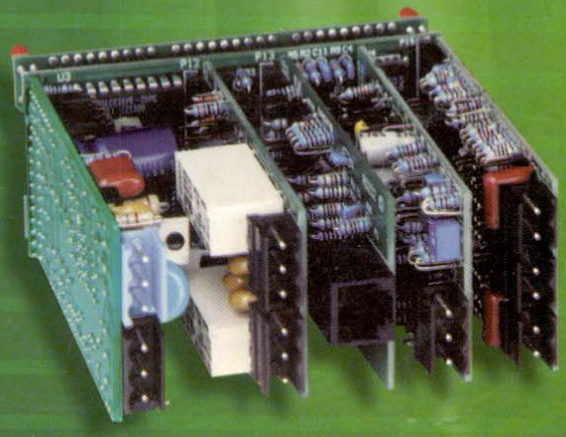
LAUREL®
ELECTRONICS, INC.

Panel Instrumentation Data Book

- Digital Panel Meters
- Setpoint Controllers
- Counters & Timers
- Remote Displays



About Laurel Electronics & FLW, Inc.

Company Background

Founded in 1990, Laurel Electronics Inc. has emerged as the technical leader in modular, microprocessor-based panel instrumentation for indication, data interface and control. Even though Laurel is young, its experience with digital panel meters and counters goes back to the early 1970's.

Laurel's founder and technology leader, Barret B. Weekes (left), an MIT graduate, also founded Newport Electronics, Inc., where he served as president and principal designer for 25 years. Laurel's vice president of sales and marketing, James K. Way (right), has served the instrumentation needs of value-added distributors since the early 1980's. The working relationship between the founding teams of Laurel Electronics and FLW goes back more than 25 years.

Designed and built in Costa Mesa, CA

Laurel's Laureate line is designed and manufactured at Laurel's plant in Costa Mesa, California, but a few minutes from FLW's headquarters. Physical proximity allows a close working relationship between both companies.

Unmatched performance and flexibility

Laurel's Laureate intelligent panel meters and counters combine exceptional accuracy with high speed, ease of use, compact size, ruggedness and low cost – an unbeatable combination for industrial applications. A wide selection of options and advance software make tough applications easy.

Plug-in modularity and programmability

Laureate panel meters and counters provide a choice of display boards, computer boards (or main boards), power supply boards, signal conditioner boards, setpoint controller boards, analog output boards, and digital interface boards. This allows each Laureate to be customized for a broad range of applications from simple monitoring to control and computer interface. All of the boards are of the plug-in type, so that instruments can be configured or reconfigured as needed.

Many of the same boards are also used in the Laureate series of remote displays, which can provide the same analog and relay control outputs as the panel meters and counters.

Advanced software provides exceptional performance and low-cost solutions to a wide range of industrial measurement and control problems.

Shipped ready to run by FLW

The needs of end-users are serviced by FLW and Laurel working as a team. If you have a challenging measurement and control application, contact FLW, which will work with Laurel as needed. If it can be done with a low-cost digital panel meter or counter, chances are that the FLW / Laurel team will come up with a superior, cost-effective solution.

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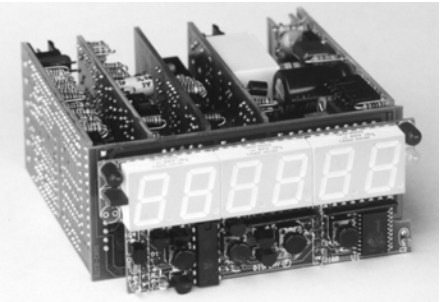
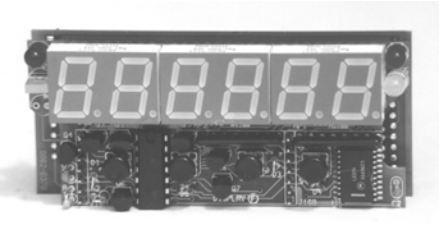


Modular Hardware

The design of the Laureate™ Series is modular for maximum flexibility at minimum cost. The base configuration for a panel meter or counter consists of a main module (with computer and plug-in display boards), a power supply board, and a signal conditioner board.

Optional plug-in boards include an isolated setpoint controller board, an isolated analog output board, and an isolated digital interface board.

Modular design and a choice of plug-in options allow the Laureate™ to be customized for a broad range of applications from simple monitoring to control and computer interface. There can be up to five plug-in boards in a fully-loaded Laureate.



Main Module

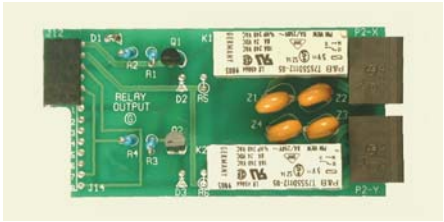
The main module (with computer and display boards) defines the Laureate series (DPM, weight meter, counter, or remote display), version (standard or extended), and LED display color (red or green). The number of digits is 5 for DPMs or 6 for counters, weight meters and remote displays. Digits are a full 14.2 mm (0.56") high.

Power Supply Boards

The same standard switching power supply board handles inputs of 85-264 Vac and 90-370 Vdc. An optional low voltage power supply board handles 8-28 Vac and 9-37 Vdc, allowing the meter to be powered by batteries. Isolated 5, 10 or 24 Vdc transducer excitation output is standard with either supply.

Signal Conditioner Boards

Input boards available for DPMs are DC (volts, amps, strain, process, pot follower), temperature (thermocouple, Pt 100 RTD), true RMS (AC volts, amps), and load cell (6-wire ratio). Input boards for weight meters can be DC or 6-wire ratio. Input boards available for counters are dual-channel (counter, timer, rate meter), V-to-F converter (rate, integrating totalizer), and quadrature (rate, position, length).



Setpoint Controller Boards

Two isolated setpoint controller options can add control and alarm capability: a board with two Form C electromechanical relays rated 10 A, 250 Vac, and one with two Form A AC/DC solid state relays for high duty cycle control applications.

Analog Output Board

An optional isolated analog output board can provide 0-10 Vdc and 4-20 mA outputs to drive a chart recorder or for transmission to a control room. The outputs are linearized and independently scaled to the display.

Digital Interface Boards

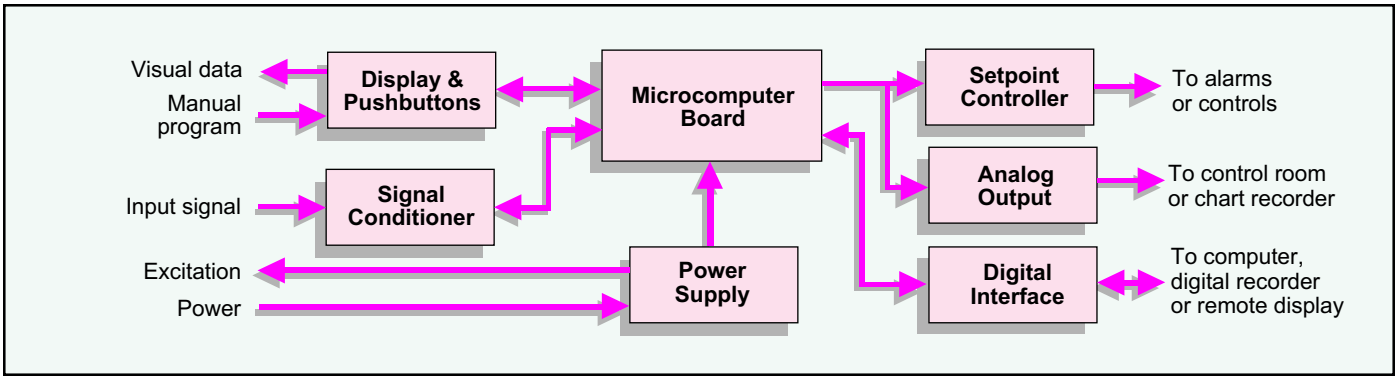
Optional isolated interface boards can provide RS-232 or RS-485 serial I/O, or isolated parallel BCD output. These allow the Laureate to communicate with a computer or PLC, or serve as a remote display.

Designed for Industrial Installation

All Laureates are housed in a compact 1/8 DIN case which fits in a standard 45 x 92 mm panel cutout and requires only 102 mm (4.0") behind the panel (plus connectors). In many applications, a Laureate can replace a larger, more expensive instrument.

All power and signal connections are via UL / IEC / CSA rated screw-clamp terminals, which are standard. The RS-232 and RS-485 options are connected via an RJ-11 phone jack. The BCD option uses a 30-pin, 0.1" mass termination ribbon cable connector.

The Laureate case is sealed to NEMA 4X (IP65) requirements from the front when panel mounted. This allows high-pressure washdown.



FLW, 3505 Cadillac Ave., Bldg E, Costa Mesa, CA 92626, USA ● Tel: (714) 751-7512 ● www.flw.com

DPM Functions

- DC Volts, mV, µV
- DC Amps & mA
- Process signals, Volts & 4-20 mA
- Thermocouples & RTDs
- Strain gauges
- Load cells, 4 and 6-wire
- Weight / scale
- True RMS Volts & mV
- True RMS Amps & mA
- Custom curve linearization

Counter Functions

- Frequency
- Rate
- Period
- Counter
- Time interval
- Stopwatch
- Phase angle
- Duty cycle
- V-to-F converter
- Square root
- Up / down totalizer
- Batch controller
- A+B, A-B, A*B, A/B
- Draw (A/B-1)
- Quadrature position
- Quadrature rate
- Custom curve linearization

Benefits

- Simple meter setup via pushbuttons or computer.
- Multifunction, high-resolution meter at single-function price.
- High read rate for fast control response and true peak value display.
- Adaptive filter eliminates noise, yet responds rapidly to changes in signal level.
- Isolated 5, 10 and 24 Vdc excitation eliminates need for external supplies.
- Wide range of input power for global use.
- Designed to meet international safety standards.
- Auto-tare for zeroing in weighing applications.
- 1/8 DIN case for easy replacement of existing meters.
- Washdown with high pressure water to NEMA-4X when panel mounted.
- Plug-in screw terminals for power and signal included.

Options

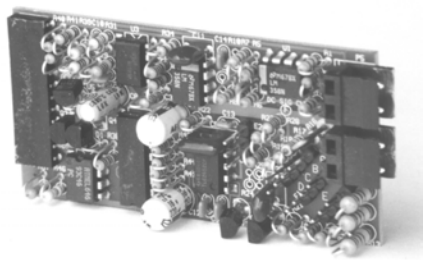
- Dual 10 A electromechanical relays or opto-isolated dual solid state relays for system control and alarm.
- Isolated, linearized analog outputs of 0-20 mA or 4-20 mA plus 10 Vdc.
- Isolated RS-232 or multipoint RS-485 data I/O.
- Parallel, stored, 3-state BCD output
- Power supply for 8-28 Vac or 9-37 Vdc operation

DC Voltage & Current Panel Meters

High accuracy, high read rate & control outputs

Features

- 0.2, 2, 20, 200 and 660 V ranges
- 2, 20, 200 mA and 5 A ranges
- All ranges factory calibrated
- 99.99% full scale accuracy
- 4 1/2 digit resolution to ±19,999 for direct readout in mV, V, mA or A
- 1 GΩ input impedance on 200 mV and 2 V scales
- Field scalable from front panel to ±99,999 for use with external current shunts
- Up to 60 conversions per second
- Peak value display
- Selectable adaptive digital filter
- Selectable fixed zero or active least significant digit
- 5, 10 or 24 Vdc excitation supply
- NEMA 4X, 1/8 DIN case
- External controls for reset, meter hold and decimal points
- Choice of isolated plug-in options for control and computer interface



The DC signal conditioner board handes DC voltages and currents, plus process signals and strain gauges.

Description

Laureate™ DC voltage and current panel meters with a DC signal conditioner combine high accuracy with high read rate and a wide range of isolated output options for computer interface and control. Accuracy is 99.99% of full scale ±1 count.

Used as a direct-reading DC voltmeter, the Laureate provides a full-scale readout of ±20,000 counts and five full-scale voltage ranges from 200.00 mV with 10 μV resolution to 660.0 V with 100 mV resolution. The 200.00 mV and 2.000 V ranges provide a high input impedance of 1 GΩ so as to minimize the load on the voltage signal. The maximum voltage which can be applied on the 20, 200 and 660 Vdc ranges is 660 Vac.

Used as a DC ammeter, the Laureate provides a full-scale readout of ±20,000 counts and four full-scale direct-reading current ranges from 2.0000 mA with 0.1 μA resolution to 5.000 A with 1 mA resolution. The 5.000 A range measures the IR drop across a built-in 10 mΩ current shunt.

Use with External Current Shunts

The Laureate can be used with external current shunts, which typically produce 50 mV or 100 mV at their rated maximum current. Scaling from millivolts to amperes for a specific shunt is easily accomplished from the front panel of the meter. The scalable readout is five full digits up to ±99,999 counts. Since the voltage signal from a current shunt can be noisy, the Laureate provides a selectable, adaptive moving-average digital filter, as explained below.

All Ranges Precalibrated

All voltage and current ranges are calibrated at the factory, with calibration factors for each range stored in an internal EEPROM. This allows ranges to be changed without recalibrating the meter.

High Read Rate and Peak Capture

All Laureate voltmeters use Concurrent Slope (US Pat 5,262,780) analog-to-digital conversion, which allows up to 60 or 50 conversions per second while integrating the signal over a full power cycle. High read rate is ideal for peak capture, real-time computer interface, and control.

The peak value of the input signal is automatically captured and may be displayed via a front panel pusbutton command or a control signal at the rear connector since the last meter reset. Other controls at the rear connector include meter hold, meter reset, and decimal point selection

Selectable Signal Filtering

The displayed readings and the data outputs can be separately selected to be either unfiltered or filtered.

- An unfiltered selection updates after each conversion for fastest response.
- A batch average filter selection averages each 16 conversions for an update every 1/4 sec.
- An adaptive moving average filter selection provides a choice of 8 time constants from 80 ms to 9.6 s. When a significant change in signal level occurs, the filter adapts by briefly switching to the shortest time to follow the change, then reverts back to its selected time constant. Another choice is Auto, which provides an automatic time constant selection based on the signal noise characteristics.

Isolated Excitation Supply

5, 10 and 24 Vdc isolated excitation outputs are standard to power external devices, such as transducers or transmitters. In many cases, these outputs can eliminate the need for an external supply.

Interface Options

Plug-in isolated analog output, dual setpoint controller, and RS-232, RS-485 communications or BCD output boards can upgrade the Laureate from a simple monitor to system interface and control.

Built-in Flexibility & Safety

Laureates may be powered from 85-264 Vac and 90-370 Vdc, or optionally from 8-28 Vac and 9-37 Vdc. They are available with red or green LEDs. They are housed in a 1/8 DIN case that meets NEMA 4X (IP65) specifications from the front when panel mounted. Any setup functions and front panel keys may be locked out for simplified usage and security.

Specifications

DC Voltage

Range	Resolution	Input Ohms	Error ± 1 count
200.00 mV	10 µV	1 G	.01% FS
2.0000 V	100 µV	1 G	.01% FS
20.000 V	1 mV	1 M	.01% FS
200.00 V	10 mV	1 M	.01% FS
660.0 V	100 mV	1 M	.03% FS

DC Current

Range	Resolution	Input Ohms	Error ± 1 count
2.0000 mA	0.1 µA	100	.01% FS
20.000 mA	1 µA	10	.01% FS
200.00 mA	10 µA	1	.01% FS
5.000 A	1 mA	0.01	.04% FS

Display

Readout .... 5 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -99999 to +99999 or -99990 to +99990 (count by 10 with rounding)
Indicators ..... Minus sign, 2 red LED lamps

A-to-D Conversion

Technique (Pat 5,262,780) Concurrent Slope™
A-to-D Rate ..... 60/s at 60 Hz, 50/s at 50 Hz
Output Update ..... 56/s at 60 Hz, 47/s at 50 Hz
Display Update ..... 3.5/s at 60 Hz, 3/s at 50 Hz

Accuracy

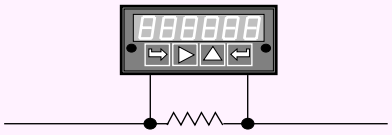
Span Tempco ..... 0.003% of reading/°C
Zero Tempco ..... 0.1 counts/°C

Noise Rejection

CMR, DC to 60 Hz ..... 130 dB
NMR at 50/60 Hz ..... 90 dB with min filtering

Maximum Signal

Max applied voltage ..... 660 Vac for 20, 200 and 600 V ranges; 125 Vac for other ranges
Overcurrent protection ... 25x for 2 mA, 8x for 20 mA, 2.5x for 200 mA, 1x for 5 A



Use with External Current Shunt

In addition to reading current directly up to 5 A, the Laureate can be used with an external current shunt. The millivolts across the shunt are easily scaled to amps with setup from the front panel. Digital filtering is selectable to reduce line noise.

Power

Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 49-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

Operating Temperature ..... 0°C to 55°C
Storage Temperature ..... -40°C to 85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA-4X when panel mounted

Connector Pin Assignments

J5 - Signal Input & Excitation Output

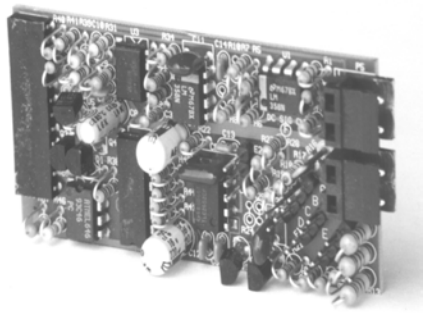
1	Excitation Return -
2	Excitation Output +
3	Signal Low -
4	Signal High +

Process, Strain & Pot Follower Meters

With scalable readout & control outputs

Features

- 0.2, 2, 20, 200 and 660 V ranges
- 2, 20, 200 mA and 5 A ranges
- All ranges factory calibrated
- 4 1/2 to 5 digit resolution
- Field scalable by front panel push-buttons or computer for readout in engineering units
- Span adjust from 0 to ±99,999
- Zero adjust from -99,999 to +99,999
- Peak value display and auto-tare
- Up to 60 conversions per second
- Selectable fixed right-hand zero with rounding
- 5, 10 or 24 Vdc excitation supply
- Ratiometric compensation for variations in excitation voltage
- NEMA 4X, 1/8 DIN case
- External controls for reset, meter hold, decimal points, and tare
- Choice of plug-in options for control and computer interface



DC signal conditioner board.

Description

Laureate™ digital process and strain panel meters are a cost-effective solution to a wide variety of monitoring and control applications which require a scalable readout from strain gauges or from process signals such as 4-20 mA, 0-5 V or 0-10 V. They are also ideal for use in potentiometer follower applications, where the transducer output is a changing resistance.

Scalable to Five Full Digits

The display may be scaled to five full digits from -99,999 to +99,999 from the front panel to read directly in engineering units such as PSI. Three scaling methods are selectable: scale and offset, two-point method, and system-level calibration using actual transducer signals. All ranges are precalibrated at the factory, so that recalibration is not needed when changing ranges or signal conditioners.

Strain gauges with a 20 mV output can be scaled to display up to 10,000 counts, while outputs of 200 mV can be scaled to 99,999 counts.

Isolated Excitation Supply

5, 10, and 24 Vdc isolated excitation outputs are standard to power strain gauge bridges and 4-20 mA transmitters, eliminating the need for an external supply. When powering strain gauges or potentiometers, the 5 or 10 Vdc excitation is monitored by the meter to eliminate errors caused by excitation voltage variations.

Fast Read Rate and Signal Filtering

The displayed readings and the data outputs can be separately selected to be either unfiltered or filtered.

- An unfiltered selection updates after each conversion for fastest response, up to 60/sec, while integrating the input signal over a full power cycle. Fast read rate provides true peak readings and aids in control applications.
- A batch average filter selection averages each 16 conversions for an update every 1/4 sec.
- An adaptive moving average filter selection provides a choice of 8 time constants from 80 ms to 9.6 s. When a significant change in signal level occurs, the filter adapts by briefly switching to the shortest time to follow the change, then reverts back to its selected time constant. Another choice is Auto, which provides an automatic time constant selection based on the signal noise characteristics.

Advanced Meter Features

Auto-tare allows the display to be zeroed for any input signal. This is normally achieved by applying a switch closure or logic signal at the rear connector. The tare value is stored in non-volatile memory and is retained when power is removed.

Peak value of the input signal is automatically captured and may be displayed via a front panel pushbutton command or control signal at the rear connector. Other controls via the rear connector include meter hold, meter reset, peak reset, and decimal point selection.

Interface Options

Plug-in isolated analog output, dual setpoint controller and RS-232, RS-485 communications or BCD output boards can upgrade the Laureate from monitor to system interface and control.

Rate & Nonlinear Curve Fit Options

An Extended Laureate computer board can display rate based on successive readings. It also allows exceptionally accurate custom curve linearization, for example to read out liquid volume or rate of flow in a horizontal cylindrical tank based on level reported by a 4-20 mA transmitter. For setup, up to 240 data points can be input into a spreadsheet or text file by the user. The computer then calculates nonlinear segments, which are downloaded into the meter via RS-232.

Built-in Flexibility

The meters may be powered from 85-264 Vac and 90-370 Vdc, or optionally from 8-28 Vac and 9-37 Vdc. They are available with red or green LEDs. The DIN case meets NEMA 4X specifications from the front when panel mounted. Any setup functions and front panel keys may be locked out for simplified usage and security.

Specifications

DC Voltage

Range	Resolution	Input Ohms	Error ± 1 count
200.00 mV	10 µV	1 G	.01% FS
2.0000 V	100 µV	1 G	.01% FS
20.000 V	1 mV	1 M	.01% FS
200.00 V	10 mV	1 M	.01% FS
660.0 V	100 mV	1 M	.03% FS

DC Current

Range	Resolution	Input Ohms	Error ± 1 count
2.0000 mA	0.1 µA	100	.01% FS
20.000 mA	1 µA	10	.01% FS
200.00 mA	10 µA	1	.01% FS
5.000 A	1 mA	0.01	.04% FS

Display

Readout .... 5 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -99999 to +99999 or -99990 to +99990 (count by 10 with rounding)
Indicators ..... Minus sign, 2 red LED lamps

A-to-D Conversion

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Span Tempco ..... 0.003% of reading/°C
Zero Tempco ..... 0.1 counts/°C

Noise Rejection

CMR, DC to 60 Hz ..... 130 dB
NMR at 50/60 Hz ..... 90 dB with min filtering

Maximum Signal

Max applied voltage . 660 Vac for 20, 200 and 660 Vdc ranges; 125 Vac for other ranges
Overcurrent protection ... 25x for 2 mA, 8x for 20 mA, 2.5x for 200 mA, 1x for 5 A

Power

Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 49-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

Excitation Output

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10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

Operating Temperature ..... 0°C to 55°C
Storage Temperature ..... -40°C to 85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA-4X when panel mounted

Connector Pin Assignments

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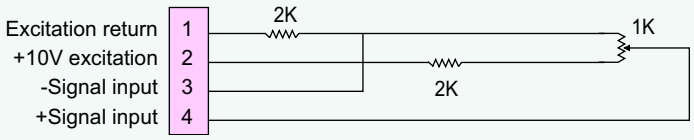
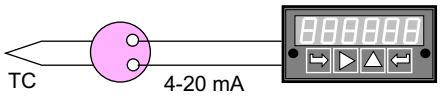


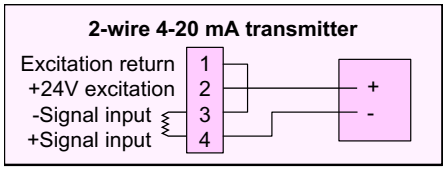
Potentiometer follower applications

In potentiometric applications, the signal from a sliding contact voltage divider can be converted to engineering units such as position, level or percentage.

For use with a 1 kΩ potentiometer, the recommended applied excitation voltage is 10 V, and a 2 kΩ resistor should be placed in series with the excitation output and excitation return leads. This will allow the meter's 2.0000 V scale with a high input impedance of 1 GΩ to be used.

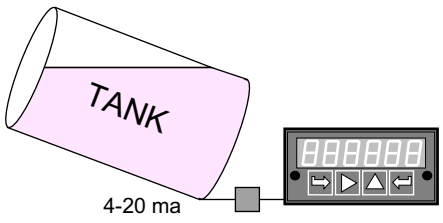
By operating in a ratiometric mode, the meter will remove any effects caused by variations in the excitation supply output.





Powering two-wire transmitters

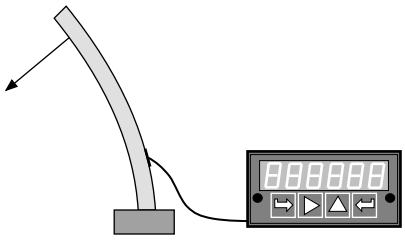
The isolated 24 Vdc, 50 mA excitation output, which is standard with all Laureate meters, is ideal for powering two-wire, 4-20 mA transmitters. The same two wires are used to apply voltage and carry the output current. Inside the meter, the 4-20 mA current is dropped across a 10 Ω resistor and sets up a 40-200 mV voltage, which is then sensed by the meter and scaled to engineering units.



Linearizing non-linear inputs

The Laureate DC meter with the Extended main board option allows exceptionally accurate custom curve linearization. For setup, up to 240 data points can be entered into a spreadsheet. The system then creates multiple non-linear spline-fit segments, which provide much better accuracy than linear segments.

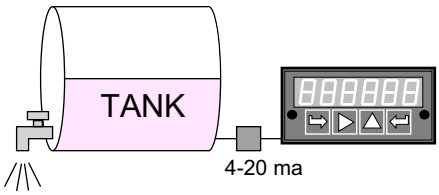
One application, as illustrated, is the read-out of volume of irregularly shaped tanks based on measured liquid level or pressure. Altimeters and thermistors are further applications.



Testing with peak detection

Destructive testing is an ideal application for the Laureate strain meter. Peak readings are automatically captured at rates up to 60 per second, while the display updates at a legible 3.5 readings per second. The peak reading can be recalled at the push of a button or be transmitted via RS-232 or RS-485.

The meter provides isolated 10 Vdc power for up to four (4) the strain gauges and can be scaled to read out directly in engineering units from -99,999 to +99,999.



Rate from successive readings

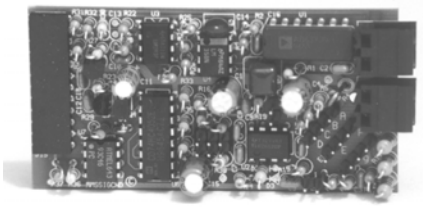
The Extended computer board allows the display of rate based on successive readings, for instance flow rate based on changes in liquid level or static pressure in a tank. In the above illustration, the meter displays the rate in gallons at which a horizontal tank is being emptied. The input to the meter can be nonlinear, since only the linearized readings are compared for the determination of rate.

True RMS Voltage & Current Panel Meters

0.2 V - 660 V & 2 mA - 5 A full-scale ranges

Features

- 0.2, 2, 20, 200 & 660 V ranges
- 2, 20, 200 mA & 5 A ranges
- 4 1/2 digit resolution
- 99.9% accuracy of full scale
- AC coupled input
- Crest factor of 2.4 at full scale
- Priced competitively with less capable averaging AC meters
- Scalable for direct readout of external current shunts or current transformers
- Peak value display
- 85-264 Vac and 90-370 Vdc power standard
- Green or red display
- NEMA 4X, 1/8 DIN case
- Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485 I/O, parallel BCD output, low voltage AC and DC power.



The RMS signal conditioner handles AC waveshapes which may be other than sinusoidal.

Description

The Laureate™ True RMS meter offers a high accuracy 4 1/2 digit display for five voltage ranges and four current ranges. It is suited for AC applications where there is considerable distortion of current waveforms from nonlinear loading. The input is AC coupled to read only the AC component, such as ripple on a power supply.

The meter uses precision circuitry to compute the root-mean-square of complex waveforms from 10 Hz to 10 kHz. Spikes up to 2.4 times the maximum of each range are accurately measured. This provides a crest factor (V_p / V_{rms}) of 240 for a signal amplitude of 1% of full scale, decreasing to 2.4 at 100% of full scale.

High common mode rejection allows stable readings with current shunts located on the high side of the line. Five amp input capability allows the output of 5 A current transformers to be applied directly to the meter, with no need for a stepdown transformer. The current reading can easily be scaled to display the input to the current transformer. Digital scaling and calibration eliminate zero and span drift associated with potentiometers in non-microcomputer based meters.

The Laureate RMS meter utilizes the same high-speed analog-to-digital conversion method as all other Laureate panel meters. However, the meter settling time and control response to a step change in AC amplitude are limited by the RMS converter circuit to approximately 1 second.

The typical accuracy is 99.9% of full scale. This decreases to 99.8% for low frequency at high amplitude, or high frequency at low amplitude. Please see graph on next page.

Plug-in isolated analog output, setpoint controller and RS-232, RS-485 or BCD output boards can upgrade the Laureate for system control and computer interface.

The meter may be powered from 85-264 Vac and 90-370 Vdc, or optionally from 8-28 Vac and 9-37 Vdc.

Laureate panel meters are available with red or green LEDs. They are housed in a 1/8 DIN case that meets NEMA 4X specifications from the front when panel mounted. Any setup functions and front panel keys may be locked out for simplified usage and security.

Specifications

Display

Readout .... 5 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -99999 to +99999 or -99990 to +99990 (count by 10 with rounding)
Indicators ..... 2 red LED lamps

Accuracy

Span Tempco ..... 0.005% of reading/°C
Zero Tempco ..... 0.1 counts/°C
Crest Factor ..... 2.4x at 100% of full scale

Voltage (1% to 100% of full scale)

Range	Resolution	Input Ohms	Typ Error at 25ºC
200.00 mV	10 µV	22 M	.1% FS ±1 count, 10 Hz to 10 kHz
2.0000 V	100 µV	22 M	
20.000 V	1 mV	1 M	
200.00 V	10 mV	1 M	
660.0 V	100 mV	1 M	

Current (1% to 100% of full scale)

Range	Resolution	Input Ohms	Typ Error at 25ºC
2.0000 mA	0.1 µA	100 Ω	.1% FS ±1 count, 10 Hz to 10 kHz
20.000 mA	1 µA	10 Ω	
200.00 mA	10 µA	1 Ω	
5.000 A	1 mA	0.01 Ω	

Response Time

RMS-to-DC conversion settling time ..... 1 s
A-to-D Rate ..... 60/s at 60 Hz, 50/s at 50 Hz
Output Update ..... 56/s at 60 Hz, 47/s at 50 Hz
Display Update ..... 3.5/s at 60 Hz, 3/s at 50 Hz

Power

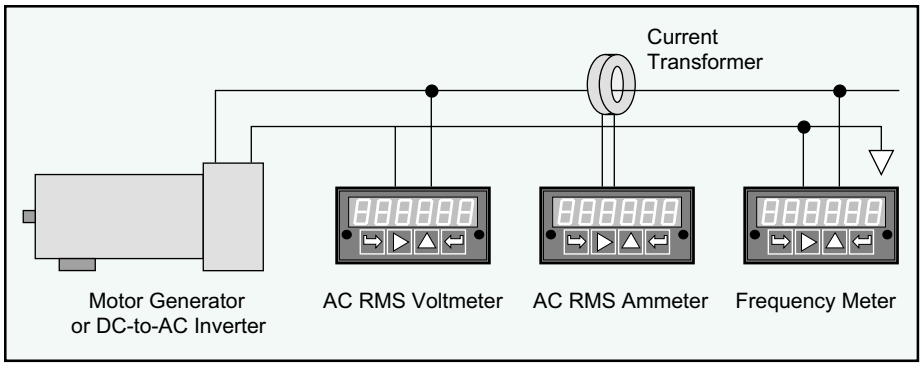
Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 49-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

Operating Temperature ..... 0°C to 55°C
Storage Temperature ..... -40°C to 85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA 4X when panel mounted



Using Laureate Meters and Counters to Instrument an AC Line

Why Measure AC Power?

Many AC loads, such as electrical motors, will only operate reliably if the AC line voltage and frequency are within specified tolerances. Otherwise permanent damage to expensive plant equipment may occur.

Motor generators and UPS systems will only operate reliably with the load for which they are rated. Drops in line voltage or frequency may indicate an excessive load and the possibility of equipment damage.

Laureate meters and counters are low-cost means to instrument AC power lines with great accuracy.

AC RMS Voltmeter

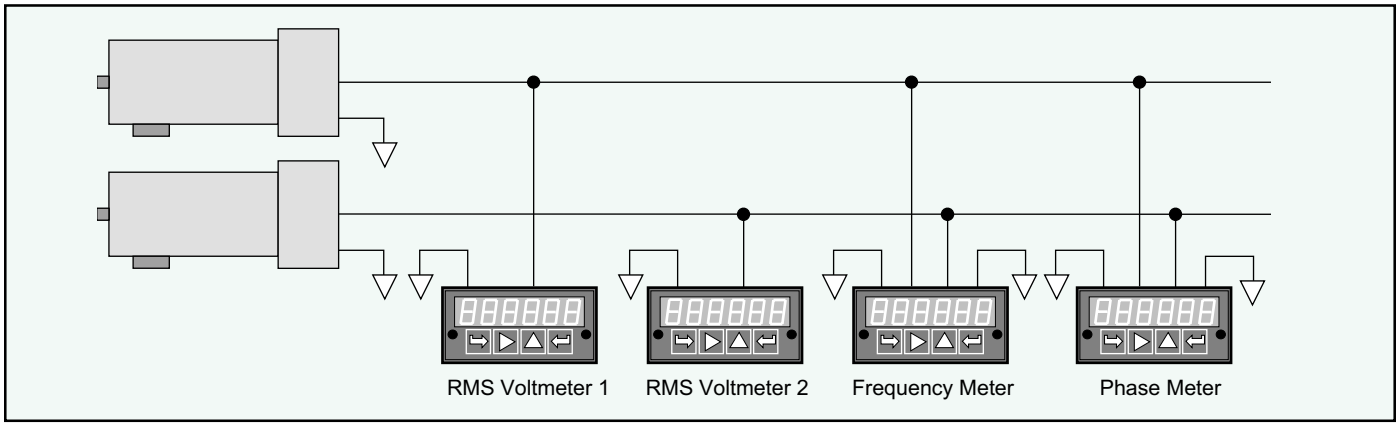
Full-scale ranges of interest are 200.00 V with 10 mV resolution and 660.0 V with 100 mV resolution. True RMS capability allows the display of RMS voltage for non-sinusoidal waveshapes, such as square waves from a UPS.

AC RMS Ammeter

A built-in 5 A range can be used to display currents up to 5.000 A with 10 mA resolution, or to accept the output of 5 A current transformers. The 200.00 mV range can be used with external current shunts. With either transformers or shunts, scaling to the input current is easily accomplished via the meter's front panel pushbutton switches.

Frequency Meter

The Laureate Dual Channel Frequency Meter uses inverse period to determine AC line frequency to six-figure accuracy (60.0000 or 50.0000) in a few line cycles plus 30 ms.



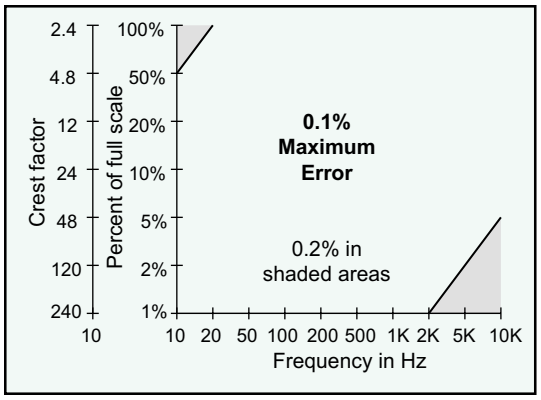
Using Laureate Meters to Synchronize Motor Generators

Successful synchronization of two motor generators requires that the voltage outputs of the generators be close to each other, that the two frequencies be identical, and that the voltage waveshapes be in phase.

The two voltages can be measured by two Laureate AC RMS Voltmeters, which offer 200.00 V and 660.0 V ranges. Or a single meter can be multiplexed by using an external toggle switch.

The two frequencies can be measured to six- figure accuracy by a single Laureate Dual Channel Counter, where each channel monitors a generator. The two AC neutrals must be tied to meter ground. Pressing a front-panel key toggles the reading between the channels.

The measurement of phase angle also uses a Laureate Dual Channel Counter. Please see the Phase Angle & Duty Cycle Meters section of this data book.



True RMS Accuracy

The graph to the left shows maximum full-scale error as a function of frequency and signal amplitude. Error is 0.1% of full scale over all frequency ranges of interest to AC power measurement. Error incrreases to 0.2% at low frequency and high amplitude, or high frequency and low amplitude.

The maximum crest factor (V_p / V_{rms}) is 2.4x at full scale amplitude. It increases in inverse proportion to signal amplitude.

Connector Pin Assignments

J5 - Signal Input & Excitation Output

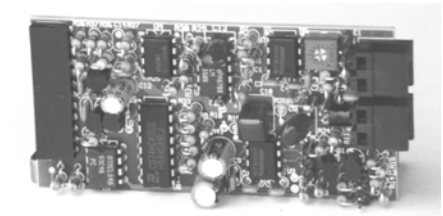
1	Excitation Return
2	Excitation Output
3	Signal Low
4	Signal High

Thermocouple & RTD Panel Meters

High accuracy plus transmitter & control capability

Features

- Input for thermocouple types J, K, T, E, N, R, S
- Input for 100 ohm platinum RTDs with DIN and ANSI curves
- High accuracy & repeatability
- Celsius, Fahrenheit, Kelvin or Rankine scales
- Selectable 1° or 0.1° resolution
- 2, 3 or 4-wire RTD connection with lead resistance compensation
- Up or downscale open sensor indication
- Up to 60 conversions per second
- Peak value display
- AC or DC powered
- Green or red display
- Field installable options
- NEMA 4X, 1/8 DIN case
- Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485 I/O, parallel BCD output, and low voltage AC or DC power.



The same temperature signal conditioner board handles multiple thermcouple and RTD types.

Description

Laureate™ panel meters with the temperature signal conditioner provide highly accurate, stable and repeatable temperature indication for multiple thermocouple types and 100 Ohm platinum RTDs. The meter accepts the outputs of types J, K, T, E, N, R and S thermocouples, plus 100 ohm platinum RTD's with DIN alpha of 0.00385 and ANSI alpha of 0.003925 . The thermocouple or RTD type, range and resolution (1° or 0.1°) are selectable from the front panel or via the serial interface. Display in Kelvin or Rankine can be selected by offsetting the Celsius or Fahrenheit range.

Cold junction compensation automatically corrects for temperature variations at the thermocouple reference junction at the meter. Open sensor indication is standard and may be set up to indicate either upscale or downscale. RTD excitation is provided by the meter. RTD connections can be of the 2-, 3- or 4-wire type. For 3- and 4-wire connections, the meter automatically compensates for lead resistance of the sensor.

All ranges for all temperature sensor types are digitally calibrated at the factory. This eliminates the need for field calibration or drift caused by potentiometers found in non-microcomputer based meters.

All Laureate meters allow exceptionally fast read rates. Concurrent Slope (Pat 5,262,780) is a method of analog-to-digital conversion that allows up to 60 conversions per second while integrating the input over a full power cycle. Fast read rates provide true readings and fast response for control applications. Display of peak value is standard.

Plug-in isolated analog output, dual-setpoint controller and RS-232/485 communications or BCD output boards can upgrade the Laureate from stand-alone monitor to system interface and control. The Laureate temperature meter can serve as a highly accurate, isolated, 4-20 mA transmitter.

Laureate panel meters are available with a red or green LED display. Blanking of leading, non-significant zeros simplifies reading. The 1/8 DIN case is water tight to NEMA 4X from the front when mounted in the panel.

Specifications

Power

Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

Thermocouple Input

TC Type	Range	Conformity Error
J	-210°C to +760°C -347°F to +1400°F	0.09°C 0.16°F
K	-244°C to +1372°C -408°F to +2501°F	0.1°C 0.17°F
T	0°C to +400°C -257°C to 0°C +32°F to 752°F -430°F to +32°F	0.03°C 0.2°C 0.05°F 0.36°F
E	-240°C to +1000°C -400°F to +1830°F	0.18°C 0.32°F
N	-245°C to +1300°C -410°F to +2370°F	0.10°C 0.17°F
R	-45°C to +1768°C -49°F to +3214°F	0.17°C 0.31°F
S	-46°C to +1768°C -51°F to +3213°F	0.12°C 0.22°F

Calibration ..... NIST Monograph 125 (IPTS-68)
Input resistance ..... 1 GΩ
Input current ..... 100 pA
Max lead resistance for rated accuracy . 1 kΩ
Span tempco ..... ±0.003% of reading/°C
Reference junction tempco ..... ±0.02 deg/deg
Span tempco ..... ±0.003% of reading/°C
Overvoltage protection ..... 125 Vac
NMR at 50/60 Hz ..... 80 dB plus selectable digital filter from 80 ms to 9.6 s time constant
CMR, DC-60 Hz . 120 dB with 500 Ω imbalance
CMV, DC-60 Hz ..... 250 Vac from power and earth ground
Open sensor indication ..... Flashes full-scale

Pt 100 RTD Input

RTD Alpha	Range	Conformity Error
DIN .00385	-202°C to +850°C -331°F to +1562°F	0.03°C 0.05°F
ANSI .003925	-202°C to +631°C -331°F to +1168°F	0.04°C 0.07°F

Calibration, DIN ..... IEC 751 (IPTS-68)

Calibration ANSI ..... NIST Monograph 126
Configuration ..... 2, 3 or 4-wire connection
Excitation current ..... 0.2 mA
Span tempco ..... ±0.003% of reading/ºC
Zero tempco ..... ±0.03 deg/deg
Sensor lead resistance tempco per conductor
2-wire ..... 10 mdeg/Ω/deg up to 10 Ω
3 & 4-wire ..... 10 μdeg/Ω/deg up to 100 Ω
Overvoltage protection ..... 125 Vac
Open sensor indication ..... Flashes full-scale

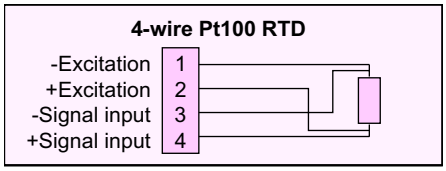
A-to-D Conversion

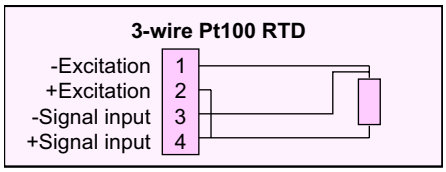
Technique (Pat 5,262,780) Concurrent Slope™
A-to-D Rate ..... 60/s at 60 Hz, 50/s at 50 Hz
Output Update ..... 56/s at 60 Hz, 47/s at 50 Hz
Display Update ..... 3.5/s at 60 Hz, 3/s at 50 Hz

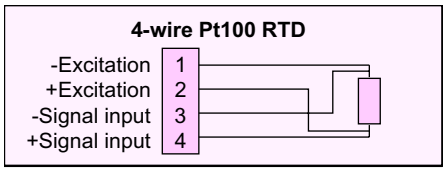
Display

Readout .... 5 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Indicators ..... 3 LED lamps

RTD Connections





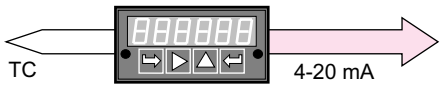


Excitation & Lead Compensation

The Laureate temperature meter allows 2-, 3- and 4-wire RTD hookup to the J5 connector. The meter applies an excitation current of 0.2 mA, which it monitors to make ratiometric corrections for excitation supply variations.

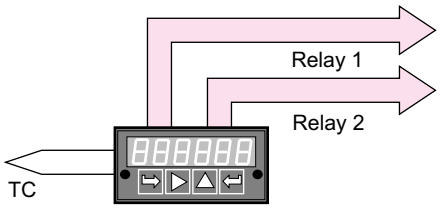
In 2-wire hookup, the meter senses the voltage drop across the 100 ohm RTD and both lead wires. The effect of the lead wires can be measured and subtracted by shorting out the RTD during meter setup.

In 3- and 4-wire hookup, the meter senses the voltage drop across the 100 ohm RTD and both lead wires as well as the voltage drop across the RTD and one lead wire. This allows it to determine the effect of one lead wire and mathematically subtract the effect of both lead wires.



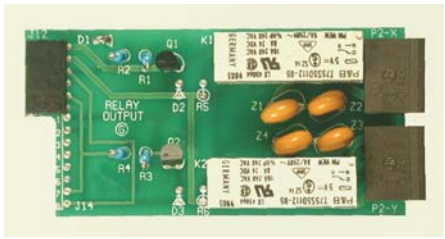
Operation as a 4-20 mA Transmitter

With the optional analog output board, Laureate temperature meters can serve as superb, isolated 4-20 mA transmitters. The analog output is scaled to the display, which is linearized to ºC or ºF and is exceptionally accurate. The analog output further tracks the high read rate of the meter, at up to 56 readings per second at 60 Hz power. Fast update rates are beneficial in many closed-loop and PID control applications.



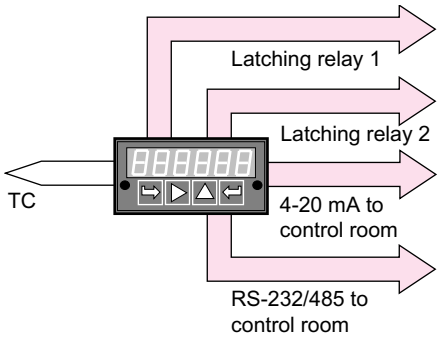
Operation as a Fast Controller

With the optional dual contact relay or dual solid state relay output options, Laureate temperature meters can serve as extremely fast and accurate ON/OFF controllers for closed-loop temperature control.



The dual contact relay or solid state relay signal conditioners are used for temperature control.

Multiple setpoint operating modes are individually selectable for each relay, as explained in the dual-setpoint controller section. Relay duty cycles and chatter can be minimized with programmable hysteresis and time delays. High duty cycles and extremely fast response times are possible with the solid state relay, which has a



typical response time of only 17 ms.

Operation as a Supervisory Monitor

By using the optional dual contact relay or dual solid state relay output options, Laureate temperature meters can monitor processes and provide alarms or shutoffs when these processes exceed normal limits.

A band deviation operating mode can be selected for each relay, where an alarm is generated whenever the reading is a selected number of counts above or below the setpoint. Relay operation can be selected as latching or non-latching. When an alarm or shutdown condition is reached, a latched output will remain in the alarm condition until it is reset by a front panel pushbutton, via the serial interface, or via the rear connector.

Load Cell & Microvolt Panel Meters

10 mV - 500 mV full-scale ranges, 4- or 6-wire connection

Features

- **20, 50, 100, 250 & 500 mV ranges.**
- **5-digit resolution with span from 0 to ± 99,999**
- **Zero from -99,999 to +99,999**
- **Isolated 10 Vdc supply to power up to four 350 ohm load cells.**
- **Selectable fixed zero or active least significant digit.**
- **4- or 6-wire hookup.**
- **Ratiometric operation cancels variations in excitation supply.**
- **Up to 60 conversions per second.**
- **Peak value display.**
- **Auto-tare with tare value stored in memory.**
- **AC and DC powered.**
- **Green or red display.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485 I/O, parallel BCD output, and low voltage power.**

Description

The Laureate™ load cell and microvoltmeter is a high-sensitivity monitor and controller for use with load cells, strain gauges and microvolt input signals where high accuracy and stability are required.

Usage as a DC microvoltmeter provides sensitivity down to 20 mV full scale with 1 µV resolution. With a digital multiplier of five, 99,999 counts can be displayed with a sensitivity of 0.2 µV per count. A moving average filter with a time constant of 1.2 sec or greater should then be selected.

Usage as a load cell meter allows six-wire hookup and scaling for direct readout in engineering units, such as pounds, kilograms or PSI. Scaling can be via front panel pushbuttons or a computer. Zero may be set from -99,999 to +99,999. Range may be scaled from 0 to ±99,999. Digital scaling and calibration eliminate drift caused by potentiometers in non-microcomputer based meters.

Built-in Excitation

An isolated 10 Vdc excitation supply can provide up to 120 mA of current to power up to four 350-ohm load cells in parallel. The meter operates in a ratiometric mode to eliminate errors due to supply variations. When excitation sense inputs are used in 6-wire connection, the meter compensates for variation in resistance of the transducer leads, thereby allowing long cable runs.

Fast Read Rate and Peak Capture

All Laureate meters use Concurrent Slope (Pat 5,262,780) analog-to-digital conversion, which allows up to 60 conversions per second, while integrating the signal over a full power cycle. High read rate is ideal for peak value capture and for real-time computer interface and control.

Selectable Signal Filtering

The displayed readings and the data outputs can be separately selected to be either unfiltered or filtered.

- An unfiltered selection updates after each conversion for fastest response, up to 60/sec, while integrating the input signal over a full power cycle. Fast read rate provides true peak readings and aids in control applications.
- A batch average filter selection averages each 16 conversions for an update every 1/4 sec.
- An adaptive moving average filter selection provides a choice of 8 time constants from 80 ms to 9.6 s. When a significant change in signal level occurs, the filter adapts by briefly switching to the shortest time to follow the change, then reverts back to its selected time constant. Another choice is Auto, which provides an automatic time constant selection based on the signal noise characteristics.

Easy Scaling

All Laureate DC, process and load cell meters allow easy setting of scale and offset by either of two methods.

- With the coordinate reading method, the meter reads the high and low signal values, and the user enters the desired high an low reading values. The meter then calculates the span multiplier and offset. This method is ideal if an external calibration reference is available.
- With the manual coordinate method, the user enters the high and low input values in Volts plus the desired high and low reading values. This method is suitable if an no external calibration reference is available.

Auto-tare

For weighing applications, auto-tare is standard. Auto-tare can set the displayed value to zero to subtract the weight of an empty container. Auto-tare may be controlled by an external pushbutton contact closure or logic signal through an input on the power supply connector. The tare value is stored in memory.

Additional capabilities for weighing applications are provided by the Laureate weight / scale meter, as described in the next section of this catalog.

Other Features and Options

Plug-in isolated analog output, dual setpoint controller and RS-232/485 communications or BCD output boards can upgrade the Laureate from a stand-alone monitor to system interface and control.

All Laureates meet NEMA 4X standards for high pressure washdown when panel mounted. All connections are via safety-rated screw-terminal connectors.

Specifications

DC Microvoltmeter Inputs

Input Range mV	Resolution	Error at 25°C
±20.000	1.0 µV	.01% FS ±1 count
±50.000	2.5 µV	
±100.00	5.0 µV	
±250.00	12.5 µV	
±500.00	25 µV	

Load Cell Inputs

Full-scale input, mV	Zero Adjust	Span Adjust	Error at 25°C
±20.000 ±50.000 ±100.00 ±250.00 ±500.00	-99,999 to +99,999	0 to ±99,999	.01% FS ±1 count

Accuracy

Span Tempco ..... 0.0015% of reading/°C
Zero Tempco ..... 0.1 µV/°C

Noise Rejection

CMR, DC to 60 Hz ..... 130 dB
NMR at 50/60 Hz line .... 90 dB with min filtering

A-to-D Conversion

Technique (Pat 5,262,780) Concurrent Slope™
A-to-D Rate ..... 60/s at 60 Hz, 50/s at 50 Hz
Output Update ..... 56/s at 60 Hz, 47/s at 50 Hz
Display Update ..... 3.5/s at 60 Hz, 3/s at 50 Hz

Display

Readout .... 5 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -99999 to +99999 or -99990 to +99990 (count by 10 with rounding)
Indicators ..... Minus sign, 2 red LED lamps

Power

Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

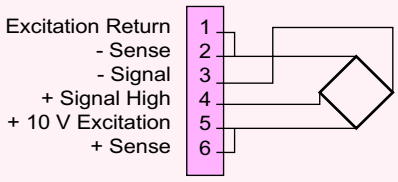
Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

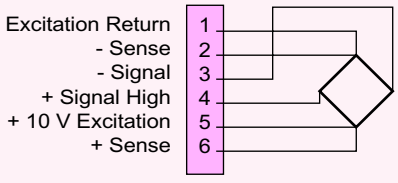
Operating Temperature ..... 0°C to 55°C
Storage Temperature ..... -40°C to 85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA-4X when panel mounted

J5 - Signal Input & Excitation Output 4-Wire Load Cell Conneciton



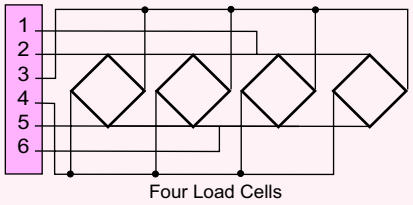
In 4-wire connection, the excitation and sense lines are tied together. The meter can make ratiometric corrections for supply voltage variations, but not compensate for variations in lead resistance. This connection is often used with short cable runs.

J5 - Signal Input & Excitation Output 6-Wire Load Cell Conneciton

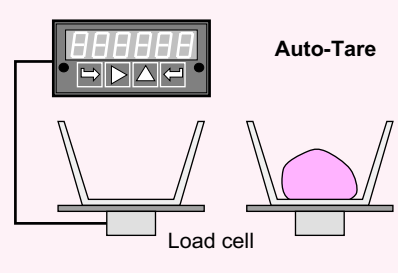


In 6-wire connection, the sense lines are separate from the excitation lines, thus eliminating effects due to variations in lead resistance. This allows long cable runs in outdoor environments with temperature extremes.

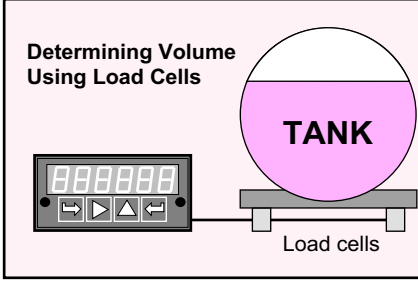
Powering Four Load Cells from a Single Laureate



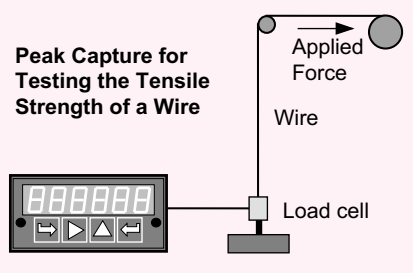
For large scales, up to four 350 ohm load cells can be powered by a single Laureate, whose excitation output is rated 120 mA at 10 V. The excitation and sense points of the four bridges are connected in parallel through a summing box.



To read the net weight of an object, the empty container is first weighed, and an external button is pushed to zero out the display. The meter will then read net weight when an object is added to the empty container. The tare value is stored in memory for subsequent readings.



An easy way to determine volume of an irregularly shaped tank with no need for linearizing is to weigh the tank using load cells. The meter will automatically tare out the weight of the empty tank and then scale the load cell signals to units of volume, such as gallons.



Peak readings are automatically captured at rates up to 60 per second, while the display updates at a legible 3.5 per second. The peak reading can be recalled at the push of a button or be always displayed. It can also be transmitted to a computer via RS-232 or RS-485.

Scale Meters

High accuracy, low cost plus control

Features

- **Setpoint control with offset compensation for filling applications.**
- **5-digit resolution with scaling from 0 to 99,999.**
- **Display to 999,990 with fixed zero.**
- **Auto-tare or manual tare, with tare value stored in non-volatile memory.**
- **Auto-zero display function.**
- **Display toggle between gross or net weight.**
- **Count by 1, 2, 5, 10, 20, 50 or 100 with rounding.**
- **Easy scale calibration using known weight.**
- **Isolated 10 Vdc supply to power up to four 350 ohm load cells.**
- **AC and DC input powered.**
- **4- or 6-wire hookup.**
- **Up to 60 conversions per second.**
- **Green or red LED display.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485 I/O, parallel BCD output, and low voltage AC or DC power.**

Description

The Laureate™ Weight Meter is more compact and less expensive than available alternatives. It provides a choice of two signal conditioner boards: the Laureate load cell signal conditioner board, which provides full-scale ranges of 20, 50, 100, 250 and 500 mV with 4- or 6-wire load cell hookup, and the Laureate DC signal conditioner board, which allows the meter to accept preconditioned signals such as 0-10 V or 4-20 mA. Options include setpoint control, analog output and digital communication boards.

Display & Setpoint Functions

Setpoint Offset. The ON/OFF setpoint control action can be programmed to occur with a specified offset. For instance, if bags are to be filled to 100 lbs and the material delivery spout is known to hold and dispense an additional 2.5 lbs following shut-off, an offset of -2.5 lbs can be programmed. The setpoint can then be set to 100 lbs, and the filling valve will be automatically shut off when the measured weight reaches 97.5 lbs.

- **Count-by Function.** The weight meter can be programmed so that the display is rounded off to multiples of 1, 2, 5, 10, 20, 50 or 100. For example, if count-by 10 is selected, the meter will display 20 for an internal count of 15 to 24.
- **Fixed Zero.** The display can be shifted left to allow a fixed zero to be displayed to the right. This allows values up to 999,990 to be displayed.
- **Auto-zero Function.** An auto-zero limit from 0 to 9 counts can be programmed to compensate for load cell drift. Whenever the meter comes to rest within that limit from zero, it will auto-zero. Entering 0 disables auto-zero.
- **Two Tare Functions.** The weight meter offers two types of tare: auto-tare and manual tare. In auto-tare, an input line is grounded by an external pushbutton. This causes the current weight, which is normally the empty weight of the container to be stored in memory as an offset. In manual tare, the tare value can be entered manually via the front panel or a computer. For instance, the tare value may be the stated empty weight of a truck or rail car. Pressing the Reset button on the front panel toggles the display between gross weight (total weight on the scale) and net weight (gross weight with tare subtracted).

Load Cell Connection

The load cell signal conditioner, which is normally used with the weight meter, is designed for 4- or 6-wire hookup. In 4-wire hookup, the meter operates in a ratiometric mode to eliminate errors due to supply variations. In 6-wire hookup, it also compensates for variations in transducer lead resistance, thereby allowing long cable runs in changing temperature environments. The built-in isolated 10 Vdc excitation supply can power up to four 350-ohm load cells in parallel.

Easy Scale Calibration

The weight meter is normally set up using a simple two-point calibration method. First, the desired LO IN reading is set to 0, and the desired HI IN reading is set to a desired value. With no weight on the scale, a button is pushed for LO IN. With a known weight on the scale, that button is pushed again for HI IN. The meter then automatically computes scale and offset for readout up to five digits in weight units.

Fast Response

The Laureate weight meter offers extremely fast read rates. These are ideal for weigh-in-motion systems, setpoint control, and computer interface applications. Concurrent Slope (Pat 5,262,780) is a method of analog-to-digital conversion that allows up to 60 conversions per second, while integrating the input signal over a full line cycle.

An adaptive digital filter can be set for time constants from 17 ms to 9 s, yet responds rapidly to a change in input signal level exceeding a threshold value. The meter can automatically select the best filter setting for maximum noise rejection and minimum response time. Control and interface outputs can be derived from the filtered signal or, for quicker response, from the unfiltered signal. Display of peak value is standard in the Laureate series.

Add-on Functions & Options

Plug-in isolated analog output, dual setpoint controller and RS-232/485 communications or parallel BCD output boards can upgrade the Laureate weight meter to system interface and control.

Specifications

With Load Cell Signal Conditioner

Full-scale input, mV	Zero Adjust	Span Adjust	Error at 25°C
±20 ±50 ±100 ±250 ±500	-99,999 to +99,999	0 to ±99,999	.01% FS ±1 count

With DC Signal Conditioner

Full-scale input	Zero Adjust	Span Adjust	Error at 25°C
±200 mV ±2 V ±20 V ±20 mA	-99,999 to +99,999	0 to ±99,999	.01% FS ±1 count

Accuracy, Load Cell Signal

Span Tempco ..... 0.0030% of reading/°C
Zero Tempco ..... Auto-Zero
Calibration Method .....
2 points using zero weight and known weight

Accuracy, DC Signal

Span Tempco ..... 0.01% FS ±1 count
Zero Tempco ..... Auto-Zero
Calibration Method .....
2 points using zero weight and known weight

Noise Rejection

CMR, DC to 60 Hz ..... 130 dB
NMR to 50/60 Hz line .... 90 dB with min filtering

A-to-D Conversion

Technique (Pat 5,262,780) Concurrent Slope™
A-to-D Rate ..... 60/s at 60 Hz, 50/s at 50 Hz
Output Update ..... 56/s at 60 Hz, 47/s at 50 Hz
Display Update ..... 3.5/s at 60 Hz, 3/s at 50 Hz

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... 0 to 99999 and
0 to +999990 (with fixed right-hand zero)
Rounding ..... Count by 1, 2, 5, 10, 20, 50, 100
Indicators ..... 4 LED lamps

Power

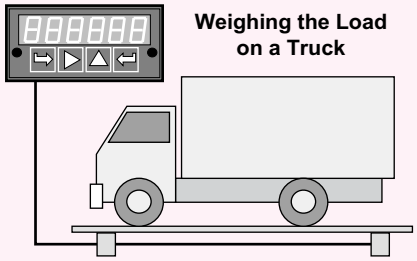
Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac,
meter ground to earth groud, DC to 60 Hz,
4.2 kVp per High Voltage Test
CMR, DC to 60 Hz ..... 130 dB

Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

Operating Temperature ..... 0°C to 55°C
Storage Temperature ..... -40°C to 85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA-4X when panel mounted

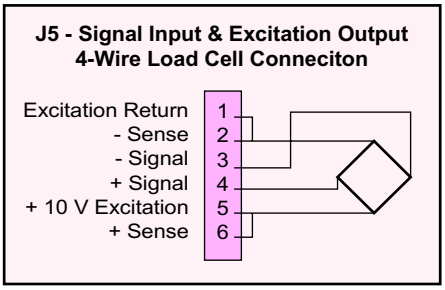


This application illustrates some of the capabilities of the Laureate weight meter. The single Laureate can power all four 350 ohm load cells of the scale with its 10 V, 120 mA isolated excitation output. Six-wire connection eliminates the effects of lead resistance and allows long cable runs from the control room to the scale.

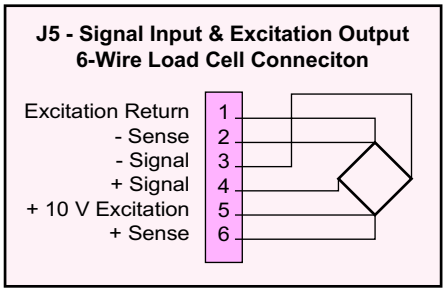
The five-digit meter can be scaled to display truck weight up to 99,999 lbs with 1 lb resolution or 999,990 lbs with 10 lb resolution. Accuracy is 0.01% of full scale at 25ºC. To avoid the effects of system-level noise, different filter settings as well as "count by" of 1, 2, 5, 10, 20, 50 or 100 with rounding are selectable.

To read out net weight of the load, the truck can first be weighed empty, and this weight can be entered as tare at the push of a button in an auto-tare mode. Or the nominal tare value of the truck can be entered manually. Display of net weight or gross weight is at the push of a button.

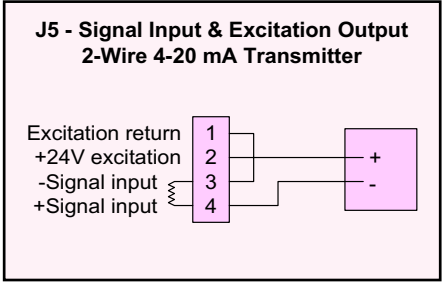
The gross weight and net weight can be alarmed, be transmitted to a computer via RS-232 or RS-485, or be transmitted via a 4-20 mA analog signal.



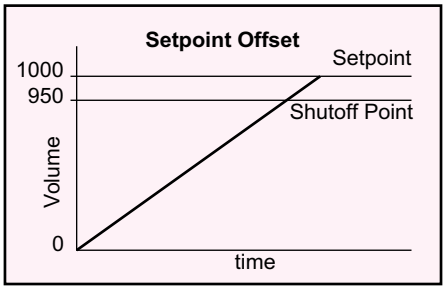
In 4-wire load cell connection, the excitation and sense lines are tied together. The meter can make ratiometric corrections for supply voltage variations, but not compensate for variations in lead resistance. This connection is often used with short cable runs.



In 6-wire load cell connection, the sense lines are separate from the excitation lines, thus eliminating effects due to variations in lead resistance. This allows long cable runs in outdoor environments with temperature extremes.



The Laureate weight meter can also utilize the DC signal conditioner board and accept preconditioned 4-20 mA or 0-10 V scale signals. In two-wire 4-20 mA transmitter connection, the same two wires are used to apply voltage and carry the output current.



In a repetitive fill operation, a setpoint offset of -50 will allow a shutoff setpoint to be set for 1000 and actual shutoff to occur at 950 if it is known that 50 units will still flow following shutoff. An offset can also be used in emptying operations.

Frequency, Rate & Period Meters

With dual, independent, field-scalable channels

Standard Counter

- **Two independently field-scalable channels selected by front panel pushbutton.**
- **Frequency from 0 Hz to 2 MHz.**
- **Inputs from NPN or PNP proximity switches, contact closures, digital logic, magnetic pickups down to 12 mV, or AC inputs up to 250 Vac.**
- **6-digit resolution at update rates up to 25/s.**
- **Line frequency measurement to 60.0000 in a few line cycles.**
- **Selectable "count by" of 10 or 100 with rounding.**
- **Square root extraction.**
- **Isolated 5, 10 or 24 Vdc excitation supply to power sensors.**
- **Green or red LED display.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485 I/O, parallel BCD output, low voltage AC and DC power.**

Extended Counter

- **Rate and total simultaneously.**
- **Linearization of non-linear inputs.**
- **Arithmetic functions A+B, A-B, A*B, A/B, A/B-1 (draw).**

Description

The Laureate dual-channel frequency, rate and period meter is a basic operating mode of the Laureate counter with the FR signal conditioner board. It can display frequency from 0 Hz to 2 MHz, rate in engineering units, and period (inverse of frequency). The normal displayed value can range up to 999,999 counts. Above that level, the display will flash and go into four-digit XXXXEX scientific notation. Square root extraction is standard.

Each channel (A or B) may be independently scaled for frequency, rate or period. The displayed channel is selected via a front panel pushbutton.

Examples of applications are the accurate display of AC line frequency, RPM, speed from proximity switch inputs, and flow from turbine flowmeter inputs.

Fast, High Resolution Measurement

The Laureate counter determines frequency by timing an integral number of periods over a specified gate time, and then taking the inverse of period. Rate is obtained by multiplying the input by a scale factor. The inverse period approach allows greater accuracy and faster update times than conventional meters which count signal pulses over a specified time interval.

AC line frequency may be accurately measured to 50.0000 or 60.0000 in a few line cycles. 1000 Hz signals may be measured to 0.01 Hz resolution at up to 25 per second. Fast response is ideal for alarm and control applications.

To reduce the effects of signal noise, a count by 10 or 100 feature with rounding is selectable. Variations in the displayed reading can also be reduced by selecting a longer gate time. An adaptive filter can reduce variations due to noise while rapidly responding to actual changes in the signal.

Extended Counter Capabilities

An Extended counter version provides capabilities beyond those of the standard counter:

Rate and total simultaneously. One channel can display total while the other displays rate. The selection for either channel is via a front panel pushbutton. This mode is ideal for flow applications when the same signal is applied to both channels.

Linearization of nonlinear inputs. Exceptionally accurate custom curve linearization capability allows linearization of the low end of turbine flowmeters. For setup, up to 240 data points can be input into a spreadsheet or text file by the user. The computer then calculates nonlinear segments, which are downloaded into the meter via RS-232. The Extended version allows linearized rates to be totalized.

Arithmetic functions. The Extended counter makes arithmetic functions available, namely A+B, A-B, A*B, A/B and A/B-1 (draw). For example, A+B allows two input flows to be summed for total flow, while A-B allows outflow to be subtracted from inflow for net flow. If transducers with a frequency output are used, A*B allows horsepower to be displayed based measured torque and RPM, or based on force and velocity. A/B can be used for the proper mixing of ingredients, while A/B-1 (draw) is used to compare rates for stretching or tensioning.

Universal Signal Conditioner

The dual-channel signal conditioner accepts inputs from proximity switches with PNP or NPN output, TTL or CMOS logic, magnetic pickups, contact closures, low-level outputs from turbine flow meters down to 12 mV , and high-level AC line inputs up to 250 Vac.

Nine hysteresis and input levels are jumper selectable for reliable counting. A 1600 Hz low-pass rolloff filter and debounce times of 3 ms or 50 ms are also selectable.

A built-in isolated 5, 10, or 24 Vdc excitation supply can power proximity switches and other sensors, and eliminate the need for an external power supply.

Other Features and Options

Plug-in isolated analog output, dual setpoint controller and RS232/485 communications or BCD output boards can upgrade the Laureate from a stand-alone monitor to system interface and control.

Laureate meters and counters meet NEMA 4X standards from the front for high pressure washdown when panel mounted.

Specifications

J5 - Signal Input & Excitation Output

1	Excitation Return
2	Excitation Output
3	B Channel Input
4	Ground
5	A Channel Input
6	Ground

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -999999 to +999999
XXXXEX scientific notation beyond 999999
Indicators ..... 4 LED lamps

Inputs

Types . AC, pulses from NPN, PNP transistors, contact closures, magnetic pickups
Isolation: ..... Common ground for Ch A & B
Channel A Frequency ..... 0 Hz to 2 MHz
Channel B Frequency ..... 0 Hz to 250 kHz
Selectable Hysteresis .... (-12 mV to +12 mV), (+30 mV to +60 mV), (-30 mV to -20 mV), (-150 mV to +150 mV), (+350 mV to +600 mV), (-600 mV to -350 mV), (-1.15 V to +1.15 V), (+1.25 V to +2.1 V), (-2.1 V to -1.25 V)
Rolloff Filter ..... Selectable, none or 1600 Hz
Debounce Time ..... Selectable 0, 3, 50 ms

Conversion

Frequency Technique ..... Inverse period
Conversion Time .....
Gate time + 30 ms+ 0-2 signal periods
Gate Time ..... Selectable 10 ms to 199.99 s
Timeout ..... Selectable 10 ms to 199.99 s
Output & Display Update Time .....
Same as conversion time

Accuracy

Time Base ..... Crystal calibrated to ±2 ppm
Span Tempco ..... ±1 ppm/°C (typ)
Long-term Drift ..... ±5 ppm/year

Power

Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

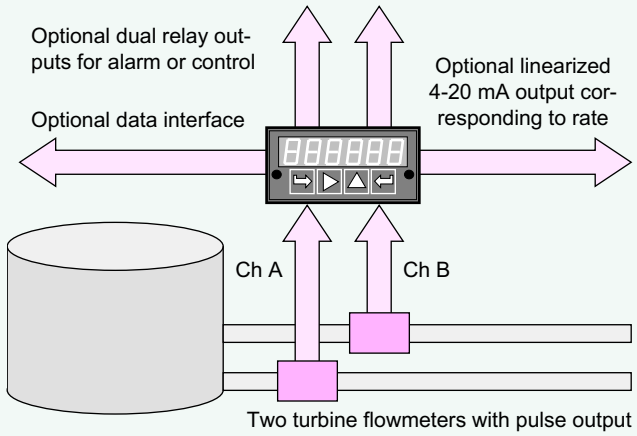
Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

Operating Temperature ..... 0°C to +55°C
Storage Temperature ..... -40°C to +85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA 4X when panel mounted

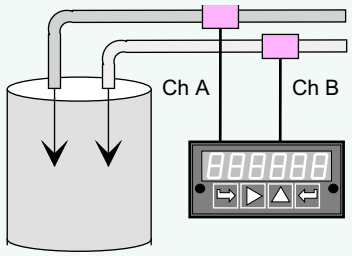
System-level Capabilities



Two turbine flowmeters with pulse output

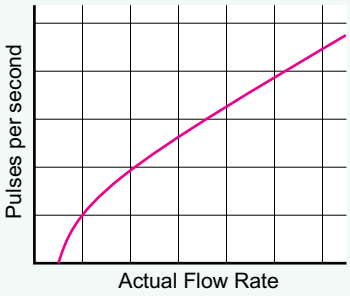
The Laureate dual channel rate meter can independently scale, display and alarm two pulse input channels, and all signal or alarm data can be transmitted via RS-232 or RS-485, including peak readings and arithmetic combinations of the two rates. The displayed rates can also be transmitted as isolated parallel BCD and isolated 4-20 mA analog output.

Combining Two Rates



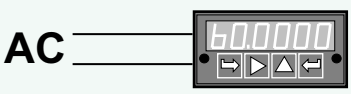
The Extended counter offers A+B, A-B and A/B arithmetic functions. A+B allows two input flows to be summed for total flow, while A-B allows outflow to be subtracted from inflow for net flow. Flow ratios aid in the proper mixing of ingredients.

Linearizing Inputs



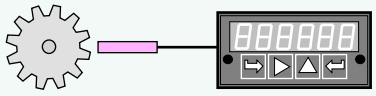
The Extended counter can linearize pulse output flow meters, which tend to be nonlinear on the low end. In particular, linearizing improves the operating range and accuracy of turbine flow meter.

AC Line Frequency



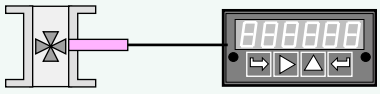
The Laureate will accept line voltages up to 250 Vac and display line frequency to 6-digit accuracy (50.0000 or 60.0000) in a few line cycles. Fast low frequency response is achieved by timing the period and taking its inverse.

RPM and Speed



The Laureate can sense the low-level signals from magnetic pickups or the NPN or PNP transistor output of active sensors. These can be powered directly by the meter. Display in RPM or units of speed is achieved by mathematically scaling the meter.

Flow Rate and Simultaneous Total



The Laureate is compatible with all flowmeters which generate pulses at a frequency proportional to flow rate. The Extended version can display scaled rate or total for the same input at the push of a button, and alarm from both the rate and total.

A/B Ratio & A/B-1 Draw Meters

With arithmetic functions applicable to rate or total

Extended Counter

- **A/B and A/B-1 (draw) arithmetic functions.**
- **Applicable to rate or total.**
- **Frequencies from 0.0025 Hz to 2 MHz.**
- **Independent scaling for each channel.**
- **Inputs from NPN or PNP proximity switches, contact closures, digital logic, magnetic pickups down to 12 mV, or AC inputs up to 250 Vac.**
- **Update rates to 25/s.**
- **Selectable "count by" of 10 or 100 with rounding.**
- **Isolated 5, 10 or 24 Vdc excitation supply to power sensors.**
- **Green or red 6-digit LED display.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485 I/O, parallel BCD output, low voltage AC and DC power.**

Description

The A/B ratio and A/B-1 draw meters are selectable operating modes of the Laureate with Extended counter main board and FR dual-channel signal conditioner board.

Ratio can be used to compare flow rates in two channels, the RPM of rollers or gears, or the speed of moving machinery, such as conveyor belts. Ratio can also be applied to scaled totals to compare two batches to be mixed. In this application, one meter is used to monitor the ratio of flow rates, and a second meter to monitor the resulting batch totals.

Draw is obtained by subtracting 1 from ratio. Draw is often used to measure the elongation or shrinkage of material as it passes between rollers, or to monitor variation in the speed of rollers for tensioning.

Ratio and draw are similar, except that 1 is subtracted from ratio to obtain draw. The frequency of channels A and B is first measured and is then converted to rate in engineering units by multiplying it by the appropriate scale factor for that channel. Either rate can be displayed. The A/B ratio is then taken mathematically by the meter, and 1 is subtracted for draw. The result can be multiplied by a multiple or 10 from 0.0001 to 100000, and the decimal point can be set to display the result with the desired precision up to six digits.

Fast, High Resolution Measurement

The Laureate counter determines frequency by timing an integral number of periods over a programmable gate time. The inverse period approach allows greater accuracy and faster update times than conventional meters which count signal pulses over a specified time interval.

Channel A accepts pulses from 0.0025 Hz to 2 MHz, while Channel B accepts pulses from 0.0025 Hz to 250 kHz.

At the minimum gate time of 10 ms, update rates can be up to 25/second. Such fast response is ideal for peak capture and for alarm and control applications.

Variations in the displayed reading can be reduced by selecting a longer gate time. An adaptive filter can further reduce variations due to noise while rapidly responding to actual changes in the signal.

Universal Signal Conditioner

The dual-channel signal conditioner accepts inputs from proximity switches with PNP or NPN output, TTL or CMOS logic, magnetic pickups, contact closures, low-level outputs from turbine flow meters down to 12 mV , and high-level AC line inputs up to 250 Vac.

Nine hysteresis and input levels are jumper selectable for reliable counting. A 1600 Hz low-pass rolloff filter and debounce times of 3 ms or 50 ms are also selectable.

A built-in isolated 5, 10, or 24 Vdc excitation supply can power proximity switches and other sensors, and eliminate the need for an external power supply.

Other Features and Options

Plug-in isolated analog output, dual setpoint controller and RS232/485 communications or BCD output boards can upgrade the Laureate from a stand-alone monitor to system interface and control.

Laureate meters and counters meet NEMA 4X standards from the front for high pressure washdown when panel mounted.

Specifications

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -999999 to +999999
XXXXEX scientific notation beyond 999999
Indicators ..... 4 LED lamps

Inputs

Types . AC, pulses from NPN, PNP transistors, contact closures, magnetic pickups
Isolation: ..... Common ground for Ch A & B
Channel A frequency ..... 0.0025 Hz to 2 MHz
Channel B frequency .... 0.0025 Hz to 250 kHz
Selectable Hysteresis ..... (-12 mV to +12 mV), (+30 mV to +60 mV), (-30 mV to -20 mV), (-150 mV to +150 mV), (+350 mV to +600 mV), (-600 mV to -350 mV), (-1.15 V to +1.15 V), (+1.25 V to +2.1 V), (-2.1 V to -1.25 V)
Rolloff Filter ..... Selectable none or 1600 Hz
Debounce Time ..... Selectable 0, 3, 50 ms

Conversion

Frequency Technique ..... Inverse period
Output & Display Update Time .....
Gate time + 30 ms+ 0-2 signal periods
Gate Time ..... Selectable 10 ms to 199.99 s
Max Wait Time for Signal .....
Selectable 10 ms to 199.99 s

Accuracy

Time Base ..... Crystal calibrated to ±2 ppm
Span Tempco ..... ±1 ppm/°C (typ)
Long-term Drift ..... ±5 ppm/year

Power

Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc

Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

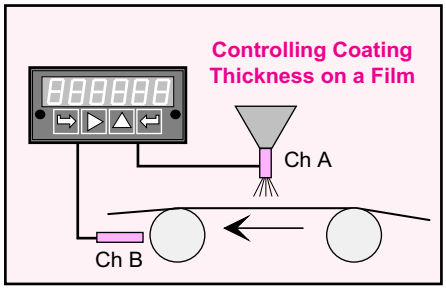
Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

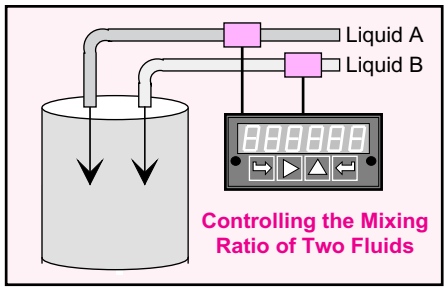
Environmental

Operating Temperature ..... 0°C to +55°C
Storage Temperature ..... -40°C to +85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA 4X when panel mounted

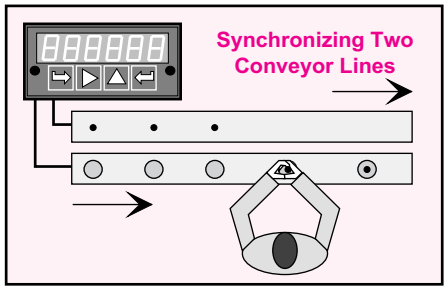
Applications



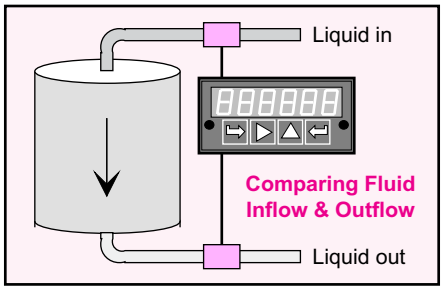
In this application, Ch A measures the rate at which a coating material is applied, as measured by a flow meter, while Ch B measures the speed of the film based on pulses from a proximity switch. Displaying and alarming the A/B ratio assures that an even thickness of coating material is applied as the speed of the film is varies.



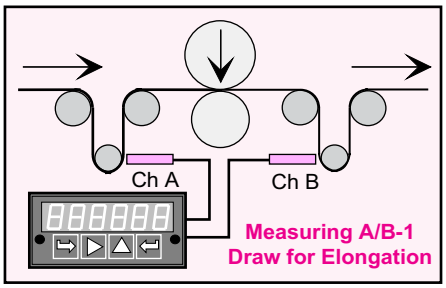
Displaying and alarming the input flow rate ratio of two fluids (gas or liquid) allows these to be mixed in a predetermined ratio in continuous processes. The sensing element is normally a turbine flowmeter, which outputs pulses at a frequency proportional to flow rate. The A/B ratio can also be displayed for totalized rate (or delivered volume).



The dual-channel Laureate counter can measure the speed of conveyor lines by using the output of proximity switches which sense gear teeth or spokes of rotating drive wheels. Displaying the speed ratio of two lines allows line speeds to be adjusted so that material arrives at work stations when needed.



The ratio of the inflow and outflow rates of a tank is a measure of the relative filling or emptying rate. The same meter can also be programmed to display the net inflow or outflow rate in flow units, or to display totalized inflow our outflow in volume units. Any of these parameters can be alarmed using the dual relay board and be transmitted via 4-20 mA, RS-232 or RS-485.



Draw can be used to display the elongation of films compressed between rollers, the shrinkage films, and the RPM difference of rollers whose speed is varied to maintain tension. The six-digit accuracy of the Laureate dual channel counter / ratemeter is ideal for the comparison of rates that are close to each other.

Dual-Channel Up / Down Totalizers

With dual, independently scalable channels & presets

Standard Counter

- **Independent, scalable totals for Channels A & B.**
- **Totals stored in non-volatile memory.**
- **Inputs from NPN or PNP proximity switches, contact closures, digital logic, magnetic pickups down to 12 mV, or AC inputs up to 250 Vac.**
- **Up counting from zero to preset value using positive scale factor.**
- **Down counting from preset to zero using negative scale factor.**
- **Data rates up to 2 MHz.**
- **Isolated 5, 10 or 24 Vdc excitation supply to power sensors.**
- **Green or red LED display.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485, and parallel BCD output.**

Extended Counter

- **Ch A total and Ch B rate simultaneously.**
- **Up/down counting on Ch A, using Ch B to control count direction.**
- **Counting on Ch A, using Ch B to inhibit counting.**
- **Arithmetic functions A+B, A-B, A*B, A/B.**

Description

The Laureate dual-channel up or down totalizer is a basic operating mode of the Laureate counter with the FR dual-channel signal conditioner board.

Each channel (A or B) may be independently set up and scaled to count up from zero (or other value) to a preset limit, or to count down from a preset value to zero (or other limit). Countdown operation is set up by entering a negative scale factor.

The six-digit counter display is capable of displaying any value from -999,999 to 999,999 with programmable decimal point. Scaling allows direct readout in engineering units, such as gallons or cubic feet based on counts from a turbine flowmeter, or the count of cans based on the count of six-packs. The displayed channel (A or B) is selected via a front panel pushbutton. The totals are stored in non-volatile memory so as to be retained in the absence of power.

The minimum recommended complementary option for the Laureate totalizer is the dual setpoint controller output board, which is available with either 10 A relays or AC/DC solid state relays.

Extended Counter Capabilities

An optional Extended counter version provides capabilities beyond those of the standard counter:

Rate and total simultaneously. Channel A can display total while Channel B displays rate. The selection of A or B for display is via a front panel pushbutton. This mode is ideal for flow applications.

Up/down counting. Channel A can serve as an up/down counter, where the count direction is dynamically changed by applying a signal to Channel B. For instance, Channel A can count and scale pulses from a turbine flowmeter, while Channel B inputs the direction of flow. This allows total volume to be tracked in case of reversible flow.

Totalizing with external inhibit. Totalizing by Channel A can be temporarily inhibited by applying a signal to Channel B. For instance, 60 Hz AC pulses can be counted by Channel A and be scaled to display elapsed hours. A signal can be applied to Channel B to start or stop pulse counting when a process is in operation.

Linearization of nonlinear inputs. Exceptionally accurate custom curve rate linearization is achievable, for instance to linearize the low flow end of turbine flowmeters. For setup, up to 240 data points can be input into a spreadsheet or text file by the user. The computer then calculates nonlinear segments, which are downloaded into the meter via RS-232. The linearized rate can then be totalized by the Extended counter.

Arithmetic functions. The Extended counter makes arithmetic functions available, namely A+B, A-B, A*B, A/B and A/B-1. These solve many applications. For instance, A+B allows two input flows to be summed for total volume, while A-B allows outflow to be subtracted from inflow for net volume. A/B allows the mixing of ingredients in a specified ratio. By monitoring and alarming the A/B volume ratio, ingredient B can be added to A until the proper ratio is achieved.

Universal Signal Conditioner

The dual-channel signal conditioner accepts inputs from proximity switches with PNP or NPN output, TTL or CMOS logic, magnetic pickups, contact closures, low-level outputs from turbine flow meters down to 12 mV, and high-level AC line inputs up to 250 Vac.

Nine hysteresis pairs are jumper selectable for reliable triggering with different signal levels. A 1600 Hz low-pass roll-off filter for noise reduction and contact debounce times of 3 ms or 50 ms are also selectable.

A built-in isolated 5, 10, or 24 Vdc excitation supply can power proximity switches and other sensors, and eliminate the need for an external power supply.

Other Features and Options

Plug-in isolated analog output, dual setpoint controller and RS232/485 communications or BCD output boards can upgrade the Laureate from a stand-alone monitor to system interface and control. The ability of the Laureate to output an isolated 4-20 mA signal which tracks a total may be unique among totalizers.

Laureates meet NEMA 4X standards from the front when panel mounted.

Specifications

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -999999 to +999999
Indicators ..... 4 LED lamps

J5 - Signal Input & Excitation Output

1	Excitation Return
2	Excitation Output
3	B Channel Input
4	Ground
5	A Channel Input
6	Ground

Inputs

Types . AC, pulses from NPN, PNP transistors, contact closures, magnetic pickups
Isolation: ..... Common ground for Ch A & B
Channel A frequency ..... 0.0025 Hz to 2 MHz
Channel B frequency .... 0.0025 Hz to 250 kHz
Selectable Hysteresis ..... (-12 mV to +12 mV), (+30 mV to +60 mV), (-30 mV to -20 mV), (-150 mV to +150 mV), (+350 mV to +600 mV), (-600 mV to -350 mV), (-1.15 V to +1.15 V), (+1.25 V to +2.1 V), (-2.1 V to -1.25 V)
Rolloff Filter ..... Selectable none or 1600 Hz
Debounce Time ..... Selectable 0, 3, 50 ms

Power

Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

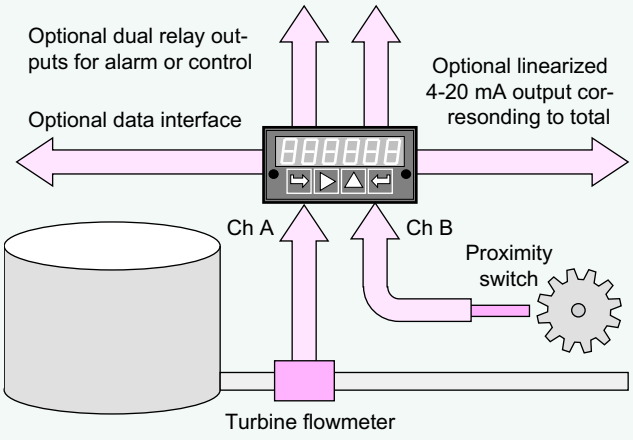
Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

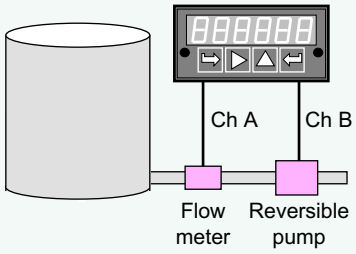
Operating Temperature ..... 0°C to +55°C
Storage Temperature ..... -40°C to +85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA 4X when panel mounted

System-level Capabilities



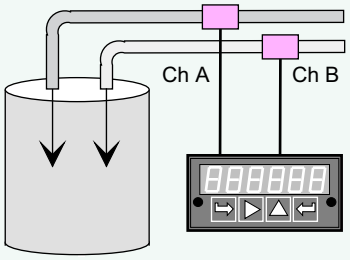
The Laureate dual channel totalizer can independently scale, display and alarm two totals, and the totals plus alarm data can be transmitted via RS-232 or RS-485. The displayed totals can also be transmitted as isolated parallel BCD and isolated 4-20 mA analog output. The Extended version can further display and transmit arithmetic combinations of the two totals.

Up/Down Totalizing



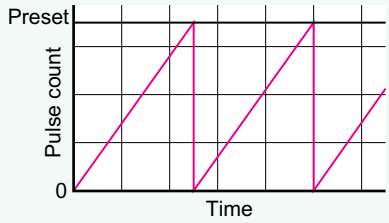
Up/down totalizing is provided by a mode of the Extended counter where pulses are either added or subtracted on Ch A based on a direction input on Ch B. The counter can also be programmed so that counting by Ch A is inhibited by an input on Ch B.

Combining Two Totals



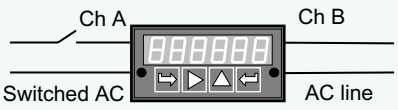
A+B, A-B and A/B arithmetic functions are available with the Extended counter. A+B sums both totals, while A-B subtracts the outflow total from inflow total. The A/B ratio applied to total helps assure the proper mixing of components.

Up or Down Counting with Preset



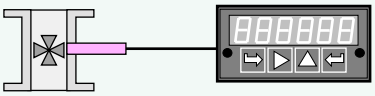
A single Laureate dual-channel counter will handle two repetitive fill operations by counting from zero up to a preset, or down from a preset to zero. A dual setpoint relay board is required.

Machine ON Time and Utilization



An easy way to measure the ON time of machines is to count AC line cycles and scale the total to hours. To display machine utilization or duty cycle in percent, use the Extended counter. Connect Ch A to switched AC and Ch B to the AC line, and have the counter display the A/B ratio with a 100 multiplier.

Total and Rate Simultaneously



The Extended version of the Laureate dual channel counter can display scaled rate or total for the same channel at the push of a button, and alarm both the rate and total. The Extended version is further capable of linearizing nonlinear inputs, thereby extending the working range and accuracy of flow transducers.

Pulse Input Batch Controllers

With three relay outputs for automated batch control

Features

- **6-digit display scalable to ±999,999**
- **Selectable display of batch total, grand total or number of batches, and rate.**
- **Single 10 A relay for batch total, with settable delay between cycles.**
- **Two optional additional relays assignable to batch total for pre-warn, grand total or number of batches, and rate.**
- **Count up from 0 to preset, or down from preset to 0.**
- **Frequency input from 0 Hz to 2 MHz.**
- **Signals from turbine flowmeters, magnetic pickups, NPN or PNP transistors, digital logic, or AC from 12 mV to 250 Vac.**
- **Selectable "count by" of 10 or 100 with rounding.**
- **Isolated 5, 10 or 24 Vdc excitation supply to power sensors.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Optional RS-232/485 I/O, or parallel BCD output.**

Description

The Laureate batch controller is a powerful and highly accurate production workhorse in the form of a compact 1/8 DIN panel meter. It can display the current batch total (Item #1), grand total or number of batches (Item #2), and flow rate (Item #3). All displayed values are scaled to engineering units of volume or flow.

The batch controller utilizes the Extended counter main board and FR dual-channel signal conditioner board to accept a wide range of pulse signals, in particular those from turbine flowmeters. The same signal is applied in parallel to the A and B channels.

A 10 A contact relay serves as the batch relay to control repetitive fill operations. It repeats the batch cycles continually with a programmable delay from 10 ms to 199.99 sec, or based on an external control input. The batch total (Item #1) can be set up to count up from zero to a preset limit, or down from a preset limit to zero. The single-relay board fits in the slot which would otherwise be available for the analog output board.

An optional dual relay board (10 A contact or 0.12 A AC/DC solid state relays) is normally used. Either relay can be assigned to the batch total (Item #1) to serve as a pre-warn to slow down filling near the setpoint, to the grand total or number of batches (Item #2), or to flow rate (Item #3).

An optional RS-232 or RS-485 board allows the batch controller to transmit Items #1, #2 and #3, as well as peak for #3 (rate). If required, all four items can be displayed simultaneously by augmenting the batch controller with up to three Laureate remote displays. Each of these can have its own analog output and dual relays for alarm or control.

Fast, High Accuracy Measurement

The A and B channels of the FR dual-channel signal conditioner are used independently. Either channel can accept pulse rates from 0.0025 Hz to 250 kHz, which exceeds the working range of turbine flowmeters.

Channel A is used for totalizing. The measured total is scaled mathematically for control and display in engineering units, such as liters.

Channel B is used for rate. The pulse frequency is determined by timing an integral number of periods over a specified gate time (plus 30 ms and 0-2 periods), and then taking the inverse of period. The inverse period approach allows much greater accuracy and faster update times than conventional rate meters which count signal pulses over a specified time interval. Update times can be as high as 25/sec. Rate in engineering units, such as liters per second, is obtained by multiplying the input by a scale factor.

For either total or rate, displayed values can be up to six digits (999,999) with a selectable decimal point.

Flowmeter Signal Conditioner

The FR dual-channel signal conditioner accepts pulses from all types of turbine flowmeters and most industrial transducers with a pulse output such as proximity switches with PNP or NPN output, TTL or CMOS logic, magnetic pickup pulses down to 12 mV, as well as AC inputs up to 250 Vac.

Nine hysteresis and input levels are jumper selectable for reliable measurements at different signal levels. A 1600 Hz low-pass rolloff filter for noise reduction is selectable.

A built-in isolated 5, 10, or 24 Vdc excitation supply can power proximity switches and other sensors, and eliminate the need for an external power supply.

Other Features

Laureate meters and counters meet NEMA 4X standards from the front for high pressure washdown when panel mounted. All power and signal connections are via UL / VDE / CSA rated screw clamp plugs, which are standard.

Specifications

J5 - Signal Input & Excitation Output

1	Excitation Return
2	Excitation Output
3	B Channel Input
4	Ground
5	A Channel Input
6	Ground

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -999999 to +999999
Indicators ..... 4 LED lamps

Inputs

Types ..... Pulses from NPN, PNP transistors,

CMOS or TTL logic, magnetic pickups, AC
Isolation ..... Common ground for Ch A & B
Channel A frequency ..... 0.005 Hz to 2 MHz
Channel B frequency ..... 0.005 Hz to 250 kHz
Selectable Hysteresis ..... (-12 mV to +12 mV), (+30 mV to +60 mV), (-30 mV to -20 mV), (-150 mV to +150 mV), (+350 mV to +600 mV), (-600 mV to -350 mV), (-1.15 V to +1.15 V), (+1.25 V to +2.1 V), (-2.1 V to -1.25 V)
Rolloff Filter ..... Selectable none or 1600 Hz
Debounce Time ..... Selectable 0, 3, 50 ms

Rate Conversion

Frequency Technique ..... Inverse period
Delay Between Batch Cycles ..... Selectable 10 ms to 199.99 s
Output & Display Update Time ..... Same as conversion time

Rate Accuracy

Time Base ..... Crystal calibrated to ±2 ppm
Span Tempco ..... ±1 ppm/°C (typ)
Long-term Drift ..... ±5 ppm/year

Power

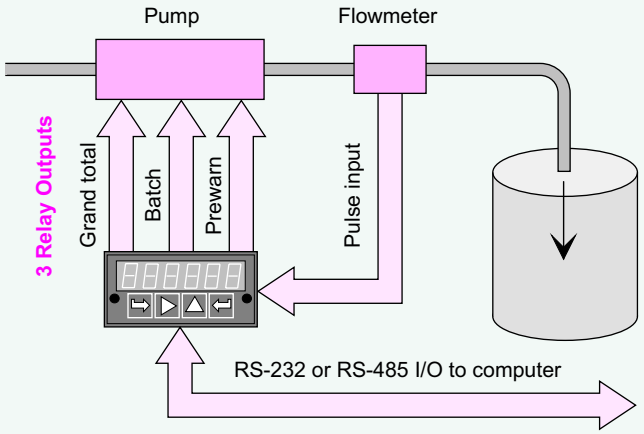
Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

Excitation Output

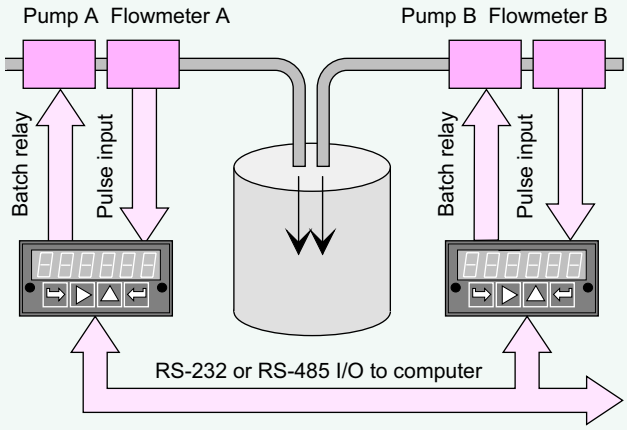
5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

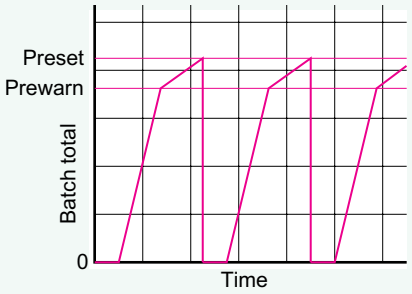
Operating Temperature ..... 0°C to +55°C
Storage Temperature ..... -40°C to +85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA 4X when panel mounted



In this drum filling application, the Laureate utilizes its maximum of three relays to control the pump. The Prewarn relay slows down the pump near the preset to avoid overshoot. The Batch relay stops the pump at the preset. The Grand Total relay stops the filling operation once a predetermined number of drums have been filled.

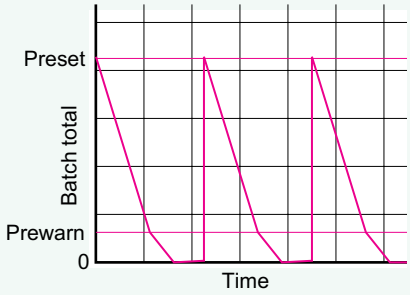


Multiple Laureate batch controllers can be used in combination to control the mixing of materials in the proper ratio. Each feed line is equipped with its own pump, flowmeter, and Laureate. Controller setup and monitoring of the mixing operation are facilitated by optional serial communications. RS-485 allows a single data line to handle multiple controllers.



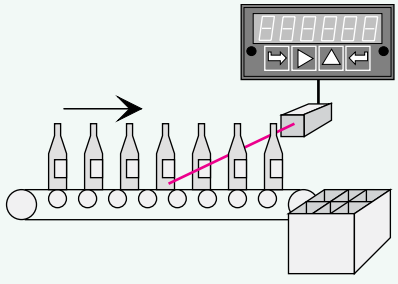
Up-Counting Batch Control

In up-counting batch control, the Laureate counts up from zero to a preset maximum. A prewarn level is available to slow down filling near the preset to avoid overshoot. A time delay can be programmed from the end of each batch to the start of the next batch.



Down-Counting Batch Control

In down-counting batch control, the Laureate counts down from the preset maximum to zero. A prewarn level is available to slow down filling or emptying near zero. Again, a time delay can be programmed from the end of each batch to the start of the next batch.



Discrete Filling and Batch Counting

The Laureate batch controller is ideal for discrete manufacturing as well as repetitive fill operations. In this example, the Laureate counts bottles which it then groups into sixpacks. Its Grand Total capability can be used to track bottles or sixpacks.

Process Receiver (V-to-F) & Integrating Totalizer

Rate, square root extraction, batch control, time based on rate

Standard Counter

- **Square root readout from analog output of differential pressure flow transducers.**
- **0-1 mA, 4-20 mA, 0-10 V inputs, or special factory scaling.**
- **6-digit resolution.**
- **Field scalable for direct readout in engineering units.**
- **Isolated 5, 10, or 24 Vdc excitation output to power sensors.**
- **Selectable "count by" of 10 or 100 with rounding.**
- **25/s update rate.**
- **Peak value display.**
- **Green or red LED display.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485 I/O, and parallel BCD output.**

Extended Counter

- **Custom curve linearization.**
- **Total based on rate and time.**
- **Batch control based on rate and total.**
- **Display of process time based on rate input.**

Description

Standard Version

Rate with Square Root Extraction

A Laureate™ meter with the Standard counter main board and a voltage-to-frequency (V-to-F) signal conditioner board is able to accurately extract the square root of analog signals. The display is a full six digits. The three standard input ranges are 0-1 mA, 4-20 mA and 0-10 V. Special input ranges are available from the factory.

One application of the Standard V-to-F meter is to accurately display flow rate in engineering units, such as gallons per minute, from the 4-20 mA signal of a flow transducer with linear or squared output.

Extended Version

Batch Control with Linearized Total

The Laureate V-to-F meter with the Extended counter main board can also totalize the linearized flow rate derived from the analog rate signal, count up to a preset value, or down to zero from a preset value for batch control. The analog input may or may not require linearization. In addition to rate and total, the grand total of the batches or the number of batches can also be displayed by pressing a front panel key.

Use of the Extended V-to-F meter as an up or down-counting batch controller requires the dual-relay output board option. One of the relays is dedicated to ON/OFF batch control. The other relay is available to slow down rate near the setpoint or to provide another alarm or control function based on rate or total.

One application of display of rate plus total is to read out kilowatts and kilowatt-hours based on 0-1 mA from a watt transducer.

Custom Curve Linearization

The relationship between the analog input and the value to be displayed can have a linear, square root, or custom curve relationship. For custom curve linearization, up to 240 data points can be input into a spreadsheet or text file by the user. The computer then calculates nonlinear segments, which are downloaded into the meter via RS-232. Custom-linearized rates can be totalized and be used for batch control.

Like the Extended analog DC panel meter, the Extended V-to-F meter can linearize and display analog inputs based on a custom curve unrelated to flow, for instance to read out the volume of an irregularly shaped tank based on level or pressure, or to linearize a nonlinear transducer.

Time Based on Rate

The Extended V-to-F meter can display a time inversely proportional to measured rate, such as the time that it will take a conveyor to traverse an oven. As the rate of the conveyor is increased, the displayed baking time will be decreased.

Principles of V-to-F Operation

The V-to-F signal conditioner board converts the full-scale 0-1 mA, 4-20 mA or 0-10 V analog signal to a frequency of 10-110 kHz. This frequency is determined by measuring period over a selected gate time (from 10 ms to 200 s) and taking the inverse of period. Selecting a short gate time provides a much higher update rate than conventional counting-type frequency meters. At the lowest frequency of 10 kHz and the minimum gate time of 10 ms, the meter is capable of 25 updates per second.

Scaling to rate in engineering units and totalizing are done mathematically. Totals are stored in nonvolatile memory in case of power loss.

High Resolution Display

The display of rate or total may be scaled to ±999,999. The two least-significant digits may be set to display zero with rounding or be active digits. In addition to a selectable gate time for rate measurement, an adaptive filter can reduce variations due to noise while rapidly responding to actual changes in signal level.

Hardware Features

Optional, plug-in analog output, dual-setpoint controller and RS-232/485 communications or BCD output boards can upgrade the Laureate from a stand-alone monitor to system interface and control. In particular, the analog 4-20 mA or 0-10 V analog output will be linearized to the reading, which may be rate or total.

All Laureate meters meet the NEMA 4X standard from the front for high pressure washdown when panel mounted.

Specifications

Connector Pin Assignments

J5 - Signal Input & Excitation Output

1	Excitation Return
2	Excitation Output
3	Signal Low
4	Signal High

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -999999 to +999999
Indicators ..... 4 LED lamps

Inputs

Signal levels ..... 0-1 mA, 4-20 mA, 0-10 V
Consult factory for other ranges.

Conversion

Technique (frequency) ..... Inverse period
Rate ..... Gate Time + 30 ms (max)
Gate Time ..... Selectable 10 ms to 199.99 s
Output & Display Update Time .....
Same as conversion time

Accuracy

Span Tempco ..... 0.003% R/°C
Zero Tempco ..... 0.001 FS/°C

Power

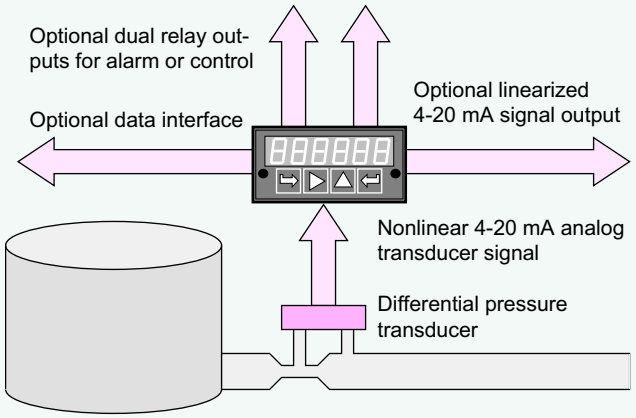
Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test
CMR, DC to 60 Hz ..... 130 dB

Excitation Output

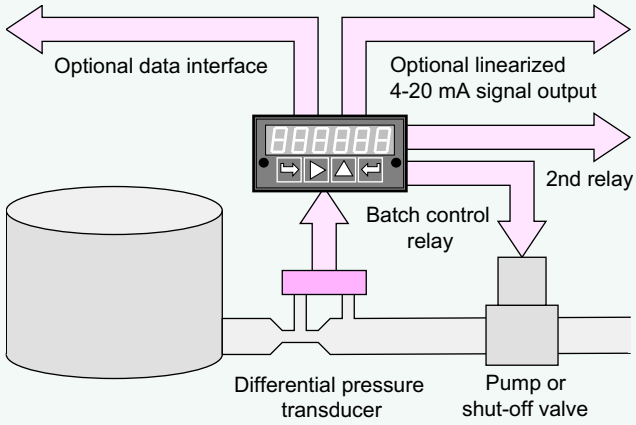
5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

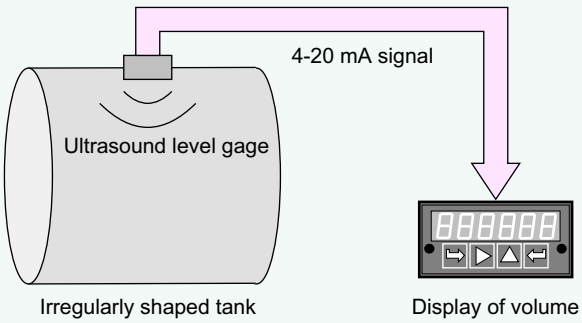
Operating Temperature ..... 0 °C to 55 °C
Storage Temperature ..... -40 °C to 85 °C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA 4X when panel mounted



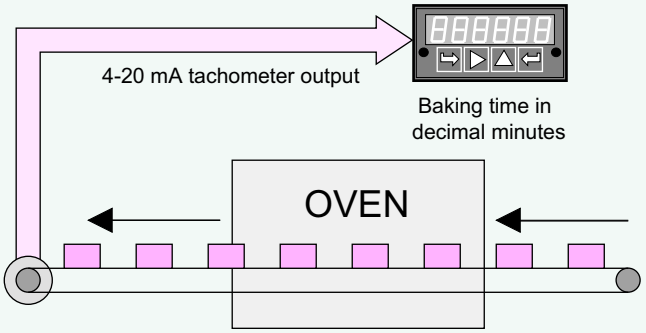
An ideal application for the Standard Laureate V-to-F meter: readout of flow based on the 4-20 mA analog signal from a differential pressure transducer. Options include dual relays for alarm or control, isolated analog output to turn the meter into a transmitter, and RS-232/485 or BCD data communications.



An ideal application for the Extended Laureate V-to-F meter: up- or down-counting batch controller. The dual-relay card is required. One relay is dedicated to batch control, the other relay is available to alarm the rate or total. The signal input can be linear or nonlinear. The display can be toggled between rate and total.



The Extended Laureate V-to-F meter can linearize analog signals for display and alarm using custom curve linearization with multiple nonlinear segments. As illustrated, tank level is measured by an ultrasound detector, which transmits a 4-20 mA signal. This signal is then converted to a highly accurate volume reading. The linearized rate readings can be totalized.



A unique application of the Extended Laureate V-to-F meter: displaying process time based on the 4-20 mA or 0-10 V signal from a rate meter. In the above example, a tachometer transmits the speed of a conveyer belt through an oven. The meter displays baking time in the oven using the mathematical relationship *time = distance / speed*.

Time Interval & Stopwatch Meters

For periodic time measurement & one-time events

Common Features

- **Inputs from NPN or PNP proximity switches, contact closures, digital logic, magnetic pickups down to 12 mV, or AC inputs up to 250 Vac.**
- **Trigger on positive or negative pulse edges.**
- **6-digit red or green LED display.**
- **Isolated 5, 10 or 24 Vdc excitation output to power sensors.**
- **Green or red LED display.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485, and parallel BCD output.**

Time Interval Mode

- **For periodic events from 1 µs to 199.99 s.**
- **Display resolution to 0.2 µs.**
- **Uses Standard counter main board and FR signal conditioner.**

Stopwatch Mode

- **Times single events with start and stop pulses from 1 ms to 54 hrs.**
- **Selectable display of single event time or accumulated time of all events up to 999,999 hrs.**
- **Selectable display in HH.MM.SS clock format or H, M or S up to 6 digits with decimal point.**
- **Uses Extended counter main board and FR signal conditioner.**

Description

The Laureate™ time interval and stopwatch timers use the FR dual-channel signal conditioner and either the Standard counter main board (time interval) or Extended counter main board (stopwatch).

A-B Time Interval Mode

The Laureate time interval meter displays pulse width or time delay between pulses for single pulses or the average for multiple pulses. Time interval is measured between inputs on channels A and B. Timing starts when a pulse is applied to Ch A (selectable positive or negative edge) and ends when a pulse is applied to Ch B (selectable posi-tive or negative edge). In case of a single pulsed signal, the A and B inputs can be tied together. A positive or negative slope may be selected to start timing, and the opposite slope must be selected to stop timing.

Timing is achieved by counting 5.5 MHz clock pulses. Multiple integral time intervals are averaged over a gate time which is selectable from 10 ms to 199.99 s and also controls the display update time. The default display is in µs. Display resolution down to 0.2 µs can be achieved by applying a multiplier of 10, moving the decimal point by one position, and averaging many time intervals. Resolutions up to 1 s or greater are also programmable.

Stopwatch Mode

The Laureate stopwatch meter is designed to time single events, such as sporting events or processes, which produce start and stop pulses. It can also time the width of a single pulse. The display is updated continuously during timing.

A-A Stopwatch Mode

Time can be measured between a start pulse and a stop pulse, both on Channel A, from either the positive or negative edges.

A-B Stopwatch Mode

Time can also be measured between a start pulse on Channel A (positive or negative edge) and a stop pulse on Channel B (positive or negative edge). This mode allows inputs from different sources. In addition, the A and B inputs can be tied together to start the stopwatch with one polarity and stop it with the other polarity.

Display

The event time (Item #1) may be displayed in HH.MM.SS clock format with 1 s resolution or in H, M or S seconds with six-digit resolution . The longest timing interval is 99 hours. The highest resolution is 1 µs.

The stopwatch display is updated during timing at a rate controlled by gate time, up to 25/s. It is reset to zero when the next start pulse occurs. Accumulated time from multiple events (Item #2) is also tracked and may be displayed up to 999,999 hours.

Universal Signal Conditioner

The dual-channel signal conditioner used for pulse detection accepts inputs from proximity switches with PNP or NPN output, TTL or CMOS logic, magnetic pickups, contact closures, and other signals from 12 mV to 250 Vac.

Nine hysteresis and input levels are jumper selectable for reliable triggering. A 1600 Hz low-pass roll-off filter for noise reduction and contact debounce times of 3 ms or 50 ms are also selectable.

A built-in isolated 5, 10, or 24 Vdc excitation supply can power proximity switches and other sensors, and eliminate the need for an external power supply.

Other Features and Options

Plug-in isolated analog output, dual setpoint controller and RS232/485 communications or BCD output boards can upgrade the Laureate from a stand-alone monitor to system interface and control.

Laureate meters and counters meet NEMA 4X standards from the front for high pressure washdown when panel mounted. All power and signal connections are via plug-in screw-clamp connectors.

Specifications

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -999999 to +999999
Indicators ..... 4 LED lamps

J5 - Signal Input & Excitation Output

1	Excitation Return
2	Excitation Output
3	B Channel Input
4	Ground
5	A Channel Input
6	Ground

Inputs

Types . AC, pulses from NPN, PNP transistors, contact closures, magnetic pickups
Isolation: ..... Common ground for Ch A & B
Channel A frequency ..... 0.005 Hz to 2 MHz
Channel B frequency ..... 0.005 Hz to 250 kHz
Selectable Hysteresis ..... (-12 mV to +12 mV), (+30 mV to +60 mV), (-30 mV to -20 mV), (-150 mV, +150 mV), (+350 mV, +600 mV), (-600 mV to -350 mV), (-1.15 V to +1.15 V), (+1.25 V to +2.1 V), (-2.1 V to -1.25 V)
Roll-off Filter ..... Selectable none or 1600 Hz
Debounce Time ..... Selectable 0, 3, 50 ms

Time Interval Mode

Timing Start ..... Ch A pulse, + or - edges
Timing Stop ..... Ch B pulse, + or - edges
Periodic Timing Interval ..... Gate time + 30 ms + 0-2 time intervals
Gate Time ..... Selectable 10 ms to 199.99 s
Timeout ..... Selectable 10 ms to 199.99 s
Output & Display Update Time ..... Same as periodic timing interval

Stopwatch Mode

Timing Start ..... Ch A start pulse, + or - edge
Timing Stop ..... Ch A stop pulse, same edge polarity as start pulse,or Ch B pulse, opposite edge polarity as start pulse
Timing interval ..... 1 µs to 99 hrs
Timing Resolution ..... 1 µs
Selectable Decimal Time ..... 999999 H, M or S, any decimal point
Selectable Clock Time ..... HH.MM.SS
Output & Display Update Time ..... Gate time

Accuracy

Time Base ..... Crystal calibrated to ±2 ppm
Span Tempco ..... ±1 ppm/°C (typ)
Long-term Drift ..... ±5 ppm/year

Power

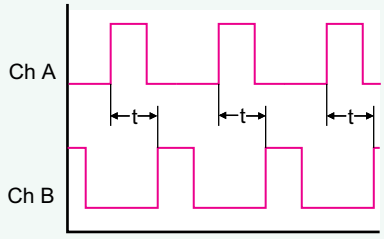
Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

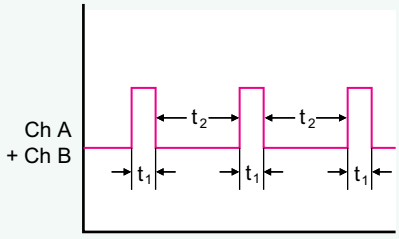
Environmental

Operating Temperature ..... 0°C to +55°C
Storage Temperature ..... -40°C to +85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA 4X when panel mounted



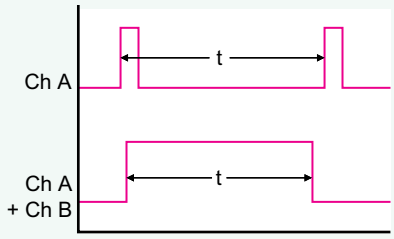
Time Interval Mode forTime Delay

For periodic pulses applied to A and B channels, time delays can be measured down to 0.2 µs resolution from the rising or falling edge of A to the rising or falling edge of B (selectable).



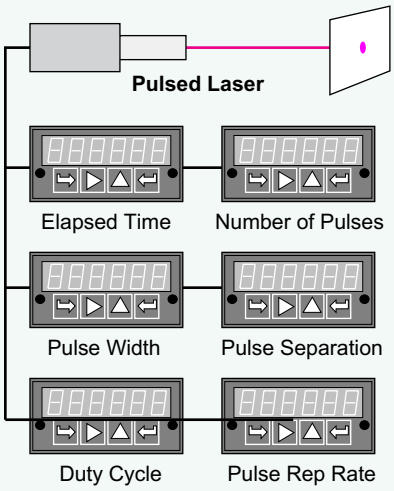
Time Interval Mode for Pulse Width

The width of periodic pulses (t_1 or t_2) can be measured by tying the A and B channels together. As for time delay, readings are averaged over a user-selectable gate time.

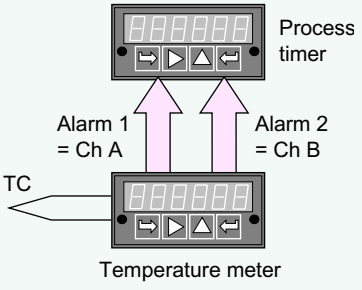


Stopwatch Mode

The stopwatch mode is used to time single events between start and stop pulses on the same channel. Duration of a single waveshape can be measured by tying the A and B channels together.

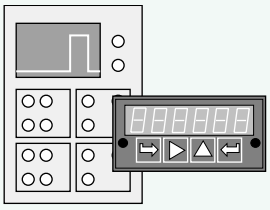


Some of the many possibilities in instrumenting a pulsed laser system with Laureate dual-channel counters.



Timing Process Dynamics

The start and stop pulses used for timing can be generated by the dual relay board in a Laureate analog panel meter or digital counter. For instance, the start and stop pulse edges can be created as a temperature passes two alarm setpoints, or a temperature cycles in a hysteresis control mode.



When to Replace an Oscilloscope with a Panel Meter

An oscilloscope can be used for viewing pulses. However, a Laureate time interval meter is the instrument of choice if high timing accuracy or control outputs are required.

Phase Angle & Duty Cycle Meters

For offset in degrees & On or Off period in percent

Common Features

- **Inputs from NPN or PNP proximity switches, contact closures, digital logic, magnetic pickups down to 12 mV, or AC inputs up to 250 Vac.**
- **Trigger on positive or negative pulse edges.**
- **Frequency from .005 Hz to 10 kHz.**
- **6-digit red or green LED display.**
- **Isolated 5, 10 or 24 Vdc excitation output to power sensors.**
- **Green or red LED display.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Uses Standard counter main board and FR signal conditioner.**
- **Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485, and parallel BCD output.**

Phase Angle Mode

- **Measures phase angle between two waveshapes of similar period**
- **Resolution of 1º, 0.1º or 0.01º.**
- **.01% accuracy at AC line frequency**

Duty Cycle Mode

- **Measures ON or OFF period as a percentage of total period.**
- **Resolution of 1%, 0.1% or 0.01%.**

Description

The Laureate™ phase angle and duty cycle meters both use the FR dual-channel signal conditioner board and the Standard counter main board.

Phase Angle Mode

Phase angle measurement requires that two signals with identical periods be applied to Channels A and B. A display from -180º to +180º is obtained by timing the rising edge of one channel and the falling edge of the other channel, and programming a 180º offset. A resolution of 1º, 0.1º or 0.01º is selectable. Accuracy is .01% up to 100 Hz, .1% at 1 kHz, and 1% at 10 kHz.

Phase angle measurement is commonly used with AC power from 50 Hz to 400 Hz. Phase angle needs to be set to zero to synchronize AC generators. It also applies to the triggering of SCRs and Triacs for power control. The phase angle between AC current and voltage determines power factor. The Laureate phase angle meter provides exceptionally fast response and six-digit accuracy for low frequencies, such as AC line frequency.

Phase angle is determined by timing crystal clock pulses over a specified gate time which is selectable from 10 ms to 199.99 s. By selecting the minimum gate time of 10 ms, the update rate can be up to 20/s for 50/60 Hz AC line frequency. Improved accuracy is obtained by making the gate time long enough so that multiple cycles can be averaged.

Duty Cycle Mode

Duty cycle is a measure of ON or OFF period as a percentage of total period. As for phase angle, duty cycle is determined by averaging an integral number of periods over a gate time which is selectable from 10 ms to 199.99 s. The same signal is applied to Channels A and B. The meter divides the average pulse width by the period between pulses and expresses this ratio in percent. A resolution of 1%, 0.1% or 0.01% is selectable. By selecting leading or falling pulse edges, the ON or OFF duty cycle can be displayed.

Duty cycle measurement is used to monitor modulated proportional control systems and pulse-modulated systems, such as radar, lasers or packet radio.

For long periods, duty cycle can be measured by using the A and B channels of the Laureate dual-channel counter to totalize AC line cycles and having the counter display the ratio of the two totals scaled to percent.

Universal Signal Conditioner

The dual-channel signal conditioner accepts inputs from proximity switches with PNP or NPN output, TTL or CMOS logic, magnetic pickups, contact closures, and AC signals from 12 mV to 250 Vac.

Nine hysteresis and signal levels are jumper selectable for reliable triggering. A 1600 Hz low-pass rolloff filter for noise re-duction and contact debounce times of 3 ms or 50 ms are also selectable.

A built-in isolated 5, 10, or 24 Vdc excitation supply can power proximity switches and other sensors, and eliminate the need for an external power supply.

Other Features and Options

Plug-in isolated analog output, dual setpoint controller and RS232/485 communications or BCD output board s can upgrade a Laureate from a stand-alone monitor to system interface and control.

Laureate meters and counters meet NEMA 4X standards from the front for high pressure washdown when panel mounted.

Specifications

J5 - Signal Input & Excitation Output

1	Excitation Return
2	Excitation Output
3	B Channel Input
4	Ground
5	A Channel Input
6	Ground

Phase Angle Mode

Item Displayed ..... Phase angle difference between two waves of same period
Display Units ..... 1°, 0.1°, 0.01°
Frequency Range ..... .005 Hz to 10 kHz
Accuracy ..... .01°, .005 Hz to 100 Hz
.1° at 1 kHz, 1° at 10 kHz
Maximum Timing Interval ..... 200 s

Duty Cycle Mode

Item Displayed ..... ON or OFF duty cycle of periodic pulse waveshape
Display Units 1%, 0.1%, 0.01%
Frequency Range ..... .005 Hz to 50 kHz
Accuracy .....01%, .005 Hz to 500 Hz
.1% at 5 kHz, 1% at 50 kHz
Maximum Timing Interval ..... 200 s

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green
Range ..... -999999 to +999999
Indicators ..... 4 LED lamps

Inputs

Types . AC, pulses from NPN, PNP transistors, contact closures, magnetic pickups
Isolation ..... Common ground for Ch A & B
Selectable Hysteresis ..... (-12 mV to +12 mV), (+30 mV to +60 mV), (-30 mV to -20 mV), (-150 mV to +150 mV), (+350 mV to +600 mV), (-600 mV to -350 mV), (-1.15 V to +1.15 V), (+1.25 V to +2.1 V), (-2.1 V to -1.25 V)
Rolloff Filter ..... Selectable none or 1600 Hz
Debounce Time ..... Selectable 0, 3, 50 ms

Timing Interval

Periodic Timing Interval .....
Gate time + 30 ms + 0-2 signal periods
Gate Time ..... Selectable 10 ms to 199.99 s
Timeout ..... Selectable 10 ms to 199.99 s
Output & Display Update Time .....
Same as period timing interval

Power

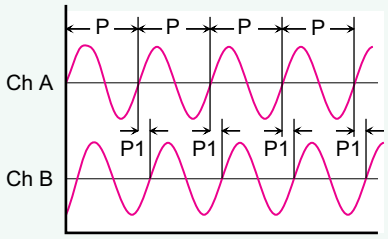
Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

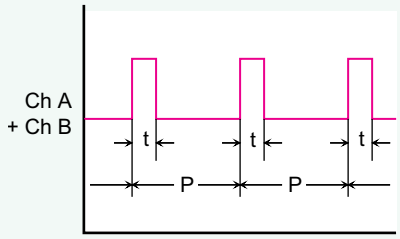
Environmental

Operating Temperature ..... 0°C to +55°C
Storage Temperature ..... -40°C to +85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA 4X when panel mounted



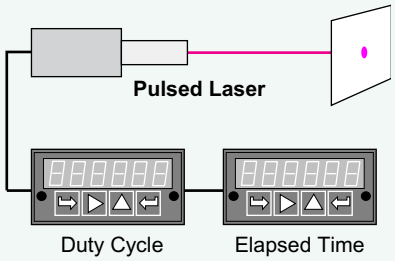
Phase Angle Mode

Phase angle indicates the lead or lag in degrees from 0° to 360° between two periodic signals having the same frequency. In the illustration, phase angle is 360*P1/P. The signals are applied to the A and B input channels.

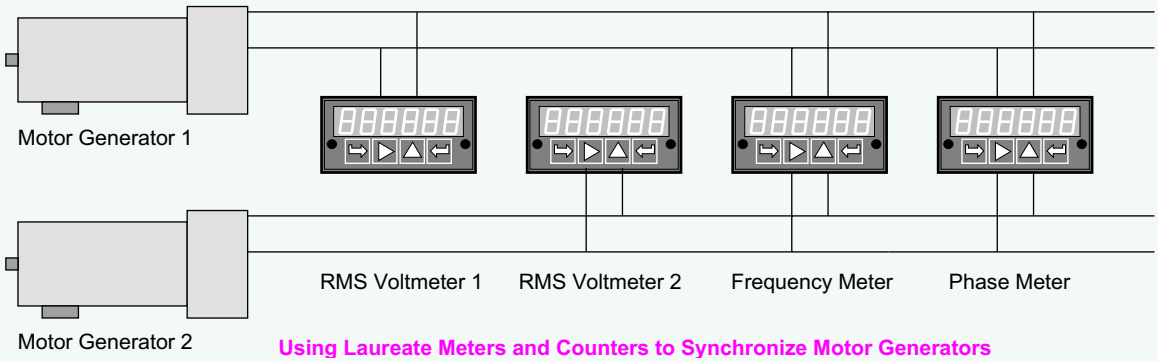


Duty Cycle Mode

Duty cycle indicates the ON or OFF time in percent from 0% to 100% of period for repetitive pulse train. In the illustration, duty cycle is 100*t/P. The same signal is applied to the A and B channels.



Duty cycle can be used to indicate the ON time of a pulsed laser in relation to total time. Laureate counters can also measure elapsed time, the number of pulses, average width in µs, the number of pulses, and total energy applied.



Using Laureate Meters and Counters to Synchronize Motor Generators

Synchronization of two motor generators requires that the two frequencies be identical, that the lines be in phase, and that the line voltages be close to each other.

A single Laureate dual channel counter measures both frequencies to six-figure accuracy in a few line cycles. Another Laureate dual channel counter measures phase angle to 0.1° resolution.

Two Laureate AC RMS Voltmeters, which offer ranges of 200.00 V and 660.0 V, are used to display RMS voltage to 0.1% accuracy.

Quadrature Position & Rate Meters

For accurate position or rate from quadrature encoders

Features

- **Accepts low-level differential or single-ended 5 V logic level outputs from shaft encoders.**
- **Count x1, x2 or x4.**
- **Combine pulse rate to 250 kHz.**
- **Programmable display refresh rate up to 25/s.**
- **Zero channel input.**
- **6-digit display scalable for direct readout in units of length.**
- **Isolated 5, 10 or 24 Vdc excitation output to power shaft encoder.**
- **AC or DC powered.**
- **Green or red LED display.**
- **NEMA 4X front panel, 1/8 DIN case.**
- **Optional dual relays, 4-20 mA & 0-10 V analog output, RS-232/485 I/O, and parallel BCD output.**
- **Extended counter option to display rate or position.**

Description

Position, Length or Angle

The Laureate™ quadrature meter with the Standard counter main board accepts the A & B signals from 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 produced. The meter totalizes the counts and then scales the total in software for display and control. A zero index signal may be added as a third input to the A & B signals.

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.

Zero Index Pulse

A zero index pulse, if available, is interpreted as by the meter as corresponding to an integral number of revolutions of the shaft encoder. It is used by the meter to correct for any cumulative pulse count errors. Special circuitry corrects for width of the zero index pulse.

Provision for Power Failure

In the event of a power failure, the current total may be stored in non-volatile memory and can be used as the starting point for counting when power resumes. Power fail or zero index capabilities are alternate meter setup choices.

Interface Capabilities

A built-in isolated 5, 10, or 24 Vdc excitation supply can power the encoder and eliminate the need for an external power supply.

Plug-in isolated analog output, dual-setpoint controller, RS-232, RS-485 communications and BCD output boards can upgrade the quadrature meter from standalone monitor to system interface and control. In particular, the meter can provide an isolated 4-20 mA output signal scaled to the display.

Specifications

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Color ..... Red or green LED
Range ..... -999999 to +999999
Display Update Rate ..... Programmed gate time +30 ms +1-2 signal periods
Indicators ..... 4 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

Rate Operation

Conversion Technique ..... Inverse period
Conversion Time ..... Gate time + 30 ms + 0-2 signal periods
Gate Time ..... Selectable 10 ms to 199.99 s
Timeout ..... Selectable 10 ms to 199.99 s
Output & Display Update Time ..... Same as conversion time
Time Base Accuracy .... Calibrated to +/-2 ppm
Span Tempco ..... +/-1 ppm/°C (typ.)
Long-term Drift ..... +/-5 ppm/year

Power

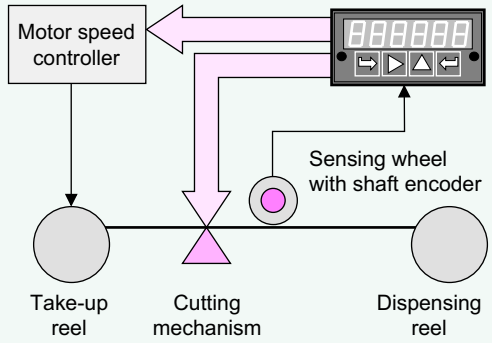
Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

Excitation Output

5 Vdc ..... 5 Vdc ±5%, 100 mA max
10 Vdc ..... 10 Vdc ±5%, 120 mA max
24 Vdc ..... 24 Vdc ±5%, 50 mA max
Output isolation ..... 50 Vdc to meter ground

Environmental

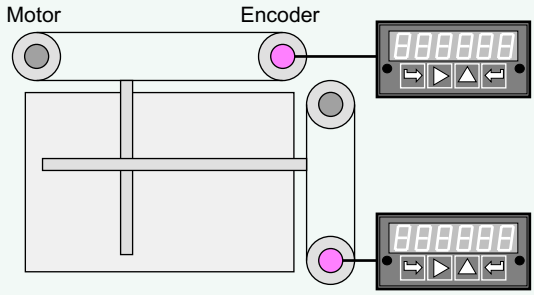
Operating Temperature ..... 0°C to 55°C
Storage Temperature ..... -40°C to 85°C
Relative Humidity 95% at 40°C, noncondensing
Protection ..... NEMA 4X when panel mounted



Using Quadrature for Cutting to Length

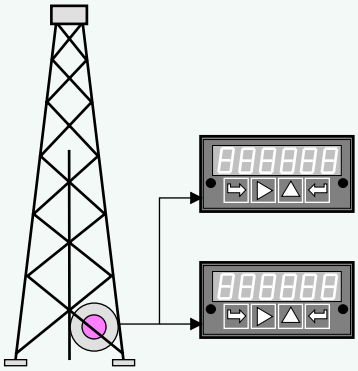
Controlling the repetitive cutting of material to length is an excellent application of the Laureate quadrature meter.

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 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.

LAUREATE Remote Displays

6-digit readouts with analog output and control capabilities

Standard Features

Mechanical

- 6 digits, -999,999 to 999,999
- Red or green LED display
- NEMA-4X front panel
- 1/8 DIN case

Digital interface

- RS-232 and RS-485
- Addressing of up to 31 remote displays from a single data line

Worldwide power input

- 85-264 Vac, 47 to 440 Hz
- 90-370 Vdc

Options

Dual-setpoint controller boards

- 10 Amp, 250 Vac contact relays.
- Isolated solid state relays.
- Actuation based on displayed value or control characters.

Isolated analog output board

- Isolated 0-10 Vdc & 0-20 mA output linearized to reading.
- Turns remote display into an isolated transmitter.

Isolated low-voltage power

- 9-37 Vdc and 8-28 Vac

Description

The Laureate™ Remote Displays accept RS-232 or RS-485 inputs from computers, programmable controllers, Laureate meters or Laureate counters. They blend in with the other Laureate products and provide a visual display from -999,999 to +999,999. They can also provide remote alarm and analog output capability.

The display consists of six 14.2 mm (.56") high LED digits, available in red or green. The 1/8 DIN front panel is environmentally sealed to NEMA-4X when panel mounted.

Standard features include input power from 85-264 Vac or 90-370 Vdc. Low voltage input power from 8-28 Vac or 9-37 Vdc is optional.

Interface to Computer or PLC

Multiple Laureate remote displays can be connected in parallel to a single data line in multidrop fashion and be addressed from a single data port, thus minimizing wiring. Each unit will only display the value transmitted for its unique address. The recognition character preceding the address is programmable. The data rate is selectable from 300 to 19,200 bps.

With the RS-485 interface, up to 31 remote displays can be addressed and be connected in parallel. With the RS-232 interface, only 5 remote displays can be connected in parallel for impedance reasons.

Interface to Laureates

All Laureate meters and counters allow the display of the sending unit to be duplicated by a remote display.

The simultaneous display of multiple parameters using multiple remote displays is possible if the sending unit is a Laureate counter equipped with an FR or VF signal conditioner board (see Ordering Guide). The sending unit may be set up to display any of up to four parameters: Item #1, Item #2, Item #3 or peak. These four parameters are transmitted in sequence, and a remote display can be set up to display any one item in that sequence.

One possibility is to install up to three remote displays in the same control panel as a counter to augment its single display. For example, a Batch Controller can show the batch total. The remote displays can show rate, peak rate, and either grand total or number of batches.

A yellow indicator light shows which item in the transmitted sequence has been chosen for display.

Isolated Analog Output Option

A Laureate remote display can be equipped with an optional isolated analog output board with 0-10 V and 0-20 mA or 4-20 mA outputs to serve as a very low cost, 12-bit digital-to-analog converter. Either output can be scaled to the displayed value. With this board, the remote display can drive a chart recorder or serve as a highly accurate, isolated 4-20 mA transmitter.

Alarm & Setpoint Control Option

Each Laureate remote display can also be equipped with an output board with dual contact relays or dual optoisolated AC/DC solid state relays to provide remote alarm and setpoint control capability.

- The relays can respond to the data values transmitted via RS-232/485. The setpoints can be programmed locally from the front panel of the remote display or remotely via RS-232/485.
- The relays can respond to any of eight control characters transmitted via RS-232/485. These characters can be transmitted by a Laureate meter or counter, thereby assuring that the local and remote alarm points are identical.

With the addition of the scaled analog output and alarm/setpoint capabilities, Laureate remote displays can become significant components of any supervisory monitoring and control system.

Specifications

Display

Readout .... 6 digits, 7-segment, 14.2 mm (.56")
Display color ..... Red or green LED
Display range ..... -999999 to 999999
Indicators ..... 4 LED lamps

Digital Interface

Signal levels ..... RS-232 and RS-485
Baud rate 300, 600, 1200, 2400 4800, 9600, 19200
Number of multidrop addresses 31
Choice of address recognition characters .. 35

Operating Power

Voltage (std) .... 85 to 264 Vac, 90 to 370 Vdc
Voltage (opt) ..... 8 to 28 Vac, 9 to 37 Vdc
Power frequency ..... DC and 47 Hz to 440 Hz

Analog Output Board Option

Output levels ..... 0-10 V and 0-20 mA
Output scaling ..... To displayed reading
Setup ..... Via front panel or computer

Alarm / Setpoint Board Option

Output types .... Dual 250 Vac, 10 A relays, or dual isolated AC/DC solid state relays
Input ..... Digital data or control characters received via RS-232/485
Setup ..... Via front panel or RS-232/485

Power

Voltage, std ..... 85-264 Vac and 90-370 Vdc
Voltage, opt ..... 8-28 Vac and 9-37 Vdc
Frequency ..... DC or 47-440 Hz
Power isolation ..... Safety-rated to 250 Vac, meter ground to earth groud, DC to 60 Hz, 4.2 kVp per High Voltage Test

Environmental

Operating temperature ..... 0°C to 55°C
Storage temperature ..... -40°C to 85°C
Relative humidity 95% at 40°C, noncondensing
Protection ..... NEMA-4X when panel mounted

Displayable Counter Parameters

FR Signal Conditioner, Non-extended

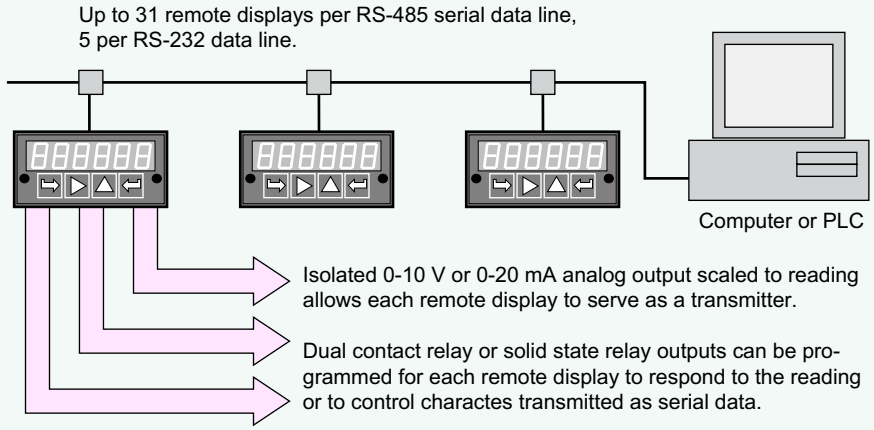
Item #1: Rate A, total A, time interval, period A.
Item #2: Rate B, total B, period B.

IFR Signal Conditioner, Extended

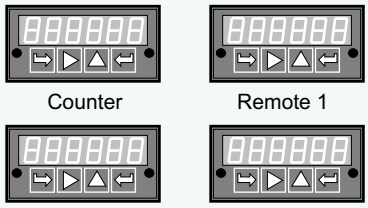
Item #1: Rate A, total A, rate B, total B, time interval, phase, A+B, A-B, A*B, A/B, A/B-1, batch total, stopwatch.
Item #2: Rate A, total A, rate B, total B, period B, batch grand total, number of batches, accumulated time.
Item #3: Rate B, total B, rate derived from batch, period B.

VF Signal Conditioner, Extended

Item #1: Rate, total, batch total.
Item #2: Rate, total, batch grand total, number of batches.
Item #3: Batch rate



Remote Displays Driven by a Computer



Remote Displays Augmenting a Laureate Counter

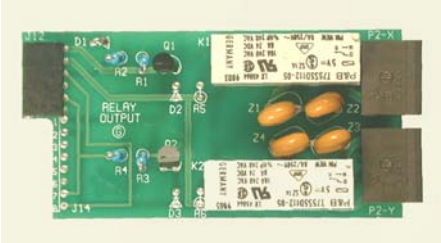
The display of a Laureate counter can be augmented by up to three local displays to show up to four parameters simultaneously: Items #1, #2, #3 and peak rate (if rate was one of the selected items). All four parameters can also be displayed at a remote location.

Dual-Setpoint Controller Options

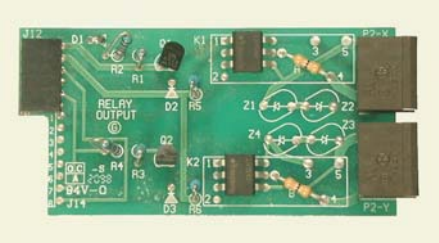
with contact or solid state relays, multiple control modes

Features

- **Isolated dual-channel contact or solid state relay versions.**
- **Form C contact relays rated 10 A at 250 Vac or 8 A at 24 Vdc.**
- **Solid state relays rated 120 mA at 125 Vac or 250 mA at 0-150 Vdc.**
- **Outputs derived from filtered or unfiltered signal input.**
- **Fast response time.**
- **Selectable output time delay.**
- **Multiple operating modes:**
  - **output above or below setpoint**
  - **latching or non-latching**
  - **band deviation or hysteresis around each setpoint.**
- **Setpoint setup via front panel pushbuttons or RS-232/485.**
- **Security lockout of front panel setpoint controls.**



Dual contact relay board.



Dual solid state relay board.

Description

Two setpoint controller options can add control and alarm capability to Laureate DPMs and counters: a plug-in board with two Form C, 10 amp, 250 Vac contact relays, and one with two dual Form A AC/DC solid state relays rated 120 mA at 125 Vac or 250 mA at 150 Vdc. The solid state version is recommended for high duty cycles and low-level loads.

Each output may be independently set to be energized above or below a setpoint, or may be disabled. The relays may be individually programmed to operate in a latching or non-latching mode. In the latching mode, when an alarm or shutdown condition is reached, the output remains in the alarm condition until it is reset by front panel pushbuttons, via the serial interface, or via the rear connector. In the non-latching mode, the output is automatically reset when the alarm condition no longer exists.

Each output may be set to operate in a band deviation mode, where an alarm is generated whenever the reading is a specified number of counts above or below the setpoint. In particular, band deviation is ideal to flag an out-of-tolerance condition.

Each output may also be set to operate in a hysteresis mode, where turn-on occurs at a specified amount above the setpoint and turn-off at the same amount below the setpoint.

Relay action may be derived from either the filtered or unfiltered DPM input signals. Using the unfiltered signal improves response time, which is typically 17 ms for a DPM with the solid state relay board. Fast response time is one of the major strengths of Laureate DPMs, which can digitize analog data as often as 60 times per second. Using the filtered input reduces the chance of alarm triggering due to noise.

A programmable time delay and reduction of relay chatter can be achieved in the DPM by selecting 1 to 128 readings in binary steps (20 ms to 2 s) prior to updating the output. Snubber circuitry is part of the contact relay board to prolong contact life.

The relay response time of counters is controlled by a selectable gate time from 10 ms to 199.99 s.

Setpoint values and deviation bands are easily entered via front panel pushbuttons or via the serial interface. Security lockout of the front panel pushbuttons may be set to allow operators to view but not change setpoint values. Front panel pushbutton operation can also be completely disabled.

The Laureate Weight Meter and Batch Controller offer control modes beyond those of normal meter or counter operation.

Specifications

Operation

Power ..... Provided by meter
Update Rate ..... 60 Hz or 50 Hz
Setup: Front panel pushbuttons or RS-232/485
Operating modes (available for each output) ..
Operate above or below the setpoint, latching or non-latching, operate in band deviation mode around setpoint, operate in hysteresis mode around setpoint, be disabled.
Lockouts .....
May be set to allow display and change of setpoint by front panel pushbuttons, allow display only by alarm pushbutton, or disable pushbuttons.
Input Filtering .....
Setpoint compared to either filtered or unfiltered input signal.
Time Delay .....
Programmable from 1 to 128 readings.

Alarm Status Indication

Type ..... Two red LED lamps
Lamp Lit ..... When relay is energized

Environmental

Operating Temperature ..... 0°C to 55°C
Storage Temperature ..... -40°C to 85°C
Relative Humidity 95% at 40°C, noncondensing

Contact Relay Version

Power Rating

AC load ..... 10 A at 250 Vac
DC load ..... 8 A at 24 Vdc

Isolation to Signal & Meter Ground

Isolation Group C
Rated Voltage ..... 250 Vac
Withstand Voltage ..... 4.2 kVp for 1 min

Response Time to Input Signal

DPM Pickup Time (unfiltered) ..... 26 ms typ
DPM Release Time (unfiltered) ..... 22 ms typ
Counter Pickup or Release time .....
Gate time +30 ms +2 periods max

Solid State Relay Version

Power Rating

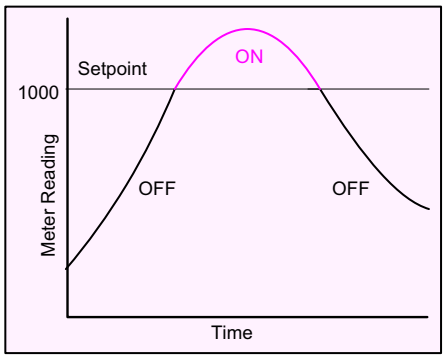
AC Load ..... 120 mA at 125 Vac
AC Mode Series Resistance ..... 20 Ω
DC Loads ... 2 loads, 250 mA, 0-150 Vdc peak hold-off, 5 Ω series resistance
4 loads, 120 mA, 0-150 Vdc peak hold-off, 10 Ω series resistance

Isolation to Signal & Meter Ground

Isolation Type ..... Optical
Safety Rating .. 250 Vac, 4.2 kVp per HV Test

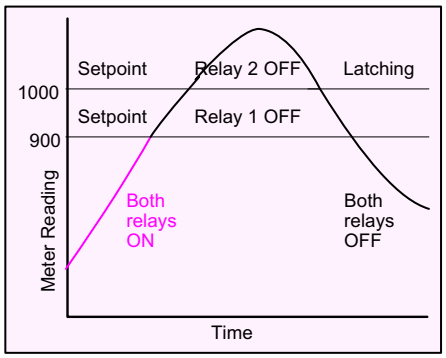
Response Time to Input Signal

DPM (unfiltered) ..... 17 ms typ
Counter ..... Gate time +30 ms + 2 periods max



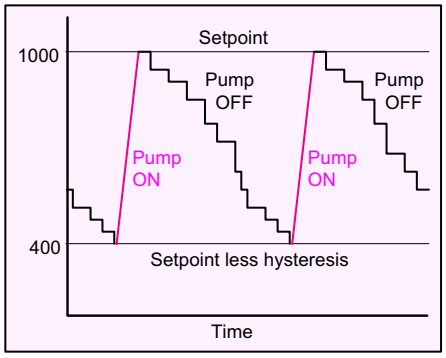
Normal, Non-latched Operation

In this example, the relay closes when the reading rises above the setpoint and opens when the reading falls below the setpoint. Relay ON/OFF control action is independently programmable for each of the two relays and can be reversed through a setup command.



Mixed Latched and Non-latched

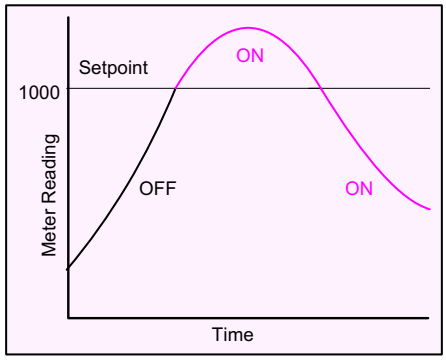
One of the relays can operate in a non-latched mode, for instance to turn off a heater when an operating temperature setpoint is reached. The other relay can operate as a latching fail-safe backup and turn off the entire process when a second, higher setpoint is reached, indicating a malfunction.



Wide Hysteresis Mode Operation

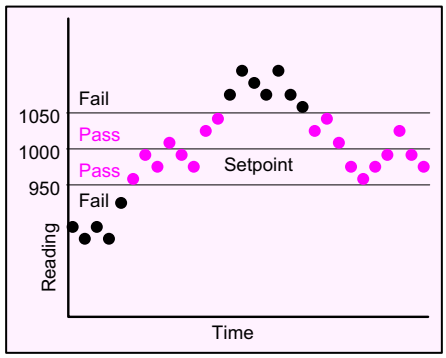
In this example, a hysteresis limit of 600 is set below the setpoint. The relay closes when the reading reaches a lower limit (the setpoint less hysteresis) and opens when the reading reaches an upper limit (the setpoint).

One application is automatic tank filling. A fill operation is automatically initiated when the tank level has reached a lower level and is terminated when the level has reached an upper level.



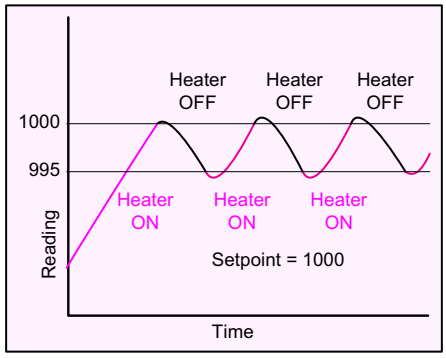
Latched Operation

The relay stays actuated until reset externally. This mode can be used to shut down machinery or a process when an operating limit has been exceeded, or to maintain an alarm until acknowledged by an operator when the alarm condition has passed.



Deviation Mode Operation

A deviation limit (50 in this example) is set up around both sides of the setpoint. The relay closes (or opens) when the reading falls within the deviation band, and opens (or closes) when the reading falls outside of this band. This mode sets up a passband around the setpoint and is often used for component testing.



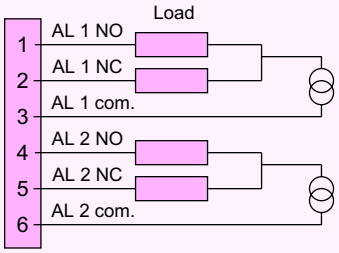
Narrow Hysteresis Mode Operation

Hysteresis can be used to minimize the number of ON/OFF control cycles around a setpoint, thereby increasing the life of motors, relays, etc.

A very narrow hysteresis band (such as 5 counts) can also be used to minimize relay chatter around a setpoint due to electrical noise on the signal, or due to signal feedback caused by load switching. The hysteresis limit should exceed the noise amplitude.

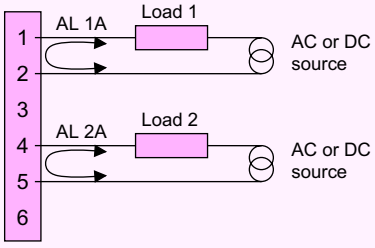
J2 - Contact Relay Outputs

Dual contact relays each rated 10 A at 250 Vac or 8 A at 24 Vdc.

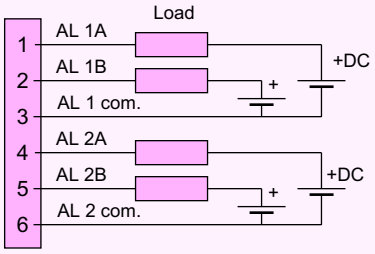


J2 - Solid State Relay Outputs

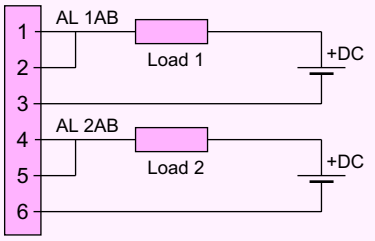
AC or bidirectional DC connection with two loads. 120 mA at 125 Vac or 120 mA at 150 Vdc, 20 series resistance.



DC connection with four loads, each up to 120 mA at 150 Vdc, 10 series resistance.



DC connection with two loads each up to 250 mA at 150 Vdc, 5 series resistance.



RS-232 & RS-485 I/O Options, Isolated

For two-way point-to-point or multipoint communications

Description

- **Allows meter or counter to:**
- **Output latest value, peak value and alarm status to a computer, PLC or remote Laureate display.**
- **Serve as a remote display to a computer, PLC or other Laureate.**
- **Be set up via computer using PC-compatible application software (furnished).**
- **Data rates selectable from 300 to 19,200 bps.**
- **Powered by meter or counter.**
- **Isolated from meter and power grounds.**
- **RS-485 version allows up to 31 meters or counters to be multi-dropped on same data line.**

Description

Laureate™ DPMs and counters offer RS-232 or RS-485 communication boards to interface with computers, PLCs or other digital devices, including the Laureate 6-digit remote display. Both boards are connected via phone jacks using standard 4- or 6-conductor phone cables. With either board, Laurel Electronics provides Windows-compatible software which allows device setup via a computer monitor.

The information transmitted via RS-232 or RS-485 includes the latest signal value (filtered or unfiltered), peak signal value, alarm values and status.

RS-232 interface board

RS-485 interface board

The RS-485 version allows transmission over distances up to one mile in electrically noisy environments. It provides up to 31 digital addresses, so that multiple Laureates can be addressed and transmit on the same data line. Data rates are selectable from 300 to 19,200 bps. In case of long line lengths, the RS-485 board at the end of the line can be terminated by a jumper-selectable 120 ohm resistor to minimize signal reflections.

A full duplex mode with separate wire pairs for transmit and receive is offered by the RS-485 version, as is a half duplex mode with shared transmit and receive wires.

The RS-232 request-to-send line (RTS) can be set to a latched mode, where a single reading is transmitted when the line is taken high. This mode allows a single data transfer to be commanded by a device other than a computer.

By using a serial interface board, a Laureate counter can be used as a remote display to an external device or to another Laureate.

Specifications

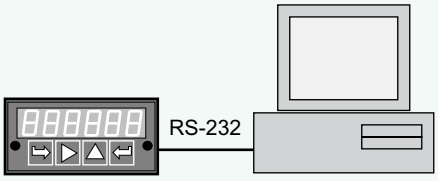
RS-232 Mode ..... Full duplex
RS-485 Modes ..... Full and half duplex
Data Rates ..... 300, 600, 1200, 2400, 4800, 9600, 19200 bps
Signal Levels ..... Compliant with RS-232 or RS-485 standards
Data format .... No parity, 8 data bits, 1 stop bit
ESD Protection ..... 15 kV per IEC 1000-4-2
EMI Immunity ..... 10 V/m per IEC 1000-4-3
EFT Protection ..... 2 kV per IEC 1000-4-4
Short Circuit Protection ..... Continuous

J3 - RS-232 Interface

1	No Connection
2	RTS (Handshake)
3	TX (Transmit)
4	RX (Receive)
5	Isolated GND
6	No Connection

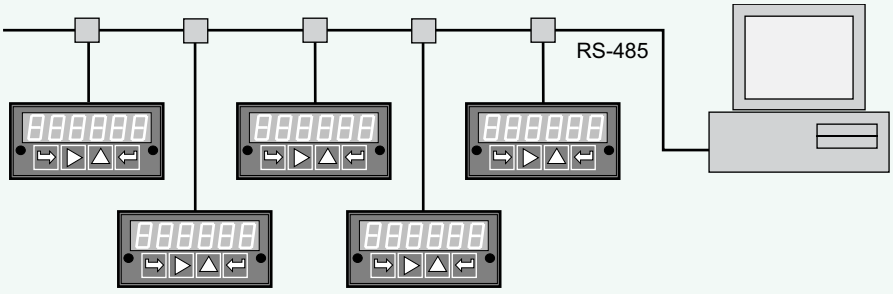
J3 - RS-485 Interface

1	Isolated GND
2	BTX (Transmit-)
3	ATX (Transmit+)
4	ARX (Receive+)
5	BRX (Receive-)
6	Isolated GND



The RS-232 option allows a Laureate meter or counter to be programmed by a computer, to output data to a computer, or to drive a panel-mount printer, remote display, or other digital device with an RS-232 interface.

There can normally only be one meter or counter per RS-232 line. However, multiple remote displays can be connected to a single RS-232 line in multidrop fashion.



The RS-485 option allows multiple Laureate meters, counters and remote displays, as well as non-Laureate devices, to be connected to the same RS-485 line in parallel, multidrop fashion. Each device has its own, unique digital address.

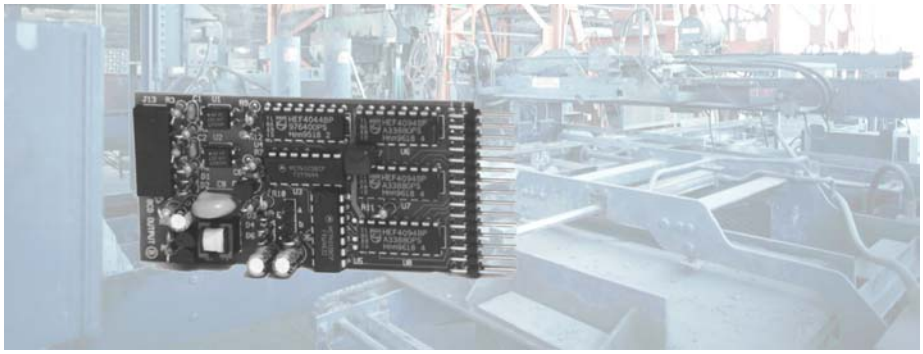
The use of RS-485 lines maximizes utilization of computer ports and simplifies plant wiring. As opposed to RS-232, RS-485 uses two pairs of balanced lines, which allow long cable runs in electrically-noisy environments.

BCD Output Option, Isolated

Three-state, stored, parallel

Features

- **Three-state, stored, parallel BCD allows multiplexing on same data line.**
- **Outputs powered by meter.**
- **Isolated from meter and power grounds.**
- **BCD Hold, Data Ready & Output Enable facilitate interface to external devices.**
- **Continuous or programmable output rate.**
- **Reflects filtered or unfiltered input signal.**



Description

The Laureate™ BCD option provides an isolated, three-state, parallel, stored BCD output to external devices such as PLCs, panel-mount printers, and dataloggers. The BCD outputs of multiple meters can be multiplexed by addressing each meter with its own Enable line. Only the addressed meter will provide data output, while the other non-addressed meters are held in a non-transmitting high impedance output state. BCD Hold and Data Ready outputs further simplify the interface.

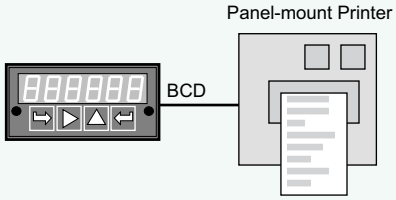
The output level is selectable for 5 or 15 Vdc logic. Isolated power for the BCD outputs is provided by an on-board supply.

Specifications

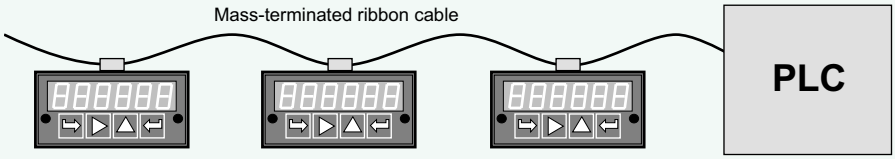
Type ..... 3-state, stored, parallel, isolated
Signal levels ..... LPTTL & CMOS-compatible
Controls ... BCD Hold, Data Ready, BCD Enable
Power ..... Provided by meter
Isolation ..... Safety rated to 250 Vac
4.2 kVp per high voltage test

Connector Pin Assignments

1	1 2	2
4	3 4	8
10	5 6	20
40	7 8	80
100	9 10	200
400	11 12	800
1K	13 14	2K
4K	15 16	8K
10K	17 18	20K
40K	19 20	80K
100K	21 22	200K
400K	23 24	800K
+POL	25 26	Data Ready
BCD Hold	27 28	BCD Enable
Isolated Gnd	29 30	Isolated +5Vdc



The parallel BCD output from a Laureate DPM or counter is often used to drive a panel-mount printer for a hard copy record. Some printer models will print at programmed time intervals.



The tri-state, parallel BCD output option allows multiple Laureate meters and counters to be interfaced to a PLC via a single ribbon cable with mass termination connectors along its length.

Only the BCD board addressed by an Enable line sends out data. All non-addressed boards remain in a high-impedance inactive state. Isolation assures freedom from ground loops.

Analog Output Option, Isolated

0-10 V & 0-20 mA scaled to displayed values

Features

- **0-20 mA or 4-20 mA plus 0-10 Vdc.**
- **0.025% resolution.**
- **Isolation to 250 Vac.**
- **Outputs linearized to reading.**
- **Scale and offset setup via RS-232, RS-485 or front panel.**
- **56/s update rate at 60 Hz power, 47/s at 50 Hz power.**
- **12 V compliance at 20 mA.**
- **Output derived from filtered or unfiltered signal input.**

Description

The Laureate analog output option board provides an isolated 0-10 Vdc voltage signal to drive a chart recorder, plus an isolated 0-20 mA or 4-20 mA current signal for transmission to a computer or central control room. This option is compatible with all Laureate meters and counters, and turns these into a highly accurate, sourcing, 4-wire transmitter. The output for thermocouples, RTDs and custom curves is linearized to the displayed reading.

A 12-bit D-to-A converter provides .025% resolution. The update rate is a fast 56/s at 60 Hz power or 47/s at 50 Hz power. The analog output can track the unfiltered signal for fastest response, or the digitally filtered signal for best noise rejection.

Analog output board for scaled 0-20 mA or 4-20 mA plus 0-10 Vdc analog outputs.

Scaling of the output is easily entered via front panel pushbuttons or via the serial digital interface. The displayed readings to produce the low and high analog outputs may be set to any value from -99,999 to +99,999 for DPMs, or -999,999 to +999,999 for counters.

Both the current (0-20 mA or 4-20 mA) or voltage (0-10 V) outputs are available at the same time, and the same scaling applies to both. The output selected in software is calibrated to 99.9% accuracy. The non-selected output is accurate to 98%.

Isolation is provided by a separate on-board power supply, which is powered by the meter. This supply can drive 20 mA current into loads up to 600 ohms, for 12 V compliance. Isolation to signal ground and power ground eliminates problems caused by ground loops.

The addition of the analog output option turns Laureate temperature meters into superb, isolated, linearized, 4-20 mA temperature transmitters with exceptional accuracy and high-speed response.

Specifications

J4 Connector Pin Assignments

J4 - Analog Output

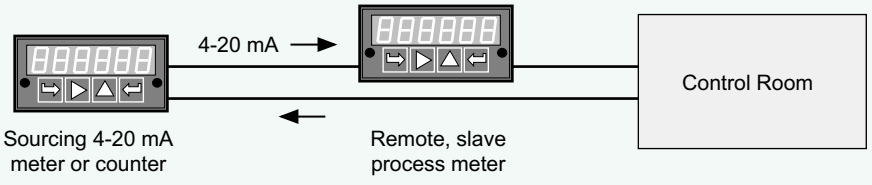
1	0-20 mA output
2	0-10 Vdc output
3	Isolated GND

Electrical

Power Source ..... Provided by meter
Signal Source ..... Filtered or unfiltered digitized signal
Linearization ..... Linearized to display
Output Levels ..... 0-20 mA or 4-20 mA and 0-10 Vdc
Compliance, 0-20 mA ..... 12 V (0-600 Ω load)
Compliance, 0-10 V ..... 2 mA (5 kΩ min load)
Isolation ..... Safety-rated to 250 Vac 4.2 kVp per High Voltage Test
Accuracy ..... 99.9% selected output 98% non-selected output
Output Nonlinearity ..... <0.05%
Output Resolution ..... 12-bit (.025% of FS)
Output Update Rate ..... 56/s at 60 Hz power, 47/s at 50 Hz power
Response Time ..... 17 ms (unfiltered DPM) Gate time + 30 ms + 0-2 periods (counter)

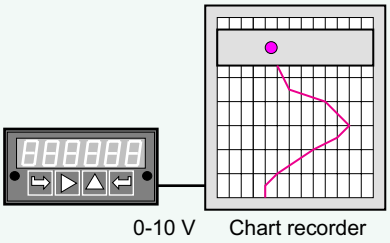
Scaling

Zero Output ..... -99,999 to +99,999 (DPM) -999,999 to +999,999 (counter)
Full Scale Output ..... -99,999 to +99,999 (DPM) -999,999 to +999,999 (counter)
Minimum Span ..... 150 counts



0-20 mA output capability turns Laureate meters and counters into high-accuracy, high-speed, isolated 4-20 mA transmitters. The output is linearized to the reading, a major benefit with thermocouple and RTD inputs.

The 4-20 mA signal can be transmitted via twisted pair wires to a control room for supervisory process monitoring and control. Process meters in series with the signal can provide local readouts in engineering units where required.



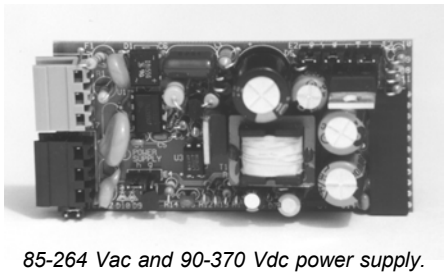
The 0-10 V output capability of the analog output board is ideal to drive a strip chart recorder. As for 4-20 mA, the 0-10 V output can be scaled to the meter reading to highlight signal level changes in a range of interest.

Power Supplies with Excitation Output

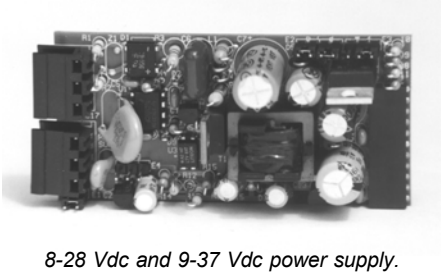
85-264 Vac & 90-370 Vdc, or 8-28 Vac & 9-37 Vdc

Features

- **Lightweight, high-frequency switching power supply design.**
- **85-264 Vac or 90-370 Vdc input standard. Allows worldwide AC operation without hardware modification.**
- **8-28 Vac or 9-37 Vdc power option allows operation from batteries or 28 Vac, 400 Hz aircraft power.**
- **Three selectable isolated excitation outputs: 5 Vdc at 100 mA, 10 Vdc at 120 mA & 24 Vdc at 50 mA.**
- **Designed to UL/IEC/CSA safety standards.**



85-264 Vac and 90-370 Vdc power supply.



8-28 Vdc and 9-37 Vdc power supply.

Description

Laureate™ DPMs, counters and 6-digit remote display offer a choice of two high-frequency switching power supplies. These provide stable, isolated power for meter operation plus excitation outputs at a substantially reduced weight and over a broader range of input voltages and power frequencies than conventional linear supplies.

The standard Laureate supply accepts power from 85 to 264 Vac, 47 to 440 Hz. This allows the same meter to operate worldwide without modification. The supply also accepts 90 to 370 Vdc.

An optional low voltage supply operates from 9 to 37 Vdc or 8 to 28 Vac, 47 to 440 Hz. This supply allows the Laureate to be powered from batteries or from 28 Vac, 400 Hz aircraft power.

Isolated Excitation Output

Each power supply provides three jumper-selectable, isolated excitation outputs: 5 Vdc at 100 mA, 10 Vdc at 120 mA, or 24 Vdc at 50 mA. These outputs can be used to power external sensors, transmitters and up to four 350 ohm load cells, thereby avoiding the need for an expensive external supply.

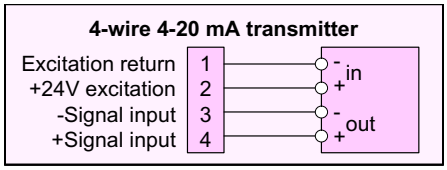
When powering a load cell or potentiometer, a ratiometric operating mode can be selected, where the meter monitors the excitation supply and removes the effects of voltage variation.

In addition to the isolated excitation output, regulated 5 Vdc at up to 50 mA is brought out and can be used to power external logic.

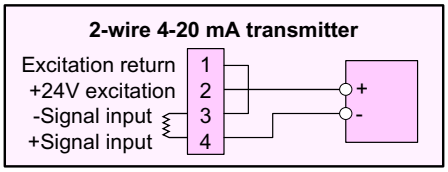
Safety-rated Clamping Connectors

Both power supplies and their connectors (standard) are designed to UL/IEC/CSA safety standards.

Wiring of Excitation Output



With four-wire transmitters, two wires are used to apply 10 or 24 Vdc, and two separate wires are used to sense the transmitter's 4-20 mA output.



With two-wire transmitters, the same two wires are used to power the transmitter and carry the 4-20 mA output, which is made to flow across an internal 10 Ω resistor between pins 3 and 4.

The two Laureate power supplies also do double-duty by providing two connector inputs (A & B) and a digital ground for signals such as meter hold, reset, tare, etc. These signals do not affect power supply operation.

J1 - Input Power & Digital Controls

1	AC High or +DC
2	AC Low or -DC
3	Power GND (Earth)
4	Digital Input B or +5 V out
5	Digital Input A
6	Digital GND (Meter GND)

Specifications

Connector Pin Assignments

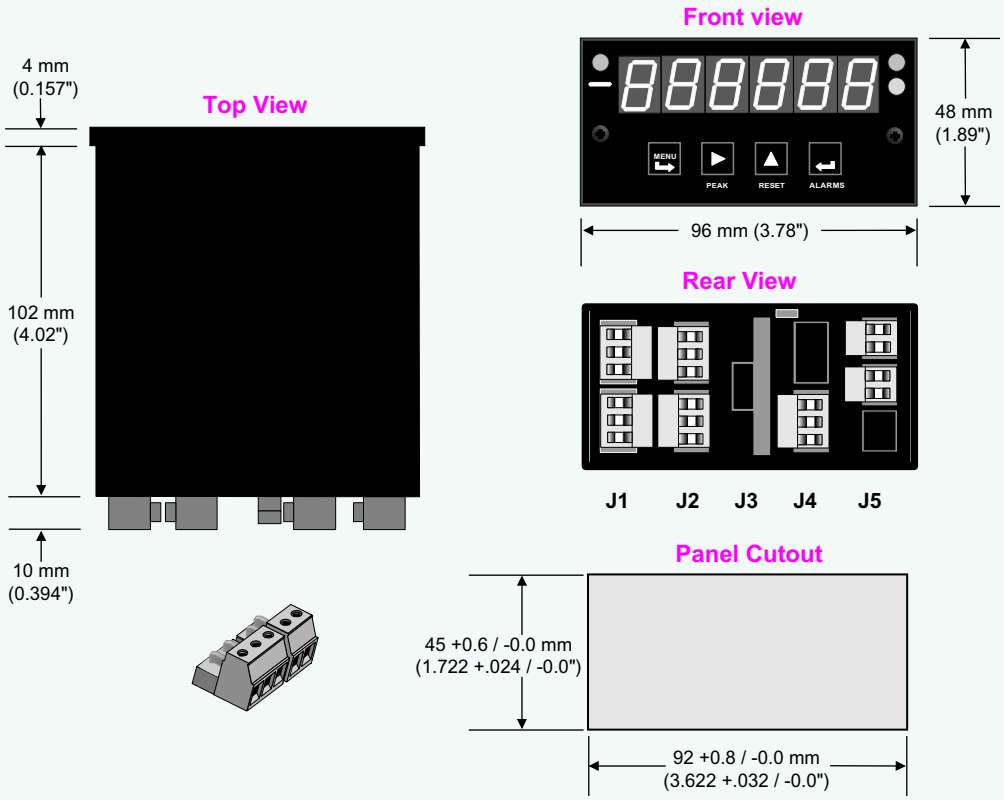
Operating Power

Voltage (std) ..... 85-264 Vac or 90-370 Vdc
Voltage (opt) ..... 8-28 Vac or 9-37 Vdc
Frequency ..... DC and 47-440 Hz
Power consumption ..... 5.3 W max

Excitation Power Supply

Selectable outputs .... 5 Vdc, 5%, 100 mA max
10 Vdc, 5%, 120 mA max
24 Vdc, 5%,50 mA max
Ripple ..... 50 mVp-p max
Isolation to power ground .....
Safety-rated to 250 Vac
4.2 kVp per High Voltage Test
Isolation to meter ground ..... 50 Vp

Mechanical Drawings



Laureate Ordering Guide

One entry required per box. Configure a model number in this format: ***L10010DCV1****. All Laureates include screw terminal connectors. Please see separate Price List and Distributor List for pricing and delivery.*

LAUREATE PANEL METERS

Laureate™ Series
L ..... Panel meter
LW ... Weight meter. Used with DC or strain signal conditioner only.

Main Board
1 ..... Standard, green LEDs
2 ..... Standard, red LEDs
3 ..... Extended, green LEDs
4 ..... Extended, red LEDs

Power
0 ..... 85-264 Vac & 90- 370 Vdc
1 ..... 9-37 Vdc & 8-28 Vac

Setpoint Output
0 ..... None
1 ..... Dual 10 A contact relays
2 ..... Dual solid state relays

Analog Output
0 ..... None
1 ..... 0-20 mA & 0-10 V

Digital Interface
0 ..... None
1 ..... RS-232
2 ..... RS-485
3 ..... BCD output

Input Type

DC Volts
DCV1 ..... 200.00 mV
DCV2 ..... 2.0000 V
DCV3 ..... 20.000 V
DCV4 ..... 200.00 V
DCV5 ..... 660.0 V

DC Amperes
DCA1 ..... 2.0000 mA
DCA2 ..... 20.000 mA
DCA3 ..... 200.00 mA
DCA4 ..... 5.000 A

100-Ohm Platinum RTD's
P385C ..... -202 to 850°C
P385F ..... -331 to 1562°F
P392C ..... -202 to 631°C
P392F ..... -331 to 1168°F

Thermocouples
JC ..... -210 to 760°C
JF ..... -347 to 1400°F
KC ..... -244 to 1372°C
KF ..... -408 to 2501°F
TC ..... -257 to 400°C
TF ..... -430 to 752°F
EC ..... -240 to 1000°C
EF ..... -400 to 1830°F
NC ..... -245 to 1300°C
NF ..... -410 to 2370°F
SC ..... -46 to 1768°C
SF ..... -51 to 3214°F
RC ..... -45 to 1768°C
RF ..... -49 to 3213°F

Process Signals (4-20 mA, 0-5 V...)
P ..... 4-20 mA = 0-10000
P1 ..... Custom Scaling
Specify min input, min reading; max input, max reading.

Strain Gauge, Potentiometer (4-wire ratio)
SG ..... 0-200 mV = 0-20000
SG1 ..... Custom Scaling
Specify min input, min reading; max input, max reading. Full scale input 20 mV to 20 V. 10 Vdc excitation provided.

RMS Volts
RMV1 ..... 200.00 mV
RMV2 ..... 2.0000 V
RMV3 ..... 20.000 V
RMV4 ..... 200.00 V
RMV5 ..... 660.0 V

RMS Amperes
RMA1 ..... 2.0000 mA
RMA2 ..... 20.000 mA
RMA3 ..... 200.00 mA
RMA4 ..... 5.000 A

Load Cells (6-wire ratio)
WM1 ..... -99,999 to +99,999
Specify min input, min reading; max input, max reading. Full-scale input 20-500 mV. 10 Vdc excitation.

LAUREATE COUNTER SERIES

L .. Laureate™ with plug-in screw clamp connectors

Main Board
5 ..... Meter with green LEDs
6 ..... Meter with red LEDs
7 ..... Extended, green LEDs
8 ..... Extended, red LEDs

Power
0 ..... 85-264 Vac & 90- 370 Vdc
1 ..... 9-37 Vdc & 8-28 Vac

Setpoint Output
0 ..... None
1 ..... Dual 10 A contact relays
2 ..... Dual solid state relays

Analog Output or Batch Relay
0 ..... None
1 ..... 0-20 mA, 0-10 V
2 ..... Rate batch relay

Digital Interface
0 ..... None
1 ..... RS-232
2 ..... RS-485
3 ..... BCD output

Input Type
FR ..... Dual Channel Frequency

With main boards 5 & 6: Scalable to ±999,999 for frequency, rate, square root of rate, up or down total, period, A-B time interval.

With main boards 7 & 8: Above plus rate and total simultaneously, linearization of nonlinear inputs, ratio, draw, arithmetic functions (A*B, A/B, A/B-1, A+B, A-B), phase angle, stopwatch, up/down counting, batch counting.

VF1 .. 4-20 mA
VF2 .. 0-1 mA
VF3 .. 0-10 V
VF4 .. Special ranges

With main boards 5 & 6: V-to-F converter for rate or square root of rate from differential pressure or target type flow meters.

With main boards 7 & 8: Above plus rate and total simultaneously, linearization of nonlinear inputs, batch counting, 1/rate (time).

QD .... Quadrature

With main boards 5 & 6: Scalable to ±999,999 to read out position, length or angle from shaft encoders.

QDR .. Quadrature rate

With main boards 7 & 8: Scalable to ±999,999 to read out rate from shaft encoders.

6-DIGIT REMOTE DISPLAYS

L .. Laureate™ with plug-in screw clamp connectors

Display Color
5 ..... Green LED display
6 ..... Red LED display

Power
0 ..... 85-264 Vac & 90- 370 Vdc
1 ..... 9-37 Vdc & 8-28 Vac

Setpoint Output
0 ..... None
1 ..... Dual 10 A contact relays
2 ..... Dual solid state relays

Analog Output
0 ..... None
1 ..... 0-20 mA and 0-10 V

Digital Interface (1 required)
1 ..... RS-232
2 ..... RS-485

LAUREATE™ Product Line Overview
Digital Panel Meters, Counters, Remote Displays

Digital Panel Meters

DC Voltage & Current
- 200 mV to 660 V or 2 mA to 5 A full-scale.
- 4 1/2 digit resolution, 0.01% accuracy.

True RMS Voltage & Current
- 200 mV to 660 V or 2 mA to 5 A full-scale
- 4 1/2 digit resolution, 0.1% accuracy

Process (4-20 mA) & Strain
- Span adjust from 0 to ±99,999.
- Zero adjust from -99,999 to +99,999.
- Linearization of non-linear inputs.
- 4 1/2 digit resolution, 0.01% accuracy.

Thermocouple & RTD
- Same meter for thermocouple types J, K, T, E, N, R, S and 100 ohm platinum RTDs.
- Selectable 1º or 0.1º resolution, ºC or ºF.
- 2, 3 or 4-wire RTD connection with lead resistance compensation.

Load Cell and Microvolt
- 20 mV to 500 mV full-scale.
- 4- or 6-wire hookup.
- 5-digit resolution, 0.01% accuracy.
- Span adjust from 0 to ±99,999.
- Zero adjust from -99,999 to +99,999.

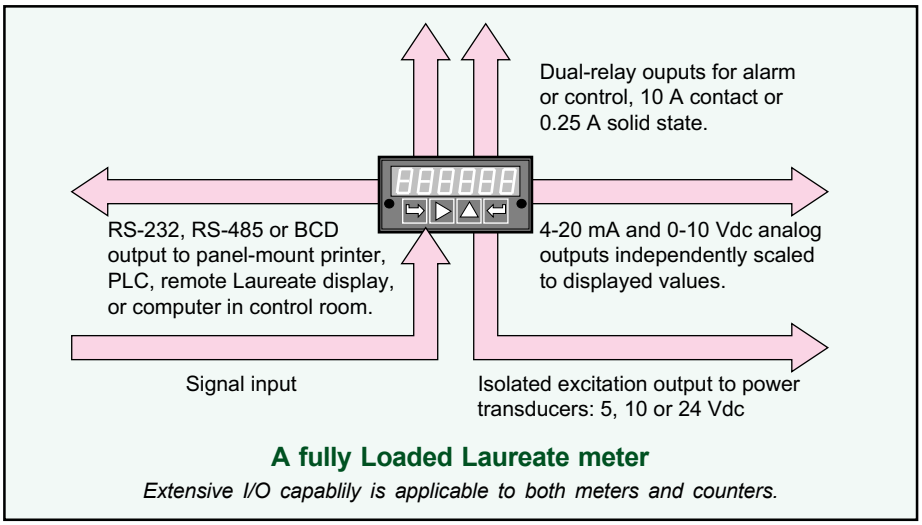
Weight Meter
- 4- or 6-wire load cell hookup.
- 5-digit resolution with scaling from 0 to 99,999.
- Display to 999,990 with fixed zero.
- Auto-tare and manual tare.
- Count by 1, 2, 5, 10, 20, 50 or 100 with rounding.

Counters

Frequency, Rate & Period
- Two independently scalable channels.
- Frequency from 0.0025 Hz to 2 MHz.
- Read rate to 25/s.
- Span adjust from 0 to ±999,999.
- Linearization of non-linear inputs.

A/B Ratio & A/B-1 Draw
- Arithmetic functions for Channels A & B.
- Frequency from 0.0025 Hz to 2 MHz.
- Read rate to 25/s.
- Span adjust from 0 to ±999,999.

Dual-Channel Up/Down Totalizer
- Up counting from zero to preset, or down counting from preset to zero, for repetitive operations.



A fully Loaded Laureate meter

Extensive I/O capablily is applicable to both meters and counters.

- Independent scalable totals for Channels A & B.
- Data rates to 2 MHz.
- Arithmetic functions A+B, A-B, AxB, A/B.

Pulse Input Batch Controller
- For turbine flowmeter and other pulsed signals.
- 6-digit display scalable to ±999,999.
- Up counting from zero to preset, or down counting from preset to zero for repetitive fill operations.
- Selectable display of batch total, grand total or number of batches, and rate.
- 10 A relay for batch total, plus two additional assignable relays.

V-to-F Converter & Integrating Totalizer
- 0-1 mA, 4-20 mA or 0-10 V analog inputs.
- 6-digit display scalable to ±999,999.
- Square root extraction for use with Venturi differential pressure transducers.
- Totalizing and batch control based on linearized rate.

Time Interval & Stopwatch
- Time interval mode for periodic events from 1 µs to 400 s, with resolution to 0.2 µs.
- Stopwatch mode for single events, with display in HH.MM.SS clock format or six-digit decimal format.

Phase Angle & Duty Cycle
- Phase angle mode for phase between two wavehapes of similar period.
- Resolution of 1º, 0.1º or 0.01º.
- Duty Cycle mode for ON or OFF period as a percentage of total period.
- Resolution of 1%, 0.1% or 0.01%.

Quadrature Position & Rate
- Count by 1, 2 or 4.
- Combined pulse rate to 250 kHz.
- 6-digit scalable display for position, length or rate.

Remote Displays

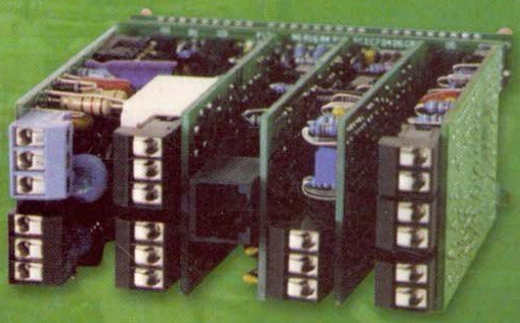
6-Digit Remote Display, 4-20 mA Transmitter & Controller
- 6-digit readout, -999,999 to 999,999
- RS-232 or RS-485 data interface to 19200 bps.
- Addressing of up to 31 remote displays on one data line.
- Optional dual-relay control output.
- Optional isolated 0-10 V and 4-20 mA analog output.
- Blends in with panel meters and counters.

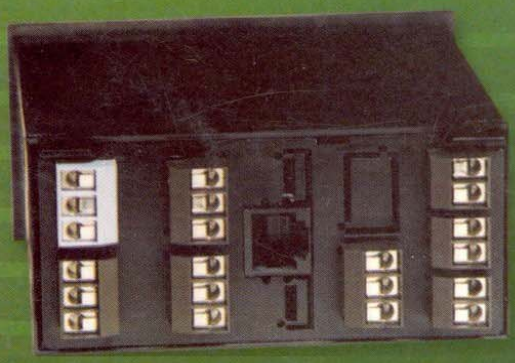
Common Features
- High accuracy at high read rate.
- Modular design.
- Choice of output and control options.
- Connectors provided.
- Worldwide input power, 85-264 Vac (std) or low-voltage power (opt).
- Compact 1/8 DIN case.
- Environmentally protected to NEMA-4X (IP-65) when panel mounted.
- Front panel keys may be locked out for simplified usage and security.

FLW, 3505 Cadillac Ave., Bldg E, Costa Mesa, CA 92626, USA ● Tel: (714) 751-7512 ● www.flw.com

LAUREATE™ High-Performance Digital Panel Meters, Controllers, Counters & Remote Displays For Demanding Industrial Applications.

- DC Voltage & Current
- AC RMS Voltage & Current
- TC & RTD Temperature
- 4-20 mA & 0-10 V Process
- Setpoint Controllers
- Strain, Load Cell, Microvolt
- Weight, Scale
- Custom Curve Linearization
- Frequency, Rate, Period
- Up/Down Totalizing
- Ratio, Draw
- Phase Angle, Duty Cycle
- Time Interval, Stopwatch
- V-to-F Process Meter
- Integrating Totalizer
- Flow from DP or Turbine
- Square Root Extraction
- Batch Controller
- Quadrature Position & Rate
- Remote Displays





FLW

3503 Cadillac Ave., Bldg E, Costa Mesa, CA 92626, USA
Tel: 714-751-7512, Toll-free: 800-576-6306, Web: www.flw.com