DC to DC Square Root Transmitters, Isolated
API 4440 G

Input: 0-50 mV to 0-200 VDC, 0-1 mA to 0-50 mADC
Output: 0-1 V to ±10 VDC or 0-1 mA to 4-20 mA

- *Converts ∆P Signal to Linear Flow*
- *Factory Set Custom I/O Ranges*
- *Easy-to-Install Plug-In Design*
- *Full 2000 V Input/Output/Power Isolation*
- *Input and Output LoopTracker® LEDs*
- *Output Test Button*

Applications

- *Linearize Flow Meters*
- *Linearize Pitot Tube ∆P Measurements*
- *Custom Signal Linearization in One Package*

DC Input Range
Factory configured, please specify input range or consult factory. See table on other side for common ranges.

Voltage:	0-50 mVDC	to	0-200 VDC
Current:	0-1 mADC	to	0-50 mADC

Voltages must not exceed socket voltage rating

Input Impedance
Voltage: 50 kΩ minimum
Current: 50 Ω nominal

Common Mode Rejection
100 dB minimum

Input Loop Power Supply
18 VDC nom., unregulated, 25 mADC, max. ripple, <1.5 V_{p-p}

LoopTracker
Variable brightness LEDs indicate I/O loop level and status

DC Output Range
Factory configured, please specify output range or consult factory. See table on other side for common ranges.

Voltage, 10 mA max.:   0-1 VDC   to   0-10 VDC
Bipolar voltage: ±1 VDC   to   ±10 VDC
Current: 0-1 mADC   to   0-20 mADC
20 V compliance, 1000 Ω at 20 mA

Output Calibration
Multi-turn zero and span potentiometers for output
±15% of span adjustment range typical

Output Ripple and Noise
Less than 0.2% of span

Output Loop Power Supply
20 VDC nominal, regulated, 25 mADC, max. ripple <10 mVRMS

Output Test
Sets output to test level when pressed
Adjustable 0-100% of span

Accuracy
±0.25% of span (includes adjustment resolution and linearity)
Better than 0.03% of span per °C temperature stability

Response Time
70 milliseconds typical, faster response times are available
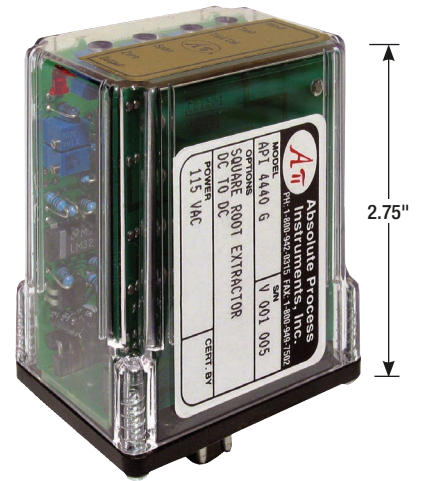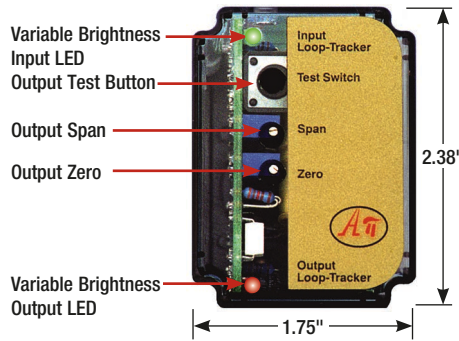
Isolation
2000 VRMS minimum
Full isolation: power to input, power to output, input to output

Installation Environment
IP 40, requires installation in panel or enclosure
Use with API 008 or API 008 FS socket
Socket mounts to 35 mm DIN rail or can be surface mounted
UL 508C pollution degree 2 environments or better
−10°C to +60°C operating ambient

Power
Standard: 115 VAC ±10%, 50/60 Hz, 2.5 W max.
P option: 85-265 VAC or 60-300 VDC 50/60 Hz, 2.5 W
A230 option: 230 VAC ±10%, 50/60 Hz, 2.5 W max.
D option: 9-30 VDC, 2.5 W typical

Variable Brightness Input LED
Output Test Button
Output Span
Output Zero
Input Loop-Tracker
Test Switch
Span
Zero
Variable Brightness Output LED
Output Loop-Tracker
2.38"
1.75"

LIFETIME WARRANTY

MADE IN USA

Free Factory I/O Setup!

Quick Link
api-usa.com/4440

Hot Swappable Plug-In Design
2.75"

cRUus E145968

115 VAC, 230 VAC models with input up to 150 VDC

Description
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.

Common ranges as well as custom ranges are possible. Consult the factory for assistance with special ranges.

LoopTracker
API exclusive features include two LoopTracker LEDs (green for input, red for output) that vary in intensity with changes in the process input and output signals. These provide a quick visual picture of your process loop at all times and can greatly aid in saving time during initial startup and/or troubleshooting.

Output Test
An API exclusive feature includes the Functional Test Button to provide a fixed output (independent of the input) when held depressed. The test output level is factory set via an internal potentiometer to approximately 50% of output span.

The functional test button greatly aids in saving time during initial startup and/or troubleshooting.

Installation
The API 4440 G plug into an industry standard 8-pin octal socket sold separately. Sockets API 008 and finger-safe API 008 FS allow either DIN rail or panel mounting.

The plug-in design, 3-way isolation, and robust electronics allows the module to be quickly hot-swapped without removing the power or I/O signals.

Model	Input	Output	Power
API 4440 G	Factory ranged 0-100 mVDC to 0-500 VDC ±100 mVDC to ±10 VDC 0-1 mADC to 0-900 mADC	Factory ranged Specify output range	115 VAC cRUus
API 4440 G A230			230 VAC cRUus
API 4440 G P			85-265 VAC or 60-300 VDC
API 4440 G D			9-30 VDC

Option—add to end of model number
U   Conformal coating for moisture resistance
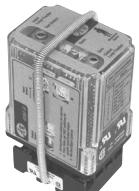
Accessories—order as separate line item
API 008   8-pin socket
API 008 FS   8-pin finger-safe socket
API CLP1   Module hold-down spring for high vibration or mobile applications

API 008 FS
300 V Rating

API 008
600 V Rating

API CLP1

Precautions

WARNING! All wiring must be performed by a qualified electrician or instrumentation engineer. See diagram for terminal designations and wiring examples. Consult factory for assistance.

WARNING! Avoid shock hazards! Turn signal input, output, and power off before connecting or disconnecting wiring, or removing or installing module.

Précautions

ATTENTION! Tout le câblage doit être effectué par un électricien ou ingénieur en instrumentation qualifié. Voir le diagramme pour désignations des bornes et des exemples de câblage. Consulter l'usine pour assistance.

ATTENTION! Éviter les risques de choc! Fermez le signal d'entrée, le signal de sortie et l'alimentation électrique avant de connecter ou de déconnecter le câblage, ou de retirer ou d'installer le module.

Socket and Mounting

The module installation requires a protective panel or enclosure. Use API 008 or finger-safe API 008 FS socket. See specifications for maximum allowable socket voltages. Note that some relay sockets may have lower voltage ratings. The socket clips to a standard 35 mm DIN rail or can be attached to a flat surface using the two mounting holes.

Ranges

API 4440 G input and output ranges are set at the factory and must be specified when ordering. Listed below are commonly ordered input and output ranges. Consult factory for other available ranges.

See the model/serial number label for module information, module power requirements, options, and I/O range information.

Common Voltage Inputs			
0-50 mV	0-500 mV	0-5 V	0-20 V
0-100 mV	0-1 V	1-5 V	0-50 V
0-200 mV	0-2 V	0-10 V	0-100 V
Common Current Inputs			
0-1 mA	0-5 mA	0-16 mA	4-20 mA
0-2.5 mA	0-10 mA	0-20 mA	10-50 mA
Common Voltage Outputs			
0-1 V	0-5 V	0-10 V	±5 V
0-2 V	1-5 V	1-10 V	±10 V
Common Current Outputs			
0-5 mA	0-16 mA	0-20 mA	4-20 mA

Signal Input

Polarity must be observed when connecting the signal input.

If your transmitter has a current output, determine if it provides power to the current loop or if it must be powered by the API module. Use a multi-meter to check for voltage at the transmitter output terminals. Typical voltage may be in the range of 9 to 24 VDC. In this case, wire the device to terminals 6 and 5.

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. See wiring diagram.

Type of Input Device	– Terminal	+ Terminal
Sensor or transmitter with a voltage output.	**6 (–)**	**5 (+)**
Connection when using **5A** current shunt. The input measures the mV drop across shunt.	**6 (–)**	**5 (+)**
Transmitter with a mA (current) output that provides power to the current loop. Typically a 3 or 4-wire device.	**6 (–)**	**5 (+)**
Transmitter with mA (current) output that is unpowered. Typically a 2-wire device. API module provides loop power.	**5 (–)**	**4 (+18 VDC)**

Signal Output

Polarity must be observed for output wiring connections. If the output does not function, check wiring and polarity.

Positive (+) is connected to terminal 7.

Negative (–) is connected to terminal 8.

With a current output the module provides power to the output loop (sourcing).

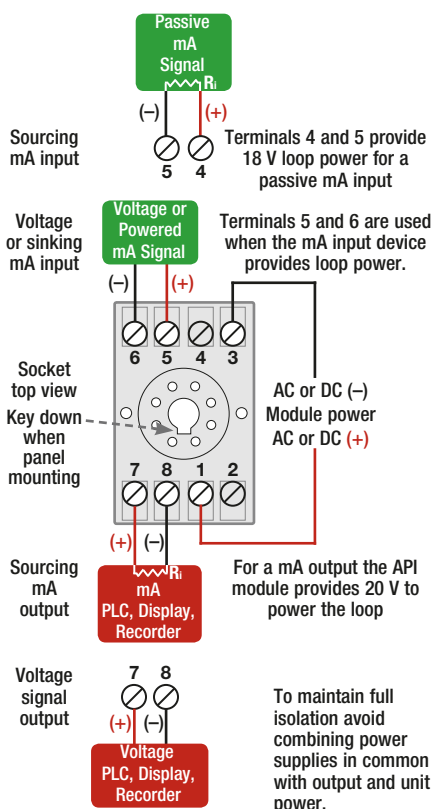| Device Connected to Output	– Terminal	+ Terminal
Measuring or recording device accepts a voltage input.	**8 (–)**	**7 (+)**
Measuring/recording device accepts a mA (current) input and its input is unpowered or passive. API module provides the loop power.	**8 (–)**	**7 (+20 V)**

Module Power

Check model/serial number label for module operating voltage to make sure it matches available power.

AC power is connected to terminals 1 and 3.

For DC powered modules (D option), polarity MUST be observed.

Positive (+) is connected to terminal 1.

Negative (–) is connected to terminal 3.

Passive mA Signal — R_i — (–) 5 (+) 4 — Sourcing mA input — Terminals 4 and 5 provide 18 V loop power for a passive mA input

Voltage or Powered mA Signal — (–) 6 (+) 5 — Voltage or sinking mA input — Terminals 5 and 6 are used when the mA input device provides loop power.

Socket top view. Key down when panel mounting.

Terminals: 6 5 4 3 / 7 8 1 2

AC or DC (–) Module power AC or DC (+)

Sourcing mA output — (+) 7 (–) 8 — R_i — mA PLC, Display, Recorder — For a mA output the API module provides 20 V to power the loop

Voltage signal output — (+) 7 (–) 8 — Voltage PLC, Display, Recorder — To maintain full isolation avoid combining power supplies in common with output and unit power.

Input	% Input	$\sqrt{\dfrac{\% \text{ Input}}{\div 100}}$ × Output Span + Output Offset = Output		
4 mA	0%	(0.000 × 16 mA) + 4 mA = **4.000 mA**
8 mA	25%	(0.500 × 16 mA) + 4 mA = **12.000 mA**
12 mA	50%	(0.707 × 16 mA) + 4 mA = **15.313 mA**
16 mA	75%	(0.866 × 16 mA) + 4 mA = **17.856 mA**
20 mA	100%	(1.000 × 16 mA) + 4 mA = **20.000 mA**

Example with 4-20 mA input and 4-20 mA output

Calibration

The API 4440 G is shipped from the factory calibrated to your input and output specifications. Calibration 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. Apply power to the module and allow a minimum 20 minute warm up time.
2. Connect a DC calibrator to the module input.
3. Connect an accurate DC voltmeter (or milliammeter, as required) to the module output.
4. Set the input to the low end of the input range.
5. 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.
6. 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.
7. Set the input to the high end of the input range.
8. Adjust the module Span control for the specified high (100%) output level.
9. The zero and span controls normally have little interaction, but it may be best to repeat the above steps to ensure maximum accuracy.

Output Test Function

The test button may be used to drive the device on the output (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.

When depressed it will drive the output with a known good signal. When released, the output will return to normal.

Turn the Test Range potentiometer while holding the Test Switch depressed until the desired output test level is reached. When released, the output will return to normal.

Operation

The API 4440 G is factory configured to your exact input and output requirements. The 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

$$\sqrt{(\% \text{Input} \div 100)} \times \text{ Output Span} + \text{Output Offset Value} = \text{Module Output Value}$$

The 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.

If the LED fails to illuminate, or fails to change in intensity as the process changes, check the module power or signal input wiring. Note that it may be difficult to see the LEDs under bright lighting conditions.

The 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.