the power to protect
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OEM'S - General Electric, Square D, Eaton Cutler-Hammer, Siemens, Cooper Power

HI-TECH - Intel, Research in Motion, IBM Data Centre, Honeywell Aerospace

PROCESS INDUSTRIES - Dofasco, Nestle, Johnson & Johnson, Labatts, Proctor and Gamble, Bayer

CONSULTANTS - SNC Lavalin, CoSyn, Fluor Daniel, Bechtel, Bantrel, Stantec, Hatch

MINING & AUTOMOTIVE - Inco, Newmont, Falconbridge, General Motors, Magna, Narmco, Keiper

PETRO-CHEMICAL - Shell, Petro-Canada, Exxon-Mobil, Dow Chemical, Syncrude, Imperial Oil

MUNICIPAL / COMMERCIAL - Royal Bank, Pearson Airport, Department of Defense, Leamington Hospital

CONSORTIUMS - SNC Lavalin, CoSyn, Fluor Daniel, Bechtel, Bantrel, Stantec, Hatch

PICTURE OF GARD EQUIPMENT
Potential ground faults often go unnoticed and can cause havoc on plant production processes. Shutting down power and equipment, ground faults disrupt the flow of products through manufacturing processes, leading to hours or even days of lost productivity.

Undetected ground faults can also pose potential health and safety risks to personnel. Ground faults can lead to safety hazards such as equipment malfunctions, fire and electric shock.

Ground faults can cause serious damage to equipment and to your processes. During a fault condition, equipment can be damaged and processes shut down, seriously affecting your bottom line.

The concern for ground fault protection is based on four factors:

1. The majority of electrical faults include ground.

2. The ground fault protective sensitivity can be relatively independent of continuous load current values and thereby have lower pickup settings than phase protective devices.

3. Since ground fault current are not transferred through system power transformers... the ground fault protection for each system voltage level is independent... This permits faster relaying that can be afforded by phase protective devices.

4. Arcing ground faults that are not properly detected and cleared can be extremely destructive.

With 25 years industry experience combined with technical leadership and investment in new and innovative products, I-Gard has the Power to Protect.

We offer a full range of neutral grounding resistors for low resistor grounding systems and the industry's widest range of high resistor grounding systems.
Neutral Grounding resistors limit the maximum fault current to a value which will not damage generating, distribution or other associated equipment in the power system, yet allow sufficient flow of fault current to operate protective relays to clear the fault.

The I-Gard SIGMA MONITOR RELAY is a combination Neutral Grounding Resistor (NGR) monitor and Ground Fault relay. In distribution systems employing Resistance Grounding the SIGMA MONITOR RELAY protects against ground faults and abnormal conditions in the path between system neutral and ground possibly caused by loose or improper connections, corrosion, foreign objects or missing or compromised copper ground wires.

The SIGMA MONITOR RELAY measures the current through the NGR, the transformer neutral-to-ground voltage and the NGR resistance. The relay compares the measured values against the field settings of the relay and provides relay outputs and LED indications when an abnormal condition is detected.

I-Gard offers a complete range of Neutral Grounding Resistors from 480V to 69,000 volts and utility for resistance grounding of industrial power systems and are connected between earth ground and the neutral of power transformers, power generators or artificial neutral transformers.

Neutral Grounding Resistors are similar to fuses in that they do nothing until something in the system goes wrong. Then, like fuses, they protect personnel and equipment from damage. Damage comes from two factors, how long the fault lasts and the fault magnitude. Ground fault relays trip breakers and limit how long a fault lasts based on current. Neutral grounding resistors limit the fault magnitude.

The I-Gard Neutral Grounding Resistor with integral Sigma Relay is the only NGR that controls both factors.

Why the I-Gard NGR is different:

The only NGR with integral monitoring of grounding circuit (2400v and above models)

The only NGR with integral ground fault relay (2400v and above models)

Designed with special element material with low temperature coefficient of resistivity for consistent fault current levels

Edgewound element design eliminates hot-spots

CSA certified and UL approved
Why consider low resistance grounded over solidly grounded?

While solidly grounded systems are an improvement over ungrounded systems, and speed the location of faults, they lack the current limiting ability of resistance grounding and the extra protection this provides. The destructive nature of arcing ground faults in solidly grounded systems is well known and documented by IEEE and are caused by the energy dissipated in the fault.

A measure of this energy can be obtained from the estimate of Kilowatt-cycles dissipated in the arc: 

\[ \text{Kilowatt cycles} = \frac{V \times I \times \text{Time (cycles)}}{1000} \]

<table>
<thead>
<tr>
<th>Kilowatt Cycles</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Fault location identifiable at close inspection-sput marks on metal and some smoke marks</td>
</tr>
<tr>
<td>2000</td>
<td>Equipment can usually be restored by painting smoke marks and repairing punctures in insulation</td>
</tr>
<tr>
<td>6000</td>
<td>Minimal amount of damage, but fault more easily located</td>
</tr>
<tr>
<td>10,000</td>
<td>Fault probably contained by the metal enclosure</td>
</tr>
<tr>
<td>20,000</td>
<td>Fault probably burns through single thickness enclosure and spreads to other sections</td>
</tr>
<tr>
<td>Over 20,000</td>
<td>Considerable destruction</td>
</tr>
</tbody>
</table>

There are two broad categories of resistance grounding: low resistance and high resistance. In both types of grounding, the resistor is connected between the neutral of the transformer secondary and the earth ground and is sized to ensure that the ground fault current limit is greater than the system’s total capacitance-to-ground charging current.

Low resistance grounding of the neutral limits the fault current to a high level (typically 50 amps or more) in order to operate protective fault clearing relays. These devices are then able to quickly clear the fault, usually within a few seconds.

What does IEEE say about Low Resistance Grounding?

**IEEE Std 142-1991 Recommended Practice for Grounding of Industrial and Commercial Power Systems**

Clause 1.4.3 Resistance Grounding

The low-resistance method has the advantage of immediate and selective clearing of the grounded circuit, but requires that the minimum ground-fault current be large enough to positively actuate the applied ground-fault relay.

**IEEE Std 242-1986 Recommended Practice for the Protection and Coordination of Industrial and Commercial Power Systems**

Clause 7.2.3 Low-Resistance Grounding

The magnitude of the grounding resistance is selected to allow sufficient current for ground-fault relays to detect and clear the faulted circuit.

Comparison of Damage

<table>
<thead>
<tr>
<th>Description</th>
<th>Kilowatt Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 kVA, 480 Volt system, single phase fault current available</td>
<td>30,000 amps</td>
</tr>
<tr>
<td>Solidly Grounded</td>
<td>100 x 30,000 x 10 / 1000 = 30,000 KWC</td>
</tr>
<tr>
<td>Assumes breaker opens in 10 cycles or 0.16 seconds</td>
<td></td>
</tr>
<tr>
<td>Low Resistance Grounded, 50 Amps 1 second</td>
<td>100 x 50 x 60 / 1000 = 300 KWC</td>
</tr>
</tbody>
</table>
The key reasons for limiting the fault current through resistance grounding are:

- To reduce burning / melting effects in faulted electrical equipment, such as switchgear, transformers, cables and rotating machines
- To reduce mechanical stresses in circuits and apparatus carrying fault currents
- To reduce electric shock hazards to personnel caused by stray ground fault currents in the ground return path
- To reduce arc blast or flash hazard to personnel who may have accidentally caused or who happen to be in close proximity to the fault current
- To secure control of transient over voltages

All I-Gard’s low resistance grounding products are standardized on the edgewound element design. Because of the rapid heating and very high temperatures encountered, this design has been proven superior for the NGR application.

The edgewound element material is mounted on porcelain supports, which are not affected by the high temperature or high voltages. The sturdy, helically coiled element is free to expand and does not deform when heated and offers consistent current density.

The element material is critical in ensuring high operating performance of the neutral grounding resistor. The element material is a special grade of electrical alloy with a low temperature coefficient of resistance. This prevents the resistance value from increasing significantly as the resistor operates through a wide temperature range. It also ensures a stable value of the fault current for proper metering and relaying.

Some manufacturers offer stamped and cast alloy grids resistors for low resistance grounding applications but the mica paper insulation they incorporate limits the temperature at which they can operate. The mica paper insulation can also absorb moisture and fail while the flat grid stampings may severely warp when rapidly heated. Also, the grids have hot spots which may burn when overloaded by the fault.

To ensure sufficient fault current is available to positively actuate the over-current relay and that the fault current does not decrease by more than 20% between ambient and the full operating temperature, it is recommended that the NGR element material to be specified to have a temperature coefficient not greater than 0.0002 ohms / C.

Typical NGR 8000 Volts, 1000 Amps 10 seconds, 760 C temperature rise as per IEEE 32.

<table>
<thead>
<tr>
<th>Material 1</th>
<th>Material 2</th>
<th>Material 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>AISI 304 Nickel Chrome</td>
<td>AISI 430 Competitor 2</td>
<td>Steel 1J (Ohmalloy)</td>
</tr>
<tr>
<td>Temp Coefficient of Resistance</td>
<td>0.001 ohms / C</td>
<td>0.00135 ohms / C</td>
</tr>
<tr>
<td>Ohms at Ambient</td>
<td>8000 / 1000 = 8 ohms</td>
<td>8000 / 1000 = 8 ohms</td>
</tr>
<tr>
<td>After 10 Seconds</td>
<td>8 * (1+0.001 * 760) = 14.08 ohms</td>
<td>8 * (1+0.00135 * 760) = 16.21 ohms</td>
</tr>
<tr>
<td>Operating Fault Current</td>
<td>8000 / 14.08 = 568 amps</td>
<td>8000 / 16.21 = 493 amps</td>
</tr>
<tr>
<td>Change</td>
<td>43.2%</td>
<td>50.7%</td>
</tr>
</tbody>
</table>
## Technical Specifications

### Electrical Ratings

<table>
<thead>
<tr>
<th>Control Power</th>
<th>110-240V AC/DC 50/60Hz</th>
<th>5VAac or 5Wdc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>-45% to +10%</td>
<td>(60-264V AC/DC)</td>
</tr>
</tbody>
</table>

### Output Relay Contacts

<table>
<thead>
<tr>
<th>Type</th>
<th>Auxiliary Ground Fault Relay: Form C (NO/NC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating</td>
<td>10A@240Vac, 10A@30Vdc, 1/2HP@240Vac</td>
</tr>
<tr>
<td>Type</td>
<td>Auxiliary NGR Fault Relay: Form C (NO/NC)</td>
</tr>
<tr>
<td>Rating</td>
<td>10A@240Vac, 8A@24Vdc, 1/2HP@240Vac</td>
</tr>
</tbody>
</table>

### Electrical Tests

<table>
<thead>
<tr>
<th>Type</th>
<th>Surge test: @ 3kV</th>
<th>Dielctic test: @ 2kV for 1 minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Temperature Range</td>
<td>Operating: -40°C to +60°C Storage: -50°C to +70°C</td>
</tr>
<tr>
<td>Type</td>
<td>Dimensions: Length: 157 mm (6.18 in.) Width: 86 mm (3.39 in.) Height: 58 mm (2.28 in.) Weight: 344 g</td>
<td></td>
</tr>
</tbody>
</table>

### Ground Fault Circuit

<table>
<thead>
<tr>
<th>Type</th>
<th>CT Input: Non-Isolated. One side of the CT input, terminal 22, is internally grounded.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>CT Ratio: T2A, T3A or equivalent</td>
</tr>
</tbody>
</table>

### DIP Switch Settings

<table>
<thead>
<tr>
<th>Trip Level</th>
<th>8 settings: 5%, 10%, 15%, 20%, 25%, 30%, 40%, and 50% of the set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip Time</td>
<td>32 settings, 0-60 msec., 150 msec. to 3.15 sec. in 100 msec. steps</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Repeat: ±1% Trip Time: ±10%, ±10 msec.</td>
</tr>
<tr>
<td>Trip Current</td>
<td>±10%</td>
</tr>
<tr>
<td>Meter Output</td>
<td>±2% at full scale.</td>
</tr>
<tr>
<td>Thermal Characteristics</td>
<td>Short Time Withstand 400A for 1 sec.</td>
</tr>
</tbody>
</table>
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 solidly grounded systems.

IEEE Std 141-1993

Stoplight

Current limiting resistor
Integral ground fault relay

Sleuth

Current limiting resistor
Integral ground fault relay
Fault location through pulsing
Harmonic filter and time / current adjustments to reduce false trips

Safety through Innovation

At I-Gard we have the necessary high resistance grounding products to cover all applications. With significant expenditure dedicated annually to product development and application research, I-Gard leads the way in bringing innovative new products to market with a commitment to reducing electrical hazards.
For low voltage power distribution systems, high resistance grounding enhances reliability and uptime of power distribution equipment and is proven effective in significantly reducing the frequency and severity of arc flash accidents.  

*2003 IEEE IAS Safety Workshop*
Ground faults cause havoc on plant production processes, shutting down power and equipment and critical loads.

Ground faults disrupt the flow of products through manufacturing processes and cause data loss in computer centers leading to hours or even days of lost productivity.

Ground faults pose potential health and safety risks to personnel, creating hazards such as equipment malfunctions, fire and electric shock.

High Resistance Grounding (HRG) is becoming more prevalent in industrial and commercial electrical power systems because it eliminates unscheduled downtime due to ground faults, and improves personnel safety by preventing ground faults from escalating into arc-flash incidents. Resistance Grounding is highly recommended for generators, to protect them from damage due to excessive ground fault currents.

**STOPLIGHT** is a complete, inexpensive high resistance grounding system that provides system wide protection against damaging ground faults. Using a simple but effective three light system, Stoplight provides visual indication and available remote annunciation to inform operations and maintenance personnel of ground faults.

A red light indicates an active ground fault, an amber light indicates a ground fault has occurred but is intermittent and a green light signifies that there are no active ground faults on the system.

Inexpensive ground fault protection with visual indication in NEMA 3R enclosure

Optional pulsing system for easier fault location

Unique 3 light system for easy visual indication of system condition

Available for 480V, 600V and 4160V distribution systems
The four key integrated elements contained in the Stoplight system work to protect against damaging ground fault currents.

1. **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.

2. **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.

3. **Automatic Pulsing System (optional)**
   Once the pulsing feature on the STOPLIGHT 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.

4. **Hand Held Pulse Tracing Sensor (for use with optional pulsing system)**
   This device, similar to a clamp-on ammeter, allows the user to follow the pulses from their source at the STOPLIGHT unit through to the specific location of the line to ground fault. Once the fault is located, it can be isolated and repaired.
Ground faults cause havoc on plant production processes, shutting down power and equipment and critical loads.

Ground faults disrupt the flow of products through manufacturing processes and cause data loss in computer centers leading to hours or even days of lost productivity.

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High Resistance-Grounding (HRG) is becoming more prevalent in industrial and commercial electrical power systems because it eliminates unscheduled downtime due to ground faults, and improves personnel safety by preventing ground faults from escalating into arc-flash incidents. Resistance Grounding is highly recommended for generators, to protect them from damage due to excessive ground fault currents.

**SLEUTH**

SLEUTH is a neutral grounding device that limits ground fault currents to non-damaging levels under a single line-to-ground fault condition. SLEUTH is the ideal tool for sensing and locating ground faults quickly and easily. When a ground fault occurs, SLEUTH controls and limits the fault current, provides an alarm that indicates an active fault, enabling electrical personnel to follow a simple sequence to locate and isolate the fault without interrupting the circuit or opening circuit breakers.

**NEMA 3R 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
The first step in protection is to limit damaging fault currents through the use of a High Resistance Grounding system.

The next step requires the fault to be located and repaired before a second fault occurs.

The Sleuth pulsing system contains four key integrated elements that limit damaging fault currents and provide process continuity. Also, the integral pulsing system facilitates the locating of the ground fault in the shortest time, so the operator is able to schedule the isolation and correction of the fault at a convenient time.

1. 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.

2. 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. Once the fault is located, it can be isolated and repaired.

3. 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 in even in complex distribution systems without de-energizing the load.

4. 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**

**GEMINI** is a unique patented, fail safe, all-in-one neutral grounding system that combines ground fault protection with a redundant resistor system, in addition to a built-in resistor integrity monitoring relay.

Providing protection against any compromising of the resistor integrity, the patented twin resistance paths in combination with the integrity monitoring relay form the heart of the Gemini system. Limiting any ground fault to predetermined and safe levels, the parallel resistance circuit protects against the damaging effect of a ground fault. Should the integrity of either resistor path be compromised, the second path continues to provide the necessary protection while an alarm is activated.

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**Ground faults cause** havoc on plant production processes, shutting down power and equipment and critical loads.

**Ground faults disrupt** the flow of products through manufacturing processes and cause data loss in computer centers leading to hours or even days of lost productivity.

**Ground faults pose** potential health and safety risks to personnel, creating hazards such as equipment malfunctions, fire and electric shock.

**High Resistance Grounding** (HRG) is becoming more prevalent in industrial and commercial electrical power systems because it eliminates unscheduled downtime due to ground faults, and improves personnel safety by preventing ground faults from escalating into arc-flash incidents. Resistance Grounding is highly recommended for generators, to protect them from damage due to excessive ground fault currents.

**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 60 milliseconds up**

**Self diagnosis through built-in test circuitry**
The GEMINI system contains a high resistance grounding unit, a ground fault relay and a resistor integrity monitor. It is available with optional pulsing capability for easier fault location.

1. High Resistance Grounding System

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.

2. 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.

The GFR-RM is the only relay with the capability to discriminate between ground faults, resistor failure and open and short circuits. The unit trips in 1.5 seconds when NGR failure is detected. NGR failure is determined when resistance varies to less than 66% or more than 150% of the selected value.

3. 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 in even in complex distribution systems without de-energizing the load.
Ground faults cause havoc on plant production processes, shutting down power and equipment and critical loads.

Ground faults disrupt the flow of products through manufacturing processes and cause data loss in computer centers leading to hours or even days of lost productivity.

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High Resistance-Grounding (HRG) is becoming more prevalent in industrial and commercial electrical power systems because it eliminates unscheduled downtime due to ground faults, and improves personnel safety by preventing ground faults from escalating into arc-flash incidents. Resistance Grounding is highly recommended for generators, to protect them from damage due to excessive ground fault currents.

The SENTINEL is the industry’s most advanced high resistance grounding system. It is designed to protect your continuous process or critical power system from unnecessary outages of electrical power.

The SENTINEL 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 locate the fault to isolate it promptly.

**SENTINEL SYSTEM**

- **NEMA 3R enclosure containing current limiting resistor and ground fault relay and isolation switch**
- **Phase and feeder indication resulting in quicker fault location**
- **Monitors and protects up to 50 feeders on one relay**
- **Available first fault alarm, first fault trip or first fault time delay trip**
- **Integral resistor monitoring module eliminates requirement for separate monitoring relay**
- **Unique selective instantaneous feeder trip (sift) on occurrence of second ground fault**
ADDITIONAL SAFETY FEATURES

1. Phase Indication

2. Feeder Identification

3. Faulted Feeder Options

Options for Faulted Feeder:
- Alarm Only (No Trip)
- Trip with Time Delay

4. Selective Second Ground Fault Protection

2nd Ground Fault:
- Prioritize Feeders
- Trips least important, maintaining operation on most important
- Up to 50 Feeders
5. **Open/Short Protection**

- **System Ground Monitor:**
  - Continually monitors circuit from Neutral to Ground
  - Alarms if OPEN circuit
  - Alarms if SHORT circuit
  - Complies with M421

6. **Main-Tie-Main Applications**

   - **Cable adapter CA(S):**
     - Controlled by tie breaker contact
     - Allows coordination of two systems either separately (Tie open) or combined (Tie closed)

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**Technical Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power requirements</td>
<td>100-240V, 50/60 Hz or DC, 25 VA</td>
</tr>
<tr>
<td>Dielectric</td>
<td>Relay contacts to chassis 1500V rms. for 1 minute</td>
</tr>
<tr>
<td></td>
<td>Control terminals to chassis 1500V rms. For 1 minute alarm level</td>
</tr>
<tr>
<td></td>
<td>IEC-60255-5</td>
</tr>
<tr>
<td>Trip Level Inhibit</td>
<td>25% of systems Ground current</td>
</tr>
<tr>
<td>Contact Ratings</td>
<td>DSP-DFM trip contacts-form C SPDT 10 Amp, 240V AC resistive</td>
</tr>
<tr>
<td></td>
<td>DSP-DPS Alarm contacts-form C SPDT 8 AMP, 240 V AC resistive</td>
</tr>
<tr>
<td></td>
<td>Insulation voltage withstand / lighting impulse withstand in accordance to IEC-60950</td>
</tr>
<tr>
<td>Performance</td>
<td>DSP-DFM</td>
</tr>
<tr>
<td></td>
<td>Pickup accuracy +/- 10% of system let-through current</td>
</tr>
<tr>
<td></td>
<td>Trip Level Accuracy +/- 10A</td>
</tr>
<tr>
<td></td>
<td>DSP-DSM</td>
</tr>
<tr>
<td></td>
<td>Alarm Level Accuracy +/-10% of IG</td>
</tr>
<tr>
<td>Temperature range</td>
<td>Operating temperature 0°C-50°C</td>
</tr>
</tbody>
</table>
With its separate easy to read digital display and modular design, the DSP OHMNI can be expanded to 50 feeders for large installations, each with a dedicated feeder module and sensitive zero-sequence current sensor.

### Features

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

FUSION is a selective coordinated high resistance grounded system with high first fault current.

Fusion converts from solid grounding to high resistance grounding giving an immediate reduction in fault current. This allows the fault to remain on the system without causing further damage and without unplanned process interruptions.

For faults in minor equipment or smaller feeders it allows the overcurrent device to trip the circuit and clear the fault and maintains solid grounding.

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Ground faults cause havoc on plant production processes, shutting down power and equipment and critical loads.

Ground faults disrupt the flow of products through manufacturing processes and cause data loss in computer centers leading to hours or even days of lost productivity.

Ground faults pose potential health and safety risks to personnel, creating hazards such as equipment malfunctions, fire and electric shock.

High Resistance Grounding (HRG) is becoming more prevalent in industrial and commercial electrical power systems because it eliminates unscheduled downtime due to ground faults, and improves personnel safety by preventing ground faults from escalating into arc-flash incidents. Resistance Grounding is highly recommended for generators to protect them from damage due to excessive ground fault currents.

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Patented Hybrid Grounding System in a single enclosure

Current limiting device can be coordinated with downstream devices to select load to trip

Converts to high resistance grounding to maintain service continuity at user selected fault levels

Available with integral pulsing capability for easier fault location
Neutral grounding systems are similar to fuses in that they do nothing until something in the system goes wrong. Then, like fuses, they protect personnel and equipment from damage. Damage comes from two factors: how long the fault lasts and how large the fault is.

The Fusion protects against both factors, with the grounding resistor limiting the magnitude of the fault, and the current limiting device built into the Fusion, limiting how long the fault lasts before converting to high resistance grounding.

The Fusion contains both a current limiting device, a high resistance grounding resistor, a ground fault sensing relay and is available with pulsing circuitry.

1. Current Limiting Device

A circuit protective device such as a current limiting fuse or circuit breaker provides a low impedance ground path for the ground fault current to flow.

Time current coordination and selectivity is maintained when the time current characteristics of the circuit protection device in Fusion is designed to coordinate with existing over current devices. This ensures that the over current or ground fault device closest to the load trips and isolates the faulty equipment.

2. High Resistance Grounding Resistors

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 with an opportunity to retain process continuity and to detect and clear the fault.

3. Automatic Pulsing System (Optional)

Once the pulsing feature on the FUSION 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.

4. 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.
## Method of Grounding

<table>
<thead>
<tr>
<th>Condition or Characteristic</th>
<th>Ungrounded</th>
<th>Solid Ground</th>
<th>Low Resistance</th>
<th>High Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunity to Transient Overvoltages</td>
<td>Worst</td>
<td>Good</td>
<td>Good</td>
<td>Best</td>
</tr>
<tr>
<td>Ground Fault Protection Can Be Added Easily</td>
<td>Worst</td>
<td>Good</td>
<td>Better</td>
<td>Best</td>
</tr>
<tr>
<td>Equipment Protected Against Arc Fault Damage</td>
<td>Worst</td>
<td>Poor</td>
<td>Better</td>
<td>Best</td>
</tr>
<tr>
<td>Safety to Personnel</td>
<td>Worst</td>
<td>Better</td>
<td>Good</td>
<td>Best</td>
</tr>
<tr>
<td>Service Reliability</td>
<td>Worst</td>
<td>Good</td>
<td>Better</td>
<td>Best</td>
</tr>
<tr>
<td>Maintenance Cost</td>
<td>Worst</td>
<td>Good</td>
<td>Better</td>
<td>Best</td>
</tr>
<tr>
<td>Continued Production After First Ground Fault</td>
<td>Better</td>
<td>Poor</td>
<td>Poor</td>
<td>Best</td>
</tr>
<tr>
<td>Ease of Locating First Ground Fault</td>
<td>Worst</td>
<td>Good</td>
<td>Better</td>
<td>Best</td>
</tr>
<tr>
<td>Relay Co-ordination</td>
<td>Not Possible</td>
<td>Good</td>
<td>Better</td>
<td>Best</td>
</tr>
<tr>
<td>73% Increase in Voltage Stress Under Line-To-Ground Fault Conditions</td>
<td>Poor</td>
<td>Best</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Two Voltage Levels on the Same System</td>
<td>Not Possible</td>
<td>Best</td>
<td>Not Possible</td>
<td>Not Possible</td>
</tr>
<tr>
<td>Reduction in Frequency of Faults</td>
<td>Worst</td>
<td>Better</td>
<td>Good</td>
<td>Best</td>
</tr>
<tr>
<td>First High Ground Fault Current Flows Over Grounding Circuit</td>
<td>Worst</td>
<td>Better</td>
<td>Good</td>
<td>Best</td>
</tr>
<tr>
<td>Potential Flashover To Ground</td>
<td>Poor</td>
<td>Worst</td>
<td>Good</td>
<td>Best</td>
</tr>
</tbody>
</table>
the power to protect

HOW TO GET IN TOUCH

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For all International Contacts please visit
www.i-gard.com/contact_int.htm
C-101 StopLight
High Resistance Grounding System Manual

C-102 Gemini
High Resistance Grounding System Manual

C-105 Fusion
Ground Fault Protection System Manual

C-107 Sentinel
High Resistance Grounding System Manual

C-408 Sleuth
High Resistance Grounding System Manual

Ground Fault Protection on Ungrounded and High Resistance Grounded Systems
Application Guide

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