LAUREL
ELECTRONICS, INC.

Laureate™ Quadrature Encoder Position & Rate Meter

Features

- **Accepts low-level differential or single-ended 5V logic level outputs from quadrature encoders**
- **Quadrature count x1, x2 or x4**
- **Combined encoder pulse rate to 250 kHz**
- **Programmable display update rate up to 25/s**
- **Zero channel input 6-digit red or green LED display**
- **Universal AC power Input, 85-264 Vac**
- **Isolated 5, 10 or 24 Vdc excitation output**
- **NEMA 4X, 1/8 DIN case**
- **Optional serial I/O: Ethernet, USB, RS232, RS485, Ethernet-to-RS485 converter**
- **Optional relay outputs: dual or quad relays, contact or solid state**
- **Optional isolated analog output: 4-20 mA, 0-20 mA, 0-10V, -10 to +10V**
- **Optional low voltage power: 10-48 Vdc or 12-32 Vac**

Description

Position, Length or Angle Measurement

The Laureate™ quadrature meter with the Standard counter main board accepts the A & B quadrature signals from linear encoders and shaft encoders to provide a highly accurate, scaled display of position, length, or angle in engineering units, such as ft, cm or degrees. The A & B quadrature signals are 90° out of phase, and their phase relationship determines whether up counts (+) or down counts (-) are counted. The meter totalizes the counts and then scales the total in software for display and control. A zero index signal, or Z signal, may be added as a third input to the A & B signals.

Scaled Rate Measurement

Use of the Extended counter main board can convert the quadrature meter from scaled position to scaled rate. For example, it can display the speed of a moving slab in ft/sec. Simultaneous display of position and rate will require two meters. The display and control output update rate for position or rate is normally set to a maximum of 25/s, as determined by a user-programmable gate time.

Quadrature Meter Capabilities

- **One, two or four transitions** may be counted at a maximum combined rate of 250 kHz and be mathematically scaled for display in engineering units from -999,999 to +999,999. The quadrature board has input circuitry which may be jumpered for either single-ended input signals or for balanced line driver signals. Anti-jitter circuitry eliminates errors produced by vibration of the encoder.
- **A zero index pulse,** if available, is interpreted by the meter as indicating a zero reference for an integral number of revolutions of a rotary shaft encoder or the home position of a linear encoder. It is used by the meter for initializing and to correct for any cumulative pulse count errors. Special circuitry corrects for width of the zero index pulse.
- **In the event of a power failure,** the latest total may be stored in non-volatile memory and can be used as the starting point for counting when power resumes. Power fail save or zero index capabilities are alternate meter setup choices.

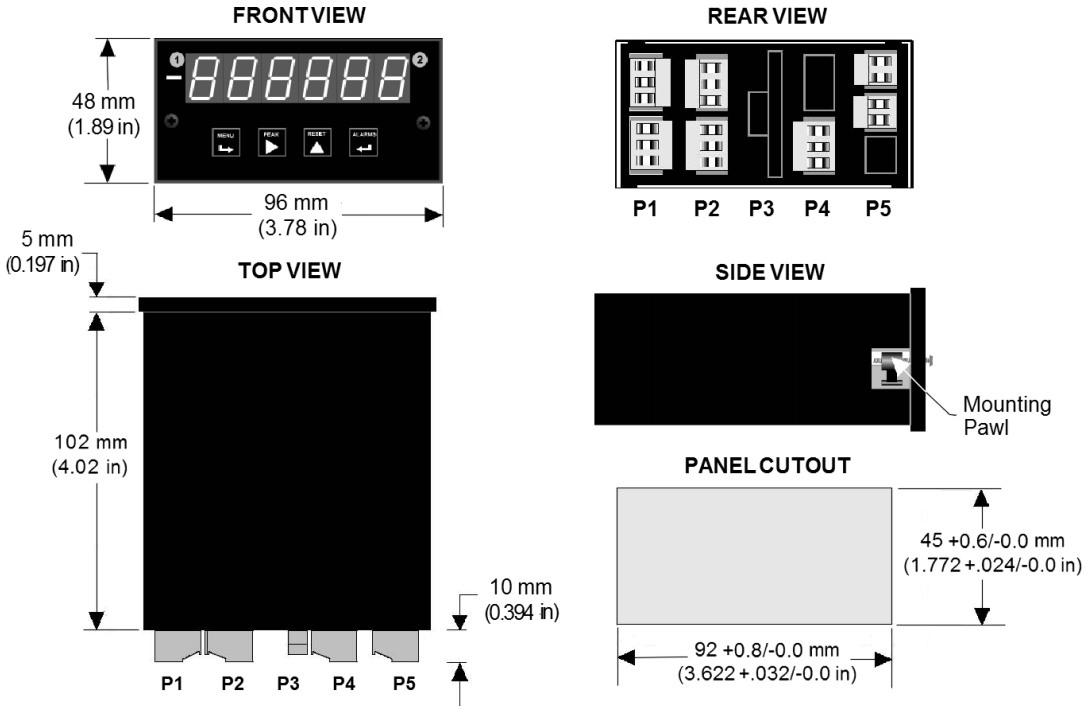
Designed for system use. Optional plug-in boards include Ethernet and other serial communication boards, dual or quad relay boards, and an isolated analog output board. Laureates may be powered from 85-264 Vac or optionally from 12-32 Vac or 10-48 Vdc. The display is available with red or green LEDs. The 1/8 DIN case meets NEMA 4X (IP65) specifications from the front when panel mounted. Any setup functions and front panel keys can be locked out for simplified usage and security. A built-in isolated 5, 10, or 24 Vdc excitation supply can power transducers and eliminate the need for an external power supply. All power and signal connections are via UL / VDE / CSA rated screw clamp plugs.

Specifications

Display	
Readout	6 LED digits, 7-segment, 14.2 mm (.56"), red or green LED
Display Range	-999999 to +999999, XXXXEX notation beyond 999999
Zero Adjust	-999999 to +999999
Span Adjust	0 to 999999
Indicators	Four LED lamps
Inputs	
Type	Differential or single-ended quadrature
Transitions Monitored	x1, x2 or x4
Max Pulse Rate	250 kHz at x1, 125 kHz at x2, 62.5 kHz at x4
Position Error	No error contributed by meter
Differential high threshold	+200 mV
Differential low threshold	-200 mV
Differential common mode	± 7V
Single-ended high voltage	2.5V to 10V
Single-ended low voltage	-1V to +1V
Input Resistance, typ.	17 kOhm
Quadrature Position Mode	
Zero Adjust	-999999 to +999999
Span Adjust	0 to 999999
Quadrature Rate Mode	
Conversion Technique	Inverse period
Conversion Time	Gate time + 30 ms + 0-2 signal periods
Gate time	Selectable 10 ms to 199.99 s
Time Before Zero Output	Selectable 10 ms to 199.99 s
Output & Display Update	Same as conversion time
Time Base Accuracy	Calibrated to ±2 ppm
Power	
Voltage, standard	85-264 Vac or 90-300 Vdc
Voltage, optional	12-32 Vac or 10-48 Vdc
Power frequency	DC or 47-63 Hz
Power consumption (typical, base meter)	1.2W @ 120 Vac, 1.5W @ 240 Vac, 1.3W @ 10 Vdc, 1.4W @ 20 Vdc, 1.55W @ 30 Vdc, 1.8W @ 40 Vdc, 2.15W @ 48 Vdc
Power isolation	250V rms working, 2.3 kV rms per 1 min test
Excitation Output (standard)	
5 Vdc	5 Vdc ± 5%, 100 mA
10 Vdc	10 Vdc ± 5%, 120 mA
24 Vdc	24 Vdc ± 5%, 50 mA
Output Isolation	50 Vdc to meter ground
Analog Output (optional)	
Output Levels	4-20 mA, 0-20 mA, 0-10V, -10 to +10V (single-output option) 4-20 mA, 0-20 mA, 0-10V (dual-output option)
Current compliance	2 mA at 10V (> 5 kΩ load)
Voltage compliance	12V at 20 mA (< 600Ω load)
Scaling	Zero and full scale adjustable from -99999 to +99999
Resolution	16 bits (0.0015% of full scale)
Isolation	250V rms working, 2.3 kV rms per 1 min test (dual analog outputs share the same ground)
Relay Outputs (optional)	
Relay Types	2 Form C contact relays or 4 Form A contact relays (NO) 2 or 4 Form A, AC/DC solid state relays (NO)
Current Ratings	8A at 250 Vac or 24 Vdc for contact relays 120 mA at 140 Vac or 180 Vdc for solid state relays
Output common	Isolated commons for dual relays or each pair of quad relays

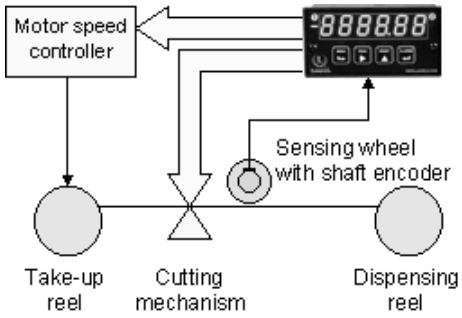
Isolation	250V rms working, 2.3 kV rms per 1 min test
Serial Data I/O (optional)	
Board Selections Protocols Data Rates Digital Addresses Isolation	Ethernet, Ethernet-to-RS485 converter, USB, USB-to-RS485 converter, RS485 (dual RJ11), RS485 Modbus (dual RJ45), RS232. Modbus RTU, Modbus ASCII, Laurel ASCII protocol 300 to 19200 baud 247 (Modbus), 31 (Laurel ASCII), 250V rms working, 2.3 kV rms per 1 min test
Environmental	
Operating Temp. Storage Temp. Relative Humidity Protection	0°C to 55°C -40°C to 85°C 95% at 40°C, non-condensing NEMA-4X (IP-65) when panel mounted

Mechanical



Application Examples

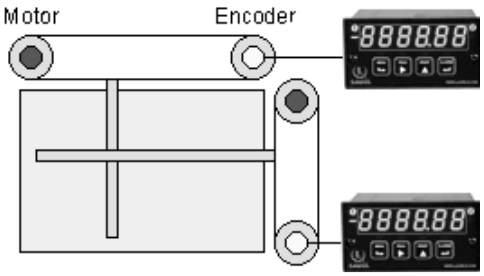
Using Quadrature for Cutting to Length



Controlling the repetitive cutting of material to length is an excellent application of the Laureate quadrature meter.

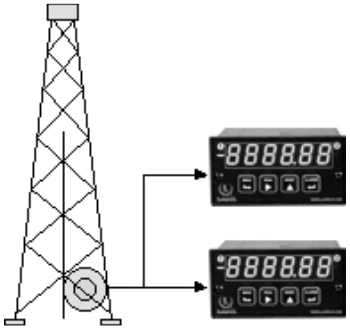
The quadrature encoder shares the shaft of a sensing wheel, whose rotation corresponds to lineal displacement of material. The meter compares the displacement reading against setpoint information, and then uses its dual relays to first slow down and then cut the material.

Using Quadrature for X-Y Positioning



Accurate X-Y position or rate can be obtained from two shaft encoders, which convert linear position to quadrature signals as a shaft turns. In addition to serving as a display, each Laureate can use its optional dual relay setpoint capability for closed loop control. It can also transmit data via RS-232, RS-485, or a 4-20 mA analog signal.

Using Quadrature to Monitor a Drilling Operation



Quadrature can be used to track position and vertical drilling speed of the bit in an oil drilling operation. A shaft encoder is rotated by a cable that moves with the drilling shaft.

In this application, the same encoder signal is applied to a Laureate quadrature meter for position, and to a second quadrature meter for rate. Both meters can be scaled to read out in appropriate engineering units, such as feet and inches per minute, and can be alarmed. A Laureate 6-digit remote display could be added to read out peak rate.

Ordering Guide

Create a model number in this format: **L50000QD, IPC**

Main Board	**L5** Standard Main Board, Green LEDs (for position) **L6** Standard Main Board, Red LEDs (for position) **L7** Extended Main Board, Green LEDs (for position or rate) **L8** Extended Main Board, Red LEDs (for position or rate)
Power	**0** Isolated 85-264 Vac **1** Isolated 12-32 Vac or 10-48 Vdc
Relay Output (isolated)	**0** None **1** Two 8A Contact Relays **2** Two 120 mA Solid State Relays **3** Four 8A Contact Relays **4** Four 120 mA Solid State Relays
Analog Output (isolated)	**0** None **1** Single isolated 4-20 mA, 0-20 mA, 0-10 V, -10 to +10V **2** Dual isolated 4-20 mA, 0-20 mA, 0-10V
Digital Interface (isolated)	**0** None **1** RS-232 **2** RS485 (dual RJ11 connectors) **4** RS485 Modbus (dual RJ45 connectors) **5** USB **6** USB-to-RS485 converter **7** Ethernet **8** Ethernet-to-RS485 converter
Input Type	**QD** Quadrature Signal Conditioner
Add-on Options	**CBL01** RJ11-to-DB9 cable. RJ11 to DB9. Connects RS232 ports of meter and PC. **CBL02** USB-to-DB9 adapter cable. Combination of CBL02 and CBL01 connects meter RS232 port to PC USB port. **CBL03-1** 6-wire data cable, RJ11 to RJ11, 1 ft. Used to daisy chain meters via RS485. **CBL03-7** 6-wire data cable, RJ11 to RJ11, 7 ft. Used to daisy chain meters via RS485. **CBL05** USB cable, A-B. Connects USB ports of meter and PC. **CBL06** USB to RS485 adapter cable, half duplex, RJ11 to USB. Connects meter RS485 port to PC USB port. **CASE1** Benchtop laboratory case for one 1/8 DIN meter **CASE2** Benchtop laboratory case for two 1/8 DIN meters **IPC** Splash-proof cover **BOX1** NEMA-4 Enclosure **BOX2** NEMA-4 enclosure plus IPC **BL** Blank Lens without button pads **NL** Meter lens without button pads or Laurel logo