

Custom Curve Linearization

Easy Programming for Custom Nonlinear Curve Fits

Applicable to Laureate™ Process, Strain Gauge, Load Cell Meters,
Frequency / Rate Meters, Totalizers



Features

- Achieves exceptional accuracy with low-cost transducers.
- Extends transducer operating range on high and low ends.
- Solves application problems involving non-linear relationships.
- Available with Extended versions of Laureate digital panel meters, counters and timers.
- Easy setup by entering data points into a computer spreadsheet, or typing in desired readings for actual signal inputs.
- Exceptional accuracy from 0.1% to 0.01% of full scale with few data points, made possible by curvilinear spline fits.

Description

Custom curve linearization is a feature available with the Extended option version of all Laureate digital panel meters, counters and timers, excluding only temperature meters. The latter already include preset linearization for specific temperature sensors.

Custom curve linearization can provide exceptional accuracy from low cost transducers, provided that these are repeatable. It can extend the working range of transducers on the high and low ends. It can also solve special application problems where there is a non-linear relationship between the input and the desired readout.

Linearizing is implemented for Laureates in the form of 20 nonlinear spline-fit segments, which provide much better accuracy than a larger number of straight line segments. The typical error will be from 0.1% to 0.01% of full scale, depending on the number of data points used for setup, the error in the data points, and the severity of non-linearities or discontinuities.

Easy Setup

Setup of a Laureate Linearizing Process Meter requires an external PC, which is connected to the meter via an RS-232 cable, and utilizes linearizing software furnished by Laurel Electronics. To download, go to our [Download Page](#). A Laureate serial communications board is required, but can be removed following setup. Three meter programming methods are offered:

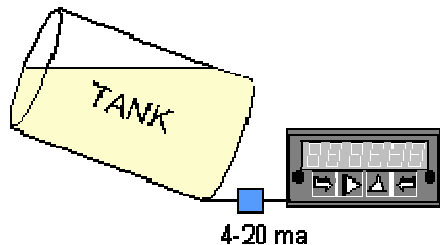
1. **Spreadsheet Method:** Data points consisting of the input signal in Volts or Amps and the desired reading are entered into an Excel spreadsheet or into a text text file using a space, comma or tab as the delimiter. There can be from 2 to 240 data points. Laurel's software then calculates 20 spline-fit segments and downloads their coefficients into the meter.

2. **Actual Input Method:** The meter is hooked up to the actual signal source, and the user enters the desired readings for different signal levels. There can be from 2 to 240 input / reading combinations. Laurel's software then calculates 20 spline-fit segments and downloads their coefficients into the meter. This method automatically compensates for any errors in the transducer.
3. **Polynomial Method:** The mathematical formula relating the input to the output is entered into the computer, which then uses this data to calculate the spline-fit segments. This method is ideal if the mathematical relationship is known, for example to calculate the contents of a tank based on the known geometry of the tank.

Applications

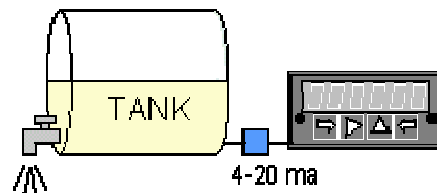
The ability to apply custom curve linearization opens many possibilities, including the following:

- **Altimeters**, since the relationship between pressure and altitude is very non-linear.
- **Rate of ascent** based on successive altimeter readings.
- **Square root extraction** from differential pressure transducers, whose signal may have zero offset.
- **Volume of irregularly-shaped tanks**, such as horizontal cylinders, based on measured liquid level or liquid pressure at the base of the tank.
- **Non-linear transducers**, such as thermistors or CdS cells.
- **Fine-calibration of linear transducers**, since even nominally linear transducers will have nonlinear components.
- **Extending the working range of transducers**, since many transducers become nonlinear at the low and high ends.
- **Compensating for inaccuracy of low-cost transducers.**



Measuring tank volume

The Extended Laureate process meter can display the volume of irregularly shaped tanks based on measured tank level or static pressure at the base of the tank. A common example is a cylindrical tank lying on its side. The tank can further be tilted to facilitate drainage, as illustrated. Spherical tanks or spheroidal water tanks are another example.



Rate from successive readings

The Extended process meter 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.

Ordering Guide

Laureate™ Custom Curve Linearizing Process Meters

Create a model number in this format: **L40010P**. This example calls out a Laureate panel meter with a, extended DPM main board, red LEDs, 85-264 Vac & 90-370 Vdc power, no setpoint output, 0-20 mA & 0-10 V analog outputs, no digital interface, and a DC signal conditioner set for the default process scaling of 4-20 mA = 0-100.00. Includes plug-in screw terminals.

Main Board	<input type="checkbox"/>	L3 Extended DPM Main Board, Green LEDs.	\$250	
	<input type="checkbox"/>	L4 Extended DPM Main Board, Red LEDs.	\$250	
	<input type="checkbox"/>	L7 Extended Counter Main Board, Green LEDs.	\$260	
	<input type="checkbox"/>	L8 Extended Counter Main Board, Red LEDs.	\$260	
	<p>Note: Extended capability is required for custom curve linearization or for display of time rate of change, such as flow rate from changing tank level or acceleration from changing speed. Not applicable to temperature meters.</p>			
Power	<input type="checkbox"/>	0 Isolated 85-264 Vac & 90-370 Vdc	NC	
	<input type="checkbox"/>	1 Isolated 8-28 Vac & 9-37 Vdc.	\$30	
Setpoint Output	<input type="checkbox"/>	0 None.	NC	
	<input type="checkbox"/>	1 Dual 10A Contact Relays.	\$80	
	<input type="checkbox"/>	2 Isolated Dual Solid State Relays.	\$55	
Analog Output	<input type="checkbox"/>	0 None.	NC	
	<input type="checkbox"/>	1 Isolated 0-20 mA & 0-10 V.	\$90	
Digital Interface	<input type="checkbox"/>	0 None.	NC	
	<input type="checkbox"/>	1 Isolated RS-232.	\$60	
	<input type="checkbox"/>	2 Isolated RS-485.	\$80	
	<input type="checkbox"/>	3 Isolated Parallel BCD Output.	\$105	
Signal Input	DC Volts			
	<input type="checkbox"/>	DCV1 ±200.00 mV.	NC	
	<input type="checkbox"/>	DCV2 ±2.0000 V.		
	<input type="checkbox"/>	DCV3 ±20.000 V.		
	<input type="checkbox"/>	DCV4 ±200.00 V.		
	<input type="checkbox"/>	DCV5 ±660.0 V.		
	DC Amps			
	<input type="checkbox"/>	DCA1 ±2.0000 mA.	NC	
	<input type="checkbox"/>	DCA2 ±20.000 mA.		
	<input type="checkbox"/>	DCA3 ±200.00 mA.		
	<input type="checkbox"/>	DCA4 ±5.000 A.		
	Process Signals (e.g., 4-20 mA, 0-5 V)			
	<input type="checkbox"/>	P Default Scaling. 4-20 mA = 0-100.00.	NC	
	<input type="checkbox"/>	P1 Custom Scaling. In the write-in field of your invoice, specify min input, min reading; max input, max reading.	\$10	
Strain Gage, Potentiometer (4-wire ratio)				
<input type="checkbox"/>	SG Default Scaling. 0-200 mV = 0-100.00.	NC		
<input type="checkbox"/>	SG1 Custom Scaling. In the write-in field of your invoice, specify min input, min reading; max input, max reading.	\$10		
<p>Note: The same DC signal conditioner board can be user-configured for DC Volts, DC Amps, process, or strain. It is precalibrated in EEPROM for all DC Volt and DC Amp ranges listed.</p>				

Load Cells (6-wire ratio)

WM Default Scaling. 0-20 mV = 0-100.00. \$55

WM1 Custom Scaling. \$55
 In the write-in field of your invoice, specify min input, min reading; max input, max reading. Full-scale input is 20-500 mV. Excitation is 10 V for up to four 350-ohm load cells.

Pulse Rate or Totalizing

FR Dual-Channel Frequency. NC

With Extended Main Board, scalable to ±999,999 for frequency, rate, square root of rate, up or down total, period, A-to-B time interval, stopwatch operation, rate and total simultaneously, ratio (A/B), draw (A/B-1), other arithmetic functions (AxB, A+B, A-B), phase angle, stopwatch, up/down counting, batching operation, linearization of nonlinear inputs.

Voltage-to-Frequency Converter

VF1 V-to-F Converter, 4-20 mA. NC

VF2 V-to-F Converter, 0-1 mA. NC

VF3 V-to-F Converter, 0-10 V. NC

VF4 V-to-F Converter, Special Range. \$35

In the write-in field of your invoice, specify min input, min reading; max input, max reading. Component changes by the factory may be required. With Extended Main Board, rate or square root of rate from differential pressure or target type flow transducers with a DC output, rate and total simultaneously, linearization of nonlinear inputs, batch operation, 1/rate (time), linearization of non-linear inputs.

Add-on Options

EB Extra Bright Red LED Display. Unselected. \$30

BL Blank Lens without Button Pads. Unselected. NC