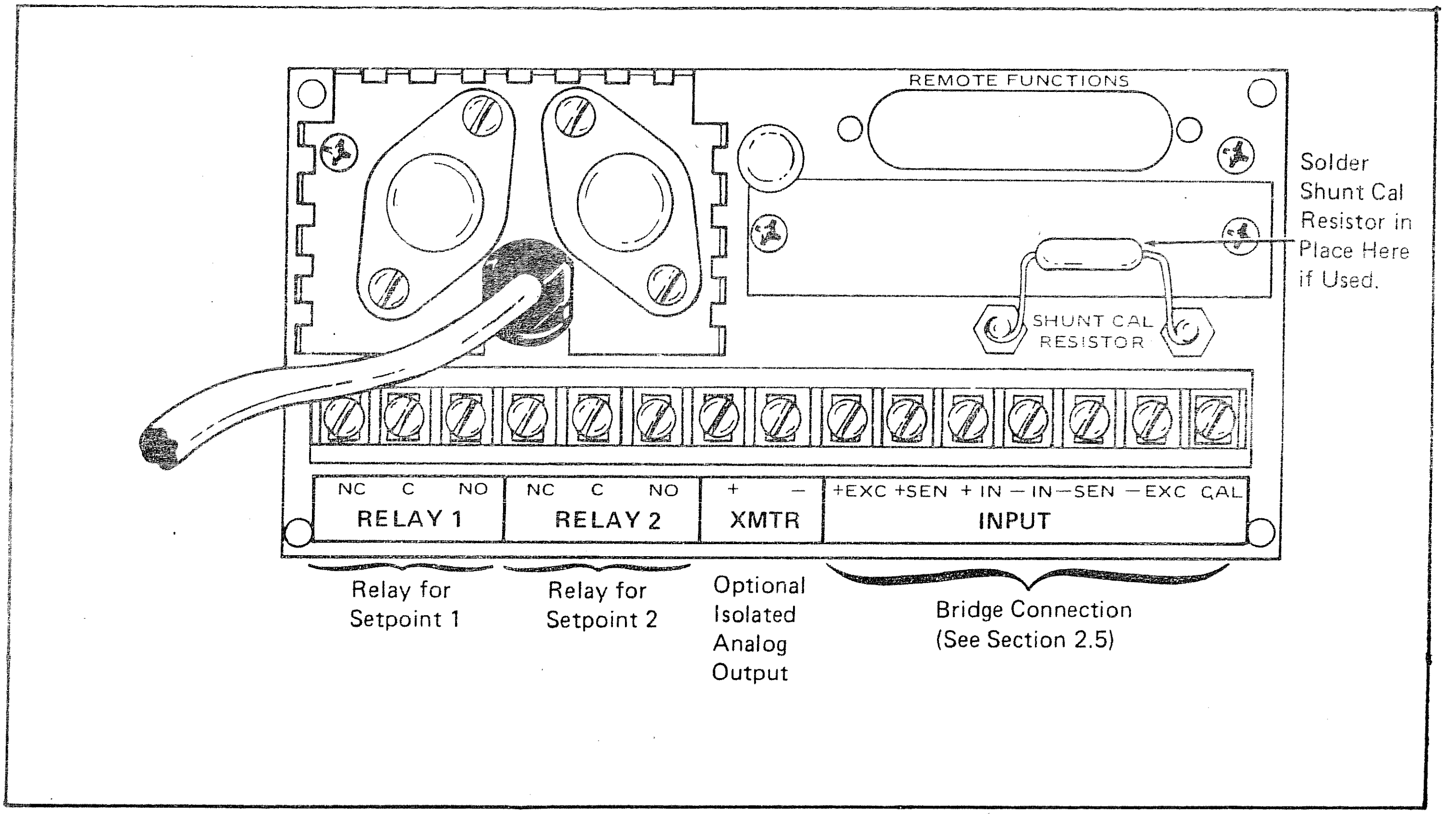


Figure 3-3. Rear Panel Connections

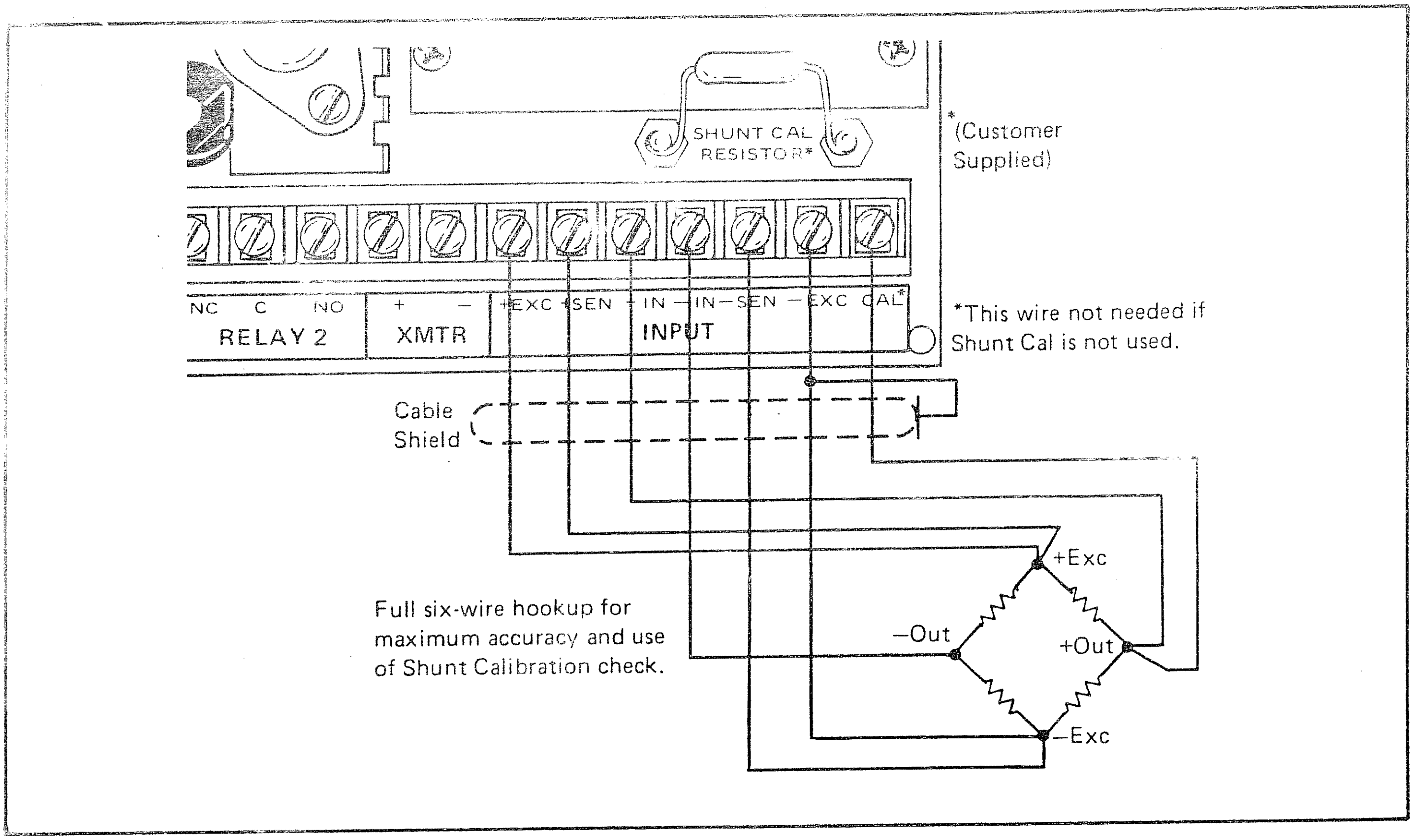


Figure 3-4(a). Six-Wire Hookup

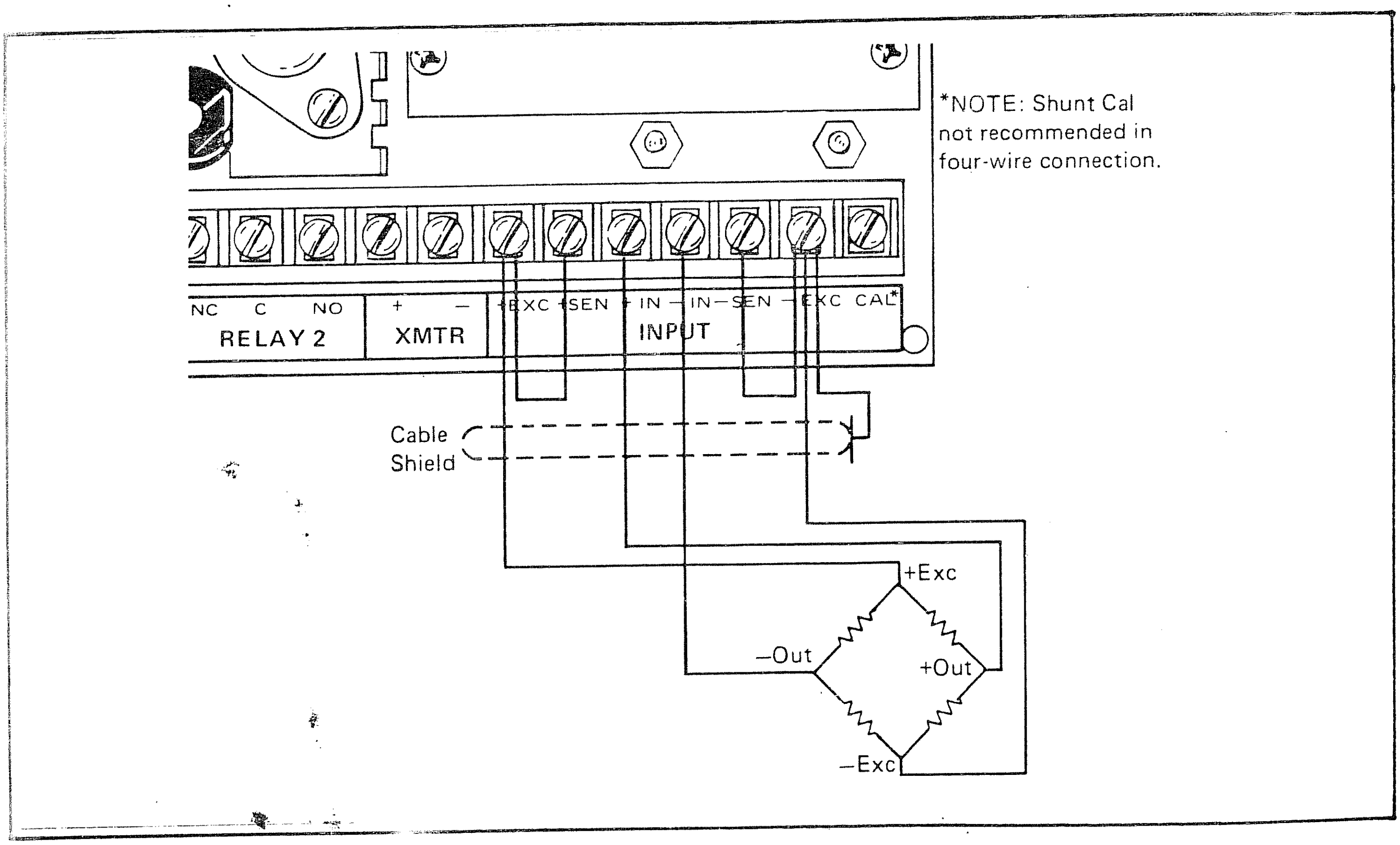
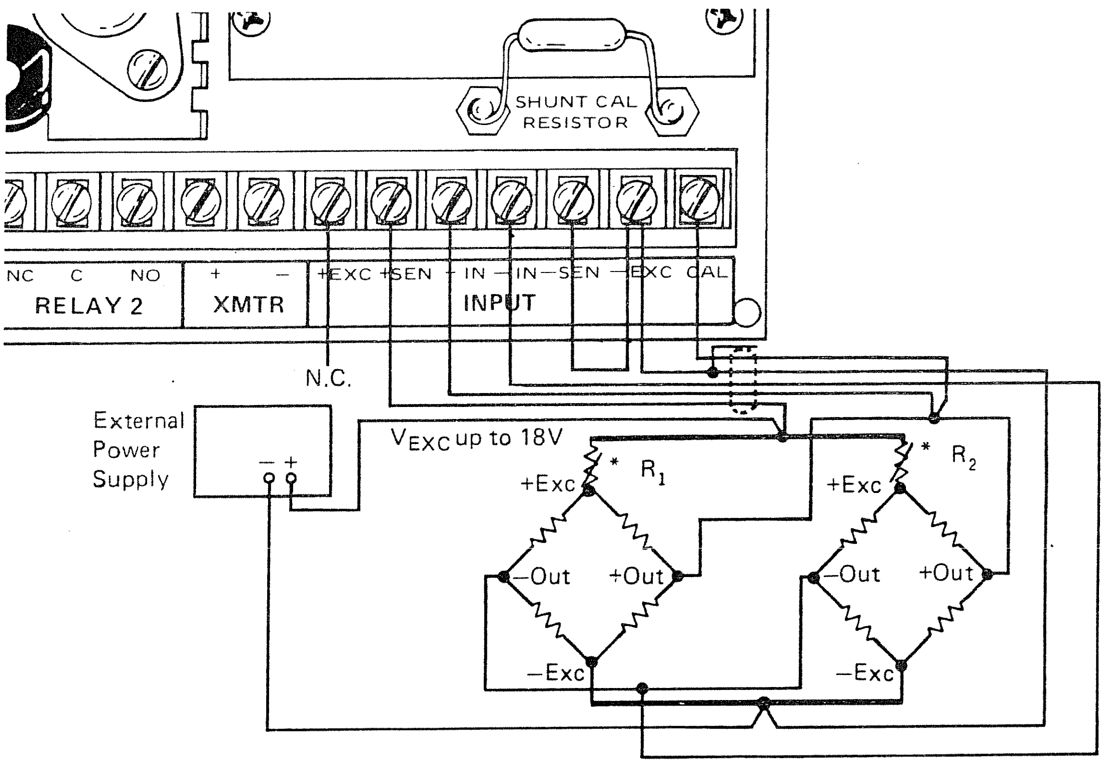


Figure 3-4(b). Four-Wire Bridge Connection



Required hookup for multiple load cells connected in parallel and used with an external power supply for excitation.

*R_1, R_2, etc., are sensitivity trims usually needed to match the load cells.

Figure 3-4(c). Hookup for Multiple Load Cells

SECTION 4

SCALE CALIBRATION

4.1 Introduction. This section of the manual enables the user to calibrate the scale. It is recommended that a one hour warm-up period proceed calibration for best reults.

4.2 Entering the Calibration Mode. To begin calibrating, perform steps (a) through (d). Switch 4 open during Cal

(a) Set front panel DIP switch 1 to desired range.
- o lbs designated by placing the DIP switch in the OPEN position.
- o kgs is designated by placing the DIP switch in the CLOSED position.

(b) Set DIP switch 2 to NET (OPEN) and DIP switch 3 to the OPEN position.

(c) Set DIP switch 8 to OPEN state.

(d) Verify that the scale is empty.

4.2.1 Now the user proceeds to calibrate the scale, beginning with the procedure for clearing the tare register.

4.3 Clearing the Tare Register. Prior to calibrating the instrument it is necessary to clear the tare register to Zero. This ensures that the values entered for calibration are representative of the test weight values used.

ACTION	DISPLAY READS
(a) Press DISP/5	CAL -d
o CAL -d represents Calibration Display.	
o DISP LED on	
(b) Press TARE	X.XX
o X.XX represents tare register contents.	
o TARE LED on	
(c) Press CHG	X.XX
o X.XX represents tare register contents.	
o TARE LED pulses on and off.	

ACTION	DISPLAY READS
(d) Press TEST/0	0
o 0 represents new tare	
o TARE LED on	
(e) Press ENT	

4.4 Decimal Point Placement.

ACTION	DISPLAY READS
(a) Press "CHG" repeatedly until decimal point is in desired position.	Decimal Point Only
(b) Press ENT	

4.5 Minimum Increment. Series V is capable of indicating the weight sensed in 1, 2, 5, 10, 20, 50 or 100 pound increments. Entering a minimum increment size allows the operator to select the least significant digit or minimum increment size to which the displayed weight should be rounded.

For example, if a tank contains 420,000 pounds of a material, the processor would weigh each count from the analog to digital converter with a value of 7. If this proved undesirable, the rounding function could be used. Rounding is available in the following increments: 1 (no rounding), 2, 5, 10, (equivalent to one dead zero), 20, 50, and 100 (equivalent to two dead zeroes).

To set the minimum increment perform the steps below:

ACTION	DISPLAY READS
(a) Press DISP/5	CAL -d (calibration display)
o DISP LED on	
(b) Press CHG	Current increment
o DISP LED toggles on and off.	
(c) Depress TARE or N/G until desired graduation is indicated.	
(d) Press ENT	

4.6 Timebase/Update Rate. The optimum update rate is selected based on environmental conditions such as mechanical variations and vibrations at the job sight. The timebase/update rate relates to the number of load cell samples taken prior to updating the current weight reading.

- o The number of averages is selectable from 2 to 4096 in binary steps (2, 4, 8, 16, 32, etc).

ACTION	DISPLAY READS
(a) Press TMB/9	Current timebase
o Display must be in gross or net mode.	
(b) Press CHG	Current timebase
o TMB LED pulses on and off.	
(c) Depress TARE or NG until desired timebase is displayed.	
(d) Press ENT	

4.7 Set Zero. This step stores the calibration value at which the scale is to read zero. By performing the steps below, the user sets up a reference value for the instrument to use in computing net weight changes.

ACTION	DISPLAY READS
(a) Remove all weight from the scale.	
(b) Press DISP/5	CAL -d
(c) Press ZERO/3	CAL -2E
o DISP and ZERO LEDs pulse on and off.	
(d) Press CHG	
(e) Press TEST/0 (or enter desired value)	0 (zero weight value)
(f) Press ENT	0 (new zero value)

4.8 Setting Full Scale. The user must now put test-weights on the scale assembly. Ideally this weight should be as close as possible to the operating capacity of the scale.

(a) Place test weights on scale	
(b) Press DISP/5	CAL -d

(c)	Press F.S./8	CAL - FS
(d)	Press CHG	
	o DISP and SPAN LEDs pulse on and off.	
(e)	Enter value of test weights via the keyboard	Entered test weight
(f)	Press ENT	Current weight
(g)	Remove test weights	0

4.9 Final Adjustments. If the display is erratic, adjust either the timebase or the minimum increment (items 4.4 or 4.5) until the situation is corrected.

4.10 For set-up procedures of set points on the optional AC analog output, refer to Section 6.

SECTION 5

OPERATION

5.1 Introduction. Operation of the Series V is contingent upon how the unit is configured by the user. The chief steps of configuring Series V for operation are: (a) mode selection, (b) pounds or kilograms selection, (c) limit alarm selection.

(a) Mode selection adjusts the scale to display weight in either gross, net or rate-of-change. The user may also select the Run/Program Mode, which locks or enables the keyboard respectively.

(b) Pounds or kilograms selection sets up the display to read in either pounds or kilograms as the unit of measurement.

(c) Limit alarm selection allows the user to establish two high or low set points which monitor either the net, gross, or the rate-of-change weight.

5.2 Initial Turn-On Test. Follow the procedure below before applying line power:

(a) Check that power to be applied is the same as specified on the label. Check that the load cell is of the correct range and is properly connected.

(b) Set all front panels DIP switches to their open position as indicated below.

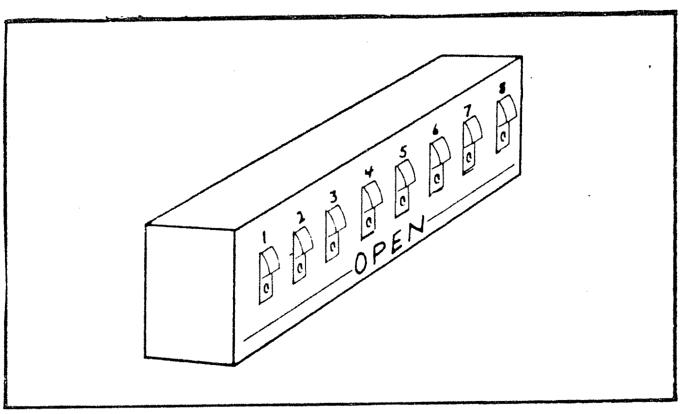


Figure 5-1. DIP Switch Set for Normal Operations

(c) Apply line power. If the battery is charged and the unit has been programmed previously (either in the field or at the factory), the display will indicate the weight value in the pre-programmed units, and will update at the preset rate. If the battery is low or if the unit has never been programmed, the processor initializes all programmed values to default numbers (refer to Table II), and the message "ERROR" will be displayed.

(d) At this point new programmed values may be set, or normal function may begin with the present values by pressing the ENT key.

(e) Next momentarily depress the TEST/0 button in the keyboard. Note that all display segments (-888888) and status LEDs light up, verifying proper operations.

(f) The display intensity may now be adjusted to the desired level. Now the unit has been checked and is ready to begin the set up procedure for unit operation.

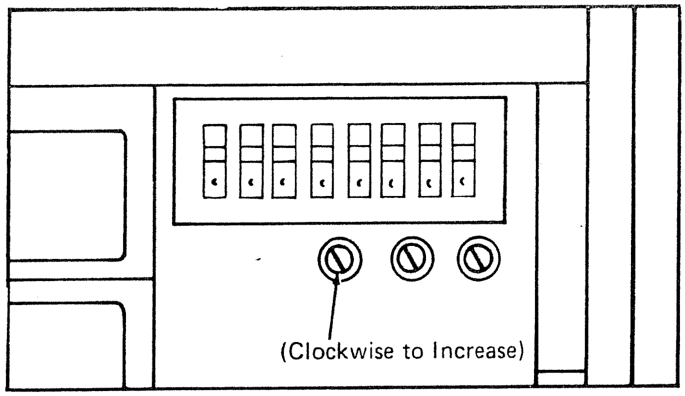


Figure 5-2. Intensity Adjustment

5.3 Mode Selection. Selecting a mode adjusts the scale to display weight in either (a) gross, (b) net, or (c) rate-of-change.

5.3.1 Gross Mode. When the Gross Mode is selected, the display indicates the current gross weight. Gross weight is all weight above calibrated zero.

5.3.2 Gross Mode Selection. Gross is selected with DIP switch 2 CLOSED and switch 3 OPEN as indicated below:

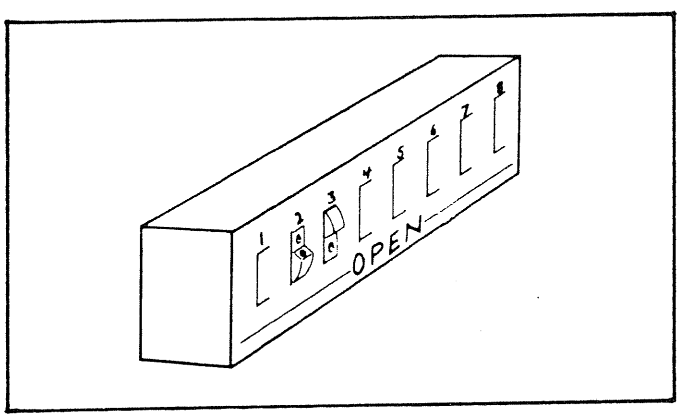


Figure 5-3. Gross Mode Selected

5.3.3 The Rate-of-Change (ROC) Mode. When the ROC Mode is selected, the display indicates the rate-of-change of the input with respect to a pre-selected timebase. The ROC Mode is useful for rate-by-weight applications, early warning fault conditions, such as clogged feed tubes, and trend indication.

TB is in sec ROC is weight/TB 1 TB to reach ROC

Set feed rate 6 LB/min TB 60 ROC = 6.0 TB 30 ROC = 3.0

- The timebase unit is programmable from 1 second to 18 hours (65000 seconds).
- The display is updated ten times every timebase period (or three times per second, whichever is slower).
- ROC is an indication of weight trend over the last timebase period.
- Limit alarms and optional transmitter output also operate in the ROC mode.

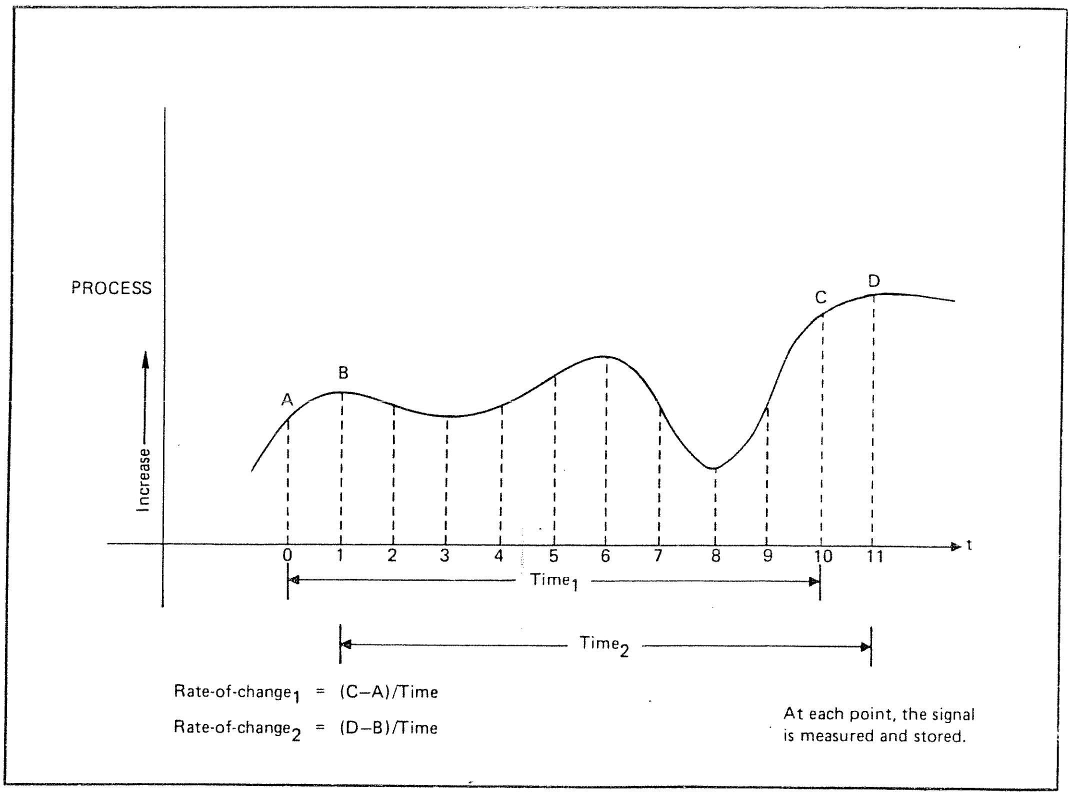


Figure 5-4. Rate-of-Change

5.3.4 Selecting the ROC Mode. The ROC Mode is selected when DIP switch #3 is CLOSED and #2 is OPEN.

NOTE: The rate-of-change timebase should always be longer than 10 times system responce time referenced in 2.3.4

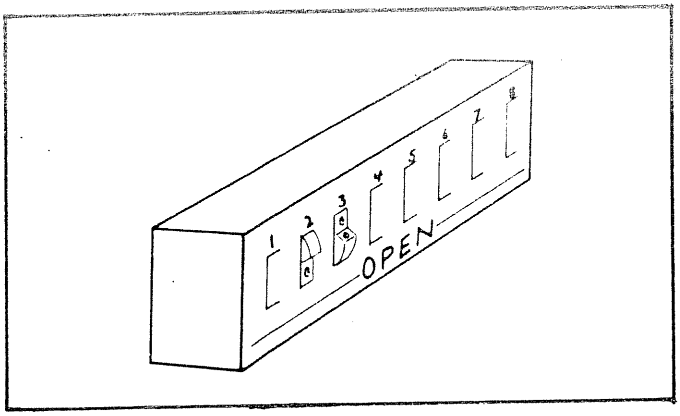


Figure 5-5. Rate-of-Change Selected

5.3.5 Net Mode. When this mode is selected the display indicates the current net weight. Net weight is gross minus any tare offset. Net is selected with DIP switches 2 and 3 OPEN.

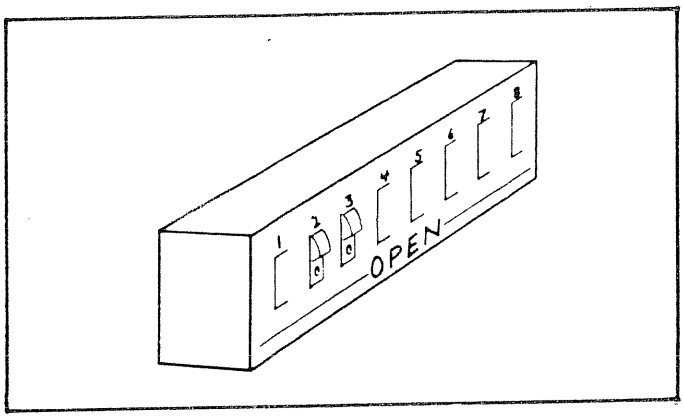


Figure 5-6. Net Mode Selected

5.3.6 Remote Access to Mode Selection. All of the operating modes are remotely selected by connecting a function pin to a common pin. The pins are located on the rear panel edge connector. This connector is in parallel with the front panel DIP switches.

- All DIP switches must be left open to allow remote control.
- Closing a front panel DIP switch disables remote control of that function.

The Remote Access Mode enables the operator to wire into a control panel with large operator switches or set up various compound modes. For example, the limit alarm relays can be used to switch the display to the hold mode, or rate-of-change mode, etc. Alternatively, the rear connector may be "read" by a remote peripheral device to determine the status of the DIP switches. When the switches are in their "open" position, a voltage representing logic level 1 (5V, CMOS logic) is present. A closed switch results in logic level zero. The CPU may be reset by momentary logic level zero or switch closure to ground at pin 8, causing a restart similar to turning power on and off. These signal lines should not be run near A.C. lines and should be shielded if run any distance.

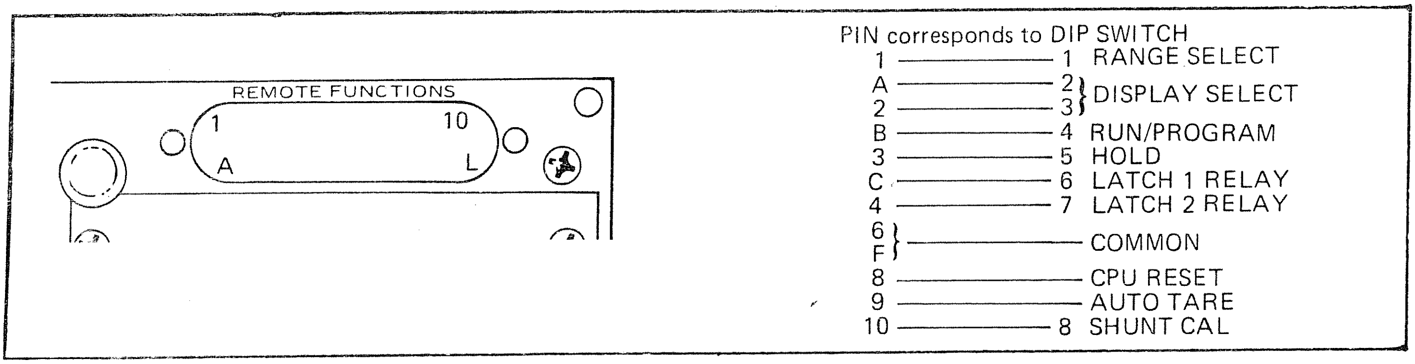


Figure 5-7. Remote Functions

5.3.7 Run/Program Mode: In the up or closed position the keyboard is locked in the Run Mode. Set points and deadbands can be viewed by pressing the appropriate pushbutton. The instrument will return to normal after release of the pushbutton. The TARE, GROSS and TEST pushbuttons are still functional. The mode of the XMTR can also be viewed in the same manner. Any other switch depression will give an 'ERR-1' message on the display. In the down or open position all keyboard functions are active. Remote connection to this DIP switch is available at remote connector P2 pin B. Grounding this pin will cause the instrument to act as if the DIP switch is up or closed regardless of the position of the switch.

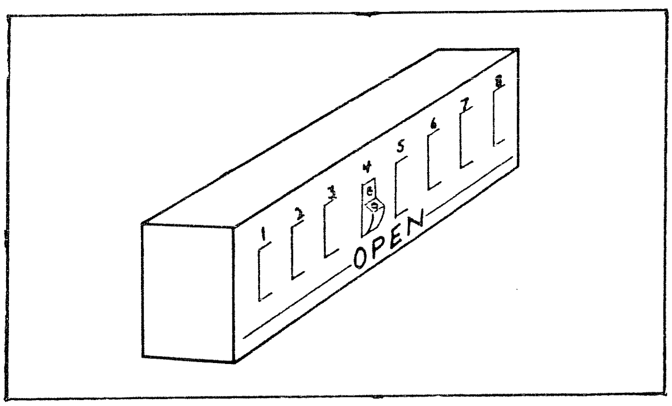


Figure 5-8. Run/Program Mode Selected

NOTE: In the above paragraphs, this manual covered the procedure used for mode selection. Next the operator configures the unit to operate in either pounds or kilograms.

5.4 Pounds or Kilograms Selection. The Series V features two independently programmable display ranges. All displayed variables (set points, deadbands, etc.) are internally converted to either lbs or kgs. LBS or KG may be selected at any time, in any mode.

- LBS: When DIP switch #1 is OPEN, the display indicates LBS. The lbs condition is verified by the LBS LED.

- KG: When switch #1 is CLOSED, KGS are selected as the unit of measurement.

5.5 Limit Alarm Selection. The Series V contains two internal limit alarms. Each of these alarms has a Form C single-pole double throw (SPDT) output relay rated 3A at 120VAC. Used as a means of monitoring either the net, gross or rate-of-change of weight, these alarms may be set as either high or low-trip alarms.

5.5.1 Establishing a Level Control System: Deadband Programming. A complete level control system can be implemented using just one set point and its deadband, as shown in figure 5-9. Using the limit alarm system, a pump fills anytime the level falls below a minimum and turns off at a certain point above it. Maximum and minimum storage levels are monitored, and the pump does not have to turn on and off in response to small changes.

5.5.2 Setting Deadbands. The Series V adopts the following convention: Programming negative values of deadband configures the set point as a high-trip limit alarm. Programming positive deadband values configures the alarm as a low trip limit. Refer to figure 5-10 and 5-11.

5.5.3 The following procedure is used to set deadbands and setpoints, which operate independently. Note that in the steps outlined below, the current value for set point 1 is set at 150.00. This value is changed to 65.00

5.5.4 Initially, the user sets the instrument in either the Gross, Net, or Rate-of-Change Mode, (DIP switches 2 or 3).

ACTION	DISPLAY READS
(a) Press either SP-1/1 or SP-2/2 (in this case, for purposes of the example, operator pressed SP1/1)	150.00
(b) Press CHG	150.00
o Set mode is enabled.	
o Status LEDs flash rapidly.	
o Next the desired value is entered: (65).	
o END	
(c) Press DB-1/6	0.06
o Press DISP/5	0.65
o Press TEST/0	6.50
o Press TEST/0	65.00
(d) Press CHG	
o Repeated actuations of the CHG key will change the polarity of the set point.	
(e) Press ENT	

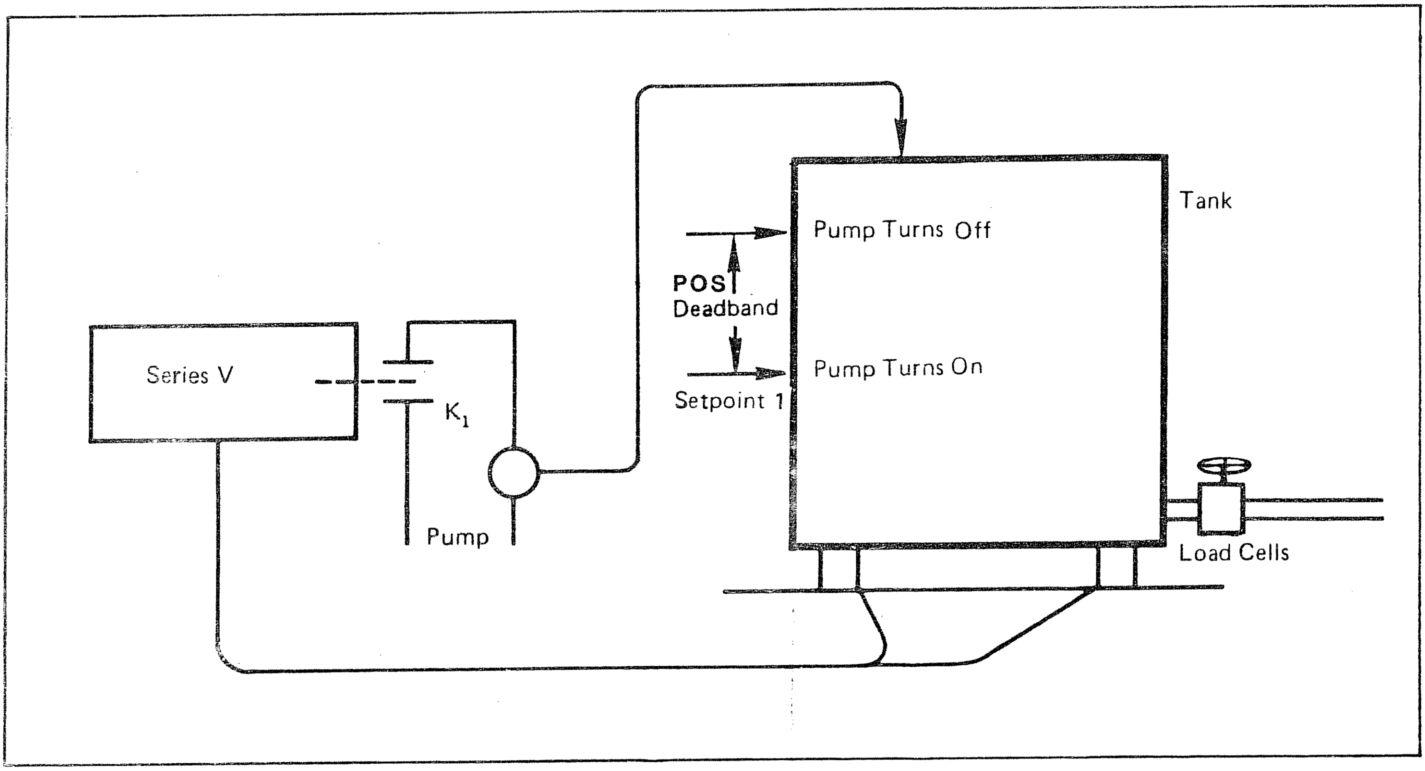


Figure 5-9. Level Control System

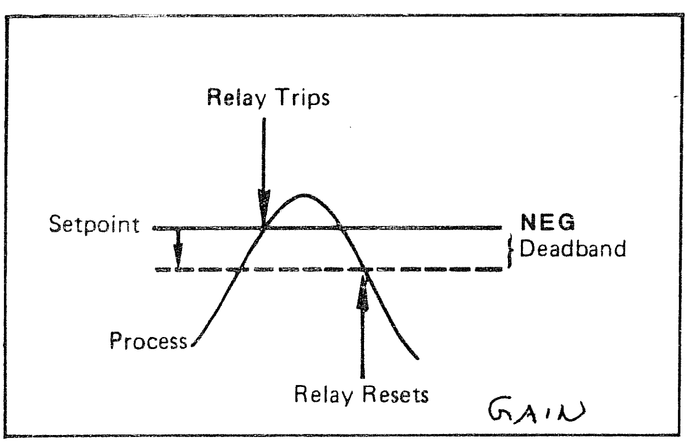


Figure 5-10. High Trip Limit

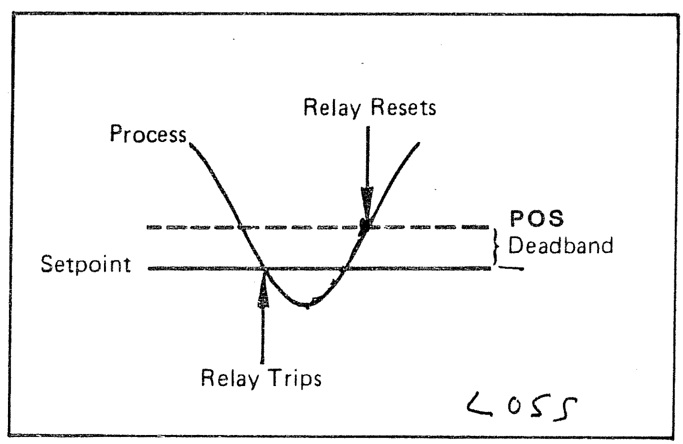


Figure 5-11. Low Trip Limit

5.6 Optional Operating Procedures. The following functions are optional operating procedures: (a) latching operation, (b) dual scaling, (c) shunt calibration, and (d) display hold.

(a) A latched limit alarm remains in a tripped state.

(b) Dual scaling allows the instrument to be set up to read in kgs. or lbs.

(c) Shunt calibration switches a precision resistor across one side of the cell which provides a quick means of verifying calibration.

(d) Setting the display hold switch holds the display reading indefinitely.

5.6.1 Latching Operation. Either or both of the two limit alarms may be set for a latching operation. Once tripped, a latched limit alarm will remain in a tripped state until a reset command is given or operating power is interrupted or the DIP switch that set in the latching operation is momentarily opened while the setpoint is no longer exceeded.

- Closing DIP switch #6 configures limit alarm 1 for a latching operation.

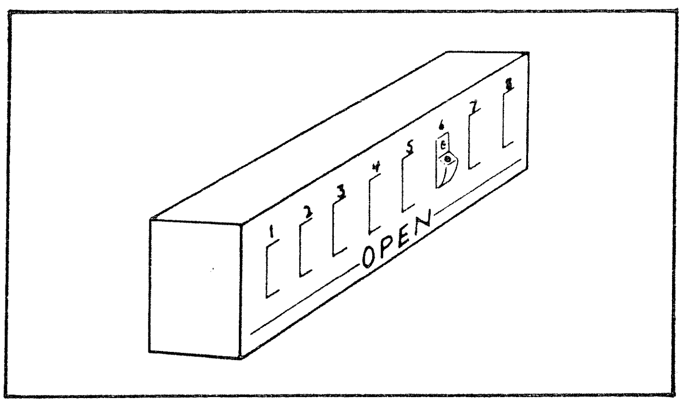


Figure 5-12. Limit Alarm #1 Set for Latching Operation

- Closing DIP switch #7 configures limit alarm 2 for a latching operation.

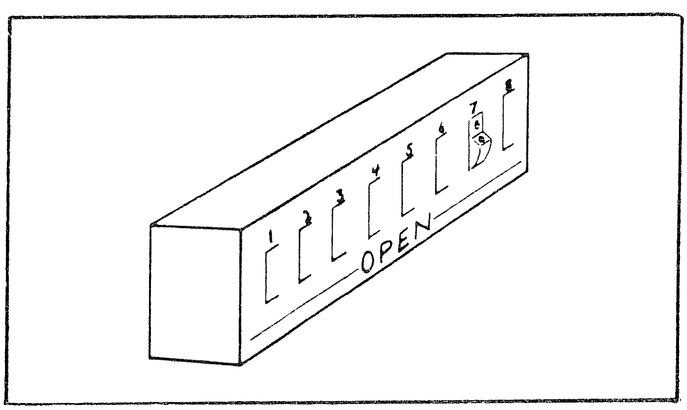


Figure 5-13. Limit Alarm #2 Set for Latching Operation

- Reset limit alarms 1 or 2 by momentarily opening DIP switches 6 and 7 (or their remote counterparts).

5.6.2 Shunt Calibration. Shunt calibration verifies calibration. A precision wire-wound resistor is connected across one side of the cell to unbalance it by a repeatable amount. Its value depends on the load cell resistance, for a 350 ohm cell try about 200K ohm. Shunt calibration resistance is usually determined in the operator's calibration lab. The Series V provides two rear-panel solder terminals for installation of this resistor.

The shunt cal resistor is soldered across the two terminals above the terminal strip. The CAL terminal has to be wired to the + IN terminal. See Figure 3-4(a).

Closing front-panel DIP switch #8 connects the resistance across the bridge via a reed relay. This provides an easy means of verifying calibration. Also, the Shunt Cal status LED lights to indicate use of the Shunt Cal feature.

5.6.3 Dual Scaling. The Series V features two independently programmable measurement ranges, one for lbs. and one for kgs. Once the ranges are programmed, either one can be selected by front-panel DIP switch #1.

- DIP switch #1 in the OPEN condition indicates LBS (verified by the LBS status LED).

- DIP switch #1 in the CLOSED position indicates KGS.

All displayed variables (set points, deadbands) are internally converted to the engineering units of the range selected.

5.6.4 Display Hold. When the display hold switch is closed, the display reading is held indefinitely. No other process functions are affected, such as alarms, transmitters, etc. NOTE: With the BCD output option, the BCD output will not update when the display is held, nor will the RS-232-C.

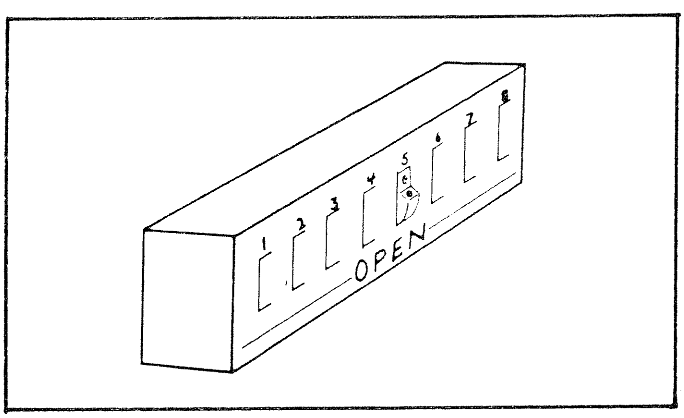


Figure 5-14. Display Hold Selected

SECTION 6

OPTIONS

6.1 Introduction. This section of the manual provides information on the unit's available options. Section 6 is divided into two parts: (a) replacement/ installation of the options, and (b) theory of operation and operating procedures. The following options are available and may be installed by the factory or an authorized field service agent.

- BCD*. Provides a parallel BCD output and a print pulse for interface to a printer.
- RS-232-C*. A serial interfacing device between computer and telephone lines.
- Analog Transmitter. A printer circuit (PC) board which provides an analog signal proportional to the current measurement.
- Input Ranging Module. Sets the excitation voltage and determines the gain of the input amplifier.
- Chassis Hardware. Includes panel mounting or lab stand kit.
- Relay Sense. Optional procedure which reverses the relay sense from energized to de-energized.

* NOTE: These options are mutually exclusive (i.e. only one may be installed in a single Series V unit).

6.2 Option Module Replacement. The input ranging modules and the optional analog transmitter may be changed in the field. Replacement of these parts requires partial disassembly of the instrument. Once disassembled, the internal fuse and the relay sense jumpers are also accessible.

The Series V is a precision instrument, and care should be taken when replacing these parts. The disassembly procedure, as specified below, should be followed exactly:

1) Disconnect power.

2) Remove four Phillips screws securing the rear panel (see Figure 6-1). CAUTION: The PC assemblies contain several MOS devices. High voltage charges induced by static discharge may cause component failure. The instrument should be disassembled on a conductive surface.

3) Slide the back panel and board assembly out by pulling firmly on the rear pull-handle. As the assembly slides out, note which grooves the PC boards ride in for later reassembly. Refer to Figure 6-2.

4) Place the assembly on a flat work surface (with the bottom PC assembly on the surface).

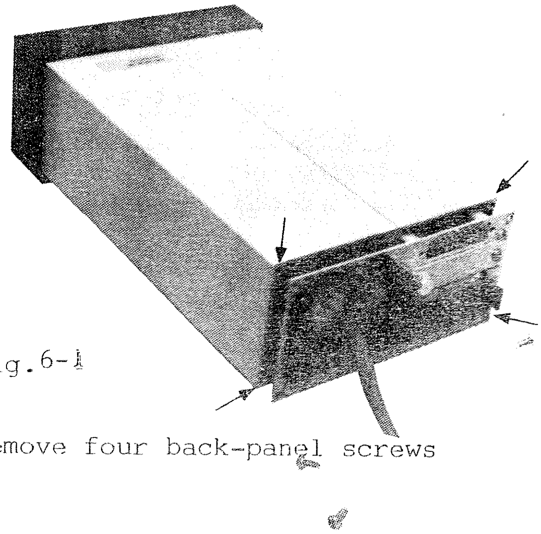
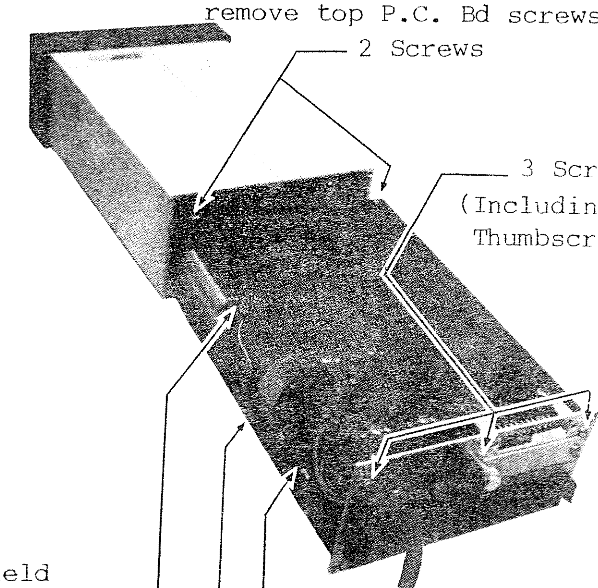


Fig. 6-1

Remove four back-panel screws

Fig. 6-2 Slide back panel and P.C. assembly out/ remove remove top P.C. Bd screws



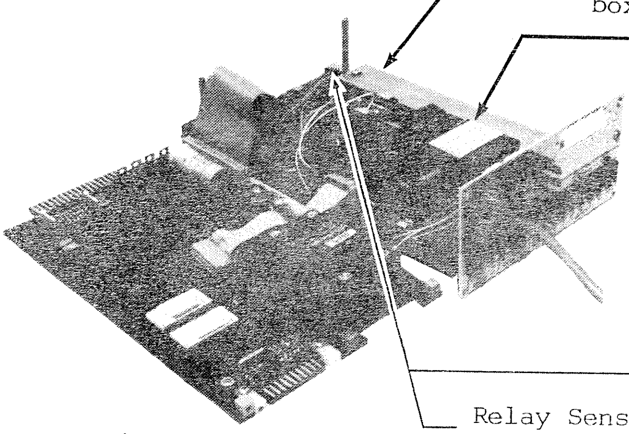


Fig. 6-3
Raise top P.C. Bd

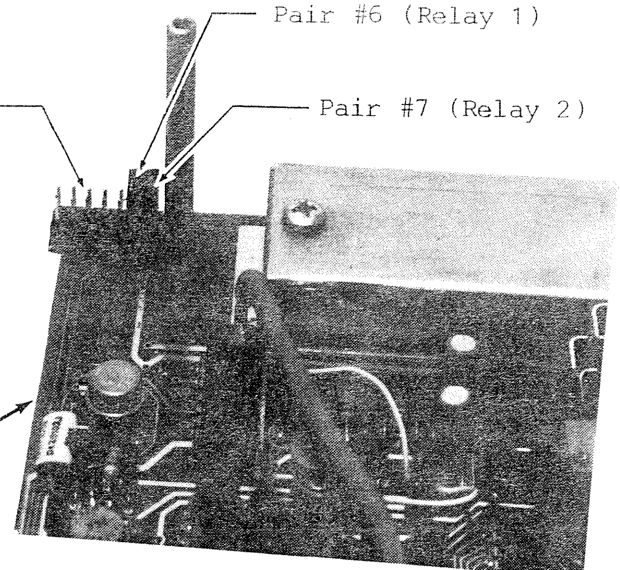


Fig. 6-4
Relay sense selection

Figure 6-1, 6-2, 6-3, 6-4

6.2.1 Fuse Replacement. The fuse, located on the lower PC board near the #1 barrier terminal is now accessible and may be replaced. Use a ½A fastblow fuse only. Refer to Figure 6-2.

6.2.2 BCD Board Replacement. Follow the instructions for removing the board assembly in 6.2 above.

(a) Remove the pull-handle and the two screws in line with it on the rear panel to free the end of the digital board. Remove the 2 screws holding the BCD board connector to the rear panel. Remove the 2 screws holding the front end of the digital board and turn the board over to lie beside the analog board, both component side up.

(b) Remove the 4 screws holding the BCD board standoffs to the digital board. Pull the BCD board out of the socket P6 on the digital board and remove the ribbon conector from the BCD board connector P4.

(c) Install the replacement board and reassemble the Series V.

6.2.3 Analog Transmitter Replacement.

(a) Gain access to the analog board following 6.2 and 6.2.2(a). In front of the 2 relays in the middle of the rear of the board is the analog transmitter in a socket. Pull out the analog transmitter module and replace it with the new one. There is a plug in one of the holes of the transmitter socket to prevent reversed installation.

(b) Reassemble the Series V.

6.2.4 RS-232-C Board Replacement.

(a) Gain access to the digital board following 6.2 and 6.2.2(a). Remove the RS-232-C board just like the BCD board in 6.2.3(b).

(b) Install the ribbon connector to P4 and mount the RS-232-C board standoffs to the digital board. If this Series V has not had an RS-232-C board before (and is prior to serial #1000) there will be an interference between the 2 boards and the unit will not reassemble. It would be best to return the unit to the factory for the modifications to make it fit, or a field service representative can do it.

(c) Remove the cover plate from the connector rear panel hole if there is one and use the screws to attach the RS-232-C board to the rear panel.

(d) Reassemble the Series V.

6.2.5 Ranging Module Replacement.

(a) Gain access to the analog board following 6.2 and 6.2.2(a). Remove the metal cover over the analog board input section. Find the 2 component headers with small components on them plugged into sockets A1 and A2.

(b) The new ranging modules go in their place.

The A1 module will contain two capacitors. The A2 module will contain a wire jumper.

(c) Reassemble the Series V.

6.3 Option Module Operation. The previous paragraphs provided procedures for replacing and installing the options. The following paragraphs provide a theory of operation and operating procedures for the unit's available options.

6.3.1 BCD Option Module Operation. This option provides a parallel BCD output and a print pulse for interface to a printer or other output device (Part #2002-0044-01). The BCD output option provides a rear panel D-subminiature connector for hookup to a printer or another output device. The BCD option gives a tri-state buffered, latched, isolated TTL logic level output. It also provides positive true logic, which corresponds to the current display reading of the instrument. In addition to the standard BCD outputs, an overrange output, print pulse, and a data-hold ("busy") input and tri-state output enable input are provided. A print pulse (approximately 15 milliseconds long) is generated every 0.3 seconds after new weight data has been computed.

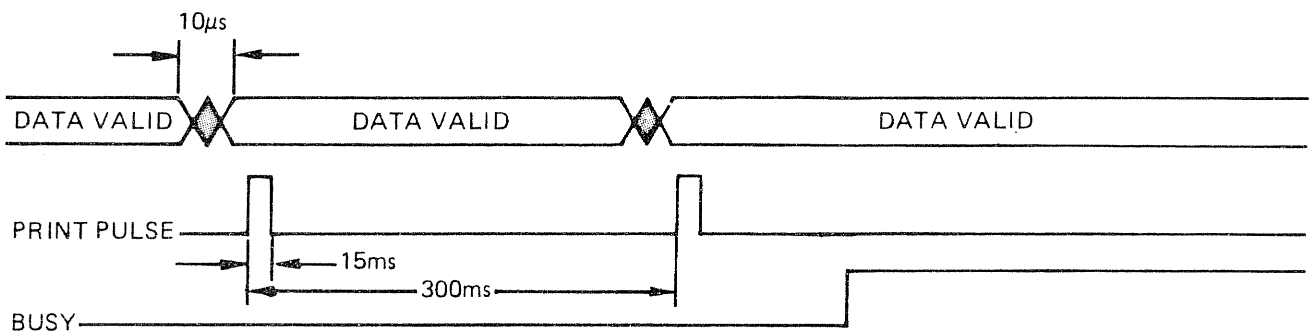
If the data-hold (busy) is set "hi" (logic 1) by an external device, the print pulse and update of the BCD outputs will be inhibited. Once the data-hold input goes low, the BCD data and the print pulse will resume. The print pulse and data-hold timing relationships are shown in Figure 6-5. Pin connections are shown in Figure 6-6.

Pin 30 will cause all the outputs to be tri-stated (disconnected) when it is grounded. This function is not there on older units. Check for 2.8V on pin 30 to see if output disable is installed on your board.

6.4 Input Ranging Module. Series V includes a standard 3 mV/V, 15V excitation input module. There are also other optional ranging modules available. The different combinations of load cell excitation voltage include: 10V, 15V and input ranged sensitivity 2mV/V.

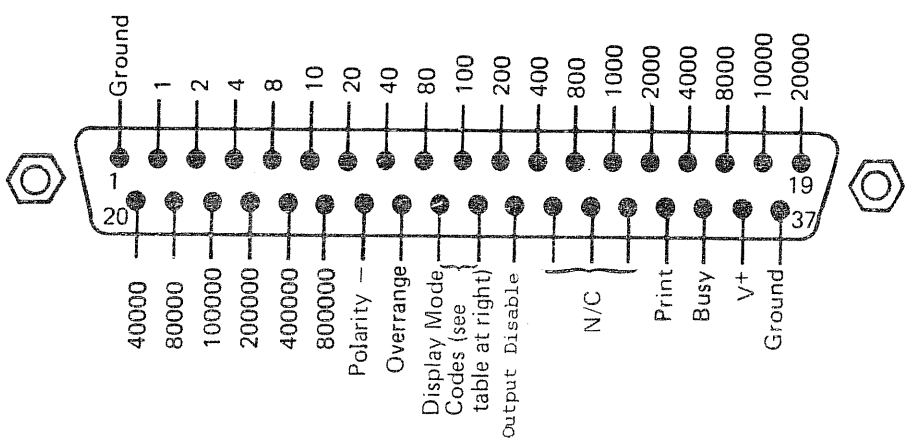
This module is field changeable. It sets the excitation voltage and determines the gain of the input amplifier based on the mV/V signal returned from the load cell. Then the analog input filtering rejects high frequency noise before it enters the system. This filtering consists of a two-pole low pass filter with a nominal cutoff frequency of 10Hz. Attenuation increases at 12dB per octave above this cutoff frequency. When ordering the unit, the user may specify a high or low frequency roll-off.

6.5 Analog Transmitter. The analog transmitter option is a PC board which provides a signal representative of what weight is on the scale. The transmitter derives its information from the central processor and has over 30,000 counts of resolution. The transmitter is optically isolated from all other inputs and digital circuits, which eliminates troublesome ground loops.



Data is not valid for approximately 10µs before print pulse.
Busy high inhibits print pulse and holds last data.

Figure 6-5. Option BCD Timing



DISPLAY MODE CODES		
Pin		Mode
28	29	
0	0	"ROC"
0	1	"NET"
1	0	"GROSS"

The pin designations for the BCD output are as noted above. All inputs and outputs are DTL/TTL compatible. All outputs have a fan out of five unit loads. A unit load is defined here as 40µA in Hi State (Logic "1") and 1.6mA in Lo State (Logic "0"). The following describes the various functions.

PIN 26, POLARITY
This signal is at logic "1" for a negative displayed weight, and is at logic "0" for a positive displayed weight.

PIN 27,OVERRANGE
This output is normally at logic "0". However, when an overrange occurs, TB5-1 goes to logic "1" for the conversion interval when the overrange data appears at the BCD output.

PIN 30,OUTPUT DISABLE
This input, when grounded, will cause all the other outputs to disconnect themselves from the pins.

PIN 35, HOLD INPUT (Busy)
A logic "1" on this pin, the print pulse and BCD data will be inhibited. Upon return to a logic "0", the BCD data and print pulse will resume.

PIN 34, PRINT TRIGGER
This is a 15-millisecond positive pulse that occurs once every 300mS after the new BCD data has been updated. It can be used to trigger a printer or other recording device.

Figure 6-6. Option BCD Pin Connections

6.5.1 The transmitter provides one of the following outputs.

- o Current measured in milliampers per unit.
- o Voltage measured in millivolts (thousandths of a volt) per unit.

6.5.2 Transmitter Options. The user has three options while working with the analog transmitter: (a) changing a mode, (b) displaying the mode, and (c) calibration.

6.5.3 Display the Current Transmitter Mode. To display the transmitter mode:

ACTION	DISPLAY READS
(a) Press XMTR/4	Present mode (nt, rc, G)
(b) Press ENT	Return to normal operation

6.5.4 Changing the Transmitter Mode to another mode:

ACTION	DISPLAY READS
(a) Press XMTR/4	Present mode (nt, rc, G)
(b) Press CHG	XMIT LED flashes

(c) Press CHG repeatedly to cycle through the 3 modes.

(d) Press ENT to select the mode displayed and return to the current operation.

6.5.5 Displaying the Transmitter Maximum (Span). To display the value at which the transmitter is at maximum:

ACTION	DISPLAY READS
(a) Press XMTR/4	Present mode (nt, rc, G)
(b) Press FS/8	Max indication at full scale
(c) Press ENT	Return to normal operation

6.5.6 Display the Transmitter Minimum (Zero). To display the value at which the transmitter is at minimum:

ACTION	DISPLAY READS
(a) Press XMTR/4	Present mode (nt, rc, G)
(b) Press ZERO/3	Max indication at full scale
(c) Press ENT	Return to normal operation

6.5.7 Calibrating the Analog Transmitter. There are two ways in which the operation may calibrate the analog transmitter:

(a) calibration via the keyboard, which specifies the operating range of the transmitter.

(b) calibration of the potentiometers which sets the unit up to accurately transmit the given values.

6.5.8 Calibration via the Keyboard. Calibration via the keyboard specifies the operating range of the transmitter. The value entered for fullscale must be at least 2 percent of the full scale range of the instrument. If the unit is calibrated for a fullscale of 2000 pounds, the minimum range is 2 percent of 2000 or 40 pounds.

6.5.9 Setting the Transmitter Zero. To set the display value corresponding to the minimum end of the transmitter range:

	ACTION	DISPLAY READS
(a)	Press XMTR/4	Current mode
(b)	Press ZERO/3	Current zero
(c)	Press CHG	XMIT LED flashes
(d)	Enter new value	New value
(e)	Press ENT	Return to normal operation

6.5.10 Setting the Transmitter Span. To set the display value corresponding to the top end of the transmitter range:

	ACTION	DISPLAY READS
(a)	Press XMTR/4	Current mode
(b)	Press FS/8	Current maximum
(c)	Press CHG	XMIT LED flashes
(d)	Enter new value	New max value
(e)	Press ENT	Return to normal operation

6.5.11 Potentiometer Adjustments. Fine-tuning potentiometer adjustments are used to calibrate zero and span. The potentiometer adjustments include: (a) setting the zero potentiometers, and (b) setting the span potentiometer.

6.5.12 Setting the Zero Potentiometer. To set the potentiometers, (which seldom needs to be done), the transmitter span needs to be a large number so that small changes to the potentiometer will show up on the transmitter output. The unit also needs the input to the weight converter to stay constant, so use a simulator or a load cell with a stable load.

Set transmitter full scale for a number 1000 to 10,000 counts larger than the display reading (per 6.5.10), via the keyboard. Then set zero to match the current reading (per 6.5.9). The transmitter zero potentiometer may now be adjusted for the specified low end transmitter output.

6.5.13 Setting the Span Potentiometer. To set the full scale output potentiometer without having to put precise weights on a scale, we convince the processor it is reading transmitter full scale now. Set transmitter zero to a number 1000 to 10,000 counts below the current reading (per 6.5.9) and set the span to match the current reading (per 6.5.10). Now adjust the span potentiometer for the specified high end output.

Slight recalibration may be needed due to the interaction of zero and span.

6.6 What is RS-232-C. RS-232-C is a convention established by the Electronics Industries Association for communication of digital data over telephone lines. This convention assumes the use of ASCII character code and is concerned mainly with the pin functions of the interface and the signal levels.

RS-232-C allows great flexibility in deciding the speed of transmission (baud rate). It does not determine how many ASCII special characters and error check bits (parity) will be recognized. RS-232-C does not mention protocal, which is the rules and formats for conducting communication between digital systems. Although RS stands for recommended standard, very few manufacturers do more than implement some selected portion of the standard, especially where phone lines are not involved. The result is that no two RS-232-C compatible devices communicate without some parameter settings.

RS-232-C was written by the EIA that defined Teletype communication which is similar, but not compatible. Teletype uses a +20mA current loop to send binary data where current on, or flowing, is a "1" or mark and no current is a "0" or space.

RS-232-C uses between -3 and -12v to indicate a "1" and +3 to +12v to indicate a "0". It also assumes an interfacing device between the computer and the telephones lines called a MODEM or DATA SET. This MODEM takes data out of the sender on pin 2 and translates it to received data for the receiver back out on pin 3. If there were no MODEM, 2 devices would plug together with their "transmitted data" pins head to head. That is why a cable between two devices which swaps pins 2 and 3 (and 5 and 20, and 4 and 6) is called a NULL MODEM.

6.6.1 Series V RS-232-C. The Series V RS-232-C option sends an RS-232-C compatible transmitted data signal out on pin 3 which is approximately +10 volts for "0" or -4.5v for a "1". Recall that pin 3 is the receiving pin in a true RS-232-C. Likewise pin 5 is called Clear to Send, which in RS-232-C is a signal from a Modem that a data path is connected, but is an output from the Series V to indicate readiness. In short, the Series V is wired as if a Null Modem were installed in the weight converter.

6.6.2 <u>Current Loop Output</u>. The Series V RS-232-C option can send a current loop signal for driving a Teletype or similar devices, but puts that signal out on pins not used by the EIA communication convention. This prevents the operator from plugging directly into an input not capable of accepting current loop power by just trying to use a cable between the Series V and some equipment. In order to be able to send 20 ma. through different loads the source of the current must be a least 12v., (20 ma. x 600 ohms) and this is done giving a positive voltage out on pin 25 and switching a 20 ma. current sink on and off at pin 18 which sinks from approximately -5v.

If desired, the positive d.c. source can be supplied from elsewhere to allow more overhead voltage. If the external power is too high a voltage, a series resistor must be installed to prevent overheating the output transistor:

SUPPLY VOLTAGE	RESISTOR
Up to 40 v.	0 ohms, none needed
40 to 80 v.	1500 ohms, 5 watt
60 to 75 v.	2200 ohms, 5 watt
above 75 v.	too high, lower the voltage

In order to hook more than one device to a current loop output, the receivers are wired in series. Since the RS-232-C option is electrically isolated from all other circuits, the current return must be to the option's D connector. When the Series V supplies the voltage from pin 25, its return is pin 18. However, when an external supply is used, a jumper JPM is replaced with another, JPL, so pin 25 becomes a -5v source. An external supply then must have its negative end tied to pin 25 and its positive output goes to the devices, and their signal return becomes pin 18.

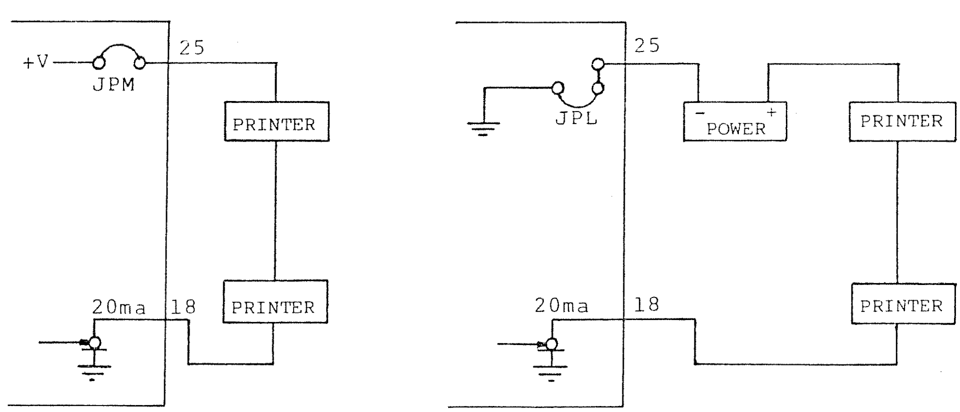


Figure 6-7. External Supply Hookups

6.6.3 <u>Connections</u>. The 25-pin connector in the back of the Series V is wired as listed below in normal configuration.

SIGNALS		PIN #
Transmission request (active low)	in	11
Clear to send (active high +3v)	output	5
Received data (logic one -3v)	output	3
Request to send (active high +3v)	in	4
Signal ground		7
Protective ground (earth, chassis)		1
Current loop (20 ma positive in)		18
Current loop (20 ma positive source)		25

The "normal" configuration assumes one receiver and RS-232-C voltage output with a NULL MODEM "installed". In the actual RS-232-C convention, pin 5 is an input, but since we are standing on the far side of the NULL MODEM, it is an input at the receiver, telling it that the communication is hooked up.

Likewise pin 3 is received data to the receiver, and pin 4 is a request to send from the receiver, telling the Series V that data should be sent.

6.6.4 Operation (RS-232-C) Voltage Out.

A) The Series V asserts the "clear to send" line to a logic one, indicating readiness. It then waits to receive a "request to send" logic one as an input as well as pin 11 (print request) must be low (ground). When the "request to send" is received, the Series V transmits the data on pin 3.

B) If the "request to send" line goes to a logic 0 during a transmission, the transmission is suspended until the "request to send" is asserted again. All 12 characters must be sent before a new set of characters can be transmitted.

C) At the completion of a transmission, "clear to send" is dropped to a logic 0 while the data is updated.

D. Data is transmitted using 7 bit ASCII plus optional parity selected with internal switches. The data is the full six digit weight, plus an indicator designating Gross, Net, or Rate-of-Change. (G=gross, N=net, R=rate-of-change). Total transmission requires 10 print columns, with a carriage return (CR) and a line feed (LF) terminator.

G
N space +/- 99999.9 (CR) (LF)
R

(The decimal point position is determined by internal switches).

6.6.5 Multiple Weight Converters (Using Transmission Request). A special feature of the RS-232-C option allows the operator to combine several Series V units together when using the RS-232-C Voltage Output.

The option board will not transmit unless pin 11 is grounded and disconnects itself from pins 5 and 3 if pin 11 is not grounded. This means the operator can combine several units by wiring their pins 1, 3, 4, 5, and 7 in parallel and only enabling the one desired by grounding its pin 11 to pin 7 (signal ground).

Pin 11 is also used as a print request line with current loop output, but current loop receivers cannot be wired to more than one Series V. Multiple current receivers are wired in series as shown in Section 2.

6.6.6 Manual Print Requests. Since pin 11 is actually a transmission request line, it can be used any time by merely connecting it to a button which will then pull pin 11 to ground for a short time. In the case of Teletype applications where a current loop device will not supply a "request to send" signal, pin 11 must be used to call for transmissions and "request to send" must be internally set high at all times by installing jumper JPK.

If JPK is installed, as long as pin 11 is grounded, the Series V will transmit as fast as it can. This transmission occurs every .25 seconds.

6.6.7 Series V RS-232-C Option Board Configuration List. The following table shows which switches to set "on" in order to configure the RS-232-C option board. On older boards, switches sp-1 through sp-8 were jumpers A through H.

a. Baud Rate =

	109.9	300	600	1200
sp - 1	on	on	off	off
sp - 2	on	off	on	off

b. Parity =

	ODD	NONE	EVEN
sp - 3	on	on	off
sp - 4	on	off	on

c. Digits after decimal point =

	0	1	2	3	4	5	6
sp - 5	on	on	on	on	off	off	off
sp - 6	on	on	off	off	on	on	off
sp - 7	on	off	on	off	on	off	on

d. Transmission Request, pin 11, always active = sp-8 on

6.6.8 Important Notes For Users.

a) The ROMS, U4 and U5 on the digital board of the weight converter must be revision "E" or later for the weight converter to work with the RS-232-C option. If there is only one 2732-type ROM, the revision will be recent enough.

b) If using external power for current loop output, recall the need for a series resistor mentioned in Section 2.

6.7 Panel Mounting Kit. The panel mounting kit is NOT provided if the Series V is ordered with the Lab Stand Kit or if it is factory mounted to a panel or enclosure door.

6.7.1 Lab Stand Kit. The Lab Stand Kit is available and installed when ordered with the instrument.

6.8 Relay Sense Selection. Relay sense selection is made by placing jumper-blocks (supplied) along a connector strip located at the front of the lower PC board (opposite the front-accessed adjustment potentiometers). For normal ("failsafe") operation, the jumper-blocks are not needed. These blocks are kept on unused pins of the connector strip for convenience. To reverse the sense of Relay 1, gain access to the analog board per section 6.2 then place a jumper-block at the sixth pair of connector pins (counting from the edge of the PC board inward). To reverse the sense of Relay 2, place a jumper-block at the seventh pair of connector pins. Figure 6-4 shows the jumper-blocks placed at the sixth and seventh positions (both relays reverse sense). For normal operation, store the jumper-blocks on the first and second pairs of pins.

SECTION 7

SPECIFICATIONS

7.1 Input Analog Section.

INPUT

4- or 6-wire bridge, load cell, or strain gauge

EXCITATION

10, 15v @ 170mA maximum. (Determined by Input Ranging Module selected)

MINIMUM INPUT SPAN

10mV

MAXIMUM INPUT SPAN

±45mV. Without front end attenuators, larger input signals will use input attenuation and lower the input impedance presented to the source

LEADWIRE COMPENSATION

Total with six-wire hookup

INPUT IMPEDANCE

1 Megohm minimum differential. 1000 Megohms minimum common mode

INPUT FILTER

Two-pole 20 milliseconds low-pass standard

INPUT BIAS CURRENT

100 nano amps maximum

INPUT COMMON MODE REJECTION

160dB minimum, referenced to earth ground

COMMON MODE VOLTAGE

600Vdc or peak ac, referenced to earth ground
200Vdc or peak ac between input and analog re-transmitter output

NORMAL MODE REJECTION

80dB minimum at power line frequency. (Optional input filtering can be increased)

NOISE (Referenced to Input)

1 microvolts p-p at 25 millisecond conversion, maximum
0.25 microvolts p-p at 375 millisecond conversion, maximum

LINEARITY

0.01% maximum independent linearity error

7.2 Digital Section.

RESOLUTION

60,000 internal counts, maximum

RESPONSE TIME
Programmable, 25 milliseconds to 103 seconds

TEMPERATURE COEFFICIENT
Less than 50ppm/°C

AMBIENT TEMPERATURE RANGE
0 to 50°C

HUMIDITY
0 to 90% non-condensing

DISPLAY
Full 6 digits (±999999)

DIGIT TYPE
7 segment, orange LED

DIGIT HEIGHT
0.56 inch

OVERRANGE INDICATION
"-HI-" for positive overrange (signal or excitation)
"-LO-" for signal underrange

DISPLAY UPDATE RATE
300 milliseconds typical

7.3 Overall Characteristics.

CONTROLS (Screwdriver Adjustable)
Display intensity
Analog transmitter zero and span

POWER
120, 240, 100Vac ±10% 50 or 60Hz, 20 Watts maximum

LIMIT ALARMS
Contacts:
Type: Two (2) isolated SPDT
Rating: 3A @ 120Vac, non-inductive
Material: Silver -Cadmium Oxide, hermetically sealed
Life: 10^5 operations at rated load
10^7 operations at no load

BATTERY BACK-UP
Type: NiCd rechargeable (recharges during operation)
Duration (After Power Failure): 30 days minimum
Charge Required: 24 hours minimum after discharge

7.4 Optional I/O.

OPTIONAL TRANSMITTER OUTPUT SPECIFICATIONS

(Voltage or Current Scales Available)

Maximum Output Voltage:	±10V
Maximum Output Current:	50mA
Maximum Output Frequency:	100kHz
Voltage Output Current Drive:	±10mA
Current Output Compliance Voltage:	20V

LINEARITY (With Respect to Input)

Better than 0.025%

TRANSMITTER RESPONSE TIME

Follows main instrument response time, 25 milliseconds to 103 seconds

OPTIONAL BCD OUTPUT

Connector:	37 pin D-type subminature
Outputs:	30 outputs representing 999999, ±, display code, OVR for overrange and positive print pulse
Output Drive:	All outputs TTL compatible
Source Current:	400 microvolts
Sink Current:	8mA
Input:	Busy, active high to disable BCD updates and print pulse.
Input:	Output disable, tri-states all output signals when brought low.
Input Drive:	Busy requires 3V @ 1mA minimum, 15V maximum
BCD Update Rate:	Same as display update, i.e. 300 milliseconds, typical
Isolation:	Optical, 600V isolation from all other circuitry

APPENDIX A: KEYBOARD QUICK REFERENCE GUIDE

KEYBOARD Key:	Initial Function:	'Set Mode' Function:
TEST/0	Lights all display segments and status LEDs testing P.	Enters "0" into display.
SP-1/1	Displays set point of limit alarm 1.	Enters "1" into display.
SP-2/2	Displays set point of limit alarm 2.	Enters "2" into display.
ZERO/3	Always used in conjunction with another key. See below.	Enters "3" into display.
XMTR/4	Identifies the process variable being transmitted.	Enters "4" into display.
DISP/5	Sets "display" mode.	Enters "5" into display.
DB-1/6	Dislays deadband of limit alarm 1.	Enters "6" into display.
DB-2/7	Displays deadband of limit alarm 2.	Enters "7" into display.
F.S./8	Always used in conjunction with another key. See below.	Enters "8" into display.

FUNCTION SELECT DIP SWITCHES

Switch #:	Function:
1	OPEN: Range 1 selected (lbs) CLOSED: Range 2 selected (kg)
2 and 3	2 & 3 OPEN: Net Mode 3 CLOSED, 2 OPEN: Display Rate-of-Change 2 CLOSED, 3 OPEN: Gross Mode
4	OPEN: Program CLOSED: Programming Inhibited (Run)
5	OPEN: Normal Operation CLOSED: Hold Display
6	OPEN: Normal/ Latch Reset SP-1

APPENDIX A: KEYBOARD QUICK REFERENCE GUIDE

KEYBOARD Key:	Initial Function:	'Set Mode' Function:	FUNCTION SELECT DIP SWITCHES Switch #:	Function:
TMB/9	Displays the rate-of-change timebase (ROC mode) or the Averages number (Normal Mode).	Enters "9" into display.	7	CLOSED: Latch at SP-1 OPEN: Normal/ Latch Reset SP-2
TARE/	Zeroes the display by auto tare;	Increments Rounding and Averages.		CLOSED: Latch at SP-2
N/G/	Displays either net or gross value while depressed (opposite of current display);	Decrements Rounding and Averages.	8	OPEN: Normal CLOSED: Shunt Cal
CHG	Moves decimal position.	Shifts keyboard into 'Set Mode'; also cycles through Limited Variables or changes the sign (polarity) of the entered value.		
ENT	Returns the keyboard from the 'Set Mode' to normal.			

APPENDIX B: CALIBRATION QUICK REFERENCE GUIDE

This is a general procedure which outlines the normal steps taken in calibrating the Series V Instrument. Detailed information on each of the individual functions is given throughout the instruction manual.

After initial hook-up (connection of load cell(s) and main power:
- set DIP switch 1 to desired range (lbs. = open or kgs. = closed).
- set DIP switch 2 to NET (open) and Dip switch 3 to open position.
- set DIP switch 8 to open state.
- verify that scale is empty.

A. Clear Tare Register
1. Depress "DISP/5".
2. Depress "TARE".
3. Depress "CHG".
4. Depress "TEST/0".
5. Depress "ENT".

B. Decimal Point Placement
1. Depress "CHG" repeatedly until decimal point is in desired position.
2. Depress "ENT".

C. Minimum Increment
1. Depress "DISP/5".
2. Depress "CHG"
3. Depress "TARE/ " or "N/G " until desired graduation is indicated.
4. Depress "ENT".

D. Timebase/Update Rate
1. Depress "TMB/9".
2. Depress "CHG".
3. Depress "TARE". or "N/G " until desired increment is displayed.
4. Depress "ENT".

E. Set Zero
1. Remove all weight from the scale.
2. Depress "DISP/5".
3. Depress "ZERO/3".
4. Depress "CHG".
5. Depress "TEST/0" (or enter desired zero setting).
6. Depress "ENT".

F. Set Full Scale

1. Place test weights on scale.
2. Depress "DISP/5".
3. Depress "F.S./8".
4. Depress "CHG".
5. Enter value of test weights via keyboard.
6. Depress "ENT".
7. Remove test weights.

G. Final Adjustment

1. If display is "noisy" adjust either the Timebase or the Minimum Increment (items C&D) until the situation is corrected.

2. See Section 2.3.3.

APPENDIX C: LIMIT ALARM QUICK REFERENCE GUIDE

SET POINTS

The following details the steps to be used in setting set points and deadband.

A. Set the instrument in the mode in which the contacts are to be used. (i.e. GROSS, NET or RATE-OF-CHANGE.) (DIP switches 2 or 3).

B. Depress "SP-1/1" or "SP-2/2".

C. Depress "CHG".

D. Enter desired set point.

E. Depress "ENT".

F. Depress corresponding deadband ("DB-1/6" or "DB-2/7").

G. Depress "CHG".

H. Enter deadband value. Note: If the output is to be a high level alarm, the deadband should be a negative value. If the output is to be a low level alarm, the dead-band should be positive. Repeated actuations of the "CHG" key will change the polarity of the setting.

I. Depress "ENT".

APPENDIX D:

OPTIONAL ANALOG OUTPUT CALIBRATION QUICK REFERENCE GUIDE

A. Depress "XMTR/4".

B. Depress "CHG" until desired output mode is indicated; i.e. TR=NT (analog equals NET weight), TR=GR (analog equal GROSS weight) or TR=RC (analog equals RATE-OF-CHANGE).

C. Depress "ENT".

D. Depress "XMTR/4".

E. Depress "ZERO/3".

F. Depress "CHG".

G. Enter desired zero value.

H. Depress "ENT".

I. Depress "XMTR/4".

J. Depress "F.S./8".

K. Depress "CHG".

L. Enter desired full scale value.

M. Depress "ENT".

APPENDIX E: ERROR MESSAGE TABLE

ERROR MESSAGE	EXPLANATION
Error	Battery discharge or programmed values lost.
Err - 1	Incorrect sequence of keys depressed.
SP-Err	Transmitter span was '0' or negative.
tb-Err	Rate-of-change timebase was less than 0 or greater than 65535.
-Hi-	Input or excitation has exceeded limits.
-LO-	Input below negative limits.
CAL-Er	Calibration error

To clear the error* press END. The previous values remain unchanged.

*NOTE: -Hi- and -Lo- errors are cleared by returning the input to within the limits.

GLOSSARY OF TERMS

ALARM
Indication or output of a tolerance deviation.

BAUD RATE
Baud rates are used as a measure of how fast serial data is transmitted - by a Modem, for example. Bits per second.

DEADBAND (DB)
Entered value that sets the point at which alarm relays will reopen. If the operator has specified a set point of 100 lbs, and sets a deadband of -2 lbs, then the output contact will close when 100 lbs is received, and the contact reopens at 98 lbs.

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

DISPLAY HOLD
When the display hold switch is closed, the last display reading is held indefinitely.

DUAL SCALING
Independently programmable display ranges which allow the display to be set up to read in any two linearly related sets of engineering units.

ENGINEERING UNITS
Pounds or Kilograms.

EXCITATION
D.C. voltage supplied to the load cell for power. Changes in excitation are directly reflected in the output of the cell.

FULL-SCALE
Capacity of the scale system.

GROSS (WEIGHT)
An overall weight exclusive of tare deductions. When the Gross Mode is selected the display indicates the current Gross Weight.

INPUT AVERAGE
The numeric average of several readings by the analog section which are done every 25 ms.

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

MENU DRIVEN
Operational prompts supplied in common language statements via the system display.

NET WEIGHT
Net weight is Gross minus the Tare value.

RAM
Random-Access Memory. Read/write memory which the processor can both write data into and read data out of. RAM is volatile, (loses its contents when power is removed).

RATE-OF-CHANGE
Mode of reporting only the rate at which weight is changing in units per update period.

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

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

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

SPAN
A calibration adjustment to set the full scale operational range of the instrument.

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

TIMEBASE (TMB)
Increment of time between update cycles in the system.

TOLERANCE DEVIATION
Amount of weight, plus or minus, in variance from the ordered weight value.

TOLERANCE ERROR
Amount of differential between ordered and actual weight.

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

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

ZERO
Weight reading once the dead load value has been offset.

ZERO-CAL
Offset of the value of the dead load of the weigh hopper.

CUSTOMER SERVICE

GENERAL POLICIES AND INFORMATION

With over sixty years of industrial weighing experience and products in the field, Hardy Instruments continues to support, design, manufacture, ship, install and start-up Hardy products worldwide.

SYSTEM SUPPORT

- On-site training seminars: Whether an old or new system, a Hardy service representative can be scheduled to come to your plant and train your operations and maintenance people on the system. This can be as simple as basic load cell theory or as complete as troubleshooting techniques which will allow you to service your equipment at various levels without having to call for a serviceman in all cases.

- Field engineers are factory trained and qualified to provide on-site calibration and installation assistance. Regular maintenance agreements are available on a case-by-case basis and are geared to protect you and your systems performance before problems occur.

- New system start-up assistance is preferred by most customers, ensuring that the installation is checked and correct, instruments are calibrated, and operators trained.

- Four field service locations to serve you: Northeast, Midwest, South and Southwest. Contact the factory for rates and schedules.

WARRANTY

Hardy warrantees its products to be free from workmanship and material defects and to be in accordance with its published specifications. A warranty problem may be handled by one of the following methods:

1. You may return the faulty product to the factory for repair or replacement under warranty.

2. You may request a field engineer to repair or replace the faulty product at the job-site. Labor time and parts on Hardy supplied products would be under full warranty.

Travel time to and from the job-site, associated travel and living expenses, customer demanded overtime, and air freight charges are not included under warranty.

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