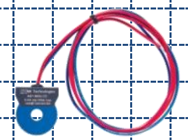
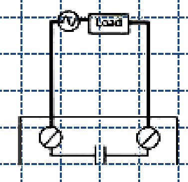
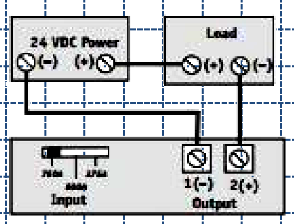
NK Technologies

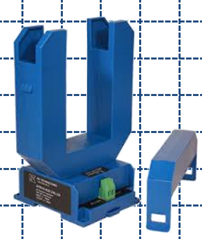


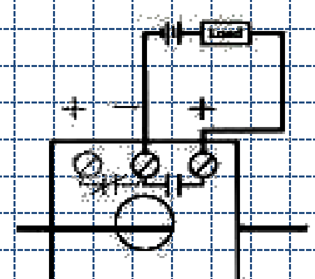


AC Switch Models

Application Notebook







DC Switch Models

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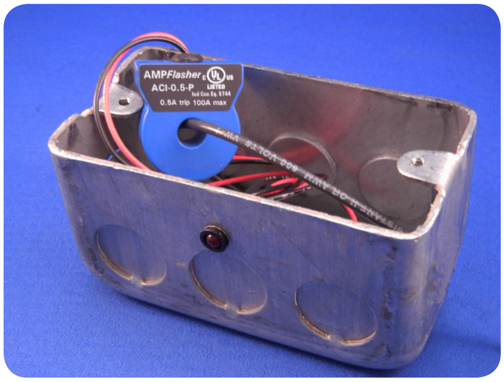
AMP Flasher™ ACI Current Indicator with Remote LED

Typically, opening an electrical equipment enclosure for maintenance or testing is unavoidable. There are numerous safety measures that need to be employed every time the enclosure is opened, including lockout and tagout of all upstream devices. A great deal of time can be saved by adding a current indicator to the conductor feeding the load and installing a remote LED.

NK Technologies' AmpFlasher™ ACI current indicator is easily installed by slipping the sensing ring over one or more conductors feeding a load, and snapping the remotely-mounted, flashing LED into the enclosure cover.

You now have a reliable visual indication that a circuit is energized. You know the circuit breaker is off, because you double checked the lockout. You know the motor disconnect is open, because you moved the handle yourself. Now you can rest assured that the motor is not energized, because the LED mounted on the control panel is not flashing.



Measuring just one inch, the AMP Flasher™ is ideal for use where space is limited.

AMP Flasher™ ACI Applications

- Monitor AC motor status
- Sense current draw for small fractional HP motors
- Identify open heater circuit connections
- Confirm operation for critical lighting or other equipment
- Compact size for control panels and motor control buckets
- A quick visual aid to troubleshooting current problems

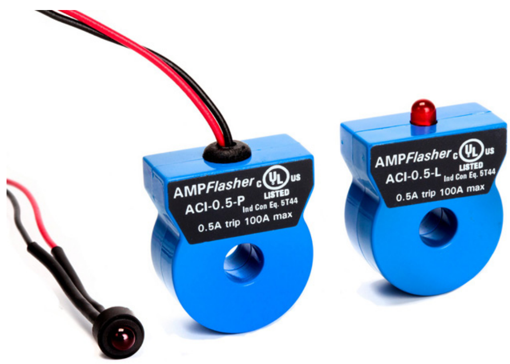
AMP Flasher™ ACI Current Indicators

A Simple, Safe Way to Monitor Live Current Carrying Conductors

The AMPFlasher™ ACI Series current indicator is a compact, inexpensive, easy-to-use LED ring which slips onto a conductor to give a flashing indication of current flow.

These AC sensors feature a compact one inch enclosure that is ideal for use in control panels, where space is limited, or wherever confirmation of current flow is desired.

AMPFlasher™ ACI current indicators are a cost-effective way to detect live conductors and see current flow to fans, heaters, pumps, lighting or other powered devices.



Amp Flasher™ with flashing LED gives visual indication of current flow.

Compact and Reliable AC Current Detection - Solid-State Contact

There are many situations when it is benefcial to monitor a circuit energized from a remote location. For example:

• If a small cooling fan stops, the heat will rise quickly if trapped inside the enclosure. There is nothing more damaging to anelectrically operated device than over heating.

• When a process uses electrical heat to cure coatings or sealants, loss of just one element will keep the bond from forming properly.

• The loss of one phase of a three phase load powering a motor can easily damage motor windings resulting in large blocks of lost production time while a seemingly insignficant motor is replaced. Seldom does the plant keep a replacement motor on hand unless management has seen this loss of production in the past and has taken measures to keep down time to a minimum.

When you need to know that a circuit is energized but you do not want to cut into the insulation or add burden to the monitored circuit, a current operated switch is the best solution. When the primary circuit draw is less than 50 amps, a small well-insulated device is just what is needed.

Monitor ing AC Current

- Independent verifcation of load status
- Input to PLC, DDS or DCS
- Control up to 120 VAC using the same sensor
- Detect loads as low as 1/2 amp

AS1Series Compact Case Current Sensing Switch

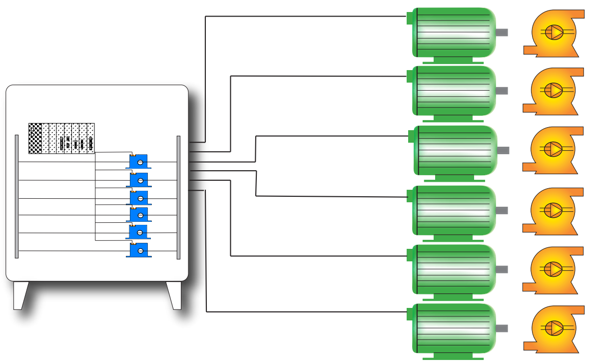
At NK Technologies we listen to our customers. They let us know they needed a sensor that would fit into cramped panel space. In response, our engineering team designed a sensor in the smallest package possible. The latest product NK Technologies has introduced in this small case is the AS1Series Compact Case; a solid-state switch contact perfect for use as an input to a PLC or other controller.

The AS1 Series-CC has 24 inch long leads that can be connected directly to the controller input terminals or brought out to a terminal block. The contact can control either AC or DC circuits to 120 volts, with a maximum load capacity of 150 mA. There is close to zero off-state leakage providing positive indication of the presence of AC current, and the output can easily handle the coil of an industrial quality relay. The switch is available with our normally open (closes on current increase) or normally closed (opens on current increase) solid-state contact. With this product, NK Technologies has found a simple solution to our customers complicated control requirements.

The AS1 Series-Compact Case is only one inch in size, makingcurrent flow monitoring in tight spaces easy and cost-effective.

Monitoring Current Made Easier in High Volume and OEM Applications

From the first one-piece current operated switch designed by NK Technologies in the early 1980's, the magnitude of current needed to create a change in the output contact was set using a potentiometer, turned while the circuit was energized. The new ASC AC current operated switch is designed with a digital processor instead of the manual potentiometer adjustment and is factory calibrated eliminating the need to set the trip point in the field. This reduces the time it takes to install the sensor and results in a significant cost savings. It also removes the possibility that the set point will drift from thermal expansion and contraction due to changing environmental conditions. Improved reliability and a reduction in alarms is the end result which is critical in many applications.



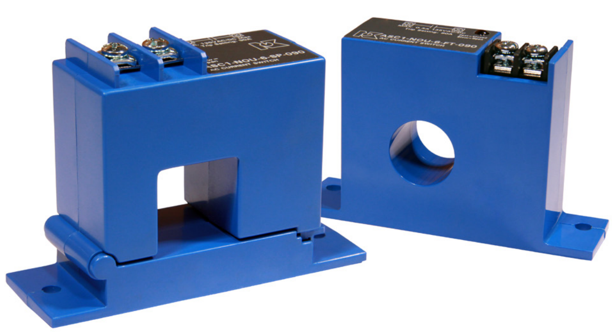
Air Handling Fan Protection: Factory-set trip points are ideal when there are several loads, all using the same motor to drive the fan blades.

For example, a manufacturer of heat treating equipment and control systems uses current operated switches to confirm that the heating elements are energized. While they could use an auxiliary mechanical interlock contact on the contactor, interlocks can fail resultomg in the interlock contact welding closed and producing a false indication that the element is working when the contactor is open. Using a current sensor has proven to be a low cost solution that is more reliable. The current draw of each element is calculated and confirmed with testing, with higher wattage demand types using more current than lower demand types. Using a current sensor set to close at the level each element draws saves time during the control panel set up and commissioning. Installing a current switch over the conductor feeding the heating element is easy; all that is required is to connect the power from the controller to the switch terminal and back to the controller. Once the wire passes through the current switch sensing window, the solid-state contact closes as current rises to the predetermined magnitude.

For an OEM of refrigeration compressors, the sensor can be installed quickly and before the control panel is energized. The final test of the equipment can be completed with the control panel door closed. This helps protect personnel by eliminating the need to adjust the sensor trip point while the compressor is running. Reduced installation time and higher accuracy help keep costs down. Providing a sensor which does not need to be adjusted when there is a hot wire inches from a screwdriver improves the safety of the installation far beyond what has been possible in the past.

ACS Series Factory Calibrated Switches Reduce Installaton Cost and Make Current Monitoring More Accurate

ASC Series Current Operated Switches are precision calibrated at the factory per customers' specifications and guaranteed within 1% accuracy. Because the switch is factory calibrated eliminating the need to turn the potentiometer to the correct position in the field, installation time is substantially reduced resulting in a significant cost savings.



The ASC combines a current transformer, signal conditioner and limit alarm into a single package for use in status monitoring or proof of operation applications and is perfect for OEM applications where the need for a limit alarm is required. Available in a solid-core enclosure or in a split-core enclosure to maximize ease of installation.

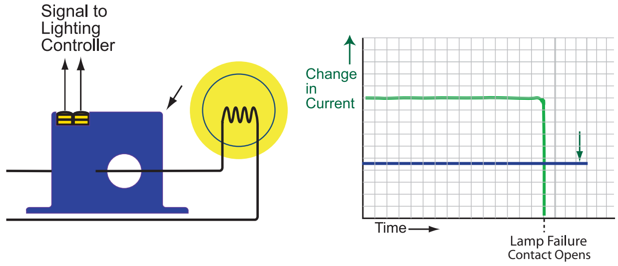
Patent Pending Linear Adjustment Provides Precise Setpoint

Since the early 1980's, one piece, self-powered current operated switches have required the trip point to be adjusted while the monitored load is energized. The original design used a multiple turn potentiometer making it uneconomical to display how much current would cause the sensor to trip.

The new ASL current switch provides a patent pending linear setpoint adjustment using a single turn potentiometer. The actual current magnitude which will trip the sensor output is indicated on the sensor. The installer turns the adjustment knob so the arrow points at the amperage value they select.

Each sensor is provided with a calibrated dial, with the amperes shown where the solid-state sensor contact will trip or change state (normally open contact closes on current increase, normally closed contact opens on current increase). There are four ranges available for either solid or split-core case types:

Model Prefix	Solid-core (-FF Case)	Split-core (-SP Case)
ASL1	1–10 amps	2–20 amps
ASL2	10–50 amps	20–50 amps
ASL3	50–100 amps	50–100 amps
ASL4	100-150 amps	100-150 amps



Critical lighting loads like waterway navigation lights are relied on by ship captains and tug boat pilots to keep their vessels from harm. If a lamp fails, a reliable way to detect this drop in current is to use a current operated switch. The switch contact can be used to set off an alarm or change to a back-up lamp.

The alternative method is to use a photocell and have a contact change state if the cell suddenly was engulfed in darkness. The complexity of this set up has several drawbacks including keeping the photocell clean and aligned with the navigation lamp, along with the cell requiring power to operate.

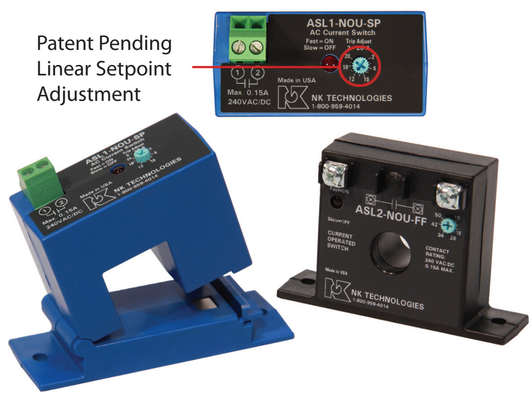
As opposed to photocell technology, ASL current switches will work regardless of the voltage to the lamp and can be installed far from the lamp fixture near the circuit breaker feeding the lamp, or in a separate enclosure.

AC Current Switch Applications

- Fans: Verification of operation and drive belt integrity
- Pumps: Detect loss of head pressure, failing bearings, open discharge and cavitation
- Heating element operation
- Air compressors
- Shredders and Grinders
- Water Treatment Facilities
- Sewage Lift Stations
- Critical Lighting (Navigation and Signals)

ASL Current Operated Switch with Linear Adjustment

The new ASL AC Series current operated switches are powered from the monitored circuit so no power supply is needed, making installation easy. The trip point is adjusted with a single 3/4 turn selector, with the current shown on the label. Point the selector to the amp level where you want the solid state contact to change state (open or close depending on the model), and connect the sensor terminals to switch a control voltage, AC or DC, to a PLC, panel meter or other controller. The setpoint adjustment can be made before the sensor is installed or after and is designed not to drift during operation. Once it is set, you can be confident there will be no call backs.



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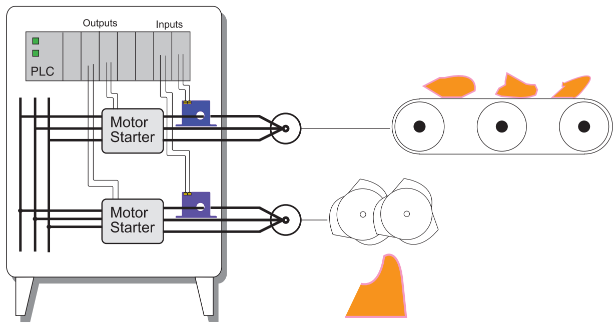
The ASXP Current Relay is a Versatile Option for Single and Three-Phase Motor Monitoring

The ASXP series current relay provides control engineers with features to help solve motor maintenance requirements for both single phase and three-phase motors.

A set delay of two seconds before the output relay closes allows the motor current inrush to occur without tripping the output contact in most applications. After the motor is running, a separate adjustable delay on current increase allows the sensor to "ride through" short duration over-loads. Over-loads that are not long enough to cause damage to the motor windings but can cause standard current operated switches to trip occur often in grinding and cutting processes. Both the current trip point and run delay are field adjustable using a single turn potentiometer conveniently mounted on the top of the sensor. The exact current magnitude can be set before or after installation, along with the time delay before the output relay energizes. Setting the adjustments before installation is easier and safer than doing so inside the confined space of a motor control center bucket or a component rich control panel.

The electromechanical single pole, double-throw relay output is rated to control up to one amp at 120 VAC and two amps up to 30 VDC. This capacity allows the sensor to be used to control NEMA size 1 contactor coils or other inductive loads without concern. The contact can also be used to provide input to a programmable controller or distributed control system with zero off state leakage (often seen with some manufacturer's solid state output "contacts").



Use the ASXP to monitor the load of a grinder drive motor, and when the grinder is working properly, the contact interlocks the in-feed drive. This allows the in-feed to be halted when the grinder is over loaded.

ASXP Models for Monitoring Three-Phase Motors

Model	HP at 208 VAC	HP at 460 VAC	HP at 575 VAC
ASXP1-SDT-120-FL	1/2, 3/4, 1, 1-1/2, 3, 5	1/2, 3/4, 1, 1-1/2, 3, 5, 7-1/2, 10	1/2, 3/4, 1, 1-1/2, 3, 5, 7-1/2, 10, 15
ASXP2-SDT-120-FL	7-1/2, 10, 15	15, 20, 25, 30	20, 25, 30, 40
ASXP3-SDT-120-FL	20, 25	40, 50, 60	50, 60 75

ASXP Models for Monitoring Single-Phase Motors

Model	HP at 115 VAC	HP at 208 VAC	HP at 230 VAC
ASXP1-SDT-120-FL	1/6, 1/4, 1/3, 1/2, 3/4, 1, 1-1/2	1/6, 1/4, 1/3, 1/2, 3/4, 1, 1-1/2, 2, 3	1/6, 1/4, 1/3, 1/2, 3/4, 1, 1-1/2, 2, 3
ASXP2-SDT-120-FL	2,3	5, 7-1/2	5, 7-1/2, 10
ASXP3-SDT-120-FL	5, 7-1/2	10	10

Motor Protection

- Serves as an electronic proof-of-operation; detects current draw changes in motors when they encounter problems such as pumps running dry or impending bearing failure.
- Non-intrusive, less expensive to install than differential pressure flow sensors or thermal switches.
- Much quicker response time than Class 10 overload relays.

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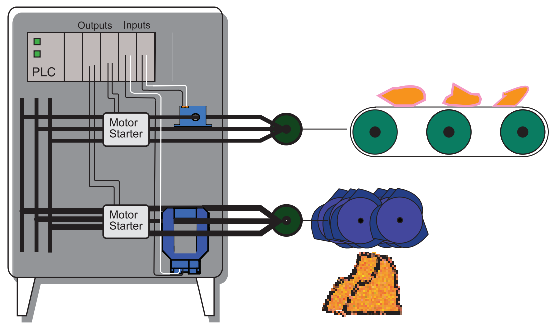
Take the Complexity Out of Monitoring High Current Loads

When the AC load exceeds 200 amps, it has required a current transformer (CT) permanently connected to a separate box enclosing a current relay. Setting the correct trip point is a challenge, since the same remote box is used with any CT ratio. The setting depends on the amount of current through the CT and how much of that current will cause the relay to change state. Most CTs produce 5 amps in proportion to the primary circuit current, so if the CT is wound for 800:5, 800 amps will create an output of 5 amps. If the load maximum current is 650, that is18.25% of the CT maximum, so this primary circuit will produce 4.0625 amps, plus or minus 1%. The current relay would be marked to adjust the trip point as 0–5 amps or 0–100% of scale. Difficult to figure out with a calculator, and much tougher in the field.

NK Technologies has reduced the complexity with the ASXP-LS Large Current Switch. Select the model with a range higher than the current you need to monitor (select an 800 amp range for a load of 650 amps as above); the trip point will be set with a potentiometer located on the side of the sensor base. The desired setpoint can be chosen by turning the potentiometer arrow to the amount of current which causes the output relay to change. The label, marked in 100 amp increments but fully adjustable across the entire range, shows where to leave the potentiometer.

The ASXP-LS can provide protection against motor damage by tripping the output contact when there is an over load condition. If the application is such that an over load occurs regularly like in a grinding or material reduction process, the output action can be delayed for up to 15 seconds so the alarm occurs only when the overload is sustained for longer periods of time. Alternately, the contact can be actuated every time the overload occurs, and be used as a counter so that an operator knows how many times each shift the drive has been over loaded, with action taken through a controller if it occurs too many times in a set time period.



When used to monitor a large pump system, the trip point can be set to detect under current conditions, which occur if the head pressure is reduced due to a dry or blocked intake or an open discharge. The ASXP-LS is designed to monitor primarily high current loads, so an open discharge line would mean hundreds of gallons of liquid spilled in a matter of seconds. If a drive belt is slipping or breaks, or a coupling shears the ASXP-LS will detect the problem quickly so action can be taken. There is no need for a pipe penetration like a pressure sensor, and no need to disconnect the power cable to install the sensor.

The ASXP-LS Series - Engineered with Great Features

The ASXP-LS is engineered to make monitoring high current loads easier. A split-core case allows the sensor to be installed after the conductors are in place and is designed to snap onto a DIN rail, or be attached to a back panel with screws through the sensor base. The extra large sensing aperture is 2.3" wide x 3.42" high to easily accommodate conductors. Multiple wires per phase can pass through effortlessly. An electromechanical relay output will work on AC or DC control circuits, and can be used for no-volt inputs such as timing relay triggers.

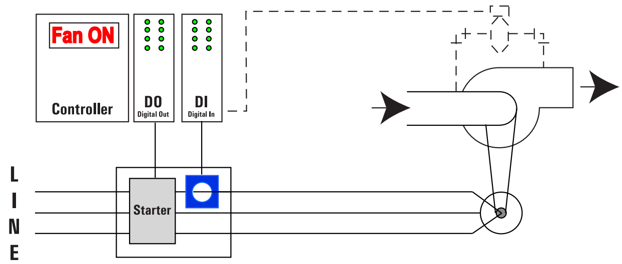
The ASXP-LS features a delay on load start designed to bypass inrush current. The delay is adjustable to allow large motors to start against high inertia loads without tripping, like a loaded conveyor. A selectable "Fail Safe" operation can be set in the field so it will act like a self-powered current switch: The normally open contact closes on current rise only. With the flip of a switch, the sensor output relay will change state as soon as the sensor is powered on, then if current rises over the trip point or power is removed from the sensor, the relay will change state. This provides the best level of protection for critical loads. The LED indicator shows green when the sensor is powered and red when the output has tripped. With four models available the trip point can be set between 200 and 1600 amps. The adjustment is made with a potentiometer on the sensor base, with a range of 400 amps in 180 degrees of swing to the knob.

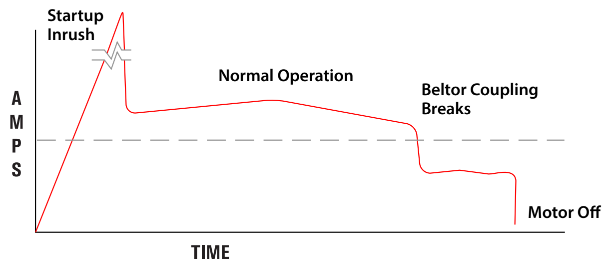
Self Calibrating Current Sensing Switches are Accurate and Easy to Use

In many applications, adjusting the trip point of a current monitoring sensor can be frustrating. The control cabinet must be open while power is on so that the load being monitored is energized and the tight space makes getting a small screwdriver in the right position challenging. An ASM Self-calibrating Smart-Switch solves this problem by using the actual load current to set the trip point. It takes just a couple of seconds of steady running conditions before the sensor locks onto the normal current level. If the load draws more current than normal or the current drops significantly, the sensor output will open. As long as the current stays between 85 and 125% of the normal level (overload/underload models only), the sensor output will be closed. No manually setting trip points and no adjustment is needed.

Monitoring Steady AC Current Applications

- Pumps
- Fans
- Heating Elements
- Conveyors
- Safety-interlocking with other loads

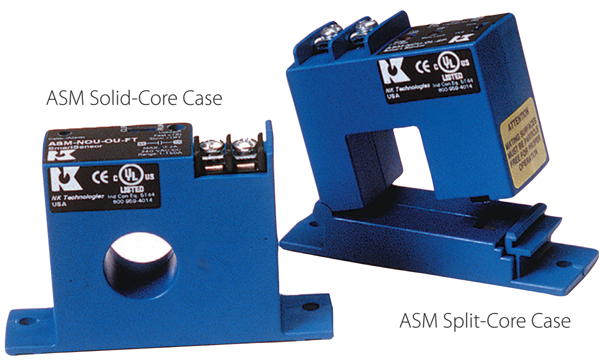




A current sensing switch is installed in the existing control cabinet or starter enclosure, and eliminates the need for differential pressure switches, the conduit, and extra wiring to install the differential sensors. In pumping applications, the sensor can replace flow indicators and their associated wiring and piping.

ASM Series Self-Calibrating Smart-Switches Make Monitoring Motor Current Loads Simple

The ASM Series Self-Calibrating Smart-Switch provides the simplest way to be sure a motor is working properly. The newly designed ASM is more accurate and easier to set up than previous models. The solid-state contact is closed when the load is energized and drawing between 85 and 125% of normal current. The sensor slides or snaps over one conductor feeding the load. The contact controls the input voltage, AC or DC, to 135 volts to a controller or small relay. If the current falls below 85% of normal or increases above 125% of normal (overload/underload models only), the contact will open. One contact to alarm in over or current conditions, or both. No adjustment is needed unless the motor is changed. If the motor is replaced, calibration is very easy and within a matter of minutes, the system is back in operation.



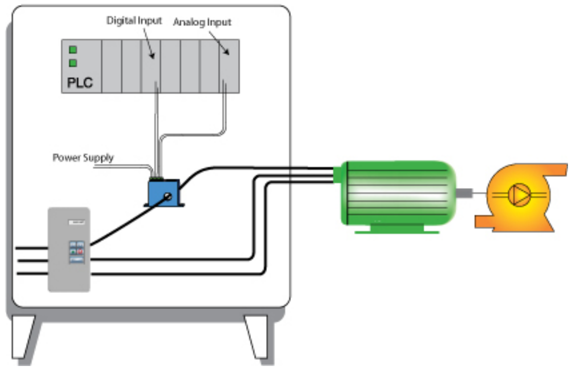
ASM Solid-Core Case

ASM Split-Core Case

Reduce Installation Cost with a Current Measurement and Alarm Contact in One Sensor

The latest AC current transducer from NK Technologies uses a revolutionary design of combining two sensors into one package. This combination reduces installation costs and allows the circuit control to take less space in crowded panels. This also provides local control of a motor starter coil or a visual alarm without having to wire the digital output back to the controller, again saving time and expense.

Pump Jam and Suction Loss Protection



The ingenuity of the design is shown in the method of alarm point adjustment. With power supplied to the sensor, a three digit LED display is activated. A potentiometer on the top of the sensor is turned, and the display changes to show the amount of current needed to actuate the contact. The trip point can be set before the monitored circuit is energized. Other designs require the installer to adjust the trip point while the primary load is powered, or often leave the adjustment at the minimum so the contact closes at any amount of current.

The ATS Current Transducer is ideal for monitoring equipment such as:

Conveyors: Use the alarm contact to turn on a revolving beacon light when a jam occurs, while the analog signal reports usage to a data acquisition system.

Pumps: The analog signal is fed to a local panel meter to display current use, and the contact closes to alarm on low current caused by loss of head pressure.

Grinders: The analog signal is sent to a PLC to record time of use and estimate power consumption while the contact controls the starter coil, shutting the machine down if an overload occurs, quicker than standard overload protection, reducing the chance of damage and lessening clean out time.

The ATS Current Transducer/Switch with Digital Setpoint Display

The new AC current transducer combines two sensors into one package. The factory set analog output calibration produces an accurate and stable signal by eliminating field zero and span adjustments. The FL model features a digital display that gives visual indication of the setpoint for greater accuracy.

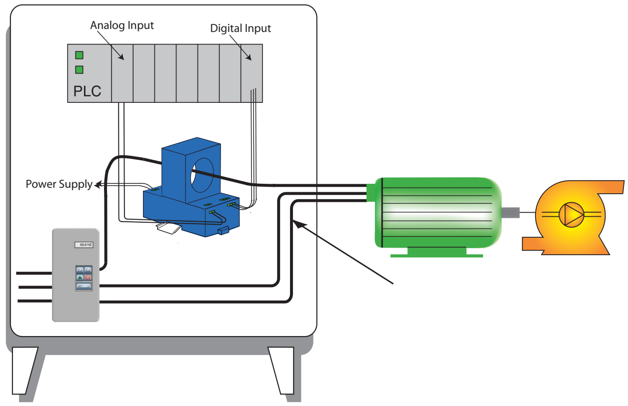
The ATS-FL Series sensors are available with a choice of 4–20 mA, 0–5 VDC or 0–10 VDC output; each output offers a range that is proportional to either 0–50 amps or 0–200 amps. In addition, there is a solid-state contact which can be adjusted to activate when AC current reaches a predetermined magnitude.

The contact can be used to set off an alarm or shut down the system, depending on your requirements. The trip point is adjustable from 2% to 100% of the analog range, and can be verified at any time by viewing the LCD display on the sensor. Any adjustments made by unauthorized personnel will be displayed, further improving overall system reliability.

The ATS-FL Series digital display shows the setpoint for greater accuracy.

Monitoring High Current Loads

To monitor high current loads, it often requires the installation of a current transformer sized for the maximum current that will be used, then the 5 amp secondary of the current transformer is connected to a shorting block for safety. The connection then runs from the shorting block to a signal conditioner to produce the analog output proportional to the current, or to a different type of signal conditioner to produce an alarm relay contact. Once these connections are made, the controller can be connected to the signal conditioner outputs. It requires a great deal of time to interconnect these components, plus the time expended to adjust the signal outputs to match the primary load characteristics. With the ATS Series AC Current Switch and Transducer all that is required is to snap the ATS onto a DIN rail, connect it to a power source and then connect the outputs to the controller.



Monitor air handling blowers, pumps, crushers and many other large loads with one self-contained current switch (limit alarm) while also using the built in analog signal to spot bearing wear and other issues before they cause a break down.

Some applications where monitoring high AC current loads is important for preventive maintenance:

- Hammer and Ball Mills
- Agitators and Mixers
- Slurry and Paste Pumping
- Lumber Mills
- Shredders and Grinders
- Compressors and Blowers
- Refrigeration and Condensers
- Cone and Jaw Crushers

ATS AC Current Switch and Transducer makes Monitoring High Current Loads Easy and Safe

NK Technologies designed the ATS Series specifically to protect loads using higher current levels. This new patent pending one pièce solution combines a limit alarm (switch) with an analog output signal transducer.

The limit contact is adjustable in ten amp increments from 10 to 1200 amps using three switches One rotary switch selects the lowest value: 10, 20, 30 up to 90 amps. A second rotary switch allows selection of the trip point by hundreds: 100, 200, 300 up to 900. A final slide switch selects either 0 or 1000 amps

The larger sensor housing provides enough space for paralleled conductors (up to 3–350 MCM THHN or 4–250 MCM THHN per phase) to pass through the sensing window. The sensor does not physically contact the conductor, similarly to our other designs, and can be used to directly monitor AC motor loads to 500 horsepower and larger, UL listed (pending) for voltages to 600V AC.

ATS Current Transducer with Rotary Switch Limit Contact Adjustment

A Smaller, Simple-to-Use Current Switch for Detecting Even Low DC Current Levels

The DS1 was designed in response to customers' requests for a smaller, simpler sensor to monitor DC current levels:

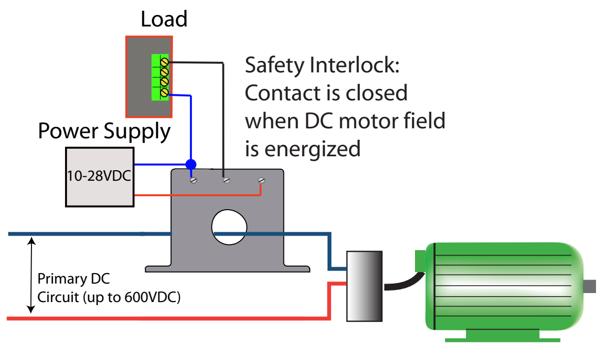
A customer who manufactures pressure washers needed a contact that closed when a heating circuit was operating, allowing the washer to operate only when the water was hot. Another wanted a remote indicating light to show when a load was energized. Both systems are used on mobile equipment, powered by 12 or 24 volt battery systems.

Safe-T-Rack uses the DS3 series switch as an interlock with their control system. They manufacture a high voltage circuit breaker draw out mechanisms which allow for remote control, so the operator can be a safe distance from the breaker to reduce any chance of arc flash.

The DS1 Series can also be used to provide independent indication of a DC load, including ventilating fans on passenger train cars, allowing the system controller to know absolutely that the air handling system is working.

DC Current Switch Applications

- Safety Interlock
  Provides a non-intrusive method to keep personnel safe.
- Alarm Contact
  Indicates when a load is operating or when it is de-energized.
- PV Systems
  Dectect leakage by monitoring the earth bond conductor.
- Lighting
  Turn a lighting circuit on when a load is energized.
- Equipment
  Provides instant indication of status.



Smaller, simpler and every bit as reliable as the adjustable DS3 series, the DS1 can be used to detect even lower current levels.

DS1 DC Current Sensor in a Compact One-Piece Design

The DS1 DC current switch is smaller than other DC current sensors and simpler to use. It is non-adjustable so the output closes when there is current and opens with there is none. It uses the same circuit voltage to power the sensor as the circuit being controlled so it is easier to install than other sensors. The DS1 current sensor can be powered by any DC voltage between 10 and 28 volts, and the solid state "contact" closes with a minimum of 0.75 amps DC through the sensing window. The contact can control a DC load up to one amp, up to 30 VDC.

AC Split-Core Transducer Applications

You don't have to sacrifice accuracy to take advantage of the easy installation provided by using an AC current transducer with a split-core design instead of a solid-core design. Any load from 200 to 800 amps can be monitored accurately using NK Technologies' AT or ATR currrent tranducers in the MS case. The split-core case allows the conductors to remain in place, and the base can be snapped on to a DIN rail, attached with screws to a control panel or suspended from the conductors using nylon cable ties. Some applications where the use of this type of transducers is ideal include:

Pump Monitoring:
Monitoring the current used by a pump will help to detect several problems that need immediate attention: Loss of head pressure and open discharge will cause the current to drop, and either can damage the equipment or the environment quickly. Bearing wear and impeller cavitation will be reflected in a rise in current. By mapping this increase over time, the equipment can be maintained or repaired before a catastrophic failure occurs.

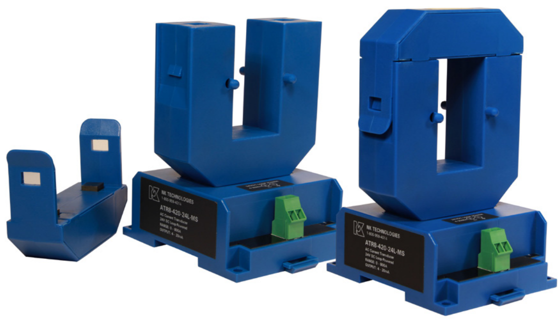
Crusher/Grinder/Shredder Operation:
Crushers, shredders, and grinding processes are notoriously hard on the drive components. Inconsistent material density, foreign objects, and over loading the in feed can cause the drive motor current to spike. If these spikes occur without sufficient time to dissipate the heat generated, the motor insulation will suffer. With enough over loading a shaft might break, and the drop in current will indicate the motor is still turning but the rest of the operation is at a stand still.

Lumber Milliing and Processing:
Lumber processing requires heavy duty machines, using massive hydraulic, pneumatic and electrical systems. Monitoring the current used by a log carriage will help the operator feed the cut with little burning. The saw blade can also be monitored as it will draw more current as the teeth become dulled.

AT/ATR-MS Current Tranducers with a Split-Core Design Provide Both Accuracy and Convenient Installation

The AT/ATR-MS AC current transducers from NK Technologies measure AC circuits from 0-200 amps to 0-800 amps. The large, easy-to-install, split-core design allows installation over existing conductors without the need to disconnect the load, even in applications where there are multiple conductors per phase. Whether installing over existing conductors or in a new control system, installation is very simple and quick.

The two-wire, loop powered output signal provides a very simple connection approach. The 4-20 mA output is highly resistant to electrical noise found in control cabinets, and the base of the transducer can be snapped onto a DIN rail, or attached to a control panel with screws.

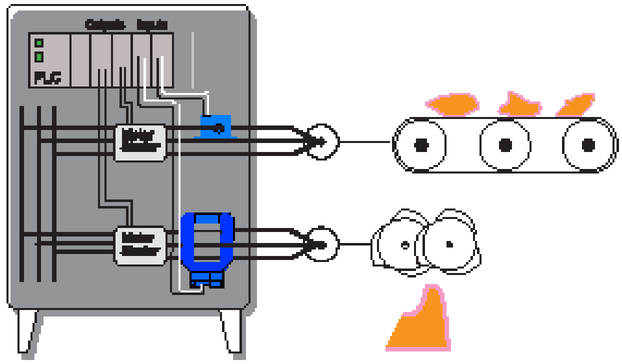


Installing a Current Sensor to Measure Current Draw of Large Machines

The need to measure current draw of large machines is just as important as for smaller loads, however installing a monitoring device is more difficult. Large wires do not bend easily and tend to spring back to their original shape when force is applied. Often heavy loads are fed using bus bars rather than cable, usually in control cabinets, switch boards and other distribution centers.

Using a solid-core current sensing device in any of these applications means threading the conductors through a ring and then onto the load terminals, a nearly impossible task when the conductors are solid bars. A split-core sensor allows the wires to be installed first, and the sensor added after the installation. If the load is fed with bus bar, the sensor can be slipped over the bar easily.

Often heavier amounts of current are carried using multiple wires for each phase. The primary requirement is having enough room to allow the sensing ring to completely surround the conductors. Bundling the wires together with nylon ties helps the conductors stay in one location while the sensor is installed. Good practise would allow the ties to stay in place so the conductors don't spring outward and apply excessive force against the sides of the sensing ring.



Use a large split core AC current transducer to measure the load of a grinding, material reduction process. If the grinding wheels become overloaded, current use will spike and the sensor output will be captured by a programmable logic controller.

Why go to the bother and expense of monitoring current?

While many specifying engineers require power monitoring, measuring voltage and current at the same instant to allow for power factor measurement, a very good representation of the power used can be achieved by measuring current only. Using an RMS responding sensor will be much more accurate if the current wave shape is not purely sinusoidal, such as what would be produced by a variable frequency inverter or a phase angle fired heating controller. With this added signal conditioning, the sensor output has very little ripple and remains highly accurate regardless if the current is smooth and even or chopped significantly.

The majority of large pumps, compressor motors and fan loads are driven with variable frequency inverters to save power by running the drive motor only at the optimal speed for the work being done, along with reducing mechanical stress during start up. Using an RMS measurement rather than an average responding sensor can help reduce troubleshooting during the initial commissioning of a control system by showing an accurate signal in all situations.

The AT/ATR-LS Current Transducer is Easy to Install

The AT/ATR-LS Series Current Transducers combine a current transformer and signal conditioner into a single package. The large, easy-to-install split-core design allows for installation over existing conductors without the need to disconnect the load, even in applications where there are multiple conductors per phase.

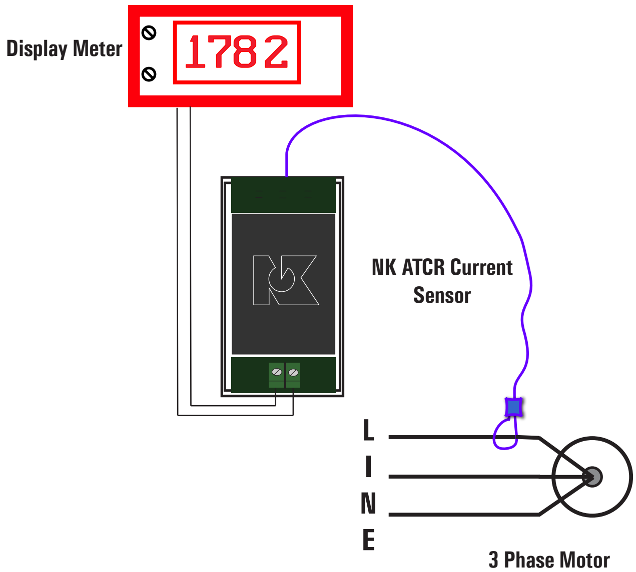
For new installations, the installation is just as easy. Just remove the top portion of the sensing ring, place the conductors inside, and snap the top back in place. The transducer uses two wires to connect to the power supply, the load, a programmable logic controller, a panel meter or a data acquisition system.

Sensing AC Current Using Flexible Loop Transducers

One of the challenges installers face when they need to monitor current or power is placing a current transformer or other sensing device over existing conductors. Space is always at a premium inside any switchgear or control panel, and the size and shape of the conductors must be known before any sensor is selected. It is much more difficult when the conductors are large wires or bus bar and the time allowed for the system to be de-energized is limited. Large wire is bent and formed to fit during an original installation, often using special tools designed for that purpose. Trying to push 500 MCM copper wire through a sensing ring is very difficult and time consuming. Adding current sensing to a distribution point comprised of bus bars forces the installer to use expensive and less accurate split core current transformers, or find a splice plate in the bus assembly where a standard CT can be inserted.

Monitoring AC Current

- Irrigation Pumps
  Detect loss of head pressure, cavitation, bearing wear
- Main Power Feed
  Monitor current use at switchgear or distribution point
- Submersible Pumps
  Perfect for tight spaces in control cabinets
- Overhead Crane Drives
  Large current use makes CT installation a challenge
- Lumber Processing
  Monitor bandmills, debarkers, chippers, planers
- Recycling Operations
  Crushers, grinders, sorting belts
- Material Processing
  Measure current use to detect jams or bearing wear
- Aluminum Processing
  Monitor power use of pit furnaces



The ATCR Series Provides a Convenient, Easy Method to Monitor AC Current up to 2000 Amps

NK Technologies' flexible cable current transducers wrap around the conductor using very little space. The cable is connected to a signal conditioner located up to several feet away from the conductor, and produces an industry standard 4 to 20 mA signal in proportion to the AC current. With ranges of 0–500 to 0–2000 amps and frequencies to 400 hertz, the ATCR series is well suited for a wide range of applications.

With just two wires providing the power supply and output signal, current sensing doesn't get much easier than this!

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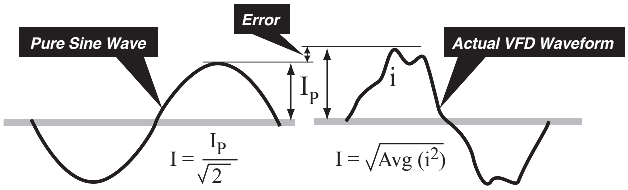
Monitoring Distorted AC Current

Engineers designing switched mode power supplies work diligently on improving pulse width modulation so the controlled load will have the cleanest power applied, reducing harmonics. This reduces overheating of transformers and motors in addition to reducing zero-crossing noise. The current methods for reducing harmonics are expensive, so distortion in these types of power supplies will continue for the foreseeable future.



Variable speed drives, electronic ballasts, uninterruptible power supplies and other devices that use switched mode power supplies are sources of current sine wave distortion and require frequent monitoring.

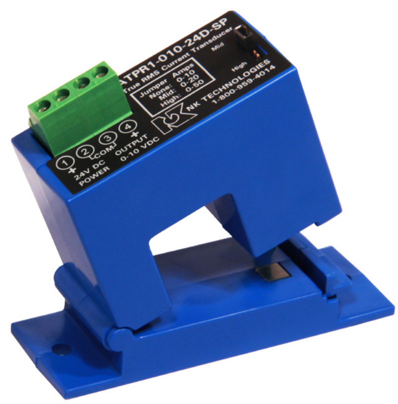
Many building energy management controllers provide only 0–5 VDC inputs and many data loggers utilize 0–10 VDC inputs. The ATPR Series Current Transducers can be used in applications where the current wave is either distorted or where it is sinusoidal with equal accuracy. Even when the amount of distortion is not known, you can be certain the measurement will be accurate. With this sensor, the installer is able to use the industry standard for monitoring AC current without having to use an external resistor, which can add a degree of inaccuracy to the system.

Monitoring AC Current

- Irrigation Pumps
  Detect loss of head pressure, cavitation, bearing wear
- Air Handling Fans
  Accurate on 6-pulse, 12-pulse or 24-pulse driven motors
- Submersible Pumps
  Perfect for tight spaces in control cabinets
- Lumber Processing
  Monitor bandmills, debarkers, chippers, planers
- Recycling Operations
  Crushers, grinders, sorting belts
- Material Processing
  Measure current use to detect jams or bearing wear

The ATPR Series Provides True RMS 0 to 5 or10 VDC Signal Output

NK Technologies has been manufacturing simple and cost effective current transducers to monitor these loads for many years, producing a 4–20mA loop powered signal proportional to the RMS current. The ATPR 'E-Out" Series provides the system designer with the option of a DC voltage output of their choice, 0–5 or 0–10 VDC. These sensors are available with current ranges as low as 0–2 amps up to 0–200 amps. The ATPR Series Current Transducers can be used in applications where the current wave is either distorted or where it is sinusoidal with equal accuracy. Even when the amount of distortion is not known, the measurement will be accurate. With the ATPR, the installer is able to use the industry standard for monitoring AC current without having to use an external resistor, which can add a degree of inaccuracy to the system.



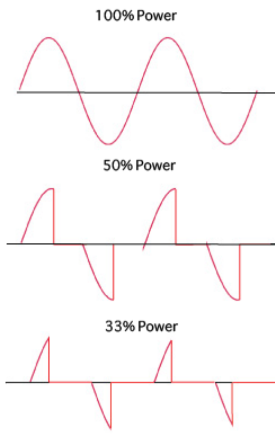
Monitoring AC Current Powering Heating Elements

Electrical resistance heating is used in a wide variety of applications. Controls can be very basic: Energize the circuit with a switch and turn off the power when the temperature rises to an acceptable level or add a thermostat to switch the power off when the heat reaches an exact temperature. A sensing element can also be installed to monitor the temperature of the heated product and vary the heat to maintain the desired temperature. Since the power factor does not vary significantly with resistive loads, monitoring only current provides the system operator with the data needed to keep the system working as designed. There are many methods of metering the power to the elements in electrical resistance heating. Two common methods use silicon controlled rectifiers (SCRs) to vary the power:

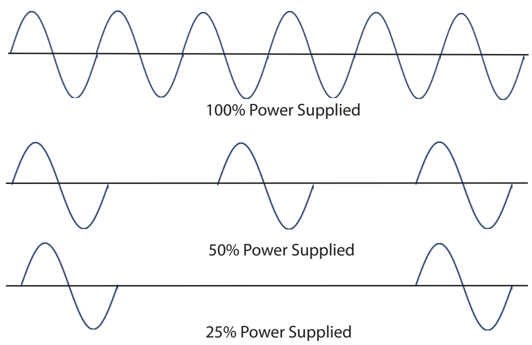
Phase Angle (Fired Control): The first method turns the circuit on and off multiple times in each cycle, changing the sinusoidal wave shape from smooth to a chopped form. The largest drawback to this method is that there is a relatively high percentage of harmonic disturbance and electrical noise created which can affect the rest of the control system or other equipment in close proximity of the load. Monitoring the power used is relatively easy since there is a rise and fall of current in each cycle (at 60 hertz, one cycle is completed in 16.7 ms). That brief amount of time where there is no magnetic flux to detect (8.3 ms at 50% power) is short enough that the sensor output can be conditioned to a smooth DC current or voltage signal with acceptable ripple.

Burst Fired (Time Proportional Control): The second method, also uses SCR's to turn the power on and off, but the power is switched only at the zero point of the sine wave. The circuit is energized in one cycle increments or energized for several cycles and de-energized for several cycles. The "off" and "on" time periods are varied. By switching the load only when the voltage reaches zero the harmonic distortion is limited and the temperature can be maintained consistently. Two SCR's can be applied to control a three phase load, reducing the installation cost when compared with phase angle fired controllers. The off periods make measuring current or power consumption very difficult. Since there is no magnetic flux produced while the SCR's are not conducting, the bursts of magnetic field generated during the on cycles much be measured and averaged over time to produce a smooth sensor output to the programmable logic controller, panel meter or operator displays.

Wave Shape of Phase Angle (Fired Control)



Wave Shape of Burst Fired (Time Proportional) Control



ATH Series Current Transducer with Time Integration

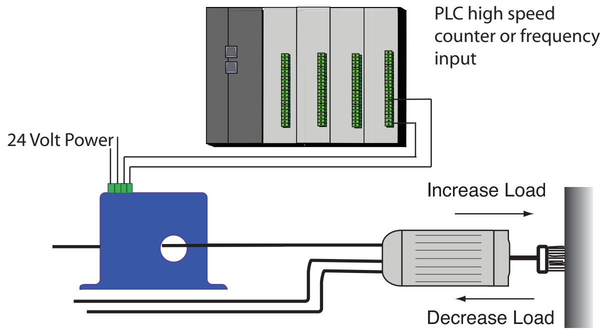
NK Technologies' ATH is a one piece, easy-to-install AC current transducer designed to monitor both phase angle fired and burst fired time proportional control of heating elements. There is no need for an external current transformer, along with the associated shorting blocks. The NK design allows the sensor to remain installed over the conductor while the heating circuit is powered regardless of what may be connected to the output terminals, even when there is nothing connected. The sensor is available with industry standard output signals: 0–5 VDC, 0–10 VDC, or 4–20 mA, and power supply options of 24 VDC or 120 VAC.

ATH Series available in solid-core or split-core case.

Monitoring AC Current Using Digital Controller Inputs

Supervisory control of an electrical system is easy when the budget allows for purchase of programmable logic controllers (PLC) or similar devices that have the capacity to accept analog signals from sensors. However, most analog input modules cost much more than digital input modules. A programmable relay with trimmed down features can replace a full PLC in many applications at a lower installed cost.

As these devices have matured in design, the features have expanded to include high speed counter and frequency inputs. Many manufacturers of programmable logic controllers include high speed counter inputs into their lower cost models to accommodate rotary encoder signals for position or travel control. The cost is kept lower than analog due to the similarity of pulse-type sensor outputs compared with the huge variety of available analog signals. An analog signal might be current or voltage, and it can be alternating or direct current. It is obvious that standard signals require much less complex systems to read and understand.



Motion and Motor Control Applications

- Motor status for pumps, grinders, and fans
- Conveyor belt jam sensing
- Motor control in deburring/brush operations
- Detect strain, acts as an electronic shear pin

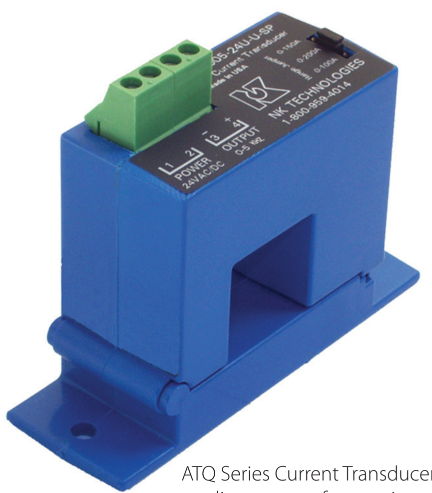
Current Measurement Applications

- Measure current use in machine tools, polishing, and cutting operations

ATQ Frequency Output Current Sensor

NK Technologies' ATQ sensor provides the system designer with a highly accurate method to monitor the current used by a machine without the need to purchase a logic controller with more complexity and larger I/O capacity than required. This sensor is designed to be used in most applications where a motor is controlled across the line, or for monitoring heating and lighting loads controlled with a contactor.

The split-core case allows the installer to add current sensing to their control scheme without the need to disconnect the existing power cables. Select from three models with multiple range selection, from 0–2 to 0–200 amps AC, to cover a wide range of applications with fewer sensors in inventory. ATQ sensors save you installation time, controller cost, and parts inventory while providing an extremely accurate signal with very high resolution. The ATQ Series will solve your need for small machine control and condition monitoring while fitting the requirement of budget constraints.

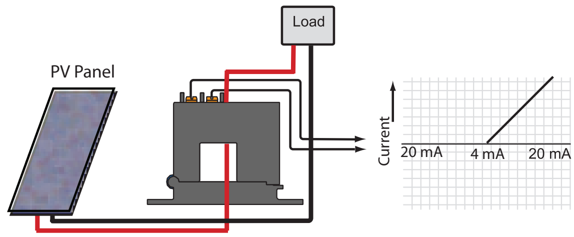


ATQ Series Current Transducer in a split-core case for easy installation.

DC Current Transducers Provide Low-Cost Alternative for Monitoring Photovoltaic Panels

Photovoltaic panels are being installed in greater numbers than ever before. Higher efficiencies, lower prices and government incentives help to increase demand, along with consumer attitudes leaning toward all things "green."

System monitoring will improve performance and one of the key components is monitoring the current output of the panels. The two most practical methods used to monitor the DC current produced are current shunts and hall element based sensors.



A typical photovoltaic panel monitoring connection.

While shunts are relatively inexpensive, the installer must cut and terminate the wire on both sides of the shunt, they are more prone to inaccurate outputs as the temperature increases and they need insulated covers to keep personnel away from potentially lethal voltages. The output is also very low, susceptible to interference and must be conditioned to be used by most programmable logic controllers or panel meters.

Compare this with the hall element design of NK Technologies' DC current transducers. There is no need to cut or strip the conductor or to disturb wiring at all with the split core models. These DC current transducers provide very stable, highly accurate output at broad temperature extremes; industry standard output signals with high levels of noise immunity; and complete isolation from the monitored circuit. These features save installation time, reduce the number of components required and make the installation very reliable and safe for inspectors or maintenance personnel.

DC Current Monitoring:

PV Array Combiner Boxes

- Measure current output of a single panel, string, or array
- Sensor ranges from 0–20 to 0–400 amps for use in combiner or recombiner boxes
- Temperature rated from -30 to 70ºC
- Two wires supply power and output signal
- Compact size for installation in confined spaces

Wind Generators

- Monitor output between cut-in and cut-out speeds

DC Current Transducers— A Low-Cost More Effective Alternative

NK Technologies has been manufacturing non-contact hall element based DC current transducers for over ten years, all made in California. Product refinements and production of thousands of units, with corporate focus on quality and reliability has helped to make NK a market leader. The latest design development is the new DLT series DC current transducer. These models are single range, take less panel space in combiner or re-combiner boxes, and produce a 4–20 mA signal through a two wire loop, using nominal 24 VDC in series with the output. As with all loop powered signals, they can be converted to 1–5 VDC or 2–10 VDC by the addition of a field installed resistor across the controller input terminals. The design saves time and cabling costs, as just two wires are used rather than four with previous designs.

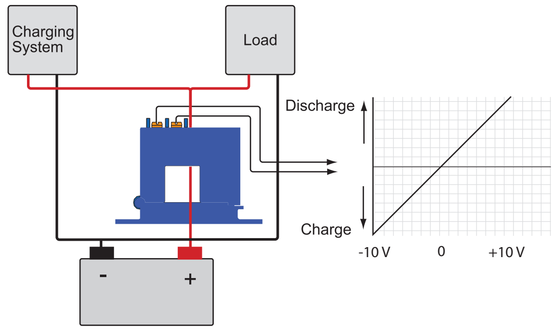
DC Sensors in Bi-Directional Applications

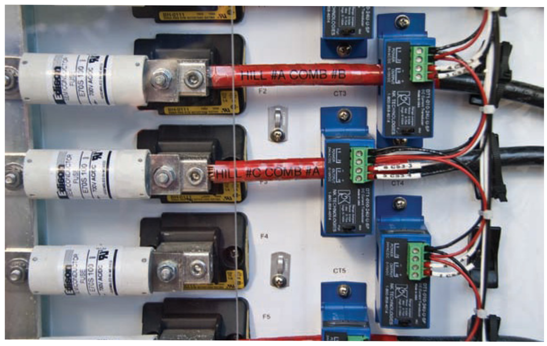
Many catastrophes can be avoided by using current sensors to monitor critical loads. It is more challenging to monitor loads powered by DC current than AC current. By far the simplest and most accurate method is to use a bi-direciton DC current sensor.

Bi-Directional transducers produce a positive voltage signal proportional to the DC current circulating in the primary direction and a negative voltage proportional to the DC current in opposite direction. Some applications include monitoring battery charge or discharge current magnitude, providing an indication DC motor rotational direction., and monitoring phootvoltaic arrays.

Common DC Load Applications

- Welders
  Measure output, duration and operation
- DC Powered Saws
  Monitor for proper operation
- Overhead Cranes
  Interlock drive with auxiliary equipment
- HV Switch gear
  Fail-safe magnetic interlock
- Electrolizers
  Monitor process conditions
- Water Purification
  Electrodeionization (EDI)
- Locomotives
  Positive indication of brake operation
- Trolleys
  Drive motor field loss protection
- Battery Charging
  Proportional signal to charge or discharge current
- Photovoltaic Arrays
  Indicates proper output and connection integrity





The photo above shows DC current sensors used in a photovoltaic array combiner box. The current produced by each PV string provides the facility manager with the data required to maintain the collectors and keep the system working at an optimal level.

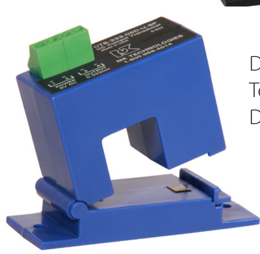
DC Series Current Switches and DT Series Current Transducers

NK Technologies' DT and DS series current sensor feature a Hall-based non-contact design that requires no cutting or terminating of the conductor; just pass the lead through the sensor or snap the sensor in place over the lead, and the sensor is ready to go.

DT transducers produce a signal to the control system proportional to the current in the conductor. The DS switches provide a contact, solid-state or electromechanical relay, which changes state at an adjustable current level.

NK Technologies can provide a cost effective method to monitor DC powered loads. Compare features with competitive methods; and your choice will be NK Technologies, the most accurate, reliable and responsive current sensing products available.

DS1 Series
DC Current Switch



DT Series
Temperarture Compensated
DC Current Transducer

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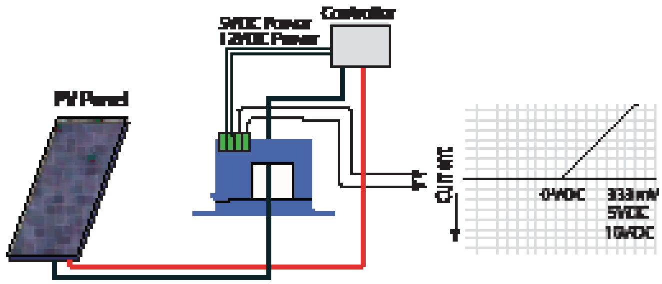
Measuring DC Current Accurately in Temperature Extremes

The two most practical methods used to monitor the DC current produced are current shunts and hall element based sensors. While shunts are relatively inexpensive, the installer must cut and terminate the wire on both sides of the shunt. Shunts are more prone to inaccurate outputs as the temperature increases and need to monitor current for several minutes before they are at their peak for accurate output levels. The output is very low, susceptible to interference and must be conditioned to be used by most programmable logic controllers or panel meters. Shunts also require insulated covers to keep personnel away from potentially lethal voltages.



This illustration shows the DT Series in used in a typical photovoltaic monitoring system.

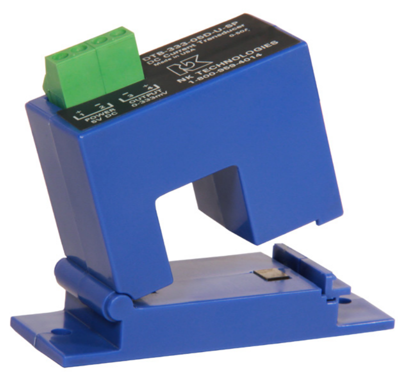
In contract, using a current transducer with a Hall element design removes the need to cut or strip the conductor, or disturb wiring at all when installing split core models. A DC current transducer with temperature compensation provides accurate current measurement whether the measurement point is in a very warm area or subject to freezing temperatures, the sensor output will remain accurate. There is no need to attempt to compensate for the temperature changes when programming the controller.

New DT Series Current Transducer with Temperature Compensation

NK Technologies' new DT Series Current Transducer with Temperature Compensation has a very stable and highly accurate output at broad temperature extremes; industry standard output signals with high levels of noise immunity; and complete isolation from the monitored circuit.

These features save installation time, reduce the number of components required and make the installation very reliable and safe for inspectors or maintenance personnel. The DT Seres current transducers are single range, take less panel space in combiner or re-combiner boxes, and produce an output of your choice: 333m VDC (powered by either 5 VDC or 12 VDC), 0–5 VDC and 0–10 VDC (powered with 12 VDC) to match the controller or data logger you select. The 333 mVDC output is often used for power monitoring applications.

There is much less than 0.1% drift in the output due to ambient temperature extremes between -20º C and +50º C. The DT Series has set the standard for accuracy at broad temperature extremes. The DT Series comes in a split-core case for easy installtion.



DT Series Current Transducer in a split-core case.

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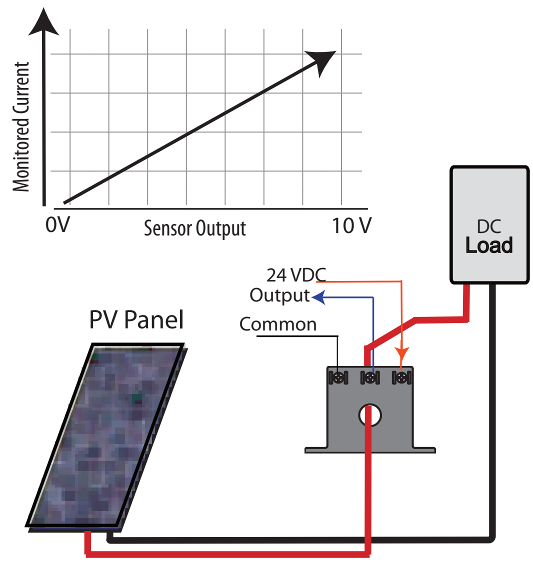
A Low-Cost Way to Monitor DC Current Using DT 3-Wire Sensors

DT series DC current transducers provide a low cost way of measuring DC current in a small and easy-to-install housing. These sensors are designed with a three-way method of monitoring DC current which uses a common point for both power supply and output signal. Using sensors designed in this way keeps current monitoring costs in check and are ideal for monitoring photovoltaic panel outputs especially in large projects such as solar "farms" where may panels and dozens of strings need to be monitored.

Other applications are in monitoring DC operated loads such as DC motors on conveyors which are moving hot freshly milled steel slabs. Measuring the current used by the conveyor drive motors can detect a shaft bearing failure which could damage the steel with a scratch or groove, requiring the steel to be remelted and remilled. Current installations of DC three-wire sensors have prevented this expensive loss of production and the mill operators are planning to add the sensors to their other production lines.



Monitoring Photovoltaic Panels with a DC Sensor

NK Technologies' DT Series of DC Current Tranducers

The newest addition to NK Technologies' DT Series of DC current transducers is a product in a very compact housing with a DC voltage output, either 0–5 or 0–10 volts. This new design uses a common point for both power supply and output signal, and is factory calibrated for a single current range. This three wire method for DC current measurement, keeps costs in check for projects where many sensors are needed.

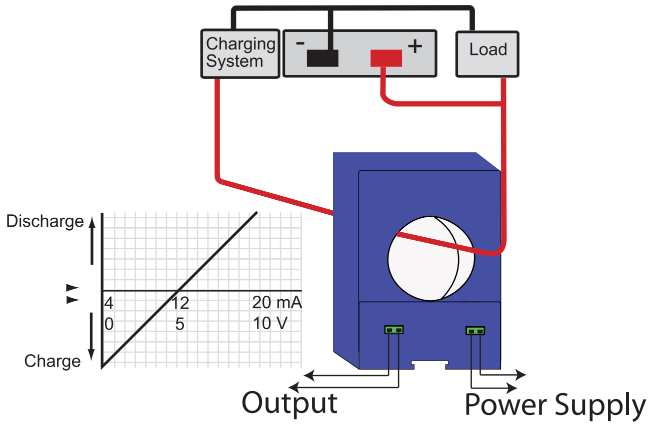
The DT Series complements the DLT Series of 4–20 mA current output sensors. Where the controllers specified cannot read current output sensors, the DT 3 wire products provide the same space saving properties without the need to add an external dropping resistor, consequently removing another place where trouble could occur.

Reliability is key in all monitoring applications, and there are gains in reliability whenever the number of connection points can be reduced. With the addition of this new series of sensors, NK Technologies has provided the system designer even more choices to measure DC current.

Monitoring DC Current

Direct current is used in many industrial processes. In most cases, AC power is used for delivery of the power, and then converted to DC though electronic modification. Computers use 5 and 12 volts DC. Servo motors operate with voltages from lower than 10 to 200 volts or much higher. Large DC motors often are designed to use 750 volts. Since the speed of the motor is directly proportional to the voltage supplied, DC motors have historically been the first choice for moving loads at varying speeds. DC power is used throughout a plant from system control to heavy lifting.

With the renewed interest in alternative power sources, DC systems are also found in photovoltaic solar power and wind power generation as well. Photovoltaic systems produce low-voltage DC power from each cell, and each cell is connected in series to boost the voltage to higher levels so the effect of impedance is minimized. Wind generators are often designed to charge batteries at 12 or 24 volts, and some produce DC voltages to 240 volts depending on the need or application.



DC Current Monitoring Applications

- Welders
- Head rigs (saw mills)
- Veneer sorters
- Gantry cranes
- DC power generation
- Telecommunications
- Transportation
- Mining

DT Series, Large Aperture For Monitoring DC Current Up to 1200 AMPS

DC power systems are growing in popularity for many reasons: only one or two conductors are required, there is no capacitance interaction between the conductors, and DC driven motors are commonly used with high inertia loads.

NK Technologies' DT series sensors are industry's first choice for measuring and monitoring DC systems. With the larger aperture models, any circuit to 1200 amps can be easily monitored. By combining the sensor output with that of NK Technologies' VTD voltage transducer, a representation of the watts used or produced can be obtained. The specific model selected will produce either a proportional analog output indicating current flow in one direction (unipolar), or a proportional output indicating current flow and direction (bipolar).

Features a large 1.81" diameter (46 mm) aperture.

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Power Monitoring for Process Control

When machinery goes quiet, everyone looks to you for a solution. While you're scrambling to find the answer and get everyone back to work, the thought that the break down could have been avoided never leaves your mind.

Monitoring the electrical power consumption of equipment will provide valuable information about the condition of the machine and of the process. A single analog signal proportional to the watts being used can be interpreted as an imminent problem before the problem causes damage to product or to equipment. Bearing failures, blocked pump intake or discharge, phase loss and voltage sags will be reflected in the power consumption.

By monitoring changes in power consumption, a significant increase or decrease will point quickly to a problem. Power use rising will indicate a need for maintenance, while declining power consumpton may indicate immediate attention is required. Monitoring inductive loads (motors and transformers) will take power factor into consideration. In applications where a load is not constant or the motor is over sized, the power factor improves as the load increases. The current draw of a standard squirrel cage motor does not rise in proportion to the wattage until the load is around half of the nameplate ratings. Consequently monitoring current only will not be as accurate as sampling power use.

Power Monitoring Applications

- Grinders
  Detect overloaded burrs; optimize feed rate
- Crushers
  Monitor for jammed or worn rolls
- Machine Tools
  Monitor force on the work or dulled bits
- Drill Presses
  Keep the operation working at maximum efficiency
- Cost Allocation
  Monitor the power usage of each machine

Power Monitoring Transducers— An Inexpensive Solution to Costly Interruptions in Your Process

NK Technologies offers several power monitoring transducers. The APS series is well suited for monitoring motor driven loads, or any load where the current is balanced across each phase. The sensor is placed over one conductor, and the line voltage is connected to two terminals.

The loop powered, 4–20 mA output signal is scaled at the factory to represent the demand in watts, based on the primary voltage and the current through the sensor opening. The APS products are suitable for all single phase loads, and balanced three phase loads, with output accurately representing the wattage used. The product features simple two wire loop powered connection to a PLC, data logger or panel meter.

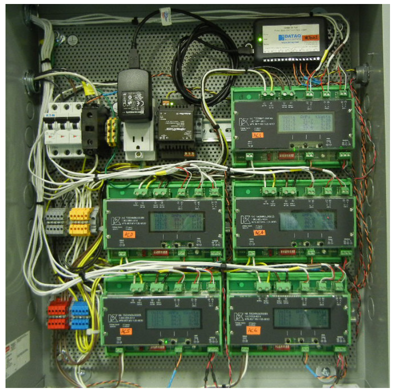
APS Series Solid-Core Case

Digital Power Monitoring/Monitoring Air Conditioning System Power Usage

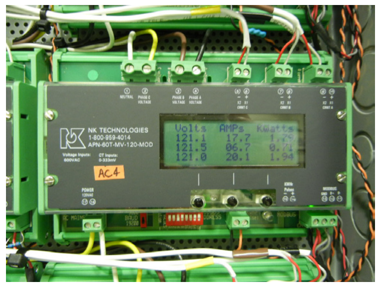
As the cost of electrical power increases, the desire to use less energy also increases and the need to measure power consumption becomes a necessity. Reduction of energy use starts with knowing where the use occurs.

Electrical energy is measured in watts over time. There are many methods to measure electrical power but all have common features. To measure watts in an alternating current circuit, the supplied voltage is compared with the current, and whether the current peaks before the voltage (leading power factor in a more reactive circuit) or the current peaks after the voltage (lagging power factor in a more inductive circuit), the real power is measured.

The old spinning disk and dial indicating watt meters supplied by the serving utility are being replaced by electronic "smart" meters, but they only provide information about the entire service consumption. To monitor individual loads or processes in industry, or more specific consumption in office buildings, watt transducers or monitors can be installed. The purpose is to obtain information regarding more precise information at each installation. This information helps to isolate potential problems such as phase loss or voltage sags and voltage spikes, unbalanced current phase to phase, and can help to avoid utility surcharges levied for poor power factor.



The LCD display shows the data points sent to a controller via network communication. The LEDs show proper network activity.



Five APN monitors monitoring the AC units at NK Technologies' factory in San Jose, CA.

Monitoring Air Conditioning System Power Usage at NK Technologies

NK Technologies has installed APN monitors to measure power use by the air conditioning system as part of its efforts to reduce power consumption at its factory. A data acquisition system designed and built by its engineering staff was also installed.

Five APN sensors are connected to the 120/208 volt power feeding the AC units mounted on the roof of the building. The pulse contact reports watt hour usage to counters made by Dataq Instruments (DI-160). This information is read at regular intervals, allowing auditors to know power consumption of each AC unit. In addition, the APN monitors are also connected via Modbus RTU to an internal wireless network using NK Technologies' WRT transceivers. This allows the details regarding power use to be seen and power usage analyzed at any time.

NK Technologies' New APN Series Power Monitoring Sensor

NK Technologies' APN series of power monitors is a big step forward from analog signal reporting watt consumption to a digital format allowing information on the system voltage, current, and power factor along with wattage. The RS485, Modbus RTU format is compatible with many programmable logic controllers and fits seamlessly into industrial communications networks, both hard wired and wireless depending on the specifics of the application.

APN Series in new redesigned slimmer case.

The APN can be configured to accept standard 5 amp current transformer inputs or sensors producing 333 mVAC proportional to the AC current of the circuit, or they can use factory matched Rogowski coil inputs. The primary circuit voltage is connected directly to the monitor for 600 VAC or lower, or through a potential transformer for monitoring circuits of higher potentials.

The APN is powered from an external supply, improving measurement accuracy of the measurement data. The APN series also provides a pulse contact which opens and closes as watt hours are accumulated. This feature allows for a less complex data acquisition device for applications where the need to monitor circuit voltages or the other data points is minimal.

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Digital Power Monitoring Provides More Information than Analog Signal Reporting

Before contracting to have an energy audit of your entire plant, it makes sense to monitor the power consumption of individual buildings, processes or machines. Knowing which area of your facility uses the most power will help you make decisions about how to reduce the consumption. Using a power monitor to collect data provides time of use, total power consumed and the cost of the power. It also provides a means to detect problems before they become catastrophic. Phase loss, voltage sags (brown out) or phase imbalances are immediately detected, and sustained periods of over or under current can be used to trigger alarms or shut the system down.

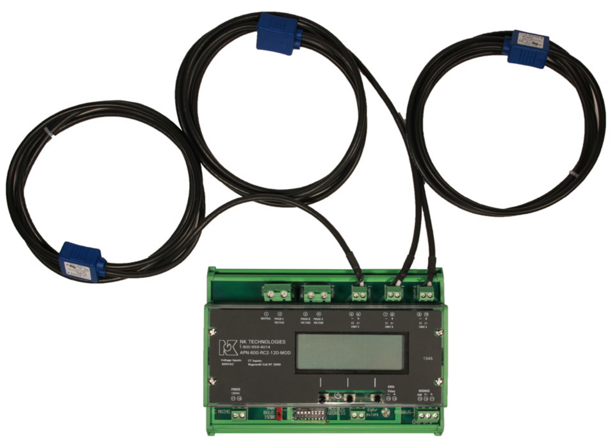
Installation of power monitoring can be a major headache. Since by definition the circuit voltage must be compared with the circuit current, the monitored circuit must be turned off before the installation can proceed. The voltage is then connected to the power monitor directly from a spare circuit breaker or through a fused potential transformer. Each phase current must also be measured and a signal corresponding to the amps used is passed to the power monitor. The most accurate inputs, both voltage and current, are ones with wave shapes nearly identical to the monitored circuit. This allows the power factor to be calculated.

Selecting a current transformer can be a challenge. The easiest approach is to select a split core design, as they allow the existing wire or bus bar to be undisturbed. Placing a split core CT over a wire or bus bar still requires some prior planning: The inside window must be large enough to allow the CT to be closed securely, and with bus assemblies, there must be enough room for the CT "legs" to fit between the bars. Standard 5 or 1 amps CT secondaries should be terminated onto a block with provision to short between the two leads. This extra effort allows the CT and main power to remain in an energized condition if there is a need to remove the power monitor. Leaving the CT secondary open can over heat the CT and create unsafe conditions as the potential between the secondary leads climbs to lethal levels.

NK Technologies' new APN Series takes a big step forward in power monitors from analog signal reporting watt consumption to a digital format that provides information on the system voltage, current, and power factor in addition to wattage. The RS485, Modbus RTU format is compatible with many programmable logic controllers and fits seamlessly into industrial communications networks, both hard wired and wireless depending on the specifics of the application.

APN-R Power Monitors with Rogoswski Coil Inputs Improve Accuracy

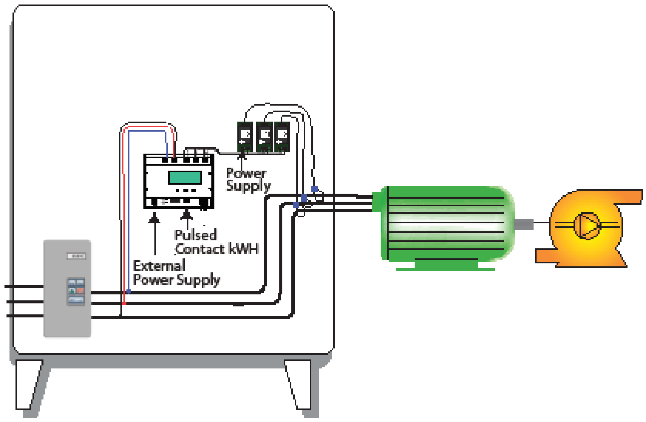
The APN-R design uses factory matched Rogowski coil inputs in two sizes. The flexible cable will conform to most any conductor shape, and can pass easily between bus bars. The Rogowski coil produces an output with very little wave shape distortion and at a very high degree of accuracy.



The primary circuit voltage is connected directly to the monitor for voltage of 600 VAC or lower, or through a potential transformer for monitoring circuits of higher potentials. This new power monitor is powered from an external supply, improving measurement accuracy of the measurement data. The APN-R series also provides a pulse contact which opens and closes as watt hours are accumulated. This feature allows for a less complex data acquisition device for applications where the need to monitor circuit voltages or the other data points is minimal.

Monitoring Power with Flexible Cable Type Current Transformers

Measuring the watts used by a load will help with cost allocation, allowing a plant manager to charge a specific process or department for the energy consumed, along with providing the means to detect maintenance issues such as bearing failure and pump impeller cavitation. A bearing which is not running smoothly causes the drive motor to require more power to turn the supported shaft, while the bubbles formed during cavitation reduces the amount of torque, resulting in lower power usage.



The flexible cable current sensing method, often referred to as Rogowski coils, was refined in 1912 by engineers Walter Rogowski and W. Steinhaus. This method of measuring AC current has some very attractive features. There is no iron core, making the device much lighter and easier to install than toroid-based current transformers. Since there is no permeable core the coils cannot be saturated with high current conditions making them just as accurate with higher circuit frequencies (up to 1MHz) as when monitoring 60 Hz. The flexibility allows the cable to surround multiple conductors or bus assemblies regardless of the shape.

Power Monitoring Applications

- Motors
  Measure motor power consumption when current alone provides insufficient resolution.
- Machine Tools
  Monitor finishing operations such as deburring.
- Car Wash Systems
  Sense brush entanglements.
- Pumping Systems
  Detect dry run, blocked intake or discharge lines, bearing failures and cavitation.
- Cost Allocation
  Monitor the power usage of each machine, process, building or the entire facility.

CTRC Current Transformer for Power Monitoring

NK Technologies' CTRC current transformers use the Rogowski coil as the first step in power monitoring. Each coil is matched with a signal integrator, and the output is calibrated for the highest degree of accuracy possible. The resulting 1/3 volt at full range current mirrors the primary circuit wave shape with less than 0.5 degree difference in the phase angle and overall linearity of better than 1% of the full scale output. When matched with the circuit voltage wave shapes, a highly accurate representation of the system power, measured in watts, can be derived.

The signal integrator is housed in a compact, DIN-compatible enclosure, with 1.5 meter (59 inches) of lead cable from the sensing loop to the integrator. The signal integrator is powered with 24 volts, AC or DC, consuming less than one watt each. The narrow dimension of the lead cable (0.87 inches) allows for installation in very close quarters, easily passing between the monitored conductor and the adjacent phase. The coils are rated to 600 VAC and do not require shorting blocks between the integrator and the connected load. Even when the current through the loop exceeds the design range the low voltage output remains at non-hazardous levels.

AC Power Measurement – Digital Output

Measuring the wattage used by a load can be very simple if the load is powered with direct current from a battery source. Measure the current and multiply that reading in amperes by the battery voltage. Add a battery charger, such as a photovoltaic panel and the voltage must also be measured because the charging voltage will vary, but the math is still simple. Volts times amps equals watts. However, this doesn't work as well with AC circuits unless the load is purely resistive, but that condition is only theoretical. There always will be some component adding inductance or capacitance or both. Any inductance (motors, transformers, etc.), will cause the current rise and fall to lag the voltage rise and fall, and capacitance will cause the current rise and fall to lead the voltage. Both cause the actual or real power (watts) to be lower than apparent power (or volts amperes). The difference is often termed as power factor and is calculated by dividing the real power by the apparent power.

Single phase wattage is calculated by multiplying the voltage by the current, then by the power factor and then by the efficiency. While the first three values change when the load is energized, efficiency (ratio between power input and the power output of the load) changes very little and is usually considered to be a constant. Three phase power is calculated using the same formula, but the result is finally multiplied by the square root of three.

Some approaches to measuring power take a simple but less than optimal approach: Measure the current, assume the voltage is constant and guess at the power factor. This method will show if there are major changes in a load, but if the goal is to convert power used into dollars spent with the serving utility, a higher degree of precision is needed. Fortunately there are easy ways to take the complexity out of this procedure.

A simpler approach is to connect the line voltage and current transformer secondaries to a single device and let the latest digital technology do the calculations. This will provide the most important information about the monitored load conditions, and do so accurately.

Power monitors can provide current, voltage, and power factor information along with kilowatts and kilowatt hours. Whether your requirement is to monitor the wattage consumed by a machine, a building, or an entire plant with a single analog signal representing the consumption, NK Technologies has a solution.

APT and APN Series of Power Monitors

Both the APT and APN Series Power Monitors measure three phases of current and voltage. The APT produces an industry standard analog signal proportional to the watts used while the APN computes fourteen values necessary to track power usage. which results in 14 data points in the RS485 Modbus RTU format

The monitors use current transformers to measure the amperes. The line voltage connects directly to the transducer, up to 600 VAC. There is also a pulse contact which opens and closes as watt hours are accumulated.

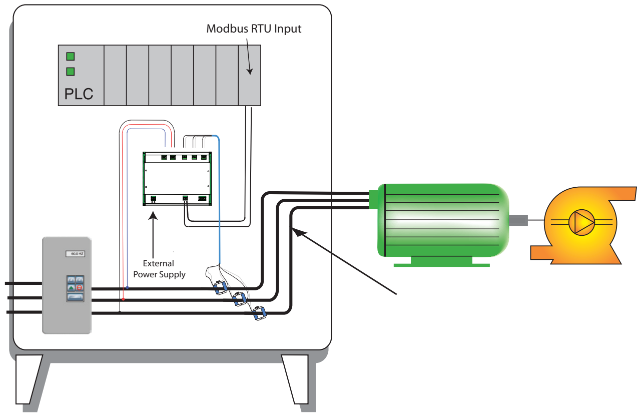
Both APN and APT power monitors are available powered with 24 volts AC or DC, or 120 and 240 VAC. Current signals can be provided from standard 5 amp secondary current transformers, the safer 333 mVAC output ProteCT models or Rogowski coils to 2000 amps. Any output willl produce an accurate set of data to help you save energy and avoid utility surcharges.

APN Series with digital display named Nasa Tech Briefs 2014 Product of the Year Finalist.

APT Series offers industry stanadard analog output.

Power Monitoring Using Power Transducers

Approximately 60% of the electrical power used in industry worldwide powers electric motors. Monitoring the amperes used by a motor will usually provide enough information to the operator to ensure the equipment runs as designed and to avoid break downs caused by overheating, since excess current is the primary cause of most electrical failures.



Measuring current alone is very useful as a part of a predictive maintenance program (PdM), but to relate energy use of a process or a machine in dollars means measuring the real power consumption. A power supplier does not bill for current or kVA (kilo volt amperes) but for wattage consumed. The difference between kVA and KW is that power factor and efficiency are taken into account when calculating watts.

A standard squirrel cage AC induction motor draws 25-35% of the full load current (FLA) with no load driven (open shaft condition), and the power factor may be as low as 0.30 at no load, rising to 0.85 or better at full load. Usually the only time no load conditions are encountered is when a drive belt has broken or has come off of the sheave, or a shaft coupling has broken leaving the motor shaft turning but no work accomplished.

Conditions where the motor draws less than full load are commonplace. Depending on the application this may indicate a major problem. If the drive motor is oversized for the application, the motor may never draw full load current. Monitoring a load using an oversized motor will likely require measuring power (watts) rather than just current as power factor will be poor, and current rise or fall will be less dramatic than if the current draw is closer to full load ratings. If the actual cost of operation is needed, wattage must be known.

Measure Wattage Reliable with APT Power Transducers

The NK Technologies APT series power transducera are a simple and reliable way to measure wattage, whether for one motor, one machine, or an entire building. Using three current transformers and connected directly to the primary circuit voltage up to 600 VAC, the APT transducer produces an industry standard analog signal of 4-20mA, 0-5 or 0-10 VDC in direct proportion to the watts consumed. The choice depends on what your programmable logic controller, panel meter, or data acquisition system can understand.

APT Power Monitor with Analog Output

The output signal allows you to monitor the power used and report the use to a website, a local display, or to be used to send alarms when the power rises to abnormal levels or falls to unexpected levels. Using too much power is never good, and too little can point to other problems, like a blocked intake or outflow from a pump, a broken or slipping coupling or belt, or a brown out (under-voltage) condition or phase loss.

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Ground Fault Sensors Can Prevent Costly Shutdowns in Industrial Processes

Since the late 1960's, the National Electric Code has required ground fault circuit protection in many areas; each revision cycle seems to add new requirements. The requirements for personnel protection in bathrooms, construction sites and for most outdoor mounted outlets has greatly reduced the number of deaths by electrocution. More recent versions have added requirements for equipment protection, which are designed to prevent damage from phase to earth faults.

In many industrial processes, shutting down the process would create huge maintenance issues. For example, it is common to use heat trace to keep material flowing through a pipe at a consistent temperature. De-energizing the heat cable would likely damage the product. Using an NK Technologies' sensor to trip an alarm may prevent costly material losses and allow the system operator to take preventative action at a more convenient time.

Ground Fault Monitoring

- Snow Melting Mats
  Monitor for insulation deterioration
- Heat Trace Cable
  Detect leakages before cable runs become dangerous
- Industrial Heating
  Detect failing elements quickly
- Submersible Pumps
  Monitor for moisture ingress or failing installation
- Semiconductor Fabrication
  Protect etch and cleaning processes
- Water Features
  Detect faults before they become hazardous
- UV Light System
  Keep sanitization or curing processes safe
- Pool Lighting
  Provide protection regardless of the circuit voltage
- Soil Heating Mats
  Keep greenhouse systems safe

AG and AGL Series Ground Fault Indicators

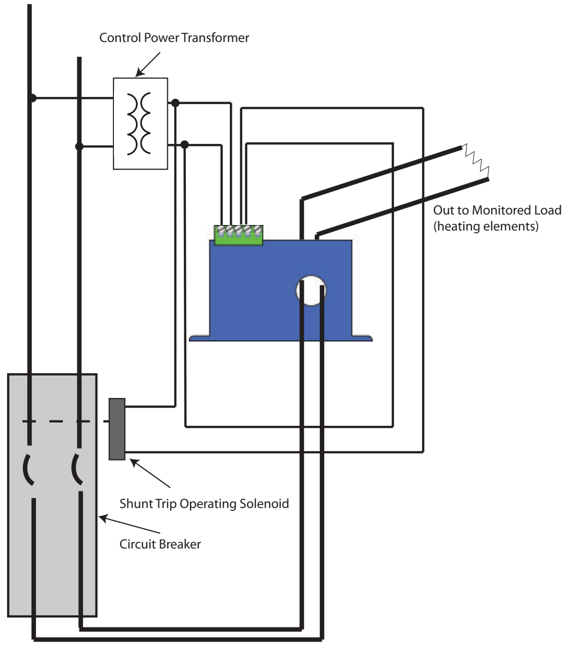
Monitoring a three phase circuit for ground fault current requires more than comparing the hot and neutral loads. NK Technologies' sensors monitor all current carrying conductors at the same time. If more current is used at the load than is being returned to the source, there is earth leakage. This leakage can be detected by using our extremely sensitive ground fault detection products like the AG and AGL Series of ground fault sensors.

These sensors allow the system designer to choose what the sensor output will do if a fault to ground is sensed. The output contact can be selected to close, operating a shunt trip circuit breaker, or a contact can open the circuit to a contactor coil. Both would shut down the monitored load.

Detect Earth Leakage Easily with NK Technologies' Ground Fault Protection or Ground Fault Protection Solutions

The drawing to the right shows an NK ground fault sensor powered from the primary (load carrying) circuit through a control power transformer. The sensor can be powered by 120 VAC or 24 VAC or DC. The output of the sensor is a single pole, double throw relay, so when used to operate a shunt trip circuit breaker operating mechanism, the normally open contact of a normally de-energized model would be the best choice.

With the -DEN model contact action, the sensor operates the output relay only when fault over the set point occurs. When power is applied to the sensor, an indicating LED will light. Another LED will indicate when the sensor has tripped. The voltage of the primary circuit can be up to 600 volts AC and meet the requirements of UL. Remember that all current carrying conductors must pass through the sensing aperture, including the neutral if the load uses one.



Ground Fault Protection Solutions

NK Technologies manufactures ground fault sensors which can be used in a wide range of applications monitoring AC circuits, from operating a shunt trip circuit breaker to sending an alarm contact to a programmable logic controller. Most models are UL recognized as a component under UL1053, ground fault sensing and relaying equipment. The trip point of the sensor is factory adjusted, so you can be assured that it will work as designed, reliably and accurately.

Some models can be adjusted for a higher or lower trip point. This is commonly used where the protected load is inductive, such as a motor or transformer. Motors are made by winding small varnish insulated wire around laminated steel cores, and small bubbles or gaps in the insulation can allow minuscule amounts of electricity to pass to ground through the motor frame. While the generally accepted equipment protection fault protection level is 30mA, these small insulation imperfections can produce fault current of 30mA easily, so the installer can adjust to a higher level to overcome spurious tripping of the sensor.

AGL Series

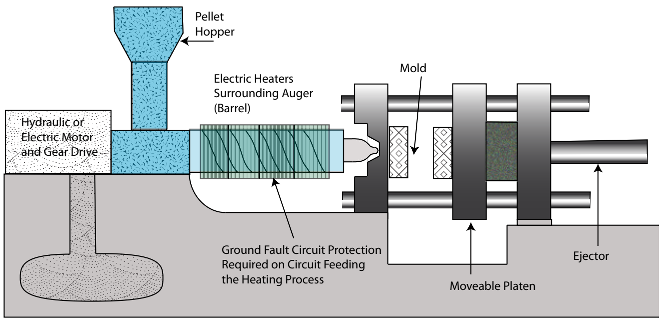
AG Series

AGT Series

Electrical Heating System Protection From Faults to Ground

The National Electric Code requires that all (with few exceptions) electric heating sources be protected against faults to ground. While the requirement is not to protect a person from being shocked when working at the process being heated, the method of detecting the fault is the same as when electrocution or electrical shock protection is needed. Bare feet on a bathroom floor provides a dangerous path for current to flow from a hand held hair dryer, where touching equipment during a fault while standing on a concrete floor with work boots is much less hazardous. Disconnecting the circuit is the best protection in both instances, and the faster the circuit is de-energized the safer the installation.

Most heating protection against ground fault is termed "equipment protection" and the target fault current level that will cause the faulting circuit to be de-energized is 30 milliamperes, although this value is arbitrary and can be much higher if the need arises. In general, a heating element will either work as designed or it will short to ground, with only a few instances where insulation deteriorates causing current to leak to earth in lower quantities.



In a plastic injecting molder application, the plastic pellets are melted using electric heater bands between the hopper and the nozzle directing the plastic into the mold. If the heaters fail, the best approach is to let the process complete rather than disassembling the machine to clean out the solidified plastic.

Electric Heating Applications

- Heat Trace Cable
- Snow Melt Mats
- Fuel Preheaters
- Plastic Injection Molding
- Drying
- Finish Curing
- Water Heating
- Baking

NK Technologies' Ground Fault Protection

Since the late 1980's, NK Technologies has been manufacturing current sensors made specifically for sensing fault current in AC branch circuits of 50 amps or lower. By using the zero sequence concept, a single magnetically permeable toroid surrounds all of the current carrying conductors. If there is any current over five milliamps flowing to ground, the sensor actuates a contact. The contact can be used to open the circuit of an operating coil of a contactor, close a shunt trip breaker solenoid, or in applications where turning off the offending circuit would create a major problem, the contact can be used to alarm an operator or controller.

NK Technologies makes sensors using this technology with larger circuit monitoring capacity by enlarging the window through which the conductors pass. This makes it possible to monitor conductors carrying over 200 amps. NK Technologies also manufactures sensors designed to produce an analog signal directly proportional to the fault current. This output can be used to identify areas where insulation is failing, allowing the user to take corrective measures before equipment is damaged.

Detect Current Leakage for Preventive Maintenance with 4-20mA Current Transducers

Imagine having the ability to detect a leak in a pipe before the liquid or gas escapes. You could repair or replace the pipe when convenient, while the equipment was at rest or during a scheduled shut down. Sensing electrical current leakage to earth can give you this ability. Monitoring the current supplied to any AC load by surrounding the conductors with a sensing ring will show if any amount of power used is not returned to the source. This lost power is "leaking" to earth.

Faults to ground occur generally in one of two ways: (1) An energized conductor will contact a grounded point, creating sparks, smoke or fire. This will usually trip the over current protection, either a circuit breaker or fuses. But metal will incandence with a fault of just 500 milliamps. (2) Insulation deteriorates causing low level current to pass to earth. This failure will seldom create enough fault current to trip a breaker or blow a fuse. The former fault occurs instantaneously, but the latter often occurs very slowly, and it occurs very frequently. This creates hazardous conditions putting operators and maintenance personnel at risk for electrocution, and increasing the probability the equipment will be damaged, resulting in production stoppage.

Current Leakage Detection

• Monitor heating or other loads to detect increasing leakage current
• Pass all current carrying conductors through aperture to sense zero-sum current

Monitoring Very Light Loads

• Measure very small, critical loads accurately
• Current measurement gives faster response than temperature measurement

AGT Ground Fault Indicators Use Proven Zero Sum Technology to Detect Earth Leakage

NK Technologies' new loop powered sensor for monitoring earth leakage is based on proven, zero sum current technology. This new sensor produces a constant signal proportional to the leakage current. The industry standard 4–20 mA output can be connected to a PLC or data logger, with the 4 mA signal representing no earth leakage, and 20 mA representing fault current of either 50 or 100 mA (dependant upon choice of unit).

As the insulation degrades the fault current increases. The controller can be programmed to alarm at one level, for example, 15 mA and disconnect the load if the fault increases over 30 mA. These parameters can be established in advance by the design engineer and are easily programmed in the controller.

Monitoring residual earth leakage current is required in many applications from electrical heating elements to water fountain pumps. Using a constant signal proportional to the fault current will help protect any electrically driven machine or process.

The Basics of Current Transformers

Current Transformers (CTs) can be used for monitoring current or for transforming primary current into reduced secondary current used for meters, relays, control equipment and other instruments. CTs that transform current isolate the high voltage primary, permit grounding of the secondary, and step-down the magnitude of the measured current to a standard value that can be safely handled by the instrument. To determine which CT is appropriate for a particular application, it is important to understand the following characteristics that are used to classify current transformers.

Ratio

The CT ratio is the ratio of primary current input to secondary current output at full load. For example, a CT with a ratio of 300:5 is rated for 300 primary amps at full load and will produce 5 amps of secondary current when 300 amps flow through the primary. If the primary current changes the secondary current output will change accordingly. For example, if 150 amps flow through the 300 amp rated primary the secondary current output will be 2.5 amps (150:300 = 2.5:5).

Polarity

The Polarity of a CT is determined by the direction the coils are wound around the core of the CT (clockwise or counter-clockwise) and by the way the leads, if any, are brought out of the transformer case.

All current transformers are subtractive polarity and will have the following designations to guide proper installation:

(H1) primary current, line facing direction; (H2) primary current, load facing direction; and (X1) secondary current.

Taking care to observe proper polarity is important when installing and connecting current transformers to power metering and protective relays.

Accuracy Class

Accuracy Class describes the performance characteristics of a CT and the maximum burden allowable on the CTs secondary. Figure 1 shows typical accuracy classes. Depending on their Accuracy Class, CTs are divided into Metering Accuracy CTs or Relaying Accuracy CTs (Protection CTs). A CT can have ratings for both groups.

Metering Accuracy CTs are rated for specified standard burdens and designed to be highly accurate from very low current to the maximum current rating of the CT. Because of their high degree of accuracy, these CTs are typically used by utility companies for measuring usage for billing purposes.

Relaying Accuracy CTs are not as accurate as Metering Accuracy CTs. They are designed to perform with a reasonable degree of accuracy over a wider range of current. These CTs are typically used for supplying current to protective relays. The wider range of current allows the protective relay to operate at different fault levels.

The CT Accuracy Class is listed on the label or the nameplate of the CT and is comprised of three parts: rated ratio accuracy rating, class rating, and maximum burden (Figure 2).

Rated Ratio Accuracy Rating is a number which is the rated ratio expressed as a percent. For example, a CT with an accuracy class of 0.3 is certified by the manufacturer to be accurate to within 0.3 percent of its rated ratio value for a primary current of 100 percent of rated ratio.

Correction Factor Limits for CTs				
Accuracy	100% Rated Current		10% Rated Current	
Class	Min	Max	Min	Max
1.2	0.998	1.012	0.976	1.024
0.6	0.994	1.006	0.988	1.012
0.3	0.997	1.003	0.994	1.006
0.5	0.995	1.005	0.995	1.005

Figure 1: Typical Accuracy Classes and Correction Factors

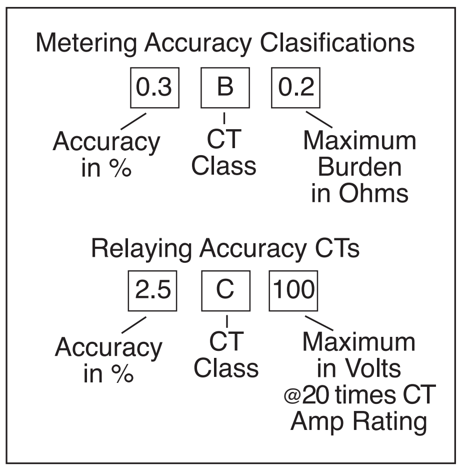


Figure 2: Examples of Accuracy Classifications for Metering CTs and Relaying (Protection) CTs.

CT Class Rating is a letter that designates the application for which the CT is rated. Metering CTs are designated with the letter B. Relaying CTs have several different letter designations:

- C: The CT has low leakage flux. (Accuracy can be calculated before manufacturing.)
- T: The CT can have significant leakage flux. (Accuracy must be determined by testing at the factory.)
- H: The CT accuracy is applicable within the entire range of secondary currents from 5 to 20 times the nominal CT rating. (Typically wound primary CTs.)
- L: The CT accuracy applies at the maximum rated secondary burden at 20 time the rated current. The ratio accuracy can be up to four times greater than the listed value, depending on connected burden and fault current. (Typically window, busing, or bar-type CTs.)

The third part of the CT Accuracy Class is the maximum burden allowed for the CT. This is the load that may be imposed on a transformer secondary without causing an error greater than the stated accuracy classification. For Metering Class CTs burden is expressed as ohms impedance. For Protection-class CTs burden is express as volt-amperes (VA). Protection-class CT burdens are displayed as the maximum secondary volts allowable if 20 times the CT rating were to flow through the secondary circuit (100 amperes with a five-ampere nominal CT secondary).

Calculating CT Burden (Figure 3):

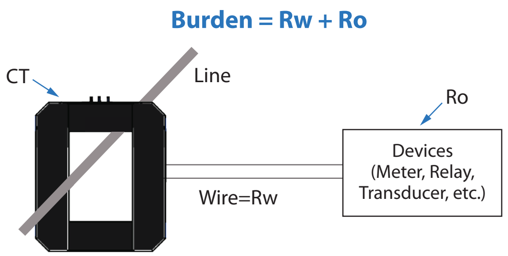


Figure 3: Calculating CT Burden

1. Determine the burden of the device connected to the CT in VA or ohms impedance. (Stated on the data sheet for the device.)
2. Add impedance of the secondary wire run. Measure the length of the wire between the current transformer and the burden (i.e. meter, relay, etc.) Refer to the table at the right to determine the resistance in ohms or VA, of the wires that connect the secondary of the current transformer to the device.
3. Make sure the total burden does not exceed the specified limits for the CT.

Examples of Burden Calculations:

Metering CT: The ratio of a 0.3B0.1 rated Metering CT is accurate to 0.3 percent if the connected secondary burden if impedance does not exceed 0.1 ohms. A 0.6B8 rated metering-class CT will operate within 0.6 percent accuracy if the secondary burden does not exceed 8.0 ohms.

Relaying (Protection) CT: A 2.5C100 Relaying CT is accurate within 2.5 percent if the secondary burden is less than 1.0 ohm (100 volts/100 amperes).

If the CT has a stated burden of 8VA, the total connected secondary load cannot exceed 0.32 ohms. This includes the resistance of the secondary wire leads and the connected load (panel meter or power monitor). Using 18 AWG wire for the secondary means that the current transformer must be less than 18.95 feet from the connected load (37.9 feet divided by two, The maximum distance from CT out to the load and back to the current transformer). This table is based on 5 amp secondary current transformer types.

Allowable Burden Expressed As[1]		Allowable Lead Length in Feet for Copper AWG Wire[2]					
VA	Ohms[3]	18	16	14	12	10	8
1	0.04	4.7	7.6	12.3	19.5	31.0	49.4
1.5	0.06	7.1	11.3	18.4	29.3	46.5	74.2
2	0.08	9.5	15.1	24.5	39.0	62.0	98.9
3	0.12	14.2	22.7	36.8	58.5	93.0	148.3
4	0.16	18.9	30.2	49.1	78.0	124.0	197.8
5	0.20	23.7	37.8	61.3	97.6	155.0	247.2
6	0.24	28.4	45.4	73.6	117.1	186.0	296.7
7	0.28	33.1	52.9	85.9	136.6	217.1	346.1
8	0.32	37.9	60.5	98.2	156.1	248.1	395.6
9	0.36	42.6	68.1	110.4	175.6	279.1	445.0
10	0.40	47.3	75.6	122.7	195.1	310.1	494.4
12	0.48	56.8	90.7	147.2	234.1	392.1	593.3
14	0.56	66.3	105.9	171.8	273.2	434.1	692.2
16	0.64	75.7	121.0	196.3	312.2	496.1	791.1
18	0.72	85.2	136.1	220.9	351.2	558.1	890.0
20	0.80	94.7	151.2	245.4	390.2	620.2	988.9
25	1.00	118.3	189.0	306.7	487.8	775.2	1,236.1
30	1.20	142.0	226.8	368.1	585.4	930.2	1483.3
35	1.40	165.7	264.7	429.4	682.9	1,085.3	1,730.5
40	1.60	189.3	302.5	490.8	780.5	1,240.3	1,977.8
45	1.80	213.0	340.3	552.1	878.0	1,395.3	2,225.0
50	2.00	236.7	378.1	613.5	975.6	1,550.4	2,472.2

[1] See the NK Technologies' Product Catalog for Allowable Burden. Add any other resistance such as terminations, etc.
[2] Lead length is the total wire run (out and back). Divide by two to get the lead distance.
[3] Resistance for 5 Amp output CTs.

Current Transformer Shorting

CTs should remain shorted during installation until secondary wiring is complete. Figure 5 shows the termination of a multi-ratio CT on a shorting terminal strip.

A shorting screw inserted through the shorting bar ties isolated terminal strip points together. Any shorting winding effectively shorts the entire CT.

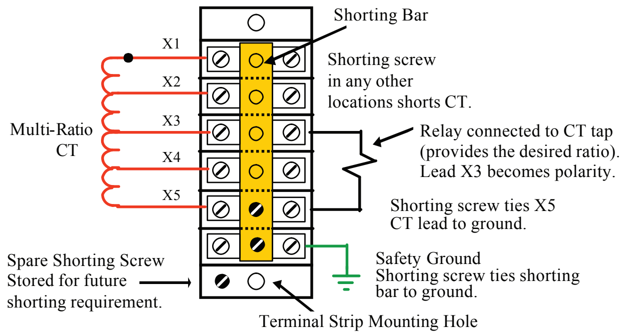


Figure 4: Termination of a CT on a shorting terminal strip.

Use Caution When Installing a Current Transformer

- Inspect the physical and mechanical condition of the CT before installation.
- Check the connection of the transformer requirments for the instrumentor the system requirements before connecting the CT.
- Inspect the space between the CT phases, ground and secondary conductor for adequate clearance between the primary and secondary circuity wiring.
- Verify that the shorting device on the CT is properly connected until the CT is ready to be installed. The secondary of the CT must always have a burden (load) connected when not in use. NOTE: A dangerously high secondary voltage can develop with an open-circiuited sencondary.

Current Transformer Model Options

There are many methods of measuring electrical current, but when the requirement is to replicate the primary current wave shape, toroid based current transformers are the most common and least expensive method available. Current transformers are available in solid-core or split core designs A split-core case allows the transformer to be installed after the conductors are in place. Pull the top bar off the sensing ring and set the transformer underneath the wires or bars. There are also CTs with larger sensing windows that will easily accommodate the conductors. Multiple wires per phase will pass through the aperture without extra efforts.

CT-MS & CT-LS current transformers feature larger sensing windows for easy installation around larger conductors and multiple wires.

ProteCT™ current transformers eliminate the need for a shorting block, and produce only a very low voltage when they are in an open secondary condition, a safety feature inherent in the product design. The drawback is that the power monitor or panel meter must be designed to accept the low voltage input. The need to calculate burden is eliminated, as the output signal can be read at a long distance from the measuring location with very little added error. The secondary leads from the ProteCT™ to the connected load should be a twisted pair, with shielding optional by highly recommended.

ProteCT ™ current transformers eliminate the need for a shorting block.

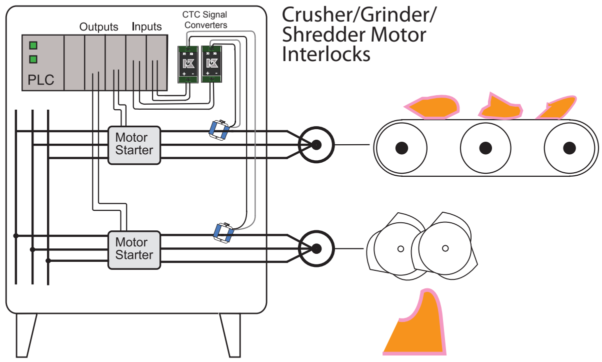
A current transformer can also be used as an input to a current relay or transmitter, or to reduce the current so that a current switch or transducer can be utilized. Simply short the secondary of the CT through the sensing window of the sensor and a trip point between 1 and 5 amps can be established with a current switch, or a transducer with a range of 0–5 amps can be used, one with a range of 0–10 amps if the CT secondary is looped through the sensor twice.

Converting a CT Signal to a Standard 4–20 mA Output

In some applications, such as monitoring a high voltage system, using a two-piece solution (current transformer and separate signal converter) works better than using a one-piece sensor. A two-piece solution is also a better choice when the system is supplied with bus bars, making installation of a sensor over the conductor extremely difficult or impossible.

In a two-piece solution, the installer connects the secondary of a standard 5 amp current transformer to the input terminals of the CTC device, and then connects the CTC secondary to a nominal 24 volt DC supply and then to the PLC or panel meter input. The converter will then produce 4 mA when there is no current through the primary CT, and 20 mA when the CT has full range current present.

As an example, if the requirement is to monitor the current used by a large enterprise, supplied with a 2000 amp, 480/277 VAC service, a split-core CT with a ratio of 2000:5 is installed over the bus in the switchboard. The secondary of the CT can be connected to the CTC, the output signal connected to a panel meter, and the meter can be scaled to read 2000 when the system is fully loaded, or the meter can read 100%. As is always the case, a load (the CTC converter) must be connected whenever the CT is energized.



Monitoring AC Current

- Photovoltaic Power Generation
- Plastics Injection Molders
- Semiconductor Fabrication
- Petroleum Refining
- Building Energy Management
- Wood Processing
- Water Treatment Facilities
- Mining Processes

CTC Series Signal Converters

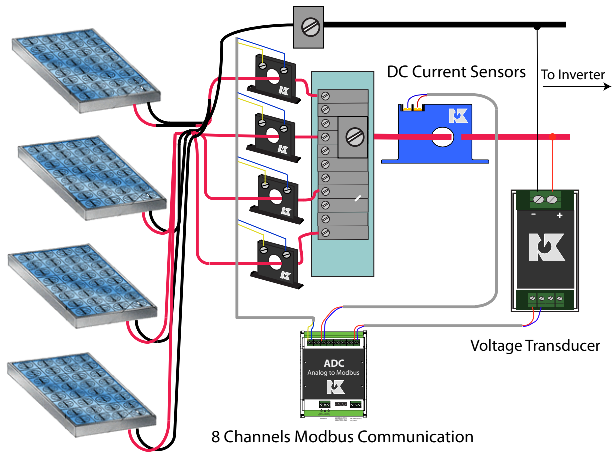
Most of NK Technologies products combine a current sensing element (toroid or hall effect based) with the signal conditioner in one package. The addition of the new CTC converter makes it possible to convert any 5 amp secondary from a CT or 0.333 VAC signal from a ProteCT™ sensor to an industry standard 2-wire, loop powered 4–20 mA output.

The CTC Series provides a solution in applications where installing a one-piece sensor is not possible. And since the sensor output is industry standard, two and one piece solutions can be mixed in the same controller cabinet.

CTC Signal Converter mounted on a DIN rail.

Converting an Analog Signal to a Modbus Output

All industries are interested in improving their processes whether it affects quality or safety, or reduces cost. The use of sensors to continually measure and monitor the process is growing as plant managers see the benefits of keeping the process at the right temperature, scrapping less product due to break downs, and using the least amount of energy possible. Each sensor has a specific function and each are equally important to the process.



The ADC Series Analog to Digital Converter provides the perfect solution for monitoirng a photovoltaic power production system that collects input from multiple sensors.

Monitoring AC Current

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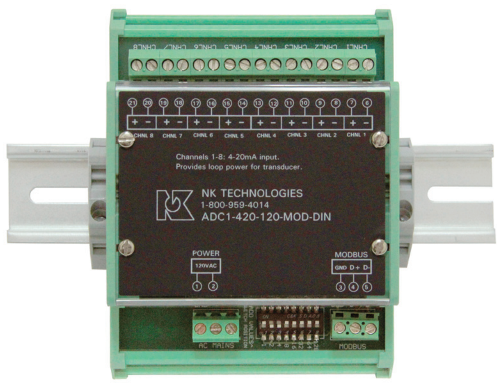
ADC Series Digital Converters

The ADC Series allows up to eight 4–20 mA output signals to be connected to one converter in three combinations of signal types and powered from either 120 or 240 VAC. For sensors that use a two-wire design with 24 VDC connected in series with the sensor output, NK Technologies offers a model that will power and convert up to eight inputs.

Many 4–20 mA sensors use a separate power supply in a four-wire design (two for power input, and two for signal output). The ADC converter can be ordered with up to eight four-wire inputs or a combination of four two-wire and four four-wire inputs.

Each input signal can be read across the Modbus network. For example, a sensor producing 20mA with 100 amps through the window will be seen digitally as 100% with the same 100 amps being used. Each group of inputs are assigned one Modbus address.



The ADC converter allows for individually ranged devices to interface with the industry standard Modbus RTU serial protocol.

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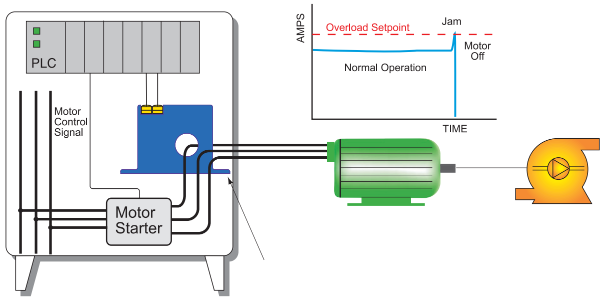
Current and Power Sensing for System Integrators

AC Current

A current transducer is a cost effective method to measure the work being done by a process and detect potential issues before they become catastrophic breakdowns. A clogged intake or loss of head pressure in a pump system will cause the drive motor to use less current than normal. The same condition occurs if the discharge is open, which in a sewage lift station means immediate intervention is required.

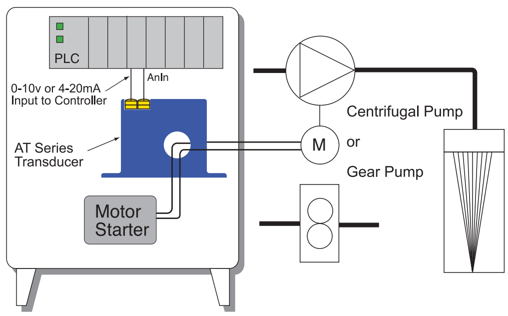
Pump Jam Suction Loss



A failing bearing will cause the motor to draw more than normal current, and using a current sensor will notify the operator of a problem long before the overload protection in the starter will react. Additionally, a current transducer can be used to shut down the system, if the system designer so chooses.

Many AC motors are driven with variable speed drives to safe energy, and while the output is much cleaner with regard to the wave shape, none are sinusoidal. An RMS responding sensor will produce a signal directly proportional to the current used. This can be connected to a second drive to match speed or work loading.

Centrifugal Pump Monitoring

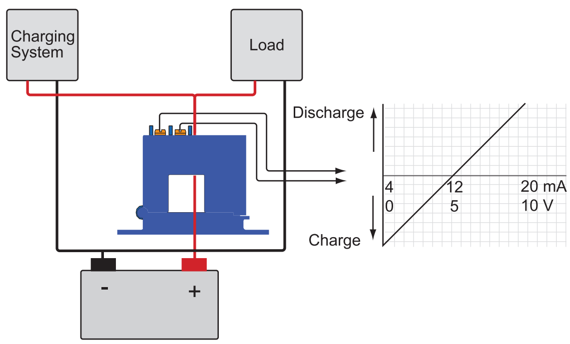


Monitoring a heating load controlled by phase angle fi red SCR's accurately also requires RMS sensing, but a simple current switch or relay will detect whether an element has failed without the latency resulting from monitoring temperature only.

AC Power

Monitoring current only might not be enough, if the pump or drive motor runs at low power factor. Monitoring power will produce a signal directly proportional to the watts (work) being used. NK Technologies APS sensor is a very compact, self contained device that will do this job perfectly. One phase is passed through a single aperture from left to right, another from right to left, and both monitored phases are connected to the circuit voltage. With this unique method of field wiring, the sensor measure the current and voltage continuously, and produces a 4–20 mA loop-powered signal which represents the true power, not just voltamperes.

Battery Charging



DC Current

DC Systems are becoming more and more common, with photovoltaic panels on many more homes and businesses. The advantages over current shunts are many: There is no need to cut and terminate the conductor, the non-contact nature of the sensor adds to burden to the system, and temperature changes cause much lower error. NK Technologies manufactures DC current transducers with ranges from 0–5 to 0–2000 amps, with a variety of outputs available to interface with panel meters, programmable logic controllers or building energy management systems.

The sensors can be used to monitor any DC voltage to 600 and still carry the UL logo, allowing your panel design to be safe and accurate in the widest variety of applications.

Whether the load uses a battery as a backup or the primary source and current flow direction must be known, or the use of a welding operation is to be monitored and studied, NK has a sensor with the range, accuracy and reliability you need and your customers demand.

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FIVE YEAR 5 WARRANTY
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Monitoring DC Systems In Industry and Alternative Energy

Direct current is used in many industrial processes. In most cases, AC power is used for delivery of the power, and then converted to DC though electronic modification. Computers use 5 and 12 volts DC, servo motors operate with voltages from lower than ten to 200 or much higher, and large DC motors often are designed to use 750 VDC.

Since the speed of the motor is directly proportional to the voltage supplied, DC motors have historically been the first choice for moving loads at varying speeds. From system control to heavy lifting, DC power is used all over the plant.

With the renewed interest in alternative power sources, DC systems are found in photovoltaic solar power and wind power generation. Photovoltaic systems produce low voltage DC power from each cell, and each cell is connected in series to boost the voltage to higher levels so the effect of impedance is minimized. Wind generators are often designed to charge batteries at 12 or 24 volts, and some produce DC voltages to 240 depending on the need or application.

Monitoring DC Voltage

• Cranes, Crushers, Shredders, Debarkers, Saws
Monitor motors and

• Cell Phone Sites, Water Craft, UPS backup
Battery Chargers

• Photovoltaic Arrays
Detect reduced panel output caused by dirt or unexpected shade

• Wind Generators
Monitor the output voltage from your generator with the assurance that the system is operating properly

VDT Series DC Voltage Transducers

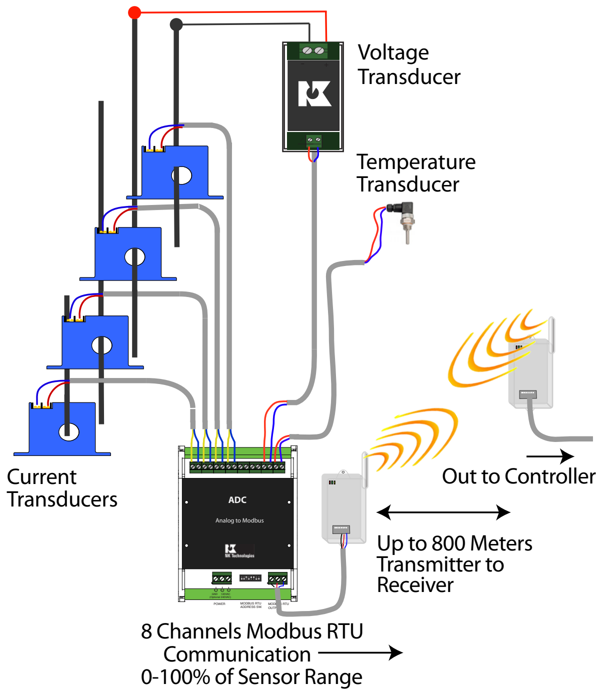
NK Technologies manufactures small, DIN-rail mounted DC voltage transducers with ranges from 15 to 600 volts. The standard output is 4–20 mA, powered by an external 24 VAC/DC supply. They can be installed in any control cabinet, enabling a control system to know exactly what voltage is being applied to a load. The sensor output can be used with most data acquisition systems, programmable logic controllers, and panel meters.

Field connections are made easy by attaching the sensor output to the controller, adding the external power supply, and connecting the sensor to the positive and negative of the primary circuit. The controller is scaled so the 20mA signal represents the sensor range maximum, with standard ranges to 600 volts.

Transmit Data Wirelessly From Up to 800 Meters Away

All industries are interested in improving their processes, whether in the area of quality, safety or cost reduction. The use of sensors to continually measure and monitor the process is growing as plant managers see the benefits of keeping manufacturing processes at the right temperatures, scraping less product due to break downs and using the least amount of energy possible. Each sensor has a specific function and each are equally important to achieve the overall goal of the perfect process.

NK Technologies makes a large selection of sensors to measure electrical parameters, including current, voltage and power. The majority of these sensors supply an analog signal in proportion to the measured value. These can be converted to Modbus RTU through our ADC product, but the data still must be delivered to a controller or data acquisition system. The RS485 output can be transmitted via wire, but in some applications this is not an option. With the WRT series radio transmitter, data can be communicated between transmitter and controller from up to 800 meters away.



Applications
- Photovoltaic Power Generation
- Plastics Injection Molders
- Semiconductor Fabrication
- Petroleum Refining
- Building Energy Management
- Wood Processing
- Water Treatment Facilities
- Mining Processes
- Produce Handling Systems
- Coal Fired Power Plants

WRT Series Wireless Data Transmitter/Receiver

NK Technologies' WRT radio unit can be configured as a master to accept several data sources or can be used to transmit the data from one source only. Each unit can be configured for channel frequency, network address and can also be set so multiple groups of transmitters can be used to cover more location data points. The transmitter is small and can be mounted on a wall or in an appropriate enclosure if the environmental conditions require the unit be protected. A non-metallic enclosure will allow the units to communicate without interference.

Configuring the transmitters is easily done in the field, and we highly recommend using three units to provide the best self-healing, self-forming wireless network possible. The 2.4 GHz (IEEE 802.15.4) operation provides a worry free data stream, insuring that your equipment is protected by providing all of the information you need and want.

With the WRT series radio transmitter, data can be communicated between transmitter and controller from up to 800 meters away.

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