

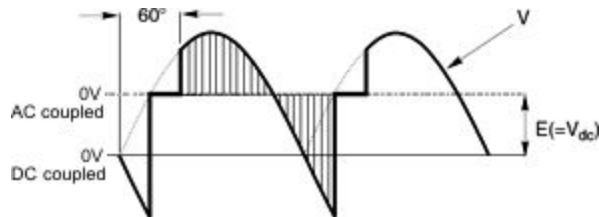


## Features

- True AC or AC plus DC RMS measurement with crest factor of 3.0 at FS
- Fast response, 0-16.7 ms to rated accuracy after each input signal cycle
- Measurement range from 0.1% to 100% of full scale
- Accurate to 99.97% of full scale, 10 Hz to 10 kHz
- 0.2, 2, 20, 200 & 600V voltage ranges
- 2, 20, 200 mA & 5A current ranges
- All ranges factory calibrated
- Scalable to 5 digits for external current shunts or 5A current transformers
- Selectable peak or valley display
- 85-264 Vac universal AC power supply
- 1/8 DIN case sealed to NEMA-4X from front panel
- Optional serial I/O: Ethernet, USB, RS232, RS485, Ethernet-to-RS485 converter
- Optional relay output: dual or quad relays, contact or solid state
- Optional isolated analog output: 4-20 mA, 0-20 mA, 0-10V, -10 to +10V
- Optional low voltage power: 10-48 Vdc or 12-32 Vac
- Priced competitively with less capable AC meters

## Description

The Laureate™ True RMS meter is a 60,000-count digital panel meter with exceptional performance at half the price of a bench top meter. It can measure true RMS voltage or current of AC signals where there is considerable distortion of the waveform, such as rectifier outputs or waveforms chopped by an SCR, TRIAC or transistor circuit, as illustrated.



- **True RMS readings** in 0-16 ms after completion of one input signal cycle allow anomalies to be detected and alarmed before they become expensive problems. Fast on/off control and alarm can be achieved with optional dual or quad relays, either contact or solid state. The meter can also capture peak and valley readings that occur at 50/60 Hz.
- **Accuracy is 0.1% of full scale** for signals from DC to 10 kHz and signal amplitudes down to 0.1% of full scale. The crest factor ( $V_p / V_{rms}$ ) is 3.0 at full-scale  $V_{rms}$  of 20,000 counts and a  $V_p$  of 60,000 counts. The meter starts to flash overrange at 132% of full scale  $V_{rms}$ , at which point the available crest factor is  $60,000 / 26,400 = 2.27$ . Meaningful readings with rated resolution continue to be obtained up to 212% of full scale  $V_{rms}$  (42,433 counts) for sinusoidal signals, at which point the available crest factor is 1.414. For safety reasons, the maximum RMS input signal should never exceed 600V or 5A. ETL certification is for a maximum voltage of 300  $V_{rms}$ .

**AC or DC coupling** is jumper selectable on the signal conditioner board. AC coupling accommodates signals from 10 Hz to 10 kHz and is suitable for applications such as measuring AC ripple on a DC power supply. DC coupling accommodates signals from 0 to 10 kHz. Multiple integral cycles are averaged for signals above 50/60 Hz. A single cycle is captured for signals from 3 Hz to 50/60 Hz. Below 3 Hz and at DC, the capture rate is 3/sec.

**Use with current Transformers.** 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 5A current transformers to be applied directly to the meter, with no need for a stepdown transformer. The meter reading can easily be scaled for the current transformer ratio. Digital filtering is selectable for noisy signals.



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



## Specifications

### AC Voltage

| AC Voltage FS Range                           | AC Voltage to Overrange Flash                | Resolution                                 | Input Resistance  | Error at 25°C   |
|---|--|--|---|---|
| 200.00 mV<br>2.0000 V<br>20.000 V<br>200.00 V | 264.00 mV<br>2.640 V<br>26.400 V<br>264.00 V | 10 $\mu$ V<br>100 $\mu$ V<br>1 mV<br>10 mV | 22 M $\Omega$<br>1 M $\Omega$<br>1 M $\Omega$<br>1 M $\Omega$ | 0.03% of FS $\pm$ 2 cts, 0-100% of FS,<br>10 Hz to 10 kHz (AC coupling)<br>or 0 to 10 kHz (DC coupling) |
| 300.0 V<br>600.0 V *                          | 650 V<br>650 V                               | 100 mV<br>100 mV                           | 1 M $\Omega$<br>1 M $\Omega$                                  | $\pm$ 0.8 V<br>$\pm$ 0.8 V  |

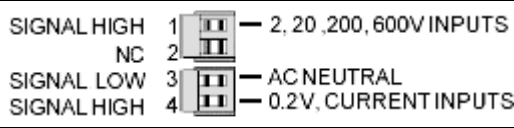
\* The 600V range is ETL certified to 300V. For purposes of accuracy calculation, the 600.0V range is 2000.0V (20,000 counts), and the 5.000A range is 20.000A (20,000 counts).

### AC Current

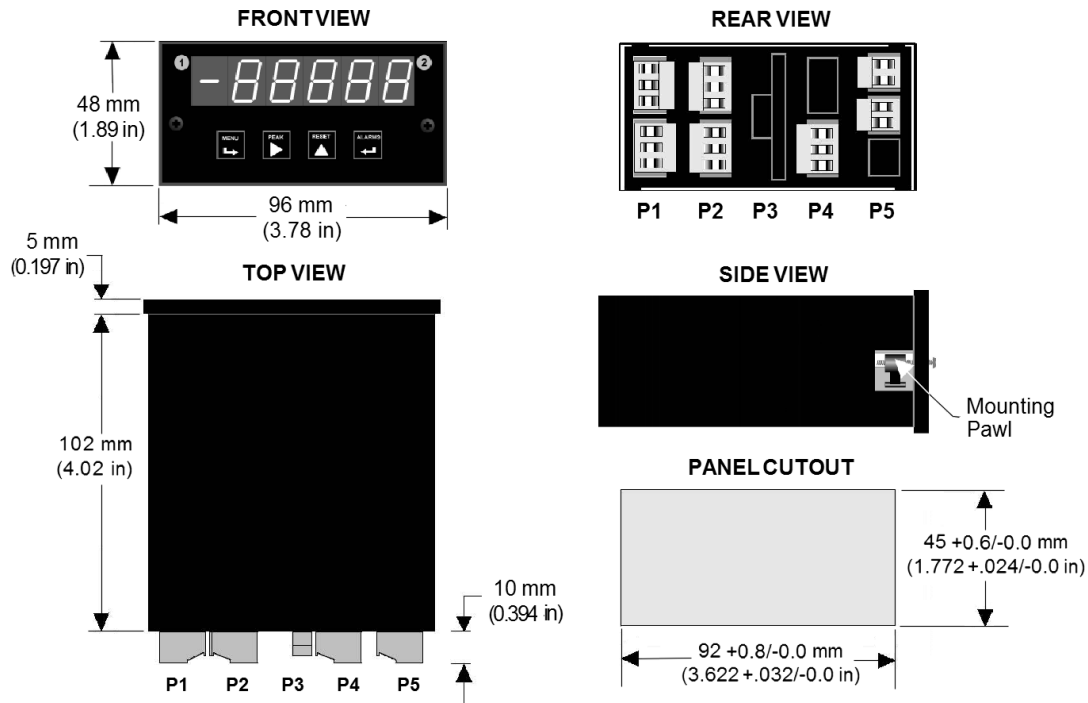
| AC Current FS Range                 | AC Current to Overrange Flash       | Resolution                               | Input Resistance                          | Error at 25°C   |
|-------------------------------------|-------------------------------------|--|---|---|
| 2.0000 mA<br>20.000 mA<br>200.00 mA | 2.6400 mA<br>26.400 mA<br>264.00 mA | 0.1 $\mu$ A<br>1.0 $\mu$ A<br>10 $\mu$ A | 100 $\Omega$<br>10 $\Omega$<br>1 $\Omega$ | 0.03% of FS $\pm$ 2 cts, 0-100% of FS,<br>10 Hz to 10 kHz (AC coupling)<br>or 0 to 10 kHz (DC coupling) |
| 5.000 A                             | 5.4 A                               | 1 mA                                     | 0.01 $\Omega$                             | $\pm$ 20 mA   |

### Both AC Voltage & Current

| Display   |  |
|---|--|
| Readout Range<br>Display Update Rate<br>Indicators<br>Crest factor $V_p / V_{rms}$                                      | 5 LED digits, 7-segment, 14.2 mm (.56"), red or green<br>-99999 to 99999 or -99990 to 99990 (count by 10)<br>3.75/s at 60 Hz power, 3.1/s at 50 Hz power<br>1 LED lamp per relay setpoint<br>3.00 at full scale range,<br>2.27 at 132% of FS range (display flashes),<br>1.414 at 212% of FS range (maximum sinusoidal signal) |
| Output Update Rate  |  |
| A-to-D rate<br>Signals > 50/60 Hz<br>Signals 3 to 50/60 Hz<br>Signals DC to 3 Hz  | 60/s at 60 Hz power, 50/s at 50 Hz power<br>60/s at 60 Hz power, 50/s at 50 Hz power<br>Signal frequency<br>3 per second   |
| Maximum Signal  |  |
| Max applied voltage<br>Current protection   | 600 Vac for 2, 20, 200, 600V ranges, 50 Vac for 0.2V range<br>25x for 2 mA, 8x for 20 mA, 2.5x for 200 mA, 1x for 5A   |
| Power   |  |
| Voltage, standard<br>Voltage, optional<br>Power frequency<br>Power consumption (typical, base meter)<br>Power isolation | 85-264 Vac or 90-300 Vdc<br>12-32 Vac or 10-48 Vdc<br>DC or 47-63 Hz<br>1.2W @ 120 Vac, 1.5W @ 240 Vac, 1.3W @ 10 Vdc, 1.4W @ 20 Vdc,<br>1.55W @ 30 Vdc, 1.8W @ 40 Vdc, 2.15W @ 48 Vdc<br>250V rms working, 2.3 kV rms per 1 min test  |
| Analog Output (optional)  |  |
| Output Levels<br>Current compliance<br>Voltage compliance<br>Scaling<br>Resolution<br>Isolation                         | 4-20 mA, 0-20 mA, 0-10V, -10 to +10V (jumper selectable)<br>2 mA at 10V (> 5 k $\Omega$ load)<br>12V at 20 mA (< 600 $\Omega$ load)<br>Zero and full scale adjustable from -99999 to +99999<br>16 bits (0.0015% of full scale)<br>250V rms working, 2.3 kV rms per 1 min test  |

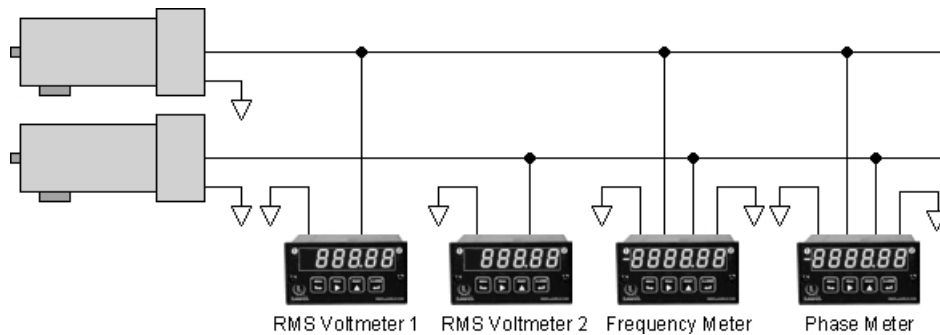
| Relay Outputs (optional)   |   |
|--|---|
| Relay types  | 2 Form C contact relays or 4 Form A contact relays (normally open)<br>2 or 4 Form A, AC/DC solid state relays (normally open) |
| Current ratings  | 8A at 250 Vac or 24 Vdc for contact relays<br>120 mA at 140 Vac or 180 Vdc for solid state relays                             |
| Output common Isolation  | Isolated commons for dual relays or each pair of quad relays<br>250V rms working, 2.3 kV rms per 1 min test                   |
| Serial Data I/O (optional)   |   |
| Board selections   | Ethernet, Ethernet-to-RS485 server, USB, USB-to-RS485 server, RS485 (dual RJ11), RS485 Modbus (dual RJ45), RS232.             |
| Protocols  | Modbus RTU, Modbus ASCII, Laurel ASCII protocol   |
| Data rates   | 300 to 19200 baud   |
| Digital addresses  | 247 (Modbus), 31 (Laurel ASCII),  |
| Isolation  | 250V rms working, 2.3 kV rms per 1 min test   |
| Signal Connections   |   |
|  |   |
| Environmental  |   |
| Operating temperature  | 0°C to 55°C   |
| Storage temperature  | -40°C to 85°C   |
| Relative humidity  | 95% at 40°C, non-condensing   |
| Protection   | NEMA-4X (IP-65) when panel mounted  |

## Mechanical



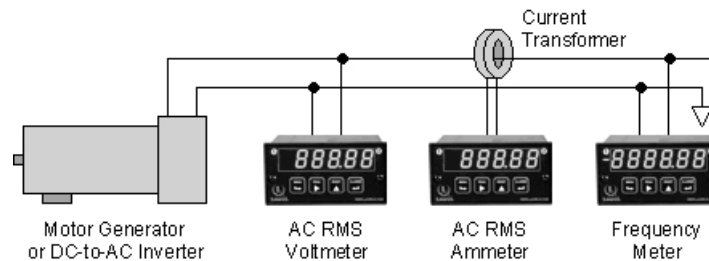
## Applications

### Using Laureate Meters to Synchronize Two Motor Generators



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 600.0 V ranges. Or a single meter can be multiplexed by using an external toggle switch.
- **Two frequencies A & B** 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 meter can also display frequency A - frequency B, or frequency A / frequency B without toggling.
- **Phase angle** can be measured using the Laureate Phase Meter.



### 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. 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 and alarm AC power lines with great accuracy:

- **AC RMS Voltmeter and Ammeter.** True RMS capability allows the display of RMS voltage for non-sinusoidal waveshapes, such as square waves from a UPS. A built-in 5 A range can be used to display currents up to 5.000 A with 1 mA resolution or 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 of the input current is easily accomplished via the meter's front panel pushbutton switches.
- **Frequency Meter.** Inverse period is used to determine AC line frequency to six-figure accuracy (60.0000 or 50.0000) in a few line cycles plus 30 ms.
- **Phase Angle & Power Factor Meter.** Two signals with identical periods are applied to Channels A and B. A phase angle resolution of 1°, 0.1° or 0.01° is selectable. Accuracy is 0.01% up to 100 Hz, 0.1% at 1 kHz, and 1% at 10 kHz.

## Ordering Guide

Create a model number in this format: **L20000RMV1, IPC**

|  |  |
|--|--|
| <b>DPM Type</b>                        | <b>L</b> Laureate Digital Panel Meter  |
| <b>Main Board</b>                      | <b>1</b> Standard Main Board, Green LEDs<br><b>2</b> Standard Main Board, Red LEDs   |
| <b>Power</b><br>(isolated)             | <b>0</b> Isolated 85-264 Vac<br><b>1</b> Isolated 12-32 Vac or 10-48 Vdc   |
| <b>Relay Output</b><br>(isolated)      | <b>0</b> None<br><b>1</b> Two 8A Contact Relays<br><b>2</b> Two 120 mA Solid State Relays<br><b>3</b> Four 8A Contact Relays<br><b>4</b> Four 120 mA Solid State Relays  |
| <b>Analog Output</b><br>(isolated)     | <b>0</b> None<br><b>1</b> Isolated 4-20 mA, 0-20 mA, 0-10 V, -10 to +10V   |
| <b>Digital Interface</b><br>(isolated) | <b>0</b> None<br><b>1</b> RS232<br><b>2</b> RS485 (dual RJ11 connectors)<br><b>4</b> RS485 Modbus (dual RJ45 connectors)<br><b>5</b> USB<br><b>6</b> USB-to-RS485 device server<br><b>7</b> Ethernet<br><b>8</b> Ethernet-to-RS485 device server   |
| <b>Signal Input</b><br>(isolated)      | <p><b>True AC RMS Volts</b></p> <p><b>RMV1</b> 200.00 mV<br/><b>RMV2</b> 2.0000 V<br/><b>RMV3</b> 20.000 V<br/><b>RMV4</b> 200.00 V<br/><b>RMV5</b> 600.0 V (range not ETL certified)<br/><b>RMV6</b> 300.0 V (range ETL certified)</p> <p><b>True AC RMS Amps</b></p> <p><b>RMA1</b> 2.0000 mA<br/><b>RMA2</b> 20.000 mA<br/><b>RMA3</b> 200.00 mA<br/><b>RMA4</b> 5.000 A</p>  |
| <b>Add-on Options</b>                  | <p><b>CBL01</b> RJ11-to-DB9 cable. RJ11 to DB9. Connects RS232 ports of meter and PC.</p> <p><b>CBL02</b> USB-to-DB9 adapter cable. Combination of CBL02 and CBL01 connects meter RS232 port to PC USB port.</p> <p><b>CBL03-1</b> 6-wire data cable, RJ11 to RJ11, 1 ft. Used to daisy chain meters via RS485.</p> <p><b>CBL03-7</b> 6-wire data cable, RJ11 to RJ11, 7 ft. Used to daisy chain meters via RS485.</p> <p><b>CBL05</b> USB cable, A-B. Connects USB ports of meter and PC.</p> <p><b>CBL06</b> USB to RS485 adapter cable, half duplex, RJ11 to USB. Connects meter RS485 port to PC USB port.</p> <p><b>CASE1</b> Benchtop laboratory case for one 1/8 DIN meter</p> <p><b>CASE2</b> Benchtop laboratory case for two 1/8 DIN meters</p> <p><b>IPC</b> Splash-proof cover</p> <p><b>BOX1</b> NEMA-4 Enclosure</p> <p><b>BOX2</b> NEMA-4 enclosure plus IPC</p> <p><b>BL</b> Blank Lens without button pads</p> <p><b>NL</b> Meter lens without button pads or Laurel logo</p> |