



4-20 mA & Serial Data Output Transmitter for AC Phase Angle & Power Factor



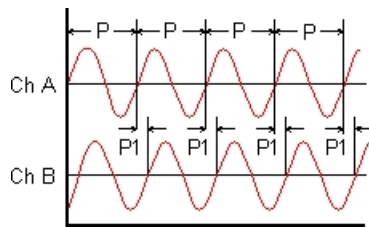
Features

- 4-20 mA, 0-20 mA, 0-10V or -10V to +10V transmitter output, 16 bits, isolated
- RS232 or RS485 serial data output, Modbus or Laurel ASCII protocol, isolated
- Dual 120 mA solid state relays for alarm or control, isolated
- Transmits phase angle between two AC wave shapes of similar period
- Transmits power factor from 1.000 to 0.000 with sinusoidal signals
- For frequencies from 0.005 Hz to 10 kHz, voltages from 10 mV to 250 Vac
- Phase angle resolution of 1°, 0.1° or 0.01°, accuracy of 0.03% at AC line frequency
- Analog output resolution 0.0015% of span (16 bits), accuracy $\pm 0.02\%$ of span
- 5V, 10V or 24V dc transducer excitation output, isolated
- DIN rail mount housing only 22.5 mm wide, detachable screw-clamp connectors
- Universal AC power, 85-264 Vac, or low voltage power, 10-48 Vdc or 12-32 Vac



Description

Phase Angle Measurement



Phase angle in degrees indicates the phase lead or lag between two periodic signals of the same period, as determined from their zero crossings. These two signals will typically be the voltage and current applied to a load. As illustrated, the phase angle in degrees is $+360^\circ \cdot P1/P$.

The Laureate 4-20 mA phase angle transmitter transmits the lead or lag in degrees from 0° to 360° between two periodic signals of the same period. In the illustration, phase angle is $360^\circ \cdot P1/P$. The signals are applied to the Channel A and B inputs of the Laureate dual-channel pulse input signal conditioner board. A 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.

Power Factor Measurement

The power factor of an AC power system is the ratio of real power in watts (W) divided by apparent power in volt-amperes (VA). For sinusoidal signals, power factor is the cosine of phase angle.

The Laureate 4-20 mA power factor transmitter computes power factor as the cosine of phase angle. Power factor readings can range from 1.000 to 0.000 with three decimal places and an accuracy of 0.1% for sinusoidal signals at 50/60 Hz power line frequency. While power factor is always positive, the meter assigns a minus sign to power factor for negative phase angles, and it sets power factor to 0 for phase angles greater than 90°.

Phase angle and power factor are 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.

Standard features of Laureate transmitters include:

- **4-20 mA, 0-10V or -10V to +10V analog transmitter output**, isolated, jumper-selectable and user scalable. All selections provide 16-bit (0.0015%) resolution of output span and 0.02% output accuracy of a reading from -99,999 to +99,999 counts that is also transmitted digitally. Output isolation from signal and power grounds eliminates potential ground loop problems.
- **Serial communications output**, isolated. User selectable RS232 or RS485, half or full duplex. Three protocols are user selectable: Modbus RTU, Modbus ASCII, or Laurel ASCII. Modbus operation is fully compliant with Modbus Over Serial Line Specification V1.0 (2002). The Laurel ASCII protocol allows up to 31 Laureate devices to be addressed on the same RS485 data line. It is simpler than the Modbus protocol and is recommended when all devices are Laureates.
- **Dual solid state relays**, isolated. Available for local alarm or control. Rated 120 mA at 130 Vac or 170 Vdc.
- **Transducer excitation output**, isolated. User selectable 5V@100 mA, 10V@120 mA or 24V@50 mA.
- **Universal 85-264 Vac power**. Low-voltage 10-48 Vdc or 12-32 Vac power is optional.

Easy Transmitter programming is via Laurel's Instrument Setup Software, which runs on a PC under MS Windows. This software can be downloaded from this website at no charge. The required transmitter-to-PC interface cable is available from Laurel (P/N CBL04).



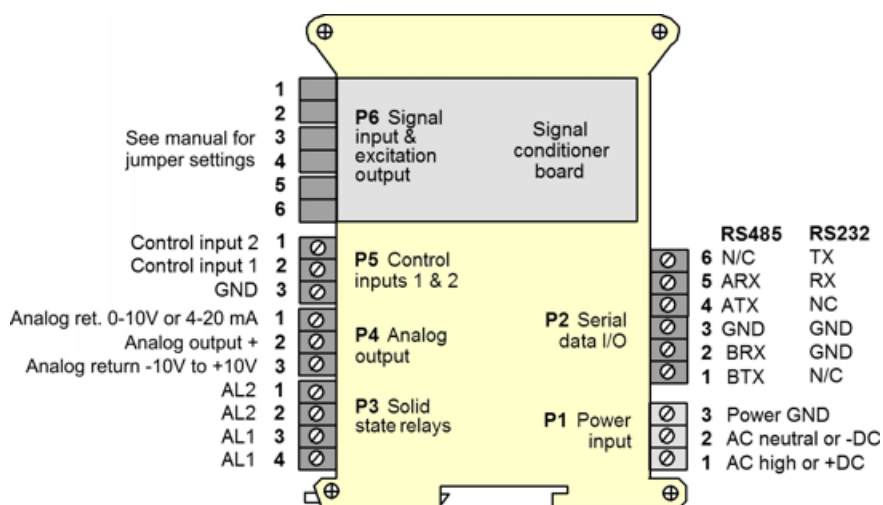
Specifications

Phase Angle Mode	
Item Transmitted	Phase angle difference between two waves of same period
Transmitted Units	1°, 0.1°, 0.01°
Frequency Range	0.005 Hz to 10 kHz
Resolution	0.01°, 0.005 Hz to 100 Hz, 0.1° at 1 kHz, 1° at 10 kHz
Accuracy	0.03° at 50 or 60 Hz
Maximum Timing Interval	200 sec
Power Factor Mode	
Item Transmitted	Power factor between two sine waves of same period
Transmitted Units	1.000 to 0.000, 1.00 to 0.00, or 1.0 to 1.0
Polarity	Negative sign indicates negative phase angle
Frequency Range	0.005 Hz to 10 kHz
Accuracy	0.1% at power line frequencies
Inputs	
Signal Types	Sinusoidal AC and square waves
Signal Ranges	10 mV to 250 Vac
Signal Ground	Common ground for channels A & B
Noise Filter	1 MHz, 30 kHz, 250 Hz (selectable)
Update Rate	
Conversion Interval	Gate time + 30 ms + 0-2 signal periods
Gate Time	Selectable 10 ms to 199.99 s
Time Before Zero Output	Selectable 10 ms to 199.99 s
Analog Output (standard)	
Output Levels	4-20 mA, 0-20 mA, 0-10 Vdc, -10 to +10Vdc (user selectable)
Compliance at 20 mA	10V (0-500Ω load)
Compliance at 10V	2 mA (5 kΩ or higher load)
Output Resolution	16 bits (65,536 steps)
Output Accuracy	0.02% of output span plus conversion accuracy
Output Isolation	250V rms working, 2.3 kV rms per 1 minute test
Serial Communications (standard)	
Signal Types	RS232 or RS485 (half or full duplex)
Data Rates	300, 600, 1200, 2400, 4800, 9600, 19200 baud
Output Isolation	250V rms working, 2.3 kV rms per 1 min test
Serial Protocols	Modbus RTU, Modbus ASCII, Laurel ASCII
Modbus Modes	RTU or ASCII
Modbus Compliance	Modbus over Serial Line Specification V1.0 (2002)
Digital Addressing	247 Modbus addresses. Up to 32 devices on an RS485 line with no repeater
Dual Relay Output (standard)	
Relay Type	Two solid state relays, SPST, normally open, Form A
Load Rating	120 mA at 140 Vac or 180 Vdc
Sensor Excitation Output (standard)	
Output Levels	5V@100 mA, 10V@120 mA, 24V@50 mA (jumper selectable)
Output Isolation	50V from signal ground
Power Input	
Standard Power	85-264 Vac or 90-300 Vdc
Low Power Option	10-48 Vdc or 12-32 Vac
Power Frequency	DC or 47-63 Hz
Power Isolation	250V rms working, 2.3 kV rms per 1 min test
Power Consumption	2W typical, 3W with max excitation output

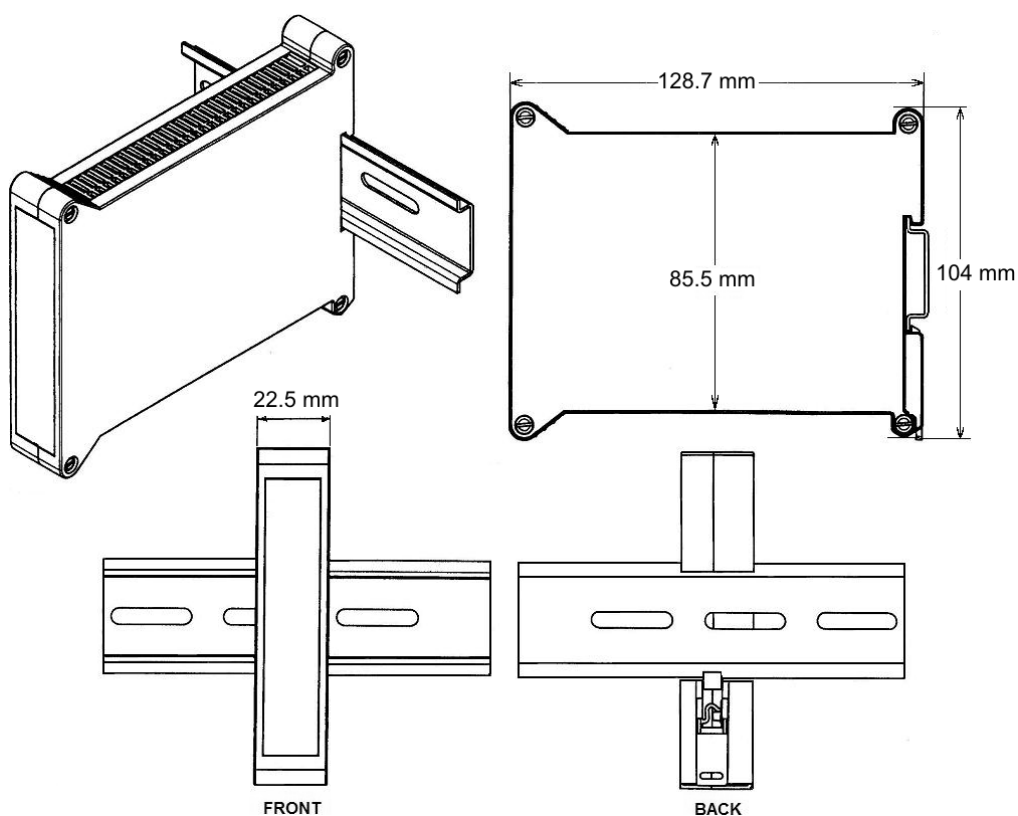


Mechanical	
Dimensions	129 x 104 x 22.5 mm case
Mounting	35 mm rail per DIN EN 50022
Electrical Connections	Plug-in screw-clamp connectors
Environmental	
Operating Temperature	0°C to 55°C
Storage Temperature	-40°C to 85°C
Relative Humidity	95% at 40°C, non-condensing
Cooling Required	Mount transmitters with ventilation holes at top and bottom. Leave 6 mm (1/4") between transmitters, or force air with a fan.

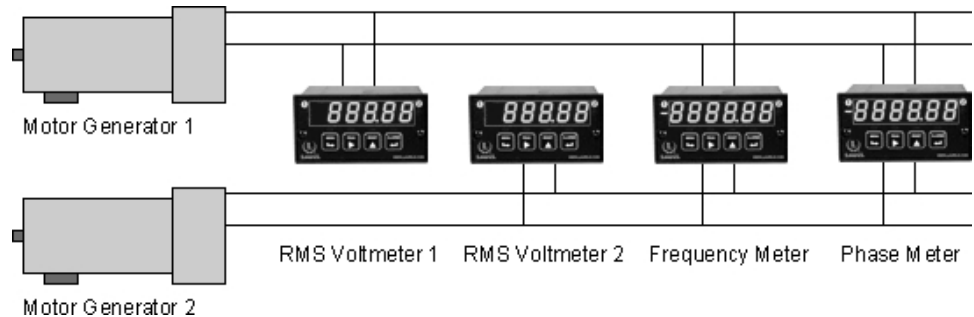
Pinout



Mechanical



Application Example



Using Laureate Meters, Counters or Transmitters 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. In this illustration, a single Laureate dual channel counter (or frequency transmitter) measures both frequencies to six-figure accuracy in a few line cycles.

Another Laureate dual channel counter (or phase transmitter) measures phase angle to 0.1° resolution. Two Laureate AC RMS Voltmeters, which offer ranges of 200.00 V and 600.0 V, are used to display the two RMS voltage to 0.1% accuracy.

Ordering Guide

Create a model a model number in this format: **LT60FR, CBL04**

Transmitter Type	LT Laureate 4-20 mA & RS485 Transmitter
Main Board	8 Extended Main Board
Power	0 Isolated 85-264 Vac or 90-300 Vdc 1 Isolated 12-32 Vac or 10-48 Vdc
Input Type	FR Dual-Channel Frequency
Accessories	CBL04 RS232 cable, 7ft. Connects RS232 screw terminals of LT transmitter to DB9 port of PC. CBL02 USB to RS232 adapter cable. Combination of CBL02 and CBL04 connects transmitter RS232 terminals to PC USB port.