

# DC Input Square Root Transmitter, Isolated

API 4440 G



**Input:** 0-50 mV to 0-200 VDC or 0-1 mA to 0-50 mADC  
**Output:** 0-1 V to  $\pm 10$  VDC or 0-20 mA to 4-20 mA

- Converts  $\Delta P$  Signal to Linear Flow
- Full Input/Output/Power Isolation
- Input and Output LoopTracker® LEDs
- Functional Test Pushbutton

## Applications

- Linearize Flow Meters
- Linearize Pitot Tube  $\Delta P$  Measurements
- Custom Signal Linearization in One Package

## Specifications

### Input Range

Factory Configured—Please specify input range  
 System voltages must not exceed socket voltage rating  
 Consult factory for special ranges

DC Voltage: 0-50 mV to 0-200 V  
 DC Current: 0-1 mA to 0-50 mA

### Input Impedance

Voltage: 50 k $\Omega$  minimum  
 Current: 50  $\Omega$  nominal

### Input Loop Power Supply

18 VDC nom., unregulated, 25 mADC, max. ripple, less than 1.5 V<sub>p-p</sub>

### LoopTracker

Variable brightness LEDs indicate input/output loop level and status

### Output Range

Factory Configured—Please specify output range

	Minimum	Maximum	Load Factor
Voltage:	0-1 VDC	0-10 VDC	
Bipolar Voltage:	$\pm 1$ VDC	$\pm 10$ VDC	
Current (20 V compliance):	0-1 mADC	0-20 mADC	1000 $\Omega$ at 20 mA

Consult factory for special ranges

### Accuracy

Better than  $\pm 0.25\%$  of span

### Output Ripple and Noise

Less than  $\pm 0.2\%$  of span

### Output Zero and Span

Multiturn potentiometers to compensate for load and lead variations  
 $\pm 15\%$  of span adjustment range typical

### Functional Test Button

Sets output to test level, factory set to approximately 50% of span  
 Adjustable 0-100% of span

### Response Time

70 milliseconds typical

### Isolation

2000 V<sub>RMS</sub> minimum  
 Full isolation: power to input, power to output, input to output

### Common Mode Voltage/Rejection

Greater than 100 dB at 500 VAC 60 Hz

### Ambient Temperature Range

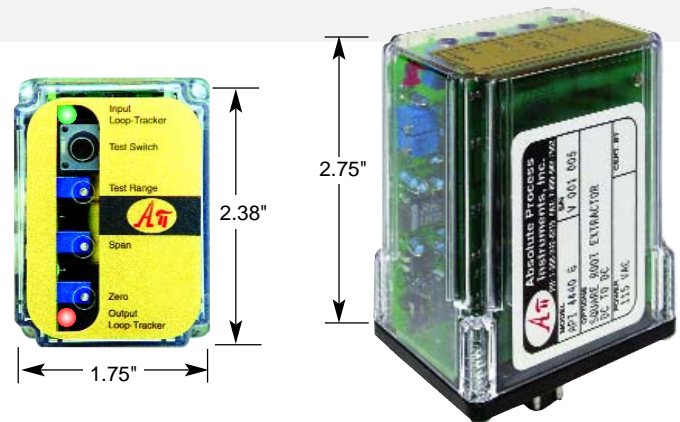
-10°C to +60°C operating

### Temperature Stability

Better than  $\pm 0.03\%$  of span per °C

### Power

Standard: 115 VAC  $\pm 10\%$ , 50/60 Hz, 2.5 W max.  
 P option: 80-265 VAC or 48-300 VDC, 50/60 Hz, 2.5 W typical  
 A230 option: 230 VAC  $\pm 10\%$ , 50/60 Hz, 2.5 W max.  
 D option: 9-30 VDC, 2.5 W typical



## Description and Features

The API 4440 G square root extractor accepts a DC voltage or current input and provides a DC voltage or current output proportional to the square root of the input. The API 4440 G can be factory-configured and calibrated for most popular input and output ranges.

Common applications include linearization of flow sensing elements such as differential pressure cells, pitot tubes, flow meters, etc.

The API 4440 filters and converts the DC input into a standard internal range. A precision integrated circuit extracts the square root of this signal. This extracted signal is passed thru a linear opto-coupler circuit that uses no pulse width modulators, transformers or capacitors to produce unwanted coupling or noise into the output.

This extracted and isolated signal is then trimmed by the external zero and span controls for fine adjustment. It is then passed to the output stage, which is internally configured for voltage or current output, with the gain scaled to the specific range required.

API exclusive features include two LoopTracker LEDs and a Functional Test Pushbutton. The LoopTracker LEDs (Green for input, Red for output) vary in intensity with changes in the process input and output signals. Monitoring these LEDs can provide a quick visual picture of your process loop at all times. The functional test pushbutton provides a fixed output (independent of the input) when held depressed. Both the LoopTracker LEDs and functional test pushbutton greatly aid in saving time during initial startup and/or troubleshooting.

An 18 VDC unregulated loop excitation power supply is standard and can be used to power passive input devices.

Industry standard sockets API 008 and finger-safe API 008 FS allow either DIN rail or panel mounting, and are sold separately.

## Models & Options

Factory Configured—Please specify input & output ranges, power and options

**API 4440 G** DC to DC square root extractor, isolated, 115 VAC

Options—Add to end of model number

- P Powered by 80-265 VAC or 48-300 VDC, 50/60 Hz
- A230 Powered by 230 VAC, 50/60 Hz
- D Powered by 9-30 VDC
- U Conformal coating for moisture resistance

Accessories—Order as a separate line item

- API 008 8-pin socket
- API 008 FS 8-pin finger safe socket
- API TK36 DIN rail, 35 mm W x 39" L, aluminum

DC Input Math



## RANGES

Listed below are commonly ordered input and output ranges. Contact factory for special ranges. Note that when a current output is ordered, it provides power to the output current loop (sourcing).

Common Voltage Inputs	
0 to 100 mV	0 to 50 V
0 to 200 mV	0 to 100 V
0 to 500 mV	±100 mV
0 to 1 V	±200 mV
0 to 2 V	±500 mV
0 to 5 V	±1 V
1 to 5 V	±2 V
0 to 10 V	±5 V
0 to 20 V	±10 V
0 to 100 V	0-200 V
Common Current Inputs	
0 to 1 mA	0 to 100 mA
0 to 10 mA	0 to 200 mA
0 to 20 mA	0 to 500 mA
4 to 20 mA	0 to 1 A
10 to 50 mA	

## Square Root of Input

Common Voltage Outputs
0 to 1 V
0 to 5 V
1 to 5 V
0 to 10 V
±5 V
±10 V
Common Current Outputs
0 to 20 mA
4 to 20 mA

## ELECTRICAL CONNECTIONS

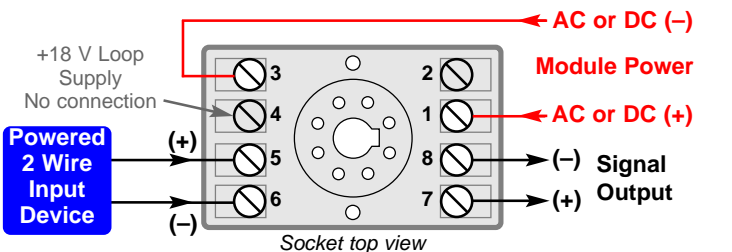
**WARNING!** All wiring must be performed by qualified personnel only. This module requires an industry-standard 8-pin socket. Order API 008 or finger-safe API 008 FS socket.

**Powered Input Terminals** – The white label on the side of the API module will indicate the power requirements. AC power is connected to terminals 1 and 3. For DC powered modules, polarity **MUST** be observed. Positive (+) is wired to terminal 1 and negative (-) is wired to terminal 3.

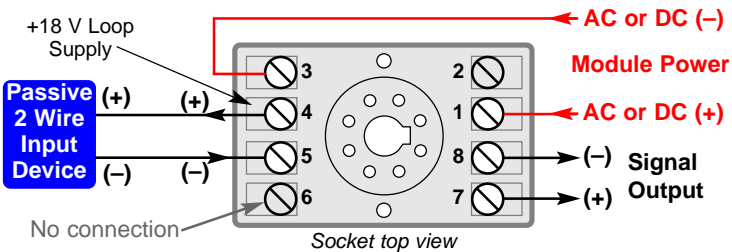
**Powered Signal Input** – Polarity must be observed when connecting the signal input. The positive connection (+) is applied to terminal 5 and the negative (-) is applied to terminal 6.

**Passive Signal Input** – Polarity must be observed when connecting the signal input. A passive input device can be powered by the 18 volt DC power supply at terminal 4. This may save the expense of purchasing a separate power supply for the input device. A typical example is shown, however it is very important to consult the manufacturer of your specific sensor to determine its compatibility and proper wiring.

**Signal Output Terminals** – Polarity must be observed when connecting the signal output to the load. The positive connection (+) is connected to terminal 7 and the negative (-) is connected to terminal 8. Output provides power to the output current loop (sourcing).



Connecting an input device which provides power to the input circuit



Using the built-in 18 VDC loop supply to power a passive input device

## CALIBRATION

The API 4440 G is shipped from the factory calibrated to your input and output specifications. Recalibration of the API 4440 G will require an accurate simulation source of DC voltage or current for the range of interest plus an accurate DC digital voltmeter for best results.

1. Connect a DC calibrator to the module input.
2. Connect an accurate DC voltmeter (or milliammeter, as required) to the module output.
3. Set the input simulator to the low end of the input range.
4. Adjust the module's Zero control for the specified 0% (low end) output. Because of the steep slope of the square root function near zero, careful calibration at the low end is important to accuracy.
5. For some applications, it may be better to adjust the Zero control at a slightly elevated input level (5 to 10% of input span) for the corresponding square root value at the output, rather than zero, to avoid calibrating on the very large input slope near zero.
6. Set the input simulator to the high end of the input range.
7. Adjust the module Span control for the specified high (100%) output level.
8. The zero and span controls normally have little interaction, but it may be best to repeat the above steps to ensure maximum accuracy.
9. The Test Cal control may be set to provide the desired output when the test pushbutton is held depressed.

## TEST BUTTON & TEST RANGE

The Test pushbutton may be set to provide the desired output when depressed. This will drive the device on the output side of the loop (a panel meter, chart recorder, etc.) with a known good signal that can be used as a system diagnostic aid during initial start-up or during troubleshooting. It can be adjusted to vary the output signal from 0 to 100% of the calibrated output range. When released, the output will return to normal.

Turn the multiturn Test Range potentiometer while holding the Test Switch depressed until the desired output test level is reached.

## OPERATION

The API 4440 G square root calculation is based on "percentage math." The output in percent of span is the square root of the percent of the input span. For example, a module using 4-20 mA input/output, the output algorithm is

$$\frac{\sqrt{\%Input \div 100} \times \text{Output Span}}{\text{Output Base Value}} = \text{Module Output Value}$$

Input Value	% Input $\div 100$	$\left[ \sqrt{\% \text{ Input } \div 100} \times \text{Output Span} \right] + \text{Output Base} = \text{Output Value}$
4 mA	0.00	$[ 0.000 \times 16 \text{ mA} ] + 4 \text{ mA} = 4.000 \text{ mA}$
8 mA	0.25	$[ 0.500 \times 16 \text{ mA} ] + 4 \text{ mA} = 12.000 \text{ mA}$
12 mA	0.50	$[ 0.707 \times 16 \text{ mA} ] + 4 \text{ mA} = 15.313 \text{ mA}$
16 mA	0.75	$[ 0.866 \times 16 \text{ mA} ] + 4 \text{ mA} = 17.856 \text{ mA}$
20 mA	1.00	$[ 1.000 \times 16 \text{ mA} ] + 4 \text{ mA} = 20.000 \text{ mA}$

**GREEN LoopTracker® Input LED** – Provides a visual indication that a signal is being sensed by the input circuitry of the module. It also indicates the input signal strength by changing in intensity as the process changes from minimum to maximum to provide a quick visual picture of your process loop at all times. If the LED fails to illuminate, or fails to change in intensity as the process changes, this may indicate a problem with module power or signal input wiring. This features greatly aid in saving time during initial start-up or troubleshooting.

**RED LoopTracker output LED** – Provides a visual indication that the output signal is functioning. It becomes brighter as the input and the corresponding output change from minimum to maximum. For current outputs, the RED LED will only light if the output loop current path is complete. For either current or voltage outputs, failure to illuminate or a failure to change in intensity as the process changes may indicate a problem with the module power or signal output wiring.

API maintains a constant effort to upgrade and improve its products. Specifications are subject to change without notice. Consult factory for your specific requirements.