

SERIAL INPUT METER & REMOTE DISPLAY

LAUREATE SERIES 2 OWNERS MANUAL



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1. ORDERING GUIDE

Configure a model number in this format: **L5002, CBL01**

L..... **Serial input meter**
Includes screw terminal connectors.

Processors & Display Color
5 Green LED
6 Red LED

Power
0 85-264 Vac, 90-300 Vdc
1 10-48 Vdc, 12-30 Vac

Setpoint Output
0 None
1 Two 8A contact relays
2 Two 130 mA solid state relays
3 Four 8A contact relays
4 Four 130 mA solid state relays

Analog Output
0 None
1 Single 4-20 mA, 0-10 V, -10 to +10 V
2 Dual 4-20 mA, 0-20 mA, 0-10 V

Digital Interface
0 None
1 RS232
2 RS485 with dual RJ11 connectors
4 RS485 with dual RJ45 connectors
5 USB
6 USB-to-RS485 converter
7 Ethernet
8 Ethernet-to-RS485 converter

Options

BL..... Blank lens, no button pads

Accessories

CBL01 RJ11-to-DB9 RS232 cable
Connects meter to PC com port
CBL02 USB-to-DB9 adapter for CBL01
CBL05 USB cable to PC USB port
CBL06 .. Half duplex RJ11 to PC USB port

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3. PRODUCT INTRODUCTION

Our Serial Input Meter (or remote display) accepts serial data from scales, computers, programmable controllers, instruments or other devices to provide a six-digit numeric display from -999,999 to +999,999. It can also provide relay closures and one or two analog outputs based on the received serial data. Its appearance matches that of our 1/8 DIN digital panel meters, counters and timers.

The Serial Input Meter is a 6-digit counter without a signal conditioner board, but with a communications board, which is required. Choices are RS232, RS485, USB or Ethernet. With RS232, RS485 or USB, the received data can be continuous (or streaming), be in command mode using Laurel's Custom ASCII protocol, or be in command mode using the Modbus RTU protocol. With Ethernet, the received data can only be in command mode using the Modbus TCP/IP protocol, which uses the same syntax as Modbus RTU.

A Serial Input Meter can augment a Laureate meter or counter by displaying parameters that cannot be displayed on the single numeric display of that instrument. For example, a Laureate FR counter can only display rate A, rate B, ratio A/B or peak one at a time. By augmenting the counter with remote displays, all these parameters can be displayed simultaneously. The required user-selectable modes are provided for the sending counter and serial input meter.

A single or dual channel analog output board is optional. Opto-isolation and 16-bit output resolution turn the Serial Input Meter into a low-cost and highly accurate isolated digital-to-analog converter or transmitter. The dual analog output board uses the same digital input to provide two individually scalable analog outputs, such as 4-20 mA plus 0-10V.

A 2- or 4-relay output board is optional and can add alarm or setpoint control capability. The relays can be 8A contact relays or 130 mA opto-isolated AC/DC solid state relays. The relays can respond to the transmitted values or to any of 8 serially transmitted control characters. The control characters can be generated by external software or by one of our meters, counters or timers, thereby assuring that the local and remote alarm points are identical.

A standard switching power supply allows the Serial Input Meter to be powered worldwide from 85 to 264 Vac. An optional power supply operates from batteries or low voltage sources, such as 12-32 Vac or 10-48 Vdc.

The meter case meets the 1/8 DIN size standard and is sealed to NEMA-4X (IP65) when panel mounted. Mounting is from the front of the panel and requires less than 110 mm behind the panel. All wiring is via removable plugs conforming to IEC950 safety standards. All output options are isolated from meter and power grounds to 250 Vac.

Meter programming can be via the meter's front panel or a PC running Windows based Instrument Setup (IS) software.

A signal conditioner board is not required but will not interfere with remote display operation if installed. Operation as a remote display is selectable for our 6-digit counters with a signal conditioner, as explained in our separate Counter Manual.

4. RECEIVING & UNPACKING

Your serial input meter was carefully tested and inspected prior to shipment. Should the meter be damaged in shipment, notify the freight carrier immediately. In the event the meter is not configured as ordered or the unit is inoperable, return it to the place of purchase for repair or replacement. Please include a detailed description of the problem.

5. SAFETY CONSIDERATIONS



Warning: Use of this equipment in a manner other than specified may impair the protection of the device and subject the user to a hazard. Visually inspect the unit for signs of damage. If the unit is damaged, do not attempt to operate.

Caution:

- This meter must be powered with AC (mains) from 85-264 Vac (or 90-300 Vdc) with the high voltage power supply option, or 12-32 Vac (10-48 Vdc) with the low voltage power supply option. Verify that the proper power option is installed for the power to be used. This meter has no AC (mains) switch. It will be in operation as soon as power is connected.
- The 85-264 Vac (or 90-300 Vdc) power connector (P1 Pins 1-3) is colored Green to differentiate it from other input and output connectors. The 12-32 Vac (10-48 Vdc) power connector is colored Black.
- Do not make signal wiring changes or connections when power is applied to the meter. Make signal connections before power is applied. If reconnection is required, disconnect the AC (mains) power before such wiring is attempted.
- To prevent electrical or fire hazard, do not expose the meter to excessive moisture.
- Do not operate the meter in the presence of flammable gases or fumes, as such an environment constitutes a safety hazard.
- This meter is designed to be mounted in a metal panel. Verify the panel cutout dimensions, and mount according to instructions.

Symbols used



Caution (refer to accompanying documents)



Caution, risk of electric shock.



Equipment protected throughout by double insulation or reinforced insulation.



Earth (ground) terminal.



Both direct and alternating current.

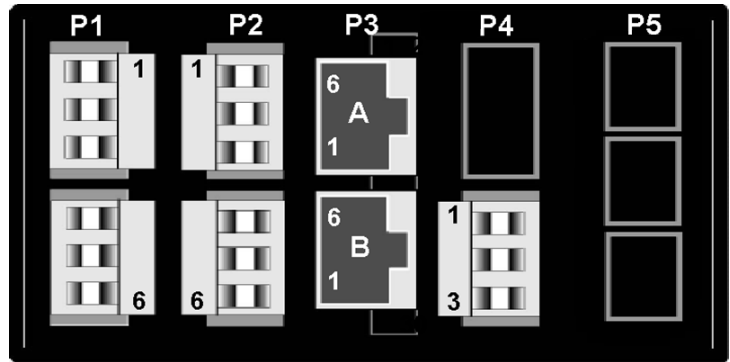
Operating environment:

The meter is Class II (double insulated) equipment designed for use in Pollution degree 2.

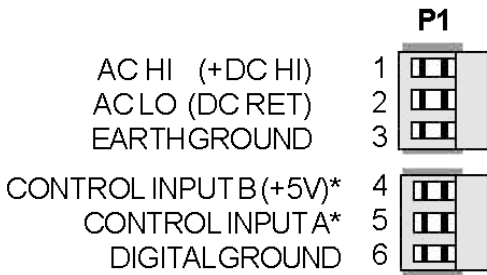
6. CONNECTOR WIRING INFORMATION

CONNECTORS

Connectors for signal and power are U/L rated screw-clamp terminal blocks that plug into mating jacks on the printed circuit board. Communication connectors are a single RJ11 plug for RS232, dual RJ11 plugs for RS485, and dual RJ45 plugs for RS485.



P1 - POWER AND DIGITAL CONTROLS



* Note: external control inputs A and B are menu selectable.

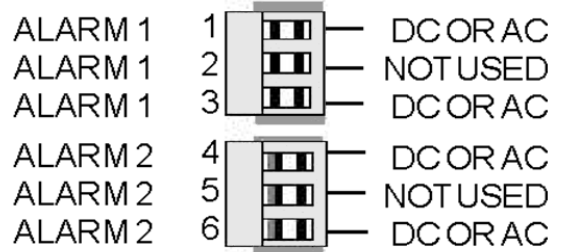
Caution: P1, pins 4, 5, and 6 may have hazardous voltages present.

P2 - SETPOINT CONTROLLER

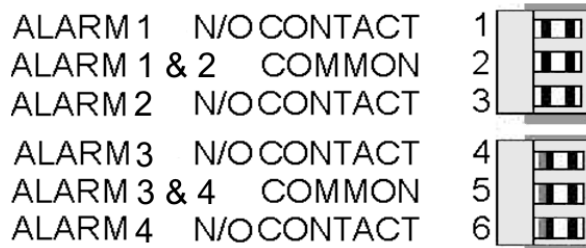
DUAL MECHANICAL RELAY OUTPUTS



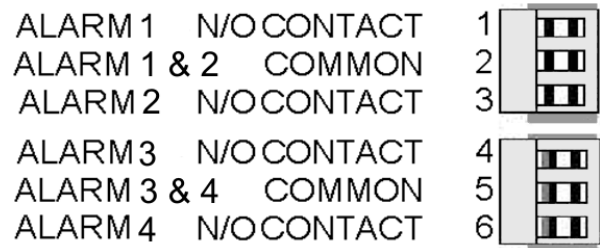
DUAL SOLID STATE RELAY OUTPUTS



QUAD MECHANICAL RELAY OUTPUTS

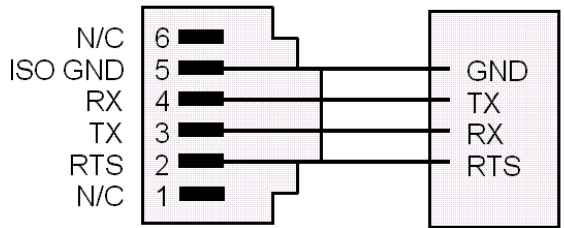


QUAD SOLID STATE RELAY OUTPUTS

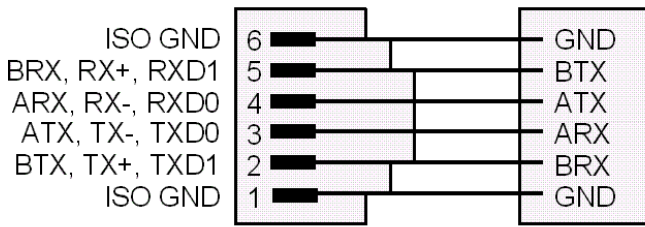


P3 - SERIAL COMMUNICATIONS

RS232 INTERFACE



RS485, RJ11, FULL DUPLEX

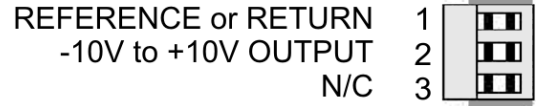


P4 - ANALOG OUTPUT

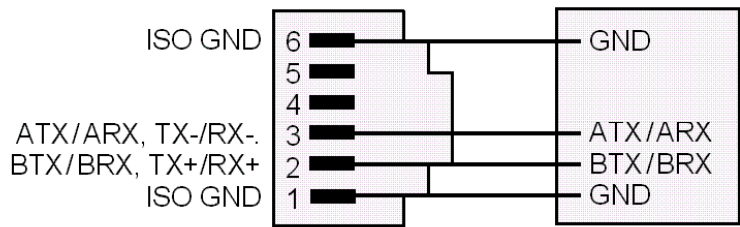
UNIPOLAR CONNECTIONS



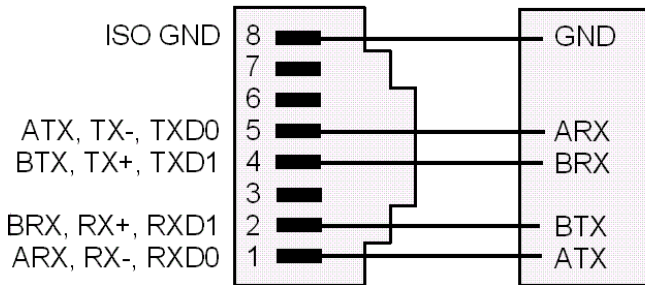
BIPOLAR CONNECTIONS



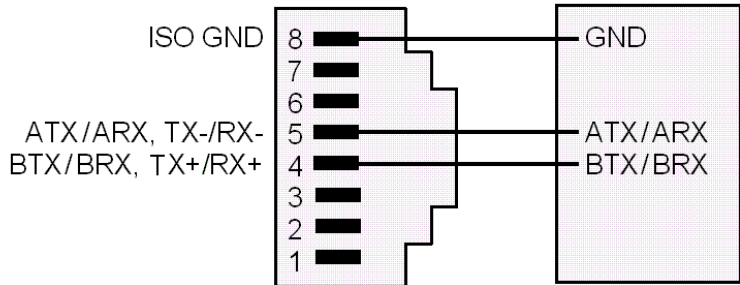
RS485, RJ11, HALF DUPLEX



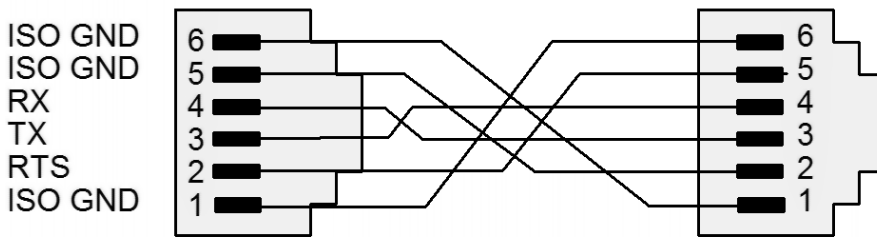
RS485, RJ45, FULL DUPLEX



RS485, RJ45, HALF DUPLEX



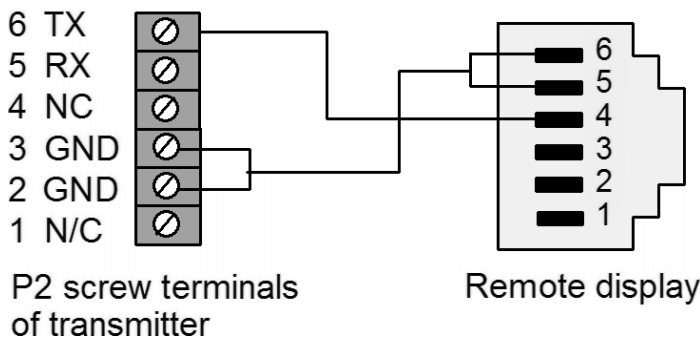
RS232 LAUREATE METER TO LAUREATE REMOTE DISPLAY



ISO GND
ISO GND
RX
TX
RTS
ISO GND

Use a crossover cable.
Program remote display for CONFIG = 7000
Keep factory default jumpers e, g.
Install jumperf.

RS232 LAUREATE TRANSMITTER TO LAUREATE REMOTE DISPLAY



ISO GND
ISO GND
RX

Program remote display for CONFIG = 7000
Keep factory default jumpers e, g.
Install jumperf.

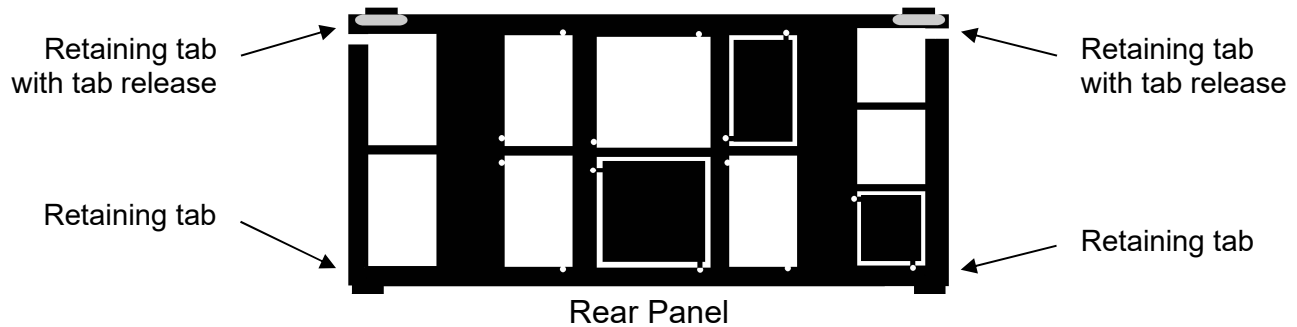
P2 screw terminals of transmitter

Remote display

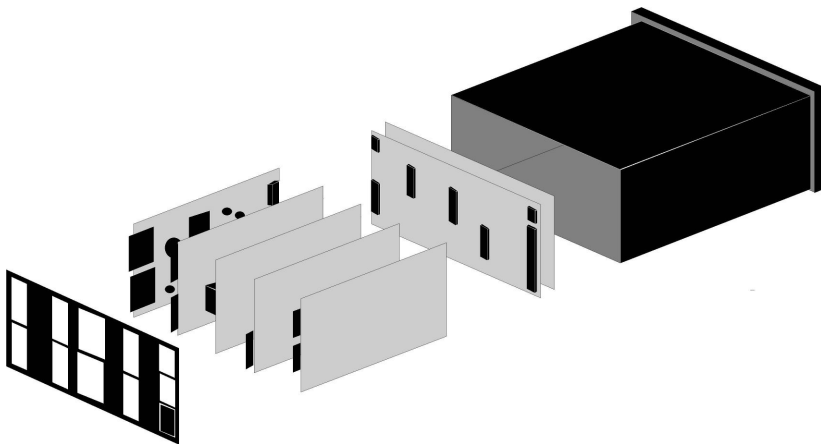
7. MECHANICAL ASSEMBLY

REMOVING THE REAR PANEL

First remove any connectors. Use one hand to press in the two sides of the rear of the case, and the other hand to press down the two protruding tab releases at the top of the rear panel (see figure below). This will unhook the rear panel from the case.



REMOVING THE ELECTRONICS & INSTALLING OPTION BOARDS



With the rear panel removed, the electronic assembly will easily slide out through the rear of the case.

Options boards plug into the main board at the front of the meter. These are plug-and-play and may be installed in the field. New boards will be recognized by the meter software for access to the appropriate menu items. You may need to remove rear panel knock-outs to fit new boards.

Note: When an option board is installed correctly, the top and bottom edges of the main board and option board are aligned. Misaligned boards will burn out the electronics.

Option Board	Rear Panel Jack
Power supply (one required)	J1
Relay board (optional)	J2
Serial interface board (one required)	J3
Analog output board (optional)	J4
Signal conditioner board (not used)	J5

REASSEMBLING YOUR METER

Slide the electronics assembly back into the case until the display board is seated flush against the front of the case. Insert the bottom tabs of the rear panel into the case, and then carefully align the board connectors with the openings in the rear panel. Ensure that all option boards are properly aligned with the molded board retaining pins on the inside of the

rear panel. Once the rear panel is in place, reinstall the input/output screw clamp terminal plugs.

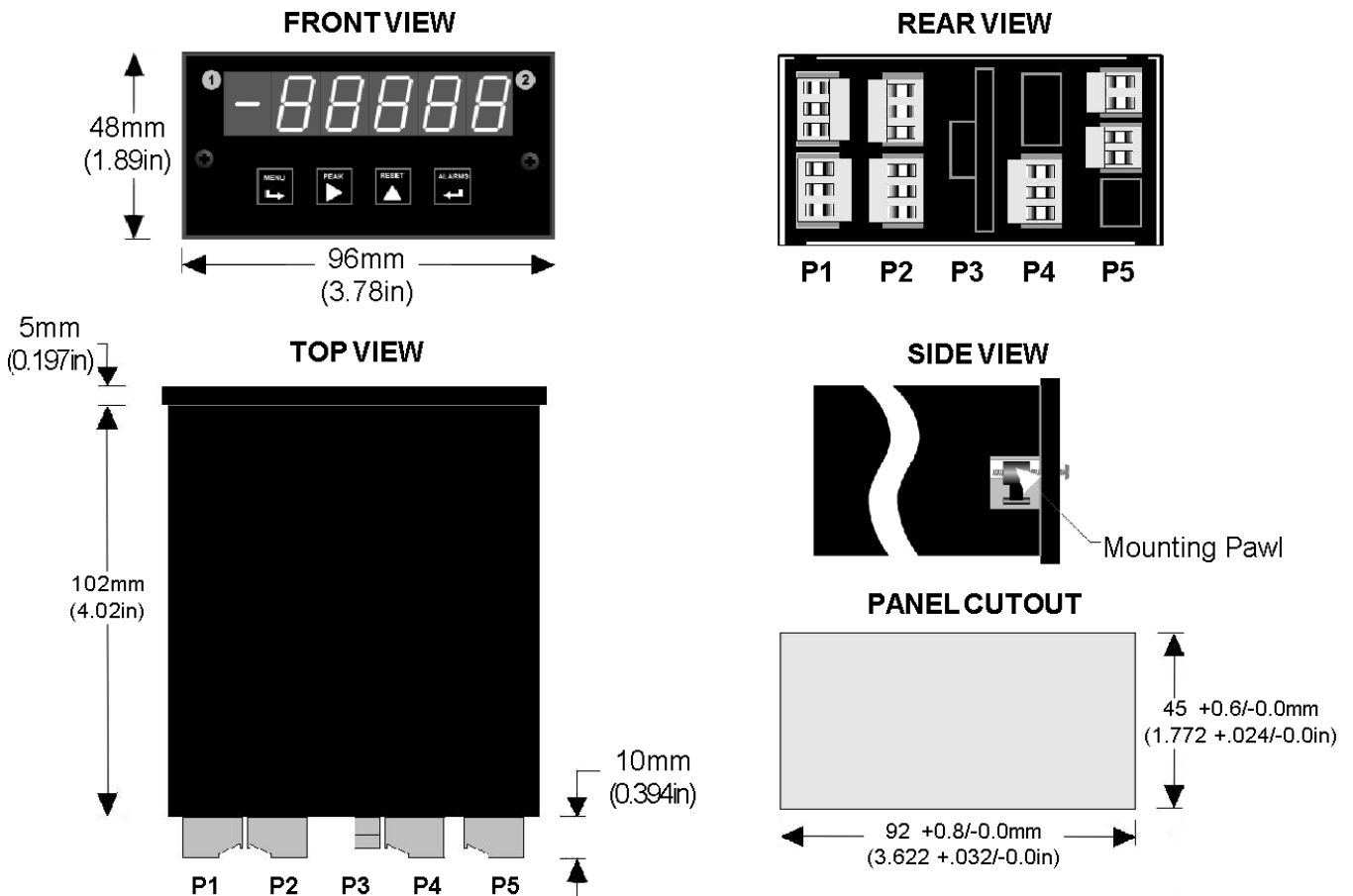
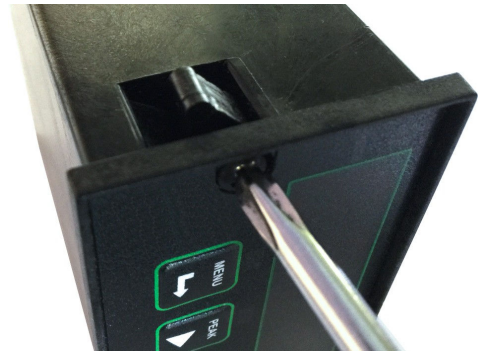
PANEL MOUNTING

Slide the meter into the 45 x 92 mm 1/8 DIN panel cutout. Ensure that the provided gasket is in place between the front of the panel and the back of the meter bezel.

The meter is secured by two pawls, each held by a screw. Turning a screw clockwise extends the pawl outward. Turning the screw clockwise further tightens it against the panel to secure the meter.

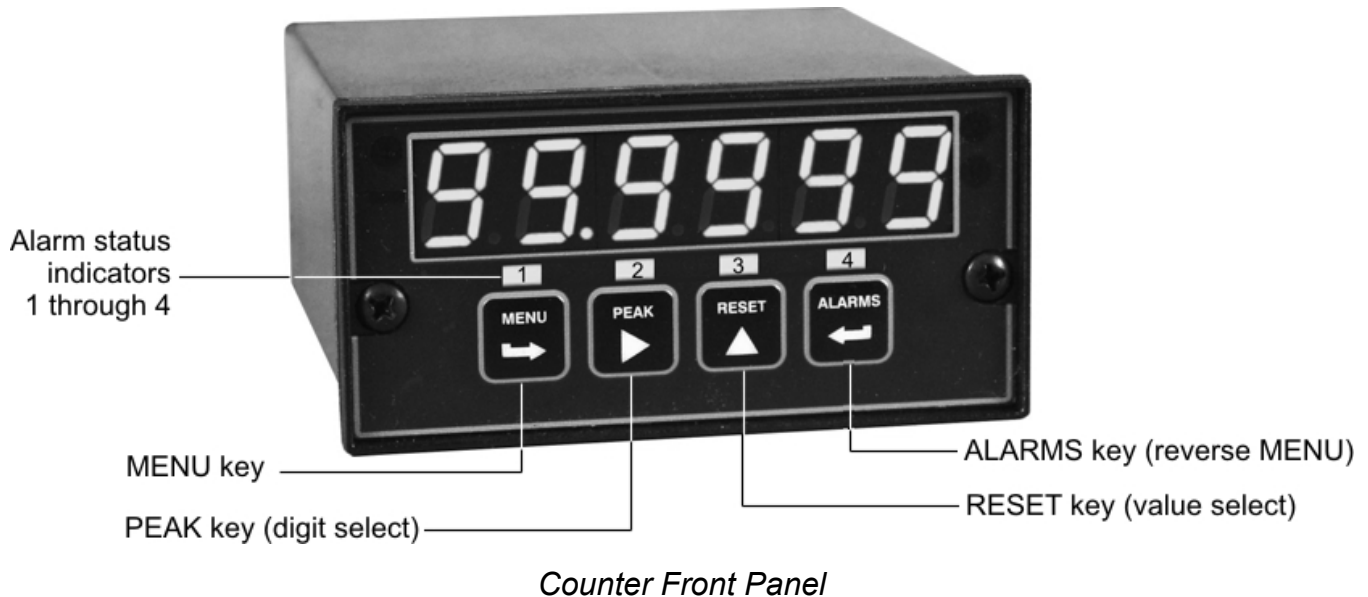
Turning a screw counterclockwise loosens the pawl and retracts it into its well. This allows the meter to be inserted into the panel cutout for installation, or to be removed from the panel cutout following installation.

Note: In no case should a screw be removed from its pawl. Doing so would cause the screw and pawl to fall off and likely get lost.



Dimensioned case drawings

8. FRONT PANEL SETUP KEYS



There are four front panel keys, which change function for the **Run Mode** and **Menu Mode**, effectively becoming eight keys. The keys are labeled with alphanumeric captions (MENU, PEAK, RESET, ALARMS) for the Run Mode and with symbols (➡ right arrow, ▶ right triangle, ▲ up triangle, ← left arrow) for the Menu Mode.

FRONT PANEL LOCKOUT

The Menu Mode will not work with most meters shipped from the factory, since all menu items have been disabled in software and a lockout jumper is in place. This jumper needs to be removed for the Menu Mode to work, and values under **Loc 1** through **Loc 4** need to be set to "0" via the front panel for these menu items to be available. See Section 9. The paragraphs below assume that all lockout features have been removed.

MENU MODE KEY ACTION

In the Menu Mode, pressing a key momentarily advances to the next item. Holding down the key advances through multiple menu items for fast menu navigation.

KEYS IN RUN MODE

MENU **MENU Key.** Pressing *MENU* from the Run Mode enters the Menu Mode. Pressing *MENU* repeatedly will step the meter through the various menu items (if these have not been locked out) and then back to the Run Mode.



RESET **RESET Key.** Pressing *RESET* with *ALARMS* resets latched alarms. Pressing *RESET* with *MENU* performs a meter reset (same as power on).



ALARMS Key. Pressing *ALARMS* once displays the setpoint for Alarm 1. Pressing it again displays the setpoint for Alarm 2. Pressing it again returns to the present value. After 30 seconds, the meter automatically returns to the present value. Timing is automatically reset whenever the *ALARMS* key is pressed.


KEYS IN MENU MODE




Right Arrow Key (MENU). Pressing  steps the meter through all menu items that have been enabled and then back to the Run Mode. If a change has been made to a menu item, that change is saved to non-volatile memory when the  key is pressed next, and **StoreE** is displayed briefly.




Right Triangle Key (Digit Select).

Pressing  from most menus sequentially selects digit positions 1 - 6, as indicated by a flashing digit: **000000**, **000000**, **000000**, **000000**, **000000**, **000000**.



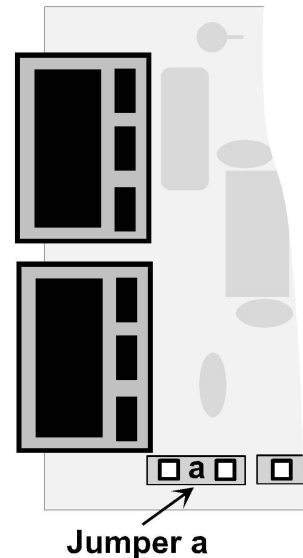
Up Triangle Key (Value Select). Pressing  for a flashing digit position or decimal point position will increment that item. Pressing the MENU key will save any changes.



Left Arrow Key (Reverse Menu). Pressing  has the same effect as the MENU key, except that menu items are brought up in reverse order.

9. ENABLING & LOCKING OUT MENU ITEMS

For security reasons and ease of counter operation, any or all menu items can be disabled or "locked out" so that they are no longer accessible from the front panel. Each function to be disabled can be set to "1" under menu headers *Loc 1-4*, while each function to be enabled can be set to "0." Access to the menu headers *Loc 1-4* can in turn be locked out by installing a hardware jumper on the power supply board. With the jumper installed, the operator only has access to previously enabled menu items, not to the menu headers *Loc 1-4* and hence not to the menu items below. With the jumper removed, the operator has access to menu headers *Loc 1-4* and hence to the menu items below.



SETTING HARDWARE LOCKOUT JUMPER

To access the lockout jumper, remove the rear panel per Section 9 and locate jumper "a" in the lower portion of the power supply board next to the input connectors (see figure at right).

SETTING SOFTWARE LOCKOUTS

When setting up the meter, it may be necessary to enable specific menu items by setting the corresponding lockout digit to 0. Be sure to reset the lockout digit to "1" if you do not want the menu item to be changed by an operator.

Loc 1 **Loc 2** **Loc 3** **Loc 4**

Press the **→** MENU key until *Loc 1*, *Loc 2*, *Loc 3* or *Loc 4* is displayed, as desired. **Note:** the lockout jumper must be removed (see above).

111111

Press **▶** to display the lockout status, consisting of 0's and 1's. The left digit will flash. Press **▶** again to step to the next digit, which will flash.

000000

123456

Press **▲** to set the flashing digit to "0" to enable the menu item or to "1" to disable. Press **MENU** to enter. See the table to the right for list of menu items that can be enabled or disabled.

Enabled / Disabled Menu Items

Loc 1

- 3 - Input type selection
- 4 - Setup, Config, Dspyno
- 5 - Gate time, timeout, batch setup
- 6 - Filter setup

Loc 2

- 3 - Slope, decimal points
- 4 - Scale, offset, resolution, 2-coord.
- 5 - Alarm setup
- 6 - Alarm setpoint programming

Loc 3

- 3 - Analog output setup & scaling
- 4 - Serial communications configuration
- 5 - Calibration
- 6 - Change displayed Item #

Loc 4

- 3 - View peak value
- 4 - View alarm setpoints
- 5 - Front panel resets (peak & latched alarms)
- 6 - Front panel reset (cold reset only)

10. SERIAL COMMUNICATION BOARD SETUP

A **serial communications board** is required for serial input meter / remote display operation. Available boards are RS232, RS485, USB, and Ethernet.



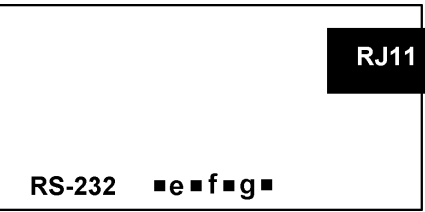
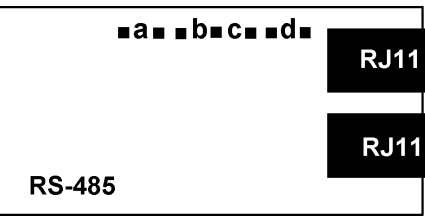
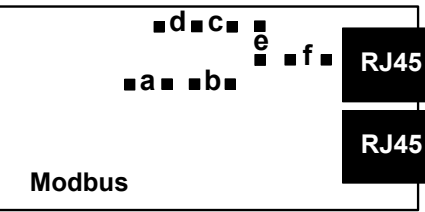
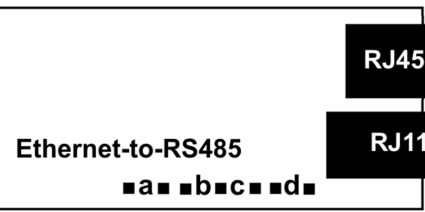
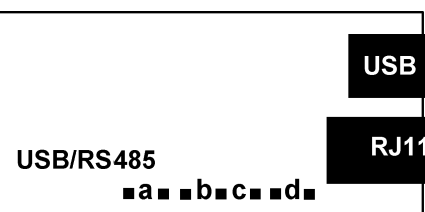
To **program the remote display** using the USB port of a PC running Instrument Setup (IS) software, set the remote display to 9600 baud and use the Custom ASCII protocol. You will also need to select a COM port, since all serial communications with the remote display use a UART. To find the COM port assigned by the PC, you can use trial and error or use Device Manager under the Windows Control Panel. After executing the last Put command, which downloads setup data from the PC into the remote display, exit IS software, disconnect your PC, and connect to the device which is sending the data to be displayed.

- **If the remote display has a USB board**, use a USB cable with Type A and Type B connectors. The PC will recognize the FTDI chip on the USB and automatically install the driver for it. You will need to select a COM port.
- **If the remoted display has an RS232 board**, use Laurel cables CBL01 and CBL02, which plug into each other. The PC will recognize the FTDI chip in the CBL02 adapter cable and automatically install the driver for it. You will need to select a COM port.
- **If the remoted display has an L485 half-duplex RS485 board**, use Laurel cables CBL06. The PC will recognize the FTDI chip in the CBL06 adapter cable and automatically install the driver for it. You will need to select a COM port.
- **If the remoted display has an LNET Ethernet board**, use an Ethernet cable with RJ45 connectors to plug the remote display into the same LAN as the PC. Use IS software to discover the Ethernet Node and the Device attached to that Node, with is the remote display. Then use the Main Menu of IS software to program the remote display.

For operation as a remote display:

- **If the remote display has a USB board**, connect that board to the sending PC with a USB cable with Type A and Type B connectors. The display can receive streaming serial data, Custom ASCII protocol commands, or Modbus RTU commands, as programmed.
- **If the remote display has an RS232 board** and is a slave to a Laureate meter or counter with a streaming RS232 output, install jumper **f** on the RS232 board of the slave meter, not the sending meter. Use a reversing phone cable, where the wire colors of the two connectors are reversed from left to right. Use 9600 baud. See the Serial Communications Options section of this manual or the Jumper Settings sections of our Custom ASCII Protocol Serial Communications Manual. The display can receive streaming serial data, Custom ASCII protocol commands, or Modbus RTU commands, as programmed.
- **If the remote display has an RS232 board** and is a slave to another instrument with a streaming RS232 output, install jumper **f** on the RS232 board of the slave meter. Make sure that RX goes to TX, and TX goes to RX. The display can receive streaming serial data, Custom ASCII protocol commands, or Modbus RTU commands, as programmed.
- **If the remote display has an Ethernet board** and is on the same LAN as a Modbus Master, it will act a Modbus Slave and respond to Modbus TCP commands as described in this manual and our separate [Modbus Communications Manual for Counters](#).

COMMUNICATIONS BOARD SETUP VIA JUMPERS

<p>Ethernet Board** or USB Board</p> <p>No jumpers needed</p>	 <p>Ethernet</p>	 <p>USB</p>
<p>RS232 Board</p> <p>e - Do not install for remote display.. f - Install for remote display operation. g - Install for normal meter operation.</p> <p>Note: Board is shipped with jumper g installed.</p>		 <p>RS-232 ■ e ■ f ■ g ■</p>
<p>RS485 Board, Full Duplex Operation *</p> <p>b & d - Installed on last meter in long cable run.</p> <p>RS485 Board, Half Duplex *</p> <p>a & c - Installed for half duplex operation. d - Installed on last meter in line with long cable runs.</p>		 <p>■ a ■ b ■ c ■ d ■</p> <p>RS-485</p>
<p>RS485-Modbus Board, Full Duplex Operation *</p> <p>b & e - Bias jumpers should be installed on 1 board. a & d - Installed on last meter in long cable run.</p> <p>RS485-Modbus Board, Half Duplex Operation *</p> <p>b & e - bias jumpers installed on 1 board. c & f - installed for half duplex operation. a - installed on last meter in line with long cable runs.</p>		 <p>■ d ■ c ■ e ■ f ■</p> <p>■ a ■ b ■</p> <p>Modbus</p>
<p>Ethernet-to-RS485 Converter Board** & USB-to-RS485 Converter Board</p> <p>Full Duplex Operation</p> <p>No jumpers for short cable runs. Add b & d for long cable runs.</p> <p>Half Duplex Operation</p> <p>a + c for short cable runs. Add d for long cable runs.</p>		 <p>Ethernet-to-RS485</p> <p>■ a ■ b ■ c ■ d ■</p>  <p>USB/RS485</p> <p>■ a ■ b ■ c ■ d ■</p>

* Board shipped with no jumpers installed.

** For Ethernet Node discovery and setup, refer to our separate [Ethernet manual](#), which explains our Node Manager software and the Web Page built into each Node. In Node Manager software, click on the Advanced tab, and set “Parent Meter Interrogation” to “Disabled”. In the Web Page under “Device Interface Setup”, set “Stop interrogating meter continuously” to “Yes.” Otherwise the Ethernet card will try in vain to fetch readings from the parent meter and reset the meter.

11. SERIAL INPUT METER / REMOTE DISPLAY CONFIGURATION

Two operation modes are available: 1) continuous (or streaming) serial data input, and 2) command mode.

- **For the continuous mode**, the sending device (such as a panel meter or weighing scale), must have an automatically repeating data output. The format of that output must be known in advance, as provided by the manufacturer of the sending device or as determined by the user with a terminal emulator program like PuTTY. The continuous mode is supported by RS232, RS485 and USB, not Ethernet.

Instrument Setup (IS) software, which runs on a PC, is required to select from a choice of continuous operating modes and to set up parameters for the Remote C operating mode, as detailed in this manual. The Remote C mode can extract readings from long ASCII text strings. It can accommodate selected Start and Stop characters, mask OFF any number of characters between the Start character and the start of data, mask ON up to 8 display characters (including sign and decimal point), and ignore characters between the last displayed character and the Stop character.

- **For the command mode**, the sending device must send specific commands to the remote display to write to a variable (or memory location) called Item #3. That variable is then displayed by the meter and can also be used for alarm comparisons and for analog output. With RS232, RS485, commands can use the Custom ASCII protocol, as documented in Laurel's [Custom ASCII Protocol Serial Communications Manual](#), or the Modbus protocol, as documented in Laurel's [Modbus Counter Manual](#). Our RS232, RS485 and USB boards support the Custom ASCII and Modbus protocols. Our Ethernet boards only support the Modbus protocol. That protocol was specified international to only works in command mode, not continuous mode.

Use the meter front panel to set up communication parameters. Two items require special explanation:




- **For the Custom ASCII Protocol**, the first digit under **ConFig** is set to a value **6** thru **C**. Since no signal conditioner board is detected, the meter defaults to setting **6**, where H, L, K commands are enabled. **H** means display the remote data only. **K** means that the received value is stored as Item #3, to become the source for alarm comparisons and analog output. **L** means both **H** and **K**. In slave mode (8, 9, A, B), the remote meter can display any item of up to four data Items (or string values), such as the Sum of Rates A & B (Item #1), Rate A (Item #2), or Rate B (Item #3).
- **For the Modbus protocol**, the first digit under **ConFig** is forced to be a **6**, where H, L, K commands are enabled.
- **A timeout ti-Out** can be set to a value from 10 ms to 199.99 sec. This is how long a serial reading will be displayed in the absence of a new serial input. If timeout is set to 0, the display will persist indefinitely in the absence of a new input.

Additional programmable features of the serial input meter are detailed in the "Command Mode for Remote Display Operation of Counter / Timer" and "Data Formats" sections of our [Custom ASCII Protocol Serial Communications Manual](#).

SELECTED FRONT PANEL SETUP ITEMS FOR SERIAL INPUT METER (not consecutive)

For the complete list of front panel setup items, see Section 10 of our separate COUNTER / TIMER / SERIAL INPUT METER OWNERS MANUAL.

If the **MENU**  key does not work, see Section 9 “Enabling & Locking Out Menu Items.”

MENU  Press Menu	PEAK  Press Digit Select Key	RESET  Press Value Select Key
SEtUP Setup	000 0 Control inputs 1 and 2	F 1 = Tare Enable, 2 = Tare Control input 2 must be at 0V or grounded for Tare to operate.
ConFiG Configu- ration	0000 Display mode Notes: Remote modes S (selection 7) and C (selection C) are used for most applications. Modbus uses selection 6 only.	6 Remote display (H, K, L commands) 7 Single-value remote display 8 Show 1 st string value, connected to a counter 9 Show 2 nd string value, connected to a counter A Show 3 rd string value, connected to a counter B Show 4 th string value, connected to a counter C Custom Start, Stop, Skip, Show characters
ti Out Time-out	000.00 000.00 000.00 000.00 000.00 Select digit to flash.	Select 0 thru 9 for flashing digit to set time-out in seconds. Decimal point location is fixed for 10 ms resolution. This is how long a serial reading will be displayed in the absence of a new serial input. Enter 0 so that the display persists indefinitely in the absence of a new input.
SEr 1	000 Baud rate Fixed parameters: No parity, 8 data bits, 1 stop bit	0 300 baud 1 600 baud 2 1200 baud 3 2400 baud 4 4800 baud 5 9600 baud 6 19200 baud
SEr 2	0000 Meter address	Select 0 thru F for addresses 1 thru 15. Select 0. thru F. (with decimal point) for addresses 16 thru 31. Address 0 is accepted by all meters. Do not use with Modbus.
SEr 3	00000 RS485	0 Full duplex 1 Half duplex
SEr 4	000 Serial protocol	0 Custom ASCII 1 Modbus RTU 2 Modbus ASCII
	000 Parity	0 None 1 Odd 2 Even
Addr	000 000 000 Modbus address	158 Select 0 through 9 for flashing digit. Address range is 1 to 247.

12. REMOTE DISPLAY OF LAUREATE METER OR COUNTER

1. OVERVIEW

If the remote display is to show the continuous RS232 or RS485 readings of a Laureate meter or counter device as the sender, setup is most easily accomplished from the front panel of both devices, without use of Instrument Setup (IS) software. The example below is for a process meter as the sender and a remote display as the receiver. Connection is via Laurel's CBL03 data cable using half duplex RS485 (data interface ordering code 2, interface board P/N L485). The CBL03 data cable is non-reversing and has RJ11 connectors on both ends. Communications use the Custom ASCII protocol which supports a continuous data output, unlike the Modbus protocol. Standard Custom ASCII communications are at 9600 baud, N81.

2. SENDING PROCESS METER

- **Set SEr1 to 151.** This sets signal to filtered, baud rate to 9600, and data output every 0.28 sec. The latter is the meter display update rate when filtering is set for 60 Hz noise rejection.
- **Set SEr2 to 0001.** This specified no line feed after carriage return, no alarm data, continuous data output, and address 1.
- **Set SEr3 to 10000.** This specifies half duplex, standard continuous mode, normal RTS, termination character only at end of all items, and sending of meter reading.
- **Set SEt4 to 000.** The first 0 specifies a Modbus gap timeout, which does not apply. The second 0 specifies the Custom ASCII protocol, which is critical for continuous data output. The third 0 specifies no parity, as required for the Custom ASCII protocol.

3. RECEIVING REMOTE DISPAY

- **Set ConFiG to 7.** This selects single-value remote display.
- **Set ti_Out to 001.00.** This specifies that the reading will be held for 0.01 sec in the absence of a new serial data input.
- **Set SEr1 to 050.** The digit 5 specifies 9600 baud.
- **Set SEr2 to 0001.** The digit 1 sets the device address to 1.
- **Set SEr3 to 10000.** The digit 1 specifies half-duplex RS485.
- **Set SEr4 to 000.** The middle digit 0 specifies the Custom ASCII protocol.

13. INSTRUMENT SETUP VIA PC

1. OVERVIEW

If the sending device is a non-Laurate device, use Laurel's free Instrument Setup (IS) software for additional flexibility. IS software runs on a PC and provides a graphical user interface. The software allows uploading, editing, downloading and saving of setup data, and execution of commands under computer control.

4. Connection to PC

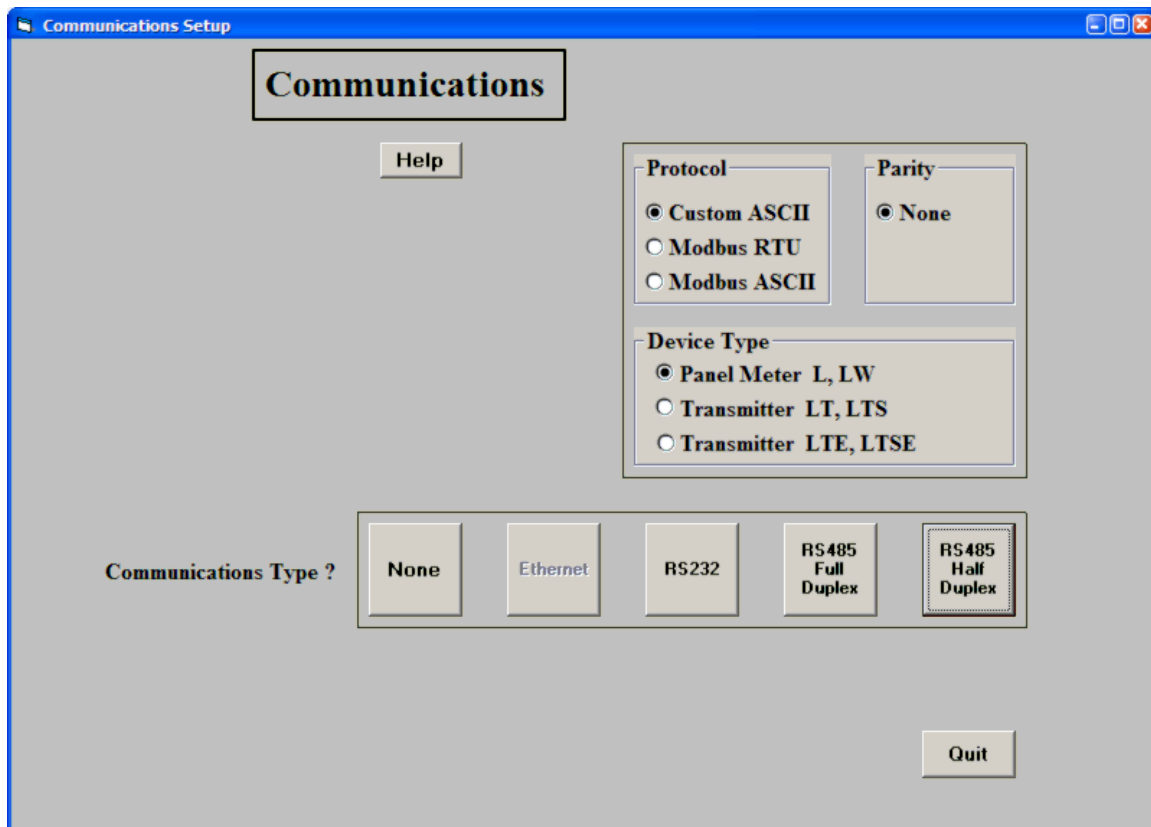
- **RS232.** To connect a Remote Display with an RS232 interface and an RJ11 connector (board P/N L232) to the USB port of a PC, use Laurel cables CBL01 and CBL02, which plug into each other. CBL02 contains an FTDI RS23-to-USB converter chip, which is compatible with all versions of Windows.
- **RS232.** To connect a Remote Display with an RS232 interface and an RJ11 connector (board P/N L232) to the RS232 port of a PC, use Laurel cable CBL01.
- **Half-duplex RS485.** To connect a Remote Display with a half-duplex RS485 interface and dual RJ11 connectors (board P/N L485) to the USB port of a PC, use Laurel cable CBL06. That cable contains an RS485-to-USB converter chip, which is compatible with all versions of Windows.
- **USB.** To connect a Remote Display with a USB interface and an RJ45 connector (board P/N LUSB) to the USB port of a PC, use Laurel cable CBL05. This is a common USB cable with Type A and B connectors.

After the Remote Display has been programmed using IS software, it can be disconnected from the PC and be connected to the data streaming source (if other than the PC).

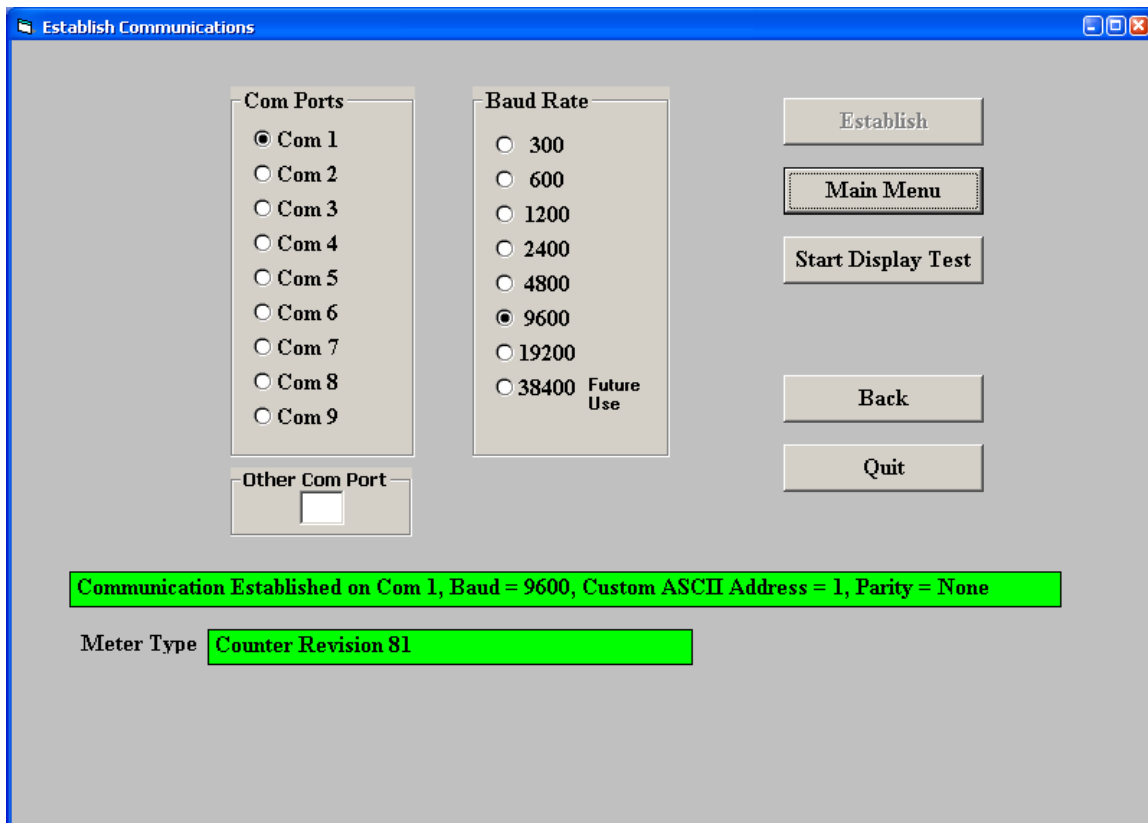
5. IS Software Installation & Launch

As a first step, set User Account Control (UAC) of your version of Windows to "Never notify" so that IS software can create directories. Use Google for instructions. Power down and restart your computer for the UAC change to take effect. Download the file IS3_5_4.exe from our website and double-click on the file name. Click on "Install Instrument Setup Software" and follow the prompts. To launch IS software, press on Start => Programs => IS2 => Instrument Setup or on the desktop icon that you may have created. Following a brief splash screen, the Communications Setup screen below will appear.

To launch IS software, press on *Start => Programs => IS2 => Instrument Setup* or on the desktop icon that you may have created. Following a brief splash screen, the *Communications Setup* screen will appear.



In the **Communications Setup** screen above, select the *Custom ASCII* as the protocol and *Panel Meter* as the Device Type. Then click on the *RS232* button, which also serves for USB and half-duplex RS485. This will take you to the *Establish Communications* screen below.



In the **Establish Communications** screen, select your Com Port and 9600 as the Baud Rate. Try different Com ports until one works, or use the Windows Device Manager to read your Com port and change it if desired. Click on *Establish*, and the two fields at the bottom of the screen should turn green. Click on *Main Menu*. The computer will remember your communication settings for the next time that you run IS software.

From the **Main Menu**, click on *Counter => Get Setup* to retrieve (or get) the existing setup data from your remote display. Click on *View => Setup* to bring up screens which allow you to easily edit the setup file using pull-down menus and other selection tools. You can download (or put) your edited file into the transmitter by clicking on *Counter => Put Setup*. You can save your setup file to disk by clicking on *File => Save Setup* and retrieve a previously saved file from disk by click on *File => Open*.

Click on **Counter => Get Setup** to retrieve the current setup information from your counter, then on *View => Setup*, which will take you to the *Input+Display* tab. Use this screen to set up *Display Type*, *Control Inputs* and *Time Out*.

For **Time Out**, enter the number of seconds that a serial reading will be displayed in the absence of a new serial input, after which *ti-Out* will be displayed. If timeout is set to 000.00, the display will persist indefinitely in the absence of a new input.

For **Display Type**, select one of the following:

Rmt Dsply A = Addressable remote display mode for string `*#LSDDDD.DDA<CR><LF>`, where * is the recognition character, # is the address, L is a command character which can be H, K or L, S is sign (space or + for positive, - for negative), D is a digit from 0 to 9, A is an optional alarm character which overrides internal alarm comparisons, <CR> is the carriage return character, and <LF> is an optional line-feed character, which is ignored. The following Remote Display data types are user selectable:

Rmt Dsply S = Single value, non-addressable remote display for SDDDD.DDA<CR> <LF>, where S is sign (space or + for positive, - for negative), A is an optional alarm character which overrides internal alarm comparisons, <CR> is the carriage return character, and <LF> is an optional line-feed character, which is ignored.

Rmt Dsply 1 = 1st value of value sequence SDDDD.DDSDDDD.DDSDDDD.DDSDDDD.DD

Rmt Dsply 2 = 2nd value of value sequence SDDDD.DDSDDDD.DDSDDDD.DDSDDDD.DD

Rmt Dsply 3 = 3rd value of value sequence SDDDD.DDSDDDD.DDSDDDD.DDSDDDD.DD

Rmt Dsply 4 = 4th value of value sequence SDDDD.DDSDDDD.DDSDDDD.DDSDDDD.DD

Data sequences with up to three data values can be generated by our digital panel meters (current reading, Peak, Valley). Data sequences with up to four data values can be generated by our counters (Items 1, 2, 3, Peak). Please refer to our DPM and counter manuals.

Rmt Dsply C = Masked remote display. Allows data extraction from a long string as specified under the *Communication* tab. The required data entry fields will only appear under the *Communication* tab if *Display Type* has been specified as *Rmt Dsply C* under the *Input+Scaling* tab. Works only with the Custom ASCII protocol, not the Modbus protocol, since a meter cannot listen to commands while in the *Rmt Dsply C* display type. For more information on *Rmt Dsply C*, see the manual section for the *Communication* tab.

Executing a *Main Menu > Counter > Put Setup* command downloads the setup information into the meter, including the *Rmt Dsply C* display mode if selected.

Warning: Do not execute a *Main Menu > Counter > Get Setup* command if you have placed the remote display into the *Rmt Dsply C mode*, since normal meter communications cannot occur in that mode. Our Instrument Setup Software will then reset the remote display to *Rmt Dsply A*.

Warning: Do not execute a *Main Menu > Counter > Get Setup* command if you have placed the sending meter or transmitter into the continuous mode, since IS software uses the command mode and will reset the sending unit to command mode.

For more information on serial communications, please download our [Series 2 Serial Communications Manual](#) (for Custom ASCII Protocol) and our [Series 2 Modbus Communications Manual](#) (for Modbus Protocol).

For Control Inputs, select the desired action of grounding Control Input 1, Control Input 2, and both Control Inputs 1 and 2.

- *Meter Reset* is a master reset like removing and reapplying power.
- *Function Reset* resets latched alarms.
- *Alarm Active* allows external control of relays, as opposed to using normal setpoint operation.
- *Display Blanking* blanks the meter display.
- *Enable Tare* enables a meter tare function and enters the current reading as a value to be subtracted as a tare value.
- *Tare if Enabled* subtracts the tare value from the current reading.

Ignore the following selections, which do not apply to remote display operation: *Peak, Valley, External Gate, Meter Hold, Total A Reset, Total B Reset*.

APPLICATION HELP

DISPLAY TYPES 6 - C

Remote Display (Addressable Command) - A value can be sent to the Counter for display using the H, K or L commands.

Remote Display (Single Value) - Using Serial Communications, a single value may be sent to a Counter without an input Signal Conditioner for display (e.g. +123.456 to display +123.456)

The following apply to the Slave Remote Display Mode:

1st Value in String - Displays the 1st measurement in a string.

2nd Value in String - Displays the 2nd in a string of 2 or more.

3rd Value in String - Displays the 3rd in a string of 3 or more.

4th Value in String - Displays the 4th in a string of 4.

Remote Display C - The Counter has special Remote Display capability using the following four items relating to the Remote Display string of data.

Start Char - The character designating the beginning of the string.

Stop Char - The character designating the end of the string.

Skip No. - The number of characters following the **Start Char** to be ignored.

Show No. - The number of characters immediately following the ignored characters to be displayed.

Example:
 * A B C D - 1 2 3 . 4 5 E F G # H I J K * etc.
 Start Skip Show Stop
 = * = 4 = 7 = #

The Remote Display value remains on the length of time set in **TimeOut** and then **ti-Out** is displayed. The value will be displayed indefinitely if **TimeOut** is set to 0.

OK

Click on the **Communication** tab to view the communication parameters that you used initially. You can reselect *Baud Rate*, *Device Address*, *Serial Protocol*, *Full/Half Duplex*, even though you may have selected different values to establish initial communications with your PC.

You can also define a *Custom Recognition Character* in lieu of the default *.

Ignore *Output Items*, *Output Filter*, *Output Rate*, *CR (LF)*, *RTS Type*, *Include Alarm Data*, *Include LF*, and *Transmission Chars*. These items only apply to data transmission by a counter, not to operation as a remote display.

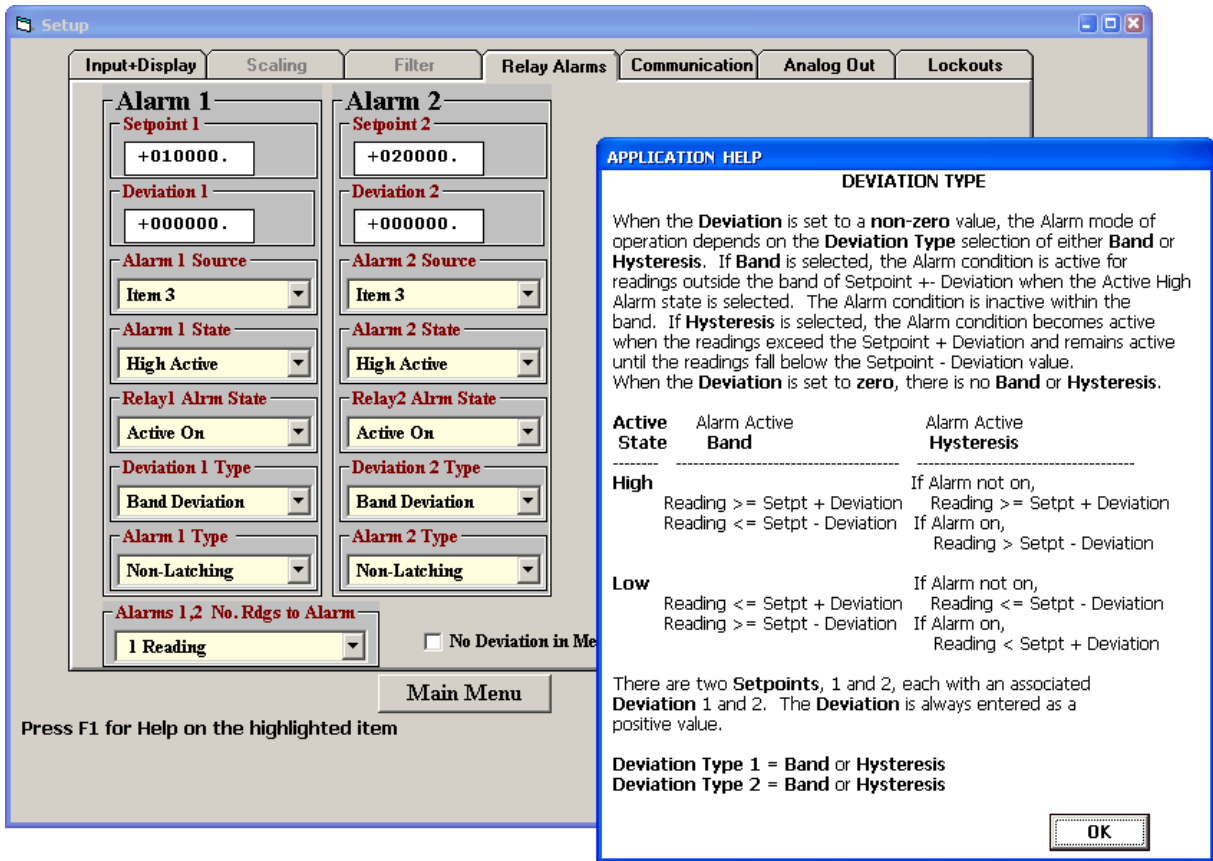
For the Custom ASCII Protocol only, the *Remote Display "C"* data entry fields will appear if you have selected *Rmt Disply C* under the *Input+Display* tab to allow data extraction from a longer data string. You can specify:

- *Start Char* = the decimal ASCII character designating the beginning of a string.
- *Stop Char* = the decimal ASCII character designating the end of the string.
- *Skip No.* = the decimal number of characters following the Start Char to be ignored.
- *Show No.* = the decimal number of characters immediately following the ignored characters to be displayed.

Example: *ABCD-123.45EFG#HIJK* etc.

Start = *, Skip = 4, Show = 7, Stop = #, data displayed = -123.45

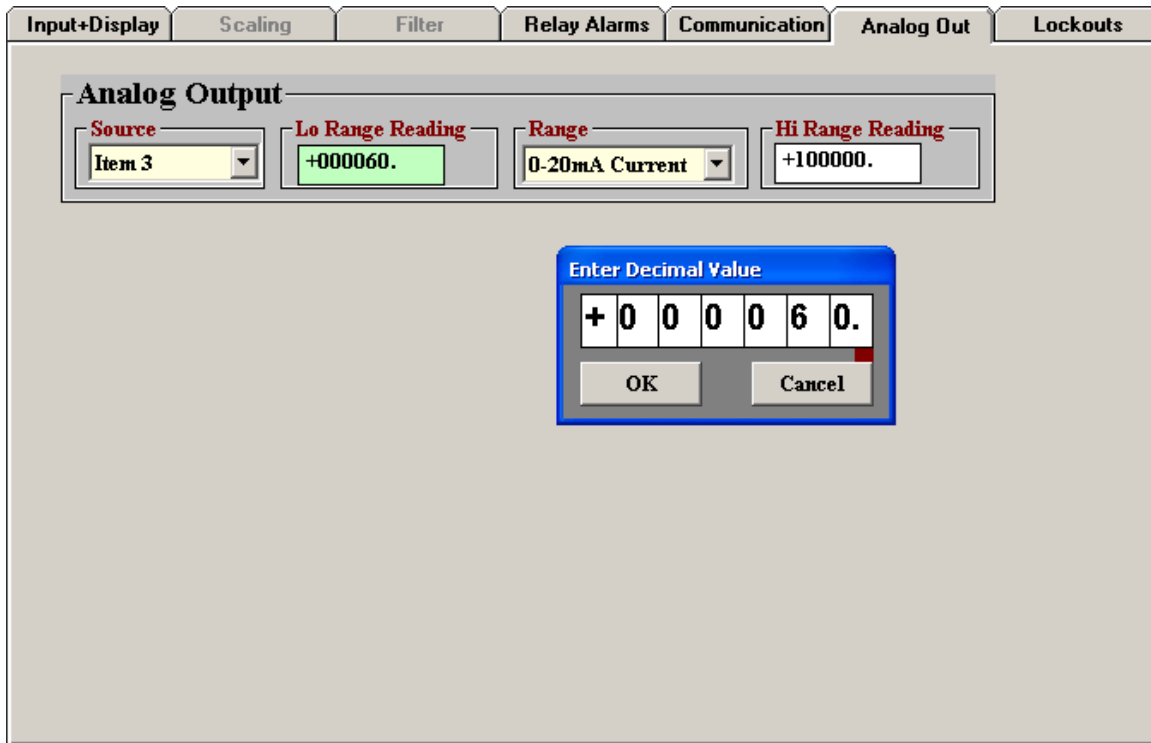
For the list of 127 possible ASCII start and stop characters and the corresponding decimal values to be entered, click on *ASCII Char Table*.



Click on the **Relay Alarms** tab to set up your meter's two or four optional relays. The same digital source is used for all relays and must be set to *Item 3* under *Alarm Source*. A separate *Setpoint* and a *Hysteresis* band or *Deviation* band can be set up for each relay. The relays will respond to your digital entries without decimal point.

For help with any selectable item, select that item with your cursor and press the F1 key. This will bring up a help window like the one shown.

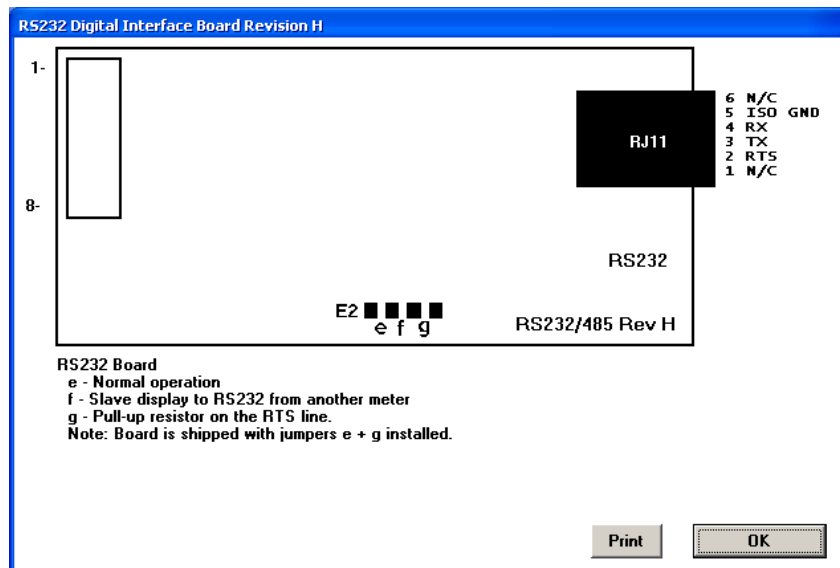
- **Alarm Type.** Selections are Non-Latching and Latching. Under Non-Latching, the relay is only closed (or open) while the Alarm State is Active. Under Latching, the activated relay remains closed (or opens) until reset regardless of the Alarm State. Resetting is normally achieved by temporarily grounding one of the transmitter's control inputs, which has been set to Function Reset under the "Input+Display" tab.
- **Alarms 1,2 No. Rdgs to Alarm.** Selections are binary steps from 1 to 128. This is the number of consecutive alarm readings that must occur to create an Active alarm. Numbers higher than 2 provide some Alarm filtering so that 1 or 2 noisy readings do not cause an Active Alarm. The Alarm becomes Inactive if one of the consecutive readings fails to be an Alarm reading. The Alarm readings counter then resets to 0.



Click on the **Analog Out** tab to scale your meter's optional single or dual analog outputs. *Item 3* must be selected as the *Analog Output Source*. With dual analog outputs, that same digital source will be used for both outputs, but the outputs can be scaled independently of each other. For each output, select *0-20 mA Current*, *0-10V Voltage*, or *4-20 mA* under *Range*. Enter the *Lo Range Reading* which will correspond to the bottom of your analog output (such as 4 mA). Enter the *Hi Range Reading* which will correspond to the top of your analog output (such as 20 mA). The analog output will then be interpolated between these two endpoints. The low and high readings will be interpreted without decimal point. For help with any selectable item, select that item and press the F1 key.

JUMPER PULL-DOWN MENU

The Jumpers pull-down menu shows jumper positions for selected plug-in boards.



14. COMMAND MODE WITH CUSTOM ASCII PROTOCOL

Laurel's Custom ASCII protocol allows the Remote Display to receive data in the form of ASCII text strings, which can be either in a streaming Continuous Mode or in a Command Mode, as described in the manual at <https://www.laurels.com/downloadfiles/serialcom2.pdf>.

To set up the Remote Display for Command Mode using the Custom ASCII Protocol, use IS software as described in a previous section of this manual. Select the Custom ASCII Protocol and Command Mode. Select the Analog Out type as 4-20 mA, 0-10 mA, 0-10V or -10V to +10V. Enter the Lo Range and Hi Range numerical readings which will serve as endpoints for the selected output type. Set the "Source" value to Item 3, which will be used for analog output interpolations and for relay setpoint comparisons.

Example on how to output 12 mA:

For setup:

1. Set the "Source" value to Item 3.
2. Set the Analog Out type to 4-20 mA.
3. Set the Lo Range Reading to 0 counts.
4. Set the Hi Range Reading is 10000 counts.

For normal operation, send ***1H005000**<CR><LF>

Recognition character: *

Address character: 1

Command character: H

Value: **005000**

Verify the analog output with a panel meter or multimeter.

15. COMMAND MODE WITH MODBUS RTU PROTOCOL

Laurel's implementation of the Modbus RTU protocol allows the Remote Display to receive data in the form of Modbus commands. As for the customer ASCII Protocol in Command Mode, these are used to write values to a variable called "Item 3", which will be used for analog output interpolations and for relay setpoint comparisons for relay action. Modbus commands are also available to overwrite setup parameters entered with IS Software "on the fly," including the following:

1. Change scale and offset or coordinates of 2 points parameters to generate the analog output derived from Item 3.
2. Change setpoints to control relay action derived from Item 3.
3. Force relay action regardless of Item 3
4. Reset latched alarms by forcing a Function Reset.

See Modbus the manual at <https://www.laurels.com/downloadfiles/Modbus-Manual-CTR.pdf> for a Modbus RTU overview and for all available Modbus commands for Counters, not just those for the Remote Display. In particular, see the long section entitled, "FC03 (READ) & FC10 (WRITE) HOLDING REGISTER ADDRESSES." Use Hi Word starting Register Addresses and an even number of Registers. The Register Addresses shown in this section apply to both FC03 and FC10. They are for Modbus numbering systems that start at 00 01 (Base 1). Subtract 1 from each Register Address for Modbus numbering systems that start at 00 00 (Base 0).

To write values to Item 3 with Base 1 addressing, write the Hi Word applied to Item 3 to hex register address **006C**, and the Lo Word applied to Item3 to hex register address **006D**. With Base 0 addressing, the Hi Word address becomes **006B**, and the Lo Word address becomes **006C**. The qModMaster example on the next page illustrates how to use Base 0 addressing to generate 4, 12 and 20 mA analog outputs.

Example on how to send the value 999999 to Item #3 of a Remote Display using the Modbus protocol:

1 10 00 6B 00 02 04 00 0F 42 3F F4 87

Address: **01**

Function Code: **FC10**

Holding Register: **006C**

Number of Registers Sent: **0002**

Number of Bytes Sent: **04**

Register Data: **000F 423F** (999999 in decimal)

CRC: **F487**

16. USING DIAGNOSTIC TOOL QMODMASTER

1. ABOUT QMODMASTER

qModMaster.exe is a freeware Windows program which allows a PC to serve as a Modbus Master. It is an easy-to-use tool to verify communications, send requests to Modbus Slaves, and view their responses. qModMaster works well with Base 0, but not with Base 1, so use it only with Base 0 and subtract 1 from the Register addresses listed in our Modbus Manual for Counters. For more information, see the qModMaster section of our Modbus Manual for Counters at <https://www.laurels.com/downloadfiles/Modbus-Manual-CTR.pdf>.

Download qModMaster from SourceForge at:
<https://sourceforge.net/projects/qmodmaster/files/latest/download>

Click on the downloaded file and install it in a directory of your choice. Create a desktop icon from the installed executable. Before using qModMaster, ensure that your Remote Display has been set to Modbus RTU as explained in the Instrument Setup (IS) software section of this manual.

2. EXAMPLE: USE MODBUS COMMANDS TO OUTPUT 4, 12 OR 20 mA

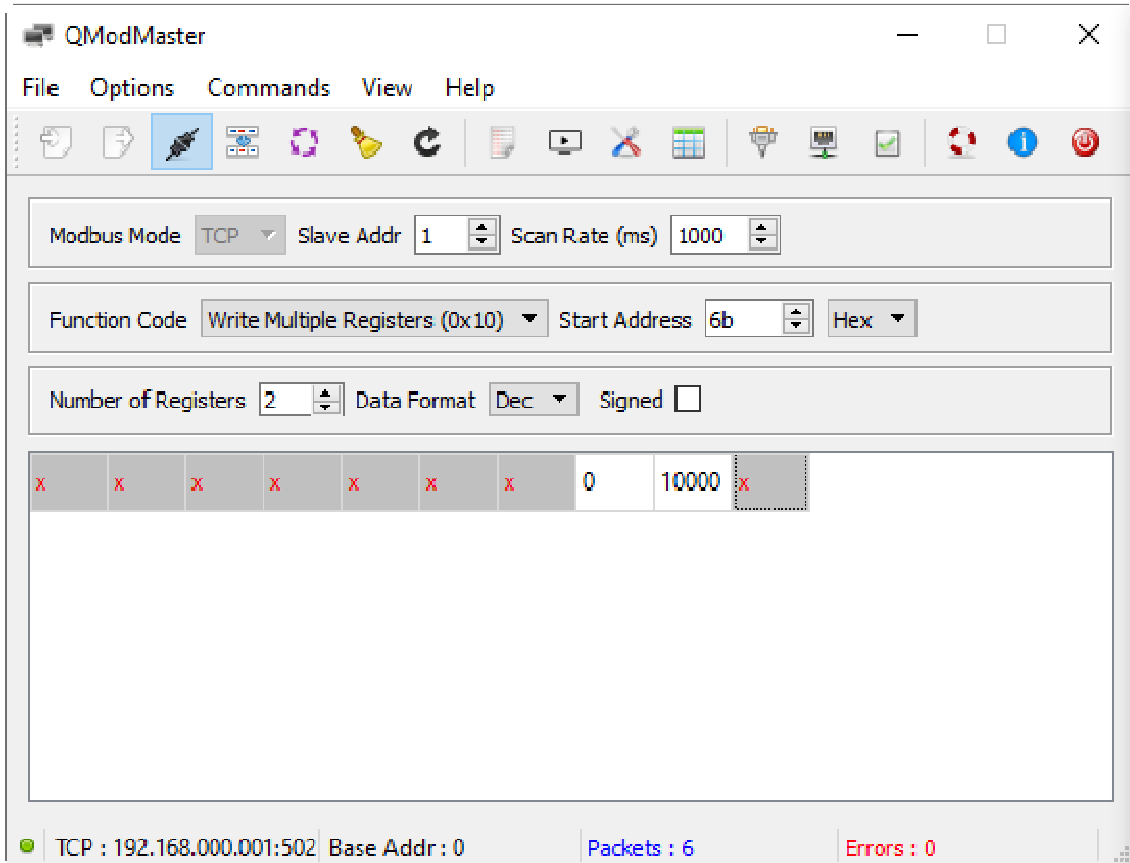
The task is to configure qModMaster to generate analog outputs of 4, 12 and 20 mA. This assumes that Instrument Setup (IS) software has already been used to set up the analog output as 4-20 mA with an Item 3 Lo Range Reading (for 0 mA) of +000000 and an Item 3 Hi Range Reading (for 20 mA) of +010000. These decimal values of 0, 5000 and 10000 form 32 bit hex values of 0000 0000, 0000 1388 and 0000 2710.

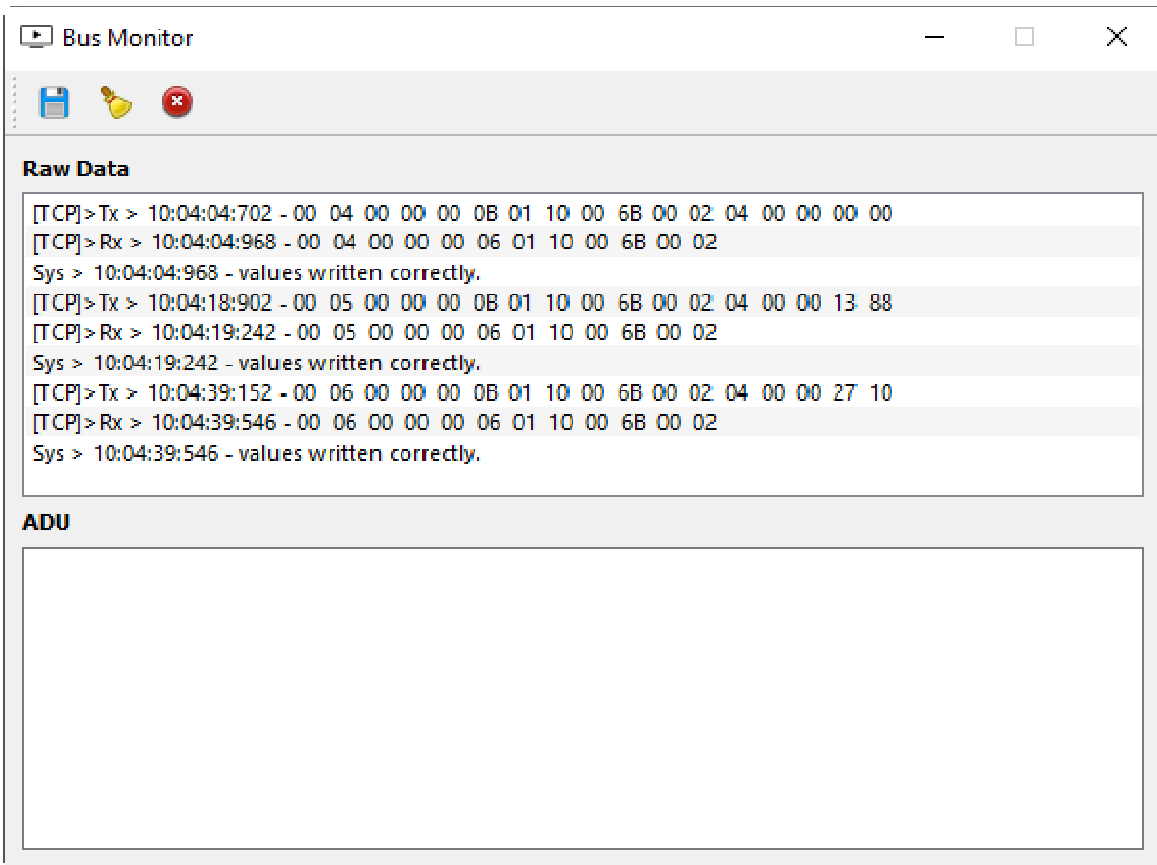
Launch qModMaster. A screen of the type shown below will appear. Under *View*, press *Bus Monitor*. Under *Options*, make the selections illustrated below. The entered serial port should be the number assigned by Windows Device Manager.

The image shows two screenshots of the qModMaster configuration dialog boxes. The left screenshot shows the 'Options' dialog with the following settings: Serial device (COM), Serial port (6), Baud (9600), Data Bits (8), Stop Bits (2), Parity (None), and RTS (Disable). The right screenshot shows the 'View' dialog with the following settings: Max No Of Bus Monitor Lines (60), Response Timeout (sec) (2), and Base Addr (1).

Note that that the entry in counts to be sent to Item 3 can be in Hex or Dec formats. Under *Commands*, press *Connect* to make the data connection. The Bus Monitor should show Tx and Rx "values written correctly." For information on these values, please see our Modbus Manual for Counters at <https://www.laurels.com/downloadfiles/Modbus-Manual-CTR.pdf>.

The screen captures below are for Modbus TCP, but the syntax is the same for Modbus RTU. An external panel meter or multimeter connected to the analog output should show the desired output currents.





3. EXAMPLE: USE MODBUS COMMANDS TO CONTROL TWO RELAYS

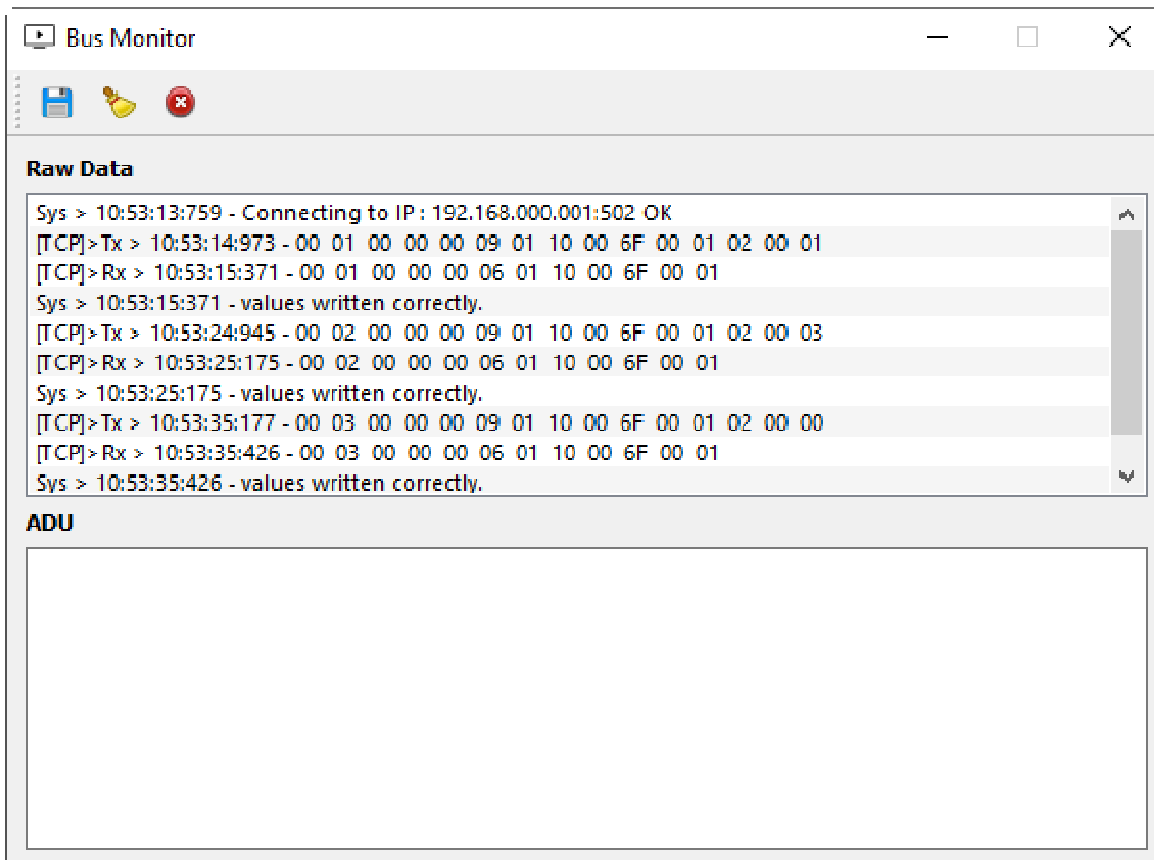
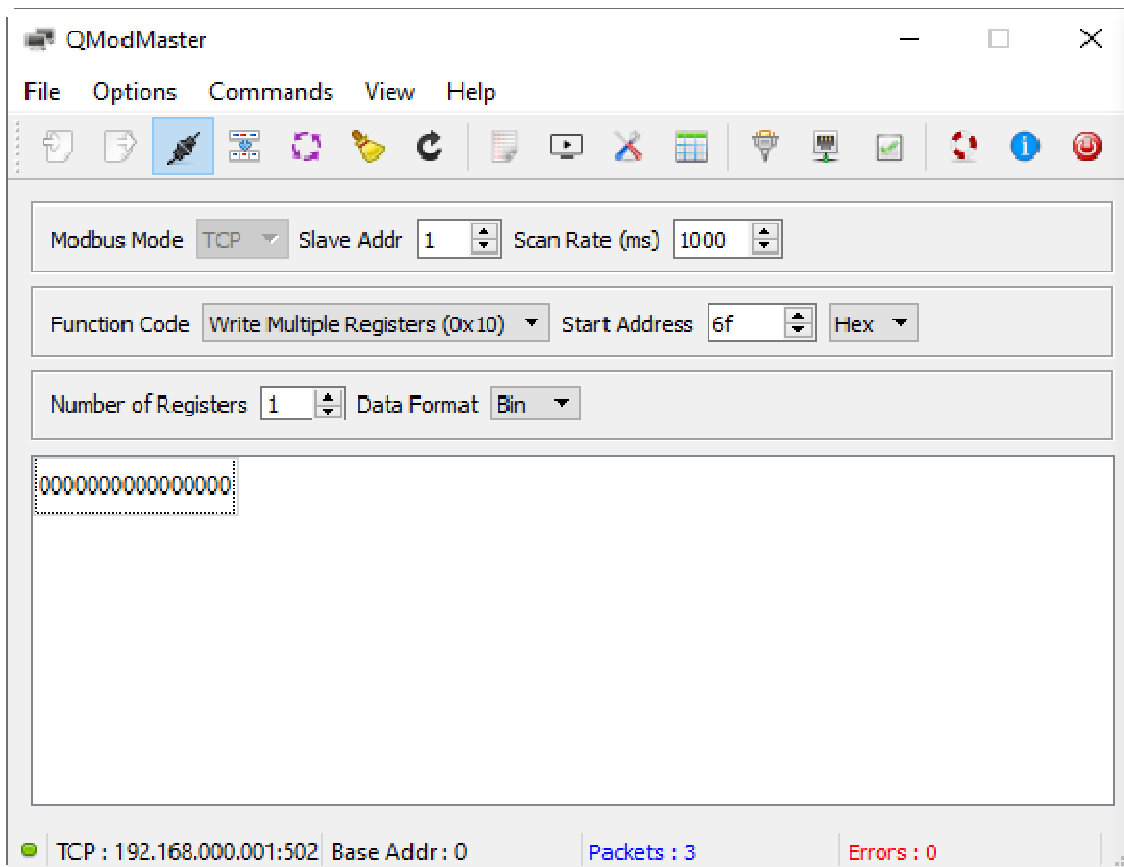
Using BASE 0 addressing, alarm relays are controlled by writing to holding register 0x006F. Bit 0 controls Relay 1. Bit 1 controls Relay 2.

First Alarm1 is forced by writing **01** to holding register 0x006. This turns Relay1 on.

Then Alarm2 is forced by writing **03** to holding register 0x006. This turns Relay2 on.

Both relays are turned off by writing **00** to holding register 0x006. The setup for this last command is seen in the qModMaster window.

The Bus Monitor window displays the result of all three write commands.






















17. DUAL & QUAD RELAY OUTPUT OPTIONS

An optional relay board may be installed in the meter main board at plug position P2, adjacent to the power supply board. Four board versions are available: 2 or 4 relays, contact or solid state. Once installed, the relay board is recognized by the meter software or PC-based Instrument Set-up software, which will bring up the appropriate menu items for the type of board. These menu items will not be brought up if a relay board is not detected. Menu selections for relays 3 and 4 will not be brought up if the dual relay board is detected. All relay boards offer a choice of operating modes: normally off or on, latched or non-latched, hysteresis band, deviation band, alarm based on filtered or unfiltered signal, and selectable number of readings in alarm zone for alarm. The source compared to the setpoint may be the displayed item or a non-displayed item. Please see the Glossary at the end of this manual for an explanation of special terms.







VIEWING & CHANGING SETPOINTS

The  (Alarms) key can be used to step through and view setpoints while the meter continues to make conversions and performs setpoint control. If the  (Peak) key is pressed while a setpoint is displayed, conversion stops and the setpoint can be changed. After pressing , you have 30 seconds, or the meter reverts to the normal display. To view setpoints, menu item Loc4, digit 4, must have been set to 0. To change setpoints, menu item Loc2, digit 6, must have been set to 0.

 Press Alarms Key	 Press Digit Select Key	 Press Value Select Key
3950.00 Press  (Alarms) to display Alarm 1 setpoint.	3950.00 Current setpoint 1 value blinks, and Alarm 1 LED indicator lights. Press  to select a digit, which will blink.	3050.00 To change setpoint 1 value, press  to change selected blinking digits.
3950.00 Press  (Alarms) to display Alarm 2 setpoint.	3950.00 Current setpoint 2 value blinks, and Alarm 2 LED indicator lights. Press  to select a digit, which will blink.	3050.00 To change setpoint 2 value, press  to change selected blinking digits.
3950.00 Press  (Alarms) to display Alarm 3 setpoint.	3950.00 Current setpoint 3 value blinks, and Alarm 3 LED indicator lights. Press  to select a digit, which will blink.	3050.00 To change setpoint 3 value, press  to change selected blinking digits.
3950.00 Press  (Alarms) to display Alarm 4 setpoint.	3950.00 Current setpoint 4 value blinks, and Alarm 4 LED indicator lights. Press  to select a digit, which will blink.	3050.00 To change setpoint 4 value, press  to change selected blinking digits.
3000.24 Press  (Alarms) again. Meter will reset and display the current reading.		

KEYSTROKES FOR SETUP

If the **MENU**  key does not work, see Section 9 “Enabling & Locking Out Menu Items.”

MENU  Press Menu	PEAK  Press Digit Select Key	RESET  Press Value Select Key
SourceE Source to compare to setpoint	0000 Setpoint 1:	3 Must be set to Item #3.
	0000 Setpoint 2:	3 Must be set to Item #3.
	0000 Setpoint 3:	3 Must be set to Item #3.
	0000 Setpoint 4:	3 Must be set to Item #3.
AL SEt Alarm Setup for relays 1 & 2 if detected. Press  until ALSEt is displayed.	00000 Relay state when alarm is active	0 Relay 1 on Relay 2 on 1 Relay 1 off Relay 2 on 2 Relay 1 on Relay 2 off 3 Relay 1 off Relay 2 off
	00000 Alarm latching or non-latching (auto reset) (see Glossary)	0 AL1 auto reset AL2 auto reset 1 AL1 latching AL2 auto reset 2 AL1 auto reset AL2 latching 3 AL1 latching AL2 latching
	00000 Alarm operates at and above setpoint (active high) or at and below setpoint (active low). (see Glossary)	0 AL1 active high AL2 active high 1 AL1 active low AL2 active high 2 AL1 disabled AL2 active high 3 AL1 active high AL2 active low 4 AL1 active low AL2 active low 5 AL1 disabled AL2 active low 6 AL1 active high AL2 disabled 7 AL1 active low AL2 disabled 8 AL1 disabled AL2 disabled
	00000 Hysteresis mode or band deviation mode (see Glossary)	0 AL1 band deviation AL2 band deviation 1 AL1 hysteresis AL2 band deviation 2 AL1 band deviation AL2 hysteresis 3 AL1 hysteresis AL2 hysteresis 4 No deviation or hysteresis on menu.
	00000 Number of consecutive readings in alarm zone to cause an alarm	0 After 1 reading 4 After 16 readings 1 After 2 readings 5 After 32 readings 2 After 4 readings 6 After 64 readings 3 After 8 readings 7 After 128 readings

MENU Press Menu	PEAK Press Digit Select Key	RESET Press Value Select Key
ALS 34 Alarm Setup for relays 3 & 4 if detected.	00000 Relay state when alarm is active.	0 Relay 3 on Relay 4 on 1 Relay 3 off Relay 4 on 2 Relay 3 on Relay 4 off 3 Relay 3 off Relay 4 off
	00000 Alarm latching or non-latching (auto reset). (see Glossary)	0 Alarm 3 auto reset Alarm 4 auto reset 1 Alarm 3 latching Alarm 4 auto reset 2 Alarm 3 auto reset Alarm 4 latching 3 Alarm 3 latching Alarm 4 latching
	00000 Alarm operates at and above setpoint (active high) or at and below setpoint (active low). (see Glossary)	0 AL3 active high AL4 active high 1 AL3 active low AL4 active high 2 AL3 disabled AL4 active high 3 AL3 active high AL4 active low 4 AL3 active low AL4 active low 5 AL3 disabled AL4 active low 6 AL3 active high AL4 disabled 7 AL3 active low AL4 disabled 8 AL3 disabled AL4 disabled
	00000 Hysteresis mode or band deviation mode (see Glossary)	0 AL3 band deviation AL4 band deviation 1 AL3 hysteresis AL4 band deviation 2 AL3 band deviation AL4 hysteresis 3 AL3 hysteresis AL4 hysteresis
	00000 Number of consecutive readings in alarm zone to cause an alarm.	0 One reading in the alarm zone will cause an alarm. This entry is ignored by remote display. Enter any number, such as 0.

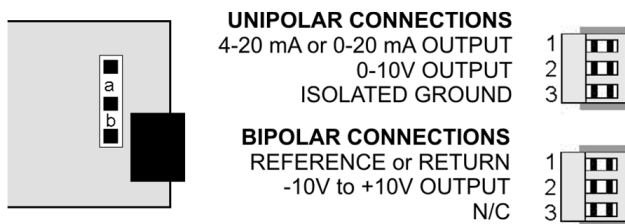
MENU Press Menu	PEAK Press Digit Select Key	RESET Press Value Select Key
dEUn1H Alarm 1 hysteresis	0.00000 0.00000 0.00000	Select 9 thru 9 for flashing first digit, 0 thru 9 for other flashing digits. Alarms will activate above the setpoint by the value entered and deactivate below the setpoint by the value entered. See Glossary.
DEUn2H Alarm 2 hysteresis	0.00000 0.00000 0.00000	
DEUn1b Alarm 1 band deviation	Select digit to flash	
DEUn2b Alarm 2 band deviation		
dEUn3H Alarm 3 hysteresis		
DEUn4H Alarm 4 hysteresis		
DEUn3b Alarm 3 band deviation		
DEUn4b Alarm 4 band deviation		

18. SINGLE & DUAL ANALOG OUTPUT OPTIONS

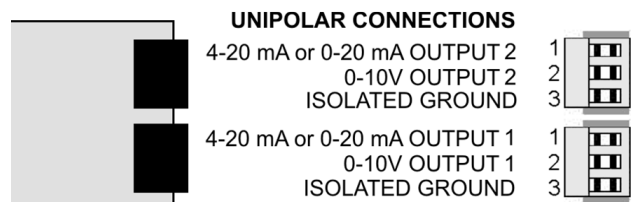
Two versions of an analog board may be installed in the meter at rear panel jack position J4, adjacent to the signal conditioner board. Once installed, this board is recognized by the meter, which will bring up the appropriate menu items for it. These will not be brought up if an analog output board is not installed.

A single analog output version can be configured for unipolar 4-20 mA current, 0-20 mA current or 0-10V voltage, or bipolar -10 to +10V voltage (with a 20V voltage swing). Unipolar or bipolar operation is selected by a jumper.

A dual analog output version can be configured for two unipolar outputs, which can each be 4-20 mA, 0-20 mA or 0-10V. Current or voltage output is selected at each connector.



Unipolar current or voltage: Jumper **a**
 Bipolar -10 to +10 voltage: Jumper **b**



No jumpers, only selections at the connectors.

With either board, current or voltage output is selected at the connector and in the Menu. The low analog output (0 mA, 4 mA, 0V, or -10V) may be set to correspond to any low displayed reading **An Lo**. The high analog output (20 mA, 0V or 10V) may be set to correspond to any high displayed reading **An Hi**. The meter will then apply a straight line fit between these two end points to provide an analog output scaled to the meter reading. The decimal point location is fixed by the **dEC.Pt1** selection.

The analog output is sourcing. Do not put an external voltage source in series with it. Applying an external 24 Vdc source will burn out the analog output board.

KEYSTROKES FOR SETUP OF SINGLE ANALOG OUTPUT BOARD





If the **MENU** key does not work, see Section 9 “Enabling & Locking Out Menu Items.”

Press Menu Key	Press Digit Select Key	Press Value Select Key
An SEt Analog Output Setup. Press until AnSEt is displayed.	00 Calibration output selection.	0 0-20 mA current output 1 0-10V voltage output 2 4-20 mA current output 3 -10V to+10V voltage output
	03 Analog output source.	3 Must be set to Item #3.

An Lo Low displayed value for -10V, 0V, 0 mA, or 4 mA	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 Select digit to flash	Select 0 thru 9 for flashing digit.
An Hi High displayed value for 10V or 20 mA output	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 Select digit to flash	Select 0 thru 9 for flashing digit.

KEYSTROKES FOR SETUP OF DUAL ANALOG OUTPUT BOARD

If the **MENU**  key does not work, see Section 9 “Enabling & Locking Out Menu Items.”

MENU  Press Menu Key	PEAK  Press Digit Select Key	RESET  Press Value Select Key
An SEt Analog Output Setup. Press  until AnSEt is displayed.	0000 Scaling of analog output 2	0 0-20 mA current output 1 0-10V voltage output 2 4-20 mA current output
	0000 Source of analog output 2	3 Must be set to Item #3.
	0000 Scaling of analog output 1	0 0-20 mA current output 1 0-10V voltage output 2 4-20 mA current output
	0000 Source of analog output 1	3 Must be set to Item #3.
An Lo1 Low displayed value for 0V, 0 mA, or 4 mA output	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 Select digit to flash	Select 0 thru 9 for flashing digit.
An Hi1 High displayed value for 10V or 20 mA output	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 Select digit to flash	Select 0 thru 9 for flashing digit. dEC.Pt1 selection.
An Lo2 Low displayed value for 0V, 0 mA, or 4 mA output	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 Select digit to flash	Select 0 thru 9 for flashing digit.
An Hi2 High displayed value for 10V or 20 mA output	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 Select digit to flash	Select 0 thru 9 for flashing digit.

19. SPECIFICATIONS

DISPLAY

Type 6 LED digits, 7-segment, 14.2mm, plus 4 LED indicators
Digit Color Red or green
Display Range -999999 to +999999

POWER REQUIREMENTS

Input Voltage rating (standard) 85-264 Vac or 90-300 Vdc
Input Voltage rating (low voltage option) 12-32 Vac or 10-48 Vdc
Power Line Frequency DC and 47-63 Hz
Power Consumption, Max 4 Watts

DUAL OR QUAD RELAY OPTIONS

Power to relay option Powered by meter
Setpoint setup Via front panel pushbuttons or RS232/485
Response time Serial input update rate
Actuation Modes (selectable) Above or below setpoint, latching or non-latching, disabled
Front Panel Enable / Lockout Modes (selectable) 1) Display and change setpoints
2) Display but do not change setpoints
3) Neither display nor change setpoints
Alarm Status Indication 2 or 4 red LED lamps
Status Indication Setup (selectable) Lit when output is ON or OFF

Form C, SPDT Relay Output:

AC Rating 8A @ 240 Vac
DC Rating 8A @ 24 Vdc
Isolation rating between signal common and contacts 250 Vac
Insulation dielectric strength between signal common and contacts
..... 3.5 kV ac for 5 sec, 2.3 kV ac for 1 min

Form A, SPST Solid State Relay Output:

AC Rating 130 mA @ 140 Vac
DC Rating 130 mA @ 180 Vdc
Isolation rating between signal common and contacts 250V ac
Insulation dielectric strength between signal common and contacts
..... 3.5 kV ac for 5 sec, 2.3 kV ac for 1 min

ANALOG OUTPUT OPTIONS

Power to Analog Output Option Powered by meter
Output Levels, Single Analog Output Option 0-20 mA, 4-20 mA, 0-10V, -10 to +10V
Output Levels, Dual Analog Output Option 0-20 mA, 4-20 mA, 0-10V
Voltage Compliance, 0-20 mA Output 12V (0-600 Ohm load)
Current Compliance, 0-10V Output 2 mA (5 kOhm or higher load)
Accuracy $\pm 0.01\%$ of full scale analog output
Resolution 16 bit (1 part in 65,536)
Response Time Serial input update rate
Scaling of Reading for Zero Output -999,999 to +999,999

Scaling of Reading for Full Scale Output..... -999,999 to +999,999
 Isolation rating between signal common and analog output..... 250V ac
 Insulation dielectric strength between signal common and analog output.....
 3.5 kV ac for 5 sec, 2.3 kV ac for 1 min

SERIAL INTERFACE OPTIONS

Output Types.....RS232, RS485, RS485-Modbus, USB
 USB-to-RS485 converter, Ethernet, Ethernet-to-RS485 converter
 Power to Interface Option.....Powered by meter
 RS485 Wiring Half or full duplex
 Baud Rates 300, 600, 1200, 2400, 4800, 9600, 19200
 Serial Protocols Custom ASCII, Modbus RTU, Modbus ASCII (selectable)
 Signal Levels..... Meet RS232, RS485, USB, Ethernet standards
 Isolation rating between signal common and serial I/O 250V ac
 Insulation dielectric strength between signal common and serial I/O
 3.5 kV ac for 5 sec, 2.3 kV ac for 1 min

Option Board Connectors:

RS232 (com option 1) Single RJ11 jack
 RS485 (com option 2) Two RJ11 jacks (for daisy chaining with 6-wire data cables)
 RS485 (com option 4) Two RJ45 jacks (for daisy chaining with 8-wire data cables)
 USB (com option 5) USB type B plug
 USB-to-RS485 converter (com option 6)USB type B plug plus RJ11 jack to RS485 bus
 Ethernet (com option 7)..... Single RJ45 to Ethernet
 Ethernet-to-RS485 converter (opt 8) ..RJ45 jack to Ethernet plus RJ11 jack to RS485 bus

ENVIRONMENTAL

Operating Temperature0°C to 55°C
 Storage Temperature -40°C to 85°C
 Relative Humidity 95% from 0°C to 40°C, non-condensing
 Case NEMA-4X (IP65) from front when panel mounted (not verified for UL)
 Shock 10 G at 1 kHz, applied in X, Y, Z axes
 Vibration 15 Hz to 150 Hz, 1 mm to 2 mm amplitude, 20 G max.

20. GLOSSARY OF TERMS

Alarm, latched: An alarm which stays actuated until reset. Latched alarms can shut down machinery or a process when an operating limit has been exceeded, or maintain an alarm condition until acknowledged by an operator.

Alarm, non-latched: An alarm which changes state automatically when the reading rises above a specified limit and changes back automatically when the reading falls below a limit.

Custom ASCII protocol: A simplified protocol for use with panel meters, counters and timers. It allows 31 digital addresses. Not an industry-standard protocol, like the more complex *Modbus protocol*.

Deviation band: A band in counts which controls relay action symmetrically around a *setpoint*. The relay actuates when the reading falls within the deviation band, and de-actuates when the reading falls outside of this band. A deviation limit (e.g., 50 counts) is set up around both sides of the setpoint to create a deviation band (e.g., 100 counts). Setting up a passband around a setpoint is often used for component testing. Deviation limits are programmed by entering menu item *dEUn1b* for Alarm 1 and *dEUn2b* for Alarm 2.

Function reset: A rear panel input or keystroke action which resets any latched alarms.

Hysteresis band: A band in counts which controls relay action symmetrically around a setpoint. The relay closes (or opens) when the reading goes above the setpoint plus one hysteresis limit, and opens (or closes) when the reading falls below the setpoint less one hysteresis limit. A narrow hysteresis band is often used to minimize relay chatter around a setpoint due to electrical noise or signal feedback caused by load switching. A wide hysteresis band can be used for control applications.

Item #: A numerical value generated by a counter and available for display or data output via serial communications. For example, in the A+B totalizer mode, the sum of A+B is Item #1, Total A is Item #2, and Total B is Item #3. Each item can be displayed by a Remote Display if the appropriate *Display Type* is selected under the *Input+Display* tab.

Meter Reset: A rear panel input or front panel keystroke action which resets the meter like

Half duplex: RS485 serial communications implemented with two wires, allowing data transmission in both directions, but not simultaneously.

Full duplex: RS485 serial communications implemented with four wires, allowing data transmission in two directions simultaneously.

Setpoint: A value compared to the reading to determine the state of a relay. Term often used interchangeably with "alarm setpoint."

Time-out: How long a serial reading will be displayed in the absence of a new serial input. If timeout is set to 0, the display will persist indefinitely in the absence of a new input.

21. WARRANTY

Laurel Electronics Inc. warrants its products against defects in materials or workmanship for a period of one year from the date of purchase.

In the event of a defect during the warranty period, the defective unit may be returned to the seller, which may be Laurel or a Laurel distributor. The seller may then repair or replace the defective unit at its option. In the event of such a return, freight charges from the buyer shall be paid by the buyer, and freight charges from the seller shall be paid by the seller.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from:

1. Improper installation or miswiring.
2. Improper or inadequate maintenance.
3. Unauthorized modification or misuse.
4. Operation outside the environmental specifications.
5. Mishandling or abuse.

The warranty set forth above is exclusive and no other warranty, whether written or oral, is expressed or implied. Laurel specifically disclaims implied warranties of merchantability and fitness for a particular purpose.

Any electronic product may fail or malfunction over time. To minimize risks associated with reliance on Laurel products, users are expected to provide adequate system-level design and operating safeguards. Laurel's products are intended for general purpose industrial or laboratory use. They are not intended nor certified for use in life-critical medical, nuclear, or aerospace applications, or for use in hazardous locations.

EXCLUSIVE REMEDIES

The remedies provided herein are Buyer's sole and exclusive remedies. In no event shall Laurel be liable for direct, indirect, incidental or consequential damages (including loss of profits) whether based on contract, tort, or any other legal theory.