Electrical Safety Toolkit

GARD
Unparalleled Protection

I-Gard's commitment to electrical safety provides both industrial and commercial customers with the products needed to protect their electrical equipment and the people that operate them.

As the only electrical-safety focused company whose product portfolio includes neutral grounding resistors, high-resistance grounding systems and optical arc mitigation, we take pride in our technologies that reduce the frequency and impact of electrical hazards, such as arc flash and ground faults.

For those customers who have purchased from us over the last 30 years, you know us for the quality and robustness of our product; our focus on quality; customer service; and technical leadership. We build on this foundation by investing in developing new products in electrical safety education – including the EFC scholarship program – by actively participating in the IEEE community programs on technical and electrical safety standards, and working with local universities at uncovering new technologies. We remain unrelenting in our goal of improving electrical safety in the workplace.

Our commitment to excellence is validated by long-standing relationships with industry leaders in fields as diverse as petroleum and chemical; hospitals; automotive; data centers; food processing; aerospace; water and waste water; and telecommunications.

We provide them with the product and application support required to ensure that their electrical distribution system is safe and reliable.

3 SOLUTIONS & FACTS ABOUT I-GARD

I-Gard offers more HRG products at more price points than any other competitor in the industry, with customizable solutions for your specific application.

I-Gard is the exclusive supplier of FAIL-SAFE and SMART HRG systems with 2nd ground fault protection to better match your need for electrical reliability and safety.

We are the only HRG supplier that also offers optical arc mitigation for Total System Protection against ground faults and arc flash incidences.

With global application and local representation, we can provide you with the technical support, application experience and product range needed to make your workplace safer.

Please feel free to give us a call at 1-888-737-4787 and don't forget to register for the up-to-date technical library on our website.

power play

High-resistance grounding provides safer, more reliable electrical distribution for healthcare facilities

By Ajit Bapat, Nick Carter & Sergio Panetta

High-resistance grounding is relatively simple and easy to apply in radial distribution systems. It has been used in the healthcare industry for many years, considered to be best practice for hospitals. The concept is well-known, recognized by the Canadian Electrical Code and driven by four basic factors: power is not interrupted in the event of a single ground fault; negligible damage at the point of fault, resulting in lower repair costs and faster return of equipment to service; negligible arc flash hazard in the event of a single ground fault; and negligible risk of a single ground fault escalating into a damaging line to line or three phase fault.

It is best practice to have the low voltage (600V) and high voltage (4,160V) systems equipped with high-resistance grounding. This has often taken the form of a neutral grounding resistor applied between trans-former neutral and ground. An alarm is raised on the occurrence of a ground fault in the distribution as required by the installation codes.

In modern relays, the zero-sequence sensor signal causes a pick up, then the simultaneous presence of unbalanced voltage to ground is verified before an alarm is indicated. To avoid the possibility of nuisance alarms caused by inrush currents and non-linear loads, the zero-sequence current sensor output is filtered and only the fundamental signal is extracted. These measures have been effective in avoiding nuisance alarms and trips in sensitive ground fault relays.

Vantage Point

The use of high-resistance grounding offers many benefits. Arc flash and blast hazard for a line to ground fault is prevented. For systems up to 4,160V, where the resistor let-through current is 10A (amperage) or less, the arc blast is unlikely. Such systems can continue to operate with one ground fault. The fault does not escalate so the distribution system is safer. Accidents causing line to ground faults will not produce a hazardous blast or arc flash.

Fault damage at the point of fault is very low and can be easily repaired. It minimizes maintenance repair costs. Motor and generator laminations will not get burnt and winding repair costs will be small.

For systems up to 4,160V, where the resistor let-through current is 10A or less, the line to ground fault can be kept on the system continuously. No fault isolation needs to occur per Canadian Electrical Code 10 -1100 through 1108.

Damaging voltage transients that can occur on ungrounded systems are avoided since the system is grounded.

On the other hand, four application concerns arise when resistance grounding is applied to distribution.

All cables need to have a line to ground voltage rating of line to line voltage for the maximum duration of the line to ground fault. This is not an issue at low voltage, such as 600V. The standard cables have adequate ratings.

Lightning arrestors and surge suppression devices that are connected line to ground also need to be adequately rated.

Voltage to ground impressed on capacitors will also increase to line to line value.

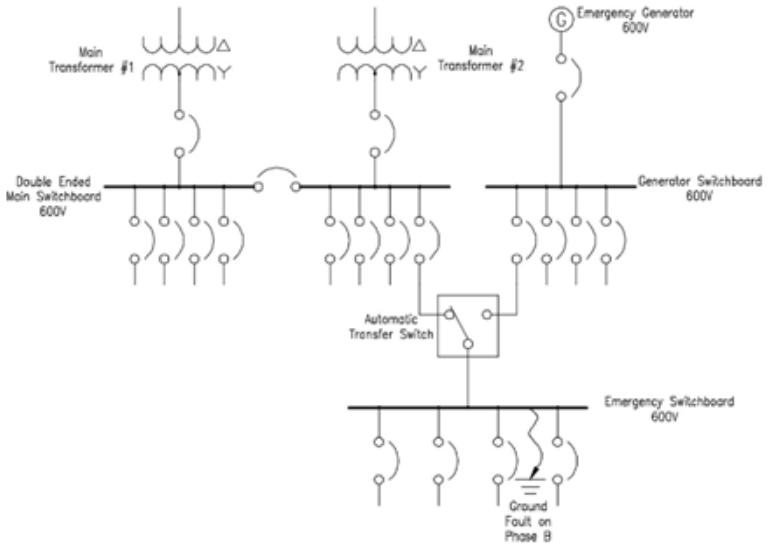
The circuit breakers and contactors employed in resistance grounded systems must be able to break line to line voltage across one pole of the device. For example, a three pole 600V breaker must be able to open fault current and withstand 600V across one pole, which most 600V breakers are capable of. However, some breakers only have a 347/600V rating. This means they are able to interrupt only 347V across one pole, making them unsuitable. The same would apply to contactors.

Fault Scenario

In a typical hospital, there will be a 600V normal power system and a 600V generator power system. The most critical loads are fed from the emergency power distribution, which is downstream of one or more transfer switches. The transfer switches get power from both the normal power system and the generator power system. In this scenario, a ground fault occurs in the switchboard downstream of a transfer switch.

This fault could have a number of causes. In the solidly grounded system, the ground fault results in a large current flow creating significant damage within the switchboard, vapourizing components and coating the inside of the switchboard with semi-conductive residue. The high fault current subjects the upstream transformer to high stresses and causes the upstream breaker to trip. All power to the critical loads is lost. The loss of power is sensed at the transfer switch, which starts the emergency generator and transfers the critical load over to the generator.

Since the switchboard is contaminated with residue from the previous fault, another fault occurs and this further damages the switchboard. It also stresses the generator with a high magnitude fault current and causes the generator breaker for the transfer switch to trip.



In this scenario, a ground fault occurs in the switchboard downstream of a transfer switch.

The critical loads, including the emergency department and intensive care unit, are shutdown and remain so until their feeders can be cut away from the failed switchboard, spliced and extended to another source of power — a process that takes many hours and leaves the critical loads on normal power only.

The hospital is forced into emergency mode and must transfer critical patients to other areas of the hospital, which were not designed for their care, and in some cases to another hospital. Full restoration of the system requires replacement of the switchboard. This takes many months as switchgear is built to order.

In the resistance grounded system, the ground fault results in an alarm. There are no power interruptions, the main transformer is not subjected to the stresses of a fault, and the generator does not start and is not exposed to a fault cur-rent. Most importantly, the damage to the switchboard is minimal requiring the replacement of a single insulator, which is scheduled for a time when the hospital can accommodate the short shutdown necessary to perform the work.

Ground Current Detection

A major functional enhancement occurs when detection and alarm of ground faults is supplemented with monitoring of all the feeders to indicate which feeder is faulted and administer assistance for quickly locating the fault.

To provide assistance in locating a fault in high-resistance grounded systems, the fault current is modulated by oscillating it between values such as 5A-10A, typically at one cycle per second. This is accomplished by changing the resistor value using a contactor, which has been called ‘pulsing’ in the industry. The pulsing is manually started. A flexible zero-sequence sensor or a clamp on the current transformer (CT) encircling all phase conductors is used to provide an oscillating signal to a handheld multimeter. Readings are taken on the faulted feeder moving away from the switchboard.

The signal will disappear once the fault location is passed. Often, two or three measurements are sufficient to point to the fault location.

Readings are taken from the outside of the grounded raceways, conduits or busways, while the system is energized and running. This technique has been in use for many years. It is quite effective for voltages up to 4,160V.

Tripping Up

The primary benefit of using high-resistance grounding is the faulted feeder does not need to be isolated on the occurrence of a phase to ground fault. While the faulted system continues to operate, there is a possibility that another phase to ground fault may occur on a different phase in some other weak spot in the distribution system.

With the presence of a second fault, the fault current is no longer limited by the resistor and will be a higher magnitude fault. The zero-sequence sensors continue to monitor the fault current and if a significantly higher current than that limited by the resistor is detected, then the system recognizes that a line to ground to line fault exists and identifies the two feeders involved.

Only one feeder breaker needs to be tripped to revert the rest of the system to a single fault condition. A level of priority can be assigned based on the relative importance of the feeders. The one feeder with lower priority is tripped. Fast operation provides protection and minimizes fault damage. Such systems have been in use for a long time and this first fault alarm and second fault trip is best applied to monitor specific loads.

Improving the System

On low voltage systems and systems up to 5 kilovolt (kV), high-resistance grounding provides a safer and more reliable distribution system. The arc flash hazard in the event of a line to ground fault can be eliminated and power continuity maintained.

The performance of the distribution system can be enhanced by using high reliability neutral grounding resistors with low temperature coefficients, monitoring the neutral ground resistor continuously, using a pulsing system to find ground faults and using coordinated selective second fault tripping. In many applications, it is more beneficial to apply the neutral grounding resistor at the main bus. In such a case, the incoming supply feeders can be monitored for ground fault very cost-effectively by applying multi-circuit relays.

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1

fact

The U.S. Labor Department's Bureau of Labor Statistics compiles the Census of Occupational Injuries from death certificates and other information for U.S. workers killed on the job. The 1992-1998 database shows that 2,287 workers died and 32,807 workers sustained days away from work due to electrical shock or electrical burn injuries.

2

fact

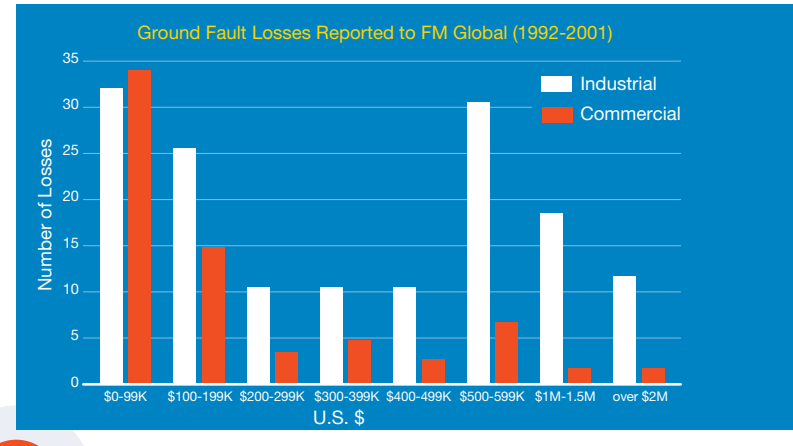
One leading U.S.-based insurance company notes that over a seven-year period, its clients reported 228 losses that were attributed to ground faults resulting in payments of $180 million.

A review of the costs shows the impact of both direct and indirect costs. On the direct side are the costs associated with equipment repair and replacement, as well as the direct medical costs associated with injuries. On the indirect side, we see the cost of business interruption in terms of unscheduled delays; employee training and redeployment; accident investigation; legal costs; and possible fines.

3

fact

According to statistics compiled by CapSchell Inc., a Chicago-based research and consulting firm that specializes in preventing workplace injuries and deaths, there are five to ten arc-flash explosions that occur in electric equipment every day in the U.S. resulting in hospitalization of workers.



4

fact

The U.S. National Fire Prevention Association notes "During the five-year period from 1994 through 1998, an estimated average of 16,900 reported industrial and manufacturing structure fires caused 18 civilian deaths, 556 civilian injuries, and $789.6 million in direct property damage per year."

structured approach to electrical safety

RISK: the likelihood that an event will occur and result in damages.

HAZARD: something with the potential to cause harm and damages.

To be safe, we must reduce both the **RISK** (frequency) and the **HAZARD** (magnitude), the American Society of Safety Engineers has developed a structured approach using a Hierarchy of Hazard Control Measures.

The first choice is to “eliminate the hazard during design”. This is the most effective control measure and must always be considered first.

If the hazard cannot be eliminated completely, then there are a number of control options that can be used to prevent or minimize exposure to the risk:

- Substituting the risk for a lesser one
- Redesigning the equipment
- Isolating the hazard
- Establishing safe work practices
- Using personal protective equipment

Administration controls and the use of personal protective equipment are the lowest priority on the list of control measures and should never be relied on as a primary means of risk control.

Personal protective equipment should be used as a last resort when exposure to risk is not, or cannot be, minimized by other measures. I-Gard provides yearly seminars on educating and raising awareness on the lasting benefits of high-resistance grounding and innovations to reducing arc flash hazards.

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Hospitals Rely on I-Gard for Electrical Safety

case study

One of the constant issues facing hospitals is electrical reliability. While significant focus, attention and capital are applied to backup power systems including generators, battery and UPS to protect critical processes and power factor correction equipment, an often overlooked issue is electrical ground faults. According to the authors J.R. Dunki-Jacobs, F.J. Shields and Conrad St. Pierre of Industrial Power Systems Grounding Design Book, 95% of all electrical outages are caused by ground faults.

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Industry
Hospital

Focus
Reliability

Sample installations

- Hospital Sacre Coeur
- Hospital For Sick Children
- Listowel Memorial Hospital
- North Bay Psychiatric Hospital
- North Bay Regional Health Centre
- Peterborough Regional Health Centre
- Scarborough General Hospital
- Sherbourne Health Centre
- St. Michaels Hospital
- Sunnybrook Health Centre
- Tillsonberg District Hospital
- William Osler Health Centre
- York Central Hospital
- San Diego Hospital

Many hospitals, whether in their main electrical distribution or for application on their emergency generators, are choosing high-resistance grounding as their method of choice.

Originally, high-resistance grounding as a technology was applied to process industries as diverse as food processing, mining and petrochemical. In the last 10 years it has been increasingly applied to commercial installations such as airports, data centers and hospitals to enhance the reliability and uptime of power distribution equipment.

High-resistance grounding allows continuity of service in the event of a ground fault that would cause an outage on a solidly grounded system.

With respect to emergency generators, resistance grounding not only ensures reliability but lessens stator damage and repairs due to ground faults.

Standard concerns with high-resistance grounding, such as risk of the loss of the neutral path due to poor connection, broken wires, corrosion, etc., are addressed by applying the I-Gard DSP relay system, the industry's only SMART HRG relay.

With the I-Gard DSP Ohmni, the neutral path is continually monitored and an alarm is given should the system deviate from normal conditions. There is also the option to install a second redundant resistor circuit for fail-safe operation. In addition, only the I-Gard DSP Ohmni allows continuity of service in the event of a ground fault and also offers additional critical process protection where a second ground fault can be detected and a lower priority feeder can be isolated rather than the whole system being compromised.

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Arc Flash Protection Overview

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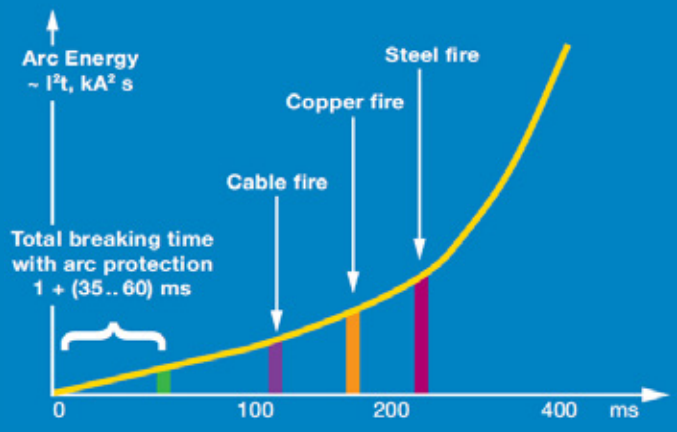
While infrequent, the impact of an arc flash is devastating and often deadly. It is estimated that there are five to ten arc flash incidents per day that require hospital treatment and the financial impact is staggering.

To minimize the impact, you need to first reduce the frequency of the hazard and HRG technology is proven in this regard.

The next task is to lower the impact. By reacting quickly to interrupt the flow of current, this can be achieved.

The arc detection relays from I-Gard detect the light signature from an arc in less than 1ms and send an interruption signal.



An arc is developed within mili-seconds and leads to the discharge of enormous amounts of destructive energy. The energy in the arc is directly proportional to the square of the short-circuit current and the time the arc takes to develop.

TOTAL CLEARING TIME IS CRITICAL		
REDUCE THE TIME	REDUCE THE DAMAGE	REDUCE THE INCIDENT ENERGY
35ms	No significant damage to persons or switchgear, which can often be returned to use after checking the insulation resistances	1.27 Cal/cm²
100ms	Small damage, requires cleaning and possibly some minor repair	3.23 Cal/cm²
500ms	Large damage both for persons and the switchgear, which must be partly replaced	18.1 Cal/cm²

The arc burning time is the sum of the time to detect the arc and the time to open the correct breaker.

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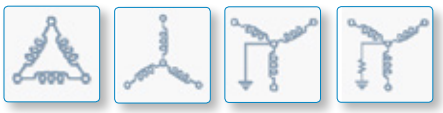

Ungrounded Electrical Distribution System

Definition

Electrical power systems, which are operated with no intentional ground connection to the system conductors, are generally described as ungrounded.

Ungrounded systems employ ground detectors to indicate a ground fault. These detectors show the existence of a ground on the system and identify the faulted phase, but do not locate the ground, which could be anywhere on the entire system. *IEEE Standard 142-1991 1.4.2*

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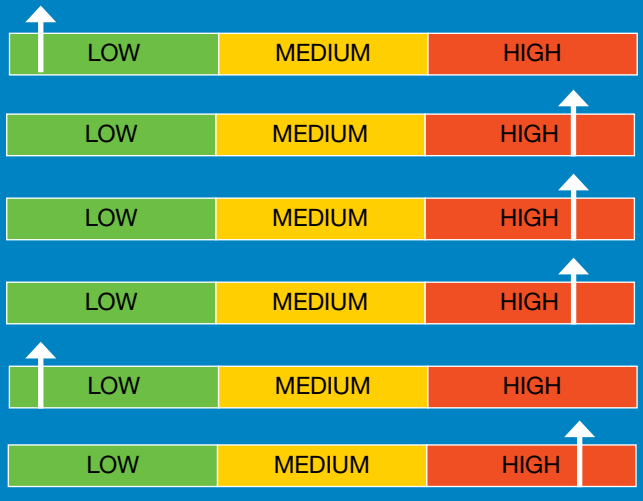
risk overview



Unscheduled process interruptions on first phase to ground fault

Unable or unwilling to locate the first ground fault in a timely manner

Loss of critical process due to power interruption (second ground fault)

Capital equipment damage
- NFPA average $45,000

Arc flash hazard
- FREQUENCY of HAZARD

Arc flash hazard
- MAGNITUDE of HAZARD

Recommendation

Consider the simple, economical and effective conversion upgrade from ungrounded to high-resistance grounded.

Justification for Recommendation

Ungrounded systems offer no advantage over high-resistance grounded systems in terms of continuity of service and have the disadvantages of transient over-voltages, locating the first fault and burn downs from a second ground fault.

For these reasons, they are being used less frequently today than high-resistance grounded systems, and existing ungrounded systems are often converted to high-resistance grounded systems by resistance grounding the neutral. *IEEE Standard 242-1986 7.2.5*

Solidly Grounded Electrical Distribution System

Definition

A solidly grounded system is one in which the neutral points have been intentionally connected to earth ground with a conductor having no intentional impedance.

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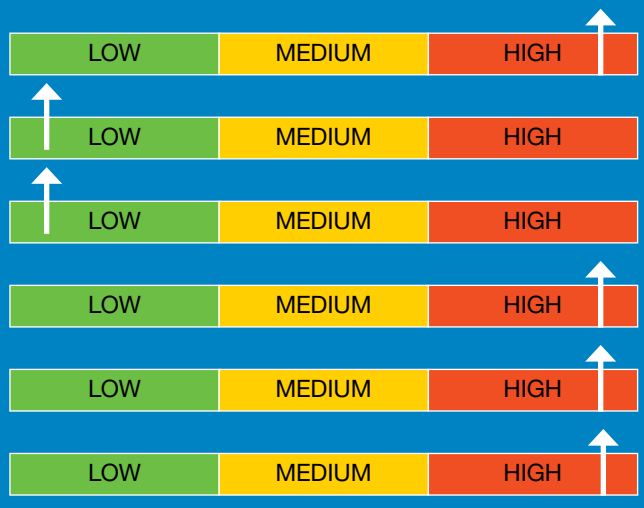
risk overview



Unscheduled process interruptions on first phase to ground fault

Unable or unwilling to locate the first ground fault in a timely manner

Loss of critical process due to power interruption (second ground fault)

Capital equipment damage
- NFPA average $45,000

Arc flash hazard
- FREQUENCY of HAZARD

Arc flash hazard
- MAGNITUDE of HAZARD

Recommendation

Converting to resistance grounded (low or high to control fault current) and/or adding optical arc flash mitigation to lower incident energy and hazard levels.

Justification for Recommendation

The solidly grounded system has the highest probability of escalating into a phase-to-phase or three-phase arcing fault, particularly for the 480V and 600V systems. A safety hazard exists for solidly grounded systems from the severe flash, arc burning and blast hazard from any phase-to-ground fault. *IEEE Standard 141-1993*

High-resistance grounding provides the same advantages as ungrounded systems yet limits the steady state and severe transient over-voltages associated with ungrounded systems. There is no arc flash hazard, as there is with a solidly grounded system, since the fault current is limited to approximately 5A. *IEEE Standard 141-1993 7.2.2*

NFPA 70E section 130.2 FPN No. 3 states “Proven designs such as arc-resistant switchgear… high-resistance grounding and current limitation… are techniques available to reduce the hazard of the system.”

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High-Resistance Grounding Overview

I-Gard has the widest range of HRG products available today and with products at every price point and for every level of application we can improve the reliability and safety of your electrical process.

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What is high-resistance grounding?

High-resistance grounding of the neutral limits the ground fault current to a very low level (typically under 25A). It is used on low and medium voltage systems under 5kV.

What does IEEE say about high-resistance grounded systems?

High-resistance grounding helps ensure a ground fault current of known magnitude, helpful for relaying purposes. This makes it possible to identify the faulted feeder with sensitive ground-fault relays. *IEEE Standard 242-1986 7.2.4*

High-resistance grounding provides the same advantages as ungrounded systems yet limits the steady state and severe transient over-voltages associated with ungrounded systems.

There is no arc flash hazard, as there is with a solidly grounded system, since the fault current is limited to approximately 5A. *IEEE Standard 141-1993 7.2.2*

PLATINUM

SENTINEL – SMART HRG

Includes all features of Gold, Silver and Bronze plus

- Selective instantaneous feeder isolation – on 2nd phase to ground fault
- Mitigate 95-98% of arc flash incidents – on 1st phase to ground fault
- Assisted fault location – identify faulted feeder and phase
- Resistor monitoring relay and fail-safe grounding circuit
- Time and date data logging

GOLD

GEMINI – FAIL-SAFE

Includes all features of Silver and Bronze plus

- Ground circuit monitoring relay
- Patented fail-safe grounding circuit (unique to I-Gard)

SILVER

SLEUTH – PULSING

Includes all features of Bronze plus

- Ground fault pulsing
- Ammeter/voltmeter

BRONZE

STOPLIGHT – BASIC HRG

- Ground fault alarm
- Reduce frequency of arc flash hazards
- Limit magnitude of ground fault current
- Ground neutral of a three-phase power system

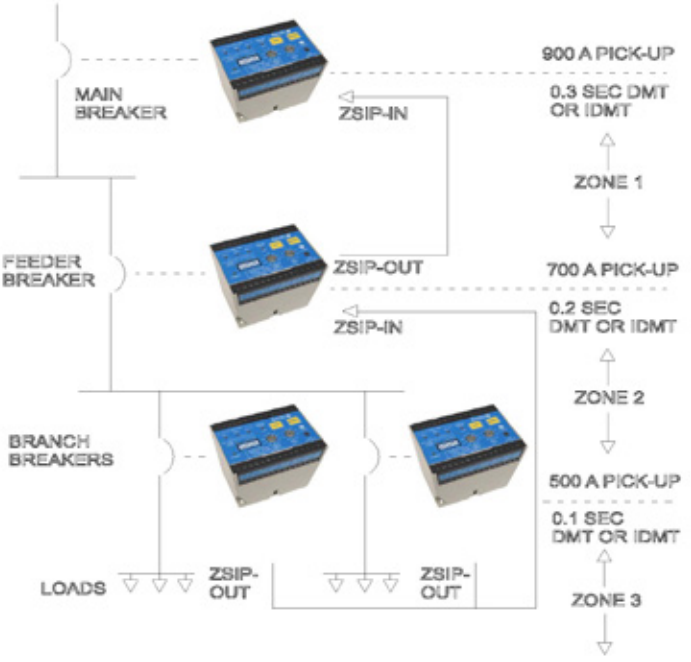
I-Gard is pleased to offer nine levels of high-resistance grounding protection to meet your specific requirements. If your specific requirements are not covered by one of the solutions below, then our in-house team will customize a solution that matches your specific needs and budget.

		PULSING	SMART
STANDARD HRG Offerings			
	Level 1 STOPLIGHT Inexpensive, simple HRG that provides visual indication of ground fault. 	Level 3 SLEUTH Self-contained HRG system with integral pulsing circuit to aid in locating fault. 	Level 7 SENTINEL Advanced HRG system that protects up to 50 feeders with critical process protection even under second ground fault. 
MONITORING	Level 2 STOPLIGHT–M Stoplight with an integral monitoring relay that continuously monitors the integrity of the grounding circuit. 	Level 4 SLEUTH–M Sleuth that provides all process continuity and fault location properties with the added monitoring relay that continuously monitors the integrity of the grounding circuit. 	Level 8 SENTINEL–M Sentinel with an integral relay that continuously monitors the integrity of the grounding circuit. 
PREMIUM Exclusive to I-Gard			
FAIL-SAFE	Level 5 GEMINI Fail-safe HRG with redundant resistor path and full-time monitoring relay. 	Level 6 GEMINI–PS Fail-safe HRG with integral pulsing, redundant resistor path and full-time monitoring. 	Level 9 GARDIAN Combines the recognized safety and reliability benefits of HRG with the incident energy reduction capabilities of arc mitigation. 

The Sentri relay is designed for application on all forms of resistance-grounded and solidly grounded systems and can detect ground faults from as low as 10mA up to 1200A. It is the only relay with built-in Zone Selective Interlocking (ZSI) and optical arc detection capability.

How can ZSI reduce the arc flash hazard from ground faults?

Arc flash hazard is the energy released in an arc flash and is proportional to the duration of the arcing fault; hence, arc flash hazard can be reduced by lowering time-delay settings of the ground fault over-current protective devices. Continuity of service is very important, and is maximized by time-current coordination of the ground fault devices. The drawback of time-current coordination is that an extra time delay is required on upstream protection devices. Zone Selective Instantaneous Protection (ZSIP) improves arc flash safety upstream in the distribution system without affecting service continuity.

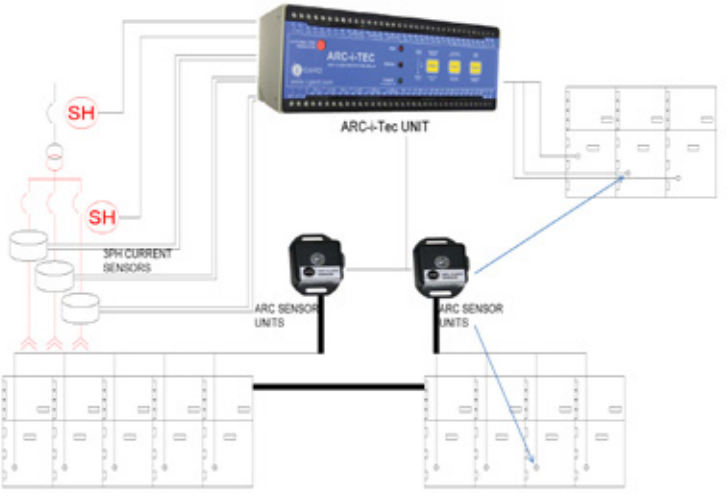


What is Arc Detection and how is it safer?

An arc is accompanied by radiation in the form of light, sound and heat. As such, the presence of an arc can be detected by analyzing visible light, sound waves and temperature change.

To avoid erroneous trips, it is normal to use a short-circuit current detector along with one of the aforementioned arc indicators, and the most common pairing in North America is current and light. By controlling the time that a fault is present on the system, the I-Gard Arc-i-tec significantly reduces the fault energy and the damage to equipment and the safety hazard to personnel.

The Arc-i-tec system is scalable and configurable to your specific application and provides protection at the speed of light.



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Risk Meter Overview

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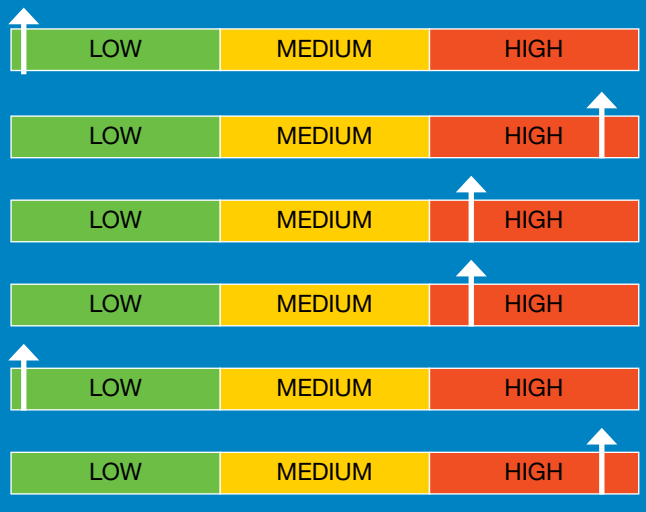
ungrounded distribution system



Unscheduled process interruptions on first phase to ground fault

Unable or unwilling to locate the first ground fault in a timely manner

Loss of critical process due to power interruption (second ground fault)

Capital equipment damage - NFPA average $45,000

Arc flash hazard - FREQUENCY of HAZARD

Arc flash hazard - MAGNITUDE of HAZARD

solidly grounded distribution system

Unscheduled process interruptions on first phase to ground fault

Unable or unwilling to locate the first ground fault in a timely manner

Loss of critical process due to power interruption (second ground fault)

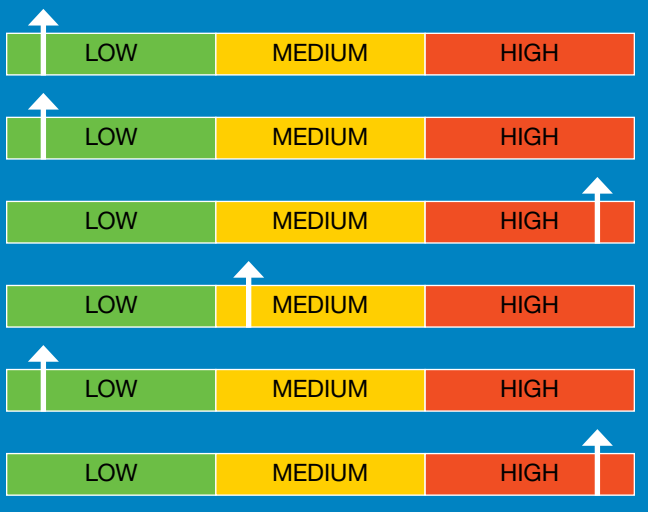
Capital equipment damage - NFPA average $45,000

Arc flash hazard - FREQUENCY of HAZARD

Arc flash hazard - MAGNITUDE of HAZARD

unparalleled protection

standard high-resistance grounded distribution system



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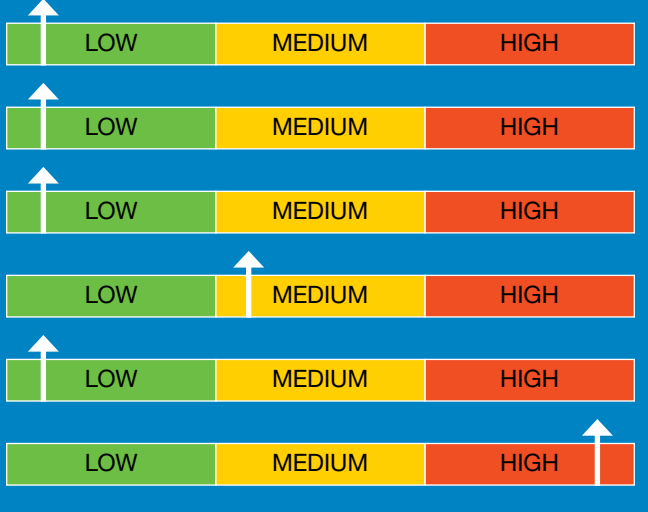
Arc flash hazard - FREQUENCY of HAZARD

Arc flash hazard - MAGNITUDE of HAZARD

SMART high-resistance grounded distribution system



Unscheduled process interruptions on first phase to ground fault

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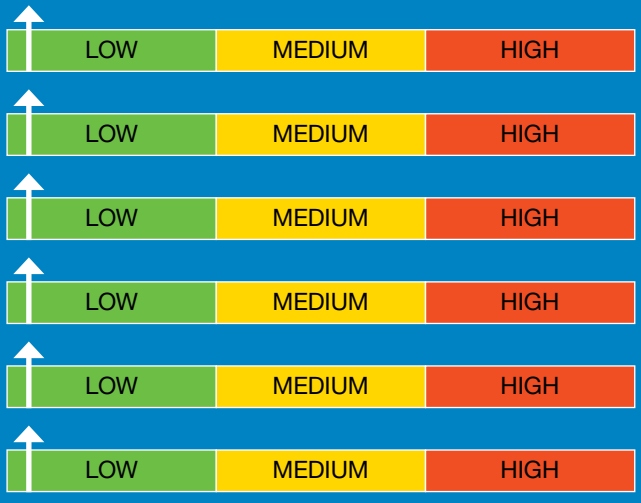
Capital equipment damage - NFPA average $45,000

Arc flash hazard - FREQUENCY of HAZARD

Arc flash hazard - MAGNITUDE of HAZARD

unparalleled protection

SMART high-resistance grounded distribution system + optical arc mitigation



Unscheduled process interruptions on first phase to ground fault

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Capital equipment damage - NFPA average $45,000

Arc flash hazard - FREQUENCY of HAZARD

Arc flash hazard - MAGNITUDE of HAZARD

Total System Protection

High-resistance grounding reduces the frequency of the ground fault hazard

By limiting the fault current to 5A or less, there is insufficient energy for an arc flash to re-strike and it self-extinguishes

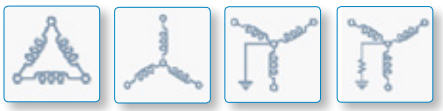
SMART HRG allows for continuous operation of critical processes even under second ground fault conditions

Optical arc mitigation reacts at the speed of light to interrupt the fault, lower the hazard level and protect personnel and equipment

The combination of SMART HRG and Optical Arc Detection provides Total System Protection

unparalleled protection

GARD



Why I-Gard?

I-Gard has the broadest range of high-resistance grounding systems (a technology that the NFPA recognizes as reducing the arc flash hazard) in the marketplace. From our simple and budget friendly Stoplight product to the industry's only fail-safe HRG system, to the only SMART HRG system that selectively protects against second faults without interrupting the entire process.

unparalleled protection

80%

PREVENT HAZARD

HRG enhances the reliability and uptime of power distribution equipment by limiting the fault current so the fault energy is insufficient to allow the arc to re-strike. The hazard is prevented since the arc self-extinguishes.

15%

CRITICAL PROCESS PROTECTION

Smart HRG incorporates current sensor and relays capable of dropping the lowest priority feeder when a second ground fault on the system occurs. This ensures that your process continuity will not be affected and avoids the risk of two simultaneous ground faults tripping the entire system.

5%

EQUIPMENT AND PERSONAL PROTECTION

The special optical sensors in Arc Detection Relays detect the high flux value of the arc and operate in 1ms, resulting in quick isolation of the fault (it takes 300ms to blink).

We are the only electrical safety-focused company whose product portfolio includes both standard HRG systems, SMART HRG systems and optical arc flash mitigation – technologies that reduce the frequency of the arc flash (HRG) and the impact of the arc flash (optical arc detection).

Our products include the innovative Sentri relay that protects against both ground faults and arc flash, and the brand new Arc-i-tec, both of which react to an arc flash in less than 1ms (it takes you 300ms to blink).

For customers who have purchased from us over the last 30 years, you know us for the quality and robustness of our product; our focus on quality; customer service; and technical leadership. We look to build on these foundations by investing in developing new products; in electrical safety education including the EFC scholarship program; by actively participating within the IEEE community on technical and electrical safety standards; and working with local universities at uncovering new technologies as we remain unrelenting in our goal of improving electrical safety in the workplace.

Safety Through Innovation

Our commitment to excellence is validated through our long-standing relationship with industry leaders in fields as diverse as petroleum and chemical; hospitals; automotive; data centers; food processing; aerospace; and telecommunications (see Case Studies), providing them the product and application support they require to ensure reliability and safety of their electrical distribution system.

- The first power resistor company in North America to be ISO 9001 certified
- The only resistor manufacturer with a CSA-approved testing facility in-house
- The only resistor manufacturer with UL listing of our complete NGR product offering
- Approved by the Government of Canada in its Controlled Goods Program for Department of Defense applications

High-resistance grounding is a proven technology that provides process continuity even under a single ground fault condition. The SMART HRG from I-Gard is the only HRG system that ensures process continuity of your most critical processes even under second ground fault conditions.

Total System Protection

High-resistance grounding is also a proven technology that reduces the frequency of the arc flash hazard as the fault current is limited to a low level and there is insufficient fault current for the arc to re-strike and it self-extinguishes.

Optical arc flash detection reduces the time the fault is active and this directly lowers the incident energy level and significantly reduces the destructive impact of the arc.

The Gardian provides total system protection with a combination of HRG technology which reduces the frequency of the arc flash hazard, and optical arc flash detection which reduces the impact of the hazard.

DSP Ohmni System

The DSP Ohmni is the industry's most advanced high-resistance grounding system. It is designed to protect your continuous process or critical power system from unnecessary outage of electrical power. It detects the event of a single ground fault, signals an alarm, and points to the affected branch or feeder.

Thus, maintenance can be immediately alerted to the problem and an operator dispatched to promptly locate and isolate the fault. The DSP Ohmni relay is the brains behind the SMART HRG system and is the only relay that ensures process continuity of your most critical processes even under second ground fault conditions.

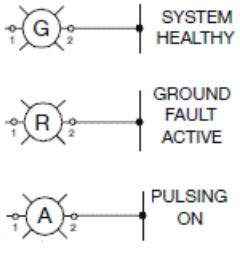
SLEUTH

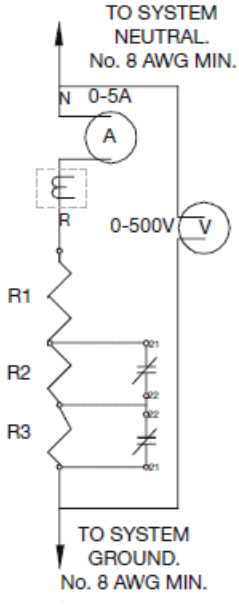
NEMA 2R enclosure containing current limiting resistor and ground fault relay

Available with artificial neutral for use on delta systems

Visual indication of system normal, active ground fault and pulsing active

Available for 480V, 600V and 4160V distribution systems





SLEUTH

FEATURES	BENEFITS
High-Resistance Grounding Resistor	This resistor is connected to the wye point of the transformer or generator supplying the facility. Its function is to limit ground fault currents to non-damaging levels under a single line-to-ground fault condition. This provides the user an opportunity to retain process continuity and to detect and clear the fault.
Hand-held Pulse-tracing Sensor	This device, similar to a clamp-on ammeter, allows the user to follow the pulses from their source at the Sleuth unit through to the specific location of the line-to-ground fault.
Automatic Pulsing System	Once the pulsing feature on the Sleuth system is selected and activated, the system will cyclically limit the fault to 100%, 75% and 50% of the available ground fault current. The cyclical pulsing combined with the hand-held pulse-tracing sensor empowers the user to trace the fault circuit to the point of the fault, even in complex distributions systems without de-energizing the load.
Ground Fault Sensing Transformer and Relay	This microprocessor-based digital relay measures ground fault current using a 1:1 zero sequence current transformer. It maintains accuracy over a range of 45Hz to 65Hz and filters out harmonics to eliminate nuisance tripping.

SENTINEL

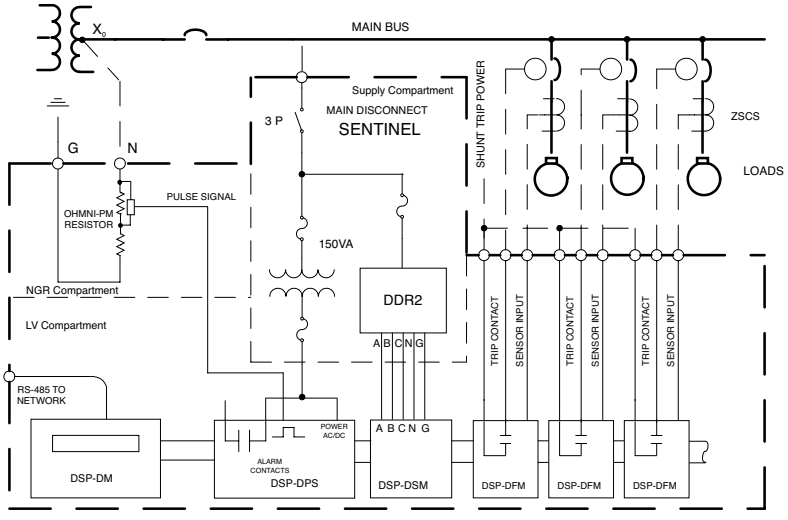
Nema 3R enclosure contains current limiting resistor, ground fault relay and isolation switch

Multi-feeder ground alarm indication with double ground fault protection

Integral resistance pulsing and MODBUS communication for remote monitoring

Inrush detection restraint prevents nuisance tripping on high inrush loads

SENTINEL

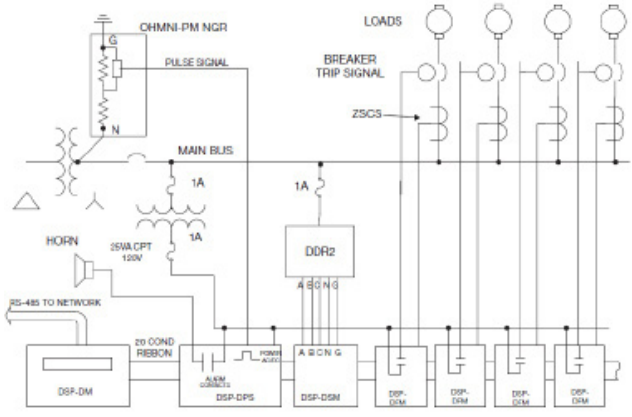


TECHNICAL SPECIFICATIONS	
Power Requirements	100-240V, 50/60Hz or DC, 25 V AC
Dielectric	Relay contacts to chassis 1500V RMS for 1 minute alarm level Control terminals to chassis 1500V RMS for 1 minute alarm level EC-60255-5
Trip Level Inhibit	25% of systems ground current
Contact Ratings	DSP-DFM Trip contacts-form C SPDT 10A, 240 V AC resistive DSP-DPS Alarm contacts-form C SPDT 8A, 240 V AC resistive Insulation voltage withstand/lighting impulse withstand in accordance to IEC-60950
Performance	DSP-DFM Pickup accuracy ±10% of system let-through current Trip Level Accuracy ±10A DSP-DSM Alarm Level Accuracy ±10% of IG
Temperature Range	Operating temperature 0°C - 50°C

DSP-OHMNI

- Phase and feeder indication resulting in quicker fault location
- Monitors and protects up to 50 feeders on one relay
- Available 1st fault alarm, 1st fault trip or 1st fault delay trip
- Integral resistor monitoring module eliminates requirement for separate monitoring relay
- Unique selective instantaneous feeder trip (sift) on occurrence of 2nd ground fault

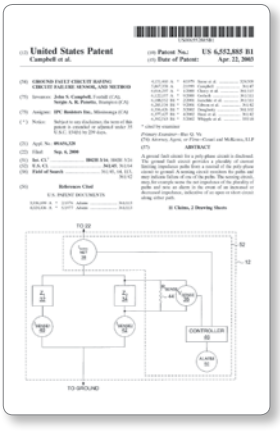
DSP-OHMNI



FEATURES	BENEFITS
DIN-rail parts	Compact mounting reduces space requirements.
Compact Feeder Modules DSP-DFM	Large systems up to 50 circuits / DSP-OHMNI can be accommodated.
Selectable MUTE ON/OFF function	Allows alarm contact to be used for other applications.
Selectable trip on 1st fault or 2nd fault operation	Provides user the option of maximizing continuity of service (2nd fault trip) or minimizing fire/damage risk (1st fault trip). Both can be used on the same system.
0-99 min. delay setting on 1st fault trip	Allows time to locate fault and/or orderly shutdown of equipment.
10-90% Alarm Level setting	User selected sensitivity in 10% increments, allows maximum sensitivity to be used while preventing nuisance alarms.
Switching Modules DSP-CAS	Provides co-ordination between systems either vertically (between zones) or horizontally (same zone) on multi-zone or main-tie-main systems.
NGR monitor DSP-DRM	Monitors the status of grounding resistor in one DSP-OHMNI compatible unit.
Password Protected Setup	Four digit codes selectable by user prevent unauthorized setup changes while still allowing self-test and read-only data.
Self-Test of Modules	Internal self-test of DSP-DFM, DSP-DSM verifies connections to provide assurance of functionality.
MODBUS Communications	Allows the operator to remotely monitor which feeder has faulted as well as the leakage currents of all feeders for trending purposes.

GEMINI

- Patented fail-safe high-resistance grounding system with twin resistance paths
- Only monitoring relay capable of discriminating between ground faults, resistor failure and open and short circuits
- Eliminates nuisance tripping through adjustable time delay settings 60ms and up
- Self diagnosis through built-in test circuitry


United States Patent
Campbell et al.

High-Resistance Grounding Resistor

This resistor is connected to the wye point of the transformer or generator supplying the facility. Its function is to limit ground fault currents to non-damaging levels under a single line-to-ground fault condition. In the case of the Gemini system there is a parallel resistance circuit comprised of two identical resistor paths connected from the neutral to the ground. The parallel resistance circuit is sized to limit any ground fault to predetermined levels. In the unlikely event that one resistor path fails, the second resistor path continues to limit the ground fault to half of the predetermined levels and still provides full ground fault protection and an alarm indicating resistor failure.

Ground Fault and Resistor Integrity Relay (GFR-RM)

In conjunction with a sensing resistor and a series current transformer, the GFR-RM measures current through the neutral grounding resistor, transformer neutral-to-ground voltage and NGR resistance for continuity. The GFR-RM compares the measured values against the field settings of relay and provides relay outputs and lighted signal when an abnormal condition is detected.

Automatic Pulsing System (optional)

Once the pulsing feature on the Gemini system is selected and activated, the system will cyclically limit the fault to 100%, 75% and 50% of the available ground fault current. The cyclical pulsing combined with the hand-held pulse tracing sensor empowers the user to trace the fault circuit to the point of the fault, even in complex distribution systems without de-energizing the load.

Ground Fault Sensing Transformer and Relay

This microprocessor based digital relay measures ground fault current using a 1:1 zero sequence current transformer. It maintains accuracy over a range of 45Hz to 65Hz and filters out harmonics to eliminate nuisance tripping.

GEMINI

AVT – Absence of Voltage Tester

meeting the need
for electrical safety

AVT

- Gives indication of de-energization before entering the panel
- Simplifies and streamlines the zero-energy check process
- Panel mounted device rather than hand-held equipment helps make the process less cumbersome
- Positive indication (a color-coded light ON) is more reliable than a negative indication (a light OFF) for indicating de-energization
- Ground fault indication and loss of phase indication
- Powered from source being monitored with no need for an external power supply

The servicing of electrical equipment involves risk of injury from electrical hazards. Before work on de-energized electrical equipment can commence, NFPA 70E requires that workers verify that the equipment is in an electrically safe state. Until this verification is complete the equipment must be treated as energized and the appropriate safety precautions applied.

Verifying the absence of voltage is a necessary step in verifying an electrical safe work condition.

The AVT (Absence of Voltage Tester) is a simple, fail-safe, intuitive product that combines the process of voltage verification and ground fault indication. AVT complements the absence of voltage requirement of NFPA 70E 2018 by automating the voltage verification process. The simple initiation of the built-in self-test function allows qualified personnel to verify the absence of voltage before accessing potentially dangerous electrical equipment.

The AVT meets the requirements for a permanently mounted test device as per NFPA 70E-2018 Article 120.5 and OSHA 1910.147(d)(6).

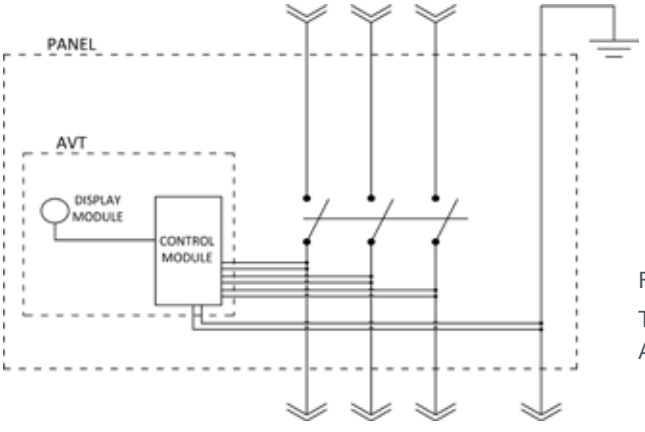


Fig. 1
Typical Application

AVT

The Absence of Voltage Tester provides the following indications

- Positive indication of presence of voltage from 3V - 600V
- Positive indication of absence of voltage
- Positive indication of ground fault
- Positive indication of loss of phase

NOTES

GARD

Unparalleled Protection

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