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White Paper: The Importance of Isolation

Learn How to Recognize the Need for Isolation

Examining important aspects of electrical isolation, what it does for you, why it is needed, and how to test for it

 8500-988A

Acromag is in the business of signal conditioning. We manufacture circuits that amplify, isolate, filter, and convert one signal form to another. Most of these circuits also provide electrical isolation. But added isolation has a cost and our customers sometimes question their need for isolation, or fail to recognize the need for adding isolation in their application. This paper covers the basic aspects of electrical isolation, what it does for you, why you need it, and how we test for it. You can download this document and others from www.acromag.com.

Briefly, electric current refers to the conceptual flow of atomic particles or electrons through wires and electrical devices. Conductive materials like metal and water allow electric current to easily pass through them. The force that drives electric current to flow through a conductive medium is potential difference or voltage, and the opposing force that curbs or limits this current flow is resistance. Comprised of 60% water, the human body is an excellent conductor, except that electric current from a source allowed to pass through the body can induce injury via electric shock. Materials that are weak conductors of electricity have a high resistance to current flow and are often used to add isolation or insulate circuits. In general, greater force (voltage) along a conductive path will drive higher current flow, which if poorly controlled in the absence of resistance (insulation or isolation) may result in circuit damage, personal injury, or even death.

WHAT IS ISOLATION?

With respect to electric circuits and electronic instruments, the term isolation refers to the deliberate introduction of a non-conductive separation to inhibit current flow. This process of blocking current flow such that there is no direct conduction path between circuits is often referred to as Galvanic Isolation. This term sometimes causes confusion because “galvanic” refers to metal and the electrochemical process in which one metal corrodes to another when both metals are in electrical contact and in the presence of an electrolyte. But galvanic isolation actually refers to the absence of metal or a conduction path. We can accomplish galvanic isolation by physically adding distance, clearance, or insulating material around a circuit to block unwanted current flow, but how do we also preserve a circuit signal and allow it to be transmitted across an isolation barrier? We can additionally isolate the signal by transmitting it magnetically using transformers or magnetoresistance. We could transmit it optically using optical couplers, optical isolators, or fiber-optic media, or we could capacitively couple the signal across an isolation barrier using capacitive isolators. Most often, signal isolation is accomplished by a combination of physical separation and insulating material combined with a method of isolated signal transmission (magnetic, optical, or capacitive). But the important thing is that regardless of our isolation method, isolation prevents the electrical conduction of unwanted current between circuits, while still allowing our wanted signal to cross an isolation barrier without providing a conductive metal path.

COMMON METHODS OF SIGNAL ISOLATION

So the real trick in isolation is not how do we add insulation or separation to our circuit, but how do we add electrical isolation to block unwanted signals and still allow our wanted signal to be transmitted through the circuit without providing a direct (galvanic) path for signal conduction. Here are some common ways to isolate a signal between two points without providing a direct conduction path between them:

TRANSFORMER OR INDUCTIVE COUPLING

The most common example of a galvanic isolator would be the transformer. The primary and secondary windings of a transformer are insulated from one another and do not connect to each other electrically (no metal to metal contact), but use magnetic field flux generated by coils of wire overlapping a ferromagnetic material (signals are inductively coupled to/from the ferro-magnetic material using a varying magnetic field).

Transformers are commonly used to buffer or change voltages by stepping them up or down, but also for isolating signals for safety, in particular for isolating a circuit from AC line voltage. A transformer allows its secondary windings to be offset from a ground reference on the primary side, breaking potential ground loops between the primary and secondary circuits. Because it involves the mutual inductance of magnetic fields from coils, it can be more susceptible to magnetic interference. Further, unless properly shielded, it can also be a source of magnetic interference to adjacent circuitry (inductive and radiated emissions). Transformers are traditionally bulkier than optical or capacitive isolators, but there is newer technology that uses chip-scale transformers encased in integrated circuit style packages to magnetically isolate signals (for one example of this technology, see Analog Devices isoPower® and iCoupler® technology).

Galvanic isolation should not be confused with the term galvanic isolator. A galvanic isolator is a device used to block low voltage DC current from coming on board a boat via a shore power ground wire. These DC currents can accelerate galvanic corrosion of the underwater metals of a boat (metal in its hull, its zinc anodes, prop, drive-shaft, etc.) and cause extensive damage. The galvanic isolator is used because boats parked at a marina and plugged into shore power each act like giant batteries that contribute DC voltage to the power signal via its ground wire, which in turn produces corrosive electric currents through all the metals that contact the water (the metal and water form a giant battery and cause the metals to corrode in galvanic fashion, just like the terminals and plates of a battery corrode as current is passed through them). The zinc anode is a sacrificial metal added to a boat's conductive metal surface to concentrate the resultant corrosion to itself.

A galvanic isolator is inserted in line with the green safety ground as it enters the boat, between the shore-power inlet and the boat's electrical panel. It allows AC fault current to pass through it while blocking DC current. In this way, AC faults are transmitted back to the power source where they can safely trip a breaker or open a fuse, while destructive galvanic DC battery currents are blocked or minimized to reduce galvanic corrosion. This enables the zinc anodes of your boat to help protect your underwater metals and not those of other vessels that surround you as they act to control the corrosion of the metal attached to your own boat. Most galvanic isolators are designed to be fail-safe, which means that if they fail, they do not also open the path to ground for fault current.

Your first instinct might suggest, "Why not just remove the ground-wire", but this would be dangerous, as the ground wire must be present to carry fault current back to the dock power source or transformer (otherwise if you happen to accidentally contact the shore power AC line by some type of wiring fault, you could become the medium to carry fault current back to the transformer which could be fatal for you).

OPTICAL ISOLATOR, OPTICAL COUPLER, OR FIBER OPTIC LINK

Optical devices transmit information through their medium or across their barriers using varying levels of light intensity, with no direct electrical conduction path. A light source (transmitter, typically an LED) sends light waves to a photo-sensitive device (receiver, typically a photo-transistor). The combination is often held in place with insulating plastic like that of an integrated circuit IC, or transmit and receive functions are separated instead using a transmitter linked to a remote receiver via fiber optic cable. One major benefit of optical isolation is its inherent immunity to EMI (Electro-Magnetic Interference or electrical and magnetic noise). Some comparative disadvantages to optical isolation are its generally higher power dissipation, its susceptibility to temperature effects, its traditionally slower speed (specifically optical couplers, not fiber optic links), and the finite life of its transmitter (LED's do degrade over time).

CAPACITOR

Remember that capacitors generally allow AC current to flow, but block DC current. As such, they can be used to efficiently couple AC signals between circuits at different DC voltages via a varying electric field. There are many capacitive isolation devices available and it is a common technology of digital isolators. Many modern devices will even use isolation rated capacitors to connect between grounds on each side of an isolation barrier, for the purpose of providing a conduction path for transient signals, perhaps to earth ground (also helpful in quelling radiated emissions). Similar to optical isolation, capacitive isolation has high immunity to magnetic or inductive noise, but it does have some vulnerability to electric field noise. Capacitive isolation is faster than optical isolation.

Unfortunately, capacitors are also more prone to failure, in particular when stressed by voltages above their voltage rating. And for some capacitors, this failure mode can result in a short circuit condition, abruptly ending its isolation-ability, and possibly rendering its circuit unsafe or hazardous (a safety rated Y-type capacitor is used in line to ground applications and is designed to fail open, while an X-type is used in line-to-line filtering applications and may fail short). Also bothersome, when used to isolate digital signals, often the first bit transmitted after power-up using capacitive digital isolators is used to setup the data stream and must be ignored (only the trailing bits contain useful data).

MAGNETORESISTANCE

Magnetocouplers use Giant Magneto Resistance (GMR) to couple from AC to DC. An explanation of GMR isolation is beyond the scope of this paper, but briefly, it refers to an isolation scheme that relies on the property of a material to change the value of its electrical resistance when an external magnetic field is applied to it. The important thing to remember about GMR is that it operates similar to a transformer, in that it uses the variable magnetic field of an AC coil, but it does this to linearly alter the DC resistance of a physically isolated sensing element.

WHY DO WE ISOLATE?

We have two principal reasons for introducing isolation into an electric circuit: first, to block the transfer of high or hazardous voltages, and second, to break ground loops.

TO BLOCK HIGH OR HAZARDOUS VOLTAGE

We use isolation to prevent the transfer of high or hazardous voltages between circuits. We typically block these voltages using isolation for safety reasons and protection from electric shock, but also to block high common mode voltage present in our signals which can prevent its measurement and damage equipment. Isolation can also be used to block transient voltages for the same reasons. High voltage may drive injury via electric shock and the unintended flow of electric current through the body, but may also drive damage to an electrical circuit as a result of unintended electric current flowing between conductive circuits.

FOR PROTECTION FROM ELECTRIC SHOCK

One reason we isolate a circuit is to help prevent electrical shock. That is, by introducing isolation between conductive bodies, we minimize or eliminate the potential for unintended current flow. Then, with no shared common reference or conductive path between two conductors or circuits, you cannot complete a circuit for current to flow as a result of potential differences between them sufficient to produce electric shock (the sudden and rapid flow of electricity between potentials when crossed with a conductor). Shock currents in the body can be felt at about 0.5mA, they can drive an erratic heartbeat and potentially be fatal above 10mA, and they can stop a human heart at 2A. Isolation can be used to block the voltage potentials that could drive dangerous current levels through your body if you happen to contact/cross them.

TO REJECT HIGH COMMON-MODE VOLTAGES

We see that isolation blocks the dangerous transmission of high voltages between circuits which can drive electric shock to personnel or equipment. But another key use of isolation is to enable the measurement of a signal with a high common-mode voltage that prevents valid measurement and could also damage equipment. The reality is that most instruments will have a common mode input range inside of ±10V (unless specifically designed to reject high common mode voltage). Thus, any signal with an offset from measurement ground greater than 10V cannot be converted properly and may even damage the instrument. Isolation is commonly used to reject the unwanted high common-mode voltage present in some signals to allow the real signal of interest to be discerned.

Remember that electromagnetic noise is ever-present in most environments as a result of nearby machinery and electric motors, relays, fluorescent lighting, etc. The result is that common-mode noise can be capacitive-coupled, inductively coupled, or radiated into the measurement system and will typically take the form of a DC offset combined with a continuously variable 50-60Hz component (and even higher frequency harmonics of 50-60Hz) that can mix with and obscure your measurement. Isolation is often used to block the transmission of this error through our system (see Ground Loops below). But some applications will naturally contain a greater offset voltage than this.

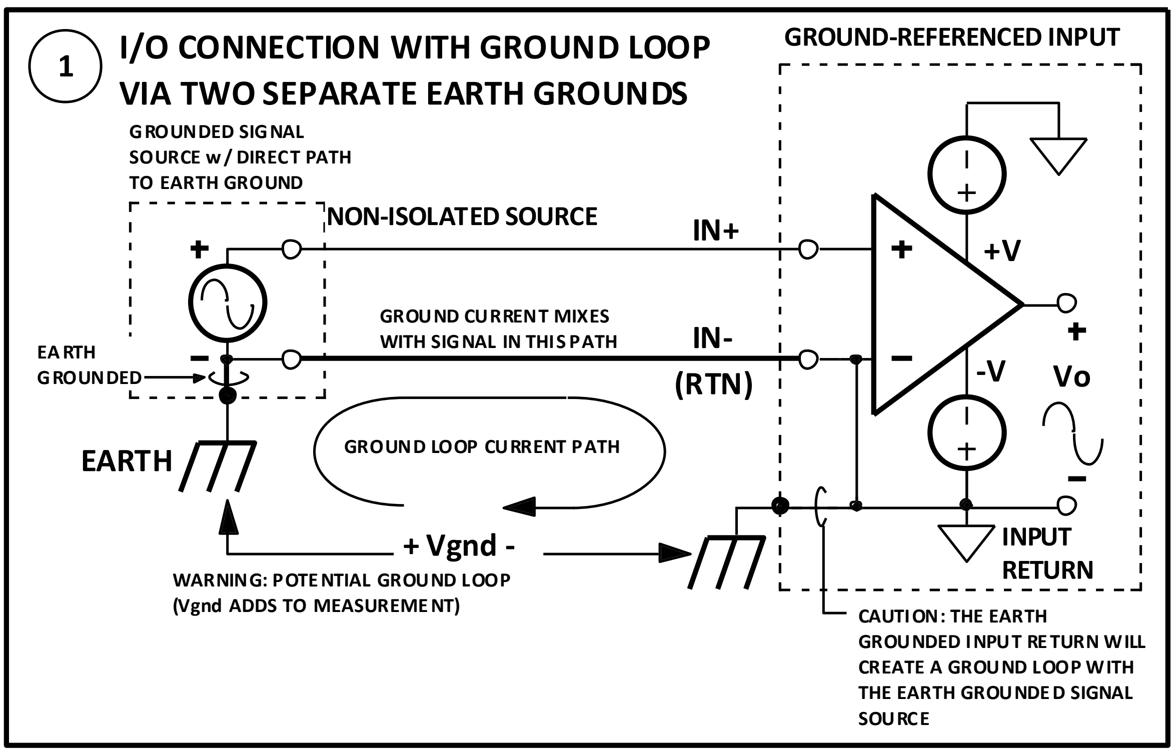
For example, how would you measure one cell of a large array of solar cells connected in series, or measure the individual cell of a large hybrid battery, when your input is restricted to voltage potentials in the ±10V range. Because these signals are offset from circuit common by larger amounts (they have high common mode voltage potentials), certainly greater than ±10V, this makes their measurement difficult and potentially dangerous to your equipment. Note that the common mode portion of an input signal is normally computed as the sum of the voltage potential of the positive lead with respect to measurement return or common, and the voltage potential at the negative lead with respect to measurement return or common, divided by two **(Vcm = [Vin+ + Vin-]/2)**. We can use signal isolation to block the high common-mode portion of input signals like these which otherwise make our measurement difficult and can damage our equipment.

TO PROTECT CIRCUITS FROM TRANSIENT NOISE

Isolation is also used to break the conduction path for high transient voltage noise between circuits, such as voltage spikes generated from switching inductive loads, lightning, or operation in the presence of nearby electric motors and machinery. Isolation is the first best defense in preventing transient noise from propagating through a measurement system.

TO BREAK POTENTIAL GROUND LOOPS

In any electric circuit or conductive path, a potential difference or voltage is the force that will drive current flow through it. This is great for transmitting signals over long distances. But as we link conductive circuits together, there will be differences in reference potentials between circuits that can drive unwanted current flow between the circuits that adds noise and signal interference increasing error. Consider that electrical power to most instruments will include a circuit common that may be referenced to earth ground. Although we idealize common and earth ground as a reference point of 0V or no potential, not all circuit commons will be 0V and at equivalent potentials. This means that as you link these circuits together to transfer signals and connect earth grounds or commons, there is potential for unwanted current flow between them as a result of their different potentials. For devices connecting to the same building earth ground, it is not uncommon to encounter differences in earth ground potential from 100-300mV, even over relatively small transmission distances. Given this potential difference between separate earth ground points, and a conductive path between them, current will flow in the resulting circuit. Refer to Figure 1 which shows an earth grounded input source connected to an earth ground referenced input, and the resultant overlapping ground loop circuit in the return signal path.

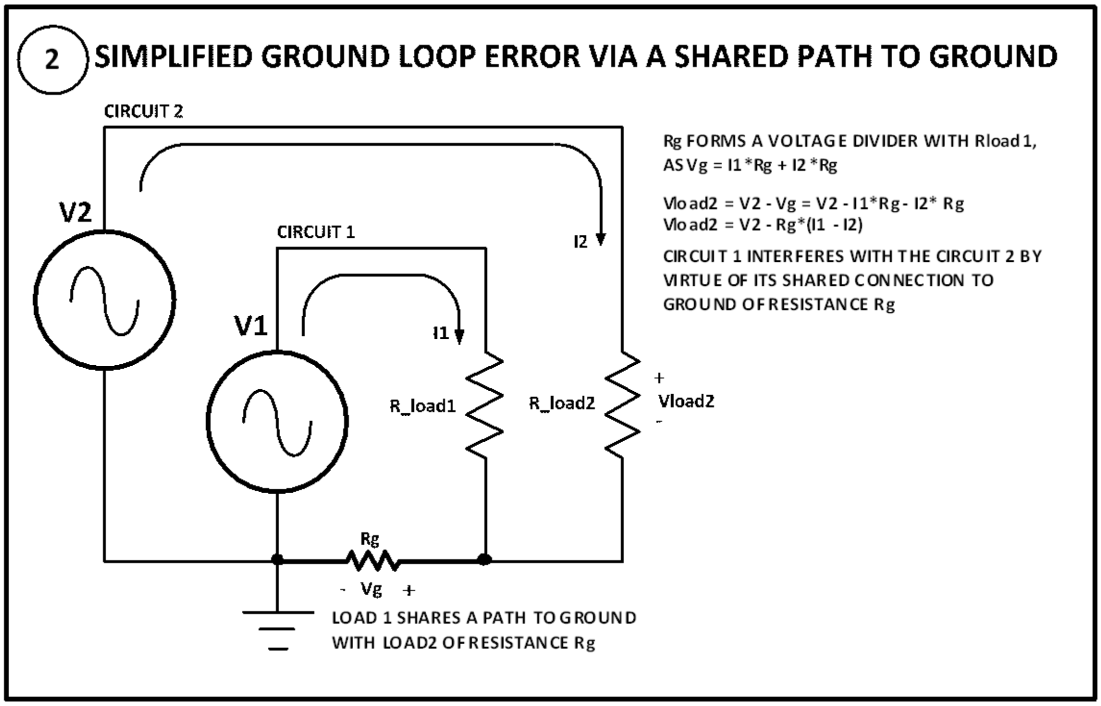


Generally for current that flows along the intended design path (the circuit conductors) the current will be predictable and controlled by the resistance or impedance of the circuit. But if a ground loop is formed as a result of varying earth ground potentials between circuits, there will be unwanted current that mixes in the signal path and returns along an unintended path between their earth grounds, which will drive measurement error, especially if our wanted signal is comparatively small. In any circuit that covers some distance, the chance that more than one earth ground point could be made is very high and probable, as all conductors have some resistance, and current flowing through this resistance will always produce a voltage difference along that conductor. The important thing to remember about earth ground loops is that they result in unwanted noise and interference which drives measurement error, and severe earth ground loops can even create a potential for electric shock.

Often, ground loops can be created accidentally and discerning extra connections to earth ground may not be obvious. For example, devices that connect to the USB port of a personal computer will make a connection to earth ground through the computer, which has the earth ground of its AC power plug connected in common to its chassis and to the USB signal and shield ground. Likewise, double-shielded Ethernet Cable may also connect to earth ground at the network interface of a personal computer. As such, you might create an unexpected ground loop circuit by simply making a USB or Ethernet connection between your PC and your instrument. Or you could inadvertently connect earth ground at more than one point in your circuit if you used a grounded oscilloscope to probe your circuit (most scopes also connect to earth ground at their AC power connection).

For some Acromag instruments, and many USB connected devices, there is potential for negative consequences when connecting to the USB port of a personal computer without using a USB signal isolator for the reason stated above. Keep in mind that your connected device may already be driven by an earth grounded input signal, or have earth ground applied at another point too. With two connections to earth ground in the circuit, and perhaps some distance between earth ground connections, there is potential for ground loop current to flow that could interfere with or prevent circuit operation. This is why we manufacture and encourage the use of a USB ISOLATOR. In similar manner, you might think that using a battery powered laptop would quell the need for a USB isolator when connecting to USB devices, and that would be true in many cases, except if that laptop were also connected to an AC adapter, or perhaps an AC-powered printer, which typically attaches to earth ground at the AC outlet.

While it's important to recognize that ground loop interference can result from more than one earth ground connection as shown in Figure 1, it can also occur from simply sharing a return path to earth ground or common as illustrated in Figure 2.



In both examples of Figure 1 and Figure 2, there are two loops of current that combine along a shared circuit path to earth ground or common, or between earth grounds where individual circuit signals overlap and interfere. Figure 1 depicts the more common form of ground loop created between two earth ground-referenced circuits linked together with their individual earth grounds at different potentials driving current to flow in the interconnection between the devices which produces signal offset error. But Figure 2 also depicts another type of ground loop error with only one ground or common connection but a shared path to ground or common used by both circuits.

Of particular concern with ground loop error, is that the offset you normally encounter in your measurement will not be a steady DC level as depicted in Figures 1 and 2—rather it usually carries a continuously variable AC component from 50-60Hz as a result of all the grounded AC powered devices common to most system earth grounds (a variable load of electric motors and machinery, florescent lighting, switching power supplies, personal computers, etc.). As such, the resultant error voltage takes the form of a DC offset combined with 50-60Hz of ripple coupled into your measurement signal common-mode via their common connections to earth ground. The continuously variable nature of this offset makes it difficult to filter or calibrate it out of your measurement.

There are really only two remedies for combating the negative effects of offset error contributed by earth ground loops: you could take complicated measures to ensure that all connections are made to the same potential, perhaps via a star grounding scheme applied to the multiple earth ground or common connections of your system (very difficult), or you could add isolation to the circuit (recommended).

Isolating a signal path will segment the circuit formed by two earth ground connections at different potentials, or by separating a shared path to earth ground or common. Isolation allows both circuits to operate at different earth ground potentials without generating an intervening earth ground loop current (the current has no conduction path across the isolation barrier). This is the simplest remedy for properly earth grounding your measurement system, and it avoids the difficulty of single-point grounding schemes like “star-grounding”, which are really only effective in close proximity or over very short transmission distances.

In this way, we say that adding isolation breaks the ground loop circuit that carries unwanted current flow along a circuit path. You must not assume that earth ground in a circuit refers to zero potential and no difference in earth ground potentials means no current will flow. This is only true in an ideal world, and the reality is that for any circuit earth ground, and especially for earth grounded circuits that cover a long distance, there is a potential difference across that circuit. The longer the circuit is extended, the greater this potential difference becomes. Be cognizant of this and recognize that all ground circuits have some resistance and any current flowing in this path reinforces and adds to the potential difference across the intervening path. This earth ground loop current and resultant voltage drop will interfere with normal signal current and voltage and will offset signal measurements (particularly troublesome for small signals). Ground loops can even create an electric shock hazard when earth “grounded” parts of equipment that encounter human contact are not at ground potential (0 volts). Simply stated, we apply isolation to safely constrain our circuit (and its circulating currents) from other circuits, and visa-versa. Isolation blocks interference between circuits and builds a barrier that can protect one circuit from the high voltages or currents that are produced in the other. Spikes, surges, and noise are stopped from propagating along a circuit’s conductive path at the isolation barrier.

A COMMON MISCONCEPTION

Usually, when schematically representing an isolated I/O circuit, perhaps a transmitter or signal isolator, a customer will be confused by our showing a connection to earth ground on each side of an isolation barrier. The appearance of this earth ground symbol in both circuits causes them to think that the isolation barrier is somehow being violated because of a common connection to earth ground on each side of the barrier (after all, earth ground is a conductor). But what they fail to recognize is that even though a path between earth ground points is present, no circuit can be completed between the circuits because a return conduction path has been broken by an isolation barrier (i.e. there is no <u>bidirectional</u> circuit path). In fact, the presence of the isolation barrier allows each side to connect to the same or different earth ground potentials (within the limits of the isolation rating) without causing problems. Thus, it helps to always think of a conduction path in terms of a circuit loop, not a one-way street--the isolation barrier actually breaks this loop and prevents the flow of current between the earth grounds within the circuit itself.

DC VOLTAGE INSULATION TEST

One common method of safe isolation testing applies a high DC voltage across an isolation barrier and measures the amount of DC leakage current across the barrier. In general, a common-mode voltage of approximately 100V DC is connected across each respective isolation barrier in a circuit and the maximum current flow between any two isolated entities must be less than or equal to 1 microampere to prove isolation. This test is normally done for all isolated product we ship.

HIPOT (HIGH-POTENTIAL) TESTING

HIPOT or High-Potential testing is used to measure the strength of an isolation barrier (also called Dielectric Withstand Test). HIPOT is the opposite of a continuity test and checks for <u>no continuity</u> with a high voltage potential applied across an isolation barrier. HIPOT is commonly used for safety testing electrical insulation in appliances, cables and wired assemblies, on printed circuit boards, inside electric motors, and across transformers. The amount of leakage current across the isolation barrier under HIPOT conditions is used to benchmark its isolation rating.

The high potential test voltage applied is typically twice the safety voltage rating plus 1000V. Most of our isolated instruments have an operating safety voltage rating of 250VAC. This is doubled in the calculation for safety margin and then 1000VAC is added to reflect real-world line transients that may occur. The HIPOT test will usually connect all electrical connections on one side of an isolation barrier to earth ground or neutral, and all electrical connections on the opposite side of the barrier to the AC hot-wire. Then 1500VAC is applied across the barrier and current flow across that barrier should be negligible to prove isolation. Per IEC 60950, the duration of this application is 1 minute. In some Production environments, it may not be practical to test every barrier for 1 minute, so the HIPOT voltage can be increased 10-20% further to reduce the application time to 1-2 seconds. The amount of allowable leakage will be related to the applicable standard, and Acromag's own test limit is in the 1-5uA range. It is also possible to substitute DC voltage HIPOT for AC voltage and a DC level equal to the peak AC level will be used (i.e. 1500VAC*SQRT[2]=2121VDC). For DC voltage HIPOT, the limit current can be set lower than for AC HIPOT.

At Acromag, HIPOT is done for all transformers before board assembly, and during product qualification. It is otherwise not repeated for all product, except occasionally for small samples to check conformance over time, or if mandated by a customer, or if required by a safety agency.

COMMON-MODE NOISE REJECTION

Common mode noise rejection refers to the ability of a differential input amplifier to amplify the "normal" mode signal and reject the "common" mode signal at its input. But the common-mode noise rejection of an isolated instrument is also an indirect measure of the ability of its isolation to block the feed-through of common-mode noise across its isolation barrier. We have stated that noise in industrial applications is commonly sourced from 50-60Hz AC powered devices, differences in earth ground potentials between these devices, and even varying levels of common mode voltage between signals--isolated instruments block this "noise" propagation. Thus, isolation enhances the instrument's common mode rejection specification and its ability to reject noise signals common to both of its input leads, inclusive of the 60Hz “line noise” sourced from AC-powered devices along the signal chain. The higher the common-mode rejection of your instrument, the better.

The common-mode rejection ratio is normally computed as the ratio of signal gain to the gain applied to its common mode signal as follows: CMRR = Vsignal_gain/Vcm_gain. You would want this to be a very high multiple to accurately discern signal from noise. Often when measuring small signals in noisy environments, such as the resistance of an RTD or the voltage of a thermocouple, this noise will offset the real signal on both measurement leads. But other times a signal will have inherently large common mode offsets, such as that encountered in measuring the cell voltage of a large solar cell or hybrid battery. The CMRR of the instrument refers to the attenuation it applies to this common signal present on both leads. CMRR is usually expressed in decibels and computed as 20*LOG [AVsignal/AVcm] and ideally should be 100dB or better. Expressed in dB, this is computed as 20*LOG [CMRR]. Thus, 100dB of CMRR implies CMRR=LOG^{-1}[100/20] = 100,000--a 100000:1 signal to noise ratio.

One way we test the AC common mode rejection of an isolated I/O circuit, is to apply a 60Hz voltage signal through the input to the instrument (powered) and across its isolation barrier (from input to isolated output). A common-mode voltage is applied by placing the AC neutral wire on the isolated output common lead, and the AC Hot wire separately on the input+ and input– leads (which are usually linked by a 100Ω resistor to simulate source impedance and to help make the 60Hz noise common to both leads).

WARNING: DO NOT TRY THIS AT HOME—this is potentially dangerous. Leave this test to the instrument manufacturer. Never directly connect line voltage across your circuit, even if it’s isolated.

The added I/O isolation of the instrument expands its common-mode voltage range for this test. The amount of 60Hz signal that leaks across the isolation barrier when high common mode is applied is measured by examining the output with an oscilloscope to determine if any 60Hz ripple is present (measured p-p). This is compared to the 60Hz ripple that may be present before applying the common mode signal across the barrier. Any increase in 60Hz pp noise will be a direct result of small leakage current across the isolation barrier. Often because the common-mode rejection is very good, no difference can be discerned. In this case, if the instrument digitizes the signal, a noise signal equivalent to the least significant bit weight is assumed (the smallest digital signal that can be discerned by the circuit) for the purpose of calculation. For true differential inputs and isolated I/O, the common-mode rejection will be very high, so high it is often difficult to discern any 60Hz feed-through ripple on the output. Sometimes the input unbalance resistor will be additionally increased from 100Ω to 1KΩ to increase the input’s sensitivity for noise pick up relative to this small leakage current. Of course, an unbalance resistor placed across the input will convert some of the common mode leakage to normal mode noise (via the small IR drop). This normal mode noise signal is usually well attenuated via normal mode filtering by the circuit, but a portion is passed along with the desired signal through the isolation barrier along with the common mode noise as a direct result of this “leakage” across the isolation barrier.

It might be hard to imagine how an isolated signal chain with no metal conduction path actually allows a small current to pass across the isolation barrier under these conditions. But no isolation barrier is perfect and a small amount of leakage will take place that is usually related to the capacitance of the isolation barrier. In many modern applications, a small safety rated isolation capacitor is also placed across an isolation barrier between isolated ground planes to help suppress radiated emissions of the circuit (a Y type is used which fails open if its voltage rating is exceeded), and additionally to help steer transient energy to earth ground on the secondary side when the primary side is missing a path to earth ground (fault condition). This added capacitance reinforces the small capacitance already present in the isolation barrier and is kept small itself (less than 1000pF) in an effort to keep resulting 60Hz leakage small. If too much capacitance is added, the device would fail HIPOT testing as its leakage current limit will be exceeded under a high potential difference applied across the isolation barrier.

CONCLUSION

At this point you should have a better understanding of the important role that isolation plays in signal transmission. Isolators, isolated transmitters, isolated signal conditioners, and other isolated equipment is used to protect personnel and equipment from electric shock, to enable measurement with high common mode voltage present, to block the transmission of noise and interference, and to prevent the formation of earth ground loops when linking circuits together. It is the isolation between circuits that allows you to operate each circuit at different ground potentials without creating a problem, as long as you keep the potential difference inside the limits of the isolation rating.

ABOUT ACROMAG

Acromag has designed and manufactured measurement and control products for more than 50 years. They are an AS9100 and ISO 9001-certified international corporation with a world headquarters near Detroit, Michigan and a global network of sales representatives and distributors. Acromag offers a complete line of industrial I/O products including a variety of process instruments, signal conditioners, and distributed fieldbus I/O modules that are available with a 2-year warranty. Industries served include chemical processing, manufacturing, defense, energy, and water services.

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