ΩE OMEGA™

User's Guide

DPF700
Ratemeter/Totalizer/Controller

ΩΞ OMEGA™

PREFACE

MANUAL OBJECTIVES

This manual shows you how to set up and use the Ratemeter/ Totalizer/ Controller.

In this manual we provide procedures for:

* Connecting power to the meter
* Mounting the meter
* Checking main board power jumpers
* Selecting main menu items
* Selecting sub-menu items
* Saving changes
* Disassembly
* Using the rate measurement mode
* Using the totalizer mode
* Installing and using an RS-232 option board
* Installing and using an analog output board
* Installing and using a dual-relay option board

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Table A-1. Sections of the Manual

NOTES, WARNINGS AND CAUTIONS

Information that is especially important to note is identified by these labels:

- **NOTE**
- **WARNING**
- **CAUTION**
- **IMPORTANT**

Note ☞   **NOTE:** provides you with information that is important to successfully setup and use the Programmable Digital Meter.

CAUTION or WARNING: tells you about the risk of electric shock.

CAUTION, risk of danger: tells you of circumstances or practices that can effect the meter's functionality and must refer to accompanying documents.

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NOTES

1.1 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, use the phone number for the Customer Service Department nearest you.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

▼ **Note** ☞ *The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.*

Verify that you receive the following items in the shipping box:

QTY   DESCRIPTION

1   Low-Cost Ratemeter/Totalizer/Controller with all applicable connectors attached.

1   Owner's Manual

1   Set of Mounting Brackets

▼ **Note** ☞ *If you order a configured meter with options, you will receive the meter with option boards installed. Refer to Table 2-1 for more information on options.*

INTRODUCTION

1.2 SAFETY CONSIDERATIONS

This device is marked with the **international caution symbol**. It is **important to read** this manual before installing or commissioning this device as it contains important information relating to **Safety and EMC** (Electromagnetic Compatibility).

Unpacking & Inspection

Note ☞ Unpack the instrument and inspect for obvious shipping damage. Do not attempt to operate the unit if damage is found.

This instrument is a **panel mount device** protected in accordance with EN 61010-1 (safety requirement standard of electrical equipment for measurement, control and laboratory). Installation of this instrument should be done by Qualified personnel. In order to ensure safe operation, the following instructions should be followed.

This instrument has **no power-on switch**. An external **switch or circuit-breaker** shall be included in the building installation as a disconnecting device. It shall be marked to indicate this function, and it shall be in close proximity to the equipment within easy reach of the operator. The switch or circuit-breaker shall not interrupt the Protective Conductor (Earth wire), and it shall meet the relevant requirements of IEC 947–1 and IEC 947-3 (International Electrotechnical Commission). The switch shall not be incorporated in the mains supply cord.

Furthermore, to provide protection against **excessive energy** being drawn from the mains supply in case of a fault in the equipment, an **overcurrent** protection device shall be installed.

The Protective Conductor must be connected for safety reasons. Check that the power cable has the proper Earth wire, and it is properly connected. It is not safe to operate this unit without the Protective Conductor Terminal connected.

Note ☞
- Do not exceed voltage rating on the label located on the top of the instrument housing.
- Always disconnect power before changing signal and power connections.
- Do not use this instrument on a work bench without its case for safety reasons.
- Do not operate this instrument in flammable or explosive atmospheres.
- Do not expose this instrument to rain or moisture.
- Unit mounting should allow for adequate ventilation to ensure instrument does not exceed operating temperature rating.
- Use electrical wires with adequate size to handle mechanical strain and power requirements. Install without exposing bare wire outside the connector to minimize electrical shock hazards.

EMC Considerations

- Whenever EMC is an issue, always use shielded cables.
- Never run signal and power wires in the same conduit.
- Use signal wire connections with twisted-pair cables.
- Install Ferrite Bead(s) on signal wires close to the instrument if EMC problems persist.

Failure to follow all instructions and warnings may result in injury!

2.1 DESCRIPTION

The meter is a fully programmable ratemeter/ totalizer/ controller with six-digit resolution for totalizing input pulses or rate measuring.

Alphanumeric display prompts make it easy to program with front-panel buttons. You may use a personal computer to program the meter and monitor the display data using the RS-232 option. You may store the program setup in the nonvolatile memory for recall upon demand or at power-on.

The crystal timebase is electronically calibrated. There are no internal adjustments and calibration is done without opening the case. Available options include field-installable dual-relay option card, RS-232 and analog output cards.

2.2 FEATURES

The following is a list of features:

* 6-digit, single input
* NEMA 4 / Type 4 Front Bezel
* Display of any engineering unit
* Front-panel scaling
* 0.5 Hz to 30 kHz frequency inputs
* Signal conditioner standard for low level inputs
* DIP switch input selection
* Sensor excitation of 5, 8.2 and 12.4 Vdc
* Front-panel programmable as rate meter or totalizer

For more detailed information on meter features, refer to Tables 6-1 and 6-2.

2.3 MAIN BOARD

Table 2-1 details information for the S2, S3, and S4 jumpers. The S2 jumper has 3 possible positions: A, B or C. Factory defaults are in bold and italics. Figure 2-1 illustrates where these jumpers are located on the main board.

Table 2-1. Main Board Jumpers

Jumper/ Switch	Position: Installed	Description
S2	S2-A	Scale, offset, setpoints and decimal points are unlocked. Everything else is locked.
	S2-B	Everything is unlocked.
	S2-C*	*Everything is unlocked, except for analog output parameters.*
	Removed	In the rate mode, meter shows "5PL0" and "5PH1" only (if the relay option board is installed). In the totalizer mode, meter shows the OFF5EL, 5PL0 and 5PH1 - everything besides the relays are locked out. In either mode, the meter stores changes in the nonvolatile memory automatically.
S3	*S3-A*	*Enables front-panel buttons.*
	Removed	Disables front-panel buttons.
S4	*S4*	*Enables RECALL button.*
	Removed	Disables **RECALL** button.

Note ☞   * For units with analog output option, S2-B is factory default, not S2-C.

2.3   MAIN BOARD (Continued)
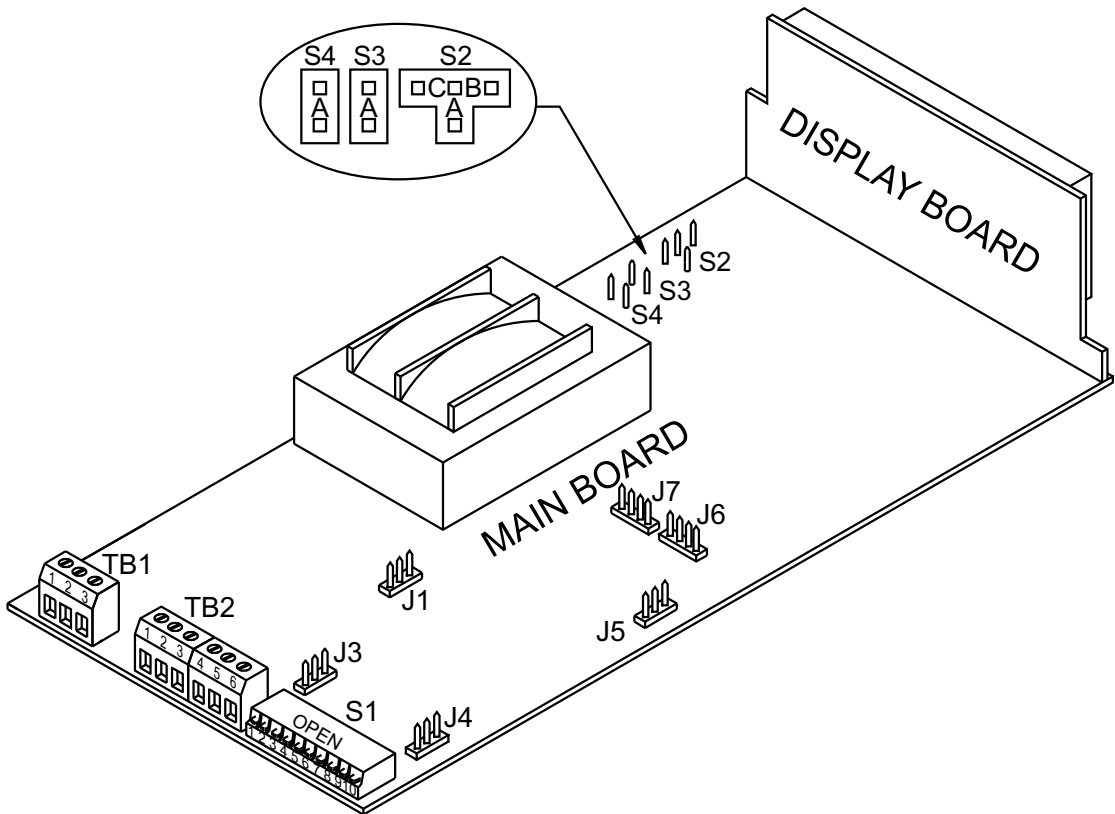
Figure 2-1. Main Board

2.4 FRONT OF THE METER

Figure 2-2 shows each part of the front of the meter.
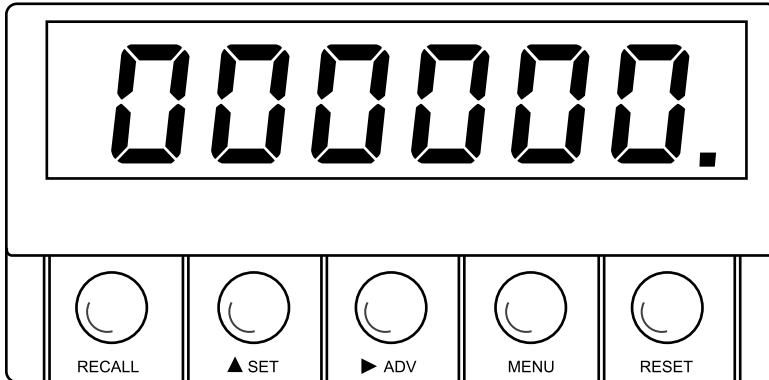
Figure 2-2. Front-Panel

METER DISPLAY:

Digital LED display   −99999 or 999999 6-digit 7-segment, 0.56" high LED display with programmable decimal point.

METER BUTTONS

RECALL Button
To initialize (hard reset) the meter, press the **RECALL** and **RESET** buttons simultaneously. The meter momentarily shows the program revision letter and mode (totalizer or rate). The meter then shows the last stored (saved) program in the active (volatile) memory.

2.4   FRONT OF THE METER (Continued)

▲ **SET** Button
Press this button to modify the flashing function, number value or decimal point (sub-menu only).
For example, press the ▲ **SET** button to toggle between the $totAL$ (totalizer) and $rAtE$ (rate) modes. Once the correct function, number value or decimal point shows, press the **MENU** button to enter the change into the active (volatile) memory.

▶ **ADV** Button
Press this button to show the sub-menus and values for a selected menu item. The meter shows values with left-most digit flashing. Press the ▶ **ADV** button to move the flashing item from left to right through the digital display and the ▲ **SET** button to change the flashing item's value.

MENU Button
Press this button to show main menu items (refer to Section 6 for more information). The meter does not show locked out (bypassed) items. The S2 and S3 jumpers determine lock out status.

RESET Button
Press this button to reset a latched alarm. Also, if you are in the totalizer mode, press this button to reset the counter and begin counting from the offset. If you are in the setup menu (in either mode) the meter returns to the run mode and makes measurements with the latest updated menu items.

2.5 BACK OF THE METER

Table 2-3 shows S1 positions for different types of transducer signals and excitation. You may change default settings via the front-panel buttons.

Table 2-2. S1 Dip Switch Positions
(Factory defaults are bold and in italics)

Transducer Type (Connect to TB2-2 & TB2-3)	Close the Following S1 Positions:
5 V CMOS	S1-4, S1-1
TTL	*S1-4, S1-1*
NPN Open Collector	S1-4, S1-7
PNP Open Collector	S1-4, S1-6
NAMUR	S1-4, S1-2, S1-6
Contact Closure to RTN	S1-4, S1-5, S1-6
Contact Closure to EXC	S1-4, S1-5, S1-6
Low Level Signal (Magnetic Pickup)	S1-3
Low Level Signal When Average is Positive	S1-4, S1-3
Excitation Output (Available on TB2-1)	
5 V @ 50 mA max	*S1-1 Close*
8.2 V @ 70 mA max*	S1-2 Close
12.4 V @ 100 mA max*	S1-1 and S1-2 Open

* Line voltage range is limited to 115/230 ±10% for excitation currents more than 50 mA.

2.5 BACK OF THE METER (Continued)

Figure 2-3 shows the connector label depicting the back view of the meter.

EXCITATION (TB2-1)	S1 POSITION CLOSED	TRANSDUCER TYPE (TB2-2 & 3)	S1 POSITIONS CLOSED
5.0V	S1-1	5V CMOS	S1-4, S1-1
8.2V	S1-2	TTL	S1-4, S1-1
12.4V	NONE	NPN Open Collector	S1-4, S1-7
		NAMUR	S1-4, S1-2, S1-6
		Contact Closure to RTN	S1-4, S1-6, S1-5
		Low Level Signal (Magnetic Pickup)	S1-3

J1/ ANALOG OUT

1*	2*	3*

ANLG 4-20 0-10V
RTN   mA

N/C
RTN
RX
TX
RTS
N/C

6
1

J2*/ RS232

TB3/ RELAY

1	2	3	4	5	6

NC1 NO1 CM1 NC2 NO2 CM2

TB1

1	2	3

L   N   ⏚
~

TB2

1*	2*	3*	4*	5*	6*

EXC SIG SIG RST EXT BATT
OUT IN   RTN IN   GATE IN

S1

OPEN
1 2 3 4 5 6 7 8 9 10
CLOSED

* = CONNECT TO LOW VOLTAGE LIMITED ENERGY CIRCUITRY ONLY.

Figure 2-3. Connector Label

⚠ **WARNING: Incorrect power input can damage the meter.**

ABOUT THE METER

Table 2-3. S1 - S10 Switch Functions

(Factory defaults: bold & italics)

Jumper/ Switch	Status	Description
S1-1 S1-2	Open Closed	Excitation output is set to 8.2 V.
S1-1 S1-2	Open Open	Excitation output is set to 12.4 V.
S1-1 S1-2	*Closed* Open	*Excitation output is set to 5.0 V.*
S1-3	*Open* Closed	*High hysteresis = 1.5 V.* Low hysteresis = 20 mV.
S1-4	Open *Closed*	Threshold is normal. *Threshold is shifted to positive.*
S1-5	*Open* Closed	*No low pass filter.* 12 Hz low pass filter for contact closure.
S1-6	*Open* Closed	*No pull-down resistor.* 1.0 K ☐pull-down resistor.
S1-7	*Open* Closed	*243K pull-up to +excitation.* 3K pull-up resistor to excitation.
S1-8	*Open* Closed	*Trigger edge = Negative (high to low transition).* Trigger edge = Positive (low to high transition).
S1-9	*Open* Closed	*No signals internally connects to the input.* Twice line frequency signal internally connects to the input.
S1-10	*Open* Closed	*Detects an ac power loss.* (For more information refer to Section 3.3) Maintains digital display during a dc power operation.

3.1 POWERING THE METER

1. Set the S1 dip switches according to Table 2-3.
2. Connect input signal (refer to Section 3.2 for commonly used sensors).
3. Connect the proper voltage to the power screw terminal (TB1). The meter shows the programmed function (default is ⌐RＬE mode).

Table 3-1. ac Power Detail

Connector	Description	Wire Colors	
		Europe	USA
TB1-1	∿ ac Line	Brown	Black
TB1-2	∿ ac Neutral	Blue	White
TB1-3	∿ ac Earth Ground	Green/Yellow	Green

Table 3-2. Signal Connector

Connector	Connection From Meter
TB2-1	Excitation Output (5 V, 8.2 V or 12.4 Vdc)*
TB2-2	Signal Input*
TB2-3	Signal Return
TB2-4	Reset Input (active when tied to TB2-3)
TB2-5	External Gate Input**
TB2-6	Backup Battery (positive connection, use TB2-3 for return).

*   Refer to Table 2-3, S1 DIP Switch Positions.
** Normally used in timing applications, not rate applications. Refer to Section 5.2 (Stopwatch in the Totalizer Mode) for more information
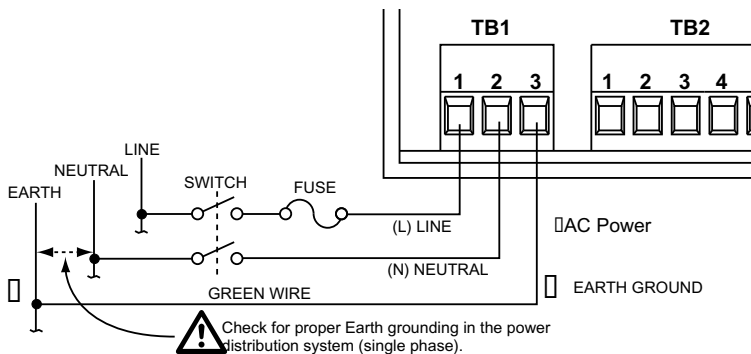
Figure 3-1. Electrical Connection for ac Power

3.2 CONNECTING TO COMMONLY USED SENSORS
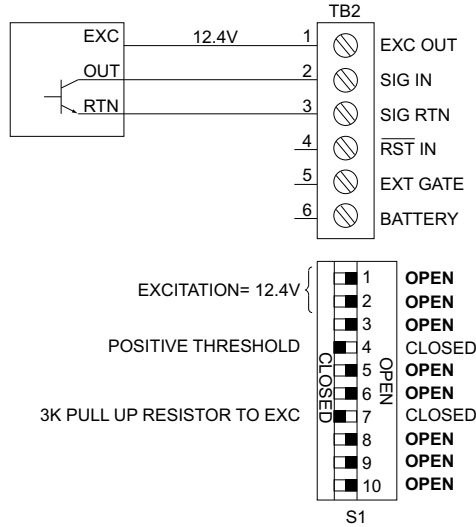
Figure 3-2. 3-Wire Sensor with NPN Open Collector Output
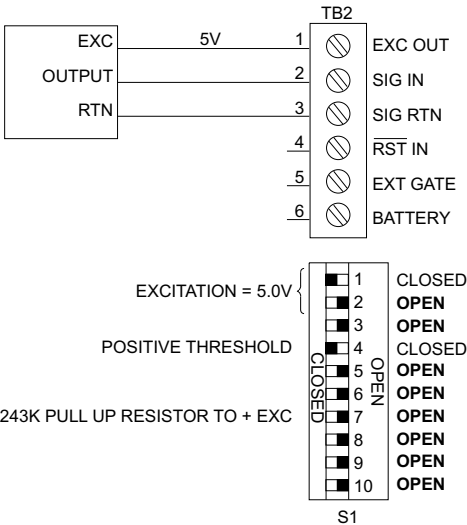
Figure 3-3a. TTL Output   **Figure 3-3b. 5V CMOS Output**
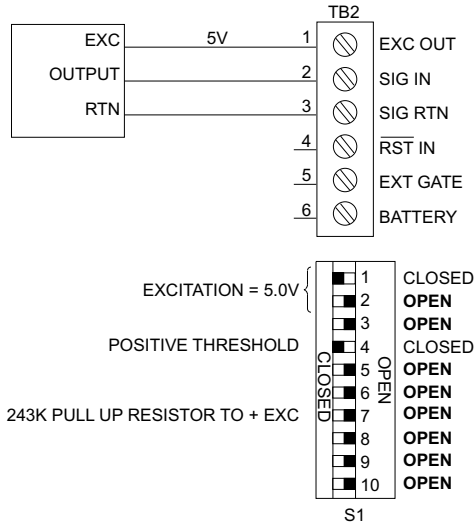
3.2 CONNECTING TO COMMONLY USED SENSORS (Continued)
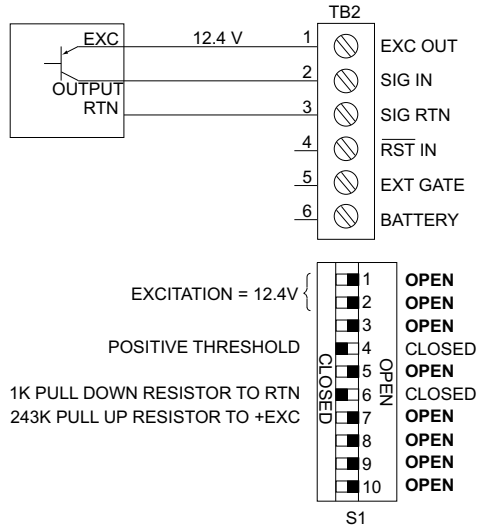
Figure 3-4. 3-Wire Sensor with PNP Open Collector Output
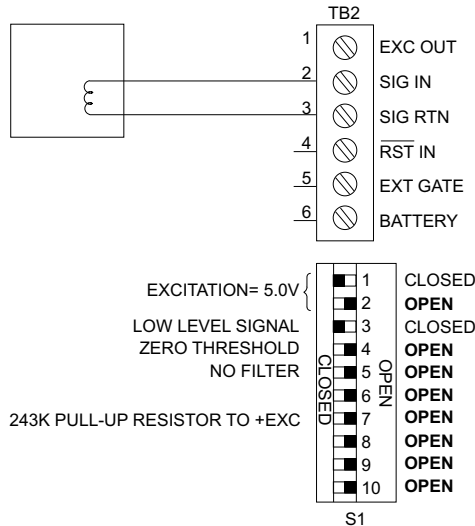
Figure 3-5. 2-Wire Magnetic Pickup (Low Level Signals)

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3.2 CONNECTING TO COMMONLY USED SENSORS (Continued)
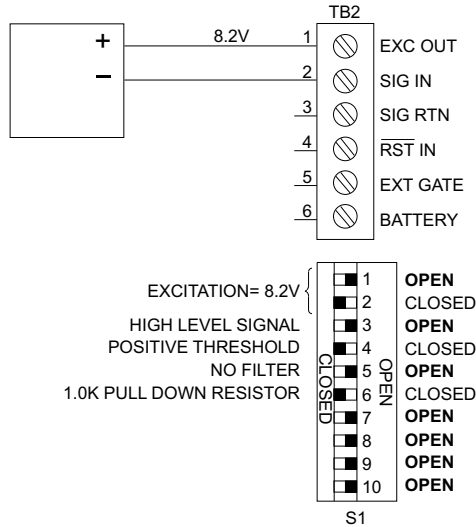
Figure 3-6. 2-Wire NAMUR Sensor
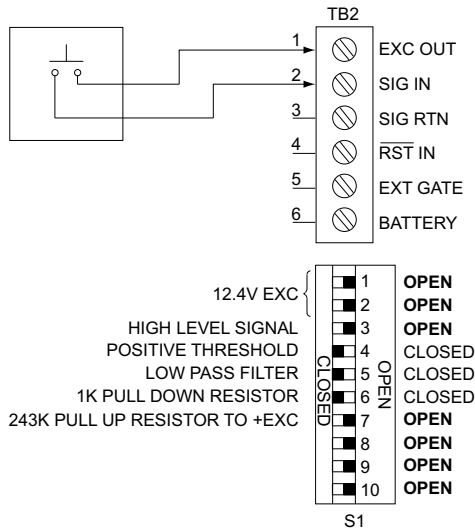
Figure 3-7. 2-Wire Contact Closure

3.3 MAIN BOARD POWER JUMPERS

⚠ **Caution:** The meter has no power-on switch, so it will be in operation mode as soon as you apply power.

Typically the meter is shipped per order (per the part number requested) and no modification is necessary. However, if you want to check voltage jumpers, or to change from 115 Vac to 230 Vac (refer to Figure 3-8):

Note ☞ Disconnect the power from the unit before proceeding.

1. Remove the main board from the case.
2. Locate the wire jumpers W1, W2 and W3 (located near the edge of the main board alongside the transformer).
3. If your power requirement is 115 Vac, install solder jumpers W1 and W2, but do not install jumper W3.

   If your power requirement is 230 Vac, install solder jumpers W3, but do not install jumpers W1 or W2.
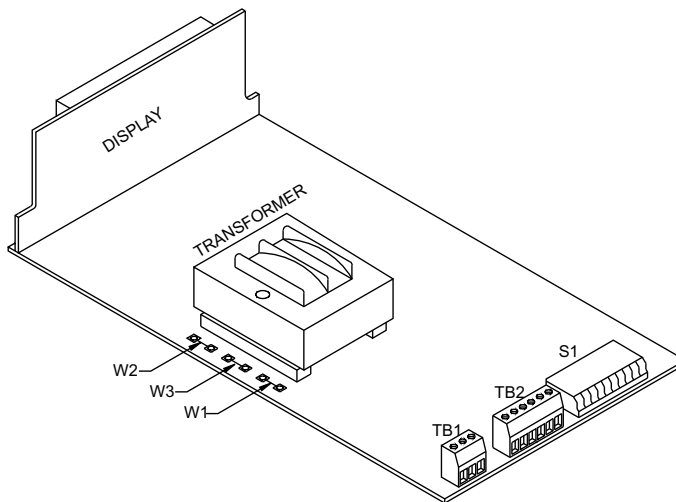
Figure 3-8. Main Board Jumpers (W1, W2, W3)

3.3.1 ac Power Failure Provision

To store a total count in the nonvolatile memory if an ac power loss occurs set the S1-10 switch to "open". When ac power resumes the meter **displays the total at the time of the power loss**, and then resumes totalizing.

3.3.2 dc Power/Backup Battery Provision

You may power the meter from an external dc power supply, or an external battery. The typical current requirement is 260 mA at 7.5 to 13 Vdc to maintain full operation and meter display when no option board is installed. You can shut off the display without affecting any meter functionality by setting the S1-10 switch to open. Shutting off the digital display reduces the current requirement to 30 mA (if option boards are installed, add 180 mA for an analog output board, 120 mA for a dual-relay board, and 20 mA for an RS232 board).

CAUTION: If the S1-10 switch is in the "closed" position, the meter does not detect any power loss (ac or dc), and therefore will not load the display data into the nonvolatile memory. In this case the Total is loss when both ac and dc power are lost.
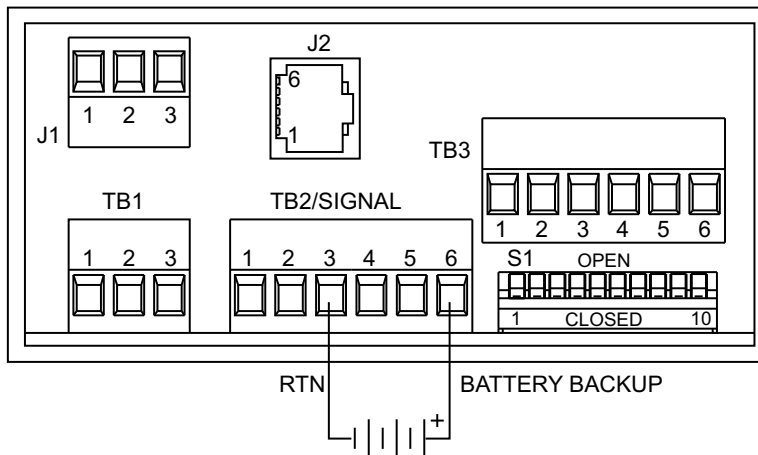
Figure 3-9. dc Power/Battery Backup

3.4 MOUNTING THE METER

PANEL CUT-OUT

REAR COVER (REMOVED)

"NEW" STYLE MOUNTING BRACKET

CONNECTOR LABEL

PRODUCT LABEL

CASE

Note: Gasket is only used when "New" style mounting bracket is used.

"OLDER" STYLE MOUNTING BRACKET 2 PCS
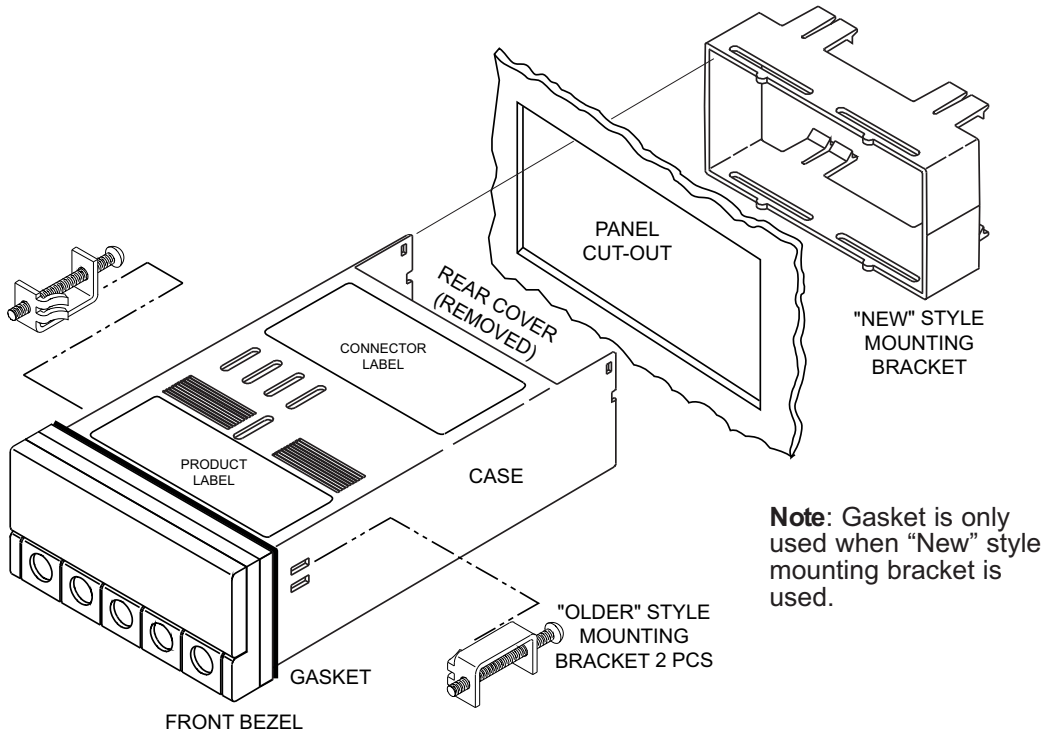
GASKET

FRONT BEZEL

Figure 3-10. Meter - Exploded View

1. Cut a hole in your panel, as shown in **Figure 3-10**. For specific dimensions refer to **Figure 3-11**.

2. Insert the meter into the hole. Be sure the front bezel gasket is flush to the panel.

3. Slide on mounting bracket to secure.

PANEL THICKNESS
6,4 (.25) MAX
0,8 (.03) MIN

1,5
R(.06)   45,00 + 0,61/-0,00
4 PLCS   (1.772 + .024/-.000)

92,00 + 0,81/-0,00
(3.622 + .032/-.000)
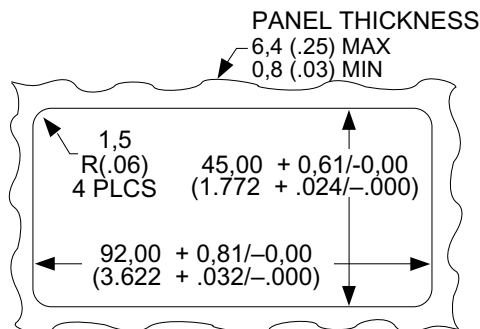
NOTE: Dimensions in Millimeters (Inches)

Figure 3-11. Panel Cut-Out

3.5 SELECTING MAIN MENU ITEMS

Note ☞ Refer to Table 6-1 for summary list of menu configurations.

1. Press the **MENU** button. The meter shows a main menu item.
   Continue to press the **MENU** button to scroll through main menu items.

2. Once the desired main menu item shows, press the ▲ **SET** button to show the item's current value or the active sub-menu item.

3.6 SELECTING SUB-MENU ITEMS

1. Select main menu item.

2. Once the meter shows the correct main menu item, press the ▲ **SET** button. The meter shows either the active sub-menu item or the main menu item's current value.

3. If the meter shows an available sub-menu item, press the ▶ **ADV** button to show the sub-menu item's current value.

Note ☞ *The main menu items "OFFSEt" and "COnFIG" do not have sub-menus. If you press the ▲ SET button when the meter shows either of these items, the meter will show the current number value.*

4. Press the ▲ **SET** button to change the flashing number value. The left-most digit (above the **RECALL** button) may be set to a minus sign. Also, press the ▲ **SET** button to change the decimal point position.

5. Press the ▶ **ADV** button to change which digit is flashing.

3.7 SAVING CHANGES

You may store (save) meter changes in the volatile and nonvolatile memory. **Remember you cannot store changes in the nonvolatile memory without first storing them in the volatile memory.**

To store changes in the nonvolatile memory, follow these steps:

1. **Make required changes**, using the ▶ **ADV** button to show current values and also to move from left to right through the digital display. The digit or value that may be changed will flash. Use the ▲ **SET** button to change the function, number value or decimal point of the flashing item.

2. **Press the MENU button** until the meter shows "no5ɫoɾ".

3. **Press the ▲ SET button.** The meter shows "5ɫoɾE".

4. **Press the MENU button** to store the changes to the nonvolatile memory. If power loss occurs, or meter is hard reset these changes stay in the meter's memory.

To store changes in the volatile memory, follow these steps:

1. **Make required changes**, using the ▶ **ADV** button to show current values and also to move from left to right through the digital display. The digit or value that may be changed will flash. Use the ▲ **SET** button to change the function, number value or decimal point of the flashing item.

2. **Press the MENU button** to store changes to the volatile memory.

3. **Press the RESET button** to operate the meter from the volatile memory.

4 RATE MEASUREMENT

Rate Measurement measures the input rate. This measurement defaults to show in Hz (pulse/sec), but may also show in kHz, RPMs (for tachometer applications), feet/seconds, or other engineering units.

4.1 LINE FREQUENCY MEASUREMENT

Line frequency measurement is useful as a self-test of the meter. A signal equal to twice the line frequency is internally available. Close the S1-9 and S1-4 switches and set the scale factor to multiply by 0.5 (or divide by 2) to measure line frequency. The display shows "50" or "60", depending upon your local ac line frequency.

Note ☞ *No external connection to TB2 is necessary.*

4.2 REVOLUTIONS PER MINUTE (RPM) MEASUREMENT EXAMPLE

Example: 10 pulses per revolution

A sensor generates ten pulses for every revolution of a shaft.

If n pulses per revolution is generated, use the following formula:

SCALE = X/n
      X = 1 units/seconds (e.g. Hz)
           60 units/minutes (e.g. rpm)
           3600 units/hours (e.g. GPH)
      n = pulses/units
   units = gallons, revolutions, feet

To measure the input frequency and show in RPM (instead of Hz), set the SCALE FACTOR to 60/10, or 6.

4.2 REVOLUTIONS PER MINUTE (RPM) MEASUREMENT EXAMPLE (Continued)

In this example you will do the following:

* Set function to rate mode
* Set scale to use "multiply by"
* Set scale value to 6.00000
* Set measurement decimal point to fixed, far right position
* Store set up information in nonvolatile memory

To set up the meter for this example, follow these steps:

Note ☞ Refer to Table 6-1 for summary list of menu configurations.

1. Press the **MENU** button. The meter shows "Func".

2. Press the **MENU** button. The meter shows "SCALE".

3. Press the ▲ **SET** button. The meter shows " In .SC" or " Inr/SC", with the multiply (.) or divide by (/) symbol flashing. Press the ▲ **SET** button until the meter shows " In .SC".

4. Press the ▶ **ADV** button. The meter shows actual scale value, with left-most digit flashing. The flashing display indicates the position or function may be modified.

5. Set the value at "6.00000". Press the ▶ **ADV** button to move through the display. Press the ▲ **SET** button to change the flashing digit's value or flashing decimal point position.

6. Once the meter shows the correct scale value, press the **MENU** button to store to volatile memory. The meter shows "OFFSEt". "OFFSEt" = 0 for all flowmeters where: 0 Hz = 0 GPM or RPM. For flowmeters with an "OFFSEt", enter the "OFFSEt" in engineering units, such as GPM or LPM.

4.2 RPM MEASUREMENT EXAMPLE (Continued)

7. Press the **MENU** button again to show "dEC Pt". This is the measurement decimal point, not the scale value decimal point.

8. Press the ▲ **SET** button to show current measurement decimal point, with decimal point flashing. Press the ▶ **ADV** button (if required) to change from "AUto" to "FFFFFF".

9. Press the ▲ **SET** button until the meter shows "FFFFFF.".

10. Press the **MENU** button to save this decimal point to operating memory. The meter shows "COnF IG".

▼ Note ☞ *If a relay card is installed, the meter shows "SP LO".*

11. Press the **MENU** button again until the meter shows "no Stor".

12. Press the ▲ **SET** button. The meter flashes "StorE".

13. Press the **MENU** button to store changes in the nonvolatile memory. The meter stores changes. If this were a real application (not the example), the meter would start measuring.

▼ Note ☞ *If you connect a signal to an input, a frequency reading in RPM replaces this display.*

The totalizer mode registers a precise total count. Use the totalizer mode for cumulative totals and stopwatch (timer) applications. Meter up-counts (positive scale factor) or down-counts (negative scale factor).

To use the meter as a totalizer permanently, set the function to $totAL$ and store the change in nonvolatile memory (to retain the change if power loss occurs). The meter defaults to the up-count mode. To count down, use a negative scale factor and a positive offset (display = input x scale + offset).

In case of power failure, if the S1-10 switch is set to open the meter blanks the display and stores the latest reading in nonvolatile memory.

5.1 TOTALIZER EXAMPLE

You are totalizing pulses from a flowmeter which generates 25 pulses per gallon. To show the total value in gallons:
   *   Set the meter to the totalizer mode.
   *   Use divide (IN /SC) by 25 as a scale factor
   *   Store set up information in nonvolatile memory.

Note ☞ Refer to Table 6-1 for summary list of menu configurations.
Follow these steps for the above example:

1. Press the **MENU** button. The meter shows "$Func$".

2. Press the ▲ **SET** button until the meter flashes "$totAL$".

3. Press the **MENU** button. The meter shows "$SCALE$".

4. Press the ▲ **SET** button. The meter shows " $In .SC$" or " $Inr SC$", with the multiply (.) or divide by (/) symbol flashing. Press the ▲ **SET** button until the meter shows " $Inr SC$".

Note ☞ Use multiply (.) when scale factor is less than 1, use divide by (/) when scale factor (or pulses/units) are greater than 1.

5.1 TOTALIZER EXAMPLE (Continued)

5. Press the ► **ADV** button. The meter shows actual scale value, with left-most digit flashing.

6. Press the ▲ **SET** button to enter 25.0000 as the digit's value. Press the ► **ADV** button to scroll horizontally through the display. Press the ▲ **SET** button to change the flashing digit's value or flashing decimal point position.

7. Once the meter shows "25.0000", press the **MENU** button to store the value. The meter shows "OFFSEt". In most up-count applications "OFFSEt = 0", which means the meter will **RESET** to 0.

8. Press the **MENU** button again to show "dEC Pt". This is the measurement decimal point, not the scale value decimal point.

9. Press the ▲ **SET** button to show either "AUto" or currently set decimal point (decimal point flashes). Press the ► **ADV** button (if required) to change from "Auto" to "FFFFFF".

10. Press the ▲ **SET** button until the meter shows "FFFFFF" to read in whole gallons or "FFFFFF" to read in tenths of a gallon.

11. Press the **MENU** button to save this decimal point to volatile memory. The meter will show "COnF IG".

12. Press the **MENU** button **until** the meter shows "noStor".

13. Press the ▲ **SET** button. The meter shows "StorE".

14. Press the **MENU** button. If signal were connected to the input, the meter would begin counting input pulses.

Note ☞ *Press the **RESET** button at any time to cause the meter to start counting with the latest changes in effect, but these changes will not automatically be stored in the nonvolatile memory.*

5.2 STOPWATCH IN THE TOTALIZER MODE

To use the stopwatch (timer) in the totalizer mode, close S1-4 and S1-9 jumpers to connect 120/100 Hz (twice the line frequency) to the input. Use the following scale factors:

* For readings in seconds, divide by 120 (or 100)

* For readings in minutes and fractions of a minute, divide by 7,200 (or 6,000)

* For readings in hours and fractions of an hour, divide by 432,000 (or 360,000) (for example: 12.65 hours)

Use external gate input (TB2-5) to stop and start the timer. The meter increments when the Ext. Gate input is high, or open. A contact closure between pins TB2-5 and TB2-3 will stop the timer.

5.3 DOWN COUNTING

To count down:

Use a negative scale factor (reading = input x scale + offset) and a positive offset (if an offset is required). Press the **RESET** button to cause the counter to begin counting down from the offset. After reaching zero, the counter continues to count down negative numbers.

REFERENCE TABLES

Table 6-1 provides detail information for main menu items. Table 6-2 provides detail information for sub-menu items.

Table 6-1. Main Menu Items

Main Menu Display MENU Key	Sub-Menu Display	Sub-Menu Information use ▶ADV and ▲SET key to perform changes
"Func"	Function	Select rate mode (refer to Section 4) or totalizer mode (refer to Section 5).
"SCALE"	Scale Factor	Select scale factor as a divider or multiplier. Enter scale factor value from -9.9.9.9.9. through 9.9.9.9.9.9. After measuring the input (totalling), the meter multiplies or divides the result by the scale factor then adds the offset.
"OFFSEE"	"Offset Value"	Select offset value from -9.9.9.9.9. through 9.9.9.9.9.9. In the totalizer mode, the meter calculates and shows the offset value after you press the **RESET** button. The meter will then be at a starting point for totalizing.
"dEC PE"	Decimal Point	Select where decimal point shows in the digital display. You may set a decimal point at any of six available positions. You may also choose a floating decimal point (auto-range).

SECTION 6. REFERENCE TABLES (Continued)

Table 6-1. Main Menu Items

Main Menu Display MENU Key	Sub-Menu Display	Sub-Menu Information use ▶ADV and ▴SET key to perform changes
"5P LO"	Setpoints	Shows only if the relay option board is installed. Similar to offset,
"5P HI"	Setpoints	-99999 to 999999 shows. After applying the scale factor and offset, the displayed measurement is compared to the setpoint values.
"COnF IG"	Configuration	Program internal software switches to specify baud rate, activate external or internal gate input, and modify alarm conditions. Refer to Table 6-3 for configuration detail.
"An LO"	Analog Low	Display value for low analog output.
"An HI"	Analog High	Display value for high analog output. **Note:** *Install S2-B to unlock this prompt.*
"no5tor"	NoStore/Store	Select "no5tor" to save to the volatile (active) memory. Select "5torE" to save to the nonvolatile (permanent) memory. Nonvolatile memory is not effected by power loss.

SECTION 6. REFERENCE TABLES (Continued)

Table 6-2. Sub-Menu Items

Main Menu Display MENU Key	Sub-Menu Display	Sub-Menu Information use ▸ADV and ▴SET key to perform changes
"Func"	"rAtE"	In the "rAtE" mode, the meter acts as a ratemeter for measuring the rate at which counts are received. The meter shows in Hz (pulse/sec), and may also show in kHz, RPM (for tachometer applications), feet/sec and other engineering units.
	"totAL"	In the "totAL" mode, the meter acts as a totalizer for registering a precise total count from mechanical, photoelectric, electromagnetic or electronic inputs or detectors. Use for cumulative totals and stopwatch applications. The meter up-counts (positive scale factor) and may be configured to down-count (negative scale factor).
"SCALE"	" InrSC"	Scale factor is a divider.
	" InSC"	Scale factor is a multiplier.
		Multiply or divide input by any desired scale factor from -99999 to 999999. After measuring the input, the meter multiplies or divides the result by the scale factor and then adds the offset.

SECTION 6. REFERENCE TABLES (Continued)

Table 6-2. Sub-Menu Items (Continued)

Main Menu Display MENU Key	Sub-Menu Display	Sub-Menu Information use ▶ADV and ▲SET key to perform changes
"dEC Pt"	"FFFFFF"	Decimal point moves from left to right through the digital display. You may set a fixed decimal point at any of the six available positions (e.g. -99999 to 999999). This mode is useful for low frequency, low resolution pulse inputs, such as from paddle-wheel sensors. For example, to have the meter show to the nearest 1/100 of a gallon, select the decimal point "FFFFFF". When you set a fixed decimal point, the meter maintains a meaningful unit of measurement. For example, if the input frequency is 10 Hz, the function is rate and the fixed decimal point equals 3, the display reads 10.00, not .10.
		You may also choose a **floating decimal point** (auto-range). Auto-range automatically adjusts the decimal point location to provide the highest measurement resolution possible. This mode is useful for high frequency, high resolution pulse inputs, such as outputs from turbine meters or low flow sensors.

SECTION 6. REFERENCE TABLES (Continued)

The 6 digits of Configuration show as a sub-menu of ⌐⍓⌐F ⍓⌐.

Table 6-3. Meter Configuration Detail
(Factory defaults are bold and in italics)

6 Digits of Configuration						
0	0	0	0	0	0	
0 1						Determines analog output signal. *4-20 mA* 0-10V
	0 1					*Unlatched* Latched
		0 1				*Setpoint LO works as active below the setpoint* Setpoint LO works as active above the set-point (similar to setpoint HI).
			0 1			*Message handshake - If RTS input is true,* *sends complete message* Character handshake - Checks RTS input before sending each character, and sends characters only while RTS is true.
				0 1		Determines the communication rate. *9600 baud rate* 1200 baud rate
					0 1	*Transmits alarm status (total of 9 characters)* Does not transmit alarm status character

Your meter is powerful, with a wide range of programming parameters. Before requesting service, determine your program revision letter and mode (totalizer or rate) by pressing the **RECALL** and **RESET** buttons simultaneously. The meter shows "⌐⌐⌐⌐ _" (last number or letter represent the meter firmware revision)

Table 7-1. Troubleshooting Chart

Symptom	Action to Take/Explanation
Display is completely blank	Check power connections. For battery-powered units, close S1-10. Press the **RESET** and **RECALL** buttons simultaneously or disconnect power for 20 seconds.
Display shows ⌐⌐⌐ or ⌐⌐⌐⌐ . Meter does not show a measurement.	Check the input connections, levels, and S1 positions. The input signal(s) may be advance to missing.
Display reads zero.	Press the **RESET** and **RECALL** buttons simultaneously. If display still reads zero, you may have a scale factor that is either a small multiplier (including zero) or a large divider. **RESET** input may be active low.
Display shows an illegal character (not in the glossary).	Press the **RESET** and **RECALL** buttons simultaneously or disconnect power for 120 seconds.
Display shows number in exponential format, e.g. ⌐⌐⌐ ⌐⌐ (overflow indication).	If the digit following the E is 5 or smaller, use auto-range. If it is 6 or greater, use a smaller multiply scale factor and auto-range.
One or more digits are flashing.	The counter may be in the programming mode. Press the **RESET** button to reset the counter.

8 RS-232 OPTION

8.1 INSTALLING THE RS-232 OPTION BOARD

Install the RS-232 option board as follows (refer to Figure 8-1):

⚠️ *CAUTION: The meter has no power-on switch, so it will be in operation as soon as you apply power.*

⚠️ *IMPORTANT: Disconnect the power from the unit before installing this option board.*

1. Remove the protective back panel and slide the meter out of the case.

2. Hold the RS-232 option card in a vertical position, with the J2 connector facing the back of the meter.

3. Line up the P1 connector on the RS-232 board with the J1 pins on the main board. Push down to secure.
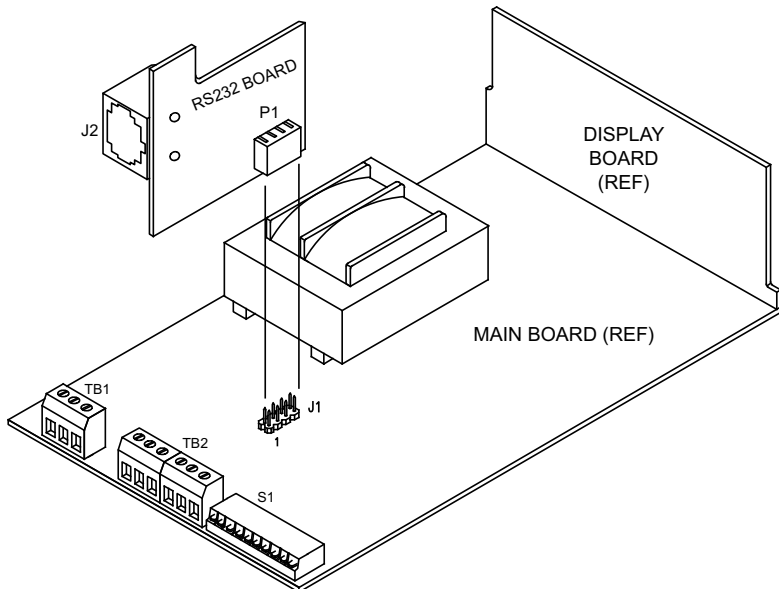
Figure 8-1. Installing the RS-232 Option Board

8.1 INSTALLING THE RS-232 OPTION BOARD (Continued)
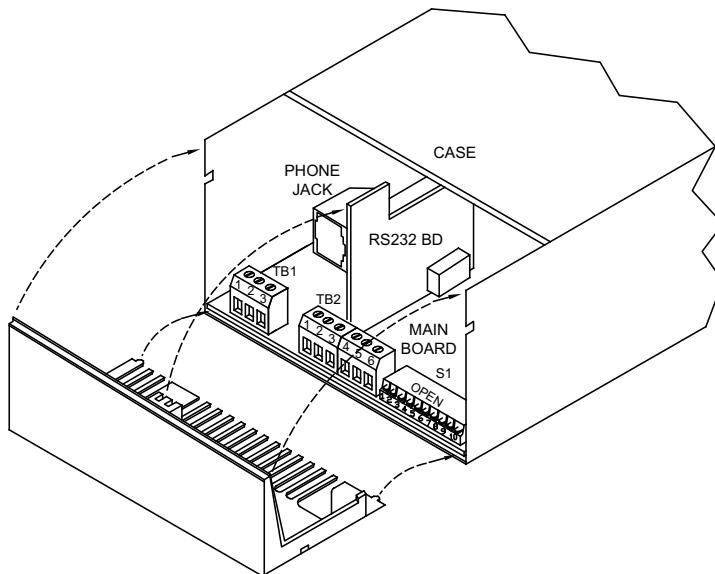
Figure 8-2. Protective Back Panel

4.   Slide meter back into the case.

5.   Install the protective rear panel to secure the board (refer to Figure 8-2):

   a.   Align the two bottom front edges of the protective panel with the corresponding groves on the meter case.

   b.   Align the top left groove of the protective panel with the RS-232 board.

   c.   Snap protective panel closed.

RS-232 OPTION

8.2 REMOTE PROGRAMMING

The meter may accept an RS-232 card for communications. The card enables the meter to receive setup commands and data, and send measurement values and current setup data to a computer. The meter operates at either 1200 or 9600 baud, 7 data bits, even parity and 1 stop bit. It emulates DCE (data communication equipment) and uses a handshake line while sending data, but none while receiving data. A 4-wire cable is the maximum required for the following communications:

```
                                    6
                    N/C ──         ┌─────────────┐
   Signal return (RTN)────  5      │             │
    Received data (RX)────  4      │             │
  Transmitted data (TX)────  3     │             │
  Request to send (RTS)────  2     │             │
                                   └─────────────┘
                    N/C ──  1
```
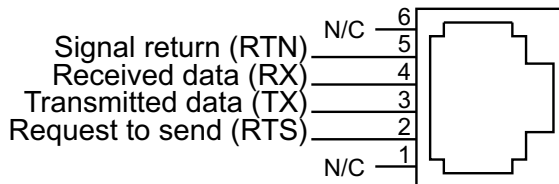
When you connect your meter to a computer, such as an IBM PC, and the meter receives one of 8 commands (P, G, W, R, V, SC, SG and SP) the meter interrupts its program, receives the message, takes appropriate action, and then starts over with a new measurement. No handshake is required because the meter devotes its full attention to receiving the command data from the computer. In the other direction, the meter sends measurement and confirming setup data to the computer under one of 2 handshake (RTS) modes.

Message Handshake - The RTS line is checked when the device is ready to send measurement data. If the RTS is true, it sends the complete message data without interruption even if the RTS goes false in the middle of transmission. If the RTS is false, it skips sending the data completely and continues with the next measurement.

Character Handshake - The device checks the RTS input before sending each character and sends characters only while the RTS is true.

8.3 ASCII OUTPUT

The meter sends measurement data according to the following fixed formats of 9 or 8 characters. Each character is sent as a 7-bit ASCII code character with even parity, and may be blank (ASCII 32)

8.3.1 9-Character Format
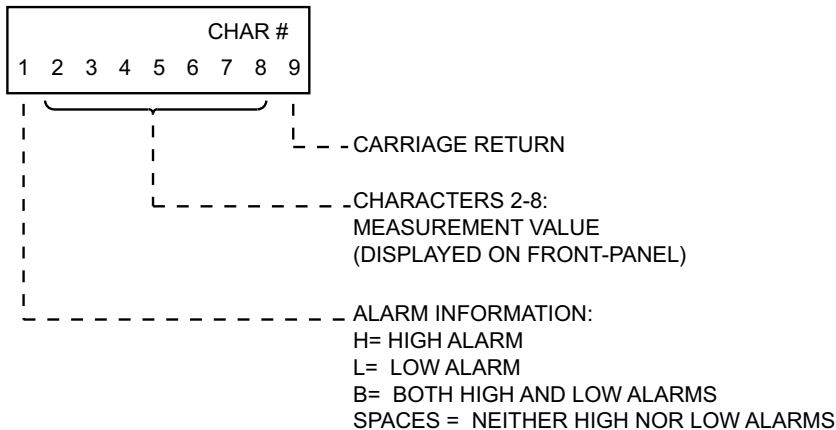
Figure 8-3. ASCII Output 9-Character Message
(COnFIG=XXXXX0)

As Figure 8-3 details, the **1st** character represents alarm information and provides one of the following: H = High Alarm, L = Low Alarm, B = Both High and Low Alarms or Space = Neither High nor Low Alarms.

Characters 1 through 8 represent the measurement value as shown on the front-panel. If positive, there are 6 digits and a decimal point; if negative, there is a minus sign with 5 digits and a decimal point. Blanks are sent in place of leading zeros. If the value overflows the 6-digit limit, it is sent in exponential format up to a maximum of 9.99 E9 or -9.9 E9. The **final character** is a carriage return.

8.3 ASCII OUTPUT (Continued)

8.3.2 8-Character Format

```
                    ┌─────────────────────────┐
                    │        CHAR #           │
                    │ 1  2  3  4  5  6  7  8   │
                    └─────────────────────────┘
```

CHARACTERS 1-7:
MEASUREMENT VALUE
6 DIGITS AND A DECIMAL POINT
(DISPLAYED ON FRONT-PANEL)
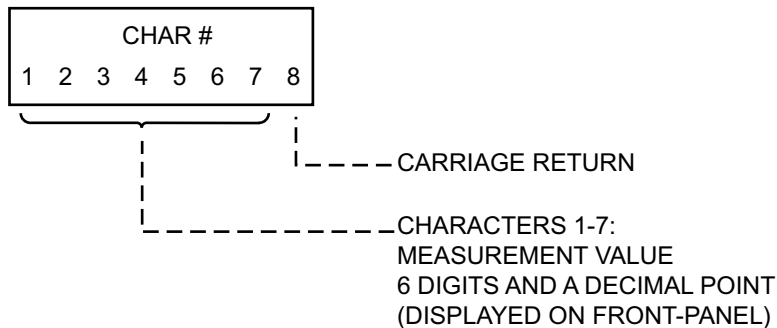
CARRIAGE RETURN

Figure 8-4. ASCII Output 8-Character
(COnFIG=XXXXX1)

Characters 1 through 7 represent the value on the display (6 digits and a decimal point). The **final character** (character 8), is a carriage return.

8.3.3 Setup Data

'Get' or 'Read' commands send setup data to the computer for verification. Setup data is sent and received as ASCII characters representing the 16 hex characters 0-9; A-F. Each hex character represents 4 bits or 16 pieces of information. The 7-bit ASCII characters are shown with a leading even-parity bit, as shown in Table 8-1.

8.3.3 Setup Data (Continued)

Table 8-1. Hex Character/Bit Pattern Information

Hex Character	Bit Pattern	Hex Character	Bit Pattern
0	0011 0000	8	1011 1000
1	1011 0001	9	0011 1001
2	1011 0010	A	0100 0001
3	0011 0011	B	0100 0010
4	1011 0100	C	1100 0011
5	0011 0101	D	0100 0100
6	0011 0110	E	1100 0101
7	1011 0111	F	1100 0110

The setup data consists of a total of 44 nibbles of information that are sent and received in the following order:

Table 8-2. Setup Order Information

Display	Parameter	# of Nibbles
------	Analog Out Scale*	2
	Analog Out Offset*	4
	Calibration	2
5P H1	Setpoint High	6
5P LO	Setpoint Low	6
OFFSEt	Offset	6
5CALE	Scale	6
------	Gate Time and Time Out	4
------	Analog Output Control*	2
COnF IG	Configuration	2
dEC Pt	Decimal Point	2
Func	Function	2

* Do not confuse with "An LO" and "An H1".

8.3.3 Setup Data (Continued)

Each parameter is sent with the most-significant nibble first. Each bit may have stand-alone significance or may be part of a binary number according to the following formats. The binary value 0-255 is used to calculate the analog output value from the display value (refer to Figure 8-9). See also Control Bit Storage (refer to Figure 8-7).

Analog Out Scale (2 Nibbles Each)

XXXX XXXX

Binary Value 0-255
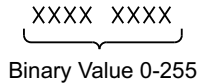
Figure 8-5. Analog Out Scale Storage Format

Analog Out Offset (4 Nibbles Each)

xxxx xxxx xxxx xxxx

Binary Value 0-65535
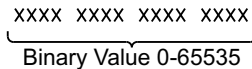
Figure 8-6. Analog Out Offset Storage Format

Note ☞ 256 generates 0 V (0 mA) and 51200 generates 10 V (20 mA).

ANALOG OUT CONTROLS

An LO and An HI menu items are for coarse adjustment of analog output. The meter uses these values to calculate Analog Scale and Offset. Analog Scale is one byte and stored in location 3E. Analog Offset is 2 bytes and is stored in locations 3C and 3D. Location 2C is used for storage of control bits as follows:

SP HI, SP LO, OFFSET, SCALE (6 Nibbles each)

MS ➜ X XXX   XXXX XXXX XXXX XXXX XXXX   LS
Nibble   Nibble

Polarity   Coded   Binary value of Magnitude
0 = +   Decimal
1 = –   Point
            Location
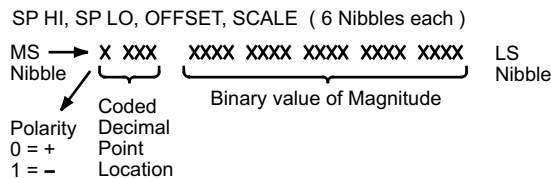
Figure 8-7. Storage Format

The decimal point value must be 1 through 6 (not 0 or 7).

Example: A01000 = -0409.6
                DP=2, - Negative Polarity

8.3.3 Setup Data (Continued)
GATE TIME

MS ⟶ XXXX XXXX XXXX XXXX LS
Nibble   Nibble

Binary value of Magnitude
in Hundredths of Seconds
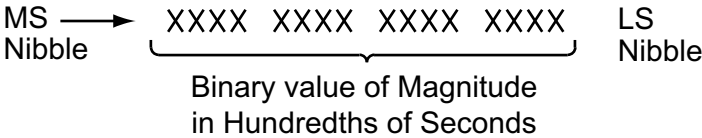
Figure 8-8. Binary Value

Note ☞ *If MS byte is 1111 1111, meter uses 00000000.*

CONFIG

X X X X   X X X X

1 = NO ALARM STATUS CHARACTER
1 = 1200 BAUD (0 = 9600 BAUD)
1 = CHARACTER HANDSHAKE (Ø = MESSAGE HANDSHAKE)
1 = CHANGE LOW ALARM TO HIGH
1 = LATCHED ALARM
1 = 0-10V ANALOG OUTPUT
1 = PRINT REQUEST
SCALE OPERATION,   1 = DIVIDE
                   0 = MULTIPLY
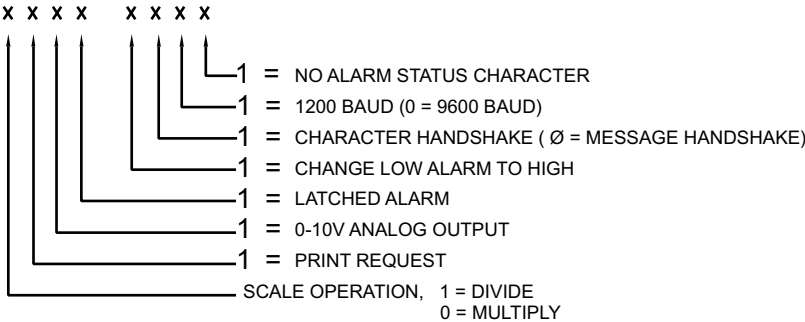
Figure 8-9. Setup Configuration

8.3.3 Setup Data (Continued)

DEC PT

```
MS  ──▶  0  0  0  0  0  X  X  X  ◀──  LS
Nibble        └────────┬────────┘         Nibble
                       │
                       ▼
                     VALUE        DECIMAL POINT LOCATION
                 └───── 0         AUTO RANGE
                        1         FFFFFF.  RIGHT OF DIGIT  1(LSD)
                        2         FFFFF.F  RIGHT OF DIGIT  2
                        3         FFFF.FF  RIGHT OF DIGIT  3
                        4         FFF.FFF  RIGHT OF DIGIT  4
                        5         FF.FFFF  RIGHT OF DIGIT  5
                        6         F.FFFFF  RIGHT OF DIGIT  6(MSD)
```
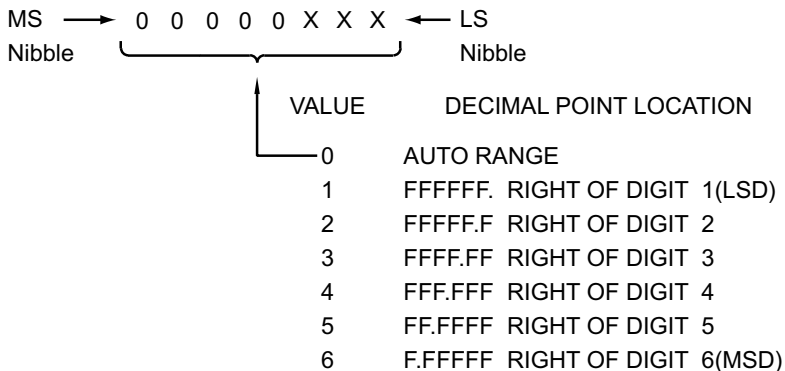
Figure 8-10. Decimal Point Setup

FUNC

```
MS  ──▶  0  0  X  X     X  X  X  X  ◀──  LS
Nibble        │  │      │  │  │  │         Nibble
              │  │      │  │  │  └── RATE
              │  │      │  │  └───── MUST BE 0
              │  │      │  └──────── MUST BE 0
              │  │      └─────────── MUST BE 0
              │  │
              │  └────────────────── TOTALIZE
              └───────────────────── ZERO TOTAL ( in TOTALIZE only )
```
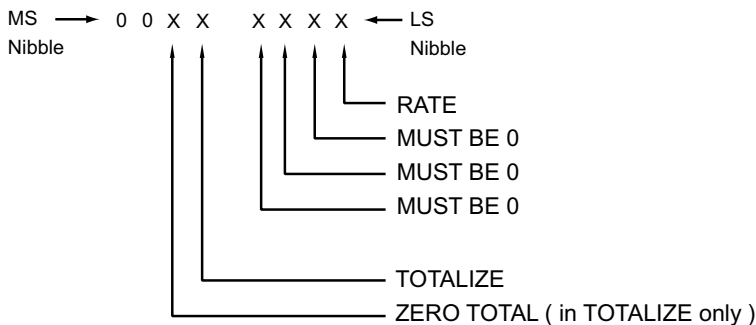
Figure 8-11. Totalizer Function Setup

One, and only one bit must be a 1 - except for the totalizer bit, which may also have the zero total bit set to a 1.

When the meter receives the totalizer bit, the zero total bit causes the value to be reset to zero; otherwise, the TOTALIZER value is unaffected.

8.4 ASCII INPUT

The meter receives commands and setup data. The meter may receive one of 8 commands: P, G, W, R, V, SC, SG, and SP. Each of these commands are explained in detail in the following pages. Each is a single letter preceded by the preamble string of the following 3 characters: @U?. For example, Put reads @U?P. The @ U and ? characters reduce the probability of noise patterns and aid in generating an acceptable command. The Put command is followed by 42 hex characters of desired setup data. All commands are terminated with a carriage return, indicated by <CR>.

```
@U?PXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX<CR>
@U?G<CR>
@U?W<CR>
@U?R<CR>
@U?V<CR>
@U?SC<CR>
@U?SGaa<CR>
@U?SPaadd<CR>
```

'Put' Command @ U?P (setup data) <CR>

Sends setup data to the meter. The meter then stores data into its active memory and starts making measurements using the new setup parameters.

'Get' Command @ U?G <CR>

Sends the current setup parameters from the meter's active memory to the computer. Use the 'Get' command after the 'PUT' command to verify that the meter has correct setup parameters.

8.4 ASCII INPUT (Continued)

'Write' Command @ U?W <CR>

Transfers the setup data in the meter's active (volatile) memory to nonvolatile memory. Once the setup data is transferred to the nonvolatile memory it becomes a stored program. A program may be active, but not stored, by executing a 'Put' command or, entered from the keyboard. Stored programs are not affected when you recall the meter or power loss occurs. When power is restored or the recall is complete, stored program data resides in both the active and nonvolatile memory.

'Read' Command @ U?R <CR>

Requests the meter to read (transfer) the setup data from the nonvolatile memory into the active memory for use in the measurements that follow and to send this setup data to the computer.

'Print' Command @U?V <CR>

Works as a print request and sends out one measurement data. This command only works when you select RTS message handshake and the RTS input is false.

Single 'GET' Command @U?SGaa <CR>

Two ASCII characters sends the content of aa address in memory. aa are two ASCII characters of 0 - 9 and A - F. aa is a hexadecimal address of memory. Refer to the Table 8-3 for available memory location for this command.

8.4 ASCII INPUT (Continued)

Table 8-3. Memory Addresses Accessed by Single 'GET' and Single 'PUT' Commands

aa	Description
29	Function
2A	Decimal point.
2B	Configuration.
2C	Analog output configuration.
2D	Gate time: low byte
2E	Gate time: High byte
2F	SCALE LSB
30	SCALE 2nd byte
31	SCALE MSB
32	OFFSET LSB
33	OFFSET 2nd Byte
34	OFFSET MSB
35	Setpoint Low LSB
36	Setpoint Low 2nd Byte
37	Setpoint Low MSB
38	Setpoint High LSB
39	Setpoint High 2nd Byte
3A	Setpoint High MSB
3B	Calibration Number
3C	Analog Output Offset LSB
3D	Analog Output Offset MSB
3E	Analog Output Scale

8.4 ASCII INPUT (Continued)

Single 'PUT' Command @U?SPaadd <CR>

Puts the dd data in the aa memory address. aa and dd are each two ASCII characters, from 0 - 9 or A - F. aa consists of two hexadecimal digits of address and dd consists of two hexadecimal digits of data. Table 8-3 shows available address locations for this command.

⚠ **CAUTION: Use this command only with addresses (aa values) shown in Table 8-3.**

Micro Controller Revision Command @U?SC <CR>

This command returns one ASCII character representing the revision number or letter of the micro controller program.

8.5 INTERFACING EXAMPLES

The meter can interface to any device with RS-232E communications. The output levels are ±8 V and the inputs may accept up to ±25 V. The pin connections are labeled for the meter to emulate DCE (Data Communications Equipment). Examples are given for connections to an IBM PC with D-25 and D-9 connectors. A 7' cable with two RJ-12 telephone jacks at two ends are provided with RS-232 option. The connector adapter for D-9 and D-25 are optional.
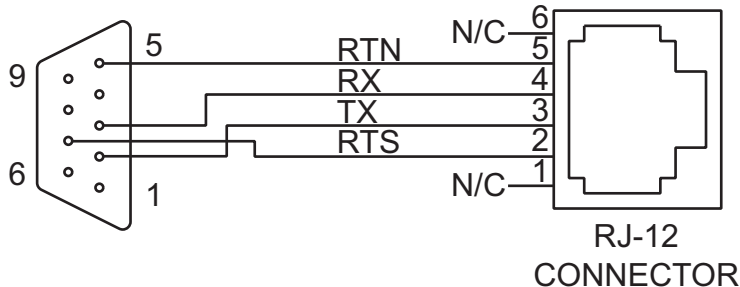
Figure 8-12. Meter Serial Port to a D-9 Connector

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8.5 INTERFACING EXAMPLES (Continued)
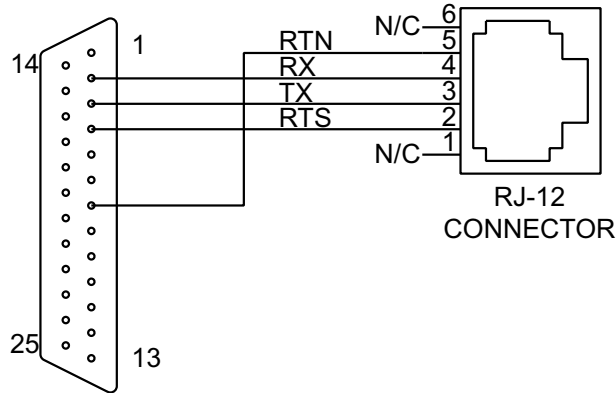
Figure 8-13. Meter Serial Port to a D-25 Connector

Table 8-4. Meter to IBM PC - D-9 or D-25 Connector

Description	IBM PC (DTE) D-25 Connector	IBM PC (DTE) D-9 Connector	Meter (DCE)	
	NC	NC	J2-1	No Connection
Request to Send	4	7	J2-2	RS-232 (RTS)
Received Data	3	2	J2-3	RS-232 OUT (TX)
Transmitted Data	2	3	J2-4	RS-232 IN (RX)
Signal Return	7	5	J2-5	Return (RTN)
	NC	NC	J2-6	No Connection

8.6 PROGRAMMING CONSIDERATIONS

8.6.1 Communication Rate

If possible, use 9600 baud for communications instead of 1200. 9600 baud has a faster reading rate and less time is spent communicating.
The table below details measurement and setup time:

Table 8-5. Baud Rate Information

	9600 Baud	1200 Baud
Measurements (9 Characters)	9.4 msec	75 msec
Setup data (43 Characters)	45.8 msec	360 msec

8.6.2 Modem Operation

You may connect the meter to a freestanding modem, such as the Hayes Smartmodem 1200, to transmit and receive data over phone lines. A typical controller would be an IBM PC with a Hayes Smartmodem 1200B plug-in modem.
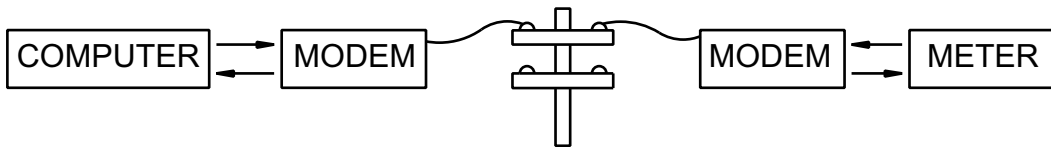
Figure 8-14. Modem Concept

Use a 1200 baud rate to receive measurement and setup data to be sent from the computer to the meter. Connect an auto answering modem to the meter to gather data from a remote location upon demand. **If you send a command to the meter at 1200 baud while the meter's active memory is programmed for 9600 baud, the meter will automatically switch to 1200 baud. This prevents the modem application from being disabled when a setup parameter of 9600 baud is accidentally sent to the meter.**

8.7 PARITY CHECKING

Although the meter includes an even parity bit with data sent out on the RS-232C interface, it does not check the data received for even parity.

8.8 TIMING

When you send a 'PUT' command to the meter, the command is accompanied by a string of 42 setup characters. The BASIC program statement PRINT #1, @U?P + SETUP$ puts the string into an output buffer for transmission and the BASIC program continues while the data is being transmitted. If, within a few lines, you execute the statement PRINT #1, @U?G, the @U?G is added to the end of the setup string in the buffer (which is still being transmitted). This causes the @U?G characters to be missed because each transmission from the computer must be completely received by the meter and the next measurement started before another command is issued. **A statement FOR J=1 TO 300:NEXT J introduces enough delay to allow separation between commands.**

8.9 PROGRAMMING EXAMPLE

```
50'**************************************************
60'    COMMUNICATION EXAMPLE
100'   THIS PROGRAM READS THE OUTPUT
110'**************************************************
150    CLS
170    PRINT"SET ALL CONFIGURATION DIGITS TO ZERO"
180    PRINT
200    INPUT "ENTER COM1 (1) OR COM2 (2) RS-232 PORT";W
220    IF W=1 THEN COMM$="COM1" ELSE COMM$="COM2"
240    INPUT "ENTER A SINGLE COMMAND (SC, SPaadd, V, ... ";BB$
270    GOSUB   1000
280    PRINT
290    PRINT RES$
330    INPUT "ENTER COMMAND, <CR> TO REPEAT, S TO START OVER";AA$
340    IF AA$="S" OR AA$="s" THEN 200
345    IF AA$<>"" THEN BB$=AA$
350    GOTO 270
450    END
1000   B$=""
1100   CR$=CHR$(13)
1200   CLOSE: OPEN COMM$+":9600,E,7,1,DS,CS,RS" AS #1
1300   IF BB$="" THEN BB$="V"
1350   PRINT #1, "@U?"+BB$+CR$;
1370   PRINT "WAITING ....    ";
1400   FOR X=1 TO 20: NEXT X
1500   PRINT ".";
1550   N=N+1
1570   IF N > 1000 THEN RES$="NO ANSWER":GOTO 2000
1600   IF LOC(1)=0 THEN 1400
1650   ON ERROR GOTO 1400
1700   A$=INPUT$(LOC(1),#1)
1800   B$=B$+A$
1850   Q=INSTR(B$,CR$)
1900   IF Q=0 THEN 1500
1950   RES$=LEFT$(B$,Q-1)
2000   N=0
2100   CLOSE #1
2200   RETURN
```

9.1 INSTALLING THE ANALOG OUTPUT BOARD

Install the analog output board as follows (refer to Figure 9-1):

⚠ **CAUTION: The meter has no power-on switch, so it will be in operation as soon as you apply power.**

⚠ **IMPORTANT: Disconnect the power from the unit before installing this option board.**

1. Hold the analog output card in a horizontal position, with the R37 and R38 potentiometers facing the back of the meter.

2. Line up the P6 connector on the interconnect board with the J6 pin on the main board. Push down to secure.

3. Line up the J8 pin on the analog output board with the P8 connector on the interconnect board. Push down to secure.
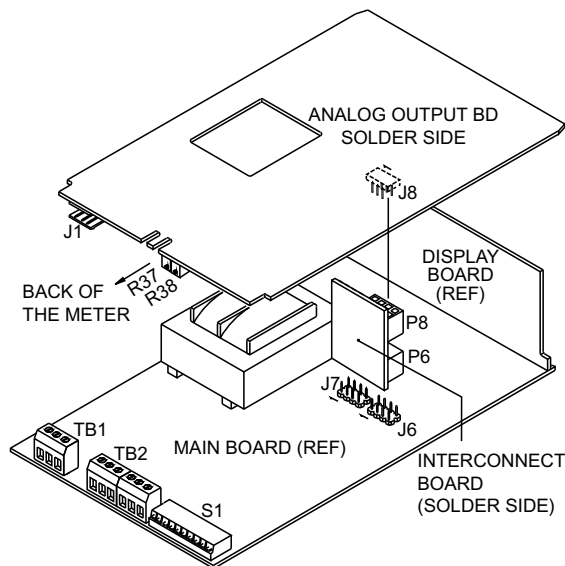
Figure 9-1. Installing the Analog Output Board

ANALOG OUTPUT

9.2 SETTING UP THE ANALOG OUTPUT BOARD

*   The display reading is in counts, disregarding the decimal point.
*   The output is in volt or milliamp.
*   The analog output may be used for proportional control applications, without integral or reset function.
*   "An LO" and "An HI" **values are write-only**. Values cannot be displayed once they are stored. Display will show "000000." even through values are stored.

Coarse adjust the analog output board as follows:

Note ☞ Refer to Table 6-1 for summary list of menu configuration.

1. Set the left digit in configuration to 0 for 4-20 mA (0XXXXX) or to 1 for 0-10 V (1XXXXX).

2. Access "An LO" menu item. Enter display value which will give you 4 milliamps (0 volts).

3. Access "An HI" menu item. Enter display value which will give you 20 milliamps (10 volts).

4. Save in either volatile or nonvolatile memory.

    Once you have performed coarse adjustment, proceed to fine adjustment as follows:

5. Adjust the input to show a value equal to "An LO". Adjust R38 potentiometer at the back of the board (refer to Figure 9-1) for 4 milliamp output (0 volts).

6. Adjust the input to show a value equal to "An HI". Adjust R37 potentiometer at the back of the board for 20 milliamp output (10 volts).

7. Repeat fine adjustment as necessary.

An easy way to set the display to "An LO" and "An HI" is to put the meter in the totalizer mode and set the offset to "An LO" and "An HI" while there is no input.

9.2 SETTING UP THE ANALOG OUTPUT BOARD (Continued)

Example 1:
0.00 - 1000.00 display counts to equal 4-20 mA analog output.

1. Set configuration = 0XXXXX

2. Enter "An LO" = 0000.00

3. Enter "An HI" = 1000.00

4. Adjust R38 potentiometer for 4 mA output, while display = 0.00

5. Adjust R37 potentiometer for 20 mA output, while display = 1000.00.

Example 2:
5000 - 10000. display counts to equal 0 - 10 V analog output.

1. Set configuration = 1XXXXX

2. Enter "An LO" = 005000.

3. Enter "An HI" = 010000.

4. Adjust R38 potentiometer for 0 V output, while display = 5000.

5. Adjust R37 potentiometer for 10 V output, while display = 10000.

Example 3:
Using analog output as a proportional controller: 8000. - 7000. display counts to equal 4-20 mA analog output. When "An LO" is greater than "An HI", the analog output may be used for proportional control applications.

1. Set configuration = 0XXXXX

2. Enter "An LO" = 008000.

3. Enter "An HI" = 007000.

4. Adjust R38 potentiometer for 0 V output, while display = 8000.

5. Adjust R37 potentiometer for 10 V output, while display = 7000.

9.2 SETTING UP THE ANALOG OUTPUT BOARD (Continued)

Example 4:
Programming "An LO" and "An HI" for analog output ranges other than 0-10 V or 4-20 mA. For example, if require 0-5 V output for the display readings of 0 - 10,000:

1. Select 0 - 10 V range and enter "An LO" = 0

2. Enter "An HI" = 20,000.

Example 5:
To get 1-5 V output for 0 - 10,000 readings, enter the desired display for 0 V output as "An LO" per the formula below:

$$\text{Gain} = \frac{\text{Reading High - Reading Low}}{\text{Input High - Input Low}}$$

$$\text{Gain} = \frac{10,000 \ - 0}{5\text{-}1} = \frac{10,000 \ \text{cts/V}}{4} = 2,500 \ \text{cts/V}$$

Output = Reading/Gain + Offset

$$\text{Output} = \frac{\text{Reading + 1}}{2500}$$

Reading = -2,500 will cause 0 V output
Reading = 22,500 will cause 10 V output
An LO = 0
An HI = 22,500

9.3 ELECTRICAL CONNECTION and SPECIFICATIONS

The analog output board is available on the J1 connector.

J1-1:   Analog Return

J1/ANALOG OUT

① ② ③

ANLG   4-20   0-10V
RTN   mA

J1-2:   Current Output
J1-3:   Voltage Output
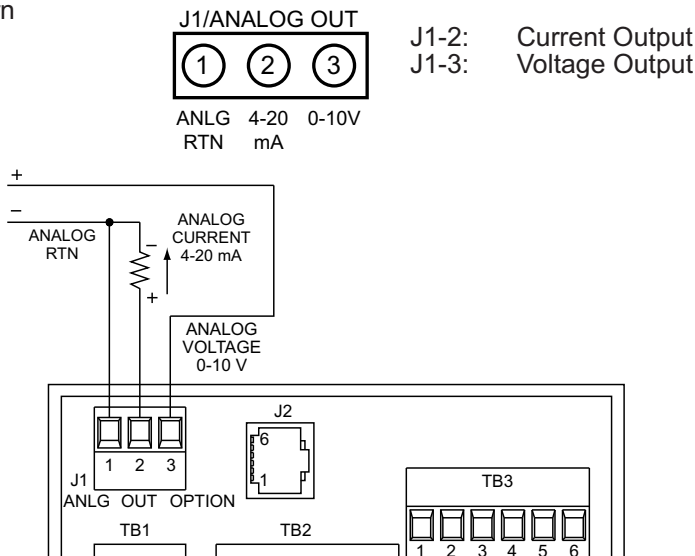
Figure 9-2. Electrical Wiring for Analog Output Connection

Maximum Load Impedance for Current Output: 500Ω
Maximum Load for Voltage Output: 20 mA
Total Current Output (pins 2 and 3 combined):   21 mA

Response Time
Total Mode: 80 mSec (99% of final value)
Rate Mode: 360 mSec (99% of final value)

Note ☞ Response time in the Rate Mode can be reduced by changing the Gate Time, using RS-232 communication.

Minimum SPAN for 20 mA (10 V) output: 220 Counts
Maximum turn down ration ($\frac{\text{An LO}}{\text{An HI - An LO}}$):   80

Resolution: 15 bits
Accuracy, 0 - 10 V   99.8%
Accuracy, 4 - 20 mA   99.75%

10 DUAL-RELAY OPTION

10.1 INSTALLING THE DUAL-RELAY OPTION BOARD

To install the dual-relay option board, follow these steps (refer to the Figure 10-1):

⚠ **CAUTION: The meter has no power-on switch, so it will be in operation as soon as you apply power.**

⚠ **IMPORTANT: Disconnect the power from the unit before installing this option board.**

1. Hold the board in a horizontal position, with the TB3 connector facing towards the rear of the meter.

2. Line up the 3 connectors located on the back side of the board with pin groups J3, J4 and J5 on the mother card.

3. Push connectors down to secure on relay board.
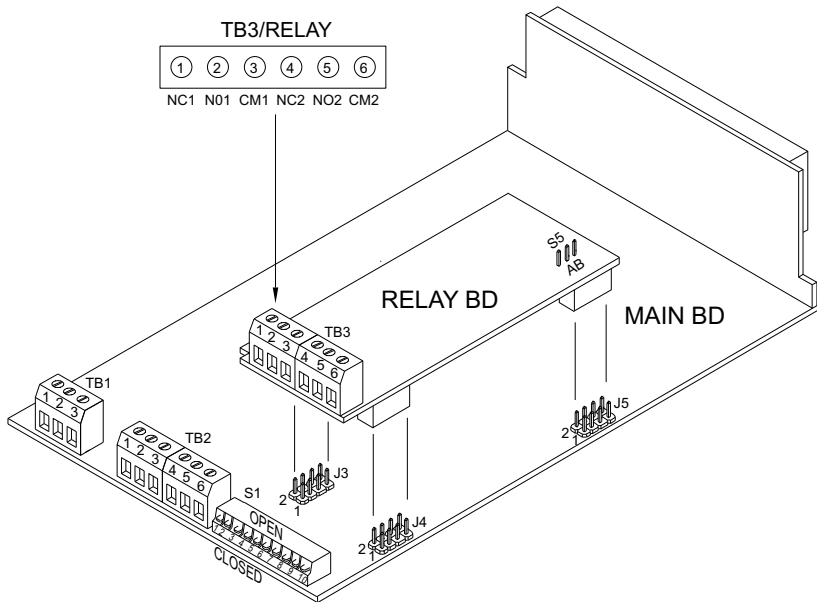
Figure 10-1. Dual-Relay Option Board

10.2 SETTING UP THE DUAL-RELAY OPTION BOARD

You may enter a setpoint from -99999 to 999999 with a decimal point in any of the following positions: 9.9.9.9.9.9. After applying the scale factor and offset, the displayed measurement is compared to the setpoint values.

LO ALARM
Displayed value is less than Setpoint LO

HI ALARM
Displayed value is more than Setpoint HI

HYSTERESIS
Relay 2 is energized when display value is more than Setpoint HI. Relay 2 is not energized when display value is less than Setpoint LO

Setpoint Example: Setpoint HI is 500.0 and Setpoint LO is 100.0. Reading changes from 0 to 600 and back to 0. Figure 10-2 on the following page illustrates Table 10-1.

Table 10-1. Setpoint Example

Reading	Alarm Status		
	LO (Relay 1)	HI (Relay 2)	HYS
0	On	Off	Off
99.9	Off	Off	Off
300	Off	Off	Off
500.0	Off	Off	Off
500.1	Off	On	On
600	Off	On	On
500.1	Off	Off	On
100 - 500	Off	Off	On
99.9	On	Off	Off
0	On	Off	Off

10.2 SETTING UP THE DUAL-RELAY BOARD (Continued)
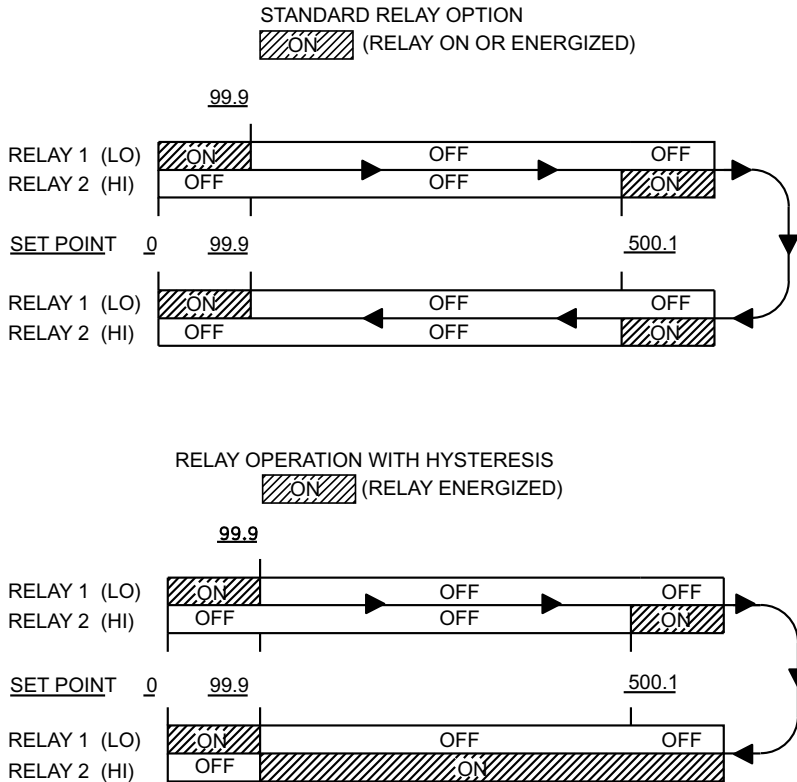
Figure 10-2. Setpoint Example Illustration

To convert Setpoint LO to a second high setpoint, set software switch 3 of the configuration menu to 1 ($\text{CDnF}\ \text{IG}$ = XX1XXX). LO ALARM becomes active when the reading is greater (more positive) than that setpoint.

To convert both setpoints to latched setpoints, set software switch 2 of the configuration menu to 1 ($\text{CDnF}\ \text{IG}$ - X1XXXX). When relays are energized, they stay energized until a Reset (either front-panel or back connector reset).

10.3 ELECTRICAL CONNECTION AND SPECIFICATION

Each relay has a form C contact. Relays are rated at 28 Vdc or 250 Vac at 5A. Refer to Figure 10-1 and Figure 10-3 to locate contacts and S5 switch.

* TB3-1 is a normally closed contact of relay 1.
* TB3-2 is a normally open contact of relay 1.
* TB3-3 is a common contact of relay 1.
* TB3-4 is a normally closed contact of relay 2.
* TB3-5 is a normally open contact of relay 2.
* TB3-6 is a common contact of relay 2.
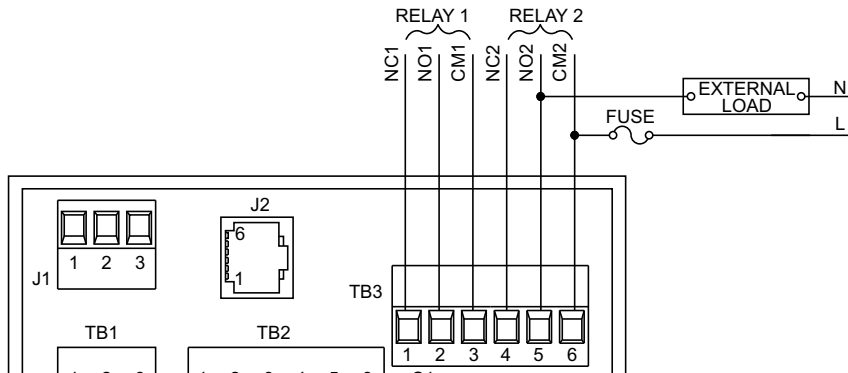
Figure 10-3. Electrical Wiring for Relay Connections
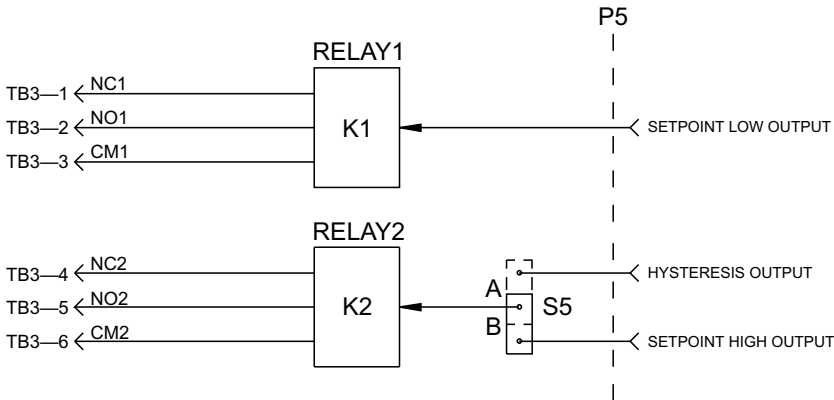
Figure 10-4. Dual-Relay Connections

11 METER SPECIFICATIONS

11.1 STANDARD DIMENSIONS

48,0 (1.89)

96,0 (3.78)

20,3 (.80)

151,4 (5.96)

FRONT BEZEL

RETAINER

CASE

REAR COVER

SIDE VIEW

TOP VIEW
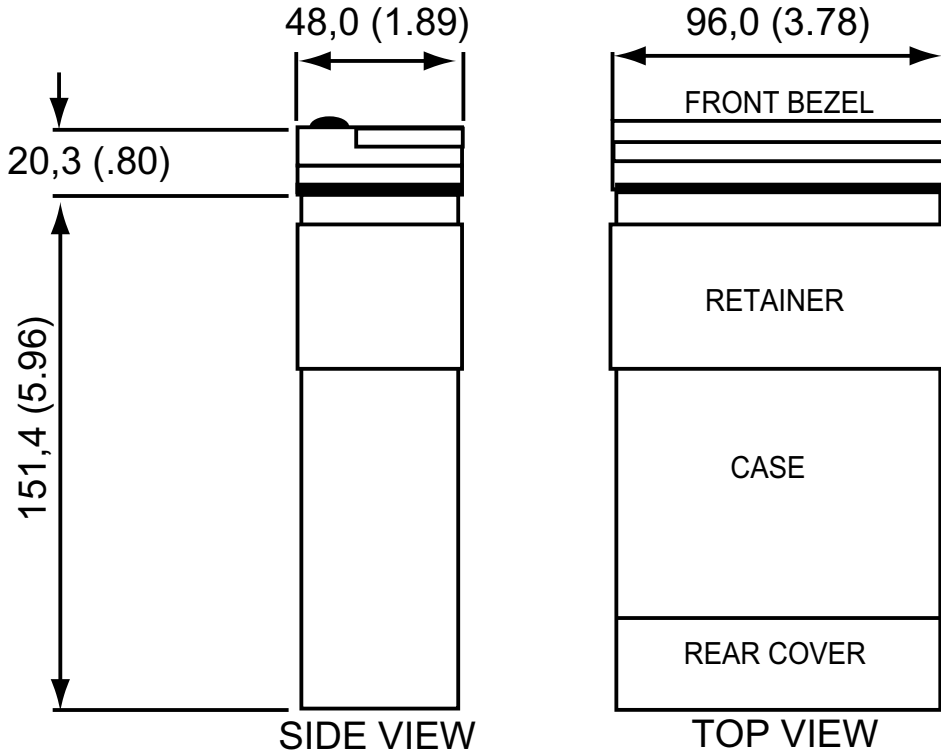
Figure 11-1. Standard Dimensions

PANEL THICKNESS
6,4 (.25) MAX
0,8 (.03) MIN

1,5
R(.06)   45,00 + 0,61/-0,00
4 PLCS   (1.772 + .024/–.000)

92,00 + 0,81/–0,00
(3.622 + .032/–.000)
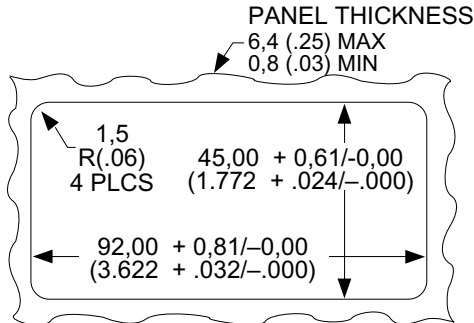
NOTE: Dimensions in Millimeters (Inches)

Figure 11-2. Panel Cut-Out

11.2 DISASSEMBLY

You may need to open up the meter to check or change the 115 or 230 Vac power jumpers. You may also need to connect or disconnect serial communication boards. To remove and access the main board, follow the steps described in Section 3.3

11.3 GENERAL INFORMATION

Programmable Functions: Rate (frequency) and totalizer

Scale Factor: -99999 to 999999 with a choice of 6 decimal point positions (9.9.9.9.9.9.), multiply or divide

Offset: -99999 to 999999 with a choice of 6 decimal point positions (9.9.9.9.9.9.)

11

Meter Specifications

11.4 INPUT CHARACTERISTICS

Maximum Frequencies Inputs

Square Wave, (0 to +5 V):	30 kHz: S1-5 open; S1-1 and S1-4 closed.
Maximum Input Voltage Signal:	S1-6 and S1-7 open 60 V rms, input protected to 120 V rms S1-7 closed: 18 V rms S1-6 closed: 15 V rms
Maximum Input Voltage (all other inputs):	0 to 5 V
Minimum Signal:	25 mV, rms (S1-3 closed)
Trigger Slopes:	Positive or Negative, select by S1-8.
External Gate and Reset Levels:	Low level = less than 0.8V High level = more than 3.5V
Input Impedance Signal Input (S1-6 and 7 open):	243K pull up to excitation voltage if signal is between 0 and excitation voltage.
External Gate and Reset Inputs:	20k pull up to +5 V

11.5 DISPLAY

Type:	6 digit, 7-segment, LED Display
Digit Height:	14.2 mm (.56 in)
Symbols:	-88888 and 888888
Decimal Point:	6 positions; programmable; Fixed or auto-range
Leading Zeros:	Blank
Overflow Indication:	Shows in rate or total mode; in exponential format to 9.99 E9
Update Rate:	3 readings per second (unless modified by RS-232)
Displayed Value:	(Measurement ☐Scale Factor) + Offset

11.6 TIME BASE

Internal Clock Reference: 921.6 KHz

Stability: ±2 ppm/°C

Fine-Calibration Method: Programmable calibration value accessible through
                                             RS232 communications. Requires frequency calibrator
                                             to calibrate the meter

Calibration accuracy at 25°C: ±10 ppm

11.7 RATE FUNCTION

Frequency range: 0.5 Hz to 30 KHz. The meter utilizes exponential format
                                             above 6 digits. 999 E9 signifies maximum display.

Unit of Measurement: Rate: Hertz
                                             (Scale Factor = 1)

Accuracy at 25°C: ±1 LSD ±0.01% of the input
                                             (0-5 V (square wave) input)

11.8 TOTALIZER

Count direction: Up or Down (determined by sign of scale factor)

Internal count capacity: (500,000,000,000) input pulses. The display utilizes
                                             exponential format above 6 digits.
                                             999 E9 signifies maximum display.

ac power failure provisions: You may store the display value in nonvolatile memory
                                             and restore with power (in totalizer mode only).

11.9 ANALOG OUTPUT OPTION BOARD

Max Load Impedance for Current Output:	500Ω
Resolution:	15 bits
Accuracy, 0-10V:	99.8%
Accuracy, 4-20 mA:	99.75%

Response Time

Total Mode:	80 mSec (99% of final value)
Rate Mode:	360 mSec (99% of final value)
Minimum SPAN:	220 counts

11.10 RELAY OUTPUT OPTION BOARD

2 Form "C" on/off relays.
Configurable for latched and unlatched by software.

Max Current:	5Amps, resistive load.
Max Voltage:	250Vac or 28Vdc

11.11 POWER

ac voltage (standard):	115 / 230 Vac ±15%
Frequency:	50 / 60 Hz
Power consumption:	11.5 W, max.

External Fuse Protection Recommended:

ac 115V:	IEC 127-2/III, 100 mA, 250 V (T Type) or UL Slow-Blow 125 mA, 250 V
ac 230V:	IEC 127-2/III, 50 mA, 250 V (T Type) or UL Slow-Blow 63 mA, 250 V

Excitation Output:	5 V @ 50 mA maximum
(Select by S1-1 and S1-2)	8.2 V @ 70 mA maximum
	12.4 V @ 100 mA maximum

For excitation currents more than 50 mA, the ac voltage must be 115 or 230 Vac ±10%.

dc Power/Battery backup: 7.5-13 V, 30 mA (typical), without any option board. The display goes blank, but the meter continues to totalizer.

260 mA is required to maintain the front-panel digital display. Add 180 mA for analog output board, 120 mA for relay board, 20 mA for RS-232 board.

11.12 ENVIRONMENT

Operating Temperature:	0° to 50°C (32° to 122°F)
Storage Temperature:	-40° to 85°C (-40° to 185°F)
Relative Humidity:	90% at 40°C (non-condensing)

11.13 MECHANICAL

Panel cutout:	1/8 DIN 3.62" x 1.78" (45 x 92mm)
Weight:	1.27 lb (575 g)
Case material:	Polycarbonate, 94 V-O UL rated

FACTORY DEFAULT VALUES

Table 12-1. Factory Default Values

S1-1	Closed	Excitation output is set to 5.0 V.
S1-2	Open	Excitation output is set to 5.0 V.
S1-3	Open	High hysteresis = 1.5 V.
S1-4	Closed	Threshold is shifted to positive.
S1-5	Open	No low pass filter.
S1-6	Open	No pull-down resistor.
S1-7	Open	243K pull-up to +excitation.
S1-8	Open	Trigger edge = Negative (high to low transition).
S1-9	Open	No signal is internally connected to the input.
S1-10	Open	Twice the line frequency/blank is not grounded.
S2-B*	Installed	Everything is unlocked
S2-C	Installed	Only "An LO" and "An HI" are locked-out.
S3-A	Installed	Enables front-panel buttons.
S4-A	Installed	Enables **RECALL** buttons.
S5-B	Installed	Selects standard relay option (SETPT HI OUTPUT)

Note ☞ * For units with analog output option, S2-B is factory default, not S2-C.

Table 12-2. Configuration Defaults

Feature	Default Description
Operating Mode (Function)	Rate
Scale	Multiply by 1.00000
Offset	0.00000
Decimal Point	Fixed decimal point: FFFFFF.
Setpoints	HI = 10000. LO = 10.
Configuration	6 digit display. Each digit may be 0 (default) or 1. Configuration is detailed below.

6 Digits of Configuration						
0	0	0	0	0	0	
0 1	Determines analog output signal. *4-20 mA* 0-10V					
	0 1	*Unlatched* Latched				
		0 1	*Setpoint LO works as active below the setpoint* Setpoint LO works as active above the set-point (similar to setpoint HI).			
			0 1	*Message handshake - If RTS input is true,* *sends complete message* Character handshake - Checks RTS input before sending each character, and sends characters only while RTS is true.		
				0 1	Determines the communication rate. *9600 baud rate* 1200 baud rate	
					0 1	*Transmits alarm status (total of 9 characters)* Does not transmit alarm status character

APPROVALS INFORMATION

This product conforms to the EMC directive 89/336/EEC amended by 93/68/EEC, and with the European Low Voltage Directive 72/23/EEC.

Electrical Safety EN61010-1:2001

Safety requirements for electrical equipment for measurement, control and laboratory.

Double Insulation Primary to Secondaries
Pollution Degree 2
Dielectric withstand Test per 1 min

- Power to Input/Output: 2500Vac
- Power to Relays Output: 2500Vac
- RS232 to Inputs: No Isolation
- Analog to Inputs: 500Vac (720Vdc)

Measurement Category I

Category I are measurements performed on circuits not directly connected to the Mains Supply (power). Maximum Line-to-Neutral working voltage is 50V ac/dc. This unit should not be used in Measurement Categories II, III, IV.

Transients Overvoltage Surge (1.2/50uS pulse)

- Input Power: 2500V
- Input/Output Signals: 500V

EMC EN61326:1997 + and A1:1998 + A2:2001

Immunity and Emissions requirements for electrical equipment for measurement, control and laboratory.

- EMC Emissions Class B of EN61326
- EMC Immunity** Table 1 of EN61326

Note: **I/O signal and control lines require shielded cables and these cables must be located on conductive cable trays or in conduits. Furthermore, the length of these cables should not exceed 30 meters*

⚠ Refer to the EMC and Safety installation considerations (Guidelines) of this manual for additional information.

NOTES

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **61 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **five (5) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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- ☛ Industrial pH & Conductivity Equipment

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- ☛ Data Logging Systems
- ☛ Wireless Sensors, Transmitters, & Receivers
- ☛ Signal Conditioners
- ☛ Data Acquisition Software

HEATERS
- ☛ Heating Cable
- ☛ Cartridge & Strip Heaters
- ☛ Immersion & Band Heaters
- ☛ Flexible Heaters
- ☛ Laboratory Heaters

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