DPM-2 SERIES

INTELLIGENT
DIGITAL PANEL METERS

OPERATORS MANUAL

Transducer Techniques

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PRELIMINARY INFORMATION

Safety Summary

This instrument is designed to prevent accidental shock to operator when Properly used. However, no engineering design can ensure the safety of an instrument used negligently. Therefore, read this manual carefully and completely prior to operating the instrument. Failure to do so could seriously damage the instrument or injure the operator. Standard safety precautions must be used during installation and operation.

Important Messages

WARNING	Denotes a hazardous procedure or condition which, if ignored, could injure or be fatal to the operator.
CAUTION	Denotes a hazardous procedure or condition which, if ignored, could damage or destroy the instrument.
IMPORTANT	Denotes a procedure or condition which is essential to the correct operation of the instrument.
NOTE	Specifies supplementary and perhaps essential information which should be recognized in relation to a particular procedure or condition.

Shock Hazard (Industry Standard)

The definition of "Shock Hazard" (as defined in Underwriters Laboratories Radio and Television Receiving Appliances Standards for Safety, 12th ed., dated June 25, 1969) is provided for the safe operation of the unit.

"Shock hazard shall be considered to exist at any part involving a potential of between 42.4 volts peak and 40 kilovolts peak in the following cases:

* If the current through a load of not less than 500 ohms exceeds 300 milliamperes after 0.0003 second.
* If the current through a load of not less than 500 ohms exceeds 5 milliamperes after 0.2 second.
* If the time required for the current through a load of not less than 500 ohms to decrease to .5 milliamperes is between 0.1 and 0.2 second, and the total quantity of electricity passed through the load up to that time exceeds 4 millicoulombs.
* If the time required for the current through a load of not less than 500 ohms to decrease to 5 milliamperes is between 0.03 and 0.1 second, and the total quantity of electricity passed through the load up to that time exceeds 75T-350T 2 millicoulombs, where T is the time in seconds.
* If the potential is more than 5 kilovolts peak and if the total capacitance of the circuit is more than 3000 microfarads.

NOTE: Additional factors might apply when potentials more than 40 kilovolts peak are present."

For Your Information . . .

* TTI claims proprietary right to the material disclosed herein. This manual is issued in confidence for engineering information only and may not be reproduced or used to manufacture anything shown without direct written permission from TTI to user.
* Specifications, Parts Lists, Component Layouts, and Schematics are subject to change without notice.
* The terms "instrument", "unit", and "meter" are used synonymously throughout this manual.

DISCLAIMER

"Warranties of sale, disclaimer thereof and limitations of liability are covered exclusively by TTI's printed warranty statement for the meters. These instructions do not expand, reduce, modify or alter TTI's warranty statement and no warranty or remedy in favor of a customer or any other person arises out of these instructions."

IMPORTANT NOTICE

Our recommendations, if any, for the use of this product are based on tests believed to be reliable. the greatest care is exercised in the selection of our raw materials and in our manufacturing operations. however, since the use of this product is beyond the control of the manufacturer, no guarantee or warranty, express or implied is made as to such use of effects incidental to such use, handling or possession or the results to be obtained, whether in accordance with the directions or claimed so to be. the manufacturer expressly disclaims responsibility therefore. furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing laws and/or patents covering any material or use.

INTRODUCTION and DESCRIPTION

This manual is divided into the following sections:

Section 1 - INTRODUCTION and DESCRIPTION

Section 2 - INSTALLATION

Section 3 - OPERATION

Section 4 - OPTION

Section 5 - DRAWINGS, and PARTS LISTS

1.1 Unit Description

Digital Panel Meter Model DPM-2 is available with 4 digits of resolution. Three front panel soft keys allow you to select input, setpoint values and hysteresis, offset and scale, Min./Max. values, and *tare function*.

Model	Digits	Display
DPM-2	4	±9999

1.2 SelfCal™ Auto-Calibration

SelfCal™ is a standard auto-calibration feature on all meters. A stable input reference (8 ppm/°C) and internal self-calibrating circuit replace the need for potentiometer adjustments. SelfCal™ auto-calibrates once every 4 seconds to compensate for any drift.

1.3 Options

Option C: Digital Limits, Form C Relays (dual high/low)

Option H: Analog Output

Option T: Serial Data Output (RS-232-C, 20mA Current Loop)

1.4 Common Specifications

* Display: 7 segment, 5 digit, blue-green, vacuum fluorescent, 0.5" (13mm).
* NMR: 60 dB typical at 50/60 Hz.
* CMV: 2500V peak, input to power line with AC power supply. 1500V, input to power line with DC power supply (Option R).
* CMRR: 80 dB at 50/60 Hz, input to power line; 120dB at DC.
* Case: 1/8 DIN cutout; splash proof NEMA 12 front panel; oil-tight with panel seal gasket.
* Dimensions: 2" (50.8 mm) h x 3.83" (97.3 mm) w x 5.36" (136.1 mm) d.
* Depth Behind Panel: 5.01" (127.2mm) min. to 6.01"(152.6mm) max., depending on model and type of connector.
* Weight: 1.22 lb. (.553 kg) max. with AC power supply, 0.72 lb. (.327 kg) with DC power supply (Option R).
* Power : 115VAC or 230VAC ±10%, 10VA, user-selectable on edge connector.
* Display Rate: 2 updates per second nominal.
* Response Time: 750 ms typical for input step change.
* Input: Floating, protection to 150V peak, 1M Ω min. input impedance.
* Environment: 0 to 45°C operating temperature (0 to 40°C with Option C; 0 to 35°C with Option H or multiple options); -40°C to +85°C storage temperature. 20 to 80% relative humidity, non-condensing.
* Terminations: Screw Terminal Connector.
* A/D Conversion: Voltage-to-frequency, microprocessor controlled. Auto-zero, auto-reference.
* SelfCal™: Auto-calibrates once every 4 seconds. Each calibration cycle takes approximately 1 second, varying with user options. Integration time is 400.0 ms max. Temperature coefficient 50ppm/°C maximum. Internal reference temperature coefficient 8ppm/°C; stability 20ppm/1000 hours maximum (non-concurrent). During SelfCal™, input measurement is suspended.

1.5 Model Specifications (at 23^{O}C +/-2^{O}C)

Digital Panel Meter	DPM-2
Accuracy without Options (± 1 count) with Options	±0.02% rdg ± 0.01% rng ±0.02% rdg ± 0.08% rng
Tempco	±0.008% rdg 0.002% F.S./C^{0}
Range	±30mV
Min. Input Impedance	1000M Ω

INSTALLATION

The Installation Section is broken down into the following sections:

Section 2.1 Installation and Assembly

Section 2.2 Electrical Connections

Section 2.3 Recalibrate Meter

Section 2.4 P2 Edge Connector Pin-Outs (Option Board C, CHT)

2.1 Installation and Assembly

Refer to Figure 1 for unit installation and assembly.

NOTE: The front frame is shown removed for assembly purposes only. The unit does not need to be unassembled for mounting in the panel. Membrane switch will be damaged if it is peeled away from the front frame.

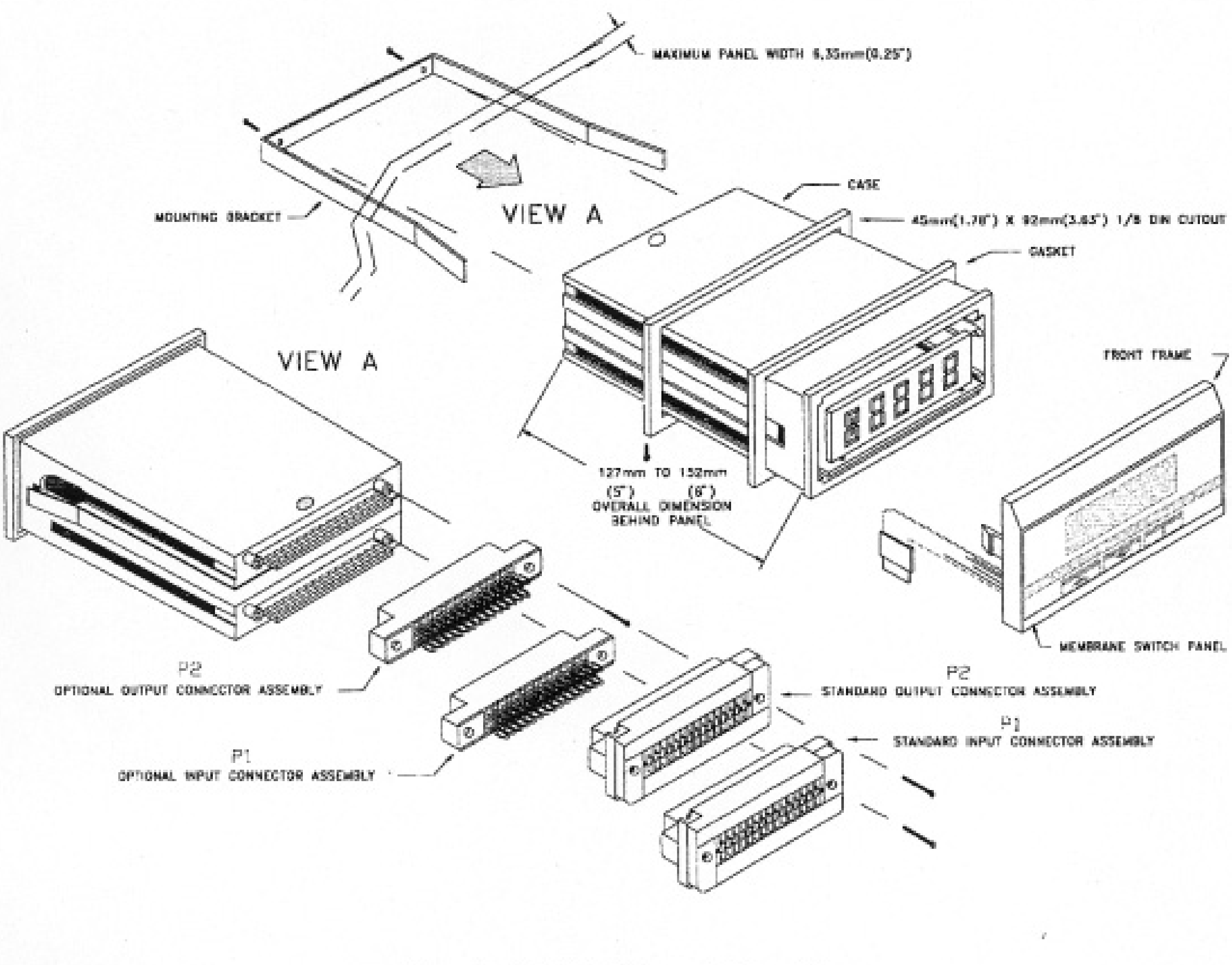

Figure 1. Unit Installation and Assembly

 2.2 Electrical Connections (P1 Edge Connector)

2.2 Electrical Connections (P1 Edge Connector)

WARNING: When making signal input connections to the P1 Edge Connector, remember that these pins float to the potential applied to P1, Pin R. Refer to the Safety Summary on page '1' at the beginning of this manual.

2.2.1 P1 Edge Connector Pin-Outs

Pin	Description
1,3,A,C	**AC** power input.
2,B	**DC** power +V input.
4,D	**DC** power V return.
5	**AC** Earth ground. Tie to AC power input grounding wire. Do not allow to float.
5	**DC** Shield. Tie to power input shielding wire if available. Do not connect to input or return.
6,8,13,15	Reserved (do not use).
E,F,P	Reserved (do not use).
7	Data. Used for field recalibration.
9	When connected through a push button switch to Pin K, switch functions as the s key.
H	When connected through a push button switch to Pin K, switch functions as the t key (TARE).
J	When connected through a push button switch to Pin K, switch functions as the "S" key.
K	Strobe common for keyboard and Strobe/Hold.
L	When tied to Pin K, holds the count in the display and stops signal processing (Strobe/Hold).
11	-15V power supply, test point only.
12	+15V power supply, test point only.
N	Internal power supply common return line. Used for field recalibration.
M	Clock in. Used for field recalibration.
10	+5V power supply, test point only.
S	Signal ground. **Do not connect a Shield to this pin.**
R,14	Input terminations (see Figure 3).

Figure 2 shows the P1 Edge Connector Pin-outs (with AC & DC power supply) on the Main Logic Board.

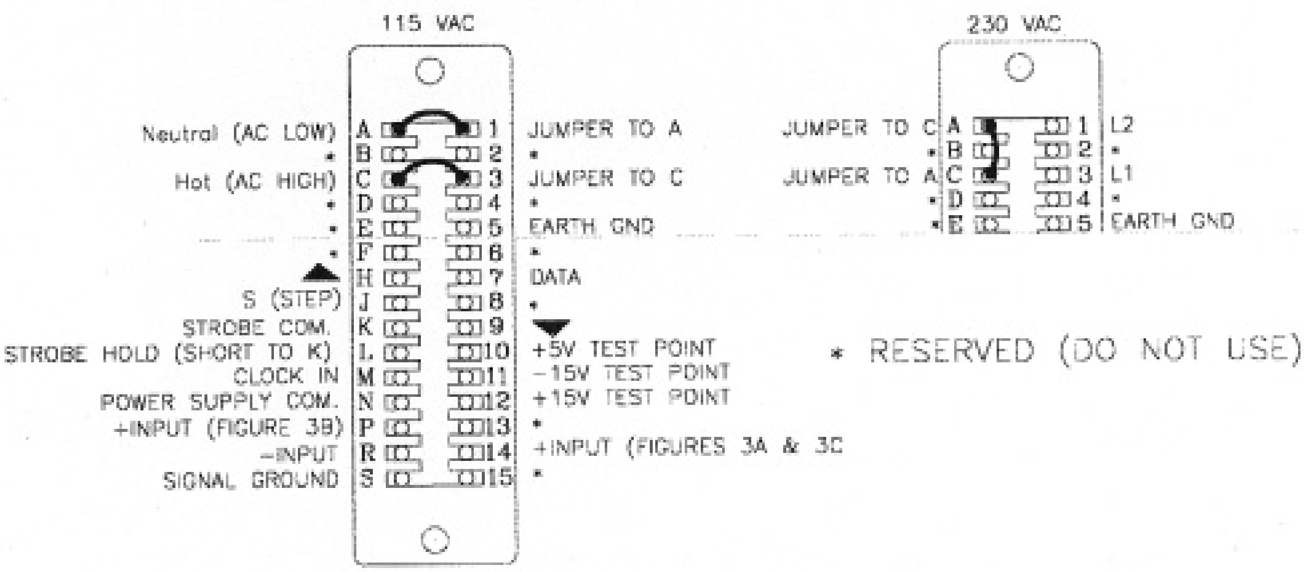

Figure 2. P1 Edge Connector

2.2 Electrical Connections (P1 Edge Connector)

2.2.3 Input Connections

Using Figure 3, make the proper signal input connections to the P1 Edge Connector.

NOTE: Pin B Must be tied to pin 5 at the transducer or at the P2 connector for proper operation.

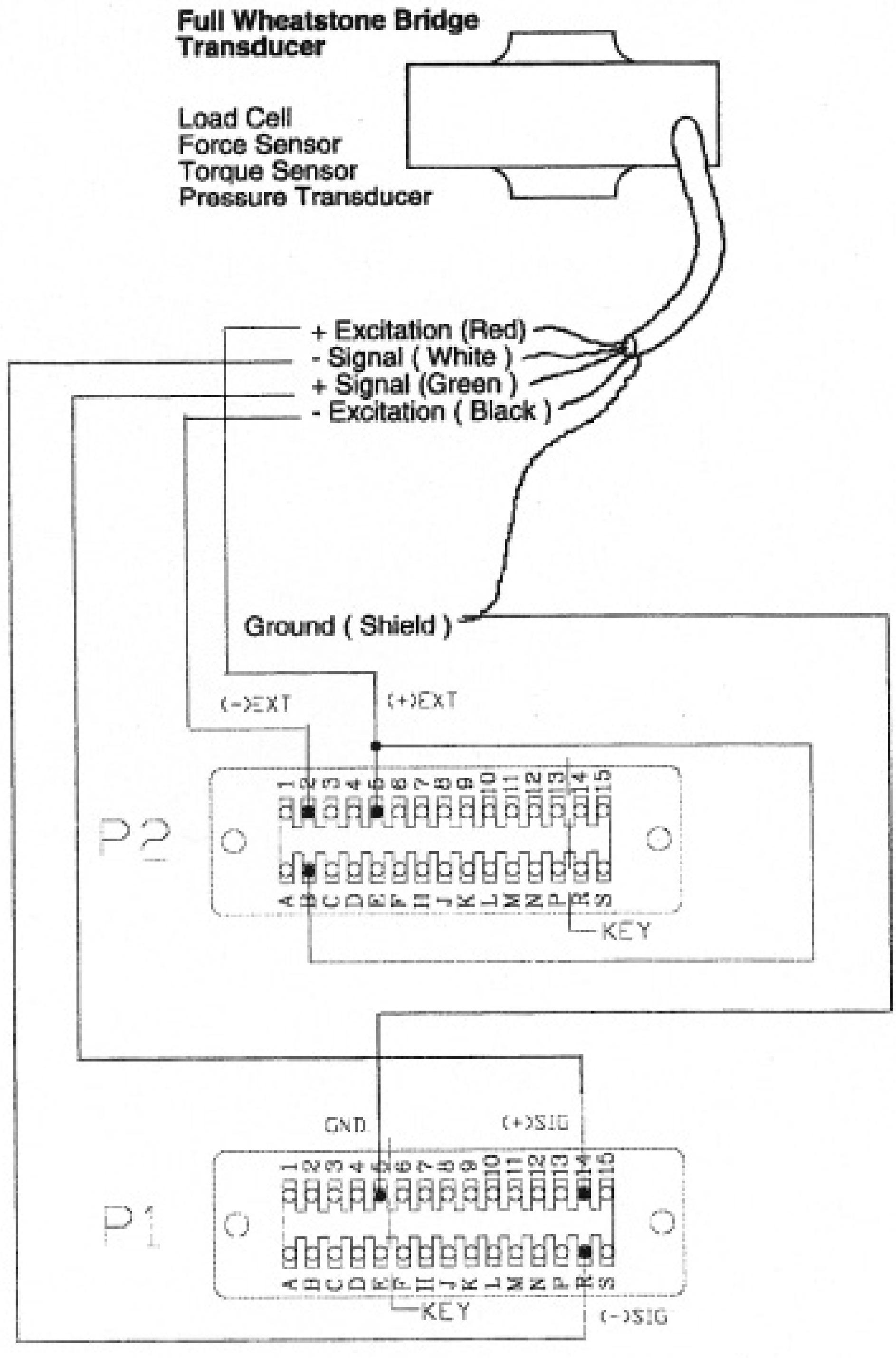

Figure 3 Input Connection

2.2.4 Strobe/Hold Connection

When strobe/hold is connected, all analog processing stops and the display freezes. To connect strobe/hold, short Pin L to Pin K.

Important: When using more then one meter each meter must have an individual contact for strobe/hold function.

2.2.5 Power Connections

2.2 Electrical Connections (P1 Edge Connector)

WARNING: If the unit has an option board, remove the anti-static edge card protector before applying power to unit.

115VAC Operation (see Figure 4A)

- 1. Make sure the connector is right-side-up.
- 2. Connect Neutral (AC Low) to P1, pin 1 and pin A.
- 3. Connect Hot (AC High) to P1, pin C and pin 3.
- 4. Connect earth ground to Pin 5.
- 5. Check connections.

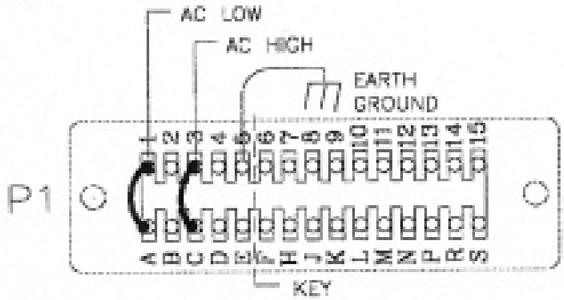

Figure 4A. Power Connections - 115V Operation

230VAC Operation (see Figure 4B)

- 1. Make sure connector is right-side-up.
- 2. Connect L1 to P1, pin 3.
- 3. Connect L2 to P1, pin 1.
- 4. Connect P1, pin A and pin C together.
- 5. Connect earth ground to Pin 5.
- 6. Check connections.

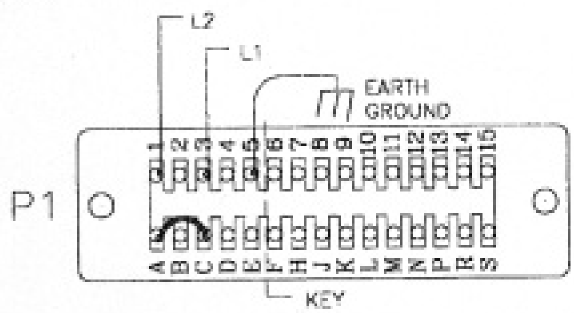

Figure 4B. Power Connections - 230V Operation

2.3 Recalibrate Meter-Optional

WARNING: When making connections to the P1 Edge Connector, remember that these pins float to the potential applied to P1, Pin R. Refer to the Shock Hazard on page 'iii' at the beginning of this manual.

All meters can be recalibrated. Since most component settling occurs during the first year of operation, recalibration should be done after one year of use. Recalibration is optional.

Procedure

1. On the P1 Connector, connect one momentary ON push-button (S1) between Pins 7 and N (data and common).
2. Connect another momentary one shot ON push-button (S2) between Pins M and N (clock and common).
3. Connect the DC calibrator to the input terminal (see Section 2.2.3 to make connections) and apply 0V or 0A, depending on the type of meter you are calibrating.
4. Press the S1 push-button for at least 3 seconds then release.
5. Adjust the calibration standard to +30mV.

NOTE: Unit reading should not change.

6. Wait at least 5 seconds.
7. Press the S2 push-button, release it.
8. Adjust the calibration standard to -30mV.
9. Press the S2 push-button, release it.
10. Remove Power & then remove recalibration connections from the P1 connector.

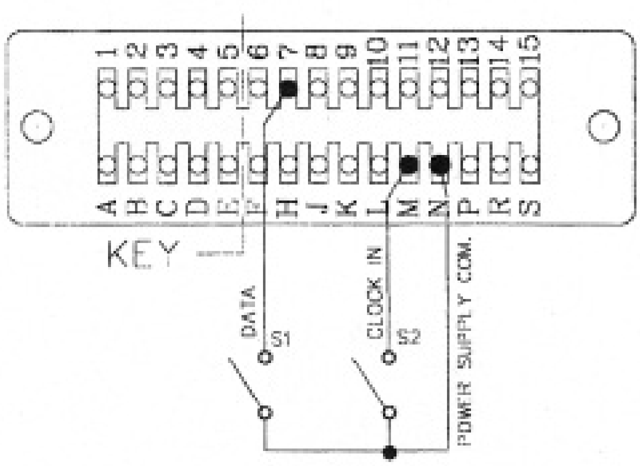

Figure 5. Recalibration Connections (P1 Connector)

2.4 P2 Edge Connector Pin-Outs

Figure 6A depicts the connections made to the P2 edge connector when only the standard exciter is present.

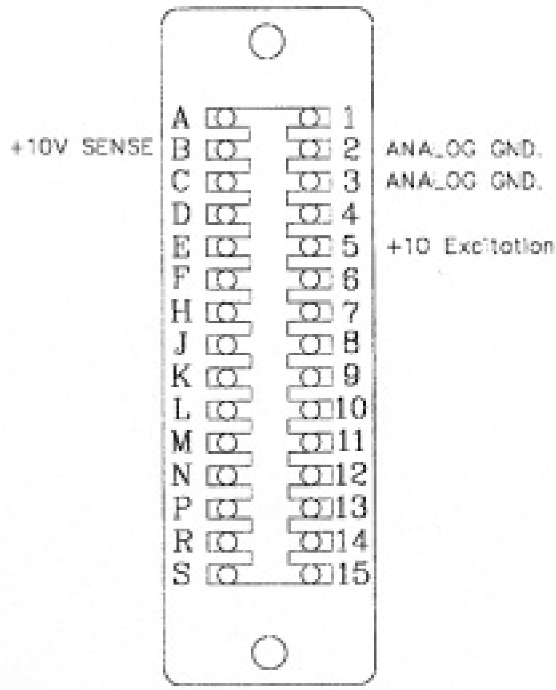

Figure 6A. P2 Edge Connector Exciter Only (No Options)

Figure 6B depicts the connections made to the P2 Edge Connector on the "C" and "H" and/or "T" Option Board.

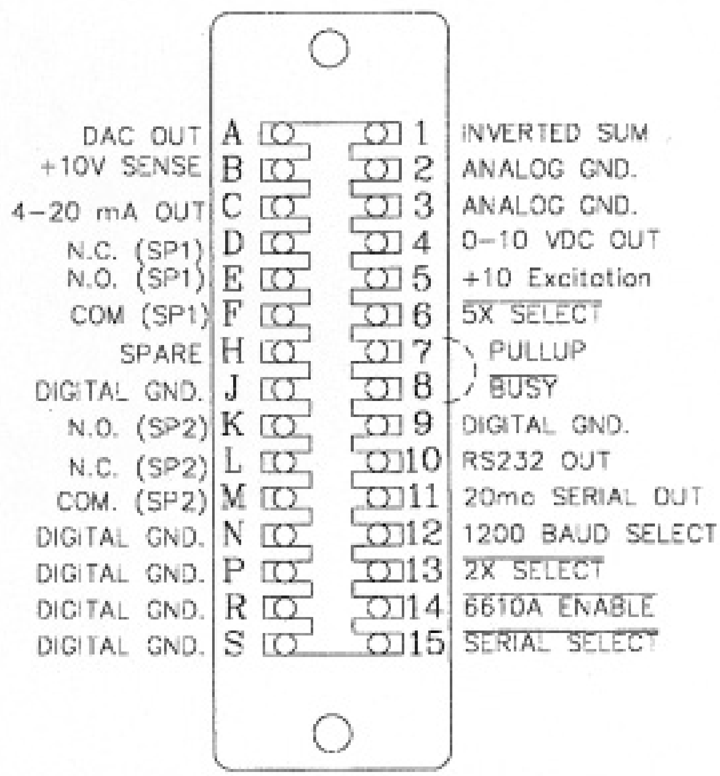

Figure 6B. P2 Edge Connector for Option C (Relays Output) and Option H (Analog Output) and Option T (Serial Output)

OPERATION

Section 3 describes how to operate the meter using the front panel keypad, and is broken down into the following sections:

Section 3.1 Normal Operation

Section 3.2 Setup Mode

Section 3.3 Digital Offset and Scale

Section 3.4 Alarm Conditions

Section 3.5 Overflow Condition

3.1 Operation

When the meter is in the run Mode displays the present reading with the scale and offset applied. If any setpoint is exceeded, the meter goes into an alarm condition (refer to option "C").

3.1.1 Non volatile Memory

All meters feature a non volatile memory, in addition to a temporary memory. The non volatile memory is maintained even when power to the meter is off. The temporary memory is used during the Setup Mode to store selected values until they are transferred to non volatile memory after exiting the Setup Mode. This feature makes it unnecessary to reprogram the meter each time it is turned on.

3.1.2 Max. Feature

The Max. feature keeps track of the highest reading since the value was last cleared. Press the ▲ key to display the highest reading.

IMPORTANT: Max. must be reset whenever the meter is turned on, if maximum reading is to be tracked.

To reset Max., press and hold the ▲ key, then press "S" key. Release "S" key and then the ▲ key. The negative full scale value will flash on the display, followed by the present reading.

3.1.3 Tare Feature

The tare function of the DPM-2 zeros the display and stores the value in non volatile memory. This is done either in the setup mode or while the desired value is on the display. Set the tare value in the run mode by pressing the ▼ key for one second, then release the ▼ key. The display will flash "tArE" and the display will change to zero. The tare value is stored in the non volatile memory.

The tare value can be cleared by the front panel. To clear tare, press and hold the the ▲ key, then press the the ▼ key. Release both keys and the display will flash "CLEAr" and then return to the normal run mode. The tare value can be viewed and altered in the setup mode.

3.2 Setup Mode

Use the setup mode to select setpoint values, hysteresis, offset and scale values, as well as setting the decimal point (dP) position.

During Setup, values are entered into the meter's temporary memory until the Run Mode is entered at the end of the Setup cycle. At that time, temporary memory is transferred to non volatile memory.

IMPORTANT

(1) Two-Minute Entry Time:

During Setup, the meter allows ONLY 2 MINUTES between keystrokes to enter or change a parameter. If 2 minutes lapse without a keystroke, the meter automatically returns to the Run Mode and erases any temporary memory without changing non volatile memory.

(2) Change setting in non volatile memory:

After entering the Setup mode, press "S" key until you come to the function you want to change. After changing the setup entry, press "S" key again until the "run" prompt is displayed. The new value is entered into non volatile memory when the display goes blank.

3.2 Setup Mode

3.2.1 Key Functions

The keys on the front panel are used to step through the Setup Program. The Setup Program is used to program setpoints and select values such as scale, offset, and hysteresis.

There are 3 keys on the front panel:

S	Used to enter Setup Mode, to scroll through setup prompts, or to enter a selection or value into temporary memory.
▲	Used to increase a displayed value. Press and hold this key to rapidly increase the displayed value.
▼	Used to decrease a displayed value. Press and hold this key to rapidly decrease the displayed value.

3.2.2 Setup Prompts

The following Setup Prompts appear in the display during the Setup Mode:

SETUP	This prompt tells you to enter the lockout code (28) to enter the Setup Mode.
InPuT	This prompt is followed by the actual input reading, disregarding scale, offset, and decimal point location.
SP 1H	This prompt, which is followed by the present setting, tells you to select the High Limit value of setpoint 1 (SP1H). SP1H is a low setpoint for positive display reading.
SP 1L	This prompt, which is followed by the present setting, tells you to select the Low Limit value of setpoint 1 (SP1L). SP1L is a low setpoint for a negative display reading.
SP 2H	This prompt, which is followed by the present setting, tells you to select the High Limit value of setpoint 2 (SP2H). SP2H is a high setpoint for a positive display reading.
SP 2L	This prompt, which is followed by the present setting, tells you to enter the Low Limit value of setpoint 2 (SP2L). SP2L is a high setpoint for a negative display reading.
HYS	This prompt, which is followed by the present setting, tells you to select the Hysteresis (deadband) value. This is a number to be added to a low limit value or subtracted from a high limit value before an alarm condition is canceled, and is common to both setpoints.
OFFSE	This prompt, which is followed by the present setting, tells you to select the Display Offset Value. (refer to Section 3.4).
SCALE	This prompt, which is followed by the present value, tells you to select the Display Scale Factor. (refer to Section 3.4). The scale factor value can be found on all of TTI's load cell calibration certificates.
tArE	This prompt, which is followed by the present value, tells you the present tare value. This value can be modified or left intact by pressing the "S" key
dP	This prompt tells you to select the decimal point position.
run	This prompt tells you that the Setup Mode is complete. Any values selected in the Setup Mode are transferred to non volatile memory when the meter returns to the Run Mode.

3.2.3 Sample Setup Program

The following example shows the Setup Program for a meter with Scale and Offset capabilities.

REMEMBER: *Three Front Panel Keys:*

"S"	key is to start Setup, scroll through Setup entries, and save changes in temporary memory.
▲	key is to increase a displayed value; and
▼	key is to decrease a displayed value.

Setup Sequence:

1. Press "S" key The display says SETUP followed by 0.
2. Enter the Lock Out Code (28) using the ▲ key to raise the displayed value to 30, then press the ▼ key twice to get to 28.
3. Press the "S" key to display InPuT, followed by the input reading.
4. Then SP 1H is displayed, followed by its present setting, enter the high limit of Setpoint 1 (SP1H) by raising or lowering the displayed value and pressing the "S" key. SP1H and SP2H are setpoints for a positive display reading.

NOTE: Limits are entered disregarding the decimal point;
For example Display range 0-100.0 Limit Desired 80.0 ENTER SP1H as 800

5. Then SP 1L is displayed, followed by its present value, enter the low limit of Setpoint 1 (SP1L) by raising or lowering the displayed value and pressing the "S" key. Repeat these steps to set the two remaining setpoint values. SP1L and SP2L are setpoints for a negative display reading. **Never set SP1L higher than SP1H** or **SP2L higher than SP2H.**
6. Then HYS is displayed, followed by its present value, enter the Hysteresis (deadband) by raising or lowering the displayed value and pressing the "S" key.
7. Then OFFSE is displayed, followed by its present value, enter the offset value by raising or lowering the displayed value and pressing the "S" key.
8. Then SCALE is displayed, followed by its present value, enter the scale factor by raising or lowering the displayed value and pressing the "S" key. The scale factor value can be found on all of TTI's load cell calibration certificates.

NOTE: Maximum scale factor is 3.2000.

9. Then tArE is displayed followed by its present value, enter the tare value by using the ▲ ▼ key to display the value then press the "S" key.
10. When dP is displayed, position the blinking decimal point using the ▲ or ▼ key switches and pressing "S" key. If you want to stay in the Setup Mode, continue to press the "S" key when run is displayed.
11. The display will say run and the display will go blank (the data that has been changed is entered into non volatile memory).

3.3 Digital Offset and Scale

This section shows how to convert an input into the desired engineering units .

Display values for offset and scale are entered during Setup.

Derived from the basic formula Y = mx + b (where Y = Display, m = scale, x = input, and b = offset), this method shows you how to calculate scale and offset values using predicted input values.

Scale Factor

First, you must calculate the scale factor using the following formula.

$$\text{Scale (m)} = \frac{\text{Display High - Display Low}}{\text{Input High - Input Low}}$$

» Display High = The desired full scale capacity of the load cell / force sensor in engineering units (ignore decimal point).

• Note: The DPM-2 is a full 4 digit display (9999), a display high of 5000 counts could be used for a 50 thru 50,000 lbs. load cell / force sensor. The decimal point is set in a later step.

» Display Low = The desired lowest meter reading in engineering units, normally set to zero. (ignore decimal point).

» Input High = The full scale mv/v reading that is stated on the TTI calibration certificate multiplied by 10 which is the +10 VDC excitation source, divided by .003 (.003 = millivolts per display count).

» Input Low = The mv/v reading with no load / weight applied to the load cell / force sensor multiplied by 10 which is the +10 VDC excitation source, divided by .003 (.003 = millivolts per display count).

Note: Use zero when calculating in conjunction with a TTI load cell / force sensors (TTI load cells are factory balanced).

3.3 Digital Offset and Scale

Example A

This example shows how to calculate the scale factor.

Input Low = (0 mv/v x 10VDC) divided by .003 = 0
Input High = (2.1 mv/v x 10 VDC) divided by .003 = 7000

Desired Display = 0 to 5000 (The display range you want as a result of scale factor).

Next, use these numbers in the formula...

$$\text{Scale (m)} = \frac{\text{Display High - Display Low}}{\text{Input High - Input Low}} = \frac{5000 - 0}{7000 - 0} = \frac{5000}{7000} = 0.7142$$

Scale Factor = .7142

Note: We have inserted a 0 mv/v for input low, because TTI load cells are factory balanced.

Offset Factor

Calculate the offset factor using the following formula with values derived during scale calculation.

Offset (b) = Display Low - (Scale x Input Low)

where:

» Display Low = The desired lowest meter reading in engineering units, normally set to 0 (ignore the decimal point).

» Input Low = The mv/v reading with no load / weight applied to the load cell / force sensor multiplied by 10, which is the +10 VDC excitation source, divided by .003 (.003 = millivolts per display count).

Note: Use zero when calculating with a TTI load cell / force sensor (TTI load cells are factory balanced).

Example B

This example shows how to calculate the offset factor.

Offset (b) = Display Low - (scale x input low)

0 - (.7142 x 0) = .7142
.7142 = 1 since 1 is the smallest count

Note: We have inserted a 0 mv/v for input low because TTI load cells are factory balanced.

3.4 Overflow Condition

An overflow condition occurs when the meter's display range (refer to Model Specification) is exceeded. This is indicated by the prompt OFLO, which will appear in the display. Certain offset and scale adjustments can inhibit the display of OFLO. The scale factor of 0.1000 could be used to display a value above the units display range. An offset of -500 could be used to display a number (display range + 500) > the display range.

3.5 Alarm Conditions

When the Display value exceeds a setpoint (SP), the meter goes into an alarm condition. During an alarm condition, the display alternates between an alarm message (Hi or Lo) and the present reading, and, if your meter has Option C, the corresponding relay is activated. The Alarm Messages which may appear during an alarm condition are listed below.

Alarm Message	Description
[Hi]	SP 1H exceeded. Display flashes present reading.
[Lo]	SP 1L exceeded. Display flashes present reading.
[Hi]	SP 2H exceeded. Display flashes present reading.
[Lo]	SP 2L exceeded. Display flashes present reading.
[Hi Hi]	SP 1H and SP 2H exceeded. Display flashes present reading.
[Lo Lo]	SP 1L and SP 2L exceeded. Display flashes present reading.
[Hi Lo]	SP 1H and SP 2L exceeded. Display flashes present reading.
[Lo Hi]	SP 1L and SP 1H exceeded. Display flashes present reading.

 4.1. Option C - Digital Limits, Form C Relay Outputs

OPTIONS

4.1. Option C - Digital Limits, Form C Relay Outputs

4.1.1. Option C Description

RATING:

* *Resistive:* 5A max. at 125VAC max.; 0.6A max. at 110VDC max.; 5A max. at 30VDC max.
* *Inductive:* 0.1A max. at 50VDC max. 1/10 H.P. at 125VAC.

This is a 1500Vpk isolation from the signal input and 500Vpk isolation from Option T, or H when Option C is used in conjunction with any of these options. Option C provides two Form C, 5 amp relays with high and low setpoints giving the meter a total of 4 setpoints with an individual deadband for each pair of setpoints (hysteresis). These setpoints (hi/lo) are programmed using the front panel keypad.

NOTE: If either SP1H/SP1L are exceeded, the SP1 relay will be activated. If either SP2H/SP2L are exceeded, the SP2 relay will be activated. To obtain maximum contact life, or when Option C is used in conjunction with Option T, and/or H, relay contacts should have arc suppression on the P2 edge connector. No internal arc suppression is provided. Use 0.047uF/500V ceramic disc capacitor in series with 10 ohm, 1/2 W resistor for proper arc suppression in most cases.

4.1.2. Alarm Condition

When the channel value exceeds the setpoint (SP), the meter goes into an alarm condition. During an alarm condition, the display alternates between an alarm message (Hi,Hi,Lo,Lo) and the present reading, and the corresponding relay output is activated.
An example of the Setpoints with Hysteresis is illustrated in the following graph. Alarm Messages which may appear during an alarm condition are listed after the graph.

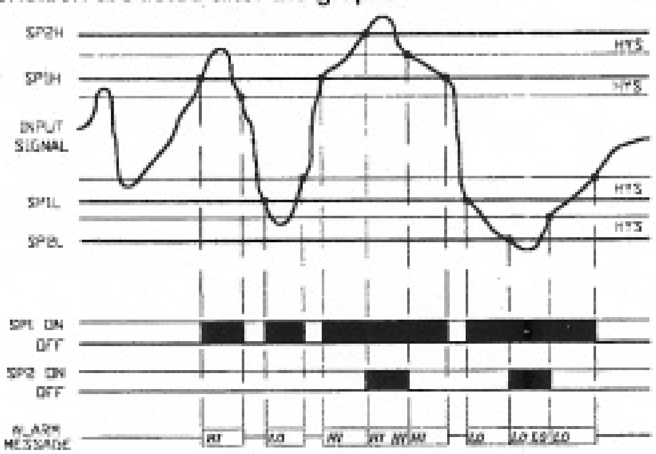

Figure 4-1. Setpoints with Hysteresis

Alarm Message	Description
[Hi]	SP 1H exceeded. Display flashes present reading.
[Lo]	SP 1L exceeded. Display flashes present reading.
[Hi]	SP 2H exceeded. Display flashes present reading.
[Lo]	SP 2L exceeded. Display flashes present reading.
[Hi Hi]	SP 1H and SP 2H exceeded. Display flashes present reading.
[Lo Lo]	SP 1L and SP 2L exceeded. Display flashes present reading.
[Hi Lo]	SP 1H and SP 2L exceeded. Display flashes present reading.
[Lo Hi]	SP 1L and SP 1H exceeded. Display flashes present reading.

4.1.3. Option C Connections

Refer to section: 2.4 P2 Edge connector Pin-Outs (C, CHT). Figures 6A and 6B.

When Option C is installed with Option H and/or Option T, Setpoint 1 High and Setpoint 1 Low control Pins D, E, and F on the P2 Edge Connector. Setpoint 2 High and Setpoint 2 Low control Pins K, L, and M on the P2 Edge Connector.

4.2. Option T - Serial Output (ASCII)

4.2. Option T - Serial Output (ASCII)

Option T provides 20mA and RS232 serial output capability. The optically isolated 20mA current source interface can be operated 2-wire half-duplex while providing up to 1500V peak isolation.

This output will only track the display value from -9999 to +9999 counts. The output to the option will max out if beyond these display counts. The display count refers to the full digital depiction on the display regardless of any decimal point.

Example, the maximum output responds to:

9999. , or 999.9, or 99.99, . . .

But, above this point the output value to the options will indicate an overflow condition.

4.3.1. Specifications

* Output: Half duplex, isolated ASCII 20mA current source or RS232.
* *Baud Rate:* 300 or 1200 bits/sec., external jumper selectable. For 1200 baud, short Pin 12 and Pin N on P2 connector. For 300 baud, leave both pins open.
* *Format:* 1 start bit; 8 data bits, no parity; 1 stop bit.
* *Transmission Sequence:* ASCII characters comprised of polarity sign, 5 digits (with dP location), and CR LF.
* *SERIAL SELECT (Pin 15):* Logic 0 = -0.5V (min.) to 0.8V (max.) at 1mA sink, selected. Logic 1 = 2.0V (min.) to 5.0V (max.) internal 5.6K pull up not selected.

NOTE: When **SERIAL SELECT** is pulled to Logic Low, a new line of data is transmitted over RS232 and 20mA lines. For continuous printing, short Pin 15 to Pin S.

* *BUSY (Pin 8):* Logic 0 = 0.5V (max.) to -50V (min.), hold transmissions. Logic 1 = 1.5V (min.) to 50V (max.) at 20mA source, resume transmission. The BUSY line functions as a handshake to control the flow of data. If BUSY is taken Low, the meter will terminate the transmission of data after the character currently in transmission is transmitted. Transmission will resume where it left off when BUSY is returned High. If BUSY is not used, it must be jumpered to Pin 7 to pull it high.
* *Distance:* 20mA current loop = 4000 ft. at 300 or 1200 baud; RS232 = 75 ft. max.

4.3.2. Option T Connections

Data Transmission

The BUSY line functions as a handshake to control the flow of data. If BUSY is taken Low, data transmission will terminate after the last character being transmitted completes transmission. Data transmission will resume where it left off when BUSY is returned High.

If BUSY **is not used, jumper Pin 8 to Pin 7.**

Single Line Transmission

4.3. Option H - Analog Output

To transmit one line of data output only, the SERIAL SELECT line must be pulsed Low for 10ms to 50ms and then returned High. If SERIAL SELECT is held Low longer than 50ms, multiple outputs will occur.

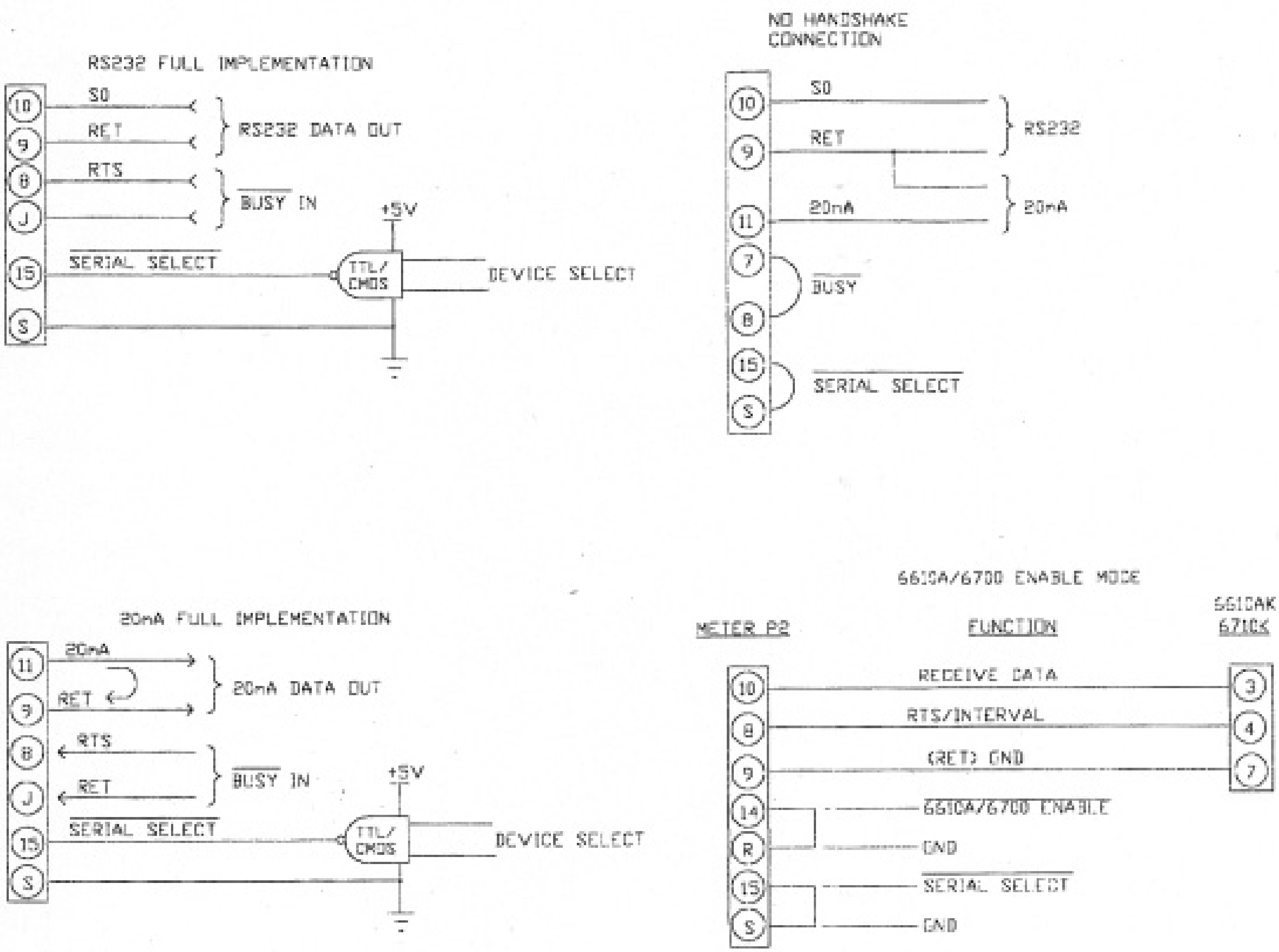

Figure 4-3. Various Option T Connections

4.3. Option H - Analog Output

Option H contains a 12 bit, D/A converter and current transmitter that enable the meter to interface with analog

 4.3. Option H - Analog Output

devices. Analog output is derived from the display, and will track from -9999 to +9999 max for DPM-2. The output can be scaled for displayed values smaller than this by using the trimpots.
In the following specifications, reference is made to NORMAL and EXTENDED operation. NORMAL operation is when the SCALE trimpot is (R17 on figure 4-6) below X5, EXTENDED operation is when the scale trimpot is from X5 to X20.

4.3.1. H Option Common Specs

* *Operating Temperature:* 0 to 35C
* *Offset Range with R12:* From 100% of output to +36% of output min.
* *Output Voltage*: 10VDC @ 17mA max.;
* *Output Current:* 20mA @17V compliance min.
* *DAC Resolution:* 12 bit (1 part in 4095, 2.441mV per step)
* *Scale Range with R17:* 0.5 to 5 (Normal), 5 to 20 (Extended)

Important Do not confuse these scale factors with X2 & X5 modes of operation. They are different.

4.3.2. H Option Specs - NORMAL OPERATION

Model	Mode	Display Counts	[1]DAC Output Typical mV/cnt	Minimum Display Count Change For Full Output Span
DPM-2	X1	-9999 to 9999	2.5 mV/ 5 counts	4000
	X2	0 to 9999	2.5 mV/ 2.5 counts	2000
	X5	0 to 3999	2.5 mV/ count	800

* *Stability:* 0.35% + 0.02%/C after 1 hour warm-up
* *Linearity:* Adjustable scaling (0.5% setability)
* *Offset Error:* Adjustable offset (1% setability)
* *Output Resolution:* Shown on charts above. Listed output values increase as the scale setting increases.

4.3.3. H Option Specs - EXTENDED OPERATION

Model	Mode	Display Counts	[1]DAC Output Typical mV/cnt	[2]Minimum Display Count Change For Full Output Span
DPM-2	X1	-9999 to 9999	2.5 mV/ 5 counts	4000
	X2	0 to 9999	2.5 mV/ 2.5 counts	2000
	X5	0 to 3999	2.5 mV/ count	800

* *Stability:* 2% + 0.05%/C after 1 hour warm-up
* *Linearity:* Adjustable scaling (5% setability)
* *Offset Error:* Adjustable offset (5% setability)
* *Output Resolution:* Shown on charts above. Listed output values increase as the scale setting increases.

1 Typical DAC output is the average change in DAC output voltage (prior to scale "R17" and offset "R12" adjustments) due to the specified count change in the display. Actual resolution of the DAC is 2.441mV per step (4095 maximum steps).

2 With R17 set for a gain of 20.

4.3. Option H - Analog Output

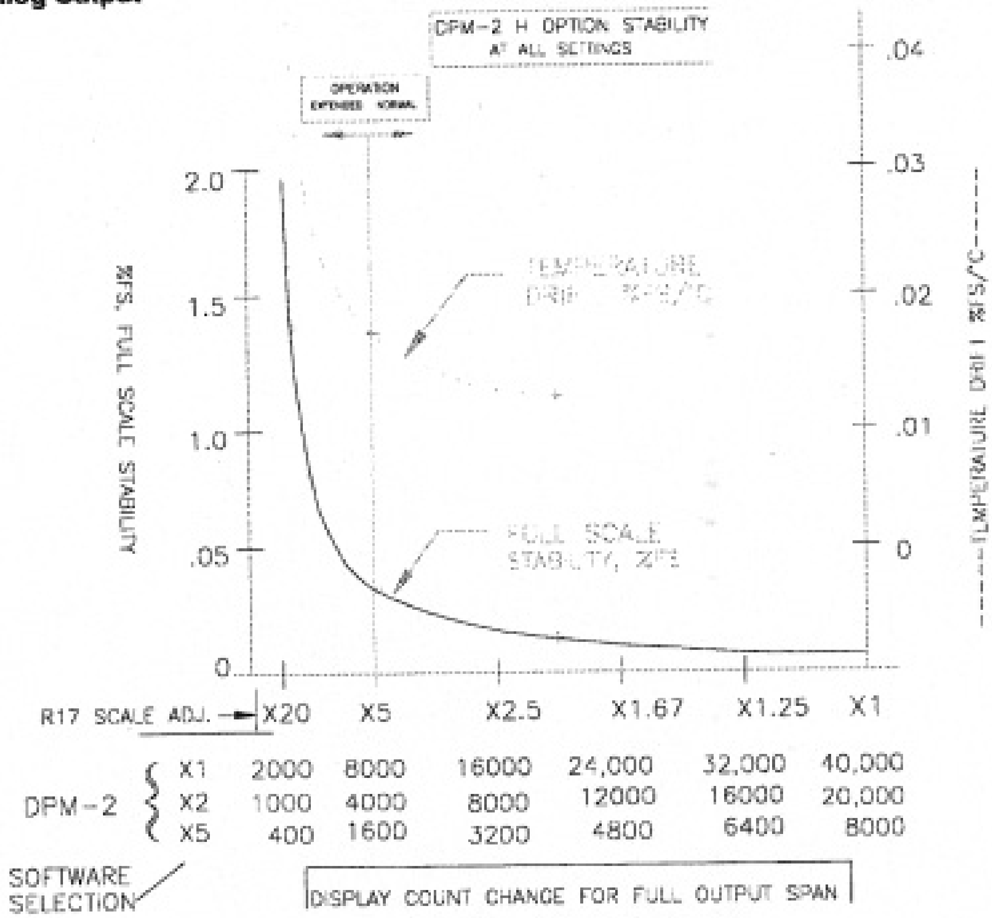

Figure 4-4. H-Option Instability Graph

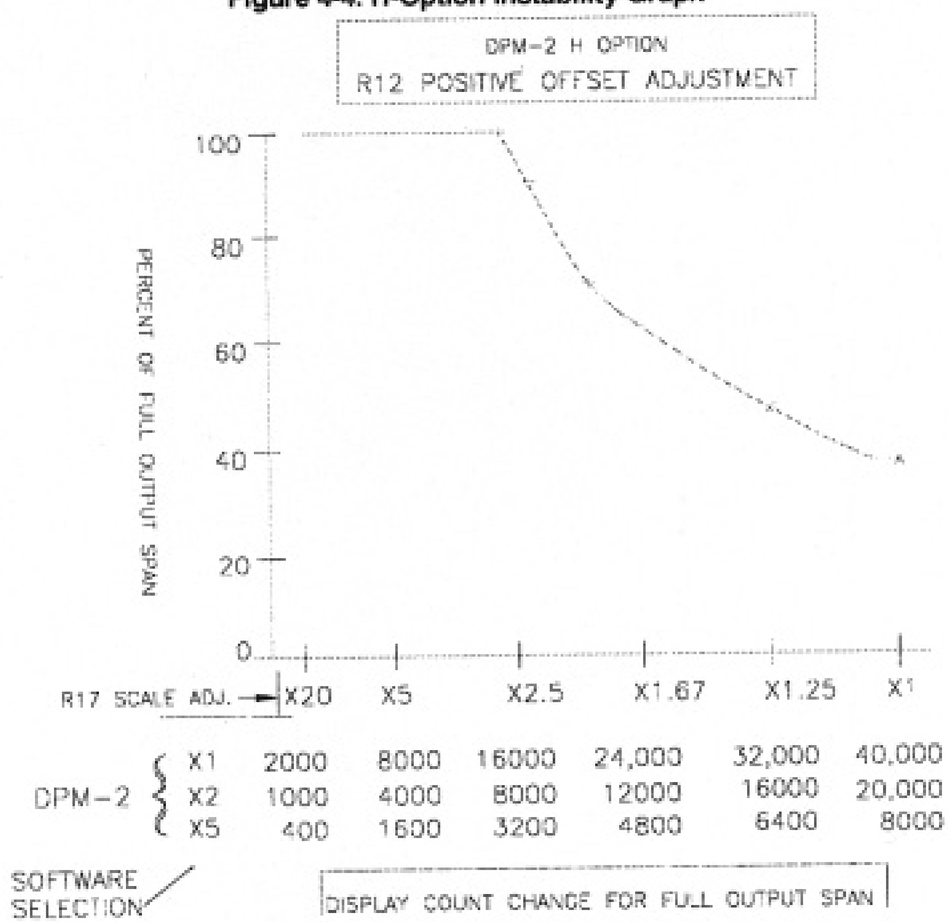

Figure 4-5. H-Option R12 Positive Offset Graph

4.3.4. P2 Edge Connector Pin-Outs for Option H

Pin	Function
A	Raw DAC output. Zero to +10 volts full scale (Not zero or gain trimmed). Can source 5mA max. The load resistance must be 2000 Ohms or higher, which includes open
1	Inverted sum of the DAC output plus the offset value determined by R12 trimpot. Can source up to 2mA and is used as a setup testpoint only.
B	Sense input for 10V compliance (excitation) source.
5	+10V compliance (excitation) source. Must be tied to pin B at transducer or at P2 connector for proper operation. Output can source up to 90mA.
2	Analog ground for pins A, B, 1, 5.
3	Analog ground for pins C, 4.
6	X5 Select. *
4	Scaled and offset voltage (0-10VDC) output controlled by the DAC plus trimpots R12 and R17. Output can supply up to 17mA and is the input to the analog current transmitter, U6.
C	Scaled and offset analog current transmitter output. Has overall range of 0 to 23 mA and can easily be adjusted to cover 4 to 20 mA with R12 and R17.
13	X2 Select. *
P	Connected to 13 or 6 by jumper to select mode.

* Only One of these two modes of Operation may be selected at a time. Use only Pin P to make such a selection.

4.3.5. Bipolar, Unipolar Connections

Current and voltage outputs are adjusted by the same potentiometers. At minimum current output, voltage output is at the minimum (and vice versa) and at maximum current output, voltage output is at the maximum (and vice versa). However, the relationship is not exact.

4.3.5.1. Bipolar Operation (X1 Mode)

During bipolar operation, the output span corresponds to both positive and negative values.
Current Output: On the P2 connector, connect (+) R Load to pin C and Connect (-) R Load to pin 3.
When the display is at negative full scale, current output is a the minimum (typically 4mA).
When the display is at positive full scale, current is a the maximum (typically 20mA).
Voltage Output: On the P2 connector, connect (+) R Load to pin 4 and connect (-) R Load to pin 3.
When the display is at full scale, voltage output is at the minimum (typically 2V).
When the display is at the positive full scale, voltage is at the maximum (typically 12V).

4.3.5.2. Unipolar Operation (X2 Mode)

During unipolar operation, the output span corresponds to only positive display values. The X2 hook-up makes negative inputs equal to zero. To select the X2 mode, connect P2, pin 13 to P2, pin P.
Current Output: On the P2 connector, first make the X2 connection, then connect (+)R Load to Pin C and then (-)R Load to Pin 3.
When the display is at zero (0), current output is at the minimum (typically 4mA). When the display is at positive full scale, current output is at the maximum (typically 20mA).
Voltage Output: On the P2 connector, first make the X2 connection, then connect (+) R Load to Pin 4 and (-) R Load to Pin 3.
When the display is at zero, voltage output is at the minimum (typically 2V). When the display is at positive full scale, voltage output is at the maximum (typically 12V).

4.3.5.3. Unipolar Operation (X5 Mode)

During unipolar operation, the output span corresponds to only positive display values. The X5 hookup makes negative inputs equal to zero. To select X5, connect P2, Pin 6 to P2, Pin P.
Current Output: On the P2 connector, first make the X5 connection, then connect (+)R Load to Pin C and then (-)R Load to Pin 3.
When the display is at zero (0), the current output is at the min. (typically 4mA). When the display is at 40% of positive full scale, current output is at the maximum (typically 20mA).
Voltage Output: On the P2 connector, first make the X5 connection, then connect (+) R Load to Pin 4 and (-) R Load to Pin 3.
When the display is at zero, voltage output is at the minimum (typically 2V). When the display is at 40% of positive full scale, voltage output is at the maximum (typically 12V).

4.3.6. 10V Compliance (Excitation) Adjustment

Pin B on the P2 Edge Connector is the sense input for the 10V excitation source. Pin 5 is the +10V excitation source. For proper operation, pin 5 must be tied to pin B at either the transducer or the P2 connector. This output can source up to 90mA. R19 (**trimpot, see figure below**) is the +10V excitation adjustment and has a range of +9Vdc to +11Vdc. Turn R19 clockwise to increase the voltage. This adjustment is not important to the operation of the DAC.

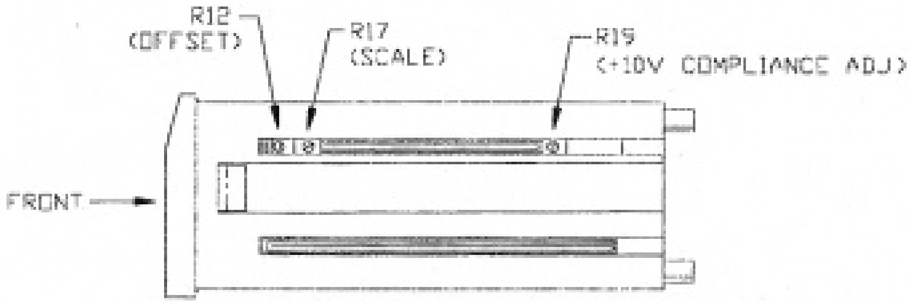

Figure 4-6. Analog Output Trimpot Positions

CAUTION: When this +10V exciter is used, the isolation between the signal input and analog output may be compromised. If Option T is being used concurrently, it too may have compromised isolation. Option C, if present, is not affected.

4.3.7. Analog Output Adjustment

The loop load resistance range for 4-20mA operation of this meter is 0 to 600 ohms. The loop is returned to Pin 3 on the P2 edge connector. The output may be adjusted for either 4-20mA or 0-10 Volt. (Refer to Figure above.)

4.3.7.1. 4-20mA Calibration

Adjust the 4-20mA current transmitter as follows:

1. Connect a volt meter between Pins 1 (+) and 2 (-) on the P2 edge connector.
2. Connect a current monitor to the transmitter loop at P2 Pin C (+) and Pin 3 (-) and measure the loop current, or calculate the loop current by measuring the voltage across the load resistance and dividing that reading by the measured value of the load resistance.
3. To the meter input, apply a potential that causes the lowest planned display reading and adjust R12 (OFFSET) until the voltage at P2 Pin 1 goes to -100mV (to get any output from the current transmitter, this point must be at some small negative potential).
4. With the display remaining at its lowest count, slowly adjust the offset trimpot R12 back and forth until the current transmitter shows a small positive output current near zero (approximately 50-100μA).
5. To the meter input, apply a potential that causes the highest planned display reading and adjust R17 (SCALE) for 16mA in the loop. Turn R17 clockwise to decrease current in the loop.
6. With the display remaining at its highest count, adjust R12 (OFFSET) until the loop current reaches 20mA. Turn R12 clockwise to increase the pedestal (OFFSET) current in the loop.
7. To the meter input, apply a potential that causes the lowest planned display reading and check the pedestal (OFFSET) current to verify it is 4mA. If it is not 4mA, repeat steps 4, 5, and 6 until it is.

4.3.7.2. 0-10 Volt Calibration

Adjust the 0-10 Volt Out as follows:

1. Connect a voltmeter between pins 1 (+) and 2 (-) on the P2 edge connector.
2. Connect another voltmeter at P2, pin 4 (+) and P2, pin 3 (-) to monitor the analog output.
3. To the meter input, apply a potential that causes the lowest planned display reading and adjust R12 (offset) until the voltage at P2 pin 1 goes to -100mV (to get any output, this point must be at some small negative potential).
4. With the display remaining at its lowest count, adjust R12 (offset) so that a small positive voltage is monitored at pin 4 (approximately 1 to 10mV).
5. To the meter input, apply a potential that causes the highest planned display reading and adjust R17 (scale) for 10 volts at pin 4. Turn R17 clockwise to decrease the voltage.
6. To the meter input, apply a potential that causes the lowest planned display reading and verify that the output (pin 4) is still at zero (1-10mV). If it is not, repeat steps 4 and 5 until they are balanced.

4.4. Option P - Exciter (Standard)

4.4.1. Exciter Specs

Adjustment Range +9VDC to +11VDC

Accuracy without options .02% max.

Accuracy with options .15% max.

4.4.2. Exciter (10V Compliance) Adjustment

Pin B on P2 connector is the sense input for the 10V excitation source. Pin 5 is the +10V excitation source. For proper operation, tie pin 5 to pin B at either the transducer or P2 connector. This output can source up to 90mA. R19 is the +10V excitation adjustment and has a range of +9VDC to +11VDC. Turn R19 clockwise to increase voltage (Figure 4-6). This adjustment will not affect the operation of the DAC out in option H.

IMPORTANT: When using the +10V exciter, isolation between the signal input and analog output may be compromised through external connections. If option T is used concurrently, it too may have compromised isolation. Option C is not affected.

4.4.3. P2 Edge Connector Pin-outs for the Exciter

Pin	Function
B	Sense input for +10V compliance (excitation) source.
5	+10V compliance (excitation) source. Must be tied to pin B at P2 connector or connect pin "B" at transducer for proper operation. Output can source up to 90mA.
2	Analog ground for pins A, B, 1, 5.
3	Analog ground for pins C,
H	Spare.

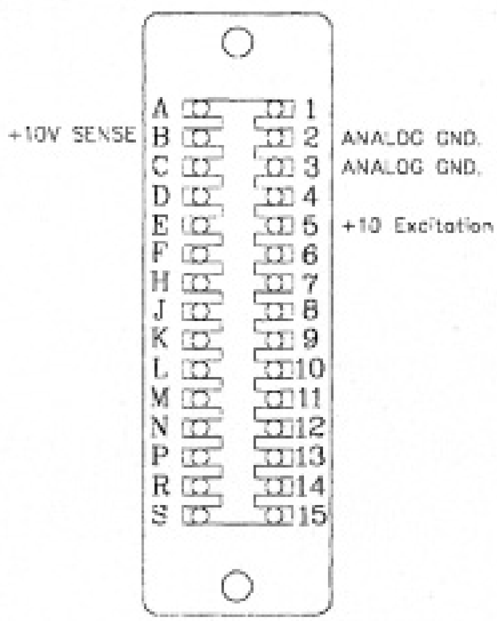

Figure 4-7. P2 Exciter Pin-out