DC to DC Math Function Transmitters, Isolated, Factory Configured

APD 44xx

Input: 0-50 mV to 0-10 VDC, ±25mV to ±10VDC, 0-1 mA to 0-20 mADC, ±0.5 to ±20 mA
Output: 0-1 V to ±10 VDC or 0-2 mA to 0-20 mA, 4-20 mA

Quick Link: api-usa.com/math

- *Add, Subtract, Average, Multiply, Divide*
- *Square Root, Square, Custom Math Function*
- *Factory Set Custom I/O Ranges*
- *1200 V Input/Output/Power Isolation*
- *Input LoopTracker® LED and Functional Test Button*
- *Built-In Loop Power Supply for Output*

Applications

- *Average Output From Metering Pumps*
- *Linearize Output From Flow Meter*
- *Output Differential Between Two Flow Meters*

DC Input Range
Factory configured, please specify each input range
Consult factory for special ranges and/or functions
Each input can have different ranges and/or units
Reverse acting input(s) available
Specify order of math functions if required
Milliamp inputs are sinking

APD 4400 through APD 4406 can have a scaling or weighting factor for each input. Division factor not included in formula.

Voltage:	0-50 mVDC	to	0-10 VDC
Bipolar voltage:	±25 mVDC	to	±10 VDC
Current:	0-1 mADC	to	0-20 mADC
Bipolar current:	±0.5 mADC	to	±20 mADC

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

Balance Between Inputs
Better than ±0.5% of span

LoopTracker
Variable brightness LED indicates input loop level and status

DC Output Range
Factory configured, please specify output range

Voltage, 10 mA max.:	0-1 VDC	to	0-10 VDC
Bipolar voltage:	±1 VDC	to	±10 VDC
Current:	0-2 mADC	to	0-20 mADC

20 V compliance, 1000 Ω at 20 mA
Milliamp output can be field wired for sink or source
Reverse acting output available

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

Output Loop Power Supply
20 VDC nominal, regulated, 25 mADC, <10 mVRMS max. ripple
May be selectively wired for sinking or sourcing mA output

Output Test
Front button sets output to test level. Enabled via pushbutton.
Default setting approximately 50% of output span
Potentiometer adjustable 0-100% of span

Output Ripple and Noise
Less than ±0.2% of span

Linearity
Better than ±0.25% of span

Ambient Temperature Range and Stability
−10°C to +60°C operating ambient
Better than ±0.02% of span per °C stability

Response Time
50 milliseconds, nominal per channel used

Isolation
1200 VRMS minimum
Full isolation: power to each input, power to output, each input to output.
Non-isolated: input to input

Housing and Connectors
IP 40, requires installation in panel or enclosure
For use in Pollution Degree 2 Environment
Mount vertically to a 35 mm DIN rail
Four 4-terminal removable connectors, 14 AWG max wire size

Power
85-265 VAC, 50/60HZ or 60-300 VDC, 4W maximum
D versions: 9-30 VDC or 10-32 VAC 50/60 Hz, 4 W maximum

1 2 3 4 Sink or Source mA Output

Mixed Voltage or mA Inputs
5 6 7 8

Adjustable Output Test/Override Function

Zero and Span for Output

Input LoopTracker LED

Custom I/O Ranges

Removable Plugs
9 10 11 12

Universal Power
13 14 15 16

See Wiring Diagrams on Next Page

Dimensions
0.89" W x 4.62" H x 4.81" D
22.5 mm W x 117 mm H x 122 mm D
Height includes connectors

Description
The APD 44xx series accepts 1 to 4 DC voltage or current inputs, depending on the model. They provide an optically isolated DC voltage or current output that is calculated from the mathematical function built in to the module.

Full 3-way isolation (input, output, power) makes this module useful for ground loop elimination, common mode signal rejection or noise pickup reduction. The inputs are not isolated from each other.

The APD 44xx series can be wired to allow a mA output to be either sinking (passive) or sourcing (active).

LoopTracker
API exclusive features include a green LoopTracker LED that varies in intensity with changes in the process input signal. It provides a quick indication of your process input at all times and can greatly aid in saving time during initial startup and/or troubleshooting.

Functional Test
An API exclusive feature includes the Functional Test Button to provide a fixed output (independent of the input) when enabled. The test output level is potentiometer adjustable from 0 to 100% of output span. The functional test button can greatly aid in saving time during initial startup and/or troubleshooting.

How to Order

All models are factory ranged
The APD 44xx models are configured to your specifications
Each input can have different ranges and/or units

With the model number, please specify
The range and units for each input
Output range
Options as required

Model	Power	Model	Power	Function	Input(s)	Output
APD 4400		APD 4400 D		(A + B + C + D) / 4		
APD 4401		APD 4401 D		(A + B + C) / 3		
APD 4402		APD 4402 D		(A + B) / 2		
APD 4403		APD 4403 D		(A + B + C − D) / 3		
APD 4404		APD 4404 D		(A + B − C − D) / 2		
APD 4405	85-265 VAC, 50/60HZ or 60-300 VDC	APD 4405 D	D versions 9-30 VDC or 10-32 VAC	A − B − C − D	Factory configured Specify VDC or mADC range for each input as required by function. Specify weighting or scaling factor for each input if required. Provide data table or graph for custom linearization	Factory configured Specify VDC or mADC output range
APD 4406		APD 4406 D		(A + B − C) / 2		
APD 4407		APD 4407 D		A − B − C		
APD 4408		APD 4408 D		A − B		
APD 4410		APD 4410 D		A x B		
APD 4420		APD 4420 D		A / B		
APD 4430		APD 4430 D		Input or output squared		
APD 4440		APD 4440 D		Square root of input or output		
APD 44xx		APD 44xx D		Custom math or linearization	Call us!	

Options—add to end of model number
R Input/output reversal, such as 4-20 mA input to 20-4 mA output
U Conformal coating for moisture resistance

Accessory—order as separate line item
API BP4 Spare 4-terminal plug, black

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.

API maintains a constant effort to upgrade and improve its products. Specifications are subject to change without notice. See api-usa.com for latest product information. Consult factory for your specific requirements.

⚠️ **WARNING:** This product can expose you to chemicals including nickel, which is known to the State of California to cause cancer or birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

Ranges

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

Electrical Connections

See wiring diagrams. Observe polarity. If the output does not function, check all wiring and polarity.

* Do not make any connections to unused terminals or use them as wiring junctions for external devices. This may cause permanent damage to the module!

Inputs

Polarity must be observed when connecting the signal inputs.

Inputs may each be different ranges and types.

For a transmitter with a current output, it must provide power to the current loop. This is typically a 3- or 4-wire device, or a passive transmitter with a loop power supply. 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.

Version	Channels	+ Terminal	− Terminal
All	1 (A)	5 (+)	6 (−)
2, 3, and 4 input	2 (B)	7 (+)	8 (−)
3 and 4 Input	3 (C)	9 (+)	10 (−)
4 Input	4 (D)	11 (+)	12 (−)

Output

Polarity must be observed when connecting the signal output.

If your device requires a current input, determine if it provides power to the current loop or if it must be powered by the APD module. Use a multi-meter to check for voltage at the input terminals. Typical voltage may be in the range of 9 to 24 VDC.

Device Connected to Output	− Terminal	+ Terminal
Measuring or recording device accepts a voltage input.	3 (−)	4 (+)
Measuring/recording device accepts a mA (current) input and the input is unpowered or passive. APD module provides the loop power.	3 (−)	4 (+20 V)
Measuring or recording device accepts a mA (current) input and provides power to the current loop.	2 (−)	3 (+)

Module Power Terminals

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

When using DC power, either polarity is acceptable, but for consistency with similar API products, positive (+) can be wired to terminal 13 and negative (−) can be wired to terminal 16.

The power supplies are fuse protected and the unit may be returned to API for fuse replacement.

Mounting to a DIN Rail

Install module vertically on a 35 mm DIN rail in a protective enclosure away from heat sources. Do not block air flow. Allow 1" (25 mm) above and below housing vents for air circulation.

1. Tilt front of module downward and position against DIN rail.
2. Clip lower mount to bottom edge of DIN rail.
3. Push front of module upward until upper mount snaps into place.

Removal

1. Push up on the bottom back of the module.
2. Tilt front of module downward to release upper mount from top edge of DIN rail.
3. The module can now be removed from the DIN rail.

Calibration

Input and output ranges are factory pre-configured (at 24°C ±1°C). Use the front-mounted Zero and Span potentiometers to calibrate the output.

1. Apply power to the module and allow a minimum 20 minute warm up time.
2. Using an accurate calibration source, provide an input to each channel equal to the minimum input required for the application.
3. Using an accurate measurement device for the output, adjust the Zero potentiometer for the exact minimum output desired. The Zero control should only be adjusted when the input signal is at its minimum. This will produce the corresponding minimum output signal. For example: 4 mA for a 4-20 mA output or −10 V for a ±10 V output.
4. Next, set all of the inputs at maximum, then adjust the Span pot for the exact maximum output desired. The Span control should only be adjusted when the input signal is at its maximum. This will produce the corresponding maximum output signal. Example: for 4-20 mA output, the Span control will provide adjustment for the 20 mA or high end of the signal.
5. Repeat adjustments for 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 pressed it will drive the output with a known good signal. When pressed again, the output will return to normal.

The Test Cal. potentiometer can be used to set the test output to the desired level. It is factory set to provide approximately 50% output. It is adjustable from 0 to 100% of the output span.

Push the Test button to enable the output test and adjust the Test Cal. potentiometer for the desired output level. Press the button again and the output will return to normal.

Operation

The APD 44xx is factory configured to your exact input and output requirements. Each input is filtered, either amplified or attenuated as required, then passed through to the output stage.

The output level is determined by the levels of inputs and the math function depending on the model.

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 LED under bright lighting conditions.

Wire terminal torque 0.5 to 0.6 Nm or 4.4 to 5.3 in-lbs

* Do not make connections to unused terminals!

Voltage Output
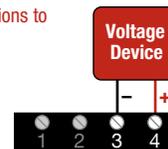
mA output: determine if receiving device has a passive or powered input. The module can be wired for a sinking or sourcing mA output.

Current Sourcing Output

Module powers mA output loop
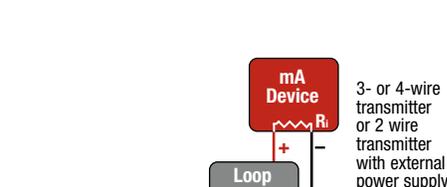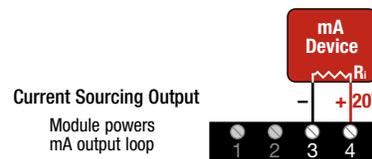
Current Sinking Output

Module mA output is unpowered

3- or 4-wire transmitter or 2 wire transmitter with external power supply

Voltage or mA inputs

Milliamp inputs are sinking and mA transmitters must provide power to the loop.

Ch. 1 Input   Ch. 2 Input
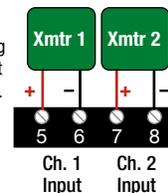
* To avoid damage to the module, do not make any connections to unused terminals

APD 44XX
DC to DC Math Isolated Transmitter

3 and 4 input models
Voltage or mA inputs

Milliamp inputs are sinking and mA transmitters must provide power to the loop.

Ch. 3 Input   Ch. 4 Input

* Do not make connections to unused terminals!

13   Power AC or DC +
14   Earth Ground
16   Power AC or DC −

Cu 60/75°C conductors 14 AWG max.
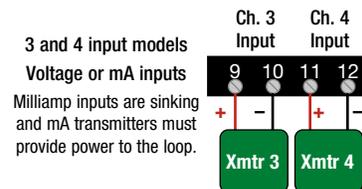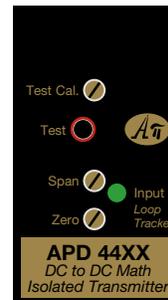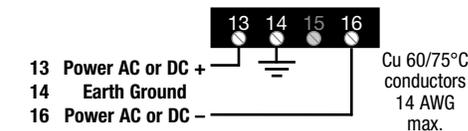
To maintain full isolation avoid combining power supplies in common with inputs, outputs, or unit power.