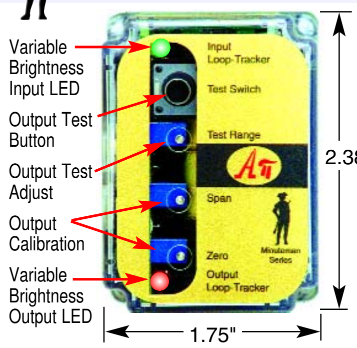
Strain Gauge (Bridge) to DC Transmitter, Isolated

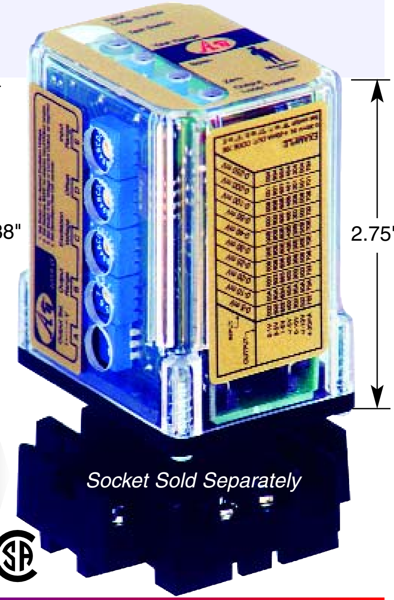
API 4059 G

Input: *0-5 mV to 0-400 mVDC, 4-10 V Excitation*
Output: *0-1 V to ±10 V or 0-1 mA to 4-20 mA Isolated*

Field Selectable
One Minute Setup!

- ***Drive up to Four 350 Ω Bridges***
- ***Non-Interactive Zero and Span Controls***
- ***Easy to Cancel or Tare out Deadweights***
- ***Easy-to-use External Rotary Switches and Setup Tables***
- ***Input and Output LoopTracker® LEDs***





Free Factory Input & Output Calibration!

LIFETIME WARRANTY

Applications

- **Strain Gauge or Load Cell Weighing Systems**
- **Strain Gauge Pressure Sensors**
- **Monitor Tanks, Hoppers, Scales, Etc.**

Specifications

Input Range

Minimum:	0 to 5 mV range	0.5 mV/V sensitivity
Maximum:	0 to 400 mV range	40 mV/V sensitivity

Millivolt output range is determined by the sensor sensitivity (mV/V) and the excitation voltage: *mV/V sensitivity X excitation voltage = total mV range*

Input Impedance

200 kΩ typical

Excitation Voltage

Maximum output:	10 VDC maximum at 120 mA
Drive capability:	Up to four 350 Ω bridges at 10 VDC
Adjustability:	Switch-selectable, 0 to 10 VDC in 1 V increments
Fine adjustment:	±5% via multiturn potentiometer
Stability:	±0.01% per °C

Sense Lead Compensation

Compensation better than ±0.01% per 1 Ω change in leadwire resistance
Leadwire resistance 10 Ω maximum for 10 VDC excitation for 350 Ω bridge

Zero Offset (Tare)

±100% of span in 15% increments

Shunt Calibration Resistor Provision

Option **M02**: Toggle switch for customer-supplied external shunt resistor

LoopTracker

Variable brightness LEDs indicate input/output loop level and status

Output Ranges

	Minimum	Maximum	Load Factor
Voltage:	0-1 VDC	0-10 VDC	
Bipolar Voltage:	±1 VDC	±10 VDC	
Current (20 V compliance):	0-2 mADC	0-25 mADC	1000 Ω at 20 mA

Output Linearity

Better than ±0.1% of span

Output Zero and Span

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

Functional Test Button

Sets output to test level when pressed. Potentiometer factory set to approx. 50% of span. Adjustable 0-100% of span

Response Time

70 milliseconds typical, faster response times are available
Option **DF**:10 millisecond response time

Common Mode Rejection

100 dB minimum

Isolation

2000 V_{RMS} min. Full isolation: power to input, power to output, input to output

Ambient Temperature Range and Stability

–10°C to +60°C operating ambient
Better than ±0.02% of span per °C stability

Power

Standard:	115 VAC ±10%, 50/60 Hz, 2.5 W max.
A230 option:	230 VAC ±10%, 50/60 Hz, 2.5 W max.
D option:	9-30 VDC, 3 W with 4 load cells

Description and Features

The **API 4059 G** accepts a strain gauge, bridge, load cell, or a summed input from up to four sensors, and provides a proportional, isolated DC voltage or current output. It includes filtering and processing to allow effective use of low-level transducers in the noisy environments found in industrial applications. The full 3-way (input, output, power) isolation makes this module useful for ground loop elimination, common mode signal rejection or noise pickup reduction.

The adjustable bridge excitation power supply generates a stable source of excitation voltage to drive from one to four 350 Ω (or greater) bridge type sensors such as load cells, pressure transducers and strain gauges and amplifies and converts the resulting millivolt signal into the selected output. Sense lead circuitry is included to cancel the effects of leadwire resistance, if required.

Input, output, excitation and zero offset are field-configurable, via external rotary and slide switches. Common ranges are on the module label. Offsets up to ±100% of span can be used to cancel sensor offsets or non-zero deadweights (taring). Non-interactive zero and span simplifies calibration.

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 the state of 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. The test output level can be adjusted 0-100% output span. Both the LoopTracker LEDs and functional test pushbutton greatly aid in saving time during initial startup and/or troubleshooting.

The **API 4059 G** plugs into an industry standard 11-pin octal socket sold separately. Sockets **API 011** and finger-safe **API 011 FS** allow either DIN rail or panel mounting.

Models & Options

Please specify power and options

API 4059 G	Field rangeable strain gauge to DC transmitter, isolated, 115 VAC

Options—Add to end of model number

A230	Powered by 230 VAC, 50/60 Hz
D	Powered by 9-30 VDC
M02	Toggle switch for external shunt calibration resistor
DF	Fast response, 10 millisecond nominal response time
U	Conformal coating for moisture resistance

Accessories—Order as separate line item

API 011	11-pin socket
API 011 FS	11-pin finger-safe socket
API TK36	DIN rail, 35 mm W x 39" L, aluminum

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905-457-6322 or 800-794-5883
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ELECTRICAL CONNECTIONS

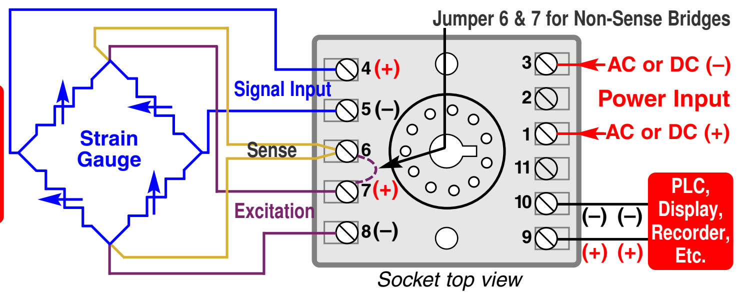
WARNING! All wiring must be performed by qualified personnel only. This module requires an industry-standard 11-pin socket. Order API 011 or finger-safe API 011 FS socket.

Power 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.

Strain Gauge Input – Refer to strain gauge manufacturer's data sheet for wire color-coding. Polarity must be observed when connecting the signal input. The positive connection (+) is applied to terminal 4 and the negative (–) is applied to terminal 5.

Excitation Voltage – *CAUTION: Never short the excitation leads together. This will cause internal damage to the API 4059 G.* Refer to strain gauge manufacturer's data sheet for wire color-coding. Terminals 7 and 8 provide connections for the DC voltage that is used to excite the strain gauge load cell. Polarity must be observed when connecting the Excitation Output. The positive connection (+) is applied to terminal 7 and the negative (–) is applied to terminal 8. Connect the sense leads to terminal 6. If no sense lead is available, connect pin 6 to pin 7.

Signal Output Terminals – Polarity must be observed when connecting the signal output to the load. The positive connection (+) is connected to terminal 9 and the negative (–) is connected to terminal 10.

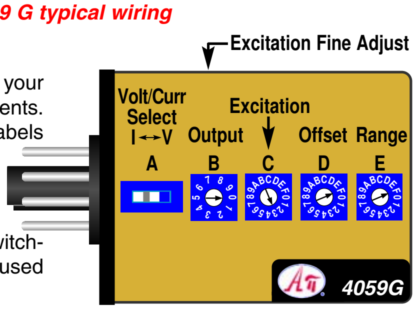


API 4059 G typical wiring

RANGE SELECTION

The API 4059 G is configurable to your exact input and output requirements. Ranges are listed on the module labels and below. See www.api-usa.com or contact factory for special ranges.

Four rotary switches and a slide switches on the side of the module are used to select input and output ranges.



1. See table and set **Excitation** rotary switch **C** to desired excitation voltage.

Excitation Voltage	10 V	9V	8 V	7 V	6 V	5 V	4 V	3 V	2 V	1 V	0 V
Switch C	A	9	8	7	6	5	4	3	2	1	0

2. Set **Volt/Curr** switch **A** to voltage (**V**) or current (**I**) depending on output type.
3. From the table, find the rotary switch combination that match your input/output ranges and set rotary switches **B**, **D**, and **E**.
4. The Excitation Fine Adjust, Zero, Span and Test Range potentiometers can now be adjusted for the desired output range.

			API 4059 G INPUT RANGES										
		Rotary Switches	0-5 mV	0-10 mV	0-20 mV	0-25 mV	0-30 mV	0-40 mV	0-50 mV	0-100 mV	0-200 mV	0-250 mV	0-400 mV
			BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE
OUTPUT RANGES	Switch A to V	0-1 V	002	00A	003	006	00E	00B	000	008	001	004	009
		0-2 V	802	80A	803	806	80E	80B	800	808	801	804	809
		0-4 V	102	10A	103	106	10E	10B	100	108	101	104	109
		1-5 V	602	60A	603	606	60E	60B	600	608	601	604	609
		0-5 V	902	90A	903	906	90E	90B	900	908	901	904	909
		0-10 V	302	30A	303	306	30E	30B	300	308	301	304	309
		±5 V	402	40A	403	406	40E	40B	400	408	401	404	409
		±10 V	502	50A	503	506	50E	50B	500	508	501	504	509
	A to I	4-20 mA	702	70A	703	706	70E	70B	700	708	701	704	709
		0-20 mA	302	30A	303	306	30E	30B	300	308	301	304	309

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

CALIBRATION

Top-mounted, Zero and Span potentiometers can be used should fine-tuning of the output be necessary. An excitation voltage fine adjust potentiometer is located on the side of the module.

1. Apply power to the module and allow a minimum 20 minute warm up time.
2. Using an accurate voltmeter across terminals 7 and 8, adjust the excitation voltage fine adjust potentiometer for the exact output desired.
3. Provide an input to the module equal to zero or the minimum input required for the application.
4. Using an accurate measurement device for the module 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.
5. Set the input at maximum, and 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.
6. This is a basic calibration procedure and does not account for offsets or tare weights. To achieve optimum results, it is recommended that the API 4059 G be calibrated by an accurate bridge simulator before being placed in service.
7. Offset switch **D** can be used to cancel or tare non-zero readings by offsetting the low end of the input range.

   Switch position 0 results in no offset.

   To raise the output zero, rotate switch **D** clockwise from **1** through **7** until the zero potentiometer is within range of your desired output.

   To lower the output zero, rotate switch **D** through ranges **9** through **F** until the zero potentiometer is within range of your desired output. This range is often used for elevated input ranges.

TEST BUTTON

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 multi-turn Test Range potentiometer while holding the Test Switch depressed until the desired output test level is reached.

OPERATION

Strain gauges and load cells are normally passive devices that are commonly referred to as "bridges" due to their four-resistor Wheatstone bridge configuration. These sensors require a precise excitation source to produce an output that is directly proportional to the load, pressure, etc. that is applied to the sensor.

The exact output of the sensor (measured in millivolts) is determined by the sensitivity of the sensor (mV/V) and the excitation voltage applied. For example, a load cell rated for 3 mV/V sensitivity and 10 VDC excitation will produce an output of 0 to 30 mV for load variations from 0 to 100%.

3 mV/V sensitivity X **10** VDC excitation = **30** mV range

An additional input, the "sense" lead, monitors the voltage drop in the sensor leads and automatically compensates the excitation voltage at the module in order to maintain a constant excitation voltage at the sensor.

The API 4059 G provides the excitation voltage to the sensors and receives the resulting millivolt signal in return. This input signal is filtered and amplified, then offset, if required, and passed to the output stage. Depending on the output configuration selected, a DC voltage or current output is generated.

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 level 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, this may indicate a problem with module power or signal input wiring.

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.

RANGE SELECTION

The API 4059 G is configurable to your exact input and output requirements. Ranges are listed on the module labels and below. See www.api-usa.com or contact factory for special ranges.

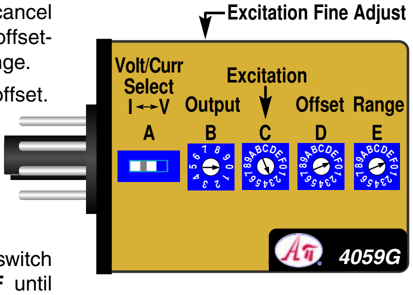
Four rotary switches and a slide switches on the side of the module are used to select input and output ranges.

1. See table and set **Excitation** rotary switch **C** to desired excitation voltage.
2. Set **Volt/Curr** switch **A** to voltage (**V**) or current (**I**) depending on output type.
3. From the table, find the rotary switch combination that match your input/output ranges and set rotary switches **B**, **D**, and **E**.
4. The Excitation Fine Adjust, Zero, Span and Test Range potentiometers can now be adjusted for the desired output range.
5. Offset switch **D** can be used to cancel or tare non-zero readings by offsetting the low end of the input range.

   Switch position 0 results in no offset.

   To raise the output zero, rotate switch **D** clockwise from **1** through **7** until the zero potentiometer is within range of your desired output.

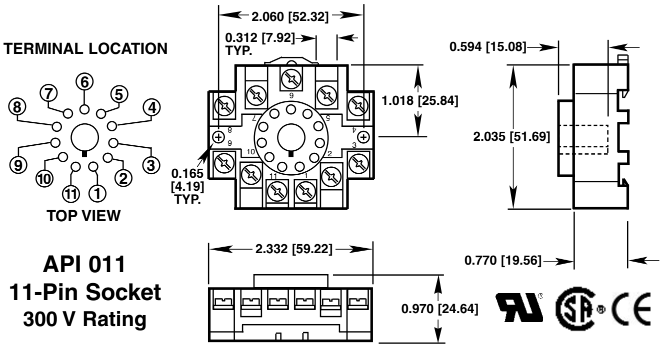
   To lower the output zero, rotate switch **D** through ranges **9** through **F** until the zero potentiometer is within range of your desired output. This range is often used for elevated input ranges.



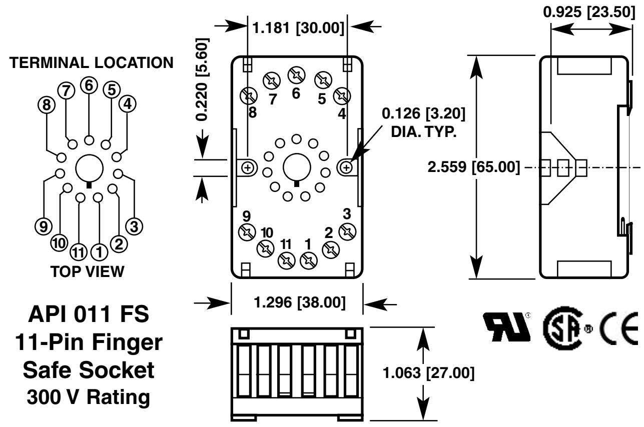
		Rotary Switches	API 4059 G INPUT RANGES													
			0-5 mV	±10 mV	0-10 mV	±20 mV	0-20 mV	0-25 mV	0-30 mV	0-40 mV	0-50 mV	0-100 mV	0-200 mV	0-250 mV	0-300 mV	0-400 mV
			BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE	BDE
OUTPUT RANGES	Switch A to "V"	0-1 V	002	033	00A	03B	003	006	00E	00B	000	008	001	004	00C	009
		0-2 V	802	833	80A	83B	803	806	80E	80B	800	808	801	804	80C	809
		0-4 V	102	133	10A	13B	103	106	10E	10B	100	108	101	104	10C	109
		1-5 V	602	633	60A	63B	603	606	60E	60B	600	608	601	604	60C	609
		0-5 V	902	933	90A	93B	903	906	90E	90B	900	908	901	904	90C	909
		0-8 V	202	233	20A	23B	203	206	20E	20B	200	208	201	204	20C	209
		2-10 V	702	733	70A	73B	703	706	70E	70B	700	708	701	704	70C	709
		0-10 V	302	333	30A	33B	303	306	30E	30B	300	308	301	304	30C	309
		±5 V	402	433	40A	43B	403	406	40E	40B	400	408	401	404	40C	409
		±10 V	502	533	50A	53B	503	506	50E	50B	500	508	501	504	50C	509
	Switch A to "I"	0-2 mA	007	033	00A	03B	003	006	00E	00B	000	008	001	004	00C	009
		2-10 mA	602	633	60A	63B	603	606	60E	60B	600	608	601	604	60C	609
		0-10 mA	902	933	90A	93B	903	906	90E	90B	900	908	901	904	90C	909
		0-16 mA	202	233	20A	23B	203	206	20E	20B	200	208	201	204	20C	209
		4-20 mA	702	733	70A	73B	703	706	70E	70B	700	708	701	704	70C	709
		0-20 mA	302	333	30A	33B	303	306	30E	30B	300	308	301	304	30C	309

Strain Gauge

API 011 and API 011 FS Sockets



API 011
11-Pin Socket
300 V Rating



API 011 FS
11-Pin Finger Safe Socket
300 V Rating

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Frequently Asked Questions

What is the performance over the entire range for the API 4059 G? How well does the output track the input over the entire range?

The linearity specification for the **API 4059 G** is ±0.1% of span. The **API 4058 G** is the same.

Is the API 4059 G approved for Europe's CE standards?

No, but if the entire system in the application needs to be CE approved, then our unit does not.

What does the 70 msec response time mean on the API 4059 G? Are faster times available? If a signal with pulse width of less than 70 msec is present at the input, will it show up at the output?

The output will track the input with about a 70msec delay. The **API 4059 G** can be factory set to 10 msec minimum. If a pulse of less than the response time (70 msec or 10 msec) occurs at the input, the output will not reveal it, or there might be a small blip.

When trying to adjust the span potentiometer on an API 4059 G the output signal, which drives a numerical display, jumps by too large an amount when barely turning the potentiometer screw. What is wrong?

The resolutions of the zero and span potentiometers are related to the amount of turns of the pot screw and the amount of adjustment capability (±15%). The factory can provide a finer resolution which means that the potentiometer screw must be turned more to have the same amount of change in signal, however the total amount of adjustment capability of the potentiometer will be reduced.

We have a load cell application with a very low output signal and we would like to drive the cell with a higher excitation voltage (the load cell is rated 24 VDC max. and 10 VDC typical). Can your modules provide an excitation voltage higher than 10 VDC?

No, however you can use an **API 9046-24** power supply with 24 VDC output to excite the load cell. The output signal would then be higher for the same load which could then drive an **API 4310 G**, narrow input span.

We are trying to set up the API 4059 G to allow a ±30 mV input signal (3mV/V load cell operating in the tension/compression mode) with a ±10 V output signal. The unit does not have a code to select for the input of ±30 mV. Can we have this input option?

No, the **API 4059 G** will not accept ±30 mV and the span potentiometer does not have enough adjustment for this special range. You can lower the excitation voltage to 7 VDC so that you would have a ±20 mV input (7 V excitation x 3 mV/V = 21 mV). If isolation is not necessary, select the **API 4058 G** which allows a ±30 mV to ±10 VDC input/output combination.

What would be the input range for our load cell that has a maximum capacity of 200 pounds, an excitation voltage of 10 VDC, a rating of 2 mV/V, operating in the tension/compression mode, and measuring 75 pounds full scale?

Full scale-input to our module would be

(75 / 200) x 10 V x 2 mV/V = 7.5 mV.

For tension and compression, the signal will be ±7.5 mV.

We have two load cells and wish to wire them to your API 4059 G. How do we accomplish this?

Connect both load cells in parallel. Each load cell would be wired the same, excitation voltage and return signals, to the **API 4059 G** so there would be two sets of wires to terminals 4 & 5 and 7 & 8.

We use an API 4059 G with a load cell that comes with a calibration resistor to simulate 80% of full load. The load cell will be used in both the tension and compression modes. How do we connect the calibration resistor to your API 4059 G?

For both tension and compression modes, the signal will be bipolar (±). The tension mode (negative) places the resistor between the (+) excitation signal, terminal 7, and the (–) signal input, terminal 5. This will simulate –80% of full tension load. To calibrate the output, adjust the zero potentiometer to set the output to 10% of span.

The compression mode (positive) places the resistor between the (+) excitation signal, terminal 7, and the (+) signal input, terminal 4. This will simulate +80% of full compression load. To calibrate the output, adjust the span potentiometer to set the output to 90% of span.

Total span is ±100 % (bipolar) = 200% of full capacity, with 100% being the midpoint.

–80% = 20% / 200% = 10%

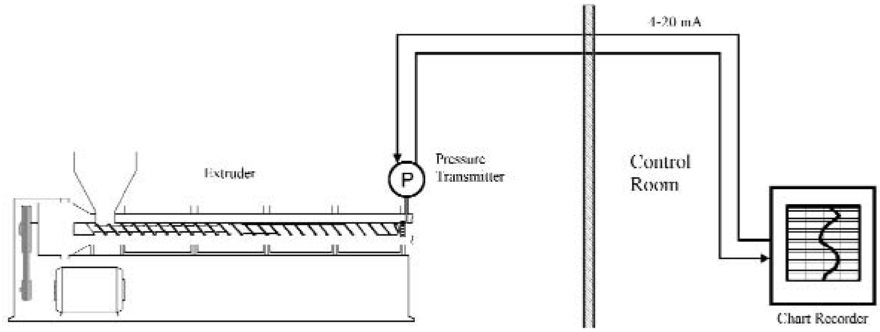
+80% = 180% / 200% = 90%

We have 4 load cells in our application each with a resistance of 350 ohms. Can we use your API 4051 G in this application?

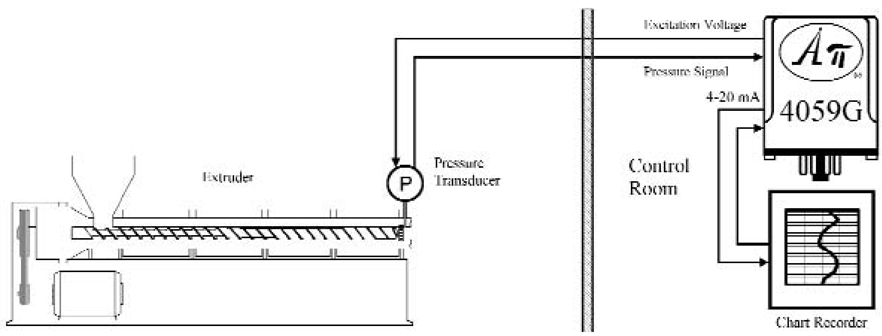
No. The **API 4051 G** excitation circuit can only source 30 mA maximum. Since your 4 load cells require about 114 mA total current, you must use either the **API 4058 G** or the **API 4059 G**.

Why Take the Heat When You are Under Pressure?

Sometimes it is necessary to locate a pressure sensor where it is continuously exposed to temperatures near or exceeding its upper temperature limits. When a pressure transmitter is used, the high temperatures gradually degrade the electronics and considerably shorten the life of the sensor. The cost of production downtime and repair or replacement of the sensor can run into thousands of dollars.

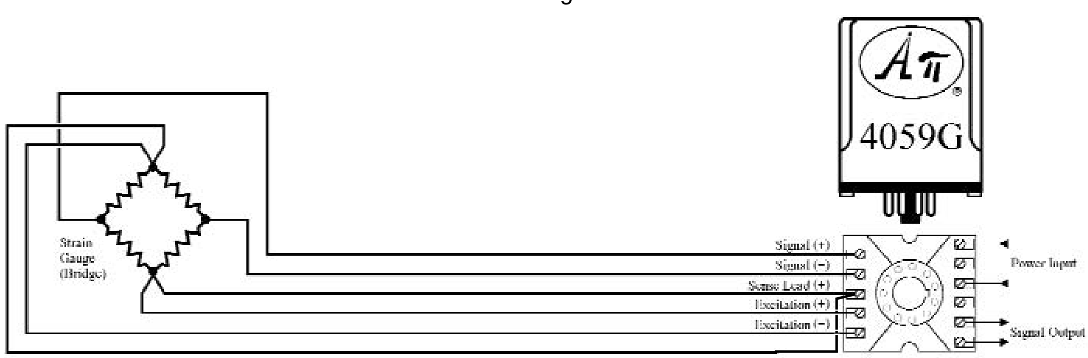


A solution would be to use a pressure transducer in the high temperature area and an Api Strain Gauge Signal Conditioner mounted in a remote location such as the control room. The transducer will likely withstand the high temperatures for longer periods of time and is less costly to replace should it become necessary. The **API 4059 G** module provides the power to the transducer and is fully field rangeable for the excitation supply, sensitivity and DC voltage or current output. The **API 4059 G** can be calibrated and fine tuned to the new transducer in minutes reducing the downtime to a minimum.



When Does Six Make Sense Over Four?

Many strain gauges (bridges) are located a considerable distance from the Api Strain Gauge Signal Conditioner. The long leads add an additional lead resistance that can result in a drop in the excitation supply voltage at the bridge and unwanted errors in the measurement. Although the excitation supply on all Api Strain Gauge Signal Conditioners is adjustable, it is suggested a six-wire bridge be used to compensate for variations in the lead resistance due to temperature changes. The additional two wires are called Sense Leads.

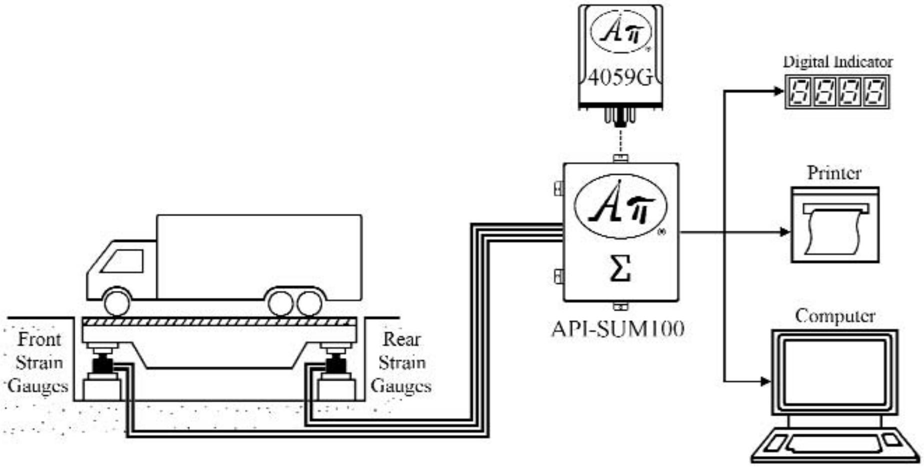


The **API 4059 G** Isolated Strain Gauge Signal Conditioner accepts a Sense Lead input. Internal circuitry in the module monitors the voltage drop in the bridge leads and automatically compensates the excitation voltage at the module so the actual excitation voltage at the bridge remains constant. Due to the design of the **API 4059 G**, it is only necessary to connect one of the sense leads for the feature to be effective.

Truck Scale System

PROBLEM
Total vehicle weight is to be displayed, printed out and sent to a computer for record keeping purposes.

SOLUTION
A weighing platform is equipped with strain gauges at each of its four corners, and the strain gauges are wired to an API summing box **API-SUM 100** with an **API 4059 G** Field Selectable Isolated Strain Gauge (Bridge) to DC Transmitter module.

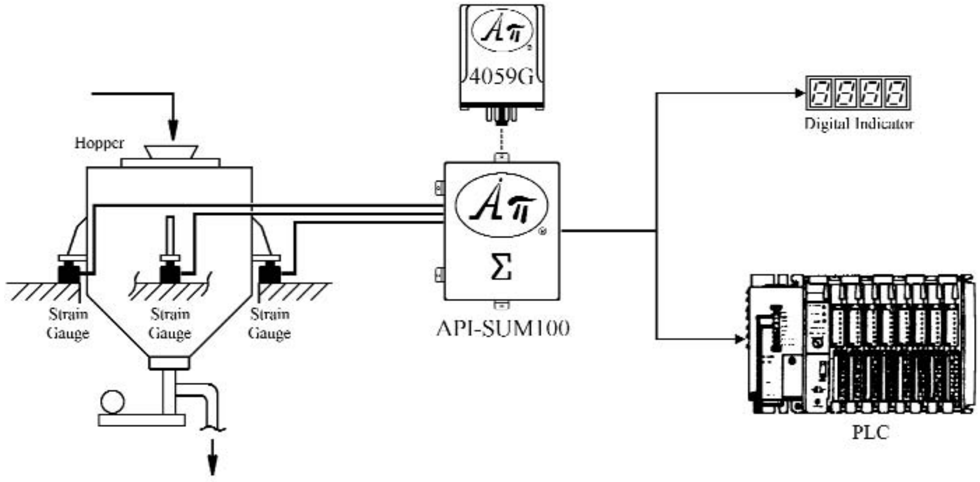


The **API 4059 G** plugs into a socket on the **API SUM 100** board and provides excitation voltage for all four of the strain gauges from its built-in excitation power supply. The **API SUM 100** summing box combines the four strain gauge outputs and the **API 4059 G** converts the signal and drives the display, the printer and the computer.

Automation of a Dispensing Operation

PROBLEM
Automatically control the amount and rate of feed to a hopper dispensing dog food into a container.

SOLUTION
The hopper is equipped with three strain gauge load cells which are wired to an Api summing box with an **API 4059 G** Isolated Strain Gauge Input to DC Transmitter Module.



The **API 4059 G** plugs into a socket on the **API SUM 100** board and provides excitation voltage for all three of the strain gauges from its built-in excitation power supply. The **API SUM 100** summing box combines the three strain gauge outputs and the **API 4059 G** converts the signal and drives the display and the PLC.

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