Our Company

We are an engineering-oriented and application-driven company that provides solutions to our customers' technical problems. All of our API and Cecomp manufactured products are designed by our engineering staff and assembled in our Libertyville facility. We have also formed strategic alliances with companies in Australia, Germany, and Switzerland in order to broaden our product offering as well as opening channels for serving overseas markets.

Absolute Process Instruments designs and manufactures industrial electronics in a broad range of industries, including machinery manufacturing, automotive, dairy, and factory automation and control. Products include

- Microprocessor-based controls
- Vacuum and pressure measurement and control instruments
- Temperature measurement and control products
- Flow measurement and control systems
- Motion control products
- DC/AC/Servo motor drives
- Signal processing equipment
- Data logging and measurement instruments.

Our products range from board level through complete products such as portable computers and hand-held instrumentation.

History

Absolute Process Instruments Inc. (API), was founded in 1987 as a designer and manufacturer of signal conditioning and signal interface products for the industrial marketplace. API has grown to become a market leader in custom signal conditioning products.

Cecomp Electronics, Inc. was founded in 1983, as a "Custom Electronics Company" hence the name Cecomp. Cecomp is a diverse designer and manufacturer of a wide variety of standard and custom electronic products. Cecomp specializes in pressure/vacuum test, measurement and process control instrumentation as well as custom electronic products and contract manufacturing. Cecomp joined the API family in 1995 and in 1998 began to produce its highly regarded line of digital pressure gauges.

Cecomp became a division of API in 2000 at which time both companies moved to a new 12,500 square foot building in Libertyville, Illinois. This new headquarters and manufacturing facility is expected to accommodate the growth of API with state-of-the-art equipment, highly skilled engineers and staff, and innovative ideas. API will continue to be a leading manufacturer of signal conditioning products, digital pressure gauges, and custom electronics.

Absolute Process Instruments and Cecomp Electronics products are manufactured in the USA with extensive electronic circuit design, development and manufacturing experience in both thru-hole and fully automated SMT (Surface Mount Technology) production equipment.

In 2002, Absolute Process Instruments and Camille Bauer based in Wohlen, Switzerland formed a strategic alliance for their industrial process products with the newly formed API-Camille Bauer Division to exclusively promote, service and sell Camille Bauer products in North America. These products will complement and expand the product lines manufactured by API.

This partnership will continue the tradition of excellent product support, competitive prices, and fast delivery for the Camille Bauer SINEAX high performance signal conditioning, KINAX position transducers and SINEAX electric power measurement products.

In 2003, Absolute Process Instruments and RheinTacho Messtechnik GmbH of Freiburg, Germany formed an alliance to exclusively promote, service and sell their non-contact speed sensors and programmable speed monitors in North America. These products also complement and expand the product lines manufactured by API and those sold by the API-Camille Bauer Division.

Quality plays a primary role at API. This is achieved through excellent manufacturing practices, investment in the latest equipment, and a dedicated stable workforce. Quality people mean quality products at API. Our confident in our manufacturing quality allows us to offer a lifetime warranty on API signal conditioners. Every product is tested before it is shipped. NIST traceable standards ensure accuracy.

Company Philosophy

We are committed to providing high quality products at affordable prices along with expert application assistance and quick delivery. This provides our customers with the benefits of increased productivity while backing our products with a total commitment to customer service and support.

When you call us you will talk to a real person, not an automated help line. Our customer service staff is trained to not only answer questions about our products, but to provide technical assistance and solutions to your application questions.

We continue to maintain our reputation for being a company that is "easy to deal with" by offering solutions to your application challenges and providing high quality economical products with timely delivery.

Product improvements and enhancements as well as new product development often start with information from the field. We encourage customer feedback on our product lines. We feel this provides an opportunity to serve your special requirements.

At API we measure our performance by our ability to provide the right product for a customer's application in a timely manner. Our approach to each business opportunity is summarized as follows:

Facta non Verba

Deeds not Words

We are dedicated to maintaining quality field support by utilizing independent sales representatives within defined territories. We value these organizations and consider them extensions of our company when dealing with our customers. Through these organizations, we are able to offer in-depth customer service, not only via technical support, but by striving to build long term relationships.

We also support a North American distributor network many of whom specialize in certain industries and stock our products. We also serve our worldwide customers via our industrial product exporters. Contact us to find a representative or distributor near you or visit our web sites.

api-usa.com **cecomp.com**

apicb.com **rheintacho.us**

API Info

Products

Absolute Process Instruments, Inc.

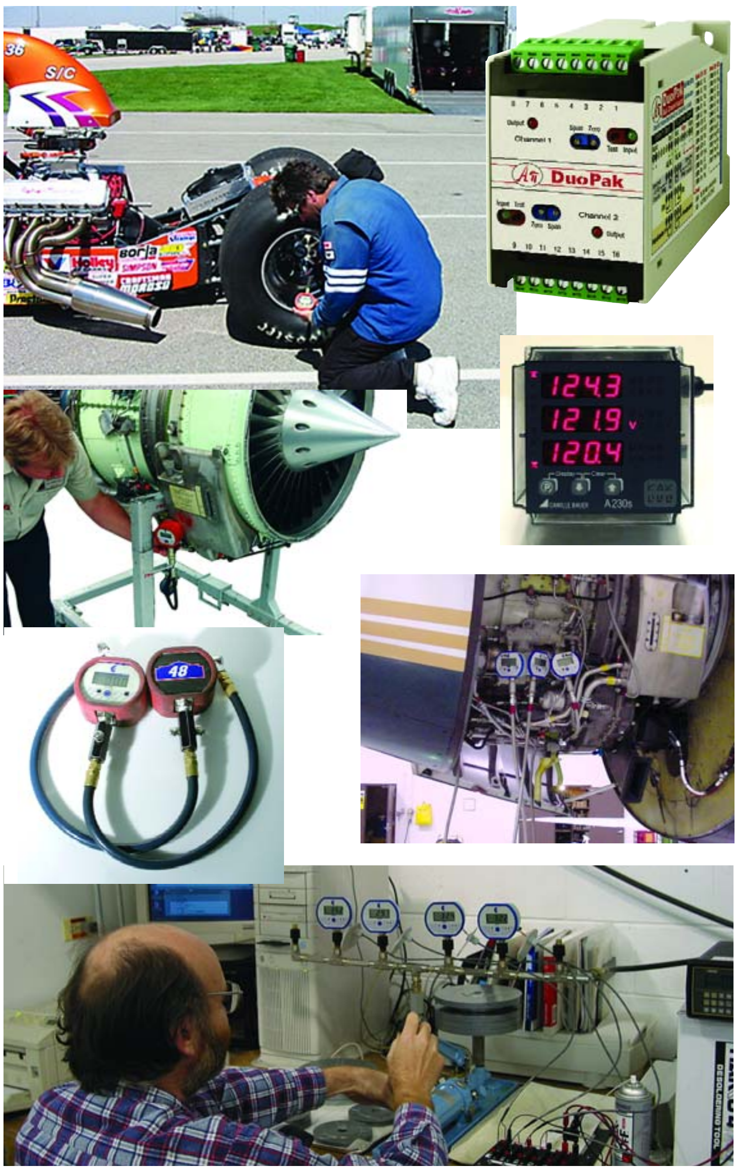
- Manufactures a complete line of industrial signal conditioners, signal converters, alarms, signal transmitters, temperature alarms and transmitters
- Engineers and manufactures custom signal conditioning products

Cecomp Electronics Division

- Manufactures digital pressure and vacuum gauges, transmitters, pressure switches and alarms
- Manufactures digital temperature products and transmitters
- Engineers and manufactures custom and private label electronic products

Api-Camille Bauer Division

- Industrial signal conditioners, signal converters, alarm relays, signal transmitters, temperature alarms and transmitters from Switzerland
- **SINEAX** electrical power monitors and transducers, including models with MODBUS, PROFIBUS and Hart communications
- **KINAX** ruggedized capacitive-type rotary position transducers
- **LINEAX** chart recorders and supplies
- **RheinTacho** non-contact speed sensors and programmable speed monitors
- **APCS** specialty signal conditioners and signal interface products from Australia



New Products

Custom Manufacturing

API custom products include microprocessor controls, vacuum and pressure measurement and control, temperature measurement and control, flow measurement and control, motion control, DC/AC/servo motor drives, signal processing, and data logging and measurement. Our products range from board level through complete products such as portable computers and hand-held instrumentation.

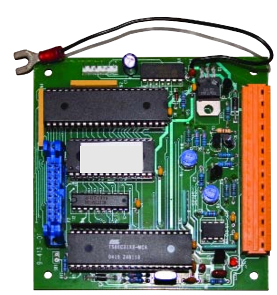
We are an engineering-oriented and application-driven company that provides solutions to our customers' technical problems. All of our API and Cecomp manufactured products are designed by our engineering staff and assembled in our Libertyville facility.

In-house engineering capabilities include circuit design, software design, printed circuit board layout, prototype assembly, qualification testing, and documentation. Our in-house manufacturing process (UL/CUL Certified Shop) includes automated surface mount assembly equipment, as well as testing and calibration equipment (NIST traceable pressure and voltage standards) allowing economical custom products, fast delivery, and excellent quality.

We also offer cost-reduction, miniaturization, design review, and consulting services for product redesign or updates. Mechanical design and finished product testing when combined with the design capabilities listed above allows API to offer full turnkey electronic design and manufacturing services to a wide range of industrial OEM markets. We are often able to quote projects involving fewer than 1000 units per year.

Absolute Process Instruments has designed and manufactured industrial electronics in a broad range of industries, including machinery manufacturers, automotive, aviation, dairy, and factory automation and control.

Please call us at 800-942-0315 to discuss your OEM project!



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api-usa.com

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ABSOLUTE PROCESS INSTRUMENTS, Inc.
1220 American Way Libertyville, IL 60048
Phone: 800-942-0315 Fax: 800-949-7502
For latest product information or to contact your local representative visit api-usa.com

DC Input: Signal Isolators, Splitters, Loop Isolators

DC Input: Math and Square Root Modules

DC Power Supplies

Frequency Input: Alarms, Frequency Input and Output Transmitters

Potentiometer Input: Alarms and Transmitters

Pressure: Cecomp Pressure Products

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ABSOLUTE PROCESS INSTRUMENTS, Inc.
1220 American Way Libertyville, IL 60048
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api-usa.com

Accuracy Class (ansi.org, ieee.org, iec.ch, iso.ch, nist.gov)

Error in an instrument or sensor is typically made up of several combined factors such as linearity, hysteresis, repeatability, temperature effects, etc. Standards organizations such as ANSI, IEC, IEEE, ISO, NIST have summarized accuracies for various types of products into numbered or lettered classes and defined the conditions under which these accuracy standards apply. Typical accuracy classes for current transformers are listed below.

Typical Application	Accuracy Class	Error at percent of rated current			
		5%	20%	100%	120%
Precision testing	0.1	±0.4%	±0.2%	±0.1%	±0.1%
High accuracy indication	0.2	±0.75%	±0.35%	±0.2%	±0.2%
Commercial and industrial metering	0.5	±1.5%	±1.5%	±0.5%	±0.5%
General purpose measurements	1	±3.0%	±3.0%	±1.0%	±1.0%
Approximate measurements	3	±3.0% at 50% rated current			±3.0%
	5	±5.0% at 50% rated current			±5.0%

CE newapproach.org

The CE (Conformite Europeenne) mark is an indication that a company has met the essential heath, safety and environmental requirements detailed in European Union directives covering an array of industrial and consumer products. Once a company has met these requirements, it can affix the CE mark to its products and sell them throughout the European Union.

CSA csa.ca

The Canadian Standards Association develops standards to enhance public safety, health, and the environment. CSA standards cover an array of industrial and consumer products, and are harmonized with North American and international requirements wherever practical. The "C" and "US" indicate compliance with both Canadian and U.S. requirements.

GL gl-group.com

Germanischer Lloyd approved for shipboard installations. GL is an independent, non-profit organization setting safety and quality standards for ships and marine equipment.

NEMA nema.org

The National Electrical Manufacturers Association (NEMA®) promotes standardization of electrical equipment, enabling consumers to select from a range of safe, effective, and compatible electrical products. See table below for housing classifications.

UL ul.com

Underwriters Laboratories Inc. (UL) is a product safety testing and certification organization covering an array of industrial and consumer products. Recognized Component Mark for Canada and the United States may be used on components certified by UL to both Canadian and U.S. requirements. Recognized Component Mark for the United States may be used on components certified by UL to U.S. requirements.

International Symbols for Electrical Equipment

Power Supply | Input | Output | Communications | Test Voltage kV (3.7) | Double Insulated

NEMA Enclosure Ratings nema.org

Type	Protection	Location	Description	IP*
1	General Purpose	Indoor	Accidental contact	IP 10
2	Drip-Proof	Indoor	Falling non-corrosive liquids and falling dirt	IP 11
3	Dust-tight Rain-tight	Outdoor	Windblown dust, water, and sleet; ice-resistant	IP 54
3R	Dust-tight Rain-tight	Outdoor	As above, plus melting sleet/ice will not damage external enclosure or mechanisms	IP 14
4	Water-tight Dust-tight	Indoor/Outdoor	Splashing water, outdoor seepage of water, falling or hose-directed water	IP 56
4X	Water-tight Dust-tight	Indoor	As above, plus corrosion resistant	IP 56
5	Dust-tight	Indoor	Dust and falling dirt	IP 52
6	Water-tight Dust-tight	Indoor/Outdoor	Temporary entry of water limited submersion, formation of ice on enclosure	IP 67
6P	Water-tight Dust-tight	Indoor/Outdoor	As above, plus prolonged submersion	IP 67
7	Explosion proof Class I Group D Hazardous Locations	Indoor	Hazardous chemicals and gases	n/a
9	Explosion proof Class II Hazardous Locations	Indoor	Hazardous dust	n/a
11	Drip-proof & Corrosion Resistant	Indoor	Oil immersion, corrosive effects of liquids and gases	n/a
12	Drip-tight Dust-tight	Indoor	Fibers, lint, dust, and splashing and dripping condensation of non-corrosive liquids	IP 52
13	Oil-tight Dust-tight	Indoor	Dust, spraying of water, oil, and non-corrosive coolant	IP 54

* NEMA and IEC test standards are different and IEC 529 does not specify protection against corrosion, rust, oil or coolants, thus a direct correlation between the standards cannot be made. IP ratings can not be correlated to NEMA ratings.

IP (Ingress Protection) Rating for Equipment and Enclosures iec.ch

IEC 60529 outlines the classification system for sealing effectiveness of electrical enclosures against the intrusion of foreign bodies (i.e. tools, dust, fingers) and moisture. This classification system utilizes the letters "IP" followed by two or three digits, for example, IP65.

Value	First Digit (Solids)	Second Digit (Liquids)	Third Digit (Impact)
0	No protection	No protection	No protection
1	Solid objects over 50mm e.g. hands, large tools.	Vertically falling drops of water.	0.225 joule impact (150 g @ 15 cm)
2	Solid objects over 12mm e.g. hands, large tools.	Direct sprays of water up to 15° from vertical.	0.375 joule impact (250 g @ 15 cm)
3	Solid objects over 2.5mm e.g. wire, small tools	Direct sprays of water up to 60° from vertical.	0.5 joule impact (250 g @ 20 cm)
4	Solid objects over 1.0mm e.g. wires.	Water sprayed from any direction. Limited ingress permitted.	
5	Limited protection against dust ingress (no harmful deposit)	Low pressure water jets from any direction. Limited ingress permitted.	2.0 joule impact (500 g @ 40 cm)
6	Totally protected against dust ingress.	High pressure water jets from any direction. Limited ingress permitted.	
7		Immersion between 15cm and 1M.	6.0 joule impact (1.5 Kg @ 40 cm)
8		Long periods of immersion under pressure.	
9			20 joule impact (5 Kg @ 40 cm)

Ex Mark, ATEX, and Intrinsic Safety

europa.eu.int, ptb.de, ul.com/hazloc

This is overview on intrinsic safety and is provided for reference only. The installation and maintenance of products in hazardous areas must be carried out by qualified personnel.

The low energy levels maintained by intrinsically safe circuits prohibit ignition of an explosive atmosphere. The electrical energy of the circuit in the hazardous area is restricted by current and voltage limiters. It is vital that these circuits and associated equipment be installed in accordance with the instructions provided.

These instructions state that the wiring must be routed in a separate raceway or segregated from all power and other circuit wiring (including intrinsically safe wiring, in some cases) to prevent ignition-capable currents and voltages from combining with the intrinsically safe circuits. If wiring is not correctly routed or segregated, a fire or explosion could occur.

The ATEX Directive is named after the French "ATmosphere EXplosible" Directive 94/9/EC which provides requirements for equipment intended for use in potentially explosive atmospheres. It covers electrical and mechanical equipment and protective systems, which may be used in potentially explosive atmospheres (flammable gases, vapors or dusts.)

Marking and Categorization According to EC Directive 94/9

Group **I** = Mining M1 = Must continue to operate in potentially explosive atmospheres.
M2 = Does not operate in potentially explosive atmospheres.

Group **II = All other applications**

Cat.	Zone	Ex atmosphere	Marking CE_{0102}	Safety
1	**0**	continuous/long periods Ex	II (1) G/D	with 2 faults
2	**1**	occasionally Ex	II (2) G/D	with 1 fault
3	**2**	seldom + short periods Ex	II (3) G/D	normal operation

CE The device fulfills the requirements of all applicable EU Directives including 94/9.

0102 Number of the notified body that performed the Ex audit (0102 = PTB, Germany).

Ex Ex symbol

II Group

(1) Category

(1_) Associated apparatus

G Gas (**D** = Dust)

Temperature Class T1 to T6 defines the maximum surface temperature at the typical ambient temperature of 40°C.
T1 = 450°C **T2** = 300°C **T3** = 200°C **T4** = 135°C **T5** = 100°C **T6** = 85°C

Summary of NEC® Class I, II, III Hazardous Locations nfpa.org

Explosion-proof: Enclosures or housings are designed to withstand internal explosions and prevent the spread of fire to the outside.
Intrinsically-safe: Systems designed in which electrical energy in the circuits is not present at levels that would ignite a flammable mixture of a gas and air.

CLASSES	GROUPS	DIVISION 1 (Normal Cond.)	DIVISION 2 (Abnormal Cond.)
I (Art. 501) Gases, vapors, liquids	**A**: Acetylene **B**: Hydrogen, etc. **C**: Ether, etc. **D**: Hydrocarbons, fuels, solvents, etc.	Normally explosive and hazardous	Not normally present in an explosive concentration (but may accidentally exist)
II (Art. 502) Dusts	**E**: Metal dusts (conductive* and explosive) **F**: Carbon dusts (some are conductive* and all are explosive) **G**: Flour, starch, grain, combustible plastic or chemical dust (explosive) * Electrically conductive dusts are dusts with a resistivity less than 105 ohm-centimeter.	Ignitable quantities of dust normally are or may be in suspension, or conductive dust may be present.	Dust not normally suspended in an ignitable concentration (but may accidentally exist). Dust layers are present.
III (Art. 503) Fibers and flyings	Textiles, wood-working, etc. (easily ignitable, but not likely to be explosive)	Handled or used in manufacturing	Stored or handled in storage (exclusive of manufacturing)

Ethernet ieee.com

Ethernet systems generally follow the IEEE 802.3 standards consisting of cabling guidelines, frame formats for header and footer fields to encapsulate data, and media access control (MAC) to preserve data integrity by regulating network traffic. The Ethernet protocol allows for linear bus, star, or tree topologies. Data can be transmitted via twisted pair, coaxial, fiber optic cable, or wireless devices.

Ethernet uses an access method called CSMA/CD (Carrier Sense Multiple Access/Collision Detection). This is a shared baseband system where devices take turns transmitting data only when the network is clear. Data collisions from simultaneous transmissions require a random wait time before attempting to retransmit but this does not seriously impair speed.

HART® & FSK hartcomm.org

The HART protocol uses the Bell 202 Frequency Shift Keying (FSK) standards to superimpose digital communication signals at a low level on top of an analog signal.

HART uses a master/slave protocol that communicates at a slow speed (1200 bits/sec) without interrupting the analog signal. The speed is fast enough to allow a host application to get two or more digital updates per second from a field device. The FSK signal, which varies between ±0.5 mA, is either 1200 or 2200 Hz. 1200 Hz represents a logical "1", and 2200 Hz a logical "0". The FSK signal is phase continuous so there is no interference with the 4-20 mA signal.

LONWORKS® echelon.com

LonWorks networks are used in building and home automation, industrial plants, transportation, and utility control. LonWorks technology is an open system with a peer-to-peer (P2P) architecture allowing direct communication between two devices without having to pass the signal through a master controller.

Devices in a LonWorks network communicate using the standardized language LonTalk® (ANSI/EIA 709.1). This allows the application program in a device to send and receive messages from other devices over the network without needing to know the topology of the network or the names, addresses, or functions of other devices. LonWorks networks can use media such as power lines, twisted pair, radio frequency, infrared, coaxial cable, and fiber optics.

MODBUS® RTU modbus.org

MODBUS network protocol is used in industrial manufacturing, building systems, infrastructure, transportation, and energy applications. MODBUS is used to monitor, program and link devices with sensors and instruments, monitor field devices using PCs and HMIs (Human Machine Interfaces), and for RTU (Remote Terminal Unit) applications.

MODBUS is an open standard using master-slave or client-server communications where each message or "frame" contains the address of the target slave, a command code, data needed to complete the desired command, and a checksum to ensure that the message is received intact. Connections often use a serial RS232 or RS485 cable. In MODBUS-RTU each eight bit byte in the message is sent as two four-bit hexadecimal characters providing greater data throughput at a given speed.

PROFIBUS® DP profibus.com

PROFIBUS is an open digital communication system widely used in factory and process automation. It is suitable for both fast, time-critical applications and complex communication tasks. The PROFIBUS communication standard is specified in IEC 61158 Type 3 and IEC 61784.

PROFIBUS offers three types of device integration technologies that allow different devices to communicate with the master and each other. A General Station Data (GSD) is an electronic data sheet used to identify the communications characteristics of a connected device. An Electronic Device Description (EDD) is used to describe device parameters and applications.

A Field Device Tool (FDT) is used to describe device parameters, applications and software Device Type Management (DTM) functions. These technologies are implemented as required depending on the complexity of the device function.

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Terms and Definitions

Accuracy: The closeness of an indication or reading of a measurement device to the actual value of the quantity being measured. Accuracy calculations are based on the linearity, hysteresis, and repeatability characteristics of the transducer/sensor and supporting electronics, the range of the transducer/sensor, as well as the resolution being displayed. It is usually expressed as a ±% of full scale output of the transducer/sensor/system.

A/D (Analog to Digital): Conversion of a continuously varying signal (analog) to discrete binary numbered values (digital).

Alarm Condition: The input (process signal) has crossed the set (trip) point and the relay has changed states into the alarm condition. The relay will remain in this state until the input signal returns to the normal condition.

Background Noise: The total amount of noise from all sources of interference in a process loop, independent of the presence of a data/control signal.

CAN (Controller Area Network): Developed by Bosch as a high speed industrial control network, but it adopted by the automotive industry for in-vehicle use. It will be mandatory on all cars by 2008. Computerization of vehicles has shifted from one engine management computer to the CAN distributed system with many interoperable computers, each having its own area of responsibility.

Chatter: Describes a condition where the input signal hovers near the set (trip) point, causing the relay to trip off, then back on in short bursts. Generally solved by adding or expanding the deadband.

Clipping: A phenomena that occurs when an output signal is limited in some way (usually in amplitude) by the full range of an amplifier/unit.

Common-Mode Rejection (CMR): The ability of a device to eliminate the effect of AC or DC noise between the input signal and ground. Normally expressed in dB at DC to 60 Hz.

D/A (Digital to Analog): Conversion of a discrete binary numbered values (digital) to a continuously varying signal (analog).

Deadband: The range through which an input can be varied without initiating an observable response. Deadband is usually expressed in percent of span.

Dual Alarm Trip: A unit that accepts one input signal, has two set (trip) points, and one output relay per set point. Each set point is independent of the other and can be set between 0-100% of the input range.

Electrical Interference: Electrical noise induced upon the signal wires that obscures (interferes with) the wanted information signal.

Gain: The amount of amplification used in an electrical circuit.

High Alarm: The relay changes state when the input signal reaches or exceeds the set (trip) point.

Hysteresis: The difference in output from a transducer/sensor when a measured value is first approached with increasing and then decreasing values.

Input Impedance: The total opposition, both resistive and reactive, that the unit presents to the input signal loop.

Linearity: The closeness of a calibration curve to a specified straight line. Linearity is expressed as the maximum absolute deviation of any calibration point on a specified straight line during any one calibration cycle.

Loop Resistance: The total resistance in a circuit to current flow caused by the resistance of all components.

Loop Impedance: The total opposition (resistive plus reactive) to current flow in a circuit.

Low Alarm: The relay changes state when the input signal falls to or below the set (trip) point

MOV (Metal Oxide Varistor): A voltage dependent resistor whose resistance predictably changes with voltage, often used as transient protectors.

Negative Temperature Coefficient: A decrease in resistance with an increase in temperature.

Noise: An unwanted electrical signal on any signal wires.

Normal Acting Alarm: Relay coil is energized when the input signal is in the normal operating condition. In the alarm condition, the relay coil de-energizes. In the event of a loss of power to the relay coil, the unit goes to an alarm condition.

Reverse Acting Alarm: Relay coil is de-energized when the input signal is in the normal condition. In the alarm condition, the relay coil energizes. There is no alarm when there is a loss of power.

Normal (Non-Alarm) Condition: The process signal has not crossed the set (trip) point.

Normally Closed: Describes a set of relay contacts that, in the unpowered state, have continuity across them.

Normally Open: Describes a set of relay contacts that, in the unpowered state, have no continuity across them.

Optical Isolation: Two circuits that are connected only through an LED transmitter and photoelectric receiver with no electrical continuity between them.

Positive Temperature Coefficient: An increase in resistance with an increase in temperature.

Relay (Mechanical): An electromechanical device that completes or interrupts a circuit by physically moving electrical contacts.

Relay (Solid State): A solid state switching device that completes or interrupts a circuit electrically with no moving parts. Commonly called an SSR.

Repeatability: The ability of a transducer/sensor to reproduce output readings when the same measured value is applied to it consecutively.

Reset: The action of returning to the normal (non-alarm) condition.

Resistance: Opposition to current flow offered by a purely resistive component, measured in ohms.

Response Time: The time required by a sensor to reach 63.2% of its final value in response to a step-change input. This is typically called "one time constant". Five time constants are required for the sensor to approach 100% of the step change value.

Root Mean Square (RMS): Square root of the mean of the square of the signal taken during one full cycle.

Sensitivity: The minimum change in input signal to which an instrument/sensor can respond.

Set Point: The point at which an alarm/controller is set to control a system.

Single Alarm Trip: A unit that accepts one input signal, has one set (trip) point, and one output relay. The set point can be set between 0-100% of the input range.

Span: The difference between the upper and lower limits of a range expressed in the same units as the range.

Span Adjustment: The ability to adjust the gain of a sensor/unit so that the output signal corresponds to the maximum input signal. The adjustment range is normally expressed in counts or percentage.

Transducer: A device that converts energy from one form to another. This term is generally applied to devices that take physical phenomenon (pressure, temperature, humidity, flow, etc.) and convert it to an electrical signal.

Triac: A solid state switching device used to control alternating current.

Trip Point: Value at which the alarm relays change to the alarm condition.

True RMS: The true root-mean-square value of an AC or AC-plus-DC signal, for a perfect sine wave the RMS value is 1.11072 times the rectified average value. This value is often used to determine the power of a signal. For significantly non-sinusoidal signals a true RMS converter is required.

Volt: The unit of potential difference and electromotive force. One volt will send a current of one ampere through a resistance of one ohm.

Voltage: The electrical potential difference that exists between two points and is capable of producing a flow of current when a closed circuit is connected between the two points.

Zero Adjustment: The ability to adjust the output from a sensor/unit so that the minimum output corresponds to the minimum input. The adjustment range is normally expressed in counts or percentage.

Ohm's Law

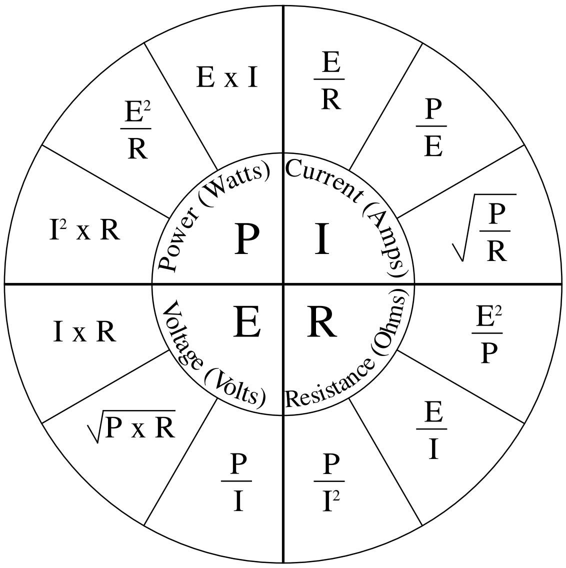
E = I x R

OHM'S LAW is the relationship between current, voltage and resistance. It states that current varies directly with voltage and inversely with resistance.

E (Electromotive Force or Voltage) is the electrical potential that exists between two points and is capable of producing a flow of current when a closed circuit is connected between the two points. The unit of measure for voltage is the volt (V). One volt will send one ampere of current through a resistance of one ohm.

I (current) is the flow of electrons past a point in a specified period of time, usually one second. The unit of measure for current is the ampere (A). One ampere of current is 6.24 x 10^{18} electrons passing a point in one second. Ampere is often shortened to amp.

R (resistance) is the opposition to current flow offered by a resistive component. The unit of measure for resistance is the ohm. One ohm is the resistance through which a current of one ampere will flow when a voltage of one volt is applied.



AWG	Dia. in.	Dia. mm	Ohms per 1000 ft 0°C	Ohms per 1000 ft 20°C	Ohms per 1000 ft 50°C	AWG	Dia. in.	Dia mm	Ohms per 1000 ft 0°C	Ohms per 1000 ft 20°C	Ohms per 1000 ft 50°C
10	0.1019	2.588	0.92 Ω	0.99 Ω	1.12 Ω	**22**	0.0254	0.6451	14.87 Ω	16.14 Ω	18.05 Ω
12	0.0808	2.052	1.46 Ω	1.59 Ω	1.78 Ω	**24**	0.0201	0.5105	23.65 Ω	25.67 Ω	28.70 Ω
14	0.0641	1.628	2.33 Ω	2.53 Ω	2.82 Ω	**26**	0.0159	0.4038	37.61 Ω	40.81 Ω	45.63 Ω
16	0.0508	1.290	3.70 Ω	4.02 Ω	4.49 Ω	**28**	0.0126	0.3200	59.80 Ω	64.90 Ω	72.55 Ω
18	0.0403	1.023	5.88 Ω	6.39 Ω	7.14 Ω	**30**	0.0100	0.2540	95.10 Ω	103.20 Ω	115.40 Ω
20	0.0320	0.812	9.36 Ω	10.15 Ω	11.35 Ω	**32**	0.0080	0.2032	151.20 Ω	164.10 Ω	183.40 Ω

Resistance may vary ±10% or more depending on impurities, alloys, coatings, state of annealing, etc. Always check wire manufacturer's specifications.

The **Celsius** scale (°C), sometimes referred to as the "centigrade" scale, was devised by Swedish astronomer Andres Celsius (1701-1744) for scientific purposes. It has 100 degrees between the freezing point of 0°C and boiling point of 100 °C of pure water at a standard air pressure of 29.92 inches of mercury. The term Celsius was adopted in 1948 by an international conference on weights and measures to replace the term centigrade. This is the most widely used temperature scale in the world.

The **Fahrenheit** scale (°F) is used primarily in the United States. The freezing point of water is 32°F and the boiling point is 212°F while measured at a standard air pressure of 29.92 inches of mercury. 0°F was the coldest temperature Dr. Gabriel Daniel Fahrenheit (1686-1736) could create with a mixture of ice and salt. He is credited with the invention of the mercury thermometer introducing it and the °F scale in 1714. His thermometer was based on a design by Galileo.

The absolute or **kelvin** (K) scale is used primarily for scientific work. It was invented by William Thomson, also know as Lord Kelvin. The hypothetical temperature characterized by a complete absence of heat energy and the point at which molecular motion would theoretically stop is –273.15°C or "absolute zero". The kelvin scale uses this number as 0 K with divisions being the same as the Celsius scale. Temperatures on this scale are called kelvins, thus the degree symbol is not used with the capital "K" symbol, nor is the word kelvin capitalized when referring to the temperature units.

The **Réaumur** scale was created by R A F de Réaumur (1683-1757). He used the freezing point of water as 0°Re and the boiling point at 80°Re. It was used in the 18th and 19th centuries mainly in France for scientific work, but is still used today by some European wine and cheese makers.

W J M **Rankine** (1820-1872) created this scale, which was merely the kelvin scale using the Fahrenheit degree instead of the Celsius. It has been used in some scientific and thermodynamics work but is not commonly used today.

From	To	Formula
Fahrenheit	Celsius	°C = (°F – 32) / 1.8
Fahrenheit	kelvin	K = (°F + 459.67) / 1.8
Fahrenheit	Rankine	°Ra = °F + 459.67
Fahrenheit	Réaumur	°R = (°F – 32) / 2.25
Celsius	Fahrenheit	°F = °C × 1.8 + 32
Celsius	kelvin	K = °C + 273.15
Celsius	Rankine	°Ra = °C × 1.8 + 32 + 459.67
Celsius	Réaumur	°R = °C × 0.8
kelvin	Celsius	°C = K – 273.15
kelvin	Fahrenheit	°F = K × 1.8 – 459.67
kelvin	Rankine	°Ra = K × 1.8
kelvin	Réaumur	°R = (K – 273.15) × 0.8
Rankine	Celsius	°C = (°Ra – 32 – 459.67) / 1.8
Rankine	Fahrenheit	°F = °Ra – 459.67
Rankine	kelvin	K = °Ra / 1.8
Rankine	Réaumur	°R = (°Ra – 459.67 – 32) / 2.25
Réaumur	Celsius	°C = °R × 1.25
Réaumur	Fahrenheit	°F = °R × 2.25 + 32
Réaumur	kelvin	K = °R × 1.25 + 273.15
Réaumur	Rankine	°Ra = °R × 2.25 + 32 + 459.67

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Frequently Asked Questions

1. **Do you recommend protecting the module's 115 VAC power input with a fuse?**
It is not required, but a ½ Amp Fast Blow fuse can be used for each module.

2. **We are using many different types of your signal conditioners and wish to protect the inputs and outputs from short circuits and over voltage. How can we achieve this?**
Applying a short circuit to any of the signal input terminals will not affect the modules. Exposing the signal input to high voltage will damage the unit but using a zener diode, due to its resistance value, will cause the input range to need recalibrating. Try a Varistor or TransZorb®. Do NOT under any circumstances short circuit the signal output, the unit can be damaged.

3. **Which direction do we turn the deadband potentiometer screw to give the minimum and the maximum deadband?**
For the minimum amount (1%), turn the potentiometer screw CCW, counterclockwise. For the maximum amount (100%), turn the potentiometer screw CW, clockwise.

4. **We have a 4-20 mA input and require 4 set points at the output. Do you have a product for this?**
Yes, you can connect 2 of our **API 1020 G** units in series in the 4-20 mA input loop since the input impedance for current is 50 Ω and the drop is very low.

5. **We are running a 4-20 mA signal between a chart recorder and a DCS over a distance of 5000 feet (10,000 total loop). Can we use your isolator signal conditioner for this?**
Yes, however you must select the proper gauge wire to reduce the impedance of the system

total load = impedance of the instrument + impedance of the wire

For a 4-20 mA loop, our compliance voltage is 20 V which allows a total of 1000 Ω load. Also, to prevent problems from noise, it is recommended that you use shielded, twisted pair wires.

6. **For modules with a 4-20 mA output signal, what are the minimum and maximum output load resistance?**
For the units with a 20 V compliance, the output range is 10 to 1000 ohms. For the units with a 12 V compliance, the output range is 10 to 600 ohms.

7. **For the DC output models, what are the output impedances in the voltage and current mode?**
The DC outputs are FET driven and are active outputs that change depending on the mode and range.

DC output with 12 V Compliance

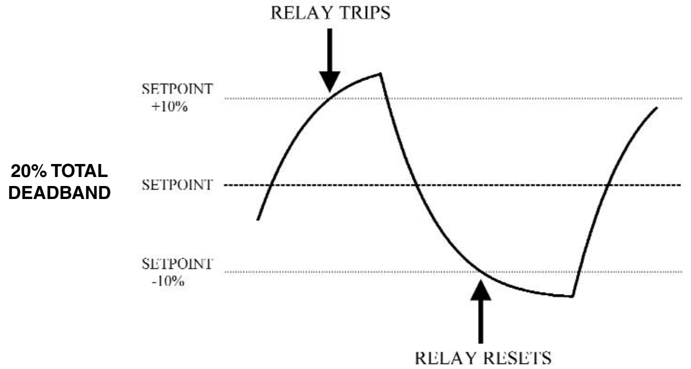
CURRENT Mode	VOLTAGE Mode
less than 600 ohms	greater than 1000 ohms

DC output with 20 V Compliance

CURRENT Mode	VOLTAGE Mode
less than 1000 ohms	greater than 1000 ohms

8. **What is Deadband?**
Deadband is the range through which an input can be varied without initiating an observable response. Deadband is usually expressed in percent of span.

EXAMPLE: A 20% total deadband is applied to the setpoint of a monitored parameter. The relay will trip and reset to its untripped state as indicated in the following graph.



9. **What are your alarm output relay contacts rated for when using a motor load?**
For inductive loads, our relay contacts are rated for 3.5 Amps Inductive at 250 VAC or 30 VDC.

10. **What is a Ground Loop?**
In a process control loop, a ground loop circuit can develop when each device's ground is tied to a different earth potential thereby allowing current to flow between the grounds by way of the process loop (Figure 1).

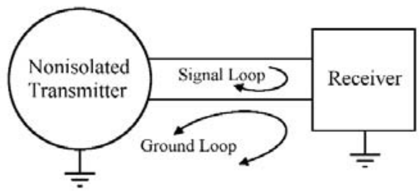


Figure 1. *Ground loops may develop with non-isolated transmitters and receivers, resulting in inaccuracy and unreliability.*

Ground loops cause problems by adding or subtracting current or voltage from the process loop. The receiving device can't differentiate between wanted and unwanted signals and this leads to erroneous signals.

The probability of multiple grounds and ground loops being established is especially high when new equipment such as PLCs or DCSs are installed. With many devices referenced to ground, the likelihood of establishing more than one ground point is great. If an instrumentation system seems to be acting erratically, and the problem seems to point toward ground loops, the chore of eliminating all unintended ground connections becomes overwhelming.

Keep in mind that eliminating ground loops just isn't feasible for some instruments, such as thermocouples and some analyzers, because they require a ground to obtain accurate measurements. In addition, some instruments must be grounded to ensure personnel safety.

When ground loops can't be eliminated, the solution lies in the use of signal isolators. These devices break the galvanic path (DC continuity) between grounds while allowing the analog signal to continue throughout the loop. An isolator also can eliminate the electrical noise of AC continuity (common mode voltage).

Signal isolators use numerous techniques to achieve their function but the best signal isolators usually employ optical isolators (Figure 2). Regardless of the isolation method used, the isolator must provide three-way isolation (input, output, and power). If this is not provided, then an additional ground loop can develop between the isolator's power supply and the process input and/or output signal.

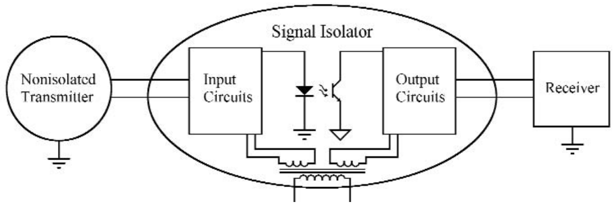


Figure 2. *A signal isolator in the process loop blocks ground current to restore signal accuracy and reliability.*

Signal Conditioners

While there are many different types of signal conditioners, their basic function is to change or alter signals so that different process devices can communicate with each other accurately. Signal conditioners are most commonly needed to link temperature, pressure, weighing, level, and flow devices with indicators, recorders, and computerized process monitoring and control systems. Signal conditioners can also perform some other tasks for you as listed below.

SIGNAL CONVERSION

A signal conditioner can change an analog signal from one form to another allowing equipment with dissimilar signals to communicate. For instance, if a piece of field equipment puts out a 4-20 mA signal and the control system needs a ±10 V input signal, the signal from the field equipment must be converted. A signal conditioner that accepts a 4-20 mA input and produces a ±10 V output solves the problem.

SIGNAL BOOSTING

The signal conditioner increases load drive capability in the loop allowing installation of additional instruments. This works because the input impedance of most isolators is much less the load drive capability of a loop. Therefore adding an isolator to the loop boosts the loop's net load drive capability. This is especially useful when it becomes necessary to add additional devices to an existing overloaded loop.

SIGNAL ALARMING

Warns of trouble if a process signal reaches a too high or too low level. A signal conditioner that accepts an analog signal (4-20 mA, 1-5 V, etc.) and produces a relay output is an inexpensive way of providing a redundant safety device in the event of a system failure.

SIGNAL ISOLATION

Stops ground loops from affecting the accuracy of a process signal. Ground loops are a common complaint at system startup and can be eliminated by installing isolated signal conditioners, or isolators, on the process loop between a non-isolated device and a control system.

SPECIFYING

A signal conditioner requires much of the same information as specifying any other instrument. Always consider these elements:

- ❑ Power Source
- ❑ Input Signal
- ❑ Output Signal
- ❑ Desired Options

Electrical interference, or noise, is an unwanted electrical signal that can cause intolerable error in, or complete disablement of an electronic control or measurement systems. Interference or electrical noise is broken down into two somewhat overlapping categories:

Radio Frequency Interference (RFI)

Electromagnetic Interference (EMI).

The effects of Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI) can cause unpredictable and non-repeatable degradation of instrument performance and accuracy, and even complete instrument failure. This can result in reduced process efficiency and production, plant shutdowns, and sometimes dangerous safety hazards.

There are two basic approaches to protecting and electronic system from the harmful effects of radio frequency and electromagnetic interference. The first is to keep the interference from entering the system or instrument using special shielding, designs and terminal filters. The second is to design the system or instruments circuitry so that it is inherently immune to RFI/EMI.

Some of the more commonly encountered sources of interference are:

- ❑ Radio, television and hand-held transmitters (walkie-talkies)
- ❑ Cellular telephones
- ❑ Fluorescent lights
- ❑ Radar
- ❑ Weather related electrical discharges such as lightning
- ❑ Static discharges
- ❑ Induction heating systems
- ❑ High speed power switching elements such as SCRs and thyristors
- ❑ High AC current conductors
- ❑ Large solenoids or relays
- ❑ Transformers
- ❑ AC or DC motors
- ❑ Ultrasonic cleaning or ultrasonic welding equipment
- ❑ Welding equipment
- ❑ Vehicle ignition systems

When using Api alarm module relays to switch inductive loads, maximum relay life and transient EMI suppression is achieved by using external protection. All external protection devices should be placed directly across the load and all leads lengths should be kept to a minimum length.

For AC inductive loads (see Figure 1), place a properly rated MOV across the load in parallel with a series RC snubber. A good RC snubber consists of a 0.1 µF polypropylene capacitor of sufficient voltage and a 47 ohm ½ Watt carbon film resistor.

For DC inductive loads (see Figure 2), place a diode across the load (1N4006 recommended) being sure to observe proper polarity. Use of an RC snubber is an optional enhancement.

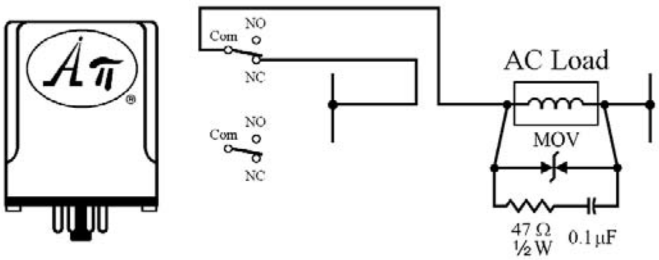


Figure 1: AC inductive loads.

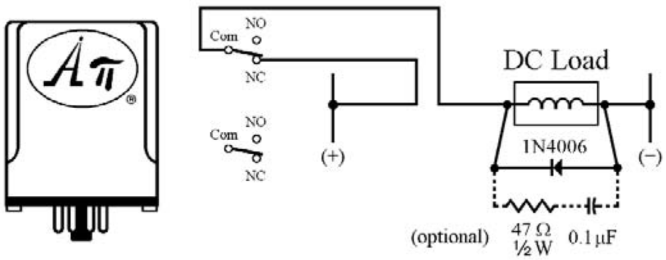


Figure 2: DC inductive loads.

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Single Ended vs. Differential, Sink vs. Source, EXTSUP Option

When connecting analog current (such as 4-20 mA) signals to a PLC, data acquisition system or measuring instrument, you can often choose between single-ended or differential inputs. When using transmitters and signal conditioners you must choose between sinking or sourcing I/O. What is the difference between these and which should you use?

It is important to keep three things in mind:

POWER Which device is providing power to the loop?

SIGNAL What is the signal path? It must be connected correctly and be the right type of signal for the circuit to operate.

GROUND Where are the ground connections? Is there a potential for a ground loop?

An Api signal conditioner can provide solutions to the above issues. It can power a loop, or be passive, convert incompatible signals and provide isolation to break ground loops.

Single-Ended Inputs

Typically used with a two-wire transmitter, one wire is connected to a power source and the other wires from each signal source are connected to the PLC or receiving device. This assumes the sensor ground and the PLC or measuring device ground have the same value. In reality, earth ground can vary in different locations. These potential differences create current paths or ground loops leading to measurement errors. The errors generally increase as distance between earth grounds increase and with the presence of other electrical equipment in the vicinity.

Single ended inputs are also susceptible to radiated electrical noise, since the single wires pick up stray EMI and superimpose it on the signal.

Differential Inputs

Two signal wires run from each signal source to the PLC or receiving device. One goes to the + input and one to the – input. This allows the PLC or receiving device to measure each of the wires in reference to its own ground, eliminating grounding differential errors. Noise immunity is improved since the pair of wires pick up interference equally.

When using differential inputs, the sensor may “float” or have no ground connection. It may be preferable to connect the negative (–) signal wire to the PLC terminal marked 0V, REF or GND.

Sink vs. Source

When connecting various current inputs and outputs it is important to keep in mind what device is powering the circuit. Inputs and outputs can either “sink” current or “source” current. A 2-wire transmitter is a passive device and thus “sinks” current. A 4-wire transmitter operates on an external power source and thus “sources” or provides power to the circuit.

Sinking Input The device receiving the signal does not provide power. It acts as a resistive load It must be connected to device that sources its output signal, or a to sinking output with a loop power supply in the circuit.

Sourcing Input The device receiving the signal provides power for the input signal. It must be connected to sinking output, such as a 2-wire transmitter which uses the power from the receiving device.

Sinking Output The device’s output signal does not provide power. It must be connected to a device that provides power for the output signal, or a sinking input with a loop power supply in the circuit.

Sourcing Output The device’s output signal powers the output circuit. It must be connected to a receiving device that provides no power and acts as a resistive load, such as a 2-wire passive transmitter

Note that sinking-sourcing and sourcing-sinking pairing is always used, and never sourcing-sourcing or sinking-sinking.

EXTSUP (External Supply) Option

The Api EXTSUP option provides a sinking or unpowered signal conditioner current output. It is required due to the fact that PLC analog input cards can either be configured to accept differential (individual common) inputs or single-ended (one common) inputs.

A PLC often has an input power supply, or one installed in the panel, as the power source for the inputs. Due to differences in ground potential between differential inputs and single-ended inputs, they cannot be intermixed on the same PLC analog input card. Doing so may cause input signal errors or possible PLC shutdown. Use of the EXTSUP option is required to provide a sinking output for the signal conditioner to be compatible with the PLC’s single ended inputs.

Active Power (Watt): Sometime called Real Power, True Power or Effective power. It describes the actual amount of power present in a system in watts (W) and the symbol is P. In a simple resistive circuit, the voltage and current are in phase and the active power is equal to the apparent power.

Ambient Temperature: The temperature of the air, water, or surrounding earth.

Ampacity: The current-carrying capacity of conductors or equipment, expressed in amperes.

Ampere (A) or amp: The basic SI unit measuring the quantity of electricity. The unit for electric current or the flow of electrons. One amp is 1 coulomb passing in one second. One amp is produced by an electric force of 1 volt acting across a resistance of 1 ohm.

Ampere-hour (Ah): Quantity of electricity or measure of charge. (1 Ah = 3600 Coulomb)

Apparent power (VA): Used to describe the useful or working power in a system. It is measured in VA volt-amperes (not watts). The symbol is S. It is used to describe the resultant power due to the phase separation between the voltage and current. In an alternating current circuit, both the current and voltage are sinusoidal. The Apparent Power is the useful power in the system by taking into account the Power Factor.

Ground: A large conducting body (such as the earth) used as a common return for an electric circuit and as an arbitrary zero of potential.

Impedance: The total opposition that a circuit offers to the flow of alternating current or any other varying current at a particular frequency.

Inductive reactance: Electrical current produces heat and/or a magnetic field (such as in the windings of a motor). The tendency for current flow and changes in flow to be influenced by magnetic fields is inductance. An AC circuit that contains only inductance, capacitance, or a combination of the two is defined by the total opposition to current flow expressed in reactance. Inductance only affects current flow when the current is changing. Inductance produces a self-induced voltage (called a counter EMF) that opposes changes in current. Obviously, the current changes constantly in an AC circuit. Inductance in an AC circuit, therefore causes a continual opposition to current flow is called inductive reactance.

Power Factor (PF): Power factor is the ratio of the Active Power to the Apparent Power factor. It is a number between 0 and 1 and is used to determine how efficient a power system is. It is determined by the type of loads connected to the power system. For a purely resistive load, the power factor will be 1, and only real power will flow. Inductive loads such as transformers and motors absorb reactive power. Capacitive loads such as capacitor banks or long cables generate reactive power.

Reactive Power (VAR): Reactive power is described as the amount of power required to overcome the phase shift between the current and voltage due to inductive and capacitive effects. It is measured in reactive volt-ampere's (VAr) and the symbol is Q. It is desirable to keep Reactive Power to a minimum.

Kilowatt-hour (kWh): One thousand watts acting over a period of 1 hour. The kWh is a unit of energy. 1 kWh=3600 kJ.

Ohm: The derived SI unit for electrical resistance or impedance; one ohm equals one volt per ampere.

Total harmonic distortion (THD): The measure of closeness in shape between a waveform and its fundamental component.

Volt (V): A unit of measure of the force given the electrons in an electric circuit. One volt produces one ampere of current when acting on a resistance of one ohm.

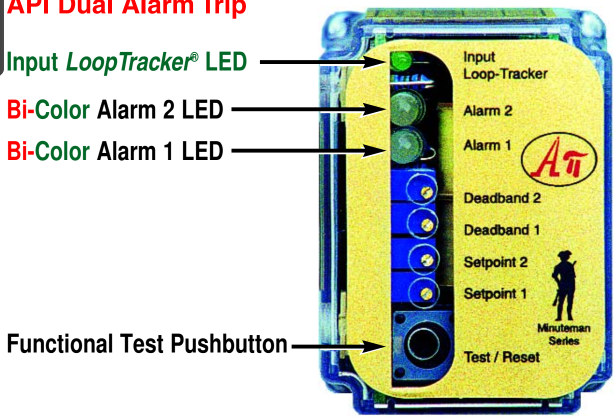
Voltage Drop: The loss of voltage between the input to a device and the output from a device due to the internal impedance or resistance of the device. In all electrical systems, the conductors should be sized so that the voltage drop never exceeds 3% for power, heating, and lighting loads or combinations of these. Furthermore, the maximum total voltage drop for conductors for feeders and branch circuits combined should never exceed 5%.

Watt (W): The unit of electric power, or amount of work (J), done in a unit of time. One ampere of current flowing at a potential of one volt produces one watt of power.

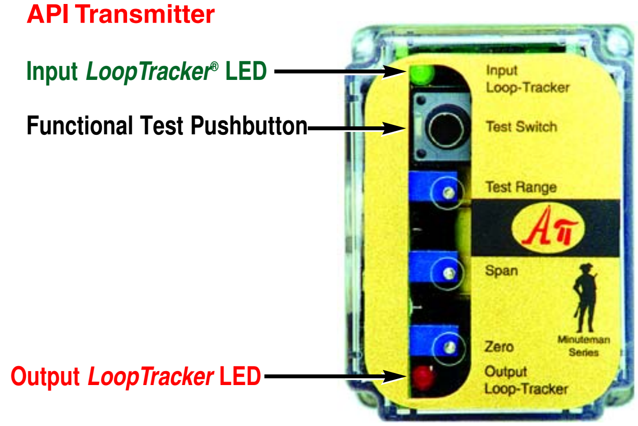
Watt-hour (Wh): One watt acting over a period of 1 hour. The Wh is a unit of energy. 1 Wh=3.600 kJ.

API Standard Features

API Dual Alarm Trip



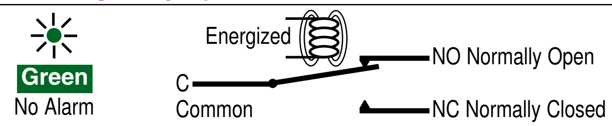
API Transmitter



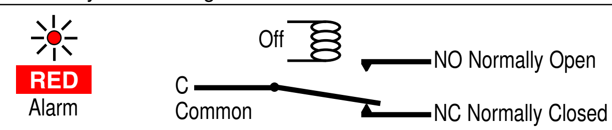
API Bi-Color Alarm LEDs

The API alarm family provides alarm status indication via a bi-color LED for each setpoint. The LED indicates **green** for a non-alarm condition and **red** for an alarm condition whether or not the unit is configured for normal acting or reverse acting.

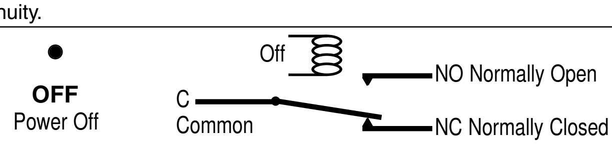
Normal Acting Relay Operation



In the normal (fail-safe) mode the LED will indicate **green** for a non-alarm condition. The relay coil is energized and the "C" & "NO" contacts have continuity.

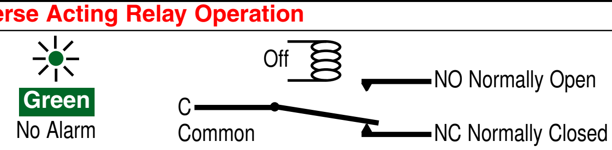


When the process signal crosses the setpoint, the LED will indicate **red** for an alarm condition. The relay coil de-energizes and the "C" and "NC" contacts have continuity.

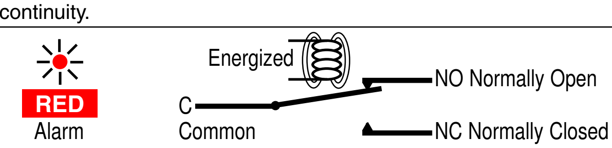


Should the alarm lose power in the normal acting mode, the coil will de-energize and go to an alarm condition.

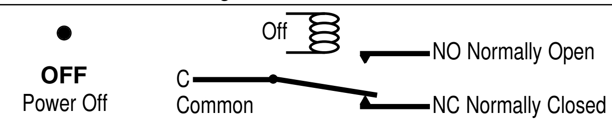
Reverse Acting Relay Operation



In the reverse acting mode of operation the LED will indicate **green** for a non-alarm condition. The relay coil is de-energized and the "C" and "NC" contacts have continuity.

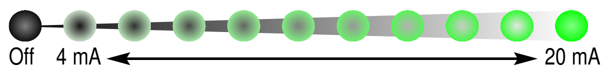


When the process signal crosses the setpoint, the LED will indicate **red** for an alarm condition. The coil energizes and the "C" & "NO" contacts have continuity.

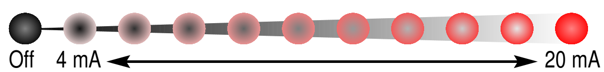


Should the alarm lose power in the reverse mode the coil will de-energize and fail to a non-alarm condition.

API LoopTracker Diagnostic Tool



Input *LoopTracker*® LED



Output *LoopTracker* LED

The API *LoopTracker* LEDs indicate the level of the input and/or output signal by varying its intensity. As the process signal increases, the brightness of the LED increases, and as the signal decreases the LED brightness decreases.

Should a problem develop in the loop, such as a faulty device in the loop causing an incomplete path for current, the *LoopTracker* detects this and ceases to illuminate. This function works on both the input and output loop allowing the technician to diagnose the cause of the problem quickly and efficiently therefore minimizing system down time.

API Functional Test Pushbutton

Transmitter Output Test

The Functional Test Pushbutton will, when pressed, output a test signal independent of the input signal. This signal is adjustable from 0-100% of span by holding the Test button down and adjusting the Test potentiometer on the unit. On some models the test signal is fixed at 50% of output span.

This feature allows the technician to temporarily inject a test or preset calibration signal into the output loop without manipulating the input signal. This signal can be used to check loop status, downstream display operation, downstream alarm operation, etc.

Alarm Function Test

Pressing the Functional Test Pushbutton will switch the relay(s) and bi-color LED(s) to the opposite state regardless of the input signal level. When released, the module will return to its normal operating state.

With the latching alarm mode or option, pressing the Test button allows the latched alarm to be reset, provided the alarm condition no longer exists for that setpoint.

The functional test button not only allows the technician to test the relays, but also the operation of the device the relays are controlling. For example, an API 1000 G is used as a high level alarm to prevent the overflow of a wastewater tank. The relay is wired to a pump which, when a high level is detected, turns on and pumps the wastewater to an overflow tank. Since over-filling the tank to test the pump is impractical, the technician simply has to depress the Test button and check the operation of the pump.

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LIFETIME WARRANTY

■ Standard
✻ Optional
▲ Approvals Pending

Input	Output	Model	Field Rangeable	Input Loop Tracker® LED	Loop Power Supply for Input	Output Loop Tracker LED	Functional Test Pushbutton	Isolated, Linearized Output	Non-Isolated Output	Zero & Span Potentiometers	240 VAC/7 A Resistive Contacts	Bi-Color Green/Red Alarm LED	Deadband Potentiometer	120/240 VAC Power	85-265 VAC 48-300 VDC Power	9-30 VDC Power	10-30 VAC Power	Loop Powered	Noise Immunity Filtering	100 dB Common Mode Rejection	UL, CUL Approvals	Free Factory Setup
DC	1 Relay	Api 1000 G		■			■				■	■	■	■		✻	✻		■	■	■	■
DC	1 Relay	Api 1005 G		■	■		■				■	■	■	■		✻	✻		■	■	■	■
DC	2 Relay	Api 1020 G		■			■				■	■	✻	■		✻	✻		■	■	■	■
DC	2 Relays	Api 1025 G		■	■		■				■	■	✻	■		✻	✻		■	■	■	■
DC	1 Relay & DC	Api 1040 G		■	■		■		■	■	■	■	■	■		✻	✻		■	■	■	■
DC	1 Relay & DC	Api 1040 G SPR		■	■		■		■	■	■	■	■	■		✻	✻		■	■	■	■
DC	1 Relay	Api 1080 G	■	■	■		■				■	■	■	■		✻	✻		■	■	■	■
DC	1 Relay	Api 1080 DIN	■	■	■		■				■	■	■		■				■	■	▲	■
DC	2 Relays	Api 1090 G	■	■	■		■				■	■	■	■		✻	✻		■	■	■	■
DC	2 Relays	Api 1090 DIN	■	■	■		■				■	■	■		■				■	■	▲	■
DC	2 Relays	Api 1090 DD	■	■	■		■				■	■	■			■	✻		■	■	▲	■
DC	DC	Api 4300 DIN		■	■	■	■	■		■				■	■				■	■	■	■
DC	DC	API 4300 DD		■	■	■	■	■		■				■		■	■		■	■	■	■
DC	DC	Api 4300 G		■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api 4300 G HC		■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api 4300 G M01		■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api 4300 G M09		■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api 4300 G EXTSUP		■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api 4310 G		■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api 4380 G	■	■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api 4380 G DF	■	■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api 4380 G HV3	■	■		■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api 4380 DIN	■	■	■	■	■	■		■					■				■	■	▲	■
DC	DC	Api 4380 DD	■	■	■	■	■	■		■						■	✻		■	■	▲	■
DC	DC	Api 4385 G	■	■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	DC	Api DPI-HV-DC	■	■		■	■	■		■				■					■	■	■	■
2 DC	2 DC	Api 2000 DIN Series		■	■	■	■	■		■					■				■	■	▲	■
2 DC	2 DC	Api 2000 DD Series		■	■	■	■	■		■						■	■		■	■	▲	■
2 DC	2 DC	Api 4390, 4391, 4392		■	✻	■	■	■		■				■		✻	✻		■	■	▲	■
DC	2 DC	Api 4393 DIN		■		■	■	■		■				■		✻	✻		■	■	▲	■
DC	2 DC	Api 4393 L1 DIN		■	■	■	■	■		■				■					■	■	▲	■
DC	DC	Api LPI-1				■	■	■		■								■	■			■
2 DC	2 DC	Api LPI-2				■	■	■		■								■	■			■
2 DC	2 DC	Api DPI-2				■	■	■		■								■	■			■
115/230 VAC	DC Volts	Api 9046-xx				■								■					■			■
115/230 VAC	DC Volts	Api 9046-CH				■								■					■			■
T/C	1 Relay	Api 1200 G		■			■				■	■	■	■		✻	✻		■	■	■	■
T/C	2 Relays	Api 1220 G		■			■				■	■	✻	■		✻	✻		■	■	■	■
T/C	DC	Api 4130 G L		■		■	■	■		■				■		✻	✻		■	■	■	■

Signal Conditioner Comparison

LIFETIME WARRANTY

■ Standard
✻ Optional
▲ Approvals Pending

Input	Output	Model	Field Rangeable	Input Loop Tracker LED	Loop Power Supply for Input	Output Loop Tracker LED	Functional Test Pushbutton	Isolated Linearized Output	Non-Isolated Output	Zero & Span Potentiometers	240 VAC/7 A Resistive Contact	Bi-Color Green/Red Alarm LED	Deadband Potentiometer	120/240 VAC Power	85-265 VAC 48-300 VDC Power	9-30 VDC Power	10-30 VAC Power	Loop Powered	Noise Immunity Filtering	100 dB Common Mode Rejection	UL, CUL Approvals	Free Factory Calibration
RTD	1 Relay	**Api 1400 G**		■			■				■	■	■	■		✻	✻		■	■	■	■
RTD	2 Relays	**Api 1420 G**		■			■				■	■	✻	■		✻	✻		■	■	■	■
RTD	DC	**Api 4001 G L**		■		■	■	■		■				■		✻	✻		■	■	■	■
∆ RTD	DC	**Api 4001 G SA-B**		■		■	■	■		■				■		✻	✻		■	■	■	■
Frequency	1 Relay	**Api 1700 G**		■	✻		■				■	■	■	■		✻	✻		■	■	■	■
Frequency	2 Relays	**Api 1720 G**		■	✻		■				■	■	✻	■		✻	✻		■	■	■	■
Frequency	DC	**Api 7010 G**		■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	Frequency	**Api 7500 G**	■	■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	Frequency	**Api 7500 G M02**	■	■	■	■	■	■		■				■		✻	✻		■	■	■	■
DC	Frequency	**Api 7500 G SS**	■	■	■	■	■	■		■				■		✻	✻		■	■	■	■
Frequency	DC	**Api 7580 G**	■	■	■	■	■	■		■				■		✻	✻		■	■	■	■
AC	1 Relay	**Api 1600 G**		■			■				■	■	■	■		✻	✻		■	■	■	■
AC	2 Relays	**Api 1620 G**		■			■				■	■	✻	■		✻	✻		■	■	■	■
AC	DC	**Api 6010 G**		■		■	■	■		■				■		✻	✻		■	■	■	■
AC	DC	**Api 6010 G 5A**		■		■	■	■		■				■		✻	✻		■	■	■	■
AC	DC	**Api 6380 G**	■	■		■	■	■		■				■		✻	✻		■	■	■	■
AC (RMS)	DC	**Api 6380 G S**	■	■		■	■	■		■				■		✻	✻		■	■	■	■
Potentiometer	DC	**Api 4003 G I**		■		■	■	■		■				■		✻	✻		■	■	■	■
Potentiometer	DC	**Api 4008 G**	■	■		■	■	■		■				■		✻	✻		■	■	■	■
Strain Gauge	DC	**Api 4051 G**		■		■	■		■	■				■		✻	✻		■	■	■	■
Strain Gauge	DC	**Api 4058 G**	■	■		■	■		■	■				■		✻	✻		■	■	■	■
Strain Gauge	DC	**Api 4059 G**	■	■		■	■	■		■				■		✻	✻		■	■	▲	■
Strain Gauge	DC	**Api 4059 G D**	■	■		■	■	■		■						■	✻		■	■	▲	■
Strain Gauge	DC	**Api 4059 DIN**	■	■		■	■	■		■				■		✻	✻		■	■	▲	■
Strain Gauge	DC	**Api 4059 DD**	■	■		■	■	■		■						■	✻		■	■	▲	■
Strain Gauge	DC Sum	**Api SUM 025**	■	■		■	■	■		■				■		✻	✻		■	■	▲	■
DC	Relay	**Api 3200 G**		■		■	■			■	■	■	■	■		✻	✻		■	■	■	■
DC	Relay	**Api 3200 G M01**		■		■	■			■	■	■	■	■		✻	✻		■	■	■	■
DC	Relay	**Api 3200 G M420**		■		■	■			■	■	■	■	■		✻	✻		■	■	■	■
DC	DC Math	**Api 440X G**		■		■	■	■		■				■		✻	✻		■	■	■	■
DC	DC Sqr. Root	**Api 4440 G**		■	■	■	■	■		■				■		✻	✻		■	■	■	■

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